to several reference victim reference antenna patterns that correspond to operation with this link (see Item 3).

2. DBS operators should provide or identify electronic versions of satellite transmit e.i.r.p patterns over the United States. One pattern must be provided or identified for each link provided in Item 1. above. The format should be the one that is understood by the GIMS utility of the MSPACE set of ITU-R software. With an electronic pattern and this utility, the e.i.r.p at any point in the pattern can be calculated. These patterns are routinely provided with DBS license applications.

3. One or more victim receive antenna patterns (gain in the plane of the horizon) need to be established as reference parameters for the contour generation process. There are several viable sources for the generation of reference antenna patterns. These include patterns provided to Study Group 6S of the ITU-R for the NGSO FSS sharing studies[36] or the antenna pattern provided by DIRECTV in its 1994 submission on point-to-point terrestrial interference.[37] The reference antenna patterns must include the worst case gain over frequency, and can include horizon gain pattern changes as a function of antenna elevation angle. The reference patterns must take into account expected variations in back-lobe antenna gain over various antenna models because this is not a specified or controlled parameter. The reference patterns must also represent the recent entry of antennas that provide reception from multiple satellite operating longitudes (*e.g.*, reception from 110° and 119° or reception from 101°, 110° and 119° using a single reflector) and larger antennas serving multiple dwelling units. Polarization isolation between the DBS victim antenna and MVDDS transmissions must be assumed to be zero because the polarization purity of the back lobes is very poor.

DIRECTV also recommends the following process to develop a worst case epfd contour for any proposed MVDDS transmitter site. This method is based on the description contained in an earlier DIRECTV filing in this proceeding,[38] and must occur at least once for each proposed MVDDS transmitter site prior to its activation. The method should be repeated if the analysis yields unacceptable results and, if necessary, the transmit site must be redesigned.

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36 Document ITU-R 6S/17, Annex 1.

37 *See* DIRECTV, Inc., "Terrestrial Interference in the DBS Downlink Band" (April 11, 1994).

38 DIRECTV January Ex Parte at 51-59.

1. The proposed MVDDS operator provides the following information for each proposed MVDDS transmitter installation:

   a. Frequency and polarization plan (for all polarizations used);

   b. Modulation type;[39]

   c. Transmit antenna location and height above ground level;

   d. Transmit power level;

   e. Transmit antenna boresight azimuth and elevation angles;

   f. Transmit antenna peak gain; and

   g. Transmit antenna relative gain pattern (as a function of azimuth and elevation).

2. For each reference DBS link and the corresponding reference victim antenna pattern(s), epfd interference contours using the OH Loss (or equivalent) propagation model are provided. Ideally, these would be calculated and provided by an independent third party. These are epfd contours that correspond to the "2.86%" interference criterion. One contour is generated per combination of DBS link and reference victim antenna pattern. Note that if the MVDDS operator uses two orthogonal polarizations, then the power received at the victim antenna must be adjusted upward.

   The MVDDS transmitter parameters required for this epfd contour calculation, in addition to the parameters listed in Item 1, are:

   a. Interference epfd limit calculated from the reference link under analysis;

   b. Reference victim antenna pattern in the plane of the horizon (worst case over frequency);

   c. Desired DBS spacecraft operating longitude (for victim antenna pointing); and

   d. Any other MVDDS transmit sites within the region surrounding the MVDDS transmit site under study that could significantly affect interference levels.

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[39] DIRECTV notes that all of the analyses to date have assumed that the proposed MVDDS transmissions are QPSK, and that the transmitted spectra are flat. If the proposed MVDDS transmitted spectra are not flat, then significant modifications may need to be made to the interference epfd calculation.

3. Combine all epfd contours onto one map and plot the outermost (aggregate) contour. Confirm that there is no habitable land within this outermost MVDDS epfd contour.

E. The Commission Should Limit Initial MVDDS System Deployment at 12 GHz to a Single City for Further Evaluation of Harmful Interference Potential to Primary DBS and NGSO FSS Services

The Commission has proposed and Congress has required[40] that no MVDDS facility licensed or authorized by the Commission can cause harmful interference to DBS service. Given the tremendous capital investment that DBS operators have made to bring an extraordinary level of service to consumers on a nationwide basis, the stakes are far too high for the Commission to permit widescale MVDDS system deployment until the implications for millions of DBS consumers are fully understood. Furthermore, the Commission has proposed to introduce MVDDS systems into the 12 GHz band without understanding the combined interactions of DBS, proposed MVDDS and NGSO FSS systems.

Northpoint's deployment plans to date have been deliberately opaque. However, based upon an analysis of the sparse coverage information that has been provided, it is clear that the impact of MVDDS system deployment in an environment featuring multiple overlapping MVDDS transmitters and exacerbated by multipath effects must receive further attention and study before nationwide MVDDS deployment can be contemplated.[41]

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40 The Commission has described the proposed MVDDS service as satisfying the goal of the recently-enacted Rural Local Broadcast Signal Act ("RLBSA"), which was enacted as Title II of the Intellectual Property and Communications Omnibus Reform Act of 1999, Pub.L. 106-113 Stat. 1501. However, the RLBSA requires the FCC to "ensure that no facility licensed or authorized" under the statute "causes harmful interference to the primary users of that spectrum," in this case, the DBS service. *See* RLBSA, § 2002(b)(2).

