Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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

PETITION FOR RECONSIDERATION OF SATELLITE INDUSTRY ASSOCIATION

The Satellite Industry Association ("SIA") hereby petitions for reconsideration of the Memorandum Opinion and Order and Further Notice of Proposed Rule Making ("MO&O") in the above-captioned proceeding.[1]

SIA is a national trade association representing the leading U.S. 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] SIA demonstrates below and in the attached Engineering Statement that the Commission's rules for ultra-wideband ("UWB") devices should be revised because they expose fixed satellite service ("FSS") systems operating in the 4 GHz downlink bands (*i.e.*, 3650-3700 MHz and 3700-4200 MHz) to harmful interference.

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[1] *In the Matter of Revision of Part 15 of the Commission's rules Regarding Ultra-Wideband Transmission Systems*, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, ET Docket 98-153, FCC 02-48 (*rel.* Mar. 12, 2003).

[2] SIA Executive Members include 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; SES Americom, Inc.; and Associate Members include Inmarsat Ventures PLC and New Skies Satellites Inc.

INTRODUCTION

From the outset of this proceeding, SIA has supported - and continues to support - the Commission's goal of facilitating the development of UWB technology. At the same time, SIA has urged the Commission to take into account the potential for UWB devices to interfere with fixed and mobile satellite systems.[3]

In the First Report and Order ("R&O") in this proceeding,[4] the Commission determined that "[w]ith appropriate technical standards, UWB devices can operate using spectrum occupied by existing radio services without causing interference."[5] While acknowledging the concerns that SIA had expressed, the Commission found that the technical standards it adopted were "designed to ensure that existing and planned radio services . . . are adequately protected."[6] In developing these technical standards, the Commission relied on an interference assessment that had been made by the National Telecommunications and Information Administration ("NTIA").[7]

SIA filed a petition seeking reconsideration of the rules the Commission adopted in the R&O, based on the potential for UWB devices operating pursuant to those rules to cause harmful interference to FSS systems downlinking on 4 GHz C-band

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[3] *See, e.g.,* Comments of the Satellite Industry Association (Sept. 12, 2000); Petition for Reconsideration of the Satellite Industry Association (June 17, 2002).

[4] *In the Matter of Revision of the Commission's rules Regarding Ultra-Wideband Transmission Systems,* First Report and Order at 2, ET Docket 980-153, FCC 02-48, *adopted* Feb. 14, 2002, *rel.* Apr. 22, 2002 ("UWB devices operate by employing very narrow or short duration pulses that result in very large or wideband transmission bandwidths.").

[5] *Id.*

[6] *Id.*

[7] *Id.; see Assessment of Compatibility Between Ultrawideband Devices and Selected Federal Systems,* NTIA Special Publication 01-43, U.S. Department of Commerce, National Telecommunications and Information Administration, January 2001 ("NTIA Report"); *see also The Temporal and Spectral Characteristics of Ultrawideband Signals,* U.S. Department of Commerce, National Telecommunications and Information Administration, January 2001.

frequencies.[8] SIA later supplemented its filing with a Technical Analysis providing empirical support for its interference concerns.[9]

Deployment of ubiquitous UWB devices that will interfere with C-band downlinks is a matter of grave concern to the satellite industry, because FSS systems make widespread use of the C-band. Among other things, they use C-band frequencies for program distribution to cable head-ends and radio/TV broadcast stations, broadband communications to U.S. Navy vessels, commercial weather data distribution to airlines and pilots, and position location and status for trucking fleets. UWB interference could jeopardize the billions of dollars that FSS operators, customers, and distributors have invested in FSS systems for commercial and national security purposes, and could interrupt vital FSS services.

In the MO&O, the Commission denied SIA's petition, and SIA hereby seeks reconsideration of that denial. SIA demonstrates below and in the attached Engineering Statement that the denial was based on criticisms of SIA's methodology and other findings that do not withstand scrutiny. In particular: (1) the interference to noise ratio adopted by the Commission, unlike the ratio that SIA employed, will expose FSS earth station receivers to harmful interference; (2) the assumptions underlying SIA's Technical Analysis are appropriate and are necessary to evaluate the potential for interference to FSS receivers from UWB devices; (3) it is improper for the Commission to presume that UWB devices always will operate substantially below the peak EIRP levels its own rules permit; and (4) XtremeSpectrum's arguments concerning satellite operations, on which the Commission relied, are misplaced.

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[8] Petition for Reconsideration of the Satellite Industry Association.

[9] Letter to Marlene H. Dortch, Secretary, Federal Communications Commission, from Richard DalBello, Executive Director, Satellite Industry Association (Jan. 10, 2003) ("Technical Analysis").

Discussion

I. An Interference to Noise Ratio of 0 dB is Inadequate to Protect Earth Stations in the 4 GHz Band from Interference from UWB Devices.

Although in the MO&O the Commission adopted the other elements of NTIA's analysis to evaluate the potential for UWB devices to cause harmful interference to FSS systems, it replaced NTIA's interference-to-noise ("I/N") ratio of -10 dB with a ratio of 0 dB because it "disagreed" with NTIA.[10] The only stated basis for using a 0 dB ratio was a provision in Appendix 7 of the ITU's Radio Regulations. The Commission also believed that SIA has no objection the use of a 0 dB I/N ratio.[11] The Commission's reliance on the ITU's Appendix 7, however, is misplaced; its impression of SIA's position on the I/N ratio issue is incorrect; and the approach the Commission has taken is inconsistent with international standards.

The ITU's Radio Regulations do not support the Commission's departure from NTIA's methodology. Although Appendix 7 to the Radio Regulations makes use of a 0 dB I/N ratio, it does so for an entirely different purpose.

Appendix 7 is used to determine the required coordination distance between a receiving earth station and a terrestrial transmitter in shared frequency bands.[12] If a terrestrial transmitter is within the coordination distance, a detailed coordination must be conducted, using not a 0 dB I/N ratio, but rather an I/N ratio that depends on the specific technical characteristics of the terrestrial station and the receiving earth station. There is no rational basis for applying this coordination distance methodology to an unlicensed service (*i.e.*, UWB) in which individual stations will not be coordinated.

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[10] MO&O at 51.

[11] *Id.*

[12] There is a comparable requirement in the Commission's rules for coordination between earth stations and terrestrial fixed stations. *See* 47 C.F.R. Parts 25 & 101.

To set the record straight, SIA opposes the use of a 0 dB I/N ratio. There may be confusion arising from the fact that, in an ex parte filing, SIA used a 0 dB I/N ratio - but also used a -10 dB ratio - for the purpose of illustrating the effect of various I/N values on the required protection distance for a receiving earth station.[13] This illustrative use, however, was not intended to signify acceptance of 0 dB as an acceptable interference threshold for receiving earth stations.

The Commission's use of a 0 dB I/N ratio also is inconsistent with international standards for maximum permissible interference to earth station receive antennas. Application of these international standards - which the Commission has used in coordinating with satellite systems not licensed in the United States - would result in an I/N ratio of -12.2 dB, not 0 dB.[14] Although these standards were developed for purposes of limiting interference from adjacent satellite, they are equally applicable in the UWB context, because receive earth stations are susceptible to interference from UWB devices to the same degree as they are susceptible to interference from adjacent satellites.[15]

In short, a 0 dB I/N ratio will not adequately protect FSS receivers in the 4 GHz band. The Commission's use of a 0 dB I/N ratio is based on a misreading of the ITU's Radio Regulations and SIA's position, conflicts with NTIA's analysis, and represents a departure from international standards. Accordingly, on reconsideration, the Commission should adopt an I/N ratio of -10 dB or lower.

II. <u>SIA's Assumptions Were Valid.</u>

In the MO&O, the Commission stated "it was not convinced" that UWB devices will cause harmful interference to FSS reception, characterizing the SIA's

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[13] *See* Technical Analysis.
[14] *See* Engineering Statement at 1-3.
[15] *See* Engineering Statement at 1.

Technical Analysis as "overly conservative."[16] In support of this finding, the Commission identified five SIA assumptions with which it did not agree. As demonstrated below and in the attached Engineering Statement, however, well established engineering principles and the Commission's rules provide a solid foundation for SIA's assumptions.

Elevation angles. In its Technical Analysis, SIA assessed the impact of UWB devices on FSS receive earth stations based on elevation angles of five, ten, and fifteen degrees. The Commission, in the MO&O, questioned SIA's assumption "that FSS receivers will operate with the antennas directed low towards the horizon."[17] As demonstrated in the attached Engineering Statement, however, low elevation angles are commonplace, and necessary, for international transmissions via mid-ocean satellites and for domestic transmissions between earth stations located on one coast and satellites positioned on the opposite end of the U.S. domestic arc.[18] Use of these elevation angles, moreover, is consistent with the Commission's longstanding earth station licensing practices, well-settled procedures for earth station coordination, and, of course, the Commission's rules, which permit elevation angles as low as five degrees. [19] Consequently, the elevation angles on which SIA's Technical Analysis was based are appropriate.

Natural and man made obstructions. The Commission also challenged what it characterized as an assumption by SIA "that the area surrounding FSS antennas will be clear of obstacles for wide separation distances enabling the

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[16] MO&O at 52.
[17] *Id.*
[18] *See* Engineering Statement at 3-4.
[19] *See* 47 C.F.R. § 25.205. Although Section 25.205 governs transmitting antennas, the Commission has applied this standard to receive earth stations as well for purposes of protecting them against interference from terrestrial stations and adjacent satellites. In any event, this standard applies to the many receive earth stations that have both transmit and receive functions, because such earth stations employ a single reflector.

