May 17, 2024

ELECTRONIC FILING
VIA ECFS and ELS

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
45 L Street NE
Washington, DC 20554

Re: **Notice of *Ex Parte* Communication, GN Docket No. 23-65 and IB Docket No. 22-271; Call Sign WW9XPI, File Nos. 2479-EX-ST-2023, 0519-EX-ST-2024, 0661-EX-ST-2024**

Dear Ms. Dortch:

In tests of its proposed supplemental coverage from space service at 1990-1995 MHz, experimental authorization holder Space Exploration Holdings, LLC (SpaceX) is causing harmful interference to the primary, Mobile Satellite Service (MSS) operations of Omnispace, LLC (Omnispace). SpaceX, which must operate on a non-interference basis, transmits harmful co-channel emissions from its satellites into Omnispace's MSS satellite receiver. SpaceX's operations violate the terms of its experimental authorization and must cease.[1] SpaceX is also operating at variance with its authorized parameters in violation the Communications Act and Commission rules. Enforcement is warranted.

On May 15, 2024, Omnispace met with Federal Communications Commission staff to document the harmful interference SpaceX continues to cause to Omnispace's operations and to stress the importance of the FCC taking swift action to protect the communications integrity of licensed, primary-status operators.[2] After providing a brief overview of events, Omnispace explained how

[1] *See, e.g.*, 47 C.F.R. § 5.84 ("Operation of an experimental radio station is permitted only on the condition that harmful interference is not caused to any station operating in accordance with the Table of Frequency Allocation of part 2 of this chapter."); SpaceX, Experimental Special Temporary Authorization, Call Sign WW9XPI, File No. 0519-EX-ST-2024, Special Condition 9 (eff. Apr. 1, 2024) (requiring SpaceX to avoid causing harmful interference to any other lawfully operating station); *id.*, Condition 10 (requiring SpaceX to immediately cease operations and inform the Commission upon receiving notification that it caused harmful interference). Omnispace has repeatedly complained of the harmful interference SpaceX's experimental tests have produced into the primary-licensed Omnispace 2 GHz MSS system. For the avoidance of doubt, however, Omnispace has contemporaneous with this letter provided SpaceX with written notice that SpaceX has caused harmful interference to Omnispace and, by the express terms of Condition 10 of SpaceX's experimental authorization, SpaceX must "immediately cease" the operations authorized by Call Sign WW9XPI. *Id.*, Condition 10.

[2] The following personnel of the Federal Communications Commission attended the meeting: Alice Koethe, John Lockwood, Jon Markman, Kamran Etemad, Ira Keltz, Jessica Quinley, Joseph Hill, Kari Hicks, Kathyrn Medley, Roger Noel, Jennifer Gilsenan, Whitney Lohmeyer, and Jeanine Poltronieri. The following personnel of Omnispace

it collected radiofrequency observations during SpaceX's tests and showed how those observations demonstrate harmful interference. This presentation is described below, and slides used during the presentation are attached.

Background. A Virginia-based satellite licensee, Omnispace operates MSS satellites on a primary basis outside of the United States in a primary 2 GHz MSS allocation assigned consistent with the International Telecommunication Union's (ITU) Table of Frequency Allocations.[3] California-based SpaceX received an experimental temporary authorization on March 29, 2024, to test operations on a non-conforming, non-interference basis to all other licensed operators, including primary-status licensees such as Omnispace.[4] Before and after the grant of SpaceX's experimental test authority, Omnispace explained the high likelihood of interference that SpaceX's tests would create and, subsequent to grant of SpaceX's experimental authorization, Omnispace sought basic information about SpaceX's test plan to document the interference Omnispace anticipated would occur.[5]

---

attended the meeting: Ram Viswanathan, Jeff Snyder, Ron Olexa, Molly Gavin, John Zukoski, Amit Saluja, Jose Cisneros, Paul Bulford, and Mindel De La Torre. The following personnel of RKF Engineering Solutions, LLC, an engineering consulting firm retained by Omnispace, attended the meeting: Ted Kaplan, Farinaz Edalat, and Alex Yeh.

[3] Omnispace's Omni-F2 satellite operates under the authority of Papua New Guinea. *See* Papua New Guinea, CRC/C 3434 (Aug. 13, 2013); M5L2SAT, CR/C 5023 (Mar. 24, 2019). While SpaceX has maligned Omnispace as a "foreign" system operator due to this licensing heritage, *see, e.g.*, Letter of Jameson Dempsey, Director, Satellite Policy, SpaceX, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 23-135, ICFS File No. SAT-MOD-20230207-00021 (Nov. 30, 2023), SpaceX's claims are as irrelevant as they are xenophobic. Omnispace is a duly authorized, primary-service licensee with priority rights recognized by the International Telecommunication Union to which, as a matter of both treaty and practice, the United States has agreed to be bound. 47 C.F.R. § 2.100 ("The United States is a Member State of the International Telecommunication Union (ITU). The legal framework of the ITU is comprised of the Constitution and Convention of the International Telecommunication Union—which have treaty status and are binding on ITU Member States—and the Administrative Regulations—which complement the Constitution and the Convention."). Moreover, even if SpaceX's aspersions were somehow germane to the current proceeding, SpaceX might itself qualify as a "foreign" satellite system by SpaceX's standards as a result of SpaceX's submission of ITU filings through the administration of the Federal Republic of Germany and its intent to serve locations other than the United States. *See, e.g.*, Application of Space Exploration Holdings, LLC for Modification of Authorization for the SpaceX Gen2 NGSO Satellite System to Add a Direct-to-Cellular System at 8, ICFS File No. SAT-MOD-20230207-00021, GN Docket No. 23-135 (filed Feb. 7, 2023) (acknowledging that SpaceX's DTC operations will proceed under the MARS-VLS and MARS-ULS filings that the German Administration has submitted to the ITU on SpaceX's behalf).

[4] SpaceX, Experimental Special Temporary Authorization at 1, Call Sign WW9XPI, File No. 0519-EX-ST-2024 (eff. Apr. 1, 2024).

[5] *See, e.g.*, Letter from Mindel De La Torre, Chief Regulatory and International Strategy Officer, Omnispace, LLC to Marlene H. Dortch, Secretary, FCC, GN Docket No. 23-135, ICFS File No. SAT-MOD-20230207-00021 SAT-APL-20230717-00172, ULS File Nos. 0010303032, 0010303084, 0010303124, and 0010303146 (Feb. 9, 2024); Email from Mindel De La Torre to Jameson Dempsey (Apr. 6, 2024, 9:55 PM), attachment to Letter from Mindel De La Torre, Chief Regulatory and International Strategy Officer, Omnispace, LLC, to Marlene Dortch, Secretary, FCC, Call Sign WW9XPI, 0519-EX-ST-2024, at attach. A-1–2 (Apr. 9, 2024) (requesting information including satellite catalog identification numbers for each satellite involved in testing, daily test times and durations of the transmissions from each identified satellite, frequencies to be used, and related information).

On April 5, 2024, SpaceX notified Omnispace of an initial round of testing but declined to provide much of the basic information Omnispace had requested about SpaceX's test parameters.[6] Perhaps by way of an explanation for the shortcomings of its notice, SpaceX said any information provided to Omnispace was offered only as a "courtesy" because, based on an unexplained and undocumented internal review, SpaceX claimed Omnispace would not be affected by SpaceX's in-band reverse operations.[7] In response, Omnispace reiterated the high likelihood of interference SpaceX's experimental authorization posed to Omnispace's primary-licensed operations and renewed its request for basic information about SpaceX's test plan.[8] SpaceX again disregarded Omnispace's requests for information about SpaceX's test plans.[9] On April 19, 2024, the FCC reminded SpaceX of its obligation to share test parameters with potentially affected parties.[10] And on May 8, 2024, just 27 minutes prior to the launch window for additional test satellites, SpaceX provided Omnispace with some, but far from all, of the basic test data Omnispace had requested more than a month earlier.[11] SpaceX repeated this last-minute provision of incomplete information shortly before they launched additional satellites on May 14, 2024. Notwithstanding SpaceX's untimely notice and incomplete disclosures, Omnispace used internal and third-party resources to deploy observation systems that documented harmful satellite-to-satellite interference from SpaceX's experimental test satellites into Omnispace's licensed, primary-status operations in the 1990-1995 MHz band.

Observation Setup. Omnispace chronicled SpaceX's harmful satellite-to-satellite interference in the 1990-1995 MHz band using two primary tools: (1) Omnispace's "Omni-F2" medium-earth

---

[6] Email from Jameson Dempsey to Mindel De La Torre (Apr. 5, 2024, 7:52 PM), attachment to Letter from Mindel De La Torre, Chief Regulatory and International Strategy Officer, Omnispace, LLC, to Marlene Dortch, Secretary, FCC, Call Sign WW9XPI, 0519-EX-ST-2024, at attach. A-3 (Apr. 9, 2024).

[7] *Id*. SpaceX's experimental operations in the 1990-1995 MHz band are space-to-Earth which runs counter to the ITU global MSS band plan in which operations in 1980-2010 MHz band are Earth-to-space.

[8] Email from Mindel De La Torre to Jameson Dempsey (Apr. 6, 2024, 9:55 PM), attachment to Letter from Mindel De La Torre, Chief Regulatory and International Strategy Officer, Omnispace, LLC, to Marlene Dortch, Secretary, FCC, Call Sign WW9XPI, 0519-EX-ST-2024, at attach. A-1–2 (Apr. 9, 2024).

[9] Email from Jameson Dempsey to Mindel De La Torre (Apr. 7, 2024, 9:34 PM), attachment to Letter from Mindel De La Torre, Chief Regulatory and International Strategy Officer, Omnispace, LLC, to Marlene Dortch, Secretary, FCC, Call Sign WW9XPI, 0519-EX-ST-2024, at attach. A-1 (Apr. 9, 2024).

[10] Letter from Ira Keltz, Deputy Chief, Office of Engineering and Technology, FCC, to David Goldman, Vice President of Satellite Policy, SpaceX, ICFS File No. SAT-MOD-20230207-00021, ELS File Nos. 2479-EX-ST-2023 and 0519-EX-ST-2024 (Apr. 19, 2024) (reminding SpaceX of its obligation to provide test data to Omnispace and other potentially affected parties and requiring SpaceX to provide Omnispace and EchoStar with the NORAD Satellite Catalog Identification number for each satellite involved in the [supplemental coverage from space] testing).

