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

In the Matter of	)	
	)	
Theia Holdings A, Inc.	)	File No. _____
	)	
Application 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	)	

APPLICATION

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TABLE OF CONTENTS

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APPLICATION

Theia Holdings A, Inc. ("Theia"), pursuant to Sections 301, 307, 308 and 309 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 301, 307, 308 and 309, and Part 25 of the rules of the Federal Communications Commission ("FCC" or "Commission"), 47 C.F.R. Part 25, hereby requests authority to launch and operate a non-geostationary satellite orbit ("NGSO") system operating in the Ku-band Fixed-Satellite Service ("FSS") (10.7-12.7 GHz, space-to-Earth; and 12.75-13.25 GHz and 14.0-14.5 GHz, Earth-to-space), the Ku-band Mobile-Satellite Service ("MSS") in the 14.0-14.5 GHz band, and the Ka-band FSS (17.8-18.6 GHz and 18.8-20.2 GHz, space-to-Earth; 27.5-30.0 GHz Earth-to-space), as well as in the Ka-band Earth-Exploration Satellite Service ("EESS") (25.5-27.0 GHz, space-to-Earth) and the 1215-1300 MHz EESS (active) band. This low-Earth orbit ("LEO") constellation of satellites will operate as the space segment of the Theia Satellite Network ("TSN"). The TSN is a global remote sensing and integrated satellite communications system capable of obtaining, processing and delivering remote sensing analytics and broadband connectivity directly to commercial, industrial, and consumer customers, as well as other users, via its integrated communications network. The communications portion of the TSN includes a high-bandwidth data, analytics and information

transport capacity, the capability of supporting low-cost, bi-directional machine-to-machine ("M2M") communications, and the capability to support the collection of image and sensor data from ground points anywhere in the world (forming a part of the Internet-of-things, or "IoT").

By integrating advanced visible and hyperspectral satellite imaging capabilities with active remote sensing technologies and ground-based calibration, sensors, and data and image collection, the TSN will efficiently deliver next-generation remote sensing-based analytic and information products and services directly to consumers and commercial users, regardless of their location, via affordable Ku-band user terminals. The TSN platform will enable an array of new applications that combine remote sensing and analytics delivered anywhere via broadband satellite connectivity, providing value to users in diverse fields of science, agriculture, natural resource exploration and development, insurance and finance, infrastructure monitoring and integrity assurance, domestic and international trading, transportation management and other similarly core sectors of the economy. The TSN's innovative remote sensing, analytics, and M2M communications capabilities have the potential to beneficially transform foundational sectors of the global economy by enhancing the effectiveness and efficiency of their business models.

I. INTRODUCTION AND SUMMARY

With this Application, Theia seeks Commission authority to launch and operate an NGSO system that will revolutionize the fields of satellite communications and remote sensing and analytics, as well as the global industries they support. Theia's proposed NGSO system will accelerate solutions to multiple social and economic problems, and promote creative disruption in multiple physical industries such as natural resources exploration and development, agriculture, infrastructure, insurance and finance, global physical trade, and commercial intelligence and security.

The TSN represents a quantum leap forward in commercial remote sensing and analytics. It will provide advanced remote sensing analytic products and services directly to end users using its integrated communications system and M2M capabilities, thereby expanding the availability and richness of geophysical and geospatial information. Because the TSN will obtain and process high-resolution data, profound new applications and analytics will become possible. This, in turn, will not only enhance competition in the remote sensing and satellite broadband markets, but also will enhance the efficiency and competitiveness of multiple industries in the United States and globally. Theia's vision is to fundamentally transform commercial remote sensing from space by significantly expanding data collection and distribution, thereby dramatically increasing the benefits of space-based remote sensing to multiple industries and consumers in the United States and around the world.

The TSN will have the capability to capture continuous visible and broad infrared video of the entire Earth, and nearly continuous (400 second revisit rate) high-resolution hyperspectral and active radar data, as well as comprehensive microwave radiometer data, to drive Theia and client analytical engines. Because the data sets continuously captured with the TSN will have high spatial resolution in the visible wavelengths and very high spectral resolution in the non-visible wavelengths, profound new applications and analytics will become possible. Theia will make available this high-resolution optical, radar, and hyperspectral sensing data to individuals and institutions around the world, consistent with Commission satellite regulatory requirements and U.S. commercial remote sensing policy.[1]

[1] Theia is actively engaged with the Commercial Remote Sensing Regulatory Affairs ("CRSRA") office at the National Oceanic and Atmospheric Administration ("NOAA"), U.S. Department of Commerce, and has commenced the NOAA commercial remote sensing licensing process. NOAA authority to operate a commercial remote sensing system is complementary to FCC authority to launch and operate an NGSO satellite system. This Application focuses on the technical, public interest and other factors supporting grant of the

As one example, the TSN products and services will be able to perform a global, hyperspectral and ground penetrating radar survey of cultivated land, including the United States, in less than one week. And with the TSN's proposed direct-to-user communications capabilities, the TSN will enable Theia to provide precision farm analytics to almost any agricultural enterprise, anywhere, regardless of any terrestrial communications limitations, thereby enhancing the efficiency of agricultural operations globally, including in the United States.

As another example, the TSN's instruments and coverage rate will enable Theia to map the surface water and sub-surface aquifers of the entire world in approximately two years. When coupled with the proposed direct-to-user communications capabilities, the TSN can directly monitor water quality and its ground terminals can serve as aggregation points for related local health and disease monitoring.

Through the use of the high bandwidth and high throughput available in the FSS satellite spectrum bands, the TSN will be able to provide and collect high-quality, high-resolution data and information via fixed, transportable and mobile terminals, providing customers and clients with near real-time remote sensing information products directly, rather than requiring customers to accommodate traditional lengthy tasking, collection, and processing queues.

This Narrative, along with the Technical Narrative, Form 312, Schedule S and other components of the Application, establish that launch and operation of Theia's proposed system will comply with applicable Commission rules and policies. Appropriate waivers associated with Theia's unique system proposal are requested where the grant will be consistent with the purpose underlying the rules, will not undermine the purpose of the rules, and will serve the public interest. In addition, Theia acknowledges that certain aspects of its system design may

requested satellite license, whereas the separate NOAA licensing activity focuses on the operational, security and other issues associated with authority to operate a commercial remote sensing system.

require modification as a result of negotiations with other applicants in this NGSO processing round or in conjunction with its application for a commercial remote sensing system license from NOAA. Commission decisions in separate rulemaking proceedings affecting spectrum access and NGSO licensing issues may also have an impact on specific aspects of Theia's system proposal.[2] Accordingly, like other applicants in this proceeding, Theia may update or amend its Application as appropriate to address such developments.

II. TSN OVERVIEW

The TSN will provide satellite-based broadband connectivity to support a wide range of remote sensing information and associated communication needs for commercial, industrial, consumer, scientific and other users worldwide. The TSN will communicate with user terminals using Ku-band FSS spectrum and with gateway earth stations using Ka-band FSS (uplink and downlink), and EESS (downlink) spectrum. In addition, free space optical ("FSO") inter-satellite links ("ISLs") will be used by the TSN to create a mesh network, and FSO gateway links will be used where feasible and appropriate to connect the TSN to the terrestrial network.[3]

The TSN will be comprised of a constellation of 112 highly capable, cross-linked LEO satellites with active and passive remote sensing instrumentation, communications payloads and onboard processing capabilities. The TSN's satellite communications payloads, gateways and

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[2] For example, the Commission's list of items on circulation identifies a pending Notice of Proposed Rulemaking to consider an "Update to Parts 2 and 25 Concerning Non-geostationary, Fixed-Satellite Service Systems and Related Matters," *see* https://transition.fcc.gov/osec/weeklylist/circulate-weekly.pdf.

[3] There is some technical uncertainty with respect to the potential use of FSO gateway links, including atmospheric attenuation/cloud cover, gateway earth station siting and other issues. As a result, Theia is applying for Ka-band uplink and downlink spectrum to support TSN gateway links. TSN can share spectrum with other NGSO systems and will employ only a limited number of gateway sites that can be coordinated with other co-frequency operations. Authorizing access to Ka-band gateway spectrum is consistent with Commission precedent. *See, e.g.*, *In the Matter of Teledesic LLC for Minor Modification of License to Construct, Launch and Operate a Non-Geostationary Fixed Satellite Service System*, File No. 195-SAT-ML-97, Order and Authorization, DA 99-267, at ¶ 14 (IB 1999) (where the FCC authorized RF ISLs even though the applicant sought to pursue optical ISLs).

user terminals will employ advanced antenna technologies which enable the TSN to re-use spectrum within the coverage footprint of each satellite, resulting in highly efficient spectrum utilization and significant aggregate system capacity. The capabilities of the TSN include the ability to:

- process raw remote sensing data onboard the satellite into usable and compressed remote sensing analytics continuously or on demand, resulting in very efficient use of the spectrum for data transmission on a "valuable information per Hertz of spectrum" basis;

- deliver usable remote sensing analytics and provide communications connectivity to users in Ku-band downlink spectrum via fixed, transportable and mobile terminals regardless of their location on Earth;

- receive uplinked data and imagery from Earth-based sensors connected to specially configured M2M/IoT-class terminals, as well as return-link communications from general-class user terminals, in Ku-band uplink spectrum;

- deliver bandwidth-intensive remote sensing analytics and/or data that may require further on-ground processing, or enhancement or combining with other data, as well as user terminal return link communications, to the terrestrial network via Ka-band FSS and EESS downlink spectrum;[4]

- receive ground-processed data and forward link communications for retransmission to appropriate users in Ka-band uplink spectrum; and

- utilize active remote sensing in the 1215-1300 MHz EESS band, to collect high-resolution radar-based imaging and sounding data of the Earth.

The TSN will collect an enormous volume of remote sensing data, including ultimate information products which are transmitted or forwarded directly to users. The sheer amount of data to be transmitted between and among the TSN satellites, the terrestrial network, user terminals and M2M/IoT terminals, and gateways requires that TSN have shared access to large amounts of spectrum. Access to Ka-band EESS downlink spectrum alone is insufficient for the

[4] Return link downlink communications will be delivered to the terrestrial network in Ka-band FSS spectrum only. Ka-band EESS spectrum will be used for remote sensing data downlink only.

TSN's downlink requirement and similar amounts of paired EESS uplink spectrum do not exist because legacy remote sensing systems generally use downlink spectrum for intermittent satellite data downloads only. Moreover, as currently allocated, EESS spectrum is not appropriate for direct-to-user communications because it is shared with numerous other government operations and coordinated on a site-specific basis for relatively brief intervals.

Access to FSS spectrum for user terminals, M2M/IoT terminals and gateway links is fully consistent with the Commission's FSS spectrum access policies. The Commission has consistently facilitated and encouraged access to FSS spectrum by additional services that can use the spectrum to deliver services consistent with the original FSS allocation and without interfering with incumbent users or impairing their access to the bands in question. Examples of this approach include direct-to-home ("DTH") video and mobility applications (including vehicle-mounted earth stations ("VMES"), earth stations onboard vessels and earth stations aboard aircraft in FSS spectrum. Similarly, Theia's transformational business plans can also be accommodated in FSS spectrum without adversely affecting access to the spectrum by other systems and services.

As with any complex network, there are overhead and management functions integral to the network to monitor and control operations, including primary and back-up satellite operations and network control centers. The TSN's monitoring and control functionality, along with its uniquely flexible design, helps ensure compliance with relevant domestic and international regulatory requirements, as also described more fully in the Technical Narrative attached hereto. The following discussion explains the TSN constellation and spectrum plan, as well as the TSN's major elements: (i) satellites, comprising the space segment; (ii) user

terminals; (iii) gateway earth stations; (iv) network operations centers; and (v) satellite control centers and tracking, telemetry and control ("TT&C") earth stations.

A. TSN Constellation and Spectrum Plan

The TSN constellation will have the capability of providing global, continuous coverage of the Earth for remote sensing, and M2M/IoT, user terminal and gateway communications connectivity. The TSN consists of satellites employing active and passive remote sensing and communications payloads, with substantial onboard processing capabilities that are interconnected with FSO ISLs that enable dynamic, cross-constellation routing of data and information. This mesh of satellites enables user traffic and remote sensing data to be transferred to the ground, as well as user traffic and sensing data originating on ground to be uplinked, using only a limited number of gateway sites.

Ka-band and FSO gateways connect the TSN constellation to the terrestrial network, facilitating global broadband communications, terrestrial distribution of data-intensive remote sensing analytics products and delivery of ground-processed data to end users. Ku-band user terminals connect directly to the TSN constellation to access communications and remote sensing products and services, limited only by the requirement to avoid interference with GSO systems or other co-frequency operations (and coordinate with other NGSO systems which are the subject of the Commission's present processing round). In addition, Ku-band M2M/IoT terminals provide sensor and imagery data to, and receive directives and requests from, the TSN constellation using Ku-band spectrum. Figure 1 below shows the global coverage of the TSN constellation.

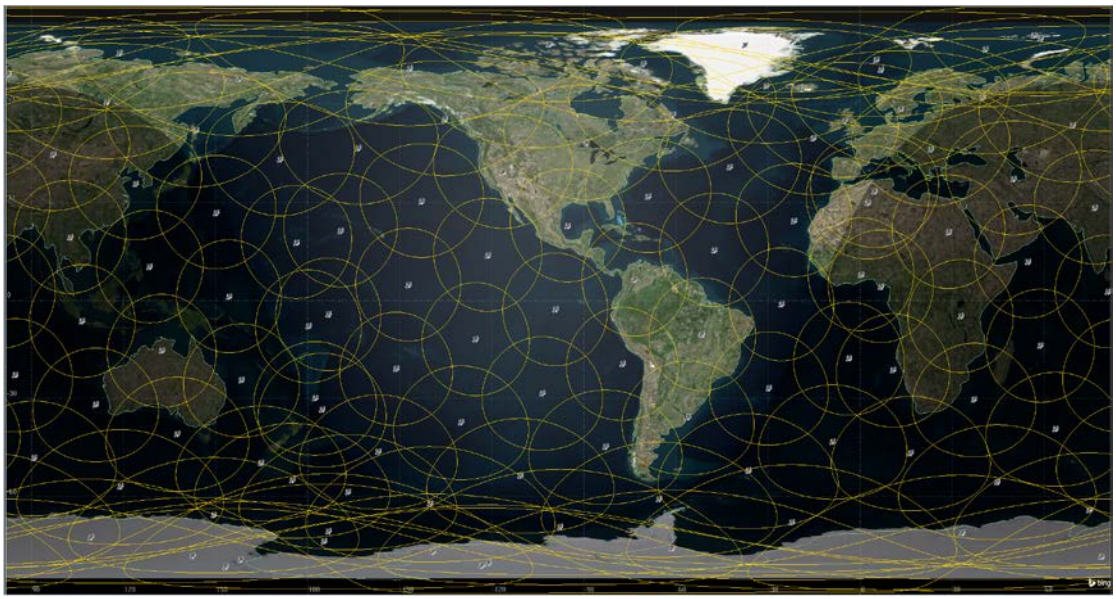

Figure 1 – TSN Constellation Global Coverage

The TSN constellation parameters are summarized in Table 1, below.

Constellation Parameter	TSN Value
Total Number of On-Orbit Satellites	120
Number of Active On-Orbit Satellites	112
Number of On-Orbit Spares (initial deployment, 750 km storage orbit)	8
Number of Planes	8
Number of Active Satellites per Plane	14
Average Altitude – Active Satellites	800 km
Orbit Type	Sun Synchronous
Inclination	98.6°
Active Service Arc	Satellites will be active over the full 360° of their orbits

Table 1. TSN Constellation Parameters

As discussed more fully in the section on spectrum usage below, Theia seeks access to the following frequency bands for TSN operations. Theia will need access to these bands both inside and outside the United States, with waivers requested as appropriate. In bands where NGSO operations are secondary or nonconforming, Theia believes it can operate without causing

harmful interference to or needing protection from users with superior spectrum rights. Theia therefore requests access on that basis.

