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FEDERAL COMMUNICATIONS COMMISSION
INTERNATIONAL BUREAU

November 2, 1995

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, D.C. 20554

RE: Ex Parte Communication
CC Docket 92-297

Dear Mr. Caton:

Pursuant to Section 1.1206 of the Commission's rules, 47 C.F.R. § 1.1206, this will serve to indicate that on November 2, 1995 Tom Tycz, Harry Ng, Karl Kensinger, Jennifer Gilsenan, and Joslyn Read of the International Bureau, Bob James and Susan Magnotti of the Wireless Telecommunications Bureau, and Michael Marcus of the Office of Engineering and Technology, met with the attached list of people, to discuss interservice frequency sharing rules. The attached documents were distributed to those present.

TRW's representative, Mr. David Keir, indicated that based on Texas Instruments's analysis submitted at the October 10, 1995 meeting, TRW could share the 29.1-29.25 GHz band with transmitting LMDS subscriber terminals.

Sincerely,

Jennifer M. Gilsenan

Jennifer M. Gilsenan

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List ABCDE

11/2/95

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LELAND LANGSTON	TI	214-917-6209
BILL MYERS	TI	214-917-7345
Gene Robinson	TI	214 917-6202
DOUG LOCKIE	ENDGATE	408-737-7300
PAUL MISENER	WR+F / TEXAS INSTRUMENTS	202-828-7506 / 202-429-7049

20/30 GHz Technical Characteristics of the Iridium (R) Network

WG1/6 (Rev 2)
WG2/6 (Rev 2)
8/05/94

PARAMETER	CHARACTERISTIC
1. ORBITAL PARAMETERS	
No. of Planes / No. of satellites per plane	6 planes / 11 satellites
Spacing of planes / Phasing of planes	5 @ 31.6° , 1 @ 22°
Inclination (°) / Orbital period (min.)	86.5° / 100.3 min.
Apogee / Perigee	780 km. / 780 km.
Right Ascension (°) / Argument of Perigee (°)	0°,31.5°,63.2°,94.8°,126.3°,157.9° / 86.5°
2. FREQUENCY BANDS	
Uplink / Downlink (GHz)	29.1 - 29.3 GHz / 19.4 - 19.6 GHz
3. CARRIER TRANSMISSION PARAMETERS	
Multiple Access Technique	FDMA
Modulation Types / Coded Data Rate (Mbps)	QPSK / 6.250 Mbps
Xmtr. Necessary BW for each carrier (MHz)	6.250 MHz
Information Data Rate (Mbps)	3.125 Mbps
Xmtr. Occupied BW for each carrier (MHz)	4.375 MHz
Assigned BW for each carrier (MHz)	7.67 MHz, Earth-to-space / 7.22 MHz, space-to-Earth
Required Eb/(No+Io) [and C/(N+I)] (dB)	7.7 dB
C/(N+I), rain / C/(N+I), clear; including margin (dB)	7.8 dB / 10.7 dB
Interference Criteria is delta-T/Ts (%)	5% single entry (service aggregate) / 10% total all services
Transmitter Noise, C/N (dB)	> 25 dB
Uplink Xmtr. Power per Carrier (dBW)	-22.3 dBW to 12 dBW, APC (to compensate for range and atmospheric losses) is employed to keep a constant Eb/(No+Io) at the receiver antenna.
Downlink Xmtr. Power per Carrier (dBW)	-22.4 dBW to -3.2 dBW, APC (to compensate for range and atmospheric losses) is employed to keep a constant Eb/(No+Io) at the receiver antenna.
Satellite / Earth Station Noise Temp (°K)	1295 °K / 731 °K
Io, max. long term interference at the satellite receiver	-210.5 dBW/Hz
4. SATELLITE ANTENNA PARAMETERS	
No. of spot beams / Pointing direction from nadir	4 steerable
Xmtr. Peak Gain (dBi) / Beamwidth (°) / Polarization	26.9 dBi / 7.4° / RHCP
Rcvr. Peak Gain (dBi) / Beamwidth (°) / Polarization	30.1 dBi / 5° / RHCP
Sidelobe Mask	ITU Appendix 29, Annex III, D/lambda < 100
5. EARTH STATION ANTENNA PARAMETERS	
Service min. elevation angle (°) / Steerable?	5° / Yes
Xmtr. Peak Gain (dBi) / Beamwidth (°) / Polarization	56.3 dBi / 0.24° / RHCP
Rcvr. Peak Gain (dBi) / Beamwidth (°) / Polarization	53.2 dBi / 0.36° / RHCP
Sidelobe Mask	47 CFR 25.209
Number of Earth Stations and distribution	
CONUS Gateways:	1 or 2 initial system, 4 or 5 with system growth
Four North American Satellite Control Stations:	Yellowknife, Canada; Iqualuit, Canada; Waimea, Hawaii; Chandler, Arizona

MOTOROLA
Satellite Communications Division

LOCAL MULTIPOINT DISTRIBUTION SERVICE SUBSCRIBER SHARING ANALYSIS WITH IRIDIUM®

(STATIC ANALYSIS)

John T. Knudsen

Motorola
Satellite Communications Division

2 November 1995

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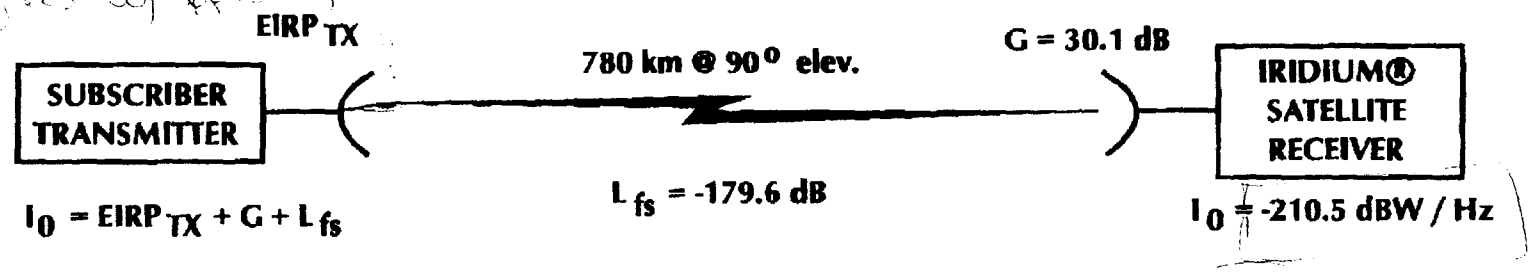
MOTOROLA
Satellite Communications Division

