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International Bureau
Federal Communications Commission
2000 M Street, N.W.
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Received

APR 12 1997

Satellite Policy Branch
International Bureau

Re: EchoStar Satellite Corporation
Directsat Corporation
Request for Special Temporary Authority
FCC File Nos. 155-SAT-STA-96, 156-SAT-STA-96

Dear Mr. Tycz:

TEMPO Satellite, Inc. ("TEMPO"), through its counsel, submits these comments on the Technical Annex filed by EchoStar Satellite Corporation ("EchoStar") on March 28, 1997 in response to your letter of inquiry regarding the above captioned request for special temporary authority ("STA").¹ EchoStar was instructed to supply a technical showing "demonstrating that harmful interference will not be caused to other potentially affected satellite systems and U.S. permittees," or, alternatively, to obtain the consent of affected satellite operators.²

¹ Letter from Thomas S. Tycz, Chief, Satellite and Radiocommunication Division, International Bureau, to Pantelis Michalopoulos, counsel to EchoStar Satellite Corporation and Directsat Corporation, dated Feb. 26, 1997.

² Id.

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As the Commission has been advised, TEMPO has had discussions with EchoStar regarding its request to reposition USABSS-3 and USABSS-4 to 119.05° W.L. and 118.95° W.L., respectively. In this regard, TEMPO has indicated that it has no objection to EchoStar's request to relocate USABSS-4 to 118.95° W.L. Relocating USABSS-4 alleviates some of the problems that are inherent with the continuous coordination of co-located satellites. Thus, the FCC should promptly authorize EchoStar to relocate USABSS-4 at least as far west as 118.95° W.L., and preferably to 119.1° W.L.

TEMPO does not believe, however, that the Technical Annex filed by EchoStar is adequate to demonstrate that relocation of USABSS-3 to 119.05° W.L. will not result in harmful interference to TEMPO's system at 118.8° W.L. In particular, as explained in the attached Technical Statement of TEMPO, EchoStar's Technical Annex contains a number of critical errors and omissions.

First, EchoStar's interference calculations do not conform to the format specified in Appendix 30A of the International Telecommunication Union ("ITU") Radio Regulations and fail to evaluate critical factors that may exacerbate the potential for interference. For example, EchoStar concludes that there is no potential for interference assuming it uses a maximum clear sky EIRP of 87.4 dBW and TEMPO uses a clear sky EIRP of 83.34 dBW. However, the maximum licensed EIRP levels for EchoStar and TEMPO are 95 dBW and 80 dBW, respectively. As noted in the attached Technical Statement, EchoStar's interference formula, using licensed EIRP levels and correcting for the inaccurate cross-polarization value in EchoStar's Technical Annex, would yield a carrier to interference level ("C/I") that is 17.7 dB above TEMPO's noise floor. Even if EchoStar operates with the lower EIRP of 87.4 dBW suggested in its Technical Annex, the C/I level would still be 10.1 dB above TEMPO's noise floor.

In addition, other factors neglected by EchoStar must be considered to assess fully the potential for harmful interference into TEMPO's system. For example, EchoStar's analysis fails to make an allowance for naturally occurring satellite drift, which could result in only 0.1° of physical separation between USABSS-3 and TEMPO's satellite.³ EchoStar also has failed to make an allowance for antenna mispointing, which must be considered in a worst case analysis of interference pursuant to ITU Appendix 30A.

³ TEMPO's satellite has an east-west station keeping of 0.1° and USABSS-3 has an east-west station keeping of 0.05°. As a result, in order to determine if relocating USABSS-3 to 119.05° W.L. could result in interference to TEMPO, a worst case spacing of 0.15° must be included in any calculations.

