TECHNICAL APPENDIX

Tyvak Nano-Satellite Systems Inc. 60-Day Special Temporary Authorization (STA)

- I. 400 MHz Yagi Radiation Hazard Report
- II. 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 mW/cm²) 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 mW/cm²) 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:

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

Calculated Parameters:

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

corresponding formulas:

Parameter	Value	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
Antenna Surface Area	1.964	m ²	A	$G\lambda 2/(4\pi)/\lambda$
Antenna Efficiency	0.95		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor	41.7		g	10 G/10
Wavelength	0.75	m	λ	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:

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

Parameter	Value	Unit	<u>Symbol</u>	<u>Formula</u>
Power Density in the Near-Field	8.65	mW/cm ²	\mathbf{S}_{nf}	$16.0 \eta P/(\pi D^2)$
Power Density in the Far-Field	0.14	mW/cm^2	$\mathbf{S}_{f\!f}$	$GP/(4\pi Rff^2)$
Power Density in the Transition Region	8.65	mW/cm^2	\mathbf{S}_t	$S_{nf}R_{nf}/(R_t)$

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

Parameter	Value	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
Power Density b/w Reflector and Ground	2.28	mW/cm ²	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.

Power Density	Value	<u>Unit</u>	Controlled Environment
Far Field Calculation	0.14	mW/cm ²	Satisfies FCC MPE
Near Field Calculation	8.65	mW/cm ²	Exceeds Limits
Transition Region	8.65	mW/cm ²	Exceeds Limits
Region b/w Antenna & Ground	2.28	mW/cm ²	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/cm² will be complied with for those regions in close proximity to the antenna, which could be occupied by operating personnel.

II. Nkom Email Authorization

From:	"Målen Frode" <frode.maalen@nkom.no></frode.maalen@nkom.no>
Sent:	Fri, 21 Apr 2017 07:56:17 +0000
То:	"BRMAIL, ITU" <brmail@itu.int></brmail@itu.int>
Subject: Attachments:	Submission of Advance Publication Information for Satellite Network Tyvak-0082 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 Norwegian Communications Authority

SpacePub Submission

E_TSUM Requested by: RICKY	Date: 19.04.2	2017 10:20:01 AM DE	3: TYVAK-0082-API.M	DB	Plan Id.:	Notice type: NONGEO
A A1a Sat. Network TYV	/AK-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 /
Article 9, sous-section IAResumen/Article

Article 9, sous-s 第9条第1A分节 / Article 9, sub-section IA/ Статья 9, подраздел IA

Artículo 9, sub-sección IA

IA الملادة 9، القسم الفرعي

Tyvak Proprietary

B1a Beam designation	B2 Emi-Rcp	BR8 Action code	BR7a Group id.	BR9 Action code	Freque	BR47 ncy band	i (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

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E_TSUM Requested by: RICKY	P	Date: 19.04	1.2017 10:2	20:01 A	M D	B: TYVAK-008	32-API.M	DB		Plan le	J.:	Notice	type: NONGEO
A A1a Sat. Network TYV	AK-0082		A1f1 No	tifying ac	dm. NOR	A1f3 Inter.	sat. org.		BR1 Date of	receipt 22.02	.2017	<i>BR20</i> BR	IFIC no.
<i>BR6a/BR6b</i> Id. no.	6		BR3	a Provisi	ion reference	9.1/IA			BR2 Adm. se	erial no.			UHFRX R
A1f2 Submitted on behalf				_									
A4b1 No. of orbital planes	1	A4b2 Ref.	body T										
				-									
A4b3a No. of space stations sim	ult trans o	n Northern He	misnhere		A1636	No. of snace st	ations simi	ilt trans	on Southern He	misphere	_		
			aniisphere		74030				7				
Orbital A4b4a Inclination	A4b4	b No. of	A4b4c Perio	d A4k	b4d Apogee	A4b4e Perig	ee A4b	4† Min.					
plane la. no. angle	satellites	In this plane	0-01.37		60000	60000	an	and a construction of the	_				
1 97.0		4	0-01.37		00060	00060	(500					
B1a/BR17 Beam designa	ation UHF	RX		B1b Stee	erable	B2 Emi-I	Rcp R		B3a1 Max.	co-polar gain	2		
Bobis a Transmit only when visit	le from not	tified service a		B2	his h Min El			_					
B2013.a Transmit Only when visit				D21									
Conclor ref. nettorn	Coof A		B3C1 C	o-polar a	intenna patte	ern				alar rad diag			
Co-polar ref. pattern	Joer. A		Der. B						Со-р	olar rad. diag.			
ND-SPACE													
List of orbital planes													
1													
B4a3a1 Angle alpha	B4a3	3a2 Angle beta	a 🗌										
BB02 Attach for missing angle of	laha/hata												
BR92 Allach. Ior missing angle a	ipna/beta												
BR7a/BR7b Group id. BR14 Special Section		12	BF	R1 Date o	of receipt 22	2.02.2017	C2c	RR No.	4.4		_		
	EW		U.	Sa Assig	l ⁱ ed freq. bai	nd	_	Ct	a Noise tempera	iture 30	3		
C4b Nature of service	CR			C6a P0	^o larization ty	pe ^{CL}		С	6b Polarization a	ngle			
C11a2 Service area	OR								C11a3	Service area dia	agram]	
42b Boried of valid	122 On 2		A2h Adm			6 Value of type	Ceh	1				-	
	Аза Ор. а		ASD Aum. I	esp. 🗠		o value of type		J					
BR60 Regulatory deadline(s)	11.44/11.44	4.1											
C1 Frequen	cy Range												
C1a Lower limit	C1b	Upper limit											
401 MHz	401.	.3 MHz											
C7a	C8a1/C8	Bb1 C8	3a2/C8b2	C	8c1	C8c2	C8	c3	C8c4	C8e1	C8e2		C8f2
Design. of emission	Max. peak	pwr Max.	. pwr dens.	Min. p	eak pwr	Attch.	Min. pw	/r dens.	Attch.	C/N ratio	Attch.	E.i.r.p	on the beam axis
1 16K5G1D	22	2.6	-19.6		13			-29.2		84			
				C7h C	arrier freque	ancy of the emis	sions (16k	(5C1D)	•	•			
404 04 MHz 401	0.8	MH7 401	12 MH7	, <u>4</u> 0		MH ₇ 401	2	MH ₇	401 24	MH 7			
C10b1	<u>C10b2</u>	C100	·12 Mil2	C10c2	1000000000000000000000000000000000000	n12 - 401	. 2 C10d4	11112	401.24	PHIZ			
Assoc earth station id	Type	Geographics	al coord	Ctrv	Cls / Nat	Max iso	Bmwdth	,					
Associ culti station la.	Type	Geographio		July		gain	Diriwaa	·					
ORBEX1	S 01	18E29 14 6	9N03 19	NOR	1 TW C	R 16.2	25						
		I -			I	C10d5a 0	Co-polar ar	ntenna pa	attern	1	I		
C10b1 Assoc. earth station id.	Со-ро	lar ref. pattern	ı Coe	f. A	C	oef. B	Coe	f. C '	Coef. I)	Phi1 C	Co-polar rad. d	ag.
ORBEX1	REC-58											-	
13C Remarks			л						·	•	JL_JL		

