

**TECHNICAL APPENDIX**

**RBC Signals LLC  
60-Day Special Temporary Authorization (STA)**

- I. 400 MHz Yagi Radiation Hazard Report
- II. Draft FCC Form 312 Schedule B
- III. Nkom Email Authorization

**\*Proprietary & Confidential\***

# I. Radiation Hazard Study

## 400 MHz Earth Station

This study analyzes the non-ionizing radiation levels for a 400 MHz Yagi tracking earth station. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01.

Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are depending on the area of exposure and/or the status of the individuals who are subject to the exposure -- the General Population/Uncontrolled Environment and the Controlled Environment, where the general population cannot access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 1.33 milliwatts per square centimeter ( $1.33 \text{ mW/cm}^2$ ) averaged over any 6 minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 0.27 milliwatt per square centimeter ( $0.27 \text{ mW/cm}^2$ ) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna surface are expected to exceed safe levels. The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the antenna edge and the ground

### Input Parameters

The following input parameters were used in the calculations:

<u>Parameters:</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>
<i>Antenna Diameter</i>	3.57	m	<i>D</i>
<i>Antenna Transmit Gain</i>	16.2	dBi	<i>G</i>
<i>Transmit Frequency</i>	400	MHz	<i>f</i>
<i>Power Input to the Antenna</i>	44.7	W	<i>P</i>

### Calculated Parameters:

The following values were calculated using the above input parameters and the

corresponding formulas:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
<i>Antenna Surface Area</i>	1.964	m <sup>2</sup>	A	$G\lambda^2/(4\pi)/\lambda$
<i>Antenna Efficiency</i>	0.95		$\eta$	$G\lambda^2/(\pi^2D^2)$
<i>Gain Factor</i>	41.7		g	$10^{G/10}$
<i>Wavelength</i>	0.75	m	$\lambda$	300/f

### **Behavior of EM Fields as a Function of Distance**

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also is the region between the antenna and ground.

For yagi antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Formula</u>
<i>Near-Field Distance</i>	4.25	m	$R_{nf} = D^2/(4\lambda)$
<i>Distance to Far-Field</i>	10.2	m	$R_{ff} = 0.60D^2/(\lambda)$
<i>Distance of Transition Region</i>	4.25	m	$R_t = R_{nf}$

The distance in the transition region is between the near and far fields. Thus,  $R_{nf} \leq R_t \leq R_{ff}$ . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

### **Power Flux Density Calculations**

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
<i>Power Density in the Near-Field</i>	8.65	mW/cm <sup>2</sup>	$S_{nf}$	$16.0 \eta P/(\pi D^2)$
<i>Power Density in the Far-Field</i>	0.14	mW/cm <sup>2</sup>	$S_{ff}$	$GP/(4\pi R_{ff}^2)$
<i>Power Density in the Transition Region</i>	8.65	mW/cm <sup>2</sup>	$S_t$	$S_{nf} R_{nf}/(R_t)$

The power density between the antenna and ground, is calculated as follows:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
<i>Power Density b/w Reflector and Ground</i>	2.28	mW/cm <sup>2</sup>	$S_g$	$P/A$

The below table summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below.

These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

<u>Power Density</u>	<u>Value</u>	<u>Unit</u>	<u>Controlled Environment</u>
<i>Far Field Calculation</i>	0.14	mW/cm <sup>2</sup>	Satisfies FCC MPE
<i>Near Field Calculation</i>	8.65	mW/cm <sup>2</sup>	Exceeds Limits
<i>Transition Region</i>	8.65	mW/cm <sup>2</sup>	Exceeds Limits
<i>Region b/w Antenna &amp; Ground</i>	2.28	mW/cm <sup>2</sup>	Exceeds Limits

In conclusion, the results show that the antenna, in a controlled environment, may exist in the regions noted above and applicant will take the proper mitigation procedures to ensure it meets the guidelines specified in 47 C.F.R. § 1.1310.

The antenna will be installed at DS12 Access Road, Prudhoe Bay, Alaska 99734. Access to the antenna requires a 45 ft man-lift, which should safely restrict any public access. It should be noted that all spaces at least 7.5m away from the antenna satisfy the FCC MPE limits for the general population. The earth station will be marked with the standard radiation hazard warnings, as well as the area in the vicinity of the earth station to inform the general population, who might be working or otherwise present in or near the path of the main beam.

The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any building, or other obstacles in those areas that exceed the MPE limits. Since one diameter removed from the center of the main beam the levels are down at least 20 dB, or by a factor of 100, public safety will be ensured.

Finally, the earth station's operational personnel will not have access to areas that exceed the MPE limits while the earth station is in operation. The transmitter will be turned off during periods of maintenance so that the MPE standard of 1.33 mW/cm<sup>2</sup> will be complied with for those regions in close proximity to the antenna, which could be occupied by operating personnel.

