KELLEY DRYE & WARREN LLP
A LIMITED LIABILITY PARTNERSHIP INCLUDING PROFESSIONAL ASSOCIATIONS
1200 19TH STREET, N.W.
SUITE 500
WASHINGTON, D.C. 20036
(202) 955-9600

NEW YORK, NY
LOS ANGELES, CA
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CHICAGO, IL
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PARSIPPANY, NJ

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FEDERAL COMMUNICATIONS COMMISSION
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April 14, 1999

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
The Portals
445 - 12th Street, S.W.
Washington, DC 20554

Re: EMS Technologies, Inc. Reply Comment/ET Docket No. 98-206

Dear Ms. Salas:

Please find attached an original and 8 copies of the above referenced filing. Also attached is a diskette labeled EMS Technologies, Inc. – Reply Comment.

Please date stamp the duplicate copy and return it to me in the enclosed envelope.

Please contact the undersigned counsel if there are questions or problems.

Respectfully submitted,

EMS TECHNOLOGIES, INC.

By: J M Griffin
Joan M. Griffin
Its Attorney

cc: International Transcription Service, Inc.

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range	)	**ET Docket No. 98-206**
	)	**RM-9147**
	)	**RM-9245**
	)	
	)	
and	)	
	)	
Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licensees and Their Affiliates	)	

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REPLY COMMENTS OF EMS TECHNOLOGIES, INC.

EMS Technologies, Inc. ("EMS"), by its attorneys, hereby submits these Reply Comments in accordance with the Commission's Notice of Proposed Rulemaking ("Notice") in the proceeding that is captioned above.[1] In this proceeding, the Commission is considering the rules and policies that will govern non-geostationary satellite orbit ("NGSO") fixed-satellite service ("FSS") operations in the Ku-band.

I. Interest of EMS

Founded in 1968, EMS is a company headquartered in Norcross, Georgia with over 1600 employees located both in Canada and the U.S. EMS designs, manufactures, and markets products that are used in a wide range of wireless communications

[1] FCC 98-210, rel. Nov. 24, 1998. By Order released February 5, 1999 (DA 99-284), the Commission extended the date for filing reply comments to March 29, 1999.

applications. EMS' Space and Electronics Group serves the markets for satellite communications, radar, and other specialized applications. Among other things, the Group supplies both flight hardware and earth-based terminals in support of satellite communications. EMS' Wireless Products Group provides wireless networks and systems integration for logistics and healthcare, as well as wireless infrastructure products for public and private communications. In addition, EMS holds an ownership interest in SkyBridge Limited Partnership, one of the applicants for a Ku-band NGSO FSS satellite system. As such, EMS has a direct and vital interest in this proceeding.

EMS is uniquely qualified to comment on the Commission's proposals as set forth in the Notice. Its Space and Electronics Group includes Montreal-based operations (formerly the Space Products Division of Spar Aerospace Limited) that have been a full member of the ITU Radio Sector ("ITU-R") for over 20 years, and have been actively involved in various ITU proceedings, including WRC-97. As a result, EMS' experience includes responsibility for developing many ITU-R Recommendations, including Recommendation ITU-R S.672-4, *Satellite antenna radiation pattern for use as a design objective in the fixed-satellite service employing geostationary satellites.* EMS is an active member of Joint Task Group ("JTG") 4-9-11 and its personnel have prepared a number of papers contributed to this group, such as JTG 4-9-11/134, *NGSO Interference into GSO Earth Stations in the Ku-band Fixed Satellite Service.*

II. Adoption of Rules and Policies that Reflect JTG 4-9-11's Consensus Conclusions and that Require Satellite Diversity and Global Coverage Will Serve the Public Interest By Fostering the Deployment of Broadband Capability Worldwide.

