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AKOS endeavor in small satellite filing/notification

Mag. Tomo Žbontar

March 2015, Prague

NEMO-HD

- The Slovenian Centre of Excellence for Space Sciences and Technologies (SPACE-SI) in collaboration with The Space Flight Laboratory (SFL) at the University of Toronto Institute for Aerospace Studies, have developed a microsatellite for earth monitoring.

- The spacecraft will be capable of performing global imaging and real-time video streaming over Slovenia.

- NEMO-HD will be used for experimental operations and not for amateur-satellite service, so API filing, Notification and ITU cost recovery fee are needed, but there is possibility of one FREE filing per year, ITU C482 decision 4 (570 CHF- API, 7030 CHF- Notification).

NEMO-HD frequencies, mission lifetime

- Frequencies :

- Command uplink in the UHF band at 401-403 MHz Space Operations Band.
- The telemetry downlink in the S-Band at 2200 MHz Space Research band.
- The captured still images and movies are to be down loaded via X-band
-
- Mission lifetime:
- The required mission lifetime is one year in the reference orbit.

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Reference orbit

The reference orbit is 600 km Sun synchronous orbit (inclination angle 98 degrees) with 10:30 local time of ascending node (LTAN).

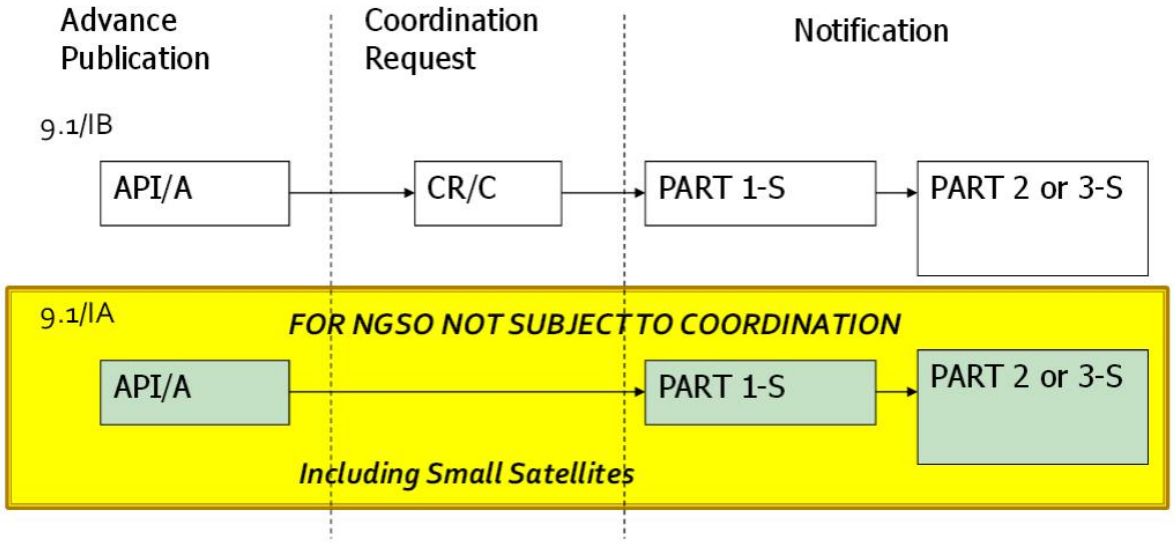
Ref.: ITU

Which procedure is applicable for small satellite missions?