INTERFERENCE FROM A SINGLE MISPOINTED LMDS SUBSCRIBER UNIT



SYSTEM	SUBSCRIBER TRANSMITTER EIRP / Hz dBW / Hz	INTERFERENCE THRESHOLD FOR $I_0/N_0 = -13$ dB EIRP / Hz dBW / Hz	EXCESS INTERFERENCE dB
Proposed Rule (with Power Control)	-40.0	-61.0	21.0
Proposed Rule (without Power Control)	-46.0	-61.0	15.0

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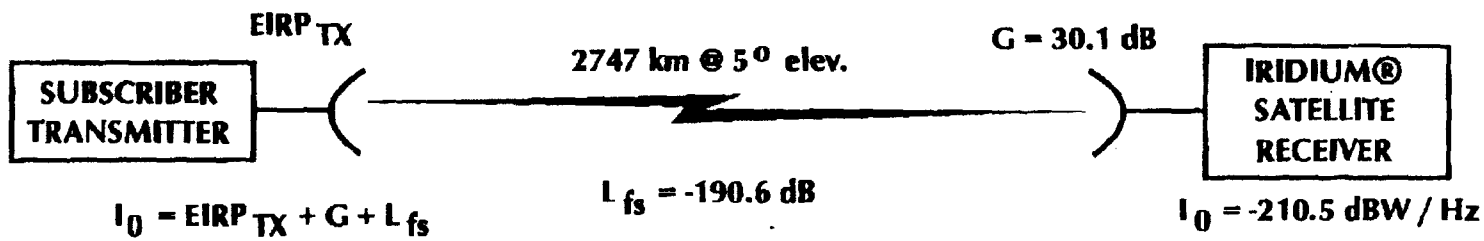
Satellite Communications Division

INTERFERENCE FROM A SINGLE CORRECTLY POINTED SUBSCRIBER UNIT



SYSTEM	SUBSCRIBER TRANSMITTER EIRP / Hz dBW / Hz	INTERFERENCE THRESHOLD FOR I_0/N_0 = -13 dB EIRP / Hz dBW / Hz	EXCESS INTERFERENCE dB
Proposed Rule (with Power Control)	-40.0	-50.0	10.0
Proposed Rule (without Power Control)	-46.0	-50.0	4.0

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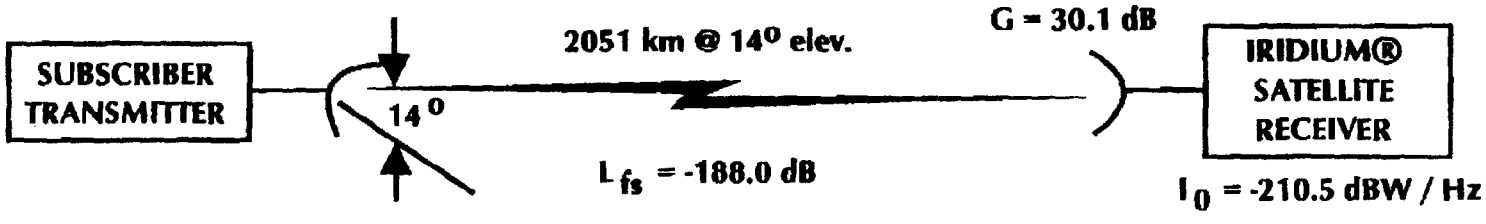
MOTOROLA
Satellite Communications Division

INTERFERENCE FROM SIDELOBES OF CORRECTLY POINTED LMDS SUBSCRIBER UNIT

ASSUME 16 dB SIDELOBE ATTENUATION



SYSTEM	SUBSCRIBER TRANSMITTER SIDELOBE POWER EIRP /Hz dBW / Hz	INTERFERENCE THRESHOLD EIRP / Hz dBW / Hz	NUMBER REQUIRED TO CAUSE EXCESS INTERFERENCE
Proposed Rule -40 dBW / Hz Peak	-56.0	-52.6	3
Proposed Rule -46 dBW / Hz Peak	-62.0	-52.6	9

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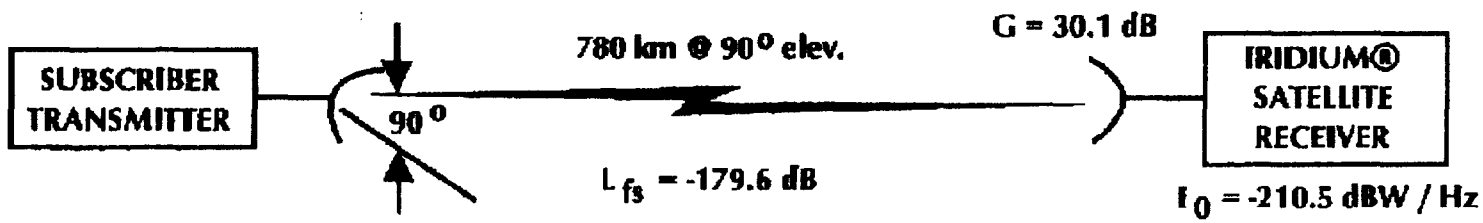
Satellite Communications Division

INTERFERENCE FROM SIDELOBES OF CORRECTLY POINTED LMDS SUBSCRIBER UNIT

ASSUME 30 dB SIDELOBE ATTENUATION



SYSTEM	SUBSCRIBER TRANSMITTER SIDELOBE POWER EIRP /Hz dBW / Hz	INTERFERENCE THRESHOLD EIRP / Hz dBW / Hz	NUMBER REQUIRED TO CAUSE EXCESS INTERFERENCE
Proposed Rule -40 dBW / Hz Peak	-70.0	-61.0	8
Proposed Rule -46 dBW / Hz Peak	-76.0	-61.0	32

