Exhibit B – Technical Annex

1. Scope

This Attachment contains technical information regarding the Yet Another Mission 3 (YAM-3) non-geostationary satellite orbit (NGSO) satellite, as required by Section 25.114 and other sections of the Part 25 rules.

2. General Description (Section 25.114(d)(1))

The YAM-3 satellite hosts the following payloads:

- Two RGB imaging sensors
- a UHF Internet of Things (IoT) Payload that transmits in the 400.05-400.15 MHz band and receives in the 864-925 MHz band[1]
    - TX – Beacon
        - 400.05-400.15 MHz (programmable in this range)
        - 20% TX Duty cycle within 5s frame
        - Turnstile antenna
        - 1.1 dBi antenna gain
        - 5 dBW EIRP
    - RX – Data Collection
        - Channels
            - CH1: 865.7 MHz – 1.4 MHz bandwidth
            - CH2: 868.85 MHz – 1.7 MHz bandwidth
            - CH3: 904.0 MHz – 4.0 MHz bandwidth
            - CH4: 922.0 MHz – 4.0 MHz bandwidth
        - Patch RX Antenna (low gain)
            - 80-degree half power beamwidth
            - 6.7 dBi peak gain
        - Patch Array RX Antenna (high gain)
            - 43-degree half power beamwidth
            - 10.5 dBi peak gain
- a software defined radio that receives and processes L-band data signals in the 1535-1559 MHz band from authorized and coordinated Inmarsat plc (Inmarsat) Geostationary (GSO) satellites
- a Globalstar terminal to demonstrate space-to-space communications relayed via the Globalstar constellation in the Globalstar-authorized and assigned frequencies, *i.e.*, 1615.65 MHz/1616.88 MHz and 2489.31 MHz/2490.54 MHz
- an S-band IoT Payload that transmits and receives in the 2400-2483.5 MHz band
    - TX
        - 2400-2483.5 MHz (26 channels from 2403.5 MHz, every 3 MHz)
        - RHCP
        - Patch antenna
        - 7.0 dBi antenna gain
        - 7.0 dBW EIRP
    - RX – Data Collection
        - 2400-2483.5 MHz (101 channels from 2402.75 MHz, every 0.75 MHz)

[1] This payload will operate pursuant to the International Telecommunication Union (ITU) filing F-SAT-NG-8 and will also be separately licensed by the French administration. *See* Exhibit A, Narrative at n.9.

- RHCP
- Patch antenna
- 7.0 dBi antenna gain
- 3.5 dB noise figure

3. Spacecraft Overview

The satellite is 3-axis stabilized, achieves beam steering via body steering of the bus, and does not employ any form of propulsion.

The YAM-3 satellite has the following characteristics:

- UHF uplink and downlink telemetry, tracking, and command (backup TT&C)
- S-band uplink primary TT&C
- X-band downlink mission data and primary TT&C
- Software defined radios
- Intersatellite communications with the Globalstar constellation

The spacecraft will operate in the frequencies listed below.

Table 1 Frequencies

Usage	Link Direction	Spectrum Range
Primary TT&C Uplink	Uplink (Earth-space)	2025-2110 MHz
Backup TT&C Uplink	Uplink (Earth-space)	449.75-450.25 MHz
Backup TT&C Downlink	Downlink (space-Earth)	400.15-401.0 MHz, 401.0-402.0 MHz
Primary TT&C and Payload Downlink	Downlink (space-Earth)	8025-8400 MHz
UHF IoT Payload Beacon	Downlink (space-Earth)	400.05-400.15 MHz
UHF IoT Payload Data Collection	Uplink (Earth-space)	864-925 MHz
S-band IoT Payload TX	Downlink (space-Earth)	2400.0-2483.5 MHz
S-band IoT Payload RX	Uplink (Earth-space)	2400.0-2483.5 MHz
L-band Data Signal	Receive (space-space)	1535-1559 MHz
Globalstar - Data	Transmit (space-space)	1615-1617.5 MHz[2]
Globalstar - Data	Receive (space-space)	2483.5-2495 MHz[3]

4. Orbital Parameters

The YAM-3 satellite is expected to be deployed at a target altitude of 525 km orbital altitude at an inclination of 97.6 degrees.[4] This deployment (with a 10 km margin) ensures that the satellite will meet the FCC's 6-year de-orbit requirement for satellites authorized under the FCC's new small satellite streamlined licensing rules.[5]

[2] Specifically, Loft Orbital will transmit in the L-band on Globalstar channels 5 and 6 (*i.e.*, 1615.65 MHz and 1616.88 MHz center frequencies; and 1.23 MHz bandwidth).
[3] Specifically, Loft Orbital will receive in the S-band (*i.e.*, 2489.31 MHz and 2490.54 MHz center frequencies).
[4] As a worst-case analysis, Loft Orbital has assumed a 535 km deployment orbital altitude for purposes of the orbital debris analysis.
[5] *See* Narrative at Part II.

5. TT&C

The YAM-3 TT&C sub-system provides for communications during on-station operations, as well as during spacecraft emergencies. S-band telecommand transmissions are received by the spacecraft through patch antennas with near-omni directional patterns during on-station operations and during both transfer orbit and emergency operations. The UHF band is used for backup TT&C operations. UHF telecommand transmissions are received by the spacecraft, and UHF telemetry is transmitted by the spacecraft through whip antennas with near-omni directional patterns during on-station operations and during both transfer orbit and emergency operations.

The S-band command channels have a bandwidth of up to 132 kHz. The UHF commanding channels have a bandwidth of 34 kHz and UHF telemetry channels have a bandwidth of 17 kHz. TT&C operations will be conducted from Kongsberg Satellite Services (KSAT) TT&C sites including: Svalbard, Troll, and potentially others. The specific S-band commanding channel and UHF commanding and telemetry channels are listed in the Schedule S and reproduced below for convenience. Planned channel information is provided below in Table 2 and Table 4.

The S-band TT&C command receive beam have peak gains of 6 dBiC, and the UHF command/telemetry beams have peak gains of 4.4/4.1 dBiL respectively. Therefore, pursuant to Section 25.114(c)(4)(vi)(A) of the Commission's rules, contours for these beams are provided in the associated GXT files included in Schedule S.

The YAM-3 satellite will use a sufficiently unique telemetry marker at deployment to assure that its telemetry stream can be unambiguously identified.

Contact details for the control center are provided below:

Address:
Alexander B. Greenberg
Co-Founder and Chief Operating Officer
715 Bryant Street, Suite 202
San Francisco, CA 94118

Telephone:
410-382-5050

6. Frequency Plan

6.1 UHF

The following tables list the uplink and downlink UHF channels planned for the YAM-3 satellite. This information is also provided in the accompanying Schedule S but is included here for completeness.

Table 2 UHF Downlink Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
UTX1	0.034	400.875	H
UTX2	0.034	401.015	H
UTX3	0.034	401.085	H

UTX4	0.034	401.155	H
UTX5	0.034	401.225	H
UTX6	0.034	401.375	H
UTX7	0.034	401.4375	H
UTX8	0.034	401.5	H

Table 3 UHF Uplink Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
UR1	0.017	450.125	H
UR2	0.017	450.2	H

6.2 S-Band

The following table lists the uplink S-band channel planned for the YAM-3 satellite. These channels are not finalized and are representative uplink and downlink channels. This information is also provided in the accompanying Schedule S but is included here for completeness.

Table 4 S-Band Uplink Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
SU1	0.132	2070	R
SU2	0.132	2071.25	R
SU3	0.132	2071.875	R
SU4	0.132	2072.5	R
SU5	0.132	2073.5	R

6.3 X-Band

The following table lists the downlink X-band channel planned for the YAM-3 satellite. This information is also provided in the accompanying Schedule S but is included here for completeness.

Table 5 X-Band Downlink Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
XD1H	100	8125	R

6.4 Globalstar Intersatellite Link

The following tables list the S-band space-space receive channels and the L-band space-space transmit channels planned for the YAM-3 satellite. The channels listed in the following two tables reflect the channels used for communications to/from the Globalstar network. This information is also provided in the accompanying Schedule S but is included here for completeness.

Table 6 Globalstar L-Band Space-Space Transmit Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
GT01	1.23	1615.65	LHCP
GT02	1.23	1616.88	LHCP

Table 7 Globalstar S-Band Space-Space Receive Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
GR01	1.23	2489.31	LHCP
GR02	1.23	2490.54	LHCP

6.5 L-band Data Signals

The following table lists the L-band space-to-space receive channels planned for the YAM-3 satellite. The receive-only payload concurrently receives MSS L-band data signals in the 1535-1559 MHz band from authorized and coordinated Inmarsat satellites. The L-band data signal provides satellite navigation correction data, augmenting the accuracy of Loft Orbital's location assessment.[6]

Table 8 L-Band Data Signal Space-to-Space Receive Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
IR01	0.005	1539.9325	RHCP
IR02	0.005	1545.895	RHCP
IR03	0.0025	1539.9525	RHCP
IR04	0.0025	1546.26	RHCP
IR05	0.005	1539.9125	RHCP
IR06	0.005	1545.9275	RHCP

[6] *See* Narrative at 18. The Commission has authorized earth stations licensed in the United States to communicate with Inmarsat satellites in this band. *See, e.g.*, Application of Deere & Company, IBFS File No. SES-LIC-20130422-00340, Exhibit C (filed Mar. 14, 2013); *see also Inmarsat, Inc. Request to Streamline Licensing of L-band Mobile-Satellite Service Terminals Using Inmarsat Satellites as Points of Communication*, Order, IBFS File No. SES-PDR-20080303-00367 (rel. Oct. 21, 2008).

