

Before the
Federal Communications Commission
Washington, DC 20554

Application of

Capella Space Corp.

For Modification of Authorization
for the Capella Non-Geostationary
Orbit Satellite System

Call Sign: S3073

File No SAT-LOA-20200914-00108

**Application of Capella Space Corp. for Modification of
Authorization for the Capella Non-Geostationary Orbit Satellite
System**

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Table of Contents

I. Grant of the proposed modification would serve the public interest by helping Capella meet the diverse needs of its customers.....	2
II. The Proposed modification would not cause interference to other systems or limit the Capella satellites' ability to share spectrums.....	2
III. Small satellite certifications.....	6
IV. Orbital debris mitigation.....	6
V. Other matters	6
A. NOAA authorization	6
B. ITU compliance	7
VI. Conclusion	7

**Application of Capella Space Corp. for Modification of Authorization to
Launch and Operate the Capella Non-Geostationary Orbit Satellite System**

Capella Space Corp. (“Capella”) hereby requests modification of its existing license to launch and operate the Capella-2, -3, and -4 satellites. Specifically, Capella seeks to operate the synthetic aperture radar (“SAR”) beam of each of these currently authorized satellites¹ at narrower bandwidths and, thus, higher EIRP densities and power flux densities than described in the materials associated with the respective application.

A completed Form 312 and accompanying Schedule S are included with this application to provide the information required by the Commission’s rules. Other pertinent information is provided in the underlying, previously filed application pursuant to 47 C.F.R. 25.117(c). Capella incorporates by reference the application SAT-LOA-20200914-00108, which granted Capella with the authority to launch the Capella-2, -3, and -4 satellites. Capella hereby certifies that any information not updated in this modification application remains unchanged. Capella further certifies that this modification will not diminish Capella’s ability to share spectrum, as detailed below. This application is submitted under the Commission’s streamlined licensing procedures governing small satellites.²

¹ *Capella Space Corp. Application for Satellite Space Station Authorization*, IBFS No. SAT-LOA-20200914-00108, Call Sign S3073 (granted Dec. 17, 2020).

² 47 C.F.R. 25.122. *See also Streamlining Licensing Procedures for Small Satellites*, 34 FCC Rcd. 13077 (2019) (“*SmallSat R&O*”).

I. Grant of the proposed modification would serve the public interest by helping Capella meet the diverse needs of its customers

The Capella system is optimized for high bandwidth imaging which produces finely detailed, high resolution SAR images. There are also, however, important customer use cases where a narrower SAR bandwidth can be helpful because imaging with a narrower bandwidth can offer a wider field of view. The Capella satellites' onboard systems have the flexibility to dynamically adjust the SAR bandwidth to meet these differing customers objectives.

Therefore, to take full advantage of these capabilities, Capella requests authorization to transmit with the following parameters:

Minimum Bandwidth: 10 MHz

Maximum EIRP Density: -6.00 dBW/Hz

Max EIRP: 76.0 dBW (unchanged)

Maximum Power Flux Density (dBW/m²/4 kHz):

$0^{\circ}\text{-}5^{\circ}$	$5^{\circ}\text{-}10^{\circ}$	$10^{\circ}\text{-}15^{\circ}$	$15^{\circ}\text{-}20^{\circ}$	$20^{\circ}\text{-}25^{\circ}$	$25^{\circ}\text{-}90^{\circ}$
-95.61	-93.91	-92.31	-90.91	-89.61	-83.41

Note that these parameters represent maximum, worst-case density values for a very narrow bandwidth of 10 MHz. Capella anticipates that the large majority of its imaging will be performed at significantly wider bandwidths with lower power densities.

II. The Proposed modification would not cause interference to other systems or limit the Capella satellites' ability to share spectrums

As detailed below the increased power level described in this application would not cause interference to other operators. In fact, the increased power levels are consistent with the power

levels for the Capella-9 and -10 satellites that were recently approved by the International Bureau.³ Furthermore, as depicted below, Capella’s proposed emissions are comparable to or lower than other SAR operations recently authorized by the Commission:

PFD (dBW/m²/4 kHz) Comparison to Recently Authorized SAR Transmissions:

	<i>0°-5°</i>	<i>5°-10°</i>	<i>10°-15°</i>	<i>15°-20°</i>	<i>20°-25°</i>	<i>25°-90°</i>
Capella (Requested)	-95.61	-93.91	-92.31	-90.91	-89.61	-83.41
Umbra ⁴	-	-	-87.8	-86.4	-85.1	-78.8

There is no reason to expect that this modest increase in EIRP density would limit Capella satellites’ ability to share spectrum. Capella’s operations in this band involve highly directional radar transmissions and the receipt of reflected return signals. The only plausible scenario where this would result in harmful interference to other space-station operators would be an in-line event where multiple SAR satellites are spatially aligned with respect to a given imaging target and transmit imaging signals in the same band at the same moment. However, Capella is able to meet its’ customers’ needs with a limited number of satellites, making such an event highly unlikely, and leaving ample room to share the band with other operators. Indeed, as noted above, other operators currently use power levels similar to, or higher than, the power levels requested herein. The Commission has never found that this imposes material limitations on their spectrum sharing ability.

³ *Capella Space Corp. Application for Satellite Space Station Authorization*, IBFS No. SAT-MOD-20220919-00111, Call Sign S3137 (granted Jan. 17, 2023).