UWB RF energy to propagate toward the FSS antenna without any shielding."[20] SIA, however, did not make this assumption. Rather, the Technical Analysis identified the required separation distance between a UWB device and an earth station for the stated interference threshold into the earth station. SIA never claimed that the area in front of the FSS antenna will be clear of obstacles for a distance up to 4.4 km in the 0 degree azimuth direction. Rather, SIA's Technical Analysis demonstrates that if a UWB device is located anywhere within 4.4 km and is visible to the earth station, the earth station will receive unacceptable interference. The attached Engineering Statement clarifies the basis for this finding and reaffirms that large separation distances between UWB devices and receive earth stations are required to prevent harmful interference.[21]

Peak emissions. The Commission took issue with SIA's assumption that UWB devices will have peak emissions directly towards satellite receivers at maximum permissible levels.[22] This assumption is not "overly conservative." SIA simply assumed that UWB devices may operate at power levels permitted by the Commission's rules, and that, as omnidirectional devices, they would transmit in the direction of satellite receivers. Because they were rooted in the operating parameters established by the Commission's own rules, SIA's assumptions were necessary and warranted.

Height of antenna. The Commission deemed overly conservative SIA's assumption that "the FSS antenna will be only 6 meters higher than the height of the UWB device."[23] It did not, however, explain why it considered this figure to be overly conservative, or provide an analysis justifying an alternative figure.

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[20] MO&O at 52.
[21] *See* Engineering Statement at 4-16.
[22] MO&O at 52.
[23] *Id.*

In any event, the relative heights of the antenna centerline (*e.g.*, 7.5 meters) and the UWB device (*e.g.*, 1.5 meters) have a *de minimis* impact on the required separation distance. It is immaterial, therefore, whether the Commission uses a six meter figure (*i.e.*, 7.5 - 1.5), as SIA did, or some other figure, and a disagreement as to relative heights provides no basis for rejecting SIA's analysis.[24]

I/N ratio. Finally, the Commission criticized SIA's reliance on an I/N ratio of -10 dB. As explained in Section I above and in the attached Engineering Statement,[25] however, there is a sound basis for an I/N ratio of between -10 dB and -12.2 dB for the sharing analysis.

III. Peak Emission Limits Must Be Either Taken Into Account or Reduced.

In denying SIA's Petition for Reconsideration, the Commission relied on an assumption that "most outdoor UWB devices . . . will not radiate emissions approaching the peak limits."[26] As demonstrated in the attached Engineering Statement, however, every UWB emission has an average value and a peak value, and the separation distance required for the protection of a receiving earth station is a function of both the operating average EIRP level and the related peak EIRP.[27] Without consideration of peak EIRP levels, which also were an integral part of NTIA's analysis, it is not possible to assess adequately the potential for interference from UWB devices.

In any event, if the Commission is genuinely confident that outdoor UWB devices will not radiate emissions approaching peak limits, it should amend its rules by lowering the allowable peak EIRP. Such a reduction would limit harmful interference to FSS systems and, by the Commission's own reasoning,

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[24] *See* Engineering Statement at 17.
[25] *See* Engineering Statement at 1-3.
[26] MO&O at 52.

would not compromise operations of outdoor UWB devices. Absent this reduction, taking peak levels into account for interference purposes is a necessity.[28]

IV. XtremeSpectrum, Inc.'s Arguments are without Merit.

In a filing that the Commission relied on in the MO&O, XtremeSpectrum, Inc. ("XSI") took issue with SIA's interference analysis because, according to XSI, the angle of elevation of FSS earth stations will produce at least 10 dB of isolation from outdoor UWB devices.[29] XSI, however, is attempting to improperly double-count a factor that SIA already has taken into account in its basic interference path calculation. In that calculation, the required earth station antenna isolation is based on the earth station antenna elevation angle, the antenna centerline height above ground, the UWB height above ground, and the distance between the antenna and the UWB device. Consequently, XSI's criticism is unwarranted.

XSI also asserted that indoor UWB devices cannot pose an interference threat to FSS receive earth stations. XSI maintained that receive earth stations would not, given their need for a line of sight to the satellites they are communicating with, be pointed at buildings in which UWB devices are located. XSI's argument evinces a misunderstanding of the geometry of satellite operations. An earth station can be pointed in the direction of a building in which UWB devices are located and still have ample clearance for a line-of-sight to a satellite.

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[27] *See* Engineering Statement at 18.
[28] The Commission's related assumption that outdoor UWB devices will not be in operation during inclement weather, when the signal received from the satellite will be at its weakest, MO&O at 52, conflicts with current experience concerning outdoor operations. One need only walk downtown during a rainstorm, and observe people using their cellphones at building overhangs, while walking under umbrellas, and in cars to conclude that the Commission's assumption is incorrect.
[29] MO&O at 51.

CONCLUSION

For the reasons set forth herein, the Commission should reconsider its MO&O denying SIA's Petition for Reconsideration and modify the rules it adopted in the R&O.

Respectfully submitted,

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ENGINEERING STATEMENT OF HAROLD NG
ET DOCKET NO. 98-153

I am the Director of Regulatory Engineering for PanAmSat Corporation ("PanAmSat"), an Executive Member of the Satellite Industry Association ("SIA"). I have prepared this Engineering Statement in support of the SIA's Petition for Reconsideration in the above-referenced proceeding. This Engineering Statement addresses the issue of the appropriate interference to noise ("I/N") ratio for protecting receive earth stations; provides support for certain assumptions underlying SIA's interference analysis that the FCC has questioned; and explains the need for taking the peak EIRP of ultra-wideband ("UWB") devices into account.

Appropriate I/N Ratio for Fixed Satellite Services in the 4 GHz Band

There are four ITU-R recommendations that provide guidelines for maximum permissible levels of interference. Although these recommendations were developed in the context of interference to receive earth station antennas from adjacent satellites, they are equally applicable to interference from UWB devices. Two are for analog services, namely analog telephone channel[1] and analog television[2]. The other two are for digital services, namely pulse code modulation (PCM)[3] and ISDN[4] services. These international standards recommend that the internetwork interference into digital services caused by the earth and space station emissions of any one other network operating in the same frequency band should be limited to 6% of the total system power under clear-sky conditions.[5] This 6% translates into an interference-to-noise ratio (I/N) of –12.2 dB.

This interference threshold is not conservative since the UWB interference having an I/N ratio equal to –12.2 dB would degrade the received signal at the earth station by 0.25 dB. This is demonstrated by the following figure for a typical satellite link budget in one of the domestic C-band satellites:

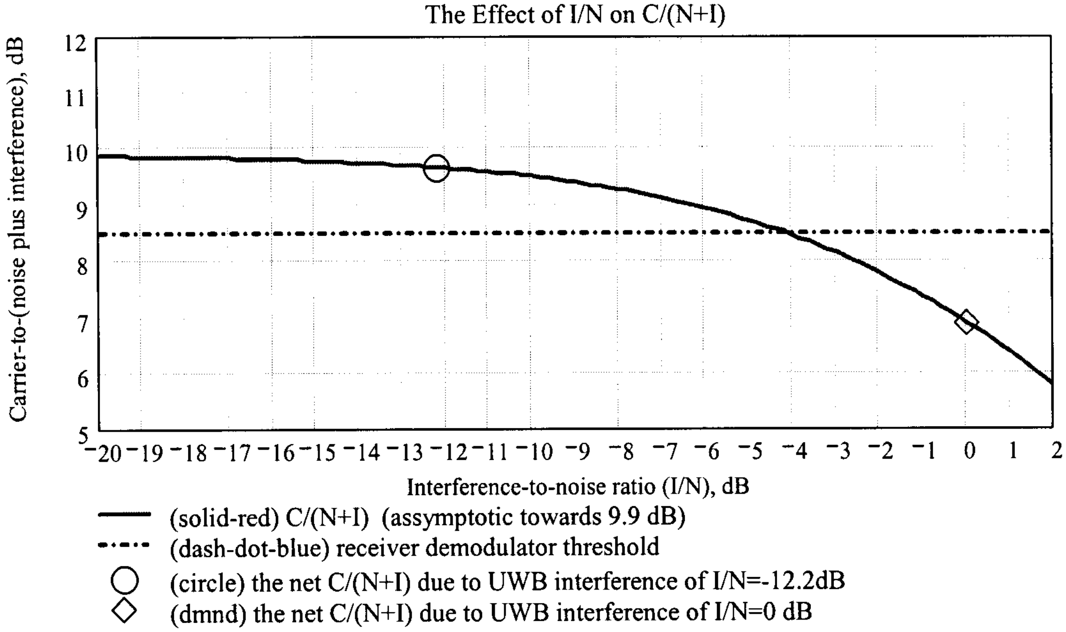
[1] ITU-R S.466 Maximum permissible level of interference in a telephone channel of a geostationary-satellite network in the fixed-satellite service employing frequency modulation with frequency-division multiplex, caused by other networks of this service.
[2] ITU-R S.483 Maximum permissible level of interference in a television channel of a geostationary-satellite network in the fixed-satellite service employing frequency modulation, caused by other networks of this service.
[3] ITU-R S.523 Maximum permissible level of interference in a geostationary-satellite network in the fixed-satellite service using 8-bit PCM encoded telephone, caused by other networks of this service.
[4] ITU-R S.735 Maximum permissible levels of interference in a geostationary-satellite network for an HRDP when forming part of the ISDN in the fixed-satellite service caused by other networks of this service below 15 GHz.
[5] For analog services, the acceptable interference is specified as 600 pWOp for telephone service or 4/10 of 15% of the permissible video noise.

Parameter	Value
Uplink EIRP (dBW)	77.8
Uplink C/N_u (dB)	29.9
Downlink EIRP (dBW)	35.7
Downlink C/N_d (dB)	13.7
C/I due to adjacent satellites and x-pol transponders (dB)	12.3
Aggregate $C/(N+I)_{total}$ (dB) ; [$C/N_u \oplus C/N_d \oplus C/I$]	9.9
Receiver demodulator threshold (dB)	8.5
Available link margin , C/N_{margin} ,(dB) [9.9-8.5=1.4]	1.4

This table highlights the available link margin for a typical C-band MCPC digital service from a 7.0 m transmit antenna to a 3.7 m receiving antenna. The total satellite link carrier-to-noise plus interference ratio ($C/(N+I)_{total}$) at the receiving antenna output is 9.9 dB and the receiver demodulator threshold is 8.5 dB. The resulting available link margin is 1.4 dB (9.9 – 8.5 = 1.4). This link margin is, in general, used for equipment degradation in the system (e.g., satellite TWTA, receiving antenna LNA and receiver demodulator) and rain attenuation in the uplink and the downlink.

