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Subject: Status of the EMC Compatibility Study and Frequency Coordination for Kubos
Experimental Operations

Kubos Corp. is seeking an FCC Experimental License¹ in support of their nanosat system testing. The testing frequency of interest is 149.8 MHz. Kubos is requesting operation of a 20-kHz carrier centered at 149.8 MHz in the earth-to-space direction. There is some concern from the FCC regarding interference into other systems. Specifically, since the use of the band 148-149.9 MHz is also allocated to the space operation service (Earth-to-space) on a primary basis, subject to agreement obtained under No. 9.21. Kubos must coordinate with licensed operators in the band and provide an EMC analysis showing it will not cause harmful interference to any FIXED, MOBILE and MOBILE SATELLITE operations. The main uplink site is in Denton, TX but operation throughout the state of Texas is desired.

Skjei Telecom has conducted a frequency search of all applicable FCC databases to determine which Fixed, Mobile, and Mobile Satellite existing licensed systems could occur from the Kubos Corp. experimental operations. The tables below summarize the information collected. Table 1 below contains the Kubos Corp. technical parameters. The frequency of operation spans 149.79-149.81 MHz, so the entire channel falls within the 148.149.9 band which is a Part 25 band under the Table of Allocations, see Table 2. The adjacent bands include another Part 25 Space Operations band above and a FIXED and MOBILE band above, Amateur Services Part 97 below. Since the band of operation and the adjacent bands include Part 25 and Fixed/Mobile services both the IBFS and the ULS databases were queried.

¹ See Kubos FCC OET Experimental Authorization File # 0489-EX-CN-2017

Table 1 - Kubos Uplink (Earth-to-Space) Transmitter Technical Parameters		
Center Frequency	149.8	MHz
Channel Spectrum	149.79 - 149.81	MHz
Bandwidth	20	kHz
Power (W)	50	W
Antenna Gain	14.4	dBi
Power EIRP	31.4	W
Antenna	Circular Polarized Yagi (M ² 2MCP22)	
Ground Station 1	608 E. Hickory St. Ste 108	
	Denton, TX 76205	
lat/long (NAD83):	33.21418, -97.125	
Antenna Height	Less than 6 m	
Radius of Operation	Possible uplink operation within the State of Texas	
Table 1a - Hamilton-1 Cubesat		
Launch date - No later than	1-Apr-18	
Orbital Parameters	600 km	Altitude
	98°	inclination
Size	1.5kg	mass
	10x10x11 cm	size
Space-to-Earth Tx Freq	449	MHz

146-148 FIXED MOBILE except aeronautical mobile (R)	146-148 AMATEUR 5.217	146-148 AMATEUR FIXED MOBILE 5.217		146-148 AMATEUR	
148-149.9 FIXED MOBILE except aeronautical mobile (R) MOBILE-SATELLITE (Earth-to-space) 5.209	148-149.9 FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) 5.209		148-149.9 FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) US319 US320 US323 US325	148-149.9 MOBILE-SATELLITE (Earth-to-space) US319 US320 US323 US325	Satellite Communications (25)
5.218 5.219 5.221 149.9-150.05 MOBILE-SATELLITE (Earth-to-space) 5.209 5.224A RADIONAVIGATION-SATELLITE 5.224B	5.218 5.219 5.221		5.218 5.219 G30	5.218 5.219	
5.220 5.222 5.223			149.9-150.05 MOBILE-SATELLITE (Earth-to-space) US319 US320 RADIONAVIGATION-SATELLITE		

Table 2 – Summary of International and Domestic Frequency Allocations at 148.0-149.9 MHz

IBFS Results – As can be seen in Table 3 the only licenses which have been granted include Orbcomm and a company called Terra Bella Technologies. All other satellite licenses in the band were either dismissed or surrendered. A detailed search of the Terra Bella license shows that the actual frequencies of operation for this satellite system is 8025-8400 MHz Space-to-

Earth and 2025-2110 Earth-to-Space. The notation in the database search results that the system operates between 148-150 MHz is in error. A detailed review of all actions, including licenses, STAs, and modification show that no other company has been granted operation between 148.0-149.9 MHz. The only satellite operator in the band is Orbcomm and we have commenced coordination with them.

