Purpose of Experiment

Introduction

Science Applications International Corporation, Inc. ("SAIC") has the Prodigy satellite to operate in Low-Earth-Orbit (LEO). Prodigy will carry two payloads: (1) an onboard edge computer and will conduct in-situ processing of collected data to demonstrate its capabilities, and (2) an experimental atomic physics module AQUAMOD for a quantum proof-of-concept sensor head. The payloads are owned and operated by third parties that are under contract with the Naval Sea Systems Command Crane Division. Both payloads rely on Prodigy for satellite resources and will rely on Prodigy's onboard radio to transmit experimental data back to earth.

Although the core experimental mission is only expected to take three months, SAIC seeks authority to operate Prodigy from February 1, 2027, to February 1, 2029. Prodigy is designed to operate for up to five years and SAIC may seek a renewal prior to the expiration of this license if useful data can still be collected from Prodigy's mission. Prodigy will be integrated with the launch vehicle no-later-than December 1, 2026 and respectfully requests a grant of this application by that date.

The Prodigy satellite, is an 8U cubesat, and will be deployed by the Transporter-19 launch vehicle at an altitude of approximately 510 km into a nominally Sun-Synchronous Orbit (SSO). Prodigy will conduct operations to demonstrate how on-orbit edge computing can facilitate the efficient processing of large volumes of collected data and extract the pertinent information delivering only that information to the ground users thereby achieving extremely high efficiency in terms of utilization of communications bandwidth since large volumes of raw operational data is not brought to ground only actionable information. Prodigy does not have propulsion.

Upon completion of its missions, the Prodigy satellite will passively de-orbit into the Earth's atmosphere in a manner consistent with the Commission's rules.

Mission Description

During this mission, SAIC will demonstrate the data-processing capabilities of the edge computer onboard Prodigy. Below is a detailed description of the Prodigy mission. Once deployed, Prodigy will make contact with its ground station network, as described below, to locate the satellite and issue initial commands. Prodigy is equipped with a receiver onboard to provide GPS locations,[1] which will be used to refine the orbital determination of the satellite for the mission duration.

Prodigy will be launched by Transporter-19 no earlier than February 1, 2027. The Falcon 9 will deploy Prodigy at approximately 510 km in a Sun-Synchronous Orbit ("SSO") with an approximate inclination of 97.4°. At the injection orbit, SAIC will conduct a thorough and extensive evaluation of all satellite bus systems and systems check of Prodigy with GOM Space's support to confirm the satellite is performing nominally. The payload manufacturers will then check out proper functioning of their payloads. All parties will report back to SAIC their findings.

[1] Prodigy will receive Global Positioning System signals (specifically, GPS L1 (1575.42 MHz), L2 (1227.60 MHz), and L5 (1176.45 MHz)).

Once SAIC confirms that Prodigy is operating nominally, it will use its onboard edge computer to process data under simulated exercises. This approach will demonstrate to potential customers how the unique edge computing technology can enable direct reporting of actionable information rather than large volumes of raw data that must be delivered and processed on the ground for information extraction. This greatly reduces the need for RF bandwidth and the latency of Course of Action (COA) determinations.

At the same time as the AI processor mission, the Atomic Quantum Physics Package (AQUAMOD) will undergo a series of tests to verify its operation and survivability in adverse space conditions. Internal sensor data will be transmitted to the ground for analysis. Upon completion of this demonstration, Prodigy will have completed its mission. Once the Prodigy satellite is no longer capable of producing useful information and results, SAIC will decommission and passivate Prodigy as it falls into a passive decay orbit.

Satellite Description

Prodigy

Prodigy will be equipped with transceivers that receive in the 2025-2110 MHz range ("S-band uplink") and transmit in the 400.15-401 MHz band ("UHF downlink"), 2200-2290 MHz band ("S-band downlink"), and 8025-8400 MHz band ("X-band downlink"). Prodigy will transmit and receive telemetry, telecommand, and control ("TT&C") in these bands as well as transmit payload data.

