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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

November 16, 2000

By HAND DELIVERY

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
The Portals – TW-A325
445 Twelfth Street, S.W.
Washington, D.C. 20554

Re: ***Ex Parte* Communication – *Wireless Telecommunications Bureau Seeks Comment on Broadwave Albany, L.L.C., et al. Request for Waiver of Part 101 Rules*, Public Notice, DA 99-494 (rel. Mar. 11, 1999)**

***Ex Parte* Communication – *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range and Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licensees and Their Affiliates*, ET Docket No. 98-206, Notice of Proposed Rulemaking, FCC 98-310 (rel. Nov. 24, 1998)**

Dear Ms. Salas:

DIRECTV, Inc. ("DIRECTV") and EchoStar Satellite Corporation ("EchoStar") (collectively, the "DBS Operators") jointly submit this letter to provide the Commission with additional important technical information responsive to questions raised in connection with the proposal of Northpoint Technology and its affiliates (collectively "Northpoint") to use the 12.2-12.7 GHz band, which is used by the DBS Operators to downlink programming to U.S. consumers. Specific questions and answers are provided below.

Question: *Please clarify the current link performance of DBS operations in terms of actual outage time in minutes or hours, and clarify the use of the two different performance thresholds that apply to digital DBS transmissions.*

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Answer: With this answer we clarify the current International Telecommunications Union ("ITU") link performance objectives, and their relation to outage times, as they apply to the United States frequency assignments in the ITU Plan for the Broadcasting-Satellite Service (BSS) in the 12.2-12.7 GHz band. Such clarification is necessary because at least one element of the ITU objectives has been misinterpreted in these proceedings by Northpoint to argue that the interference resulting from the introduction of terrestrial services into this band would not significantly increase the unavailability of operational BSS systems beyond that indicated in the Radio Regulations.[1] Northpoint also has misinterpreted the meaning of the transmission threshold values used in digital DBS systems. Our answer totally refutes these arguments and also compares the expected outage times based on the ITU Plan performance objectives with those demonstrated by current digital DBS systems. It finds that current systems approach the ITU outage performance objectives but do not yet exceed them. The results plainly illustrate the critical need to protect the BSS service from further degradations in availability performance. Because of the importance of this analysis, more technical detail is presented in Attachment A.

Our comprehensive review of the ITU link performance objectives for the BSS reveals that, in developing the Plan, the ITU clearly intended the BSS to have a very high signal availability. Annex 5 of Appendix S30 of the ITU Radio Regulations sets forth the technical bases for the performance objectives for the Plan. It is essential to recognize that these bases lead to minimum performance objectives that cover a wide range of DBS link availabilities, including levels of availability much higher (*i.e.*, outage times much smaller) than the 99% of-

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[1] Northpoint has presented its interpretations of the availability requirements of DBS systems on numerous occasions. *See, e.g.*, Northpoint Ex Parte Notice (Sept. 1, 2000), at Charts 6-9, 16 (incorrectly characterizing the freeze frame threshold and quasi-error free threshold, seeking to pro-rate the number of hours of outage based on average viewing hours, and stating that "an additional 1 – 3 minutes [of outage] is trivial"); "Northpoint's Evaluation and Analysis of DBS-Terrestrial Compatibility Testing at Oxon Hill, Maryland" (July 31, 2000), at ii ("DBS states if an Echostar customer had been located at the exact spot where it took its reading that customer would have an availability of 99.87% instead of 99.94%, as a result of the Northpoint system, a reduction it calls harmful. However, we need not debate whether this *tiny* reduction of availability is in fact harmful") (emphasis added); *Id.* at 1 ("Yes, according to DBS, without Northpoint that customer would have an availability of 99.94%, but it is important to remember that DBS is a consumer television service with a stated 99.7% availability."); *Id.* at 5 ("The claimed worst-case availability with Northpoint is variously 99.87% to 99.93%. These levels of availability are far higher than the stated DBS performance objective of 99.7%, and it is unlikely that any consumer would be able to discern the difference."); Progress Report W2XMY, Northpoint – DBS Compatibility Tests, Washington DC (October 1999), at Appendix 5, pg. 14 ("In order to cause harmful interference, a terrestrial service would need to repeatedly interrupt or seriously degrade the signal. DBS availability is specified as a minimum of 99.7%, for an unavailability of 0.3% or 26.3 hours per year. A serious degradation of the DBS signal would significantly increase the outage level beyond 26.3 hours per year."); Reply Comments of Northpoint Technology (April 14, 1999), at 9 ("Northpont proposes the following criteria to be used to determine if there is harmful interference into DBS: Whether DBS availability drops below 99.7%").

the-worst-month (or, in rain climates with little seasonal variation, 99.7% of-the-year) cited by the proponents of terrestrial systems.

Based upon their misinterpretation of the ITU performance objectives, the proponents of terrestrial systems at 12 GHz have stated that DBS outages of 1%, or 131 minutes of the average month, or equivalently, 438 minutes of the worst month, should be acceptable. However, as demonstrated by the detailed technical analyses in Attachment A, the actual ITU link performance objective for a DBS system designed, for example, to operate in the rain zone represented by Washington, D.C., would require it to provide a high quality television picture for all but at most 79 minutes of the worst month, or 18 minutes of an average month. Indeed, with a less conservative assumption regarding the threshold of the reference DBS receiver, the ITU performance objective would correspond to outages of only 33 minutes of the worst month, or 7 minutes of an average month.

