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PETITION FOR DECLARATORY RULING

Kepler Communications Inc., doing business as Kepler ("Kepler"), pursuant to §25.137 of the Commission's Rules,[1] hereby files this Petition for Declaratory Ruling ("PDR") requesting access to the U.S. market for Kepler's planned low earth orbit ("LEO"), non-geostationary orbit ("NGSO"), satellite system (the "Kepler System") being licensed through Canadian authorities. The PDR should be considered in the FCC's announced satellite processing round for applications or petitions for operation in the Ku-band and Ka-band frequencies.[2]

I. INTRODUCTION AND BACKGROUND

Kepler is on a mission to enable the information age by providing real-time connectivity for intelligent devices that gather the world's information.

The way of human life has fundamentally changed over the past two decades with the advent of internet connected smart devices. What started as early as 1982 at Carnegie Mellon University with a modified Coke vending machine that would report inventory levels over the internet, is now becoming a ubiquitous way for society to gather data and progress forward into an information age.[3] As the International Telecommunications Union ("ITU") has recognized, these devices - known as the Internet of Things (IoT), will act "as a global infrastructure for the information society."[4]

IoT devices are being deployed en-masse to gather vital data that powers our society serving applications from inventory tracking, and remote asset monitoring to daily weather forecasting. Their information leads to increased efficiencies, cost reductions, and even has the ability to save lives. Today, over five billion of these smart devices are operating on the earth's surface and Intel expects that number to grow to over 25 Billion by 2020[5]. Similarly, hundreds of these devices (satellites) are

[1] 47 C.F.R § 25.137.
[2] *See* Public Notice, "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 (July 15, 2016).
[3] CMU SCS Coke Machine. http://www.cs.cmu.edu/~coke/
[4] Internet of Things Global Standards Initiative http://www.itu.int/en/ITU-T/gsi/iot/Pages/default.aspx
[5] IDC, Intel, United Nations

being sent annually off the earth's surface to gather vital information and that number is expected to grow to over 500 satellites annually by 2020[6].

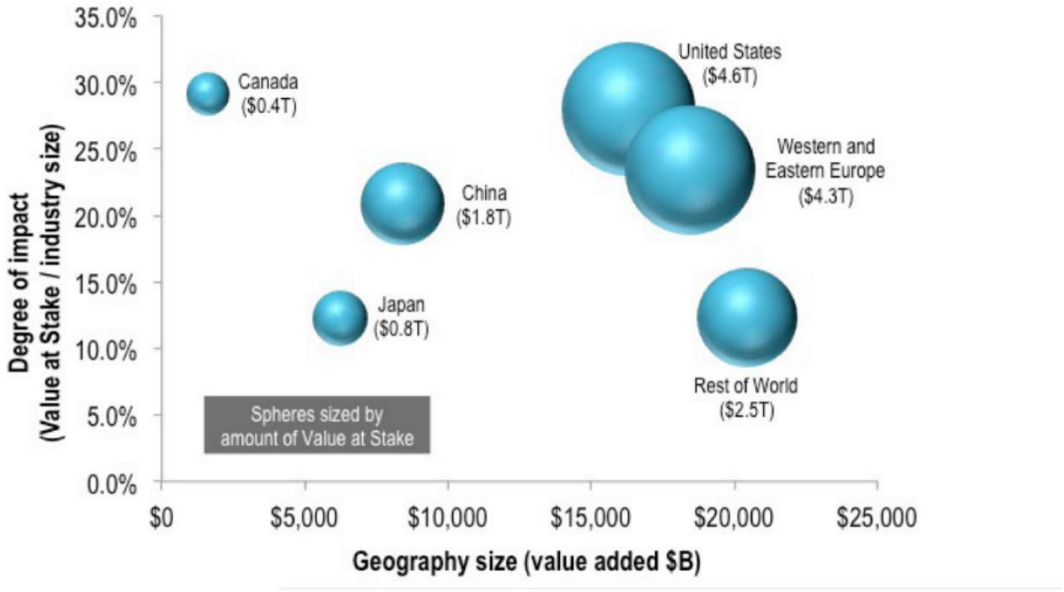

Figure 1 The IoT market potential in the global economy[7]

The underlying theme for this breathtaking growth is standardization of hardware which, has led to plummeting hardware costs and wide spread adoption. As noted during the Global Symposium for Regulators on the internet of things "More standardization would enable more innovation, and enable information to flow between industry verticals…".[8] Yet despite all this development, intelligent devices still lack a standard telecommunications infrastructure, which is often cited as one of the challenges that must be addressed to facilitate the proliferation of the industry. [9]

The state of the industry for connectivity of intelligent earth based devices remains disparate. Developers and service providers continue to use a poor combination of infrastructures not designed to serve their needs. Most typically, they are channels of costly traditional satellites that are not interoperable with

[6] SpaceWorks Enterprises Inc. Nano/Microsatellite Market Forecast. 2016. Available at http://spaceworksforecast.com/2016-market-forecast/.
[7] *See* Embracing the Internet of Everything To Capture Your Share of $14.4 Trillion *http://www.cisco.com/c/dam/en_us/about/ac79/docs/innov/IoE_Economy.pdf*
[8] GSR Discussion Paper at 15. https://www.itu.int/en/ITU-D/Conferences/GSR/Documents/GSR2015/Discussion_papers_and_Presentations/GSR_DiscussionPaper_IoT.pdf
[9] See Harnessing the IoT for Global Development. *Available at* https://www.itu.int/en/action/broadband/Documents/Harnessing-IoT-Global-Development.pdf

cellular networks. Similarly, for devices deployed off the earth's surface, there doesn't exist a network to seamlessly support their connectivity needs. This often results in developers being forced to deploy their own ground infrastructure. This approach for devices orbiting the earth forces its operators to face the added complexity of spectrum licensure and coordination, both of which have been recognized by the FCC as a fundamental issue facing upcoming NGSO.

