

March 28, 2016

Mr. Jose Albuquerque  
Chief, Satellite Division  
International Bureau  
Federal Communications Commission  
445 12<sup>th</sup> Street, SW  
Washington, DC 20554

*Re: Iridium Constellation LLC; Application for Modification of Non-Geostationary Mobile Satellite Service System Authorization (S2110) To Launch and Operate Replacement Satellites; Call Sign S2110; File No. SAT-MOD-20131227-00148; Iridium Constellation LLC Petition for Rulemaking RM-11697*

Dear Mr. Albuquerque:

On April 29, 2015, the National Radio Astronomy Observatory (NRAO) submitted an *ex parte* letter that has been filed in the above-noted dockets. The NRAO letter appears to express the frustration that some radio astronomers have felt arising from the radio frequency challenges presented by the first-generation Iridium system.

Iridium recognizes the importance of radio astronomy observations for scientific research and education, and the sensitivity of the equipment required to make such observations. It also understands the frustrations reflected in the NRAO letter. Thus, its new Iridium NEXT constellation has been designed specifically to address the concerns of the radio astronomy community. As explained below, once Iridium NEXT is fully operational, it will reduce unwanted emissions into the Radio Astronomy Service (RAS) band to the levels that the RAS community has been seeking.

#### I.

Iridium has always strived to make the most efficient use of spectrum technically possible. Its unique constellation of low-earth orbiting satellites with spot-beam antennas, and its innovative use of time-division duplex (TDD) that re-uses the same frequency band for service uplinks and downlinks, allows Iridium to do more with less spectrum than other systems. Indeed, with only 8.775 MHz of spectrum, Iridium serves over three-quarters of a million users globally. Its original constellation also uses filtering and other techniques to reduce unwanted emissions. However, as the Iridium system has become critical to first responders and others — and as traffic has grown — over the past two decades, the challenge of avoiding interference into the RAS bands has also grown.

## II.

The NRAO letter expressed concern that due to these changed conditions, especially increased use of the Iridium network and changes in how RAS measurements are made, Iridium's previously proposed interference protection mechanisms for RAS were insufficient. To address this concern, Iridium has developed new, technically sophisticated solutions that will satisfy the needs of the RAS community.

Specifically, Iridium NEXT will improve the interference environment for RAS in three ways:

### **1) Improved hardware to improve linearity and filtering in the transmission stages**

Through the specification of more linear high-power amplifiers (HPAs) and output noise filters, the new design will reduce the unwanted emissions into the RAS band by about 15dB compared to each satellite in the original constellation.

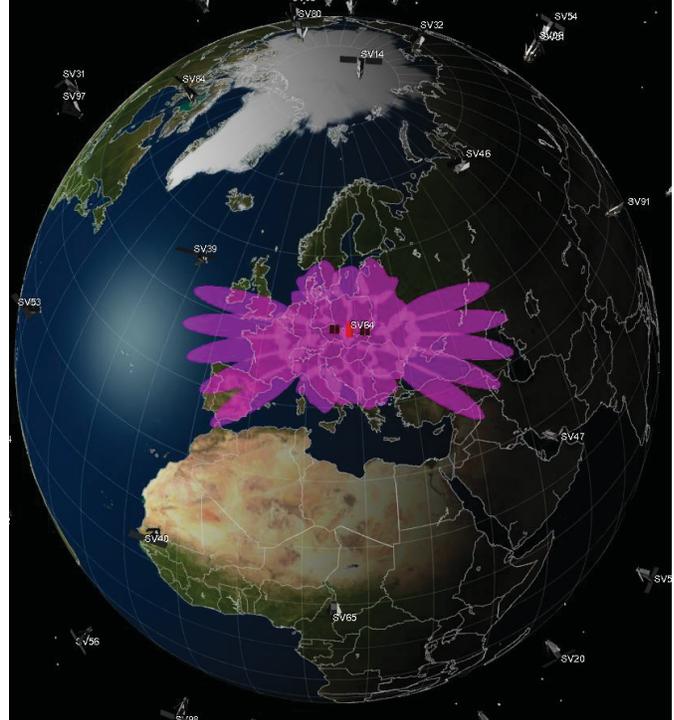
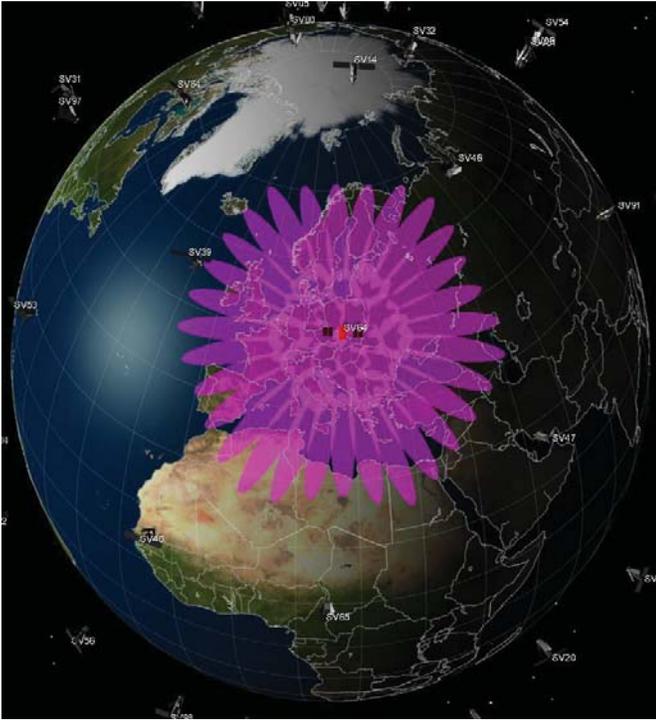
### **2) Improved traffic and satellite resource management controls**