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CONCLUSIONS

1. A SINGLE CORRECTLY POINTED LMDS ANTENNA WILL CAUSE HARMFUL INTERFERENCE

2. CUMULATIVE INTERFERENCE FROM SIDELOBES OF LMDS SUBSCRIBER ANTENNA WILL CAUSE HARMFUL INTERFERENCE

3. SHARING RISK TO THE IRIDIUM® SYSTEM IS VERY HIGH

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$$\frac{C_o}{I_o} = 20.9 \text{ dB}$$

$$I_o = C_o - 20.9 \text{ dB}$$

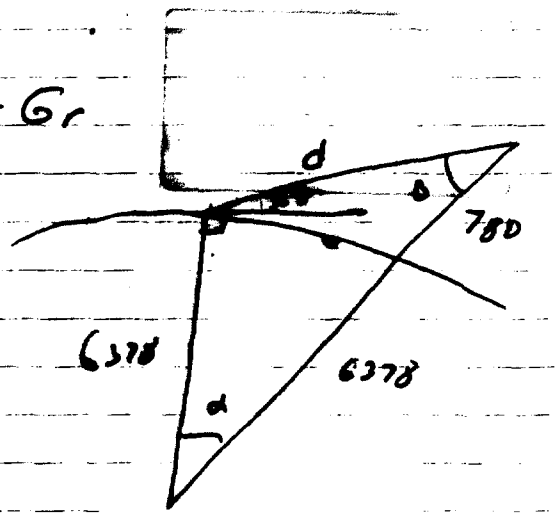
$$C_o = EIRP_{TX} - P_L + G_r$$

$$P_L = \left(\frac{4\pi d}{\lambda}\right)^2$$

$$\lambda = \frac{3\times10^8 \text{ m/s}}{29.169 \text{ 1/s}} \cdot \frac{1}{1000}$$

$$P_L = \left(\frac{4\pi \cdot 2521}{3\times10^8 / 29.169 \times 10^{-3}}\right)^2$$

$$= 189.8 \text{ dB}$$



$$\sin \beta = \frac{6378}{6378+780} \cos 7.5$$

$$\beta = 62.06°$$

$$\alpha = 180 - 90 - 7.5 - \beta = 20.44$$

$$d = \frac{\sin \alpha \cdot 6378}{\cos(7.5)} = 2521 \text{ Km}$$

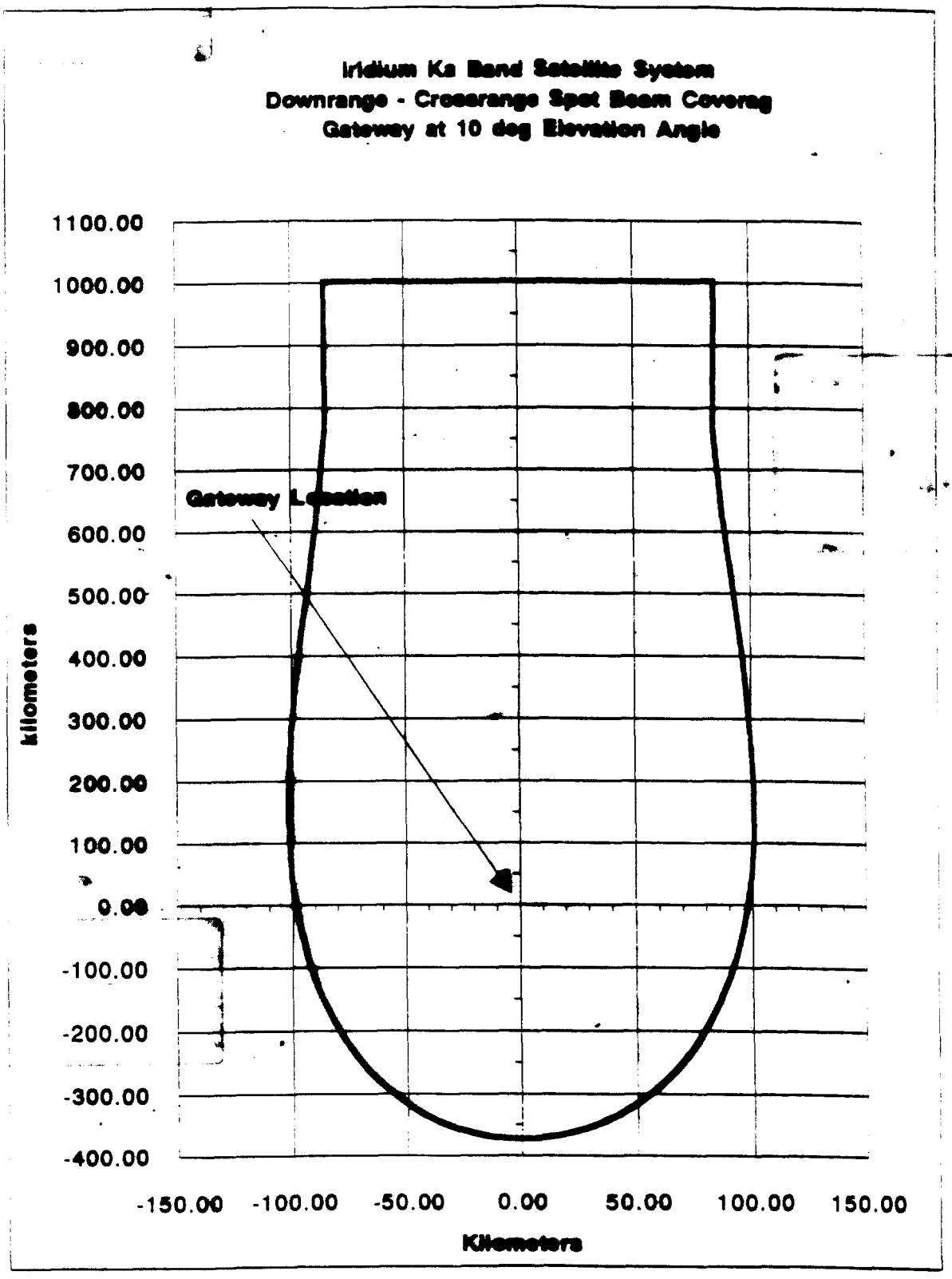
$EIRP_{TX} = 21.1$ dBW/Hz

$G_r = 30.1$

$$C_o = -21.1 - 189.8 + 30.1$$
$$= -180.8 \text{ dBW/H}$$

$$I_o = -201.7 \text{ dBW/Hz}$$

$$\boxed{\frac{C_o}{I_o} = 20.9 \text{ dB} \Longrightarrow \frac{I_o}{N_o} = -4.2 \text{ dB}}$$



K&M Company POLY-WU
Torrance, CA 90503 #PV119E

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Satellite Communications Division