This proceeding affords the Commission an excellent opportunity to promote the deployment of advanced telecommunications services to the ultimate benefit of U.S. business and consumers and in fulfillment of its obligations under Section 706 of the 1996 Act.[2] Section 706 requires the FCC to ensure that high-speed, interactive broadband services are made available to all Americans. While the Commission recently found in its *Section 706 Report* that the deployment of broadband capability to date is reasonable and timely given that the consumer broadband market is "in the early stages of development," the Commission also recognized that demand for broadband services will grow rapidly in coming years.[3] Thus, the Commission stated in its *Section 706 Report* that it is "committed to ensuring that deployment of broadband capability to the consumer market remains timely and reasonable as the market for broadband develops, and that the supply of broadband meets consumer demand."[4]

As is evident from the comments and other pleadings submitted in this and related proceedings to date, NGSO FSS Ku-band satellite systems such as proposed by SkyBridge are uniquely suited to the provision of broadband services to the public. As SkyBridge and other commenters in this proceeding observe, NGSO FSS Ku-band

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2 Pub.L. 104-104, Title VII, § 706, Feb. 8, 1996, 110 Stat. 56 (1996).

3 *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, FCC 99-5, rel. Feb. 2, 1999, at ¶ 16 ("*Section 706 Report*").

4 *Id.*

satellite systems are inherently global in nature and thus will be able to provide broadband access to every location in the U.S.[5] But equally important for achievement of the Commission's broadband capability goals is the fact that NGSO FSS Ku-band satellite systems are capable of providing effective and efficient access to broadband services to every location in *other countries* as well.

The Commission recognizes in its *Section 706 Report* that "widespread" access to broadband capability can increase the nation's productivity, create jobs, and meaningfully improve the country's educational, social, and health care services.[6] EMS submits that "widespread" must be "worldwide" to maximize the realization of these benefits for U.S. businesses and consumers. As is readily apparent to everyone who "surfs the Web," the flow of information and commerce on the Internet is global in nature. U.S. consumers and Internet-based businesses will realize the full potential of these global markets only if there is efficient and effective access to the Internet around the world.[7]

NGSO FSS Ku-band satellite systems, because they are global by nature, are uniquely suited to deliver broadband access to consumers worldwide and as such to ensure that the benefits to be derived from broadband access are achieved in reality. Thus, the public interest is best served by the Commission moving forward in this

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5 Comments of SkyBridge at 104-105; Comments of the Boeing Company ("Boeing") at 73; Comments of Loral Space & Communications Ltd. ("Loral") at 19.

6 *Section 706 Report* at ¶ 2.

7 Thus, purely domestic, terrestrial Internet access proposals, such as that proffered by Northpoint (at least in this iteration of its ever-changing business plan), are inherently inferior to global systems. While they arguably are capable of providing access for U.S. urban and suburban users, their rural reach is questionable at best and their global reach is non-existent. There is no rational public interest basis for sacrificing the benefits to U.S. consumers and businesses of a global access system.

proceeding to adopt rules and policies that will facilitate the operation of NGSO FSS satellite systems at Ku-band. To ensure that NGSO FSS systems at Ku-band are developed, implemented, and operated in a timely manner that guarantees the availability of broadband services around the world, the FCC's rules should reflect the following principles and requirements.

First, the technical parameters adopted by the Commission to address NGSO/GSO/terrestrial sharing issues should be consistent with the conclusions ultimately adopted by JTG 4-9-11. EMS concurs in SkyBridge's assessment that a consensus will be reached on essentially all necessary technical parameters relevant to sharing well before the commencement of WRC-2000.[8] It is important for the Commission's Rules to reflect these conclusions because they are the product of multilateral deliberations to which the U.S. Government (as well as NGSO FSS proponents and opponents alike) have had substantial input. While the Satellite Coalition apparently would give this consideration short shrift,[9] the fact remains that if the FCC's rules reflect the JTG 4-9-11 conclusions, the U.S. will be in a better position to shape the details of regulations to be adopted at WRC-2000. In addition, the FCC's adoption of technical rules that reflect the considered views of other countries may facilitate NGSO FSS Ku-band satellite operators in their dealings with these countries on technical and other issues relevant to the establishment of critical satellite support operations abroad.