By managing traffic more closely and distributing it more efficiently across the available beams and satellites, it is possible to reduce unwanted emissions further. The beams of Iridium satellites converge as the satellites approach the poles. As a result, and as illustrated below, improved load management will allow the Iridium NEXT network selectively and automatically to switch off beams on satellites passing over RAS sites between 30° and 60° North Latitude, transferring traffic from the satellite over the RAS site to adjacent satellites.<sup>1</sup> Switching off beams on satellites in full view of RAS sites in this way results in fewer intermodulation product signals and less out-of-band noise — yielding fewer spurious satellite emissions in the radio astronomy band and protecting RAS sites 24 hours a day. Analysis of simulations of the Iridium NEXT satellite system operating under this beam management approach showed an RAS data loss of 2 percent (which meets the ITU's strict recommendation for protection of RAS) — or even less.

The figure on the left below illustrates the beam laydown of a satellite operating all 48 available beams. By contrast, the figure on the right shows a satellite where only 28 beams are active because the traffic has been transferred to beams on adjacent satellites.

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<sup>1</sup> The system is capable of doing the same between 30° and 60° South Latitude, but lighter traffic in this portion of the southern hemisphere makes this unnecessary.



### 3) New network management software

Iridium NEXT features new network management software that enables Iridium to optimize both the satellite hardware and the traffic distribution to maximize the protection of RAS sites, while maintaining traffic capacity and supporting growth.

### III.

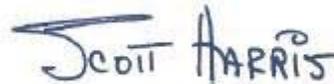
Iridium has twice met with the RAS community, under the auspices of the National Science Foundation, to explain that with the three developments noted above, Iridium NEXT can fully protect RAS observatories. Radio astronomers should begin to see a reduction in unwanted emissions in the RAS band at 1610.6-1613.8 MHz due to the improved hardware as soon as the first Iridium NEXT satellites become operational, and this reduction will continue as more and more first-generation Iridium satellites are replaced. By the end of 2017, when the entire Iridium NEXT constellation is scheduled to be operational and the traffic management software features activated, unwanted emissions will be reduced to the thresholds desired by radio astronomers. Indeed, Iridium hopes that once the system is fully operational, additional software and operational advancements will allow even further reduction of emissions into the RAS band.

IV.

The Iridium constellation is, by any definition, critical infrastructure for our country. The Iridium network provides vital communications links to the U.S. military, to first responders, to those on the high seas, and to those in remote locations. Iridium provides essential links to the 85 percent of the planet that is unserved by terrestrial networks. And when natural or man-made disaster strikes the other 15 percent of the planet, Iridium is there, no matter where the disaster occurs.

Nevertheless, Iridium also recognizes the importance of radio astronomy to our collective welfare and fully understands the concerns the RAS community had about its original constellation. Accordingly, Iridium NEXT has been designed to address those concerns and, once completely operational, the constellation will reduce emissions into the RAS band to the levels long sought by the RAS community. Moreover, Iridium has committed – and looks forward – to working with the RAS community to conduct measurements of the Iridium NEXT satellites as they are launched and become operational.

Respectfully submitted,

A handwritten signature in blue ink that reads "SCOTT HARRIS". The signature is written in a cursive, slightly stylized font.

Scott Blake Harris  
*Counsel to Iridium Constellation LLC*