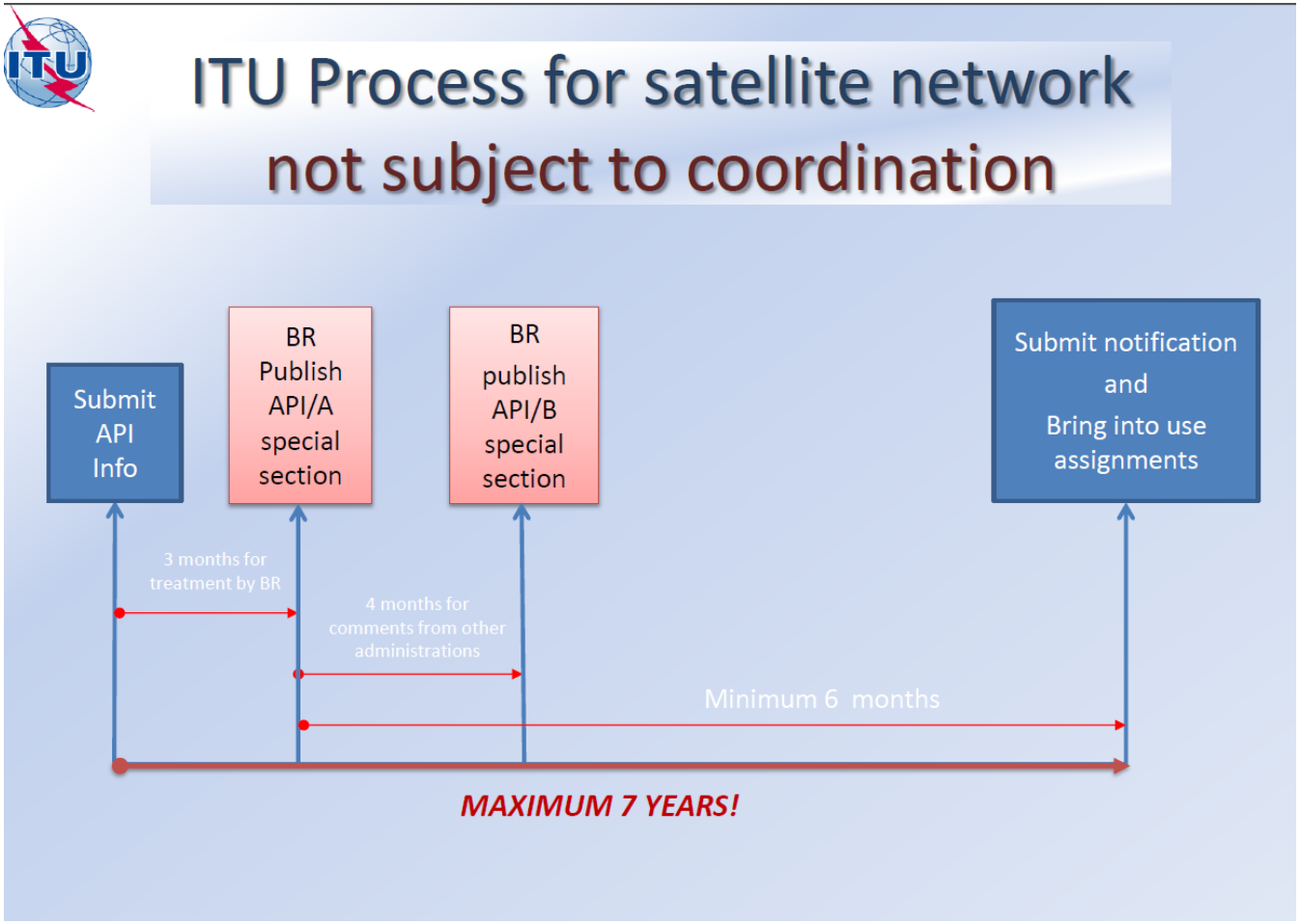
- Small satellite missions are generally NGSO systems which are not subject to any form of mandatory coordination. For such systems, the provisions of Article **9**, Sub-Section IA (*Advance publication of information on satellite networks or satellite systems that are not subject to coordination procedure under Section II*), are applicable.

Ref.: ITU

Satellite network filing procedure



Ref.: ITU


ITU Process for satellite network not subject to coordination
Submit API Info
BR Publish API/A special section
BR publish API/B special section
Submit notification and Bring into use assignments
3 months for treatment by BR
4 months for comments from other administrations
Minimum 6 months
MAXIMUM 7 YEARS!

