Kinéis Non-Geostationary Satellite System

Technical Annex

Technical information to supplement Schedule S

1. SCOPE AND PURPOSE

This attachment contains the information required under Part 25 of the Commission's rules that cannot be fully captured by the associated Schedule S.

2. OVERALL DESCRIPTION

Kinéis seeks access to the U.S. market for a non-voice, non-geostationary data collection satellite system. A constellation of nano-satellites will enable communication with low-power modules and provide connectivity to new Internet of Things (IoT) devices.
Kinéis will launch the first European constellation of nanosatellites for the spatial Internet of Things, making geolocation and satellite data collection available for a large market of millions of devices. Kinéis will also offer high performance satellite detection of maritime AIS (Automatic Identification System) signals.

Kinéis connectivity is made possible by:

- 25 nanosatellites constellation
- Miniaturized and innovative devices allowing low consumption and which adapt to the needs of Kinéis targeted applications
- A unique intrinsic geolocation system based on the ARGOS proven technology
- A network of 20 ground stations

As described in greater detail below, Kinéis will use its 40 years of experience operating the ARGOS system to provide spectrum-efficient telecommunication protocols and optimized performances that will facilitate spectrum sharing with other authorized systems.

<u>Orbital Parameters</u>

The Kinéis Constellation will be based on a Walker Star Constellation of 25 nanosatellites with the following orbital parameters and architectural characteristics:

- Sun- Synchronous Orbits (SSO)
- Altitude: 650km
- Inclination: 98°
- 5 orbital planes equally spaced over 180°
- 5 satellites per plane, one satellite per plane has maritime capabilities in addition to NVNG MSS and ARGOS service capabilities.
- The RAAN and phasing of the satellites is described in details in the Schedule S

Mission description:

The system aims at collecting data of all nature on a worldwide basis from small form factor, low-power devices. Such devices, named “beacons,” transmit at low duty cycle towards the visible Kinéis satellites. Transmission may occur in the 399.9-400.05 MHz band or in the 401-403 MHz band, depending on the nature of the data.

Once collected on board, the data are sent back to earth in the 2200-2290 MHz band to the first visible “Ground station” encountered while the satellite is orbiting. Kinéis will deploy around 20 stations worldwide, thereby ensuring that data are quickly delivered to the Kinéis customers through the internet. This downlink data flow in the S band will also include the satellite payload and platform telemetry.

The satellites have the capability to calculate GNSS-Free beacon position from the signal characteristics, thus enriching the data transmitted by the beacon, and avoiding loading the uplink messages with positioning information if not necessary. This also allows to minimize battery drain in the beacons.

Through the downlink at 400.15-401 MHz, the satellite may request a beacon to retransmit all or part of a message not properly received. Beacon control and updates, as well as Constellation Information Broadcasting, will also be executed in that band.

Each of the 20 planned ground stations include so-called “system beacons.” Such system beacons ensure the telecommand of the system as well as any communications to the customer beacons (e.g. control or upgrades and Constellation Information Broadcasting).

The Kinéis constellation will be able to support the ARGOS legacy beacons, thereby providing continuity of services to the many environmental, meteorological and governmental organisations relying today on the ARGOS service. The history of the ARGOS service is provided in section 3 below.

Spectrum

The Kinéis system seeks to operate in the following frequency ranges:

Frequency range	Purpose
399.9-400.05 MHz	NVNG MSS service uplink
400.15-401 MHz	NVNG MSS service downlink
401-403 MHz	EESS service uplink
401.58-401.61 MHz	Telecommand uplink
2200-2290 MHz	Gateway downlink and Telemetry
156.7625-162.0375 MHz	Maritime services uplink (AIS, ASM, VDES)

The frequency bands 399.9-400.05 MHz and 400.15-401 MHz will be used for NVNG MSS service. Due to difficulties encountered in capturing certain details in the Schedule S interface, the following additional information is provided:

