

Answers to Questions from the International Bureau

Iridium Satellite LLC and Iridium Carrier Services LLC (collectively, "Iridium") previously filed applications (the "Applications") seeking blanket license modifications that would add authority for a single "one size fits all" terminal, known as "Iridium CertusSM."¹ The terminal will be used to provide enhanced service, for land, air, and sea, via Iridium's second generation constellation known as Iridium NEXT.

On June 27, 2017, the International Bureau requested that Iridium respond to nine questions relating to the Applications. Iridium's answers are below. The answers are attached to amendments to the Applications (the "Amendments") that are responsive to matters raised in the Bureau's questions.

1. In October 2009 Iridium was authorized to operate "OpenPort" MES terminals to provide 128kbit/s data connections at -10.6 dBW/4 kHz for emission bandwidths of no greater than 667 kHz.² In May 2013, Iridium was authorized to operate LIVE TV terminals to provide mobile TV services at -9.3 dBW/4 kHz for emission bandwidths of no greater than 667 kHz.³ In this application, it is unclear what the EIRP limits are for each mode of operation at which the Iridium Certus will be operating. We note that the Iridium Certus application adds Antenna ID "Prototerm" with EIRP densities of 5.2 dBW/4 kHz for a 41 kHz emission designator and 3.1 dBW/4kHz for a 333 kHz emission designator. Please clarify which emission designators are associated with previously authorized services.

Response

At present, Iridium's blanket mobile earth terminal licenses⁴ authorize Iridium to operate mobile earth terminals that communicate with Iridium's first generation space stations, which are known as Block 1. The licenses authorize Iridium's handheld units, OpenPort terminals (maritime and land mobile), LiveTV terminals (non-AMS(R)S general aviation), and AMS(R)S terminals.

Iridium is not proposing any changes to the authority or specifications for these Block 1 terminals. Rather, Iridium seeks authority in the Applications for a new class of mobile earth terminals, known as Iridium Certus, that will communicate with Iridium's

¹ See File Nos. SES-MOD-20170413-00388 and SES-MOD-20170413-00389. As stated in the narrative that was submitted, two substantively-identical applications were filed, 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.

² See IBFS File No. SES-MOD-20081223-01705.

³ See IBFS File Number SES-MOD-20120119-00069.

⁴ See call signs E960132 and E960622.

second generation satellites, known as Iridium NEXT, and will make use of the enhanced operational characteristics of the Iridium NEXT satellites.

Iridium will use the Iridium Certus terminals to provide maritime mobile service, land mobile service, non-AMS(R)S general aviation mobile service, and AMS(R)S service via Iridium NEXT satellites. As shown in Schedule B, the specifications for each of these Iridium Certus services is the same. Iridium will employ the same maximum input power, EIRP per carrier, EIRP density per carrier, and other specifications across all Iridium Certus service types. For identification purposes, Iridium has broken out separate line items in Schedule B for Iridium Certus maritime, land mobile, general aviation, and AMS(R)S services. But the same Iridium Certus terminal, with the same specifications, will be used to provide each of these services.

2. Please provide a radiation hazard analysis that describes the Iridium Certus earth station near-field and far-field regions in accordance with OET Bulletin 65 and demonstrates how public safety will be addressed in more specific detail.

Response

A radiation hazard analysis is included with the Amendments that describes the Iridium Certus earth station near-field and far-field regions in accordance with OET Bulletin 65 and demonstrates in detail how public safety will be addressed. This analysis supersedes the radiation hazard analysis that was filed with the Applications.⁵

3. Iridium requests to use the term “various” for the data fields E31 and E32 in Form 312, Schedule B, and references a GUSA Licensee LLC authorization, IBFS file No. SES-MOD-20160412-00344. That authorization identifies specific manufactures for “Aviation” terminals. Please define specific antenna IDs for aviation and/or AMS(R)S stations in your application. Please file these changes by amendment(s).

