

Capella Non-Geostationary Orbit Satellite Block 4 Modification
Attachment B

Waiver Requests

Pursuant to Section 1.3 of the Commission’s rules, the Commission may waive its rules for good cause shown.¹ “Waiver is appropriate if special circumstances warrant a deviation from the general rule and such deviation would better serve the public interest than would strict adherence to the general rule,” including “more effective implementation of overall policy.”² In determining whether to waive its rules, the Commission should “take into account considerations of hardship, equity, or more effective implementation of overall policy.”³ As shown below, there is good cause for the Commission to grant a waiver of Sections 2.106, 25.202(g)(1), and 25.217(b) of its rules, and, to the extent necessary, various limitations in the Commission’s Form 312 Schedule S.

I. Waiver of U.S. Table of Frequency Allocations

Capella satellites will communicate with Inmarsat satellites using a spaceborne Inmarsat BGAN terminal operating in L-Band spectrum licensed to Inmarsat for its normal operations. Specifically, the BGAN terminal installed on Capella spacecraft will receive in the 1525.0-

¹ 47 C.F.R. § 1.3. *See also WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969), *cert. denied*, 409 U.S. 1027 (1972); *Northeast Cellular Telephone Co., LP v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990).

² *GE American Communications, Inc.*, Order and Authorization, 16 FCC Rcd. 11038, ¶ 9 (Int’l Bur. 2001).

³ *WAIT Radio*, 418 F.2d at 1159.

1559.0 MHz band and transmit in the 1626.5-1660.0 MHz band. These are bands that the Commission has authorized for regular communications between U.S.-licensed earth stations and Inmarsat’s MSS satellites.⁴ Capella already operates satellite-to-satellite links as described herein⁵ — in both the uplink and downlink directions — with no reports of interference, confirming that these transmissions will not cause harmful interference to other operators.

These satellite-to-satellite communications will allow Capella to relay customer satellite tasking and imagery collection requests immediately so that they can be acted upon without the need to wait until the appropriate satellite is within view of a Capella earth station, as would be required for other TT&C operations. This will serve the public interest by allowing Capella to provide a more responsive and capable synthetic aperture radar (“SAR”) system to users in the U.S. and internationally. Among other things, these rapid tasking capabilities will be critical for maximizing the responsiveness of the Capella imaging platform to support rapid imaging for U.S. government requirements, humanitarian disaster relief efforts, as well as reactive imaging capabilities for governmental and other users.

The Commission’s rules and the ITU Radio Regulations define “intersatellite service” as a radiocommunication service providing links between satellites.⁶ Section 25.279(a) of the Commission’s rules states that space stations may use frequencies in the inter-satellite service, as indicated in Section 2.106, and other frequencies where inter-satellite links are part of the service definition.⁷ The definition of MSS, in turn, includes radiocommunication service “between space

⁴ See, e.g., *Inmarsat Inc.*, Order, 23 FCC Rcd. 15268 (2008) (establishing ISAT list to streamline earth station licensing). Capella recognizes that the 1544-1545 MHz and 1645.5-1646.5 MHz bands are reserved for distress and safety communications only. See 47 C.F.R. § 2.106, nn. 5.356, 5.375.

⁵ See Grant of Authority, SAT-LOA-20200914-00108 (granted Dec. 17, 2020); Capella Experimental Authorization, call sign WL2XAD (granted June 26, 2020).

⁶ See 47 C.F.R. § 25.103; Int’l Telecomm. Union, Reg. 1.22, *Radio Regulations*, at 8 (2020).

⁷ See 47 C.F.R. § 25.279(a).

stations used by this service,”⁸ thereby permitting frequencies allocated to MSS to be used for inter-satellite links. However, the Table of Frequency Allocations specifies a directional limitation on MSS operations in the L-band — i.e., either space-to-Earth (1525-1559 MHz) or Earth-to-space (1626.5-1660.0 MHz). The best interpretation of the Commission’s rules is that Section 25.279(a) controls and authorizes the proposed intersatellite communications. However, it could be argued that, because transmissions would neither originate nor terminate on Earth, the directional limitations in the Table of Allocations would render inter-satellite service a non-conforming use of these bands. Accordingly, out of an abundance of caution, Capella requests a waiver of Section 2.106 to allow communications between its spacecraft and Inmarsat satellites.

The tasking capabilities that these satellite-to-satellite communications will support will primarily involve data transmitted to the Capella satellite via the satellite-to-satellite link in the 1525-1559 MHz band. The signals will be transmitted by Inmarsat satellites with the same technical parameters that Inmarsat would use to communicate with its authorized MSS terminals on the Earth’s surface. Capella satellites will not transmit in this band. Thus, because these transmissions are indistinguishable from other Inmarsat network traffic with respect to other terrestrial and space-based systems, they do not present a risk of harmful interference.