Attachment A also provides a comparison on a picture quality vs. outage basis between the ITU performance objectives and current digital DBS systems serving the Washington, D.C. area, which have been shown to have an outage time of at most 88 minutes. Attachment A provides similar performance comparisons for other representative U.S. cities in different rain climate zones.

Figure 1 below displays these results for the Washington, D.C. area. The ITU performance objective of at most 79 minutes of the worst month is shown by the lowest bar from the top. The performance of a current digital DBS system serving the Washington D.C. area that provides a high-quality picture for all but at most 88 minutes of the worst month is shown by the third bar from the top.

In considering the outage performance, the Commission must recognize that the DBS community has already compromised on link availability performance by agreeing to allow NGSO FSS systems to increase DBS unavailability by 10%. This agreement would permit outage times of up to 96.8 minutes in the Washington, D.C. area, as shown by the second bar from the top of Figure 1.

The top bar in Figure 1 represents the impact on DBS outage time due to levels of interference typical of those that would be produced if Northpoint-type terrestrial systems were allowed to operate in the 12.2–12.7 GHz band. These outage levels are based on interference levels seen in the Oxon Hill testing.[2] The impact on outage time due to such terrestrial interference corresponds to an increase in unavailability of *101% over that provided by current DBS systems in the Washington, D.C. area.* This is clearly unacceptable for DBS operations.

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[2] Specifically, they are based on the 122% increase in average monthly outage time from Test 14 performed at Oxon Hill.

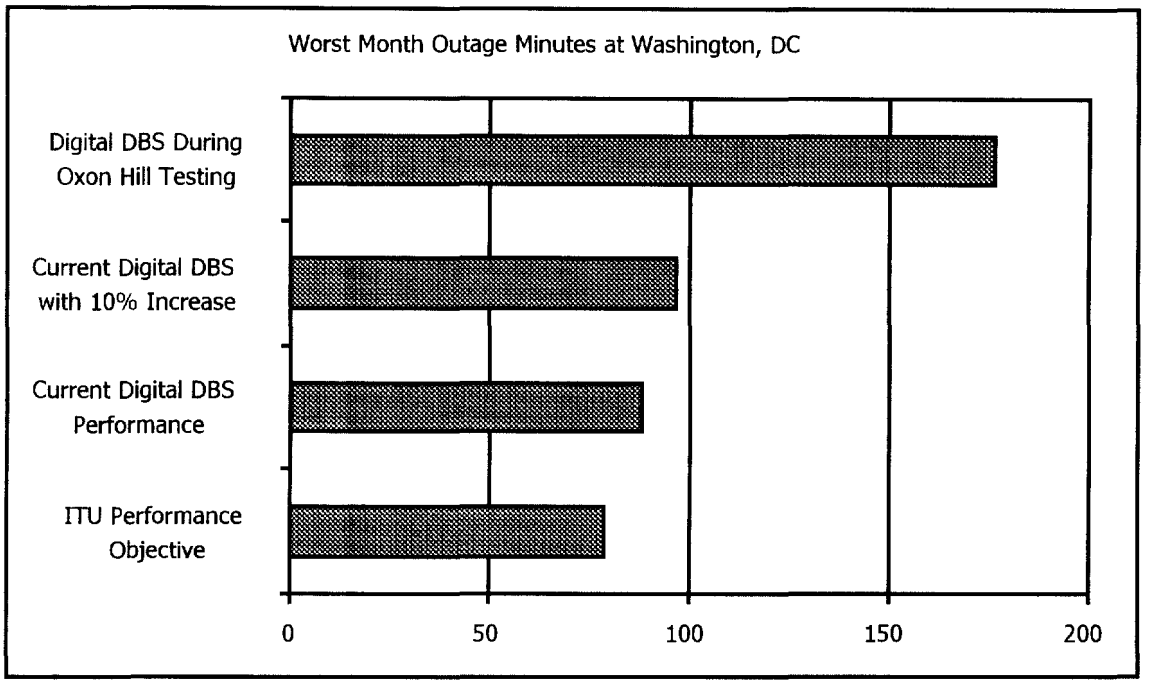

Figure 1
Comparison of Worst Month Outage Minutes at Washington DC

Although the outages of current digital DBS systems are somewhat higher (availabilities lower) than the ITU Plan objectives, it was a major concession for BSS operators to agree at the ITU to a 10% increase in unavailability due to interference from non-GSO FSS systems and other networks. Ongoing technological developments will provide new opportunities to improve DBS link availability. This will enable future DBS systems not only to provide even better service to the public, but also to compete better with incumbent cable television systems. Therefore, it is critically important to the public interest, and to the competitive future of DBS in the United States, that digital DBS systems not be forced to accept more than the already-internationally-agreed-to 10% degradation in present outage levels due to any combination of interference into DBS systems -- whether from NGSO-FSS or terrestrial systems.

As noted previously, a detailed discussion of the ITU-R performance objectives, a picture quality based comparison with digital DBS systems, and a description of the quasi-error free and the freeze-frame thresholds are presented in Attachment A.

