C

Exhibit C

ITU Downlink EIRP Density Specifications & Spacenet/StarBand Proposal

This exhibit presents the ITU specifications for downlink EIRP density and compares them to the current FCC Rules and the Spacenet/StarBand proposed rules. The below table provides the ITU recommendations for satellite transmit power flux density for space-to-earth links in the FSS domestic Ku-Band 11.7 to 12.2 GHz for Region 2 and the FSS international Ku-Band 10.7 to 11.7 GHz[1]:

TABLE S21-4 ***(partial listing)***

Frequency band	Service*	Limit in dB(W/m²) for angle of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	5°-25°	25°-90°	
10.7-11.7 GHz	Fixed-satellite (space-to-Earth), geostationary-satellite orbit	−150	$-150 + 0.5(\delta - 5)$	−140	4 kHz
10.7-11.7 GHz	Fixed-satellite (space-to-Earth), non-geostationary-satellite orbit	−126	$-126 + 0.5(\delta - 5)$	−116	1 MHz
11.7-12.5 GHz (Region 1) 12.5-12.75 GHz (Region 1 countries listed in Nos. **S5.494** and **S5.496**) 11.7-12.7 GHz (Region 2) 11.7-12.75 GHz (Region 3)	Fixed-satellite (space-to-Earth), non-geostationary-satellite orbit	−124	$-124 + 0.5(\delta - 5)$	−114	1 MHz

This table provides the ITU recommendations for the power flux density (PFD) per 1 MHz of bandwidth at the various angles of arrival at the earth's surface. The 1 MHz reference bandwidth can be translated to a 4 kHz reference bandwidth by reduction of the bandwidth ratio, which equals 24 dB. The formula for the PFD realized from a transmit source is provided below[2]:

$$F = P_t G_t / (4\ \ R^2)\ W/m^2$$

were : F = power flux density

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[1] ITU Article S21, Terrestrial and space services sharing frequency bands above 1 GHz

[2] Satellite Communications, ISBN 0-471-87837-5, 1986, page 109

P_t = transmit power input into the antenna in watts
G_t = antenna transmit gain
P_tG_t = EIRP
R = satellite-to-earth range in meters

If the power (P_t) is provided in power spectral density terms (e.g. dBW/4kHz) the EIRP represents the Commission's downlink EIRP density specification in § 25.212 and 25.134 and allows the ITU recommendation for power flux density to be compared to the Commission's downlink EIRP density specification. Therefore, with the power provided in power spectral density terms, the above formula can be used to determine the maximum downlink EIRP spectral density as follows :

