The International Amateur Radio Union

Since 1925, the Federation of National Amateur Radio Societies
Representing the Interests of Two-Way Amateur Radio Communication

AMATEUR SATELLITE FREQUENCY COORDINATION REQUEST

(Make a separate request for each space station to be operated in the amateur-satellite service.)

Administrative information:

0	**DOCUMENT CONTROL**	
0a	Date submitted	(dd-MMM-yyyy)
0b	Expected launch date	(dd-MMM-yyyy)
0c	Document revision number (start at zero and increment with each revised request)	**Ver.0.2**
1	**SPACECRAFT (published)**	
1a	Name before launch	NEXUS
1b	Proposed name after launch	NEXUS
1c	Country of license	JAPAN
1d	API/A special section number	TBD
2	**LICENSEE OF THE SPACE STATION (published)**	
2a	First (given) name	Yasuyuki
2b	Last (family) name	Miyazaki
2c	Call sign	JS1YAV
2d	Postal address	7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan
2e	Telephone number (including country code)	+81-47-469-5430
2f	E-mail address (licensee will be our point of contact and receive all correspondence)	miyazaki@forth.aero.cst.nihon-u.ac.jp
2g	Skype or FaceTIme name (if available)	N/A
2h	Licensee's position in any organisation referenced in item 3a.	Professor
2i	List names and e-mail addresses of *additional* people who should receive copies of correspondence.	kiyoshi@forth.aero.cst.nihon-u.ac.jp
3	**ORGANISATIONS (published) — complete this section for EACH participating organization**	
3a	Name of organisation	Department of Aerospace Engineering, College of Science and Technology, Nihon University The Japan AMSAT Association (JAMSAT) The Japan Amateur Radio League, Inc. (JARL)

3b	Physical address	Department of Aerospace Engineering, College of Science and Technology, Nihon University 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan The Japan AMSAT Association (JAMSAT) 3-30-22 Wada, Suginami, Tokyo 166-8532, Japan The Japan Amateur Radio League, Inc. (JARL) 3-43-1 Minamiothuka, Toshima, Tokyo 170-8073, Japan
3c	Postal address	Department of Aerospace Engineering, College of Science and Technology, Nihon University 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan The Japan AMSAT Association (JAMSAT) 3-30-22 Wada, Suginami, Tokyo 166-8532, Japan The Japan Amateur Radio League, Inc. (JARL) 3-43-1 Minamiothuka, Toshima, Tokyo 170-8073, Japan
3d	Telephone number (including country code)	Department of Aerospace Engineering, College of Science and Technology, Nihon University +81-47-469-5430
3e	E-mail address	miyazaki@forth.aero.cst.nihon-u.ac.jp
3f	Web site URL	Department of Aerospace Engineering, College of Science and Technology, Nihon University http://sat.aero.cst.nihon-u.ac.jp/nexus/ The Japan AMSAT Association (JAMSAT) http://www.jamsat.or.jp/ The Japan Amateur Radio League, Inc. (JARL) http://www.jarl.or.jp/
3g	National Amateur Radio Society (including contact information)	The Japan Amateur Radio League, Inc. (JARL) http://www.jarl.or.jp/
3h	National Amateur Satellite organisation (including contact information)	The Japan AMSAT Association (JAMSAT) http://www.jamsat.or.jp/
3i	Have you involved your National Amateur Satellite organization and/or National Amateur Radio Society? Please, explain.	We are the members of JARL and JAMSAT.

Space station information:

4	**SPACE STATION (published)**	
4a	Mission(s). *Describe in detail what the space station is planned to do. Use as much space as you need.*	The main mission of NEXUS is as follows. ➢ **Demonstration of $\pi/4$ shift QPSK transmitter.** NEXUS performs data downlink by $\pi/4$ shift QPSK transmitter using the amateur radio band. We will perform the new radiowave format fast communication between satellite and groundstation To evaluate its superiority, against the communication speed(1200~9600bps) which was the mainstream in conventional amateur radio communication. The demodulation performs the evaluation by using both hardware and software proprietary.