To the extent a waiver is not granted to operate within a particular jurisdiction, including the United States, Theia respectfully requests authority to include the bands on the satellite for use in those jurisdictions which grant appropriate authority.[5]

Remote Sensing	Frequency Band	Notes
EESS (active)	1215.0 – 1300.0 MHz	Subject to USG/international coordination and NOAA authorization

Gateway Links	Frequency Band	Notes
EESS (s-to-E)	25500.0 - 27000.0 MHz	Subject to USG and commercial EESS coordination requirements
FSS (E-to-s)	29500.0 - 30000.0 MHz	FSS primary but NGSO systems operate on a secondary basis
FSS (E-to-s)	29100.0 - 29500.0 MHz	Primary for NGSO MSS feeder links; NGSO FSS is nonconforming
FSS (E-to-s)	27500.0 - 28350 MHz	FSS secondary allocation, subject to limits set forth in the *Spectrum Frontiers Order*[6]
FSS (E-to-s)	28350.0 – 28600 MHz	GSO FSS primary; NGSO FSS secondary
FSS (E-to-s)	28600.0 – 29100.0 MHz	NGSO FSS primary allocation

[5] The notes included in the frequency tables and the supporting discussion focus on U.S. allocations and spectrum sharing in the United States. Theia acknowledges that different allocations and uses in other countries, and in the various ITU regions, may affect its ability to utilize the spectrum included in this Application outside the United States. However, Theia believes that grant of requested waivers and/or appropriate conditions will enable all spectrum bands to be included in the TSN satellites and used in areas where such operations are consistent with applicable regulation.

[6] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, GN Docket No. 14-177, Report and Order and Further Notice of Proposed Rulemaking, FCC 16-89, 31 FCC Rcd 8014 (2016) ("*Spectrum Frontiers Order*"), at ¶¶ 43-60.

Gateway Links	Frequency Band	Notes
FSS (s-to-E)	19700.0 - 20200.0 MHz	Primary FSS; radioastronomy and federal coordination required
FSS (s-to-E)	19300.0 - 19700.0 MHz	Primary NGSO MSS feeder links; NGSO FSS nonconforming
FSS (s-to-E)	18800.0 - 19300.0 MHz	Primary allocation for NGSO FSS operations; radioastronomy and federal coordination required
FSS (s-to-E)	18300.0 - 18600.0 MHz	Co-primary allocations for fixed service (“FS”) and GSO FSS gateway use; NGSO operations nonconforming
FSS (s-to-E)	17800.0 - 18300.0 MHz	Primary allocations for FS use; NGSO operations are nonconforming

User Links	Frequency Band	Notes
FSS (E-to-s)	14000.0 - 14500.0 MHz	FSS primary and MSS secondary;[7] subject to TDRSS and Radio Astronomy coordination or exclusion zones
FSS (E-to-s)	12750.0 - 13250.0 MHz	Co-primary FS and FSS gateways; waiver for M2M/IoT and user terminals
FSS (s-to-E)	12200.0 - 12700.0 MHz	Co-primary for MVDDS and NGSO FSS; grandfathered FS links
FSS (s-to-E)	11700.0 - 12200.0 MHz	Primary user terminal downlink band
FSS (s-to-E)	10700.0 - 11700.0 MHz	Primary NGSO FSS gateway earth station use; provisional waiver for user terminals sought

B. TSN Elements

1. TSN Satellites

The TSN constellation of 112 satellites (plus eight in-orbit spares) will operate in eight orbital planes of 14 satellites each, connected via FSO inter-satellite links. The TSN satellites will carry active and passive remote sensing instruments, onboard data processing capabilities, payloads for communications in the Ku-band for M2M/IoT and standard user terminals, payloads for communications in the Ka-band for gateway earth stations, and FSO terminals for ISL connectivity among adjacent satellites and possible gateway communications. The satellites will be launched into an orbital configuration designed to meet the mission and safety requirements.

[7] VMES and other Ku-band mobility operations have been granted primary status as applications of the FSS in the United States, but generally operate internationally on the uplink under the secondary MSS allocation and on the downlink as a non-conforming use.

The remote sensing payload for all satellites includes a visible wavelength and mid-infrared wavelength optical fixed-staring system, which is capable of capturing a complete picture of the 120° coverage cone of each satellite (approximately 60° half angle from nadir), continuously. In addition, 52 of the satellites will carry a hyperspectral sensor with 1.2 meter primary, 52 of the satellites will carry an active L-band radar configured both for imaging and soil measurements, and eight of the satellites will carry a passive offset microwave radiometer.

2. Ku-Band User and M2M/IoT Terminals

TSN user terminals will be used at customer sites to access TSN products and services directly from the TSN constellation, particularly in areas that lack terrestrial broadband Internet access connectivity. The TSN user terminals will operate in Ku-band frequencies and will be available in fixed, transportable and mobility configurations. Fixed user terminals are designed for installation and long-term operation at a customer facility and will be equipped with standard interfaces such as USB and Ethernet to enable communication with local computer and/or routing equipment. Transportable user terminals will have similar operational features, but will be designed for short-term use at a customer site and add optional wireless connectivity for local interface with customer computer and routing equipment. Finally, given the well-settled rules governing Ku-band mobility applications,[8] Theia anticipates deploying TSN user terminals for remote mobility applications (e.g., communications to operational farm and mining equipment).

User terminals include all capabilities required to operate as part of the TSN, including such functions as satellite acquisition and tracking, link acquisition and maintenance, and authentication functionality. The TSN will primarily utilize user terminals with 40 cm and 80 cm antennas with electronically steered flat panel arrays. Some antennas for lower-rate user

[8] *See, e.g.*, 47 C.F.R. § 25.226 (authorizing deployment and operation of vehicle-mounted earth stations).

terminals will utilize 20 cm antennas. Other user terminals, potentially including larger or smaller antennas but operating within the performance envelope of a routinely authorized VSAT, are also anticipated to be deployed. Except in limited circumstances where they can be site-licensed pursuant to the Commission's rules in the 12.75-13.25 GHz band,[9] user terminals will uplink in the 14.0-14.5 GHz band.[10] All user terminals will be capable of receiving Ku-band downlink transmissions throughout the 10.7-12.7 GHz band and will be able to operate in some of the bands on an unprotected, non-interference basis.

The user terminals will track the TSN satellites during their service period to the user terminal location, and near the end of that service period will repoint and acquire the next serving satellite to ensure continuous connectivity to the TSN space segment. User terminals will ascertain their own locations, the positions of relevant satellites and emissions restrictions (e.g., permissible frequencies and power levels), and thereby will be able to operate without causing interference to other satellites or services. The foregoing capabilities will enable TSN user terminals to provide IP-based broadband connectivity for transmission and receipt of remote sensing analytics information and other data, as well as support general commercial, industrial, and consumer communications needs.

M2M/IoT terminals are intended for lower data rate, spread spectrum communications with the TSN constellation. For example, they will be connected to things such as Earth-based sensors, cameras and other instruments to uplink data and video imagery to TSN satellites for onboard processing (including incorporation into deliverable analytics) or forwarding to the

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[9] *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, ET Docket No. 98-206, First Report and Order and Further Notice of Proposed Rulemaking, FCC 00-418, 16 FCC Rcd 4096 (2000), at ¶122.

[10] *Id.* at ¶ 151.

terrestrial network for ground-based processing, as appropriate. M2M/IoT terminals may also receive information or directives via the TSN constellation for various purposes. The smaller, lower-cost terminals will uplink in the 12.75-13.25 GHz band (where possible) and the 14.0-14.5 GHz band, depending on the outcome of terminal licensing decisions in individual national jurisdictions.[11]

Although Theia has included technical information regarding representative user terminal operations in this Application to demonstrate their operation with the TSN, it has not included specific technical information regarding M2M/IoT terminal operations. The TSN will operate with M2M/IoT terminals within the same operational envelope specified in this Application (e.g., PFD and EPFD compliance, etc.). Additional details regarding M2M/IoT and standard user terminal operational characteristics, including compatibility with other services in relevant spectrum bands, will be included in appropriate earth station applications requesting FCC authority to operate such terminals.

3. Ka-Band Gateway Earth Stations

Gateway earth stations will connect the TSN constellation with terrestrial communications networks. Traffic carried by these earth stations will include user traffic that can be delivered using terrestrial backhaul (rather than direct Ku-band connections to user terminals), management and control information for handling user traffic, and TT&C operations. Gateway sites are expected to be located at high latitudes, both to enable contact with many TSN satellites simultaneously and to minimize interference with other users in more congested locations. In addition, because the TSN satellites are interconnected by FSO ISLs, only a small

[11] Theia understands that waivers may be necessary to operate M2M/IoT terminals in the 12.75-13.25 GHz band in the United States, which will be sought at the appropriate time, but this should not preclude including these bands on the satellite for operation outside the United States or with other terminal types.

number of gateway sites will be required to support TSN operations. The specific number and location of gateways will be optimized when the final constellation is authorized by the Commission.

The TSN's gateway earth stations will operate in Ka-band frequencies and employ 1.6 m, 3.2 m and 4.8 m equivalent circular aperture sizes, depending on regional climate, regulatory requirements and other factors. Each gateway earth station will employ multiple, steerable antennas to allow make-before-break connectivity with the TSN constellation. Some gateway earth stations will also employ FSO links where feasible and appropriate.

4. Network Operations Centers

The TSN communications links are managed through several network operations centers ("NOCs"). A global NOC with back-up functionality will coordinate all user traffic operations, set policies and data rates, perform quality of service management, schedule updates, and manage or supervise the management of all gateways and user terminals. Regional and national NOCs will be established as required. The NOCs will be interconnected and connected to gateways through the terrestrial communications network and will use secured, encrypted protocols to ensure data security.

5. Satellite Operations Centers and TT&C Earth Stations

The TSN will employ primary and back-up satellite operations centers ("SOCs") to provide 24x7 monitoring and control of TSN satellites throughout all mission phases. Communication between the SOC and satellites occurs in one of two ways. For operational satellites within the TSN constellation, TT&C communications are conducted through the gateway links. For spare satellites and during launch, deployment and transit, as well as deorbit and disposal, TT&C communications are generally conducted using dedicated TT&C sites through the satellites' Ka-band omnidirectional antennas.

The TT&C sites will be located at high latitude to permit access to a larger number of satellites at any one time. The sites will be equipped with multiple 1.6 to 4.8 meter transmit/receive antennas and associated electronics, depending on regional climate, regulatory requirements and other factors. The specific number and location of TT&C earth stations will be optimized when the final constellation is authorized by the Commission.

C. TSN Implementation and Operation

As noted previously, Theia has commenced the commercial remote sensing licensing process with CRSRA at NOAA. Grant of NOAA authority to operate a commercial remote sensing system is necessary to implement the TSN, and turns on separate legal, regulatory, and policy issues that are outside the scope of this Application. Theia is working with NOAA and other U.S. Government stakeholders to implement the TSN in a manner that is fully consistent with U.S. commercial remote sensing policy. Theia will apprise the Commission of material developments in the NOAA licensing process.

FCC and NOAA licensing authorities overlap with respect to operation of EESS instruments onboard the TSN satellites. While NOAA has the authority to authorize operation of a commercial (private) remote sensing system under the National and Commercial Space Programs Act,[12] Section 60125(e) of that act provides that nothing in the act shall affect the FCC's authority under the Communications Act of 1934, under which the FCC authorizes the launch and operation of satellite systems and the use of spectrum. This Application includes information regarding Theia's proposed EESS (active) radar operations because they constitute a use of spectrum by the TSN satellites that could have an impact on other users of the spectrum. This Application does not include information regarding the EESS (passive) bands that may be

[12] 51 U.S.C. § 60121 *et seq.*

included in the satellites' hyperspectral imager or passive microwave radiometer because the particulars of those instruments are subject to the outcome of the NOAA licensing process and passive observations may not constitute a use of spectrum that requires specific authority from the Commission.[13] To the extent that Theia's inability to specify EESS (passive) characteristics at this time may affect the Commission's determination that this Application is "substantially complete," Theia requests a limited waiver of that provision with respect to the EESS (passive) instrumentation onboard the TSN satellites.

With respect to its use of EESS (active) radar spectrum, Theia is actively engaged with NASA, the GPS Directorate and other stakeholders regarding spectrum access and compatibility issues. Theia believes that these consultations will result in appropriate access to the 1215-1300 MHz band consistent with Theia's business plan and protection of U.S. Government and other interests in the band. Because various portions of the band may be usable in different regions of the world, Theia requests authority to operate across the entire band subject to appropriate conditions.

Theia acknowledges that ultimate implementation of the TSN will be contingent on successful conclusion of the FCC and NOAA licensing processes, including successful coordination of access to FSS/MSS and EESS spectrum bands. Theia believes that this process will result in operational conditions that are fully consistent with its business plan. In accordance with the Commission NGSO satellite system milestone and surety bond requirements, Theia will satisfy the bond requirement and fully implement the TSN within six years of license grant.

[13] Theia acknowledges the Commission's authority to license satellites, including their components, but uncertainty with respect to characteristics of the passive sensors and commercial confidentiality issues preclude specifying these characteristics at this time. Theia will update the Commission and amend this Application, as appropriate, once the final configuration of the EESS sensors is authorized.

To this end, Theia is also finalizing NGSO satellite system Advanced Publication and Request for Coordination filings for submission to the International Telecommunication Union ("ITU"). Theia will coordinate with Commission staff regarding delivery of this information. In addition, consistent with Section 25.111(d) and (e) of the Commission's rules, along with the ITU materials, Theia will submit a declaration of unconditional acceptance of all consequent ITU cost-recovery charges in the Application docket and provide a paper copy of that declaration to the Commission.[14]

III. LAUNCH AND OPERATION OF TSN WILL SERVE THE PUBLIC INTEREST

In evaluating the public interest benefits of new and innovative spectrum-based services, the Commission embraces "[a]dvances in technology [that create] the potential for radio systems to use radio spectrum more intensively and more efficiently than in the past."[15] For example, the Commission created room for satellite DTH broadcasting in the FSS bands as early as the 1970s, long before it created rules or service-specific spectrum allocations for direct-broadcast satellite ("DBS") service,[16] because of the significant public interest benefits the new service could deliver. In doing so, the Commission "did not require FSS licensees transmitting the programming to obtain special licenses to provide this direct-to-home service," but continued to regulate them under the "existing FSS rules contained in Part 25, which apply whether the

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[14] *See* 47 C.F.R. § 25.111(d)-(e).

[15] *Facilitating Opportunities for Flexible, Efficient, and Reliable Spectrum Use Employing Cognitive Radio Technologies*, ET Docket No. 03-108, Report and Order, FCC 05-57, 20 FCC Rcd. 5486 (2005), at ¶ 1.

[16] *See, e.g., Policies and Rules for the Direct Broadcast Satellite Service*, IB Docket No. 98-21, Notice of Proposed Rulemaking, FCC 98-26, 13 FCC Rcd 6907 (1998) ("*DTH-FSS NPRM*"), at ¶¶ 4-7.

satellite is providing video, voice or data services."[17] This was the case, despite the characteristics of DBS that distinguish it from other satellite services.[18]

Similarly, in creating a framework under which to grant U.S. market access to foreign-licensed satellite systems under the World Trade Organization Agreement on Basic Telecommunications Services, the Commission sought to produce substantial public interest benefits by enabling a greater range of providers and services, facilitating technical innovation, and spurring development of broader, more global satellite systems.[19] In order to capture these benefits, the Commission identified a series of considerations, including issues relating to competition, spectrum availability, eligibility and operating requirements, as well as national security, law enforcement, foreign policy, and trade concerns.[20] Particularly regarding spectrum availability, the Commission focuses not on the specific service being provided by the aspiring foreign entrant, but on whether the new entrant would "require existing U.S. satellite systems to change their licensed operating parameters or to decrease their capacity,"[21] or "where grant would create debilitating interference problems."[22]

Thus, while the TSN will not primarily provide telecommunications or broadband Internet access service, that does not preclude the Commission from authorizing it to operate in the FSS and MSS bands it seeks. Theia's services fit within the Commission's Part 25

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17 *Id.* at ¶ 4.