$$\text{EIRP spectral density} = P_tG_t = 4\ \ R^2F\ \text{W/m}^2\text{/4kHz}$$

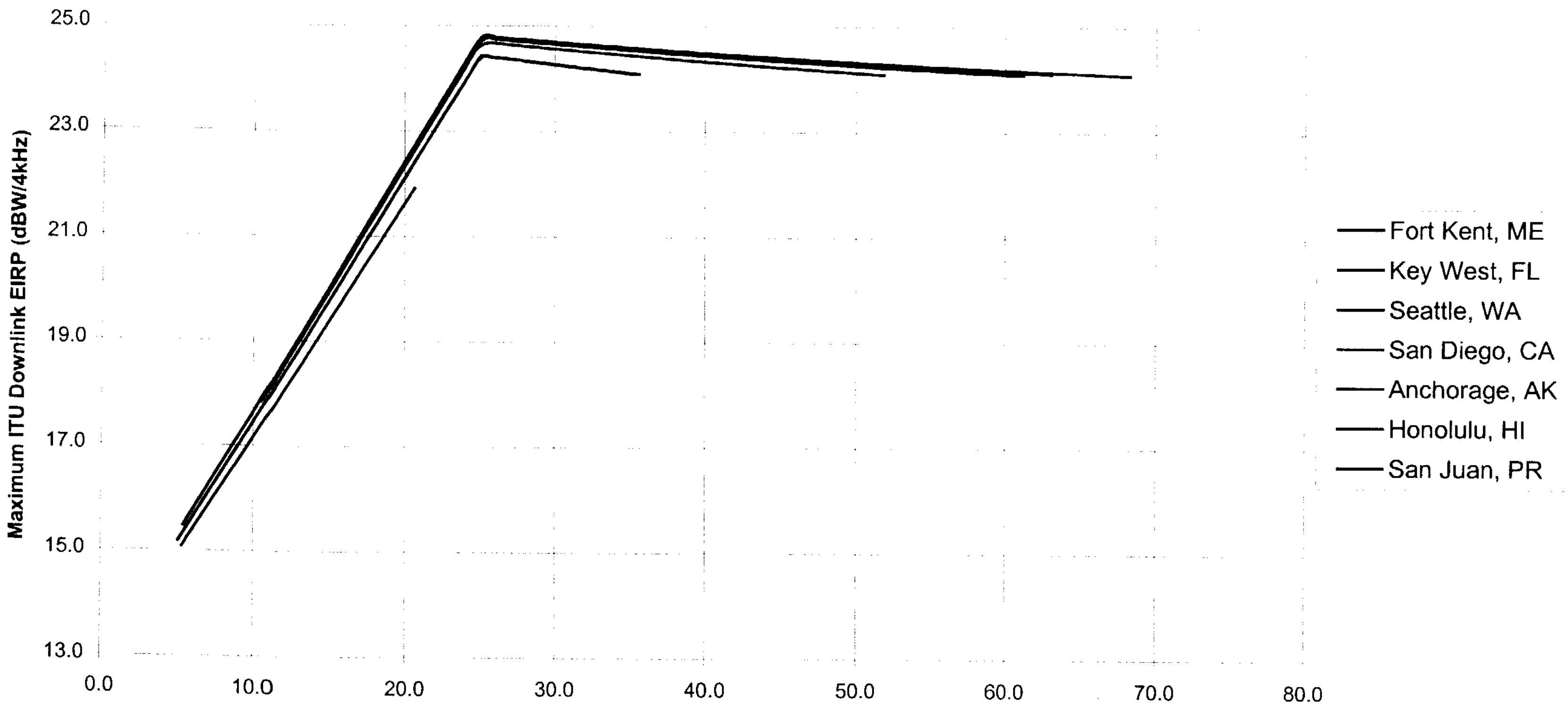
Using the ITU values for flux density at the given angles of arrival at the earth's surface the satellite downlink EIRP spectral density can be plotted for various US earth station locations verses the site elevation angle, which provides the angle of arrival above the horizontal plane as specified above. Figure 1 provides a graphical representation of these results for the ITU Article S21 specifications. This figure shows that for angles of arrival above five degrees[3] the equivalent satellite downlink EIRP spectral density as specified by the ITU is 15 dBW/4kHz or greater. Additionally, for elevation angles above 7.5 degrees the satellite downlink EIRP spectral density is above the Spacenet proposed 16 dBW/4kHz limit for wideband digital carriers. At all angles of arrival the ITU specification for acceptable downlink EIRP density is significantly above the current 6 dBW/4kHz specified by the Commission in § 25.212 and 25.134 for the maximum transmitted satellite carrier EIRP density for digital services.

For the international downlink Ku-Bands 10.95-11.2 and 11.45-11.7 GHz the Commission specifies the power flux density limits in § 25.208(b). These limits are in agreement with the ITU Table S21-4 recommendations in this band as shown in the above table. Figure 2 provides a similar analysis for the FCC and ITU specifications for international Ku-band links. This figure reveals that for earth station elevation angles at and above 13 degrees the ITU and FCC specification are in agreement with the Spacenet proposed 16 dBW/4kHz downlink EIRP density.

[3] 47 CFR 25.205 specifies a minimum earth station elevation angle of 5 degrees is required and only special exemptions up to 3 degrees will be considered

Figure 1 - Maximum ITU PSD vs Elevation Angle

ITU Article S21 Table S21-4 for 11.7 to 12.2 GHz FSS Ku-Band Downlink using Site Data for Elevation Angles at 5 degrees and Above

