

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)	
)	
Theia Holdings A, Inc.)	IBFS File No. SAT-LOA-20161115-00121
)	and SAT-AMD-20170301-00029
Request for Authority to Launch and Operate a)	
Non-Geostationary Satellite Orbit System in the)	Call Sign S2986
Fixed-Satellite Service, Mobile-Satellite Service,)	
and Earth-Exploration Satellite Service)	
)	

MEMORANDUM OPINION, ORDER AND AUTHORIZATION

Adopted: May 9, 2019

Released: May 10, 2019

By the Commission: Commissioner Carr approving in part, concurring in part, and issuing a statement;
Commissioner Rosenworcel issuing a statement.

I. INTRODUCTION

1. In this Memorandum Opinion, Order and Authorization (Order), we grant, to the extent set forth below, those portions of the application of Theia Holdings A, Inc. (Theia), as amended,¹ to construct, launch, and operate a non-geostationary-satellite orbit (NGSO) satellite system using frequencies in the earth exploration satellite service (EESS)² and fixed-satellite service (FSS) that the International Bureau accepted for filing.³ Theia proposes a constellation of 112 active NGSO satellites and 8 on-orbit spare satellites to conduct imaging of the entire surface of the Earth.⁴ Theia intends to

¹ *Theia Holdings A, Inc., Application for Launch and Operating Authority*, IBFS File No. SAT-LOA-20161115-00121 (filed Nov. 15, 2016) (Theia Application), as amended by IBFS File No. SAT-AMD-20170301-00029 (filed Mar. 1, 2017) (V-band Amendment). In addition, Theia submitted a letter agreeing to adopt certain measures to mitigate the risk of interference to Radionavigation-Satellite Service (RNSS) receivers operating in the 1215-1300 MHz frequency band. Letter from Joseph Fagnoli, Chief Technology Officer, Theia Group to Marlene H. Dortch, Secretary, FCC (dated June 1, 2018) (*June 1 Letter*).

² The EESS is, “[a] radiocommunication service between earth stations and one or more space stations, which may include links between space stations, in which:

(1) Information relating to the characteristics of the Earth and its natural phenomena, including data relating to the state of the environment, is obtained from active sensors or passive sensors on Earth satellites;

(2) Similar information is collected from airborne or Earth-based platforms;

(3) Such information may be distributed to earth stations within the system concerned; and

(4) Platform interrogation may be included. This service may also include feeder links necessary for its operation.” 47 CFR § 2.1.

³ The FSS is “A radiocommunication service between earth stations at given positions, when one or more satellites are used; the given position may be a specified fixed point or any fixed point within specified areas; in some cases this service includes satellite-to-satellite links, which may also be operated in the inter-satellite service; the [FSS] may also include feeder links of other space radiocommunication services.” 47 CFR § 25.103.

⁴ Theia Application, Legal Narrative at 9.

operate these satellites in 8 planes at an average altitude of 800 kilometers (for active satellites)⁵ with an inclination of 98.6 degrees. Theia states that its constellation will be part of a global remote sensing and communications system capable of obtaining, processing, and delivering remote sensing analytics and broadband connectivity directly to commercial, industrial, and consumer customers via an integrated communications network.⁶ Theia proposes to capture continuous visible and broad infrared video of the entire Earth, near continuous high-resolution hyperspectral and active radar data, and microwave radiometer data and provide this data to individuals and institutions around the world.⁷ Theia states that data derived from its constellation will be used to provide a range of services, including precision agriculture analytics, surveying and monitoring of infrastructure, and real-time geophysical information and first responder support.⁸ Theia notes its proposed system will vastly increase the Earth-imaging data available to consumers.⁹

2. We grant Theia's application in part, subject to conditions. In authorizing Theia's system, we address concerns expressed by commenters seeking various conditions on the license and requests by Theia for waiver of certain rule provisions.¹⁰ Grant of Theia's application will facilitate the development of new capabilities for satellite-delivered services and enhance the availability and quality of imaging data in the United States and globally.

II. BACKGROUND

3. *Application.* Theia proposes to use the 1215-1300 MHz band, which is allocated to EESS, for its remote sensing operations. It proposes to transmit data to gateway earth stations in the 25.5-27.0 GHz frequency band, which is allocated to EESS (space-to-Earth), as well as in frequencies in the Ka-band¹¹ and the V-band¹² in the FSS. Theia also proposes to communicate with user terminals, both at fixed locations and while in motion, in Ku-band frequencies.¹³ The following chart summarizes the frequencies that Theia requests authority to use for communications between its proposed NGSO

⁵ Theia states that on-orbit spares will be initially deployed to a 750 km storage orbit. Theia Application, Technical Narrative at 12.

⁶ Theia Application, Legal Narrative at 1.

⁷ *Id.* at 3.

⁸ *Id.* at 24-29.

⁹ *Id.* at 23.

¹⁰ Theia seeks waivers of the following sections of the Commission rules: 2.106, 25.112(a), 25.114(d)(14)(ii), 25.116(c), 25.156(d)(4) & (5), 25.157(c) & (e), 25.202(a)(1), 25.208(r), and 25.283(c). Theia Application, Legal Narrative at 32-54; V-band Amendment, Legal Narrative at 11.

¹¹ The term "Ka-band" refers to the 18.3-18.8 GHz, 19.7-20.2 GHz, 28.35-28.6 GHz, and 29.25-30.0 GHz frequency bands, also known as the "conventional Ka-band," which the Commission has designated as primary for GSO FSS operation. *See* 47 CFR § 25.103. Theia also requests use of the 27.5-28.35 GHz, 28.6-29.1 GHz, 29.1-29.25 GHz, 17.8-18.3 GHz, 19.3-19.7 GHz, and 25.5-27.0 GHz frequency bands, which are not included in the definition of "Ka-band" under Part 25, but which will be referred to as Ka-band frequencies for purposes of this Order.

¹² For purposes of this Order, we use the term "V-band" to refer to frequencies ranging from 37.5- 52.4 GHz.

¹³ Under the Commission's rules, the term "Ku-band" includes both the "conventional Ku-band" (11.7-12.2 GHz and 14.0-14.5 GHz) and the "extended Ku-band" (10.95-11.2 GHz, 11.45-11.7 GHz, and 13.75-14.0 GHz). 47 CFR § 25.103. Theia's application also requests use of frequencies in the 12.2-12.7 GHz and 12.75-13.25 GHz frequency bands which are not included in the definition of "Ku-band" under Part 25, but which will be referred to as Ku-band frequencies for purposes of this Order. Although it did not file comments on the Theia Application, the MVDDS 5G Coalition has expressed concern in other proceedings regarding protection of current and potential future MVDDS operations in the 12.2-12.7 GHz band. *See, e.g.*, Letter from MVDDS 5G Coalition to Marlene H. Dortch,

(continued...)

satellites and earth stations and that the Commission has accepted for filing:¹⁴

Operations	Frequencies
Remote Sensing	1215-1300 MHz
Gateway	17.8-18.6 GHz (space-to-Earth) 18.8-19.4 GHz (space-to-Earth) ¹⁵ 19.6-20.2 GHz (space-to-Earth) 25.5-27.0 GHz (space-to-Earth) 27.5-29.1 GHz (Earth-to-space) ¹⁶ 29.5-30.0 GHz (Earth-to-space) 37.5-42.0 GHz (space-to-Earth) ¹⁷ 47.2-50.2 GHz (Earth-to-space) 50.4-51.4 GHz (Earth-to-space)
User	10.7-12.7 GHz (space-to-Earth) 12.75-13.25 GHz (Earth-to-space) 14.0-14.5 GHz (Earth-to-space)

4. *Processing Rounds.* Theia's Application and V-band Amendment are part of processing rounds initiated for applications and petitions for U.S. market access for NGSO-like satellite operations, in the frequency bands proposed by Theia that overlap with those in the processing rounds.¹⁸ Theia filed its application on November 15, 2016. The Commission issued a Public Notice requesting comment on Theia's application on May 26, 2017.¹⁹ In response to the Public Notice, three parties filed petitions to deny Theia's application, six parties filed comments, and eight parties filed reply comments.²⁰ On March 1, 2017, Theia amended its application to request the addition of V-band frequencies. The International

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Secretary, FCC (dated March 6, 2018), *available in* IBFS File No. SAT-LOA-20161115-00118. To the extent they would be applicable here, such concerns are addressed in paragraph 55f below, requiring Theia to comply with established PFD limits in this band and subjecting the authorization to modification to conform it to any future rules or policies adopted by the Commission in pending rulemaking proceedings. *See, e.g.,* Petition of MVDDS 5G Coalition for Rulemaking, RM-11768 (filed Apr. 26, 2016).

¹⁴ In addition, Theia will use free space optical inter-satellite links (ISLs) to communicate between satellites in its constellation. *See* Theia Application, Technical Narrative at 3; Letter from Joseph Fagnoli, Chief Technology Officer, Theia Group, Inc., to Jose P. Albuquerque, Chief, Satellite Division (dated Apr. 14, 2017) (*April 14 Letter*).

¹⁵ As discussed below, the International Bureau did not accept for filing Theia's request to operate in the 19.4-19.6 GHz frequency band.

¹⁶ As discussed below, the International Bureau did not accept for filing Theia's request to operate in the 29.1-29.5 GHz frequency band.

¹⁷ As discussed below, the International Bureau did not accept for filing Theia's request to operate in the 42.0-42.5 GHz frequency band.

¹⁸ *OneWeb Petition Accepted for Filing; Cut-Off Established for Additional NGSO-Like Satellite Applications or Petitions for Operations in the 10.7-12.7 GHz, 14.0-14.5 GHz, 17.8-18.6 GHz, 18.8-19.3 GHz, 27.5-28.35 GHz, 28.35-29.1 GHz, and 29.5-30.0 GHz Bands*, Public Notice, 31 FCC Rcd 7666 (IB 2016); *Boeing Application Accepted for Filing In Part: Cut-Off Established for Additional NGSO-Like Satellite Applications or Petitions for Operations in the 37.5-40.0 GHz, 40.0-42.0 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz Bands*, Public Notice, 31 FCC Rcd 11957 (IB 2016); *Applications Accepted for Filing; Cut-Off Established for Additional NGSO-Like Satellite Applications or Petitions for Operations in the 12.75-13.25 GHz, 13.85-14.0 GHz, 18.6-18.8 GHz, 19.3- 20.2 GHz, and 29.1-29.5 GHz Bands*, Public Notice, DA 17-524, 32 FCC Rcd 4180 (IB 2017).

Bureau issued a Public Notice seeking comment on the amendment on June 16, 2017.²¹ Four parties filed in response to Theia's amendment, and five parties filed reply comments.

5. *Developments Subsequent to Application.* In September 2017, the Commission adopted the *NGSO FSS Report and Order* updating several rules and policies governing NGSO FSS systems.²² Among other changes, the Commission adopted equivalent power-flux density (EPFD) limits on NGSO FSS systems operating in portions of the 17.8-20.2 GHz and 27.5-30.0 GHz frequency bands in order to protect GSO FSS networks. The *NGSO FSS Report and Order* also adopted changes to the Ka-band Plan and to spectrum sharing rules, among other things.²³ The Commission also adopted a more flexible milestone schedule for NGSO constellations and eliminated the international geographic coverage requirement. The rule changes adopted in the *NGSO FSS Report and Order* are now in effect,²⁴ and we therefore consider below their impact on the actions we take on Theia's Application.