Second, EchoStar's analysis fails to consider the potential for interference from its tracking carriers in its channels 1 and 2 into TEMPO's authorized telemetry operations. As noted in the Technical Statement, the combination of EchoStar's tracking carriers and service carriers could create intermodulation products that could interfere with TEMPO's telemetry operations.⁴

Third, TEMPO has learned that Telesat Canada intends to locate an FSS satellite at 118.7° W.L., which would be operated in an inclined orbit, possibly as early as May 1997.⁵ EchoStar's Technical Annex does not consider the significant impact that location of an FSS satellite just 0.1° away from TEMPO's and Directsat's authorized slot would have on the ability to coordinate EchoStar's proposed operations with TEMPO's system.⁶

Thus, TEMPO submits that EchoStar's Technical Annex fails to demonstrate that EchoStar's proposed operations would not cause harmful interference into TEMPO's system. This inadequacy is underscored by EchoStar's own long-standing position that a serious potential for harmful interference exists between USABSS-3's operations at its existing authorized position at 119.2° W.L. and TEMPO's system at 118.8° W.L. EchoStar has twice opposed applications of TEMPO and its affiliate, Western Tele-Communications, Inc. ("WTICI"), for FCC authorizations on the grounds that even the presently required 0.4° spacing may be insufficient to prevent interference between EchoStar's and TEMPO's satellites.

For example, as early as 1994, EchoStar argued that "interference at numerous frequencies may occur" if TEMPO and EchoStar operate 0.4° apart.⁷ In 1996, EchoStar repeated

⁴ Because EchoStar's channel 2 tracking carrier and TEMPO's telemetry carrier are co-polarized, the proposed relocation of USABSS-4 (with channel 2 service) to 118.95° does not eliminate the potential for that satellite to interfere with TEMPO's operations.

⁵ TEMPO understands that EchoStar has been informed of Telesat's intention.

⁶ Telesat has proposed that TEMPO move its satellite to 118.95° W.L. in order to provide Telesat's satellite with a deadband of 0.15°. As the Commission is aware, TEMPO was required to design the shaped reflector for its satellite to serve Alaska while suppressing the signal towards Siberia. Thus, it is unclear whether TEMPO could move its satellite to the West without causing unauthorized transmissions into Siberia.

⁷ See Letter from David K. Moskowitz, Vice President and General Counsel, EchoStar Satellite Corporation, to William F. Caton, Acting Secretary, Federal Communications Commission, at 10, dated Sept. 30, 1994. EchoStar indicated that 0.4° of spacing is insufficient between

this argument in a petition to deny WTCI's earth station application because of EchoStar's "serious interference concerns."⁸ EchoStar argued that even with 0.4° of separation, "EchoStar's uppermost channel (21) is so close to TEMPO's lowermost channel (22) that TEMPO's operations could easily cause interference . . ."

Moreover, as TEMPO has previously indicated, EchoStar acknowledged in its November 1995 technical submissions to the Commission that its system would cause "excessive interference" to DBS systems operating at 119° W.L.¹⁰ EchoStar disregarded the severity of this interference, however, by incorrectly assuming that it is authorized to operate all 32 channels at 119° W.L. and thus the interference would be into its own system.¹¹

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USABSS-3 and TEMPO's satellite because of the potential for both satellites to drift towards each other. Taking the potential for drift into account, EchoStar stated that interference may result at numerous frequencies. Id.

⁸ EchoStar Satellite Corporation and Directsat Corporation Joint Reply to Opposition to Petition to Deny, FCC File No. 1735-DSE-P/L-96, at 9 (Nov. 4, 1996).

⁹ EchoStar Satellite Corporation and Directsat Corporation Petition to Deny, FCC File No. 1735-DSE-P/L-96, at 5 (Oct. 18, 1996).

¹⁰ Additional Technical Information on EchoStar Communications System Performance Including Intersystem, Interference and Related Considerations, at unnumbered page 2, included as an attachment to Request for Removal of Conditions, Minor Modification and Issuance of Launch Authority, FCC File No. 15-SAT-MP/LA-96 (Nov. 13, 1995) ("EchoStar Request for Launch Authority"), also included as an attachment to Letter from Pantelis Michalopoulos, Steptoe & Johnson LLP, to Giselle Gomez, Satellite Engineering Branch, FCC, dated Nov. 3, 1995 ("November 3rd Letter"); see also Western Tele-Communications, Inc. Opposition to Petition to Deny, FCC File No. 1725-DSE-P/L-96, at 10 (Oct. 28, 1996).