Using a $C/(N+I)_{total}$ equal to 9.9 dB, the following graph shows a 0.25 dB degradation (9.9-9.65=0.25) due to UWB interference of I/N equal to –12.2 dB. In other words, due to UWB interference equal to I/N= –12.2 dB, the "available link margin, C/N_{margin}" is reduced from 1.4 dB to 1.15 dB (9.65 – 8.5 = 1.15). Assuming there is minimum equipment degradation, the remaining "available link margin" of 1.15 dB would provide link availability between 99.95% and 99.97% for uplink from the Mid-Atlantic States.[6] This range of availability due to rain is near the low-end of typical C-band service quality and is marginally acceptable.

[6] The percentage of availability is computed from the ITU-R P.618-6 rain attenuation model.



The graph also shows that if I/N= – 4 dB, there is 0 dB link margin available (i.e., $C/(N+I)_{total} = C/N_{margin} = 8.5$ dB). Under this condition and if there is no equipment degradation, the demodulator still can demodulate the received signal. However, if there is any precipitation (fog, cloud, mist or rain) in the atmosphere, the receiver could not demodulate the received signal since the signal level is below the demodulation threshold due to attenuation by precipitation.

Finally, the graph shows that, if I/N = 0 dB, the resultant $C/(N+I)_{total}$ would be 6.9 dB. Since this signal level is below the demodulator threshold of 8.5 dB, the demodulator would not be functional. Therefore, the UWB interference is harmful.

Validity of SIA Technical Assumptions

FSS Receivers do Operate with Antennas Directed low towards the horizon.

The SIA technical study analyzed the effect of UWB devices for three elevation angles: 5 degrees, 10 degrees and 15 degrees. These values cover the lower end of the elevation angles for receiving earth stations in the CONUS environment and are used by actual receiving earth stations.[7] The 5-degree elevation angle is primary for those satellites located near the middle of the Atlantic Ocean basin (e.g., 45WL, 43WL, 34WL and 31WL) and Pacific Ocean basin (e.g.,180EL and 166EL) and is primary for international services. An elevation angle between 10 and 15 degrees is primary for domestic services such as East Coast earth stations accessing the Western-arc satellites

[7] The existence of earth stations using low elevation angles may be confirmed by reference to the Commission's earth station database, which contains specific earth station locations and corresponding points-of-communication.

(e.g., 133WL to 139WL) and West Coast earth stations accessing the Eastern-arc satellites (e.g., 58WL).[8] The following table shows a few typical elevation angles.

Satellite Longitude	Geographic Area	Elevation angle (deg)
166 EL	Sacramento, CA	5
169 EL		7.3
180 EL		15.8
139 WL	Portland ME	6.7
133 WL		10.8
58 WL	Seattle, WA	8.4
72 WL		17.2
45 WL	Salt Lake City, UT	8.7
43 WL		7.2
34.5 WL	Denver, CO	6.0
31.5 WL		4.2
1.0 WL	Andover, ME	5.6

<u>SIA did not Assume that the Area Surrounding the FSS Antennas would be Clear of Obstacles for Wide Separation Distance.</u>

The following tables clarify the earlier SIA technical study concerning the interference environment and expand upon that study by using a 36 MHz receiver bandwidth instead of the 50 MHz used in the SIA technical study.[9] This 36 MHz bandwidth is equal to the transponder bandwidth on a typical domestic C-band satellite and is the typical IF bandwidth at the earth station. This new bandwidth reduces the received interference power at the earth station and, hence, the required separation distance relative to the earlier SIA technical study. The reduction in distance relative to the earlier SIA technical study can be extrapolated from Table 2 of the earlier study and the following Table A.[10] In addition, the following tables provide the required separation distance for I/N = –10 dB and for various azimuth angles from the direction towards the satellite (i.e., the azimuth angle varies from 0 to ±45 degrees whereas the earlier study only provided the information for 0 degrees in the azimuth direction). The other parameters remain unchanged, such as the propagation model, the antenna heights and the earth station thermal noise floor.

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[8] The West Coast earth stations accessing the satellites at 45 WL and 58WL have elevation angles as low as 5 degrees.

[9] The change of receiver bandwidth from 50 MHz to 36 MHz is at the request of one FCC staff at the *ex parte* briefing given by SIA on March 21, 2003.

[10] The reduction is shown only in the column under 0-degree in the azimuth angle. For example, the distance of 4.4 km from the earlier SIA technical study is reduced to 4.0 km for the 36 MHz bandwidth, see Table A.

Table B is for a UWB device in an indoor environment. The indoor environment assumes an average building attenuation equal to 12 dB.[11] The other parameters remain the same as for Table A (e.g., antenna centerline = 7.5 m and UWB height = 1.5 m). Table C is another indoor environment analysis except that the UWB height is equal to 15.0 m. In addition, these three tables are also based on the following peak-EIRP and average-EIRP levels. These peak-to-average ratios are based on the information contained in Appendix E to the First Report and Order in this docket.

PRF (MHz)	Peak-EIRP (dBm/50MHz)	Peak-EIRP (dBm/36MHz)	Average-EIRP (dBm/MHz)
1.0	-0.3	-3.1	-41.3
10.0	-10.4	-13.1	-41.3
≥ 50.0	-12.8	-15.7	-41.3

Table A
Required Separation Distance (km) between an Outdoor UWB Dithered Device and a Receiving Earth Station for I/N Equal to –10 dB and an IF Bandwidth Equal to 36 MHz

Required Separation Distance (km) for Various Azimuth Angle Offset from the Satellite											
Elevation Angle	PRF (MHz)	Azimuth Angle Offset from the Satellite Direction (degrees)									
		0°	5°	10°	15°	20°	25°	30°	35°	40°	45°
5°	1.0	4.0km	3.2	2.4	1.9	1.4	1.07	0.86	0.71	0.61	0.52
10°		2.6km	2.5	2.1	1.8	1.3	1.05	0.86	0.71	0.61	0.52
15°		2.1km	1.9	1.8	1.5	1.2	1.0	0.84	0.71	0.61	0.52
5°	10.0	2.2km	1.77	0.94	0.61	0.44	0.34	0.27	0.23	0.19	0.17
10°		1.1km	0.97	0.73	0.54	0.42	0.32	0.27	0.23	0.19	0.17
15°		0.7km	0.66	0.56	0.46	0.38	0.31	0.27	0.23	0.19	0.17
5°	≥50.0	1.9km	1.2	0.69	0.46	0.33	0.25	0.20	0.17	0.15	0.13
10°		0.82km	0.71	0.54	0.40	0.31	0.25	0.20	0.17	0.15	0.13
15°		0.51km	0.48	0.41	0.34	0.28	0.23	0.20	0.17	0.15	0.13

[11] This average building attenuation is based on Table 7 of §145 of the First Report and Order, ET Docket 98-153.

Table B
Required Separation Distance (km) between an Indoor UWB Dithered Device and a Receiving Earth Station for I/N Equal to –10 dB and an IF Bandwidth Equal to 36 MHz and the Building (or Obstacle) Attenuation equal to 12 dB the Antenna Center-line = 7.5m and UWB height=1.5 m

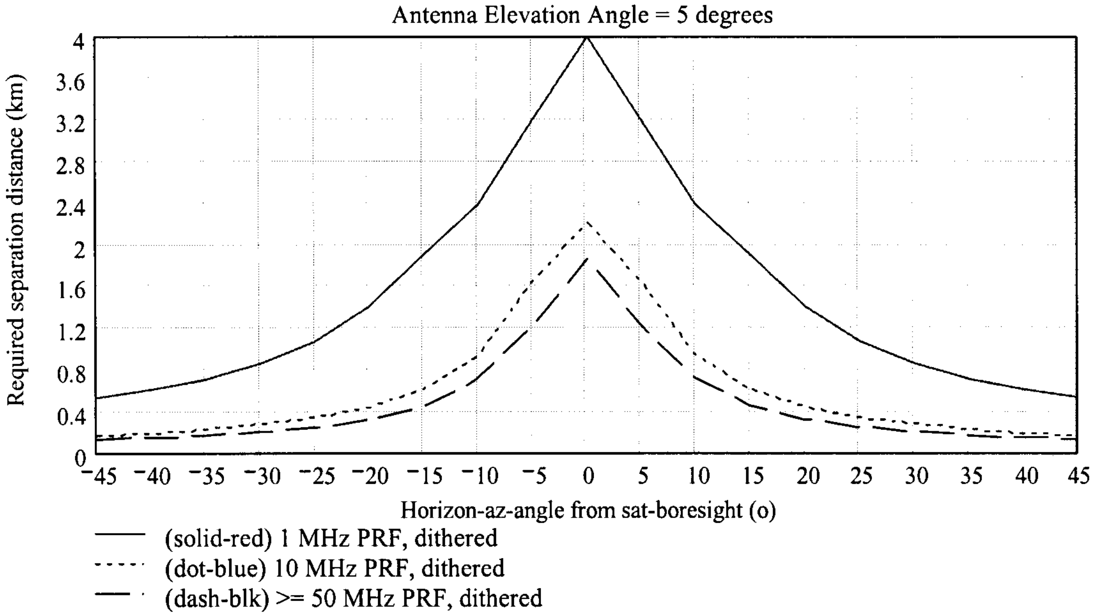
Required Separation Distance (km) for Various Azimuth Angle Offset from the Satellite											
Elevation angle	PRF (MHz)	Azimuth Angle Offset from the Satellite Direction (degrees)									
		0°	5°	10°	15°	20°	25°	30°	35°	40°	45°
5°	1.0	1.9km	1.3	0.74	0.48	0.35	0.27	0.22	0.18	0.15	0.14
10°		0.87km	0.76	0.58	0.43	0.33	0.26	0.22	0.18	0.15	0.14
15°		0.55km	0.51	0.44	0.36	0.30	0.25	0.21	0.18	0.15	0.14
5°	10.0	0.58km	0.38	0.22	0.15	0.11	0.08	0.07	0.06	0.05	0.04
10°		0.25km	0.22	0.17	0.13	0.10	0.08	0.07	0.06	0.05	0.04
15°		0.16km	0.15	0.13	0.11	0.09	0.08	0.06	0.06	0.05	0.04
5°	≥50.0	0.40km	0.28	0.16	0.11	0.08	0.06	0.05	0.04	0.03	0.03
10°		0.18km	0.15	0.12	0.09	0.07	0.06	0.05	0.04	0.03	0.03
15°		0.11km	0.10	0.09	0.08	0.06	0.06	0.05	0.04	0.03	0.03