- The channelling in the 399.9-400.05 MHz band described in Schedule S mentions channels of 150 kHz or 10 kHz bandwidth. The Kinéis payload can accommodate a wider array of channel bandwidths including down to 1.2 kHz, which cannot be captured in the interface.
- In the band 400.15-401 MHz, the Kinéis payload will transmit a single 4 kHz bandwidth carrier at a variable selectable frequency within that range. As it is not practical to include in the Schedule S all possible carrier frequencies, a single carrier of 4 kHz has been declared and positioned at the center of the 400.15-401 MHz range as an example carrier frequency.
- In the band 2200-2290 MHz, the Kinéis payload will transmit a single carrier of 1 MHz bandwidth or less at a variable selectable center frequency within that range, whose determination will result from international coordination with the US and other administrations. As it is not practical to include in the Schedule S all possible carrier frequencies, a single carrier of 1 MHz has been declared and positioned at the center of the 2200-2290 MHz range as an example carrier frequency.
- In the band 156.7625-162.0375 MHz, the AIS and ASM (Application Specific Messages) channels have been declared in the Schedule S and reflect system operations. As regards other VHF receive channels declared in the Schedule S, these cover potential VDES uplink channels as envisaged in the ITU-R CPM Report to WRC-19 under agenda item 1.9.2. The definitive VDES uplink channels supported by the system will be fixed after WRC-19.

3. ARGOS History

The cooperative ARGOS program of CNES, NASA and NOAA started in 1978 for the purpose of long-term continued global satellite data collection services (DCS) (in particular environmental data) from fixed and mobile platforms located anywhere in the world.

ARGOS DCS has been used with great success in the following applications:

- Studying oceans and atmospheric conditions (oceanography, meteorology)
- Preserving and monitoring wildlife
- Monitoring volcanoes
- Monitoring fishing fleets
- Monitoring shipments of dangerous goods
- Humanitarian applications
- Managing water resources

The majority of ARGOS DCS users are government/non-profit agencies and researchers. At the start of the 21st century, ARGOS DCS customers were already engaged in over 1,000 programs operating approximately 15,000 data collection platforms in 72 countries.

Historically, the US National Oceanic and Atmospheric Administration, also called NOAA, was and remains a strong partner and contributor to the ARGOS System for Environmental Applications:

- Space segment: the long-time cooperation between NOAA and CNES agencies allowed ARGOS payloads hosting on NOAA POES Satellites in the last decades. Three NOAA satellites are still operational in 2019, participating to the distribution of Environmental ARGOS Data to users in the EESS bands. This cooperation will continue with the CDARS-HoPS satellite (NOAA/USAF/CNES cooperation), embedding an ARGOS-4 payload onboard and planned to be launched in 2021.

- Ground segment:
    - NOAA ground stations all over the world contribute to receive weather satellites data including ARGOS ones. In 2019, as part of this collaboration, Kinéis was allowed to install and operate its own ground station dedicated to the tracking of the ARGOS Legacy Satellites on the NOAA site of Fairbanks/Gilmore Creek, Alaska.
    - On this same site of Fairbanks, since 2006, NOAA hosts ARGOS System beacons used by Kinéis to control and command its ARGOS-3 and future ARGOS-4 Legacy payloads in orbit, using the UHF 401.58-401.61 MHz frequency band.

- Users beacons: like other users of the ARGOS System, many NOAA applications benefit from the ARGOS System to retrieve environmental data from assets on the ground (oceanographic and meteorological applications, wildlife animal tracking).

Kinéis will also use the 401-403 MHz band identified in the U.S. Table of Frequency Allocations for EESS to continue providing the Environmental ARGOS services in the U.S. and worldwide.

4. PREDICTED SPACE STATION ANTENNA GAIN CONTOURS

The predicted antenna gain contours are provided as attachments to the Schedule S submitted with this application.

Section 25.114(c)(4)(vi)(B) of the FCC's Rules specifies that 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. The provided plots deviate slightly from this requirement, for the reasons explained hereafter:

In the case of Kinéis beams operating in the 399.9-400.05 MHz (Earth-to-space), 400.15-401 MHz (space-to-Earth) and 401-403 MHz (Earth-to-space) the same spacecraft antenna is used. The satellite antennas used respectively in the 400 MHz range and in the 2200-2290 MHz band are fixed on the spacecraft and pointed at satellite Nadir. They provide a quasi-isoflux gain pattern in order to compensate part of the path loss at the lower elevations. Hence the Nadir gain is the minimum gain of the antenna, and it is not possible to represent "the space stations' peak antenna gain pointed at nadir » as required in 25.114(c)(4)(vi)(B). For this reason, the gain contours are provided in dB above the nadir gain.