Local Multipoint Distribution Service Sharing Analysis With Iridium®

(Statistical Analysis)

Dr. Robert Kubik

Motorola Satellite Communications Division

November 2, 1995

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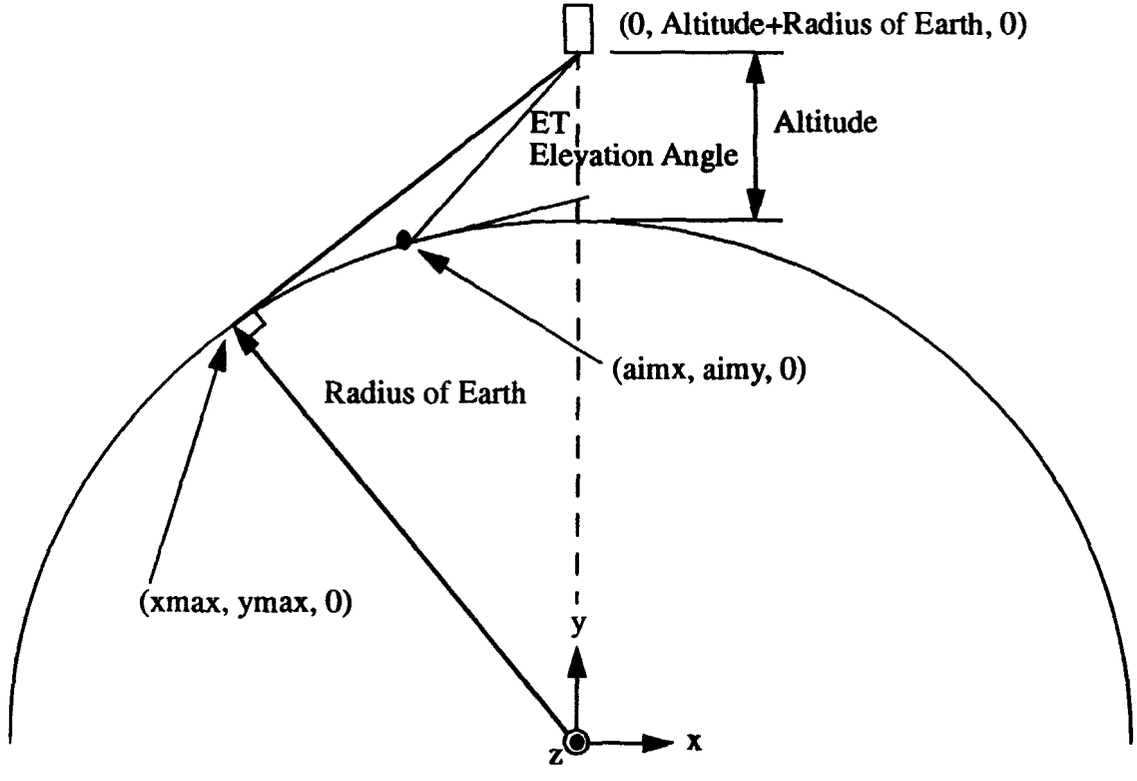
- Analysis Description

-Computes total contribution to C/I from all Customer Premise Equipment (CPE) into the Iridium satellite communicating to a ground station.



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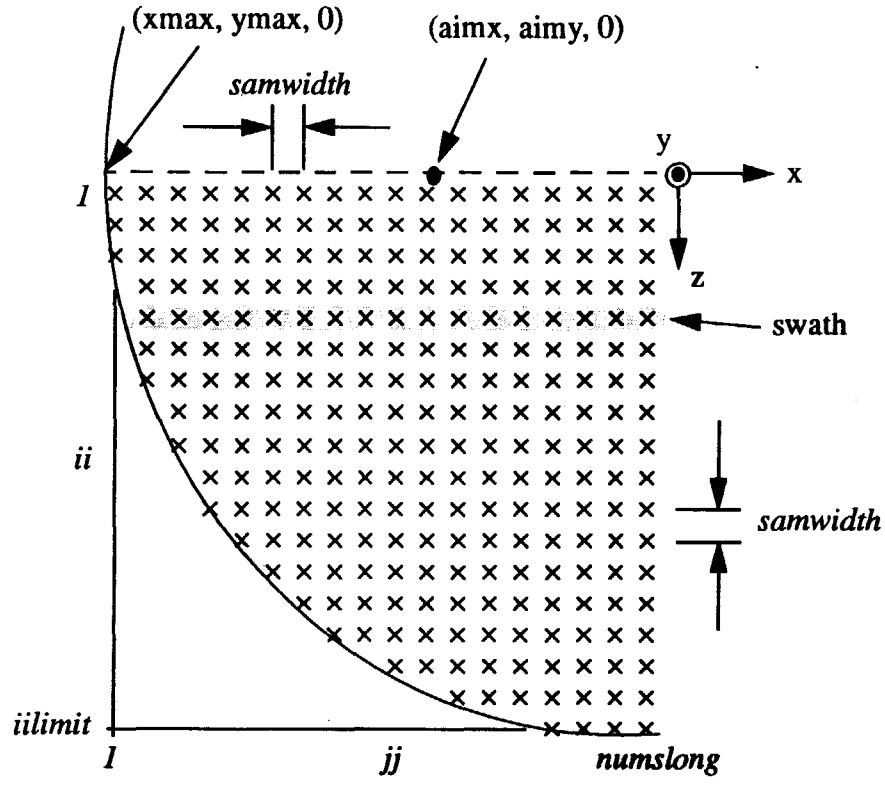
- The CPEs are distributed uniformly in latitude and longitude for 1/4 of the earth that is visible to the Iridium satellite.



