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MAR 27 1998

Federal Communications Commission
Office of Secretary

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of

EchoStar Satellite Corporation
Directsat Corporation
EchoStar DBS Corporation

Application for Authority to Make
Minor Modifications to Direct
Broadcast Satellite Authorizations,
Launch and Operation Authority

EchoStar Satellite Corporation
Directsat Corporation

Application for Special Temporary

File No. DBS-88-01/68-SAT-ML-96/
File No. DBS-88-02/6-SAT-ML-97/
File No. DBS-74-SAT-P/L-96/

File No. 155-SAT-STA-96
File No. 156-SAT-STA-96

MOTION FOR LEAVE TO FILE SUPPLEMENT

TEMPO Satellite Inc. ("TEMPO"), by its attorneys, hereby requests leave, pursuant to Section 1.45(c) of the Commission's Rules, to submit a Supplement ("*Supplement*") regarding its petition to deny, or in the alternative, to hold in abeyance ("*Petition*") the application of EchoStar Satellite Corporation and its subsidiaries Directsat Corporation and EchoStar DBS Corporation (collectively "EchoStar") to modify their direct broadcast satellite ("DBS") systems

(“*Modification Application*”) and TEMPO’s comments on their request for special temporary authority to reduce the spacing between satellites (“*STA Request*”).¹

In the *Modification Application* and *STA Request*, EchoStar seeks authority to modify its authorizations to permit the launch of an additional satellite into the nominal 119° W.L. orbital location and to reposition its existing stations at that slot. TEMPO has argued, however, that EchoStar has not provided any technical details about its plans and has not demonstrated that the proposed operations would not interfere with TEMPO’s system at 119° W.L.

TEMPO has recently learned that EchoStar, without authority from the Commission, apparently is operating its two existing satellites at 119° W.L. outside of their licensed orbits. In particular, the data shows that EchoStar has reversed the order of its two satellites and moved them closer to TEMPO’s station. This unauthorized operation substantially increases the interference into TEMPO and the potential for satellite collision.

These new facts confirm that the Commission should deny the *Modification Application*, and deny the *STA Request* to the extent EchoStar seeks authority to move the “EchoStar 1” satellite east of its specific authorized orbit of 119.2° W.L. Also, as demonstrated in the

¹ See *Petition to Deny or To Hold in Abeyance*, File Nos. DBS-88-01/68-SAT-ML-96, DBS-88-02/6-SAT-ML-9, DBS-74-SAT-P/L-96 (filed Feb. 17, 1998); Letters from TEMPO to Thomas S. Tycz, Chief, Satellite and Radiocommunication Division, FCC File Nos. 155/156-SAT-STA-96 (March 28 and April 10, 1997).

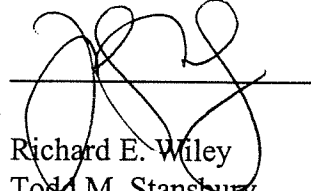
Supplement, the Commission should investigate EchoStar's operations and immediately order EchoStar to return its satellites to positions that eliminate the potential to interfere with TEMPO.

Accordingly, the Commission should grant TEMPO's motion for leave and accept the attached *Supplement*.

Respectfully submitted,

TEMPO SATELLITE, INC.

By:

A handwritten signature in black ink, appearing to be "Richard E. Wiley", written over a horizontal line.

Richard E. Wiley
Todd M. Stansbury
Wiley, Rein & Fielding
1776 K Street, N.W.
Washington, DC 20006-2304
202/828-4948

Its Attorneys

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Application for Special Temporary

File No. DBS-88-01/68-SAT-ML-96/
File No. DBS-88-02/6-SAT-ML-97/
File No. DBS-74-SAT-P/L-96/

File No. 155-SAT-STA-96
File No. 156-SAT-STA-96

SUPPLEMENTAL FILING OF TEMPO SATELLITE, INC.

TEMPO Satellite Inc. ("TEMPO"), by its attorneys, hereby submits this supplemental filing regarding the pending applications of EchoStar Satellite Corporation and its subsidiaries Direcstsat Corporation and EchoStar DBS Corporation (collectively "EchoStar") to modify their direct broadcast satellite ("DBS") systems ("*Modification Application*") and for special temporary authority to reduce the spacing between the satellites ("*STA Request*"). According to data recently made available to TEMPO, EchoStar is operating its two existing satellites at the nominal 119° W.L. slot outside of their authorized locations. In particular, EchoStar apparently

has reversed the order of its two satellites, and reduced the overall spacing between the stations. As a result, the potential for interference and satellite collision has been substantially increased. These apparent moves have been made without authority and in spite of express statements from the Commission that such changes could be detrimental to TEMPO's operations.

The Commission should immediately order EchoStar to cease its unauthorized operations and return the satellites to locations that eliminate the potential to interfere with TEMPO. In light of these new facts, the Commission also should investigate EchoStar's activities and deny its pending requests to make changes to its licensed facilities as discussed herein.

I. EchoStar is Operating Two Existing Satellites at the Nominal 119° W.L. Position Outside of Their Licensed Orbital Slots Without Authority.

TEMPO is licensed to operate a DBS satellite ("TEMPO 1") at 118.8° W.L., using channels 22 through 32.¹ EchoStar is licensed to operate "EchoStar 1" at 119.2° W.L. (odd-numbered channels 1 through 21), and "EchoStar 2" at 118.8° W.L. (even-numbered channels 2 through 20).² Because EchoStar 1 operates, *inter alia*, on channel 21 and TEMPO 1 operates, *inter alia*, on adjacent channel 22, the satellites must maintain orbital spacing of 0.4° as provided in the BSS Plan in order to avoid interference.

¹ See *TEMPO Satellite, Inc.*, 1997 FCC Lexis 954 (Feb. 24, 1997) (granting authority to launch and operate at 118.8° W.L.). The TEMPO 1 satellite is referred to in the attached Engineering Statement as "Tempo 2."

² See *EchoStar Satellite Corp.*, 11 FCC Rcd 3015 (Int'l Bur. 1996) (granting authority to launch to 119.2° W.L.); *Directsat Corporation*, 11 FCC Rcd 10575 (Int'l Bur. 1996) (granting authority to launch to 118.8° W.L.).

In the *Modification Application*, EchoStar proposes to launch a new satellite (“EchoStar 4”), which originally had been authorized and designed to operate at 148° W.L., into 119° W.L. Traffic on EchoStar’s existing satellites at 119° W.L. would then be transferred to EchoStar 4.