41 *See, e.g.*, DIRECTV Further Response at 14-23.

For these reasons, to the extent that the Commission eventually licenses secondary MVDDS services at 12 GHz, the Commission should initially do so in a single city that will enable the interference effects of MVDDS technology and operations on DBS subscribers' receipt of service to be more fully understood in the context of a "real-world" system deployment. This approach is consistent with Commission actions leading up to the creation of the LMDS service,[42] and should be adopted here.

III. ADDITIONAL COMMENTS ON PROPOSED TECHNICAL RULES

In paragraph 311 of the Further Notice, the FCC proposes a maximum e.i.r.p. of MVDDS transmitters of 12.5 dBM with exceptions for mountain ridges and "tall manmade structures and natural formations that are adjacent to bodies of water or other significant and clearly unpopulated areas." First, DIRECTV observes that this e.i.r.p. level is more than 4 dB in excess of the transmit power used in the DBS operators' Oxon Hill testing, where unacceptable levels of interference were seen. Second, the Commission should not rely not on transmit e.i.r.p. power levels *per se*, but on the proposed sharing criteria and calculated epfd levels discussed earlier as the primary means of protecting the DBS service.

In paragraph 312 of the Further Notice, DIRECTV agrees that the use of a C/I level or the use of a fixed power flux density level as the sharing criterion is not appropriate because of the variation in DBS link parameters from operator to operator and across the United States for a given operator. DIRECTV agrees that the protection criteria should be based on a percentage

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42 The Commission initially granted Hye Crest Management, Inc. license to provide commercial LMDS service in a limited geographic area, the New York PMSA, in order to tests its implementation in "the rigors of the marketplace." *In re Application of Hye Crest Management, Inc.*, 6 FCC Rcd 332 (1991), at ¶ 18. After a period of successful

degradation in outage time (2.86% per MVDDS system), and that epfd interference limit contours should be generated for each proposed MVDDS transmitter site that define the unacceptable interference zones.

In paragraph 315 of the Further Notice, the Commission has proposed several restrictions on MVDDS antennas. DIRECTV believes that these restrictions could undermine future technical efforts by others to improve MVDDS technology if it is authorized. Future research may result in systems that produce less interference to the DBS service. DIRECTV therefore recommends that such restrictions not be included in the MVDDS service rules.

IV. IF THE COMMISSION CREATES A SECONDARY TERRESTRIAL SERVICE AT 12 GHz, DBS PROVIDERS SHOULD NOT BE PRECLUDED FROM APPLYING FOR SUCH LICENSES

If the Commission does proceed to create secondary terrestrial licenses at 12 GHz, there is no legal or policy reason to exclude DBS providers from the opportunity to acquire this spectrum to develop terrestrial operations that may be complementary to and non-interfering with the DBS service, in a fashion which could enhance further DBS competition to cable. In this regard, the Further Notice acknowledges that the relevant market for considering this issue is the MVPD market,[43] which includes cable operators, DBS providers, home satellite dishes, wireless cable systems, satellite master antenna television ("SMATV") systems,[44] and presumably, would-be MVDDS service providers.[45] The Commission also has concluded recently that cable firms

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operation, the Commission initiated proceedings to expand the geographic scope and allocation of LMDS service.

43 Further Notice at ¶ 298.

44 *See, e.g.*, 2000 Competition Report at ¶¶ 3, 135,

45 As DIRECTV has pointed out on many occasions, Northpoint has changed the characterization of its service from a complementary technology that it hoped would be

continue to "dominate" the MVPD market,[46] and has found repeatedly that DBS providers such as DIRECTV do not possess MVPD market power.[47] Nevertheless, the Commission claims that it must apply a standard that involves "much more than examining market power," and suggests that DBS firms should be lumped with incumbent cable operators as entities with the incentive and ability to "carry out . . . competition-precluding behavior."[48]

The Commission's suggestion is without merit for a number of reasons. First, under established economic theory, a firm cannot engage in unilateral conduct that will actually exert any detrimental effect on competition unless it has market power.[49] Given the Commission's repeated findings that DBS operators do not possess MVPD market power, there is no basis for excluding them from MVDDS service eligibility.

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embraced by DBS providers to offer local service, *see, e.g.*, Further Notice at ¶ 208, to a standalone MVPD competitor to cable and DBS.

46 Further Notice at ¶ 298; *see also* 2000 Competition Report at ¶ 5.

47 *See, e.g.*, MCI Telecommunications Corp. and EchoStar 110 Corp., *Order and Authorization*, 15 Comm. Reg. (P&F) 1038 (1999), at ¶ 14 (finding that "DBS operators . . . do not have enough subscribers to give them market power in the acquisition of video programming, nor are they dominant distributors of such programming").