18 *Id.* at ¶ 16.

19 *Amendment of the Commission's Regulatory Policies to Allow Non-U.S. Licensed Space Stations to Provide Domestic and International Satellite Service in the United States*, IB Docket No. 96-111, Report and Order, FCC 97-399, 12 FCC Rcd 24094 (1997) ("*DISCO II Order*"), at ¶ 4.

20 *Amendment of the Commission's Regulatory Policies to Allow Non-U.S. Licensed Space Stations to Provide Domestic and International Satellite Service in the United States*, IB Docket No. 96-111, First Order on Reconsideration, FCC 99-325, 15 FCC Rcd 7207 (1999), at ¶ 11, n.28; *see also DISCO II Order* at ¶ 7.

21 *DISCO II Order* at ¶ 147.

22 *Id.* at ¶ 150.

definitions of "Fixed-Satellite Service" and "Mobile-Satellite Service."[23] Moreover, Theia seeks to enhance the business models of many crucial industries, including agriculture, natural resource exploration and development, transportation logistics, environmental and insurance monitoring, infrastructure monitoring and integrity assurance, and other equally foundational industries, through the use of global, persistent, high spatial and high spectral resolution remote sensing analytics, coupled with direct-to-user satellite communications capabilities. The industries that Theia's TSN and analytics can immediately begin serving after launch represent multi-trillion-dollar pillars of the international economic system,[24] and enhancing efficiency in these industries and others will further economic and social advancement in developed and developing countries alike. Given its breadth of economic activity and global economic leadership, the United States is particularly well-positioned to benefit from this remote sensing revolution.

The TSN will be the first major commercial satellite constellation to combine direct-to-user communications, substantial onboard processing power, and persistent, global spectral-based remote sensing capabilities into one integrated system. The TSN will also be the first commercial satellite constellation to deploy remote sensing instruments of sufficient size (aperture) and in sufficient number to produce spatial, spectral and temporal data with sufficient fidelity to directly produce useful commercial and industrial analytics. The ability of the TSN to provide real-time geophysical and geospatial information, remote sensing analytics, and associated communications directly to end users will be as transformational as the communications and computing revolutions have been over the last 20 years. Moreover, the

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[23] 47 C.F.R. § 25.103.

[24] Based on data from the 2015 CIA World Fact Book, globally, the agricultural sector alone contributes 6.1 percent of the world's economic production, some $4.8 trillion annually, while industrial production contributes over 30 percent, some $23.9 trillion annually. *See* analysis at http://statisticstimes.com/economy/countries-by-gdp-sector-composition.php.

ability of the TSN to deliver remote sensing information in a form that can be directly integrated into commercial, industrial, and consumer decision-making processes – and even remotely instruct machines employed by these industries in M2M fashion – will further enhance the usefulness, efficiency, and adoptability of remote sensing information and analytics globally.[25] A U.S.-led remote sensing network such as the TSN will have immediate beneficial effects domestically and will help preserve U.S. technological and economic leadership globally.

In this way, TSN is a logical extension of the transformative power of broadband Internet access service. While the Internet can provide powerful information to the farmer regarding the benefits of new fertilizers, pesticides or irrigation, only TSN can provide the farmer with customized monitoring information about the particular health, growth, and needs of a specific crop in real time as it grows. Theia's proposed NGSO system, which brings together broadband connectivity and remote sensing analytics, constitutes a significant step in the global remote sensing revolution.

A. Public Interest Benefits of TSN's Next-Generation Remote Sensing Analytics

The TSN represents a monumental step forward in the performance, quality and delivery of commercial remote sensing analytics and the integration of such analytics directly into the daily business processes of many industries, via its integrated M2M-compatible communications services. Theia's TSN will have the capability of providing continuous global coverage from LEO using high-resolution, high-fidelity active and passive sensors. For example, with the

[25] *See, e.g.*, National Telecommunications and Information Administration, *The Benefits, Challenges, and Potential Roles for the Government in Fostering the Advancement of the Internet of Things*, Request for Public Comment, 81 Fed. Reg. 19956 (Apr. 6, 2016), at 19957 (observing that, "most [IoT devices] will serve the function of enabling existing industries to better track, manage, and automate their core functions. The potential health, safety, environmental, commercial, and other benefits of IoT are enormous, from reducing the risk of automobile-related injuries and fatalities to enabling micro-cell weather forecasting. IoT has the potential to catalyze new user applications and give rise to new industries.").

persistent visible staring instrument on each TSN satellite, geophysical events such as earthquakes, volcanic eruptions, tsunamis, plane crashes, fires or other natural or man-made phenomena will be recorded as they happen, with no need for human tasking or queuing activities. The satellites in the TSN have sufficient processing capability such that, for many information products, remote sensing data and other data collected from the ground can be processed onboard the satellites directly. Even in situations where processing occurs on-ground, the results can be distributed immediately, in real time, to customers via Ku-band user terminals, regardless of customer location. In this way, the TSN will dramatically enhance the accessibility, reliability, timeliness, and adoptability of remote sensing information products and associated information and data transport services, compared to traditional request-task-respond architectures.

Theia's operational concept and business model can only be accommodated through access to satellite broadband spectrum that is the subject of this application processing round. Legacy EESS allocations are based on access to spectrum for intermittent data downloads from a relatively small number of satellites,[26] and simply do not contemplate the two-way broadband communications connectivity necessary to realize the benefits of high-fidelity, persistent remote sensing constellations.[27]

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[26] *Amendment of Parts 2, 25, and 73 of the Commission's Rules to Implement Decisions from the World Radiocommunication Conference (Geneva, 2003) (WRC-03) Concerning Frequency Bands Between 5900 kHz & 27.5 GHz and to Otherwise Update the Rules in this Frequency Range*, ET Docket No. 04-139, Report and Order, FCC 05-70, 20 FCC Rcd 6570 (2005), at ¶ 87 ("We are raising the secondary non-Federal EESS downlink allocation in the band 25.5-27 GHz to primary status. We find that this allocation upgrade is necessary to meet the requirements of the commercial remote sensing industry and that it is consistent with the new national policy for commercial remote sensing space capabilities that the President authorized on April 25, 2003. In order to implement this decision, we are revising footnote US258 by including the band 25.5-27 GHz in its text.").

[27] The 25.5-27.0 GHz allocation was raised to primary status more than ten years ago in 2005, because the U.S. remote sensing industry needed it for "wider bandwidth operations." Bandwidth needs for all services have grown exponentially over this period, and the remote sensing industry is no exception.

Delivering real-time remote sensing analytics and communications capabilities in FSS spectrum allocations (in addition to use of EESS spectrum) is fully consistent with the Commission's spectrum access policies. There are no limitations on the type of data or communications that can be supported in FSS bands; indeed, Commission precedent is replete with examples of important new services from direct-to-home video to aeronautical, maritime and land-based mobility applications being accommodated in FSS spectrum.[28] As discussed below, Theia's innovative remote sensing and communications system proposal is in accordance with this precedent.

The potential transformative impact on the agriculture and infrastructure sectors illustrate but a few of the numerous public interest benefits of Theia's proposed operation of the TSN in FSS, MSS and EESS spectrum, as explained in more detail below.

1. Agriculture

The TSN will have the capacity to perform a ground-penetrating radar and hyperspectral survey of all of the Earth's agricultural regions every week, including passive infrared sensors to measure ground temperature and thermal inertia, and active radar to measure root density and soil moisture. These high-fidelity, space-based sensing capabilities will be augmented by Earth-based sensors that can provide further data to the TSN constellation for onboard or on-ground integration. With this unprecedented measurement capacity and the associated in-orbit and on-ground processing capabilities, Theia will be able to produce precision agriculture analytics and yield predictions for farms, orchards, pasture lands and similar areas on a global scale at approximately 1 meter ground resolution, on a weekly basis.

[28] *See, e.g., DTH-FSS NPRM* at ¶ 4.

Unlike traditional multi-spectral vegetation stress metrics, which can only sense distress on a broad coverage basis, with the TSN's high-fidelity hyperspectral and radar sensors, Theia will be able to provide forensic agriculture analytics to ascertain detailed characteristics of the state of cultivated and pasture ecosystems on a meter-by-meter basis, such as where a crop may need more or less fertilizer, more or less water, or a certain pesticide or disease fighting agent.[29] These types of analytics from aircraft are already well-proven by researchers and businesses to enhance yields as much as 30%, while simultaneously reducing costs as much as 30%.[30] The

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[29] *See* Group on Earth Observations, "Participating Programs," (2011) ("Near real-time applications are of increased interest such as fire monitoring, biosecurity surveillance, extreme events, and precision agriculture."), available at https://www.earthobservations.org/cop_ag_gams_pp.shtml.

[30] *See generally*, Clement Atzberger, "Advances in Remote Sensing of Agriculture: Context Description, Existing Operational Monitoring Systems and Major Information Needs," 2013*Remote Sensing* 5, at 949, 971 (concluding that remote sensing plays a "strong role . . . within the agricultural sector," because. "for most crops, large production increases (between 45 and 70%) are possible from closing yield gaps to 100% of attainable yields " and "[r]emotely sensed information can help with identifying yield gaps and monitoring related agricultural practices"), available at: http://www.mdpi.com/2072-4292/5/2/949/pdf; Jeffrey T. Bailey and Claire G. Boryan, "Remote Sensing Applications in Agriculture at the USDA National Agricultural Statistics Service," SDA (Sept. 20, 2010) ("Remote sensing currently performs a central role in NASS's statistical program in the estimation of crop area and yields. With today's software, imagery and IT capabilities NASS has transitioned its remote sensing program from a research effort to a production process. Looking to the future NASS expects to see more rapid development of remote sensing applications from research to operational status and hopes to achieve agency benefits with reduced respondent burden, the development of additional spatially rich data and savings from data collections in traditional surveys."); Accenture Digital, "Digital Agriculture: Improving Profitability" (2015) ("Geared toward mature, large-scale farms, the Accenture Precision Agriculture Service helps farmers gather and cross-correlate a wide range of critical data to make meaningful and timely operating decisions that can enhance yield and profitability. Designed for developing countries and small-holder farmers, the Accenture Connected Crop Solution can enable agro-input providers to boost field agent productivity and help farmers improve yields by providing fertilizer, pesticide and seed recommendations personalized for each farmer's land and needs."), *available at:* https://www.accenture.com/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Digital_3/Accenture-Digital-Agriculture-Point-of-View.pdf; International Fertilizer Development Center, "Promoting Agriculture Technology to Improve Productivity and Net Returns for Smallholder Farmers" (2016) ("The ability to apply site-specific nutrient management to match spatially and temporally variable conditions can increase application efficiencies and reduce environmental impacts while improving yields. Thus, precision farming technologies are critical. They can spatially vary nutrients and water prescriptions within a field based on various information sources (soil properties maps, terrain attributes, remote sensing, yield maps, etc.). Soil- and crop-specific fertilization, as well as balanced plant nutrition, could significantly increase crop productivity."), *available at:* https://ifdcorg.files.wordpress.com/2016/09/brochure-promoting-ag-techn-to-improve-productivity-and-net-returns-for-shfs-final.pdf.

TSN will scale such proven capabilities globally, but will deliver them locally via inexpensive user terminals, so that the entire U.S. and international agricultural sector can benefit.

Not only will the TSN be able to distribute precision farming analytics and a wide range of other agriculture-related information directly to users, it can collect additional information from terrestrial sensors in remote agricultural locations to integrate into analytics and further enhance the efficiency of agricultural operations. For example, sensors connected to user terminals or smaller M2M terminals can transmit calibration information regarding crop and soil conditions from specific spot measurements on-ground that can be used to enhance the remote sensing data captured by the TSN satellites, in order to augment the analysis available to farms and farmers. In addition, a TSN M2M terminal installed on a tractor or other farm equipment can transmit data to the TSN to compare the actual precision farming implemented to the precision farming directives provided, and can also monitor maintenance needs, consumables usage, and other information, even where terrestrial communications options are limited or non-existent. These efficiency-enhancing, communications-reliant sub-applications are as important to the farm enterprise as they are to suppliers, insurance and finance companies, and others that support the agricultural sector.

2. Infrastructure

The TSN will have the ability to survey important infrastructure such as pipelines, roads, bridges, and railways as often as required, and even provide continuous monitoring for critical infrastructure. For example, using its space-based remote sensing instrumentation, the TSN can provide critical real-time leak, damage, or right-of-way ingress information to pipeline operators and response personnel, no matter where or when incidents occur. The TSN can also be used to regularly obtain information about roads, bridges, buildings, manufacturing facilities, refineries and other structures from local sensors and imagers, even in the most remote locations, and even

for parts of infrastructures which are not visible from space (e.g., the underside of a bridge, the inside of a pipeline pump station, etc.). By employing M2M/IoT communications links, the TSN can collect super-fine resolution ground-based imagery and data from specific key spots associated with a larger infrastructure at the same time that it completes a broad survey of the wide areal extent of the same infrastructure, thereby forming a complete understanding of an entire infrastructure system, aggregated by a single source/supplier. Furthermore, a long-term change record of a structure can be compiled, which can also include correlation with related geophysical information such as earthquakes, temperature cycles or other metrics that are co-collected.

The TSN's optical and hyperspectral imaging capabilities can also detect anomalies such as chemical releases and other pollution, as well as other dangerous conditions before they result in loss-of-life or loss-of-property incidents, regardless of location, that otherwise may go undetected using conventional monitoring methods. Thus, the TSN can become a key element in monitoring and maintaining the integrity of the critical infrastructure of the United States and other countries, enhancing public safety and reducing the incidence and magnitude of accidents and polluting events, which negatively affect the environment and the public.

3. Real-Time Geophysical Information and First Responder Support

Through the weekly monitoring of the world's agriculture, as well as location-based information about water consumption and other human-related activities, which will employ both the up-link and down-link portions of the spectrum requested by this Application, the TSN will enable experts to predict problems affecting people, groups, and whole countries further in advance than previous methods made possible. Also, because Theia anticipates deploying inexpensive solar-powered earth terminals in many remote regions of the world for remote sensing instrument calibration and related activities supporting water management and

agricultural operations, the TSN will embody a ready-response network for use by first responders to epidemics or other emergencies, no matter where they occur.

In addition, the TSN's staring instrument capabilities will enable the TSN to record calamitous events as they happen, even before first responders may become aware of them. Examples include, but are not limited to, airplane crashes, earthquakes, volcanic eruptions, fires, floods, rogue waves, wind and related weather events, as well as explosions, train derailments and the like. Using the direct-to-user downlink portion of this application, the TSN can directly supply real-time maps and geophysical information to the first responders to disasters and emergencies, assisting them in saving lives and minimizing loss. Also, during many disasters, local terrestrial wired and wireless services are often compromised, necessitating an alternate communications link for first responders to make requests of, and supply information to, the outside world. Thus, through the use of the spectrum requested in this Application, the TSN can become a key element in understanding natural and man-made disasters both in the United States and other countries, as well as directly assisting first responders in managing such disasters effectively, in many cases where there is no alternative communications or information channel.