IR07	0.005	1545.9375	RHCP
IR08	0.0025	1539.9625	RHCP
IR09	0.0025	1545.835	RHCP
IR10	0.0025	1545.52	RHCP
IR11	0.005	1539.9625	RHCP
IR12	0.005	1545.875	RHCP

6.6 UHF IoT Payload Signals

The following table lists the UHF IoT Payload's space-to-Earth beacon channels planned for the YAM-3 satellite. The UHF beacon operates at 400.1 MHz with a bandwidth of 1 kHz, 12 kHz, or 50 kHz depending upon operational mode. The UHF beacon signal is a programmable I/Q sampled waveform that lasts for 1s and is transmitted every 5s.

Table 9 UHF Beacon Signal Space-to-Earth Transmit Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
ET11	0.001	400.1	RHCP
ET21	0.012	400.1	RHCP
ET31	0.05	400.1	RHCP

The following table lists the UHF IoT Payload's Earth-to-space IoT receive channels planned for the YAM-3 satellite. The received UHF IoT signals are in the 864-925 MHz band. The payload digitizes the channels listed in

Table 10 and stores the digitized data into memory for subsequent data processing.

Table 10 UHF Data Collection Earth-to-Space Receive Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
ER1	1.4	865.7	RHCP
ER2	1.7	868.85	RHCP
ER3	4.0	904.0	RHCP
ER4	4.0	922.0	RHCP

6.7 S-Band IoT Payload Signals

The following table lists the S-band IoT Payload's space-to-Earth transmit channels planned for the YAM-3 satellite. The S-band IoT Payload downlink operates at 2400.0-2483.5 MHz with a bandwidth of 100 kHz and varying spreading factors depending upon operational mode.

Table 11 S-Band IoT Downlink Signal Space-to-Earth Transmit Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
TT01	0.5	2403.5	RHCP
TT02	0.5	2406.5	RHCP
TT03	0.5	2409.5	RHCP
TT04	0.5	2412.5	RHCP
TT05	0.5	2415.5	RHCP
TT06	0.5	2418.5	RHCP
TT07	0.5	2421.5	RHCP
TT08	0.5	2424.5	RHCP
TT09	0.5	2427.5	RHCP
TT10	0.5	2430.5	RHCP
TT11	0.5	2433.5	RHCP
TT12	0.5	2436.5	RHCP
TT13	0.5	2439.5	RHCP
TT14	0.5	2442.5	RHCP
TT15	0.5	2445.5	RHCP
TT16	0.5	2448.5	RHCP
TT17	0.5	2451.5	RHCP
TT18	0.5	2454.5	RHCP
TT19	0.5	2457.5	RHCP
TT20	0.5	2460.5	RHCP
TT21	0.5	2463.5	RHCP
TT22	0.5	2466.5	RHCP
TT23	0.5	2469.5	RHCP
TT24	0.5	2472.5	RHCP
TT25	0.5	2475.5	RHCP
TT26	0.5	2478.5	RHCP

The following table lists the S-band IoT Payload’s Earth-to-space IoT receive channels planned for the YAM-3 satellite. The receive S-band IoT Payload signals are in the 2400.0-2483.5 MHz.

Table 12 S-Band IoT Uplink Signal Earth-to-Space Receive Frequency Plan

Channel ID	Bandwidth (MHz)	Center Frequency (MHz)	Polarization
TR01	0.5	2402.75	RHCP
TR02	0.5	2403.5	RHCP
TR03	0.5	2404.25	RHCP
TR04	0.5	2405	RHCP

TR05	0.5	2405.75	RHCP
TR06	0.5	2406.5	RHCP
TR07	0.5	2407.25	RHCP
TR08	0.5	2408	RHCP
TR09	0.5	2408.75	RHCP
TR10	0.5	2409.5	RHCP
TR11	0.5	2410.25	RHCP
TR12	0.5	2411	RHCP
TR13	0.5	2411.75	RHCP
TR14	0.5	2412.5	RHCP
TR15	0.5	2413.25	RHCP
TR16	0.5	2414	RHCP
TR17	0.5	2414.75	RHCP
TR18	0.5	2415.5	RHCP
TR19	0.5	2416.25	RHCP
TR20	0.5	2417	RHCP
TR21	0.5	2417.75	RHCP
TR22	0.5	2418.5	RHCP
TR23	0.5	2419.25	RHCP
TR24	0.5	2420	RHCP
TR25	0.5	2420.75	RHCP
TR26	0.5	2421.5	RHCP
TR27	0.5	2422.25	RHCP
TR28	0.5	2423	RHCP
TR29	0.5	2423.75	RHCP
TR30	0.5	2424.5	RHCP
TR31	0.5	2425.25	RHCP
TR32	0.5	2426	RHCP
TR33	0.5	2426.75	RHCP
TR34	0.5	2427.5	RHCP
TR35	0.5	2428.25	RHCP
TR36	0.5	2429	RHCP
TR37	0.5	2429.75	RHCP
TR38	0.5	2430.5	RHCP
TR39	0.5	2431.25	RHCP
TR40	0.5	2432	RHCP
TR41	0.5	2432.75	RHCP
TR42	0.5	2433.5	RHCP
TR43	0.5	2434.25	RHCP
TR44	0.5	2435	RHCP
TR45	0.5	2435.75	RHCP
TR46	0.5	2436.5	RHCP
TR47	0.5	2437.25	RHCP

TR48	0.5	2438	RHCP
TR49	0.5	2438.75	RHCP
TR50	0.5	2439.5	RHCP
TR51	0.5	2440.25	RHCP
TR52	0.5	2441	RHCP
TR53	0.5	2441.75	RHCP
TR54	0.5	2442.5	RHCP
TR55	0.5	2443.25	RHCP
TR56	0.5	2444	RHCP
TR57	0.5	2444.75	RHCP
TR58	0.5	2445.5	RHCP
TR59	0.5	2446.25	RHCP
TR60	0.5	2447	RHCP
TR61	0.5	2447.75	RHCP
TR62	0.5	2448.5	RHCP
TR63	0.5	2449.25	RHCP
TR64	0.5	2450	RHCP
TR65	0.5	2450.75	RHCP
TR66	0.5	2451.5	RHCP
TR67	0.5	2452.25	RHCP
TR68	0.5	2453	RHCP
TR69	0.5	2453.75	RHCP
TR70	0.5	2454.5	RHCP
TR71	0.5	2455.25	RHCP
TR72	0.5	2456	RHCP
TR73	0.5	2456.75	RHCP
TR74	0.5	2457.5	RHCP
TR75	0.5	2458.25	RHCP
TR76	0.5	2459	RHCP
TR77	0.5	2459.75	RHCP
TR78	0.5	2460.5	RHCP
TR79	0.5	2461.25	RHCP
TR80	0.5	2462	RHCP
TR81	0.5	2462.75	RHCP
TR82	0.5	2463.5	RHCP
TR83	0.5	2464.25	RHCP
TR84	0.5	2465	RHCP
TR85	0.5	2465.75	RHCP
TR86	0.5	2466.5	RHCP
TR87	0.5	2467.25	RHCP
TR88	0.5	2468	RHCP
TR89	0.5	2468.75	RHCP
TR90	0.5	2469.5	RHCP

TR91	0.5	2470.25	RHCP
TR92	0.5	2471	RHCP
TR93	0.5	2471.75	RHCP
TR94	0.5	2472.5	RHCP
TR95	0.5	2473.25	RHCP
TR96	0.5	2474	RHCP
TR97	0.5	2474.75	RHCP
TR98	0.5	2475.5	RHCP
TR99	0.5	2476.25	RHCP
TRX1	0.5	2477	RHCP
TRX2	0.5	2477.75	RHCP

7. Frequency Tolerance

The frequency tolerance requirements of Section 25.202(e) that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency will be met.

8. Out of Band Emissions

The out-of-band emission limits of Section 25.202(f)(1), (2), and (3) will be met.

9. Frequency Reuse

The YAM-3 satellite does not operate in any frequency bands where Section 25.210(f) applies.

10. Cessation of Emissions

All downlink transmissions can be turned on and off by ground telecommand, thereby achieving cessation of emissions from the satellite, as required by Section 25.207 of the FCC's rules.

11. International Telecommunication Union (ITU) Filings

Loft Orbital will be submitting an ITU Advance Publication Information, USASAT-30L, for the YAM-3 satellite. The UHF IoT Payload will be operated under an ITU filing submitted by the French Administration.[7]

12. Power Flux Density (PFD) Analysis

A. 8025-8400 MHz

The Commission's rules do not specify a PFD limit in the 8025-8400 MHz band; however, there are PFD limits specified in rule No. 21.16 of the ITU Radio Regulations. The maximum PFD levels for the YAM-3 transmissions were calculated for the 8025-8400 MHz band. The results are provided in Schedule S and demonstrate that the downlink PFD levels of the YAM-3 carriers do not exceed the limits specified in rule No. 21.16 of the ITU Radio Regulations.

Figure 1 below illustrates the X-band downlink PFD values in comparison with the ITU PFD limits in No. 21.16. This figure represents the maximum transmitted EIRP when the satellite is at the orbital altitudes of 525 km and 535 km.

[7] *See supra* note 1.