48 Further Notice at ¶ 298.

49 *See, e.g., FTC v. Indiana Fed'n of Dentists*, 476 U.S. 447, 460 (1986) (noting that "purpose of . . . inquiries into market definition and market power is to determine whether an arrangement has the potential for genuine adverse effects on competition"); *Time Warner Entertainment Co. v. FCC*, 2001 U.S. App . LEXIS 3102 (D.C. Cir 2001), at *24 (observing that "the assessment of a real risk of anti-competitive behavior . . . is itself dependent on an understanding of market power"); *United States v. Baker Hughes Inc.*, 908 F.2d 981, 992 (D.C. Cir. 1990) ("[M]arket power. . . is the ultimate consideration" when evaluating whether a firm's expansion will enable it to engage in anticompetitive conduct) (citation omitted); *United States v. Western Electric Co.*, 900 F.2d 283, 296 (D.C. Cir.) (holding that "[it] is surely correct that no damage to competition . . . can occur unless the BOCs can exercise market power"), *cert denied*, 498 U.S. 911 (1990). The Department of Justice Merger Guidelines similarly establish market power as the sole

Second, a prohibition on DBS companies' acquisition of secondary-use MVDDS spectrum is absolutely contrary to the approach that the Commission has taken regarding various similar technologically suited frequency bands allocated to fixed wireless services,[50] in which the Commission has imposed no eligibility restrictions or spectrum aggregation limits.[51] Indeed, with respect to Local Multipoint Distribution Service ("LMDS") licenses, for example -- a service that is functionally identical to the secondary MVDDS services proposed here -- the Commission recently *eliminated* restrictions on incumbent local exchange carriers and cable companies' eligibility to acquire in-market LMDS licenses.[52] The idea that DBS provider acquisition of such spectrum would pose a greater competitive risk than cable or telephone companies is absurd.

Finally, the Commission itself initiated these proceedings acknowledging Northpoint's claims that it might be a terrestrial means of supplementing or complementing DBS service -- a service that could be "integrated with DBS."[53] While Northpoint's business plan has been ever-changing, and Northpoint now casts itself as a MVPD competitor to both DBS and cable

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barometer of the competitive effects of any merger. 1992 Merger Guidelines, 4 Trade Reg. Rep. (CCH) ¶ 13,104 at §§ 0.1, 1.51.

50 Parenthetically, DIRECTV reiterates that these are the very frequencies that Northpoint should be required to utilize in the first instance.

51 In the Matter of 2000 Biennial Regulatory Review Spectrum Aggregation Limits for Commercial Mobile Radio Services, *Notice of Proposed Rulemaking*, WT Docket No. 01-14, FCC 01-28 (rel. Jan. 23, 2001), at ¶ 26.

52 *See* Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services, *Third Report and Order and Memorandum Opinion and Order*, 15 FCC Rcd 11857 (2000).

services, there is no reason why other parties, including DBS providers, should not be allowed to develop their own complementary secondary uses of 12 GHz spectrum. Commissioner Furchtgott-Roth has observed that "we have no clear idea about the types of services that may be offered by" MVDDS licensees.[54] However, if Northpoint's own proposal contemplated the development of alleged secondary "DBS-friendly" uses of the 12 GHz band, it serves no public interest purpose to exclude DBS providers from developing such uses themselves.

V. NORTHPOINT'S PENDING APPLICATIONS SHOULD BE DISMISSED

A. There Is No Reason for the Commission to Proceed by Waiver to Bypass Its Standard Fixed Service Allocation and License Assignment Processes

Through its BroadWave affiliates, Northpoint filed a number of requests, on a market-by-market basis, for the Commission to waive various Part 101 fixed microwave service rules in order for Northpoint to deploy its proposed point-to-multipoint service.[55] That effort was a flawed attempt by Northpoint to bypass the Commission's normal rulemaking and license assignment processes. The Further Notice recognizes that Northpoint's approach is fundamentally "different from our traditional process for establishing a new terrestrial wireless service," and is aptly summarized by the Commission as follows:

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53 Further Notice at ¶ 207. The DBS operators viewed Northpoint as an interference threat even when it was "pitched" as a complementary service.

54 *Id.*, Separate Statement of Commissioner Harold Furchtgott-Roth.

55 Specifically, Northpoint's BroadWave affiliates filed requests for waiver of 47 C.F.R. §§ 101.105, 101.107, 101.109, 101.111, 101.115, 101.139 and 101.603, as well as any other fixed microwave radio service rules necessary to permit the processing of its applications pertaining to deployment of service in the 12.2-12.7 GHz band. *Corrected Public Notice*, DA 99-494 (rel. Mar. 11, 1999) ("Public Notice"). BroadWave seeks authority to provide multichannel video programming, including the retransmission of local television broadcast signals, and Internet service to 212 markets throughout the United States. *Id.*

> When a party or the Commission proposes such a service, we generally initiate rulemaking proceedings both to allocate spectrum for the new service and establish service rules before we accept any applications for licenses. In the context of these proceedings, we establish rules governing the application and licensing process for the new service. After the completion of such proceedings, parties are provided an opportunity to submit applications in accordance with the adopted service rules. If mutually exclusive applications are accepted, licenses must be assigned by auction, with few exceptions.[56]