TEMPO filed a petition to deny, or in the alternative, to hold the *Modification Application* in abeyance (“*Petition*”). TEMPO identified several substantial unresolved issues concerning how EchoStar proposes to coordinate frequency use and physical co-location of numerous satellites at 119° W.L. In particular, EchoStar has provided scant detail or technical information about how its proposal to launch a fourth satellite into 119° W.L., migrate satellites, and transfer traffic could be accomplished without causing objectionable interference to TEMPO’s operations.³

TEMPO has learned that EchoStar’s two satellites licensed for service at 119° W.L. apparently are operating well outside their authorized parameters. According to information from EchoStar’s satellite operator, Loral Skynet, as of March 11, 1998, EchoStar 1 and 2 were operating at 118.95° W.L. and 119.05° W.L., respectively, instead of their licensed slots at 119.2° W.L. and 118.8° W.L.⁴ To verify these locations, the orbits for EchoStar 1 and 2 were also calculated using data from the Norad Two-Line Element Sets. This analysis, which included a conservative margin of error, confirmed that EchoStar 1 was operating in the same vicinity as TEMPO 1, and EchoStar 2 was *west* of EchoStar 1:

³ *Petition* at 3-5.

⁴ See attached Engineering Statement of Gary McCue, March 27, 1998, at ¶ 5 (“*Engineering Statement*”).

<u>Station</u>	<u>Estimated Orbit</u>	<u>Authorized Orbit</u>	<u>Date of Data (as of)</u>
TEMPO 1:	118.73° W.L. +0.05/-0.00	118.8° W.L.	March 19, 1998
EchoStar 1:	118.78° W.L. +0.05/-0.00	119.2° W.L.	March 20, 1998
EchoStar 2:	119.04° W.L. +0.05/-0.00	118.8° W.L.	March 7, 1998 ⁵

The study also showed that TEMPO 1 has been operated as authorized at 118.8° W.L. +/- 0.1°.⁶

EchoStar has no authority to operate EchoStar 1 and 2 at any positions other than 119.2° W.L. and 118.8° W.L., respectively.⁷ In September 1996, EchoStar requested special temporary authority (“*STA Request*”) to reduce the spacing between EchoStar 1 and EchoStar 2 to 0.1°, with 119.0° W.L. as the mid-point.⁸ However, to TEMPO’s knowledge, the *STA Request* remains pending.⁹ TEMPO supported EchoStar’s request to move EchoStar 2 west of 118.8° W.L. in

⁵ *Id.* at ¶ 6.

⁶ *Id.* at ¶ 7. The EchoStar 1 and 2 satellites may have been operating from unauthorized slots for a substantial period of time. Thus, according to information from Loral Skynet, in March 1997, EchoStar 1 and 2 were operating at 119.05° W.L. and 118.95° W.L., respectively. *Id.* at ¶ 4.

⁷ EchoStar’s ITU Appendix 4 and S4 also represent that EchoStar 1 and 2 would be located at 119.2° W.L. and 118.8° W.L., respectively. *See Engineering Statement* at ¶ 3.

⁸ *Applications of EchoStar Satellite Corporation and Directsat Corporation for Special Temporary Authority*, File Nos. 155-SAT-STA-96 and 156-SAT-STA-96 (Sept. 12, 1996). It is unclear exactly what satellite positions EchoStar requested. The original request appears to propose to operate EchoStar 1 and 2 “at 118.95° W.L. and 119.05° W.L., respectively.” *STA Request* at 1. In its next submission, however, EchoStar reverses these positions and requests to move EchoStar 1 to 119.05° W.L., and EchoStar 2 to 118.95° W.L. *See Letter from EchoStar to Thomas S. Tycz, Chief, Satellite and Radiocommunication Division*, at 1-2 (March 28, 1997). In a subsequent filing, the request is characterized both ways. *See Letter from EchoStar to Thomas Tycz*, at 2 and Technical Annex at 1 (May 21, 1997).

⁹ In March 1996, EchoStar received temporary authority to operate EchoStar 1 at 119.0° W.L. pending the launch of EchoStar 2. *EchoStar Satellite Corporation*, 11 FCC Rcd 5353 (Int’l Bur. 1996). The FCC explicitly conditioned its grant of this STA on EchoStar’s commitment to move EchoStar 1 to 119.2° W.L. immediately upon the launch of EchoStar 2. *Id.* (“EchoStar has stated its intention to cease operations at 119.0° W.L. and move its eastern satellite to 119.2° W.L.

(Continued...)

order to reduce the potential for satellite collision, but opposed the request to move EchoStar 1 any closer to TEMPO 1 because of the need to properly separate adjacent channels.¹⁰

According to the data available to TEMPO, EchoStar 1 and TEMPO 1, which should be separated by 0.4°, are now operating in the same vicinity. This greatly increases the cross-polarized interference from EchoStar 1's channel 21 into TEMPO 1's channel 22.¹¹ Indeed, in a February 1997 letter requesting additional technical analysis from EchoStar to support its still-pending *STA Request*, the Commission stated, "We are concerned that the potential for interference to or from Tempo's assigned channels is increased by moving [EchoStar 1] closer to 118.8° W.L."¹² Despite the lack of authority and the Commission's explicit concern, EchoStar now appears to have moved its satellites as proposed in the pending *STA Request*.¹³

(...Continued)

immediately upon expiration of its STA, and we will make this a further condition of this grant."). Accordingly, both the terms of its license and the Commission's 1996 order require EchoStar 1 to be operated at 119.2° W.L.

¹⁰ See Letter from TEMPO to Thomas S. Tycz, File Nos. 155/156-SAT-STA-96, April 10, 1997.

¹¹ See *id.*

¹² See Letter from Thomas S. Tycz to EchoStar, File Nos. 155/156-SAT-STA-96, Feb. 24, 1997.

¹³ In support of its own request for STA, EchoStar asserts that reducing the spacing between EchoStar 1 and TEMPO 1 would not result in interference. Letters from EchoStar to Thomas S. Tycz, File Nos. 155/156-SAT-STA-96, March 28, 1997, and May 21, 1997. As TEMPO has previously noted, however, this claim is directly inconsistent with EchoStar's own objections to TEMPO's requests for Commission authorizations. See Comments of EchoStar Satellite Corporation, File No. DBS-88-04/93-02MP, (Sept. 30, 1994) at 8, 9-11 (objecting to TEMPO's application for modification of a construction permit arguing that even maintaining 0.4° spacing between satellites could result in interference to EchoStar's system or force more costly station-keeping maneuvers); EchoStar Petition to Deny, FCC File No. 1735-DSE-P/L-96 (Oct. 18, 1996) at 5-6 (objecting to application of TEMPO's then-affiliate, Western Tele-Communications, Inc., for a license to operate a DBS uplink station).