		➢ **Demonstration of transponder.** We perform a space demonstration of transponder made by JAMSAT . We will operate the liner transponder for amateur radio operators. ➢ **Demonstration of FM transmitter.** We perform a space demonstration of FM transmitter which made by JAMSAT. ➢ **Demonstration of a camera system with high versatility and multifunction.** Construction of a camera system with high versatility, focused on newly selected camera modules. We will take some pictures of the earth and use them for amateur radio operators.
4b	Planned duration of each part of the mission.	Critical phase ・Link verification between the satellite and the ground station. The acquisition of House Keeping data by CW beacon. 1 ~ 3 days after launch ・Orbit determination Specific object 3 ~ 7 days after launch ・Check out of satellite function Test operation of satellite system and equipment. a) CW/FM integrated transmitter. b) Acquisition of sensor data. c) Confirmation of the power and heat balance. Within 1 months after launch ・Mission phase Mission equipment operation check. a) π/4 shift QPSK transmitter test transmission. b) Open part of the transponder. c) FM transmitter test transmission(GMSK(600~19200bps)). d) Photographed by the on board camera. Within 5 months after launch ・Evaluation of the success level a) Performance evaluation of the π/4 shift QPSK transmitter. b) Performance evaluation of the FM transmitter. c) Demonstration of the transponder. Within 1 years after launch
4c	Proposed space station **transmitting** frequency plan. *List for each frequency or frequency band:* ➔ *frequency or frequency band (e.g. 435-438 MHz)* ➔ *requested frequency, if any* ➔ *output power*	**CW/FM integrated transmitter** Frequency: 437.075 [MHz] Output power: 0.1[W](CW), 0.8[W](FM) Emission designator: 500HA1A (CW) 16K0F2D, 16K0F3E, 16K0F3F, 26K0F1D (FM) Modulation method: Morse(CW) AFSK1200bps,GMSK9600bps(FM) Antenna gain: -2[dB] Antenna pattern: nearly same as mono-pole antenna pattern. **Linear transponder** Transmit frequency: 435.880-435.910 [MHz] Total pass band: 30kHz Output power: 0.5[W] Emission designator: 500HA1A, 3K00J3E Modulation method: Morse(CW),SSB Antenna gain: -2[dB] Antenna pattern: nearly same as mono-pole antenna pattern. **π/4 shift QPSK transmitter** Transmit frequency: 435.900 [MHz] Output power: 0.8[W] Emission designator: 30K0G1D

	➔ *ITU emission designator*[1,2] ➔ *common description of the emission including modulation type AND data rate* [3] ➔ *antenna gain and pattern* ➔ *attitude stabilisation, if used*	Modulation method: π/4 shift QPSK 38400bps Antenna gain: -2[dB] Antenna pattern: nearly same as mono-pole antenna pattern. **FM transmitter** Transmit frequency: 435.900 [MHz] Output power: 0.4[W] Emission designator: 09K0F1D, 15K0F1D, 18K5F1D,30K0F1D Modulation method: GMSK:600-19200bps Antenna gain: -2[dB] Antenna pattern: nearly same as mono-pole antenna pattern.
4d	Proposed space station **receiving** frequency plan. *List for each frequency or frequency band:* ➔ *frequency band* ➔ *requested frequency, if any* ➔ *ITU emission designator* ➔ *common description of the emission including modulation type AND data rate* ➔ *noise temperature* ➔ *associated antenna gain and pattern*	**FM receiver** Frequency: 145.860 [MHz] Emission designator: 20K0F2D Modulation method: AFSK 1200bps Antenna gain: -2[dB] Antenna pattern: nearly same as mono-pole antenna pattern. Noise temperature: 300[K] **Linear transponder** Reception frequency: 145.900~145.930 [MHz] Total pass band: 30kHz Emission designator: 500HA1A, 3K00J3E Modulation method: Morse(CW),SSB Noise temperature: 300[K] Antenna gain: -2[dB] Antenna pattern: nearly same as mono-pole antenna pattern.
4e	Physical structure. *General description, including dimensions, mass, antennas and antenna placement, whether stabilized or tumbling, etc. Give URL's for drawings.*	Structure material: A7075-T7351 Satellite mass: 1.3kg Dimension: 106.1×105.4×113.5[mm] Antenna: mono-pole antenna Antenna material: elastic phosphorus bronze strip with teflon coating on the antenna surface Please refer to Appendix 1 for the details of the structure.
4f	Functional Description. *Describe each sections function within the satellite.*	The abbreviations used in the following are as follows. ・SG(Sensor Group Sub System) ・EPS(Electric Power Supply Sub System) ・FMR(Flight Management Receiver Sub System) ・CW(Continuous Wave Sub System) ・C&DH (Command & Data Handling Sub System) ・CAM(Camera Sub System) **Transponder**: Transponder is a radio repeater with an uplink frequency of 145MHz, and a downlink frequency of 435MHz. The transmission power is 0.5[W].

[1] ITU emission designators are explained at: http://life.itu.int/radioclub/rr/ap01.htm. (Thank you, 4U1ITU.) Effect of Doppler shift is NOT included when determining bandwidth.

[2] If using a frequency changing transponder, indicate the transmitting bandwidth. Effect of Doppler shift is NOT included when determining bandwidth.