	B1a/BR17 Beam designation S	SBANDTX	B1b Steerable	B2 Emi-Rcp E	B3a1 Max. co-polar gain	5	
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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 B	R20 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 Co-polar rad. diag. ND-SPACE Image: Co-polar angle alpha B4a3a2 Angle beta BR92 Attach. for missing angle alpha/beta Image: Co-polar angle alpha/beta	
BR7a/BR7b Group id. 10 BR1 Date of receipt 22.02.2017 C2c RR No. 4.4 BR14 Special Section	
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 C1a Lower limit C1b Upper limit 2200 MHz 2202	
C7a C8a1/C8b1 C8a2/C8b2 C8c1 C8c2 C8c3 C8c4 C8e1 C8e2 Design of emission Max peak pwr Max pwr dens, Min, peak pwr Attch, Min, pwr dens, Attch, C/N ratio Attch,	<i>C8f1</i> E.i.r.p. on the beam axis
1 1M50G1D 3 -58 -3 -64 80	3
C7b Carrier frequency of the emissions (1M50G1D)	
C10b1 C10b2 C10c1 C10c2 C10d1/C10d2 C10d3 C10d4 C10d6 Assoc. earth station id. Type Geographical coord. Ctry Cls. / Nat. Max. iso. Bmwdth Noise gain Total Ctry Class Ctry Class Ctry Class	
ORBOPEX T I I TT CR 40 I.6 I50	
C10d5a Co-polar antenna pattern	
C10b1 Assoc. earth station id. Co-polar ref. pattern Coef. A Coef. B Coef. C Coef. D Phi1 Co-pola	ar 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	
R/a2a1 Angle alpha	
Draja i Aliyic alpha Drajaz Aliyic bela	

E_TSUM Requested by: RICI	KYP	Date:	19.04.2017 10	:20:01 AM	[DB: TYVAK-008	32-API.MD	В		Plan Id.:		Notice type:	NONGEO
A A1a Sat. Network	YVAK-008	2	A1f1 N	lotifying adm.	NOR	A1f3 Inter.	sat. org.		BR1 Date of red	ceipt 22.02.2	017	BR20 BR IFIC r	10.
<i>BR6a/BR6b</i> Id. no.	6		BF	R3a Provision	referenc	9.1/IA			BR2 Adm. seria	al no.			UHFTX E
BR7a/BR7b Group id. BR14 Special Section C4a Class of station C4b Nature of service C8d1 Max. tot. peak pwr. C11a2 Service area	ET CR NOR		8d2 Contiguous ba	BR1 Date of re C3a Assigr ec C6a Po _{lar} Indwidth	eceipt 2 d freq. ba ization ty	22.02.2017 and ype CL	C2c R	R No. 4.4 C6b	Polarization ang C11a3 Se	gle	ram		
	1.00.00	. ugenej											
BR60 Regulatory deadline(s) C1 Freque C1a Lower limit 401 MHz	11.44/11 ency Rang 0 40	.44.1 e C1b Upper	limit MH z										
С7а	C8a1/	C8b1	C8a2/C8b2	C8c1		C8c2	C8c	3	C8c4	C8e1	C8e2	C8	8f1
	Max. pe	ak pwr	Max. pwr dens.	Min. peak	o 5	Attch.	Min. pwr	dens.	Attch.	C/N ratio	Attch.	E.I.r.p. on the	e beam axis
I IOKOGID		J	-39.2		0.5			41./		57			
401.04 MHz 40	1.08	MHz	402.12 MH	C7b Carr Hz 401.	ier frequ 16	ency of the emis	sions (16K)	G1D) 1Hz	401.24 MH	Hz			
Assoc. earth station id.	Туре	Geogi	raphical coord.	Ctry	Cls. / Na	at. Max. iso.	Bmwdth	Noise temp.					
ORBOP	S	018E29	14 69N03 19	NOR 1	TT (CR 30	5	150					
						C10d5a (Co-polar ant	enna patt	ern	•			
C10b1 Assoc. earth station id	I. Co-	polar ref. p	oattern Co	pef. A	C	Coef. B	Coef.	С	Coef. D	PI	ni1 Co	-polar rad. diag.	
ORBOP	REC-	580-6											
13C Remarks													
B1a/BR17 Beam desig	nation X	BANDTX		B1b Steerat	ble	B2 Emi-l	Rcp E		<i>B3a1</i> Max. co	o-polar gain	8		
B2bis.a Transmit only when vi	sible from	notified se	rvice area Y	B2bis.	<i>b</i> Min. E	lev. Angle	10						
			B3c1	Co-polar ante	enna pati	tern							
Co-polar ref. pattern	Coef. A		Coef. B						Co-pola	ar rad. diag.			
ND-SPACE													
<i>B4a3a1</i> Angle alpha <i>BR</i> 92 Attach. for missing angle	B4 alpha/beta	4a3a2 Ang a	le beta										
BR7a/BR7b Group id. BR14 Special Section		11	E	BR1 Date of re	eceipt 2	22.02.2017	C2c R	R No. 4.4					
C4b Nature of service C8d1 Max. tot. peak pwr. C11a2 Service area	CR		8d2 Contiguous ba	C6a Po _{lar}	ization ty	ype CL	_	C6b	Polarization ang	jle			
						Page / Págir	na 5						