Table C
Required Separation Distance (km) between an Indoor UWB Dithered Device and a Receiving Earth Station for I/N Equal to –10 dB and an IF Bandwidth Equal to 36 MHz and the Building (or Obstacle) Attenuation equal to 12 dB the Antenna Center-line = 7.5m and UWB height=15.0 m

Required Separation Distance (km) for Various Azimuth Angle Offset from the Satellite											
Elevation angle	PRF (MHz)	Azimuth Angle Offset from the Satellite Direction (degrees)									
		0°	5°	10°	15°	20°	25°	30°	35°	40°	45°
5°	1.0	2.2km	1.4	0.78	0.5	0.36	0.28	0.22	0.18	0.16	0.14
10°		0.97km	0.84	0.62	0.46	0.35	0.28	0.23	0.19	0.16	0.14
15°		0.61km	0.57	0.48	0.39	0.32	0.26	0.22	0.19	0.16	0.14
5°	10.0	0.76km	0.48	0.26	0.17	0.12	.087	.07	.057	.048	.041
10°		0.34km	0.3	0.21	0.15	0.12	.089	.072	.06	.05	.043
15°		0.22km	0.2	0.17	0.14	0.11	.087	.072	.061	.052	.045
5°	≥50.0	0.60km	0.37	0.19	0.12	.086	.065	.051	.042	.035	.03
10°		0.27km	0.23	0.17	0.12	.087	.067	.054	.045	.037	.032
15°		0.17km	0.16	0.13	0.1	.082	.066	.055	.046	.039	.033

For visualization purpose, Figures A-1, A-2, A-3, B-1, B-2, B-3 and C-1, C-2, C-3 plot the required separation distance, based on Tables A, B and C respectively. Each group (A's, B's and C's) of figures plots the three elevation angles (A-1, B-1 and C-1are for 5-degree, A-2, B-2 and C-2 are for 10-degree and A-3, B-3 and C-3 are for 15-degree). Each figure contains one top-graph for "km" scale to highlight the near-in azimuth angles and one bottom-graph for "meter" scale to highlight the far-off azimuth angles. Within each Figure, each graph plots the required separation distance as a function of the azimuth angle, from – 45 degrees to + 45 degrees, relative to the antenna boresight direction and for three PRF values (1, 10 and ≥ 50 MHz).

These figures show that, if a UWB device were located anywhere below the specific curve (or within the distance identified in the table), the device would cause unacceptable interference to the receiving earth station. For example, the peak of the curve (the table column under 0-degree) represents the maximum required separation distance and the two far-ends of the curve (the table column under 45-degree) represent the required separation distance for the UWB device located at ±45 degrees from the earth station antenna boresight direction. It can be seen, given the large required separation distance and the size of the affected area (one-quarter of the area around the earth station, *i.e.*,±45 = 90 degrees in a 360 degree circle), that ubiquitous UWB operation would cause harmful interference to the receiving earth stations.



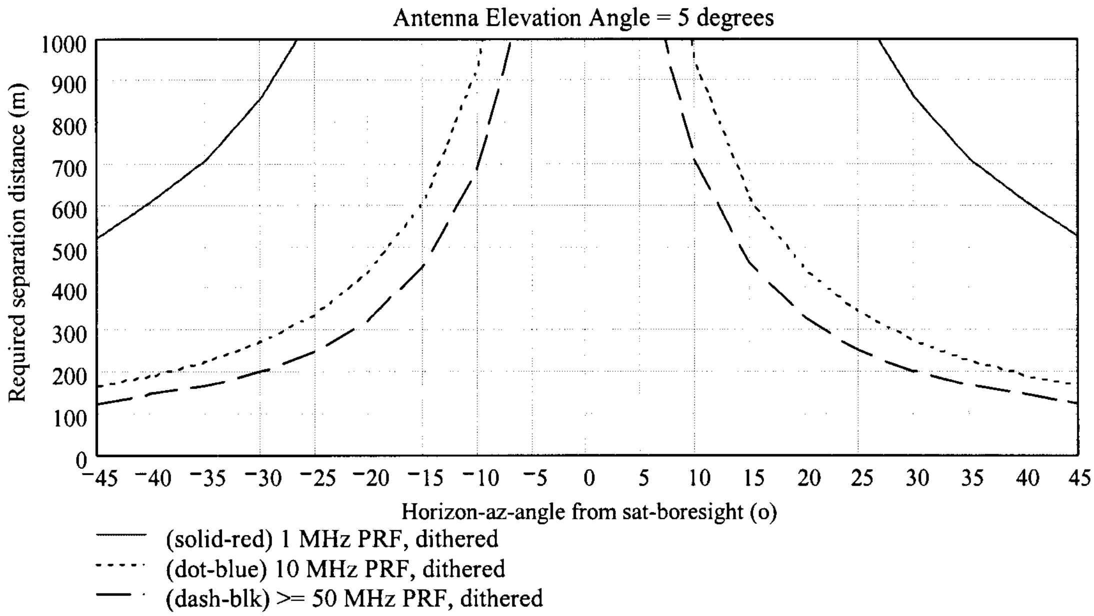
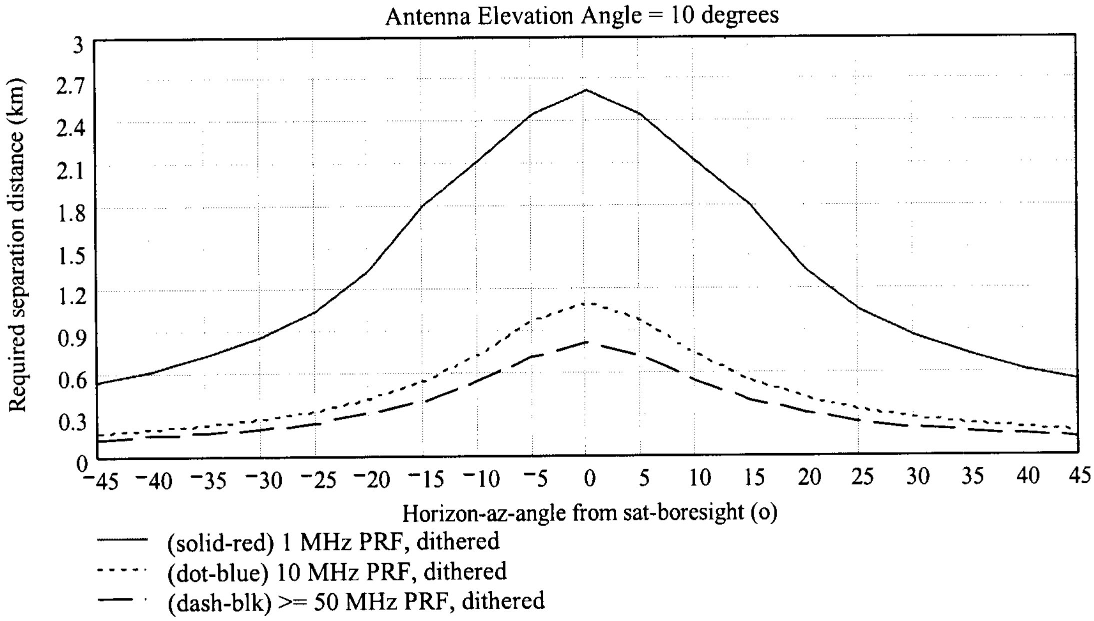


Figure A-1
The Required Separation Distance (for I/N= -10 dB & Peak-EIRP) Between a Receiving Earth Station (at 5-degree Elevation) And an Out-door UWB Device Using Dithered Signal