API/A/8329 MOD-1

UNION INTERNATIONALE DES TÉLÉCOMMUNICATIONS
BUREAU DES RADIOCOMMUNICATIONS

INTERNATIONAL TELECOMMUNICATION UNION
RADIOCOMMUNICATION BUREAU

UNIÓN INTERNACIONAL DE TELECOMUNICACIONES
OFICINA DE RADIOCOMUNICACIONES

RÉSEAU À SATELLITE SATELLITE NETWORK RED DE SATÉLITE	NEMO-HD	SECTION SPÉCIALE Nº SPECIAL SECTION No. SECCIÓN ESPECIAL N.º	API/A/8329 MOD-1
		BR IFIC / DATE BR IFIC / DATE BR IFIC / FECHA	2769 / 13.05.2014
ADM. RESPONSABLE RESPONSIBLE ADM. ADM. RESPONSABLE	SVN	LONGITUDE NOMINALE NOMINAL LONGITUDE LONGITUD NOMINAL	NGSO
		NUMÉRO D'IDENTIFICATION IDENTIFICATION NUMBER NÚMERO DE IDENTIFICACIÓN	114540142 / 113540143
RENSEIGNEMENTS REÇUS PAR LE BUREAU LE / INFORMATION RECEIVED BY THE BUREAU ON / INFORMACIÓN RECIBIDA POR LA OFICINA EL			24.01.2014

Ces renseignements sont publiés par le Bureau des radiocommunications en application du No. 9.2B. Ils font l'objet de la (les) procédure(s) suivante(s), indiquée(s) ci-dessous par un X dans la case pertinente.

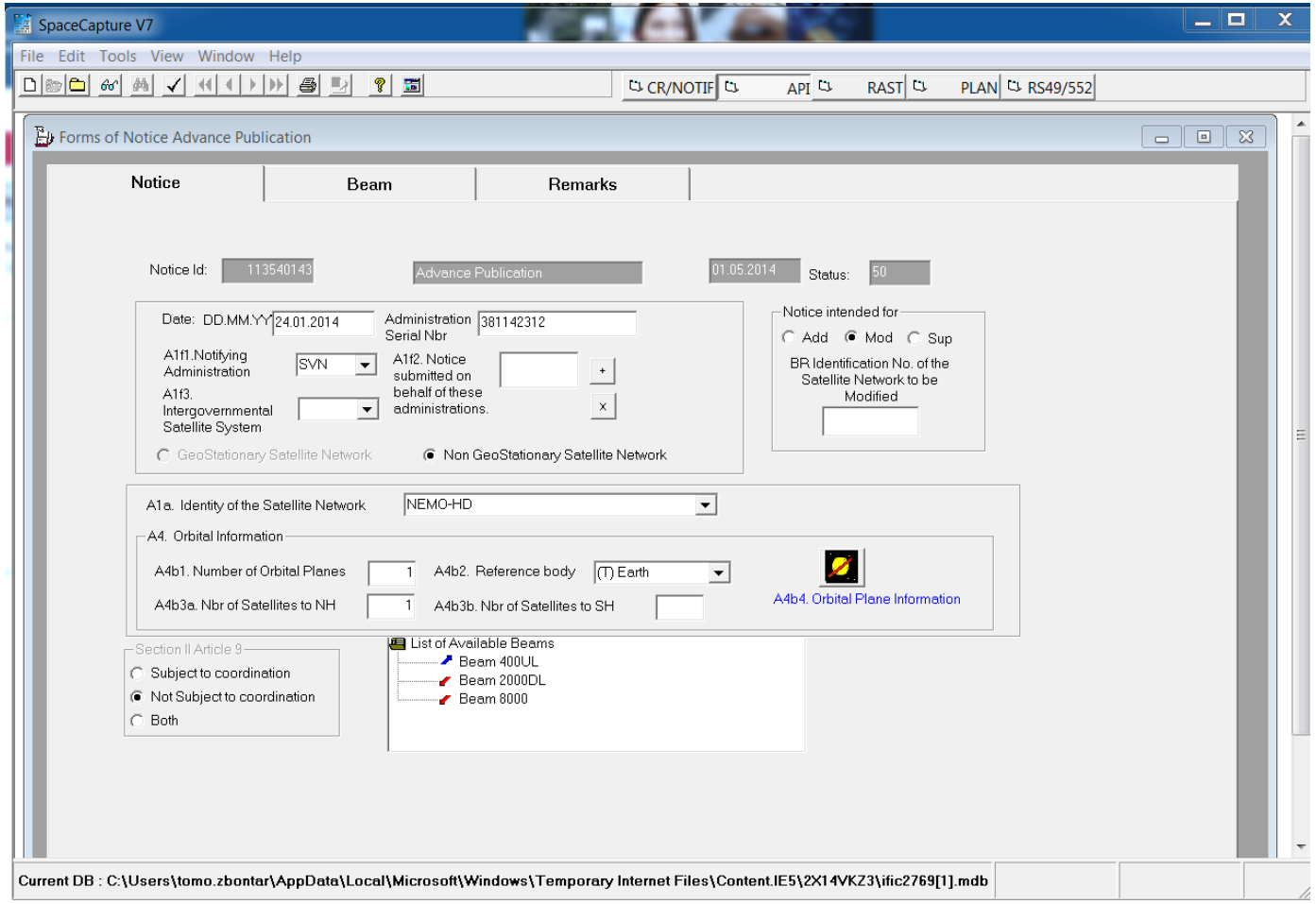
This information is published by the Radiocommunication Bureau in accordance with No. 9.2B. It is subject to the procedure(s) indicated below by an X in the relevant box.