6. In November 2017, the Commission adopted the *Spectrum Frontiers Second Report and Order, Order on Reconsideration and MO&O*,²⁵ which, among other things, made or affirmed determinations that the 40.0-42.0 GHz and 48.2-50.2 GHz frequency bands will be reserved for FSS use,²⁶ while limiting satellite operations to communications with individually licensed earth stations in the 37.5-40.0 GHz and 47.2-48.2 GHz frequency bands.²⁷ The Commission also affirmed that the existing power flux density (PFD) limit is applicable to satellite operations in the 37.5-40.0 GHz frequency band. More recently, the Commission adopted rules permitting licensing of individual FSS earth stations in the 50.4-51.4 GHz band using criteria identical to those applicable in the 24.75-25.25 GHz band.²⁸ To the extent that Theia requests waiver of rules already addressed in the *Spectrum Frontiers* proceeding, we consider those requests taking into account the decisions taken in that proceeding. Where rules are modified as a result of future actions in the *Spectrum Frontiers* proceeding, or in other proceedings such as the

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¹⁹ Public Notice, DA 17-524, 32 FCC Rcd 4180 (IB 2017). The International Bureau accepted for filing Theia's application to operate in the following frequency bands: 10.7-12.2 GHz, 12.75-13.25 GHz, 17.8-19.3 GHz, 19.6-20.2 GHz (space-to-Earth); and 14.0-14.5 GHz, 25.5-27.0 GHz (Earth-to-space). While Theia's application was accepted for filing in the 1215-1300 MHz (active) and 25.5-27.0 GHz (Earth-to-space) frequency bands to provide EESS, the International Bureau made no determination as to whether to initiate a processing round for these frequency bands and did not invite additional applications in these bands. The International Bureau also deferred, at that time, a determination concerning the acceptability for filing for Theia's request to operate in the 19.3-19.6 GHz and 29.1-29.5 GHz bands. The International Bureau subsequently accepted for filing and sought comment on Theia's request to operate in the 12.2-12.7 GHz (space-to-Earth) and 19.3-19.4 GHz (space-to-Earth) frequency bands. *Satellite Policy Branch Information: Space Station Applications Accepted for Filing*, Public Notice, Report No. SAT-01325 (June 29, 2018), as corrected by *Satellite Policy Branch Information: Space Station Applications Accepted for Filing*, Public Notice, Report No. SAT-01329 (July 13, 2018) (accepting for filing Theia's request to operate in the 12.2-12.7 GHz and 19.3-19.4 GHz frequency bands, but continuing to defer on making a determination on the acceptability for filing of Theia's request to operate in the 29.1-29.5 GHz (Earth-to-space) frequency band). No comments were filed in response.

²⁰ Petitions to Deny were filed by ViaSat, Inc., Telesat Canada, and GPS Innovation Alliance (GPSIA).

²¹ *Satellite Policy Branch Information: Space Station Applications Accepted for Filing*, Public Notice, Report SAT-01245, June 16, 2017. The International Bureau did not accept for filing Theia's request for operations in the 42.0-42.5 GHz band because there is no domestic allocation for satellite services in this frequency band. See 47 CFR § 2.106.

rulemaking addressing NGSO FSS operations or orbital debris mitigation,²⁹ Theia's FSS operations will be subject to those modified rules. We discuss these matters with greater specificity below.

III. DISCUSSION

7. After review of the record, we conclude that grant of the Theia Application will serve the public interest, subject to the requirements and conditions specified herein. Below we discuss and address various issues raised by Theia's Application, as well as conditions that we impose on Theia's authorization. Where appropriate, we defer matters of general applicability to ongoing or potential future rulemakings.

8. As part of its application, Theia seeks waivers of certain Commission rules. Generally, the Commission may waive any rule for good cause shown.³⁰ Waiver is appropriate where the particular facts make strict compliance inconsistent with the public interest.³¹ In making this determination, we may take into account considerations of hardship, equity, or more effective implementation of overall policy on an individual basis.³² Waiver is appropriate if special circumstances warrant a deviation from the general rule and such deviation will serve the public interest.³³ We address the specific requests for waivers below.

A. Remote Sensing Operations

9. Theia proposes to use the 1215-1300 MHz frequency band to collect high resolution synthetic aperture radar (SAR) imaging. Under the U.S. Table of Frequency Allocations, the 1215-1300 MHz band is allocated for Federal EESS operations on a primary basis and non-Federal EESS operations on a secondary basis.³⁴ For the reasons set forth below, we find that Theia's proposed operations in this band is consistent with our rules and that authorization of the proposed operations, as conditioned, serves the public interest.

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²² *Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7809 (2017) (*NGSO FSS Report and Order*).

²³ *Id.* at 7820-21, paras. 35-36.

²⁴ See 82 FR 59972 (Dec. 18, 2017); 83 FR 22391 (May 15, 2018).

²⁵ *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services et. al.*, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, 32 FCC Rcd 10988, 11878 (2017). When citing to the *Second Report and Order* portion of the document, we will refer to the *Second Report and Order*, when citing to the *Second Further Notice of Proposed Rulemaking* portion of the document, we will refer to the *Second FNPRM*, when citing to the *Order on Reconsideration*, we will refer to *Reconsideration Order*, and when citing to the *Memorandum Opinion and Order* portion of the document, we will refer to the *MO&O*.

²⁶ *Spectrum Frontiers MO&O*, 32 FCC Rcd at 11050-51, paras. 189, 192.

²⁷ *Spectrum Frontiers Second Report and Order and MO&O*, 32 FCC Rcd at 11005, 11062, paras. 55, 220.

²⁸ *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Fifth Report and Order, FCC 19-30, paras. 10-12 (rel. Apr. 15, 2019).

²⁹ See generally *NGSO FSS Report and Order*. See also *Mitigation of Orbital Debris in the New Space Age*, Notice of Proposed Rulemaking, FCC 18-159 (rel. Nov. 19, 2018).

³⁰ 47 CFR § 1.3.

³¹ *Northeast Cellular Tel. Co. v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990).

³² *WAIT Radio v. FCC*, 418 F.2d 1153, 1159 (D.C. Cir. 1969), *cert. denied*, 409 U.S. 1027 (1972); *Northeast Cellular*, 897 F.2d at 1166.

10. Theia states that it will not cause harmful interference to, or claim protection from, or otherwise impose constraints on operation or development of services allocated on a primary basis in the 1215-1300 MHz band.³⁵ We note that the Spectrum Efficient National Surveillance Radar program is currently studying the feasibility of vacating the spectrum between 1300-1350 MHz to make it available for non-Federal use.³⁶ If this occurs, the adjacent 1300-1350 MHz band may become available for high-density fixed and mobile broadband systems. Because EESS is secondary, Theia would not have harmful interference protection from systems of primary service to which frequencies have already been assigned or may be assigned at a later date.³⁷ While we appreciate that satellite receivers are often designed for electromagnetic compatibility with other operations in existence at the time of design, we note that Theia's secondary status for EESS would warrant consideration of the potential that the radio frequency environment that existed when Theia filed its application could well change before its satellite network becomes operational. We therefore condition grant of Theia's authorization with respect to the 1215-1300 MHz band such that it will not cause harmful interference to, or claim protection from, or otherwise impose constraints on operation or development of services allocated now or in the future on a primary basis.³⁸

11. We also find that the concerns raised in pleadings against Theia's proposed operations in the 1215-1300 MHz band have been resolved and do not form a basis for denial of the Theia Application. The GPS Innovation Alliance (GPSIA) filed a Petition to Deny or Defer the Theia Application, arguing that Theia's proposed operations in the 1215-1300 MHz band could cause harmful interference to Radionavigation-Satellite Service (RNSS) receivers operating in the same frequency band.³⁹ Theia subsequently notified the Commission that it agreed to adopt certain measures to mitigate the risk of interference to RNSS receivers.⁴⁰ In turn, the GPSIA notified the Commission that the interference concerns raised in its Petition to Deny would be resolved if the measures proposed by Theia in *June 1*

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³³ *Northeast Cellular*, 897 F.2d at 1166.

³⁴ 47 CFR § 2.106. Specifically, in the 1215-1240 MHz band, non-Federal EESS operations are secondary to Federal EESS, radiolocation, radionavigation-satellite, and space research service (SRS) operations. In the 1240-1300 MHz band, non-Federal ESS operations are secondary to Federal EESS, radiolocation, SRS, and aeronautical radionavigation operations. In the 1240-1300 MHz band, non-Federal EESS operations are also secondary to non-Federal aeronautical radionavigation operations. *Id.*

³⁵ Theia Application, Technical Narrative at 37.

³⁶ Fact Sheet – Spectrum Efficient National Surveillance Radar (SENSR), Federal Aviation Administration, https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=21734.

³⁷ 47 CFR § 2.105(c)(2)(ii).

³⁸ For example, as Theia operations in the band 1215-1300 MHz have secondary status, they have to protect primary federal SRS/EESS operations.

³⁹ GPSIA Petition to Deny or Defer (filed June 26, 2017). While there is an RNSS allocation in the International Table of Frequency Allocations for 1215-1300 MHz, in the U.S. Table of Allocations there is an RNSS allocation for federal use of 1215-1240 MHz and an Aeronautical RNSS allocation for federal use of 1240-1300 MHz. The Commission has recently granted a waiver to permit non-Federal use of the 1215-1219 MHz portion of the 1240-1300 MHz band for operations with an RNSS signal. *Waiver of Part 25 Licensing Requirements for Receive-Only Earth Stations Operating with the Galileo Radionavigation-Satellite Service*, IB Docket No. 17-16, Order, FCC 18-158, para. 32 (Nov. 16, 2018).

Letter were accepted by the Commission.⁴¹ The Commission accepts such measures to avoid interference to RNSS receivers described in the amendment, which are a material basis for our grant of the Theia Application. Accordingly, we condition this authorization on Theia's compliance with its proposed mitigation measures and dismiss the GPSIA Petition to Deny or Defer as moot.

12. Similarly, we find that Spire's concern of interference to the reception of GPS signals by space-borne receivers does not constitute a basis for us to require Theia to coordinate with Spire prior to any license grant.⁴² We find that this concern is addressed by the condition requiring Theia not to cause harmful interference to, or claim protection from, or otherwise impose constraints on operation or development of services allocated on a primary basis.⁴³

13. Theia's application as originally filed did not include information regarding the frequency bands that may be received by the satellites' hyperspectral imager or passive microwave radiometer. Theia requested a limited waiver, to the extent necessary, of the "substantially complete" requirement of Section 25.112(a)(1) of the Commission's rules⁴⁴ with respect to frequencies received by Theia's satellites that were not identified as part of Theia's application. Theia subsequently filed a letter identifying the following frequency bands that will be received by Theia's microwave radiometer, but in which Theia will not transmit: 1420-1427 MHz, 1660.5-1668.4 MHz, 2655-2690 MHz, 8.55-8.65 GHz, 9.3-9.9 GHz, and 10.6-10.7 GHz.⁴⁵ Since Theia submitted this information, there is no need for a waiver of Section 25.112(a)(1), and we dismiss the waiver request as moot. We also authorize reception of the frequencies above by Theia's satellites as part of this authorization.⁴⁶

14. We also conclude that we can grant Theia's request to provide EESS in the 1215-1300 MHz band without initiating a processing round. We find that Theia's proposed EESS operations will be able to share spectrum with other EESS systems by time sharing its transmissions over the same geographic area, and thus will not preclude future operators from providing EESS in these frequency bands.⁴⁷ Accordingly, we grant Theia's request for a waiver of our modified processing round

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⁴⁰ See *June 1 Letter*. Because the commitments proposed by Theia resolve frequency conflicts with authorized stations and do not create new or increased frequency conflicts, the *June 1 Letter* does not constitute a major amendment under our rules. CFR § 25.116(b). As a result, Theia's Application for an NGSO-like satellite license is not considered a new-filed application as a result of the filing of the *June 1 Letter*. 47 CFR § 25.116(c)(1).