Second, the Commission should require that *all* NGSO FSS Ku-band satellite systems employ some type of interference mitigation technique to ensure that these

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8 Comments of SkyBridge at 6.

9 Comments of the Satellite Coalition at 5.

systems are able to share frequencies and coverage areas successfully and thus that multiple systems can be licensed and deployed. Consistent with the use of NGSO FSS Ku-band systems for broadband services, the Commission should require use of satellite diversity as a mitigation technique. As SkyBridge discussed in its comments, band segmentation is not a feasible alternative, because provision of the sorts of broadband services intended by WRC-97 and Section 706 of the 96 Act requires use of all the spectrum proposed in this proceeding.[10]

In no event should the Commission mandate specific system designs or orbit configurations such as proposed by Virtual Geosatellite ("Virtual Geo") in its Comments.[11] As Virtual Geo effectively admits, such an approach is a radical departure from the Commission's long-standing practice of mandating minimal performance criteria that are then implemented by designs developed in the marketplace.[12] Furthermore, the Commission has already indicated that it will not mandate specific technical designs in promoting the availability of advanced telecommunications services. The Commission stated in its *Section 706 Report* that its role in fostering the deployment of broadband capability is "not to pick winners and losers, or to select the best technology to meet consumer demand."[13] Rather, the Commission intends "to rely as much as possible on free markets and private enterprise."[14]

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10 Comments of SkyBridge at 81.

11 Comments of Virtual Geo at 3.

12 *Id.* at 3-4.

13 *Section 706 Report* at 5.

14 *Id.*

Finally, the Commission should mandate minimum coverage areas as currently applied to the NGSO systems in the 17.7-20.2 GHz and 27.5-30.0 frequency bands and as proposed in this proceeding.[15] As noted previously, if U.S. consumers are to realize fully the intended benefits of advanced telecommunications services, then high-quality broadband access must be universally available. Furthermore, the spectrum allocated for this service is available on a global basis. Thus, a requirement that NGSO FSS Ku-band satellite systems be capable of global coverage is both necessary to the public interest and entirely appropriate.

III. Airborne BSS Antennas Are Unlikely to Be More Sensitive to Interference From NGSO FSS Ku-band Satellites Than Terrestrial BSS Antennas and Thus Do Not Deserve Special or Additional Protection.

In its comments, DIRECTV argues that BSS antennas located on aircraft may suffer more severely from interference generated by NGSO FSS Ku-band satellite systems than BSS antennas located on the ground.[16] The analysis of DIRECTV is questionable for the following reasons.

EMS has retained the services of Dr. Leon Ricardi of Creative Engineering to compare and contrast the antenna patterns of airborne and terrestrial BSS antennas. Dr. Ricardi is an electrical engineer with 49 years of antenna design and systems analysis

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15 *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*, CC Docket No. 92-297, 12 FCC Rcd 22310 at ¶ 34; Notice at ¶ 84.

16 Comments of DIRECTV at 15-18.

experience.[17] A copy of Dr. Ricardi's analysis is provided in Attachment 1. As explained in that analysis, airborne antennas in general are no more sensitive to interference than terrestrial BSS antennas. Airborne BSS antennas have roughly the same gain as terrestrial antennas in order to receive the incoming signals. Airborne antennas must conform to different configurations due to the physical constraints under which airborne antennas must operate, *i.e.,* they must be low and elongated to fit under an aerodynamic radome on the plane's fuselage. The directive gain pattern of an airborne BSS antenna is somewhat different than the directive gain pattern of a terrestrial BSS antenna. An airborne BSS antenna aperture is rectangular, so it is more sensitive to interference along its vertical axis than a terrestrial BSS antenna, which has a circular aperture. However, between its horizontal and vertical axes, an airborne BSS antenna is much *less* sensitive (up to 10-20 times less) to interference than a terrestrial BSS antenna.

Thus, while the airborne BSS antenna is slightly more sensitive to interference in some directions, it will be much less sensitive in other directions. In fact, an airborne BSS antenna will provide more protection from interference than a terrestrial BSS antenna. In light of these facts, there is strong basis for affording airborne BSS antennas less protection from interference.