Question: *There are many different claims about the size of the Northpoint interference zones and the number of DBS customers affected. Why are there these large differences?*

Answer: First, it is important to note that both Northpoint and the DBS community are calculating the same general shape and orientation of interfering signal strength contours (or

carrier to interference (C/I) contours). These similarities were discussed in DIRECTV's "Further Response to Northpoint Ex Parte Filings" (September 2000) at 3 ("DIRECTV Further Response").

Although there is clearly a difference in the calculated size of a given interference signal level contour, by far the largest difference lies not in this calculated size but in the selection of the contour value representing unacceptable or harmful interference. Here there is a tremendous difference of opinion. To protect DBS customers to the equivalent interference level of one NGSO FSS system, a C/I ratio of about 27.2 dB is required for a DIRECTV low information rate signal. *See* DIRECTV Further Response at 14. Similarly, a 30 dB C/I value is required for the more frequently used high information rate signal. By contrast, Northpoint has most recently proposed values of 16 dB[3] and 20 dB[4] as sufficient to protect DBS customers.

These Northpoint values, however, fall well short of adequate protection for the DBS service, a point that has been explained numerous times by the DBS Operators. It is this large difference – from the Northpoint proposed 16 dB to a DBS-required 27 dB to 30 dB – that is at the core of the interference issue. A difference in accepted C/I ratio of 11 dB (the difference between 27 dB and 16 dB) multiplies (or divides) the area of the resulting interference zone by a factor of 12.6. Put another way, Northpoint is understating the size of the affected area by a factor of 12.6. Should the Commission accept these understated Northpoint values, the entire DBS service, and its present and future customer base, will be put at risk.

Question: *Please provide additional detail on DIRECTV's recent experience with addressing terrestrial interference into several of its DBS customers in the San Francisco area.*

Answer: DIRECTV recently experienced a serious case of interference from a secondary terrestrial point-to-point microwave link in the San Francisco area. This link was operating at 12.510 GHz, and caused DBS customers in the area to lose all channels on transponders 20 and 21. DBS customers reported the inability to receive 8 to 10 channels, including PPV (pay-per-view), premium, and sports programming. Sony Customer Service responded by providing warranty replacements of the DBS receiver, coaxial cable, and low noise block downconverter, and then moving the antenna to a sheltered location. Each attempted solution required one or more site visits by the DBS installer, and occurred over the course of many months. None of the remedies worked.

An affected customer cooperated in performing a signal strength survey on each of the two receivers in the household. Both showed a "0" signal strength reading on transponders 20

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[3] *See* Northpoint Technology, "The Northpoint EPFD Mask" (March 28, 2000), at 4, Table 2.

[4] *See, e.g.*, Northpoint *Ex Parte* Notice (Sept. 1, 2000).

and 21. The channel allocations for those two transponders matched exactly the list of viewer channels the customer could not watch.

A search of the FCC license data base showed one licensed terrestrial point-to-point path on or near the frequency overlap within the same zip code as our customer. A standard form letter was sent to the Board of Regents of the operator of the terrestrial link, asking for assistance. After several requests by DIRECTV to shut down the terrestrial link in order to determine if this was the interference source, and several denials by the link operators that the link was even operating, a local field technician was hired to visit the customer location with a spectrum analyzer to verify the interference. The field technician found the interfering carrier, and confirmed the frequency as 12.510 GHz. Triangulation was performed to pinpoint the location of the interference.

After being presented with solid evidence that they were operating a terrestrial link that was interfering with DBS reception in the same band, the operators continued to deny that the link in question was indeed operating. The San Francisco FCC field office was notified with DIRECTV's findings in writing. The FCC field officer performed similar tests, confirming DIRECTV's findings. He visited the site and asked for an *immediate* shutdown. No one at the site (a hospital) had knowledge of the transmitter. The microwave system was not well known or understood. It took one additional day after the FCC's initial visit to get a communications engineer on site and finally shut down the offending link.

This incident illustrates the possible difficulties in actually shutting down interfering sources, and the length of time DBS customers must wait for interference-free service to be restored. Even with relatively few terrestrial point-to-point microwave links, the process, as illustrated can be extremely difficult. The idea of this process occurring between the DBS service and a ubiquitously deployed Northpoint service (with little incentive, as a competitive service, to work with the DBS Operators to solve the problem) is unthinkable.

Two originals and two copies of this letter are submitted to be included in the above-captioned dockets.

Sincerely,

By: _____

Gary M. Epstein
James H. Barker
Latham & Watkins
1001 Pennsylvania Avenue, NW
Washington, DC 20004
(202) 637-2231

Counsel for DIRECTV, Inc.

By: _____

Pantelis Michalopoulos by JHB
Omer C. Eyal
Steptoe & Johnson LLP
1330 Connecticut Avenue, NW
Washington, DC 20036
(202) 429-3900

Counsel for Echostar Satellite Corp.

cc: Attached Certificate of Service

Attachment A

Expanded Technical Discussion of ITU Performance Objectives and A Comparison with Current Digital DBS System Performance

This analysis describes in detail the outage time performance objectives developed by the International Telecommunications Union ("ITU") for the BSS Plans, and corrects some significant misunderstandings about these objectives. The analysis then utilizes the parameter Q, Picture Quality, to provide a common parameter for comparing outage performance of digital DBS links to these ITU performance objectives. It will be seen that current digital DBS systems generally offer TV pictures equal or superior in quality to the minimum ITU link objective, but with somewhat higher outages than the ITU performance objective. This detailed comparison illustrates the important need to protect the BSS from further degradations in availability performance.

