Narrative

Iridium Satellite LLC and Iridium Carrier Services LLC (collectively, "Iridium") hold blanket licenses[1] to operate user mobile earth stations, maritime mobile earth stations, land mobile earth stations, aeronautical mobile earth stations, and Aeronautical Mobile Satellite (Route) Service ("AMS(R)S") earth stations. The authorized point of communication for these earth stations is the Iridium "Big LEO" non-geostationary, mobile-satellite service space station constellation.[2]

Last year, the Commission granted an application to modify the license for the Iridium space station constellation by authorizing the launch and operation of second generation replacement satellites known as "Iridium NEXT."[3] The Iridium NEXT satellites will continue to provide the services offered by the first generation satellites, but with increased total and peak network performance. The first 10 Iridium NEXT satellites were launched in January 14, 2017.

In this application, Iridium seeks to modify its blanket license by adding authority for next generation maritime mobile earth stations, land mobile earth stations, aeronautical mobile earth stations, and AMS(R)S earth stations.[4] These next generation earth stations are designed to make use of the enhanced operational characteristics of the Iridium NEXT satellites.

The first generation of these earth stations come in multiple varieties that are associated with the OpenPort, LiveTV, and AMS(R)S entries on Iridium's blanket license. The second generation of these earth stations, however, consists of a single "one size fits all" terminal that will be used to provide enhanced service, known as "Iridium Certus^{SM}," for land, air, and sea.

The Iridium Certus terminal has different operating modes, depending on the modulation schemes and wave forms that are employed.[5] The parameters shown in this modification application are based on operational modes that will produce the highest EIRP and EIRP density. These maximum operational values are shown in Schedule B of this modification application.

The Iridium Certus antenna is an array of identical antenna elements that possesses electronic beamformers providing the capability to independently point two high gain beams in any of 61 azimuth and elevation directions uniformly distributed about the hemisphere under software command. These beams are used for voice and data traffic. One beam is a transmit and receive beam while the other is a receive only beam. Each beam is right-hand-circularly-polarized (RHCP) with an approximate 3 dB beamwidth of 40 degrees and a gain that varies between 10.1 and 11.8 dBic. In addition, the receive only beam has two additional

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[1] Call signs E960131 and E960622, respectively.

[2] Call sign S2110. The licensee of the space station constellation, Iridium Constellation LLC, is a sister company to Iridium Satellite LLC and Iridium Carrier Services LLC.

[3] *Application of Iridium Constellation LLC for Modification of License to Authorize a Second-Generation NGSO MSS Constellation*, Order and Authorization, 31 FCC Rcd 8675 (IB 2016).

[4] This Narrative accompanies two substantively-identical applications, one of which seeks to modify the blanket license held by Iridium Satellite LLC and the other of which seeks to modify the blanket license held by Iridium Carrier Services LLC.

[5] The Iridium Certus terminals may transmit either a single RF carrier or two carriers simultaneously. The Iridium Certus terminals that employ a single waveform are known as "H-1," and the Iridium Certus terminals that employ two waveforms are known as "H-2."

configurations that provide omnidirectional coverage in azimuth, albeit at a lower gain of 3 dBic, to permit faster acquisition of control signals from the Iridium satellites. The antenna and associated electronics are enclosed in a circular radome that is 22 inches in diameter and 8 inches in height. In addition to an Iridium Certus antenna, each Iridium Certus terminal also includes a BCX transceiver, active electronics, and an associated power supply.

The operational values shown in Schedule B are based on test measurements taken on a prototype Iridium Certus terminal developed by Iridium. Iridium Certus products developed by third-party manufacturers will use the same transceiver as was used in the prototype and will be built to Iridium's specifications so that they will produce the same operational values as are shown in Schedule B.

The following information bears upon the values that are shown in Schedule B and other elements of this modification application:

Items E30 and E31: Iridium has stated "various" in response to items E30 and E31 to reflect the fact that multiple manufacturers will produce Iridium Certus terminals, based on Iridium's specifications, and these manufacturers will attach company-specific model numbers to their Iridium Certus terminals. This approach is comparable to the approach taken by Globalstar in an application, which the Commission granted, to modify its blanket license for mobile earth stations.[6]

Item E38 (Total Power at Antenna Flange for All Carriers): For a passive antenna, the EIRP is calculated by multiplying the power at the antenna flange by the antenna gain. The Iridium Certus earth station has an active antenna and there is no antenna flange, as such. Accordingly, for field E38 the Max. Peak EIRP (dBW) was taken (see note for field E40) and the lowest antenna gain (dBi) was subtracted (see note for field E41) to determine an equivalent maximum flange power in dBW. This power was then converted to watts.

Item E40 (Total EIRP for All Carriers): The EIRP varies with the number of carriers and the modulation and coding used for each carrier. Furthermore, satellites in the Iridium constellation are in low-earth orbit (LEO) and each satellite will move with respect to any point on the earth. The satellites spend a different proportion of the time for each elevation angle from a point on the earth. The gain of the high-gain antenna used for voice and data varies as a function of elevation angle. (See note for Item E41.) For the EIRP value given in Item E40, the maximum antenna gain, which occurs for an elevation angle of 39 degrees, was used for the case of two carriers (the terminal cannot transmit more than two carriers), each employing the modulation giving the highest EIRP.