There is no legal or policy basis for deviating from the Commission's standard approach here. The contours of the secondary service that Northpoint seeks to provide using the DBS downlink band, and how that service may be licensed, are the precise subjects of this rulemaking proceeding. There is no reason why the Commission should bypass its traditional processes to proceed by a waiver mechanism to authorize Northpoint's proposed fixed microwave operations, which is itself an "extraordinary" remedy.[57]

The Further Notice recognizes that "if we were to follow our traditional approach in creating terrestrial MVDDS in the 12.2-12.7 GHz band, it would appear that the Northpoint waiver requests and applications would be subject to dismissal."[58] There simply is no special circumstance here that counsels for the Commission to abandon its traditional approach. If a secondary MVDDS fixed wireless service is created at 12 GHz, or located in other frequency

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56 Further Notice at ¶ 327 (footnote omitted).

57 *In the Matter of Optel, Inc., Petition for Waiver of Section 101.603 of the Commission's Rules,* Order, DA 99-406 (rel. Mar. 10, 1999) ("Optel"), at ¶ 12. A waiver is granted only upon a petitioners' showing that (i) application of the rules would frustrate the underlying purpose of the rules and waiver of the rules otherwise is in the public interest, or (ii) a waiver should be granted based on unique facts and circumstances in which the petitioner would suffer unjust or unduly burdensome consequences from application of the rules. A waiver applicant must also demonstrate that it has no other reasonable alternative than to request extraordinary relief. *Id.* at ¶ 5; *see* 47 C.F.R. § 101.23.

58 Further Notice at ¶ 327.

bands, the Commission may open an MVDDS filing window and permit Northpoint and any other qualified applicant to file applications at that time to provide the service.

B. Northpoint Cannot Claim "Cut-Off" Protection Based On The Opening Of The NGSO FSS Filing Window

Northpoint has attempted to insulate itself from mutual exclusivity with other applicants, and from the use of auctions to assign MVDDS licenses, by claiming that the public notice that the Commission used to open the filing window for NGSO FSS systems[59] also placed the public on adequate notice that the 12.2-12.7 GHz band could be used for terrestrial operations of the type Northpoint proposes.[60] This claim is without merit.

The *Ku Band Cut-Off Notice*, by its terms, invited "entities wishing to implement NGSO FSS systems . . . to do so by filing such requests."[61] It cannot be credibly read to also be soliciting the filing of terrestrial MVDDS applications at 12 GHz.

The courts have been very clear that, in a cut-off context, the Commission "may not . . . give public notice of a cut-off date which does not fairly advise prospective applicants of what is being cut off by the public notice."[62] The *Ku Band Cut-Off Notice* refers to the filing of competing NGSO FSS satellite applications, and interested parties seeking to use the 12.2-12.7

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59 *Cut-Off Established for Additional Applications and Letter of Intent in the 12.75-13.25 GHz, 13.75-14.5 GHz and 10.7-12.7 GHz Frequency Bands*, Report No. SPB-141 (Nov. 2, 1998) ("Ku Band Cut-Off Notice").

60 Further Notice at ¶ 323.

61 *Ku Band Cut-Off Notice*. The public notice further noted that such requests could take "one of three forms," none of which relate to terrestrial operations: "(1) application for a space station license; (2) application for an earth station license that will communicate with a non-U.S. licensed satellite; (3) letter of intent to use a non-U.S. licensed satellite to provide service in the United States." *Id.*

62 *Ridge Radio Corp. v. FCC*, 292 F.2d 770, 773 (D.C. Cir. 1961); *see McElroy Electronics Corporation v. FCC*, 886 F.3d 248 (D.C. Cir. 1996).

GHz band for other uses simply were not placed "on notice that [their] rights were at stake."[63] Thus, to the extent that the Commission ever proceeds with MVDDS licensing in any frequency band, it will need to solicit the filing of applications, most likely in an auction context.[64] The pending BroadWave applications, however, should be dismissed.

VI. CONCLUSION

If the Commission decides to proceed along the ill-considered course of introducing a secondary point-to-multipoint service into the 12 GHz band, it must afford the maximum protection possible to primary BSS operations, as set forth above. DBS subscribers must not be required to accept harmful interference from proposed secondary MVDDS systems.

Furthermore, Northpoint should not be accorded favorable treatment in any secondary spectrum licensing at 12 GHz. All qualified applicants should be permitted to access the assignment process for MVDDS licenses, including DBS operators if they choose to do so. In accordance with the Commission's traditional Fixed Service licensing approach, the pending applications of Northpoint's BroadWave affiliates should be dismissed. If and when the Commission opens a filing window for MVDDS applications, Northpoint or its affiliates may file at that time.

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63 *McElroy Electronics*, 886 F.3d at 257.