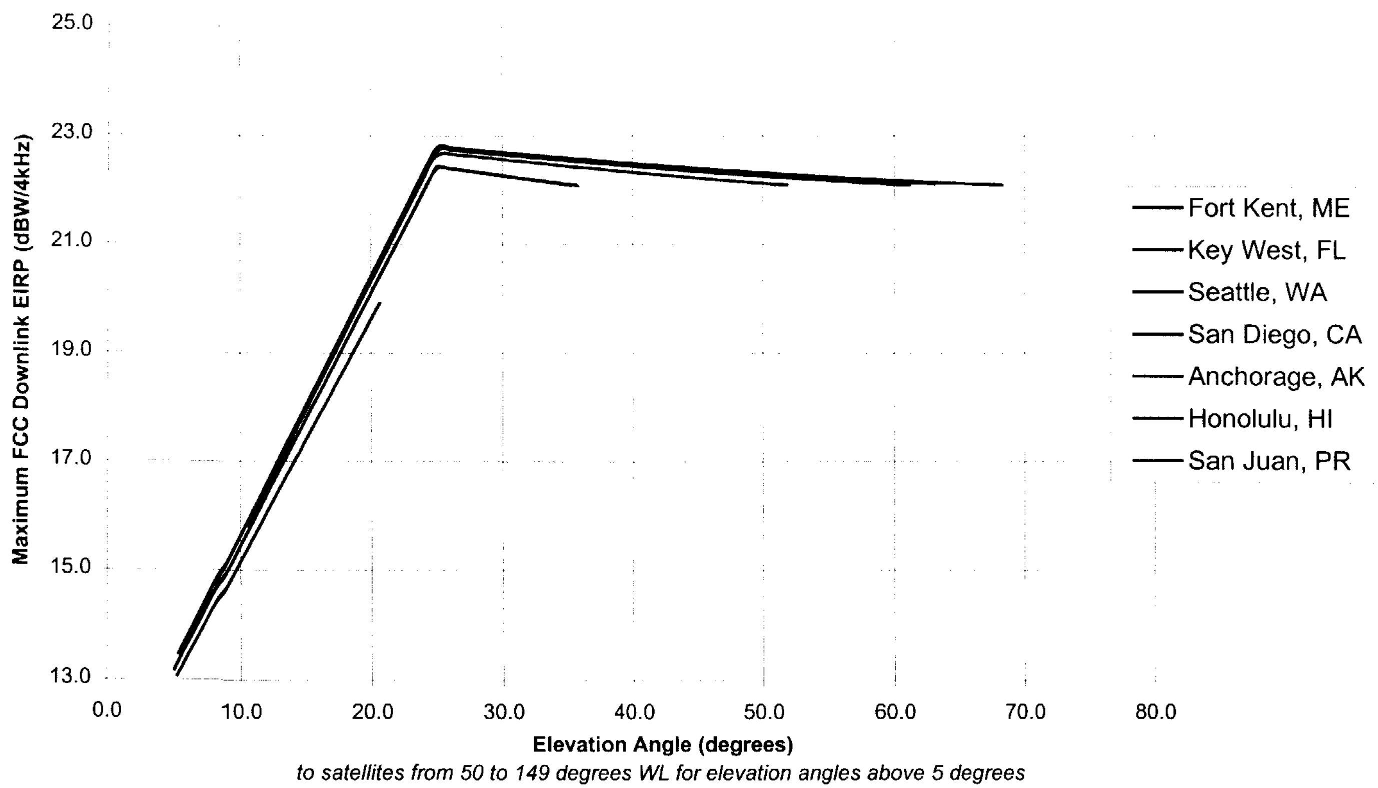


Elevation Angle (degrees)

to satellites from 50 to 149 degrees WL for elevation angles above 5 degrees

Figure 2 - Maximum FCC PSD vs Elevation Angle

Section 25.208(b) for International Downlink Ku-Bands and Site Data for Elevation Angles at 5 degrees and Above