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A3a Op. agency 999 A3b Adm. resp. A

BR16 Value of type C8b

C11a3 Service area diagram

E_TSUM Requested by: RICH	KYP	Date:	19.04.20	17 10:	20:01 AM		DB: TYVAK-00	82-API.MD	В		Plan Id.:		Notice type: NO	NGEO
A A1a Sat. Network TY	YVAK-0082	2		A1f1 No	otifying adm	1. NOR	A1f3 Inter	. sat. org.		BR1 Date of re	eceipt 22.02.2	017	BR20 BR IFIC no.	
BR6a/BR6b Id. no.	6			BR	3a Provisior	n referen	ce 9.1/IA			BR2 Adm. ser	ial no.		XB	ANDTX E
BR60 Regulatory deadline(s)	11.44/11.	.44.1												
C1 Freque	ency Range	Э												
C1a Lower limit	C	1b Upper	limit											
8045 MHz	805	9	MHz											
C7a Design. of emission	C8a1/0 Max. pea	C <i>8b1</i> ak pwr	C8a2/ Max. pw	C8b2 r dens.	C8c Min. pea	1 ak pwr	C8c2 Attch.	C8c Min. pwr	:3 dens.	C8c4 Attch.	C8e1 C/N ratio	C8e2 Attch.	C8f1 E.i.r.p. on the b	eam axis
1 1M72G1D		-3	•	-65.4		-3.5		-	-65.9		90			3
C7h Corrier frequency of the emissions (1M72G1D)														
8046 MHz 805	0	MH-7	805/	мн	7 8058	nei nequ			<u>2010)</u>					-
		11112	0034									<u> </u>		J
C1061		~	C10c1		C10c2 C	210d1/C1		C10d4	C10d6					
Assoc. earth station id.	Type	Geog	raphical co	ord.	Ctry	CIS. / N	at. Max. Iso	Bringth	Noise					
ODDEV2						1 1 111	CP 50	0.5	150	0		-		
ORBEAZ						TIM	CR JU	0.5	13	0]		
						-	C10d5a	Co-polar ant	enna patt	ern				
C10b1 Assoc. earth station id	I. Co-p	oolar ref.	pattern	Co	ef. A		Coef. B	Coef.	С	Coef. D	Pr	ni1 C	Co-polar rad. diag.	
ORBEX2	REC-5	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

<u>*Tyvak Proprietary*</u>

E	E_TSUM Requested by: I	RICKYP Date:	19.04.2017 10:20	0:01 AM DB	: TYVAK-0082-API.M	1DB	Plan Id.:	Notice type: NO	NGEO
Z	A A1a Sat. Network	TYVAK-0082	A1f1 Notif	fying adm. NOR	A1f3 Inter. sat. org.	BR1 Date of receip	t 22.02.2017	BR20 BR IFIC no	
	<i>BR6a/BR6b</i> Id. no.	6	BR3a	Provision reference	9.1/IA	BR2 Adm. serial no).	XE	ANDTX 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	
BR23 Radiocommunication Bureau comments	

SES-STA-20180607-01103 IB2018002333 RBC Signals, LLC

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3060-0678 Approved by OMB crichins@rbcsignals.com 404-803-7734 APPLICATION FOR EARTH STATION SPECIAL TEMPORARY AUTHORITY APPLICANT INFORMATIONEnter a description of this application to identify it on the main menu: 98052 WA **Phone Number:** Fax Number: Zipcode: **E-Mail:** State: 2205 152nd Ave NE RBC Signals, LLC Redmond USA 60-Day STA for TT&C **DBA Name:** Country: Name: Street: City: 1. Applicant

Mr. Christopher Richins

Attention:



File # SES - STA - 20180607 - 01/03 Grant Date 9/26/2018 (or other identifier) Term Dates GRANTED International Bureau

This emergency special temporary authority is granted based on the report that due to a mechanical failure of the Tyvak Nano-Satellite Systems Inc. ground station in Norway Tyvak is unable to adequately communicate with the four CICERO-7 (NORAD ID 43143, Int'l Code 2018-004AJ) and TYVAK-61C (NORAD ID 43144, Int'l Code 2018-004AK) NGSO spacecraft to provide them tracking, telemetry and command signals.