ULS Results – Since the Kubos carrier is sufficiently separated from any Fixed Services a cursory search of the ULS database for any in-band (148-149.9 MHz) authorizations was performed and none was found.

Frequency Coordination – Since Orbcomm is the only licensee in the band they were contacted about performing coordination. Walter Sonnenfeldt, Orbcomm's spectrum attorney takes the lead on these matters and all technical details included with the Kubos FCC Experimental filing were forwarded to his team. This was performed on December 13, 2017. A request for the timing of response was forwarded to Mr. Sonnenfeldt on 12/20/2017. If required to complete coordination, Kubos will provide Orbcomm with additional technical data or analyses.

TABLE 3 IBFS Report File Number	P/E	Applicant Name	Callsign	Frequency Band (MHz)	Status	Last Action	Date Expire	AFFPN Date
SAT-AMD-20120809-00125	E	ORBCOMM License Corp.	S2103	148- 150	ATPN	Dismissed by Delegated Authority	4/30/2025	8/31/2012
SAT-AMD-20140116-00006	E	ORBCOMM License Corp.	S2103	148- 150	AC	Grant of Authority		2/7/2014
SAT-AMD-20150420-00027	E	ORBCOMM License Corp.	S2103	148- 150	AC	Grant of Authority		5/22/2015
SAT-LOA-19940906-00051	P	LEO ONE WORLDWIDE, INC.	S2145	148- 150	AC	Surrender of Authorization		8/3/1999
SAT-LOA-19941116-00088	P	FINAL ANALYSIS COMMUNICATION SERVICES, INC.	S2150	148- 150	AC	Revocation of License or Authorization		11/25/1994
SAT-LOA-20000814-00139	P	Volunteers in Technical Assistance	S2424	150- 150	AC	Dismissed at Applicant's Request		10/16/2000
SAT-MOD-19990318-00029	P	ORBCOMM License Corp.	S2103	148- 148	AC	Grant of Authority		4/27/1999
SAT-MOD-19990318-00029	P	ORBCOMM License Corp.	S2103	149- 149	AC	Grant of Authority		4/27/1999
SAT-MOD-19990318-00029	P	ORBCOMM License Corp.	S2103	149- 150	AC	Grant of Authority		4/27/1999
SAT-MOD-20070531-00076	E	ORBCOMM License Corp.	S2103	148- 150	AC	Grant of Authority	4/30/2025	10/5/2007
SAT-MOD-20110801-00141	E	ORBCOMM License Corp.	S2103	148- 150	AC	Dismissed by Delegated Authority		
SAT-MOD-20111021-00207	E	ORBCOMM License Corp.	S2103	148- 150	AC	Granted in Part / Dismissed in Part	4/30/2025	12/2/2011
SAT-MOD-20150408-00019	E	Terra Bella Technologies Inc.	S2862	148- 150	AC	Grant of Authority	12/16/2028	5/1/2015
SAT-STA-20070919-00127	E	ORBCOMM License Corp.		148- 150	AC	Dismissed by Delegated Authority		
SES-LIC-19940406-01536	P	ORBCOMM License Corp.	E940535	150- 150	AC	Grant of Authority	6/12/2005	2/15/1995
SES-LIC-19940406-01537	P	ORBCOMM License Corp.	E940536	150- 150	AC	Grant of Authority	5/17/2005	2/15/1995
SES-LIC-19940406-01538	P	ORBCOMM License Corp.	E940537	150- 150	AC	Grant of Authority	5/17/2005	2/15/1995
SES-LIC-19940406-01539	P	ORBCOMM License Corp.	E940538	150- 150	AC	Grant of Authority	5/17/2005	2/15/1995
SES-LIC-19940524-01329	P	ORBCOMM License Corp.	E940534	148- 150	AC	Grant of Authority	6/12/2005	2/15/1995
SES-LIC-19961112-00199	P	SCIENTIFIC-ATLANTA, INC.	E970140	148- 150	AC	Grant of Authority		6/11/1997
SES-LIC-19961112-00200	P	SCIENTIFIC-ATLANTA, INC.	E970141	148- 150	AC	Grant of Authority		6/11/1997