Approved by OMB  
3060-0678

## II. Draft FCC Form 312 Schedule B

Date & Time Filed:  
File Number: ---  
Callsign/Satellite ID:

<b>APPLICATION FOR EARTH STATION AUTHORIZATIONS</b>	<b>FCC Use Only</b>
<b>FCC 312 MAIN FORM FOR OFFICIAL USE ONLY</b>	

### APPLICANT INFORMATION

Enter a description of this application to identify it on the **aim** menu:  
**DRAFT FORM TO SUPPORT 60-DAY STA REQUEST (Tyvak)**

<b>1-8. Legal Name of Applicant</b>			
Name:	RBC Signals, LLC	Phone Number:	404-803-7734
DBA Name:		Fax Number:	
Street:	2205 152nd Ave NE	E-Mail:	crichins@rbcsignals.com
City:	Redmond	State:	WA
Country:	USA	Zipcode:	98052 -
Attention: Mr. Christopher Richins			

<b>9-16. Name of Contact Representative</b>			
Name:	Carlos Nalda	Phone Number:	5713325626
Company:	LMI Advisors	Fax Number:	
Street:	2550 M Street NW Suite 345	E-Mail:	cnalda@lmiadvisors.com
City:	Washington	State:	DC
Country:	USA	Zipcode:	20037-
Attention: Mr. Carlos Nalda		Relationship:	Other

### CLASSIFICATION OF FILING

<p>17. Choose the button next to the classification that applies to this filing for both questions a. and b. Choose only one for 17a and only one for 17b.</p> <p>a.</p> <p><input checked="" type="radio"/> a1. Earth Station (N/A) a2. Space Station</p>	<p>b.</p> <p><input type="radio"/> b1. Application for License of New Station</p> <p><input type="radio"/> b2. Application for Registration of New Domestic Receive-Only Station (N/A) b3. Amendment to a Pending Application (N/A) b4. Modification of License or Registration (N/A) b5. Assignment of License or Registration (N/A) b6. Transfer of Control of License or Registration (N/A) b7. Notification of Minor Modification (N/A) b8. Application for License of New Receive-Only Station Using Non-U.S. Licensed Satellite (N/A) b9. Letter of Intent to Use Non-U.S. Licensed Satellite to Provide Service in the United States</p> <p><input checked="" type="radio"/> b10. Other (Please specify)</p> <p><input type="radio"/> b11. Application for Earth Station to Access a Non-U.S. satellite Not Currently Authorized to Provide the Proposed Service in the Proposed Frequencies in the United States.</p>
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17c. Is a fee submitted with this application?

If Yes, complete and attach FCC Form 159.

If No, indicate reason for fee exemption (see 47 C.F.R. Section 1.1114).

Governmental Entity    Noncommercial educational licensee

Other (please explain): DRAFT FORM

17d.  
Fee Classification

18. If this filing is in reference to an	19. If this filing is an amendment to a pending application enter:
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existing station, enter: (a) Call sign of station: Not Applicable	(a) Date pending application was filed: Not Applicable	(b) File number of pending application: Not Applicable
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TYPE OF SERVICE

20. NATURE OF SERVICE: This filing is for an authorization to provide or use the following type(s) of service(s): Select all that apply:

a. Fixed Satellite  
 b. Mobile Satellite  
 c. Radiodetermination Satellite  
 d. Earth Exploration Satellite  
 e. Direct to Home Fixed Satellite  
 f. Digital Audio Radio Service  
 g. Other (please specify)  
 NGSO

21. STATUS: Choose the button next to the applicable status. Choose only one.  
 Common Carrier  Non-Common Carrier

22. If earth station applicant, check all that apply.  
 Using U.S. licensed satellites  
 Using Non-U.S. licensed satellites

23. If applicant is providing INTERNATIONAL COMMON CARRIER service, see instructions regarding Sec. 214 filings. Choose one. Are these facilities:  
 Connected to a Public Switched Network  Not connected to a Public Switched Network  N/A

24. FREQUENCY BAND(S): Place an "X" in the box(es) next to all applicable frequency band(s).  
 a. C-Band (4/6 GHz)  b. Ku-Band (12/14 GHz)  
 c. Other (Please specify upper and lower frequencies in MHz.)  
 Frequency Lower: 401 Frequency Upper: 401.3

TYPE OF STATION

25. CLASS OF STATION: Choose the button next to the class of station that applies. Choose only one.  
 a. Fixed Earth Station  
 b. Temporary-Fixed Earth Station  
 c. 12/14 GHz VSAT Network  
 d. Mobile Earth Station  
 (N/A) e. Geostationary Space Station  
 (N/A) f. Non-Geostationary Space Station  
 g. Other (please specify)