RBC Signals, LLC, is authorized special temporary authority for 14days beginning September 26, 2018 to operate a 3.57 meter Yagi antenna fixed earth station in Deadhorse, AK, to provide telemetry, tracking and command services in the 401-401.3 MHz (Earth-to-space/space-to-Earth) frequency band to the four Norwegian-licensed CICERO spacecraft operating that are operating at an orbital altitude of approximately 550 km and an inclination of 97.8° on the following conditions:

- This STA is for emergency operations for a period not to exceed 14 days, and for purposes of Section 1.62(c) of the FCC rules is issued for an activity that is not of a continuing nature. For operations to continue beyond the 14 day period, a request for extension of this STA must be filed and granted prior to expiration of the current STA. Otherwise, operations must cease. Any request for an extension must be support by a detailed showing concerning the status of the Norwegian ground station and a detailed time-line of actions taken to repair it.
- 2. Operations are authorized only as specified below.

Applicant: RBC Signals, LLC

Call Sign: None

File No: SES-STA-20180607-01103

Special Temporary Authority (STA)

	Freq,	Polar	Emission	EIRP per	eirp density
Transm	nitting:			Carrier (ubw)	(0000/4662)
	401.0-401.3 MH	lz RHC	16K5G2[32.7	26.7
Receivi	ing: 401 0-401 3 MF	Iz RHC	16K5G2[) N/A	N/A

- The Remote Control Point Personnel, located at 2205 152nd Street NE, Redmond (King), Washington 98052, Tel. 650-746-8744 and Zachary Reich, RBC Signals - +1 415 622 5548 must be available at all times to respond to interference issues and shut down operations if needed.
- 4. Operations shall be on an unprotected, non-interference basis with respect to other authorized stations, including federal stations.
- 5. This is not a grant of market access to the United States.
- 6. RBC Signals, LLC shall be aware that future STA requests will be considered on a case-by-case basis and shall have no expectations that future operations will be approved.
- 7. Any action taken or expense incurred as a result of operations pursuant to this STA is solely at RBC Signals, LLC's risk.
- Grant of this STA is without prejudice to any determination that the Commission may make regarding any future applications.

This grant is issued pursuant to Section 0.261 of the Commission's rules on delegated authority, 47 C.F.R. § 0.261, and is effective upon release.

Name:	Carlos Nalda	Phone Number	: 57	13325626
Company:	LMI Advisors	Fax Number:		
Street:	2550 M Street NW	E-Mail:	CU	alda@lmiadvisors.com
	Suite 345			
City:	Washington	State:	Ā	U
Country:	USA	Zipcode:	20(037 -
Attention:		Relationship:	Ō	ther
(If your application is r application. Please ente 3. Reference File Num	elated to an application filed v r only one.) ber SESSTA2018033000293	with the Commission, ent or Submission ID	er either the file number	r or the IB Submission ID of the related
4a. Is a fee submitte If Yes, complete an	d with this application? d attach FCC Form 159. If	No, indicate reason for fe	e exemption (see 47 C.I	F.R.Section 1.1114).
O Governmental Enti	ty O Noncommercial educ	cational licensee		
O Other(please expla	in):			
4b. Fee Classification	CGX – Fixed Satellite Trans	mit/Receive Earth Statior		
5. Type Request				· ·
Use Prior to Grant	0	Change Station Location	0	Other
6. Requested Use Prior 06/08/2018	Date			
7. CityDeadhorse		8. La (dd n	iitude un ss.s h) 70 12 4	2.9 N

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9. State AK	10. Longitude (dd mm ss.s h) 148 26 15.2 W
 Please supply any need attachments. Attachment 1: Narrative Attachment 1: Narrative 	al Appendix Attachment 3:
12. Description. (If the complete description does not appear in this bound	x, please go to the end of the form to view it in its entirety.)
60-day STA request to provide TT&C for CICERC	mission.
13. By checking Yes, the undersigned certifies that neither applicant nou subject to a denial of Federal benefits that includes FCC benefits pursus of 1988, 21 U.S.C. Section 862, because of a conviction for possession See 47 CFR 1.2002(b) for the meaning of "party to the applicatio	any other party to the application is Area Section 5301 of the Anti-Drug Act or distribution of a controlled substance.
14. Name of Person Signing Christopher Richins	15. Title of Person Signing CEO
WILLFUL FALSE STATEMENTS MADE ON THIS FORM (U.S. Code, Title 18, Section 1001), AND/OR REV (U.S. Code, Title 47, Section 312(a)(1)), AND/OR	ARE PUNISHABLE BY FINE AND / OR IMPRISONMENT OCATION OF ANY STATION AUTHORIZATION FORFEITURE (U.S. Code, Title 47, Section 503).

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The public reporting for this collection of information is estimated to average 2 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.

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 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 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:

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

Calculated Parameters:

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

corresponding formulas:

Parameter	Value	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
Antenna Surface Area	1.964	m ²	A	<i>Gλ2/(4π)/λ</i>
Antenna Efficiency	0.95		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor	41.7		g	10 ^{G/10}
Wavelength	0.75	m	λ	300/ <i>f</i>

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:

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

The distance in the transition region is between the near and far fields. Thus, $R_{nf} \le R_t \le R_{ff}$. 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.