[3] Common emission description means terms like transponder, NBFM, PSK31, 1200 baud packet (AFSK on FM), etc.

		π/4 shift QPSK transmitter: The π/4 shift QPSK transmitter is a transmitter with a communication speed of 38400bps. It will be used for downlink of data in the band of 435MHz. The transmission power is 0.8[W]. **SG**: SG a geomagnetism sensor, gyro sensor, temperature sensor, and a galvanometer is on board of NEXUS. SG has a function of relaying the sensor data to other sub systems. **EPS**: Six Li-ion secondary batteries (3.7V-1880mAh) in parallel are stored in NEXUS. NEXUS has 12 solar cells arranged 2 in series and 6 in parallel. **Communication system**: a total of 5 transceivers; The CW/FM integrated transmitter, FM receiver, π/4 shift QPSK transmitter, FM transmitter, and a transponder are on board. Each of the integrated CW/FM integrated transmitter's transmission powers are; CW:0.1[W], FM:0.8[W]. The 437MHz band will be used for downlink, and 145MHz band for uplink. Also, for an antenna, a monopole antenna will be used. **FMR**: FMR receives the uplink command from the earth station, it sends a command received in each of the sub-system. **CW**: This system transmits the housekeeping data to the earth station in Morse code. **C&DH**: C&DH transmits the camera data and the sensor data of the downlink, also SSTV, digi-talker sound by using CW/FM integrated transmitter. In addition, C&DH manages a mission equipment π / 4 shift QPSK transmitter, linear transponder , FM transmitter, and the CAM. **CAM**: This using for shooting of Earth images by a small camera module. Captured image data is stored in a Flash EPROM, and camera sends the data to the ground station through the C&DH.
ﾚﾊ	Power budget. *Describe each power source, power consuming section, power storage, and overall power budget.*	Please refer to Appendix 2 for the details of the power budget.
5	**TELECOMMAND (NOT published)**	
5a	**Telecommand** frequency plan. *List:* ➔ *space station telecommand frequencies,* ➔ *ITU emission designator(s)* ➔ *common description of the emission including modulation type AND data rate* ➔ *link power budget(s)* ➔ *a general description of any cipher system*	**FM receiver** Frequency: 145.860 [MHz] ITU emission designator: 20K0F2D Modulation method: AFSK1200bps Link budgets : 24.99[dB](AFSK) Noise temperature: 300[K] Antenna pattern: nearly same as mono-pole antenna pattern Link power budget: 50W(Earth Station) Cipher system: N/A (NEXUS is based on AX.25 protocol.) Please refer to Appendix 3 for the details of the link budget.
5b	Positive space station transmitter control.	NEXUS turns off the system by the kill command from the following earth station.

	Explain how telecommand stations will turn off the space station transmitter(s) immediately, even in the presence of user traffic and/or space station computer system failure. ***NOTE:** Transmitter turn off control from the ground is absolutely required. Good engineering practice is to make this capability independent of all other systems.* Be sure to read the paper at: http://www.iaru.org/satellite/ControllingSatellites v27.pdf.	Department of Aerospace Engineering, College of Science and Technology, Nihon University Amateur Radio Station Call sign: JS1YAW Location: Latitude 35:43:30.0000 N_DMS Longitude 140:03:25.2000 E_DMS Altitude 50.0[m] Address: 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan
5c	Telecommand stations. *List telecommand stations, including contact details, for sufficient Earth command stations to be established before launch to insure that any harmful interference caused by emissions from a station in the amateur-satellite service can be terminated immediately. See RR 25.11 and RR 22.1*	Department of Aerospace Engineering, College of Science and Technology, Nihon University Amateur Radio Station Call sign: JS1YAW Location: Latitude 35:43:30.0000 N Longitude 140:03:25.2000 E Altitude 50.0[m] Address: 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan Tel: +81-47-469-5430
5d	Optional: Give the complete space station turn off procedure. *As a service, the IARU Satellite Advisor will keep the space station turn off procedure as a backup for your operation. Only the space station licensee may request the information. If interference occurs and the licensee cannot be located, the licensee grants the Satellite Advisor permission to use the turn off procedure. Please note that the Satellite Advisor will use his best efforts, but cannot guarantee success. The space station licensee is still held responsible for the space station transmitter(s) by the licensing administration.*	N/A
6	**Telemetry (published)**	
6a	Telemetry frequencies *List:* ➔ *all telemetry frequencies or frequency bands,* ➔ *ITU emission designators*	Frequency: 437.075[MHz] ITU emission designators: 500HA1A, 16K0F2D, 16K0F3E, 16K0F3F, 26K0F1D Modulation method: CW, AFSK, GMSK Link budgets: 16.49[dB](CW), 10.47[dB](AFSK), 8.37[dB](GMSK) Please refer to Appendix 3 for the details of the link budget.

