



312 File Number: **SATAMD2020050400041**

Filing Description

Question	Response
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Description	Amendment to "Application to Modify the Authorization for the Swarm NGSO Satellite System" in VHF MSS band (137-138 MHz and 148-150.05 MHz)
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**Satellite
Information**

Question	Response
Select Orbit Type	NGSO
Space Station or Satellite Network Name	Swarm 1
Estimated Lifetime of Satellite(s) From Date of Launch	5 Years
Will the space station(s) operate on a Common Carrier basis?	No

Operating
Frequency
Bands (2)

Nature of service	Description	Frequency Band(s)	Mode Type
Mobile-Satellite Service		148.0 MHz -150.05 MHz	Receive
Mobile-Satellite Service		137.0 MHz -138.0 MHz	Transmit

**Orbital
Information For
Non-
Geostationary
Satellites**

Question	Response
Total Number of Satellites in the active constellation	300
Orbit Epoch Date	07/01/2020
Celestial Reference Body	Earth

Orbital Plane 1:

Question	Response
Number of Satellites in Plane	32
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	234.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	259.9
2	271.2
3	282.5
4	293.8
5	305.1
6	316.4
7	327.7
8	339.0
9	350.3
10	0.0
11	11.3
12	22.6
13	33.9

14	45.2
15	56.5
16	67.8
17	79.1
18	90.4
19	101.7
20	113.0
21	124.3
22	135.6
23	146.9
24	158.2
25	169.5
26	248.6
27	237.3
28	226.0
29	214.7
30	203.4
31	192.1
32	180.8

Orbital Plane 2:

Question	Response
Number of Satellites in Plane	32
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	168.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds

Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	101.7
2	90.4
3	79.1
4	67.8
5	350.3
6	339.0
7	327.7
8	316.4
9	305.1
10	293.8
11	282.5
12	271.2
13	259.9
14	248.6
15	237.3
16	226.0
17	214.7
18	203.4
19	192.1
20	180.8

21	0.0
22	11.3
23	22.6
24	33.9
25	45.2
26	56.5
27	113.0
28	124.3
29	135.6
30	146.9
31	158.2
32	169.5

Orbital Plane 3:

Question	Response
Number of Satellites in Plane	32
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	54.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
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1	180.8
2	192.1
3	203.4
4	169.5
5	158.2
6	146.9
7	135.6
8	124.3
9	113.0
10	350.3
11	339.0
12	327.7
13	316.4
14	305.1
15	293.8
16	282.5
17	271.2
18	259.9
19	248.6
20	237.3
21	226.0
22	214.7
23	0.0
24	11.3
25	22.6
26	33.9

27	45.2
28	56.5
29	67.8
30	79.1
31	90.4
32	101.7

Orbital Plane 4:

Question	Response
Number of Satellites in Plane	36
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	332.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	170.0
2	160.0
3	50.0
4	150.0
5	140.0
6	130.0

7	120.0
8	110.0
9	100.0
10	90.0
11	80.0
12	70.0
13	60.0
14	40.0
15	30.0
16	20.0
17	10.0
18	0.0
19	350.0
20	340.0
21	330.0
22	320.0
23	310.0
24	300.0
25	290.0
26	280.0
27	270.0
28	260.0
29	250.0
30	240.0
31	230.0
32	220.0

33	210.0
34	200.0
35	190.0
36	180.0

Orbital Plane 5:

Question	Response
Number of Satellites in Plane	32
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	288.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	192.1
2	203.4
3	214.7
4	226.0
5	237.3
6	248.6
7	259.9
8	271.2

9	282.5
10	293.8
11	305.1
12	316.4
13	327.7
14	339.0
15	350.3
16	33.9
17	45.2
18	56.5
19	67.8
20	79.1
21	90.4
22	101.7
23	113.0
24	124.3
25	135.6
26	146.9
27	158.2
28	169.5
29	180.8
30	0.0
31	11.3
32	22.6

Orbital Plane 6:

Question	Response
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Number of Satellites in Plane	32
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	127.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	350.3
2	339.0
3	327.7
4	316.4
5	305.1
6	293.8
7	282.5
8	271.2
9	259.9
10	248.6
11	237.3
12	226.0
13	214.7
14	203.4
15	192.1

16	180.8
17	0.0
18	11.3
19	22.6
20	33.9
21	45.2
22	56.5
23	67.8
24	79.1
25	90.4
26	101.7
27	113.0
28	124.3
29	135.6
30	146.9
31	158.2
32	169.5

Orbital Plane 7:

Question	Response
Number of Satellites in Plane	24
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	105.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km

Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
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Active Service Arc End Angle with respect to Ascending Node	90.0 degrees
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Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	165.0
2	150.0
3	135.0
4	120.0
5	105.0
6	90.0
7	75.0
8	60.0
9	45.0
10	30.0
11	15.0
12	0.0
13	225.0
14	240.0
15	180.0
16	330.0
17	315.0
18	270.0
19	255.0
20	300.0
21	345.0

22	210.0
23	195.0
24	285.0

Orbital Plane 8:

Question	Response
Number of Satellites in Plane	40
Inclination Angle	10.0 degrees
Right Ascension of Ascending Node	0.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-10.0 degrees
Active Service Arc End Angle with respect to Ascending Node	10.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	0.0
2	9.0
3	18.0
4	27.0
5	36.0
6	45.0
7	54.0
8	63.0
9	72.0

10	81.0
11	90.0
12	99.0
13	108.0
14	117.0
15	126.0
16	135.0
17	144.0
18	153.0
19	162.0
20	171.0
21	351.0
22	342.0
23	333.0
24	324.0
25	315.0
26	306.0
27	297.0
28	288.0
29	270.0
30	261.0
31	252.0
32	243.0
33	234.0
34	225.0
35	216.0

36	207.0
37	198.0
38	189.0
39	180.0
40	279.0

Orbital Plane 9:

Question	Response
Number of Satellites in Plane	40
Inclination Angle	45.0 degrees
Right Ascension of Ascending Node	0.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-45.0 degrees
Active Service Arc End Angle with respect to Ascending Node	45.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	180.0
2	189.0
3	198.0
4	207.0
5	171.0
6	162.0
7	153.0

8	144.0
9	135.0
10	126.0
11	117.0
12	108.0
13	99.0
14	90.0
15	81.0
16	72.0
17	63.0
18	54.0
19	45.0
20	36.0
21	27.0
22	18.0
23	9.0
24	0.0
25	351.0
26	342.0
27	333.0
28	324.0
29	315.0
30	306.0
31	297.0
32	288.0
33	279.0

34	270.0
35	261.0
36	252.0
37	243.0
38	234.0
39	225.0
40	216.0

**Receiving
Beams 1:**

Question	Response
Beam ID	RB01
Receive Beam Frequency	148.0 MHz -150.05 MHz
Beam Type	Fixed
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees
Polarization Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
G/T at Max. Gain Point	-24.8 dB/K
Min. Saturation Flux Density	-154.2 dBW/m2
Max. Saturation Flux Density	-125.2 dBW/m2
Co- or Cross Polar Mode	C
Service Area Description	Global

Receiving Channels (41)

Channel ID	Channel Bandwidth (MHz)	Center Frequency s (MHz)	Feeder Link, Service Link or TT&C
R022	0.05	149.075	Service Link
R041	0.05	150.025	Service Link
R040	0.05	149.975	Service Link
R039	0.05	149.925	Service Link
R038	0.05	149.875	Service Link
R037	0.05	149.825	Service Link
R036	0.05	149.775	Service Link
R035	0.05	149.725	Service Link
R034	0.05	149.675	Service Link
R032	0.05	149.575	Service Link
R031	0.05	149.525	Service Link
R030	0.05	149.475	Service Link
R029	0.05	149.425	Service Link
R027	0.05	149.325	Service Link
R026	0.05	149.275	Service Link
R025	0.05	149.225	Service Link
R024	0.05	149.175	Service Link
R023	0.05	149.125	Service Link
R021	0.05	149.025	Service Link
R020	0.05	148.975	Service Link
R019	0.05	148.925	Service Link
R018	0.05	148.875	Service Link
R017	0.05	148.825	Service Link
R016	0.05	148.775	Service Link