Parameter	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
Power Density in the Near-Field	8.65	mW/cm ²	Snf	16.0 η P/(πD ²)
Power Density in the Far-Field	0.14	mW/cm ²	Sff	$GP/(4\pi Rff^2)$
Power Density in the Transition Region	8.65	mW/cm ²	\mathbf{S}_t	$S_{nf} R_{nf} / (R_t)$

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

<u>Parameter</u>	Value	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
Power Density b/w Reflector and Ground	2.28	mW/cm ²	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.

Power Density	<u>Value</u>	<u>Unit</u>	Controlled Environment
Far Field Calculation	0.14	mW/cm ²	Satisfies FCC MPE
Near Field Calculation	8.65	mW/cm ²	Exceeds Limits
Transition Region	8.65	mW/cm ²	Exceeds Limits
Region b/w Antenna & Ground	2.28	mW/cm ²	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/cm² 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:

AP	PLICATION FOR EAD	RTH STATION AUTHORIZAT	IONS	
	FCC FOR O	312 MAIN FORM FFICIAL USE ONLY		FCC Use Only
APPLICA	ANT INFORMATION			annean ann ann an tha ann an tha ann an tha ann ann
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1-8. Legal	Name of Applicant			
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 Richin	S		
9-16. Name	of Contact Representative			
Name:	Carlos Nalda	Phone Number:	5713325626	
Company:	LMI Advisors	Fax Number:		
Street:	Suite 345	E-Mail:	cnalda@lmi	advisors.com
City:	Washington	State:	DC	
Country:	USA	Zipcode:	20037-	
Attention:	Mr. Carlos Nalda	Relationship:	Other	
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17c. Is a fee	submitted with this application	on?	poold rioque	
O If Yes, c	complete and attach FCC Form	n 159.		
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20. NATURE OF SERVICE: Thi	is filing is for an authorization to provide	or use the following type(s) of se	ervice(s): Select all that
a. Fixed Satellite			
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C. Radiodetermination Satelli	te		
d. Earth Exploration Satellite			
e. Direct to Home Fixed Sate	llite		
F . Digital Audio Radio Servic	ce		
NGSO			
21 STATUS: Choose the button	next to the applicable status 22.	If earth station applicant, check al	ll that apply.
Choose only one.		Using U.S. licensed satellites	11 2
Common Carrier Non-Co	ommon Carrier	Using Non-U.S. licensed satellites	S
23. If applicant is providing INTF	ERNATIONAL COMMON CARRIER s	ervice, see instructions regarding S	Sec. 214 filings. Choose
Are these facilities:	_	-	
• Connected to a Public Switch	ned Network • Not connected to a Publ	ic Switched Network 🔍 N/A	· · · · · · · · · · · · · · · · · · ·
24. FREQUENCY BAND(S): PI	ace an "X" in the box(es) next to all app	icable frequency band(s).	·····
🗖 a. C-Band (4/6 GHz) 🗖 b. K	Lu-Band (12/14 GHz)		
C.Other (Please specify upper	and lower frequencies in MHz.)		
Frequency Lower: 401 Frequency	y Upper: 401.3		
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25. CLASS OF STATION: Choo	se the button next to the class of station	hat applies. Choose only one.	
a. Fixed Earth Station			
• b. Temporary-Fixed Earth St	ation		
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- C. 12/14 OHZ VSAI Netwon	k		
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 c. 12/14 GHZ VSAT Netword d. Mobile Earth Station (N/A) e. Geostationary Space St (N/A) f. Non-Geostationary Space g. Other (please specify) 26. TYPE OF EARTH STATION Transmit/Receive Transmit/Receive Transmit/Receive Transmit/Receive Transmit/Receive Transmit/Receive Transmit/Receiv	k ation ce Station I FACILITY: Choose only one. it-Only O Receive-Only O N/A PURPOSE OF MOI I modification is to: (Place an 'X' in the b ENVIRONMENTA of any proposal in this application or amo by 47 CFR 1.1307? If YES, submit the ission's rules, 47 C.F.R. §§ 1.1308 and 1 Study must accompany all applications f ents. th station applicants not proposin autical fixed radio station services vernment or the representative of any for	DIFICATION ox(es) next to all that apply.) AL POLICY endment have a significant statement as required by Sections 1311, as an exhibit to this or new transmitting facilities, maj g to provide broadcast, com are not required to respond eign government?	O Yes ● No or nmon carrier, aerona to Items 30-34. O Yes ● No
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 c. 12/14 GHZ VSAT Netword d. Mobile Earth Station (N/A) e. Geostationary Space St (N/A) f. Non-Geostationary Space g. Other (please specify) 26. TYPE OF EARTH STATION Transmit/Receive Transmit/Receive Transmit/Receive Transmit/Receive Transmit/Receive 27. The purpose of this proposed Not Applicable 28. Would a Commission grant of environmental impact as defined 1.1308 and 1.1311 of the Comm application.<u>A Radiation Hazard modifications, or major amendmin</u> ALIEN OWNERSHIP Earth en route or aerona 29. Is the applicant a foreign gov 30. Is the applicant an alien or th 	k ation ce Station I FACILITY: Choose only one. it-Only Receive-Only N/A PURPOSE OF MOI I modification is to: (Place an 'X' in the b ENVIRONMENTA of any proposal in this application or amo by 47 CFR 1.1307? If YES, submit the ission's rules, 47 C.F.R. §§ 1.1308 and 1 Study must accompany all applications f ents. th station applicants not proposin nutical fixed radio station services vernment or the representative of any for a representative of an alien?	DIFICATION ox(es) next to all that apply.) AL POLICY endment have a significant statement as required by Sections 1311, as an exhibit to this or new transmitting facilities, maj g to provide broadcast, com are not required to respond eign government?	O Yes O No or imon carrier, aerona i to Items 30-34. O Yes O No O Yes O No O No
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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? If Yes, attach as an exhibit, copies of the requests for waivers or exceptions with supporting documents.	0	Yes	۲	No
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 explination of circumstances.	0	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 explination of circumstances.	0	Yes '	۲	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	0	Yes	۲	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 exhinit, an explanation of the circumstances.	0	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.	۲	Yes (o :	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.	۲	Yes ()	No
42b. What administration has licensed or is in the process of licensing the space station? If no license will be i has coordinated or is in the process of coordinating the space station?Norway	issue	ed, wl	hat	administration
43. Description. (Summarize the nature of the application and the services to be provided). Draft Form to surequest to provide TT&C for CICERO spacecraft.	upp	oort i	30	-day STA
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.	۲	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.	0	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.	0	С		
CERTIFICATION				
The Applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as ag of the United States because of the previous use of the same, whether by license or otherwise, and requests an a	gain auth	st the oriza	reg tior	gulatory power