Esta información se publica por la Oficina de Radiocomunicaciones en virtud del No. 9.2B. Está sujeta al (a los) procedimiento(s) siguiente(s), señalado(s) con una X en la casilla apropiada.

X	Les renseignements ont été reçus conformément à l'**Article 9, sous-section IA** Toute administration estimant que des brouillages inacceptables peuvent être causés à ses réseaux ou à ses systèmes à satellites existants ou en projet devra communiquer ses commentaires à l'administration qui a demandé la publication, avec copie au Bureau des radiocommunications, dans le délai de quatre mois qui suit la date de la présente publication.	The information has been received pursuant to **Article 9, Sub-Section IA** Any administration which believes that unacceptable interference may be caused to its existing or planned satellite networks or systems shall communicate its comments to the publishing administration, with a copy to the Radiocommunication Bureau, within four months after the date of this publication.	La información ha sido recibida de conformidad con **el Artículo 9, sub-sección IA** Toda administración que estime que pueden causarse interferencias inaceptables a sus redes o sistemas de satélites existentes o previstos comunicará sus comentarios a la administración que haya publicado la información, con copia a la Oficina de Radiocomunicaciones, en un plazo de cuatro meses contados a partir de la fecha de esta publicación.
	DATE LIMITE POUR LA RÉCEPTION DES COMMENTAIRES **EXPIRY DATE FOR THE RECEIPT OF COMMENTS** **FECHA LÍMITE PARA LA RECEPTIÓN DE LOS COMENTARIOS**		**13.09.2014**
	Les renseignements ont été reçus conformément à l'**Article 9, sous-section IB** Toute administration estimant que ses réseaux à satellite, ses systèmes à satellites ou ses stations de terre, selon le cas, existants ou en projet, sont affectés, peut envoyer ses observations à l'administration qui a demandé la publication des renseignements, avec copie au Bureau des radiocommunications.	The information has been received pursuant to **Article 9, Sub-Section IB** Any administration which considers that its existing or planned satellite systems or networks or terrestrial stations, as appropriate, are affected, may send its comments to the administration which has requested publication of the information, with a copy of such comments to the Radiocommunication Bureau.	La información ha sido recibida de conformidad con **el Artículo 9, sub-sección IB** Cualquier administración que considere que sus sistemas o redes de satélites o estaciones terrenales, según el caso, existentes o planificados se verán afectados, podrá comunicar sus comentarios a la administración que haya solicitado la publicación de la información, enviando una copia de dichos comentarios a la Oficina de Radiocomunicaciones.