26. TYPE OF EARTH STATION FACILITY: Choose only one.  
 Transmit/Receive  Transmit-Only  Receive-Only  N/A

PURPOSE OF MODIFICATION

27. The purpose of this proposed modification is to: (Place an 'X' in the box(es) next to all that apply.)  
 Not Applicable

ENVIRONMENTAL POLICY

28. Would a Commission grant of any proposal in this application or amendment have a significant environmental impact as defined by 47 CFR 1.1307? If YES, submit the statement as required by Sections 1.1308 and 1.1311 of the Commission's rules, 47 C.F.R. §§ 1.1308 and 1.1311, as an exhibit to this application. A Radiation Hazard Study must accompany all applications for new transmitting facilities, major modifications, or major amendments.  Yes  No

ALIEN OWNERSHIP Earth station applicants not proposing to provide broadcast, common carrier, aeronautical en route or aeronautical fixed radio station services are not required to respond to Items 30-34.

29. Is the applicant a foreign government or the representative of any foreign government?  Yes  No

30. Is the applicant an alien or the representative of an alien?  Yes  No  N/A

31. Is the applicant a corporation organized under the laws of any foreign government?  Yes  No  N/A

32. Is the applicant a corporation of which more than one-fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?  Yes  No  N/A

33. Is the applicant a corporation directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a

foreign government or representative thereof or by any corporation organized under the laws of a foreign country?

34. If any answer to questions 29, 30, 31, 32 and/or 33 is Yes, attach as an exhibit an identification of the aliens or foreign entities, their nationality, their relationship to the applicant, and the percentage of stock they own or vote.

**BASIC QUALIFICATIONS**

35. Does the Applicant request any waivers or exemptions from any of the Commission's Rules?  Yes  No  
If Yes, attach as an exhibit, copies of the requests for waivers or exceptions with supporting documents.

36. Has the applicant or any party to this application or amendment had any FCC station authorization or license revoked or had any application for an initial, modification or renewal of FCC station authorization, license, or construction permit denied by the Commission? If Yes, attach as an exhibit, an explanation of circumstances.  Yes  No

37. Has the applicant, or any party to this application or amendment, or any party directly or indirectly controlling the applicant ever been convicted of a felony by any state or federal court? If Yes, attach as an exhibit, an explanation of circumstances.  Yes  No

38. Has any court finally adjudged the applicant, or any person directly or indirectly controlling the applicant, guilty of unlawfully monopolizing or attempting unlawfully to monopolize radio communication, directly or indirectly, through control of manufacture or sale of radio apparatus, exclusive traffic arrangement or any other means or unfair methods of competition? If Yes, attach as an exhibit, an explanation of circumstances  Yes  No

39. Is the applicant, or any person directly or indirectly controlling the applicant, currently a party in any pending matter referred to in the preceding two items? If yes, attach as an exhibit, an explanation of the circumstances.  Yes  No

40. If the applicant is a corporation and is applying for a space station license, attach as an exhibit the names, address, and citizenship of those stockholders owning a record and/or voting 10 percent or more of the Filer's voting stock and the percentages so held. In the case of fiduciary control, indicate the beneficiary(ies) or class of beneficiaries. Also list the names and addresses of the officers and directors of the Filer.

41. By checking Yes, the undersigned certifies, that neither applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. See 47 CFR 1.2002(b) for the meaning of "party to the application" for these purposes.  Yes  No

42a. Does the applicant intend to use a non-U.S. licensed satellite to provide service in the United States? If Yes, answer 42b and attach an exhibit providing the information specified in 47 C.F.R. 25.137, as appropriate. If No, proceed to question 43.  Yes  No

42b. What administration has licensed or is in the process of licensing the space station? If no license will be issued, what administration has coordinated or is in the process of coordinating the space station? Norway

43. Description. (Summarize the nature of the application and the services to be provided). Draft Form to support 30-day STA request to provide TT&C for CICERO spacecraft.

43a. Geographic Service Rule Certification  
By selecting A, the undersigned certifies that the applicant is not subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25.  A  
By selecting B, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will comply with such requirements.  B  
By selecting C, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will not comply with such requirements because it is not feasible as a technical matter to do so, or that, while technically feasible, such services would require so many compromises in satellite design and operation as to make it economically unreasonable. A narrative description and technical analysis demonstrating this claim are attached.  C

**CERTIFICATION**

The Applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests an authorization in accordance with this application. The applicant certifies that grant of this application would not cause the applicant to be in violation of the spectrum aggregation limit in 47 CFR Part 20. All statements made in exhibits are a material part hereof and are incorporated herein as if set out in full in this application. The undersigned, individually and for the applicant, hereby certifies that all statements made in this application and in all attached exhibits are true, complete and correct to the best of his or her knowledge and belief, and are made in good faith.