Response

A revised Schedule B is included with the Amendments in which the manufacturers for the maritime and land mobile Iridium Certus terminals are identified as “various,” but separate antenna IDs and specific manufacturers are shown for Iridium Certus general aviation and AMS(R)S terminals.

⁵ Conforming changes have been made to the Iridium Certus user manual, based on the information in the new radiation hazard analysis. The previous version of the user manual was submitted with the type certification filing for the Iridium Certus prototype. Iridium is exploring whether it should update the type certification file for the prototype by submitting the new user manual.

4. The U.S. Table of Allocations cites International footnote 5.364.⁶ Does the Iridium Certus earth station operate within the limits of 5.364?

Response

The Iridium Certus terminals will satisfy the -3 dB(W/4 kHz) mean EIRP density limit of international footnote 5.364. The highest Iridium Certus mean EIRP density, which is only -3.9 dB(W/4 kHz), is produced by the Iridium Certus waveform associated with emission code 41K7Q7W. The mean EIRP density for each Iridium Certus waveform, therefore, will be below the 5.364 limit by 0.9 dB or more.⁷

5. Have the proposed terminals and operations been coordinated under ITU RR 9.21 with FSS services for the proposed AMS(R)S terminals? (See 5.367)

Response

Iridium intends to coordinate its Iridium Certus AMS(R)S terminals with FSS services under ITU RR 9.21. Iridium has no objection to a condition that it not provide Iridium Certus AMS(R)S in territories in which it has not successfully completed this process.

⁶ The use of the band 1610-1626.5 MHz by the mobile-satellite service (Earth-to-space) and by the radio determination-satellite service (Earth-to-space) is subject to coordination under No. 9.11A. A mobile earth station operating in either of the services in this band shall not produce a peak e.i.r.p. density in excess of -15 dB(W/4 kHz) in the part of the band used by systems operating in accordance with the provisions of No. 5.366 (to which No. 4.10 applies), unless otherwise agreed by the affected administrations. In the part of the band where such systems are not operating, the mean e.i.r.p. density of a mobile earth station shall not exceed -3 dBW/4 kHz. Stations of the mobile-satellite service shall not claim protection from stations in the aeronautical radio navigation service, stations operating in accordance with the provisions of No. 5.366 and stations in the fixed service operating in accordance with the provisions of No. 5.359. Administrations responsible for the coordination of mobile-satellite networks shall make all practicable efforts to ensure protection of stations operating in accordance with the provisions of No. 5.366.

⁷ In addition to the -3 dB(W/4 kHz) *mean* EIRP density limit, 5.364 includes a -15 dB(W/4 kHz) limit for *peak* EIRP density. The -15 dB(W/4 kHz) limit, however, is inapplicable. It is relevant only to mobile earth stations that employ frequencies used by systems operating in accordance with the provisions of No. 5.366, *i.e.*, satellite and terrestrial aeronautical radionavigation systems, and there are no such systems on the frequencies to be used by Iridium Certus terminals. The ITU's Master International Frequency Register lists no satellite aeronautical radionavigation systems in the Iridium Certus band and only a single Swedish terrestrial aeronautical radionavigation system, which Iridium understands from previous coordination discussions has been decommissioned, in the Iridium Certus band. If in the future there are operational aeronautical radionavigation systems in the Iridium Certus band, Iridium will comply with 5.364 either by satisfying the -15 dB(W/4 kHz) limit for peak EIRP density or by coordinating alternate limits with affected administrations.

6. Does Iridium accept harmful interference pursuant to RR 4.10 and 5.368? Please explain.

Response

Consistent with the provisions of RR 4.10 and 5.368, Iridium does not claim protection from interference for its Iridium Certus mobile-satellite service operations from stations in the aeronautical radionavigation-satellite service. As stated in n. 7 above, however, at present there are no aeronautical radionavigation-satellite service systems on the frequencies to be used by Iridium Certus terminals.