5. TT&C CHARACTERISTICS

Kinéis TT&C operations will occur during launch, transfer orbit, on-station operations, including emergency situations. TT&C links are encrypted and will support satellite platform and satellite payload operations and maintenance.

The frequency bands used are as follows:

- Telecommand (Earth-to-space): 401.58-401.61 MHz

The telecommand link reuses a frequency band already used in the ARGOS legacy system for the same purpose. The telecommand data flux includes payload and platform commands multiplexed with beacon control information. The characteristics of the emitting system beacon are similar to the characteristics of existing ARGOS user beacons today, especially in terms of modulation scheme, duty cycle and transmission power. As previously stated, some of the existing NOAA ground station sites already include such system beacon for ARGOS Legacy Satellites (ex: Fairbanks/Gilmore Creek, Alaska).

- Telemetry (space-to-Earth): 2200-2290 MHz

The payload and platform telemetry data will be multiplexed with main mission data and downlinked to dedicated Earth station.

The TT&C functionality is present in all of the 20 planned Earth stations around the globe, including the three Earth stations planned in the US (East coast, West coast and Hawaii).

A total bandwidth of less than 1 MHz (including Doppler) is needed to download the overall telemetry to Earth stations. Kinéis is confident that such a requirement could be satisfied within the 2200-2290 MHz range and can easily be coordinated with other systems in the band.

6. CESSATION OF EMISSIONS

Each active satellite transmission chain (channel amplifiers and associated solid state power amplifier) can be individually turned on and off by ground telecommand, thereby causing cessation of emissions from the satellite, as required by Section 25.207 of the Commission's rules.

7. SPECTRUM SHARING ANALYSES

As discussed in Section orbital parameters above, the frequency ranges that Kinéis proposes to use in the U.S. have been designated by the Commission for use by commercial NVNG MSS systems. However, that spectrum is also shared with other services in the U.S. Table of Frequency Allocations. As required in Section 25.142 of the Commission’s rules, Kinéis below (1) demonstrates, based on existing system information publicly available at the Commission, that it will not cause unacceptable interference to any NVNG MSS system currently authorized to construct or operate, (2) provides the power flux-density (“PFD”) produced by its system at the Earth’s surface in the 400.15-401 MHz band to demonstrate that no further coordination with terrestrial systems is necessary, (3) describes the measures it would employ to protect the radio astronomy service in the 406.1-410 MHz

band from harmful interference from unwanted emissions, and (4) demonstrates compliance with applicable emission limitations.

7.1. Spectrum Sharing with Respect to Other NVNG Satellite Systems

Other satellite systems to be considered for spectrum sharing include systems already authorized by the Commission, and systems for which applications have been received by the Commission in the context of this processing round.[1]

7.1.1 Spectrum sharing in the 400.15-401 MHz band

Kinéis has identified that Orbcomm has been licensed by the Commission to operate in the band 400.15-401 MHz (space-to Earth). Specifically, Orbcomm is licensed to operate in the bands 400.15-400.505, and 400.645-401 MHz on a primary basis, and in the reminder of the band on a shared basis with new coming NVNG MSS systems.

Kinéis requirements for downlink in the band 400.15-401 MHz is related to traffic flow control and constellation information broadcasting and may be used occasionally to task/update beacons. Thanks to optimized protocols, this requirement can be met with a single 4 kHz bandwidth carrier. The carrier frequency is not fixed at this stage and can be selected so to minimize coordination issues. In addition, the high flexibility of the Kinéis payload will permit to tune the carrier frequency as required. If required, the Kinéis satellites will be able to cease emissions.

Kinéis is confident that such a limited a 4 kHz bandwidth requirement out of the 850 kHz of the 400.15-401 MHz range can easily be coordinated with other systems in the band.

7.1.2 Spectrum sharing in the 399.9-400.05 MHz band

The band 399.9-400.05 MHz has been allocated for many years for commercial NVNG MSS service.

There is no identified NVNG MSS system authorized by the Commission to date in the 399.9-400.05 MHz band, and therefore there is no interference issue to be expected with respect to existing licensees.

Kinéis beacons will transmit at low duty cycle (typically 0.01% and up to 0.3%) signal burst of about 1 second, only when a Kinéis satellite is passing overhead. The maximum beacon EIRP level will not exceed 5 dBW, consistent with the expected outcome of WRC-19 Agenda Item 1.2. In effect, the beacon level will most of the time be largely below 5 dBW, and

[1] See FCC Public Notice DA 19-779 released: August 15, 2019

typically in the range -9 dBW to 0 dBW. These features largely limit the potential for harmful interference among systems operating in this band.