64 In *ex parte* filings leading up to the Further Notice, Northpoint also provided a makeweight argument that the Open-Market Reorganization for the Betterment of International Telecommunications Act ("Orbit Act"), which expressly prohibits the Commission from auctioning any spectrum used for global satellite services, should be stretched beyond its plain meaning to prevent any other service, such as Northpoint's proposed secondary terrestrial offering, from being auctioned if there is another overlapping use of such frequencies. *See* Further Notice at ¶ 326. Citing several recent counter-examples, the Commission has rightly rejected this position, concluding that the

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Orbit Act "is not a bar to auctioning licenses to provide [a terrestrial] service merely because the terrestrial service operates on the same frequencies as a satellite service." *Id.*

APPENDIX I

Table A below provides a reference link budget example that can be used by DBS operators to supply information on each of their links requiring protection. These can be either current operational links or planned links. Column E provides a detailed explanation of the calculations performed in each row. A general description of the function of certain rows or a group of rows follows.

1	B	C	D	E
2	**Link Description**	**Units**	**Example**	**Notes and Formulas**
3	Operator		DIRECTV	
4	Satellite longitude	°	101	
5	Modulation Type		QPSK 6/7	
6	Earth Station Location		Washington DC	
7	Earth Station Reference Antenna Pattern (Horizon Plane)		45cm Classic	
8	**Inputs**			
9	Earth station latitude	°	38.9	
10	Earth station longitude	°	77.0	
11	Earth station altitude above mean sea level	km	0.01	
12	Satellite e.i.r.p. in the direction of the earth station	dBW	55.8	Provided by GIMS database for operational spacecraft
13	Frequency - Low Band End	GHz	12.224	Assumes worst case victim receiver gain is at low end of DBS band
14	C/N+I required at operating threshold	dB	7.6	
15	Receiver noise bandwidth	MHz	24	
16	On-axis antenna gain at receiver input (Per Reference Antenna Pattern)	cm	34	
17	Earth station antenna pointing loss toward satellite	dB	0.5	
18	Clear sky earth station antenna system noise temperature	degrees K	125	
19	Atmospheric absorption	dB	0.2	
20	Cross-Polarization Isolation	dB	22.9	
21	C/I due to other GSO BSS networks	dB	20.7	
22	Clear sky feeder link C/N+I	dB	27.7	
23	Boltzman's constant		-228.6	
24	**Calculate Link Parameters**			
25	Slant path	km	37890	
26	Free space loss	dB	205.8	=20*LOG(4*PI()*D25*1000/0.3*D13)
27	Clear sky G/T	dB/K	13.0	=D16-10*LOG(D18)
28	**Calculate Clear Sky C/(N+I) Ratios without MVDDS**			
29	Clear Sky Down link C/N	dB	17.17	=D27+(D12-D17-D19)-D26-(D23+10*LOG(D15*10^6))
30	Clear Sky Downlink C/(N+I)	dB	14.84	=-10*LOG(10^(-D29/10)+10^(-D21/10)+10^(-D20/10))
31	Clear Sky Total Link C/(N+I)	dB	14.62	=-10*LOG(10^(-D30/10)+10^(-D22/10))
32	Clear Sky Link Margin above operating threshold	dB	7.02	=D31-D14
33	**Calculate Rain Faded C/(N+I) Ratios Without MVDDS**			
34	Faded Downlink C/N	dB	8.00	=D27+(D12-D17-D19)-D26-(D23+10*LOG(D15*10^6))-D39-D40
35	Faded Downlink C/(N+I)	dB	7.64	=-10*LOG(10^(-D34/10)+10^(-D21/10)+10^(-D20/10))
36	Faded Total downlink C/(N+I)	dB	7.60	=-10*LOG(10^(-D35/10)+10^(-D22/10))
37	Faded Link Margin	dB	0.00	=D36-D14
38	**Calculate Availability Performance Without MVDDS**			
39	Rain attenuation for availability percentage of time	dB	5.03	Value to make faded link margin D37 = zero
40	Noise increase due to rain for availability percentage of time	dB	4.14	=10*LOG((D18+290*(1-10^(-D39/10)))/D18)
41	Satellite link unavailability due to rain	%	0.038	=100-D42
42	Calculated link availability	%	99.9624	Value of ITU-R 618-5 corresponding to the attenuation in D39
43	**Calculate allowed degradation in availability Performance**			
44	Maximum increase in unavailability due to MVDDS interference	%	2.86	Interference Criterion
45	Allowed unavailability due to rain and MVDDS interference	%	0.0387	=(1+D44/100)*D41
46	Allowed availability performance with MVDDS interference	%	99.9613	=100-D45
47	Rain attenuation for availability percentage of time with MVDDS interference	dB	4.97	Value of ITU-R 618-5 corresponding to the availability in D46
48	Noise increase due to rain for availability percentage of time with MVDDS interference	dB	4.12	=10*LOG((D18+290*(1-10^(-D47/10)))/D18)
49	**Calculate Rain Faded C/(N+I) Ratios With MVDDS**			
50	Faded Downlink C/N	dB	8.08	=D27+(D12-D17-D19)-D26-(D23+10*LOG(D15*10^6))-D47-D48
51	**MVDDS Minimum C/I Ratio**	**dB**	**25.5**	Minimum C/I value that makes faded link margin D54 = zero
52	Faded Downlink C/(N+I)	dB	7.64	=-10*LOG(10^(-D50/10)+10^(-D21/10)+10^(-D20/10)+10^(-D51/10))
53	Faded Total downlink C/(N+I)	dB	7.60	=-10*LOG(10^(-D52/10)+10^(-D22/10))
54	Faded Link Margin	dB	0.00	=D53-D14
55	**Calculate corresponding epfd level**			
56	Carrier power flux density in clear sky	dBW/m^2/24 MHz	-107.5	=D12-D17-D19-10*LOG(4*PI()*((D25*10^3)^2))
57	MVDDS interference maximum equivalent power flux density in 24 MHz	dBW/m^2/24 MHz	-133.0	=D56-D51
58	**MVDDS interference maximum equivalent power flux density in 40 kHz**	**dBW/m^2/40 kHz**	**-160.8**	=D57-10*LOG(24000/40)