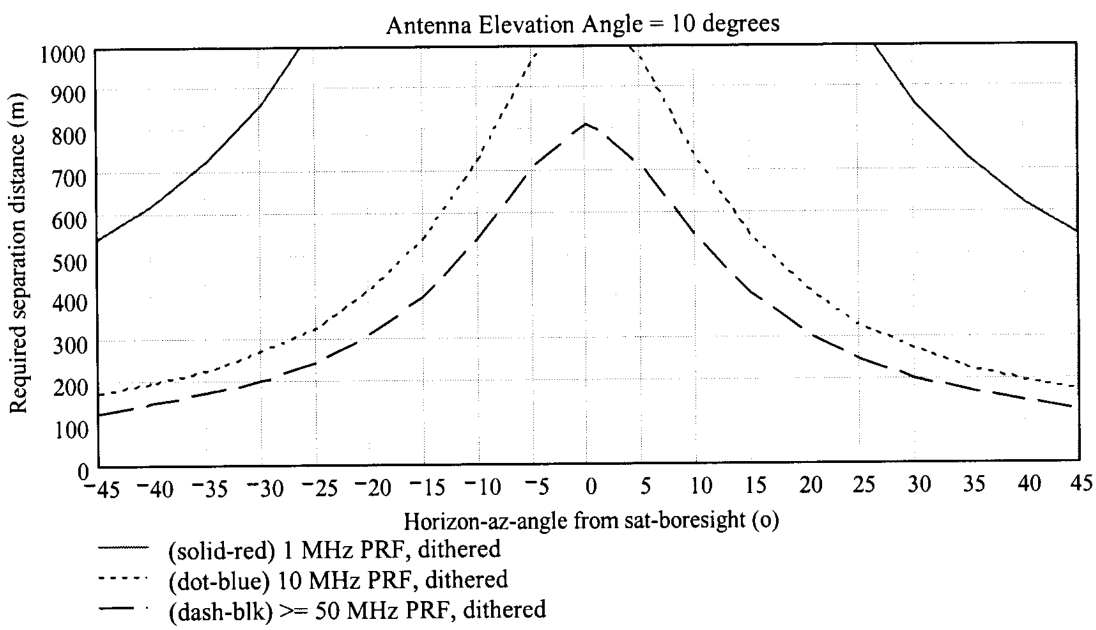
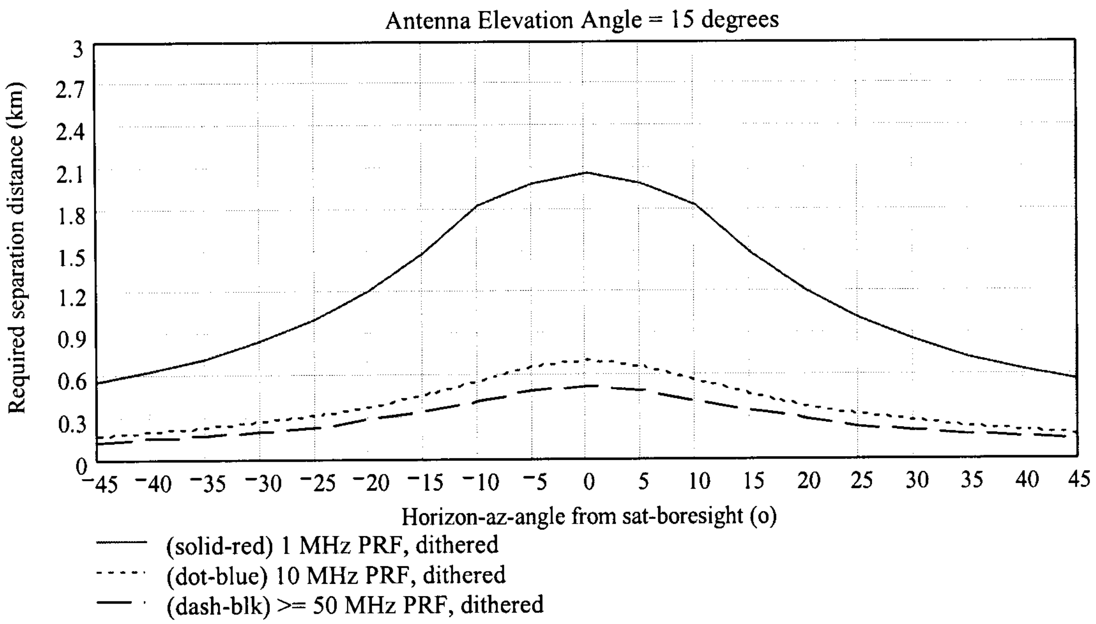


Figure A-2

The Required Separation Distance (for I/N= -10 dB & Peak-EIRP) Between a Receiving Earth Station (at 10-degree Elevation) and an Out-door UWB Device Using Dithered Signal



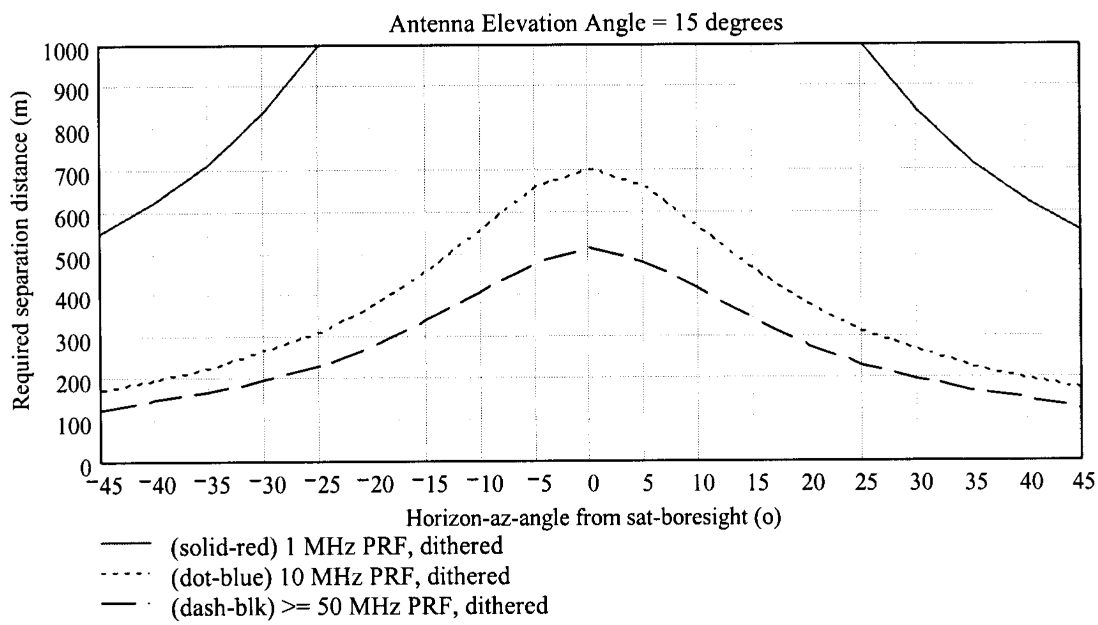
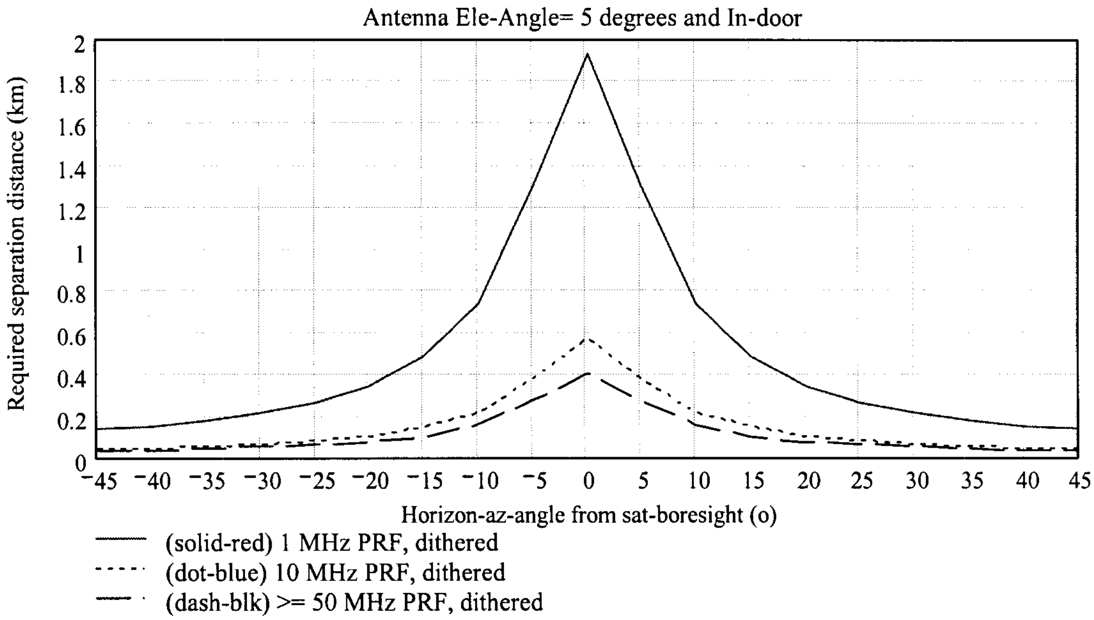


Figure A-3
The Required Separation Distance (for I/N= -10 dB & Peak-EIRP) Between a Receiving Earth Station (at 15-degree Elevation) and an Out-door UWB Device Using Dithered Signal,