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.)

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O Individual				
Unincorporated A	ssociation			
• Partnership				
• Corporation • Covernmental En	t; ta,			
Other (please specified)	uty http://			
LLC	,iry)			
45 Name of Person S	ianina	46 Title of Pe	rson Signing]
Christopher Richi	ns	CEO	130h Orgining	
47 Please supply any r	need attachments			
Attachment 1:	Attachme	ent 2:	Attachment 3:	
			ADI E DX EINE AND //	D IMPRICONMENT
(U.S. Co (U.S. Co	de, Title 18, Section 1001), ANI ode, Title 47, Section 312(a)(1))/OR REVOCATION OF), AND/OR FORFEITURE	ABLE BY FINE AND / C ANY STATION AUTHO E (U.S. Code, Title 47, Sec	RIZATION ction 503).
	SATELLITE EAR	TH STATION AU	THORIZATIONS	5
FCC	Form 312 - Schedule	B:(Technical and	Operational Desc	ription)
				_
	17. P		T X7	
	FOR	OFFICIAL USE ON	LY	
Location of Farth Stati	on Site			
E1: Site Identifier:	Deadhorse	E5. Call Sign:		
E2: Contact Name	Zachary Reich	E6. Phone Number:	415-622-5548	
E3. Street:		E7. City:	Deadhorse	
		E8. County:	North Slope Boro	ugh
E4. State	АК	E9. Zip Code	99734	0
E10. Area of Operation	1:	Deadhorse, AK		
E11. Latitude:	70 ° 12 ' 42.9 " N	,		
E12. Longitude:	148 ° 26 ' 15.2 " W			
E13. Lat/Lon Coordina	ites are:	o _{NAD-27}	●NAD-83	o _{N/A}
E14. Site Elevation (A)	MSL):	15.0 meters		
E15. If the proposed an do(es) the proposed ant	tenna(s) operate in the Fixed Sate enna(s) comply with the antenna	ellite Service (FSS) with geo gain patterns specified in Se	estationary satellites, ection 25.209(a) and (b) as	o _{Yes} o _{No}
compliance with two-de	egree spacing policy.	ement: II NO, provide asa t	eennical analysis snowing	IN/A
E16. If the proposed an	tenna(s) do not operate in the Fix	ed Satellite Service (FSS), o	or if they operate in the	_
Fixed Satellite Service	(FSS) with non-geostationary sate	ellites, do(es) the proposed a	ntenna(s) comply with	●Yes ONO N/A
qualification measurem	ents?	and (0) as utilionstrated by	the manufacturel S	IN/A
E17. Is the facility oper	ated by remote control? If YES, j	provide the location and tele	phone number of the	Vec O No
control point.				
E18. Is frequency c as	oordination required? If Y	ES, attach a frequency	coordination report	⁰ Yes ● No
E19. Is coordinatio	n with another country requ	uired? If YES, attach th	ne name of the	O Yes ● No
Country(les) and pl	St of coordination contours	as	* 119(_)) XX71_	
E20. FAA Notifica	tion - (See 47 CFR Part 1 s required have you attac	7 and 47 CFR part 25	o.113(c)) Where	
854 and or the FA	A 's study regarding the n	otential hazard of the	structure to	
aviation?	in stary repairing the p	Contractions and the television of televisio		• Yes • No
FAILURE TO CO	MPLY WITH 47 CFR PA	ARTS 17 AND 25 WI	LL RESULT IN	
THE RETURN O	F THIS APPLICATION.			