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[17] Dr. Ricardi was Group Leader at MIT's Lincoln Laboratories for 31 years prior to forming his own consulting business.

IV. Conclusion

In sum, the Commission should adopt rules and policies that reflect JTG 4-9-11's consensus conclusions and that require satellite diversity and global coverage. As shown herein, such action will foster the deployment of broadband capability worldwide and thus will serve the public interest. However, the Commission should not adopt rules that grant special protection from interference to airborne BSS antennas. As demonstrated above, there is no basis for affording airborne BSS antennas special treatment.

Respectfully Submitted,

EMS TECHNOLOGIES, INC.

By: _____

Robert J. Aamoth
Joan M. Griffin
KELLEY DRYE & WARREN LLP
1200-19th Street, N.W.
Suite 500
Washington, D.C. 20036
(202) 955-9600

Its Attorneys

Date: April 14, 1999

Creative
Engineering

Airborne BSS Antenna Interference Study for FCC NPRM

Tuesday, March 23, 1999

Airborne BSS Antenna Interference Study For FCC NPRM

1. Introduction

Airborne antennas used by Broadcast Satellite Service systems usually have gain, actually gain-to-noise-temperature ratio (G/T), comparable to that of a 45 cm diameter paraboloid reflector. That is, the dish-type BSS antennas that are commonly used for this purpose, throughout the United States. However, an antenna with a 45 cm diameter circular aperture is not acceptable for use on an airplane because it introduces an intolerable increase in aerodynamic drag. To reduce the drag produced by the antenna, airborne BSS antennas have a rectangular aperture, with width-to-height ratio approximately equal to four. Furthermore, they are usually an array antenna and hence have a separable aperture distribution. This leads to an antenna radiation pattern (directive gain) consisting of relatively high sidelobes along the principal axes and very low sidelobes in planes between these axes. These antennas do not have a sidelobe structure that is even vaguely similar to that of a reflector antenna with a circular aperture. The antenna radiation pattern, or directive gain, cannot be represented by using two, or more, reference antenna templates that have been developed for use with a circular aperture. In view of this, there is a strong need to define a suitable reference antenna template that can be used in the calculation of equivalent power flux density, when analyzing the ability of two systems to operate in the presence of one another.

This note describes an EMS effort to develop a suitable reference antenna template. First, a typical antenna is described. This is followed by a brief review of how interference occurs and why it should be of concern to the BSS community. Finally, this information is summarized and conclusions are presented.

2. Characteristics Of An Airborne BSS Antenna

An airborne antenna is designed to have as little as possible protrusion into the aerodynamic slip stream of an airplane. At the same time, it must have an aperture large enough to produce the desired antenna gain. Recall that there is substantial area available, to support an antenna, along the surface of the fuselage of the airplane. It is natural for antenna designers to achieve the required antenna gain by using an antenna aperture that is much wider than it is high. That is the antenna protrudes from the fuselage of the airplane much less than it spreads out along the surface of the fuselage.

The antenna customarily is mounted on a flat metallic disk, a ground plane. The antenna and its ground plane are rotated on a vertical axis to steer the antenna beam toward the azimuthal direction of a broadcast satellite. A horizontal axis, mounted on the ground plane, permits the antenna to be steered in elevation, so that it will point directly toward a satellite. A "tear-drop" radome houses the antenna to protect it from the air stream and environment. Although some designers have considered using a phased array antenna that conforms to the surface of the fuselage, these antennas are much more costly than those that are steered mechanically, and not used nearly as much as the mechanically steered antennas. The typical radiation pattern of conformal phased array will be similar to that of the planar array antenna described in the foregoing. Hence, it is highly likely that a

reference antenna template that is acceptable for a planar array antenna will also be acceptable for a conformal phased array antenna.