R015	0.05	148.725	Service Link
R014	0.05	148.675	Service Link
R013	0.05	148.625	Service Link
R012	0.05	148.575	Service Link
R011	0.05	148.525	Service Link
R010	0.05	148.475	Service Link
R009	0.05	148.425	Service Link
R008	0.05	148.375	Service Link
R007	0.05	148.325	Service Link
R006	0.05	148.275	Service Link
R005	0.05	148.225	Service Link
R004	0.05	148.175	Service Link
R003	0.05	148.125	Service Link
R002	0.05	148.075	Service Link
R001	0.05	148.025	Service Link
R033	0.05	149.625	Service Link
R028	0.05	149.375	Service Link

Transmitting
Beams 1:

Question	Response
Beam ID	TB01
Transmit Beam Frequency	137.0 MHz -138.0 MHz
Beam Type	Fixed
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees
Polarization Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
Max. Transmit EIRP Density	-41.4 dBW/Hz
Max. Transmit EIRP	1.76 dBW
Co- or Cross Polar Mode	C
Service Area Description	Global

Max. Power Flux Density

	* 0° - 5°	* 5° - 10°	* 10° - 15°	* 15° - 20°	* 20° - 25°	* 25° - 90°
	(dbW/m ²	(dbW/m ²	(dbW/m ²	(dbW/m ²	(dbW/m ²	(dbW/m ²
* BW:	/BW):	/BW):	/BW):	/BW):	/BW):	/BW):
4.0 kHz	-129.4	-129.3	-129.2	-129.0	-128.8	-125.9

**Transmitting
Channels (20)**

Channel ID	Channel Bandwidth (MHz)	Center Frequency s (MHz)	Feeder Link, Service Link or TT&C
T020	0.05	137.975	Service Link
T019	0.05	137.925	Service Link
T018	0.05	137.875	Service Link
T017	0.05	137.825	Service Link
T016	0.05	137.775	Service Link
T015	0.05	137.725	Service Link
T014	0.05	137.675	Service Link
T013	0.05	137.625	Service Link
T012	0.05	137.575	Service Link
T010	0.05	137.475	Service Link
T009	0.05	137.425	Service Link
T005	0.05	137.225	Service Link
T004	0.05	137.175	Service Link
T003	0.05	137.125	Service Link
T002	0.05	137.075	Service Link
T011	0.05	137.525	Service Link
T001	0.05	137.025	Service Link
T006	0.05	137.275	Service Link
T007	0.05	137.325	Service Link
T008	0.05	137.375	Service Link

Certification Questions

Question	Response
Are the applicable service area coverage requirements of 25.143(b)(2) (ii) and (iii), or 25.144(a)(3)(i), or 25.145 (c)(1) and (2), or 25.146(i)(1) and (2), or 25.148(c), or 25.225 met?	N/A
Are the applicable frequency tolerances of 25.202(e) and out-of-band emission limits of 25.202(f)(1),(2), and (3) met?	Yes
Are the cessation of emissions requirements of 25.207 met?	Yes
Are the applicable power-flux-density limits of 25.208 met, and is the appropriate technical showing provided within the application?	
For NGSO applications, are the applicable equivalent-power-flux-density limits of 25.208 met, and is the appropriate technical showing provided within the application?	N/A
Are the applicable full-frequency-reuse requirements of 25.210 met?	
If the application is for a 17/24 GHz BSS space station, will it be operated at an offset location with full power and interference protection in accordance with 25.262(b)?	

Attachments

File Name	Beam	Field	Attachment Type	Description
<u>Transmit Antenna Pattern.pdf</u>	TB01	NGSO Antenna Gain Data	PDF file (*.pdf)	Antenna pattern for satellite transmit beam
<u>Receive Antenna Pattern.pdf</u>	RB01	NGSO Antenna Gain Data	PDF file (*.pdf)	Antenna pattern for satellite receive beam