SES-MOD-20060106-00014	E	ORBCOMM License Corp.	E940534	148- 150	AC	Grant of Authority	6/12/2020	1/25/2006
SES-MOD-20130930-00853	E	ORBCOMM License Corp.	E940535	150- 150	AC	Grant of Authority	6/12/2020	11/6/2013
SES-MOD-20130930-00854	E	ORBCOMM License Corp.	E940537	150- 150	AC	Grant of Authority	5/17/2020	11/6/2013
SES-MOD-20130930-00855	E	ORBCOMM License Corp.	E940538	150- 150	AC	Grant of Authority	5/17/2020	11/6/2013
SES-MOD-20130930-00856	E	ORBCOMM License Corp.	E940536	150- 150	AC	Grant of Authority	5/17/2020	11/6/2013
SES-RWL-20050412-00437	E	ORBCOMM License Corp.	E940535	150- 150	AC	Grant of Authority	6/12/2020	
SES-RWL-20050412-00438	E	ORBCOMM License Corp.	E940534	148- 150	AC	Grant of Authority	6/12/2020	
SES-RWL-20050412-00439	E	ORBCOMM License Corp.	E940538	150- 150	AC	Grant of Authority	5/17/2020	
SES-RWL-20050412-00440	E	ORBCOMM License Corp.	E940537	150- 150	AC	Grant of Authority	5/17/2020	
SES-RWL-20050412-00441	E	ORBCOMM License Corp.	E940536	150- 150	AC	Grant of Authority	5/17/2020	
		Action Taken Public Notice	ATPN					
		Action Complete	AC					

Table 3 – IBFS 148.0-149.9 MHz Database. Only Orbcomm has valid license operating in this frequency.

A summary of the in-band frequency table with footnotes in provided.

Table 4 - Table of Allocations (Freqs in MHz) with Footnotes	
148.0-149.9	
FIXED MOBILE MOBILE SATELLITE (Earth-to-Space) US319 US320 US323 US325	
5.218 5.219 G30	
US319	In the bands 137–138 MHz, 148–149.9 MHz, 149.9–150.05 MHz, 399.9–400.05 MHz, 400.15–401 MHz, 1610–1626.5 MHz, and 2483.5–2500 MHz, Federal stations in the mobile-satellite service shall be limited to earth stations operating with non-Federal space stations.
US320	The use of the bands 137–138 MHz, 148–150.05 MHz, 399.9–400.05 MHz, and 400.15–401 MHz by the mobile-satellite service is limited to non-voice, non-geostationary satellite systems and may include satellite links between land earth stations at fixed locations.
US323	In the band 148–149.9 MHz, no individual mobile earth station shall transmit on the same frequency being actively used by fixed and mobile stations and shall transmit no more than 1% of the time during any 15 minute period; except, individual mobile earth stations in this band that do not avoid frequencies actively being used by the fixed and mobile services shall not exceed a power density of ≤ 16 dBW/4 kHz and shall transmit no more than 0.25% of the time during any 15 minute period. Any single transmission from any individual mobile earth station operating in this band shall not exceed 450 ms in duration and consecutive transmissions from a single mobile earth station on the same frequency shall be separated by at least 15 seconds. Land earth stations in this band shall be subject to electromagnetic compatibility analysis and coordination with terrestrial fixed and mobile stations.
US325	In the band 148–149.9 MHz fixed and mobile stations shall not claim protection from land earth stations in the mobile-satellite service that have been previously coordinated; Federal fixed and mobile stations exceeding 27 dBW EIRP, or an emission bandwidth greater than 38 kHz, will be coordinated with existing mobile-satellite service space stations.
5.218	Additional allocation: the band 148–149.9 MHz is also allocated to the space operation service (Earth-to-space) on a primary basis, subject to agreement obtained under No. 9.21. The bandwidth of any individual transmission shall not exceed ± 25 kHz.
5.219	The use of the band 148–149.9 MHz by the mobile-satellite service is subject to coordination under No. 9.11A. The mobile-satellite service shall not constrain the development and use of the fixed, mobile and space operation services in the band 148–149.9 MHz.
G30	In the bands 138–144 MHz, 148–149.9 MHz, and 150.05–150.8 MHz, the fixed and mobile services are limited primarily to operations by the military services.