Typically an airborne BSS antenna has a fan shaped radiation pattern with a halfpower beamwidth equal to ~2° in the azimuth plane and ~8° in the elevation plane. A typical 45 cm diameter BSS antenna has a beam with ~4° halfpower beamwidth and a circular cross section. As described above, the sidelobes of a typical airborne antenna are maximum along the vertical and horizontal planes. The first sidelobe is ~-12 dB compared to the peak of the main beam. The sidelobe level decreases with increasing angular separation from the main beam axis, as with a terrestrial antenna. Along a 45° plane, the first sidelobe is ~-24 dB with respect to the peak of the main beam. In comparison, the first sidelobe of a terrestrial BSS antenna is ~-20 dB with respect to the peak of the main beam and it forms a ring around the main beam.

When computing the probability of a NGSO interfering with a BSS antenna, it is necessary to consider all intercept angles between the NGSO satellite and an airborne terminal, regardless of their relative location. Note that although their antenna pattern shapes are different, the airborne BSS antenna and a BSS terrestrial antenna will have about the same antenna ***gain***, in order to provide the same service to the user. Taking the directive gain of these antennas into account, the probability of a NGSO interfering with an airborne BSS is up to 20 times less than the probability that the same NGSO will interfere with a terrestrial BSS terminal. In other words, an airborne BSS antenna will provide ***greater*** protection from NGSO interference.

A detailed calculation of the cumulative probability distribution of the directive gain of these antennas is shown in Figure 1. Note that both antennas have the same probability of providing their maximum gain. That is, about 0.03 %, as expected. Note that for a given probability, a BSS antenna has up to 17 dB (an average of 13 dB) less directive gain than a terrestrial BSS antenna.

Recall that the BSS terrestrial antenna performance is controlled by the ITU regulations. Since the airborne BSS antenna is less susceptible to interference than a terrestrial BSS antenna, these regulations indirectly guarantee a system using an airborne BSS antenna does not need any special protection from interference due to a NGSO. However, it is necessary to define a reference antenna template for airborne BSS antennas in order to verify this conjecture.

3. Summary and Conclusion

Airborne BSS antennas have a fan shaped beam. The beam has a halfpower beamwidth ~2° in the horizontal plane and ~8° in the elevation plane. Compared to a BSS terrestrial antenna, the airborne BSS antenna beamwidth is narrower in one plane and broader in the other. Furthermore, its first sidelobes are higher than those of a BSS terrestrial antenna, **in the horizontal and elevation planes.** Along essentially all other planes, an airborne BSS antenna will have sidelobes much lower than those of a BSS terrestrial. This is not surprising since both antennas must have about the same gain. Recall that antenna gain function (i.e.; directive gain) must be conserved. Simply stated, higher directive gain in one direction must be accompanied by lower gain in another direction. Directive gain of an airborne BSS antenna is capable of providing greater protection from interference than that which can be provided by a terrestrial BSS antenna, for the foregoing reasons and because the fuselage of the airplane shields the antenna from interfering sources located on the Earth.

Until more data and analysis become available, it is safe to say that a BSS receiving system, using an airborne antenna, is unlikely to experience any more interference from NGSO FCC satellites than terrestrial BSS antennas.