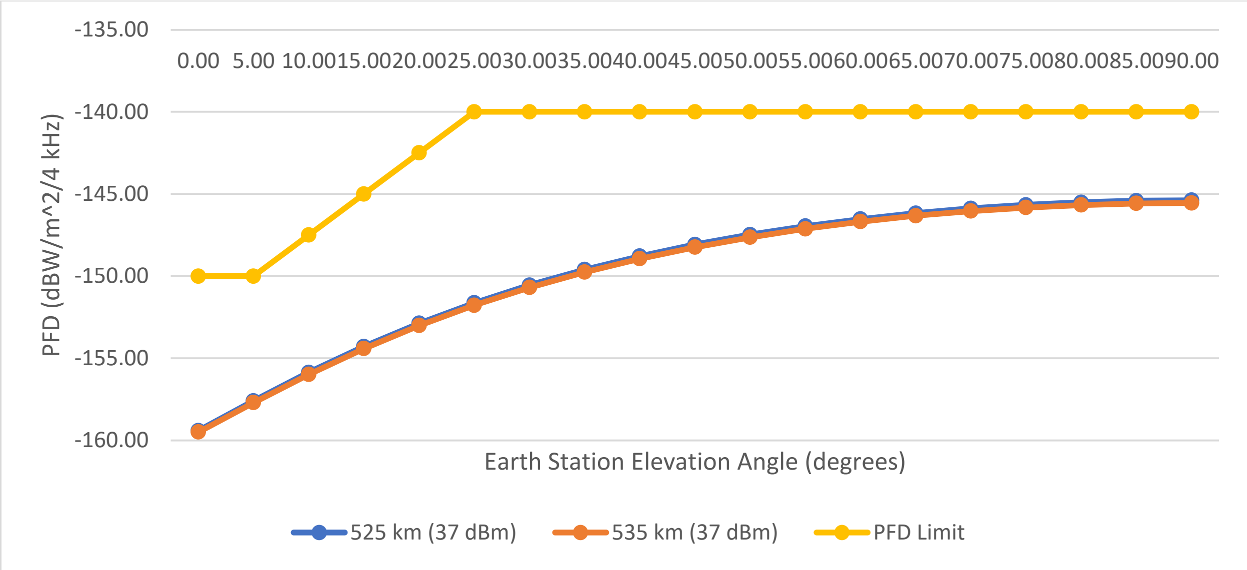

Figure 1 X-band Downlink PFD Analysis

B. 8400-8500 MHz

ITU-R Recommendation SA-1157 specifies a maximum allowable interference power spectral flux-density level at the earth's surface of –221 dB(W/Hz) to protect ground receivers in the deep-space research band operating in the 8400-8450 MHz frequencies.[8] Loft Orbital uses a combination of baseband digital filtering and hardware radio frequency filtering to achieve the ITU recommended protection for its out-of-band emissions in this frequency band.

13. L-band Interference Analysis

Loft Orbital will use a Globalstar modem, the GSP-1720, to conduct space-to-space communications relayed via the Globalstar constellation in the Globalstar-authorized and assigned frequencies, *i.e.*, 1615.65 MHz (Channel 5)/1616.88 MHz (Channel 6). Given an emission bandwidth of 1.23 MHz, the top end of this emission is 1617.495 MHz, which provides 280 kHz frequency separation between this emission and the bottom end of the shared Iridium/Globalstar spectrum band: 1617.775-1618.725 MHz.

Loft Orbital's use of the Globalstar modems on its YAM-3 satellite will not cause harmful interference into Iridium for the following reasons:

- Globalstar uses closed-loop power control to manage PFD at its satellite receiver.
- Loft Orbital will only operate in frequencies authorized to Globalstar.
- The Globalstar modem provides 24-32 dB more out of band isolation than required by ITU-R M.1343-1 and therefore causes less than –20 dB I/N into Iridium links in the shared Iridium/Globalstar bands.

The FCC has previously approved similar usage of the identical Globalstar modem on NGSO satellites.[9]

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[8] *See* Recommendation ITU-R SA.1157-1 (Protection criteria for deep-space research) (2006).

[9] *See, e.g.*, Stamp Grant, Astro Digital U.S., Inc., IBFS File No. SAT-LOA-20170508-00071 at Frequencies and n.4 (granted in part Aug. 1, 2018); Stamp Grant, Astro Digital U.S., Inc., IBFS File No. SAT-LOA-20170508-00071 at Frequencies and n.3 (granted in part Dec. 14, 2017).

14. S-band Interference Analysis

2400-2483.5 MHz Frequency Band

The YAM-3 satellite will transmit in this band via a near-omni antenna with a maximum EIRP of 7 dBW over 500 kHz. At an orbital altitude of 525 km, the results in interference levels are as high as 7 dB below the noise floor for a typical Wifi receiver with 0 dBi gain towards Zenith. This maximum interference level drops down to ~ 30 dB below the noise floor at the edge of coverage. Since the minimum bandwidth of a Wifi device is 20 MHz, the aggregate interference into a Wifi device would actually peak at 23 dB below the noise floor.

The S-band IoT payload will be operational no more than 1 hour / day, typically when within line-of-sight of San Diego, in a TDD configuration resulting in a maximum average transmitter utilization of 3%. For a Bluetooth device, employing frequency hopped spread spectrum, the maximum interference from the S-band IoT payload would be 10 dB below the noise floor and only affect 1 of 79 Bluetooth channels. Considering the 3% activity factor, the interference would only affect 0.04% of transmitted packets with a maximum link degradation of ~ 0.3 dB and a typical link degradation that is not measurable.

It should also be noted that most wireless devices operating in unlicensed spectrum do so in an indoor environment where an additional 5-40 dB of RF isolation can be expected. In the case of outdoor point-point links operating in the 2.4 GHz unlicensed ISM band, these links would typically employ directional antennas operating at low elevation angles with minimal directivity towards Zenith.

Totum Labs, Inc. ("Totum"), the customer of this payload, is separately seeking a Part 5 authorization to operate a single ground terminal ("Endpoint") with YAM-3 for experimental purposes.[10] Operations will occur in two sessions daily (0.5 hours each) over the San Diego, California Endpoint (horizon-to-horizon coverage).[11] Because of the limited operations for test purposes, as discussed more in Totum's Part 5 application, the proposed use of this band will not cause harmful interference to other services.

15. Link Budgets

Link analysis was conducted for YAM-3 for representative carriers in the S-band uplink and X-band downlink bands communicating with a 3.7m KSAT earth station. The results of the link analysis are shown in Attachment 1.

16. Satellite Antennas

S-band uplink employs a patch receive antenna. An antenna pattern cuts for the antenna in the vicinity of the planned uplink carriers, 2072 MHz, is shown in Figure 2. The peak uplink antenna gain is 6 dBi towards Nadir. The S-band uplink beam is effectively steerable via body steering of the YAM-3 satellite. This beam can be steered to a minimum elevation angle of 5 degrees anywhere within the satellite footprint. The X-band downlink antenna is a fixed-steering patch array with maximum gain of 16.2 dBi. The antenna pattern for the downlink X-band antenna is illustrated in Figure 3, and a projection of the X-band downlink antenna pattern, pointed towards Nadir, is illustrated in Figure 4. The X-band downlink beam is effectively steerable via body steering of the YAM-3 satellite. This beam can be steered to a minimum elevation angle of 5 degrees anywhere within the satellite footprint. The antenna patterns for the Globalstar space-space link are illustrated in Figure 5 and Figure 6.

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[10] *See* Application of Totum, ELS File No. 0391-EX-CN-2020 (filed May 4, 2020).

[11] As development progresses, Totum may conduct experiments with Endpoints in Germany and Sweden and would seek the appropriate regulatory authorizations in those countries prior to operations.

The Globalstar RX beam is Zenith pointing and has a maximum gain of 5.0 dBi and a 3dB beamwidth of 80 degrees. The Globalstar TX beam is Zenith pointing and has a maximum gain of 4.3 dBi and a 3dB beamwidth of 90 degrees.

The antenna pattern for the reception of the L-band data signals from Inmarsat satellites is illustrated in Figure 7. The L-band data signal RX beam is Zenith pointing and has a maximum gain of 5.0 dBi and a 3dB beamwidth of 80 degrees.

The antenna pattern for the transmission of the UHF programmable beacon waveform to the UHF IoT terminals is illustrated in Figure 8. The UHF beacon transmit beam is Zenith pointing and has a maximum gain of 1.1 dBi with a near omni-direction pattern.

The wide-beam and narrow-beam antenna patterns for the reception of the UHF waveforms from the UHF IoT terminals is illustrated in Figure 9 and Figure 10 for the wide-beam antenna pattern and in Figure 11 and Figure 12 for the narrow-beam antenna pattern. The UHF receive beams are Zenith pointing and have a maximum gain of 10.5 dBi for the narrow-beam and 6.7 dBi for the wide-beam near omni-direction pattern.

The UHF uplink and downlink TT&C links employ a whip antenna on the satellite with maximum transmit gain of 4.1 dBiL at 401 MHz and maximum receive gain of 4.4 dBiL at 450 MHz. The UHF TT&C antenna patterns are illustrated in Figure 13.

The S-band IoT payload uses a common patch antenna for both transmit and receive signals in the 2400-2483.5 MHz band. The maximum antenna gain is 7 dBi, and the antenna pattern is illustrated in Figure 14.

The antenna projections provided in the accompanying Schedule S reflect the beam projection towards Nadir from a NGSO satellite with an orbital altitude of 525 km. Due to limitations in the ITU GIMS software, the beam projections provided are GSO footprints. This approach was taken in order to provide actual GXT contours rather than just images of projected contours which is the only available option for NGSO systems.