Canada and the United States have an abundance of agreements in place. These reinforce the bilateral effort of both governments to actively collaborate and further their economic and diplomatic prosperity on a global front. Kepler's System will integrate itself into both country's critical infrastructure over the coming years by supporting organizations and the public to collect, assess and use information in ways not economically feasible to date. Both countries are in the midst of collaborating to secure and develop such infrastructures, this is clearly seen in the Canada-United States Action Plan for Critical Infrastructure.[10] By 2022, Kepler's deployed System will have the ability to expand its network on an as needed basis and help secure North America's access to a secure data network, regardless of time or location. In doing so, it will directly contribute to unleashing over $5 trillion in market value associated with IoT devices and facilitate the growth of space systems by reducing the burden of coordination.

Kepler's innovative non-geostationary satellite constellation, made of nanosatellites the size of a football, will make real-time connectivity available for devices both on and off the earth's surface – empowering the information age across the world. At the core of each satellite within the network is a novel Software Defined Radio (SDR), electronically steerable antenna array, and networking protocol that has the potential to become the standard for satellite communications with dynamic links, and variable channel sizes.

When fully deployed, the Kepler constellation will be an enabler, supporting endeavors of economic development and human advancement both in the United States and abroad. The Kepler constellation will enable:

- **IoT Data Aggregation & Backhaul.** The Kepler System will provide localized and extremely economical terminals that can aggregate data from IoT devices. This data will then be backhauled

[10] *See https://www.dhs.gov/publication/canada-us-action-plan-critical-infrastructure*

to users through the Kepler space segment. Kepler's revolutionary low cost infrastructure will be an enabler for many IoT applications in remote areas. This includes animal monitoring, crop monitoring, seismic data collection, weather data collection, asset tracking, and many more.

- **Spectrum Sharing.** The Kepler System's novel Software Defined Radio (SDR), electronically steerable antenna array, and networking protocol, in combination with inter-satellite links will allow other NGSO operators to communicate with each other and the ground in real-time. In addition, this will enable NGSOs to dynamically request and release bandwidth as their system need dictates. The Kepler network will allow for frequency reuse in ways never seen before. In doing so, it will unlock the previously inhibited business opportunities for real-time earth exploration satellites and data-scientists alike. Through the introduction of such a novel system, the world will see a reduction in the number of ground stations that must be deployed, directly relieving the licensure / coordination burden from both the FCC and up and coming NGSO networks.

Grant of this PDR is an important step toward realizing the true potential of IoT. As recognized by the ITU "…connectivity and therefore spectrum is a key part of supporting the expansion of the IoT"[11]. Kepler's goal is to enable society to enter the information age and advance human kind through gathering and sharing the world's information. This application is a critical part of said process, and by granting the PDR, the Commission will lead the charge towards realizing the economic and societal benefit of IoT—both in the United States and internationally.

II. THE KEPLER COMMUNICATIONS SYSTEM

Kepler was founded in 2015 with the mission of providing economic real-time connectivity for the devices that gather the world's information. Kepler is currently venture financed and has a number of industry partners that are supporting Kepler's ground, space and business segments. The Innovation Science and Economic Development ("ISED") Office in Canada will license the Kepler space segment in addition to authorizing the use of the spectrum mentioned below and has made the spectrum filings on behalf of Kepler to the ITU.

[11] See Harnessing the IoT for Global Development at 47 *available at* https://www.itu.int/en/action/broadband/Documents/Harnessing-IoT-Global-Development.pdf

The Kepler System is an innovative new paradigm for satellite communications. It leverages nearly 16 years of on-going development towards the CubeSat standard. Using this standard in combination with a novel, proprietary, Software Defined Radio ("SDR") and electronically steerable antenna array, the Kepler System will deliver cost effective real-time connectivity for the billions of devices that gather the world's information. The complete system will be in operation by 2022 with the first two spacecraft already manifested for launch in 2017. Providing low-cost real-time connectivity through the Kepler System will be a key enabler to realizing the true economic potential of the data gathered by devices on the ground and satellites deployed in space.

The Kepler System is made up of a constellation of LEO spacecraft and ground equipment, both of which are based on the same novel SDR technology. As a result, the system will be able to achieve high spectral efficiency and dynamically coordinate with both current and future systems, ensuring no harmful interference in the requested Ku-bands. Broken down further, the complete Kepler System is composed of three subsystems, the spacecraft subsystem, the user terminal subsystem, and the gateway subsystem. Each subsystem is described briefly in the sections that follow, while a more detailed description is provided in Schedule S and the accompanying Technical Narrative included with this PDR.