Moreover, EchoStar's maneuvers substantially increase the risk of collision between satellites. The deadbands of the East-West station-keeping of EchoStar 1 and TEMPO 1 apparently overlap.¹⁴ In addition, a Canadian satellite operates at 118.6° W.L. (and a future satellite will be operated at 118.7° W.L.), so that a total of four satellites are now operating in the congested space of less than five-tenths of one degree.¹⁵ In light of EchoStar's current operations, its unspecified plan to launch yet another satellite into 119° W.L. is not consistent with sound engineering practice.¹⁶

II. The Commission Should Require EchoStar to Return Its Satellites to Locations that Eliminate the Risk to TEMPO and Deny Any Further Requests to Modify EchoStar's Facilities

EchoStar's current unauthorized operations substantially increase the interference into TEMPO's system, threaten the physical collision of satellites, and complicate the ability of the parties to successfully operate their respective systems. Accordingly, the Commission should take the following actions:

First, EchoStar should be ordered immediately to return EchoStar 1 to its assigned orbital location of 119.2° W.L. As the Commission has recognized, operating EchoStar 1 less than 0.4 degrees from TEMPO 1 substantially increases the potential for interference. Returning EchoStar 1 to its licensed slot would reduce this threat. The Commission also should monitor EchoStar's actions to ensure that unauthorized operations are not repeated. EchoStar should be required to file periodic reports verifying the precise location of its satellites.

¹⁴ *Engineering Statement* at ¶ 9.d.

¹⁵ *Id.* at ¶¶ 8, 9.d.

¹⁶ *Id.* at ¶ 10.

Second, the Commission should deny the *Modification Application*. EchoStar has not disclosed any details of its plans to launch, test and operate EchoStar 4 at 119° W.L. In particular, EchoStar has not identified what, if any, changes would be made to the satellite which originally was designed for service at the “western” orbital slot of 148° W.L., or how it would coordinate frequencies and physical co-location of a fourth satellite at the 119° W.L. location.¹⁷ EchoStar has not disclosed the timing of the launch, the exact orbital location for the new satellite, whether other satellites may be repositioned, how long all three of EchoStar’s satellites would remain at 119° W.L., and how service would be transitioned to the new satellite.¹⁸ Rather, EchoStar has made only the faint promise to exercise “greatest care” in operating another satellite at some unspecified orbital location in the same area as TEMPO 1.¹⁹ In view of EchoStar’s failure to submit critical details and its present unauthorized operations, EchoStar has not demonstrated how the receipt of further authorizations from the Commission would serve the public interest. Accordingly, the *Modification Application* should be denied.

Finally, the Commission should deny EchoStar’s pending *STA Request* to relocate EchoStar 1 any further east of 119.2° W.L. TEMPO supports, however, EchoStar 2 remaining at 119.05° W.L. or moving further to the west. This action would substantially reduce the difficulty of operating co-located satellites and the risk of harmful interference with TEMPO’s operations.

¹⁷ *Petition* at 3-4. Moreover, coordination of all the U.S. BSS satellites will be complicated by the location of a Canadian satellite currently at 118.6° W.L. and the future satellite at 118.7° W.L. See *Engineering Statement* at ¶ 8, 10.

¹⁸ *Petition* at 4-5.

¹⁹ Opposition of EchoStar Satellite Corporation, File Nos. DBS-88-01/68-SAT-ML-96, 88-02/6-SAT-ML-97, 74-SAT-P/L-96, March 4, 1998, Technical Annex at 1.

III. Conclusion

EchoStar appears to have reversed the operating order of its two satellites, moved them in the direction of TEMPO 1, and relocated EchoStar 1 (with adjacent channel 21) to the same vicinity as TEMPO 1 without authority from the Commission. EchoStar has taken these actions in disregard of the Commission's expressed concern that interference to TEMPO could result. Accordingly, the Commission should order EchoStar to return EchoStar 1 to 119.2° W.L., deny the *Modification Application*, and deny the *STA Request* with respect to the relocation of EchoStar 1 east of its licensed orbit.

Respectfully submitted,

TEMPO SATELLITE, INC.

By: 

Richard E. Wiley
Todd M. Stansbury
Wiley, Rein & Fielding
1776 K Street, N.W.
Washington, DC 20006-2304
202/828-4948

Its Attorneys

March 27, 1998

Engineering Statement of Gary B. McCue

1. I am Director of Satellite Services for TCI Technology Ventures, which provides technical management services for the TEMPO Satellite Inc. (TEMPO) system.
2. The following DBS and communications satellites currently operate with orbital locations in the vicinity of 119° West Longitude (WL):

Tempo 2: operated by TEMPO (USABSS-7)¹
EchoStar 1: operated by EchoStar Satellite Corp. (USABSS-3)
EchoStar 2: operated by Directsat Corp. (USABSS-4)
Anik C1: operated by Telesat Canada

3. The orbit locations assigned to U.S. DBS satellites at 119° WL are:

Tempo 2: 118.8° WL
EchoStar 1: 119.2° WL
EchoStar 2: 118.8° WL

EchoStar confirmed orbits of 119.2° WL for EchoStar 1 and 118.8° WL for EchoStar 2 in its Appendix 4 and S4 filings.

4. In March 1997, Space Systems/Loral (SS/L), TEMPO's satellite contractor, indicated that EchoStar 1 was located at 119.05° WL and EchoStar 2 was located at 118.95° WL. See Attachment 1. This was based on information provided from EchoStar's satellite operator, Loral Skynet.
5. On March 11, 1998, I was informed by SS/L that the EchoStar satellites had changed orbital locations: EchoStar 2 was located at 119.05° WL and EchoStar 1 was located at 118.95° WL. This is the opposite arrangement to that in effect in paragraph 4 above. This was based on information obtained from Loral Skynet. See Attachment 2.

¹ As referred to by Space Systems/Loral and others in the attachments, TEMPO, TEMPO 2, TEMPO FM2 or flight model 2, may be used interchangeably with TEMPO or TEMPO 1 for purposes of the satellite launched on March 8, 1997 and operated at 118.8° W.L.