The Capella satellite will also make a limited number of transmissions in the 1626.5-1660 MHz bands. These transmissions will occur only on frequencies that Inmarsat assigns to the spaceborne Inmarsat BGAN terminal onboard the Capella satellite. As with its other operations, Inmarsat will assign channels to Capella satellites consistent with its coordination agreements with other operators in the band, ensuring that no other licensee will be transmitting at the same

⁸ See *id.* § 25.103.

time and on the same frequency as a Capella space-to-space transmission, thereby preventing harmful interference.

Moreover, these transmissions will be limited and would be highly unlikely to cause harmful interference even if they had not been pre-coordinated with other operators in the band. The primary anticipated use of this “uplink” is merely to acknowledge receipt of tasking requests and other data delivered via the satellite-to-satellite “downlink” (i.e., transmissions from Inmarsat satellites). In addition, these space-to-space uplink capabilities will be used to provide critical health and status telemetry periodically, when no ground station is available. The communication protocol the link uses is designed to transmit the minimum amount of information necessary and only actively transmit when there is information to send. When no data is queued for transmission, the link will remain inactive. Thus, Capella anticipates that any space-to-space transmissions from the Capella satellite will be brief and infrequent, preventing any harmful interference to other operators even absent the time- and frequency-based coordination built into Inmarsat’s channel-assignment process.

As a result, these intersatellite transmissions will not result in any additional interference. In considering requests for such non-conforming spectrum uses, the Commission has indicated that it would generally grant waivers “when there is little potential for interference into any service authorized under the Table of Frequency Allocations and when the non-conforming operator accepts any interference from authorized services.”⁹ Capella acknowledges that, to the extent they require a waiver of the Table of Allocations, these satellite-to-satellite

⁹ *Fugro-Chance, Inc.*, Order and Authorization, 10 FCC Rcd. 2860, ¶ 2 (Int’l Bur. 1995) (authorizing non-conforming MSS in the C-band); *see also, e.g., Motorola Satellite Communications, Inc.*, Order and Authorization, 11 FCC Rcd. 13952, ¶ 11 (Int’l Bur. 1996) (authorizing service to fixed terminals in bands allocated to MSS).

communications will occur on an unprotected, non-interference basis. Additional discussion and analysis regarding the minimal interference potential of these operations to other authorized spectrum users, including operators in adjacent bands, is provided in the Technical Attachment provided with this application.

Finally, Capella requests a waiver of the Commission's Table of Allocations to permit earth-to-space transmissions used to calibrate Capella's synthetic aperture radar systems to further improve the quality of Capella SAR data. As discussed in greater detail in the Technical Attachment included with this application, these operations are exceedingly unlikely to cause harmful interference to other operators, including operators in adjacent bands. These operations will be limited to brief periods of transmission of a low power signal from the ground to the spacecraft. Because these transmissions will be extremely brief, occur only over a limited time after deployment, and be directed towards the Capella satellite, they present little risk of harmful interference to other systems.

II. Waiver of U.S. Table of Allocations and Section 25.202(g)(1) for TT&C Operations in the 2025-2110 MHz band

Section 25.202(g)(1) anticipates that satellite systems will conduct TT&C operations using spectrum at the edge of or within their assigned bands.¹⁰ Capella proposes to conduct its TT&C uplink transmissions at 2035-2037 MHz — spectrum in which non-federal Earth-to-space transmissions may be authorized for EESS operations subject to conditions on a case-by-case basis and on a non-harmful interference basis.¹¹ Capella intends to operate on such a basis, but

¹⁰ See 47 C.F.R. § 25.202(g)(1).

¹¹ See *id.* § 2.106, n. US347.

will use the spectrum solely for TT&C. In this case, waiver is appropriate due to the unusual spectrum usage of the Capella system.

Specifically, Capella uses spectrum to take radar images of the Earth. Although its satellites must process a return echo from these transmissions, they do not need an uplink channel to carry commercial communications typical of most satellites. Thus, there is no assigned uplink band for customer traffic, and therefore no band edge at which to conduct TT&C operations in accordance with Section 25.202(g)(1). Indeed, the only uplink spectrum used by the Capella system is for TT&C itself.

For similar reasons, to the extent necessary, Capella hereby requests a waiver of the U.S. Table of Allocations. If the Capella system made use of uplink transmissions for its EESS operations, those operations would be consistent with the EESS (Earth-to-space) allocation in the 2025-2110 MHz band, subject to the conditions outlined above. Under those circumstances, Capella's TT&C operations could have occurred within that service band, consistent with Section 25.202(g)(1) and the U.S. Table of Allocations.

However, because Capella's uplink operations are TT&C only, whether these operations are consistent with the EESS (Earth-to-space) allocation may be unclear. Thus, Capella hereby requests a waiver of the U.S. Table of Allocations to the extent necessary to authorize TT&C-only operations in support of Capella's EESS system within the 2035-2037 MHz portion of the 2025-2110 MHz band. These TT&C-only operations plainly have less potential to cause interference than they would if they were combined with service uplink traffic. In addition, Capella acknowledges that such operations are subject to such conditions as the FCC may apply on a case-by-case basis and may not cause harmful interference to Federal and non-Federal stations operating in accordance with the Table of Frequency Allocations.