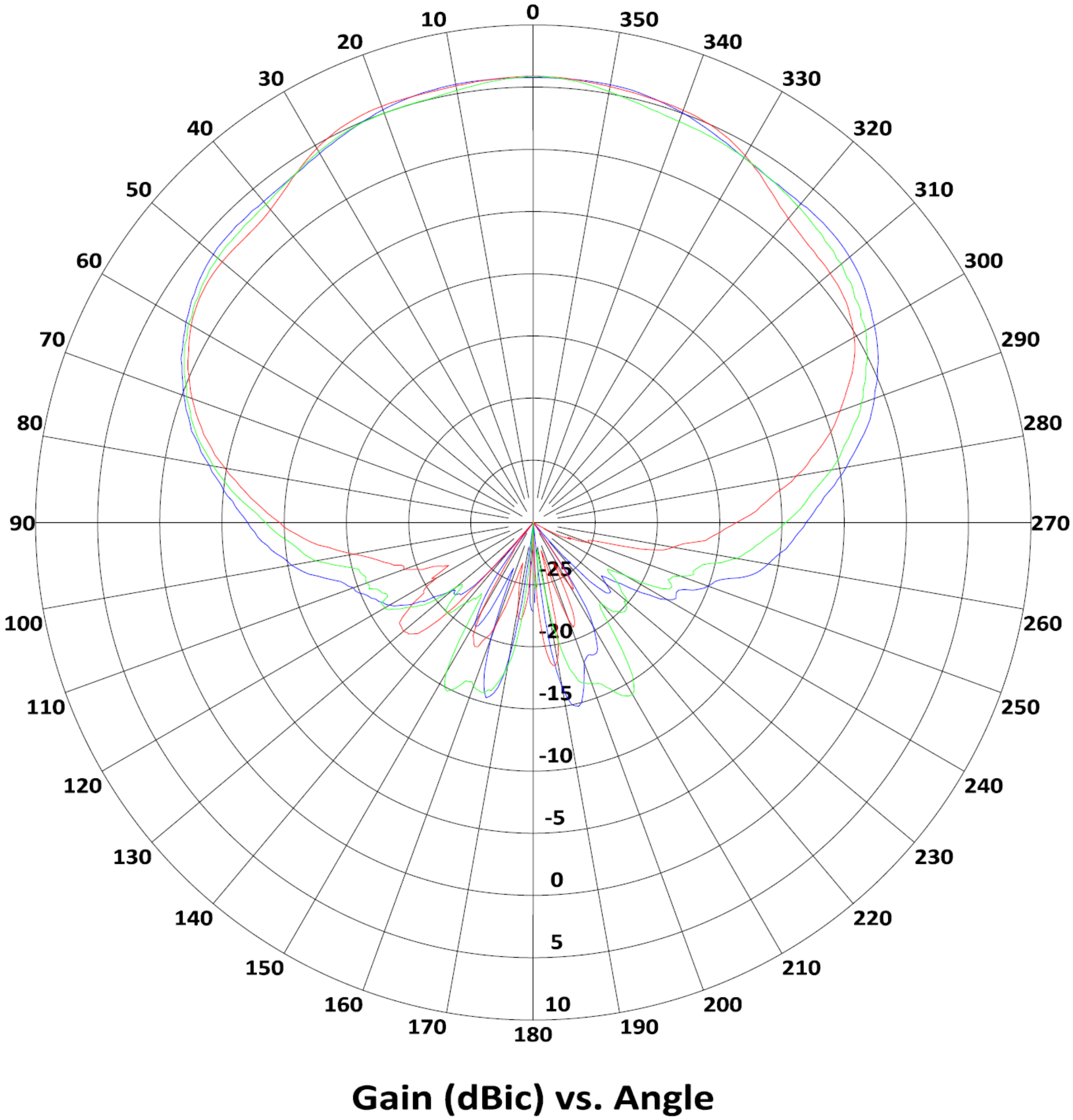


Figure 2 S-band Uplink TT&C (SRX) - Antenna Pattern

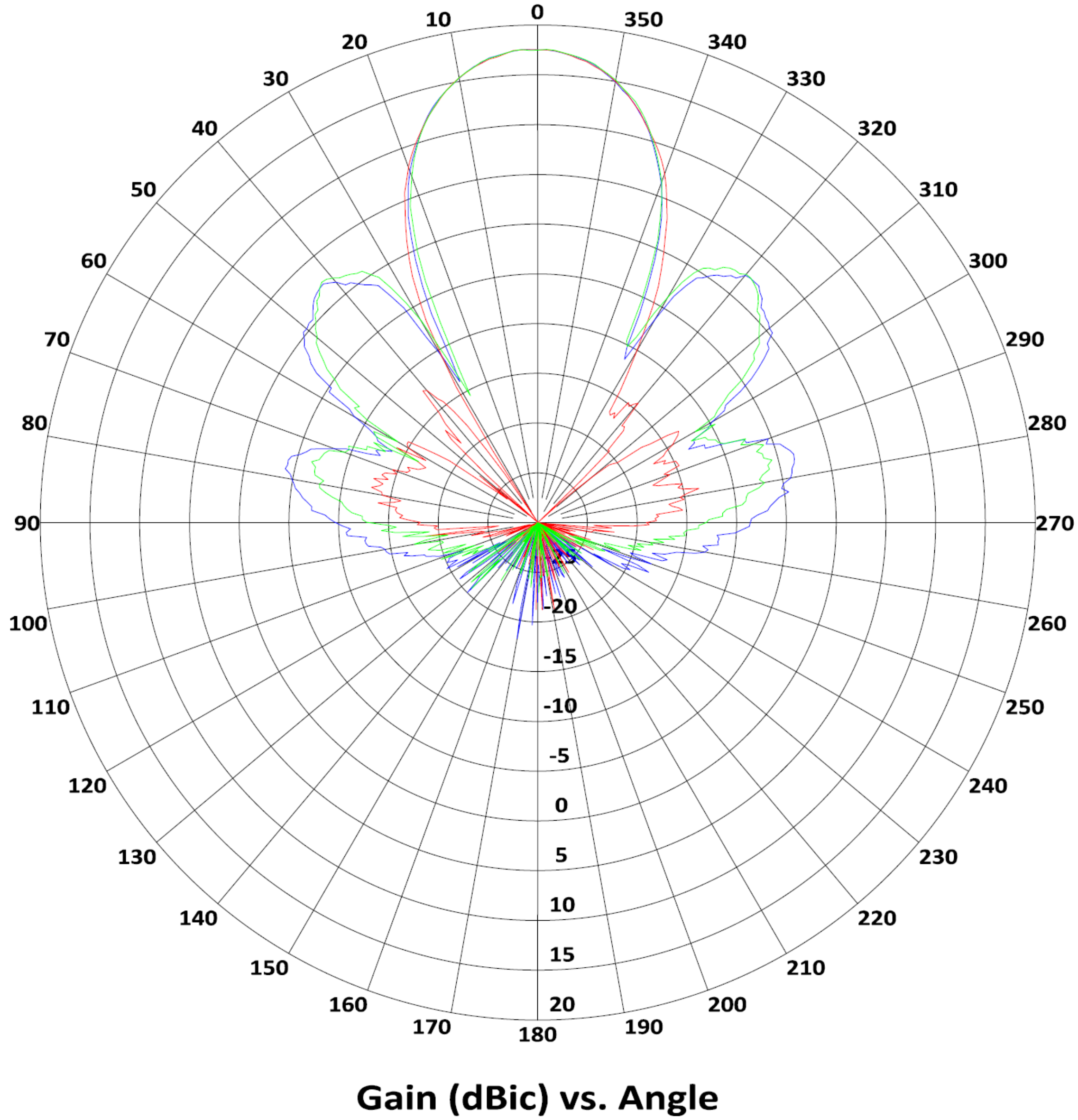


Figure 3 X-band Downlink Mission Data - Antenna Pattern

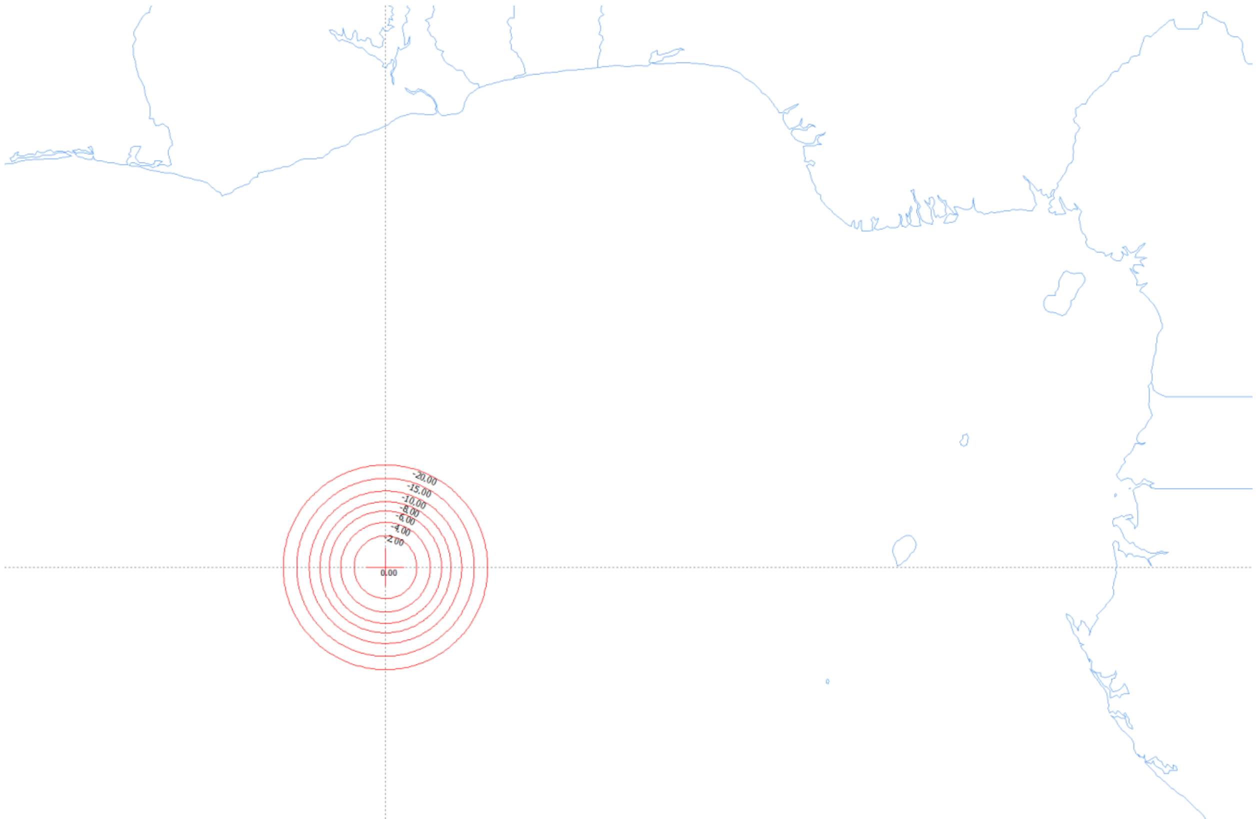


Figure 4 Projection of Nadir X-band Downlink Beam (XTX) near the West Coast of Africa