6. In order to confirm the locations noted in 5 above, Tempo requested that SS/L calculate the orbit longitudes of EchoStar 1, EchoStar 2, Tempo 2 and Anik C1. Attachment 3 is the calculated positions of EchoStar 1, EchoStar 2, Tempo 2 and Anik C1. This was provided by SS/L using the Norad Two-Line Element Sets for the satellites as of March 7, 1998 for EchoStar 2, March 19, 1998 for Tempo 2, March 20, 1998 for EchoStar 1, and March 23, 1998 for Anik C1. See Attachment 3. SS/L confirmed that it calculated the orbital locations using the same model as the source for the Norad Two-Line Element Sets, so that no computational errors are created. See Attachment 4.

7. The Norad Two-Line Element Sets are the U.S. Government's data. To estimate the accuracy of the Norad Two-Line Element Sets, a comparison was made to the actual ephemeris data of TEMPO 2, believed by SS/L to be very accurate. Using SS/L's Orbit Initial Conditions Program, Tempo elements from flight software and Norad Two-Line Elements from March 14, 1998 were propagated ahead to a common epoch of 00.00.00 hours UT on March 20, 1998. The Norad 2-Line Element longitude result was 118.715° WL with the Tempo ephemeris longitude result 118.7270° WL, an error of 0.012° east. To be conservative, an amount of 0.05° could be added to the results presented in Attachment 3 for the other satellites in paragraph 9.

8. I have been informed by Telesat Canada that as of March 19, 1998, the Anik C1 satellite was located at approximately 118.6° WL. The Anik C1 satellite is located at 118.6° WL on a temporary basis. See Attachment 5. The future Anik F satellite is assigned 118.7° WL. See Attachment 6.

9. Based upon the discussions with and calculations by SS/L, according to the Norad Two-Line Element Sets data, as adjusted above:

a. EchoStar 1, which is authorized to operate at 119.2° WL, was located at approximately 118.78° WL $+0.05/-0.00$ as of March 20, 1998, with diurnal motion of approximately $\pm 0.05^{\circ}$. As Tempo has previously stated, any orbit closer to the east than 119.2° WL for EchoStar 1 will increase interference into Tempo 2.

b. EchoStar 2, which is authorized to operate at 118.8° WL, was located at approximately 119.04° WL $+0.05/-0.00$ as of March 7, 1998, with diurnal motion of approximately $\pm 0.025^{\circ}$. To reduce the potential for

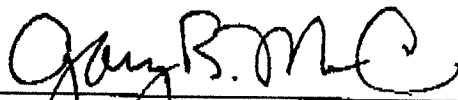
satellite collision, Tempo has previously stated that it has no objection to EchoStar 2 using an orbit west of 118.8° WL.

c. Tempo 2 has remained at its assigned orbit of 118.8° WL with +/- 0.1° E-W station-keeping. The adjusted Norad Two-Line Elements for March 19, 1998 would place Tempo 2 at 118.73° WL +0.05/-0.00 with diurnal motion of approximately +/- 0.045°. As of March 23, 1998, Anik C1 was located at approximately 118.55° WL +0.05/-0.00 with diurnal motion of approximately +/- 0.034°.

d. The calculated positions of EchoStar 2, Tempo 2, and Anik C1 are very close to the positions stated by the operator. In the case of EchoStar 1, it is calculated in an orbit east of that stated by at least 0.12°. It also has a calculated diurnal motion of +/- 0.05° East-West of that position. If the calculated orbit for EchoStar 1 is accurate, a potential of collision exists with Tempo 2, since the deadbands of the East-West station-keeping of these satellites overlap.

10. It is my opinion that the present proximity of TEMPO 2, EchoStar 1, EchoStar 2 and Anik C1, as shown by the SS/L calculations, is not consistent with reasonable engineering practices. EchoStar's proposal to place a fifth satellite, EchoStar 4, in the vicinity of 119° WL appears to be simply risky. To avoid the potential for physical collision and interference, EchoStar should immediately relocate EchoStar 1 to 119.2° WL, and maintain EchoStar 2 at 119.05° WL or any point further west. Also, consideration should be given to the location of Anik C1 and the future Anik F satellite.

The foregoing is true and correct to the best of my knowledge, information and belief.



Gary B. McCue

Date: March 27, 1998

CERTIFICATE OF SERVICE

I, Audrey M. Williams, hereby certify that on this 27th day of March, 1998, I caused copies of the foregoing Motion for Leave to File Supplement to be sent via first class mail to the following:

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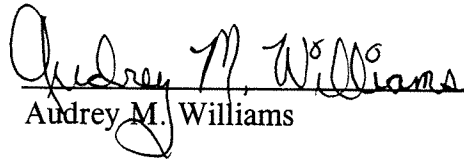
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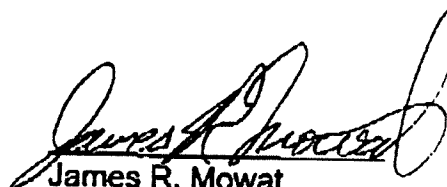
SPACE SYSTEMS/LORAL18 March 1997
3UM050-JRM-97-005

To: Ron Haymore
From: : Jim Mowat, Tempo Payload System Engineering
Subject: : Conversation with Loral Skynet regarding Echostar Locations

The following summarizes details of a telephone conversation with Marty Speckhardt (phone number 717 226-6641), Manager of Spacecraft Operations at the Loral Skynet site at Hawley Pennsylvania on March 18, 1997. Loral Skynet is the operator of the Echostar spacecraft TT&C system. Mr. Speckhardt stated that the Echostar 1 spacecraft is located at 119.05 degrees west and the Echostar 2 spacecraft is located at 118.95 degrees west longitude and each is contained within a +/- 0.05 degree box. He also told us that he is the Loral Skynet contact for matters regarding Echostar and that Karl Jessinghaus is the Echostar Corp contact for similar matters at phone number 307 633-5227 in Cheyenne, Wyoming. The console in Cheyenne is 307 633-5263.

We told Mr. Speckhardt that we would be moving Tempo to 118.8° W around mid-April would be testing it using transponder channels 22-32 only from that location.

Please call me at 415 852-4611 if you have any questions or concerns.



James R. Mowat
TEMPO System Engineering

SPACE SYSTEMS/LORAL

To: G. McCue, TCI

From: Tim Cole

Subject: Orbit Locations

11 March 1998

Per telephone conversation with Marty Speckhardt of Loral/Skynet
the Echostar 1 satellite is located at 118.95 deg. The
Echostar 2 satellite is located at 119.05 deg.
Per Mike Sato, LTO OA, Tempo2 is located at 118.80 degrees.