Section 1 examines current link performance. It is prefaced by a detailed explanation of the ITU performance objectives applicable to frequency assignments in the BSS Plan for Region 2. It concludes with a comparison of typical digital DBS system performance with these ITU performance objectives.

Section 2 then provides clarification regarding the two different performance thresholds that apply to digital DBS transmissions.

1. Current link performance

1.1 ITU minimum link performance objectives

In order to clarify the link performance of current digital DBS systems in terms of outage time, it is first necessary to understand the DBS link performance objectives used by the ITU in establishing the frequency assignments used by U.S. DBS operators. These assignments are part of the broadcasting-satellite service (BSS) Plan for the 12.2-12.7 GHz band in ITU Region 2 (Western Hemisphere) whose technical bases are specified in Annex 5 to Appendix S30 of the ITU Radio Regulations. Understanding the performance objectives is critical because they have been misquoted and misinterpreted by those who seek to introduce terrestrial TV and data distribution services in the 12.2-12.7 GHz band. It is essential to recognize that the ITU minimum performance objectives cover a wide range of DBS link availabilities, including levels much higher (outage times much smaller) than the 99% of-the-worst-month (or, in rain climates with little seasonal variation, 99.7% of-the-year) availability cited by the proponents of secondary terrestrial systems at 12 GHz.

The ITU specified two reference points from which the complete objectives for minimum link performance can be derived. One requires that the "overall" (the combined uplink and downlink) carrier-to-thermal noise ratio (C/N) at the DBS receiver input equal or exceed 14 dB for 99% of the worst month (see Section 3.3 of Annex 5 to Appendix S30 of the Radio Regulations). The other reference point ensures that the picture quality corresponding to the C/N

objective will not be corrupted by the effects of interference from other BSS systems (see Sections 3.4, 1.7 through 1.11, and 2.2.4 of Annex 5 to Appendix S30 of the Radio Regulations). In particular, it specifies the "protection ratios" for co-channel interference and for interference in the first and second upper and lower adjacent-channels -- *i.e.*, the values of carrier-to-total interference (C/I) in these channels at which interference effects on the TV picture would become just barely perceptible. In designing (or subsequently modifying) the BSS Plan, assignments are carefully configured so that the C/I exceeded for 99% of the worst month at test points throughout the DBS service area simultaneously exceed both the co-channel and the four adjacent-channel protection ratio specifications. Thus, "99% of the worst month" is merely the level of availability used to "anchor" the statistical curves which, for a BSS link in a particular rain climate, define the complete ITU noise and interference objectives for that link – *i.e.*, for all levels of availability.

Although the use of digitally-modulated television signals was explicitly anticipated (see Section 3.1 of Annex 5 to Appendix S30), the Plan for Region 2 was developed in 1983 when frequency modulation was normally used for satellite TV signals (as it still is in some older DBS systems). Accordingly, the link performance in terms of picture quality versus availability specified for Region 2 Plan assignments was, and still is (despite revisions to Annex 5 at both WRC-1997 and WRC-2000), that which would be delivered by an FMTV system subject to the reference point C/N and C/I specifications just described.

In order to illustrate the ITU link performance specification graphically, picture quality will be expressed using the ITU five-grade picture quality impairment scale (see Recommendation ITU-R BT.500-7). This scale provides a means of rating the impact of noise, interference, and signal processing artifacts on picture quality. On this scale, a rating of 5 means that the impact is imperceptible; 4 = perceptible but not annoying; 3 = slightly annoying; 2 = annoying; and 1 = very annoying. To relate picture quality to C/N, it is first noted that the impairment grade depends primarily on the ratio of video signal-to-unweighted noise (S/N) at the receiver output. Impairment grades 3, 3.5, 4.0 and 4.5 correspond respectively to S/N = 29, 31, 33, and 37 dB (see Recommendation ITU-R BT.654). It is then only necessary to observe that, for C/N levels above threshold, S/N exceeds C/N by an amount in dB equal to 10 log $[3(Dpp/fv)^2]$ + 10 log [b/(2fv)] where Dpp is the peak-to-peak frequency deviation by the video signal, b is the RF bandwidth (24 MHz), and fv is the highest video frequency (4.2 MHz for the NTSC standard) (see Report ITU-R BO.215-7). For example, if Dpp = b, then S/N = C/N + 10 log $[1.5\ (b/fv)^3]$ = C/N + 24.5 dB.

Since the percentage of time that C/N , and hence picture quality, exceeds a particular value depends on the rain-attenuation statistics at the receiving site, the ITU minimum link performance specification for percentages of time higher or lower than 99% of the worst month will be different for sites in different rain climate zones. In calculating the effects of rain attenuation on C/N, the increase in antenna noise temperature, and hence N, due to rain as well as the dB for dB reduction in C were taken into account. Figure 1 displays the resultant ITU minimum performance specifications that apply for receiving sites in Seattle, Washington DC, and Miami, which correspond to ITU rain climate zones D, K, and N, respectively. This figure shows how C/N varies with p_w, the percentage of time that, during the worst month of the year at

the sites in question, these quantities have the values below those indicated by the curves. It should be noted that all three of the C/N curves pass through the reference point (C/N = 14 dB, p_w = 1 % or 438 minutes of the worst month), as they must in order to reflect the basic ITU link performance specification. Also included are horizontal lines corresponding to FM C/N thresholds of 7 dB and 10 dB.