Kinéis has identified that Hiber and Myriota are also seeking U.S. market access for NVNG MSS. Kinéis notes that the broad characteristics (low power, low duty cycle, flexible frequency use) are similar. Kinéis is confident that coordination among such systems will be possible.

In particular, Kinéis has already started coordination discussions with Hiber and plans to do so with Myriota as soon as possible.

7.2 Spectrum Sharing with Respect to Terrestrial Networks in the 400.15-401 MHz

Section 25.142(a)(2) of the Commission's rules requires applicants for NVNG MSS authorizations to provide the PFD produced at the Earth's surface by each space station in the 400.15-401 MHz band, to allow determination of whether coordination with terrestrial services is required under any applicable footnote of the U.S. table of frequency allocations. In this case, the relevant footnote is 5.264, which provides that the PFD limit indicated in Annex 1 of Appendix 5 of the ITU Radio Regulations shall apply in this band. That PFD limit is -125 dBW/m2/4 kHz at the Earth's surface.

In order to demonstrate compliance with this limit, the Table below provides the PFD for a satellite in Kinéis's system for the whole range of satellite transmit off-axis angles with Earth visibility (elevations ranging from 0 to 90°). In all cases, the PFD on Earth is below the prescribed power flux density limit.

Off-axis angle (°)	0.0	9.0	18.0	27.0	36.0	45.0	52.0	59.0	64.0	65.2
Elevation (°)	90.0	80.1	70.1	60.0	49.6	38.8	29.7	19.2	7.9	0.0
Gain (dBi)	-3.96	-3.4	-2.6	-1.7	-0.6	0.9	2.2	3.5	4.1	4.2
Power (dBW/4kHz)	3	3	3	3	3	3	3	3	3	3
EIRP (dBW/4 kHz)	-0.96	-0.4	0.4	1.3	2.4	3.9	5.2	6.5	7.1	7.2
Range (km)	650.0	658.9	687.2	739.4	826.4	971.8	1163.5	1525.3	2201.4	2948.5
Spreading loss (dB)	127.3	127.4	127.7	128.4	129.3	130.7	132.3	134.7	137.8	140.4
Flux (dBW/m²/4 kHz)	-128.2	-127.8	-127.3	-127.1	-126.9	-126.8	-127.1	-128.2	-130.7	-133.2

In addition, Kinéis's satellites comply with the requirement set forth in Section 25.142(a)(3)(ii) of the Commission's rules that no signal received by satellites from sources outside of the system shall be retransmitted with a PFD level exceeding the limits discussed above. Signals received from terrestrial sources are demodulated and processed onboard the satellite. Unknown or incompatible signals received by a satellite are rejected and do

not result in a transmission response, ensuring that signals originating from sources outside of the Kinéis network will not be re-transmitted.

7.3 Protection of Radio Astronomy in the 406.1-410 MHz Band

Pursuant to 25.142(a)(2), the applicants must identify the measures they would employ to protect the radio astronomy service from harmful interference from unwanted emissions. The band 406.1-410 MHz is allocated to Radioastronomy service and is used for continuum observations integrated throughout the band.

The Kinéis transmitter in the band 400.15-401 MHz is implementing filtering to comply with the requirements of 25.202(f)(1)-(3) as described below and will therefore reject at least 46 dBc with respect to in-band level. The actual emissions of the Kinéis payload in the 406.1-410 MHz will actually be much lower than the prescribed 46 dBc rejection:

- The transmission bandwidth is narrow, 4 kHz maximum, and the natural decay of the signal is steep, considering that the Radioastronomy band is distant of at least 3.9 MHz from the Kinéis carrier frequency.
- The Kinéis Payload will transmit a single carrier, which limits the generation of intermodulation products in the output amplifier.
- By design, the Kinéis P/L shall limit its out-of-band emissions in the adjacent band 401-403 MHz where simultaneous beacon signal reception shall be ensured. This design feature *de facto* protects the Radioastronomy band located a few MHz further.
- In addition, the protection levels derived from ITU-R Recommendation RA.769-2 are part of the payload specifications.