A. Space Subsystem

The Kepler System will employ up to 140 satellites, inclusive of in-orbit spares, with the capability to increase the number of satellites in operation to meet user demand. Each spacecraft's cost will be low enough that they can be upgraded every 3 years with the latest advancement in communication technology. As such, Kepler is shifting the satellite operating paradigm from mainframes that are seldom upgraded, towards PC-like spacecraft upgraded at the pace of advancements in cell phone components. At the core of each spacecraft is Kepler's novel SDR and antenna arrays that enable the most efficient use of spectrum possible.

The spacecraft will operate in Low Earth Orbit ("LEO") in the altitude range of 500 - 650km using 7 orbital planes, each consisting of 20 spacecraft equally spaced along the orbital plane.[12] The desired orbit will be

[12] *Note* the expected operating altitude for the constellation is in the range of 600km. The number of satellites and orbital planes may increase as a result of system demand and to prevent interference. The Commission will be notified of any changes to the constellation.

a Polar Orbit ("PO"). This configuration has the capability of providing complete coverage of the earth and LEO. The spacecraft will have the following links (i) ground user terminal links in the Ku-band; (ii) space user terminal links in the Ka-band; (iii) inter-satellite links in the Ka-band; (iv) primary/back up tracking, telemetry, & control ("TT&C") in the UHF/VHF and S-band frequencies; and (v) gateway links in the Ku-band.[13] The frequency used in each of the aforementioned links is shown in the table below. To be clear, Kepler seeks U.S. market access authority only for the [14.0 to 14.5 GHz] user terminal-to-satellite frequency bands and the [10.7 to 12.7 GHz] satellite-to-user terminal frequency bands.[14] Kepler does not intend to operate gateway stations in the U.S. at this time and its satellite-to-satellite links will be authorized by the Canadian administration. A more detailed description of the frequencies, bandwidths and dynamic channelization capabilities of the SDR are included in Schedule S and the Technical Narrative included with this PDR.

Link	**Frequency Range**	**Covered in this Application**
Satellite-to-Satellite	25.25 - 27.5 GHz[15]	No
User terminal-to-Satellite	12.75 - 13.25 GHz[16]	No
	14.0 - 14.5 GHz	Yes
Satellite-to-User terminal	10.7 - 12.7 GHz	Yes
Satellite-to-Gateway	10.7 - 12.7 GHz	Yes
Gateway-to-Satellite	12.75 - 13.25 GHz[17]	No
	14.0 - 14.5 GHz	Yes

For clarity, TT&C frequencies have been separated out from the above table. Their use and rollout phases are further discussed in the technical narrative.

[13] Operation of user terminal and gateway links in the same Ku-band is achieved by dynamically adjusting bandwidth through the use of the SDR.
[14] Kepler is not providing in the Schedule S technical information for those frequency bands that the company is not seeking U.S. market access. To the extent necessary, Kepler will provide such information at the FCC's request.
[15] Kepler will be working with the Canadian authorities to license inter-satellite links. Where required and on an as needed basis, Kepler will disclose to the FCC the operation of inter-satellite links with U.S. licensed operators
[16] Despite the capability of Kepler's System to operate in the 12.75 – 13.25 GHz band, use of said band within the U.S. is not being requested at present
[17] *See* id

	Phase I	Phase II	Phase III[18]
Gateway-to-Satellite	148 – 149.9 MHz[19]	2025 – 2110 MHz[20]	449.75 – 450.25 MHz[21]
Satellite-to-Gateway	401 – 402 MHz	2200 – 2290 MHz[22]	401 – 402 MHz

The satellites will be deployed using an incremental approach being opportunistic of any available secondary payload launch opportunities. This strategy is employed for a number of reasons: (i) the Kepler System can begin to offer service with the first spacecraft in-orbit; (ii) this reduces launch risk; (iii) this reduces launch costs and subsequently the cost to the end user. However, this launch strategy will inherently lead to variability in the spacecraft orbits.

B. User Terminal Subsystem

The Kepler System will provide connectivity to devices that gather the earth's information through a variety of user terminal offerings. For devices deployed on the ground, Kepler will offer a low-cost Ku-band user terminal that can aggregate data from many devices. This device can later backhaul the aggregated data through the Space Subsystem. The user terminal will aggregate data using known protocols such as LoRA, SigFox, and NB-IoT to ensure compatibility with the many devices currently being developed in terrestrial applications.

For other satellites, the Kepler System will provide connectivity through a space-rated user terminal leveraging the Ka-band inter-satellite links on board the Space Subsystem. Since the space user terminal uses novel SDR technology, the system can dynamically allocate bandwidth and channels based on user needs. This technology will ensure efficient spectrum sharing and reuse, alleviating some the licensing and coordination burden the FCC will face with the impending growth in NGSO constellations. Kepler's System has the potential to support the FCC mission statement of "Authorizing as many satellite systems as possible and as quickly as possible to facilitate deployment of satellite services"[23].