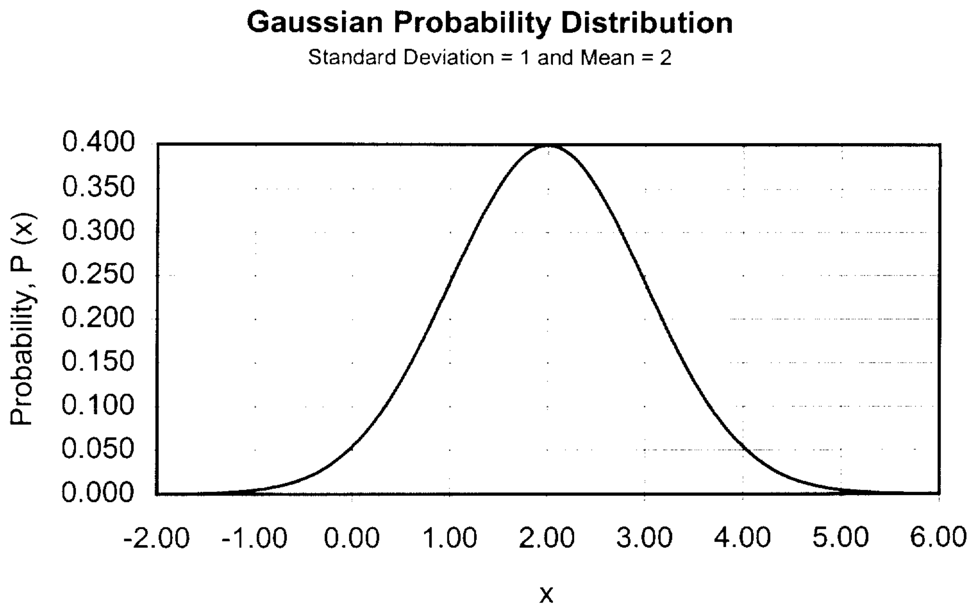
D

Exhibit D

Explanation Why 3 dB Reduction In Power Is Unnecessary to Avoid Interference From ALOHA Access Schemes

Because interference from earth stations using Aloha access is similar in power distribution to thermal noise, which satellite systems are designed to tolerate, there is no need to require them to reduce their power.

Thermal contributions to link degradation are due to imperfections in the satellite and earth station equipment electrical performance and to the non-zero temperature of the electronic components. Thermal noise is characterized by a Gaussian probability distribution function. These distributions are centered about a mean or average noise power. The portion of the curve greater than the mean represents the probability that the average thermal noise power will be exceeded, and the portion below the mean represents the probability that the average thermal noise power will be less than the average. Thus, as illustrated in the chart below, there are periods of time when the thermal noise will exceed the average thermal noise power:



Therefore, systems that function properly with a certain amount of average noise power necessarily also function properly with peak noise power in excess of the average value some portion of the time. As the chart shows, Gaussian noise will be double the average noise power approximately 5% of the time.[1]

The interference caused by a digital transmission, within its occupied bandwidth, closely approximates uniform Gaussian noise power spectral density distribution. As a result, interference from digital carriers is analytically equivalent to thermal noise. If every time slot in an Aloha network were to be occupied by exactly one transmission, the total network interference power would be a constant Gaussian noise, similar to a single earth station transmitting a continuous digital bit stream. This noise energy has a

[1] The probability of the noise power being greater than or equal to twice the average is higher than 5%, and is represented by the area under the curve to the right of "4.00."

particular average value that is set by the rules to be acceptable to other satellites.[2] Therefore, satellites are designed to function properly while receiving at least this level of average interference power. But because the interference power spectral density is Gaussian-distributed, there are times when the interference power is higher than this average, just as with Gaussian thermal noise. Therefore, systems operate properly while receiving interference power higher than the average for some fraction of time.

As demonstrated in the Spacenet Petition, and accepted in the Spacenet Order, the probability of two earth stations transmitting simultaneously in an Aloha network at maximum practical loading is also approximately 5%. Therefore, the receiving satellite receives twice the average power of a single station transmitting continuously approximately 5% of the time, the same as it would from the continuous transmission.

[2] As we have argued above, this limit is nearly 10 dB lower than other regulatory bodies allow, and we agree with PanAmSat that the existing FCC limit is needlessly low.

E

Exhibit E

Explanation re Effect of Collisions Caused by WideBand VSAT Transmissions on NarrowBand Services

Because the rules related to interference on the earth-to-space link are defined on a power spectral density basis (power per unit bandwidth), interference caused by collisions from VSAT transmissions will not affect victim systems with smaller bandwidths to any greater extent than a carrier of equal bandwidth. This is due to the fact that the victim receiver will only receive the amount of the interference energy spectral density that falls within the narrower bandwidth to which the victim receiver is tuned.