[11] Email from Jameson Dempsey to Mindel De La Torre (May 8, 2024, 9:33 PM EDT) (stating the next launch expected to take place no earlier than 7 PM PDT, and that "[i]nitial check-out testing will take place during the first 10 days following launch"); Will Robinson-Smith, *SpaceX Flies 13 More Direct to Cell Starlink Satellites on Falcon 9 Rocket Launch from Vandenberg SFB*, SPACEFLIGHT NOW (May 8, 2024), https://spaceflightnow.com/2024/05/08/live-coverage-spacex-to-fly-13-more-direct-to-cell-starlink-satellites-on-falcon-9-rocket-launch-from-vandenberg-sfb/ (noting that liftoff occurred at 9:30 PM PDT). In its correspondence, SpaceX once again implied, without support or explanation, that its dilatory and incomplete notice should be of no consequence to Omnispace because providing data remained a mere "courtesy." Emails from Jameson Dempsey to Mindel De La Torre (May 8, 2024, 9:33 PM EDT and May 14, 12:06 PM EDT).

orbit (MEO) satellite to detect the interference, and (2) a helix antenna located in Brewster, Washington aimed to zenith to confirm SpaceX satellite transmissions in the band. The Omni-F2 satellite is configured in accordance with the ITU global MSS band with the uplink receive band in the 1980-2010 MHz band. The helix antenna in Washington was used to confirm operation of a SpaceX satellite by receiving emissions generated by SpaceX satellites in the 1990-1995 MHz band. At the time of observation, SpaceX had launched six Direct-to-Cellular (DTC) satellites on January 2, 2024, and a second batch of six satellites on April 6, 2024, and it had publicly announced that it is testing the performance of those satellites from ground positions in Redmond, Washington, and Brewster, Washington, among other locations.[12]

At the time of the test, Omni-F2 was located over Asia in an area where it had line of sight visibility to the SpaceX low-earth orbit (LEO) satellites passing over Washington state at an altitude of 355 kilometers, but where the Earth would block Omni-F2's view to the land mass of the United States over which T-Mobile has deployed terrestrial G block base stations. Thus, any transmissions that Omni-F2 detected originated from SpaceX's test satellites rather than from T-Mobile's terrestrial G block base stations that have downlink operations in the 1990-1995 MHz band. Omni-F2's receiver was configured to monitor ten 200-kilohertz segments of the 1990-1995 MHz band, and these segments were evenly distributed across the band's five-megahertz bandwidth. Omni-F2 is a "bent pipe" satellite that relies on extended C-band frequencies for its gateway transmissions. In this case, it relayed the measurements in these ten segments to a gateway located in Dubai via a 7 GHz feeder link. In Dubai, the 7 GHz feeder link was received by a 7.6-meter antenna, amplified by a Low Noise Amplifier (LNA), and downconverted from 7 GHz to a 1 GHz intermediate frequency (IF) that is used for signal distribution at the gateway. The portion of the 1 GHz IF that represents the 1990-1995 MHz band was then displayed and captured on a spectrum analyzer to document how the noise floor changed over time in response to the absence or presence of a SpaceX test satellite transmitting in the Washington state study area.

---

[12] SpaceX, Experimental Special Temporary Authorization at 1, Call Sign WW9XPI, File No. 0519-EX-ST-2024 (eff. Apr. 1, 2024) (authorizing Brewster, WA as a test location); Mike Wall, *SpaceX Launches 1st Batch of 'Direct to Cell' Starlink Satellites (Video)*, Space.com (Jan. 2, 2024), https://www.space.com/spacex-starlink-launch-group-7-9; Will Robinson-Smith, *SpaceX Begins Commercial Direct to Cell Starlink Constellation with Falcon 9 Flight from Vandenberg Space Force Base*, SPACEFLIGHT NOW, (Apr. 6, 2024), https://spaceflightnow.com/2024/04/06/live-coverage-spacex-to-launch-next-6-direct-to-cell-capable-starlinks-on-falcon-9-flight-from-vandenberg-space-force-base/; Letter from Jameson Dempsey, Director, Satellite Policy, Space Exploration Technologies Corp., to Marlene Dortch, Secretary, FCC, ELS File Nos. 2398-EX-ST-2023 (call sign WW9XOX); 2479-EX-ST-2023 (call sign WW9XPI) (Mar. 4, 2024), attached to Letter from David Goldman, Vice President of Satellite Policy, Space Exploration Technologies Corp., to Marlene H. Dortch, Secretary, FCC, GN Docket No. 23-65, IB Docket No. 22-271 (Mar. 7, 2024). SpaceX has since launched an additional 26 satellites in two batches on May 8, 2024, and May 14, 2024, for a total of 38 SpaceX experimental DTC satellites currently in orbit. Will Robinson-Smith, *SpaceX Flies 13 More Direct to Cell Starlink Satellites on Falcon 9 Rocket Launch from Vandenberg SFB*, SPACEFLIGHT NOW (May 8, 2024), https://spaceflightnow.com/2024/05/08/live-coverage-spacex-to-fly-13-more-direct-to-cell-starlink-satellites-on-falcon-9-rocket-launch-from-vandenberg-sfb/; Will Robinson-Smith, *SpaceX Launches 50th Falcon 9 Rocket of 2024 on Starlink Mission*, SPACEFLIGHT NOW (May 8, 2024), https://spaceflightnow.com/2024/05/14/live-coverage-spacex-to-launch-starlink-satellites-on-falcon-9-flight-from-vandenberg-space-force-base/.

In Brewster, Washington, Omnispace deployed a helix antenna with 12 dBi of gain positioned at a 90-degree elevation angle (*i.e.*, to zenith) to capture signals in the 1990-1995 MHz band transmitted from SpaceX's test DTC satellites. The helix antenna was connected to an LNA and then connected to a spectrum analyzer. This setup allowed Omnispace to confirm when the SpaceX test satellites were transmitting in the 1990-1995 MHz band overhead. During this test, terrestrial operations in the 1990-1995 MHz band were not observed, likely because Brewster is a remote, thinly populated location where other bands adequately provide terrestrial wireless coverage. If T-Mobile operates any G block cell sites in the area of Brewster, the company seems to have discontinued those operations for the duration of the DTC test to avoid skewing SpaceX's test results.

Findings. The results of Omnispace's observations of the effects of SpaceX's testing were definitive and unambiguous. The observations showed that when the spectrum analyzer in Brewster confirmed that SpaceX test satellites were transmitting a 5-megahertz carrier in the 1990-1995 MHz band, the spectrum analyzer in Dubai showed that the Omni-F2 satellite detected a noise rise of 2 to 5 dB across the 1990-1995 MHz band. When the spectrum analyzer in Brewster showed the 5-megahertz SpaceX test satellite transmissions had ended, the noise rise observed by Omni-F2 over Asia and recorded in Dubai also stopped, and the noise floor returned to normal levels.

These observations are significant on their face. They also understate the true interference threat SpaceX's experimental tests pose to primary 2 GHz MSS operations.

First, the Omni-F2 MEO satellite at 10,500-kilometer altitude was located more than 17,000 kilometers from the SpaceX test satellite at the time of the observations. This distance is much greater and has a higher path loss than would be experienced by another low-earth orbit satellite operating around 600-kilometer altitude using the 1990-1995 MHz band for uplink operations consistent with the ITU Table of Allocations. Due to Earth limb obstruction of the free space path, such an LEO satellite would see no terrestrial signals from current T-Mobile operation when it was 2,900 kilometers away from the United States. Accounting for only the path loss difference attributed to distance, that LEO satellite would see a noise rise about 15 dB higher than the Omni-F2 MEO satellite observed from a single satellite. The independent analysis of interference to LEO constellations provided by RKF shows that SpaceX downlink operation in the MSS uplink band would make MSS uplink operations in the global band impossible across a large portion of the world.

Second, the interference observed by the Omni-F2 satellite is due to one — or at most two — of SpaceX's test satellites, given the separation of the satellites currently on orbit. If SpaceX's DTC service were ever to be deployed at scale, the aggregate interference from hundreds of DTC satellites visible to MSS LEOs would be hundreds of times greater than the levels seen in this test

and, as mentioned above, would render the band unusable by other MSS operators over large portions of the globe.[13]

Third, because the Omni-F2 satellite is a MEO satellite orbiting at 10,500 kilometers, the angle from the interfering SpaceX test satellite(s) is generally farther off-axis than the angle would be to an MSS LEO satellite. Thus, the off-axis antenna gain from the SpaceX DTC satellites toward MSS LEO satellites is likely to be greater than seen in this test, which will further increase the interference level. In short, the Omni-F2 measurements document harmful interference in a test setup that real-world conditions will only exacerbate.

Fourth, while Omnispace's analysis focused on in-band emissions from SpaceX's experimental test operations on licensed, primary MSS operations in the 1990-1995 MHz band, SpaceX's out-of-band emissions in adjacent bands also produce harmful interference to licensed, primary MSS operations elsewhere in the 2 GHz band. As demonstrated by Omnispace's technical consultant, RKF, SpaceX's non-conforming experimental test operations impair up to 15 megahertz of primary MSS spectrum around the 1990-1995 MHz band segment, or approximately half of all the spectrum the ITU has allocated on a primary basis to 2 GHz MSS operations.

Unauthorized Operations. While operating non-conforming satellite transmissions in a global satellite receive band would create a high risk of interference under almost any deployment scenario, SpaceX has not complied with the express requirements of its experimental authorization. As Omnispace explained in the experimental license file,[14] SpaceX's experimental authorization permits SpaceX to perform experiments from satellites operating consistent with the terms of SpaceX Gen2 Partial Grant, as modified, which limits SpaceX's operating authority to orbital altitudes of 525 kilometers, 530 kilometers, and 535 kilometers, and explicitly prohibits SpaceX from "deploy[ing] any satellites designed for operational altitudes below the International Space Station."[15] Despite the FCC requiring SpaceX to conduct tests between 525 and 535 kilometers, multiple independent authorities and Omnispace's own observations indicate that SpaceX has conducted its experimental operations under WW9XPI at approximately 350-360 kilometers

---

[13] SpaceX's continued deployment and operations of DTC test satellites will only exacerbate the harmful interference conditions its present-day testing has already created.

[14] Letter from Mindel De La Torre to Marlene Dortch, Call Sign WW9XPI, 0519-EX-ST-2024 at n4.

[15] *See, e.g.*, SpaceX, Experimental Special Temporary Authorization, Call Sign WW9XPI, File No. 2479-EX-ST-2023, Condition 2 (eff. Dec. 20, 2023) ("All operations of the Gen2 Starlink satellites must also comport with the Commission's decision in the SpaceX Gen2 Partial Grant, Order and Authorization, FCC 22- 91 (rel. Dec. 1, 2022), and the terms and conditions in the SpaceX Gen2 V-band Grant, ICFS File No. SAT-MOD-20230322-00062 (granted-in part/dismissed-in-part Oct. 13, 2023, reissued Nov. 9, 2023). Except for the addition of testing authority specifically addressed in this grant of STA, operations must also comport with all terms and conditions of the SpaceX Gen2 modification, ICFS File No. SAT-MOD-20230207-00021 (granted-in-part/deferred-in-part December 1, 2023)."); SpaceX, Experimental Special Temporary Authorization, Call Sign WW9XPI, File No. 0519-EX-ST-2024, Condition 3 (eff. Apr. 1, 2024) (same); s*ee also In re Space Exploration Holdings, LLC Request for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System*, Order and Authorization, ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105, 37 FCC Rcd 14882, 14897, 14952-53 ¶¶ 19, 135.bb (rel. Dec. 1, 2022) ("SpaceX Gen2 Partial Grant").

altitude, many kilometers below SpaceX's authorized orbital altitude and contrary to the operating authority the Commission awarded to SpaceX.[16] Although SpaceX sought to obtain FCC authority to operate in the range of 360 kilometers,[17] the Commission has not authorized operations[18] at that altitude and, indeed, on March 8, 2024 reiterated that "*SpaceX may not deploy any satellites designed for operational altitudes below the International Space Station*," which operates between altitudes of 370 and 460 kilometers.[19] Based on May 1, 2024 data drawn from the U.S. Space Force, however, SpaceX operates its satellites many kilometers lower than their authorized locations in the range of 354 to 359 kilometers, well below the International Space Station.[20] Table 1 summarizes the altitude and orbit of the SpaceX test satellite launch in April 2024 as of May 1, 2023, and Table 2 summarizes the altitude and orbit of the SpaceX test satellite launch in January 2024 as of May 1, 2024.