III. Waiver of Limitations in Schedule S and Section 25.114(c)

As required by the Commission's rules,¹² Capella has submitted with this application a completed Schedule S, which contains certain technical information in a prescribed form. Capella has found that it cannot accurately describe its system in certain respects due to limitations in Schedule S itself. Below we discuss several aspects of the system that fall into this category, as well as how the associated Schedule S was completed in light of these limitations. To the extent necessary, Capella requests that the Commission waive these aspects of the requirement to complete Schedule S.

First, Section 25.114(c)(4)(v) requires both the minimum and maximum saturation flux density ("SFD") values for each space station receive antenna that is connected to transponders. The concept of SFD only applies to "bent pipe" satellite systems, and thus is not relevant to the Capella system. However, the Schedule S system does not allow an entry of "not applicable." Instead, it requires a numerical entry for SFD, which must include different maximum and minimum values. In order to accommodate this requirement, Capella has entered values of "0" and "-0.1" in Schedule S with respect to these parameters.

Second, as noted in Capella's Technical Attachment, Capella is unable to provide a precise value for the right ascension of the ascending node ("RAAN") for the satellites described in this application. Capella has provided a possible value for this parameter on the Schedule S and elsewhere in this application. However, this parameter is very sensitive to specific launch details, including timing, which are not under Capella's control as a "ride share" launch customer and remain subject to change. Accordingly, as with other NGSO operators with similar launch

¹² See 47 C.F.R. § 25.114(a)(1).

agreements, Capella will be unable to provide a specific RAAN value until much closer to the planned launch date. Because Capella has provided a potential RAAN value, waiver of the relevant portions of Schedule S and Section 25.114(c)(6)(viii) is unnecessary. However, if the Commission deems such a waiver necessary, the public interest would strongly favor it, as such a waiver is necessary to allow operators such as Capella to take advantage of lower-cost launch opportunities. Waiver of this rule would also present few, if any, public interest harms. Because the RAAN of NGSO satellites precesses with each orbit, this parameter, even when it can be provided, is only accurate for a single epoch date. Thus, for the Capella system, this parameter is of extremely limited use in interference analyses and has no material impact on orbital debris analyses. Accordingly, the Commission should waive requirements to specify RAAN in 25.114(c)(6)(viii) and on the Schedule S, and proceed with processing Capella's application while permitting Capella to defer submission of the final RAAN parameter until it is known with certainty.

Third, Schedule S requires completion of the field "Polarization Alignment Relative to the Equatorial Plane" for antennas with linear polarizations such as Capella's SAR emitter. However, due to Capella's orbital and operational characteristics — in particular, the fact that the Capella system is an NGSO, not a GSO system — Capella's satellites will not operate with a consistent alignment relative to the equatorial plane. Thus, Capella has entered a value of 0 for this parameter.

Fourth, Capella's payload downlink beam at 8043.75–8381.25 MHz has a switchable polarization between LHCP and RHCP. However, Schedule S does not permit this information to be correctly entered. Thus, Capella has completed that form to indicate only LHCP polarization.

Fifth, Schedule S requires submission of a channel plan for each transmit and receive beam. However, as explained in Capella’s Technical Attachment, Capella’s space-to-space links will operate on channels, and with bandwidths, specified by Inmarsat. Accordingly, it is not possible for Capella to provide a specific channel plan beyond the information provided in the Technical Attachment. Therefore, for each space-to-space beam, Capella has entered information for only a single channel on Schedule S, which will not be representative of Capella’s anticipated operations. Likewise, because PFD and EIRP density of Capella’s space-to-space transmissions will vary depending on bandwidth, Capella has provided the worst-case EIRP density and PFD values on Schedule S.

Sixth, Schedule S does not appear to permit a two-digit value for the field “Active Service Arc End Angle,” making it impossible to properly represent full-arc coverage (i.e., 0-360 degrees). Capella has entered 0 for both begin and end values in light of this limitation to reflect full-arc coverage.

Seventh, Capella has provided information on Schedule S corresponding to two possible operational modes of its SAR beam, with minimum and maximum transmissions bandwidths. This is necessary to accurately specify both the maximum power flux density and maximum channel bandwidth. The beams labeled SAR1 and SAR2 reflect these different operating modes with SAR1 indicating the narrowest bandwidth and highest power density at which Capella proposes to operate, while SAR2 indicates the widest bandwidth and lowest power density. For the avoidance of doubt, these represent two operating modes of a single beam, and do not indicate that the Capella satellite plans to operate multiple SAR beams.

Finally, the transmissions associated with Capella’s ground-based calibration procedures cannot be captured on the associated Schedule S because they transmit only from the ground.

The appropriate technical information about these transmissions is provided in the Legal Narrative and Technical Narrative attached to this application.