Tim Cole, LTO FD

cc. Jim Baxley

Mike Rubin

3/25/98

To: Gary McCue, Fax # (719)-488-1258
 From: Fred Emmenegger, SS/L, Phone (650)-852-4070
 Fax (650)-852-4666
 cc: Mike Rubin, Gene Williams
 Subject: NORAD Element Conversion

The current NORAD 2-line elements for Tempo 2, Echostar 1/2, and Anik C1 were downloaded from the Internet, and are reproduced below. They have been converted to the osculating elements shown on the following pages, then propagated for +/- 24 hours, with display at 3-hr intervals.

NORAD 2-Line Elements (from set # 166):

										Epoch Date
NAHUEL I1 (ANIK C1)										
1	15642U	85028B	98082.38808463	-.00000017	00000-0	10000-3	0	8327		
2	15642	0.8109	95.5491	0003235	271.6423	194.6286	1.00275838	53197	3/23	
ECHOSTAR 1										
1	23754U	95073A	98079.78801479	-.00000012	00000-0	10000-3	0	2544		
2	23754	0.0040	183.9036	0004186	162.6540	356.4385	1.00274641	8018	3/20	
ECHOSTAR 2										
1	24313U	96055A	98066.23969212	-.00000029	00000-0	10000-3	0	1607		
2	24313	0.0291	267.7477	0001843	86.0314	138.1875	1.00273966	5513	3/07	
TEMPO 2										
1	24748U	97011A	98078.83774749	-.00000011	00000-0	10000-3	0	1904		
2	24748	0.0065	283.2349	0004437	64.7023	12.0619	1.00275451	3882	3/19	

SATELLITE SUMMARY - KEPLERIAN ELEMENTS

ID	EPOCH	A	E	INC	RAAN	ARGP	MA
1	ANIK 82/09:18:50.5	42164.67	.000283	.813	93.788	271.540	196.503
2	ECH1 79/18:54:44.5	42165.01	.000454	.021	188.593	157.509	356.905
3	ECH2 66/05:45:09.4	42165.20	.000157	.025	312.594	50.224	129.159
4	TEMP 78/20:06:21.4	42164.78	.000478	.009	353.647	355.079	11.283

*** SATELLITE 1 (ANIK C1) STATE AT EPOCH ***

Epoch Date	= 23 MAR 98	GPS Date	= 23 MAR 98
Universal Time	= 09:18:50.512	GPS Time	= 09:19:02.512
NORAD Epoch Time	= 98082.3880846	GPS Week	= 950
Greenwich Hr Angle	= 320.374 deg	GPS Time of Week	= 119942.51 sec
Semimajor Axis	= 42164.67 km	X	= -39149.81 km
Eccentricity	= .000283	Y	= -15677.81 km
Inclination	= .813 deg	Z	= 568.85 km
R.A. of Asc Node	= 93.788 deg	Xdot	= 1.14276 km/s
Argument of Perigee	= 271.540 deg	Ydot	= -2.85346 km/s
True Anomaly	= 196.494 deg	Zdot	= -.01350 km/s
Mean Anomaly	= 196.503 deg	Period	= 1436.093 min
Eccentric Anomaly	= 196.499 deg	Lon of Asc Node	= 133.414 degE
Perigee Radius	= 42152.73 km	Arg of Latitude	= 108.034 deg
Apogee Radius	= 42176.61 km	Geodetic Latitude	= .774 degN
Perigee Altitude	= 35774.60 km	Longitude	= -118.550 degE
Apogee Altitude	= 35798.47 km	Radius	= 42176.12 km
Mean Motion	= 1.00272 revs/day		

*** SATELLITE 2 (ECHOSTAR 1) STATE AT EPOCH ***

Epoch Date	= 20 MAR 98	GPS Date	= 20 MAR 98
Universal Time	= 18:54:44.478	GPS Time	= 18:54:56.478
NORAD Epoch Time	= 98079.7880148	GPS Week	= 949
Greenwich Hr Angle	= 101.786 deg	GPS Time of Week	= 500096.48 sec
Semimajor Axis	= 42165.01 km	X	= 40305.07 km
Eccentricity	= .000454	Y	= -12319.77 km
Inclination	= .021 deg	Z	= 6.65 km
R.A. of Asc Node	= 188.593 deg	Xdot	= .89909 km/s
Argument of Perigee	= 157.509 deg	Ydot	= 2.94170 km/s
True Anomaly	= 356.902 deg	Zdot	= -.00101 km/s
Mean Anomaly	= 356.905 deg	Period	= 1436.111 min
Eccentric Anomaly	= 356.903 deg	Lon of Asc Node	= 86.807 degE
Perigee Radius	= 42145.85 km	Arg of Latitude	= 154.411 deg
Apogee Radius	= 42184.16 km	Geodetic Latitude	= .009 degN
Perigee Altitude	= 35767.71 km	Longitude	= -118.782 degE
Apogee Altitude	= 35806.02 km	Radius	= 42145.88 km
Mean Motion	= 1.00271 revs/day		

*** SATELLITE 3 (ECHOSTAR 2) STATE AT EPOCH ***

Epoch Date	= 7 MAR 98	GPS Date	= 7 MAR 98
Universal Time	= 05:45:09.399	GPS Time	= 05:45:21.399
NORAD Epoch Time	= 98066.2396921	GPS Week	= 947
Greenwich Hr Angle	= 251.036 deg	GPS Time of Week	= 539121.40 sec
Semimajor Axis	= 42165.20 km	X	= -28211.80 km
Eccentricity	= .000157	Y	= 31342.49 km
Inclination	= .025 deg	Z	= .19 km
R.A. of Asc Node	= 312.594 deg	Xdot	= -2.28524 km/s
Argument of Perigee	= 50.224 deg	Ydot	= -2.05647 km/s
True Anomaly	= 129.173 deg	Zdot	= -.00133 km/s
Mean Anomaly	= 129.159 deg	Period	= 1436.120 min
Eccentric Anomaly	= 129.166 deg	Lon of Asc Node	= 61.558 degE
Perigee Radius	= 42158.56 km	Arg of Latitude	= 179.397 deg
Apogee Radius	= 42171.83 km	Geodetic Latitude	= .000 degN
Perigee Altitude	= 35780.42 km	Longitude	= -119.045 degE
Apogee Altitude	= 35793.69 km	Radius	= 42169.39 km
Mean Motion	= 1.00270 revs/day		