Table 1

Sat. ID	Name	Orbital status	Designation	Name in Spacetrack catalog	Orbit			
59421	STARLINK-11087 [DTC]	in Earth orbit	2024-065-A	STARLINK-11087	354 x 355 km; 53.2°	Visible Passes	All Passes	Close encounters
59422	STARLINK-11090 [DTC]	in Earth orbit	2024-065-B	STARLINK-11090	354 x 355 km; 53.2°	Visible Passes	All Passes	Close encounters
59423	STARLINK-11093 [DTC]	in Earth orbit	2024-065-C	STARLINK-11093	354 x 355 km; 53.2°	Visible Passes	All Passes	Close encounters
59424	STARLINK-11083 [DTC]	in Earth orbit	2024-065-D	STARLINK-11083	353 x 356 km; 53.2°	Visible Passes	All Passes	Close encounters
59425	STARLINK-11085 [DTC]	in Earth orbit	2024-065-E	STARLINK-11085	354 x 356 km; 53.2°	Visible Passes	All Passes	Close encounters
59426	STARLINK-11089 [DTC]	in Earth orbit	2024-065-F	STARLINK-11089	354 x 355 km; 53.2°	Visible Passes	All Passes	Close encounters

Table 2

Sat. ID	Name	Orbital status	Designation	Name in Spacetrack catalog	Orbit			
58705	STARLINK-11072 [DTC]	in Earth orbit	2024-002-A	STARLINK-11072	359 x 360 km; 53.2°	Visible Passes	All Passes	Close encounters
58706	STARLINK-11075 [DTC]	in Earth orbit	2024-002-B	STARLINK-11075	358 x 360 km; 53.2°	Visible Passes	All Passes	Close encounters
58707	STARLINK-11077 [DTC]	in Earth orbit	2024-002-C	STARLINK-11077	359 x 360 km; 53.2°	Visible Passes	All Passes	Close encounters
58708	STARLINK-11079 [DTC]	in Earth orbit	2024-002-D	STARLINK-11079	359 x 360 km; 53.2°	Visible Passes	All Passes	Close encounters
58709	STARLINK-11076 [DTC]	in Earth orbit	2024-002-E	STARLINK-11076	358 x 361 km; 53.2°	Visible Passes	All Passes	Close encounters
58710	STARLINK-11078 [DTC]	in Earth orbit	2024-002-F	STARLINK-11078	358 x 360 km; 53.2°	Visible Passes	All Passes	Close encounters

Inserting and maintaining so many different satellites for use in tests at altitudes hundreds of kilometers away from the altitudes the Commission has actually authorized for experimental

---

[16] *Cf., e.g.*, Jonathan McDowell (@planet4589), X (Mar. 4, 2024, 2:03 AM), https://twitter.com/planet4589/status/1764547101969494427?lang=en (posting a plot of SpaceX test satellite altitudes and noting that "[t]he six test satellites for … direct-to-cell system were launched as part of Group 7-9 in Jan…. [and] are being operated at 360 km").

[17] *See* Letter from David Goldman, Vice President of Satellite Policy, SpaceX to Marlene H. Dortch, Secretary, FCC, ICFS File Nos. SAT-LOA-20200526-00055 & SAT-AMD-20210818-00105 (Feb. 20, 2024).

[18] SpaceX Gen2 Partial Grant ¶ 19 (deferring consideration of SpaceX's proposed satellites at altitudes lower than 525 km).

[19] *Space Exploration Holdings, LLC Request for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System*, Order and Authorization, SAT-LOA-20200526-00055, SAT-AMD-20210818-00105 SAT-AMD-20221216-00175, __ FCC Rcd. __ (Mar. 8, 2024) (emphasis added). SpaceX's subsequent request to operate its direct-to-cellular payloads in the 340 km-360 km altitude shells is likewise still pending. Application of *Space Exploration Holdings, LLC for Modification of Authorization for the SpaceX Gen2 NGSO Satellite System to Add a Direct-to-Cellular System,* ICFS File No. SAT-AMD-20240322-00061 (filed Mar. 22, 2024).

[20] *See* Satellite Database, HEAVENS ABOVE, https://heavens-above.com/Satellites.aspx?lat=0&lng=0&loc=Unspecified&alt=0&tz=UCT (search "*DTC*" for all years of launch and with a satellite number range of 1 to 99999).

operations cannot be dismissed as a mere oversight or a response to dynamic on orbit conditions. SpaceX's operations are at odds with the license and authorization that other operators depend upon to identify hazards to their operations and may pose risks to the safety and sustainability of space, including safety of life on the International Space Station.

The Commission has ample authority to enforce its rules and license conditions,[21] and it has delegated authority to the Space Bureau to "interpret and enforce rules and regulations pertaining to matters under its jurisdiction and not within the jurisdiction of the Enforcement Bureau."[22] The Commission has also sought to sanction licensees with operations far less egregiously at variance from authorized parameters than those SpaceX appears to have used.[23] To the extent the Commission has not already begun investigating SpaceX's operations at variance with its authorized test parameters based on Omnispace's prior submission in SpaceX's experimental license file, Omnispace respectfully requests the Commission do so now.

* * *

The test operations authorized in Call Sign WW9XPI create harmful interference to licensees in the primary 2 GHz MSS service in violation of section 5.84 of the Commission's rules and contrary to multiple special conditions of SpaceX's experimental authorization. Omnispace's latest empirical measurements and RKF's technical analysis corroborate evidence of interference Omnispace previously provided to the Commission in multiple proceedings, including this one. Enforcing conditions that require SpaceX to cease testing due to harmful interference and then investigating SpaceX's well-documented operations at variance from its authorized test parameters will help restore integrity to satellite operations and protect the interests of all stakeholders in the new space economy.

Sincerely,

/s/ Mindel De La Torre

Mindel De La Torre
Chief Regulatory and International Strategy Officer
Omnispace, LLC

---

[21] *See, e.g.*, 47 U.S.C. §§ 309(k), 503(b); 47 C.F.R. § 1.80.
[22] 47 C.F.R. § 0.261(a)(4).
[23] *See, e.g.*, *AT&T Inc., Parent Company of New Cingular Wireless PCS, LLC and AT&T Mobility Puerto Rico, Inc.*, Notice of Apparent Liability for Forfeiture, 30 FCC Rcd 856 (2015) (issuing a notice of apparent liability for forfeiture based on findings that AT&T had changed the antenna height of certain fixed microwave facilities by more than three meters or changed site locations by more than five seconds of longitude or latitude, or roughly 154 meters).

Attachment

cc: Alice Koethe (WTB)
John Lockwood (WTB)
Ira Keltz (OET)
Jessica Quinley (WTB)
Joseph Hill (SB)
Kari Hicks (WTB)
Kathyrn Medley (SB)
Roger Noel (WTB)
Jennifer Gilsenan (SB)
Whitney Lohmeyer (SB)
Jeanine Poltronieri (SB)
Loyaan Egal (EB)
Elizabeth Mumaw (EB)
Jason Koslofsky (EB)
Shannon Lipp (EB)
Kimberly Cook (EB)
Jon Markman (WTB)
Kamran Etemad (WTB)

Omnispace Meeting with the FCC
May 15, 2024

Agenda for Meeting

- Recap of January 7, 2024, interference from the first batch of SpaceX direct-to-cell (DTC or SCS) satellites into Omnispace MEO F2 satellite
  - SpaceX launched the first 6 Starlink DTC satellites on January 2, 2024
  - Omnispace informed the FCC of this interference on January 22, 2024, under the auspices of SpaceX's STA
- April 29, 2024, interference from SpaceX second batch of SpaceX DTC satellites into Omnispace F2 satellite launched on April 6, 2024
- Similarities between the two examples of interference
- RKF Analysis of Starlink-to-Omnispace Satellite-to-Satellite Interference Simulation
- Conclusions

Recap of January 7, 2024 interference from the first batch of SpaceX satellites into Omnispace F2 satellite

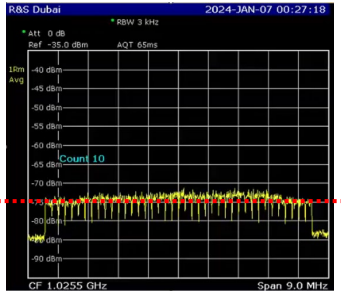
SpaceX launched its first DTC satellites on January 2, 2024, and started testing

- In December 2023, FCC approved testing of the SpaceX Starlink's direct-to-cell (DTC) satellites for 10 days after launch per the FCC's Dec. 14, 2023, STA and Dec. 1 partial grant
  - Because SpaceX would be testing its satellites providing downlink in the 1990-1995 MHz band, which is the global uplink MSS band, Omnispace planned relevant measurements
- SpaceX launched the first 6 Starlink DTC satellites on January 2, 2024 19:44 PST
- SpaceX notified the FCC that testing would commence at 2 locations (Redmond, WA and Mountain View, CA) immediately after launch of the 6 satellites having this capability
  - Omnispace used STK to plot orbits of the SpaceX satellites using public Norad published TLEs
  - On Jan 7, 2024, around 00:28 UCT Omnispace's MEO satellite F2 was flying over Asia at the same time as the 6 SpaceX DTC satellites were coming into view over the test locations on the U.S. West Coast
- F2 measured a significant rise in the noise floor for the several minutes when the SpaceX satellites were expected to be operational
  - The data shows a 5 MHz wide carrier that had characteristics of an LTE carrier
  - The time the carrier was in operation coincided with the pass of the SpaceX DTC satellites over the target test locations
  - The spectrum was quiet before the carrier suddenly appeared
  - The carrier then disappeared, and the band showed a return to normal noise floor