7. In accordance with 47 C.F.R. § 2.201, the emission designator “333KQ7W” indicates multiple channels within a 333 kHz bandwidth. Form 312, Schedule B, Item E40 reflects a total EIRP of 27.7 dBW for all carriers. Please clarify which other carrier listed in your application could be combined with the 333KQ7W carrier density to operate at less than 27.7 dBW?

Response

The total EIRP of 27.7 dBW represents the maximum combined “peak” EIRP for two carriers, each operating within a 333 kHz bandwidth. Operation in this fashion enables Iridium to double the data rate by dividing a data stream between the two carriers at the terminal and having the data stream recombined at the gateway earth station.

The only combinations of two carriers supported by the Iridium Certus terminal are two C8 16APSK waveforms or two C8 QPSK 333 kHz waveforms. In both cases, the total combined peak EIRP for the two carriers is less than or equal to 27.7 dBW.

8. Please demonstrate the lowest and highest center frequency of the 41 kHz and 333 kHz emissions that will comply with 47 C.F.R § 25.209(f) and 25.216 (g) and (i) limits.

Response

The FCC has type certified the Iridium Certus prototype. In its type certification application for the prototype, Iridium showed compliance with 47 C.F.R. § 25.216 (g) and (i) limits with greater than 10 dB of margin. More specifically, compliance was demonstrated at three frequencies: 1) 1616.167 MHz, 2) 1621.167 MHz and 3) 1625.833 MHz, which is a sufficient range of frequencies to demonstrate compliance over Iridium’s entire operating frequency range of 1618.725 MHz to 1626.5 MHz. Iridium Certus products developed by third-party manufacturers, which 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 the prototype, also will be type

certified and will need to be shown as complying with 47 C.F.R. § 25.216 (g) and (i) limits.⁸

The lowest center frequency on which Iridium will operate a 41 kHz emission is 1618.746 MHz (center frequency for channel 3 of sub-band 9, i.e. the lowest channel closest to 1618.725 MHz), the lowest center frequency on which Iridium will operate a 333 kHz emission is 1619.167 MHz (center frequency for sub-band 10 which is the lowest sub-band closest to 1618.725 MHz), the highest center frequency on which Iridium will operate a 41 kHz emission is 1626.438 MHz (center frequency of simplex channel 11 of 12 channels, since highest frequency channel 12 is a guard channel) and the highest frequency on which Iridium will operate a 333 kHz emission is 1625.834 MHz (center frequency for sub-band 30).

9. Please describe in greater detail how the AMS(R)S version of the Antenna ID Prototerm stations will operate.

Response

What the “Prototerm” is. The antenna ID “Prototerm” is shorthand for the Iridium Certus prototype Iridium has developed and type certified. The prototype will not be operated commercially. But as stated above, commercial Iridium Certus terminals will be developed by third-party manufacturers; will use the same transceiver as is used in the prototype; and will be built to Iridium’s specifications so they produce the same operational values as the prototype. Some of these commercial terminals will be used to provide AMS(R)S.⁹

How the Iridium Certus terminal will be used to provide non-safety and safety aviation services. Iridium Certus AMS(R)S terminals will be installed in commercial air transport, air cargo and business jets that operate in U.S. and international airspace and will be used to provide Future Air Navigation Services¹⁰ (FANS) and Air Traffic Service (ATS) Safety Voice,¹¹ which are AMS(R)S capabilities required by civil aviation authorities. FANS and ATS Safety Voice services only can be provided on systems approved under (i) DO-262, a Minimum Operational Performance Standard developed

⁸ Based on discussions with the International Bureau’s staff, Iridium is not responding to the portion of Question 8 that addressed 47 C.F.R § 25.209(f).

⁹ In the revised version of Schedule B that Iridium is submitting in response to question 3, separate antenna IDs and specific manufacturers are shown for Iridium Certus general aviation and AMS(R)S terminals.