⁴¹ GPSIA Notice of Resolution of Petition to Deny or Defer (filed June 1, 2018). See also Letter from J. David Grossman, GPSIA, to Marlene H. Dortch, Secretary, FCC, Apr. 29, 2019.

⁴² Comments of Spire Global, Inc (filed June 26, 2017) (Spire Comments).

⁴³ Spire originally asked that Theia be required to coordinate its use of the 1215-1300 MHz frequency band with Spire prior to any license grant. Spire Comments at 5-6. We find that such a coordination requirement is unnecessary in light of the requirement that Theia not cause harmful interference to, or claim protection from, or otherwise impose constraints on operation or development of services allocated on a primary basis in the 1215-1300 MHz band. In addition, the record was updated to inform that Spire, upon reviewing the information regarding the SAR parameters and the letter amendment adopting the SAR Conditions, concluded that it no longer had concerns regarding Theia's proposed operations. See Letter from Joseph Fargnoli, Chief Technology Officer, Theia Group, Inc., to Marlene H. Dortch, Secretary, FCC (filed Apr. 9, 2019).

⁴⁴ Theia Application, Legal Narrative, at 17-18 (citing 47 CFR § 25.112(a)(1)).

⁴⁵ Letter from Joseph Fargnoli, Chief Technology Officer, Theia Group, Inc. to Stephen Duall, Chief, Satellite Policy Branch, FCC (dated Sept. 19, 2018).

⁴⁶ 47 CFR § 2.106. We note that the Theia satellites are only receiving in the band and must be mindful that there are active sensors transmitting in the band.

⁴⁷ This finding is consistent with past findings by the International Bureau and Satellite Division that authorizing an EESS licensee to operate in a particular frequency band does not necessarily preclude other EESS licensees from operating in that band. See *DigitalGlobe, Inc.*, Order and Authorization, 20 FCC Red 15696, 15699 (Sat. Div., IB
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requirements of Section 25.157(c) given the opportunities for additional entrants to operate in the 1215-1300 MHz frequency band.

15. Theia also seeks to use the 25.5-27.0 GHz (space-to-Earth) frequency band to downlink remote sensing data from its constellation to gateway earth station operations that will be compatible with Federal and other non-Federal operations in the band and will not claim protection from stations in the fixed and mobile services operated by other administrations.⁴⁸ The 25.5-27.0 GHz band is currently under consideration in the Commission's *Spectrum Frontiers* proceeding, which will consider the best uses of this band and sharing rules for the various services in the band.⁴⁹ Rather than act on access to this band prematurely, we defer action until sharing between terrestrial and satellite operations in the band, as well as other uses of the band, are addressed in the context of the *Spectrum Frontiers* proceeding.

B. User Operations in the Ku-band

16. Theia seeks to operate user terminals in the following frequency bands: 10.7-11.7 GHz (space-to-Earth), 11.7-12.2 GHz (space-to-Earth), 12.2-12.7 GHz (space-to-Earth); 12.75-13.25 GHz (Earth-to-space), and 14.0-14.5 GHz (Earth-to-space).⁵⁰ Theia also requests authorization to use the 14.0-14.5 GHz frequency band while operating in the MSS.⁵¹ Theia states that its user terminals will operate in fixed, transportable, and mobility configurations.⁵² We dismiss without prejudice Theia's request for a waiver in connection with operations in the 10.7-11.7 GHz and 12.75-13.25 GHz frequency bands for the reason set forth below, but otherwise grant Theia's request to operate in these bands as proposed, subject to conditions.⁵³ However, we note that the current Order does not authorize any earth station operations. Such authorizations will have to be subject to the submission and consideration of separate earth station applications. In particular, with respect to "mobility configurations" mentioned in the Theia Application, it should be observed that currently there are no Commission rules addressing the use of FSS frequencies for earth stations in motion communicating with NGSO space stations.⁵⁴ We also defer consideration of Theia's request to use the 14.0-14.5 GHz frequency band while operating in the MSS. These operations in the MSS would be conducted under a secondary status pursuant to the U.S. Table of Frequency

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2005); *Astro Digital U.S., Inc.*, IBFS File No. SAT-LOA-20170508-00071, grant stamp Dec. 14, 2017 and Aug. 1, 2018 (Sat. Div., IB) (granted in part, deferred in part); *Planet Labs, Inc.*, IBFS File No. SAT-LOA-20130626-00087 (grant stamp dated Dec. 3, 2013); *Skybox Imaging, Inc.*, IBFS File No. SAT-LOA-20120322-00058, grant stamp dated Sep. 20, 2012 (Sat. Div., IB).

⁴⁸ Theia Application, Technical Narrative at 35 (citing 47 CFR§ 2.106, footnote 5.536A). Theia also acknowledges Federal use of the 25.5-27.0 GHz band by NASA, the National Science Foundation, and other federal users. *Id.* at 36.

⁴⁹ See *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services; Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services*, GN Docket No. 14-177, WT Docket No. 10-112, Third Report and Order, Memorandum Opinion and Order, and Third Further Notice of Proposed Rulemaking, FCC 18-73 (Spectrum Frontiers Third Further Notice) at paras. 79-84 (2018).

⁵⁰ Theia Application, Technical Narrative at 4, 27-28; Theia Application, Legal Narrative at 12, 13-15.

⁵¹ *Id.*, Legal Narrative, at 1.

⁵² *Id.*, Technical Narrative at 27. Theia Application, Legal Narrative at 13.

⁵³ See *infra*, paras. 55c and 55f. When Theia filed its Application, note 6 to Section 25.202(a)(1) limited use of these bands by NGSO FSS systems to transmissions to or from gateway earth stations. Subsequently the Commission removed note 6 from Section 25.202(a)(1) and incorporated its provisions applicable to the 12.75-13.25 GHz frequency band into a footnote to the U.S. Table of Frequency Allocations. See *NGSO FSS Report and Order*, 32 FCC Rcd at 7816, para. 22. At the same time, the Commission clarified that the permitted operation of NGSO FSS earth stations in these bands applied to all individually licensed earth stations, rather than to gateway earth stations only, as previously prescribed. *Id.* at para. 24.

Allocations,⁵⁵ and any reception of satellite signals in associated frequency bands would not be protected because, as noted above, ESIMs are not currently authorized to operate with NGSO space stations and no MSS frequencies have been identified for space-to-Earth operations. Therefore, we believe that it would be more appropriate to act on Theia's request after action is taken on the ongoing rulemaking proceeding to establish rules for ESIMs communications with NGSO satellites, or when earth station applications for such use are submitted.⁵⁶

17. In the 10.7-11.7 GHz bands, Theia requests a waiver of Section 25.202(a)(1), note 6, in order to permit Theia to operate its user terminal earth stations on a non-conforming, non-interference, unprotected basis.⁵⁷ In the *NGSO FSS Report and Order*, the Commission modified its rules to permit blanket licensing of receive earth stations on an unprotected basis in that band.⁵⁸ Accordingly, we dismiss as moot the waiver request for operation of user terminals in the 10.7-11.7 GHz band.

18. Theia requests a similar waiver in order to operate its user terminal earth stations in the 12.75-13.25 GHz band.⁵⁹ In the *NGSO FSS Report and Order*, the Commission declined to allow blanket licensing of earth stations in this band⁶⁰ and clarified that the limitation on the operation of NGSO FSS earth stations in these bands applied to all individually licensed earth stations, rather than being limited to gateways. While Theia's waiver request is therefore not moot, it is premature, as there are no earth station applications before us, and issues regarding the parameters of earth station operations and their compliance with the rules are more appropriately considered and addressed in response to such applications when they are filed. Accordingly, we dismiss without prejudice the waiver request for the 12.75-13.25 GHz band.

19. In the 14.0-14.2 GHz band, NASA operates Tracking and Data Relay Satellite System facilities at four locations: Guam (latitude 13°36'55" N, longitude 144°51'22" E); White Sands, New Mexico (latitude 32°20'59" N, longitude 106°36'31" W and latitude 32°32'40" N, longitude 106°36'48" W); and Blossom Point, Maryland (latitude. 38° 25' 44" N, longitude 77°05' 20" W). Although we do not grant any earth station authorizations here, we remind Theia that for transmissions in the 14.0-14.2 GHz band from NGSO FSS earth stations located within 125 kilometers of these four sites, earth station operators should take account of these NASA facilities.

C. Operations in the Ka-band

20. Theia seeks to operate downlinks from its satellite constellation to gateway earth stations in the following Ka-band frequencies: 17.8-18.3 GHz (space-to-Earth), 18.3-18.6 GHz (space-to-Earth), 18.8-19.3 GHz (space-to-Earth), 19.3-19.7 GHz (space-to-Earth), and 19.7-20.2 GHz (space-to-Earth). It proposes to operate uplinks from gateway earth stations to its satellite constellation in the following Ka-band frequencies: 27.5-28.35 GHz (Earth-to-space), 28.35-28.6 GHz (Earth-to-space), 28.6-29.1 GHz (Earth-to-space), 29.1-29.5 GHz (Earth-to-space), and 29.5-30 GHz (Earth-to-space).

21. We grant Theia's request to operate gateway earth stations using the 17.8-18.6 GHz,

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⁵⁴ Rules governing earth stations in motion are currently being considered by the Commission. See *Facilitating the Communications of Earth Stations in Motion with Non-Geostationary Orbit Space Stations*, Notice of Proposed Rulemaking, FCC 18-160, IB Docket No. 18-315 (rel. Nov. 16, 2018) (*ESIMs NGSO NPRM*).

⁵⁵ 47 CFR § 2.106.

⁵⁶ See generally *ESIMs NGSO NPRM*.

⁵⁷ Theia Application, Legal Narrative at 37-40.

⁵⁸ See *NGSO FSS Report and Order*, 32 FCC Rcd at 7816, para. 22.

⁵⁹ Theia Application, Legal Narrative at 37-40.

⁶⁰ *NGSO FSS Report and Order*, 32 FCC Rcd at 7817, para. 25.

18.8-19.3 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz, 28.6-29.1 GHz, and 29.5-30 GHz frequency bands.⁶¹ These operations are consistent with the Commission's Ka-band Plan that designates these frequency bands for NGSO FSS operations, with primary status in 18.8-19.3 GHz and 28.6-29.1 GHz and secondary status in the other frequency bands.⁶² The authorized operations are conditioned accordingly.⁶³ We address Theia's requests for remaining Ka-band frequencies below, including any necessary conditions or requests for waivers in connection with operations in these bands. Although Theia is not authorized to operate in the 18.6-18.8 GHz band, out of band emissions generated by Theia transmissions in this band must comply with the limits in footnote US 255.⁶⁴

22. *Operations in 19.3-19.7 GHz and 29.1-29.5 GHz.* Theia seeks to use the 19.3-19.7 GHz (space-to-Earth) and 29.1-29.5 GHz (Earth-to-space) for its gateway earth stations. The International Bureau accepted for filing Theia's application for operations in the 19.3-19.4 GHz and 19.6-19.7 GHz frequency bands. The Commission has opened these bands to NGSO FSS use on a secondary basis with respect to GSO FSS networks in these bands.⁶⁵ Because Theia intends to use these bands with a limited number of gateway earth stations, we grant Theia's request to operate in the frequency bands 19.3-19.4 GHz and 19.6-19.7 GHz. In accordance with the U.S. Table of Frequency Allocations, these operations are to be conducted on a secondary basis with respect to GSO FSS systems and NGSO MSS feeder links.⁶⁶ As such, Theia's limited gateway operations may not cause harmful interference to, and must accept any interference from, GSO FSS systems and NGSO MSS feeder links in the bands.