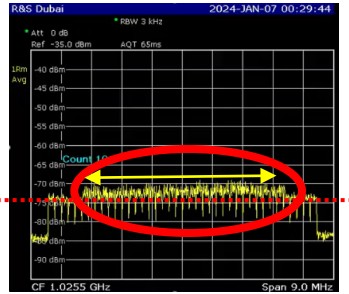
omnispace

Signal Measured by F2 from SpaceX Starlink DTC Operation over the U.S. Jan 7, 2024 from on 01/07/24 @ 00:27:18 to 00:32:55 UTC

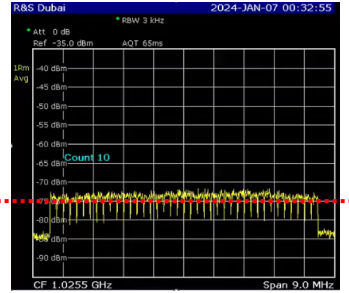
1/7/24 @ 00:27:18



1/7/24 @ 00:28:00



1/7/24 @ 00:32:55

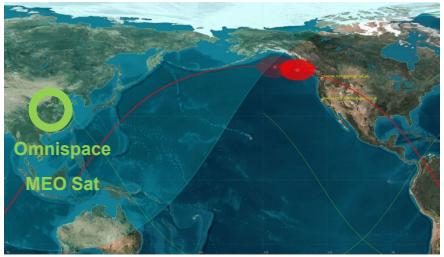


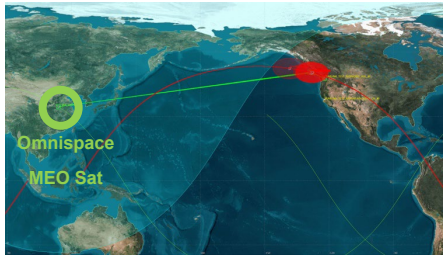
Starlink Signal is ~3-5dB+ above noise floor

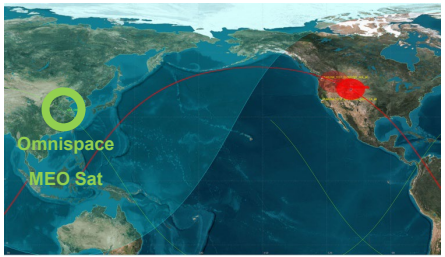
Predicted Starlink Pass Times to Redmond Starlink test site

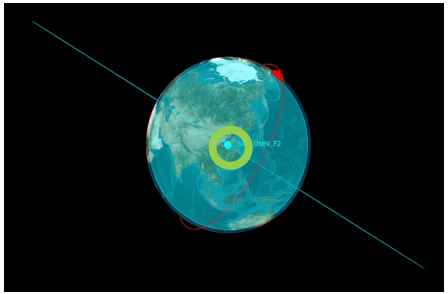
7 Jan 2024 00:27

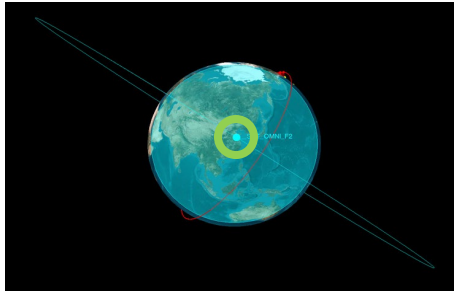
7 Jan 2024 00:32

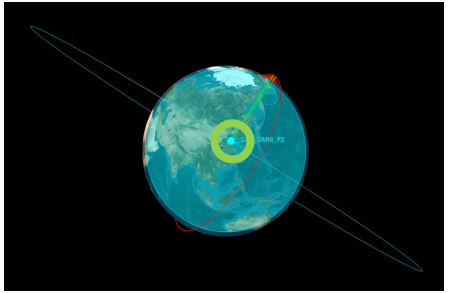






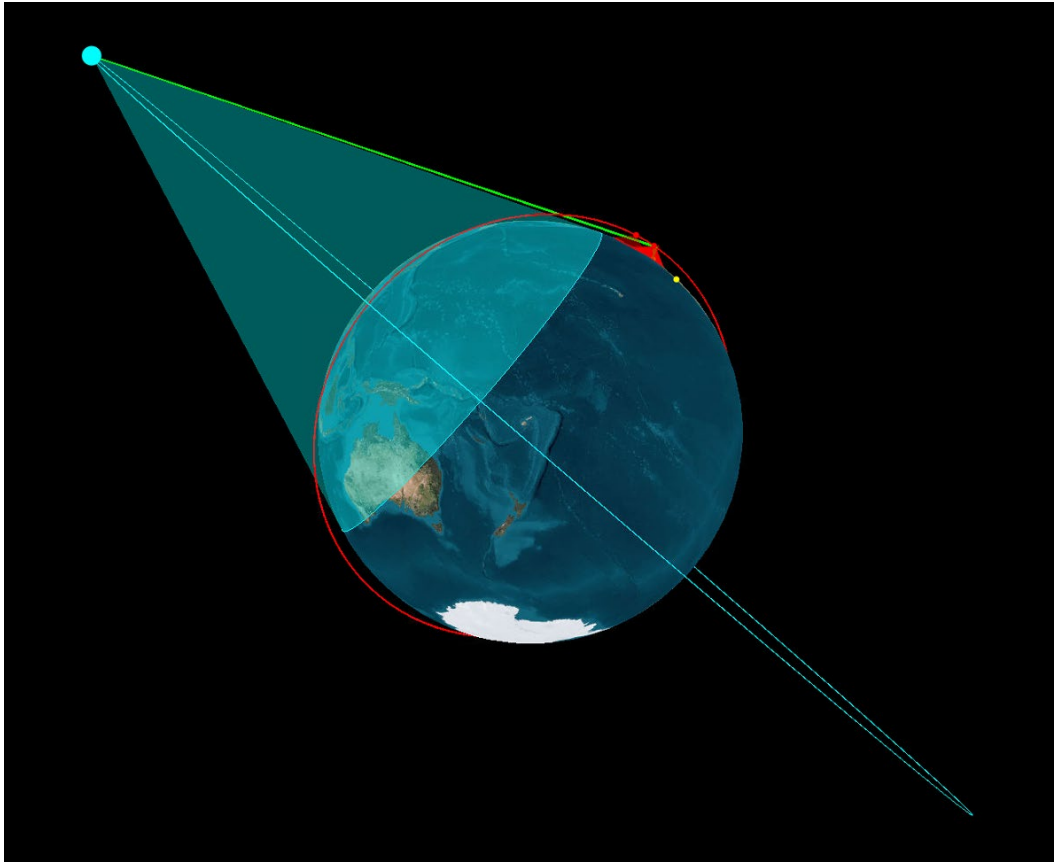






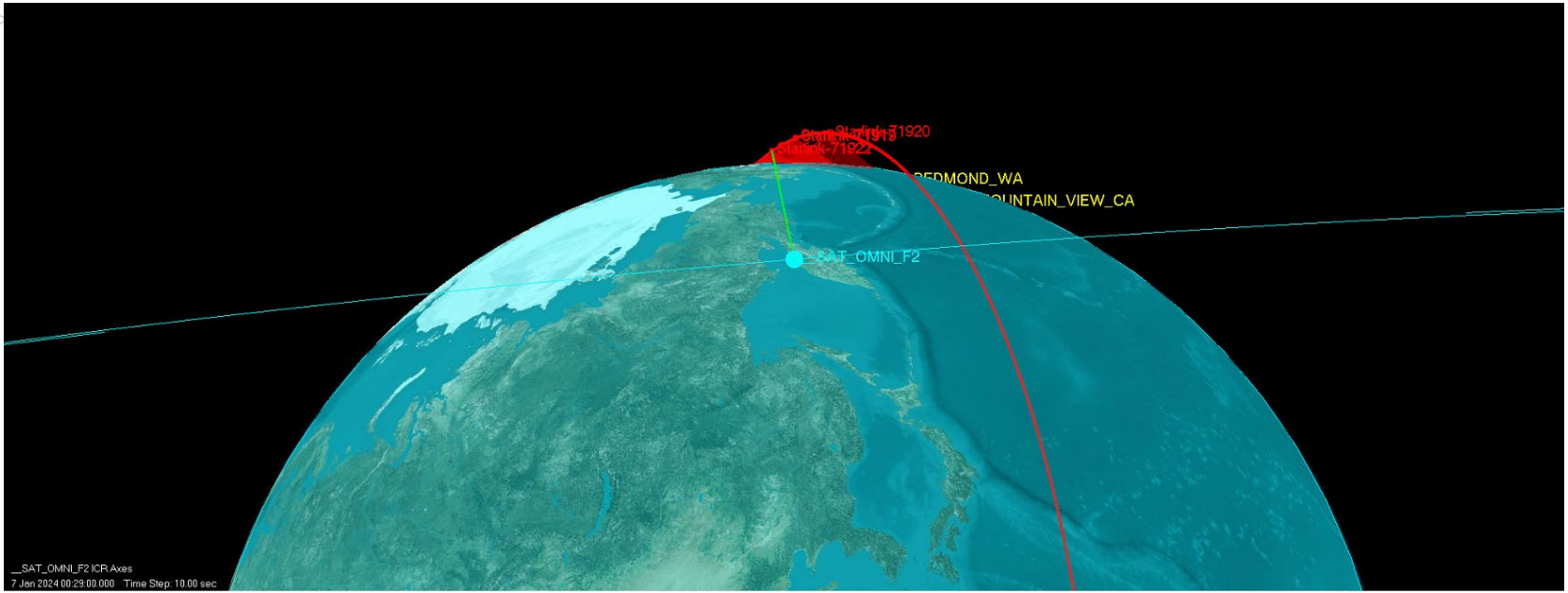
omnispace

F2 Satellite – SpaceX Interference (Jan 7, 2024 00:29 UTC)