¹⁰ The Future Air Navigation System (FANS) is an avionics system that provides a data link between the pilot and the air traffic controller.

¹¹ ATS Safety Voice is an avionics system that provides voice communication between the pilot and the air traffic controller.

by the Radio Technical Commission for Aeronautics (RTCA),¹² and (ii) an FAA Technical Standard Order (TSO) or Supplemental Type Certification (STC). Air Traffic Control (ATC) centers around the world will be able to communicate through the Iridium AMS(R)S system for the efficient and safe flight operations in the Organized Track System (OTS).¹³ Consistent with Iridium's FCC authorization, Iridium Certus AMS(R)S operations outside the United States will be limited to oceanic regions, the Antarctic land mass and adjacent waters, and the remote areas of those territories for which it has successfully completed the agreement seeking process pursuant to ITU Radio Regulation 5.367.¹⁴

Iridium Certus terminals used for AMS(R)S also will be capable of providing non-safety services. These non-safety services are made available to pilots on Electronic Flight Bag (EFB) systems in support of aircraft operations. Such services could include graphical weather information, airport charts and runways, maintenance and engine operations statistics, or other aircraft services. Iridium's network can distinguish between AMS(R)S and non-AMS(R)S traffic and gives AMS(R)S priority over non-safety aeronautical services.

How the Iridium Certus terminal will be installed on aircraft. Each Iridium Certus terminal used on an aircraft either for non-safety services or for AMS(R)S will include an electronically steered high gain antenna and a low gain antenna that will be housed in a small radome mounted on the exterior of the aircraft, commonly on the crown of the aircraft's fuselage. The antenna will be connected via coaxial cable to a box, typically in the electronics bay of the aircraft that houses all avionics.

How adjacent band interference will be avoided. Section 25.202(f) of the Commission's rules establishes out-of-band emissions limits to protect services on adjacent frequencies. Iridium Certus terminals will satisfy these requirements for all services – aeronautical, terrestrial, and maritime. As stated in the Applications, Iridium Certus terminals will be the subject of equipment authorizations under Parts 2 and 25 of the FCC's rules. The applications for these equipment authorizations will include test reports that demonstrate compliance with Sections 25.202(f) of the Commission's rules. The Iridium Certus prototype already has been type certified under Parts 2 and 25.

¹² RTCA is a Federal advisory committee that works in response to requests from the Federal Aviation Administration (FAA) to develop technical performance standards for air transportation.

¹³ Each civil aviation region has its own OTS specifying flight routes that are designed to maintain aircraft separation over the ocean.

¹⁴ If in the future a need arises to expand Iridium's service area for AMS(R)S, Iridium will request modification of its AMS(R)S authorization. Although the focus of AMS(R)S has been oceanic, remote and polar airspace, approval has been given in Europe for continental use of AMS(R)S services under the Iris Precursor Program. Similarly, the United States has declared that it will move to continental use of AMS(R)S by 2025 as part of the NextGen program.

In the case of AMS(R)S, which Iridium and Inmarsat provide in adjacent bands, the following measures afford an added level of protection against out-of-band interference:

- DO-262, which is a Minimum Operational Performance Standard (“MOPS”) developed by RTCA, puts aircraft owners on notice that simultaneous operation of Inmarsat and Iridium aeronautical earth station equipment on the same aircraft has the potential to cause interference, and calls for them to take measures to protect AMS(R)S communications. It is standard industry practice to avoid simultaneous operation of Inmarsat and Iridium terminals on the same aircraft.
- DO-262 also establishes an RTCA review process for new equipment such as the Iridium Certus terminals. Iridium will be submitting technical studies to RTCA as part of the review process, and Inmarsat and other interested parties will have an opportunity to submit comments addressing interference or other concerns. The FAA will not issue a Technical Standard Order or allow a Supplemental Type Certification for the Iridium Certus terminals until the RTCA review process has been successfully completed.