Information aussi disponible sur le / Information also available on the / Información también disponible en: Space Network Systems Online Service : http://www.itu.int/sns/advpub.html

API/A


SpaceCapture V7
File Edit Tools View Window Help
CR/NOTIF API RAST PLAN RS49/552
Forms of Notice Advance Publication
Notice Beam Remarks
Notice Id: 113540143
Advance Publication
01.05.2014
Status: 50
Date: DD.MM.YY 24.01.2014
Administration Serial Nbr 381142312
A1f1.Notifying Administration SVN
A1f2. Notice submitted on behalf of these administrations.
A1f3. Intergovernmental Satellite System
GeoStationary Satellite Network
Non GeoStationary Satellite Network
Notice intended for
Add Mod Sup
BR Identification No. of the Satellite Network to be Modified
A1a. Identity of the Satellite Network NEMO-HD
A4. Orbital Information
A4b1. Number of Orbital Planes 1
A4b2. Reference body (T) Earth
A4b3a. Nbr of Satellites to NH 1
A4b3b. Nbr of Satellites to SH
A4b4. Orbital Plane Information
Section II Article 9
Subject to coordination
Not Subject to coordination
Both
List of Available Beams
Beam 400UL
Beam 2000DL
Beam 8000
Current DB : C:\Users\tomo.zbontar\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\2X14VKZ3\ific2769[1].mdb

API/B/443

Povečaj (Ctrl+Plus)

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RÉSEAU À SATELLITE SATELLITE NETWORK RED DE SATÉLITE	NEMO-HD			SECTION SPÉCIALE Nº SPECIAL SECTION No. SECCIÓN ESPECIAL N.º	API/B/443
				BR IFIC / DATE BR IFIC / DATE BR IFIC / FECHA	2780 / 14.10.2014
ADM. RESPONSABLE RESPONSIBLE ADM. ADM. RESPONSABLE	SVN	LONGITUDE NOMINALE NOMINAL LONGITUDE LONGITUD NOMINAL	NGSO	NUMÉRO D'IDENTIFICATION IDENTIFICATION NUMBER NÚMERO DE IDENTIFICACIÓN	113540143 / 113540143

RÉFÉRENCE DE LA SECTION SPÉCIALE (BR IFIC / DATE) SPECIAL SECTION REFERENCE (BR IFIC / DATE) REFERENCIA DE LA SECCIÓN ESPECIAL (BR IFIC / FECHA)	API/A/8329 MOD-1 (BR IFIC /)

1. La présente Section spéciale est publiée conformément au numéro 9.5 du Règlement des radiocommunications, et concerne la demande de coordination publiée dans la section spéciale API/A indiquée ci-dessus. 2. Les administrations qui ont soumis des observations au titre du numéro 9.3 dans le délai de quatre mois suivant la date de publication de la Section spéciale API/A précitée, sont indiquées ci-dessous et le tableau contient un résumé de ces observations.	1. This Special Section is published in accordance with No. 9.5 of the Radio Regulations, in respect of the request for coordination published in the API/A Special Section referenced above. 2. Administrations that have submitted comments under No. 9.3 within four months of the date of publication of the mentioned API/A Special Section are listed below and the table contains a summary of the comments.	1. Esta Sección Especial se publica de conformidad con lo dispuesto en el número 9.5 del Reglamento de Radiocomunicaciones, en lo que respecta a la solicitud de coordinación publicada en la Sección Especial API/A antes citada. 2. Las administraciones que han presentado comentarios conforme al número 9.3 dentro de un plazo de cuatro meses a partir de la fecha de publicación de la Sección Especial API/A mencionada, se indican a continuación y en el cuadro se presenta un resumen de los comentarios.