Item E41 (Antenna Gain): As stated above, satellites in the Iridium constellation are in low-earth orbit (LEO) and each satellite will move with respect to any point on the earth. As also stated above, the satellites spend a different proportion of the time for each elevation angle from a point on the earth. This is represented in the Antenna Weighting Function shown in Figure 1, which illustrates probability density as a function of elevation angle. It may be seen

[6] *See* File No. File No. SES-MOD-20160412-00344 (granted Jul.5, 2016).

that the lowest probability occurs for satellites directly overhead and that the most probable elevation angle is at 16 degrees.

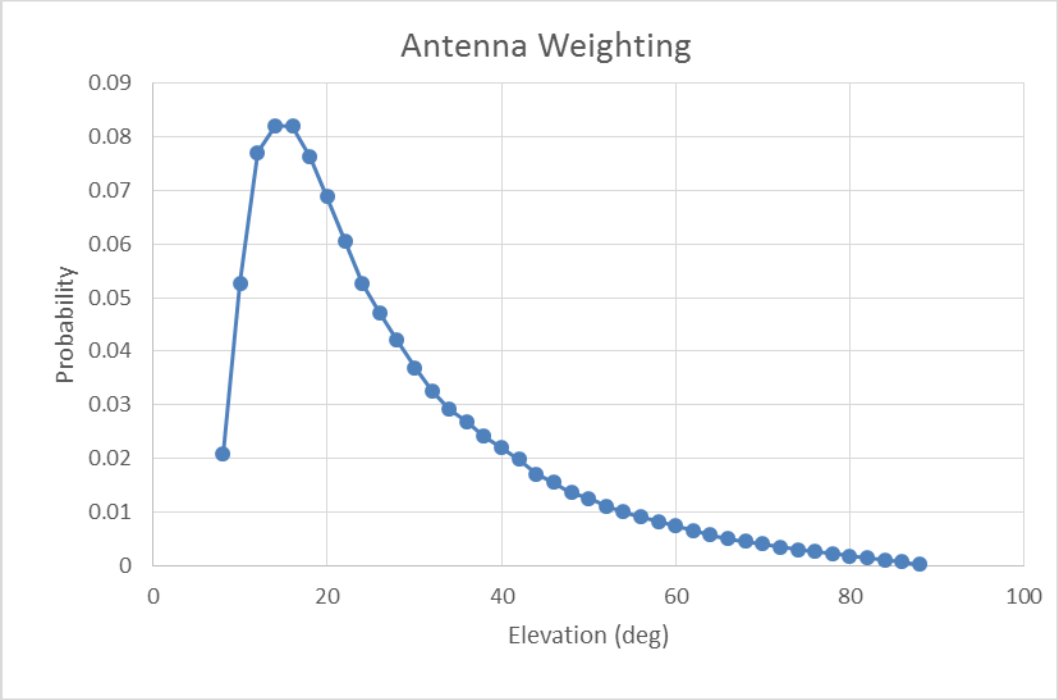

Figure 1 Antenna Weighting vs. Elevation Angle

The gain of the high-gain antenna used for voice and data varies as a function of elevation angle from 10.1 dBi to 11.8 dBi. The highest gain of 11.8 dBi has been entered. Since the terminals transmit and receive in the same frequency band, this gain applies to both transmit and receive. The terminals also have a second low-gain antenna used only to receive control signals from the Iridium satellites. The gain of the low-gain antenna is 3 dBi at 1.621 GHz and does not vary as a function of elevation angle.

Item E45 (T/R Mode): The terminals transmit and receive within the same frequency band.

Other information provided with Schedule B

Radiation hazard study. Iridium has provided with this modification application a radiation hazard study, which is based on the maximum transmit EIRP that would be used with Iridium Certus terminals.

Contact information. The name and telephone number of the network control center for Iridium's earth stations is: Iridium Tempe AZ Gateway; 480-752-5111.

The 24/7 contact at the control center is: Network Operations, 480-752-5111.

Minimum power for most sensitive receive emission type. On the receive side, the minimum power that needs to be delivered to the receiver through the antenna for the most sensitive emission type covered by this application is -112 dBm, which is based on a system design Bit Error Rate of 2% or less.

Protection of RNSS and adjacent channel operators. The Iridium Certus terminals operated pursuant to this license will comply with the requirements of Sections 25.202(f) and 25.216 of the Commission's rules.[7] The Iridium Certus terminals will be the subject of FCC equipment authorizations under Parts 2 and 25 of its rules.[8] The applications for these equipment authorizations will include test reports that demonstrate compliance with Sections 25.202(f) and 25.216 of the Commission's rules.

AMS(R)S operations. Separately from this application, civil aviation approvals are being pursued under the auspices of RTCA and the Federal Aviation Administration for operating Iridium Certus terminals to provide AMS(R)S. These approvals may include performance requirements that would necessitate operating Iridium Certus terminals at levels below the maximum levels specified in this application when they are used to provide AMS(R)S. Iridium will, of course, comply with any such performance requirements.

[7] 47 C.F.R. §§ 25.202(f), 25.216.
[8] 47 C.F.R. Parts 2 and 25.