Table A: Example Annotated Link Budget

1. Description And Notes For The Proposed Link Budget (Table A)

Rows 3 through 7: These provide a short description of the DBS link for identification purposes.

Row 12: For simplicity, it is recommended that one link be generated for every combination of satellite and modulation operating mode. Then the satellite E.I.R.P. for each of

these combinations can be calculated for proposed MVDDS transmit sites. The value of E.I.R.P. for operational satellites can be readily determined using information already on public file. These are patterns used to determine BSS intra-service interference. They can be used to determine E.I.R.P. at any location over CONUS. This is done using the "GIMS" utility that is included with the MSPACE ITU-R software. It must be recognized, however, that these patterns represent the highest E.I.R.P. at a given location over the 12.2 to 12.7 GHz band of operation. They are intended to represent worst case interference of one DBS system into another. However, in the MVDDS sharing case, the DBS system is the victim, and the minimum (not maximum) E.I.R.P. over frequency should ideally be used. Unfortunately, these patterns are not routinely generated or, if generated, are not publicly disseminated.

Row 13: The low end of the frequency band is suggested as the base frequency because current measurements show that the victim antenna pattern is most sensitive here.

Rows 29 through 32: These calculate the carrier to interference-plus-noise ratio values in clear weather and without MVDDS interference.

Rows 34 through 37: These calculate the faded carrier to interference-plus-noise ratio values without MVDDS interference. This calculation is used to derive the maximum rain affects that the link can tolerate without MVDDS interference, which are listed in lines 39 through 42.

Rows 44 through 48: These calculate new rain availability statistics given that the MVDDS interference is not allowed to degrade the unavailability of the desired signal by more than 2.86%. The ITU-R 618-5 rain model was used in this example, but the ITU-R 618-6 model could be used as well.

Rows 50 through 54: These calculate the minimum C/I value of an MVDDS interference source that just meets the "2.86%" criterion.

Rows 56 through 58: Calculate the corresponding epfd level in 40 kHz that corresponds with the C/I value calculated in row 51. Note that the carrier power flux density in clear sky includes receive antenna pointing loss and atmospheric loss.

2. **Two Link Budget Examples**

Table B describes a group of link budgets representing service from a particular set of satellites operating at 101 degrees and using QPSK modulation with a 6/7 code rate. The victim earth station location is taken as Washington DC, but could be moved anywhere around the U.S. by recalculating the satellite e.i.r.p as described above.