ARM, CAN, CHN, D, E, F/EUT, F/GLS, F, IND, J, RUS, S, UAE, USA

Ref.: ITU

Regulatory procedures for comments and resolution of difficulties

- Commenting procedures
  - Comments to an API/A should be submitted within 4 months of API (No.**9.3**)
  - Comments to be captured using SPACECOM (**RES-55**)
  - The Bureau publishes the list of administrations which have sent comments in an API/B special section
- Resolution of difficulties
  - Both administrations shall endeavour to cooperate in joint efforts to resolve any difficulties and shall exchange any additional relevant information that may be available
  - *Either party can request for the assistance of the Radiocommunication Bureau (No.**9.3**)*
  - In case of difficulties, the administration responsible for the planned satellite network shall explore all possible means to resolve the difficulties without considering the possibility of adjustment to networks of other administrations
  - If no such means can be found, it may request the other administrations to explore all possible means to meet its requirements.
  - The administrations concerned shall make every possible effort to resolve the difficulties by means of mutually acceptable adjustments to their networks.

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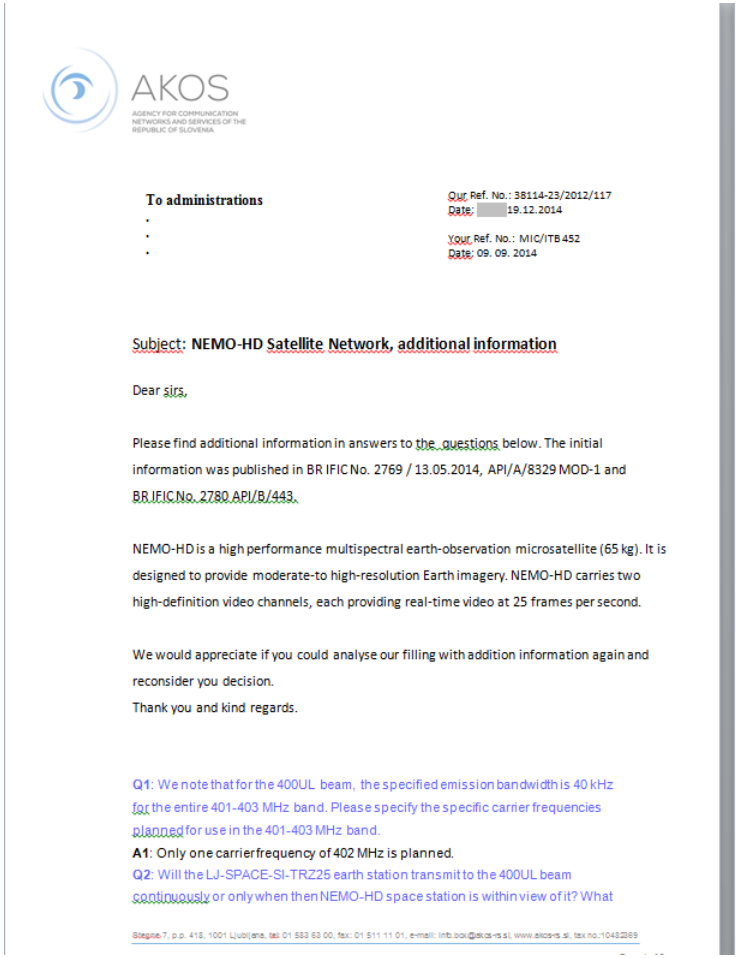
Add. info to ARM, CAN, CHN, D, E, F/EUT, F/GLS, F, IND J, RUS, UEA, USA

- Additional information on:

- 400UL beam
- 2000DL beam
- 8000DL beam
- Earth station
- NEMO-HD space station will transmit using the 2000DL only when it is within view of the associated earth station in Slovenia.
- Expected duration of the transmissions for the 2000DL beam is below 5 minutes during each pass
- The ascending node (equatorial crossing time) for the NEMO-HD space station
- The spacecraft modulation/coding scheme

- ----------
- We would appreciate if you could analyse our filling with addition information again and reconsider you decision.

The letter to administrations



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To administrations
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Our Ref. No.: 38114-23/2012/117
Date: 19.12.2014

Your Ref. No.: MIC/ITB 452
Date: 09. 09. 2014

Subject: **NEMO-HD Satellite Network, additional information**

Dear sirs,

Please find additional information in answers to the questions below. The initial information was published in BR IFIC No. 2769 / 13.05.2014, API/A/8329 MOD-1 and BR IFIC No. 2780 API/B/443.