44. Applicant is a (an): (Choose the button next to applicable response.)

- Individual
- Unincorporated Association
- Partnership
- Corporation
- Governmental Entity
- Other (please specify)  
LLC

45. Name of Person Signing Christopher Richins	46. Title of Person Signing CEO
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47. Please supply any need attachments.

Attachment 1:	Attachment 2:	Attachment 3:
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**WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND / OR IMPRISONMENT (U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION (U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).**

## SATELLITE EARTH STATION AUTHORIZATIONS FCC Form 312 - Schedule B:(Technical and Operational Description)

### FOR OFFICIAL USE ONLY

Location of Earth Station Site

E1. Site Identifier:	Deadhorse	E5. Call Sign:	
E2. Contact Name	Zachary Reich	E6. Phone Number:	415-622-5548
E3. Street:		E7. City:	Deadhorse
E4. State	AK	E8. County:	North Slope Borough
E10. Area of Operation:		E9. Zip Code	99734
E11. Latitude:	70 ° 12 ' 42.9 " N	E13. Lat/Lon Coordinates are:	<input type="radio"/> NAD-27 <input checked="" type="radio"/> NAD-83 <input type="radio"/> N/A
E12. Longitude:	148 ° 26 ' 15.2 " W	E14. Site Elevation (AMSL):	15.0 meters

E15. If the proposed antenna(s) operate in the Fixed Satellite Service (FSS) with geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a) and (b) as demonstrated by the manufacturer's qualification measurement? If NO, provide a technical analysis showing compliance with two-degree spacing policy.	<input type="radio"/> Yes <input type="radio"/> No <input checked="" type="radio"/> N/A
E16. If the proposed antenna(s) do not operate in the Fixed Satellite Service (FSS), or if they operate in the Fixed Satellite Service (FSS) with non-geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a2) and (b) as demonstrated by the manufacturer's qualification measurements?	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
E17. Is the facility operated by remote control? If YES, provide the location and telephone number of the control point.	<input checked="" type="radio"/> Yes <input type="radio"/> No
E18. Is frequency coordination required? If YES, attach a frequency coordination report as	<input type="radio"/> Yes <input checked="" type="radio"/> No
E19. Is coordination with another country required? If YES, attach the name of the country(ies) and plot of coordination contours as	<input type="radio"/> Yes <input checked="" type="radio"/> No
<b>E20. FAA Notification - (See 47 CFR Part 17 and 47 CFR part 25.113(c)) Where FAA notification is required, have you attached a copy of a completed FCC Form 854 and or the FAA's study regarding the potential hazard of the structure to aviation? FAILURE TO COMPLY WITH 47 CFR PARTS 17 AND 25 WILL RESULT IN THE RETURN OF THIS APPLICATION.</b>	<input type="radio"/> Yes <input checked="" type="radio"/> No



**POINTS OF COMMUNICATION**

Satellite Name:OTHER   OTHER   If you selected OTHER, please enter the following:	
E21. Common Name: CICERO Cubesats	E22. ITU Name: Tyvak-0082
E23. Orbit Location: NGSO	E24. Country: Norway

**POINTS OF COMMUNICATION (Destination Points)**

E25. Site Identifier: Deadhorse	
E26. Common Name:	E27. Country:USA

**ANTENNA**

Site ID	E28. Antenna Id	E29. Quantity	E30. Manufacturer	E31. Model	E32. Antenna Size	E41/42. Antenna Gain Transmint and/or Recieve(____dBi at ____GHz)
Deadhorse	YAGI-1	1	M2 Antenna Systems	400CP30A	3.57	16.2 dBi at 0.400

E28. Antenna Id	E33/34. Diameter Minor/Major(meters)	E35. Above Ground Level (meters)	E36. Above Sea Level (meters)	E37. Building Height Above Ground Level (meters)	E38. Total Input Power at antenna flange (Watts)	E39. Maximum Antenna Height Above Rooftop (meters)	E40. Total EIRP for al carriers (dBW)
YAGI-1	0.025/3.57	15.0	0.0	0.0	44.7	0.0	32.7

**FREQUENCY**

E28. Antenna Id	E43/44. Frequency Bands(MHz)	E45. T/R Mode	E46. Antenna Polarization(H,V,L,R)	E47. Emission Designator	E48. Maximum EIRP per Carrier(dBW)	E49. Maximum ERIP Density per Carrier(dBW/4kHz)
YAGI-1	401 401.3	R	Right Hand Circular	16K5G1D	0.0	0.0

**E50. Modulation and Services TT&C Downlink**

YAGI-1	401 401.3	T	Right Hand Circular	16K5G1D	32.7	26.7
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**E50. Modulation and Services TT&C Uplink**