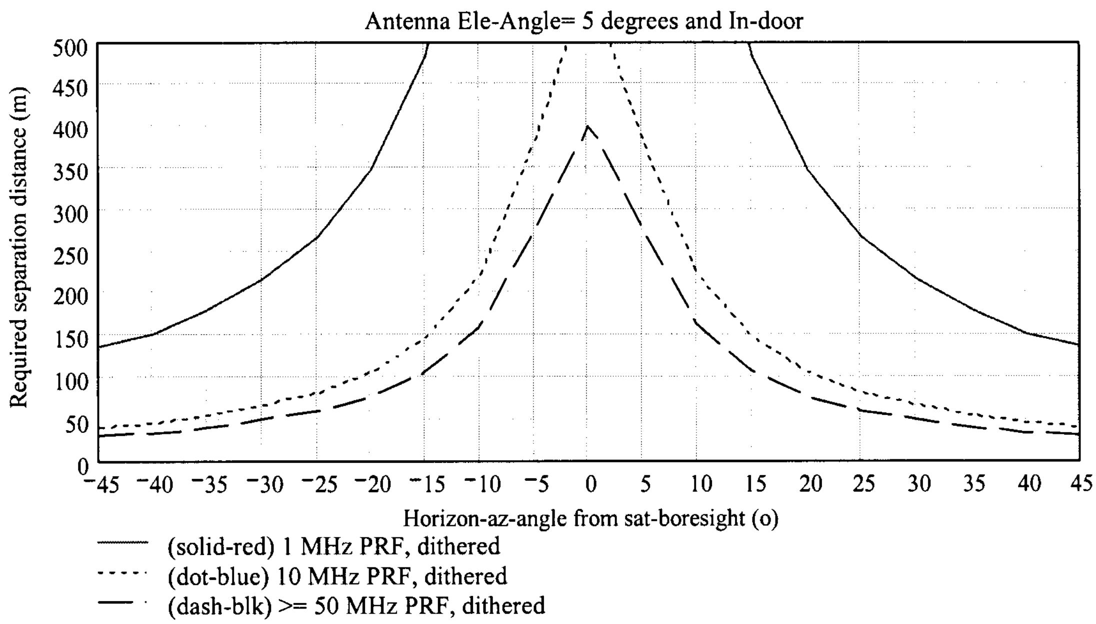
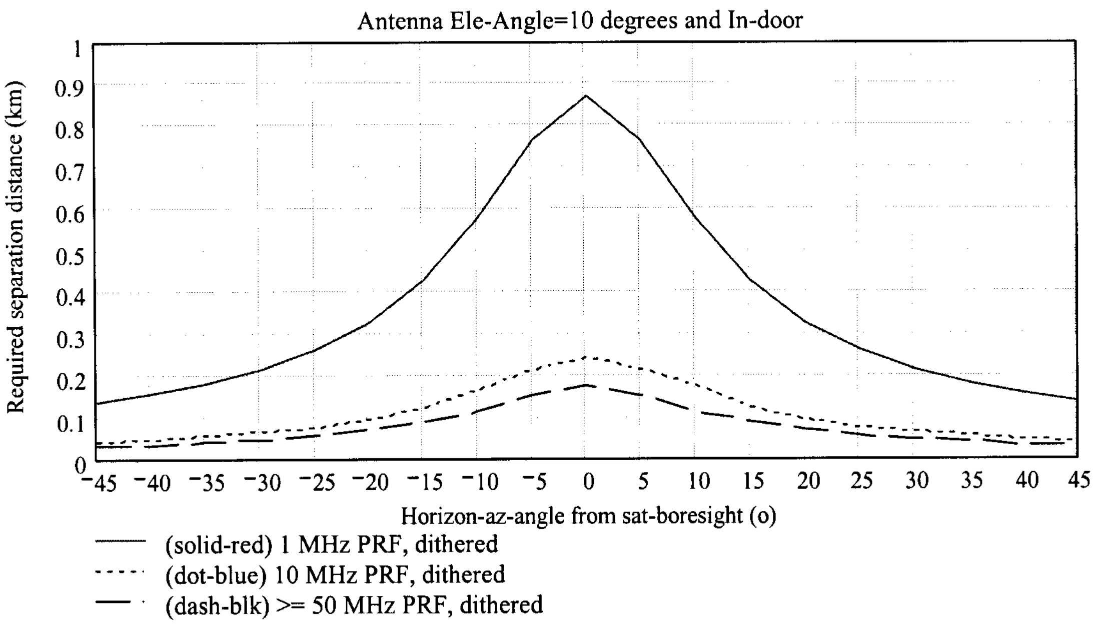


Figure B-1

The Required Separation Distance (for I/N= -10 dB & Peak-EIRP) Between a Receiving Earth Station (at 5-deg-Ele & Centerline=7.5m) and an In-door (12dB) UWB Device Using Dithered Signal, and Height=1.5m



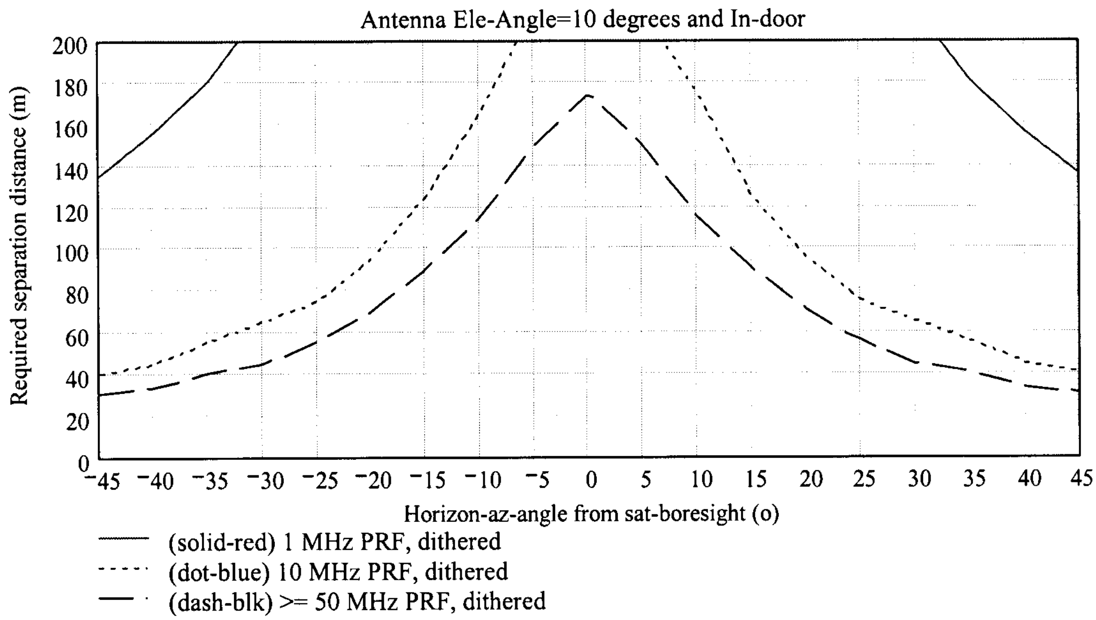
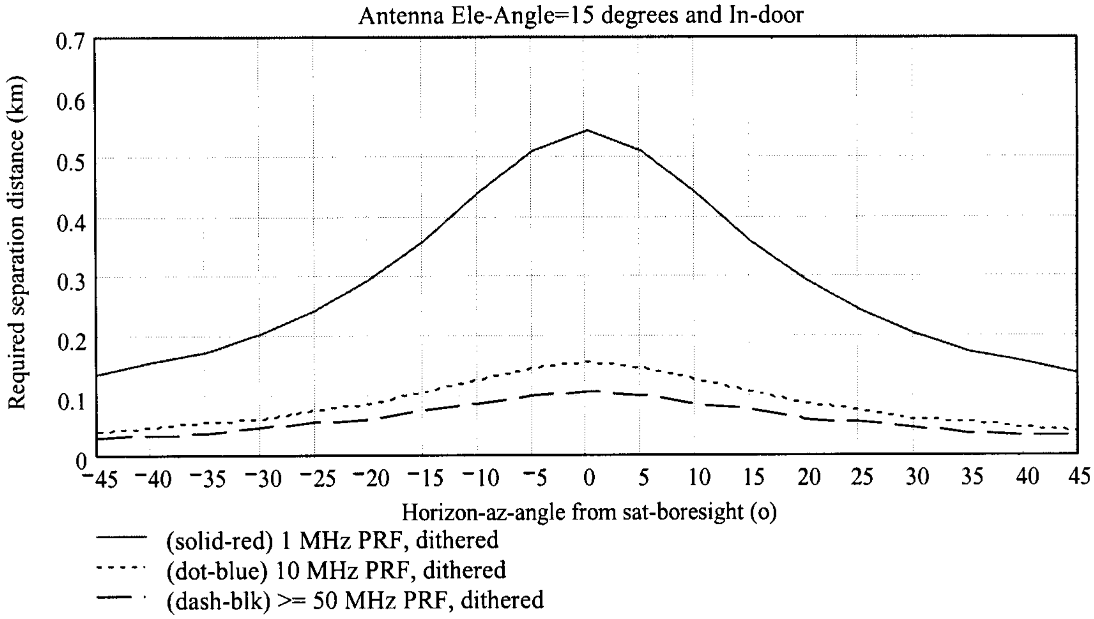


Figure B-2

The Required Separation Distance (for I/N= -10 dB & Peak-EIRP) Between a Receiving Earth Station (at 5-deg-Ele & Centerline=7.5m) and an In-door (12dB) UWB Device Using Dithered Signal, and Height=1.5m