*** SATELLITE 4 (TEMPO 2) STATE AT EPOCH ***

Epoch Date	= 19 MAR 98	GPS Date	= 19 MAR 98
Universal Time	= 20:06:21.383	GPS Time	= 20:06:33.383
NORAD Epoch Time	= 98078.8377475	GPS Week	= 949
Greenwich Hr Angle	= 118.753 deg	GPS Time of Week	= 417993.38 sec
Semimajor Axis	= 42164.78 km	X	= 42144.99 km
Eccentricity	= .000478	Y	= 14.77 km
Inclination	= .009 deg	Z	= .72 km
R.A. of Asc Node	= 353.647 deg	Xdot	= -.00079 km/s
Argument of Perigee	= 355.079 deg	Ydot	= 3.07608 km/s
True Anomaly	= 11.294 deg	Zdot	= .00047 km/s
Mean Anomaly	= 11.283 deg	Period	= 1436.099 min
Eccentric Anomaly	= 11.288 deg	Lon of Asc Node	= 234.894 degE
Perigee Radius	= 42144.60 km	Arg of Latitude	= 6.373 deg
Apogee Radius	= 42184.95 km	Geodetic Latitude	= .001 degN
Perigee Altitude	= 35766.47 km	Longitude	= -118.733 degE
Apogee Altitude	= 35806.82 km	Radius	= 42144.99 km
Mean Motion	= 1.00272 revs/day		

EAST-WEST MOTION OF ANIK C1

*** INITIAL VEHICLE STATE ***

EPOCH DATE	= 23 MAR 98	SEMI-MAJOR AXIS	= 42164.67 KM	X	= -39149.93 KM
UNIVERSAL TIME	= 09:18:51	ECCENTRICITY	= .000283	Y	= -15677.48 KM
SATELLITE LOCAL TIME	= 1.299 HR	INCLINATION	= .813 DEG	Z	= 569.04 KM
SIMULATION START TIME	= .00 MIN	ARGUMENT OF PERIGEE	= 271.540 DEG	XDOT	= 1.14273 KM/S
GREENWICH HOUR ANGLE	= 320.38 DEG	R.A. OF ASC NODE	= 93.788 DEG	YDOT	= -2.85347 KM/S
SUN RIGHT ASCENSION	= 2.34 DEG	TRUE ANOMALY	= 196.494 DEG	ZDOT	= -.01351 KM/S
SUN DECLINATION	= 1.01 DEG	MEAN ANOMALY	= 196.503 DEG	PERIOD	= 1436.093 MIN
INITIAL REV NUMBER	= 0	ECCENTRIC ANOMALY	= 196.498 DEG	LONGITUDE OF ASC NODE	= 133.412 DEG
LAST ASCENDING NODE	= 0	APOGEE RADIUS	= 42176.60 KM	ARGUMENT OF LATITUDE	= 108.034 DEG
LAST DESCENDING NODE	= 0	PERIGEE RADIUS	= 42152.74 KM	GEODETIC LATITUDE	= .774 DEGN
LAST APOGEE	= 0	APOGEE ALTITUDE	= 35798.47 KM	LONGITUDE	= -118.552 DEGE
LAST PERIGEE	= 0	PERIGEE ALTITUDE	= 35774.60 KM	RADIUS	= 42176.11 KM

VEHICLE STATE HISTORY

TIME (MIN)	TRUE ANOMALY (DEG)	RADIUS (KM)	ALTITUDE (KM)	VELOCITY (M/S)	EARTH DIAMETER (DEG)	SUB-SATELLITE LAT (DEG-N)	LONG (DEG-E)
.00	196.494	42176.11	35797.98	3073.81	17.396	.774	-118.552
179.50	246.618	42169.75	35791.61	3074.27	17.399	.369	-118.571
359.00	297.701	42159.45	35781.31	3075.07	17.403	-.252	-118.576
538.50	342.938	42152.59	35774.46	3075.57	17.406	-.726	-118.557
718.00	24.884	42153.23	35775.10	3075.47	17.406	-.775	-118.527
897.50	65.015	42159.66	35781.52	3075.00	17.403	-.370	-118.509
1077.00	102.734	42167.92	35789.78	3074.44	17.399	-.252	-118.512
1256.50	145.661	42174.35	35796.21	3073.99	17.397	-.727	-118.527
1436.00	194.232	42175.67	35797.54	3073.85	17.396	-.776	-118.546
-00	196.494	42176.11	35797.98	3073.81	17.396	.774	-118.552
-179.50	146.628	42174.91	35796.77	3073.94	17.397	.726	-118.531
-359.00	100.693	42167.88	35789.74	3074.45	17.399	.253	-118.516
-538.50	60.788	42159.16	35781.02	3075.05	17.403	-.368	-118.514
-718.00	21.588	42153.02	35774.89	3075.49	17.406	-.773	-118.533
-897.50	341.531	42152.79	35774.65	3075.54	17.406	-.725	-118.562
-1077.00	299.147	42159.40	35781.26	3075.08	17.403	-.252	-118.581
-1256.50	250.318	42169.51	35791.37	3074.31	17.399	.367	-118.577
-1436.00	199.558	42176.33	35798.20	3073.79	17.396	.771	-118.558

EAST-WEST MOTION OF ECHOSTAR 1

*** INITIAL VEHICLE STATE ***

EPOCH DATE	= 20 MAR 98	SEMIMAJOR AXIS	= 42165.01 KM	X	= 40305.22 KM
UNIVERSAL TIME	= 18:54:44	ECCENTRICITY	= .000454	Y	= -12319.32 KM
SATELLITE LOCAL TIME	= 10.869 HR	INCLINATION	= .021 DEG	Z	= 6.67 KM
SIMULATION START TIME	= .00 MIN	ARGUMENT OF PERIGEE	= 157.509 DEG	XDOT	= .89906 KM/
GREENWICH HOUR ANGLE	= 101.78 DEG	R.A. OF ASC NODE	= 188.593 DEG	YDOT	= 2.94170 KM/
SUN RIGHT ASCENSION	= 359.97 DEG	TRUE ANOMALY	= 356.905 DEG	ZDOT	= -.00102 KM/
SUN DECLINATION	= -.01 DEG	MEAN ANOMALY	= 356.904 DEG	PERIOD	= 1436.111 MIN
INITIAL REV NUMBER	= 0	ECCENTRIC ANOMALY	= 356.904 DEG	LONGITUDE OF ASC NODE	= 86.809 DEG
LAST ASCENDING NODE	= 0	PERIGEE RADIUS	= 42184.15 KM	ARGUMENT OF LATITUDE	= 154.411 DEG
LAST DESCENDING NODE	= 0	APOGEE RADIUS	= 42145.87 KM	GEODETIC LATITUDE	= .009 DEG
LAST APOGEE	= 0	APOGES ALTITUDE	= 35806.01 KM	LONGITUDE	= -118.780 DEG
LAST PERIGEE	= 0	PERIGEE ALTITUDE	= 35767.73 KM	RADIUS	= 42145.90 KM