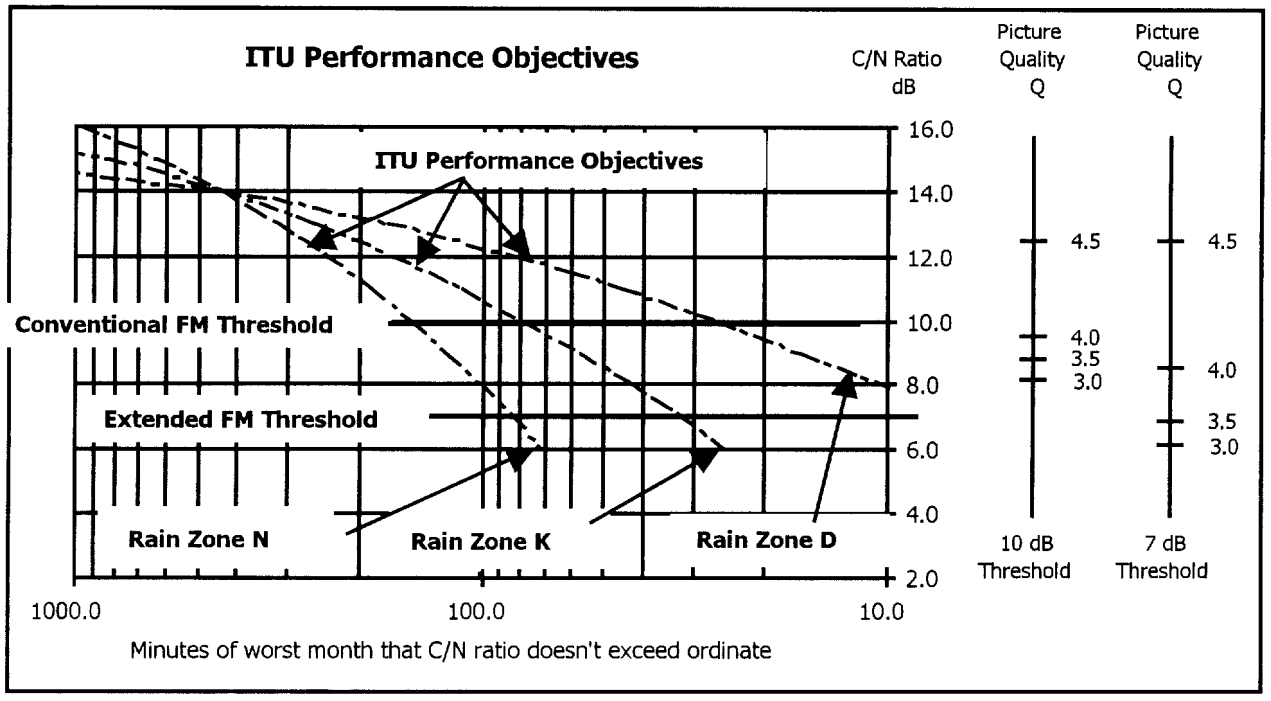

Figure 1 - ITU link performance objectives for BSS systems serving cities in rain climate zones D (e.g., Seattle), K (e.g., Washington, DC), and N (Miami)

As previously noted, the quality of an FM TV picture deteriorates rapidly for C/N values below the FM threshold. However, Figure 1 shows that, for all values of C/N above either of the reference FM threshold levels, picture quality is never much worse than grade 4 (interference and noise effects perceptible, but not annoying). More specifically, at the extended FM threshold C/N value of 7 dB, the un-weighted S/N is 31.5 dB, and the picture quality value Q is estimated at about 3.5. At the 14 dB C/N level that is exceeded for all but 1 % of the worst month, picture impairments are almost imperceptible (Picture quality Q is better than 4.5).

From this it can be concluded that, for DBS systems that just meet the ITU minimum link performance specification, the "outages" (C/N below threshold), expressed as a percentage, p_W, of the worst month (or, alternatively, m_w = minutes of outage during the worst month) and as a percentage of the year (or m_a = minutes of the average month) are as shown in Table 1. In this table, the values for p were calculated using the formula $p = 0.3\ p_w^{1.15}$ (see Recommendation ITU-R P.679-2), which applies to rain climates where there is little seasonal variation in rainfall. For climates with greater seasonal variations, the values of p (and of m_a) should be reduced by 20 or 30%.