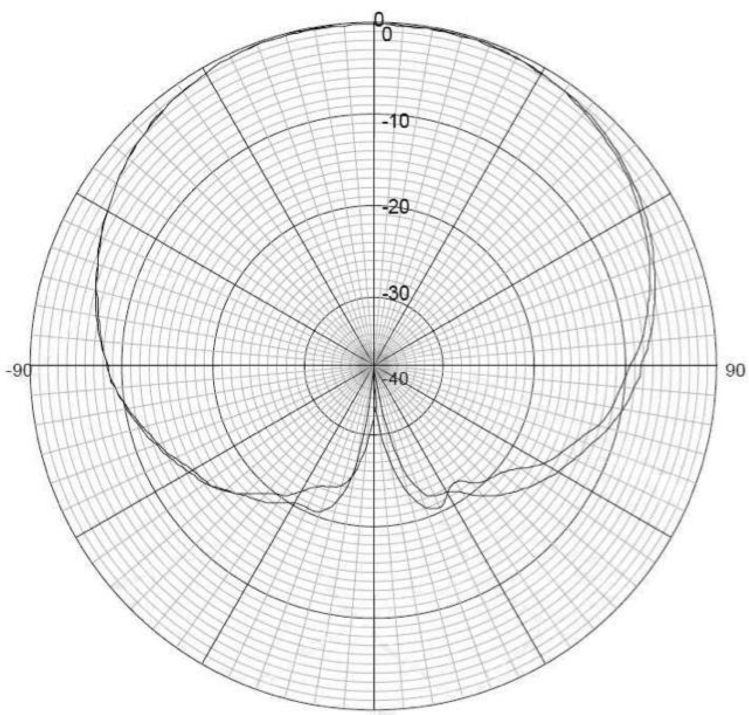


Figure 5 Globalstar Duplex Antenna (GTX) – L-band Transmit Pattern

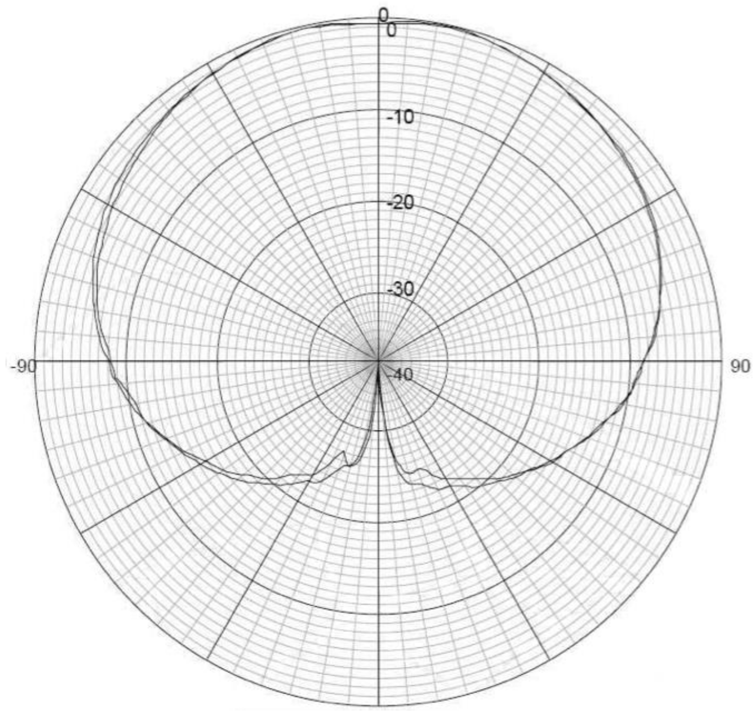


Figure 6 Globalstar Duplex Antenna (GRX) – S-band Receive Pattern

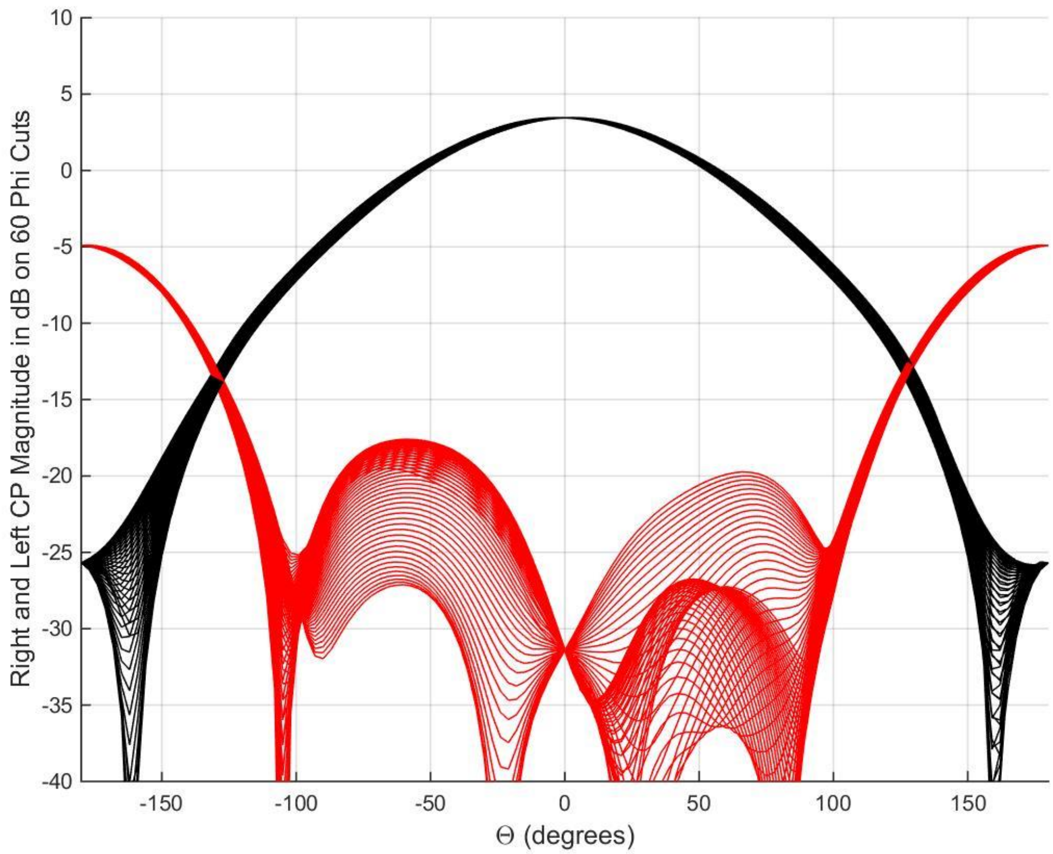
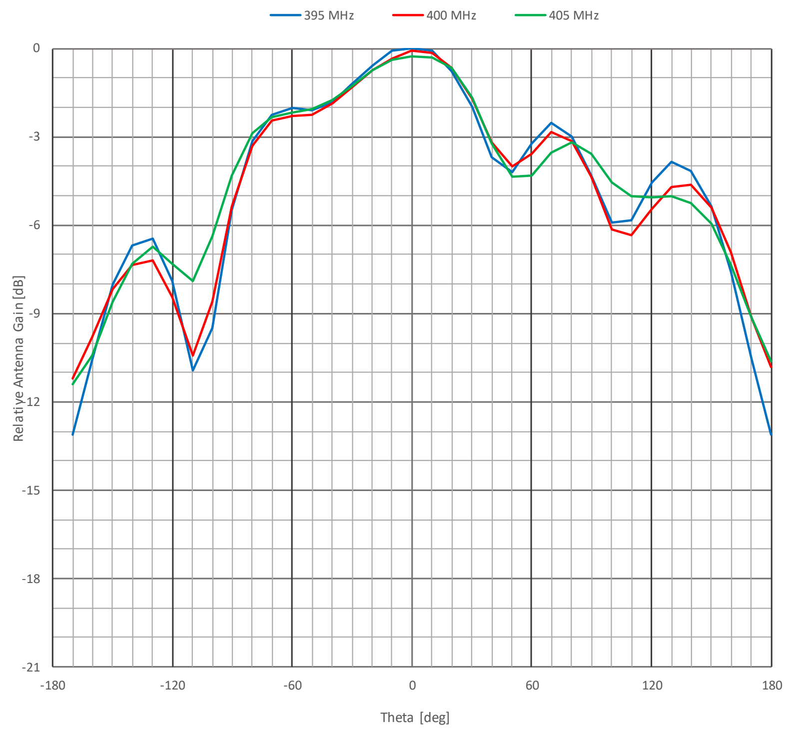