[18] Considered primary TT&C frequency for operation as of Phase II – *See technical narrative* for more information
[19] Kepler will coordinate with other operators as required by ITU RR §5.218
[20] Operation in this frequency is bidirectional. Placement in a given direction is for ease of representation only
[21] Kepler will coordinate with other operators as required by ITU RR §5.286
[22] *See* id.
[23] International Bureau Satellite Division. https://www.fcc.gov/general/international-bureau-satellite-division

C. Gateway Subsystem

The Kepler System will be supported by a network of multiple 2.4m Ku-band gateway antennas that are discussed briefly in the Technical Narrative but will be included in a separate filing[24]. In addition, the Kepler System will use a variety of S and UHF/VHF antenna for backup TT&C.

III. THE PUBLIC INTEREST WILL BE SERVED BY AUTHORIZING THE KEPLER SYSTEM TO SERVE THE U.S. MARKET

In order for the Commission to approve this PDR for a non-U.S. licensed space station it must serve the U.S. public interest. The Commission considers (A) the effect on competition in the U.S., (B) spectrum availability, (C) eligibility and operational requirements, and (D) national security, law enforcement, foreign policy, and trade considerations. In addition, foreign licensed space stations must show compliance with the same legal and technical requirements provided by U.S. applications for space station licenses issued by the Commission.

Kepler's request to operate the Kepler System in the U.S. market is supported by the aforementioned considerations, and therefore it is in the public interest to allow Kepler to provide service within the U.S. In addition, as will be shown in the sections to follow, Kepler is legally and technically qualified to use the Kepler System to serve the U.S. market and more specifically the U.S. public needs.

A. Effect on Competition in the United States

Kepler has filed and will be authorized through the respective Canadian regulatory bodies, specifically the department of Innovation, Science and Economic Development. As Canada is a member of the WTO and Kepler's proposed system is not intended to operate direct-to-home, Digital Audio Radio Service, or Direct Broadcast Service(s), Kepler is entitled to a presumption that market entry for the system will satisfy the competition component of the public interest analysis. As such, Kepler is not required to provide a competitive opportunities showing.[25]

[24] The size of the gateway may increase based on regulatory requirements for given frequencies. *See* ITU RR 5.502 and 5.503.
[25] See 47 C.F.R. § 25.137(a)(2);

B. Spectrum Availability

The Commission also considers spectrum availability as a factor in determining whether grant of authorization to a foreign-licensed satellite to serve the U.S. market is in the public interest.[26] In this evaluation the Commission assesses whether granting of access creates the potential for harmful interference with U.S.-licensed satellite and terrestrial systems.

Kepler will comply with the Commission's rules and the ITU's requirements regarding EPFD limits as demonstrated in Schedule S and the *Technical Attachment* accompanying this PDR. Kepler's system is novel in its use of an SDR which enables the system to dynamically reconfigure radio characteristics based on prevailing circumstances and geographic location. Existing systems are typically not equipped with this level of versatility which results in unexploited spectrum not only over the United States but on a global stage. Through its use of a SDR, Kepler is able to both actively and continuously adapt to ensure coordination with existing GSO, NGSO, and terrestrial system as well as future GSO, NGSO and terrestrial systems that might be deployed in these bands. This leaves spectrum available to be reused for new services that are conceived in the frequency bands being requested for the Kepler System – moving frequency allocations from their archaic and monopolistic nature.

Following the proceedings initiated by the Commission in 1998 to permit NGSO FSS operations in the Ku-band and adopt technical sharing criteria[27], Kepler has developed a system that it believes will set a precedent in the level of technology employed and efficient spectrum use for satellites moving forward. Without doubt, Kepler's proposed system offers the greatest level of flexibility to enable and simplify coordination, which is consistent with the commission's requirements to share and coordinate with existing operators. [28]

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[26] *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*, Report and Order, 12 FCC Rcd 24094 ¶ 149 (1997) ("*DISCO II Order*")("We adopt our proposal to consider spectrum availability as a factor in determining whether allowing a foreign satellite to serve the United States is in the public interest.").

[27] *See 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*, Notice of Proposed Rulemaking, 14 FCC Rcd 1131 (1998); E*stablishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ku- Band*, Notice of Proposed Rulemaking, 16 FCC Rcd 9680 (2001).

[28] *See generally 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) ("*Ku-Band Sharing Order*") (deciding the means for intra-service sharing among prospective NGSO FSS licensees in the Ku-band); *Establishment of Policies and Service Rules for the Non-Geostationary Satellite*

In the associated Schedule S and Technical Narrative, Kepler demonstrates its system's compliance with both the Commission's and ITU's requirements regarding EPFD limits, spectrum sharing, and its ability to prevent potentially harmful interference with U.S. licensed satellites and terrestrial systems. As such, granting market access to Kepler's System would be consistent with the Commission's spectrum availability policies for non-U.S. licensed satellites.

C. National Security, Law Enforcement, Foreign Policy, and Trade Issues

Kepler's System does not pose any risk to national security, law enforcement, foreign policy, and trade as assessed by the Commission and expected to only arise in "rare circumstances".[29] Furthermore, Kepler is a Canadian Owned and Operated Corporation ("COOC"), whose jurisdiction falls under numerous agreements and action plans between the Canadian/U.S. governments with respect to trade, foreign policy and national security. The North American Free Trade Agreement (NAFTA) and the Canada-United States Action Plan for Critical Infrastructure are examples of the continued effort between the two jurisdictions and relative regulatory bodies to actively collaborate on the named issues. Given the above, Kepler's request for authority to operate its System in the U.S market raises no concern on the named issues and as such, this element of the Commission's *DISCO II Order* public interest analysis is satisfied.