Table 1 - ITU performance objectives for DBS link outages in minutes /month for three U.S. cities

Assumed FM threshold	Quantity	Seattle (D)	City (rain zone) Washington (K)	Miami (N)
C/N = 7 dB	p_w (%)	0.016	0.074	0.192
	m_w (minutes)	6.8	33	84.1
	p (%)	0.0025	0.015	0.045
	m_a (minutes)	1.1	7	20
C/N = 10 dB	p_w (%)	0.060	0.180	0.343
	m_w (minutes)	26	79	150
	p (%)	0.0118	0.042	0.088
	m_a (minutes)	5.2	18	38

In contrast to the claim by terrestrial system proponents that the ITU performance objectives would allow DBS link outages totaling 1%, or 438 minutes, of the worst month, Table 1 shows that the objectives in fact call for *much lower* outages. For example, with a 7 dB threshold-extension receiver in Seattle, the ITU objective is an outage of 0.016%, or only 6.8 minutes of the worst month. This is only 16/1000 of the outage time that terrestrial system proponents claim should be permitted. The corresponding outage for an average month in Seattle is only 0.4 minutes. At the other extreme (a 10 dB threshold receiver in Miami), the ITU objective would permit an outage of only 0.34%, or 150 minutes, of the worst month, which is only one third of the DBS outage which terrestrial proponents advocate. With a 7 dB threshold, the maximum outage at Miami would be only 20 minutes of an average month.

1.2 Link performance of current digital DBS systems

The performance of an operating digital DBS system using assignments in the BSS Plan for Region 2 differs in two ways from the ITU minimum performance objectives described above. First of all, digital picture quality is generally equivalent to or superior to the ITU objective for all values of the carrier-to-noise ratio C/N above a certain threshold value corresponding to the limit of quasi error-free operation. Second, above this digital threshold level, picture quality is nearly constant, whereas the ITU objective for picture quality permits a gradual deterioration of picture quality with decreasing C/N down to a point corresponding to the threshold of a representative FM TV receiver.

The outage performance of some example operational DBS links serving Seattle, Washington DC and Miami are shown in Table 2. These examples are based on the "DIRECTV at 101; 6/7 code" link budget found in Appendix B of the DIRECTV report on the Oxon Hill test

results.[5] Outage times are based on the quasi-error free threshold point, consistent with all calculations performed within the ITU-R concerning sharing with NGSO-FSS systems.

Table 2 – Outage performance of example digital DBS links in minutes /month for three U.S. cities

Quasi-Error Free Threshold	Quantity	Seattle (D)	City (rain zone) Washington (K)	Miami (N)
C/N = 7.6 dB	p_w (%)	0.114	0.202	0.693
	m_w (minutes)	50	88.3	304
	p (%)	0.025	0.048	0.197
	m_a (minutes)	10.8	20.8	86.2

The performance differences between these example digital DBS links and the ITU performance objectives are illustrated in Figures 2, 3, and 4. In each figure, the curves show the TV picture quality Q that is available for the indicated number of minutes during the worst month.[6] The distinction between the quasi error-free threshold and the so-called freeze-frame performance threshold shown on the digital performance curve are discussed further in Section 2 below.

[5] For rain zone K, the e.i.r.p level was assumed to be 55.8 dBW. For rain zone N, the e.i.r.p level was assumed to be 57.2 dBW. For rain zone D, the e.i.r.p level was assumed to be 52.2 dBW. The CCIR 564-3 rain model was used for both the ITU-R performance objective calculations and the digital DBS performance calculations. This provides a direct comparison of relative performance.

[6] A 10 dB threshold has been assumed for the ITU performance objectives curves in Figures 2, 3 and 4.

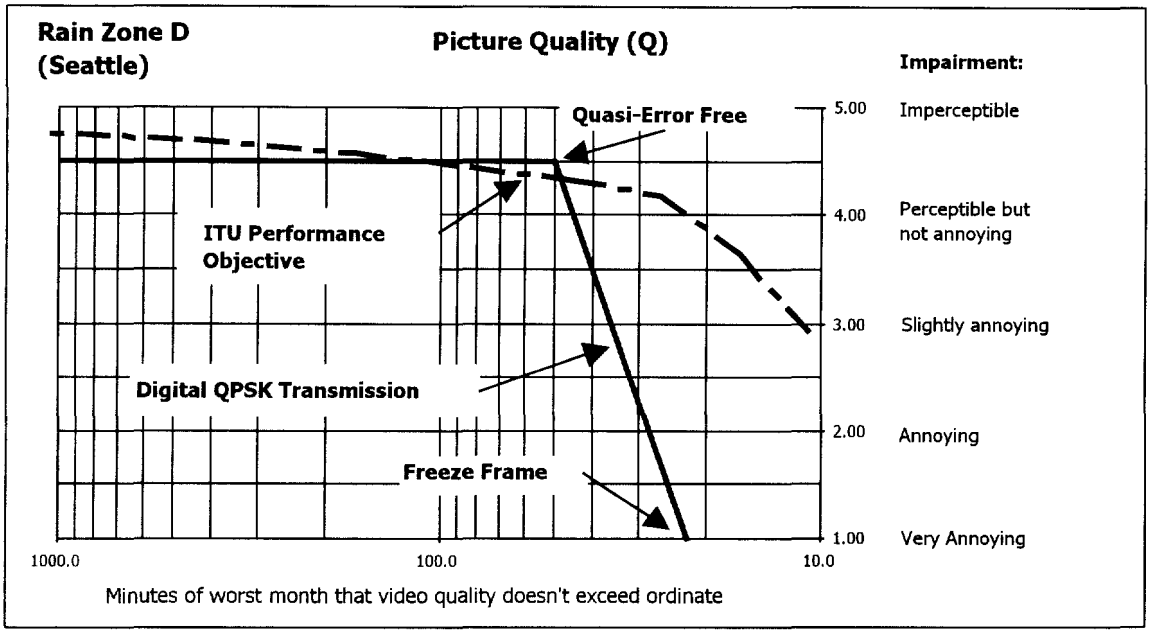

Figure 2
Comparison of current digital DBS service to Seattle with the ITU link performance objective for rain climate D