¹¹ See Output Results From 'MSPACE' Program for the Modified Input Data for the Beam USAEH004 (Reduced E.I.R.P. of EchoStar), at unnumbered pages 3-4, included as Attachment 3 to EchoStar Request for Launch Authority, also included as an attachment to November 3rd Letter (disclosing excessive interference to channels 22-32 at 119° W.L., but indicating that EchoStar's satellite would be the satellite operating channels 22-32); see also EchoStar DBS Satellite, Technical Input, at 17 (Aug. 1994), included as an attachment to EchoStar Request for Launch Authority (excluding TEMPO's authorized channels at 119° W.L. from a list of

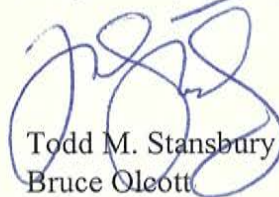
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In light of EchoStar's past statements of concern, the Commission should view EchoStar's Technical Annex in support of its request for STA with skepticism. Indeed, TEMPO has shown that the annex is based on erroneous assumptions and fails to consider key factors that could contribute to interference. Accordingly, EchoStar's showing is wholly inadequate to demonstrate that the proposed operation of USABSS-3 from 119.05° W.L. would not cause harmful interference to TEMPO's system at 118.8° W.L.

Thank you for your attention to this matter. If you have any questions, please contact this office.

Respectfully submitted,



Todd M. Stansbury
Bruce Oleott

Enclosure

cc: Kim Baum, Satellite and Radiocommunication
Division, International Bureau, FCC
Pantelis Michalopoulos, counsel to EchoStar
Satellite Corporation and Directsat Corporation

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authorized systems between 101.2° W.L. and 148.2° W.L. and incorrectly indicating that EchoStar would be the sole operator at 119° W.L.).

TECHNICAL STATEMENT OF TEMPO SATELLITE, INC

The following is an analysis of the Technical Annex filed by Echostar/Directsat on March 28, 1997. Echostar was directed to show that their system will not interfere into Tempo's system or other BSS satellites. For the reasons explained in the following analysis, Echostar has failed to satisfy this obligation.

Facts Important to the Analysis**A. Authorized Locations, Polarization, Channels, and Station-keeping**

Echostar is authorized to operate its satellite USABSS-3 at 119.2° WL using odd channels 1-21 with right hand-circular (RHC) polarization. Directsat's satellite USABSS-4 is authorized to operate at a location of 118.8° WL using even channels 2-20 with left-hand-circular (LHC) polarization. Echostar/Directsat are authorized to use +/- 0.05° E-W station-keeping.

Tempo's satellite USABSS-7 is authorized to operate at 118.8° WL with even and odd channels 22-32 inclusive with LHC polarization on even channels and RHC polarization on odd channels. Tempo is authorized to use +/- 0.10° E-W station-keeping.

B. ITU BSS Plan for Feeder links in the 17.3-17.8 GHz band in Region 2

The BSS plan for feeder links to BSS satellites is defined in Appendix 30A to Orb 88 of the ITU radio regulations. The Feeder link is the segment between the uplink earth station on the ground and the associated receiving satellite space station.

Appendix 30A and Technical Characteristics Annex 3

Annex 3 to Appendix 30A contains the procedures and calculations to be used to determine if proposed changes to the plan will cause harmful interference. The Region 2 technical characteristics are contained within Section 4 of Annex 3. Article 9 to Appendix 30A contains the plan tables for Region 2 that define each channel, the various beams, orbital locations, and polarization. These sections include all the necessary parameters to properly determine the potential for interference.

Plan for Feeder links in the 17.3-17.8 GHz band in Region 2 using beam USAEH004

The satellites operated by Echostar, Directsat and Tempo share the cluster centered at 119° WL. The ITU Radio Regulations include a diagram that shows the geometry for clusters of the plan's BSS satellites. See ITU Radio Regulations Appendix 30A Figure 9 on page 245. Allowances for E-W station-keeping, satellite spacing between cross-polarized satellites, feeder link antenna mis-pointing, and the pattern of the reference antenna is also shown.