D. Eligibility and Operational Requirements

Pursuant to Section 25.137 of the Commission's rules, the entity filing a PDR for U.S. market access must provide the legal and technical information for its non-U.S. licensed space stations required under Part 25 of the Commission's rules, including Section 25.114.[30]

1. Legal and Technical Qualifications

Orbit, Fixed Satellite Service in the Ka-band, Report and Order, 18 FCC Rcd 14708, 14709 (2003) (deciding the means for sharing among existing and prospective NGSO FSS licensees in certain Ka-band frequencies).

[29] *DISCO II Order* at ¶ 180 ("We emphasize, however, that we expect national security, law enforcement, foreign policy and trade policy concerns to be raised only in very rare circumstances. Contrary to the fears of some commenters, the scope of concerns that the Executive Branch will raise in the context of applications for earth station licenses is narrow and well defined.").

[30] *See* 47 C.F.R. § 25.137(b). See also *DISCO II Order* at ¶ 189.

The information set forth in this legal narrative, the associated *Technical Narrative*, Schedule S, and the accompanying FCC Form 312 demonstrates compliance with the requirements of Section 25.137 and the other applicable sections of Part 25 of the Commission's rules.

Items required in Schedule S to comply with current FCC rules

Information provided here within, in the technical narrative, Schedule S and Form 312 are consistent with the latest available FCC instructions.[31] The table below provides oversight of items applicable to the operation of a NGSO and included within the aforementioned documents for review by the Commission.

	Required	NOT Required
S1: General Information	a, b, c, d	
S2: Operating Frequency Bands	a	
S3: Orbital Information for Geostationary Satellites		Entire Section
S4: Orbital Information for Non-Geostationary Satellites	a, b, c, e	
S5: Receiving Beam	a[32]	a(x)[33]
S6: Receiving Channels	a, b[34], c[35], d	
S7: Transmitting Beam	a[36]	a(x)[37]
S8: Transmitting Channels	a, b[38], c[39], d	
Items 12, 13, 16	Completed/Observed	

[31] *See* SPECIFIC INSTRUCTIONS FOR SCHEDULE S, Revised April, 2016 – Approved by OMB 3060-0678
[32] Kepler's System uses "space stations with steerable beams that are shapeable"
[33] Automatically disabled by online filing software. Kepler's system is capable of switching polarization.
[34] Values provided are for reference only, Kepler is capable of dynamically changing bandwidths and center frequencies as a result of its SDR
[35] *See* id.
[36] Kepler's System uses "space stations with steerable beams that are shapeable"
[37] Automatically disabled by online filing software. Kepler's system is capable of switching polarization.
[38] Values provided are for reference only, Kepler is capable of dynamically changing bandwidths and center frequencies as a result of its SDR
[39] *See* id.

Rules that warrant special attention:

Section 25.114(d)(14) – End-of-Life Disposal

Kepler's proposed system is subject to direct and effective regulatory oversight by Canada's regulatory authorities with respect to its orbital debris mitigation plans. In good faith, Kepler has provided an orbital debris mitigation example showing how it's satellites will comply in connection with this PDR. See the associated *technical narrative* for more information.

2. Waiver Requests

The Commission may waive a rule if special circumstances indicate that a departure from the rule would better serve the public interest than would strict application[40]. In such circumstances, the Commission may grant the waiver if it does not undermine the policy objective of the rule and if the waiver otherwise serves the public interest.[41]

Section 25.157(e) – Band Segmentation Requirements

Kepler is aware of the ongoing proceeding with WorldVu and its request to allocate spectrum based on an "avoidance of in-line interference" approach adopted by the Commission in the *Ku-Band Sharing Order*.[42] Similarly to WorldVu and the Commission[43], Kepler agrees with the stance that the most efficient use of spectrum can be obtained by providing access to the entire band and allowing for licensees to coordinate appropriate use. While satellites typically use fixed beams and set frequencies, Kepler's proposed system operates with some of the latest technology available to nanosatellites, including antenna arrays and SDRs. This in effect simplifies Kepler's ability to avoid inline interference and coordinate with both existing and new NGSO systems alike. As such, to the extent necessary, Kepler requests a waiver of the band segmentation requirements of Section 25.157(e) and in line with the *Ku-Band Sharing Order* is capable of operating using a "home base" allocation where coordination is non-trivial. While true that in the past there have been instances of NGSO projects which failed to finalize their proposed systems[44], Kepler's

[40] Northeast Cellular Telephone Co. v. FCC, 897 F.2d 1164, 1166 (D.C. Cir. 1990).
[41] WAIT Radio v. FCC, 418 F.2d 1153, 1157 (D.C. Cir. 1969).
[42] *See Ku-Band Sharing Order*, ¶¶ 27-55.
[43] See OneWeb Petition at 17-19.
[44] For example, the processing round established by the Commission in 1998 had seven Ku-band NGSO applicants. *See Ku-Band Sharing Order*, ¶ 4. None of these systems was ever built or launched.