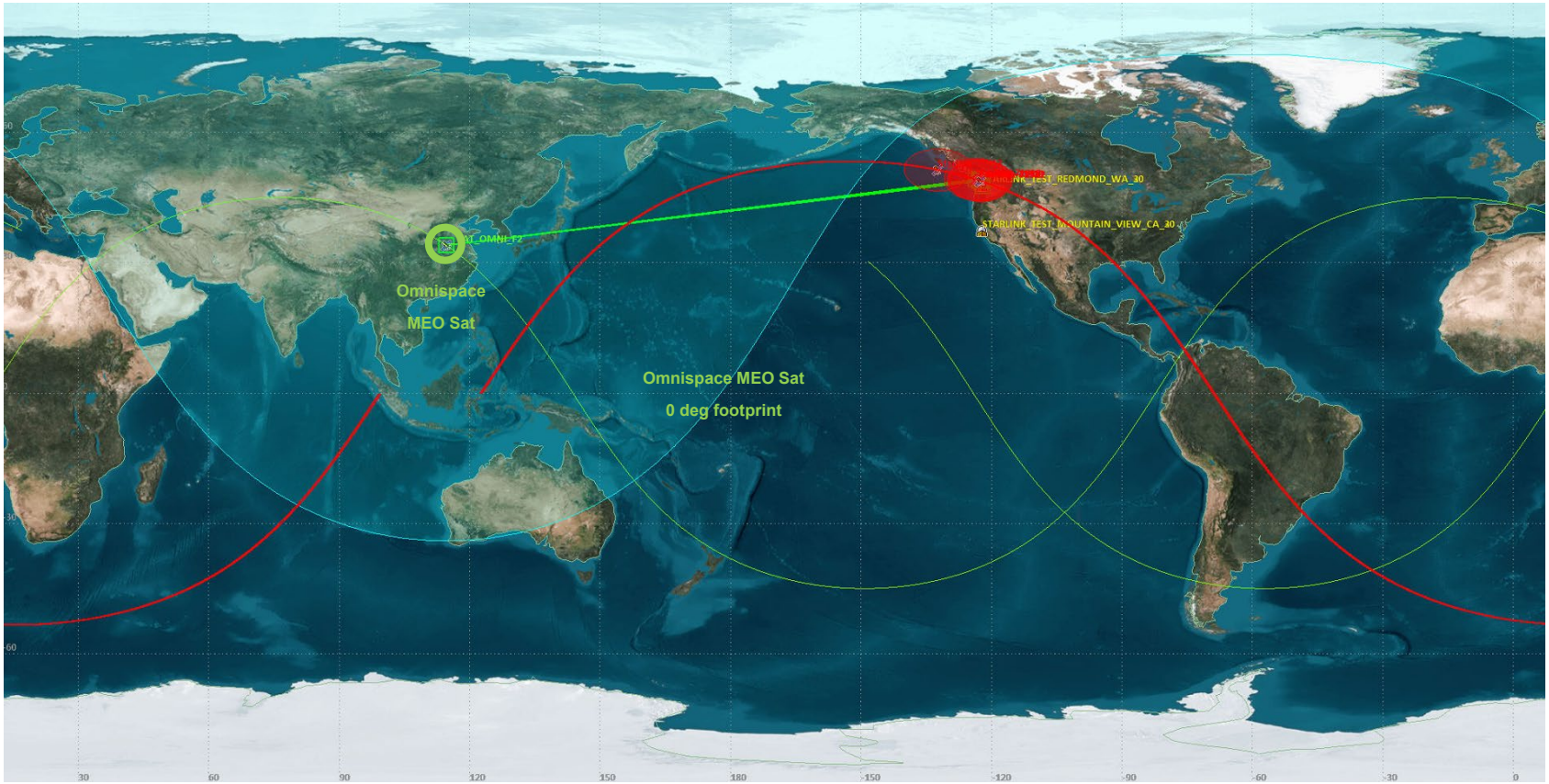
omnispace

F2 Satellite – SpaceX Interference (Jan 7, 2024 00:29 UTC)

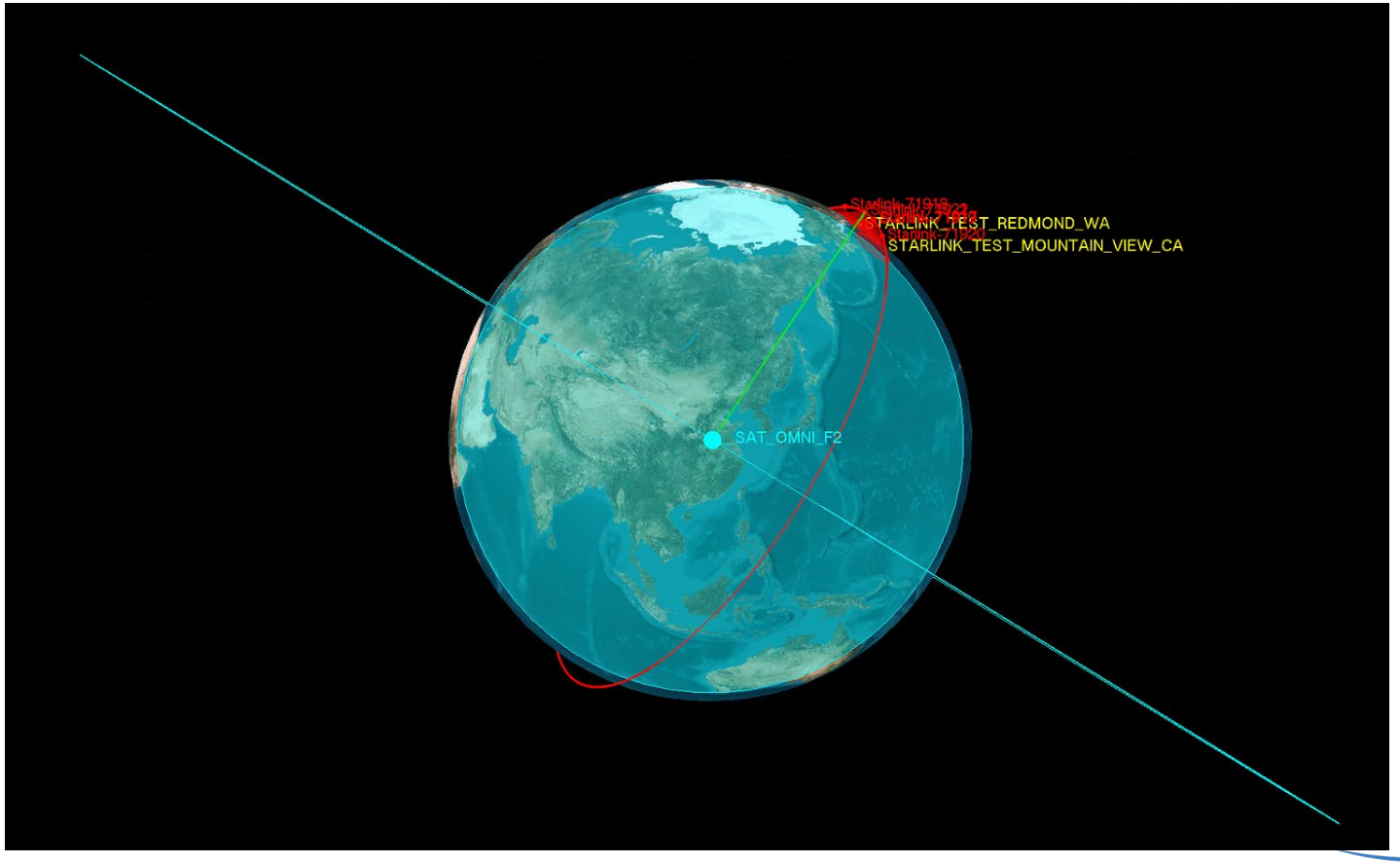


omnispace

F2 Satellite – SpaceX Interference (Jan 7, 2024 00:29 UTC)



F2 Satellite – SpaceX Interference (Jan 7, 2024 00:29 UTC)



omnispace

F2 Satellite – SpaceX Interference (Jan 7, 2024 00:29 UTC)
Distance between satellites

Range Distance from Omnispace F2 Satellite to Starlink DTC Satellites over Redmond, WA

Time (UTCG)	Azimuth (deg)	Elevation (deg)	Range (km)
7 Jan 2024 00:27:00.000	275.963	-66.984	16647.352570
7 Jan 2024 00:28:00.000	274.211	-67.242	17057.231638
7 Jan 2024 00:29:00.000	272.622	-67.578	17469.029028
7 Jan 2024 00:29:57.592	271.238	-67.970	17863.959522

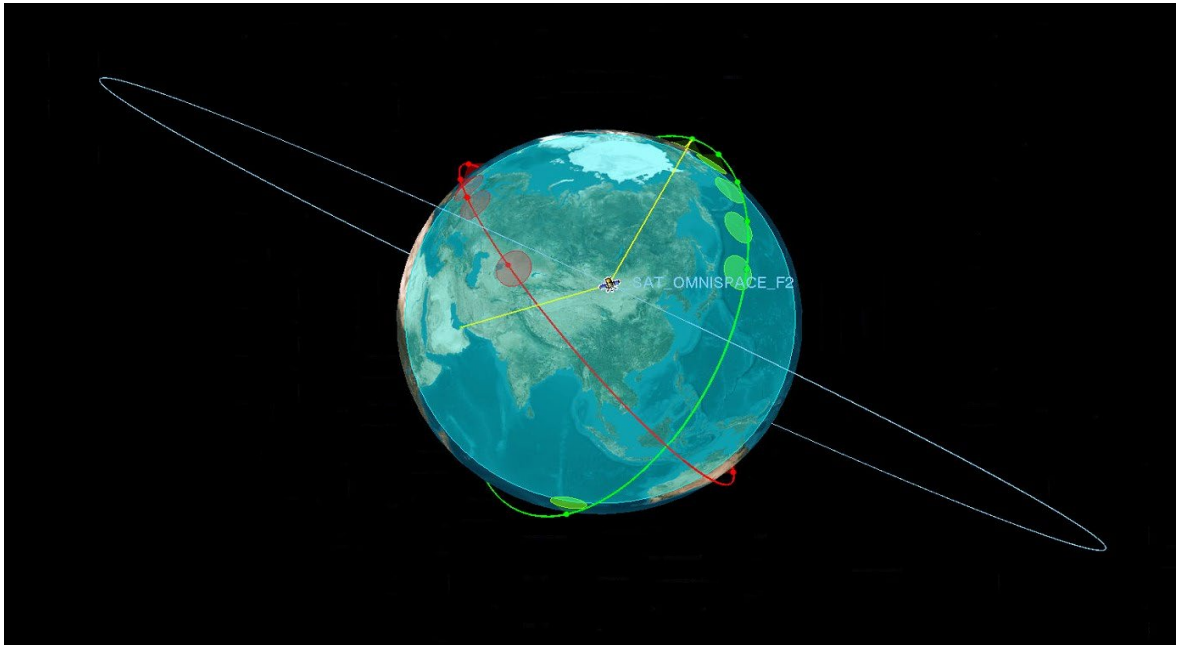
Starlink DTC satellites are in a 360 km, 53.2 deg inclination orbit

Distance from SpaceX DTC satellites to Omnispace F2 MEO satellite that suffered empirical unacceptable interference was over 17,000 km

omnispace

April 29, 2024: interference from SpaceX second batch of SpaceX DTC satellites into Omnispace F2 satellite