3/30/2018

POINTS O	F COMMUNIC	ATION											
Satellite	Name:OTHE	RIOTHE	RlIfy	you selec	ted O	THE	R, please	ent	ter the fol	lowing	:		
E21. Con	nmon Name:	CICERO	Cubes	ats			E	22.	. ITU Nar	ne: Tyv	ak-	0082	
E23. Orb	it Location: N	IGSO					E	24.	. Country	: Norwa	ay		
POINTS O	F COMMUNIC	ATION (De	estinatio	on Points)									
E25. Site	Identifier: De	adhorse					*****						
E26. Con	nmon Name:	***	*					Ē	E27. Cour	ntry:US	A		
ANTENNA				*******									
Site ID	E28. Antenna Id	E29. Quantity	29. E30. E31. Anto ntity Manufacturer Model Si				E32 Anter Size	32. E41/42. Antenna GainTransmin enna and/or Recieve(dBi at GHz)				ansmint Bi at	
Deadhors	ieYAGI-1M2 Antenna Systems400CP30A3.5716.2 dBi at 0.400												
E28. Antenna Id	E33/34. D Minor/Majo	iameter r(meters)	ter ters) E35. Above Ground Level (meters) E36. Above Sea Level Level (meters) E37. Bu Above Sea Level (meters) E37. Bu		. Building ght Above round Level neters)	ng E38. Total Input Power at antenna flange (Watts)		al E3 ver na H	al E39. Maximum /er Antenna ha Height Above Rooftop (meters)		E40. Total EIRP for al carriers (dBW)		
YAGI-1	0.025/3.57		15.0	0.0		0.0		4	4.7	0.0)	i	32.7
FREQUEN	CY	1							I				
E28. Antenna Id	E43/44. Frequency Bands(MH:	E45. T/R z) Mode	Pola	E46. Antenna Polarization(H,V,L,R		L,R)	E47. Emissio Designat	on tor	E48. Maximu EIRP per Carrier(dBV		mum E49. Maxin Der Densit IBW) Carrier(dF		num ERIP y per W/4kHz)
YAGI-1	401 401.3	R	Righ	t Hand C	ircula	ar	16K5G11	D	0.0		0	.0	
E50. Mod	lulation and S	ervices T	Г&С I	Downlink									
YAGI-1	401 401.3	Т	Righ	t Hand C	ircula	ar	16K5G11	D	32.7		2	6.7	
E50. Mod	lulation and S	ervices T	Г&С I	Jplink									
FREQUEN	CY COORDINA	TION											
E28. Antenna Id	E51. Satellit Orbit Type	e E52/ Freque Limits()	53. ency MHz)	E54/55. Range of Satellite Arc E/W Limit	E Ea Sta Azi Aı Eas Li	56. arth ation muth ngle stern	E57. Antenn Elevatic Angle Eastern Limit	a)n n	E58. Earth Station Azimuth Angle Western Limit	E59 Anten Elevat Ang Weste Lim	ina ion le ern it	E60. M EIRP towa Horizon(d	laximum Density ırd the 1BW/4kHz
YAGI-1	Non- Geostationar	401 401	.3	0.0/ 0.0	0.0		5.0		360.0	5.0		0.0	
	Non- Geostationar	401 401	.3	0.0/ 0.0	0.0		5.0		360.0	5.0		26.7	
REMOTE (CONTROL POI	NT LOCAT											
E61. Call Si NOTE: Plea application i	gn use enter the calls is being filed.	ign of the co	ontrollin	ig station, r	not the	callsig	n for which	h thi	S	E65. Ph 650-74	one 16-8	Number 3744	
2205 1521	Address												
E63. City Redmond						E67. C King	County			Ed St W	54/6 ate/0 /A/	8. Country USA	E66. Zip Code 98052
FCC NOT	TICE REQUI	RED BY 1	THE P	APERW	ORK	RED	UCTION	A	CT				h

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 licensing.fcc.gov/ibfsweb/ib.page.FetchForm?id_app_num=114146&form=P013_101.htm&mode=display

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.

From:	"Målen Frode" <frode.maalen@nkom.no></frode.maalen@nkom.no>
Sent:	Fri, 21 Apr 2017 07:56:17 +0000
To:	"BRMAIL, ITU" <brmail@itu.int></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 92 82 46 04 Mobile: + 47 93 45 58 64 www.nkom.no Norwegian Communications Authority

bmission	I: TYVAK-0082-APT.MDB Plan Id.: Notice type: NONGEO	A113 Inter sat. org. BR1 Date of receipt 22.02.2017 BR20 BR IFIC no.	9.1/IA BR2 Adm. serial no.		b-sección IA المسمرة *Tyvak Proprietary*	C4a C4a	Hz) Class of station	101.3 EW	:02 ET, EW	101.3 ET ET	159 EW	
SpacePub	10:20:01 AM	 Notifying adm. Not 	BR3a Provision refer		/ Artículo { / IA ,	BR47	Frequency ban	401 -	2200 -	401 -	8045 -	
	4.2017 1	Atf.	-		sction IA аздел IA	BR9	Action code					
	Date: 19.0	82		en	vrticle 9, sub-se Статья 9, подра	BR7a	Group id.	12	10	6	11	
	CKYP	TYVAK-00	6	Resum	~ ~	BR8	Action code					-
	ested by: RI	at. Network 🛛	ld. no.	ummary /	5-section IA	B2	Emi-Rcp	ж	Е	ы	ы	
•	E_TSUM Requi	A A1a S	BR6a/BR6b	Résumé / S	Article 9, sous 第9条第1A分节	B1a	Beam designation	UHFRX	SBANDTX	UHFTX	XBANDTX	