23. In contrast, the International Bureau did not accept for filing Theia's request for NGSO FSS operations in the 19.4-19.6 GHz and 29.1-29.5 GHz frequency bands, as well as for a waiver of the rules that limit operation in these bands to NGSO MSS feeder links or to GSO FSS systems in the 29.25-29.5 GHz frequency band. These pending requests and associated waivers will be addressed, if needed, in a future order.⁶⁷

24. *Operations in 27.5-28.35 GHz.* The 27.5-28.35 GHz band is designated for FSS on a secondary basis in the United States.⁶⁸ The FSS (Earth-to-space) is secondary to the Upper Microwave Flexible Use Service (UMFUS) in the band except for FSS operations associated with earth stations authorized pursuant to Section 25.136. Theia's operations in this band are limited accordingly. Theia's request to operate in this band is granted on a non-protected non-interference basis with respect to GSO FSS systems and subject to the applicable EPFD limits.

⁶¹ At the time of filing of the Theia Application, NGSO use of the 17.8-18.6 GHz band was on a non-conforming basis and Theia requested a waiver of the U.S. Table of Allocations and the Commission's Ka-band Plan to permit its operations in this band. See Theia Application, Technical Narrative at 43. Recently, the Commission added an FSS allocation to the 17.8-18.3 GHz band on a secondary basis and also included a NGSO FSS designation on a secondary basis to GSO FSS in the 18.3-18.6 GHz band. *NGSO FSS Report and Order*, 32 FCC Rcd at 7812-13, paras. 7-10. Thus, Theia's request for waivers of the U.S. Table of Frequency Allocations to operate a NGSO FSS constellation in the 17.8-18.6 GHz band is dismissed as moot.

⁶² *NGSO FSS Report and Order*, Appendix B.

⁶³ See *infra*, paras 55(i-n).

⁶⁴ 47 CFR § 2.106.

⁶⁵ *NGSO FSS Report and Order*, 32 FCC Rcd at 7815, para. 19.

⁶⁶ See *infra*, para. 55(l).

⁶⁷ We note that the Commission declined to open the 19.4-19.6 GHz and 29.1-29.5 GHz bands for NGSO FSS use. See *NGSO FSS Report and Order*, 32 FCC Rcd at 7815, paras. 17 & 20.

⁶⁸ *Rulemaking to Amend Parts 1, 2, 21, & 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Establish Rules & Policies for Local Multipoint Distribution Services and for Fixed Satellite Services*, First Report and Order and Fourth Notice of Proposed Rulemaking, 11 FCC Rcd 19005, 19025 (1996) (*Ka-band First Report and Order*).

25. *Operations in 28.35-28.6 GHz.* The Commission designated the 28.35-28.6 GHz frequency band for GSO FSS on a primary basis with NGSO FSS services permitted on a secondary basis.⁶⁹ Theia has provided a demonstration that it can operate NGSO FSS gateway earth stations in this band without causing harmful interference to authorized spectrum users and agrees to accept any harmful interference from primary GSO FSS operations.⁷⁰ Theia's request to operate in this band is granted on a non-protected non-interference basis with respect to GSO FSS systems.

D. Operations in the V-band

26. Theia seeks authority to operate in the 37.5-42.5 GHz band (space-to-Earth), the 47.2-50.2 GHz band (Earth-to-space), and the 50.4-51.4 GHz band (Earth-to-space) for gateway and other high capacity links.⁷¹ Commenters raise concerns over spectrum sharing, interference, and the need for rules to address these issues in the V-band.⁷² As Theia notes, none of these commenters requests a denial of Theia's V-band Amendment.⁷³ Theia asserts that these issues are appropriately addressed in a rulemaking, and states its willingness to abide by a condition on its license requiring it to conform to any technical standards the Commission may impose on use of the V-band in a subsequent rulemaking.⁷⁴

27. *Operations in the 37.5-40.0 GHz Band and Associated Waivers.* The 37.5-40.0 GHz band is currently allocated to the fixed and mobile services on a primary basis.⁷⁵ FSS (space-to-Earth) operations are limited to communications with individually licensed earth stations, which must not be ubiquitously deployed and must not be used to serve individual consumers.⁷⁶ In addition, earth station operations in the FSS cannot claim interference protection from stations in the fixed and mobile services, except where the individually licensed earth stations are authorized under Section 25.136 of the Commission's rules.⁷⁷

28. Part 25 also includes PFD limits applicable to operations in the 37.5-40.0 GHz frequency band.⁷⁸ In the *Spectrum Frontiers MO&O*, the Commission declined to permit satellite operations in the 37.5-40.0 GHz band at higher PFD levels than the existing limits applicable to clear sky conditions.⁷⁹ The

⁶⁹ *Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*, Third Report and Order, 12 FCC Rcd 22310, 22326 (1997).

⁷⁰ Theia Application, Technical Narrative at 40 and at Appendix 1.

⁷¹ See generally V-band Amendment.

⁷² SpaceX Comments to V-band Amendment at 15-16; Telesat Comments to V-band Amendment at 2-3; Hughes Comments to V-band Amendment at 2; ViaSat Comments to V-band Amendment at 5-6.

⁷³ Theia Reply to V-Band Amendment Comments at 2.

⁷⁴ *Id.*

⁷⁵ U.S. Table of Frequency Allocations, 47 CFR § 2.106.

⁷⁶ 47 CFR § 25.202(a)(1)(ii).

⁷⁷ 47 CFR § 2.106, footnote NG63. Section 25.136 specifies processes for earth station applicants in the 37.5-40.0 GHz band and includes procedures to enable sharing with Upper Microwave Flexible Use Service (UMFUS) licensees. 47 CFR § 25.136.

⁷⁸ 47 CFR § 25.208(r). These limits were adopted alongside the limitations on FSS earth station operations, in implementing the Commission's soft segmentation plan for the V-band, to accommodate high density fixed service in the 37.5-40.0 GHz band and FSS in the 40-42 GHz band. *Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz, and 48.2-50.2 GHz Frequency Bands, et. al.*, Second Report and Order, 18 FCC Rcd 25428, 25439-40, paras. 23-24 (2003) (*V-band Second R&O*).

⁷⁹ *Spectrum Frontiers MO&O*, 32 FCC Rcd at 11058-60, paras. 214-216.

Commission considered studies by satellite operators to support satellite systems transmitting at higher power levels in this band, but found that the studies were insufficient to show that higher satellite power levels could be permitted while at the same time promoting deployment of flexible terrestrial technologies.⁸⁰ Theia now seeks a waiver of Section 25.208(r) to allow Theia to operate at power levels up to those permitted under existing ITU Radio Regulations for NGSO satellites, which are up to 12 decibels (dB) higher than those permitted by our rules.⁸¹ Theia states that its use of the band by employing directional beams to communicate with a limited number of individually licensed earth stations at fixed geographic points in isolated areas would mitigate the risk of harmful interference to incumbent terrestrial fixed service systems and future 5G systems that might otherwise arise from these higher power levels.⁸² Theia has failed to provide a sufficient basis for permitting the requested higher power operations. Given that it has not identified any unique circumstances that it faces—the reasons that Theia provides for the request could be applicable to any satellite system—a grant of the waiver would undermine the underlying purpose of the rule. Moreover, the waiver appears to be unnecessary, as Theia acknowledges that it could operate its system in accordance with our rules.⁸³ Therefore, consistent with our determinations in the *Spectrum Frontiers MO&O* and the rationale underlying those determinations, we deny Theia’s request for waiver of Section 25.208(r).

29. Theia also requests a waiver of Part 30 licensing rules governing terrestrial users of this band.⁸⁴ Theia has failed to specify for which rules under Part 30 it seeks to waive and has not explained how its proposed operations would be subject to Part 30. Accordingly, we deny this request.

30. Theia also seeks a waiver of the prohibition of the use of the 37.5-40.0 GHz band by FSS to serve “individual consumers.”⁸⁵ Theia suggests that the customer earth stations in this instance are more akin to gateway earth stations, since the customer earth stations will be individually licensed and not ubiquitously deployed, and therefore such operations were not intended to be prohibited in the 37.5-40.0 GHz band.⁸⁶ In other words, Theia states that it does not expect to serve individual *consumers* with its individually licensed earth stations, but that it is possible that one or more of its individually licensed earth stations operating in this band could be dedicated to a single *customer*.⁸⁷ We agree that the context of the prohibition on serving individual consumers is in relation to small, ubiquitously deployed earth stations,⁸⁸ not large individually-licensed earth station facilities as proposed by Theia, even if used to serve a single customer. Accordingly, we grant Theia’s request for a waiver of Section 25.202(a)(1)(ii), with a condition that Theia may only use the 37.5-40.0 GHz band to serve individually-licensed customer earth stations, and not ubiquitously-deployed customer earth stations under a blanket license.

31. *Operations in the 40-42 GHz Band.* In the *Spectrum Frontiers* proceeding, the Commission reserved the 40-42 GHz band for FSS use.⁸⁹ Theia’s proposed use of the 40-42 GHz band is

⁸⁰ *Id.* at 11058-59, para. 214.

⁸¹ Theia V-band Amendment, IBFS File No. SAT-AMD-20170301-00029, Legal Narrative at 18 (citing ITU Radio Regulations, Article 21, Table 21-4).

⁸² Theia V-band Amendment at 19.

⁸³ Theia V-band Amendment, Legal Narrative at 8 (stating “downlink operations in [the 37.5-40.0 GHz band] can comply with the most stringent PFD requirements to ensure there is no potential for interference into terrestrial systems and services.”).

⁸⁴ *Id.* Part 30 of the Commission’s rules governs Upper Microwave Flexible Use Service.

⁸⁵ Theia V-band Amendment, Legal Narrative at 16-17.

⁸⁶ *Id.* at 16-17, n.31.

⁸⁷ *Id.* at 16-17 (emphasis in the original).

⁸⁸ *Spectrum Frontiers MO&O*, 32 FCC Rcd at 11057, paras. 208-209.

⁸⁹ *Id.* 32 FCC Rcd at 11051, para. 192.

consistent with the Commission's rules and the Table of Frequency Allocations.⁹⁰ We therefore grant Theia's request for operations in this band.

32. *Operations in the 47.2-50.2 GHz Band.* The 47.2-48.2 GHz portion of the V-band is currently allocated in the U.S. Table of Frequency Allocations for FSS, fixed service, and mobile service, limited to non-Federal stations, and the 48.2-50.2 GHz portion is allocated for these same services for both Federal and non-Federal stations.⁹¹ In the *Spectrum Frontiers Second R&O*, the Commission decided to limit operations to individually-licensed earth stations in the 47.2-48.2 GHz portion of the band, which will also be authorized for terrestrial UMFUS operations,⁹² and it declined to provide any mechanism for satellite end user equipment in that band. In addition, earth station operations in the FSS in the 47.2-48.2 GHz band are prohibited from causing interference to stations in the fixed and mobile services, except where the individually licensed earth stations are authorized under Section 25.136 of the Commission's rules.⁹³ In the *Spectrum Frontiers Second R&O*, the Commission indicated that the 48.2-50.2 GHz portion of the band will be reserved for FSS use, including for deployment of satellite user terminals.⁹⁴ We grant Theia's request for operations in the 47.2-50.2 GHz band, subject to the rules adopted in the *Spectrum Frontiers* proceeding.

33. *Operations in the 50.4-51.4 GHz Band and Associated Waivers.* Theia seeks authorization for uplinks in the 50.4-51.4 GHz band.⁹⁵ This band is allocated in the U.S. Table of Frequency Allocations to the FSS, but at the time Theia filed its application the 50.4-51.4 GHz band was not listed among the available frequencies for FSS in Section 25.202(a)(1) of the rules. Theia requested a waiver of the Section 25.202(a)(1) list of available frequencies for FSS.⁹⁶ The Commission recently decided to remove the list of frequencies in Section 25.202(a)(1) as unnecessary,⁹⁷ thereby eliminating this barrier against applying for FSS use of the frequencies in the 50.4-51.4 GHz band. Accordingly, Theia's request for a waiver of Section 25.202(a)(1) is dismissed as moot.