The TSN will serve the public interest by advancing U.S. and international development, and commercial and safety objectives better than any alternative available today. Through its deployment of high-fidelity multi-mode sensors, coupled with the real-time global communications capabilities that are the subject of this Application, the TSN will provide timelier, more detailed, higher fidelity, and more interactive and real-time useful information about foundational global industries than is available from any other source or method. The TSN will make substantial contributions to lowering costs and increasing efficiency for agriculture, physical goods trading, physical insurance, transportation and shipping, natural resources and

water exploration and development and management, infrastructure operations and other foundational physical businesses around the world. The TSN will also provide information that will enable national and regulatory decision-makers to better shape policies that benefit global access to nutritious food, access to clean water, integrity of public infrastructure and create policies that enhance the economic and physical security of the world. Taken together, the TSN's combined remote sensing and communications capabilities will thus enhance productivity and improve quality of life for everyone in the world, particularly those in the United States.

B. Spectrum Availability and Sharing

Theia seeks to operate the TSN in the Ku-band and Ka-band spectrum that is the subject of the Commission's public notice announcing the cut-off date for NGSO satellite applications in these bands,[31] other Ku-band and Ka-band spectrum (including EESS downlink spectrum) that is not subject to the cut-off notice, and EESS (active) remote sensing spectrum.[32] Certain waivers are requested herein to facilitate contemplated access to some of these bands and Theia will operate the TSN in compliance with the Commission's rules and policies, including such waivers as may be granted to permit proposed TSN operations.

As noted previously, the transformational capabilities of the TSN will require shared access to significant amounts of spectrum – more than past or present remote sensing systems based on older operational paradigms. The TSN will generate vast amounts of observational

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[31] Public Notice, "OneWeb Petition Accepted for Filing, IBFS File No. SAT-LOI-20160428-00041; 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," DA 16-804 (Int'l Bur., rel. July 15, 2016).

[32] With respect to its application for authorization to operate in Ka-band spectrum, Theia complies with the requirement of 47 C.F.R. § 25.145(e) that prohibits the grant of authorization to use the 18.3-20.2 GHz and 28.35-30 GHz bands to an applicant that enjoys or acquires any right, or whose affiliates enjoy or acquire any right, for the purpose of handling traffic to or from the United States, its territories or possessions, to construct or operate space segment or earth stations, or to interchange traffic, which is denied to any other United States company by reason of any concession, contract, understanding, or working arrangement to which the licensee or any persons or companies controlling or controlled by the licensee are parties.

data using its 112 satellites to provide always-on global measurement and monitoring of terrestrial phenomena in unprecedented spectral, spatial, and temporal detail. The TSN will also be able to process data onboard the satellites to enable efficient transmission of usable remote sensing analytics, resulting in more efficient use of spectrum on a "value per Hertz" measure. The TSN will also carry significant amounts of user communications and M2M traffic to and from the terrestrial network, as well as receive substantial data, M2M datagrams, and imagery from ground-based sensors.

As a global service provider, Theia requires operational flexibility to utilize the FSS and MSS bands that are available in the various jurisdictions around the world where it will provide service. Around the world and in the United States, these allocations may vary or for other reasons certain bands present more attractive candidates for the necessary regulatory approvals. Thus, among the three ITU regions, and indeed among individual countries within those regions, it may be necessary or beneficial for Theia to deliver its services using various portions of the spectrum bands covered in this Application. It is not possible for Theia to know with certainty now which bands will ultimately be approved for use in relevant jurisdictions and potential bands may shift over time as spectrum policy evolves or new systems and services are authorized. Authorizing Theia to incorporate the requested spectrum into the TSN constellation, subject to appropriate authorization for use within foreign jurisdictions, is essential to preserve operational flexibility and "future proof" the TSN over the course of its useful life.

Importantly, the TSN can share all the spectrum that it seeks to utilize with other NGSO systems that may be licensed in this proceeding, as well as other co-frequency systems and services. Through avoidance of in-line interference events and other coordination measures, it will be possible for multiple NGSO systems to share available FSS and MSS spectrum. The

TSN's ability to effectively share spectrum with other systems and services, particularly in satellite downlink (earth station receive) bands where compliance with applicable PFD limits protects terrestrial operations and TSN terminals can accept potential interference from terrestrial operations, is discussed in detail in the Technical Narrative.[33]

Theia also notes that it is in active discussions with Federal government and other stakeholders with respect to its use of the 1215-1300 MHz EESS (active) band for radar operations. These discussions may result in certain frequency, temporal or other access limitations to this band. Theia will apprise the Commission of material developments with respect to these discussions and, as with the communications frequencies sought in this Application, the need for operational flexibility and related factors cause Theia to request that the Commission authorize Theia to incorporate the entire 1215-1300 MHz EESS (active) band on its satellites, subject to appropriate operational conditions.

Finally, Theia's use of the 1215-1300 MHz EESS (active) band, as well as EESS passive bands, is subject to commercial remote sensing licensing by NOAA.[34] Theia is engaged with NOAA in the licensing process and will apprise the Commission of material developments in this area. All other remote sensing instruments on the satellites of the TSN are passive in nature, do not radiate energy in any manner as part of their normal operations, and do not require any protection or coordination. Theia respectfully reserves the right to update or amend this Application at the appropriate time with further information about its remote sensing instruments, if required.

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[33] *See* Technical Narrative at §§ 4.1-4.3.

[34] *See* 15 C.F.R. Part 960.

IV. REQUESTS FOR WAIVERS

The TSN's current baseline satellite design and operational plan incorporate state-of-the-art manufacturing, operational and decommissioning concepts. Nonetheless, Theia respectfully requests limited waivers of certain Commission rules in connection with this Application, including specific orbital debris/satellite end-of-life provisions and operational rules to accommodate the proposed TSN system. It is possible that some design elements and operational characteristics may be improved in the process of finalizing the satellite and full system designs, but the waivers below address currently contemplated characteristics. Theia will withdraw any waiver requests that become unnecessary as a result of satellite design improvements.

The Commission may waive its rules for "good cause shown."[35] In general, good cause exists if grant of a waiver would not undermine the purposes of the rule and would otherwise serve the public interest.[36] More specifically, the Commission may exercise its discretion to waive a rule where special circumstances warrant a deviation from the general rule and such deviation would serve the public interest, or where the particular facts make strict compliance inconsistent with the public interest.[37] In conducting this analysis, the Commission may consider hardship, equity, or more effective implementation of overall policy on an individual basis.[38] The requests below amply meet that standard.

A. 47 C.F.R. §§ 25.114(d)(14)(ii) and 25.283(c)

Theia respectfully requests a waiver of Sections 25.114(d)(14)(ii) and 25.283(c) of the Commission's rules, 47 C.F.R. §§ 25.114(d)(14)(ii) & 25.283(c), to the extent necessary to

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35 47 C.F.R. § 1.3.

36 *See, e.g., WAIT Radio*, 418 F.2d 1153, 1157, (D.C. Cir. 1969), *affirmed by WAIT Radio v. FCC*, 459 F.2d 1203 (D.C. Cir. 1972); *Intelsat North America LLC*, 22 FCC Rcd. 11989, at ¶ 6 (2007).

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

38 *WAIT Radio*, 418 F.2d at 1159; *Northeast Cellular*, 897 F.2d at 1166.

authorize the TSN system. Section 25.283(c) of the Commission's rules requires space stations to ensure that at the end of life, "all stored energy sources on board the satellite are discharged, by venting excess propellant, discharging batteries, relieving pressure vessels, and other appropriate measures."[39] Similarly, Section 25.114(d)(14)(ii) requires space station applications to address "whether stored energy will be removed at the spacecraft's end of life, by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy, or through other equivalent procedures specifically disclosed in the application."[40]

The TSN's orbital debris mitigation/satellite end-of-life plan is included in this Application as Appendix 4 to the Technical Narrative. Although Theia has not selected a satellite manufacturer or established a final design for its satellites, it has consulted with numerous engineering partners in developing its current baseline design. Theia will incorporate into the final design features for minimization of orbital debris, including, for example, the use of non-debris generating appendage hold down and release mechanisms, selection of appropriate construction materials including external thermal control surfaces and coatings, and operational procedures.

The current TSN satellite design includes tanks and propellant lines that will maintain a small amount of gas in tanks rated for pressures many times greater than that anticipated at end-of-life. Throughout the life of the satellite, fuel is consumed for various maneuvers. As discussed in Appendix 4, at the end of operational life, the satellite is commanded into a deorbit maneuver with a depletion burn to exhaust all available fuel. At the completion of this

[39] 47 C.F.R. § 25.283(c).

[40] 47 C.F.R. § 25.114(d)(14)(ii).

maneuver, the 4.5 kg of inert nitrogen pressurant will remain on the "dry" side of the bladder in the tank, at a residual pressure of approximately 6 bar. Also, a small amount of fuel will remain in the propellant lines of the system in vapor form, which presents no hazard of escaping or causing later rupture, as it will reach the vapor pressure of hydrazine, about 0.28 bar at 25°C when all lines are opened at the thruster valves to passivate the system. This vapor will remain in the lines when the valves are closed upon removal of electrical power. In the unlikely event of a small particle (debris or meteor) puncturing the tank, the residual gaseous nitrogen would be released in a rapid manner, similar to a cold gas thruster, with a theoretical maximum delta-V of less than 5 m/s. In the extraordinarily unlikely event of a particle striking a passivated space vehicle on precisely the line required to puncture both the fuel portion of the tank and the bladder, the maximum theoretical delta-V is about 7 m/s. Given that the orbital velocity during disposal is on the order of 7 km/s, this delta-V will have no noticeable effect on the orbit of the satellite, or alter the possibility of space vehicle breakup in any fashion.

Waiver is appropriate in this case because grant would not undermine the purpose of the rule, and, in fact, will serve the purpose underlying the rule, which is to reduce the risk of accidental explosion. In the unlikely event of a small particle (debris or meteor) puncturing the tank and/or lines, the residual gaseous nitrogen and fuel vapor would be released in a manner similar to a cold gas thruster or air being released from a balloon, with no material impact on satellite trajectory and no ability to cause break-up of the satellite. Furthermore, there is essentially no probability of the remaining pressurant or fuel vapor becoming a source of accidental explosions or orbital debris in a passivated satellite.

There is substantial Commission precedent for granting waivers to satellite operators with spacecraft that are unable to fully vent at end-of-life but instead maintain a small amount of fuel

and/or gas and resulting pressure onboard.[41] Among other things, because these end-of-life pressures are well below that of the associated tanks and the design reduces overall risk associated with the launch and operation of the satellite, the Commission has found such waivers to be in the public interest. Similarly, Theia requests a waiver of Section 25.114(d)(14)(ii) and/or Section 25.283(c) of the Commission's rules, to the extent required to permit Theia to incorporate a design which contemplates a fuel system in which small amounts of inert nitrogen and fuel vapor remain under a low level of residual pressure following the exhaustion of all usable fuel at end-of-life.

B. 47 C.F.R. § 25.156(d)(4)

In this application processing round, the Commission has aggregated proposals to use Ku-band and Ka-band spectrum for both user links and gateway links with a single cutoff date, even though OneWeb proposes to operate user links in Ku-band and gateway links in Ka-band.[42] For its part, Theia also proposes to operate user links in Ku-band and gateway links in Ka-band. Out of an abundance of caution, Theia hereby requests a waiver of Section 25.156(d)(4) of the Commission's rules, 47 C.F.R. § 25.156(d)(4), which states that an application for feeder link or ISL authority will be treated by the Commission as a separate application from its associated service band.

The impact of Section 25.156(d)(4) is unclear in the context of a single processing round for multiple bands where applications may describe a single NGSO system that uses the bands

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[41] *See, e.g.*, Stamp Grant, *XM Radio, LLC*, IBFS File. No. SAT-STA-20140922-00103 (granted Sept. 26, 2014) (granting a waiver to XM Radio of the venting requirement for the XM-2 satellite); Stamp Grant, *PanAmSat Licensee Corp.* IBFS File No. SAT-STA-20110112-00011 (granted Jan. 14, 2011) (granting waiver of venting requirement to Intelsat 2; Stamp Grant, *DIRECTV Enterprises, LLC*, IBFS File No. SAT-LOA-20090807-00085 (granted Dec. 15, 2009) (granting waiver of the venting requirement for the DIRECTV 12/RB2-A satellite).

[42] OneWeb Public Notice (DA 16-804) at 1.

identified to operate as an integrated whole, even if user terminals and gateway operations are proposed in separate band segments. While certain 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. 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.

C. Waiver of 47 C.F.R. §§ 2.106 & 25.202(a)(1)

Theia requests a waiver of the Table of Allocations, 47 C.F.R. § 2.106, the Commission's Ka-band Plan,[43] and Section 25.202(a)(1) of the Commission's rules, 47 C.F.R. § 25.202(a)(1), to the extent necessary to permit operations that may be considered a non-conforming use of the following bands: 10.7-11.7 GHz and 12.2-12.7 GHz (Ku-band downlink), 12.75-13.25 GHz (Ku-band uplink), 17.8-18.3 GHz, 18.3-18.6 GHz and 19.3-19.7 GHz (Ka-band downlink) and 29.1-29.5 GHz (Ka-band uplink) bands.[44] Although these frequencies are available for use by the

[43] The Commission issued a series of related Orders in CC Docket No. 92-297 and IB Docket No. 98-172 establishing a designation plan for use of the Ka-band by non-Federal users. *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*, First Report and Order and Fourth Notice of Proposed Rulemaking, 11 FCC Rcd 19005 (1996) ("*Ka-band Report and Order*"), modified by Third Report and Order, 12 FCC Rcd 22310 (1997); *Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5- 30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3-17.8 GHz and 24.75-25.25 GHz Frequency Bands for Broadcast Satellite Service Use*, Report and Order, IB Docket 98-172, 15 FCC Rcd 13430 (2000) ("*18 GHz Report and Order*").

[44] *See* United States Table of Frequency Allocations, 47 C.F.R. §2.106.

FSS pursuant to § 25.202(a)(1) of the Commission's rules,[45] they have certain band-specific restrictions which are the subject of this waiver request.[46]

In considering requests for non-conforming uses, the Commission has indicated it would grant such waivers when there is little potential for interference into any service authorized under the Table of Allocations and when the non-conforming operator accepts any interference from authorized services.[47] As demonstrated below, in each case, Theia's proposed access to these bands satisfies the foregoing standard, is in accord with the purpose behind the requirement, does not undermine the purpose of the requirement, and serves the public interest.

1. 10.7-11.7 and 12.2-12.7 GHz (Ku-band Downlink) Bands

Although the 10.7-11.7 GHz band is allocated on a co-primary basis between FS and FSS, the Commission adopted note 6 to Section 25.202(a)(1) of the Commission's rules to limit use of this band by NGSO FSS systems to downlink transmissions to gateway earth stations.[48] Because Theia proposes to operate user terminal downlinks in the 10.7-11.7 GHz band, it requests a waiver of the gateway use restriction in this band.

Theia will operate its user terminals in the 10.7-11.7 GHz band on a non-interference, unprotected basis to ensure that the ability of FS operators to expand service in the 10.7-11.7 GHz band in the future is not restricted in any manner. In addition, the downlink transmissions in the 10.7-11.7 GHz band will comply with the PFD limits in Section 25.208(b) of the Commission's rules. The Commission has determined that such PFD limits are sufficient to

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[45] This is true except for the 17.8-18.3 GHz band, which has no FSS allocation under Section 2.202(a)(1).

[46] *Id.*; 47 C.F.R. §25.202(a)(1).

[47] *See* Letter from Jose Albuquerque, Chief, Satellite Division and Mark Settle, Chief, Policy and Rules Division, to Suzanne Malloy, O3b Limited, DA 14-1369 (rel. September 22, 2014); *Contactmeo Communications, LLC*, Order and Authorization, 21 FCC Rcd 4035, 4044 (IB 2006); *ViaSat AMSS Order*, File No. SES-MFS-20090624-00789; see *also* 47 C.F.R. § 1.3.