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A A A1a Sum Requested by: KICKXP Late: 19.04.	.201/ 10:20:01 AM DB: TYVAK-0082-API.MDB Aff1 Notifying adm NOR Aff3 Inter sat ord	Plan Id.: RP1 Date of receint [22 02 2017]	Notice type: NONGEO
BR6a/BR6b ld. no.	BR3a Provision reference 9.1/IA	BR2 Adm. serial no.	UHERX R
A1f2 Submitted on behalf			
A4b1 No. of orbital planes 1 A4b2 Ref A4b3a No. of space stations simult. trans. on Northern He.	f. body T A4b3b No. of space stations simult. tr	ans. on Southern Hemisphere	
OrbitalA4b4aInclinationA4b4bNo. ofplane id. no.anglesatellites in this plane1976	A4b4c Period A4b4d Apogee A4b4e Perigee A4b4f Mi 0-01-37 600-0		
		1	
B1a/BR17 Beam designation UHFRX	B1b Steerable B2 Emi-Rcp R	B3a1 Max. co-polar gain 2	
B2bis.a Transmit only when visible from notified service al	trea B2bis.b Min. Elev. Angle		
Co-polar ref. pattern Coef. A Co. ND-SPACE	B3c1 Co-polar antenna pattern bef. B	Co-polar rad. diag.	·
List of orbital planes			
T			
B4a3a1 Angle alpha B4a3a2 Angle bett BR92 Attach. for missing angle alpha/beta			
BR7a/BR7b Group id: 12	BR1 Date of receipt [22.02.2017] C2c RR N	vo. 4.4	
BR14 Special Section			
C4a Class of station EW C4b Nature of service CR	C3a Assigned freq. band	C5a Noise temperature 303 C6b Polarization anole	
C11a2 Service area		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 C8a1/C8b1 C8. Design. of emission Max. peak pwr Max.	ta2/C8b2 C8c1 C8c2 C8c3 Dwr dens. Min. peak pwr Attch. Min. pwr den:	s. Attch. CN ratio Attch.	C8f2 E.i.r.p. on the beam axis
1 16K5G1D 22.6	-19.6 13 -29.	2 84	
404.04 MHz 401.08 MHz 401.	C7b Carrier frequency of the emissions (16K5G11 .12 MHz 1 401 16 MHz 1 401 2 MHz	D) (1 401 24 (MH> (1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
C10b1 C10b2 C10c1	1 C10c2 C10d1/C10d2 C10d3 C10d4		
Assoc. earth station id. Type Geographica	al coord. Ctry Cls. / Nat. Max. iso. Bmwdth gain		
ORBEX1 S 018E29 14 65	9N03 19 NOR 1 TW CR 16.2 25		
	C10d5a Co-polar antenna	a pattern	
C1001 ASSOC. Earth Station Id. CO-polar ref. pattern ORBEX1 REC-580-6	Coef. G Coef. B Coef. C	Coef. D Phi1 Co-pc	olar rad. diag.
13C Remarks			
B1a/BR17 Beam designation SBANDTX	B1b Steerable B2 Emi-Rcp E	B3a1 Max. co-polar gain 5	

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<u>*Tyvak Proprietary*</u>	
E. TSUM Requested by: RICKYP Date: 19.04.2017 10:20:01 AM DB: TYVAK-0082-API. MDB Plan Id.: Notice type: Notice type: Noi A A1a Sat. Network TYVAK-0082 A111 Notifying adm. Not	IFIC no.
B2bis.a Transmit only when visible from notified service area Y B2bis.b Min. Elev. Angle [10] B3c1 Co-polar antenna pattern B3c1 Co-polar antenna pattern Co-polar ref. pattern Coef. A Coef. B ND-SFACE B4a3a2 Angle beta B4a3a2 Angle beta	
BR92 Attach. for missing angle alpha/beta	
BR14 Special Section ET EW C3a Assigned freq. band C4a Class of station ET EW C3a Assigned freq. band C4a Class of station ET EW C3a Assigned freq. band C4b Nature of service CR CR Polarization type C4f Max. tot. peak pwr. C3d2 Contiguous bandwidth C6b Polarization angle 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 C1 Frequency Range 2200 MHz 2202	
C7a C8a1/C8b1 C8a2/C8b2 C8c1 C8c2 C8c3 C8c4 C8e1 C8e2 C8f1 C8e2 C8f1 C8e1 C8e2 C8f1 C8e2 C8f1 C8e2 C8f1 C8e1 C8e2 C8f1 C8e2 C8f1 C8e2 C8f1 C8e2 C8f1 C8e2 C8f1 C8e2 C8f1 C1f1 C1f1 C8f1	<i>C8f1</i> on the beam axis 3
2201 MHz C7b Carrier frequency of the emissions (1M50G1D)	
C10b1 C10b2 C10c1 C10c2 C10d2 C10d2 C10d3 C10d6 Assoc. earth station id. Type Geographical coord. Ctry Cls. / Nat. Max. iso. Bmwdth Noise ORBOPEX T T 1 TT CR 40 1.6 150]
C10b1 Assoc. earth station id. Co-polar ref. pattern C10d5a Co-polar antenna pattern ORBOPEX NEC-580-6 Coef. A Coef. B Coef. C 13C Remarks Image: Complex of the station of	
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 B10 B2bis.a Transmit only when visible from notified service area Y B2bis.b Min. Elev. Angle 10 Co-polar ref. pattern Coef. A Coef. B Coef. B Coeplar antenna pattern ND-SPACE B4a3a1 Angle alpha B4a3a2 Angle beta Coeplar antenna Coeplar rad. diag.	
BR92 Attach. for missing angle alpha/beta	

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UHF Beam Pattern



LHCP 3D Pattern

RHCP 3D Pattern



FAR FIELD Amplitude 399.925 MHz: Theta Cut for Phi = 75°