34. In the *V-band First Report and Order*, the Commission designated the 50.4-51.4 GHz segment for use by fixed and mobile service.⁹⁸ In the *Spectrum Frontiers Fifth Report and Order*, the Commission authorized licensing of individual FSS earth stations in the 50.4-51.4 GHz band, applying

⁹⁰ U.S. Table of Frequency Allocations, 47 CFR § 2.106.

⁹¹ Historically, the 47.2-50.2 GHz band has been subject to a band plan for sharing between wireless services and FSS. In 1998, as part of the V-band plan, the Commission designated the lower segment of the band, 47.2-48.2 GHz, for wireless services use, and the upper 48.2-50.2 GHz segment for FSS use. *Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands, et al.*, First Report and Order, 13 FCC Rcd 24649, 24651, para. 2 (1998) (*V-band First R&O*). In 2003, the Commission noted that it was preserving the 47.2-48.2 GHz FSS uplink allocation for gateway operations, pairing with downlink operations in the 37.5-40.0 GHz band. *V-band Second R&O*, 18 FCC Rcd at 25457, para. 67. The upper 48.2-50.2 GHz (Earth-to-space) portion of the band is identified in international footnote 5.516B for use by high-density applications in the FSS in ITU Region 2. International Table of Frequency Allocations, 47 CFR § 2.106, footnote 5.516B. Theia's earth station operations in the 47.2-50.2 GHz band, including limitations on such operations, will be addressed as part of the earth station licensing process.

⁹² *Spectrum Frontiers Second Report and Order*, 32 FCC Rcd at 11005-06, paras 54-56.

⁹³ Section 25.136 specifies processes for earth station applicants in the 47.2-48.2 GHz band and includes procedures to enable sharing with UMFUS. 47 CFR § 25.136(d).

⁹⁴ *Spectrum Frontiers MO&O*, 32 FCC Rcd at 11050, para. 189.

⁹⁵ Theia V-band Amendment, Legal Narrative at 6-7.

⁹⁶ *Id.* at 6, 13-15; 47 CFR § 2.106.

⁹⁷ *NGSO FSS Report and Order*, 32 FCC Rcd at 7817-18, para. 27.

⁹⁸ *V-Band First Report and Order*, 13 FCC Rcd at 24651 (jointly referring to fixed and mobile services as "wireless service").

the licensing criteria adopted by the Commission for the 24.75-25.25 GHz frequency band—that is, applying the permitted aggregate population limits within the specified earth station power flux density contour on a per-county basis and adopting constraints on the number of permitted earth stations on both a per county and a per partial economic area basis.⁹⁹ Accordingly, we authorize Theia to operate in the 50.4-51.4 GHz band, subject to the limitations imposed by Section 25.136 of the Commission’s rules, as modified by the *Spectrum Frontiers Fifth Report and Order*.

E. Other Matters

35. *Matters Applicable to NGSO FSS Applications.* Hughes urges the Commission to adopt mechanisms for ensuring that aggregate EPFD limits are met by all NGSO systems authorized in the United States.¹⁰⁰ ViaSat questions the sufficiency of the EPFD limits proposed by the Commission to protect GSO systems from harmful interference and requests that each NGSO operator be held jointly and severally liable for harmful interference caused to GSO systems until the Commission adopts adequate aggregate EPFD limits and enforcement mechanisms.¹⁰¹ Space Norway requests that grant of Theia’s application be conditioned on Theia’s implementation of mechanisms to avoid in-line interference with highly elliptical orbit NGSO systems, such as that proposed by Space Norway.¹⁰² Spire states that the Commission should condition grant of these applications on the outcome of future rulemakings, specifically if the Commission adopts any new orbital debris requirements.¹⁰³

36. All of these comments relate to issues of general applicability that are more appropriately addressed in the context of a rulemaking. Several of these issues were already raised in the then-ongoing rulemaking proceeding concerning NGSO FSS matters¹⁰⁴ that were addressed in a *Report and Order* adopted September 26, 2017.¹⁰⁵ For example, Hughes and ViaSat express concerns about international EPFD limits and aggregate EPFD enforcement mechanisms, and these concerns have since been addressed in the *NGSO FSS Report and Order*.¹⁰⁶ Space Norway’s request for a condition requiring Theia to protect the Space Norway NGSO system as though it were a GSO space station is in effect a request that the Commission reevaluate its licensing procedures with regard to an entire class of NGSO systems, *i.e.*, those with highly-elliptical orbits. As indicated above, we defer consideration of such broadly applicable matters to future rulemakings, and condition grant of the Theia Application on the outcome of such rulemaking proceedings, including the most recent NGSO FSS decision.¹⁰⁷ We note that, as with the other recent NGSO FSS grants, grant of the Theia application will not prejudice any

⁹⁹ *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Fifth Report and Order, FCC 19-30, paras. 10-12 (rel. Apr. 15, 2019) (*Spectrum Frontiers Fifth Report and Order*).

¹⁰⁰ Hughes Comments at 3.

¹⁰¹ ViaSat Petition to Deny (filed June 26, 2017).

¹⁰² Space Norway Comments at 2.

¹⁰³ Spire Global Comments at 2-5.

¹⁰⁴ *Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Notice of Proposed Rulemaking, 31 FCC Rcd 13651, 13656-58, paras. 12, 17 (2016) (*NGSO FSS NPRM*).

¹⁰⁵ *See generally* *NGSO FSS Report and Order*.

¹⁰⁶ Recently, we considered ViaSat’s concerns regarding the sufficiency of existing international EPFD limits and found that although ViaSat had not proposed any new EPFD limits, it would not be advisable to remain without Ka-band EPFD limits in our rules pending such deliberations. Thus, we adopted the ITU EPFD limits in the 17.8-30 GHz frequency range and require NGSO FSS licensees to comply with existing aggregate EPFD limits. *See NGSO FSS Report and Order* at 7820-21, para. 35.

¹⁰⁷ We note that this condition also addresses several comments that requested that grant of Theia’s application be conditioned on compliance with certain pending and future rulemakings. *See* ViaSat Petition to Deny at 3, 7, and 9-10; Spire Comments at 3, 5, and 7; Hughes Reply at 2.

decision, including a contrary action, in any future rulemaking proceedings.¹⁰⁸ Rather, decisions of general applicability in such proceedings will be based on the totality of comments and proposals in those proceedings, including Theia's.¹⁰⁹

37. *Orbital Debris Mitigation.* An applicant for a space station authorization must submit a description of the design and operational strategies that it will use to mitigate orbital debris, including a statement detailing post-mission disposal plans for space stations at the end of their operating life.¹¹⁰ Theia included an orbital debris mitigation plan in its application.¹¹¹ Thereafter, the Satellite Division sent a letter to Theia requesting additional information regarding its plan.¹¹² On April 14, 2017, Theia replied to the Satellite Division's letter.¹¹³

38. Although we appreciate the level of detail and analysis that Theia has provided for its orbital debris mitigation plans, we find that the unprecedented number of satellites proposed by Theia and the other NGSO FSS systems in response to recent processing rounds will necessitate a further assessment of the appropriate reliability standards of these spacecraft, as well as the reliability of these systems' methods for deorbiting the spacecraft.¹¹⁴ In addition, the National Aeronautics and Space Administration (NASA) raises specific concerns regarding Theia's proposed 120 satellite constellation in sun-synchronous orbits at a mean altitude of 800 km.¹¹⁵ Specifically, NASA notes this proposed orbit is in close proximity to two orbits used by Federal operators and is a relatively high-risk orbital area due to the high percentage of debris from low-Earth orbit fragmentation events in this orbit.¹¹⁶

39. We conclude that it would be premature to grant Theia's application based on its current orbital debris mitigation plan. Theia states that it has not selected a satellite manufacturer or established a final design for its satellites,¹¹⁷ and has provided an approximate, rather than specific, orbital altitude for its system.¹¹⁸ Theia also states that it intends to develop and submit an amendment in the future to effect a revised orbital debris mitigation plan.¹¹⁹ Accordingly, we believe it is appropriate to condition grant of

¹⁰⁸ See, e.g., *NGSO FSS Report and Order; Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (2016) (*Spectrum Frontiers R&O and FNPRM*); *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, 32 FCC Rcd. 6373, 6377 n.14 (2017) (*Mid-Band NOI*).

¹⁰⁹ To the extent that commenters believe that their concerns are not already addressed by ongoing rulemakings, we remind commenters that they have the option to file petitions for rulemaking with the Commission.

¹¹⁰ *Mitigation of Orbital Debris*, Second Report and Order, 19 FCC Rcd 11567, 11619 (2004); 47 CFR § 25.114(d)(14).

¹¹¹ See Theia Application, Technical Narrative at Appendix 4.

¹¹² See Letter from Jose P. Albuquerque, Chief, Satellite Division, to Tom W. Davidson, Counsel to Theia (dated Mar. 15, 2017).

¹¹³ See Letter from Joseph Fagnoli, Chief Technology Officer, Theia Group, Inc., to Jose P. Albuquerque, Chief, Satellite Division (dated Apr. 14, 2017) (*April 14 Letter*).

¹¹⁴ See, e.g., NASA Comments (filed June 26, 2017) (noting that (1) the reliability of the design and fabrication of the spacecraft and the reliability that the spacecraft can accomplish the post-mission disposal are of particular interest from the perspective of keeping the orbital environment safe, and that currently, no consensus exists on what the two reliability numbers should be, and (2) a design and fabrication reliability on the order of 0.999 or better per spacecraft may be prudent to mitigate the risk of malfunction in a 4,000+ spacecraft constellation).

¹¹⁵ *Id.* at 2.

¹¹⁶ *Id.* NASA notes that Theia's proposed orbits at a mean altitude of 800 km are right above the orbits used by Federal operators (at 705 km) and right below orbits used by Federal weather satellites (at 820 km). NASA also identifies the accidental collision of the Iridium-33 and Cosmos-2251 in 2009 and the intentional destruction of the Fengyun-1C satellite in 2007 as the events contributing to the increased risk of impacts from orbital debris.

Theia's application on the Commission's approval of an updated description of the orbital debris mitigation plans for its system.¹²⁰

40. Theia also requests waivers of the requirements for satellite end-of-mission passivation contained in Section 25.283(c) of our rules, and the requirement that license applicants address their end-of-mission passivation plans contained in Section 25.114(d)(14)(ii) of our rules.¹²¹ Under the Commission's 2004 *Mitigation of Orbital Debris* Second Report and Order, however, the Commission does not address matters involving post-mission disposal of satellites licensed by the National Oceanic and Atmosphere Administration (NOAA) as part of its examination of the debris mitigation disclosures of remote sensing satellites.¹²² Theia states that it has commenced the commercial remote sensing licensing process with NOAA and that it will apprise the Commission of any developments in the licensing process.¹²³ Consistent with our 2004 *Order*, we condition our grant on Theia receiving a commercial remote sensing license from NOAA and notifying the Commission of receipt of such a license. Accordingly, we dismiss Theia's request to waive our rules concerning the post-mission disposal plans for its satellites as moot.¹²⁴

41. We also note that the Commission recently opened a proceeding that proposes to update the current orbital debris rules. Theia's updated orbital debris mitigation plan must comply with any new rules adopted by the Commission in this proceeding.¹²⁵ Additionally, Theia will be subject to the same orbital debris mitigation conditions as other authorized NGSO systems, including a requirement that it coordinate its physical operations with space stations of NGSO systems operating at similar orbital altitudes.¹²⁶

42. *ITU Coordination.* In its Petition to Deny, Telesat observes that international coordination will be required between Theia's system and Telesat's own NGSO FSS system because the two systems will operate in overlapping geographical areas using overlapping Ka-band frequencies and

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¹¹⁷ Theia Application, Legal Narrative at 33.