The Kinéis beacons operating uplink transmissions in the 399.9-400.05 MHz band are also capable to protect Radioastronomy sites. The Radiotelescopes use highly directive antennas, with low gain towards transmitters located on Earth. In addition, terrain often provides significant path attenuation.

The Kinéis beacons transmit at low power levels, typically in the range -9 dBW to 0 dBW and never more than 5 dBW. The low duty cycle further reduces the interference impact as Radioastronomy observations are made over large integration times.

The ARGOS system beacons are operated for decades in the band 401-403 MHz with similar technical characteristics than the beacons intended for operation in the band 399.9-400.05 MHz. The band 401-403 MHz is located closer to the Radioastronomy band 406.1-410 MHz than the 399.9-400.05 MHz, nevertheless no interference issue for the Radioastronomy has been reported.

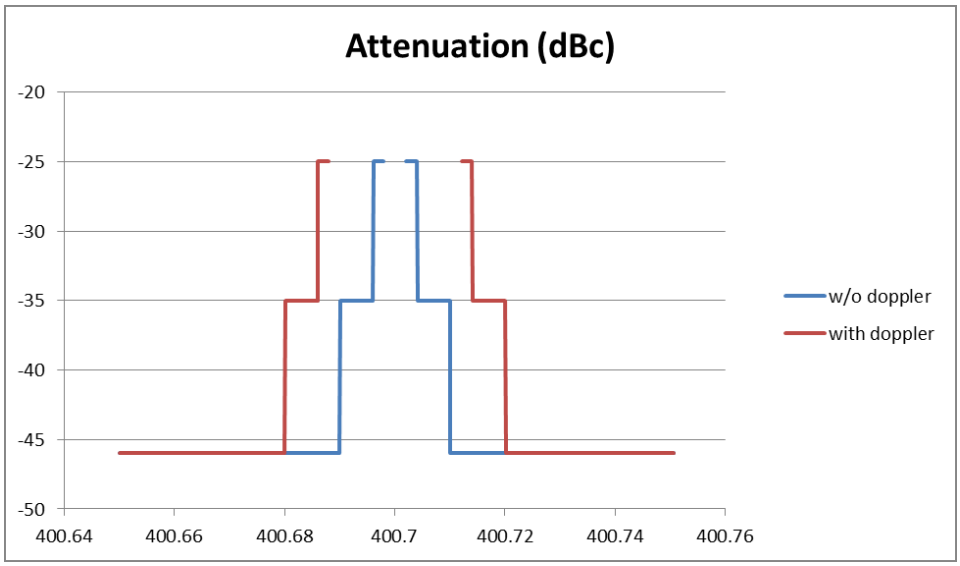
If however an interference issue was to arise, the beacons in the Kinéis system are individually located, and transmissions from beacons causing interference to Radioastronomy sites could be inhibited by network control.

7.4 Compliance with Emission Limits

Section 25.142(a)(3) requires applicants for NVNG authorizations to show that their space stations will not exceed the emission limitations specified in Sections 25.202(f)(1)-(3), as calculated for a fixed point on the Earth's surface in the plane of the space station's orbit, considering the worst-case frequency tolerance of all frequency determining components, and maximum positive and negative Doppler shift of both the uplink and downlink signals, taking into account system design.

The maximum doppler shift for a satellite orbiting at 650 km is estimated to 10 kHz.

The transmitter is specified to meet the requirements of 25.202(f)(1)-(3) with an associated emission bandwidth of 4 kHz. The following diagram provides the resulting out-of-band emission mask corresponding to emission having a carrier center frequency, as an example, of 400.7 MHz.



7.5 Coordination with U.S. Federal Government users

The frequency bands allocated for NVNG MSS systems are also authorized for use by Federal Government agencies. Kinéis is aware that such uses may include Meteorological Radio sondes, Space-research systems and Meteorological satellite systems.[2]

Kinéis notes the Commission role to liaise with NTIA to ensure that NVNG systems and Government users operate in a compatible manner. Kinéis is ready to cooperate and provide the necessary support and information to the Commission in this respect as required by 25.142(b)(2).