VEHICLE STATE HISTORY

TIME (MIN)	TRUE ANOMALY (DEG)	RADIUS (KM)	ALTITUDE (KM)	VELOCITY (M/S)	EARTH DIAMETER (DEG)	SUB-SATELLITE LAT (DEG-N)	LONG (DEG-E)
.00	356.902	42145.89	35767.76	3076.02	17.409	.009	-118.780
179.50	38.287	42150.35	35772.21	3075.72	17.407	-.007	-118.743
359.00	81.165	42162.94	35784.80	3074.81	17.401	-.019	-118.725
538.50	127.163	42176.64	35798.50	3073.81	17.396	-.019	-118.737
718.00	175.424	42183.29	35805.16	3073.30	17.393	-.008	-118.772
897.50	223.977	42178.54	35800.41	3073.65	17.395	.008	-118.809
1077.00	272.105	42165.14	35787.01	3074.65	17.401	.019	-118.826
1256.50	316.717	42151.63	35773.49	3075.64	17.406	.018	-118.811
1436.00	358.475	42145.94	35767.80	3076.03	17.409	.007	-118.776
.00	356.902	42145.89	35767.76	3076.02	17.409	.009	-118.780
-179.50	315.839	42151.79	35773.65	3075.61	17.406	.020	-118.815
-359.00	273.224	42165.04	35786.90	3074.67	17.401	.018	-118.829
-538.50	226.079	42178.45	35800.30	3073.67	17.395	.006	-118.813
-718.00	177.254	42183.66	35805.52	3073.27	17.393	-.010	241.225*
-897.50	128.639	42177.16	35799.02	3073.76	17.396	-.021	241.261*
-1077.00	81.389	42163.00	35784.86	3074.81	17.401	-.018	241.273*
-1256.50	37.361	42150.01	35771.87	3075.75	17.407	-.005	241.255*
-1436.00	355.536	42145.71	35767.57	3076.04	17.409	.011	241.217*

* Subtract from 360 for W. Longitude

EAST-WEST MOTION OF ECHOSTAR 2

*** INITIAL VEHICLE STATE ***

EPCCE DATE	= 7 MAR 98	SEMIMAJOR AXIS	= 42165.20 KM	X	= -28211.87 KM
UNIVERSAL TIME	= 05:45:09	ECCENTRICITY	= .000157	Y	= 31342.41 KM
SATELLITE LOCAL TIME	= 21.630 HR	INCLINATION	= .025 DEG	Z	= .19 KM
SIMULATION START TIME	= .00 MIN	ARGUMENT OF PERIGEE	= 50.224 DEG	XDOT	= -2.28524 KM/
GREENWICH HOUR ANGLE	= 251.03 DEG	R.A. OF ASC NODE	= 312.594 DEG	YDOT	= -2.05648 KM/
SUN RIGHT ASCENSION	= 347.54 DEG	TRUE ANOMALY	= 129.173 DEG	ZDOT	= -.00134 KM/
SUN DECLINATION	= -5.34 DEG	MEAN ANOMALY	= 129.159 DEG	PERIOD	= 1436.120 MIN
INITIAL REV NUMBER	= 0	ECCENTRIC ANOMALY	= 129.166 DEG	LONGITUDE OF ASC NODE	= 61.560 DEG
LAST ASCENDING NODE	= 0	APOGEE RADIUS	= 42171.62 KM	ARGUMENT OF LATITUDE	= 179.397 DEG
LAST DESCENDING NODE	= 0	PERIGEE RADIUS	= 42158.58 KM	GEODETTIC LATITUDE	= .000 DEG
LAST APOGEE	= 0	APOGEE ALTITUDE	= 35793.68 KM	LONGITUDE	= -119.043 DEG
LAST PERIGEE	= 0	PERIGEE ALTITUDE	= 35780.44 KM	RADIUS	= 42169.38 KM

VEHICLE STATE HISTORY

TIME (MIN)	TRUE ANOMALY (DEG)	RADIUS (KM)	ALTITUDE (KM)	VELOCITY (M/S)	EARTH DIAMETER (DEG)	SUB-SATELLITE LAT (DEG-N)	LONG (DEG-E)
.00	129.173	42169.38	35791.24	3074.32	17.399	.000	-119.043
179.50	183.843	42171.42	35793.28	3074.13	17.398	-.017	-119.057
359.00	237.088	42168.42	35790.28	3074.35	17.399	-.025	-119.070
538.50	288.373	42161.95	35783.81	3074.85	17.402	-.018	-119.073
718.00	333.710	42156.55	35778.41	3075.26	17.404	-.001	-119.061
897.50	14.797	42155.79	35777.66	3075.28	17.404	.016	-119.043
1077.00	54.350	42159.34	35781.20	3075.00	17.403	.023	-119.028
1256.50	87.383	42164.46	35786.32	3074.66	17.401	.017	-119.023
1436.00	126.200	42169.14	35791.00	3074.35	17.399	.001	-119.028
.00	129.173	42169.38	35791.24	3074.32	17.399	.000	-119.043
-179.50	84.106	42164.43	35786.29	3074.68	17.401	.018	-119.038
-359.00	50.180	42159.40	35781.27	3075.01	17.403	.026	-119.043
-538.50	13.821	42156.25	35778.11	3075.24	17.404	.019	-119.057
-718.00	335.056	42156.91	35778.77	3075.22	17.404	.000	-119.074
-897.50	292.522	42161.75	35783.61	3074.87	17.402	-.019	-119.086
-1077.00	243.078	42167.96	35789.83	3074.39	17.399	-.027	-119.085
-1256.50	189.275	42171.36	35793.21	3074.14	17.398	-.020	240.928*
-1436.00	134.006	42169.68	35791.54	3074.28	17.399	-.001	240.942*