¹¹⁸ *Id.*, Technical Narrative, Appendix 4 at 4.

¹¹⁹ *April 14 Letter* at 1.

¹²⁰ We have required applicants to file a modification application including updated orbital debris mitigation information in some instances. *See, e.g., Space Norway AS*, Order and Declaratory Ruling, 32 FCC Rcd 9649 (2017); *Telesat Canada*, Order and Declaratory Ruling, 32 FCC Rcd 9663 (2017). *See also Northrop Grumman Space & Mission Systems Corp.*, Order and Authorization, 24 FCC Rcd 2330, 2363-64, para. 102 (IB 2009) (*Northrop Grumman Order*); *ContactMEO Communications, LLC*, Order and Authorization, 21 FCC Rcd 4035, 4052-53, para. 47 (IB 2006).

¹²¹ Theia Application Legal Narrative at 32-35; 47 CFR §§ 25.114(d)(14)(ii) and 25.283(c).

¹²² *Mitigation of Orbital Debris*, Second Report and Order, 19 FCC Rcd 11567, 11610 at para. 104 (2004). The Commission also stated, however, with respect to elements of debris mitigation other than post-mission disposal, and for which NOAA has not received information necessary for review and approval, it will require FCC remote sensing satellite applicants to submit such information as part of an application for Commission authority, and will review any such aspects of a remote sensing applicant's debris mitigation plans that are outside the scope of NOAA review. *Id.*

¹²³ Theia Application, Legal Narrative at 17.

¹²⁴ In doing so, we note that we recently sought comment on, and are in the process of reviewing, the specific conclusions drawn by the Commission in 2004 with respect to the role of the Commission's review of orbital debris mitigation vis-à-vis other agencies such as NOAA. *See Mitigation of Orbital Debris in the New Space Age*, Notice of Proposed Rulemaking, FCC 18-159 (rel. Nov. 19, 2018) (*2018 Orbital Debris NPRM*).

that absent a coordination agreement, band segmentation would be unworkable.¹²⁷ Telesat also claims that its own NGSO FSS system has ITU date priority. We recently declined to adopt Telesat's proposal to tie coordination obligations and licensing conditions directly to ITU filing dates by awarding priority according to those dates.¹²⁸ Accordingly, we deny Telesat's petition in so far as it reiterates Telesat's ITU filing date priority proposal. We include a condition requiring Theia, like all other NGSO FSS operators, to comply with the spectrum sharing requirements specified in Section 25.261 of the Commission's rules with respect to any other NGSO system licensed or granted U.S. market access pursuant to the processing rounds in which Theia participated.¹²⁹ We recently adopted changes to Section 25.261 that replaced the avoidance of in-line interference methodology for triggering spectrum division (absent coordination) with a default spectrum splitting sharing mechanism that is triggered when the change in system noise temperature caused by interference, or $\Delta T/T$, exceeds a threshold of 6 percent, and Theia is required to comply with this mechanism.¹³⁰ However, we note that outside the United States (*i.e.* when communications to or from the U.S. territory are not involved) the coexistence between Theia's operations and operations of a system that has been licensed by the Commission or has received a grant for access to the U.S. market is governed only by the ITU Radio Regulations and is not subject to Section 25.261.

43. *EPFD Analysis.* Theia provided an EPFD analysis as part of its Application showing compliance of its Ku-band and Ka-band operations with the Commission's rules and with the limits established by Article 22 of the Radio Regulations, including an analysis using ITU approved software.¹³¹ We find that these demonstrations are sufficient to justify grant of Theia's Application. To ensure that Theia will satisfy its EPFD obligations going forward, we condition this grant on Theia receiving a favorable or "qualified favorable" finding of its EPFD demonstration by the ITU prior to the initiation of service. Review by the ITU of Theia's compliance with ITU EPFD limits, using methods now approved by the ITU, will provide sufficient assurances, beyond the other technical demonstration that Theia has already provided, that it will comply with the EPFD limits specified in Article 22 of the Radio Regulations.

44. As we did in other recent approvals for NGSO FSS operations, we are permitting Theia to operate up to the PFD and EPFD levels specified in applicable regulations, rather than the levels associated with specific demonstrations in its application. We find this flexibility is warranted given the preliminary nature of the system design, the fact that this grant is conditioned on Theia's satisfaction of the ITU's EPFD assessment and the condition that Theia cooperate with other NGSO operators to meet

(Continued from previous page) _____

¹²⁵ See generally *2018 Orbital Debris NPRM*.

¹²⁶ See, e.g., *Telesat Ka-Band Order*, 32 FCC Rcd 9663, 9675 (2017).

¹²⁷ Telesat Petition to Deny at 3-4; Telesat Reply (filed July 7, 2017); see also International Telecommunication Union (ITU) Radio Regulations, No. 9.12 (requiring coordination of certain NGSO systems), No. 9.53 (requiring both parties in coordination to "make every possible mutual effort to overcome [coordination] difficulties, in a manner acceptable to the parties concerned"), No. 11.42 (requiring the immediate cessation of harmful interference actually caused to a recorded assignment with which coordination is required but has not been effected).

¹²⁸ *NGSO FSS Report and Order*, 32 FCC Rcd at 7825-26, para. 50.

¹²⁹ See *WorldVu Satellites Limited, Petition for Declaratory Ruling Granting Access to the U.S. Market for the OneWeb NGSO FSS System, Order and Declaratory Ruling*, 32 FCC Rcd 5366, 5377 (2017) (*OneWeb Order*); *Space Norway AS, Order and Declaratory Ruling*, 32 FCC Rcd 9649, para. 24(i) (2017). (*Space Norway Order*); *Telesat Canada, Order and Declaratory Ruling*, 32 FCC Rcd 9663, para. 27(h) (2017) (*Telesat Canada Order*).

¹³⁰ *NGSO FSS Report and Order*, 32 FCC Rcd at 7825, para. 49.

¹³¹ Theia Application, Technical Appendix at Appendix 2 (Compliance with EPFD Limits).

limits for aggregate EPFD. For these reasons, as well as those set forth previously by the Commission,¹³² we therefore reject ViaSat's arguments that Theia should be limited to the levels used in the EPFD demonstration in its application and deny this portion of ViaSat's Petition to Deny.¹³³

45. *Waiver of Section 25.116(c) – Major Amendment.* In its amendment filed in March 2017, Theia seeks authority to include V-band frequencies as part of its previously filed application for authority to launch and operate an NGSO FSS system in certain Ku-band and Ka-band frequencies.¹³⁴ Section 25.116 (c) of the Commission's rules provides that if a major amendment to a NGSO FSS processing round application is submitted after the cut-off date, the application will be considered newly filed and will lose its status in the processing group.¹³⁵ Generally, a "major amendment" is one that changes orbital locations, frequency bands, increases the potential for interference, or has a significant environmental impact.¹³⁶ Theia asks for a waiver of Section 25.116(c) "to the extent required" in order to ensure that its initial application for authority does not lose its place in Ku- and Ka-band processing round due to the addition of frequencies by Theia's amendment filed in the later V-band processing round.¹³⁷

46. We find that a waiver of Section 25.116(c) is justified under the circumstances presented here. Although the addition of V-band frequencies to Theia's proposed Ku- and Ka-band NGSO FSS system could be considered a change in the frequencies bands that constitutes a "major" amendment, the addition of V-band frequencies does not increase the potential for interference to other participants in the Ku- and Ka-band processing round, since applicants in that processing round did not propose to operate in V-band frequencies and Theia's operations in V-band frequencies will not cause interference to operations of applicants proposed in Ku- and Ka-band frequencies. The potential for interference was the key consideration for the Commission when it proposed Section 25.116(c),¹³⁸ and since there is no potential for interference, waiver under these circumstances will not undermine the purpose of the rule. Furthermore, Theia's addition of V-band frequencies was filed in a separate processing round, which the Commission opened to specifically solicit and consider applications to use V-band frequencies as part of NGSO FSS systems. It would not serve the public interest to demote the status of Theia's timely filed Ku- and Ka-band application simply because it filed its request to operate in V-band frequencies in the more appropriate V-band processing round.¹³⁹

¹³² See, e.g., *WorldVu Satellites Limited*, Order and Declaratory Ruling, 32 FCC Rcd 5366 (2017); *Space Norway AS*, Order and Declaratory Ruling, 32 FCC Rcd 9649 (2017); *Telesat Canada*, Order and Declaratory Ruling, 32 FCC Rcd 9663 (2017).

¹³³ ViaSat Petition to Deny at 5-8.

¹³⁴ Theia Amendment, Legal Narrative at 1.

¹³⁵ 47 CFR § 25.116(c).

¹³⁶ *Id.* at § 25.116(b).

¹³⁷ Theia Amendment, Legal Narrative at 22.

¹³⁸ See *Amendment of the Commission's Space Station Licensing Rules and Policies*, Notice of Proposed Rulemaking and First Report and Order, 17 FCC Rcd 3847, 3867, para. 56 (2002) (stating that a "major amendment" is one that increases the potential for interference" and the Commission is revising Section 25.116 to "make clear that filing a major amendment to a license application would cause the applicant to lose its status relative to other mutually exclusive applications filed prior to the amendment.").

¹³⁹ We also note that Theia's situation is not unique, and that the Commission has considered and granted requests involving NGSO systems that were filed in both Ku/Ka-band and V-band processing rounds without considering the need to waive Section 25.116(c). See *Space Exploration Holdings, LLC*, Memorandum Opinion, Order and Authorization, 33 FCC Rcd 11434 (2018)(Space Exploration Holdings filed a separate, complete application for V-band operation); *Telesat Canada*, Order and Declaratory Ruling, 33 FCC Rcd 11469 (2018)(Telesat's request was also granted in part because it clarified that its proposed V-band system will be separate from the Ka-band NGSO operations for which it was previously authorized).

47. *Waiver of Separate Treatment of Service Link and Feeder Link Applications.* Theia requests waiver of Section 25.156(d)(4) of the Commission's rule that states that applications for feeder link or intersatellite link (ISL) authority will be treated as an application separate from its associated service band.¹⁴⁰ Theia states that while "Commission rules may limit band segments to user terminals or gateway operations, advances in satellite and earth station technology may permit both user terminal and gateway operations in the same band in appropriate circumstances (particularly in downlink/receive bands), and some bands have no such limits."¹⁴¹ To ensure that all NGSO proposals can be adequately considered in the context of this processing round, Theia requests that the Commission waive this rule rather than segregating or requiring separate applications for user and gateway links.¹⁴² We dismiss Theia's request for a waiver as moot because its system does not include feeder links, while its intersatellite links use optical frequencies.

48. *Section 25.156(d)(5) Waiver.* Theia requests a waiver of Section 25.156(d)(5) of the Commission's rules.¹⁴³ Section 25.156(d)(5) states that in frequency bands where the Commission has not adopted band specific service rules it will not consider applications for NGSO-like operation after it has granted an application for GSO-like operation, and vice-versa, unless and until the Commission establishes NGSO/GSO sharing criteria for that frequency band.¹⁴⁴ The Commission eliminated Section 25.156(d)(5) in the *NGSO FSS R&O*¹⁴⁵ and this rule change is now in effect. Consequently, Theia's request for a waiver of this requirement is moot.