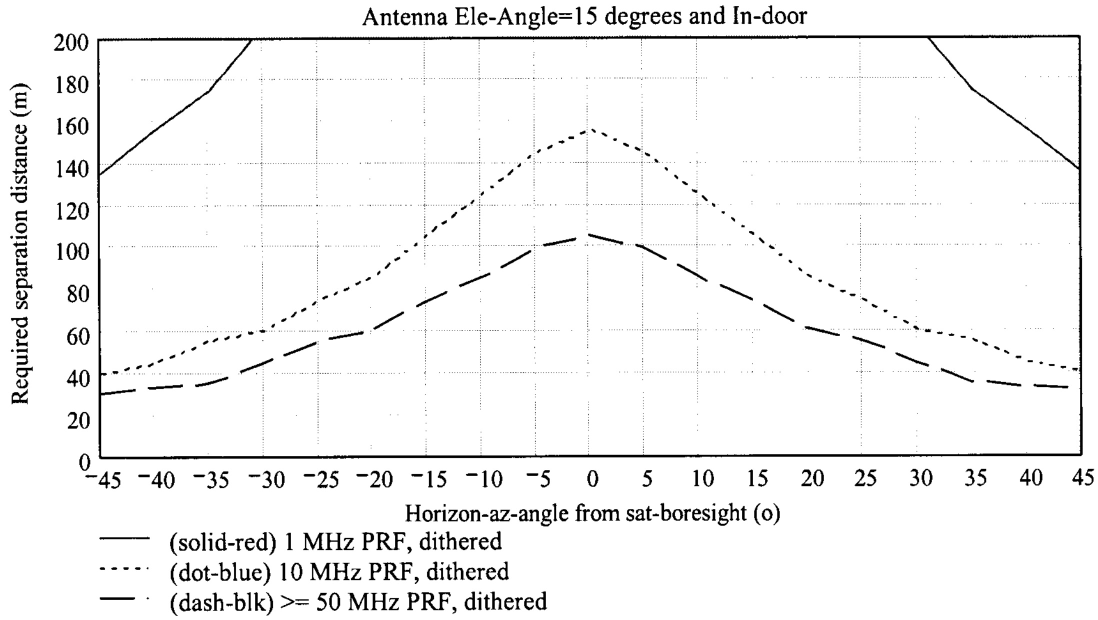
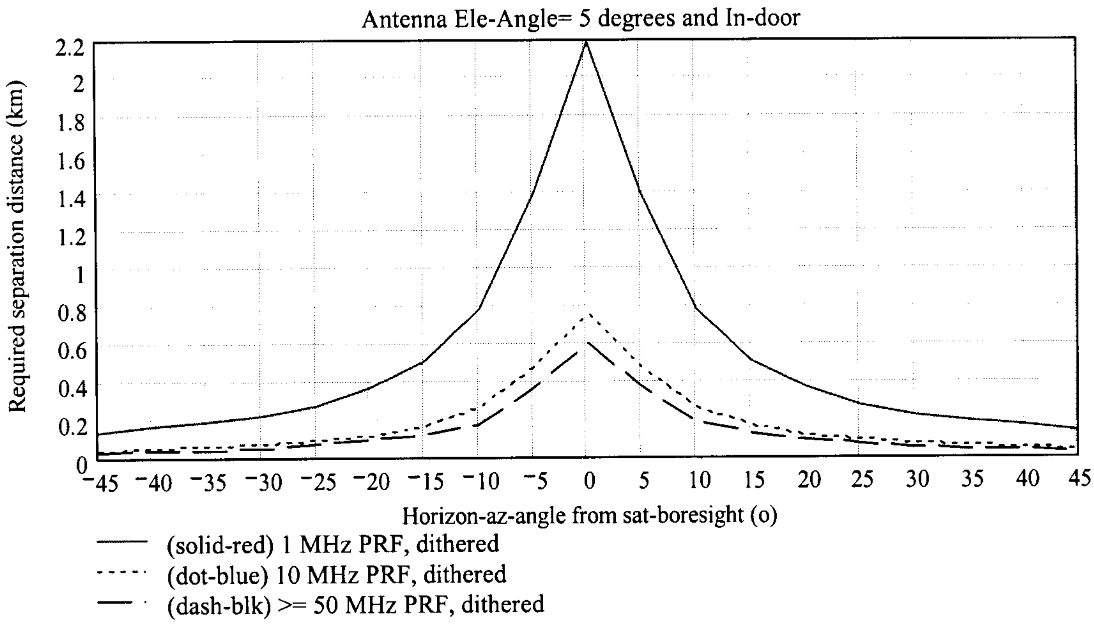


Figure B-3
The Required Separation Distance (for I/N= -10 dB & Peak-EIRP) Between a Receiving Earth Station (at 5-deg-Ele & Centerline=7.5m) and an In-door (12dB) UWB Device Using Dithered Signal, and Height=1.5m



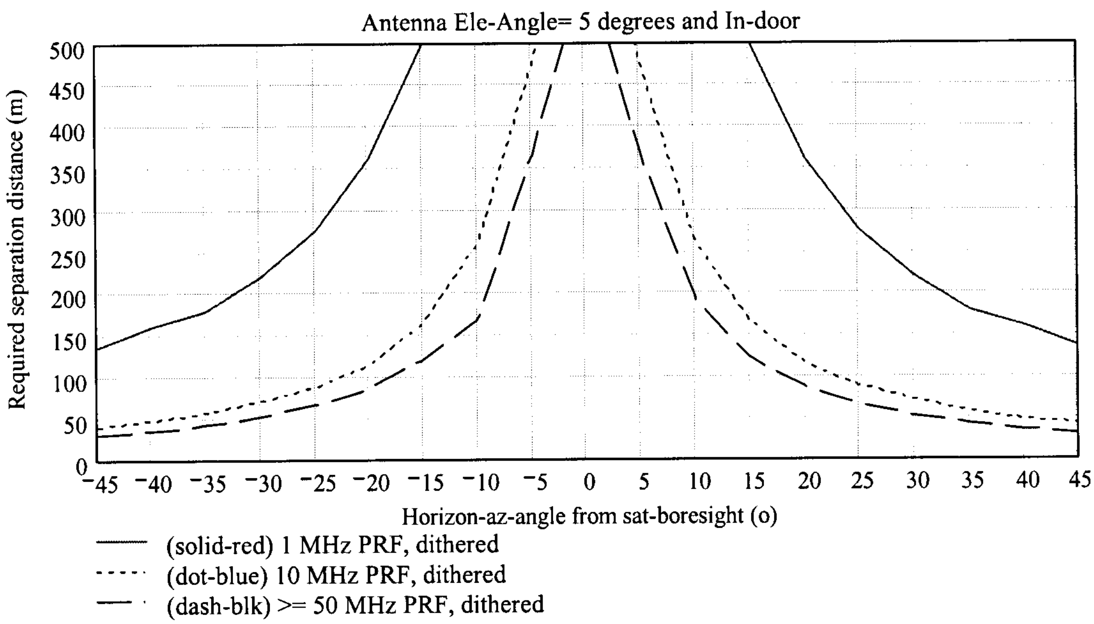
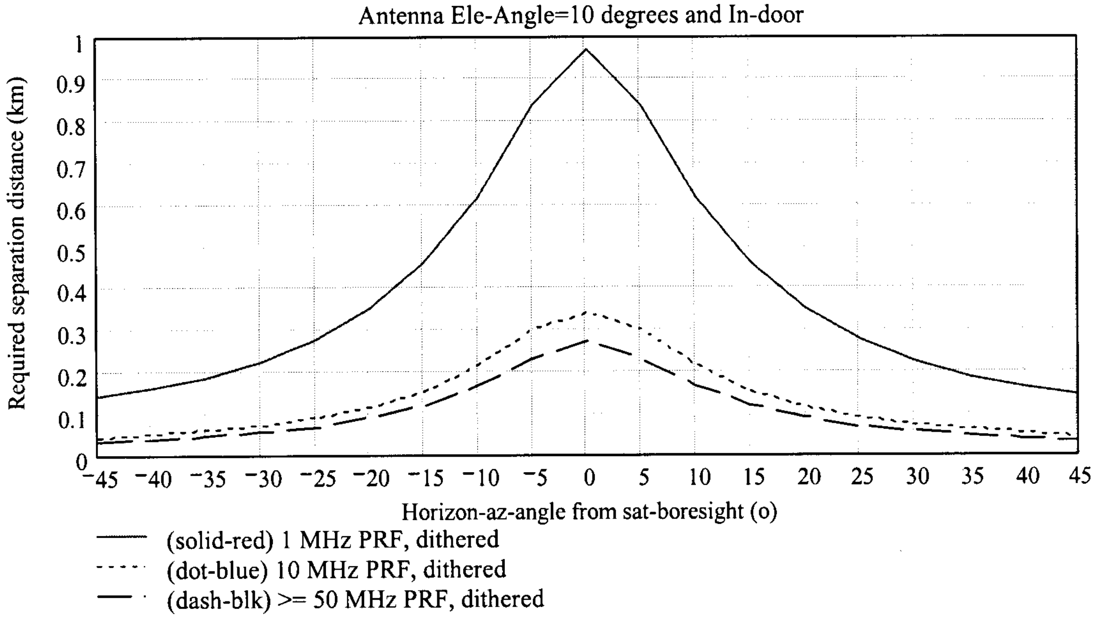


Figure C-1

The Required Separation Distance (for I/N= -10 dB & Peak-EIRP) Between a Receiving Earth Station (at 5-deg-Ele & Centerline=7.5m) and an In-door (12dB) UWB Device Using Dithered Signal, and Height=15.0m