Figure 7 Inmarsat Antenna (IRX) – L-band Receive Pattern



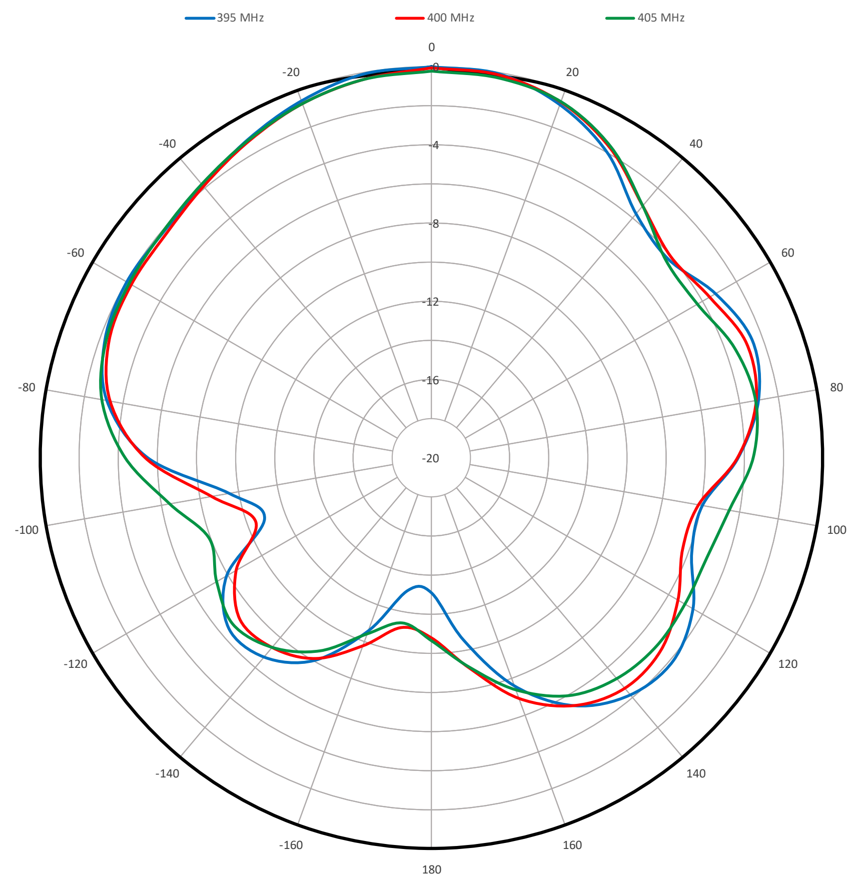


Figure 8 UHF IoT Beacon (ETXL) - Transmit Antenna Pattern

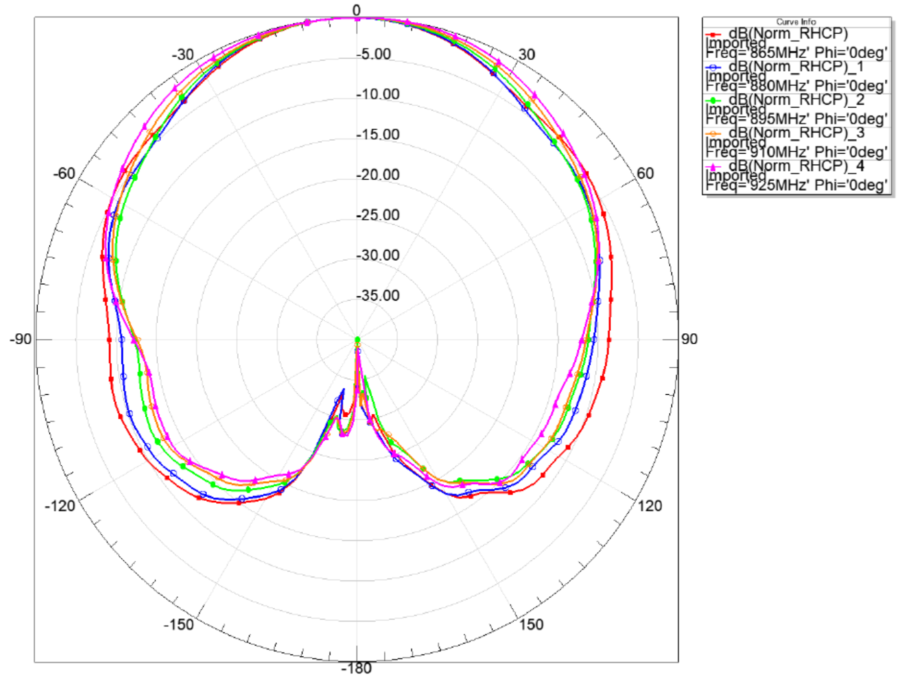


Figure 9 UHF IoT Wide-Beam (ERXL) - Receive Antenna Pattern – 0-deg Cut

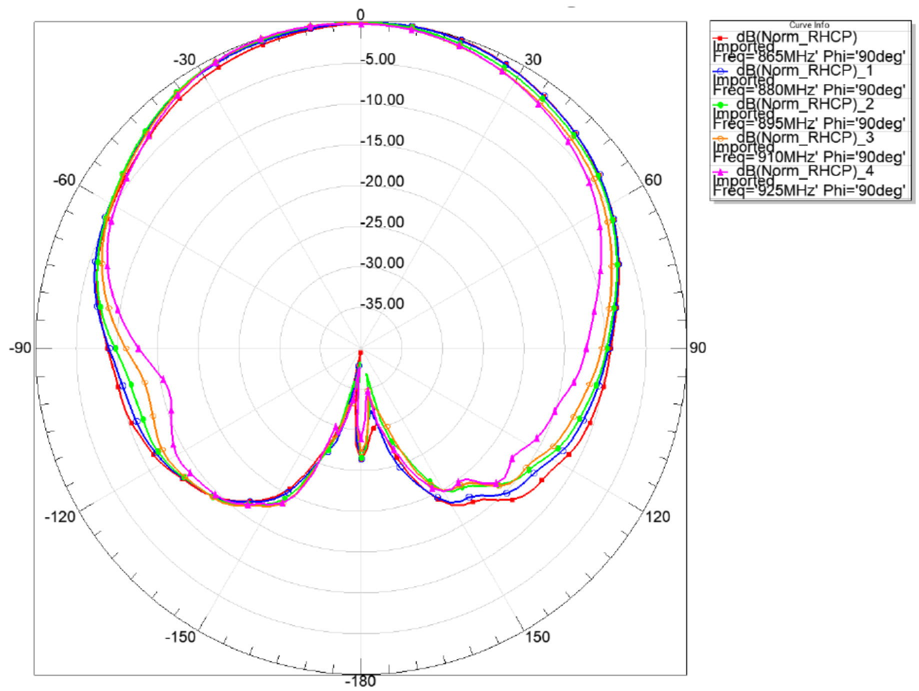


Figure 10 UHF IoT Wide-Beam (ERXL) - Receive Antenna Pattern – 90-deg Cut

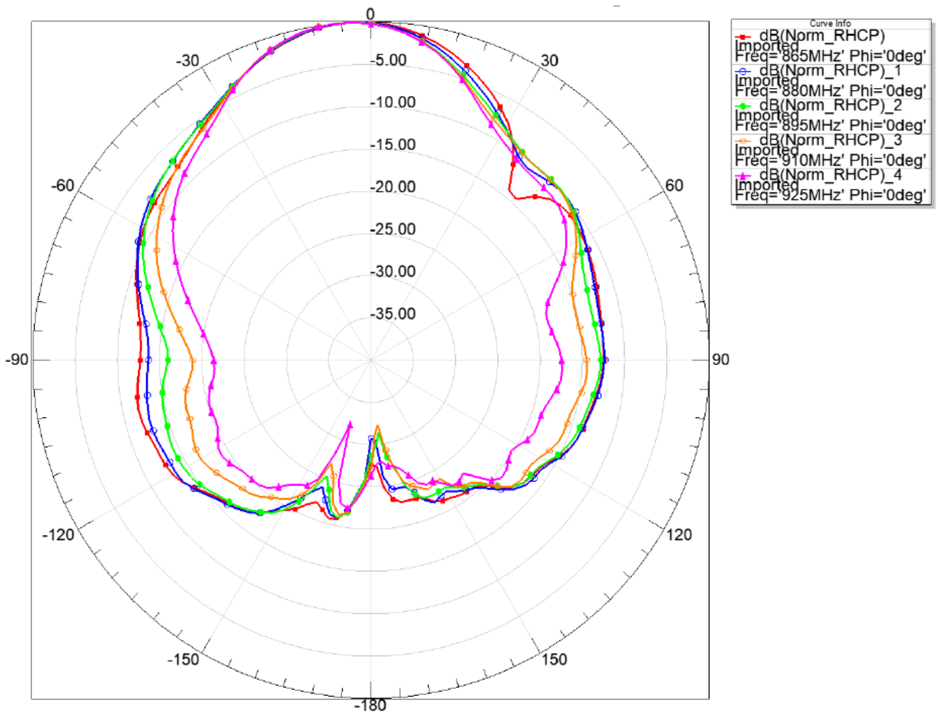


Figure 11 UHF IoT Narrow-Beam (ERXH) - Receive Antenna Pattern – 0-deg Cut

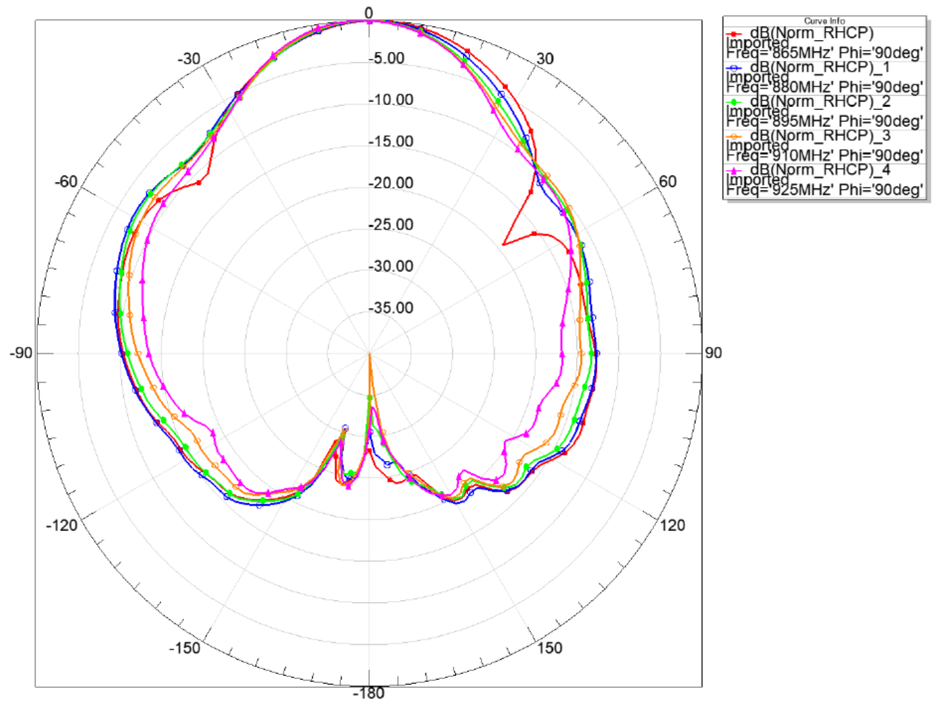


Figure 12 UHF IoT Narrow-Beam (ERXH) - Receive Antenna Pattern – 90-deg Cut

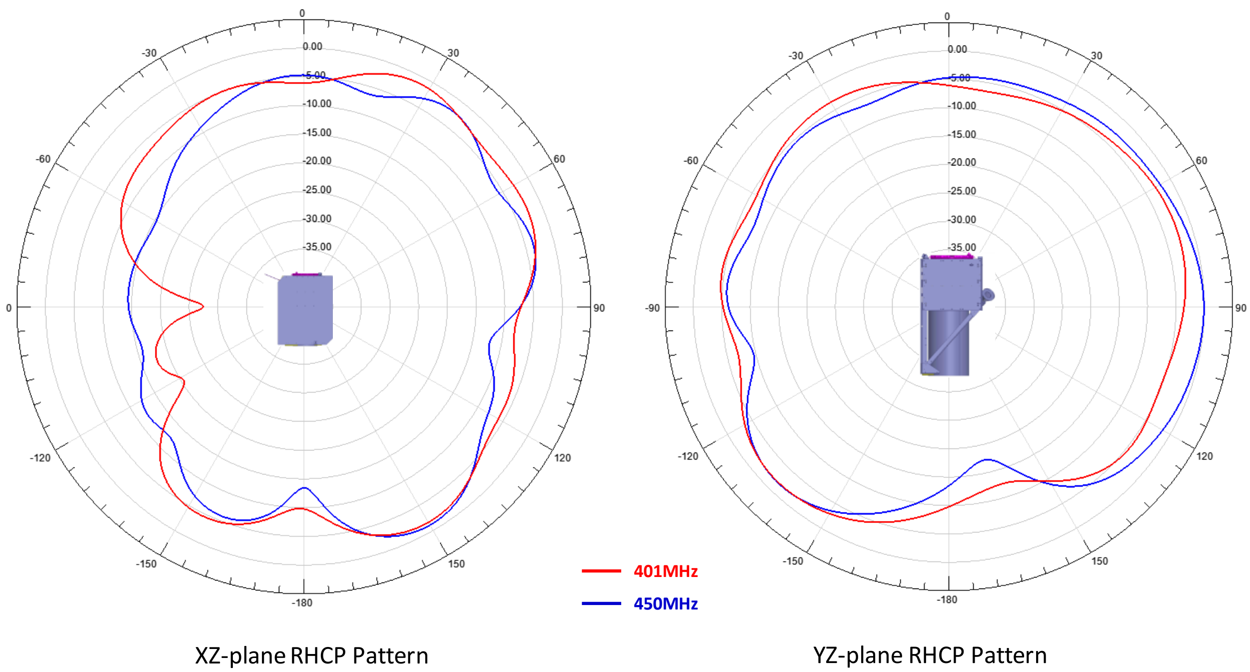


Figure 13 UHF TT&C Uplink (450 MHz) and Downlink (401 MHz) Satellite Antenna Patterns

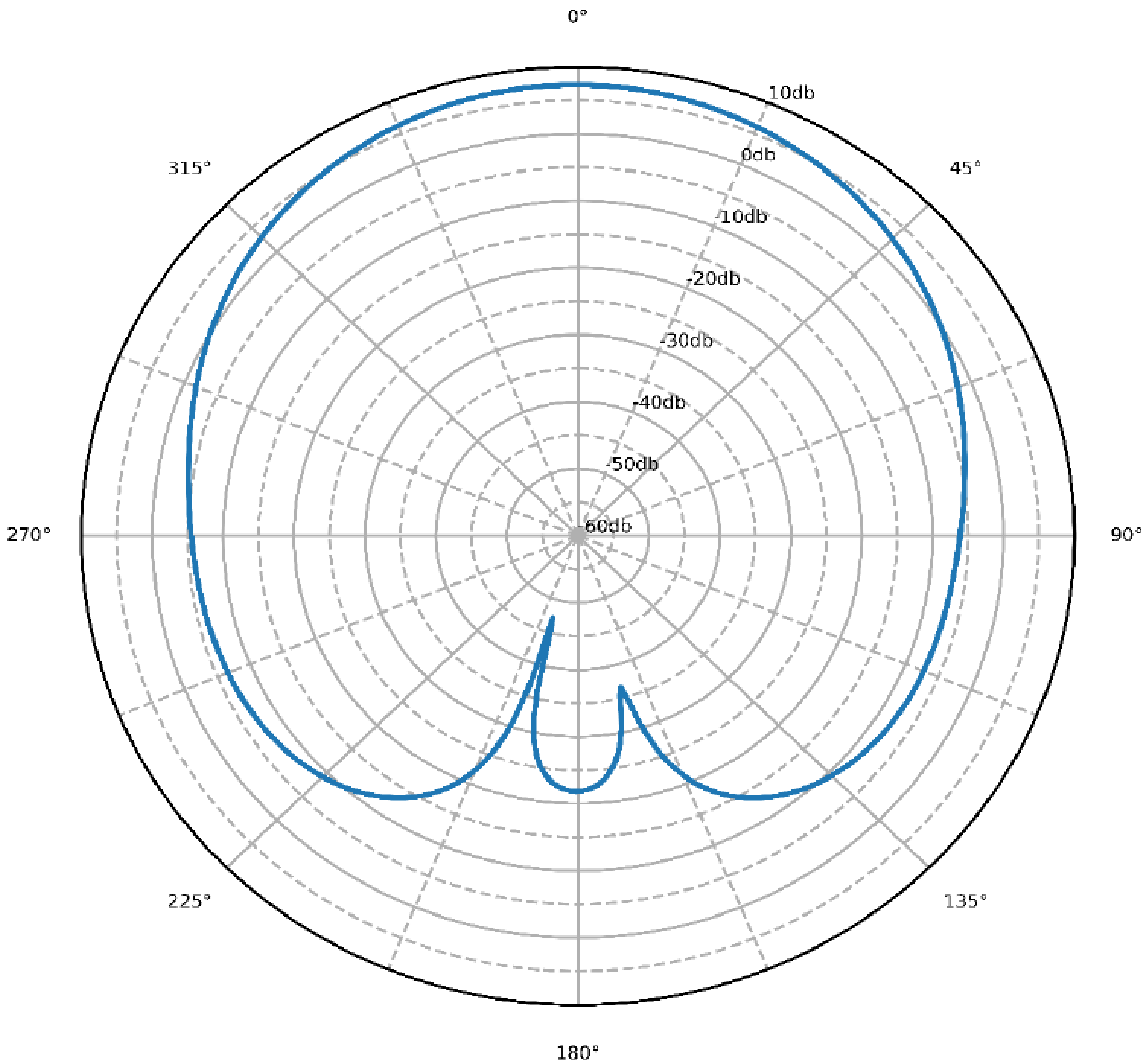


Figure 14 S-Band IoT Payload Uplink / Downlink Satellite Antenna Pattern

17. Earth Stations[12]

The YAM-3 satellite will rely upon the KSAT Lite network of 3.7m earth stations for S-band uplink TT&C communications and X-band downlink payload communications services. The characteristics of the KSAT Lite network of 3.7m antennas are summarized in Table 13 below.

Table 13 KSAT Antenna Characteristics

	S-band	X-band
Reflector Size	3.7m	3.7m
Downlink Band	NA	8025-8400 MHz
G/T (20-deg elevation)	NA	26.5 dB/K
Polarization	LHCP/RHCP	LHCP/RHCP

[12] The terminals transmitting in the 864-925 MHz band will comply with Part 15 or other analogous rules regarding the operation of unlicensed devices. *See* Narrative at 13-14, 19.

Uplink Band	2025-2110 MHz	NA
EIRP	44.8 dBW	NA

Loft Orbital will be using two ground stations in the KSat Lite network, SvalSat and TrollSat.

Table 14 KSAT Earth Station Locations Supporting the YAM-3 Satellite