49. *Waiver of Section 25.157(c) – Processing Round Procedure.* Theia filed its application in the processing round triggered by the OneWeb petition for market access. In addition to the frequency bands proposed by OneWeb, the Theia application included the following frequency bands: 12.75-13.25 GHz, 19.3-19.7 GHz, 19.7-20.2 GHz, 29.1-29.5 GHz, 25.5-27 GHz, and 1215-1300 MHz. Theia requests that no processing round be initiated for operation in these bands and therefore asks for a waiver of Section 25.157(c).¹⁴⁶ As discussed above, we have granted the waiver with respect to the frequency bands 25.5-27 GHz and 1215-1300 MHz. The waiver for the remaining frequency bands was denied when the Commission initiated a processing round including those frequency bands. The Commission was not persuaded by the reasoning presented by Theia. There is no basis to treat the frequency bands in question differently from those portions of the Ku-band and Ka-band which were included in the processing round triggered by the OneWeb petition for U.S. market access.

50. *Waiver of Section 25.157(e)-Band-Splitting Procedure.* Theia seeks to operate throughout a wide range of frequency bands. It requests a waiver of the band-splitting provisions of Section 25.157(e) of the Commission's rules.¹⁴⁷ Since Theia filed its application, the Commission adopted changes to its rules that apply to all NGSO FSS systems that have sharing capabilities (e.g., directional earth station antennas), regardless of the frequency bands used.¹⁴⁸ Theia will use directional earth station antennas and therefore Theia's request for waiver of Section 25.157(e) is moot.

¹⁴⁰ Theia Application, Legal Narrative at 35-36 (citing 47 CFR § 25.156(d)(4)).

¹⁴¹ *Id.* at 36.

¹⁴² *Id.*

¹⁴³ Theia Amendment, Legal Narrative at 19-20.

¹⁴⁴ 47 CFR § 25.156(d)(5).

¹⁴⁵ *NGSO FSS Report and Order*, 32 FCC Rcd at 7821-22, para. 39.

¹⁴⁶ Theia Application, Legal Narrative at 45-51.

¹⁴⁷ *Id.* at 51-54.

¹⁴⁸ *NGSO FSS Report and Order*, 32 FCC Rcd at 7826, para. 52 (applying the newly adopted Section 25.161 to NGSO FSS systems in any frequency band).

51. *Radio Astronomy.* Out-of-band signals into allocated radio astronomy bands can cause interference to radio astronomy observations. We also note that radio astronomy as a service frequently makes use of observations (passive) in bands not allocated to the radio astronomy service. This practice is a result of scientifically valuable signals being subject to the Doppler Effect and shifted in frequency outside radio astronomy-allocated bands. Although not a condition to this authorization, Theia should be aware of these facts and contact the National Science Foundation Spectrum Management Unit (esm@nsf.gov) to assist with coordination and information on radio astronomy sites.

IV. ORDERING CLAUSES

52. Accordingly, IT IS ORDERED that the Application filed by Theia Holdings A, Inc. (Theia), as amended, and accepted for filing IS GRANTED IN PART, DEFERRED IN PART, DISMISSED IN PART, AND DENIED IN PART, as set forth in this Memorandum Opinion, Order and Authorization, pursuant to Section 309(a) of the Communications Act of 1934, as amended, 47 U.S.C. § 309(a).

53. IT IS FURTHER ORDERED that Theia must not cause harmful interference to, or claim protection from harmful interference from, or otherwise impose constraints on operation or development of a primary service to which frequencies are already assigned or may be assigned at a later date consistent with the rights afforded stations operating with a secondary allocation under the U.S. Table of Frequency Allocations, 47 CFR § 2.106.

54. IT IS FURTHER ORDERED that Theia must comply with the mitigation measures to avoid interference to RNSS receivers agreed to by Theia in its *June 1 Letter*.

55. IT IS FURTHER ORDERED that this authorization IS SUBJECT to the following requirements and conditions:

a. Theia must timely provide the Commission with the information required for Advance Publication, Coordination, and Notification of the frequency assignment(s) for this constellation, including due diligence information, pursuant to Articles 9 and 11 of the ITU Radio Regulations. This authorization may be modified, without prior notice, consistent with the coordination of the frequency assignment(s) with other Administrations. *See* 47 CFR § 25.111(b). Theia is responsible for all cost-recovery fees associated with the ITU filings. 47 CFR § 25.111(d).

b. Operations in the 1215-1300 MHz band may not cause harmful interference to, or claim protection from, or otherwise impose constraints on operation or development of services allocated now or in the future on a primary basis.

c. Operations in the 1215-1300 MHz band are conditioned on Theia successfully completing coordination with Air Force GPS and Air Defense Radar Operators.

d. Operations in the 10.7-11.7 GHz (space-to-Earth) frequency band are authorized up to the applicable power flux-density limits in 47 CFR § 25.208(b), and up to the equivalent power flux-density requirements of Article 22 of the ITU Radio Regulations, as well as Resolution 76 (Rev. WRC-15) of the ITU Radio Regulations.

e. Operations in the 11.7-12.2 GHz (space-to-Earth) frequency band are authorized up to the power flux-density limits in Article 21 of the ITU Radio Regulations, and up to the equivalent power flux-density requirements of Article 22 of the ITU Radio Regulations, as well as Resolution 76 (Rev. WRC-15) of the ITU Radio Regulations.

f. Operations in the 12.2-12.7 GHz (space-to-Earth) frequency band are authorized up to the power flux-density limits in 47 CFR § 25.208(o) and Article 21 of the ITU Radio Regulations, and up to the equivalent power flux-density requirements of Article 22 of the ITU Radio Regulations, as well as Resolution 76 (Rev. WRC-15) of the ITU Radio Regulations.

g. Operations of non-geostationary-satellite systems in the 12.75-13.25 GHz (Earth-to-space) frequency band are restricted to individually licensed earth stations in accordance with footnote

NG57 to the U.S. Table of Frequency Allocations, 47 CFR § 2.106, NG57. In the 12.75-13.25 GHz (Earth-to-space) frequency band reception is permitted for levels up to the equivalent power flux-density requirements of Article 22 of the ITU Radio Regulations.

h. Operations in the 14-14.2 GHz band within 125 km of NASA's Tracking and Data Relay Satellite System facilities at the following four locations: Guam (latitude 13°36'55" N, longitude 144°51'22" E); White Sands, New Mexico (latitude 32°20'59" N, longitude 106°36'31" W and latitude 32°32'40" N, longitude 106°36'48" W); and Blossom Point, Maryland (latitude. 38°25' 44" N, longitude 77°05' 20" W); should take account of these NASA facilities.

i. Operations in the 17.8-18.3 GHz frequency band are on a secondary basis with respect to the fixed service.

j. Operations in the 18.8-19.3 GHz (space-to-Earth) frequency band are authorized up to the power flux-density limits in Article 21 of the ITU Radio Regulations.

k. Out of band emissions from Theia's network into the 18.6-18.8 GHz frequency band must comply with the limits in footnote US 255.

l. Space-to-Earth operations in the 17.8-18.6 GHz, 18.8-19.4 GHz, and 19.6-20.2 GHz frequency bands must complete coordination with U.S. Federal systems, in accordance with footnote US334 to the United States Table of Frequency Allocations, 47 CFR § 2.106, prior to being used. The use of space-to-Earth operations in the 17.8-18.6 GHz, 18.8-19.4 GHz, and 19.6-20.2 GHz bands must be in accordance with any signed coordination agreement between Theia and U.S. Federal operators. Two weeks prior to the start of any operations in the 17.8-18.6 GHz, 18.8-19.4 GHz, and 19.6-20.2 GHz bands, Theia must provide contact information for a 24/7 point of contact for the resolution of any harmful interference to Jimmy Nguyen, Email: Jimmy.Nguyen@us.af.mil.

m. Operations in the 27.5-28.35 GHz frequency band are secondary with respect to Upper Microwave Flexible Use Service (UMFUS) operations, except for FSS operations associated with earth stations authorized pursuant to 47 CFR § 25.136 and will comply with any determinations set forth in the Spectrum Frontiers Proceeding (GN Docket 14-177).

n. Operations in the 27.5-28.6 GHz and 29.5-30 GHz (Earth-to-space) frequency bands are on a secondary basis with respect to GSO FSS operations. Reception in these frequency bands is permitted for levels up to the equivalent power flux-density requirements of Article 22 of the ITU Radio Regulations.

o. Operations in the 19.3-19.4 GHz and 19.6-19.7 GHz (space-to-Earth) frequency bands are authorized up to the power flux-density limits in Article 21 of the ITU Radio Regulations that govern NGSO FSS systems in the 17.7-19.3 GHz (space-to-Earth) frequency band. Operations in the band 19.3-19.4 GHz and 19.6-19.7 GHz are on a secondary basis with respect to the GSO FSS and NGSO MSS feeder links. Blanket authorized earth stations in the 19.3-19.4 GHz and 19.6-19.7 GHz operate on a secondary basis with respect to the fixed service.

p. Operations in the 37.5-40.0 GHz band are authorized up to the power flux-density limits in 47 CFR § 25.208(r)(1). These limits cannot be exceeded even during rain fade.

q. Operations in the 37.5-40.0 GHz band are unprotected with respect to the fixed and mobile services, except as authorized pursuant to 47 CFR § 25.136.

r. Operations in the 37.5-38.0 GHz and 40.0-40.5 GHz bands must be successfully coordinated with Federal Space Research Service (SRS) facilities, pursuant to Recommendation ITU-R SA.1396, "Protection Criteria for the Space Research Service in the 37-38 GHz and 40.0-40.5 GHz Bands."

s. Operations in the 40.0-42.0 GHz band are authorized up to the power-flux density limits in 47 CFR § 25.208(s) and (t).

t. In accordance with footnote US211 to 47 CFR § 2.106, Theia is urged to take all practicable steps to protect radio astronomy observations in the adjacent bands from harmful interference from its operations in the 40.5-42.0 GHz band.

u. Operations in the 47.2-48.2 GHz band must provide interference protection to the fixed and mobile services, except as authorized pursuant to 47 CFR § 25.136.

v. Any future grant of earth station licenses for operations with the Theia system will be subject to the following condition, unless the condition is satisfied prior to such license grant: in the 48.94-49.04 GHz band, operations must be coordinated with radio astronomy stations operating on a co-primary basis in this band. Operations in the 47.2-50.2 GHz band will be subject to the rules adopted in the *Spectrum Frontiers Proceeding*, GN Docket 14-177.

w. In accordance with footnote US342 to 47 CFR § 2.106, Theia is urged to take all practicable steps to protect radio astronomy observations from harmful interference from its operations in the 48.94-49.04 GHz band.

x. Earth station emissions into the 50.2-50.4 GHz band must comport with the limits contained in ITU-R Resolution 750 (REV. WRC-15) and/or footnote US156 to Section 2.106 of the Commission's rules, 47 CFR §2.106, footnote US156, including any future revisions of footnote US156 to Section 2.106. Such revisions may be introduced either because of modifications that may be approved by WRC-19 to Resolution 750, or as a result of a Commission rulemaking proceeding, independent of any ITU deliberation.

y. Operations must comply with the spectrum sharing procedures among NGSO FSS space stations specified in 47 CFR § 25.261 with respect to any NGSO system licensed or granted U.S. market access pursuant to the processing round initiated in Public Notice, DA 16-1244. Spectrum sharing between Theia's operations and operations of NGSO systems granted U.S. market access, where such operations do not include communications to or from U.S. territory, are governed only by the ITU Radio Regulations and are not subject to Section 25.261.

z. Operations shall not cause interference to, and shall not claim protection from, GSO networks operating in the FSS and BSS in accordance with Section 25.289 of the Commission's rules, 47 CFR § 25.289. In the event that relevant EPFD limits or procedures related to sharing between GSO and NGSO networks are adopted by the Commission or the ITU, operations must be in conformance with such limits and procedures.

aa. Theia must comply with the sharing of ephemeris data procedures described in new Section 25.146 of the Commission's rules, 47 CFR § 25.146(e).¹⁴⁹

bb. Theia must coordinate physical operations of spacecraft with any operator using similar orbits, for the purpose of eliminating collision risk and minimizing operational impacts. The orbital parameters specified in this grant are subject to change based on such coordination.

cc. Upon finalization of its space station design and prior to initiation of service, Theia must seek and obtain the Commission's approval of a modification containing an updated description of the orbital debris mitigation plans for its system, as discussed in paragraph 39 above.

dd. Prior to initiation of service, Theia must receive a favorable or "qualified favorable" finding in accordance with Resolution 85 with respect to its compliance with applicable EPFD limits in Article 22 of the ITU Radio Regulations.