* Subtract from 360 for W. Longitude

EAST-WEST MOTION OF TEMPO 2

*** INITIAL VEHICLE STATE ***

EPOCH DATE	= 19 MAR 98	SEMIMAJOR AXIS	= 42164.78 KM	X	= 42145.01 KM
UNIVERSAL TIME	= 20:06:21	ECCENTRICITY	= .000478	Y	= 14.51 KM
SATELLITE LOCAL TIME	= 12.061 HR	INCLINATION	= .009 DEG	Z	= .73 KM
SIMULATION START TIME	= .00 MIN	ARGUMENT OF PERIGEE	= 355.079 DEG	XDOT	= -.00077 KM/
GREENWICH HOUR ANGLE	= 118.75 DEG	R.A. OF ASC NODE	= 353.647 DEG	YDOT	= 3.07608 KM/
SUN RIGHT ASCENSION	= 359.10 DEG	TRUE ANOMALY	= 11.294 DEG	ZDOT	= .00048 KM/
SUN DECLINATION	= -.39 DEG	MEAN ANOMALY	= 11.283 DEG	PERIOD	= 1436.099 MIN
INITIAL REV NUMBER	= 0	ECCENTRIC ANOMALY	= 11.288 DEG	LONGITUDE OF ASC NODE	= 234.896 DEG
LAST ASCENDING NODE	= 0	APOGEE RADIUS	= 42184.93 KM	ARGUMENT OF LATITUDE	= 6.373 DEG
LAST DESCENDING NODE	= 0	PERIGEE RADIUS	= 42144.63 KM	GEODETIC LATITUDE	= .001 DEG
LAST APOGEE	= 0	APOGEE ALTITUDE	= 35806.80 KM	LONGITUDE	= -118.732 DEG
LAST PERIGEE	= 0	PERIGEE ALTITUDE	= 35766.49 KM	RADIUS	= 42145.02 KM

VEHICLE STATE HISTORY

TIME (MIN)	TRUE ANOMALY (DEG)	RADIUS (KM)	ALTITUDE (KM)	VELOCITY (M/S)	EARTH DIAMETER (DEG)	SUB-SATELLITE LAT (DEG-N)	LONG (DEG-E)
.00	11.294	42145.02	35766.88	3076.08	17.409	.001	-118.732
179.50	53.714	42153.37	35775.23	3075.49	17.405	.007	-118.697
359.00	99.039	42168.24	35790.11	3074.40	17.399	.009	-118.689
538.50	146.991	42180.69	35802.55	3073.47	17.394	.006	-118.712
718.00	195.645	42182.90	35804.76	3073.31	17.393	.000	-118.752
897.50	244.182	42173.58	35795.44	3074.02	17.397	-.007	-118.783
1077.00	289.651	42158.85	35780.71	3075.09	17.403	-.010	-118.787
1256.50	331.279	42147.45	35769.30	3075.90	17.408	-.008	-118.761
1436.00	12.517	42145.32	35767.18	3076.05	17.409	-.001	-118.721
.00	11.294	42145.02	35766.88	3076.08	17.409	.001	-118.732
-179.50	329.815	42147.49	35769.36	3075.88	17.408	-.006	-118.772
-359.00	289.052	42158.94	35780.80	3075.08	17.403	-.009	-118.797
-538.50	245.551	42173.45	35795.31	3074.04	17.397	-.008	-118.793
-718.00	197.503	42182.99	35804.86	3073.31	17.393	-.002	241.238*
-897.50	148.899	42181.21	35803.07	3073.43	17.394	.004	241.278*
-1077.00	100.480	42168.66	35790.52	3074.36	17.399	.009	241.302*
-1256.50	53.953	42153.25	35775.11	3075.51	17.406	.008	241.294*
-1436.00	10.682	42144.64	35766.50	3076.12	17.409	.003	241.259*

* Subtract from 360 for W. Longitude

SPACE SYSTEMS/LORAL
3825 Fabian Way, M/S PS-1
Palo Alto CA 94303-4604
Phone: 650-852-7259
Fax: 650-852-7508 *****Please note new fax number *****

TEMPO Program Office

Facsimile Transmittal Sheet

DATE: 3/19/98 SUBJECT: Orbit analysis

FROM: Mike Rubin Total Pages + this page: 1

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TO: Gary McCue 303-486-3813 FAX: 303-486-3890

CC: TCI file FAX: _____

Message:

Gary,

Our orbits analysis department reports that they use the same orbital modeling software that Norad uses to generate its ephemeris data. This being the case, when the Norad data is reanalyzed to give an orbital location, no computational errors are introduced.

M. D. Rubin

PLEASE CALL 650-852-7259 IF YOU DO NOT RECEIVE ANY OF THE FOLLOWING PAGES



Call Report

Gary McCue TCI 3/19/98

Conversation with Al Smalley regarding location of Anik satellites and future coordination requirements with Telesat Canada.

1. Anik C1 is currently located at 118.6° WL. The East-West deadband is $\pm 0.1^{\circ}$ station-keeping. Anik C1 is temporary, it is being operated without N-S station-keeping in inclined mode. There is no problem with Tempo since it's orbit of 118.8° WL and 118.6° WL for Anik C1, both with $\pm 0.1^{\circ}$ E-W, will not overlap.

Telesat's position on Anik F remains the same as the previous discussions with Al, as defined in letter dated April 4, 1997 with Anik F being located at 118.7° WL, with two exceptions:

1) Al specified that Anik F would not be expected for some years, perhaps 2005, and 2) it would use 0.05° E-W station-keeping.

FACSIMILE COVER SHEET

To: Gary McCue
 Company: TCI
 FAX No: (303) 486 - 3890

From: Al Smalley

Message: Gary,

Further to a number of recent discussions on coordination of a DBS satellite at 119°W and Anik satellites at 118.7°W, the attached notes are a summary of our views.

Regards,

Date: April 4, 1997 Time: _____

Operator: _____ Ext: _____

Number of Pages (including cover sheet): 2

Please call (613) 748-0123 if any problems should occur during the transmission or reception of any document coming from Telesat.

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 1601 Telesat Court
 Gloucester, Ontario
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 Fax 613-748-8712
 Telex 053-4184
 Internet a.smalley@telesat.ca

- A Telesat Anik satellite has been assigned to the 118.7°W position as part of the trilateral agreement
- Telesat plans to bring Anik C1 into service at this orbital location within a few weeks. This satellite operates in the Ku-band and has a projected life of about three years.
- Telesat plans to operate a new Anik F series satellite at the 118.7°W position within about 2 years. This will be a dual band (C and Ku) satellite
- To ensure that there is no possibility of physical interaction between the satellites, Telesat would suggest that the most easterly DBS satellite be assigned to a nominal position no closer than 118.95°W
- The Echostar satellites use telemetry and command frequency assignments in the C-band. In order to minimize any potential coordination difficulties it would be preferable to have as much separation as possible between these satellites and the Anik F satellite which will be located at 118.7°W.