Name	Type	Country	Coordinates
SvalSat	S band (uplink, downlink) X band (downlink)	Norway (Svalbard)	78.2298° N, 15.3965° E
TrollSat	S band (uplink, downlink) X band (downlink)	Antarctica	72.0167° S, 2.5333° E

The YAM-3 satellite will rely upon the KSAT network for UHF uplink and downlink TT&C communications. Loft Orbital will be using the same two ground stations in the KSAT network, SvalSat and TrollSat.

18. Orbital Debris Risk Mitigation Plan

Loft Orbital confirms that the YAM-3 satellite will not undergo any planned release of debris during its normal operations.[13] In addition, all separation and deployment mechanisms, and any other potential source of debris, will be retained by the spacecraft. Loft Orbital has also assessed the probability of the space station becoming a source of debris by collision with small debris or meteoroids of less than one centimeter in diameter that could cause loss of control and prevent post-mission disposal. Loft Orbital has taken steps to limit the effects of such collisions through shielding, the placement of components, and the use of redundant systems.

Loft Orbital has assessed and limited the probability of accidental explosions during and after completion of mission operations through a failure-mode verification analysis.[14] As part of the satellite manufacturing process, Loft Orbital has taken steps to ensure that debris generation will not result from the conversion of energy sources on board the satellite into energy that fragments the satellite. All sources of stored energy onboard the spacecraft will have been depleted or safely contained when no longer required for mission operations or post-mission disposal.