1	B	C	D	E	F
2	**Link Description**	**Units**			
3	Operator		DIRECTV	DIRECTV	DIRECTV
4	Satellite longitude	°	101	101	101
5	Modulation Type		QPSK 6/7	QPSK 6/7	QPSK 6/7
6	Earth Station Location		Washington DC	Washington DC	Washington DC
7	Earth Station Reference Antenna Pattern (Horizon Plane)		45 cm Classic	Multi-Satellite	MDU
8	**Inputs**				
9	Earth station latitude	°	38.9	38.9	38.9
10	Earth station longitude	°	77.0	77.0	77.0
11	Earth station altitude above mean sea level	km	0.01	0.01	0.01
12	Satellite e.i.r.p. in the direction of the earth station	dBW	55.8	55.8	55.8
13	Frequency - Low Band End	GHz	12.224	12.224	12.224
14	C/N+I required at operating threshold	dB	7.6	7.6	7.6
15	Receiver noise bandwidth	MHz	24	24	24
16	On-axis antenna gain at receiver input (Per Reference Antenna Pattern)	cm	34	33.5	40
17	Earth station antenna pointing loss toward satellite	dB	0.5	0.5	0.5
18	Clear sky earth station antenna system noise temperature	degrees K	125	120	125
19	Atmospheric absorption	dB	0.2	0.2	0.2
20	Cross-Polarization Isolation	dB	22.9	22.9	22.9
21	C/I due to other GSO BSS networks	dB	20.7	20.7	20.7
22	Clear sky feeder link C/N+I	dB	27.7	27.7	27.7
23	Boltzman's constant		-228.6	-228.6	-228.6
24	**Calculate Link Parameters**				
25	Slant path	km	37890	37890	37890
26	Free space loss	dB	205.8	205.8	205.8
27	Clear sky G/T	dB/K	13.0	12.71	19.03
28	**Calculate Clear Sky C/(N+I) Ratios without MVDDS**				
29	Clear Sky Down link C/N	dB	17.17	16.85	23.17
30	Clear Sky Downlink C/(N+I)	dB	14.84	15.35	18.75
31	Clear Sky Total Link C/(N+I)	dB	14.62	15.11	18.23
32	Clear Sky Link Margin above operating threshold	dB	7.02	7.51	10.63
33	**Calculate Rain Faded C/(N+I) Ratios Without MVDDS**				
34	Faded Downlink C/N	dB	8.00	8.00	8.00
35	Faded Downlink C/(N+I)	dB	7.64	7.64	7.64
36	Faded Total downlink C/(N+I)	dB	7.60	7.60	7.60
37	Faded Link Margin	dB	0.00	0.00	0.00
38	**Calculate Availability Performance Without MVDDS**				
39	Rain attenuation for availability percentage of time	dB	5.03	4.70	10.26
40	Noise increase due to rain for availability percentage of time	dB	4.14	4.15	4.92
41	Satellite link unavailability due to rain	%	0.038	0.044	0.006
42	Calculated link availability	%	99.9624	99.9559	99.9940
43	**Calculate allowed degradation in availability Performance**				
44	Maximum increase in unavailability due to MVDDS interference	%	2.86	2.86	2.86
45	Allowed unavailability due to rain and MVDDS interference	%	0.0387	0.0454	0.0062
46	Allowed availability performance with MVDDS interference	%	99.9613	99.9546	99.9938
47	Rain attenuation for availability percentage of time with MVDDS interference	dB	4.97	4.64	10.15
48	Noise increase due to rain for availability percentage of time with MVDDS interference	dB	4.12	4.13	4.91
49	**Calculate Rain Faded C/(N+I) Ratios With MVDDS**				
50	Faded Downlink C/N	dB	8.08	8.08	8.11
51	**MVDDS Minimum C/I Ratio**	**dB**	**25.5**	**25.6**	**24.0**
52	Faded Downlink C/(N+I)	dB	7.64	7.64	7.64
53	Faded Total downlink C/(N+I)	dB	7.60	7.60	7.60
54	Faded Link Margin	dB	0.00	0.00	0.00
55	**Calculate corresponding epfd level**				
56	Carrier power flux density in clear sky	dBW/m^2/24 MHz	-107.5	-107.5	-107.5
57	MVDDS interference maximum equivalent power flux density in 24 MHz	dBW/m^2/24 MHz	-133.0	-133.1	-131.5
58	**MVDDS interference maximum equivalent power flux density in 40 kHz**	**dBW/m^2/40 kHz**	**-160.8**	**-160.9**	**-159.3**

Table B: Example Link Budgets; DIRECTV 101 °W, Washington DC

Note that in this example there are three columns of figures. The epfd contours on the ground will vary depending on the type of victim antenna. Example victim reference antenna patterns are identified in Row 7. Currently, the most common DBS receive antenna utilizes the 45 cm offset fed reflector. However, there are increasing numbers of antennas in the field that can receive signals from multiple DBS satellites using a single aperture (identified here as a "Multi-Satellite" antenna in Column E). These antennas need to be characterized for receive gain in the

plane of the horizon, and their characteristics included in the epfd contour calculations. Another example is given in Column F of Table B, that of an MDU or multiple dwelling unit antenna. These again will have a different pattern in the plane of the horizon, and must be taken into account and protected. DBS operators should provide reference antenna patterns for all antennas requiring protection.

To get this protection, the maximum epfd value is calculated for each link. This value is combined with the shape of the reference horizon gain pattern of the victim antenna to produce an epfd contour. One contour is generated for each column or link around any given MVDDS transmission site. The outer envelope of these contours can then be identified, and this must not enclose any habitable land. A more detailed discussion of this process is provided in discussing Table C.