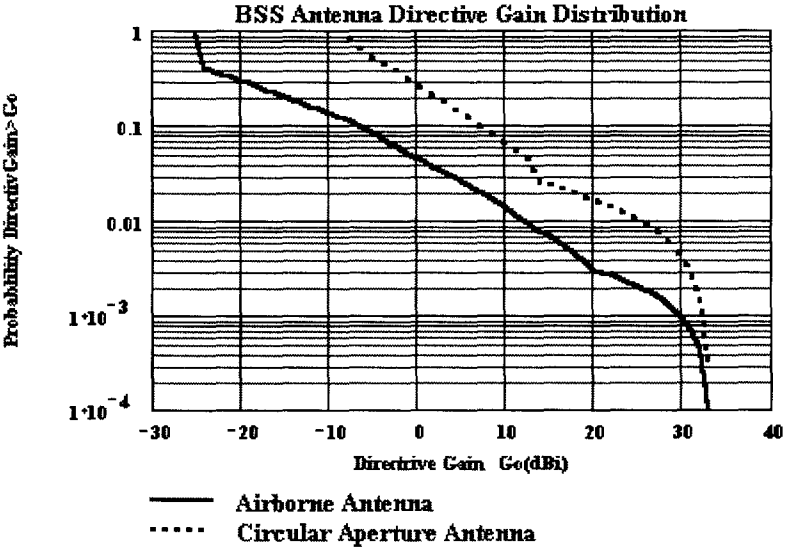

Figure 1

CERTIFICATE OF SERVICE

I, Najmah Rashad, do hereby certify that on this 14th day of April, 1999, a copy of the foregoing Reply Comments of EMS Technologies, Inc. was mailed by U.S. first class mail, postage prepaid, upon the parties on the attached service list.

Najmah Rashad

Najmah Rashad

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SERVICE LIST

Phillip L. Spector
Jeffrey H. Olson
Diane C. Gaylor
Paul, Weiss, Rifkind, Wharton & Garrison
1615 L Street, N.W., Suite 1300
Washington, D.C. 20036
Attorneys for Skybridge L.L.C.

Stephen R. Bell
Jennifer D. McCarthy
Sophie J. Keefer
Willkie Farr & Gallagher
Three Lafayette Centre
1155 21st Street, N.W.
Washington, D.C. 20036-3384
Attorneys for Loral Space
& Communications Ltd.

Mark A. Grannis
Evan R. Grayer
Harris, Wiltshire & Grannis LLP
1200 Eighteenth Street, N.W.
Washington, D.C. 20036
(202) 730-1300
Attorneys for Teledesic LLC

Gary M. Epstein
James H. Barker
Latham & Watkins
1001 Pennsylvania Avenue, N.W.
Suite 1300
Washington, D.C. 20004-2505
Attorneys for DIRECTV, INC.

Craig Holman
Office of the Group Counsel
Space & Communications Group
The Boeing Company
P.O. Box 3999, M/S 84-10
Seattle, Washington 98124-2499

Raul R. Rodriguez
Stephen D. Baruch
David S. Keir
Colin D. Horst
Leventhal, Senter & Lerman P.L.L.C.
2000 K Street, N.W., Suite 600
Washington, D.C. 20006
Attorneys for Virtual Geosatellite, LLC

Joseph P. Markoski
Herbert E. Marks
David A. Nall
Bruce A. Olcott
Squire, Sanders & Dempsey LLP
1201 Pennsylvania Avenue, N.W.
P.O. Box 407
Washington, D.C. 20044-0407
Attorneys for The Boeing Company

David Hartshorn, GVF General Secretary
Global VSAT Forum
Fountain Court
2 Victoria Square
Victoria Street
St. Albans, Herts. AL1 3TF
U.K.

Veronica M. Ahern
J. Breck Blalock
NIXON, HARGRAVE, DEVANS
& DOYLE, LLP
One Thomas Circle, Suite 700
Washington, D.C. 20005-5802
Attorneys for QUALCOMM Incorporated

Philip L. Malet
Pantelis Michalopoulos
Colleen Sechrest
Steptoe & Johnson LLP
1330 Connecticut Avenue, N.W.
Washington, D.C. 20036
Attorneys for EchoStar Communications Corporation

Philip V. Otero
Senior Vice President and General Counsel
GE American Communications, Inc.
Four Research Way
Princeton, NJ 08540

Antionette Cook Bush
Eric C. Broyles
Brian D. Weimer
Skadden, Arps, Slate, Meagher & Flom LLP
1440 New York Avenue, NW
Washington, D.C. 20005
Attorneys for Northpoint Technology, Ltd.

Peter A. Rohrbach
Yaron Dori
Hogan & Hartson, L.L.P.
555 Thirteenth Street, N.W.
Washington, D.C. 20004
Attorneys for GE American Communications, Inc.