The diagrams below assist in the visualization of the above statement:

Figure 1: Spectrum Display of Wide Bandwidth Carrier (11 MHz)

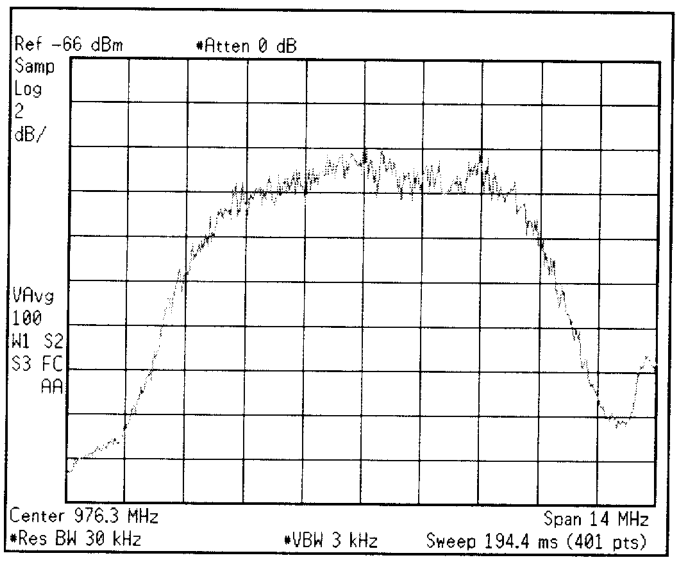
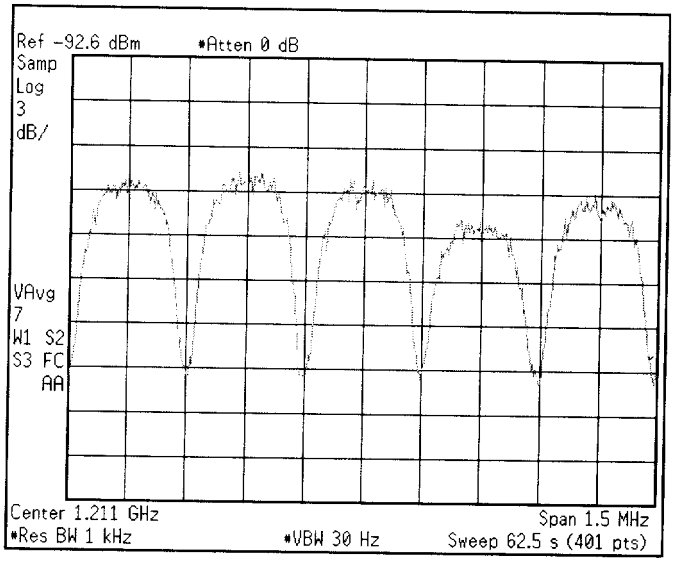


Figure 2: Spectrum Display of Narrow Bandwidth Carriers (0.3 MHz/Carrier)



These figures are actual spectrum analyzer displays of GSO FSS Ku-Band carriers taken from an earth station's receive spectrum. The spectrum analyzer display represents the signal amplitude (power) on the vertical axis and frequency on the horizontal axis. Figure 1 shows a carrier that occupies a considerably larger bandwidth (11.2 MHz with 1.4 MHz per horizontal division) than the bandwidth occupied by each of the five individual narrowband carriers shown in Figure 2 (0.3 MHz per carrier with 0.15 MHz per horizontal division). These figures show that the carrier power is distributed over the occupied bandwidth on a per unit bandwidth basis that is consistent with the rules. Additionally, they show that a receiver's bandwidth must be limited to the bandwidth occupied by the carrier to avoid introducing additional noise and adjacent carrier power interference into the receiver's detection circuit from other carriers on its own transponder. If the receiver's bandwidth were larger than the desired carrier's occupied bandwidth, the additional noise introduced by other traffic on the same transponder would degrade the link performance by increasing the noise contribution to the link and therefore reducing the link's carrier-to-noise ratio.