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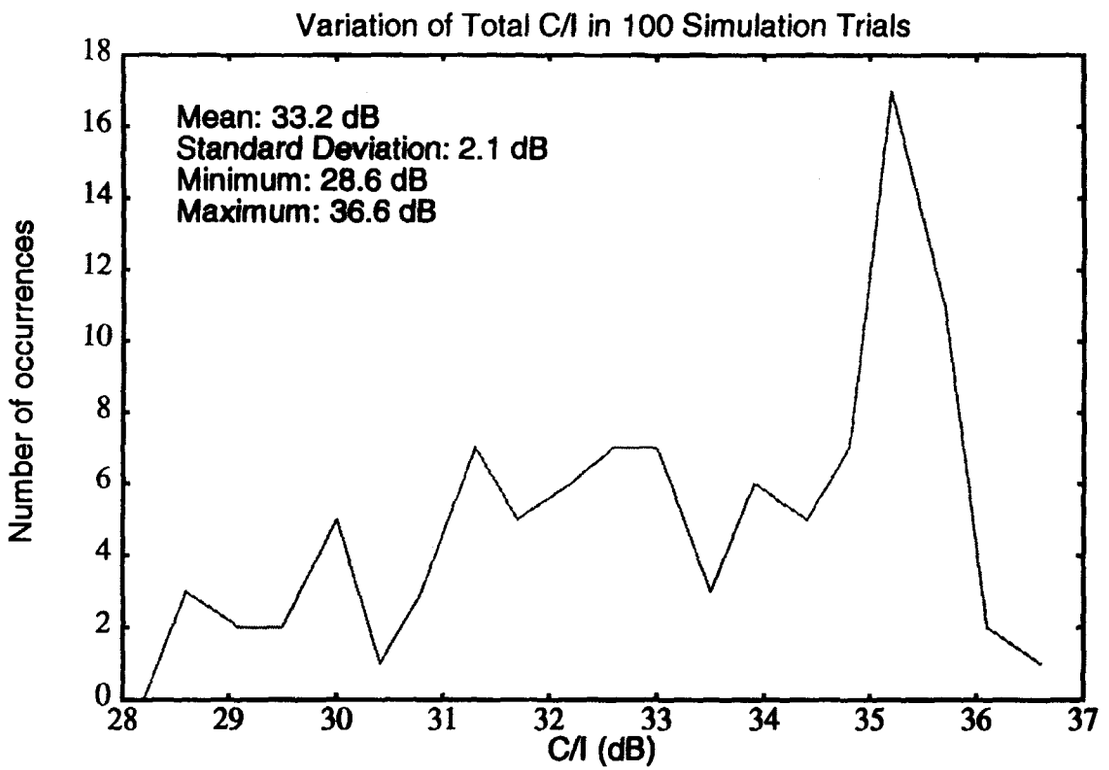
Comments on Analysis

- The random nature of the analysis is not fully examined. The analysis was performed 100 times for Texas Instruments CPE (LMDS proponents quote total C/I as 35.4 dB).



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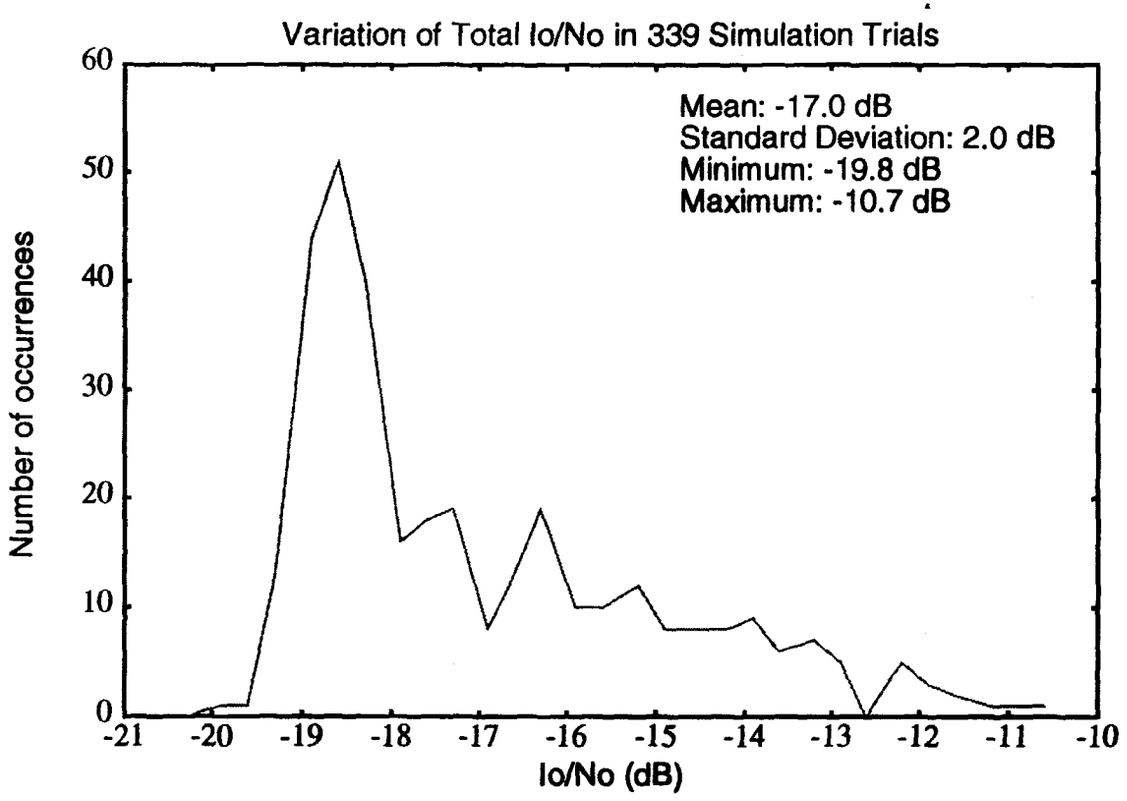
- The negotiated rulemaking used Io/No as the method to compute levels of interference (Iridium single entry interference criteria is -13 dB).



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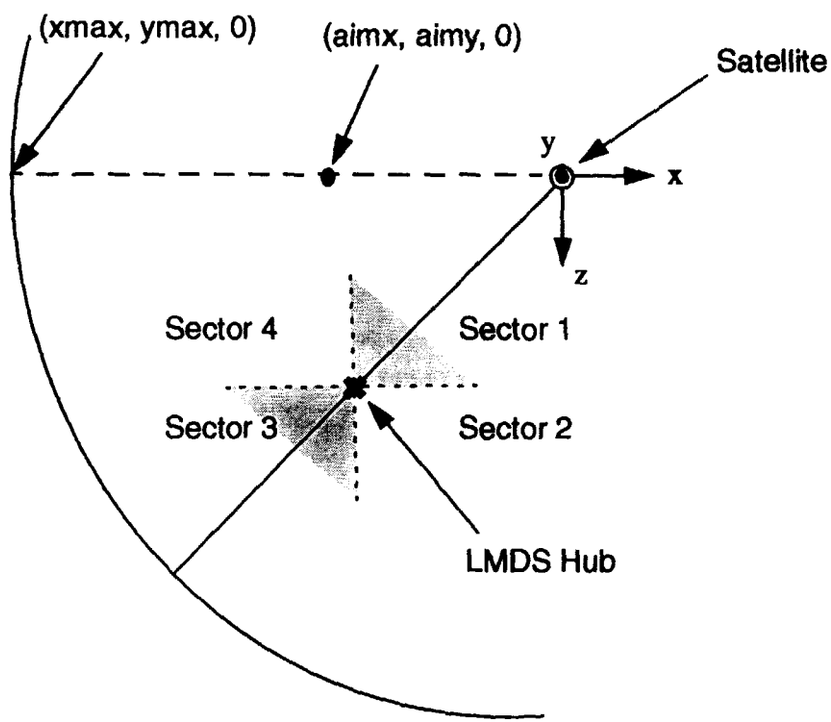
- The analysis under-samples the worst case frequency reuse sector.