[48] *See* 47 C.F.R. § 25.202(a)(1), n.6.

protect FS operators from interference from satellite downlinks.[49] Accordingly, a waiver of the NGSO FSS gateway use restriction in the 10.7-11.7 GHz band is warranted.

With respect to the 12.2-12.7 GHz band, the FCC specifically stated that the Multichannel Video Distribution and Data Service ("MVDDS") must share the spectrum with NGSO FSS systems on a co-primary basis when it established technical and service MVDDS operations in the band.[50] Theia is requesting this waiver in this band due to a recent *ex parte* filing made by the MVDDS 5G Coalition in response to OneWeb's Petition in which it argues that the OneWeb request for market access is procedurally defective and should be dismissed because OneWeb's proposed operations constitute MSS services not permitted under the U.S. Table of Allocations and OneWeb did not request a waiver.[51] Although Theia disagrees with the position held by the MVDDS 5G Coalition, it nonetheless requests this waiver to enable its user terminals to be used for mobility applications in the event the Commission agrees with the MVDDS 5G Coalition.

The nature of the TSN's mobility applications – such as use of TSN terminals on farming, construction, transportation, mining and similar equipment in remote locations – suggest that they will be compatible with and substantially unaffected by MVDDS operations.

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[49] *See, e.g., The Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band*, IB Docket No. 06-123, Report and Order and Further Notice of Proposed Rulemaking, FCC 07-76, 22 FCC Rcd 8842 (2007), at ¶¶ 82 *et seq.*

[50] *See In the Matter of Amendment of Parts 2 and 25 of the Commission's rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, ET Docket No. 98-206, Memorandum Opinion and Order and Second Report and Order, FCC 02-116, 17 FCC Rcd 9614 (2002), at ¶ 111.

[51] *See* Letter to Ms. Marlene H. Dortch, Ex Parte Presentation, *Re: Ex Parte Presentation in Petition for Rulemaking to Permit MVDDS Use of the 12.2-12.7 GHz Band for Two-Way Mobile Broadband Service, RM-11768; WorldVu Satellites Limited, Petition for a Declaratory Ruling Granting Access to the U.S. Market for the OneWeb System, IBFS File No. SAT-LOT-20160428-00041* (Oct. 28, 2016).

In addition, Theia agrees to accept interference from MVDDS operations into its user terminal receivers in this downlink band. Since the TSN user terminals cannot cause interference or otherwise constrain MVDDS deployment in this band and its downlink transmissions will comply with applicable PFD limits, there is good cause for, and no adverse impact of, granting the requested waiver.

Theia would also note that while the Commission has afforded Ku-band mobility applications, including VMES operations, primary status in the United States, there is a secondary MSS allocation in the Ku-band uplink at 14.0-14.5 GHz and no MSS allocation in the Ku-band downlinks at 10.7-12.2 GHz internationally. As a result, mobility applications in these bands operate on an unprotected, non-harmful interference basis as a non-conforming use. Because these earth station receive operations use traditional FSS satellites that comply with downlink PFD and other applicable regulatory requirements, however, there is no potential for interference from these mobility operations. Except to the extent national regulations provide otherwise, Theia will conduct its mobility downlink operations outside the United States on a similar non-conforming basis.

2. 12.75-13.25 GHz (Ku-Band Uplink) Band

Although the Table of Allocations provides that the 12.75-13.25 GHz band is allocated on a co-primary basis between FS and FSS operations, Section 25.202(a)(1) of the Commission's rules limits the use of the 12.75-13.25 GHz band by NGSO FSS systems to gateway earth station uplinks. Theia proposes to use this band to support a limited number of user terminals, as well as certain IoT/M2M uplink operations. Accordingly, Theia requests a waiver to permit non-gateway uplink operations in this band.

Specifically, Theia proposes to operate a limited number of larger Ku-band earth stations at select locations on an individually licensed rather than blanket-licensed basis. These earth

stations would be dedicated for service to larger customers such as major enterprise or government users. Operation of these site-licensed earth stations would be subject to coordination and electromagnetic compatibility analyses as appropriate, as well as transmit power limitations and related provisions designed to limit the potential for interference to co-frequency operations (including compliance with ITU Article 22 EPFD limits designed to protect GSO systems).

In addition, Theia seeks to operate M2M/IoT terminals in the 12.75-13.25 GHz band. These terminals will operate at low power using spread spectrum to connect Earth-based sensors of various types directly to the TSN satellite constellation, similar to the authorized Omnitracs system using Ku-band GSO FSS satellites. Such satellite-based sensor connectivity will primarily be used in remote areas where limited or no alternative connectivity options exist. Given their low power and typical remote deployment, TSN M2M/IoT terminals will not be a source of harmful interference to co-frequency systems and services. To the extent any such interference may occur on a particular band, Theia can remotely adjust the terminal uplink frequencies to resolve such interference. In the unlikely event that interference cannot be resolved, Theia will discontinue operations on the offending frequencies at the affected location.

In view of the foregoing, there is little or no potential for interference to FS or other FSS systems in the 12.75-13.25 GHz band. Theia will not claim protection from conforming uses of the spectrum and agrees to accept any harmful interference from other lawfully authorized radio stations while operating on an unprotected, non-conforming basis. In addition, if any large user earth station or M2M/IoT terminal operations cause harmful interference to any lawfully authorized radio stations operating in the 12.75-13.25 GHz band in conformity with the Commission's rules, Theia will immediately suspend such operations.

3. 17.8-18.3 GHz, 18.3-18.6 GHz and 19.3-19.7 GHz (Ka-Band Downlink) Bands

The Table of Allocations and the Commission's Ka-band Plan provide that the 17.8-18.3 GHz band may be used by FS systems on a primary basis.[52] Theia seeks to conduct Ka-band NGSO FSS downlink/gateway receive operations on an unprotected, non-conforming basis only in this band and therefore will accept any harmful interference from other services. In addition, there is no material potential for TSN satellite downlink/gateway receive operations to cause interference because they will comply with applicable PFD limits designed to protect terrestrial services, as well as with ITU EPFD limits designed to protect GSO FSS systems that may operate in the band.[53] However, to the extent its operations are determined to cause harmful interference to co-frequency systems and services, Theia will immediately suspend such offending operations. The Commission has previously authorized O3b to operate its NGSO system and associated earth stations in this band on a non-conforming basis.[54] In view of the foregoing, a waiver to permit limited TSN gateway receive operations in the 17.8-18.3 GHz band would be consistent with Commission precedent and the public interest.

The U.S. Table of Allocations provides that in the 18.3-18.6 GHz band, FSS services are limited to GSO FSS operations.[55] Theia requests a waiver of this limitation to permit non-

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[52] *See Redesignation of Ka-band Plan R&O* ¶¶ 28 and 34.

[53] *See* Appendices 1 & 2.

[54] *See, e.g.*, Application of O3b Limited, File No. SAT-LOI-20141029-00118 (granted Jan. 22, 2015); Letter from José Albuquerque, Chief, Satellite Division, International Bureau and Mark Settle, Chief, Policy and Rules Division, Office of Engineering and Technology, to Suzanne Malloy, Vice President, Regulatory Affairs, O3b Limited, File No. SES-MSC-20151021-00760 (granted Jan. 29, 2016); Letter from Letter from José Albuquerque, Chief, Satellite Division, International Bureau and Mark Settle, Chief, Policy and Rules Division, Office of Engineering and Technology, to Suzanne Malloy, Vice President, Regulatory Affairs, O3b Limited, File No. SES-MSC-20140318-00150 (granted Sep. 22, 2014).

[55] *See* 47 C.F.R. § 2.106, footnote NG164 (stating that, "[t]he use of the band 18.3–18.8 GHz by the fixed-satellite service (space-to-Earth) is limited to systems in the *geostationary-satellite orbit*." (emphasis added). Terrestrial FS operations are co-primary with GSO FSS in the 18.3-18.58 GHz portion of the band.

conforming use of the 18.3-18.6 GHz band to support its Ka-band NGSO downlink/gateway receive operations. Theia will not claim protection from conforming uses, agrees to accept all interference from other authorized services in the band and will comply with ITU EPFD limits designed to protect GSO FSS systems.[56] To the extent its operations are determined to cause harmful interference to co-frequency systems and services, Theia will immediately suspend such offending operations. In addition, the Commission has previously authorized O3b to operate in this band on a non-conforming basis. Thus, a waiver to permit limited TSN gateway receive operations in the 18.3-18.6 GHz band would be consistent with Commission precedent and the public interest.

Finally, Section 2.106 of the Commission's rules limits FSS use of the 19.3-19.7 GHz band (space-to-Earth) to MSS feeder links.[57] As indicated above, the TSN supports Ku-band mobility applications and therefore access to this band for gateway operations to support such operations may be considered consistent with the MSS feeder link limitation. To the extent the Commission concludes otherwise, however, Theia hereby seeks a waiver to use the 19.3-19.7 GHz band for limited gateway receive operations.

There is no incremental risk of interference from TSN gateway receive operations in the 19.3-19.7 GHz band. As demonstrated in the Technical Narrative, the TSN's Ka-band gateway operations comply with the relevant PFD limits for the 19.3-19.7 GHz band, as well as EPFD limits in the band to protect GSO operations.[58] Theia will also accommodate all Federal operations in the band, including those contemplated in note US334(b) to the US Table of

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[56] *See* ITU Radio Regulations Nos. 22.5C, 22.5D and 22.5F.

[57] *See* 47 C.F.R. § 2.106, n. NG166. There are no ITU PFD limits in this band, but Theia plans to operate at levels consistent with those in the 17.8-18.3 GHz and 18.3-18.6 GHz bands discussed above.

[58] *See* Technical Narrative, Appendices 1 and 2.

Allocations.[59] Finally, Theia believes that even on a non-conforming unprotected, non-interference basis, it will be possible to site and operate the TSN gateways in a manner that fully protects existing and future MSS feeder link operations in the band.

In view of the foregoing, the Commission should waive the NGSO FSS feeder link limitation to the extent necessary to include this gateway downlink band on the TSN satellites. In addition, even if it does not permit use of this band in the United States, it should permit use of the band outside the United States subject to appropriate conditions.

4. 29.1-29.5 GHz (Ka-Band Uplink) Band

The U.S. Table of Allocations and Section 25.202 permits use of the entire 29.1-29.5 GHz band on a primary basis for NGSO mobile-satellite service ("MSS") feeder links systems on a primary basis.[60] In the 29.1-29.25 GHz portion of this band, that allocation is co-primary with the Local Multipoint Distribution Service ("LMDS").[61] In the 29.25-29.5 GHz portion of this band, that allocation is co-primary with GSO FSS service.[62] Throughout the entire band, NGSO FSS operations are otherwise considered non-conforming.

As noted above, Theia intends to operate user terminals in mobility applications in the Ku-band.[63] As a result, use of the 29.1-29.5 GHz band for gateways (i.e., feeder links) to support mobility applications can be considered a conforming use of the band. Granting Theia authority to access the 29.1-29.5 GHz band for limited gateway operations to support such

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59 *See Redesignation of Ka-band Plan R&O* ¶¶ 28 and 34.

60 47 C.F.R. § 2.106; 47 C.F.R. § 25.202(a)(1) (nn. 4-5).

61 47 C.F.R. § 25.202(a)(1) (n.4).

62 47 C.F.R. § 25.202(a)(1) (n.5).

63 Among other applications, the TSN will provide service to user terminals under the Commission's VMES rules operating pursuant to the blanket licensing provisions of Section 25.226 of the Commission's rules, 47 C.F.R. § 25.226. Theia acknowledges, however, that such mobility applications may be considered applications of the FSS for certain regulatory purposes.

operations, as well as other TSN functions, would be consistent with permitted uses of the band.[64]

Nonetheless, Theia requests a waiver of the Table of Allocations and Section 25.202(a) of the Commission's rules to the extent required for Theia to use the 29.1-29.5 GHz band on a non-conforming basis for TSN gateway operations that support non-mobility applications. Access to this band for a limited number of gateway earth stations in remote areas can be effectively coordinated with existing and future MSS feeder link earth stations, and will have no adverse impact on other co-frequency operations such as LMDS links. Additionally, while there is no applicable ITU EPFD limit in this band, there is little or no potential for interference to GSO FSS systems in the 29.25-29.5 GHz band because the TSN's gateway operations will comply with the EPFD limits in the neighboring bands set forth in Article 22 of the ITU Radio Regulations.[65]

Thus, TSN gateway operations can be permitted in the 29.1-29.5 GHz band, in part on a conforming basis. To the extent that TSN gateway operations in this band are authorized on a non-conforming basis only: (1) Theia will not claim protection from conforming uses of the spectrum and agrees to accept any harmful interference from other services while operating on an unprotected, non-conforming basis; and (2) Theia will immediately suspend gateway uplink operations in this band if it is determined that such operations are causing harmful interference to

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[64] In fact, it has even been suggested that a portion of this band be authorized for remote sensing uplink operations. *See generally* Reply Comments of Terra Bell Technologies Inc., File No. SAT-LOI-20160428-00041 (filed Sept. 1, 2016).

[65] *See* ITU Radio Regulations Nos. 22.5C, 22.5D and 22.5F; *See* O3b Limited, File No. *See* File No. SES-LIC-20130528-00455, Technical Appendix, A.7; *contactMEO Communications, LLC*, 21 FCC Rcd 4035, 4043-4044 (IB 2006) (where the Commission held that compliance with the ITU's EPFD limits provides a sufficient basis for an NGSO FSS system to operate on a non-interference basis in a band in which GSO FSS systems are primary).

any lawfully authorized radio stations in the 29.1-29.5 GHz band operating in conformance with the Commission's rules.

D. Waiver of 47 C.F.R. § 2.157(c)

Theia also respectfully requests a waiver of the Commission's modified processing round requirement codified in Section 25.157(c) of the Commission's rules for bands not included in the OneWeb Public Notice that commenced this application processing round. Theia is proposing to operate in certain bands that are not included in the subject public notice, including: (i) the 12.75-13.25 GHz, 19.3-19.7 GHz, 19.7-20.2 GHz and 29.1-29.5 GHz bands (collectively, the "Additional Ku-Band and Ka-Band Spectrum"); (ii) the 25.5-27.0 GHz band (the "EESS (s-to-E) Band"); and (iii) the 1215-1300 MHz band (the "EESS (Active) Band"). Grant of the requested waiver is consistent with Commission policy and precedent, and will serve the public interest by allowing Theia to utilize the full capabilities of its innovative NGSO system.

1. Additional Ku-Band and Ka-Band Spectrum

Out of an abundance of caution and to the extent required, Theia hereby requests a waiver of the processing round requirements of Section 25.157(c) with respect to its request to use the 12.75-13.25 GHz, 19.3-19.7 GHz, 19.7-20.2 GHz and 29.1-29.5 GHz bands, which were not explicitly included in the OneWeb Public Notice but are considered part of the Ku-band and Ka-band spectrum range. Theia believes that the Commission has already placed potential applicants on notice that they should incorporate into their applications additional Ku-band and Ka-band spectrum that may be integral to their proposed systems. In this context, the International Bureau ("Bureau") has expressly stated that it will consider as part of this processing an application filed by O3b that implicates access to spectrum outside of the range

sought by OneWeb, even though the Bureau did not explicitly call for applications utilizing that spectrum to be filed by the cut-off date.[66]

In addition, there is no basis to suggest that the Commission's public notice announcing the instant processing round required applicants to expressly limit their system designs to the bands sought by OneWeb. Such a limitation would be directly contrary to decades of clear Commission precedent enabling satellite proponents to design their systems as they deem appropriate consistent with the spectrum access and operational requirements embodied in the Commission's rules.[67] Although the Commission correctly identified spectrum bands requested by OneWeb in initiating this processing round, it did not and could not require applicants to design systems that operate in only those bands. Rather, the OneWeb Public Notice effectively put NGSO system proponents on notice that if they sought to obtain an FCC satellite license (or access to the U.S. market) that included any of (but not only) the identified bands, they must participate in the processing round. Even a hypothetical applicant that is planning an NGSO

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[66] OneWeb Public Notice, at 2, n.5.

