SQUIRE, SANDERS & DEMPSEY L.L.P.
1201 Pennsylvania Avenue, N.W.
P.O. Box 407
Washington, D.C. 20044-0407
Office: +1.202.626.6600
Fax: +1.202.626.6780

SQUIRE SANDERS | LEGAL COUNSEL WORLDWIDE

(202) 626-6634

December 19, 2003

VIA HAND DELIVERY

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20054

Re: Application for Authority of The Boeing Company
For Modification of Authority for Use of the 1990-2025/2165-2200 MHz and Associated Frequency Bands for a Mobile-Satellite System
FCC File Nos. 79-SAT-P/LA-97(16), 90-SAT-AMEND-98(20);
IBFS Nos. SAT-LOA-19970926-00149, SAT-AMD-19980318-00021,
SAT-AMD-20001103-00159 and SAT-MOD-20020726-00113,
SAT-MOD-20030711-00128, SAT-AMD-20030827-00241

Dear Secretary Dortch:

On December 4, 2003, representatives of The Boeing Company ("Boeing") met with representatives of the International Bureau, the Wireless Telecommunications Bureau and the Office of Engineering and Technology in order to discuss Boeing's July 11, 2003 application to modify its 2 GHz MSS license, along with Boeing's amendment to that application, which was filed on August 27, 2003. During the meeting, three technical questions were raised regarding Boeing's pending application and amendment. Boeing provides this letter to respond to these questions.

Feeder Link Spectrum Requirements

The first question addresses Boeing's request for authority to operate its 2 GHz MSS network using additional spectrum for feeder links in the Planned Ku-band. Specifically, Boeing's amendment requests authority to use an additional 355 MHz of paired feeder link spectrum, giving Boeing access to a total of 480 MHz of paired feeder link spectrum in the Planned Ku-band. Boeing was asked to provide operating scenarios for its 2 GHz MSS network that would demonstrate Boeing's need for 480 MHz of paired feeder link spectrum. Boeing was also asked whether the Commission had previously granted authority to a MSS licensee to use 480 MHz or more of paired spectrum for feeder link operations.

Boeing is requesting access to 480 MHz of paired feeder link spectrum in the Planned Ku-band in order to accommodate the anticipated operating conditions of Boeing's 2 GHz MSS network. As indicated in Boeing's amendment, the increased spectrum requirement is attributable to several factors, including:

- a decrease in the cell size of the service link from 0.7° to 0.24°;
- use of a four-cell frequency re-use pattern, rather than a seven-cell pattern;
- the Commission's assignment to Boeing of 5 MHz of paired service link spectrum; rather than its previous assignment of 3.5 MHz of spectrum;
- a need to enable redundancy between Boeing's gateway stations, thus potentially reducing spectrum re-use between the two gateways; and
- anticipated spectrum sharing agreements with other 2 GHz MSS licensees permitting the secondary use of their service link spectrum.

In order to illustrate Boeing's increased feeder link spectrum needs, Boeing is providing below two operating scenarios that require the use of at least 480 MHz of paired feeder link spectrum. Boeing, however, emphasizes that although these examples illustrate configurations in which Boeing is likely to operate its 2 GHz MSS network, it would be inappropriate to limit Boeing's authorization by restricting Boeing to the operating scenarios provided below. Boeing has designed its satellite with the flexibility to operate in a variety of configurations in order to respond quickly to the evolving needs of its customers.

The following analysis assumes the use of up to 20 MHz of paired spectrum for spacecraft telemetry, tracking and control. The remaining 460 MHz of paired communications spectrum could be employed as follows:

	Parameter	Scenario A	Scenario B	
	2 GHz authorized bandwidth	5.0	5.0	MHz
+	2 GHz use of other operator's segment	5.0	5.0	MHz
=	2 GHz spectrum (concurrent use)	10.0	10.0	MHz
÷	Cell re-use pattern	4	4	
x	Number of cells	392	500	
=	Total feeder link requirement	980	1250	MHz
÷	Ku-band polarization re-use factor	2	2	
÷	Gateway spectrum re-use factor	1.07	1.36	
=	Feeder link spectrum requirement	460	460	MHz

The above examples illustrate two conditions under which the spectrum requested may be utilized by Boeing during the operation of its network. Alternative scenarios could involve other variations of the above parameters including use of 15 MHz of paired service link spectrum, a change in the number of user cells (up to a maximum of approximately 500 cells), and variations in the amount of frequency re-use between Boeing's two proposed gateway facilities.

Finally, Boeing observes that the Commission recently authorized Celsat to use 500 MHz of paired feeder link spectrum in the Ka-band.[1] Boeing believes that the Commission's decision regarding Celsat provides precedent for Boeing's request.

Satellite De-orbit Plan

The second question addresses the end-of-life strategy for Boeing's 2 GHz MSS satellite. Boeing was asked whether its proposed use of a large, 22 meter spacecraft service link antenna will alter the appropriate de-orbit altitude for Boeing's spacecraft. Boeing was also asked to determine what de-orbit altitude would be appropriate for its satellite using a formula developed by the Inter-Agency Space Debris Coordination Committee ("IADC"). Finally, if the IADC formula results in a higher de-orbit altitude than the one planned for by Boeing, Boeing was asked to explain why its proposed de-orbit altitude is adequate.