proposal significantly undercuts the operational cost of other failed and newly proposed systems by orders of magnitude while being technologically superior. It is thus in the best interest of the public for the Commission to support Kepler's proposal for access to the entire spectrum and prevent "spectrum warehousing by non-implemented NGSO FSS systems at the expense of operational systems".[45]

Section 25.146(a)(1)(iii) and 25.146(a)(2)(iii) – Source Code Requirements

Sections 25.146(a)(1)(iii) and 25.146(a)(2)(iii) require each applicant to provide a computer program as well as source code for the $EPFD_{down}$ and $EPFD_{up}$ validation computation, if a computer program has not been made available by the ITU for this purpose. Software has been made available by the ITU however it is still defined as a *test version*. Kepler is aware that the test version has been created by Transfinite Systems based on their currently available commercial equivalent.[46] Kepler has confirmed with Transfinite that the underlying code to generate EPFD limits is fundamentally the same across both versions. Out of an abundance of care and given the underlying suggestion that the software provided by the ITU is still a "test" version, Kepler respectfully requests a waiver for the source code requirement in Sections 25.146(a)(1)(iii) and 25.146(a)(2)(iii).[47] Due to the commercial value of Transfinite System's EPDF application, it is unlikely to surrender any proprietary code. Kepler will provide the Commission with assistance and files, where necessary, to ensure it is capable of validating Kepler's proposed system against EPDF limits.

Code Section 25.146 – Power Flux Density Demonstration

In accordance with section 25.146 of the Commission's regulations, Kepler is providing a demonstration of its System's EPFD compliance. In light of the proposed deployment schedule for

[45] *Ku-Band Sharing Order*, ¶ 9.
[46] *See* http://www.transfinite.com/content/itu2.
[47] The FCC has previously waived a requirement to provide information in a specified format when that information could not be obtained from a third party and alternative information was provided to fulfill the purpose of the rule. *See, e.g,* Intelsat License LLC, Application to Launch and Operate Intelsat 20, IBFS File No. SAT-LOA-20111024-00208, grant condition 17 (July 26, 2012) (waiving the Section 25.114(d)(3) requirement to provide beam patterns in accordance with specified parameters "because the satellite manufacturer does not provide the patterns in the required form" and the alternate information provided "fulfill the requirements of Section 25.114(d)(3)").

the 140 satellite constellation, namely the launch of up to 5 satellites for Phase I and 20 satellites in Phase II, Kepler respectfully requests a waiver where required of section 25.146 of the Commission's regulations. The attached technical narrative demonstrates EPFD compliance for both Phase I and Phase II of the proposed System which will likely extend into the 2020 timeframe. Both Phases are intended to operate in a single orbital plane before subsequently adding further planes to complete Kepler's global real-time network.[48] In the interest of alleviating the upfront burden towards the Commission, Kepler will provide Phase III EPFD compliance statements as and when Phase III nears launch. Such a demonstration, in keeping with the request for a waiver, would nonetheless be required by Section 25.146(b) of the Commission's regulations. As such, this request for waiver would not be outside the public interest given Kepler's inability to operate without demonstrating full compliance with the Commission's EPFD requirements 90 days prior to launch.

NGSO FSS Use Restriction in the 10.7-11.7 GHz Band

Kepler's proposed System is capable of operating in the 10.7 – 11.7 GHz band, which appears to be restricted to use by gateway earth stations only.[49] In compliance with section 25.208(b), Kepler intends to use the band for downlink transmissions to user terminals on a non-interference and unprotected basis, ensuring that the FS operators are capable of utilizing the spectrum unhindered.[50] The Commission has previously determined that such operations, adhering to respective PFD limits as laid out in the *Technical Attachment*, protect FS operators from interference from satellite downlinks.[51] Furthermore, note NG52 of the US frequency allocations limits the use of the 10.7-11.7 band to international services (GSO). While Kepler is a COOP business and intends to remain Canadian domiciled, future investment may sway ownership/jurisdictional oversight of the corporation. As such, to the extent necessary and where

[48] *See* Kepler's associated technical narrative for further details on the proposed launch and implementation sequence
[49] *See, e.g.,* 47 C.F.R. § 25.202(a) (2012).
[50] 47 C.F.R. § 25.208(b).
[51] *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,* 16 FCC Rcd 4096 at ¶ 39 (2000)

applicable, Kepler respectfully requests a waiver of note NG52 and operating a NGSO FSS with user terminals transmitting in the 10.7-11.7 GHz band.[52]

Inapplicable, irrelevant, and/or burdensome Schedule S requirements

Kepler also requests a limited waiver of Section 25.114(c) of the Commission's rules, which requires certain information to be filed in the Schedule S. In many cases, the Schedule S and Form 312 are not formulated to readily accommodate non-traditional satellite systems, such as Kepler's innovative CubeSat system, and the information requested may be inapplicable, irrelevant, and/or burdensome to produce.[53] For example, the Schedule S requests:

- beam polarization,
- channel width, and
- center frequencies.