[67] *See The Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ka-Band*, IB Docket No. 02-19, Report and Order, FCC 03-137, 18 FCC Rcd 14708 (2003), at ¶ 20 ("So long as NGSO FSS operators avoid causing in-line interference events between systems, they are free to design any constellation and any service offerings best suited for their business plans and the markets they seek to serve. This serves our technological neutrality objective."); *Inquiry into the Development of Regulatory Policy with regard to Direct Broadcast Satellites for the Period following the 1983 Regional Administrative Radio Conference*, GN Docket No. 80-603, Notice of Proposed Policy Statement and Rulemaking, FCC 81-181, 86 FCC 2d 719 (1981), at ¶ 88 (consistent with "DOMSAT open entry policy" to permit "DBS applicants [to] structure their proposals according to any particular regulatory model [and] include some or all elements of broadcast, common carrier, or private radio services, or none of them" because "our basic policy should be to maintain an open and flexible approach that will allow the business judgments of individual applicants to shape the character of the service offered" and "to encourage the submission of a wide variety of proposals and thereby achieve the full benefits of experimentation"); *Domestic Communications Satellite Facilities*, Docket No. 16495, Second Report and Order, FCC 72-531, 35 FCC 2d 844 (1972), at ¶¶ 6-8 (finding that, "the uncertainties as to the nature and scope of the special markets and innovative services that might be stimulated will only be resolved by the experience with operational [satellite] facilities," and that, "multiple entry is most likely to produce a fruitful demonstration of the extent to which the satellite technology may be used to provide existing and new specialized services more economically and efficiently," and therefore determining to "afford a reasonable opportunity for multiple entities to demonstrate how any operational and economic characteristics peculiar to the satellite technology" may achieve that goal).

constellation that would utilize only the Additional Ku-Band and Ka-Band Spectrum sought in this Application should have been on notice, based on the Bureau's treatment of the O3b Application, of the need to file in this processing round.

Moreover, it seems unlikely that a new processing round would yield anything more than a "second bite at the apple" for applicants that have already optimized their system designs as-filed or for prospective applicants that were unable to meet the November 15, 2016 filing deadline. In either case, re-opening this processing round would undermine the very purpose of establishing a cut-off date, which is to define, as of a clearly-announced date certain, the universe of applicants that will have co-equal spectrum rights.[68]

Additionally, re-opening this processing round would presage potentially endless repetitions, if new applicants themselves seek access to bands that previous applicants had not considered or sought. In such a case, additional supplemental processing rounds might be needed once the first precedent is set. At that point, the Commission risks having multiple, seriatim processing rounds that run together if, for example, an applicant were to use the opportunity to seek access in this proceeding to V-band spectrum that is already the subject of a separate processing round.[69] This could also lead to the possibility of procedural gamesmanship in the instant processing round.

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[68] *See Amendment of the Commission's Space Station Licensing Rules and Policies*, First Report and Order and Further Notice of Proposed Rulemaking in IB Docket No. 02-34, and First Report and Order In IB Docket No. 02-54, FCC 03-102 (rel. May 19, 2003), at ¶ 227 (explaining that, "[b]y announcing a cut-off date in a processing round, the Commission gives both speculative and legitimate applicants an opportunity to file, and to have their applications considered concurrently with the lead application.").

[69] Public Notice, "Boeing Application Accepted for Filing In Part, IBFS File No. SAT-LOA-20160622-00058, 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," DA 16-1244 (Int'l Bur., Satellite Pol. Branch, rel. Nov. 1, 2016).

Because the Bureau has already put applicants on sufficient notice that applications for additional Ku-band and Ka-band spectrum would be considered in this processing round and because this interpretation is consistent with the Commission's processing round approach, no waiver may be necessary. If there is any uncertainty, however, Theia believes that the Commission should waive the processing round requirements of Section 25.157(c) regarding the Additional Ku-Band and Ka-Band Spectrum identified herein that was not explicitly included in the OneWeb Public Notice. Grant of such a waiver would better serve the public interest in establishing regulatory certainty for NGSO applicants and the Commission alike, rather than delaying the processing round to accommodate new spectrum access requests that could have and should have been timely filed.

2. EESS (s-to-E) Band

Out of an abundance of caution, and to the extent required, Theia hereby requests a waiver of the processing round requirements of Section 25.157(c) with respect to its request herein to use the subject EESS (s-to-E) band at 25.5-27.0 GHz, which was not included in the OneWeb Public Notice. For the reasons discussed below, the public interest would not be served by strict application of the processing round requirements to Theia's application to use the EESS (s-to-E) band at 25.5-27.0 GHz.

As the Commission has previously stated, the purpose of the processing round procedure is to prevent one applicant from unreasonably precluding additional entry by other operators in the requested frequency band.[70] The Commission initially adopted the modified processing round because it recognized the possibility that the first applicant in the queue under its first-come, first-served model could seek authority for so much spectrum that future service providers

[70] *See Amendment of the Commission's Space Station Licensing rules and Policies*, First Report and Order, 18 FCC Rcd 10760, ¶ 25 (2003) ("*First Space Station Licensing Order*").

could be shut out from the market.[71] However, the Commission also acknowledged that the amount of spectrum a particular satellite operator needs to provide a particular service depends on the satellite operator's system design, unique technology and business assessments of the service to be provided, and the fact that the Commission cannot attempt to evaluate each licensee's individual spectrum needs.[72] As demonstrated below, Theia's use of the EESS (s-to-E) band is integral to its proposed operations and would not constrain future use of the band by other NGSO systems, and thus granting a waiver would serve the public interest.

Theia's use of the 25.5-27.0 GHz band will be limited to downlinking EESS data collected by the TSN to a limited number of gateway earth stations.[73] Although Theia has not finalized the exact locations and number of gateway earth stations, Theia believes it will be able to coordinate with new users because geographic diversity and other techniques can be employed to ensure compatibility and avoid potential interference. Indeed, Theia is actively engaged with the U.S. Government and other interests to discuss access to this band, the outcome of which cannot be known at this time.

Future operators can undertake the system-specific coordination that the FCC has traditionally relied on to facilitate access to EESS downlink spectrum. Indeed, to Theia's knowledge, the FCC has never conducted a processing round for EESS systems and has consistently waived this provision in recent license grants,[74] and there is no basis for the

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71 *Id.*

72 *Id.* ¶ 29.

73 The need for only a limited number of gateway sites is possible due to the use of FSO ISLs to transfer TSN data to those satellites in view of gateway earth stations.

74 *See, e.g., Space Imaging, LLC Petition for Clarification or Amendment of the Commission's Space Station Licensing Rules and Policies, Application for Authority to Modify Its Norman, OK, Earth Station License to Add the Indian Remote-Sensing Satellite, ResourceSat-1, as a Point of Communication*, IB Docket No. 02-34, File Nos. SES-MOD-20040607-00809, SES-AMD-20040728-01073, SES-AMD-20040728-01075, Call Sign

Commission to change its approach in this case. The FCC should grant the requested waiver because additional operators will not be unreasonably precluded by the TSN's use of the band.

3. EESS (Active) Band

Theia is also proposing to utilize the 1215-1300 MHz band for radar operations as part of the TSN's remote sensing capabilities. Theia is unaware of any U.S. commercial EESS operations in the 1215-1300 MHz band, although certain U.S. and foreign government operations occur in or near this band. Theia has already engaged with Federal and other users of the band to discuss any relevant issues.

With respect to the processing round requirement, the Commission has previously waived the existing modified processing round for similarly situated NGSO-like systems operating in EESS bands where spectrum sharing is possible and the potential for harmful interference with and preclusion of other systems is minimal.[75] Theia again notes that the Commission has never initiated a processing round for NGSO-like systems seeking to operate in EESS bands and doing so here is inconsistent with precedent and would force Theia to pursue another processing round for its EESS operations, resulting in previously-noted endless repetitions if new applicants themselves seek access to bands that previous applicants had not considered or sought.

In addition, it is clear that multiple commercial operators can be accommodated in this band so there are no mutual exclusivity concerns that would unreasonably preclude future NGSO EESS system operators from operating in the band. Because the purpose of the modified

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E960463, Declaratory Order and Order and Authorization, 20 FCC Rcd 11964, DA 05-1940, at ¶¶ 8-11 (IB 2005).

75 *See* Stamp Grant, Planet Labs, Inc., SAT-LOA-20130626-00087 (granted Dec. 3, 2013); Stamp Grant, Skybox Imaging, Inc., SAT-LOA-20120322-00058 (granted Sep. 20, 2012); Space Imaging, LLC, Declaratory Order and Order and Authorization, 20 FCC Rcd 11964, ¶¶ 9-11 (2005).

processing round is to ensure opportunities for competitive entry in frequency bands where licensing the first applicant to operate in the band would prevent subsequent applicants from using the spectrum, the Commission should grant a waiver of the processing round requirements of Section 25.157(c) of the Commission's rules, 47 C.F.R. § 25.157(c), with respect to this band as well.

E. Waiver of 47 C.F.R. § 2.157(e)

To the extent necessary, Theia requests a waiver of the band segmentation requirements of Section 25.157(e) of the Commission's rules.[76] Theia believes that the in-line avoidance approach would better serve the public interest and encourage the development of NGSO satellite systems operating in the Ku-band while avoiding interference among such systems.[77]

Section 25.157(e)(1) establishes a default spectrum management procedure that divides the available spectrum among multiple NGSO FSS systems that are granted licenses in the same processing round where insufficient spectrum is available to meet the needs of each licensee. Section 25.157(e)(2) establishes that if a processing round results in the grant of licenses to only one or two NGSO FSS systems, each licensee will be assigned only one third of the available spectrum, leaving the remaining spectrum fallow until later entrants, if any, apply for authorization to use that spectrum. Finally, Section 25.157(e)(3) establishes that if a processing round results in the grant of more than three licenses for NGSO FSS systems, each licensee will be assigned the lesser of either the amount of spectrum that it requested, or the amount of

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[76] *See* 47 C.F.R. § 2.157(e).

[77] *See* Public Notice, *International Bureau Provides Guidance Concerning Avoidance of In-Line Interference Events Among Ku-band NGSO FSS Systems*, DA 15-1197 (rel. Oct. 20, 2015) (clarifying that the text in Section 25.261 for Ka-band NGSO FSS systems also describes the same sharing criteria the Commission adopted for Ku-band systems.).

spectrum that would have been assigned to each licensee if the available spectrum were divided equally among the licensees.

Recent amendments to Section 25.157(e) that eliminate the three-licensee presumption will take effect on November 30, 2016.[78] Under the rule, as amended, each successful applicant in a processing round will receive the lesser of an equal share of the available spectrum, or the amount its application requests, with any remaining spectrum assigned to the remaining successful applicants, up to the maximum each requested.[79]

Regardless of which version of Section 25.157(e) the Commission determines to apply to this processing round – the version in effect when applications are due on November 15, 2016, or the version that takes effect on November 30, 2016 – Theia requests a waiver of this rule. Theia can employ spectrum-sharing techniques that enable co-frequency spectrum sharing among TSN and other NGSO FSS systems across the entirety of the spectrum bands requested by multiple applicants in this processing round, thereby avoiding the need for inefficient spectrum segmentation.

Specifically, Theia will employ the spectrum sharing method adopted by the Commission based on "avoidance of in-line interference events," which was premised on an acknowledgement that co-frequency spectrum sharing between NGSO FSS systems is desirable and achievable.[80] The Commission recently affirmed the importance of its "in-line avoidance" approach, indicating that the sharing requirement would be applied to NGSO FSS systems

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78 *Amendment of the Commission's Space Station Licensing Rules and Policies*, IB Docket No. 02-34, Second Order on Reconsideration, FCC 16-108, 31 FCC Rcd 9398 (2016), at ¶ 10. These changes to Section 25.157(e) take effect on November 30, 2016. 81 Fed. Reg. 75338 (Oct. 31, 2016).

79 47 C.F.R. s 25.157(e)(1-2) (eff. Nov. 30, 2016).

80 *See Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ku-Band*, Report and Order and Further Notice of Proposed Rulemaking, FCC 02-123, 17 FCC Rcd 7841, 7843 (2002) ("*NGSO Sharing Order*").

operating in additional spectrum bands.[81] Additionally, the Commission has waived both the processing round and band segmentation requirements when doing so would not prevent opportunities for additional entrants in the frequency bands allocated for NGSO FSS operations.[82] Theia requests the subject waiver because the "in-line avoidance" approach advocated by the Commission directly conflicts with the band segmentation approach embodied in Section 25.157(e) and better serves the public interest by enabling the most efficient use of spectrum.

Pursuant to the Commission's "in-line avoidance" approach to spectrum sharing, each applicant for an NGSO FSS system license in a spectrum band places no impediment on the plans of other NGSO FSS system applicants in the same spectrum band because each applicant knows that it will be expected to share spectrum on a co-frequency basis with other systems that are launched. In contrast, under the Section 25.157(e) band-segmentation approach, each additional applicant for an NGSO FSS system in a particular spectrum band substantially reduces the amount of spectrum that would be available to other NGSO FSS system applicants, therefore precluding their construction and launch without regard to whether the spectrum limitation is necessary to prevent harmful interference to any other systems and limiting the bandwidth available to support valuable products and services that benefit consumers and the public interest.

Thus, the Commission should waive the band segmentation requirements of Section 25.157(e) to allow Theia and other NGSO system proponents to use available spectrum in a more

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[81] *See* International Bureau Provides Guidance Concerning Avoidance of In-Line Interference Events Among Ku-Band NGSO FSS Systems, DA 15-1197 (Oct. 20, 2015).

[82] Application of O3b Limited to Operate a Gateway Earth Station with a Non-U.S. Licenses, Non-Geostationary Orbit Ka-band Space Station System, FCC File No. SES-LIC-20100723-00952, Radio Station Authorization, at 4, Condition 90043 (granted Sept. 25, 2012). *See also Northrop Grumman Space & Missions Systems Corporation*, DA 09-428, Order and Authorization, 24 FCC Rcd 2330, 2342, at ¶¶ 31-33 (Int'l Bur. 2009); *Space Imaging, LLC*, 20 FCC Rcd 11964, ¶¶ 10, 11 (Int'l Bur., 2005); *Digital Globe, Inc.*, DA 05-2640, Order and Authorization, 20 FCC Rcd 15696, 15698-99, ¶¶ 6-8 (Int'l Bur., 2005).

efficient manner. To the extent the applicants are unable to effectively coordinate their planned operations, the notion of "home base" spectrum may be of use.[83] It is important to note, however, that reversion to a portion of available spectrum as a "home base" should be necessary only in the context of in-line interference event which may be limited in occurrence and in the number of systems involved.

For example, an in-line event involving two systems may require each system to use only half of the spectrum for the duration of the in-line event, a convergence of three systems may require use of a third of the spectrum, etc. Onboard processing and information sharing could facilitate this type of dynamic spectrum access. Such approaches may also be addressed in the Commission's impending NGSO licensing rulemaking.[84] Thus, Theia respectfully suggests the Commission waive application of this rule pending the outcome of negotiations in this processing round and the NGSO licensing rulemaking.

F. Contingent Waiver of the "Substantially Complete" Standard and 47 C.F.R. §25.112(a)

Section 25.112(a) of the Commission's rules, 47 C.F.R. § 25.112(a)(1) states that applications will be deemed "unacceptable for filing and will be returned to the applicant" if they, among other potential defects, lack "completeness of answers to questions [or] informational showings." Even in such a case, however, the Commission's rules provide that an application found defective under Section 25.112(a)(1) may be accepted if accompanied by an appropriate waiver request, 47 C.F.R. § 25.112(b)(1).