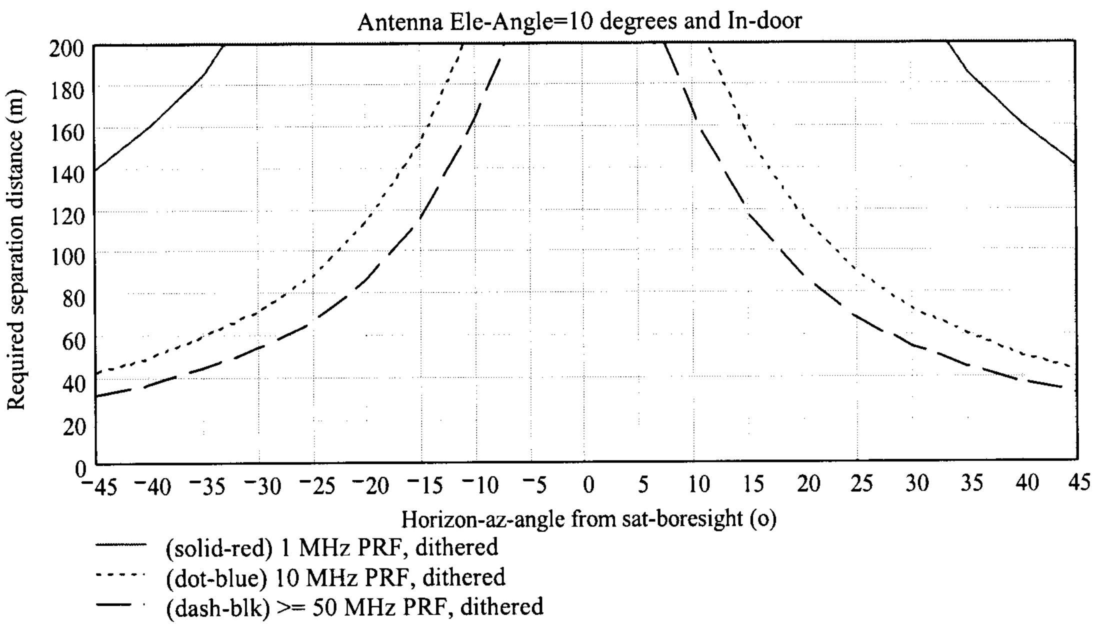
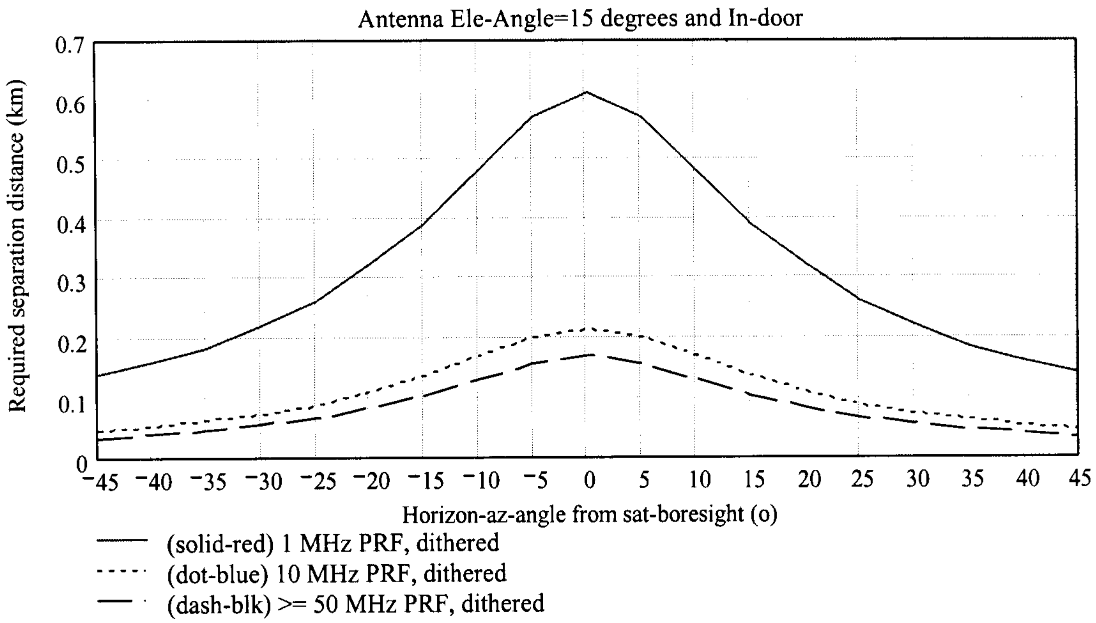


Figure C-2

The Required Separation Distance (for I/N= -10 dB & Peak-EIRP) Between a Receiving Earth Station (at 5-deg-Ele & Centerline=7.5m) and an In-door (12dB) UWB Device Using Dithered Signal, and Height=15.0m



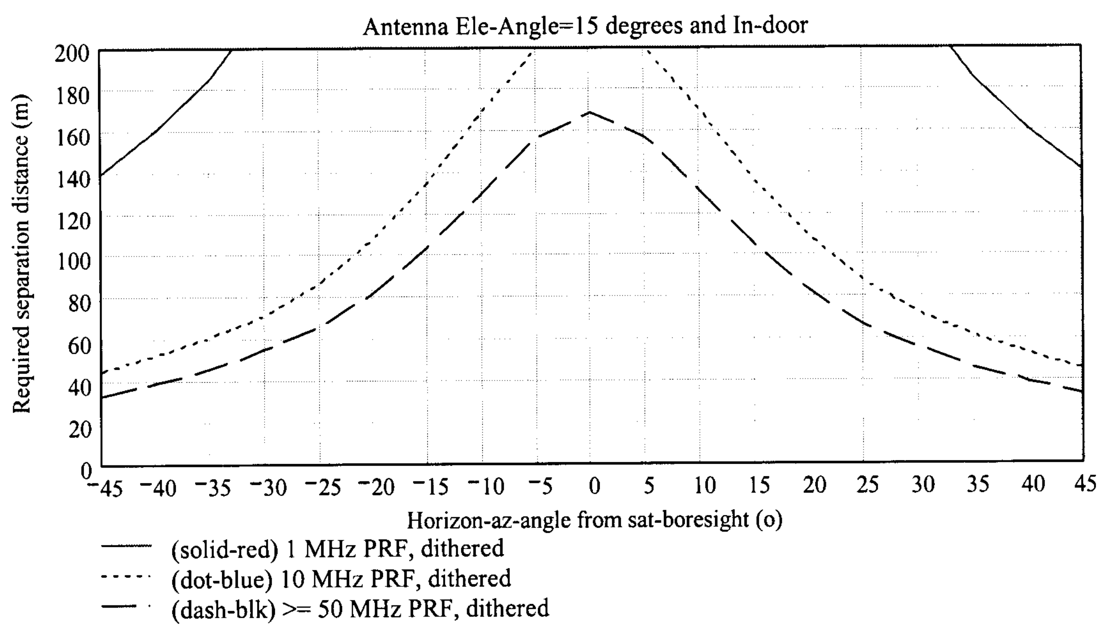


Figure C-3
The Required Separation Distance (for I/N= -10 dB & Peak-EIRP) Between a Receiving Earth Station (at 5-deg-ele & Centerline=7.5m) and an In-door (12dB) UWB Device Using Dithered Signal and Height=15.0m

The SIA's Antenna Height Assumptions do not Materially Affect Separation Distances.

In paragraph 129 of its Memorandum Opinion and Order, the Commission characterized as "overly conservative" SIA's assumption that "the FSS antenna will be only 6 meters higher than the height of the UWB device." It is not clear whether the Commission believes that the earth station antenna centerline used by SIA in its analysis is too high or too low relative to the height of the UWB device. Regardless of the answer, the impact of the antenna centerline height relative to the height of the UWB device is minimal in determining the required separation distance. For example, using Figure 1 as the reference and if the antenna centerline is increased to 10 meters from the 7.5 meters used in the SIA technical analysis, the maximum required separation distance would be changed from 2.6 km to 2.591 km (*i.e.*, a 9 meter change in 2.6 km). Similarly, if the antenna centerline height were decreased to 5 meters from the 7.5 meters use in the SIA Technical Analysis, the maximum required separation distance would be changed to 2.609 km from the original 2.6 km (*i.e.*, a 9 meter change in 2.6 km). Therefore, the earth station antenna centerline has a very minor effect on the required separation distance.

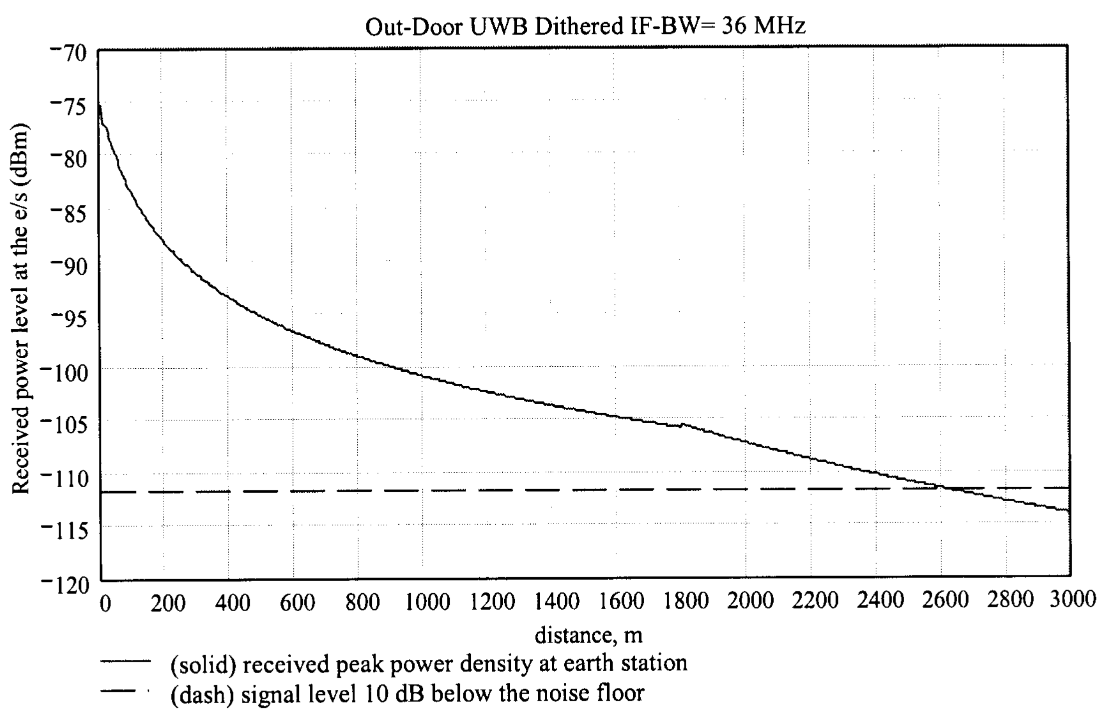


Figure 1 The Received Signal Level at the Earth Station Due to UWB Emission For the Following Conditions:
$EIRP_{pek}$ = - 3.1 dBm/36MHz
Elevation angle = 10 degrees
PRF = 1.0 MHz
Antenna Centerline Height = 7.5 m
UWB height = 1.5 m
Azimuth angle = 0 degree relative to the satellite direction

Separation Distance Depends on Peak EIRP Levels

Required separation distance depends on the specific UWB EIRP and every UWB emission has a peak value and an associated average value. These two levels are related by a constant that depends on the pulse repetition frequency (PRF) and the reference bandwidth as demonstrated here:

PRF (MHz)	Peak-EIRP (dBm/50MHz)	Peak-EIRP (dBm/36MHz)	Average-EIRP (dBm/MHz)
1.0	-0.3	-3.1	-41.3
10.0	-10.4	-13.1	-41.3
≥ 50.0	-12.8	-15.7	-41.3

Consequently, the separation distance required for the protection of the receiving earth station is a function of the operating average EIRP level and the related peak EIRP.[12]

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

/s/Harold Ng
Harold Ng

May 21, 2003

[12] *See also supra* at 4-7.