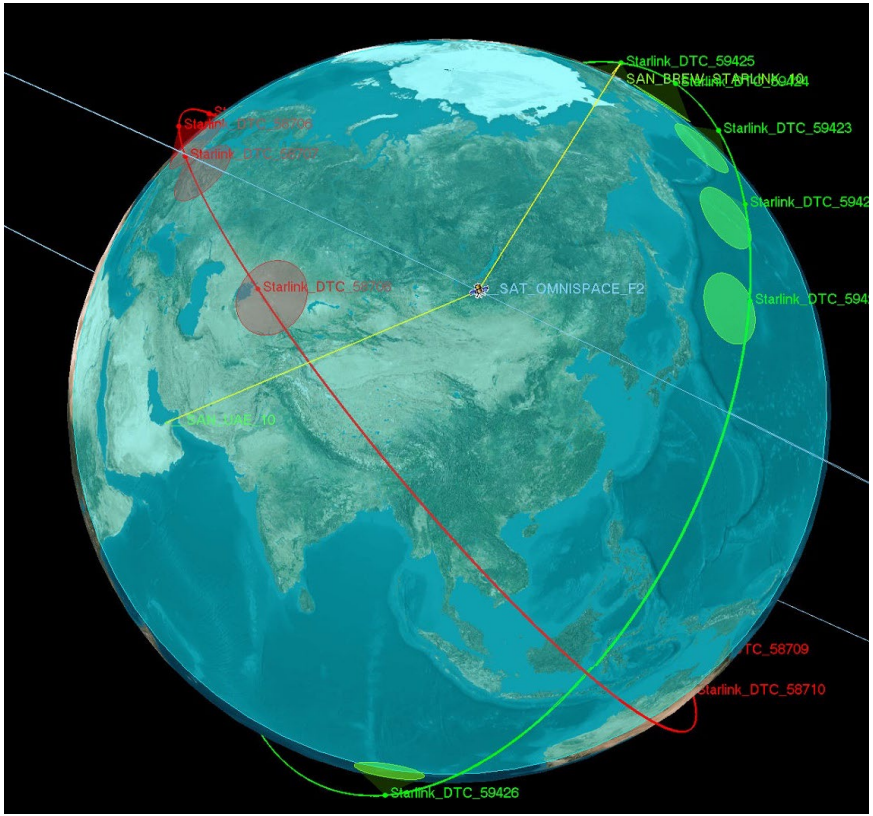
Starlink DTC Interference Example to F2 on 29 April 2024 15:40-15:44 UCT



- The green line with the satellite footprints represents the April 2024 Starlink DTC satellites, and red line represents the January 2024 Starlink DTC satellites
- The light blue area is the F2 MEO footprint
- The yellow lines show the interference path from the Starlink DTC satellite to F2, and the gateway link from F2 to the Omnispace Dubai gateway

omnispace

Starlink DTC Interference Example to F2 on 29 April 2024 15:40-15:44 UCT

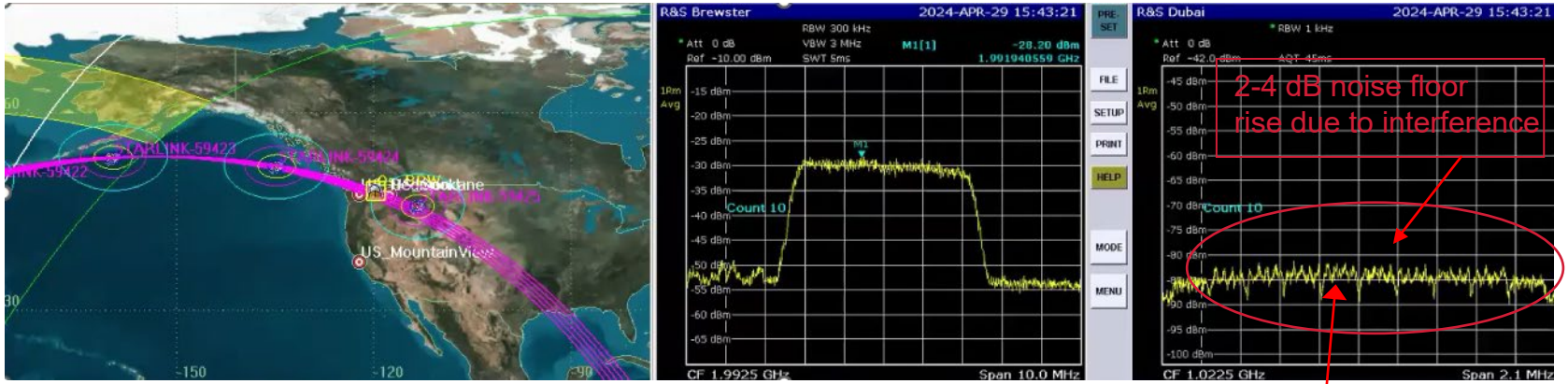


- The green line with the satellite footprints represents the April 2024 Starlink DTC satellites, and the red line represents the January 2024 Starlink DTC satellites
- The light blue area is the F2 MEO footprint
- The yellow lines show the interference path from the Starlink DTC satellite to F2, and the gateway link from F2 to the Omnispace Dubai gateway

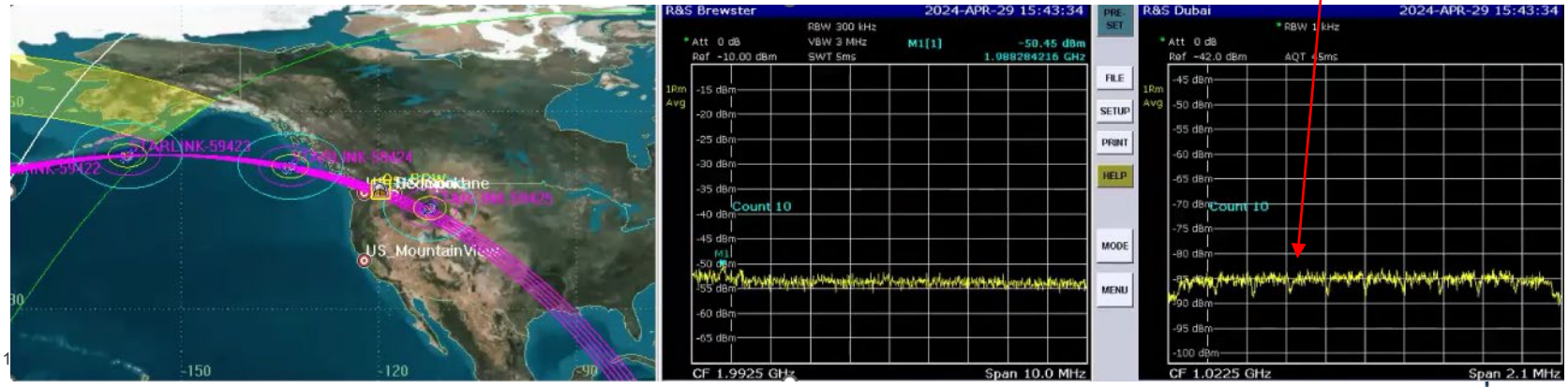
omnispace

Starlink DTC Interference Example to F2 on 29 April 2024 15:40-15:44 UCT

Harmful interference suffered by F2 during Starlink transmission



Harmful interference ceases when Starlink transmissions end



F2 Satellite – SpaceX Interference (29 April 2024 15:40 UTC)
Distance between satellites

Range Distance from Omnispace F2 Satellite to Starlink DTC Satellites over Redmond, WA

Time (UTCG)	Azimuth (deg)	Elevation (deg)	Range (km)
29 Apr 2024 15:39:43.000	274.581	-67.210	17055.4
29 Apr 2024 15:40:43.000	272.108	-67.494	17414.6
29 Apr 2024 15:41:43.000	269.782	-67.841	17779.3
29 Apr 2024 15:42:07.524	268.870	-68.000	17929.5

Starlink April DTC satellites are in a 355 km, 53.2 deg inclination orbit

Distance from SpaceX DTC satellites to Omnispace F2 MEO satellite that suffered empirical unacceptable interference was again over 17,000 km

omnispace

Similarities between the two examples of interference

Similarities Between the Two Examples of Interference

- On January 7, 2024, around 00:28 UCT and on April 29, 2024, around 15:40 UCT Omnispace's MEO satellite F2 was *flying over Asia* at the same time as the 6 SpaceX DTC satellites were coming into view over the test locations on the U.S. West Coast
- U.S. terrestrial G block usage is not visible to F2 as it is blocked by the Earth
- Interference occurred at the time when SpaceX DTC satellites would have been located over an STA identified test location
- Similar separation distance and noise floor rises occur in both examples – the 2 to 5 dB noise floor rise **equals 30-70% degradation** of service link capacity
- For the April interference measurement, Omnispace was able to directly observe SpaceX satellite signals in Washington state occurring *precisely at the same time* as the interference was suffered by F2

Omnispace has confirmed a *single* Starlink DTC satellite creates unacceptable interference levels into its F2 satellite on multiple occasions – future operations of hundreds or thousands of Starlink satellites will render the band unusable by other MSS operators over large portions of the globe

FCC's SCS Report and Order Mandates Operation on a Non-Interference Basis Regarding Existing Satellite Systems

The FCC's SCS Report and Order outlines that SCS cannot cause harmful interference to other countries' operations and FCC licensees must address and eliminate any harmful interference cases immediately:

- *Para. 224: ".. SCS will be authorized pursuant to a secondary MSS allocation in the U.S. Table. Although the operations will be consistent with the U.S. Table, these operations will not conform with the International Table, and resolution of cross-border interference will be governed by ITU Radio Regulation No. 4.4. This provision states that, "Administrations of the Member States shall not assign to a station any frequency in derogation of either the Table of Frequency Allocations in this Chapter or the other provisions of these Regulations, except on the express condition that such a station, when using such a frequency assignment, shall not cause harmful interference to, and shall not claim protection from harmful interference caused by, a station operating in accordance with the provisions of the Constitution, the Convention and these Regulations."*
- *Para. 231: "SCS shall not cause harmful interference to other countries' operations and our licensees must address and eliminate any harmful interference cases immediately.... The cross-border coordination and any negotiated technical parameters must be mutually acceptable to all involved, including our counterpart agencies who oversee or regulate spectrum use in other countries...."*

The interference from Starlink DTC to a mobile satellite service operator like Omnispace is harmful interference pursuant to the FCC's SCS Report and Order

Harmful Interference Defined by the ITU

- **RR Article 1.169 defines** *harmful interference: Interference* which endangers the functioning of a *radionavigation service* or of other *safety services* or **seriously degrades, obstructs, or repeatedly interrupts** a *radiocommunication service* operating in accordance with Radio Regulations (CS).
- The interference suffered by Omnispace's F2 satellite from the Starlink DTC satellites of a 2 to 5 dB noise floor rise **equals 30-70% degradation** of service link capacity meets the definition of harmful interference under RR Article 1.169
- The interference suffered by Omnispace F2 was 2 to 5 dB above noise floor at over 17,000 km – if F2 was only 8,000 km away the noise floor rise would be 8 to 11 dB, a level at which Omnispace would be incapable of operating

The interference from Starlink DTC to a mobile satellite service operator like Omnispace is harmful interference pursuant to the ITU's RR Article 1.69

RKF Analysis of Starlink-to-Omnispace Satellite-to-Satellite Interference Simulation

Assessment of Interference to Authorized MSS Uplinks (1980-2010 MHz) operating outside US territories from SpaceX's MSS Downlinks (1990-1995 MHz) in US territories