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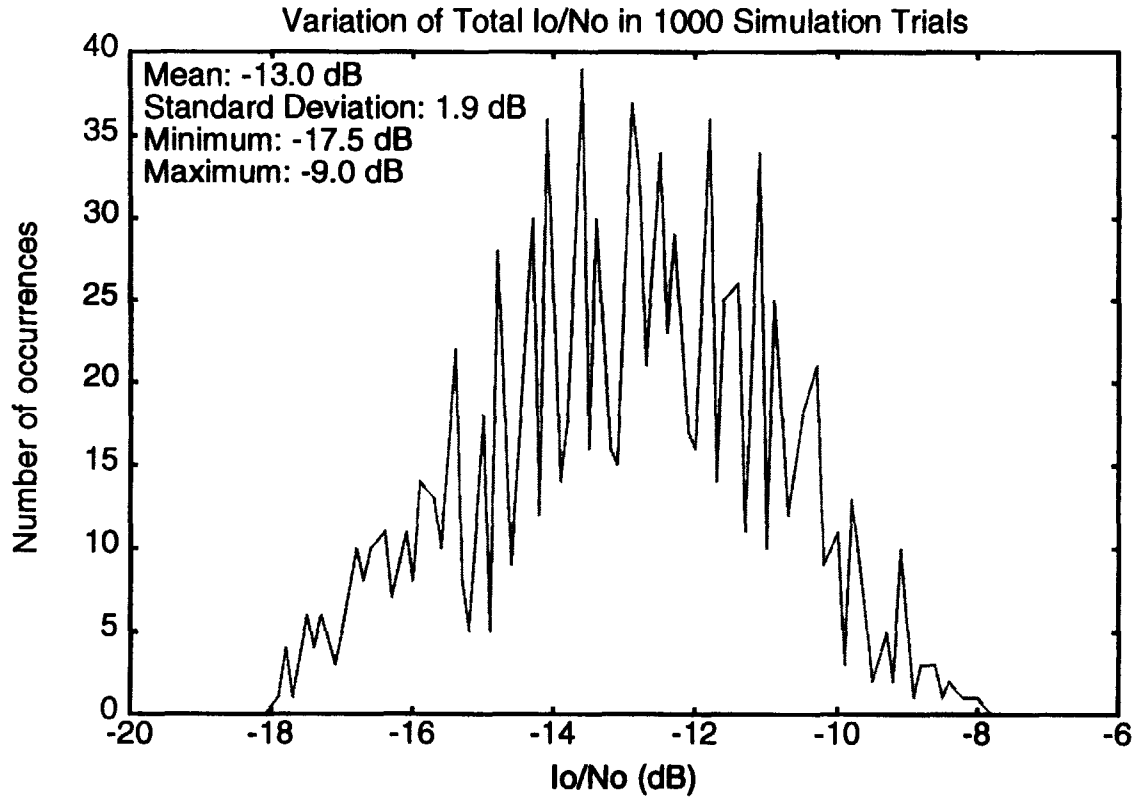

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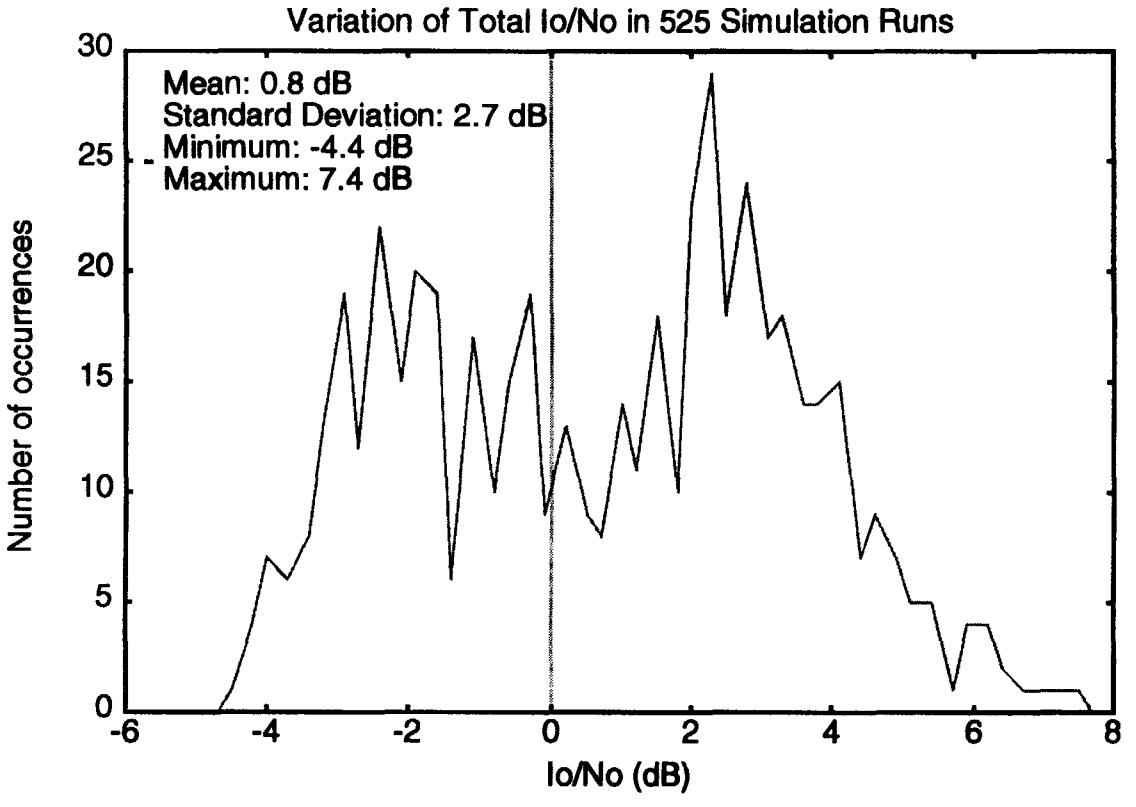
November 2, 1995

- Removal of power control (due to CPE to hub distances, and additional 3 dB blocking when elevation angle is less than 5 degrees).
- Inclusion of 1 dense CPE swath.