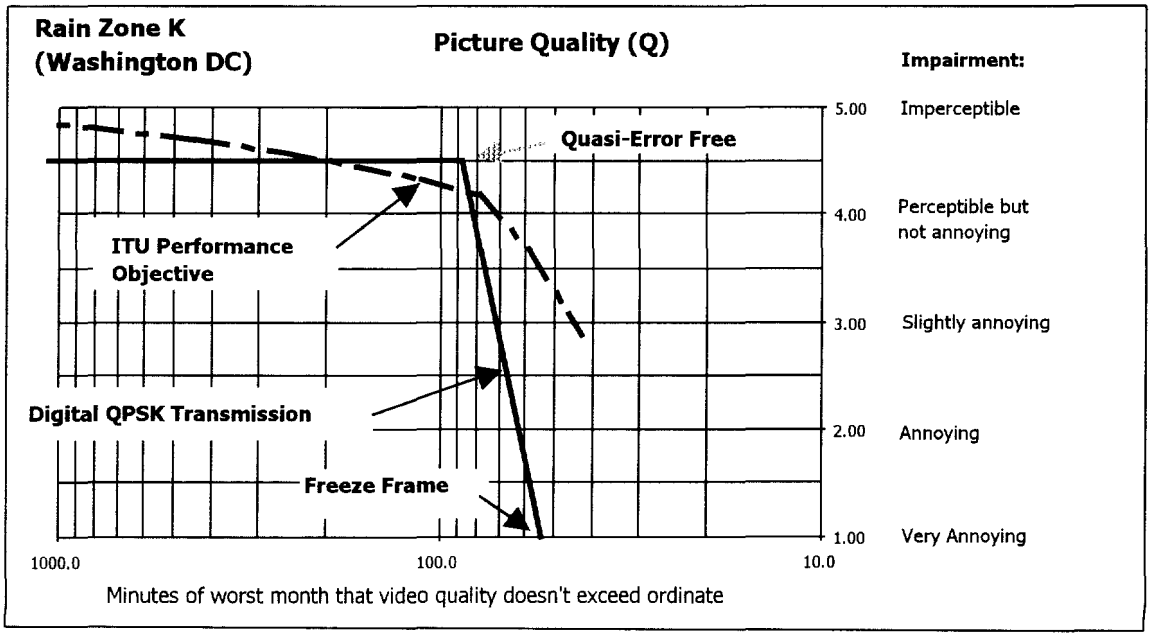

Figure 3
Comparison of current digital DBS service to Washington DC with the ITU link performance objective for rain climate zone K

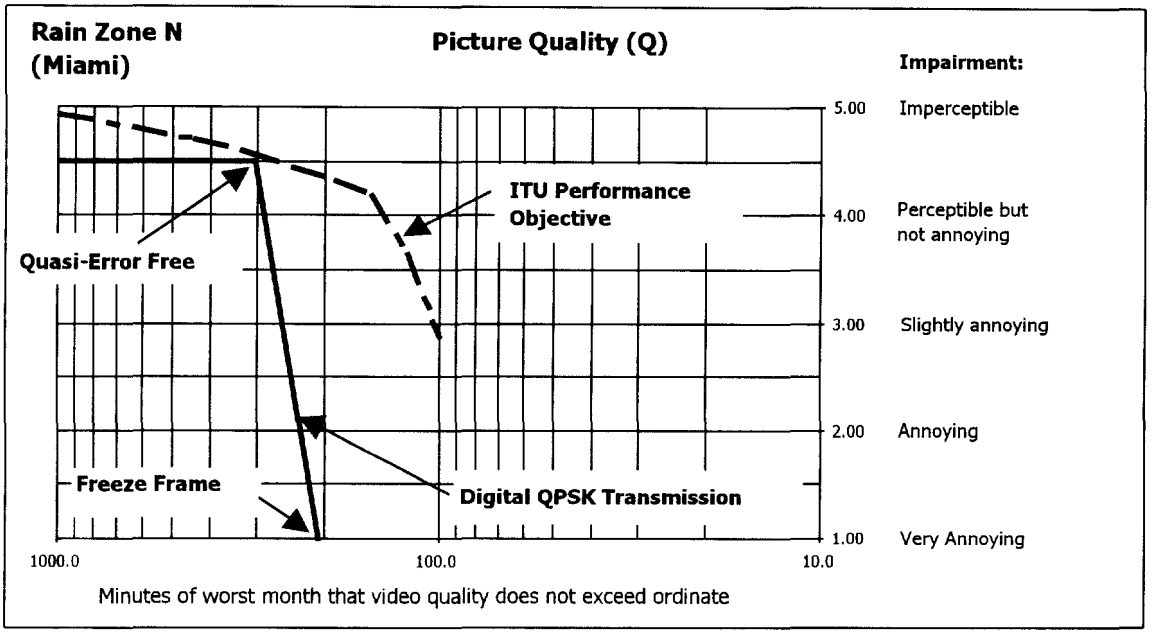

Figure 4
Comparison of current digital DBS service to Miami with the ITU link performance objective for rain climate N