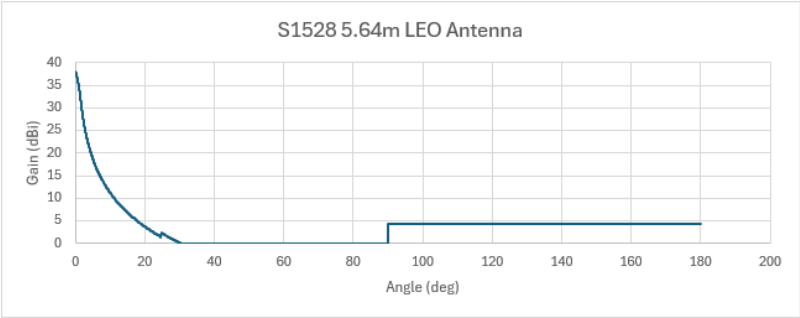
05/15/2025

Starlink Satellite Transmission Model

- Satellite transmit power/beam = 3.6 dBW and up to 43 simultaneous beams
  - PFD limit on ground = -89 dBW/m^2/MHz
  - Satellite max EIRP = 58 dBW (38 dBi peak Gain)
  - Assumed satellite keeps beam power (and PFD) constant for all elevation angles ≥ 30 deg
- Beam Laydown and Satellite Assignment:
  - Uniform laydown of fixed beams over CONUS, HI, AK, and PR
  - Beam diameters: 20 km and 40 km.
  - Selected random 100 Starlink satellite positions from the constellation instances within a 10-year span
  - Assigned beam centers to Starlink satellite with highest elevation angle
- Direct Radiating Array (DRA): 5x5m, Rec. ITU-R S.1528 (recommends 1.3 for LEO)
- OOBE limits: FCC 47 CFR § 25.202

	Plane 1	Plane 2	Plane 3*
Number of satellites	3360	3360	780
Altitude (km)	525	530	535
No. of Planes	28	28	24 4
No. of Satellites per Plane	120	120	28 27
Inclination (deg)	53	43	33

* Plane 3 modeled as 28 planes with 28 satellites/plane

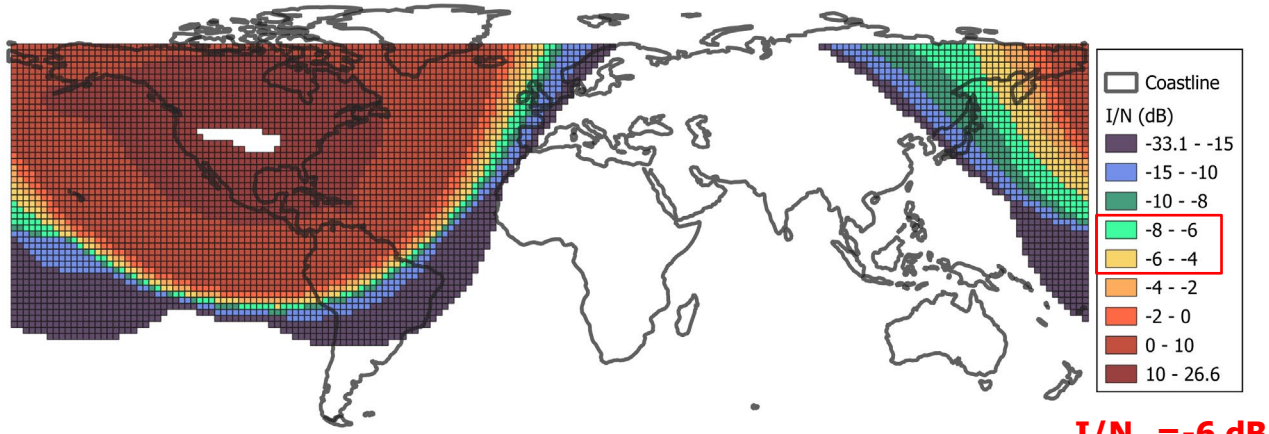


Victim Satellite Model

- Satellites
  - Altitude: 600 km (per 3GPP Rel 17 Set 1 LEO)
  - System noise temperature: 550K
  - DRA diameter: 3m (peak Gain: 36 dBi)
    - Satellite antenna pattern: Rec. ITU-R S.1528-0 (*recommends 1.3* for LEO)
  - **Locations: 2°-by-2° grid over the globe**
  - **Satellites are pointed randomly with elevation angle > 30 deg excluding coverage of US territories (+12 miles off-shore)**
    - PFD toward US territories <-108.8 dBW/MHz/m^2
- Interference Protection Criteria
  - Sharing criteria between MSS are still under study (M.1184-3)
  - Assumed conservative assumptions based on (S.1432, M.1086, Res. 679 (WRC23))
  - **Co-channel interference: I/N < -6 dB**
  - **Adjacent-channel interference: I/N < -20 dB (S.1432)**
  - **Overload limit: -55 dBm (M.1461)**

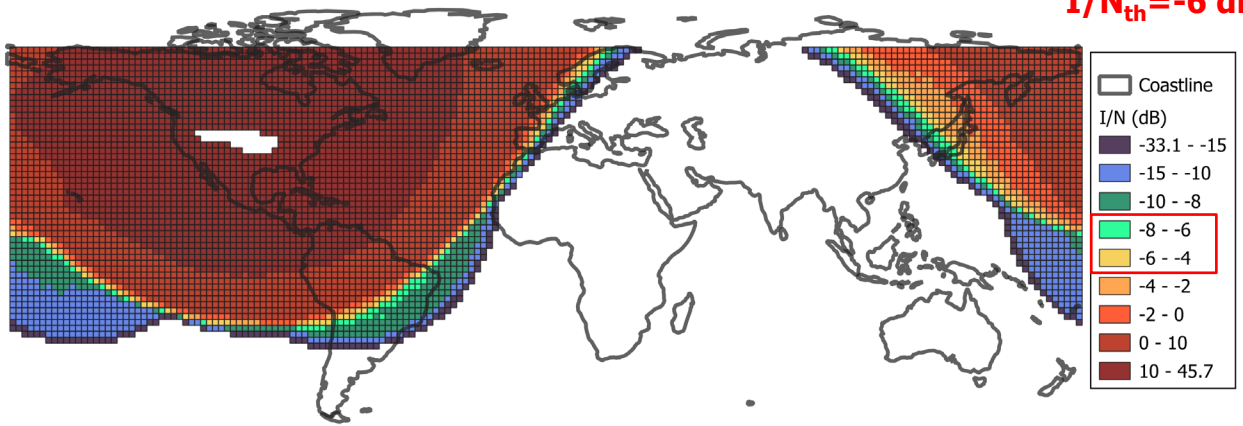
Co-channel interference results

40km Starlink beam diameter
median



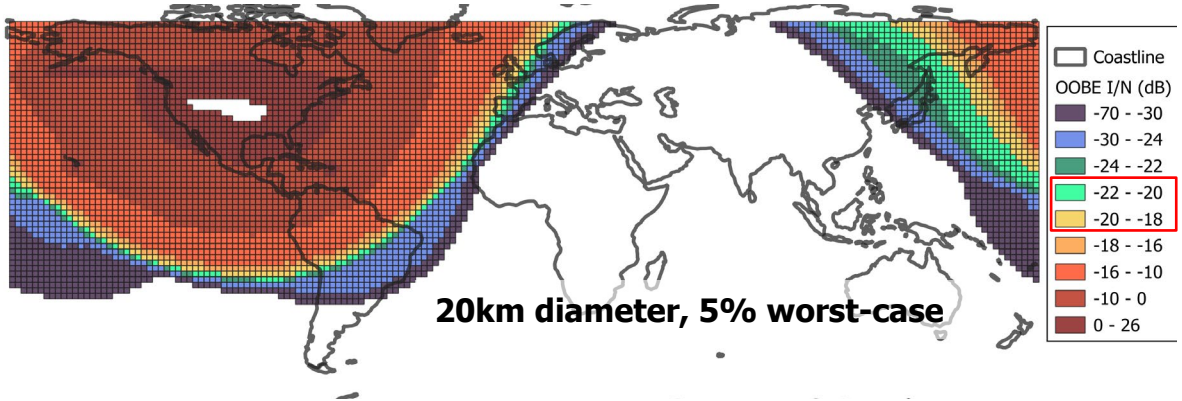
I/N_{th}=-6 dB

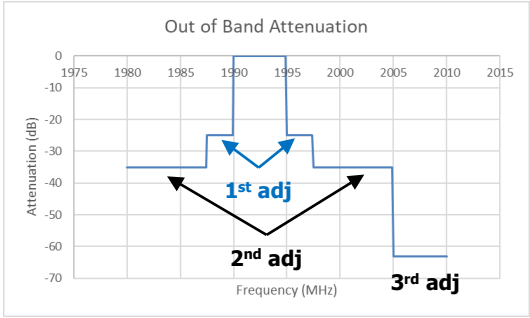
20km Starlink beam diameter
5% worst-case



Adjacent-channel interference results

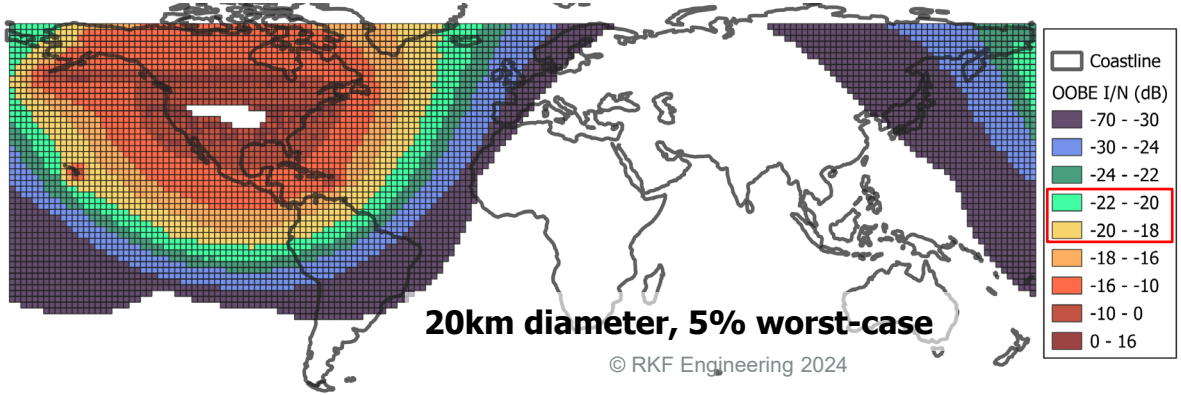
1st adjacent bands: 1987.5-1990 MHz, 1995-1997.5 MHz