NEMO-HD is a high performance multispectral earth-observation microsatellite (65 kg). It is designed to provide moderate-to high-resolution Earth imagery. NEMO-HD carries two high-definition video channels, each providing real-time video at 25 frames per second.

We would appreciate if you could analyse our filling with addition information again and reconsider you decision.
Thank you and kind regards.

Q1: We note that for the 400UL beam, the specified emission bandwidth is 40 kHz for the entire 401-403 MHz band. Please specify the specific carrier frequencies planned for use in the 401-403 MHz band.
A1: Only one carrier frequency of 402 MHz is planned.
Q2: Will the LJ-SPACE-SI-TRZ25 earth station transmit to the 400UL beam continuously or only when then NEMO-HD space station is within view of it? What

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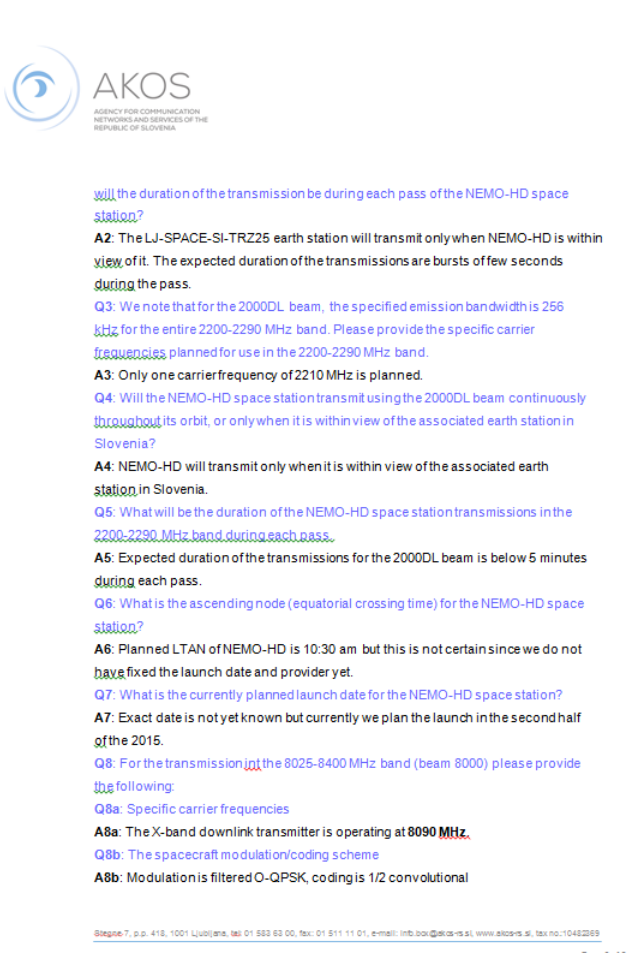

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will the duration of the transmission be during each pass of the NEMO-HD space station?
A2: The LJ-SPACE-SI-TRZ25 earth station will transmit only when NEMO-HD is within view of it. The expected duration of the transmissions are bursts of few seconds during the pass.
Q3: We note that for the 2000DL beam, the specified emission bandwidth is 256 kHz for the entire 2200-2290 MHz band. Please provide the specific carrier frequencies planned for use in the 2200-2290 MHz band.
A3: Only one carrier frequency of 2210 MHz is planned.
Q4: Will the NEMO-HD space station transmit using the 2000DL beam continuously throughout its orbit, or only when it is within view of the associated earth station in Slovenia?
A4: NEMO-HD will transmit only when it is within view of the associated earth station in Slovenia.
Q5: What will be the duration of the NEMO-HD space station transmissions in the 2200-2290 MHz band during each pass.
A5: Expected duration of the transmissions for the 2000DL beam is below 5 minutes during each pass.
Q6: What is the ascending node (equatorial crossing time) for the NEMO-HD space station?
A6: Planned LTAN of NEMO-HD is 10:30 am but this is not certain since we do not have fixed the launch date and provider yet.
Q7: What is the currently planned launch date for the NEMO-HD space station?
A7: Exact date is not yet known but currently we plan the launch in the second half of the 2015.
Q8: For the transmission int the 8025-8400 MHz band (beam 8000) please provide the following:
Q8a: Specific carrier frequencies
A8a: The X-band downlink transmitter is operating at **8090 MHz**.
Q8b: The spacecraft modulation/coding scheme
A8b: Modulation is filtered O-QPSK, coding is 1/2 convolutional