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83 *See The Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ka-Band*, IB Docket No. 02-19, Report and Order, FCC 03-137 (rel. July 9, 2003), at ¶ 45.

84 The Commission's list of items on circulation identifies a pending Notice of Proposed Rulemaking to consider an "Update to Parts 2 and 25 Concerning Non-geostationary, Fixed-Satellite Service Systems and Related Matters," *see* https://transition.fcc.gov/osec/weeklylist/circulate-weekly.pdf.

As discussed in this Application, some TSN satellites will include hyperspectral imager and microwave radiometer instruments with passive, listen-only sensing capabilities to gather data on Earth-based phenomena. The specific frequencies on which these devices will operate are not included in this Application and, indeed, are not yet known with certainty. Nonetheless, Theia believes that this Application may be considered "substantially complete" under the Commission's standards. Because these devices will only listen passively on specific frequencies, they cannot, by definition cause interference to any other licensee and do not "use" spectrum because they neither radiate on any frequency nor receive any transmission directed specifically to them. They simply incorporate the capability to monitor for and detect specific radiation signatures from Earth-based phenomena.

To the extent that the Commission may conclude that the specific frequencies on which these instruments operate are required to make this Application "substantially complete," Theia seeks a waiver of this requirement. Indeed, the FCC has accepted previous EESS applications that did not disclose their intended passive listening frequencies, and Theia asks that the Commission adhere to that precedent here.[85] The specific frequencies are highly competitively sensitive, in that they would reveal detailed information as to the capabilities and intended uses of the TSN. In any event, Theia is pursuing the NOAA commercial remote sensing licensing process and the frequencies therefore are not yet determined with finality and may change depending on consultations with NOAA and the FCC, and even with further refinement of the optimal sensing capabilities of the TSN.

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[85] *See, e.g., In the Matter of Orbital Imaging Corporation, For Authority to Construct, Launch, and Operate a Private Remote Sensing-Satellite System in Low-Earth Orbit*, Order and Authorization, 14 FCC Rcd 2997 (IB 1999), ¶ 3 (identification but no description of passive instrument characteristics); *In the Matter of AstroVision International Inc., For Authority to Construct, Launch, and Operate a Private Remote Sensing-Satellite System in Geostationary Orbit*, Order and Authorization, 15 FCC Rcd 22299 (IB 2000), ¶ 3 (same).

Furthermore, in describing this standard, the Commission has stated that applications must be "complete in substance,"[86] in order to deter the filing of frivolous or "sham" applications.[87] Here, it is clear that Theia has offered a non-frivolous, substantial proposal, and that the omission of this specific detail does not detract from the ability of the Commission or other interested parties to evaluate the proposal on the merits. Because the instrumentation will merely passively detect background emissions on specific frequencies within established EESS bands, they cannot, by definition, cause interference to any other licensee or EESS system.

V. CONCLUSION

For the foregoing reasons, including the many substantial public interest benefits that would result from implementation of the TSN remote sensing and broadband satellite communications system, Theia hereby requests that the Commission grant this Application for authority to launch and operate the proposed NGSO system described herein.

Respectfully submitted,

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86 *Amendment of the Commission's Space Station Licensing Rules and Policies*, IB Docket No. 02-34, Notice of Proposed Rulemaking and First Report and Order, FCC 02-45, 17 FCC Rcd 3847, at ¶ 84 (2002).

87 *Id.* at ¶ 93.

Theia Part 25 Compliance Matrix

Rule	Requirement	Application Citation
§ 25.110(b)	(b)(1) N/A (b)(2) Applications for space station licenses must be filed electronically on FCC Form 312 in accordance with the applicable provisions of part 1, subpart Y of this chapter and include all information required by § 25.114. (b)(3) N/A	*See* FCC Form 312, Schedule S and associated application materials.
§ 25.113(h)	(h) An operator of NGSO space stations under a blanket license granted by the Commission need not apply for license modification to operate technically identical in-orbit spare satellites in an authorized orbit. However, the licensee must notify the Commission within 30 days of bringing an in-orbit spare into service and certify that its activation has not exceeded the number of space stations authorized to provide service and that the licensee has determined by measurement that the activated spare is operating within the terms of the license.	Theia will comply.
§ 25.113(i)	(i) An operator of NGSO space stations under a blanket license granted by the Commission need not apply for license modification to deploy and operate technically identical replacement satellites in an authorized orbit within the term of the system authorization. However, the licensee must notify the Commission of the intended launch at least 30 days in advance and certify that its operation of the additional space station(s) will not increase the number of space stations providing service above the maximum number specified in the license.	Theia will comply.
§ 25.114(a)	(a) A license application filed pursuant to §25.110(b)(2) for a GSO space station or NGSO space station or space-station constellation must comprise a comprehensive proposal and must be submitted on FCC Form 312, Main Form and Schedule S, with attached exhibits required by paragraph (d) of this section.	*See* FCC Form 312, Schedule S and associated exhibits.
§ 25.114(b)	Each application for a new or modified space station authorization must contain the formal waiver to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise (*see* 47 U.S.C. 304).	*See* FCC Form 312.

§ 25.114(c)	(1) Name, address, and telephone number of the applicant. (2) Name, address, and telephone number of the person(s), including counsel, to whom inquiries or correspondence should be directed. (3) Type of authorization requested (*e.g.*, launch authority, station license, modification of authorization). (4) **See below.** (5) N/A (6) For space stations in non-geostationary orbits: (i) The number of orbital planes and the number of space stations in each plane, (ii) The inclination of the orbital plane(s), (iii) The orbital period, (iv) The apogee, (v) The perigee, (vi) The argument(s) of perigee, (vii) Active service arc(s), (viii) Right ascension of the ascending node(s), and (ix) For each satellite in each orbital plane, the initial phase angle at the reference time. (7) The frequency bands, types of service, and coverage areas; (8) Calculated maximum power flux density levels within each coverage area and energy dispersal bandwidths, if any, needed for compliance with §25.208, for the angles of arrival specified in the applicable paragraph(s) of §25.208; (9) [Reserved] (10) Estimated operational lifetime; (11) Whether the space station is to be operated on a common carrier basis; (12) [Reserved] (13) N/A	*See* FCC Form 312 and Schedule B; Schedule S; *Technical Narrative*, Sections 2.1, 2.2, 2.4.1, 3.1.2.9 and Appendices 1, 2 and 4; *Legal Narrative*, Section II.

25.114(c)(4)	(4)(i) For each space station transmitting and receiving antenna beam (including telemetry and tracking beams but not command beams), specify channel center frequencies and bandwidths and polarization plan. For command beams, specify each of the center frequencies within a 5 MHz range or a range of 2 percent of the assigned bandwidth, whichever is smaller, and the polarization plan. If the space station can vary channel bandwidth in a particular frequency band with on-board processing, specify only the range of frequencies in that band over which the beam can operate and the polarization plan. (ii) Specify maximum EIRP and maximum EIRP density for each space station transmitting antenna beam. If the satellite uses shapeable antenna beams, as defined in §25.103, specify instead maximum possible EIRP and maximum possible EIRP density within each shapeable beam's proposed coverage area. Provide this information for each frequency band in which the transmitting antenna would operate. For bands below 15 GHz, specify EIRP density in dBW/4 kHz; for bands at and above 15 GHz, specify EIRP density in dBW/MHz. If the EIRP density varies over time, specify the maximum possible EIRP density. (iii)-(iv) [Reserved] (v) For each space station receiving beam other than command beams, specify the gain-to-temperature ratio at beam peak. For receiving beams fed into transponders, also specify the minimum and maximum saturation flux density at beam peak. If the satellite uses shapeable beams, specify the minimum and maximum gain-to-temperature ratio within each shapeable beam's proposed coverage area, and for shapeable receiving beams fed into transponders, specify the minimum and maximum saturation power flux density within the 0 dB relative antenna gain isoline. Provide this information for each frequency band in which the receiving beam can operate. For command beams, specify the beam peak flux density at the command threshold; (vi)(A) N/A (B) For space stations in non-geostationary orbits, specify for each unique orbital plane the predicted antenna gain contour(s) for each transmit and receive antenna beam for one space station if all space stations are identical in the constellation. If individual space stations in the constellation have different antenna beam configurations, specify the predicted antenna gain contours for each transmit and receive beam for each space station type and orbit or orbital plane requested. The contours should be plotted on an area map with the beam depicted on the surface of the earth with the space stations' peak antenna gain pointed at nadir to a latitude and longitude within the proposed service area. The contour(s) should be plotted at 2 dB intervals down to 10 dB below the peak gain and at 5 dB intervals between 10 dB and 20 dB below the peak gain. For intersatellite links, specify the peak antenna gain and 3 dB beamwidth. (C) For space stations with shapeable antenna beams, specify the contours, as defined in paragraph (c)(4)(vi)(A) or (B) of this section, for the transmitting beam configuration that results in the highest EIRP density for the beams listed in paragraph (c)(4)(ii) of this section and for the receiving beam configuration	*See Technical Narrative*, Sections 3.1.2.1 – 3.1.2.4; Schedule S. To the extent necessary, Theia requests a waiver of § 25.114(c)(4)(vi). *See Technical Narrative*, Section 3.1.2.4.

	with the smallest gain-to-temperature ratio and the highest required saturation power flux density for the beams listed in paragraph (c)(4)(v) of this section. If the shapeable beams are also steerable, include the contours that would result from moving the beam peak around the limit of the effective beam peak area and the 0 dB relative antenna gain isoline. The proposed maximum coverage area must be clearly specified. (D) For a space station with steerable beams that are not shapeable, specify the applicable contours, as defined in paragraph (c)(4)(vi)(A) or (c)(4)(vi)(B) of this section, with a description of a proposed coverage area for each steerable beam or provide the contour information described in paragraph (c)(4)(vi)(C) of this section for each steerable beam. (vii) N/A	
§ 25.114(d)	(d)(1) Overall description of system facilities, operations and services and explanation of how uplink frequency bands would be connected to downlink frequency bands. (2)-(5) [Reserved]. (6) Public interest considerations in support of grant. (7) Applicants for authorizations for space stations in the Fixed-Satellite Service must also include the information specified in §25.140(a). (8) N/A (9) N/A (10) N/A (11) N/A (12) Applications for authorizations in the non-geostationary orbit Fixed-Satellite Service in the 10.7-14.5 GHz bands must also provide all information specified in §25.146. (13) N/A (14) A description of the design and operational strategies that will be used to mitigate orbital debris. (15) N/A (16) N/A	*See Technical Narrative*, Sections 2.3 and 3.1.2.5 and Appendix 4; *Legal Narrative*, Sections II and III. To the extent necessary, Theia requests a waiver of § 25.114(d)(14). *See Legal Narrative* Section IV.A.

	(17) N/A (18) N/A	
§ 25.139(a)	NGSO FSS licensees shall maintain a subscriber database in a format that can be readily shared with MVDDS licensees for the purpose of determining compliance with the MVDDS transmitting antenna spacing requirement relating to qualifying existing NGSO FSS subscriber receivers set forth in §101.129 of this chapter. This information shall not be used for purposes other than set forth in §101.129 of this chapter. Only sufficient information to determine compliance with §101.129 of this chapter is required.	Theia will comply.
§ 25.139(b)	Within ten business days of receiving notification of the location of a proposed MVDDS transmitting antenna, the NGSO FSS licensee shall provide sufficient information from the database to enable the MVDDS licensee to determine whether the proposed MVDDS transmitting site meets the minimum spacing requirement.	Theia will comply.
§ 25.139(c)	If the location of the proposed MVDDS transmitting antenna site does not meet the separation requirements of §101.129 of this chapter, then the NGSO FSS licensee shall also indicate to the MVDDS licensee within the same ten day period specified in paragraph (b) of this section whether the proposed MVDDS transmitting site is acceptable at the proposed location.	Theia will comply.
§ 25.145(c)	(c) In addition to providing the information specified in §25.114, each non-geostationary satellite orbit applicant shall demonstrate the following: (1) That the proposed system is capable of providing Fixed-Satellite Service to all locations as far north as 70° North Latitude and as far south as 55° South Latitude for at least 75% of every 24-hour period; and (2) That the proposed system is capable of providing Fixed-Satellite Service on a continuous basis throughout the fifty states, Puerto Rico and the U.S. Virgin Islands.	*See Legal Narrative*, Section II.A (Figure 1).
§ 25.145(e)	No license shall be granted to any applicant for a space station in the FSS operating in portions of the 18.3-20.2 GHz and 28.35-30.0 GHz bands if that applicant, or any persons or companies controlling or controlled by the applicant, shall acquire or enjoy any right, for the purpose of handling traffic to or from the United States, its territories or possessions, to construct or operate space segment or earth stations, or to interchange traffic, which is denied to any other United States company by reason of any concession, contract, understanding, or working arrangement to which the Licensee or any persons or companies controlling or controlled by the Licensee are parties.	*See Legal Narrative*, Section II.B (n.32).
§ 25.146(a)	(a) A comprehensive technical showing shall be submitted for the proposed non-geostationary satellite orbit	

	Fixed-Satellite Service (NGSO FSS) system in the 10.7-14.5 GHz bands. The technical information shall demonstrate that the proposed NGSO FSS system would not exceed the validation equivalent power flux-density (EPFD) limits as specified in §25.208 (g), (k), and (l) for $EPFD_{down}$, and $EPFD_{up}$. The technical showing consists of the following: (1) *Single-entry validation equivalent power flux-density, in the space-to-Earth direction, ($EPFD_{down}$) limits.* (2) *Single-entry additional operational equivalent power flux-density, in the Earth-to-space direction, (additional operational $EPFD_{up}$) limits.*	*See Technical Narrative*, Appendix 1; Schedule S.
§ 25.146(b)	(b) Ninety days prior to the initiation of service to the public, the NGSO FSS system licensee shall submit a comprehensive technical showing for the non-geostationary satellite orbit Fixed-Satellite Service (NGSO FSS) system in the 10.7-14.5 GHz bands. The technical information shall demonstrate that the NGSO FSS system is expected not to operate in excess of the additional operational $EPFD_{down}$ limits and the operational $EPFD_{down}$ limits as specified in §25.208(i) and (j), and notes 2 and 3 to Table 1L in §25.208(*l*). (1) *Single-entry validation equivalent power flux-density, in the space-to-Earth direction, ($EPFD_{down}$) limits.* *(2) Operational equivalent power flux-density, space-to-Earth direction, (operational $EPFD_{down}$) limits.*	*See Technical Narrative*, Appendix 1; Schedule S.
§ 25.146(e)	An NGSO FSS system licensee operating a system in compliance with the limits specified in §25.208(g), (i), (j), (k), (l), and (m) shall be considered as having fulfilled its obligations under ITU Radio Regulations Article 22.2 with respect to any GSO network. However, such NGSO FSS system shall not claim protection from GSO FSS and BSS networks operating in accordance with part 25 of this chapter and the ITU Radio Regulations.	*See Technical Narrative*, Appendix 1; Schedule S. Theia will not claim protection from GSO FSS and BSS networks.
§ 25.146(f)	(f) Coordination will be required between NGSO FSS systems and GSO FSS earth stations in the frequency band 10.7-12.75 GHz when all of the following threshold conditions are met: (1) Bandwidth overlap; and (2) The satellite network using the GSO has specific receive earth stations which meet all of the following conditions: earth station antenna maximum isotropic gain greater than or equal to 64 dBi; G/T of 44 dB/K or higher; and emission bandwidth of 250 MHz; and the $EPFD_{down}$ radiated by the satellite system using the NGSO into the GSO specific receive earth station, either within the U.S. for domestic service or any points outside the U.S. for international service, as calculated using the ITU software for examining compliance with EPFD limits set forth in Article 22 of the ITU Radio Regulations exceeds −174.5 dB(W/(m2/40kHz)) for any percentage of time for NGSO systems with all satellites only operating at or below 2500 km altitude, or −202 dB(W/(m2/40kHz)) for any percentage of time for NGSO systems with any satellites operating above 2500 km altitude.	*See Technical Narrative*, Appendix 1; Schedule S. Theia has provided the necessary input data for the ITU software to examine compliance.