1	B	C	D	E	F
2	**Link Description**	**Units**			
3	Operator		DIRECTV	DIRECTV	DIRECTV
4	Satellite longitude	°	101	101	101
5	Modulation Type		QPSK 2/3	QPSK 2/3	QPSK 2/3
6	Earth Station Location		Seattle, WA	Seattle, WA	Seattle, WA
7	Earth Station Reference Antenna Pattern (Horizon Plane)		45cm Classic	Multi-Satellite	MDU
8	**Inputs**				
9	Earth station latitude	°	47.6	47.6	47.6
10	Earth station longitude	°	122.3	122.3	122.3
11	Earth station altitude above mean sea level	km	0.01	0.01	0.01
12	Satellite e.i.r.p. in the direction of the earth station	dBW	48	48	48
13	Frequency - Low Band End	GHz	12.224	12.224	12.224
14	C/N+I required at operating threshold	dB	5.0	5.0	5.0
15	Receiver noise bandwidth	MHz	24	24	24
16	On-axis antenna gain at receiver input (Per Reference Antenna Pattern)	cm	34	33.5	40
17	Earth station antenna pointing loss toward satellite	dB	0.5	0.5	0.5
18	Clear sky earth station antenna system noise temperature	degrees K	125	120	125
19	Atmospheric absorption	dB	0.2	0.2	0.2
20	Cross-Polarization Isolation	dB	22.9	22.9	22.9
21	C/I due to other GSO BSS networks	dB	20.7	20.7	20.7
22	Clear sky feeder link C/N+I	dB	27.7	27.7	27.7
23	Boltzman's constant		-228.6	-228.6	-228.6
24	**Calculate Link Parameters**				
25	Slant path	km	38500	38500	38500
26	Free space loss	dB	205.9	205.9	205.9
27	Clear sky G/T	dB/K	13.0	12.71	19.03
28	**Calculate Clear Sky C/(N+I) Ratios without MVDDS**				
29	Clear Sky Down link C/N	dB	9.23	8.91	15.23
30	Clear Sky Downlink C/(N+I)	dB	8.76	8.63	14.15
31	Clear Sky Total Link C/(N+I)	dB	8.71	8.58	13.96
32	Clear Sky Link Margin above operating threshold	dB	3.71	3.58	8.96
33	**Calculate Rain Faded C/(N+I) Ratios Without MVDDS**				
34	Faded Downlink C/N	dB	5.22	5.21	5.22
35	Faded Downlink C/(N+I)	dB	5.02	5.02	5.02
36	Faded Total downlink C/(N+I)	dB	5.00	5.00	5.00
37	Faded Link Margin	dB	0.00	0.00	0.00
38	**Calculate Availability Performance Without MVDDS**				
39	Rain attenuation for availability percentage of time	dB	1.64	1.44	5.71
40	Noise increase due to rain for availability percentage of time	dB	2.38	2.26	4.31
41	Satellite link unavailability due to rain	%	0.060	0.081	0.002
42	Calculated link availability	%	99.9397	99.9193	99.9977
43	**Calculate allowed degradation in availability Performance**				
44	Maximum increase in unavailability due to MVDDS interference	%	2.86	2.86	2.86
45	Allowed unavailability due to rain and MVDDS interference	%	0.0620	0.0830	0.0023
46	Allowed availability performance with MVDDS interference	%	99.9380	99.9170	99.9977
47	Rain attenuation for availability percentage of time with MVDDS interference	dB	1.62	1.42	5.66
48	Noise increase due to rain for availability percentage of time with MVDDS interference	dB	2.36	2.24	4.30
49	**Calculate Rain Faded C/(N+I) Ratios With MVDDS**				
50	Faded Downlink C/N	dB	5.26	5.25	5.28
51	**MVDDS Minimum C/I Ratio**	**dB**	**25.7**	**25.9**	**23.6**
52	Faded Downlink C/(N+I)	dB	5.02	5.02	5.02
53	Faded Total downlink C/(N+I)	dB	5.00	5.00	5.00
54	Faded Link Margin	dB	0.00	0.00	0.00
55	**Calculate corresponding epfd level**				
56	Carrier power flux density in clear sky	dBW/m^2/24 MHz	-115.4	-115.4	-115.4
57	MVDDS interference maximum equivalent power flux density in 24 MHz	dBW/m^2/24 MHz	-141.1	-141.3	-139.0
58	**MVDDS interference maximum equivalent power flux density in 40 kHz**	**dBW/m^2/40 kHz**	**-168.9**	**-169.1**	**-166.8**

Table C: Example Link Budgets; DIRECTV, 101 °W, Seattle, Washington

Table C provides another example of a group of link budgets. This example is for a particular set of satellites operating at 101 degrees and using QPSK modulation with a 2/3 code rate. The victim earth station location is taken as Seattle, Washington, but could be moved anywhere around the U.S. by recalculating the satellite e.i.r.p as described above. Of particular interest here are the required C/I values and epfd values required to protect this link. The C/I levels are nearly the same as those calculated for the 6/7 code rate links shown in Table B, 25.7

dB vs. 25.5 dB, but the calculated epfd values are very different. In Seattle using the 2/3 code rate link, the required epfd level is –168.9 dBW/m^2/40kHz. In Washington DC using the 6/7 code rate link, the required epfd level is –160.8 dBW/m^2/40kHz. Thus, nearly equal C/I levels at the two locations translate into very different epfd limits for the same protection.

ENGINEERING CERTIFICATION

I, Paul R. Anderson, hereby declare as follows:

1. I am Senior Director, Communications Systems, for DIRECTV, Inc. I am an engineer by training and am familiar with the technical and interference characteristics of DIRECTV's Direct Broadcast Satellite system, the technical requirements of the Commission's rules, and the interference and technical issues referenced in the foregoing filing.

2. I have reviewed the foregoing filing, and the information found therein is true and accurate to the best of my knowledge, information and belief.

Paul R. Anderson
Senior Director, Communications Systems
DIRECTV, Inc.