Pursuant to 25.260, Kinéis will abide to the requirements related to time sharing with the DoD Meteorological-Satellite systems in the 401-400.15 MHz. Specifically:

- Kinéis satellites will not transmit co-frequency into the protection area of a DoD Meteorological Satellite System, on the basis of the ephemeris of the DoD satellite.
- Kinéis will provide a 24h per day contact point so any interference issue can be resolved expeditiously.
- In case of interference, Kinéis will cease its interfering operations, unless it can demonstrate to the Commission that it is not responsible for causing harmful interference to the DoD system.
- The Kinéis satellites time-sharing spectrum with DoD in the 400.15-401 MHz band will automatically cease satellite transmission if after 72 hours no reset signal is received from the Kinéis control station.
- The Kinéis satellite will be able to instantaneously shut-down transmission on any sub-band upon command from the Kinéis control station.
- The Kinéis system will be able to change the frequency on which the satellites are operating in less than 125 minutes from DoD notification. Best efforts will be made to reduce this time to less than 90 minutes, and Kinéis is confident this can be realized through its worldwide network of control stations.

7.6 Spectrum sharing analyses in the band 2200-2290 MHz

Kinéis seeks to use a portion of the band 2200-2290 MHz for data retrieval and satellite telemetry (TT&C) towards a set of Earth Stations planned to be located at diverse locations on Earth. Their location is designed to provide low latency service to most areas in the world.

[2] See in particular https://www.ntia.doc.gov/files/ntia/publications/compendium/0400.15-0401.00_01MAR14.pdf

The band 2200-2290 MHz is internationally allocated to the Earth Exploration Satellite Service (EESS) (space-to-Earth), the Space Operations Service (SOS) (space-to-Earth) and the Space Research Service (space-to-Earth). Kinéis is confident it will be able to coordinate the required frequencies internationally.

Kinéis is aware that the 2200-2290 MHz is designated in the U.S. Table of Frequency allocations for Federal use only. Kinéis is seeking a waiver of this limitation. Kinéis, with the support of CNES (French space agency) has already initiated discussions with the U.S. Department of Defence and is willing to engage with NTIA and all Federal users of the spectrum to resolve any issues.

As regards the U.S., Kinéis is planning to implement at least three stations in the US territory, tentative locations being respectively on the East Coast, the West Coast and Hawaii. At this stage, Kinéis is not seeking authorization of Earth Stations in the frame of this petition, but rather to get a Commission approval in principle that will allow Kinéis to request Earth Station authorizations in due time at three specific locations, once those locations have been precisely determined.

The ARGOS service currently in operations is in part hosted on board NOAA satellites under an agreement that permits ARGOS data to be downlinked to the US territory through L band METSATS receive stations. This permits fast retrieval of valuable environmental and meteorological information captured by the ARGOS beacons to the benefit of the U.S. and wider scientific community. This service will be continued and enhanced in the future with the Kinéis nanosat constellation, should Kinéis be authorized to operate its S band ground stations in the U.S. territory.
Should the Commission decline in providing the capability to Kinéis to operate its S-band downlinks in the US territory, this will degrade the system performance as more time will be necessary for a satellite collecting beacon information over the US to reach an authorized ground station for downlinking the data to the network.

As regards the compatibility with terrestrial services, the use of S-band is for downlink only. The satellite emissions are designed so that the internationally agreed power flux density limits in ITU Radio Regulations Article 21 are met at all elevations. This ensures that no harmful interference is created to the Federal Fixed and Mobile Services identified in the US Table of Frequency allocation.

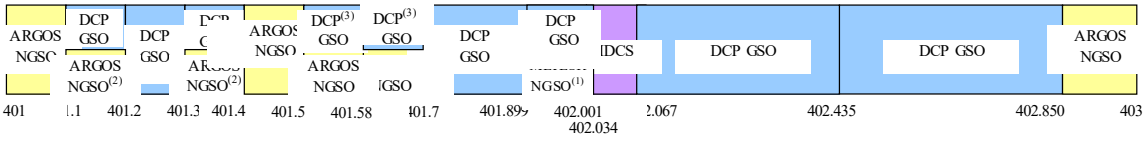
7.7 Spectrum sharing analysis in the band 401-403 MHz

As already described, Kinéis will take-over and improve the ARGOS service provided for decades in the 401-403 MHz band. While maintaining backwards compatibility with installed base of beacons, new generation beacons will also be deployed together with the new constellation (as described in schedule S).

The use of the band 401-403 MHz by the ARGOS system is internationally recognized in ITU-R Recommendation SA.2045. This recommendation sets the partitioning of the band among different user categories, and the technical conditions applying to MetSat and EESS systems. The Kinéis system will operate along these internationally recognized guidelines.