Loft Orbital has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational spacecraft.[15] Loft Orbital will work closely with its launch providers to ensure that the satellite is deployed in such a way as to minimize the potential for in-plane collision. This specifically includes minimizing the potential for collision with crewed spacecraft. The ODAR also demonstrates that the probability of success of disposal for YAM-3 is 100%.[16]

Loft Orbital participates in a sharing agreement with the Combined Space Operations Center (CSpOC) to better coordinate collision avoidance measures and receive conjunction threat reports.[17] YAM-3 will

[13] See 47 C.F.R. § 25.114(d)(14)(i).
[14] *See* 47 C.F.R. § 25.114(d)(14)(ii).
[15] *See* 47 C.F.R. § 25.114(d)(14)(iii).
[16] *See Mitigation of Orbital Debris in the New Space Age*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 4156 at Appendix A (2020) ("*Orbital Debris Order*").
[17] YAM-3 can be tracked actively through its unique telemetry marker. *See supra* § 5. YAM-3 will also be registered with the 18th Space Control Squadron or successor entity prior to deployment, and Loft Orbital will share information regarding YAM-3's initial deployment, ephemeris, and/or planned maneuvers with the 18th Space

carry onboard GPS receivers that provide for precise orbital position determination. Loft Orbital also receives from CSpOC updated two-line element sets, or "TLEs," which facilitate the identification and tracking of YAM-3. CSpOC will be able to reach Loft Orbital's satellite operations team that is accessible twenty-four hours per day/seven days per week to ensure that Loft Orbital can take immediate action to coordinate collision avoidance measures.

The YAM-3 satellite will not maintain its inclination angle, apogee, perigee, and right ascension of the ascending node to any specified degrees of accuracy.

Loft Orbital's detailed Orbital Debris Assessment Report is attached as Exhibit C.[18] The disclosure of the orbital deployment parameters, orbital plane inclination, and the orbital period to be used can assist third parties in identifying potential problems. This information also lends itself to coordination between Loft Orbital and other operators located in similar orbits to Loft Orbital satellites.[19]

Control Squadron or successor entity, other entities that engage in space situational awareness or space traffic management functions, and/or other operators. *See Orbital Debris Order* at Appendix A.

[18] *See* 47 C.F.R. § 25.114(d)(14)(iv).

[19] The *Orbital Debris Order* instructs streamlined processing applicants to list the FCC filing information for any known applications or grants related to their proposed operations. *See Orbital Debris Order* at Appendix A. Loft Orbital has requested authority for only one satellite, YAM-2, in addition to YAM-3. *See* Applications of Loft Orbital, IBFS File Nos. SAT-LOA-20190807-00072 and SAT-AMD-20200527-00063, Call Sign S3052 (filed Aug. 7, 2019 and May 27, 2020).

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this application and that it is complete and accurate to the best of my knowledge and belief.

/s/

____

David C Morse, Ph.D.
Avaliant, LLC
Bellevue, WA USA
(425) 246-3080

Date: September 7, 2020

ATTACHMENT 1: YAM-3 LINK BUDGETS

Loft Orbital/Avaliant Confidential							
PRELIMINARY		Normal Operations			Loss of Atitude Control		
		EOC	MID	NADIR	EOC	MID	NADIR
GEOMETRY, FREQUENCY, DATA RATES							
Orbit Altitude	km	535.00	535.00	535.00	535.00	535.00	535.00
Grazing (Elevation) Angle	deg	10.00	44.90	90.00	10.00	44.90	90.00
Nadir (Scan) Angle	deg	65.31	40.80	0.00	65.31	40.80	0.00
Earth Central Angle	deg	14.69	4.29	0.00	14.69	4.29	0.00
Slant Range	km	1779.92	730.42	535.00	1779.92	730.42	535.00
Link Frequency	GHz	2.07	2.07	2.07	2.07	2.07	2.07
Link Wavelength	cm	14.48	14.48	14.48	14.50	14.50	14.50
Channel Bandwidth	MHz	0.13	0.13	0.13	0.13	0.13	0.13
Excess Bandwidth		0.20	0.20	0.20	0.20	0.20	0.20
Symbol Rate	Msps	0.11	0.11	0.11	0.11	0.11	0.11
MODCOD		GMSK	GMSK	GMSK	GMSK	GMSK	GMSK
Bandwidth Efficiency	bits/sym	1.00	1.00	1.00	1.00	1.00	1.00
Burst Information Data Rate	Mbps	0.11	0.11	0.11	0.11	0.11	0.11
	dB						
ES TRANSMITER PARAMETERS							
RF Power	Watts	7.98	7.98	7.98	7.98	7.98	7.98
RF Power	dBm	9.02	9.02	9.02	9.02	9.02	9.02
Peak Antenna Gain (C.10.d.3)	dBi	36.78	36.78	36.78	36.78	36.78	36.78
TX Losses	dB	1.00	1.00	1.00	1.00	1.00	1.00
Maximum EIRP	dBW	44.80	44.80	44.80	44.80	44.80	44.80
Pointing Loss	dB	0.50	0.50	0.50	0.50	0.50	0.50
Effective EIRP	dBW	44.30	44.30	44.30	44.30	44.30	44.30
UPLINK PATH LOSSES							
Propagation Loss Allocation (Rain, Gas, Cloud, Scintillation)	dB	0.49	0.10	0.07	0.49	0.10	0.07
Depolarization Loss	dB	0.20	0.20	0.20	0.20	0.20	0.20
Free Space Loss	dB	163.78	156.04	153.34	163.77	156.03	153.33
Total Path Loss	dB	164.47	156.34	153.61	164.46	156.33	153.60
SV RECEIVER PARAMETERS							
Noise Figure	dB	4.30	4.30	4.30	4.30	4.30	4.30
Feed/Recv Noise Temperature	K	490.55	490.55	490.55	490.55	490.55	490.55
RX Antenna Temperature	K	290.00	290.00	290.00	290.00	290.00	290.00
System Noise Temperature at Antenna (C.5.a)	K	780.55	780.55	780.55	780.55	780.55	780.55
System Noise Temperature at Antenna	dB-K	28.92	28.92	28.92	28.92	28.92	28.92
Maximum Isotropic Gain (B.3.a.1)	dB	6.00	6.00	6.00	-10.00	-10.00	10.00
G/T	dBi/K	-22.92	-22.92	-22.92	-38.92	-38.92	-18.92
Pointing Error	dB	0.00	0.00	0.00	0.00	0.00	0.00
Effective G/T	dBi/K	-22.9	-22.9	-22.9	-38.9	-38.9	-18.9
Link Summary							
Receive Power	dBW	-114.17	-106.04	-103.31	-130.16	-122.03	-99.30
Objective C/N (c.8.e.1)	dB	35.10	43.22	45.96	19.11	27.23	49.97
Ideal Required C/N	dB	9.00	9.00	9.00	9.00	9.00	9.00
Implmentaton Loss	dB	3.00	3.00	3.00	3.00	3.00	3.00
External Interference Loss	dB	1.00	1.00	1.00	1.00	1.00	1.00
Link Margin	dB	22.1	30.2	33.0	6.1	14.2	37.0

Figure 15 S-Band Uplink - Link Budget

Loft Orbital/Avaliant Confidential				
PRELIMINARY				
		EOC	MID	NADIR
GEOMETRY, FREQUENCY, DATA RATES				
Orbit Altitude	km	535.00	535.00	535.00
Grazing (Elevation) Angle	deg	10.00	30.00	90.00
Nadir (Scan) Angle	deg	65.31	53.04	0.00
Earth Central Angle	deg	14.69	6.96	0.00
Slant Range	km	1779.92	967.97	535.00
Link Frequency	GHz	8.10	8.10	8.10
Link Wavelength	cm	3.70	3.70	3.70
Channel Bandwidth	MHz	100.00	100.00	100.00
Excess Bandwidth		0.20	0.20	0.20
Symbol Rate	Mbps	83.33	83.33	83.33
MODCOD		DVB-S2 8PSK 5/6	DVB-S2 8PSK 5/6	DVB-S2 8PSK 5/6
Bandwidth Efficiency	bps/sym	2.48	2.48	2.48
Burst Information Data Rate	Mbps	206.6	206.6	206.6
SATELLITE TRANSMITER PARAMETERS				
RF Power	Watts	5.01	5.01	5.01
RF Power	dBm	37.00	37.00	37.00
TX Maximum Antenna Gain (B.3.a.1)	dB	16.20	16.20	16.20
TX Losses	dB	0.00	0.00	0.00
Maximum EIRP	dBW	23.20	23.20	23.20
Pointing Loss	dB	0.50	0.50	0.50
Effective EIRP	dBW	22.70	22.70	22.70
DOWNLINK PATH LOSSES				
Propagation Loss Allocation (Rain, Gas, Cloud, Scintillation)	dB	2.90	2.90	2.90
Depolarization Loss	dB	0.20	0.20	0.20
Free Space Loss	dB	175.63	170.34	165.19
Total Path Loss	dB	178.73	173.44	168.29
UE RECEIVER PARAMETERS				
Noise Figure	dB	1.50	1.50	1.50
Feed/Recv Noise Temperature	K	119.64	119.64	119.64
RX Clear Sky Antenna Temperature	K	25.00	25.00	25.00
System Noise Temperature at Antenna (C.10.d.6)	K	144.64	144.64	144.64
System Noise Temperature at Antenna (Allocated Prop Loss)	K	263.98	263.98	263.98
Peak Antenna Gain (C.10.d.3)	dBi	48.70	48.70	48.70
G/T	dB/K	27.10	27.10	27.10
Pointing Loss	dB	0.50	0.50	0.50
Effective G/T	dBi/K	26.6	26.6	26.6
Link Summary				
Receive Power	dBW	-105.21	-99.92	-94.77
Objective C/N (c.8.e.1)	dB	19.96	25.25	30.40
Ideal Required C/N	dB	9.35	9.35	9.35
Implmentation Loss	dB	3.00	3.00	3.00
External Interference Loss	dB	0.00	0.00	0.00
Link Margin	dB	7.6	12.9	18.1

Figure 16 X-Band Downlink - Link Budget