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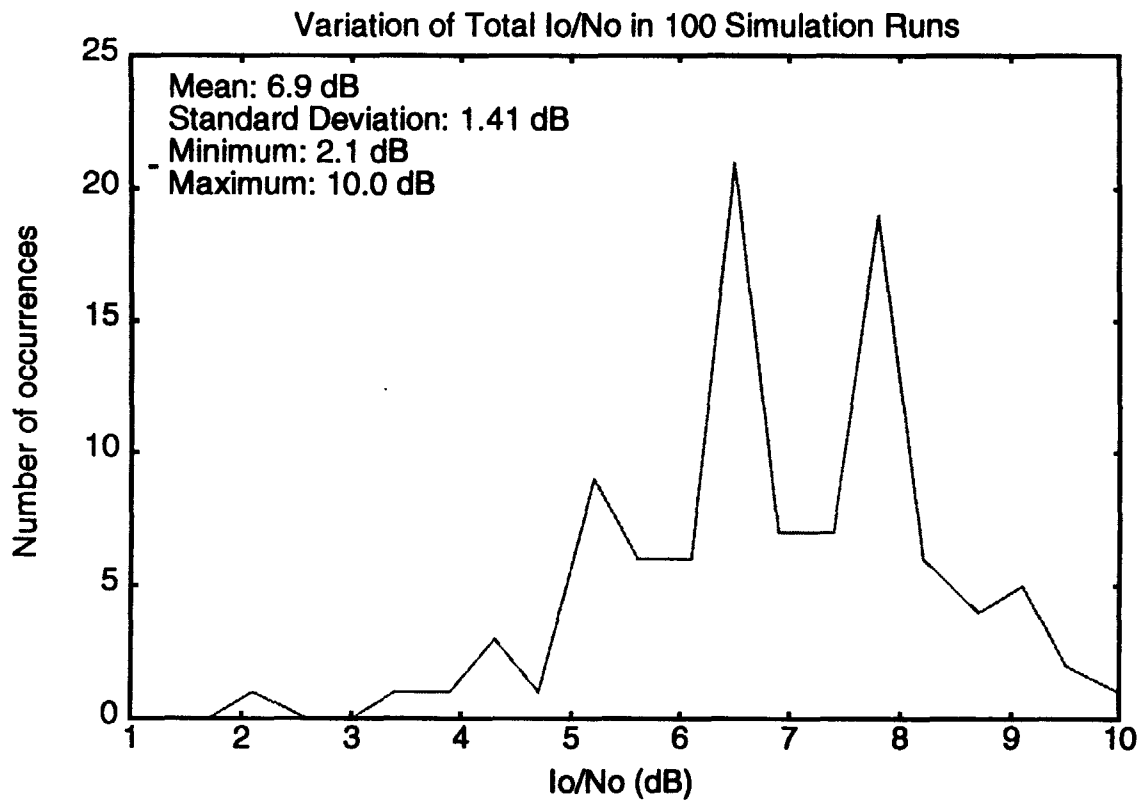
Impact of Proposed Rules:

-No Power Control



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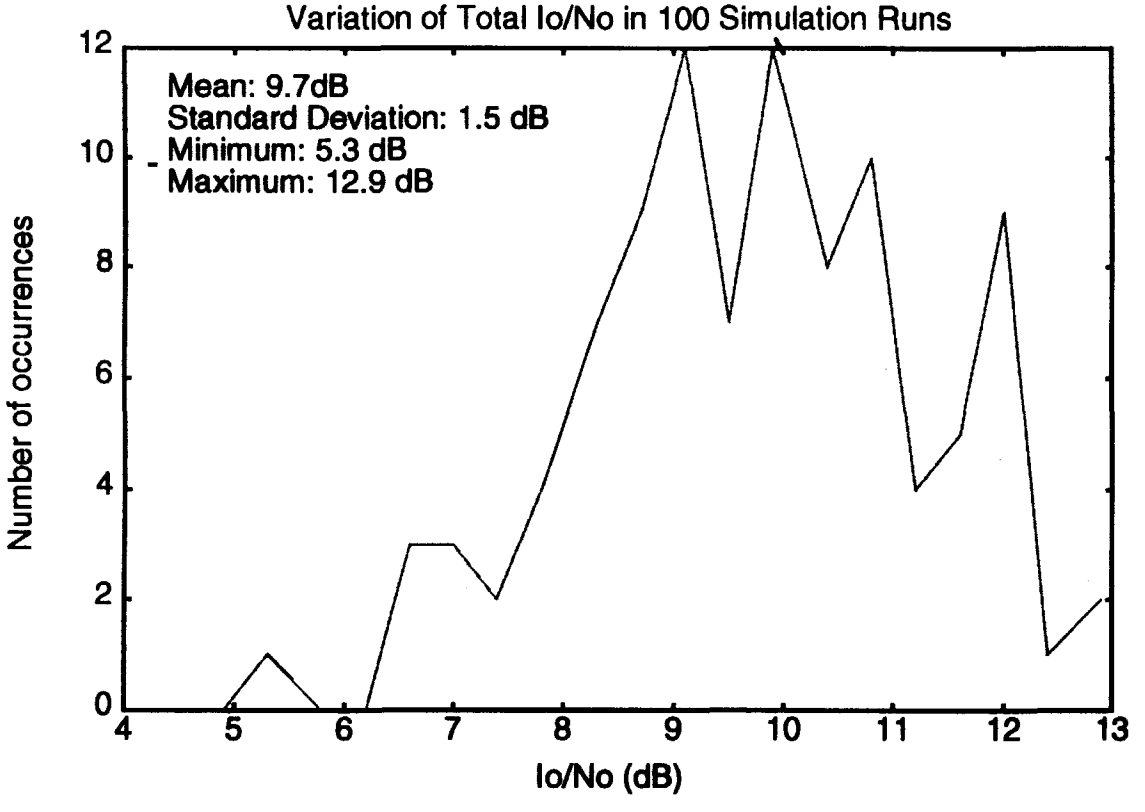
-Power Control



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Conclusions:

- The statistical analysis should be done in terms of Io/No and compared to -13 dB criterion for Iridium.
- The statistical nature of the program needs be exercised (7 dB increase in interference).
- The frequency reuse sector that is most likely to cause interference should be simulated at all times (average 4 db increase in interference).
- The effects due propagation losses and dense distributions of CPEs should be investigated (15 dB increase in interference).