The plan defines the applicable beam for the cluster at 119° WL as USAEH004. This has an orbit of 119.2° with polarization RHC for odd channels 1 to 31. The beam USAEH004 also has an

orbit of 118.8° for the even channels 2 to 32 with polarization LHC. Therefore, the plan specifies a separation of 0.4° between cross-polarized channels in a cluster. See ITU Radio Regulations section 4.13 of Annex 3.

Uplink EIRP is defined in all beams and channels as a maximum level of 87.4 dBW at the ground. The plan also requires a minimum antenna size of 5 meters, with mispointing of the antenna $\pm 0.1^\circ$ maximum with mispointing allowance of 1 dB or less.

Tempo and Echostar/Directsat have filed characteristics with the FCC for Appendix 30A on their receiving space stations and feeder link earth stations. These parameters include antenna patterns, service area, known feeder link earth station parameters, typical feeder link earth station parameters, service areas and test points.

These and the other parameters in the plan should be used to determine potential interference with the applicable test points for each DBS system over the applicable service area.

C. Echostar/Directsat Proposed Change in Satellite Locations and Reduction in the Orbital Spacing

Echostar and Directsat propose to change their orbital locations, thereby reducing the separation between Echostar's satellite and Tempo's satellite. Echostar proposes to operate its satellite USABSS-3 at 119.05° WL using odd channels 1-21 with RHC polarization. Directsat proposes to operate USABSS-4 at 118.95° WL with even channels 2-20 with LHC polarization. Tempo's satellite USABSS-7 would remain at

118.8° WL using even and odd channels 22-32 inclusive with LHC polarization on even channels and RHC polarization on odd channels.

Orbital spacing on odd channels between Echostar and even channels on Tempo would, therefore, be reduced to 0.25° from the Region 2 plan's requirement of 0.40° separation

D. Evaluation of the Calculation format and Parameters contained in the Technical Annex by Echostar

Echostar's Technical Annex evaluated the interference potential into Tempo only on the basis of EIRP and cross-polarization isolation, without regard for consideration of all variables specified in Annex 3 of the Region 2 plan. In fact, the analysis only includes values for EIRP, cross-polarization isolation, and a value for a bandwidth factor. To compound the problem, the analysis uses incorrect values for EIRP and cross-polarization. Also, the bandwidth factor is not recognized in the plan.

Additionally, Echostar's calculation refers to a level of carrier-to-interference C/I, but does not compare this C/I level to the satellite station receiver input, as required in the plan, Appendix 30A section 1.7 of Annex 3. This reference level is required to evaluate it for interference.

Echostar used the following formula in it's Technical Annex:

$$C/I_{\text{Tempo}} = EIRP_{\text{Tempo}} - EIRP_{\text{Echostar}} + XPD(\theta) + F_{\text{Overlap}}$$

Echostar's formula definitions include errors as well.

XPD(θ) The cross-polarized isolation of the transmitting antenna is a factor of cross-polarization, but the value is not equal to 30 dB, as Echostar states. This should be calculated as follows:

Using the formulas for Figure 6 on page 234 of Appendix 30A, with the antenna 0.25° off-axis, the cross-polarization isolation = 27.0 dB. Note that in it's Technical Annex, Echostar refers to the ITU pattern defined in Figure 6 as it's uplink antenna pattern.

Secondly, the cross-polarization isolation of the satellite receiving antenna must be included. Tempo's satellite receive antenna provides 30 dB cross-polarization isolation.

The combined isolation of the two antennas in the feeder link

= $10 \log (1/((\log-1(-27/10))+(\log-1(-30/10))))$ This combined isolation equals an amount of only 25.2 dB and this should be used in calculations.

EIRP factors used in the Echostar Calculations

EIRP_{Tempo} The EIRP clear-sky licensed by Tempo for it's known feeder link earth stations and the EIRP for typical feeder link earth stations with Tempo's service area has been clearly provided in it's Appendix 30A filing or in the earth station license(s). For the known feeder link earth station in Littleton, Colorado, the EIRP is an amount of 80.0 dBW and a monopulse tracking antenna of 13.1m is used. For typical earth stations within Tempo's service area, as defined in the

Appendix 30A filing, the EIRP is an amount of up to 87.4 dBW, using a 5m or larger antenna without tracking. It is important to note that these levels are consistent with the FCC rules under CFR 47 part 25.204 d. This specifies the lowest power level that will provide the required signal quality be used.