Using the carrier in the center of Figure 2 as the desired carrier, the carrier power, noise power, and carrier-to-noise ratio can be calculated for a receiver with a 300 kHz bandwidth and a spectrum analyzer setting of 1 kHz:

Carrier Power = -105.6 dBm + 10 Log (300 kHz / 1 kHz) = -80.8 dBm

Noise Power = -117.6 dBm + 10 Log10(300 kHz / 1 kHz) = -92.8 dBm

Carrier-to-Noise Ratio = -80.8 dBm – (-92.8 dBm) = 12.0 dB

If the receiver's bandwidth is increased to 1.5 MHz, the carrier power will remain the same; however, the noise power introduced will be increased by additional thermal noise and by the four adjacent carriers as follows:

Carrier Power = -80.8 dBm

Noise Power (thermal) = -117.6 dBm + 10 Log10(1,500 kHz / 1 kHz) = -85.8 dBm

Noise Power (adjacent carriers) = -80.8 dBm + 10 Log10(4) = -74.8 dBm

Noise Power total = 10 Log10(10(-85.8 / 10) + 10(-74.8 / 10)) = -74.5 dBm

Carrier-to-Noise Ratio = -80.8 dBm - (-74.5 dBm) = -6.3 dB

Therefore, the carrier-to-noise ratio is degraded by 18.3 dB for a receiver bandwidth of 1.5 MHz compared to the desired carrier bandwidth of 0.3 MHz. This is a huge reduction, due entirely to thermal noise and to other traffic on the same transponder, and not to interference from earth stations targeting other satellites. No practical link can overcome this degradation and retain link closure.

Interference caused by collisions from VSAT transmissions will not affect other systems with smaller relative bandwidth carriers to any greater extent than a carrier of equal bandwidth. The Commission presented no technical analysis support its assertion on this issue, and we believe it to be unfounded.[1]

[1] Spacenet/StarBand agree with the Commission's observation that the impact of a collision on a victim earth station with a larger bandwidth carrier will be less due to the fact that the interference is reduced by the factor of the ratio of the victim receiver's bandwidth to the interfering carrier bandwidth.

F

Exhibit F

Letters From Antenna Manufacturers Prodelin and Channel Master in Support of the Spacenet/StarBand Proposals

Channel Master

March 5, 2001

Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

To whom it may concern:

The purpose of this letter is to certify that Channel Master, LLC (Channel Master) offers Ku-Band transmit/receive sub-meter antennas for use by VSAT network operators both in the United States and abroad. Additionally, this letter provides Channel Master's support for the establishment of licensing regulations, currently under consideration by the Commission, to accommodate use of Ku-Band sub-meter antennas by VSAT network operators.

Since the 1980's, when the Commission established the current antenna performances specifications in 47 C.F.R. § 25.209, the small diameter antenna manufacturing industry has made significant technology advancements in the area of transmit/receive sub-meter Ku-Band antenna design, testing and manufacturing. These advancements have provided antenna performance improvements for sub-meter Ku-Band antennas that are consistent with the Commission's two-degree spacing policy. While the Ku-Band sub-meter antennas can meet the antenna pattern specifications of § 25.209 at angles of two degrees off-boresight and greater, due to technical constraints, they cannot meet the Commissions specifications beginning at one or 1.25 degrees off-boresight as currently specified in § 25.209(a) and (g) respectively. Additional industry improvements in high volume, high quality and low cost production methods have provided transmit/receive Ku-Band sub-meter product offerings at price levels that are viable for use in the consumer market. These critical industry advances have facilitated the Commission's desired expansion of satellite services, such as Internet access, to rural and underserved areas of the United States[1].

As an industry leader in Ku-Band sub-meter VSAT antenna products, Channel Master provides the design, test and manufacturing services to supply millions of receive-only Ku-Band antennas to DBS service providers that use the BSS Ku-Band. Additionally, Channel Master developed a transmit/receive sub-meter Ku-Band antenna for Spacenet Services License Sub, Inc. and StarBand Communications, Inc. that is currently being utilized to provide both transmit/receive high-speed Internet access in the FSS band and

[1] FCC 00-435, paragraph 4

receive-only DBS services in the BSS band. This innovate design provides a competitive alternative to cable modem services by offering high-speed Internet access and digital satellite television and audio programming to the consumer via a single antenna.