56. IT IS FURTHER ORDERED, that Theia's request for authorization using the 50.4-51.4

¹⁴⁹ In the *NGSO FSS Report and Order*, we extended the requirement for NGSO FSS operators to share ephemeris data to all frequency bands in which NGSO FSS systems operate. See *NGSO FSS Report and Order*, 32 FCC Rcd at 7828, para. 58 n.131.

GHz band for service and gateway uplinks IS GRANTED, subject to the limitations imposed by Section 25.136 of the Commission's rules, as modified by the *Spectrum Frontiers Fifth Report and Order*.

57. IT IS FURTHER ORDERED that Theia IS AUTHORIZED to receive signals via microwave radiometers in the following frequency bands: 1420-1427 MHz, 1660.5-1668.4 MHz, 2655-2690 MHz, 8.55-8.65 GHz, 9.3-9.9 GHz, and 10.6-10.7 GHz. No authority is granted to transmit in these frequency bands.

58. IT IS FURTHER ORDERED that this authorization IS SUBJECT to modification to bring it into conformance with any rules or policies adopted by the Commission in the future. Accordingly, in making any investments relating to operations in the bands authorized in this order, Theia assumes the risk that such operations may be subject to additional conditions or requirements as a result of any future Commission actions.

59. IT IS FURTHER ORDERED that this grant IS SUBJECT to the following requirements:

a. Theia must post a surety bond in satisfaction of 47 CFR §§ 25.165(a)(1) & (b) no later than June 8, 2019, and thereafter maintain on file a surety bond requiring payment in the event of a default in an amount, at minimum, determined according to the formula set forth in 47 CFR § 25.165(a)(1); and

b. Theia must launch 50 percent of the maximum number of proposed space stations, place them in the assigned orbits, and operate them in accordance with this grant no later than May 9, 2025, and must launch the remaining space stations necessary to complete its authorized service constellation, place them in their assigned orbits, and operate them in accordance with the authorization no later than May 9, 2028. 47 CFR § 25.164(b).

c. Failure to post and maintain a surety bond will render this grant null and void automatically, without further Commission action. Failure to meet the milestone requirements of 47 CFR § 25.164(b) may result in Theia's authorization being reduced to the number of satellites in use at the milestone date. Failure to comply with the milestone requirements of 47 CFR § 25.164(b) will also result in forfeiture of Theia's surety bond. By May 24, 2025, Theia must either demonstrate compliance with this milestone requirement or notify the Commission in writing that the requirement was not met. 47 CFR § 25.164(f).

60. IT IS FURTHER ORDERED that the request for waiver of the modified processing round requirements of Section 25.157(c) regarding operations in the 1215-1300 MHz frequency band IS GRANTED.

61. IT IS FURTHER ORDERED that Theia's request to operate in the 25.5-27.0 GHz frequency band IS DEFERRED, subject to the outcome of the *Spectrum Frontiers* proceeding.

62. IT IS FURTHER ORDERED that receive-only operations in the 1660.5-1668.4 MHz and 8.55-8.65 GHz bands are on an unprotected, non-harmful interference basis. Theia must not cause harmful interference to any authorized users, nor can Theia claim protection from harmful interference caused by any authorized users.

63. IT IS FURTHER ORDERED that the request to operate in the mobile-satellite service in the 14.0-14.5 GHz (Earth-to-space) frequency band IS DEFERRED.

64. IT IS FURTHER ORDERED that the request for waiver of 47 CFR § 25.202(a)(1), in order to permit Theia to operate its user terminal earth stations on a non-conforming, non-interference, unprotected basis in the 10.7-11.7 GHz frequency band, IS DISMISSED AS MOOT.

65. IT IS FURTHER ORDERED that the request for waiver of 47 CFR § 25.202(a)(1), in order to permit Theia to operate its user terminal earth stations on a non-conforming, non-interference, unprotected basis in the 12.75-13.25 GHz frequency band, IS DISMISSED without Prejudice.

66. IT IS FURTHER ORDERED that the request for waivers of the U.S. Table of Frequency Allocations to operate a NGSO FSS constellation in the 17.8-18.6 GHz band IS DISMISSED AS MOOT.

67. IT IS FURTHER ORDERED that the request for waiver of 47 CFR § 25.202(a)(1), concerning the availability of the 50.4-51.4 GHz band for FSS, IS DISMISSED AS MOOT.
68. IT IS FURTHER ORDERED that the request for waiver of 47 CFR § 25.202(a)(1), seeking to allow individually-licensed earth stations operations in the 37.5-40.0 GHz frequency band, IS GRANTED, subject to a condition that Theia may only use the 37.5-40.0 GHz band to serve individually-licensed customer earth stations, and not ubiquitously-deployed customer earth stations under a blanket license
69. IT IS FURTHER ORDERED that the request for waiver of 47 CFR § 25.208(r), concerning power flux density limits in the 37.5-40.0 GHz band, IS DENIED.
70. IT IS FURTHER ORDERED that the request for waiver of Part 30 IS DENIED.
71. IT IS FURTHER ORDERED that the request for waiver of 47 CFR § 25.112(a)(1) with respect to frequencies received by Theia's satellites that were not identified as part of Theia's application IS DISMISSED AS MOOT.
72. IT IS FURTHER ORDERED that the request for waiver of 47 CFR § 25.116(c) IS GRANTED.
73. IT IS FURTHER ORDERED that the request for waiver of 47 CFR § 25.114(d)(14)(ii) and 47 CFR § 25.283(c) IS DISMISSED AS MOOT.
74. IT IS FURTHER ORDERED that the request for waiver of 47 CFR § 25.156(d)(4) & (5) IS DISMISSED AS MOOT.
75. IT IS FURTHER ORDERED that the request for waiver of the band segmentation provision in 47 CFR § 25.157(e) IS DISMISSED AS MOOT.
76. IT IS FURTHER ORDERED that the request for waiver of the Ka-Band Plan IS DISMISSED AS MOOT.
77. IT IS FURTHER ORDERED that the Petitions to Deny of Telesat Canada and ViaSat, Inc. ARE GRANTED to the extent that some of the conditions requested by Telesat Canada and ViaSat are imposed, as indicated herein, and ARE OTHERWISE DENIED.
78. IT IS FURTHER ORDERED that the Petition to Deny or Defer of the GPS Innovation Alliance IS DISMISSED AS MOOT.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

**STATEMENT OF
COMMISSIONER BRENDAN CARR
APPROVING IN PART AND CONCURRING IN PART**

Re: *Theia Holdings A, Inc., Request for Authority to Launch and Operate a Non-Geostationary Satellite Orbit System in the Fixed-Satellite Service, Mobile-Satellite Service, and Earth-Exploration Satellite Service*, IBFS File No. SAT-LOA-20161115-00121 and SAT-AMD-20170301-00029, Call Sign S2986

Our decision today is part of the FCC's broader push to enable a new generation of low-earth orbit satellites that could bring more competition and innovative services to Americans. Start-ups and established players alike have plans to launch thousands of these new satellites. And that's great news for consumers across the country. So I support today's decision to authorize Theia to launch and operate 112 satellites that could be used for remote-sensing, smart ag, imaging, and broadband applications.

I concur, however, in the orbital debris portion of today's decision. In that section, the FCC conditions Theia's authorization on compliance with any new rules the Commission adopts in the orbital debris rulemaking we launched in November 2018. I voted to approve that rulemaking after my colleagues agreed to expand the inquiry by adding additional questions about the Commission's expertise and authority in this area. There's no question that the possibility of thousands of new satellites, passing each other in low-earth orbit at hypervelocity, presents complex questions and will likely require a new set of rules that address collision risks. But as I said at the time, it is far from clear that the FCC is the right federal agency to make these assessments.¹ It is rocket science, after all.

My initial concerns have only grown as stakeholders have filed comments in our rulemaking proceeding. For instance, those comments show that Executive Branch agencies, including NASA and the FAA, are taking action on orbital debris consistent with the President's decisions in the Space Policy Directives. This includes work NASA is doing to revise the U.S. Government Orbital Debris Mitigation Standard Practices at the direction of the President. In my view, we should continue to look to these agencies with deep background and expertise on orbital debris for their leadership on appropriate mitigation measures. While the FCC has made no final decision in our rulemaking proceeding—and I look forward to continuing to engage with my colleagues at our sister agencies on these complex issues—I remain concerned that the FCC is not the right federal agency to lead on orbital debris. Therefore, I concur on this portion of today's decision.

Finally, I want to express my thanks to the International Bureau for its work on this application.

¹ *Mitigation of Orbital Debris in the New Space Age*, Notice of Proposed Rulemaking, Separate Statement of Commissioner Brendan Carr, IB Docket No. 18-313, FCC 18-159 (2018), <https://go.usa.gov/xmQmX>. IB Dkt No. 18-313, FCC18-159 (rel. Nov. 19, 2018).

**STATEMENT OF
COMMISSIONER JESSICA ROSENWORCEL**

Re: *Theia Holdings A, Inc., Request for Authority to Launch and Operate a Non-Geostationary Satellite Orbit System in the Fixed-Satellite Service, Mobile Satellite Service, and Earth Exploration Satellite Service*, IBFS File No. SAT-LOA-20161115-00121 and SAT-AMD-20170301-00029, Call Sign S2986

Get ready for what is headed to our skies. In the past year, the Federal Communications Commission has approved over 13,000 new satellites for launch. There's a lot of good that can come from all this new activity in the atmosphere. It means more capacity to connect more people in more places, expanded access to education and health care, and an ability to grow economies beyond the limits of today's terrestrial networks. Because this order and authorization is a small part of making all these big things possible, it has my support.

Of course, increasing the number of satellites in orbit like this brings new challenges. Chief among them is that the growing amount of debris in orbit could make some regions of space unusable for decades to come. That should concern us—because junking up our far altitudes now will constrain our ability to innovate, connect, and advance satellite systems in the future.

That's why last year I called for the FCC to do more than rely on our old orbital debris rules for next-generation constellations. I called for us to initiate a comprehensive review to mitigate collision risks and ensure space sustainability going forward. And I called on the agency to coordinate more closely with other federal actors with distinct space interests and come up with clear national policies for this jumble of new satellite activity.

But instead of doing this, the agency started a rulemaking that questioned if we have the expertise to work on the satellite issues involving orbital debris. This is strange, because we have been doing just that for more than a decade and a half, since 2004 when we first adopted our existing orbital debris framework. It also asked if we should cede our authority to other federal agencies that do not have statutory responsibility over commercial satellite systems. It worries me that this agency can question its own expertise to manage new space activity and nonetheless rubber stamp 13,000 new satellites for launch. Something in that equation does not compute.

I believe our authority and responsibility to manage new commercial satellite systems and orbital debris risks is clear. We need to correct course. Because it's not enough to approve new satellite systems like we do here, we need to move expeditiously to develop a realistic debris plan that can be implemented stat. The new space age is not waiting—and we have work to do.