For a typical feeder link station at the edge of Tempo's service area, such as in Anchorage, Alaska, the G/T in the Tempo satellite is reduced 6 dB to a level of -4 dB/K. This station also has higher path losses. Therefore, to maintain the required signal quality from this station, the EIRP would be increased to 87.4 dBW, the plan maximum.

EIRPEchostar The EIRP clear-sky licensed by Echostar is provided in it's earth station license at a level of 95.0 dBW. It is important to note that this level is in excess of the power level that will provide the required signal quality. See FCC rules under CFR 47 part 25.204 d.

In it's latest ITU filing dated November 13, 1995 Echostar indicated an EIRP substantially lower, an amount of 75.6 dBW clear-sky for it's service. This parameter is consistent with CFR 47 part 25.204 d and e.

In the Technical Annex, however, Echostar indicated a new clear-sky EIRP of 87.4 dBW

Foverlap The plan for Region 2 does not recognize the use of a bandwidth factor such as the one utilized by Echostar, therefore it is not appropriate to include it.

Calculation format of Feeder Link Uplink Thermal C/N

As noted previously, Echostar's calculation did not reference the C/I to the satellite receive system as required. The calculation for uplink thermal C/N is as follows:

Uplink thermal C/N (dB) = EIRP at feeder link site (dB)
 -Dispersion loss in path to satellite (dB/m²) -Isotropic Area at uplink frequency (dB-m²) -Noise Bandwidth of 24 MHz channel (dB-Hz) -Boltzmann's Constant (dB/K-Hz) +G/T of satellite for uplink location (dB) -Antenna mispointing (dB).

Uplink thermal for Littleton, Colorado = 80.0 -162.5 -46.3
 -73.8 -(-228.6) +2.0 -0.1 = 27.9 dB.

Uplink thermal for Anchorage, Alaska = 87.4 -163.0 -46.3
 -73.8 -(-228.6) -4.0 -1.0 = 27.9 dB.

E. Evaluation of the formula provided by Echostar using the Revised Parameters above

The Echostar interference potential into Tempo is significantly higher than Echostar's calculations would lead us to believe, based on their formula.

Using the licensed EIRP of Tempo's system in Littleton, Colorado and the licensed EIRP of Echostar's system in Cheyenne, Wyoming, plus the correct cross-polarized isolation the value of C/I = 80.0 -95.0 +25.2 = 10.2 dB C/I. This level is 17.7 dB above Tempo's noise floor. This is 19.8 dB from the objective of 30 dB C/I claimed by Echostar in the Technical Annex.

Using the licensed EIRP of Tempo's system in Littleton, Colorado and the EIRP of 87.4 dBW proposed by Echostar in the Technical Annex, plus the correct cross-polarized isolation,

the value of $C/I = 80.0 - 87.4 + 25.2 = 17.8$ dB C/I. This level is 10.1 dB above Tempo's noise floor. This is 12.2 dB from the objective of 30 dB C/I claimed by Echostar in the Technical Annex.

Calculation presented by Echostar evaluated at a fringe Tempo earth station in Anchorage, Alaska

A calculation based on the plan parameters, with EIRP for Tempo's fringe earth station in Anchorage, Alaska, compared to the EIRP proposed in the Technical Annex by Echostar follows. This calculation uses the corrected cross-polarized isolation. An adjustment for the satellite G/T, equal to the amount of +2.0 dB/K effective at the interfering earth station location and a value of -4.0 dB/K effective in Anchorage, equals a reduction in the C/I ratio of -6.0 dB.

The value of C/I to the uplink from Anchorage = $87.4 - 87.4 + 25.2 - 6.0 = 19.2$ dB C/I. This level is 8.7 dB above Tempo's noise floor. This is 10.8 dB from the objective of 30 dB C/I claimed by Echostar in the Technical Annex. Note that Tempo cannot raise the EIRP in this configuration, as was suggested by Echostar in the Technical Annex, since it already uses the plan maximum.