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TI Local Multipoint Distribution Service Customer Premise Equipment Sharing Analysis with Iridium®

Introduction

Local Multipoint Distribution Service (LMDS) proponents have conducted analysis[1] to determine the feasibility of the various LMDS Customer Premise Equipment (CPE) using the 29.1 to 25.25 GHz band as the return link frequency to the LMDS hubs and to demonstrate compatibility with the Iridium satellite receiver operating in this band. This report outlines the analysis as given to Motorola by Steve Ruzic and Gene Robinson[2]. The typical CPE parameters were determined for by the four proposed LMDS systems (Cellular Vision, Endgate Technology, Hewlett Packard and Texas Instruments).

Comments on Analysis

The LMDS analysis makes some assumptions that may not be valid. These assumptions are:

1) The random nature of the analysis is not fully expanded upon. The analysis assumes that there are two random variables in the simulation, the distance of the CPE to the hub and the azimuth angle of the CPE. The analysis should be ran many times (with different seeds to the random number generators) to arrive at a distribution of the total C/I that a Iridium satellite with a confidence level (99%). Figure 7 illustrates this point, in this figure the total C/I ratio is shown for 100 runs using different seeds to the random number generator. Note that 30% percent of the time the total C/I ratio is within +-0.5 dB of the 35.4 dB quoted in TIs letter, but 12% of the time the level is less than or equal to 30.0 dB. The smallest C/I ratio is 28.6 dB. (6.8 dB decrease in C/I)
2) The sharing analysis between LMDS CPEs and an Iridium satellite assumes that the azimuth angle to the satellite is a random number between -180 and 180. The actual

1. Facsimile from Gene Robinson of Texas Instruments to John Knudsen of Motorola on September 12, 1995. Attachment of Local Multipoint Distribution Service Customer Premise Equipment Transmission and Iridium Satellite Receiver Compatibility Analysis, also dated September 12, 1995.
2. E-mail transmission to Rob Kubik from Steve Ruzic on October 13, 1995. Attachments included the following Matlab files: cvcpe1.m, egcpe5.m, hpcpe1.m, lmdscpe2.m and ticpe1.m.

azimuth angle should be in the range -180/*nsect* to 180/*nsect*, where ***nsect*** is the number of sectors in the hub antenna (i.e. the frequency reuse factor). This allows the simulation to represent the CPE equipment that is most likely to cause interference to the Iridium satellite. (Decrease in C/I of 4 dB).

3) The computations should be carried out to compute Io/No levels. This is the interference criteria used in the negotiated rulemaking. (Figure 8)
4) Power control is accounted for twice when the elevation angle to the hub is less than 5 degrees. The simulation assumes that each CPE will use power control so that the level at the hub will be constant no matter the distance from the hub, this is to account for rain attenuation and/or range compensation. The analysis has a 3 dB blocking factor if the elevation angle to the hub is less than 5 degrees. This blocking factor falls under the power control and should not be in the simulation. (Estimated decrease in C/I of 3 dB).
5) Atmospheric attenuation is used for the link between the CPE and the space vehicle. This atmospheric attenuation should also be used for the link between the Iridium earth terminal and the satellite. (Decrease in the C/I ratio of 1-2 dB).
6) The cross polarization isolation between the CPE and the space vehicle is accounted for only when the CPE is within 8 degrees of the boresight of the space vehicle and when the elevation angle to the space vehicle from the CPE is less than 6 degrees. The cross polarization factor may not have much effect due to the relatively large depolarization due to the atmosphere. This factor should be when the space vehicle is within 6 degrees of boresight of the CPE antenna.
7) The feeder links of Iridium operate as low as 5 degrees, a parameter study should be under taken using this model to show that the dependance on the elevation angle of the Iridium ground station.
8) Only 1/2 of the CPEs that fall within a footprint are simulated. It is assumed that the other 1/2 of the CPE equipment that could cause interference to the satellite will have the same contribution to the total interference level as the 1/2 that is simulated. This is not true due to the fact that a statistical insignificant number of CPE could actually fall within the 3 dB beamwidth of the Iridium satellite and it is relatively unlikely that the CPE will be point towards the Iridium satellite. Additionally there is a factor that

reduces the number of CPEs actually simulated and increases the total contribution to the interference power by a similar amount, this should be removed to allow the random nature of the analysis to be realized.

As the above 8 points outline, the model proposed by the LMDS proponents needs to have further development performed before rules could be proposed that would allow the LMDS CPE equipment to share with the Iridium feeder links. The above items show that there may be an 16 dB decrease in the levels that have been reported by the LMDS proponents. Thus all the LMDS systems would cause harmful interference into Iridium, except for Hewlett Packard which is marginal.

Questions on analysis

In reviewing the analysis the following questions have arose:

1) The antenna pattern in the elevation direction are not symmetric about the boresight for the Cellular Vision and Endgate Technology systems (see Figure 4). Is this actually reflected in the system design?
2) There are no dense swaths simulated in any of the input data files sent to Motorola. Is this the case for the data presented to Motorola?
3) Does the transmit power take into account any link margin? It would be useful to have information provide by the LMDS proponents as to the exact details of the link budgets.
4) What is the pointing accuracy of the CPE antennas? A mispointed antenna using power control will produce high interference levels at the space vehicle.

Analysis Description

The analysis computes the total carrier to interference (C/I) ratio for a distribution of CPE equipment about an Iridium earth station. This computation is performed by

$$\frac{C}{I} = \left(\sum_{ii=1}^{iilimitnumslong} \sum_{jj=1} \frac{2I_{ii,jj}}{C} \right)^{-1}$$