Leonard Robert Raish
Mitchell Lazarus
Fletcher, Heald & Hildreth, PLC
1300 North 17th Street – 11th Flor
Arlington, VA 22209
Attorneys for Fixed Point-to-Point Communications Section, Wireless Communications Division of the Telecommunications Industry Association

Henry Goldberg
Joseph A. Godles
Mary J. Dent
Goldberg, Godles, Wiener & Wright
1229 Nineteenth Street, N.W.
Washington, D.C. 20036
Attorneys for Panamsat Corporation

Henry L. Baumann
Jack N. Goodman
Valerie Schulte
National Association of Broadcasters
1771 N Street, N.W.
Washington, D.C. 20036

David K. Moskowitz
Senior Vice President and General Counsel
EchoStar Communications Corporation
5701 South Santa Fe
Littleton, CO 80120

Thomas J. Keller
John M.R. Kneuer
Verner, Liipfert, Bernhard,
McPherson and Hand, Chartered
901 15th Street, N.W., Suite 700
Washington, D.C. 20005
Attorneys for Association of American Railroads

Benjamin J. Griffin
Uzoma C. Onyeije
Mintz, Levin, Cohn, Ferris, Glovsky
And Popeo, P.C.
701 Pennsylvania Aveneu, N.W.
Suite 900
Washington, D.C. 20004
Attorneys for Home Box Office and Turner
Broadcasting System, Inc.

Betsy Stover Granger
Pacific Bell Mobile Services
4420 Rosewood Drive, 4th Floor
Pleasanton, CA 94588
Senior Counsel for SBC Communications, Inc.

James J. Dopham
Vice-President, General Counsel
Association of Local Television Stations, Inc.
1320 19th Street, N.W.
Suite 300
Washington, D.C. 20036

Carol L. Tacker
Vice President & General Counsel
SBC Wireless, Inc.
17330 Preston Road, Suite 100A
Dallas, TX 75252
Attorney for SBC Communications, Inc.

W. Kenneth Ferree
Goldberg, Godles, Wiener & Wright
1229 Nineteenth Street, NW
Washington, D.C. 20036
Attorneys for OpTel, Inc.

Robert M. Lynch
Senior Vice President & General Counsel
SBC Telecommunications Inc.
175 E. Houston, Suite 1250
San Antonio, TX 78205

Michael Katzenstein
Vice President and General Counsel
OpTel, Inc.
1111 W. Mockingbird Lane
Dallas, Texas 75247

Roger K. Toppins
General Attorney & Assistant General Counsel
- External Affairs
SBC Communications Inc.
One Bell Plaza, Suite 3008
Dallas, TX 75202

Paul J. Feldman, Esq.
Fletcher, Heald & Hildreth, PLC
1300 North 17th Street
11th Floor
Rosslyn, VA 22209
Attorney for National Academy of Sciences' Committee on Radio Frequencies

Elsa Woodall
David L. Lihani
Pierson & Burnett, LLP
1667 K Street, N.W., Suite 801
Washington, D.C. 20001
Attorneys for Denali Telecom, L.L.C.

Dr. Robert L. Riemer
HA-562
National Research Council
2101 Constitution Ave., NW
Washington, D.C. 20418
For National Academy of Sciences' Committee on Radio Frequencies

Scott B. Tollefsen
Senior Vice President, General Counsel and Secretary
Hughes Communications, Inc.
200 North Sepulveda Blvd.
El Segundo, CA 90245

Christopher D. Imlay
Booth, Freret, Imlay & Tepper
5101 Wisconsin Avenue, NW, Suite 307
Washington, D.C. 20016
Attorneys for Society of Broadcast Engineers, Inc.

Gary M. Epstein
John P. Janka
Arthur S. Landerholm
Latham & Watkins
1001 Pennsylvania Avenue, N.W.
Suite 1300
Washington, D.C. 20004

Dennis J. Burnett
President, Pentriad North America, Inc.
Manager of Denali Telecom, LLC
1667 K Street, N.W.
Suite 801
Washington, D.C. 20001

Marvin Rosenberg
Randall W. Sifers
Holland & Knight LLP
2100 Pennsylvania Avenue, N.W.
Suite 400
Washington, D.C. 20037-3202
Attorneys for United States Satellite Broadcasting Company, Inc.