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Q8c: Transmitter circuit loss, if not already accounted for in either the transmitter power or antenna gain.

A8c: The insertion loss of the coaxial cable from the X-band transmitter output to the antenna input is 0.9dB.

Q8d: Characteristics of transmitting filters, if any. Please show the filtering across the 8400-8450 MHz band.

A8d: No external filter used, because the transmitter's noise density in the deep space frequency range (8400-8450MHz) already meets the requirement. Please see the table below.

Parameter	Units	Value	Reference
Range	km	600.0	Mission Requirements
Frequency	GHz	8.4	ITU Table of Frequency Allocations - Deep Space Band Plan (8400-8500 MHz)
Transmitter Power	dBW/Hz	-140.0	Per Syrlinks e-mail 2013/06/18 and EDP Plot
Filter Loss	dB	0.0	None
Feed Cable Loss	dB	-0.9	Measured
Spacecraft Antenna Gain	dBi	7.5	Per U of Temail 2013/06/11, referred to RHCP reference
Spacecraft EIRP	dBW/Hz	-133.4	
Free Space Loss	dB	166.5	
Atmospheric Loss	dB	0.0	None assumed
Polarization Loss	dB	0.0	None assumed
Total Propagation Loss	dB	166.5	
Earth Station Gain	dBi	74.7	DSS-63 (Madrid), Per DSS 810-005 101 Rev D, Table 2
Interference Power (Actual)	dBW/Hz	-225.2	
Interference Power (Max)	dBW/Hz	-220.9	Recommendation ITU-R SA.1157-1, 2006
Margin	dB	4.3	

Q8e: Roll off of the transmitted spectrum due to on board filtering; pulse shaping, etc. Please show the spectrum roll off across the 8400-8450 MHz band.

A8e: The noise density inside the deep space frequency range is no more than

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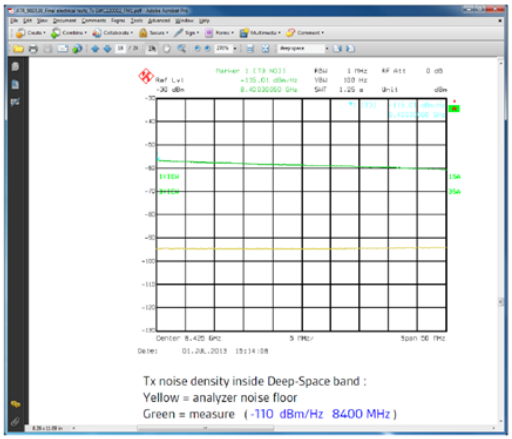
-110dBm/Hz (-110dBm/Hz = -140dBW/Hz). Please see the plot below. Since the resolution bandwidth (RBW) used is 1MHz, so the noise density (dBm/Hz) indicated by the marker is 60dB lower than the graphical vertical coordinates, which is in dBm.



Q8f: Symbol rate

A8f: Symbol rate is 50 Msps

Q8g: Ascending/descending node (equatorial crossing time) of the space station.

A8f: See A6.

Q8h: The mean local time (MLT) of the NEMO-HD ascending node

A8h: See A6.

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Notification, the launch :

- According to satellite integrator the launch is planned in the second half of the year 2015 (exact date of launch is not decided yet).

- We plan to send a Notification under Article 11 of the RR to the ITU 30 days before launch.

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Thank you

tomo.zbontar@akos-rs.si

Agency for Communication Networks and Services of the Republic of Slovenia

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