In comparing the performance of operating digital DBS links with the ITU minimum link performance objectives displayed in Figures 2 through 4, it is important to recognize that the curve for the minimum ITU objective in a given city is fixed. That is, it is entirely determined by the reference point of C/N $\geq$ 14 dB for 99% of the worst month and the rain zone attenuation statistics for the city in question. However, the performance of the digital DBS link, and the extent to which it differs from the ITU objective is dependent on the technical design of the link, including the choice of digital coding, multiplexing, and modulation methods, the e.i.r.p. of the satellite transponders, the size and efficiency of the home receiving antenna, the design of the digital receiver, etc. Taking into account the present state of the technology, and recognizing the tradeoffs among the link parameters and their impact on the number of program channels and their cost to the consumer, current digital DBS systems generally offer TV pictures equal or superior in quality to the minimum ITU link objective, but with somewhat higher outages than the ITU minimum performance objective.

Given that the outages of the current digital DBS systems are higher (availabilities lower) than those specified by the ITU Plan objectives, it was a major concession for BSS operators to agree in the ITU-R to a 10% reduction in availability due to interference from non-GSO FSS systems and other sources (see *recommends* 1.2 of Recommendation ITU-R BO.1444). Ongoing technological developments will provide new opportunities to improve availability, enabling future DBS systems not only to provide even better service to the public, but also to compete better with cable TV systems. Therefore, it is critically important to the public interest, and to the competitive future of DBS in the United States, that digital DBS systems not be forced to accept more than a 10% degradation in present outage levels due to interference from any combination of NGSO-FSS and terrestrial systems.

2. The two performance thresholds for digital DBS systems

In the curves for digital performance in Figures 2 through 4, two performance thresholds were identified: "quasi error-free", and "freeze frame." As previously noted, the former corresponds to the C/N (or Eb/No) level above which the error-correction circuits effectively deliver no errors to the video decompression circuits in the receiver. In this range of C/N, TV picture quality is really dependent on the MPEG multiplex and the video compression/decompression equipment itself, and not on the transmission channel.

Also as noted earlier, a digital link degrades very quickly from an essentially perfect picture above the quasi error-free threshold to a complete loss of picture. This complete loss of picture occurs at the freeze-frame point. This is where there are so many uncorrectable errors entering the video decompression circuits in the receiver that these circuits can no longer generate the overall structure of a video picture. As elaborated upon in NOTE 1 to *recommends 1.2* of Recommendation ITU-R BO.1444:

> A loss of MPEG video picture continuity occurs when the BER of the demodulated MPEG video bit stream is sufficiently high to cause the associated video MPEG decoder to cease to provide one or more pictures. This condition typically results in the initiation of error concealment techniques by the video decoder, such as the presentation of the last available MPEG picture (freeze frame), presentation of an all black picture, or other techniques.

Between the quasi-error free point and the freeze frame point, the receiver can typically generate a picture structure, but parts of the picture may be missing (*e.g.*, missing blocks of pixels or missing lines of pixels). Hence the quality will be degraded from the quasi-error free condition.

CERTIFICATE OF SERVICE

I, James H. Barker, hereby certify that copies of the foregoing *Ex Parte* Presentation were sent this 16th day of November, 2000 by hand delivery (indicated by *) or first class mail to the following:

Commissioner Susan Ness*
Federal Communications Commission
The Portals, Room 8-B115H
445 12th Street, S.W.
Washington, D.C. 20554

David Goodfriend*
Special Assistant to Commissioner Ness
Federal Communications Commission
The Portals, Room 8-B115
445 12th Street, S.W.
Washington, D.C. 20554

Merrill S. Spiegel
Hughes Electronics Corporation
DirecTV, Inc.
1530 Wilson Boulevard, Suite 1000
Arlington, VA 22209

Tony Lin
Shaw Pittman
2300 N Street, N.W.
Washington, D.C. 20037-1128

Antoinette Cook Bush
BroadwaveUSA
400 N. Capital Street, N.W.
Suite 368
Washington, D.C. 20001

Jeffrey H. Olson
Paul Weiss Rifkind Wharton & Garrison
1615 L Street, N.W., Suite 1300
Washington, D.C. 20036

Mark Schneider*
Special Assistant to Commissioner Ness
Federal Communications Commission
The Portals, Room 8-B115
445 12th Street, S.W.
Washington, D.C. 20554

David Pawlik
John C. Quale
Skadden Arps Slate Meagher & Flom LLP
1440 New York Avenue, N.W.
Washington, D.C. 20005-2111

David A. Nall
Squire Sanders & Dempsey L.L.P.
1201 Pennsylvania Avenue, N.W.
P.O. Box 407
Washington, D.C. 20005

Sophia Collier
BroadwaveUSA
400 N. Capital Street, N.W.
Suite 368
Washington, D.C. 20001

Andy Paul
SBCA
225 Reinekers Lane
Suite 600
Alexandria, VA 22314

James H. Barker