**FREQUENCY COORDINATION**

E28. Antenna Id	E51. Satellite Orbit Type	E52/53. Frequency Limits(MHz)	E54/55. Range of Satellite Arc E/W Limit	E56. Earth Station Azimuth Angle Eastern Limit	E57. Antenna Elevation Angle Eastern Limit	E58. Earth Station Azimuth Angle Western Limit	E59. Antenna Elevation Angle Western Limit	E60. Maximum EIRP Density toward the Horizon(dBW/4kHz)
YAGI-1	Non-Geostationary	401 401.3	0.0/ 0.0	0.0	5.0	360.0	5.0	0.0
	Non-Geostationary	401 401.3	0.0/ 0.0	0.0	5.0	360.0	5.0	26.7

**REMOTE CONTROL POINT LOCATION**

**REMOTE CONTROL POINT LOCATION**

E61. Call Sign		E65. Phone Number 650-746-8744	
NOTE: Please enter the callsign of the controlling station, not the callsign for which this application is being filed.			
E62. Street Address 2205 152nd Street NE			
E63. City Redmond	E67. County King	E64/68. State/Country WA/ USA	E66. Zip Code 98052

**FCC NOTICE REQUIRED BY THE PAPERWORK REDUCTION ACT**

The public reporting for this collection of information is estimated to average 0.25 - 24 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the

required data, and completing and reviewing the collection of information. If you have any comments on this burden estimate, or how we can improve the collection and reduce the burden it causes you, please write to the Federal Communications Commission, AMD-PERM, Paperwork Reduction Project (3060-0678), Washington, DC 20554. We will also accept your comments regarding the Paperwork Reduction Act aspects of this collection via the Internet if you send them to PRA@fcc.gov. PLEASE DO NOT SEND COMPLETED FORMS TO THIS ADDRESS.

Remember - You are not required to respond to a collection of information sponsored by the Federal government, and the government may not conduct or sponsor this collection, unless it displays a currently valid OMB control number or if we fail to provide you with this notice. This collection has been assigned an OMB control number of 3060-0678.

THE FOREGOING NOTICE IS REQUIRED BY THE PAPERWORK REDUCTION ACT OF 1995, PUBLIC LAW 104-13, OCTOBER 1, 1995, 44 U.S.C. SECTION 3507.

### III. Nkom Email Authorization

**\*Tyvak Proprietary\***

**From:** "Målen Frode" <frode.maalen@nkom.no>  
**Sent:** Fri, 21 Apr 2017 07:56:17 +0000  
**To:** "BRMAIL, ITU" <BRMail@itu.int>  
**Subject:** Submission of Advance Publication Information for Satellite Network Tyvak-0082  
**Attachments:** Tyvak-0082-API.zip

Dear Sirs,

With reference to Radio Regulations Article 9, no. 9.1, we are pleased to forward information on a Norwegian satellite network: Tyvak-0082 for Advanced Publication of Information in the BR IFIC. The network are not subject to coordination, cf. Article 9, Sub-Section IA.

The Tyvak-0082 network is a n-GSO systems with 4 satellites in one orbital plane with 97,6° inclination. The validity is 20 years.

The technical data for the network has been prepared in accordance with Radio Regulations Appendix 4, Annex 2. Enclosed please find the filing in the zipped format, prepared in the SpaceCap program.

The operating agency for the networks is Orbital Networks A/S, Norway. In the API, clause A3a is given as 9999. Notification Form of the List of Recognized Operating Agencies (ROAs) for Orbital Networks AS will be sent in a separate e-mail.

We kindly ask BR to initiate the relevant procedures under Article 9 of the Radio Regulations with regard to this network.

If further clarification is necessary, we are pleased to be at your disposal.

This E-mail has been confirmed by fax transmission to BR today.

Best regards,  
Frode Målen  
Senior Engineer  
Section for Frequency Planning  
Norwegian Communications Authority  
Switchboard: + 47 22 82 46 00  
Direct: + 47 22 82 46 04  
Mobile: + 47 93 45 58 64  
[www.nkom.no](http://www.nkom.no)



## SpacePub Submission

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM		DB: TYVAK-0082-API.MDB		Plan Id.:		Notice type: NONGEO	
A	A1a Sat. Network	TYVAK-0082	A1f1 Notifying adm.	NOR	A1f3 Inter. sat. org.		BR1 Date of receipt	22.02.2017	BR20 BR IFIC no.
BR6a/BR6b Id. no.		6	BR3a Provision reference		9.1/IA	BR2 Adm. serial no.			