I/N_{th}=-20 dB

2nd adjacent bands: 1980-1987.5 MHz, 1997.5-2005 MHz



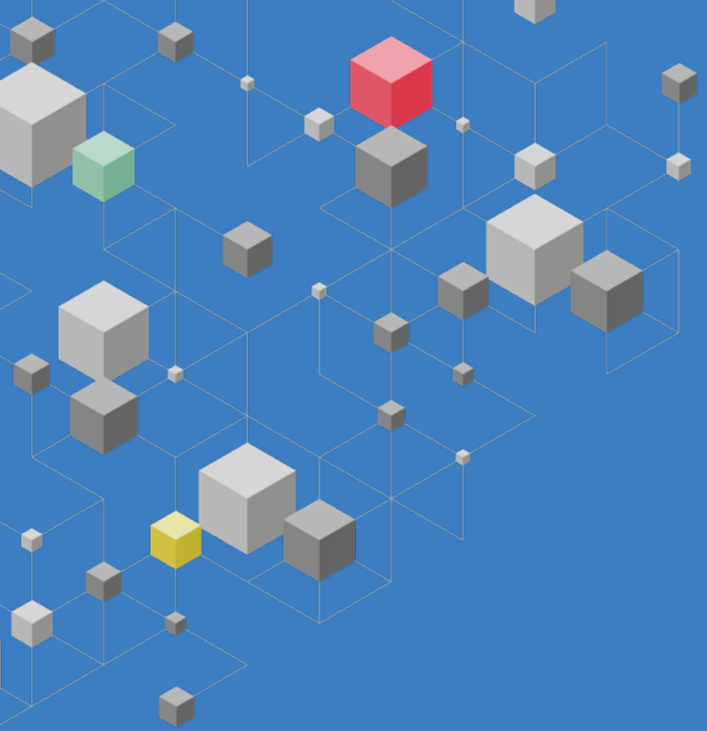
3rd adjacent bands: < 1980 MHz, > 2005 MHz
I/N < -20 dB everywhere

Overload analysis

- Maximum desired power level received at the victim satellite is added to the **max** interference power from Starlink satellites from the 20-km scenario (per Monte-Carlo simulations results).
- This resulted in total received power at victim satellite of -55.94 dBm which is below but close (with low probability) to the estimated overload limit of -55 dBm.

Conclusion

- Study finds significant in-band (1990-1995 MHz) interference risk.
- Co-channel aggregate I/N exceeds -6 dB in parts of South America, UK and Japan
- Study also finds that there can be significant interference into the 2.5 MHz on each side of the 1990-1995 MHz band, rendering the adjacent 5-MHz channel blocks unusable.
- Since 5 MHz channels are needed for 5G Non-Terrestrial Network, this results in a total of 15 MHz of spectrum being impacted by Starlink operations.
- The risk of overloading the victim satellite is low.



Omnispace Conclusions

Omnispace Conclusions

- Omnispace has shown empirically that unacceptable interference is caused by *a single* Starlink DTC satellite to an existing MSS system operating consistent with ITU MSS allocations at a distance of 17,000 km from the Starlink test bed
  - The first instance was when Starlink was testing only 6 DTC satellites using the 1990-1995 MHz band for the downlink when the global MSS allocation is for uplink operations
  - The second instance was when Starlink was testing its second batch of satellites (total of 12)
- Both Omnispace and RKF have confirmed analytically, with the RKF study including a Monte Carlo analysis, that the interference is pervasive over large portions of the globe
- Repeated requests by SpaceX to “coordinate” have no legal basis as the Starlink DTC satellite G block use is not compliant with the ITU Radio Regulations, therefore operational systems like Omnispace that are compliant with the ITU RR do not have an obligation to coordinate
  - Because the use of the G block by SpaceX is in derogation of the ITU RR, Article 4.4 applies as well as Article 15, and the non-compliant system (SpaceX) must mitigate the harmful interference that Omnispace is reporting

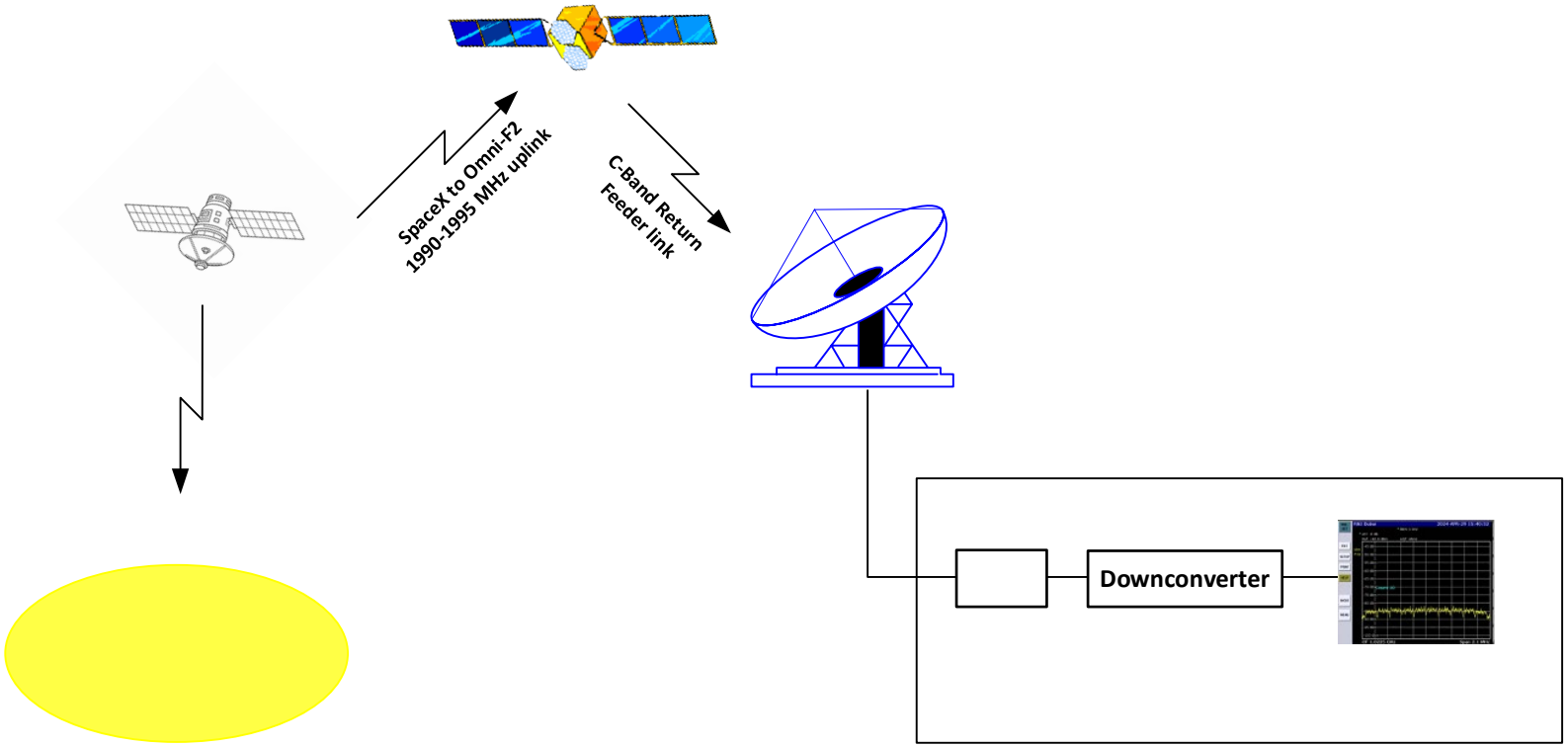
Omnispace Conclusions (Continued)

- In FCC filings, SpaceX has acknowledged that it has a broad range of spectrum bands that would be available to it for DTC, for example:
  - 3GPP Band 25 in Canada: 1850-1855 MHz UL/1930-1935 MHz DL
  - 3GPP Band 1 in Japan: 1920-1925 MHz UL/2110-2115 MHz DL
  - 3GPP Band 3 in New Zealand: 1780-1785 MHz UL/1875-1880 MHz DL
  - 3GPP Band 7 in Australia: 2550-2555 MHz UL/2670-2675 MHz DL
- With the exception of the 1930-1935 DL in Band 25, these and other bands would not interfere with ITU MSS allocations
  - 3GPP Band 66 (1710-1780 MHz UL/2110-2200 MHz DL) is an additional option
- If SpaceX was required to use one of these other bands in the United States instead of the G block, there would be no interference into global MSS operations

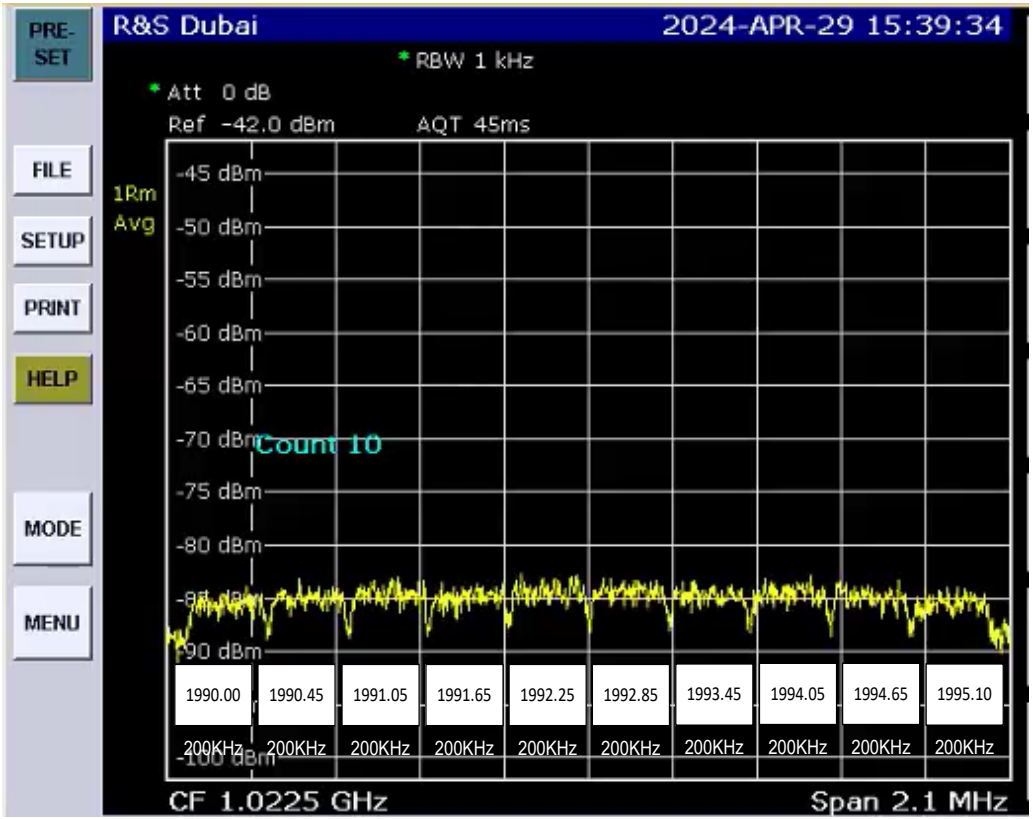
Thank you

Annex:
29 April 2024 Starlink DTC Interference Test Setup

Dubai gateway configuration



Dubai gateway spectrum plot of test beam channels



omnispace