Summary regarding the Adequacy of the Calculations

Note that these calculations do not account for all worst case analysis requirements in the plan. Addition of these could be expected to further reduce the isolation. Also note the calculations above do not include the benefit of off-axis antenna isolation based on orbital spacing between the systems. The calculations also do not include the benefits

of Echostar using similar EIRP levels to that planned for Tempo.

In summary, the calculations herein show the inadequacy of the calculations provided in Echostar's Technical Annex.

E. Additional Facts Applicable to the Analysis of Echostar/Directsat and Tempo

Other factors affect the potential of interference into Tempo from Echostar, especially considering the reduced spacing proposed. Other factors that concern the location of Directsat's satellite must also be evaluated

1. TTAC used by Tempo and the Tracking carrier in Echostar's channel 1--Reduced spacing between Echostar's satellite and Tempo's satellite also reduces the isolation between Echostar's channel 1 and Tempo's Tracking, Telemetry and Control (TTAC) that is cross-polarized with LHC polarization at 12201-12204 MHz. Tempo is concerned about intermodulation products that may fall into Tempo's TTAC from mixing of Echostar's tracking carrier with the service carrier in transponder 1. Tempo's TTAC has a minimum EIRP worst case of +3 dBW with LHC polarization at the edge-of-coverage.

2. TTAC used by Tempo and the tracking carrier in Directsat's channel 2--Mixing of the tracking carrier in Directsat's channel 2 with the service carrier in channel 2 in the LHC polarized satellite may interfere with the Tempo TTAC telemetry with LHC polarization at 12201-12204 MHz. This is still potentially a problem, even though Directsat's satellite is proposed to move West from Tempo's (118.8° WL to

118.95° WL), because Directsat's uplink and downlink are co-polarized with Tempo's LHC TTAC.

3. Channel 20 used by Directsat interfering with Tempo's channel 22--The potential of Echostar's channel 20 interfering into Tempo's channel 22 is significant if Echostar uses the very high EIRP proposed and licensed. The plan requires this channel also be evaluated.

4. Station-keeping between systems--The coordination that will be required on an on-going basis, necessary between Echostar's operator Loral Skynet. and Tempo's operator GE Americom, will be increased if Directsat's satellite and Tempo's satellite will have overlapping E-W station-keeping deadbands. Echostar and Directsat have indicated to the FCC they will use +/- 0.05° E-W station-keeping. Tempo will use +/- 0.10° E-W station-keeping.

Telesat Canada has made a recent request to place Anik C1 and a future Anik F, or move an existing Anik E series hybrid satellite, to 118.7° WL. The Anik C1 satellite would operate inclined up to 2 degrees N-S (4 degrees peak-to-peak). Inclination of this satellite will require more E-W spacing. Telesat has requested Tempo to use 118.95° WL and Directsat/Echostar to use orbits as far West of this as possible (119.1° and 119.2° WL). It is clear that some isolation from this satellite may be necessary.

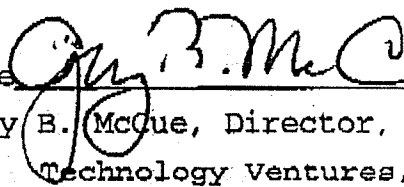
Tempo has designed it's shaped transmit reflectors for 118.8° WL to suppress Siberia and cover Alaska, in accordance to a request from the FCC, fully in accordance with Appendix 30 of the Orb 85 plan. Tempo is uncertain how much movement West

can be made in it's satellite from 118.8° WL for this reason. This complicates the orbital coordination issues between Tempo and Echostar even further.

Summary of the Analysis

Echostar's calculation is not in conformance with the calculation format specified in Appendix 30A (Orb 88) to the ITU regulations. In Appendix 30A, the potential of interference is evaluated on the basis of an OEPM (overall equivalent protection margin) as defined in Annex 3. The calculations provided by Echostar in the Technical Annex filed March 28, 1997 have been shown herein to be inadequate. Additionally, Tempo has shown that other unresolved issues exist that are affected by the orbital locations of USABSS-3 and USABSS-4 as well.

Signature



Date

4/10/97

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