Given the Software Defined Radio onboard Kepler's systems, these values can be changed to facilitate coordination, amongst other requirements.[54] By way of example, listing all the possible center frequencies using 1kHz bandwidths would result in an excessive amount of data to input and subsequently be processed by the Commission. Kepler has provided representative data that will allow the Commission to conduct an accurate technical assessment of Kepler's system and requests any necessary waivers. In sum, strict application of the rules here is unnecessary to serve the purposes of the rules, which is to ensure that the Commission has all the relevant information to evaluate the application. As Kepler has provided all relevant information in the Narrative and Schedule S, waiver of the aforementioned Schedule S requirements is appropriate.[55]

[52] Similarly, to the extent necessary, Kepler respectfully requests a waiver of the requirement set forth in 47 C.F.R. § 2.106, note NG52, limiting use of the 10.7-11.7 GHz band by GSO systems to international services, to the extent this restriction could also apply to Kepler's NGSO system. Out of an abundance of care, with respect to the aforementioned, a waiver of § 2.102 is also requested where applicable and to the extent necessary.
[53] To proceed forward in Schedule S, Kepler was required to input a value for the polarization and channel widths as well as center frequencies. See FCC Form 312 Schedule S.
[54] See FCC Form 312 Schedule S, Receiving Channels (7) and Beams.
[55] See 47 C.F.R. § 1.3; *see, e.g.,* Stamp Grant, ViaSat, Inc., SAT-LOI-20140204-00013 (granted Jun. 18, 2014) (waiving Schedule S requirements because they were found to be unnecessary for the space station application).

Sections 25.137(d)(1), 25.137(d)(4) & 25.164(b) – Milestones

Phase I of Kepler's System is intended to enter into service Q4 of 2017 and as such Kepler expects to have up to 5 operational satellites and have progressed through the majority, if not all of the relevant milestones by the time this license is granted. Kepler is aware of the requirement for a bond in the launch of an NGSO system[56] however, given the relatively low risk associated with the manufacture of a CubeSat the underlying risk is shifted to a potential launch failure. While rare, launch failures continue to be reason for concern and have occurred twice in the last quarter alone, with one being a U.S. based carrier.[57] In such an event, Kepler would be required to construct and launch a replacement satellite at its own cost. Posting the $1 million bond could significantly hamper Kepler's ability to construct a replacement satellite for Phase I, due in no part to its own doing. Furthermore, Kepler intends to roll out its constellation over the course of 4 years and continuously update its constellation with the latest technology every three years. By definition, a complete system deployment may never be attained where complete would allude to all "space stations".[58] If Kepler were to follow the guidelines purely to satisfy the bond and milestones, it may be forced to complete the constellation where replacing existing satellites could potentially make better sense for end consumers and as such the business. Given the reasonable expectation of having at least part of the system operational by the time this license is issued as well as the financial burden and risk to the continued operation of Kepler associated with a launch failure, it is not in the public interest to require the placement of a bond.[59] At the discretion of the Commission, Kepler respectfully requests the waiver of the aforementioned sections in order to minimize the overall operational risk associated with the launch of its system as well as to accommodate the replenishing nature of the system which is not accommodated by the current regulations.

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[56] *See* 47 C.F.R. § 25.165(a)(1).
[57] http://www.dailymail.co.uk/sciencetech/article-3776035/
[58] *See* 47 C.F.R. § 25.164(b)
[59] *See, e.g.*, Grant of Application of Planet Labs Inc. for Modification of Authority to Launch and Operate an NGSO Satellite System (call sign S2912), IBFS No. SAT-MOD20150802-00053, ¶ 13 (June 15, 2016)(authorizing Planet to increase the number of satellites in its constellation from 67 to 200 without imposing milestones or bond requirements for the additional deployments); *see also* Grant of Application of Spire Global, Inc. for Authority to Launch and Operate an NGSO Satellite System (call sign S2946), IBFS No. SAT-LOA-20151123-00078, ¶ 7 (June 16, 2016) (authorizing Spire Global to launch and operate an additional 20 satellites without imposing milestones or bond requirements for the additional deployment).

Section 25.137(c) – contemporaneous Operation

Kepler has commenced its coordination process with the ITU for its proposed system. The process was commenced in June 2016 through submission of an API and is subject to a six-month notification period.[60] For clarity, Kepler has attached the API for the Commission to review. As of July 1st, 2016 – APIs are no longer required which suggests that a CR/C document submitted be considered "under coordination" but only "received" as of Jan 1st 2017 in terms of priority. In light of the change, Kepler should be considered as having already filed for coordination.[61] Kepler has chosen to file through the Canadian Administration which is currently subject to a moratorium on issuing licenses for NGSO systems.[62] As such, Kepler is currently unable to have its respective license to operate issued by Innovation, Science and Economic Development Canada (ISED). The moratorium is to be in effect for a minimum of six months, effective June 15, 2016 and is expected to be lifted no later than February 2017. The moratorium in place does not affect Kepler's ability to submit its CR/C coordination document through ISED to the ITU in December 2016. With consideration to the above and purely as a precautionary measure, Kepler requests a waiver to section 25.137(c) in order to be considered and participate in this processing round.[63]

Section 25.146(i) – Continual Service

As noted in the associated *technical narrative*, Kepler intends to role its constellation out in three phases. Global real-time coverage will not be available until the constellation is fully deployed in Phase III. As such, the requirements laid out in §25.146(i) will not be met until Phase III is successfully deployed. Out of an abundance of care, Kepler respectfully requests a waiver of §25.146(i) until such a date that the constellation is sufficiently rolled out to meet the aforementioned regulation.[64]

[60] See ITU Radio Regulations § 9.1 (WRC-03)
[61] CR/401 - BR Circular Letter CR/376 dated 22 December 2014
[62] See Spectrum Advisory Bulletin (SAB) SAB-001-16, https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11200.html
[63] *See* Public Notice, "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 (July 15, 2016).
[64] Kepler's rollout plan intends to have the complete constellation operational by the year 2022. Given the opportunistic approach to launches, this date may fluctuate.