The figure below is directly extracted from ITU-R Recommendation SA.2045 and shows the sub-bands within the 401-403 MHz range identified for ARGOS NGSO service. The Kinéis system will use these sub-bands to continue supporting the ARGOS service.

Basic general partitioning of the band 401-403 MHz for future long-term coordinated use of DCS systems on geostationary and non-geostationary MetSat and EESS systems



The system will also include “system beacons” located at the ground station sites. The purpose of the system beacons is to ensure the Telecommand of the system. The EIRP of such system beacons is also consistent with the 7 dBW EIRP limit as planned for agenda item 1.2 at WRC-19. Kinéis plans to deploy about twenty of ground station sites worldwide, including at least three in the U.S. territory. The exact location is yet to be determined, but likely to be respectively on the East Coast, West Coast and Hawaii.

The telecommand link will use the 401.58-401.61 MHz band, the associated 30 kHz bandwidth accounts for Doppler shift. This band has already been used many years by the ARGOS legacy system for its payload Telecommand. Using this band for the Kinéis system will ensure compatibility of the new ground segment with the legacy ARGOS system, while accommodating the Telecommand requirements of the new system. These 30 kHz are part of the ARGOS home spectrum internationally coordinated and recognised in ITU-R Recommendation SA.2045. As such, no specific or additional interference issues are expected.

7.8 Spectrum sharing analysis in the Maritime AIS band

The Kinéis system includes a maritime service, implemented through receive-only payloads on a board a subset of the Kinéis satellite constellation. The satellite maritime receiver is capable of detecting ITU-defined AIS and ASM signals. It is also capable of detecting and processing signals in the VDES service. VDES frequencies are subject to decision by WRC-19 under agenda item 1.9.2. The definitive frequency plan implemented in the Kinéis system for the VDES service will be set upon WRC-19 decisions.

The considered channel plan for AIS and ASM channels is defined below:

ITU Appendix 18 channel designator	Channel frequency	Lower limit	Upper limit	channel name
75	156.775	156.7625	156.7875	AIS3 (LR-AIS)
76	156.825	156.8125	156.8375	AIS4 (LR-AIS)
2027	161.95	161.9375	161.9625	ASM1
2087	161.975	161.9625	161.9875	AIS1
2028	162	161.9875	162.0125	ASM2
2088	162.025	162.0125	162.0375	AIS2

The VDES uplink channels will be comprised in the range 157.1875-161.9375 MHz

As the system operates only in receive-mode in the maritime VHF frequency range, there is no risk of harmful interference to other services. These receive operations in the AIS and ASM bands are consistent with RR 5.228 *et seq*. and Footnote US52.

8. ITU FILINGS FOR ARGOS and Kinéis

The Kinéis system is registered in ITU by the Administration of France. The relevant ITU satellite networks are A4MSSNG, A4NG and A4NG-C.

Filing name	Date of information received by the BR	reference of the IFIC publication
ARGOS-4A	10/02/2015	API/A/9931, BR IFIC 2792 API/A/9931-MOD1, BR IFIC 2794
ARGOS-4A	10/02/2017	CR/C/4448, BR IFIC 2854
A4MSSNG	14/05/2018 -	CR/C/4771, BR IFIC 2880
A4NG	14/05/2018 20/10/2018 15/04/2019	API/A/12161, BR IFIC 2875 API/A/12161_MOD1, BR IFIC 2887 API/A/12161 MOD-2, BR IFIC 2899
A4NG-C	30/10/2018– 15/04/2019	CR/C/4878, BR IFIC 2891 CR/C/4878 MOD-1, BR IFIC 2904

As a background information, the legacy ARGOS system is registered under the ARGOS-B and ARGOS-4Asatellite networks and covered through different dedicated filings.

ENGINEERING CERTIFICATION

I, Michel Sarthou, hereby certify, under penalty of perjury, that the following statements are true and correct to the best of my knowledge, information and belief:

(i) I am the technically qualified person responsible for the engineering information contained in the foregoing Technical Annex, dated October 2019, and the related Schedule S and exhibits thereto;

(ii) I am familiar with Part 25 of the Commission's Rules; and

(iii) I have either prepared or reviewed the engineering information contained in the foregoing Technical Annex and found it to be complete and accurate.

October 11, 2019 By:

Michel Sarthou — Chief Technical Officer, Kinéis