	➔ *common description of the emission including modulation type AND data rate* ➔ *link budgets*	
6b	Telemetry formats and equations. *Describe telemetry format(s), including telemetry equations. NOTE: Final equations must be published as soon as available.*	TBD To the following URL we have published the HP of the NEXUS project. http://sat.aero.cst.nihon-u.ac.jp/nexus/ In the future, in the pages of "Amateur Radio", it will be release the telemetry format.
6c	Is the telemetry transmission format commonly used by radio amateurs? If not, describe how and where it will be published. Be sure to read: RR 25.2A. Text is included in the paper available at: http://www.iaru.org/satellite/sat-freq-coord.html.	To the following URL we have published the HP of the NEXUS project. http://sat.aero.cst.nihon-u.ac.jp/nexus/ In the future, in the pages of "Amateur Radio", it will be release the telemetry format.
7	**Launch plans (published)**	
7a	Launch agency	Japan Aerospace Exploration Agency
7b	Launch location	Uchinoura Space Center
7c	Expected launch date	TBD
7d	Planned orbit. *Include planned orbit apogee, perigee, inclination, and period.*	- Orbit: sun-synchronous polar orbit - altitude: 500-600㎞ The details are being adjusted.
7e	List other amateur satellites expected to share the same launch.	TBD

Earth station information:

8	**Typical Earth station — transmitting**	
8a	Describe a typical Earth station used to transmit signals to the planned space station.	**Location**:Latitude 35:43:30.0000 N_DMS Longitude 140:03:25.2000 E_DMS Altitude 50.0[m] **Address**: 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan **Ground Station Devices**: * Antenna (Oscar Hunter WHS32N (MASPRO)) * Radio (IC-9100 (ICOM)) * TNC (TNC-505 (Tasco)) * Antenna Control Unit(Antenna controller GS-232B, Direction controller G-2800DXA, Elevation controller ERC5A (Creative Design Corp)) **Antenna specification**: 144 MHz Band 1 stack antenna Actual gain 10-12[dB] VSWR 1.1-1.5 F/B 20.7-22.5[dB] Half value rate 33-35[deg] Sustainable power 50[W]
8b	Link power budget. *Show complete link budgets for all Earth station transmitting frequencies, except telecommand.*	Command uplink : 24.99[dB] Transponder : 18.97[dB] Please refer to Appendix 3 for the link budget of the details.

9	**Typical Earth station — receiving**	
9a	Describe a typical Earth station to receive signals from the planned satellite.	**Location**: Latitude 35:43:30.0000 N_DMS Longitude 140:03:25.2000 E_DMS Altitude 50.0[m] **Address**: 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan **Ground Station Devices**: * Antenna (Custom order item(Creative Design Corp)) * Radio (IC-9100 (ICOM)) * TNC (TNC-555 (Tasco)) * Antenna Control Unit(Antenna controller GS-232B, Direction controller G-2800DXA, Elevation controller ERC5A (Creative Design Corp)) **Antenna specification**: 430 MHz Band 2 stack antenna Actual gain 24[dBi] VSWR 1-1.5 F/B 25[dB] Half value rate 14[deg]
9b	Link power budget. *Show complete link budgets for all Earth station receiving frequencies.*	① 437.075[MHz] CW transmission: 16.49[dB] FM transmisson(AFSK1200[bps]): 10.47[dB] FM transmisson(GMSK9600[bps): 8.37[dB] ② 435.880~435.910[MHz] Transponder 8.45[dB] ③ 435.900[MHz] π/4 shift QPSK 4.75[dB] FSK 4.75[dB] Please refer to Appendix 3 for the link budget of the details.

Additional information:

Do not attach large files. Indicate the URL where the information is available.

10	Please, supply any additional information that may assist the Satellite Advisor to coordinate your request(s). NEXUS project web site http://sat.aero.cst.nihon-u.ac.jp/nexus/

Certification:

11*	[✔] The licensee of the planned space station has reviewed all relevant laws, rules, and regulations, and certifies that this request complies with all requirements as understood by IARU to the best of his/her knowledge. *We confirm we meet the requirements of RR 1.56 and RR 1.57 in that the proposed satellite will operate without pecuniary interest. Please list any commercial interests. If none, please state none.*
	[ ] The licensee of the planned space station has reviewed all relevant laws, rules, and regulations and disagrees with IARU interpretations of Treaty requirements. The IARU Satellite Advisor is asked to consider the following interpretation. Explanation follows.

* Please tick ONE appropriate box.

Signature:

12	(REQUIRED!)  Signature of space station licensee.	13 June, 2018 Date submitted for coordination.