On March 18, 2002, Boeing filed with the Commission a revised end-of-life strategy for its 2 GHz MSS spacecraft. The strategy stated that, following the conclusion of the useful life of Boeing's satellite, Boeing would maneuver the spacecraft to a storage orbit that is consistent with ITU-R Recommendation S.1003 (1993), as currently in force, which calls for a storage orbit with a perigee that is at least 300 kilometers above a normal GSO operational orbit.

As the Commission is aware, on July 11, 2003, Boeing filed an application to modify its license to make certain technical changes to its spacecraft, including the use of a 22 meter service link antenna. Boeing's March 18, 2002 end-of-life strategy remains adequate and appropriate for its spacecraft, even after incorporating the technical changes proposed in its July 11, 2003 modification application.

Boeing calculated the recommended de-orbit altitude for its spacecraft using the IADC formula. The formula takes into account spacecraft characteristics that may affect the longer-term stability of the end-of-life orbit, such as the mass and effective surface area of the spacecraft. The IADC formula indicates that the appropriate de-orbit altitude for Boeing's spacecraft would be approximately 280 kilometers.

Boeing calculations take into account Boeing's use of a 22 meter spacecraft antenna. Boeing determined that its 22 meter spacecraft antenna probably had little impact on the outcome of the IADC analysis because Boeing's antenna, which is designed with an open mesh structure, has a small effective area and therefore produces minimal resistance to solar radiation pressure. Boeing, however, acknowledges that the overall combination of Boeing's use of a large antenna,

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[1] *See* Celsat America, Inc., Modification of License to Authorize Geostationary-Satellite Orbit Mobile-Satellite Service Feeder Link Operations in the Ka-Band, *Order and Authorization*, DA 01-1682, ¶ 25 (Int'l Bur., Aug. 3, 2001).

a large spacecraft body and large solar arrays will result in significant solar radiation resistance, which contribute significantly to the IADC recommendation of a 280 kilometer de-orbit altitude.

Satellite Longitudinal Station Keeping

The third question addresses Boeing's proposal to operate its 2 GHz MSS spacecraft using a 0.1° longitudinal (East-West) station keeping tolerance. Boeing was asked to calculate the impact on the operational life of Boeing's spacecraft if Boeing were required to operate the satellite using a 0.05° longitudinal station keeping tolerance. Boeing was also asked to explain the basis for the impact on the operational life of its satellite.

Boeing has determined that the use of a 0.05° longitudinal station keeping tolerance for Boeing's 2 GHz MSS satellite would result in as much as a six-fold increase in the amount of onboard propellant that would be consumed to maintain the spacecraft in its assigned orbit. As a result, the anticipated 12 year useful life of Boeing's 2 GHz MSS spacecraft would be reduced by approximately 50 percent.[2] The severe negative impact of a 0.05° longitudinal station keeping tolerance results from the significant area-to-mass ratio of Boeing's spacecraft and its use of a slightly inclined orbit.

It is common industry practice to operate geosynchronous MSS satellites in a slightly inclined orbit. Consistent with this approach, Boeing's 2 GHz MSS spacecraft was designed to operate with an initial North/South inclination of as much as six degrees. The method in which this orbit is initialized eliminates the need for North/South station keeping maneuvers during the operational life of the spacecraft, reducing the need for onboard propellant.

The inclination also creates an analemma latitude and longitude deviation, which manifests as a "figure-8" ground track, crossing the equatorial plane twice per day. This longitude variation due to inclination becomes an added component to the longitudinal station keeping tolerance, even near the equator.

Additionally, the use of a large spacecraft antenna, body and solar arrays creates significantly greater solar radiation forces, which increase the required eccentricity of the orbit and, with it, the diurnal longitude variation due to eccentricity. The eccentricity contribution is the largest component of longitudinal deviation during an East/West station keeping cycle for Boeing's 2 GHz MSS satellite.

As noted above, use of a 0.05° longitudinal station keeping tolerance for Boeing's 2 GHz MSS satellite would increase greatly the use of onboard propellant for station keeping

[2] Even though Boeing anticipates that a 0.05° longitude station keeping tolerance would result in as much as a six-fold increase in the consumption of onboard propellant, Boeing expects that the reduction in the anticipated useful life of Boeing's 2 GHz MSS satellite will be limited to 50 percent. This is because Boeing designed its satellite to have some fuel remaining after operating for 12 years using a longitudinal station keeping tolerance of 0.1°.

maneuvers, potentially reducing by half the anticipated 12 year useful life of the spacecraft. The substantial increase in propellant usage that would be required is due to a significant increase in the longitudinal station keeping delta velocity requirement.

The increase arises from a change in the eccentricity control strategy from a one maneuver station keeping to a two maneuver station keeping strategy, with each of the resulting two maneuvers being much larger than the maneuver that would be necessary in the one maneuver strategy. In fact, the two maneuver strategy for a 0.05° station keeping box could result in as much as a six-fold increase in the amount of propellant that would be consumed to maintain Boeing's 2 GHz MSS satellite in its assigned orbit. The use of a two maneuver station keeping strategy would also increase the operating complexity of the satellite because of the need for more frequent maneuvers and the need for increased precision in order to ensure that the larger maneuvers do not have unintended consequences on the assigned orbit of the satellite.

Thank you for your attention to this matter. Please let us know if you have any questions.

Sincerely,

Joseph P. Markoski
Bruce A. Olcott
Counsel for The Boeing Company

cc: Marylou Cahir
Thomas Tycz
Karl Kensinger
Robert Nelson
John Martin
William Bell
Sankar Persaud