⁴ Umbra’s application uses inconsistent units for its PFD values. Its technical narrative indicates that values are expressed in “dBW/m2/4 kHz.” See Application of Umbra Lab, Inc., IBFS File No. SAT-LOA-20210616-00080 (filed June 16, 2021). However, the associated Schedule S purports to provide values in dBW/m2/Hz. Above, we have assumed that the correct unit is dBW/m2/4 kHz. However, if the Schedule S is correct, and these values are actually measured in dBW/m2/Hz, this would translate into even higher PFD values when measured in a 4 kHz bandwidth.

In addition to EESS (active) operations such as Capella's SAR sensing, the 9300-9900 MHz band is also allocated on a co-primary basis with terrestrial radiolocation services. As discussed below, the change in maximum EIRP density will also not affect Capella's ability to share spectrum with these terrestrial operations. This is fundamentally because these signals will remain very faint as received on the earth's surface due to the extremely significant spreading loss over the hundreds of kilometers between the satellite and the Earth's surface, which dominates the modest increase in maximum EIRP density requested herein.

Protection of Terrestrial Radionavigation and Radiolocation Services

RS.1280 provides a methodology for assessing whether the peak or average power of an active spaceborne sensor exceeds that of the example terrestrial sensors provided in the recommendation. Capella SAR transmissions remain lower than the example radars provided in the recommendation even with the requested change to EIRP density and PFD. Moreover, the Capella system will only transmit for brief periods, and over a limited geography at a given moment in time. Thus, transmissions from the Capella SAR system will have no material effect on terrestrial radar systems.

The underlying Capella application noted that Capella's spaceborne SAR sensing will present a much smaller PFD compared to authorized terrestrial radionavigation devices in the band. A terrestrial marine navigation radar, for example, may operate at 64 dBW. While this is 12 dB lower than the EIRP of the Capella radar, the Capella radar is much farther away from any terrestrial receiver and this propagation loss more than makes up for the difference in radiated power. For a terrestrial receiver 1 km from the navigation radar, for instance, the Capella SAR transmission would be subject to 54 dB greater propagation loss (114 dB at a distance of 500 km), resulting in a received power level 42 dB below that of the terrestrial radar.

This conclusion remains unchanged even at the maximum EIRP density requested in this application. Capella’s narrower bandwidth of operation may increase EIRP density by up to 17 dB, which remains far less than the 42 dB difference between the received power of Capella SAR transmissions and the received power of a representative terrestrial radar system. Moreover, this comparison is only relevant in the unrealistic worst-case situation where the terrestrial radar receives only in the same narrow 10 MHz portion of the 9300-9900 MHz band occupied by a 10 MHz Capella SAR transmission. It would be far more realistic to assume that any potentially affected receiver would continue to receive across the full band, in which case it would be more appropriate to compare to Capella transmit power integrated across that full band—which would remain unchanged as a result of this application.

Protection of Terrestrial Radar Beacons

Footnote 5.427 of the Commission’s Table of Frequency Allocations requires that responses from EESS radar transponders not be confused with responses from radar beacons and prohibits responses from radar transponders from causing harmful interference to ship or aeronautical radars.⁵ Capella satellites are not equipped with radar transponders, eliminating the interference risk contemplated by this footnote.

Moreover, Capella’s SAR transmissions in this band will not themselves be confused with radar beacons due to the fundamentally different timing, duration, and other characteristics of radar beacon signals compared to Capella’s SAR transmissions. In addition, as demonstrated above with respect to footnote 5.476A, Capella’s transmissions will not cause harmful interference to ship or aeronautical radars in the radionavigation service.⁶

⁵ 47 C.F.R. § 2.106 n. 5.427.

⁶ *Id.* n. 5.476A.

III. Small satellite certifications

The requested modification will not have any effect on Capella system characteristics relevant for to its continued compliance with the Commission’s small-satellite rules. Accordingly, the certifications made pursuant to Section 25.122 remain applicable.

IV. Orbital debris mitigation

The requested modification will have no effect on the physical construction or orbital characteristics of the Capella satellites. Therefore it will have no effect on the high-levels of space-safety already achieved by Capella’s satellites.

V. Other matters

A. NOAA authorization

Capella was issued an updated license to operate a private remote sensing space system by NOAA’s National Environmental Satellite, Data, and Information Service on July 14, 2022. The NOAA license permits Capella to operate a private constellation of up to 44 SAR satellites subject to the conditions and terms of the license. The NOAA license includes findings that Capella satisfies the requirements for compliance and monitoring, will comply with the national security concerns of the United States, and will comply with all applicable international obligations and foreign policies. The modifications herein remain consistent with the terms of this NOAA authorization. Capella has successfully completed and passed multiple NOAA compliance audits

and inspections since early 2019. Capella has included its current NOAA authorization as well as a request for confidential treatment.

B. ITU compliance

Capella is aware that the ITU charges processing fees for satellite network filings. As a consequence, Commission applicants are responsible for any and all fees charged by the ITU. Capella confirms that it remains aware of this requirement and accepts responsibility to pay any ITU cost recovery fees associated with this application. Invoices for such fees may be sent to the contact representative listed in the accompanying FCC Form 312.

Pursuant to 47 C.F.R. § 25.111 for space systems, it is understood that the Commission will submit filings to the ITU on behalf of Capella pursuant to international obligations for the coordination and registration of space network systems. Capella is providing the Commission the appropriate electronic files for submission to the ITU along with this application.

VI. Conclusion

For the foregoing reasons, and for the reasons set forth in the accompanying materials, Capella requests that the Commission find that granting the modification proposed herein would serve the public interest and issue such grant expeditiously.

Respectfully submitted,

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ENGINEERING CERTIFICATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this application, and that it is complete and accurate to the best of my knowledge and belief.

/s/ Christian Lenz

Christian Lenz
Chief Technology Officer

CAPELLA SPACE CORP.

February 8, 2023

Date