In summary, as a small antenna innovator and industry leader, Channel Master strongly urges the Commission to incorporate in 47 C.F.R. § 25.209, and proposed Section 25.220 of the notice of proposed rulemaking FCC 00-435, the evaluation of antenna performance compliance beginning at two degrees off-boresight. Evaluation of the antenna performance at two degrees is both consistent with the Commission's two-degree spacing policy and facilitates the Commission's initiatives regarding proliferation of broadband services to rural and underserved areas and increased broadband access competition.

Sincerely,

Peter L. Gardner

Director, New Product Development
Channel Master

Channel Master LLC ■ 1315 Industrial Park Drive ■ Smithfield, NC ■ 27577 ■ USA
Tel: (919) 934-9711 ■ Fax: (919) 989-2200

A TriPoint Global Company

P.O. Box 368
1700 NE Cable Drive
Conover, NC 28613

Ph: 828-464-4141
Fx: 828-464-5725

March 16, 2001

Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

To whom it may concern:

Prodelin Corporation ("Prodelin"), a TriPoint Global Company, offers sub-meter Ku-Band transmit/receive antennas for use by VSAT network operators in the United States and abroad. As an industry leader, Prodelin's sub one-meter, Ku-Band antenna products are used by the major VSAT network operators to provide satellite based communication services to business and consumer users.

Prodelin endorses proposed Section 25.220 of the rules under consideration by the Commission, which will facilitate the use of sub-meter, Ku-Band antennas by VSAT network operators, provided that Section 25.209(g) is also amended to require antennas smaller than 1.2 meters used in the 12/14 GHz band to comply with the performance standards of Sections 25.209(a) starting at 2 degrees in the orbital plane and at 3 degrees perpendicular to the orbital plane rather than at 1.25 degrees.

Since the 1980's, when the Commission established the current antenna performance specifications in 47 C.F.R. § 25.209, the VSAT antenna industry has made significant advances in the design, manufacturing, and testing of small antennas. Similar improvements in the performance of satellites and ground equipment have allowed closure of Ku-band satellite links with adequate margins using antennas smaller than 1.2 meters. These technical advances permit the economical manufacture of sub-meter Ku-Band antennas that are consistent with the Commission's two-degree spacing policy. While these antennas can meet the antenna pattern specifications of Section 25.209 at angles of 2 degrees and greater off-boresight in the orbital plane, they cannot meet the Commission's specifications beginning at 1.25 degrees off-boresight as currently specified in

Section 25.209(g). However, it is not necessary for an antenna to meet the standard at 1.25 degrees to be consistent with the FCC's two-degree spacing policy.

Improvements in high volume, high quality, and low cost production methods have produced Ku-Band sub-meter transmit/receive antennas at price levels that are viable for the consumer market. These critical industry advances have advanced the Commission's desired expansion of satellite services, such as Internet access, to rural and under-served areas of the United States.[1] Because small antennas are less costly and more commercially acceptable, the Commission's goals will be advanced substantially by adopting the amendment to Section 25.209 discussed above.

In summary, Prodelin strongly urges the Commission to require small 12/14 GHz VSAT antennas to comply with the envelope described in Section 25.209(a) of the rules beginning at 2 degrees off-boresight in the orbital plane and 3 degrees off-boresight perpendicular to the orbital plane, rather than the current 1.25 degrees. Such a rule is consistent with the Commission's two-degree spacing policy and furthers the Commission's initiatives regarding the provision of broadband services to rural and under-served areas. With the suggested amendment to Section 25.209, acceptance of the provisions of proposed Section 25.220 will be in the public interest and will stimulate the satellite communications industry. It will also streamline the FCC licensing process by eliminating the "case-by-case" review required under the current rules. Since the provisions of Sections 25.211 and 25.212 remain in force, interference to adjacent satellites and to non-GSO services operating in the same frequency band will not be increased beyond the present acceptable levels.

Please feel free to contact me if you have any further questions regarding our recommendation. Prodelin is pleased to support the Commission in this new rule-making activity.

Sincerely,

Colin M. Robinson.
Director of Technical Sales and Regulatory Affairs.

[1] FCC 00-435, paragraph 4