E. Grant of Kepler's PDR Is in the Public Interest

Kepler's System will provide innovative services through its use of novel and economic hardware.

Collectively, Kepler's System, its investors who have secured $5M USD for the initial development of the Kepler System, and U.S. Federal Organizations that have pledged $1.4M in signed LOI's to use the system once implemented provide resounding evidence of the validity and value towards the U.S. public. In order for the general public to benefit from Kepler's System, the Commission should grant this PDR and facilitate the economic growth currently inhibited as outlined below.

Through the use of CubeSats, the system will be operational at a cost that is an order of magnitude below current contenders. A lower infrastructure cost that covers the entire world will directly facilitate the rapid expansion of markets currently inhibited by the associated cost of accessing a real-time M2M data network. This unexploited market is worth $4.6 trillion USD in the United States economy alone.

Access to such a network will facilitate real-time monitoring and support of disasters be it on shore or off, simplify the oversight of natural resources and their exploitation, assist in both the national and international tracking of goods for both corporations and enforcement agencies, boost the yield and planning of crops and livestock, track varying forms of pollution/disease and enable healthcare. The aforementioned are a minute sample of the terrestrial markets that would be well served by Kepler's real-time, low cost, and high tech System.

Terrestrial applications aside, Kepler's System will revolutionize the way satellites relay information both around the globe and back down to earth. Entrants looking to capitalize on potential business cases in the space realm will see a substantial reduction in the time and legal proceedings required to become operational. The use of CubeSats and off the shelf hardware enables entrants to build a business case and hardware in a matter of months. The regulatory framework in place, specifically coordination, inhibits the exploitation of these business cases and is a detriment to the economy and general public alike. By providing a space network for new entrants to communicate and relay data, the requirement for coordination is reduced if not eliminated. Existing constellations that experience significant latency are able to link up with the Kepler System and turn their latency based system into a real-time, globally

available infrastructure. The benefit to the general public, U.S. domiciled companies and the FCC from said application alone is sufficient to justify granting this PDR for market access.

Furthermore, Kepler's System uses a Software Defined Radio as well as antenna arrays on both the user terminal and satellite. In doing so, Kepler is in a position to coordinate and share spectrum not only with current operators, but future ones alike. The implementation of this novel hardware allows Kepler to dynamically and continuously adjust or switch on/off center frequencies, channels, bandwidths and power levels. Coordination and complying with regulations thus becomes a moot point for Kepler's novel system. Additionally, the proposed System deorbits at the end of its operational life for disposal, thus does not use a parked orbit and effectively alleviates the public's concern with the ever-growing amount of space junk.

Granting Kepler's PDR will set a standard in the level of technology to be implemented when defining new space systems and contribute to the overall efficiency of spectrum allocation and its use. As clearly demonstrated above, such efficiencies will translate into direct benefits seen by end consumers throughout the U.S. – including Alaska and territories. Kepler's System will be the lynchpin in facilitating and unlocking the U.S.'s $4.6 trillion IOT market and directly assist in congress' mandate that the Commission support mechanisms to deliver affordable telecommunications service to all Americans.

F. CONCLUSION

As was explained above and will be further shown in the attached material, Kepler satisfies the FCC's requirements under the *DISCO II Order* for U.S. market access, and complies with Part 25 of the FCC's rules. Therefore, Kepler requests that the Commission issue a Declaratory Ruling authorizing the Kepler System to access the U.S. market.

Respectfully submitted,

Kepler Communications Inc. - November 15, 2016
By: __/s/ *Nickolas G. Spina*_____

Nickolas G. Spina
Manager of Launch and Regulatory Affairs
Kepler Communications Inc.

Annex A

Officers, Directors, and Ten Percent or Greater Shareholders

Question 40: FCC Form 312

Kepler Communications Inc. ("Kepler"), is a Canadian Controlled Private Corporation ("CCPC") with a registered office at 675 King St W, Toronto, Ontario M5V 1M9 Canada. The following individuals serve as officers and directors and can be contacted through the address listed above.

Name	Title	Nationality
Mina Mitry	Director & Chief Executive Officer	Canada
Wen Cheng Chong	Director & Chief Technical Officer	Canada
Brad Gillespie	Director	U.S.

The details of stockholders of record that directly or indirectly own 10 percent or more of Kepler voting stock are listed below. All of the shareholders can be contacted through the address listed above.

Name	Nationality / Place of Incorporation
Mina Mitry	Canada
Wen Cheng Chong	Canada
Jeffrey Osborne	Canada
Mark Michael	Canada
IA Ventures LLP	U.S.