### Résumé / Summary / Resumen

Article 9, sous-section IA / Article 9, sub-section IA / Artículo 9, sub-sección IA  
 第9条第1A分节 / Статья 9, подраздел IA / المادة 9، القسم الفرعي IA

**\*Tyvak Proprietary\***

B1a Beam designation	B2 Emi-Rcp	BR8 Action code	BR7a Group id.	BR9 Action code	BR47 Frequency band (MHz)		C4a Class of station
UHFRX	R		12		401	- 401.3	EW
SBANDTX	E		10		2200	- 2202	ET, EW
UHFTX	E		9		401	- 401.3	ET
XBANDTX	E		11		8045	- 8059	EW

**\*Tyvak Proprietary\***

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO
A	A1a Sat. Network TYVAK-0082	A1f1 Notifying adm. NOR	A1f3 Inter. sat. org.	BR1 Date of receipt 22.02.2017	BR20 BR IFIC no.
BR6a/BR6b Id. no. 6		BR3a Provision reference 9.1/IA		BR2 Adm. serial no.	UHFRX R

A1f2 Submitted on behalf \_\_\_\_\_

A4b1 No. of orbital planes 1 A4b2 Ref. body T

A4b3a No. of space stations simult. trans. on Northern Hemisphere \_\_\_\_\_ A4b3b No. of space stations simult. trans. on Southern Hemisphere \_\_\_\_\_

Orbital plane id. no.	A4b4a Inclination angle	A4b4b No. of satellites in this plane	A4b4c Period	A4b4d Apogee	A4b4e Perigee	A4b4f Min. altitude
1	97.6	4	0-01:37	600e0	600e0	600

B1a/BR17 Beam designation UHFRX	B1b Steerable	B2 Emi-Rcp R	B3a1 Max. co-polar gain 2
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B2bis.a Transmit only when visible from notified service area \_\_\_\_\_ B2bis.b Min. Elev. Angle \_\_\_\_\_

B3c1 Co-polar antenna pattern					
Co-polar ref. pattern	Coef. A	Coef. B			Co-polar rad. diag.
ND-SPACE					

List of orbital planes

1

B4a3a1 Angle alpha \_\_\_\_\_ B4a3a2 Angle beta \_\_\_\_\_

BR92 Attach. for missing angle alpha/beta \_\_\_\_\_

BR7a/BR7b Group id. 12	BR1 Date of receipt 22.02.2017	C2c RR No. 4.4
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BR14 Special Section \_\_\_\_\_

C4a Class of station EW C3a Assigned freq. band \_\_\_\_\_ C5a Noise temperature 303

C4b Nature of service CR C6a Polarization type CL C6b Polarization angle \_\_\_\_\_

C11a2 Service area NOR C11a3 Service area diagram \_\_\_\_\_

A2b Period of valid. 20 A3a Op. agency 999 A3b Adm. resp. A BR16 Value of type C8b \_\_\_\_\_

BR60 Regulatory deadline(s) 11.44/11.44.1 \_\_\_\_\_

C1 Frequency Range			
C1a Lower limit		C1b Upper limit	
401	MHz	401.3	MHz

C7a Design. of emission	C8a1/C8b1 Max. peak pwr	C8a2/C8b2 Max. pwr dens.	C8c1 Min. peak pwr	C8c2 Attch.	C8c3 Min. pwr dens.	C8c4 Attch.	C8e1 C/N ratio	C8e2 Attch.	C8f2 E.i.r.p. on the beam axis
1 16K5G1D	22.6	-19.6	13		-29.2		84		

C7b Carrier frequency of the emissions (16K5G1D)											
404.04	MHz	401.08	MHz	401.12	MHz	401.16	MHz	401.2	MHz	401.24	MHz

C10b1 Assoc. earth station id.	C10b2 Type	C10c1 Geographical coord.		C10c2 Ctry	C10d1/C10d2 Cls. / Nat.	C10d3 Max. iso. gain	C10d4 Bmwidth				
ORBEX1	S	018E29 14	69N03 19	NOR	1 TW CR	16.2	25				

C10d5a Co-polar antenna pattern							
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBEX1	REC-580-6						

13C Remarks \_\_\_\_\_

B1a/BR17 Beam designation SBANDTX	B1b Steerable	B2 Emi-Rcp E	B3a1 Max. co-polar gain 5
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**\*Tyvak Proprietary\***

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO
A	A1a Sat. Network TYVAK-0082	A1f1 Notifying adm. NOR	A1f3 Inter. sat. org.	BR1 Date of receipt 22.02.2017	BR20 BR IFIC no.
BR6a/BR6b Id. no. 6		BR3a Provision reference 9.1/IA		BR2 Adm. serial no.	SBANDTX E

B2bis.a Transmit only when visible from notified service area  Y  B2bis.b Min. Elev. Angle  10

B3c1 Co-polar antenna pattern					
Co-polar ref. pattern	Coef. A	Coef. B			Co-polar rad. diag.
ND-SPACE					

B4a3a1 Angle alpha  B4a3a2 Angle beta

BR92 Attach. for missing angle alpha/beta

BR7a/BR7b Group id.  10  BR1 Date of receipt  22.02.2017  C2c RR No. 4.4

BR14 Special Section

C4a Class of station  ET  EW  C3a Assigned freq. band

C4b Nature of service  CR  CR  C6a Polarization type  CL

C6b Polarization angle

C8d1 Max. tot. peak pwr.  C8d2 Contiguous bandwidth

C11a2 Service area  XVE  C11a3 Service area diagram

A2b Period of valid.  20  A3a Op. agency  999  A3b Adm. resp.  A  BR16 Value of type C8b

BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		C1b Upper limit	
2200	MHz	2202	MHz

C7a	C8a1/C8b1	C8a2/C8b2	C8c1	C8c2	C8c3	C8c4	C8e1	C8e2	C8f1
Design. of emission	Max. peak pwr	Max. pwr dens.	Min. peak pwr	Attch.	Min. pwr dens.	Attch.	C/N ratio	Attch.	E.i.r.p. on the beam axis
1 1M50G1D	3	-58	-3		-64		80		3

C7b Carrier frequency of the emissions (1M50G1D)									
2201	MHz								

C10b1	C10b2	C10c1		C10c2	C10d1/C10d2	C10d3	C10d4	C10d6		
Assoc. earth station id.	Type	Geographical coord.		Ctry	Cls. / Nat.	Max. iso. gain	Bmwidth	Noise temp.		
ORBOPEX	T				1 TT 2 TW	CR	40	1.6	150	

C10d5a Co-polar antenna pattern							
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBOPEX	REC-580-6						

13C Remarks

B1a/BR17 Beam designation  UHFTX  B1b Steerable  B2 Emi-Rcp  E  B3a1 Max. co-polar gain  2

B2bis.a Transmit only when visible from notified service area  Y  B2bis.b Min. Elev. Angle  10

B3c1 Co-polar antenna pattern					
Co-polar ref. pattern	Coef. A	Coef. B			Co-polar rad. diag.
ND-SPACE					

B4a3a1 Angle alpha  B4a3a2 Angle beta

BR92 Attach. for missing angle alpha/beta

**\*Tyvak Proprietary\***

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO
A	A1a Sat. Network TYVAK-0082	A1f1 Notifying adm. NOR	A1f3 Inter. sat. org.	BR1 Date of receipt 22.02.2017	BR20 BR IFIC no.
BR6a/BR6b Id. no. 6		BR3a Provision reference 9.1/IA		BR2 Adm. serial no.	UHFTX E

BR7a/BR7b Group id.	9	BR1 Date of receipt	22.02.2017	C2c RR No. 4.4	
BR14 Special Section					
C4a Class of station	ET	C3a Assigned freq. band			
C4b Nature of service	CR	C6a Polarization type	CL	C6b Polarization angle	
C8d1 Max. tot. peak pwr.		C8d2 Contiguous bandwidth			
C11a2 Service area	NOR	C11a3 Service area diagram			
A2b Period of valid.	20	A3a Op. agency	999	A3b Adm. resp.	A
BR60 Regulatory deadline(s) 11.44/11.44.1		BR16 Value of type C8b			

C1 Frequency Range	
C1a Lower limit	C1b Upper limit
401 MHz	401.3 MHz

C7a	C8a1/C8b1	C8a2/C8b2	C8c1	C8c2	C8c3	C8c4	C8e1	C8e2	C8f1
Design. of emission	Max. peak pwr	Max. pwr dens.	Min. peak pwr	Attch.	Min. pwr dens.	Attch.	C/N ratio	Attch.	E.i.r.p. on the beam axis
1 16K5G1D	3	-39.2	0.5		-41.7		57		3

C7b Carrier frequency of the emissions (16K5G1D)									
401.04 MHz	401.08 MHz	402.12 MHz	401.16 MHz	401.2 MHz	401.24 MHz				

C10b1	C10b2	C10c1		C10c2	C10d1/C10d2	C10d3	C10d4	C10d6		
Assoc. earth station id.	Type	Geographical coord.		Ctry	Cls. / Nat.	Max. iso. gain	Bmwidth	Noise temp.		
ORBOP	S	018E29 14	69N03 19	NOR	1 TT CR	30	5	150		

C10d5a Co-polar antenna pattern						
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1
ORBOP	REC-580-6					

13C Remarks

BR1a/BR17 Beam designation	XBANDTX	BR1b Steerable		B2 Emi-Rcp	E	B3a1 Max. co-polar gain	8
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B2bis.a Transmit only when visible from notified service area  Y  B2bis.b Min. Elev. Angle

B3c1 Co-polar antenna pattern			
Co-polar ref. pattern	Coef. A	Coef. B	Co-polar rad. diag.
ND-SPACE			