	(3) If there is no ITU software for examining compliance with EPFD limits set forth in Article 22 of the ITU Radio Regulations, then the $EPFD_{down}$ coordination trigger is suspended and the requirement for coordination will be based on bandwidth overlap and the satellite network using the GSO has specific receive earth stations which meet all of the following conditions: earth station antenna maximum isotropic gain greater than or equal to 64 dBi; G/T of 44 dB/K or higher; and emission bandwidth of 250 MHz.	
§ 25.146(g)	*Operational power flux density, space-to-Earth direction, limits.* Ninety days prior to the initiation of service to the public, the NGSO FSS system licensee shall submit a technical showing for the NGSO FSS system in the band 12.2-12.7 GHz. The technical information shall demonstrate that the NGSO FSS system is capable of meeting the limits as specified in §25.208(o). Licensees may not provide service to the public if they fail to demonstrate compliance with the PFD limits.	Theia will comply.

§ 25.146(i)	(i) In addition to providing the information specified in §25.114, each NGSO FSS applicant shall provide the following: (1) A demonstration that the proposed system is capable of providing fixed-satellite services on a continuous basis throughout the fifty states, Puerto Rico and the U.S. Virgin Islands, U.S.; and (2) A demonstration that the proposed system is capable of providing Fixed-Satellite Services to all locations as far north as 70° North Latitude and as far south as 55° South Latitude for at least 75 percent of every 24-hour period; and (3) Sufficient information on the NGSO FSS system characteristics to properly model the system in computer sharing simulations, including, at a minimum, NGSO hand-over and satellite switching strategies, NGSO satellite antenna gain patterns, and NGSO earth station antenna gain patterns. In particular, each NGSO FSS applicant must explain the switching protocols it uses to avoid transmitting while passing through the geostationary satellite orbit arc, or provide an explanation as to how the PFD limits in §25.208 are met without using geostationary satellite orbit arc avoidance. In addition, each NGSO FSS applicant must provide the orbital parameters contained in Section A.4 of Annex 2A to Appendix 4 of the ITU Radio Regulations (2008). Further, each NGSO FSS applicant must provide a sufficient technical showing to demonstrate that the proposed non-geostationary satellite orbit system meets the PFD limits contained in §25.208, as applicable.	*See Legal Narrative*, Section II.A (Figure 1); *Technical Narrative*, Appendices 1 and 2.

§ 25.156(a)	(a) Applications for a radio station authorization, or for modification or renewal of an authorization, will be granted if, upon examination of the application, any pleadings or objections filed, and upon consideration of such other matters as it may officially notice, the Commission finds that the applicant is legally, technically, and otherwise qualified, that the proposed facilities and operations comply with all applicable rules, regulations, and policies, and that grant of the application will serve the public interest, convenience and necessity.	*See* FCC Form 312, Schedule B, Schedule S and associated application materials; *Legal Narrative*, Section III.
§ 25.156(d)	(d)(1) Applications for NGSO-like satellite operation will be considered pursuant to the procedures set forth in §25.157, except as provided in §25.157(b). (2) N/A (3) Applications for both NGSO-like satellite operation and GSO-like satellite operation in two or more service bands will be treated as separate applications for each service band, and each service band request will be considered pursuant to §25.157 or §25.158, as appropriate. (4) Applications for feeder-link authority or inter-satellite link authority will be treated like an application separate from its associated service band. Each feeder-link request or inter-satellite link request will be considered pursuant to the procedure for applications for GSO-like operation or NGSO-like operation, as applicable. (5) In cases where the Commission has not adopted frequency-band specific service rules, the Commission will not consider applications for NGSO-like satellite operation after it has granted an application for GSO-like operation in the same frequency band, and it will not consider applications for GSO-like operation after it has granted an application for NGSO-like operation in the same band, unless and until the Commission establishes NGSO/GSO sharing criteria for that frequency band. In the event that the Commission receives applications for NGSO-like operation and applications for GSO-like operation at the same time, and the Commission has not adopted sharing criteria in that band, the Commission will divide the spectrum between GSO-like and NGSO-like licensees based on the proportion of qualified GSO-like and NGSO-like applicants. (6) N/A	To the extent necessary, Theia requests a waiver of §25.156(d)(4). *See Legal Narrative*, Section IV.B.
§ 25.157(c)	(c) Each application for NGSO-like satellite operation that is acceptable for filing under §25.112, except replacement applications described in paragraph (b) of this section, will be reviewed to determine whether it is a "competing application," *i.e.*, filed in response to a public notice initiating a processing round, or a "lead application," *i.e.*, all other applications for NGSO-like satellite operation.	To the extent necessary, Theia requests a waiver of § 25.157(c). *See Legal Narrative,* Section IV.D.

§ 25.157(e)	(e)(1) In the event that there is insufficient spectrum in the frequency band available to accommodate all the qualified applicants in a processing round, the available spectrum will be divided equally among the licensees whose applications are granted pursuant to paragraph (d) of this section, except as set forth in paragraph (e)(2) or (e)(3) of this section. (2) In cases where there are only one or two applications in a processing round granted pursuant to paragraph (d) of this section, each applicant will be assigned ⅓ of the available spectrum, and the remaining spectrum will be made available to other licensees in an additional processing round pursuant to paragraph (c) of this section. (3) In cases where there are three or more applications in a processing round granted pursuant to paragraph (d) of this section, and one or more applicants apply for less spectrum than they would be warranted under paragraph (e)(1) of this section, those applicants will be assigned the bandwidth amount they requested in their applications. In those cases, the remaining qualified applicants will be assigned the lesser of the amount of spectrum they requested in their applications and the amount spectrum that they would be assigned if the available spectrum were divided equally among the remaining qualified applicants.	To the extent necessary, Theia requests a waiver of § 25.157(e). *See Legal Narrative,* Section IV.E.
§ 25.164	(a) N/A (b) The recipient of an initial license for an NGSO satellite system, other than a DBS or SDARS satellite system, granted on or after September 11, 2003, must launch the space stations, place them in the assigned orbits, and operate them in accordance with the station authorization no later than six years after the grant of the license, unless a different schedule is established by Title 47, Chapter I, or the Commission. (c) – (e) [Reserved] (f) A licensee subject to the requirements in paragraph (a) or (b) of this section must either demonstrate compliance with the applicable requirement or notify the Commission in writing that the requirement was not met, within 15 days after the specified deadline. Compliance with a milestone requirement in paragraph (a) or (b) of this section may be demonstrated by certifying pursuant to §25.121(d) that the space station(s) in question, has, or have, been launched and placed in the authorized orbital location or non-geostationary orbit(s) and that in-orbit operation of the space station or stations has been tested and found to be consistent with the terms of the authorization. (g) N/A (h) N/A	*See Technical Narrative,* Section 2.5.

§ 25.165(a)	(a) For all space station licenses issued after September 20, 2004, other than licenses for DBS space stations, SDARS space stations, and replacement space stations as defined in paragraph (e) of this section, the licensee must post a bond within 30 days of the grant of its license. Failure to post a bond will render the license null and void automatically. (1) An NGSO licensee must have on file a surety bond requiring payment in the event of default as defined in paragraph (c) of this section, in an amount, at a minimum, determined according to the following formula, with the resulting dollar amount rounded to the nearest $10,000: A = $1,000,000 + $4,000,000 * D/2192, where A is the amount to be paid and D is the lesser of 2192 or the number of days that elapsed from the date of license grant until the date when the license was surrendered. (2) N/A (3) N/A	Theia will comply.
§ 25.202	Frequencies, Frequency Tolerance and Emission Limits.	To the extent necessary, Theia requests certain waivers of § 25.202 for its proposed FSS spectrum use. *See Legal Narrative*, Section IV.C.
§ 25.207	(a)-(b) [Reserved] (c) Space stations shall be made capable of ceasing radio emissions by the use of appropriate devices (battery life, timing devices, ground command, etc.) that will ensure definite cessation of emissions. (d)-(e) [Reserved] (f) All space stations in the Fixed-Satellite Service operating in any portion of the 3600-4200 MHz, 5091-5250 MHz, 5850-7025 MHz, 10.7-12.7 GHz, 12.75-13.25 GHz, 13.75-14.5 GHz, 15.43-15.63 GHz, 18.3-20.2 GHz, 24.75-25.25 GHz, or 27.5-30.0 GHz bands, including feeder links for other space services, and in the Broadcasting-Satellite Service in the 17.3-17.8 GHz band (space-to-Earth), shall employ state-of-the-art full frequency reuse, either through the use of orthogonal polarizations within the same beam and/or the use of spatially independent beams. This requirement does not apply to telemetry, tracking, and command operation. (g)-(h) [Reserved] (i) N/A (j) N/A	*See Technical Narrative*, Sections 3.1.2.8 and 3.1.2.10.

§ 25.208	Applicable power-flux density limits	Theia complies with the relevant PFD limits put forth in Section 25.208(b)-(p). *See Technical Narrative*, Sections 3.1.2.5, 3.1.2.9 and Appendices 1 and 2; Schedule S.
§ 25.210(f)	(f) All space stations in the Fixed-Satellite Service operating in any portion of the 3600-4200 MHz, 5091-5250 MHz, 5850-7025 MHz, 10.7-12.7 GHz, 12.75-13.25 GHz, 13.75-14.5 GHz, 15.43-15.63 GHz, 18.3-20.2 GHz, 24.75-25.25 GHz, or 27.5-30.0 GHz bands, including feeder links for other space services, and in the Broadcasting-Satellite Service in the 17.3-17.8 GHz band (space-to-Earth), shall employ state-of-the-art full frequency reuse, either through the use of orthogonal polarizations within the same beam and/or the use of spatially independent beams. This requirement does not apply to telemetry, tracking, and command operation.	*See Technical Narrative*, Section 3.1.2.10.
§ 25.261	(a) *Applicable NGSO FSS Bands.* The coordination procedures in this section apply to non-Federal-Government NGSO FSS satellite networks operating in the following assigned frequency bands: The 28.6-29.1 GHz or 18.8-19.3 GHz frequency bands. (b) *Definition of "In-line interference events."* For purposes of this section, an "in-line interference event" is defined as the interference associated with an occurrence of any physical alignment of space stations of two or more satellite networks with an operating Earth station of one of these networks in such a way that the angular separation between operational links of the two networks is less than 10° as measured at the Earth station. (c) *Default procedure.* If no agreed coordination exists between two or more satellite networks, then the bands will be divided among the affected satellite networks involved in an in-line interference event in accordance with the following procedure: (1) Each of n (number of) satellite networks involved in a particular in-line interference event shall select 1/n of the assigned spectrum available in each frequency band for its home base spectrum. The selection order for each satellite network shall be determined by and be in accordance with the date that the first space station in each satellite network is launched and operating; (2) The affected space station(s) of the respective satellite networks shall only operate in the selected (1/n) spectrum associated with its satellite network, its home base spectrum, for the duration of the in-line interference event;	*See Technical Narrative*, Section 4.1.

	(3) All affected space station(s) may resume operations throughout the assigned frequency bands once the angular separation between the affected space stations in the in-line interference event is again greater than 10°. (d) Any coordination procedure agreed among the affected operating satellite networks, which allows operations of the satellite networks when each network's respective space stations are within the 10 degree avoidance angle associated with an in-line interference event, shall supersede the default procedure of paragraph (c) of this section. Coordination may be effected using information relating to the space stations and the parameters of one or more typical earth stations. All parties are required to coordinate in good faith.	
§ 25.271	(a) The licensee of a facility licensed under this part is responsible for the proper operation and maintenance of the station. (b) N/A (c) N/A (d) The licensee shall insure that the licensed facilities are properly secured against unauthorized access or use whenever an operator is not present at the transmitter. (e) The licensee of an NGSO FSS system operating in the 10.7-14.5 GHz bands shall maintain an electronic web site bulletin board to list the satellite ephemeris data, for each satellite in the constellation, using the North American Aerospace Defense Command (NORAD) two-line orbital element format. The orbital elements shall be updated at least once every three days. (f) N/A (g) N/A	Theia will comply.
§ 25.272	(a) Each space station licensee in the Fixed-Satellite Service shall establish a satellite network control center which will have the responsibility to do the following: (1) Monitor space-to-Earth transmissions in its system (thus indirectly monitoring uplink earth station transmissions in its system) and (2) Coordinate transmissions in its satellite system with those of other systems to prevent harmful interference incidents or, in the event of a harmful interference incident, to identify the source of the interference and	*See Technical Narrative*, Sections 3.3 and 4.2.

	correct the problem promptly. (b) [Reserved] (c) N/A (d)(1) – (4) N/A (d)(5) The space station licensee may delegate the responsibility and duties of the satellite network control center to a technically qualified user or group of users, but the space station licensee shall remain ultimately responsible for the performance of those duties.	
§ 25.273	(a) No person shall: (1) Transmit to a satellite unless the specific transmission is first authorized by the satellite network control center; (2) Conduct transmissions over a transponder unless the operator is authorized to transmit at that time by the satellite licensee or the satellite licensee's successor in interest; or (3) Transmit in any manner that causes unacceptable interference to the authorized transmission of another licensee. (b) Satellite operators shall provide upon request by the Commission and by earth station licensees authorized to transmit on their satellites relevant information needed to avoid unacceptable interference to other users, including the polarization angles for proper illumination of a given transponder. (c) Space station licensees are responsible for maintaining complete and accurate technical details of current and planned transmissions over their satellites, and shall require that authorized users of transponders on their satellites, whether by tariff or contract, provide any necessary technical information in this regard including that required by §25.272. Based on this information, space station licensees shall exchange among themselves general technical information concerning current and planned transmission parameters as needed to identify and promptly resolve any potential cases of unacceptable interference between their satellite systems. (d) N/A	Theia will comply.

§ 25.275(b)	(b) When authorized frequency bands are specified in the station authorization, the licensee is authorized to transmit any number of r.f. carriers on any discrete frequencies within an authorized frequency band in accordance with the other terms and conditions of the authorization and the requirements of this part. Specific r.f. carrier frequencies within the authorized frequency band shall be selected by the licensee to avoid unacceptable levels of interference being caused to other earth, space or terrestrial stations. Any coordination agreements, both domestic and international, concerning specific frequency usage constraints, including non-use of any particular frequencies within the frequency bands listed in the station authorization, are considered to be conditions of the station authorization.	Theia will comply.
§ 25.278	Licensees of non-geostationary satellite systems that use frequency bands allocated to the Fixed-Satellite Service for their feeder link operations shall coordinate their operations with licensees of geostationary Fixed-Satellite Service systems licensed by the Commission for operation in the same frequency bands. Licensees of geostationary Fixed-Satellite Service systems in the frequency bands that are licensed to non-geostationary satellite systems for feeder link operations shall coordinate their operations with the licensees of such non-geostationary satellite systems.	Theia will comply.
§ 25.283	(a) N/A (b) N/A (c) Upon completion of any relocation authorized by paragraph (b) of this section, or any relocation at end-of-life specified in an authorization, or upon a spacecraft otherwise completing its authorized mission, a space station licensee shall ensure, unless prevented by technical failures beyond its control, that stored energy sources on board the satellite are discharged, by venting excess propellant, discharging batteries, relieving pressure vessels, or other appropriate measures. (d) N/A	To the extent necessary, Theia requests a waiver of § 25.283. *See Legal Narrative*, Section IV.A; Appendix 4.