B4a3a1 Angle alpha  B4a3a2 Angle beta

BR92 Attach. for missing angle alpha/beta

BR7a/BR7b Group id.	11	BR1 Date of receipt	22.02.2017	C2c RR No. 4.4	
BR14 Special Section					
C4a Class of station	EW	C3a Assigned freq. band			
C4b Nature of service	CR	C6a Polarization type	CL	C6b Polarization angle	
C8d1 Max. tot. peak pwr.		C8d2 Contiguous bandwidth			
C11a2 Service area	XVE	C11a3 Service area diagram			
A2b Period of valid.	20	A3a Op. agency	999	A3b Adm. resp.	A
BR60 Regulatory deadline(s) 11.44/11.44.1		BR16 Value of type C8b			

**\*Tyvak Proprietary\***

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO
A	A1a Sat. Network TYVAK-0082	A1f1 Notifying adm. NOR	A1f3 Inter. sat. org.	BR1 Date of receipt 22.02.2017	BR20 BR IFIC no.
BR6a/BR6b Id. no. 6		BR3a Provision reference 9.1/IA		BR2 Adm. serial no.	XBANDTX E

BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		C1b Upper limit	
8045	MHz	8059	MHz

C7a Design. of emission	C8a1/C8b1 Max. peak pwr	C8a2/C8b2 Max. pwr dens.	C8c1 Min. peak pwr	C8c2 Attch.	C8c3 Min. pwr dens.	C8c4 Attch.	C8e1 C/N ratio	C8e2 Attch.	C8f1 E.i.r.p. on the beam axis
1 1M72G1D	-3	-65.4	-3.5		-65.9		90		3

C7b Carrier frequency of the emissions (1M72G1D)									
8046	MHz	8050	MHz	8054	MHz	8058	MHz		

C10b1 Assoc. earth station id.	C10b2 Type	C10c1 Geographical coord.	C10c2 Ctry	C10d1/C10d2 Cls. / Nat.	C10d3 Max. iso. gain	C10d4 Bmwidth	C10d6 Noise temp.
ORBEX2	T			1 TW CR	50	0.5	150

C10d5a Co-polar antenna pattern							
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBEX2	REC-580-6						

13C Remarks

C9 Modulation characteristics	C7a Designation of emission 16K5G1D
C9a1 Type of modulation	PSK
C9a2a Lowest frequency	
C9a2b Highest frequency	
C9a2c Frequency deviation	
C9a3a Freq. deviation of the pre-emphasized signal	
C9a3b Pre-emphasis characteristics	
C9a3c Type of multiplexing	
C9a4a Bit rate	
C9a4b Number of phases	
C9a5a Modulating signal attached (see attch. no.)	
C9a5b Amplitude modulation	
C9a6a Peak-to-peak freq. dev.	
C9a6b Sweep frequency	
C9a6c Energy dispersal waveform	
C9a7 Type of energy dispersal	
C9a8 Other types of modulation (see attch. no.)	
C9a9 TV standard	
BR7a Group id.	9, 12



**\*Tyvak Proprietary\***

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO
A	A1a Sat. Network TYVAK-0082	A1f1 Notifying adm. NOR	A1f3 Inter. sat. org.	BR1 Date of receipt 22.02.2017	BR20 BR IFIC no.
BR6a/BR6b Id. no. 6		BR3a Provision reference 9.1/IA		BR2 Adm. serial no.	XBANDTX E

C9 Modulation characteristics	C7a Designation of emission 1M50G1D
C9a1 Type of modulation	PSK
C9a2a Lowest frequency	
C9a2b Highest frequency	
C9a2c Frequency deviation	
C9a3a Freq. deviation of the pre-emphasized signal	
C9a3b Pre-emphasis characteristics	
C9a3c Type of multiplexing	
C9a4a Bit rate	
C9a4b Number of phases	
C9a5a Modulating signal attached (see attch. no.)	
C9a5b Amplitude modulation	
C9a6a Peak-to-peak freq. dev.	
C9a6b Sweep frequency	
C9a6c Energy dispersal waveform	
C9a7 Type of energy dispersal	
C9a8 Other types of modulation (see attch. no.)	
C9a9 TV standard	
BR7a Group id.	10

C9 Modulation characteristics	C7a Designation of emission 1M72G1D
C9a1 Type of modulation	PSK
C9a2a Lowest frequency	
C9a2b Highest frequency	
C9a2c Frequency deviation	
C9a3a Freq. deviation of the pre-emphasized signal	
C9a3b Pre-emphasis characteristics	
C9a3c Type of multiplexing	
C9a4a Bit rate	
C9a4b Number of phases	
C9a5a Modulating signal attached (see attch. no.)	
C9a5b Amplitude modulation	
C9a6a Peak-to-peak freq. dev.	
C9a6b Sweep frequency	
C9a6c Energy dispersal waveform	
C9a7 Type of energy dispersal	
C9a8 Other types of modulation (see attch. no.)	
C9a9 TV standard	
BR7a Group id.	11

BR22 Administration remarks	<input style="width:95%;" type="text"/>
BR23 Radiocommunication Bureau comments	<input style="width:95%;" type="text"/>