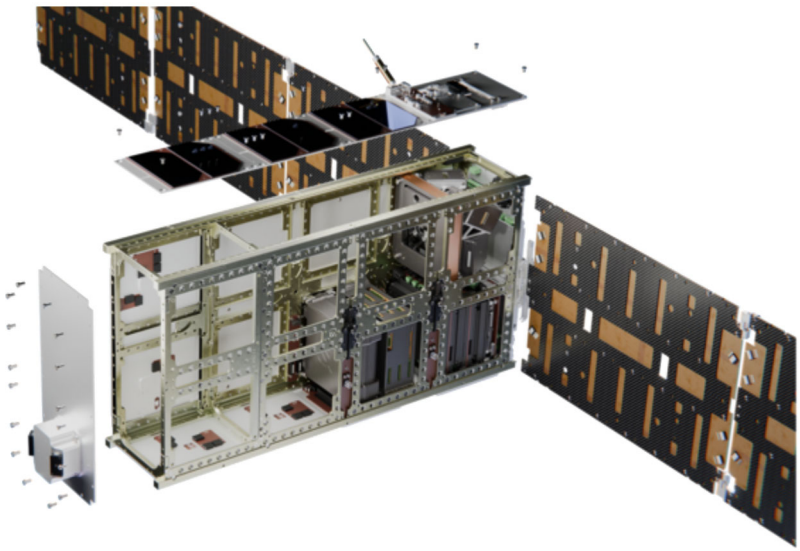

Figure 1. Prodigy Bus

Technical Description

Earth Station Network

Prodigy will also communicate with third-party operated earth stations for TT&C and Data communications located outside the United States. Below is an overview of the third-party ground network that will support the Prodigy Mission.

Type	Earth Station Location/Operator	Coordinates
UHF (downlink), S-band (uplink and downlink), X-band (downlink)	Svalbard, Norway, KSAT	78.23 N, 15.41 E

Spectrum Use

Below is an overview of the planned frequency use for the Prodigy satellite. The overview identifies the planned nature of the frequency use as well as other relevant technical considerations.

Coordination with Federal Systems

SAIC recognizes that all the bands in which it seeks to operate in will require coordination with U.S. Federal agencies. SAIC has commenced this coordination as the time of filing this application and understands that it must finalize the coordination agreements before receiving a Commission authorization.

SAIC anticipates being able to successfully coordinate its proposed frequency use. The characteristics and timetable of SAIC's proposed use of spectrum are limited and consistent with other commercial missions that have been able to complete coordination with Federal agencies.

Band-by-Band Analysis

UHF Downlink (400.15-401 MHz)
Prodigy will transmit signals in the 400.15-401 MHz band for Launch and Early Orbit Phase ("LEOP"), TT&C and payload data. Prodigy will use this band at its center frequency to be determined after completing coordination with the applicable Federal spectrum users. SAIC is currently coordinating operations around a center frequency of 400.575 MHz.

SAIC recognizes that its use of this band will be permitted only on a secondary, non-interference basis. SAIC will meet the protection criteria specified in Table 2 (Type C) of Recommendation ITU-R RS.1263-2 to protect National Oceanic and Atmospheric Administration (NOAA) radiosonde operations in the United States and its territories. SAIC will also coordinate its use of this band with the necessary federal agencies.

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
UTX	254	400.575	RHCP

S-Band TMTC Uplink (2025-2110 MHz)

The GOMSpace AX2150 is a COTS S-Band TMTC transceiver using GMSK Modulation with programmable center frequency and bandwidth. It is compatible with the KSATLite ground station network (within a subset of configurations). It is paired with the COTS GOMSpace AM2150-O Near-Omnidirectional Antenna System. The transceiver supports in-flight reconfiguration of frequencies, bitrate and channel-filter bandwidth.

Prodigy will receive TT&C signals in the 2025-2110 MHz band (S-band uplink). The exact center frequency is 2050 MHz and SAIC can reprogram the center frequency as needed after launch if required for coordination purposes.

Spectrum sharing in the proposed frequencies is feasible because Prodigy and satellites in other similar systems receive only for short durations while they are within view of an earth station. For harmful interference to occur, satellites from different systems would need to be visible to the same earth station and actively transmitting or receiving using the same frequencies at exactly the same time. In such an unlikely event, the resulting in-line interference could be mitigated by coordinating satellite transmissions to avoid simultaneous operations or changing center channel frequency. Accordingly, there is no mutual exclusivity between Prodigy and other NGSO systems operating in the same frequency band.

SAIC intends to use a channel with a bandwidth not to exceed 1100 kHz. The bandwidth is programable as well as the center channel frequency and Prodigy will always use the minimum bandwidth necessary. The short-term duration of the Prodigy mission, along with the limited duty cycle, and the use of programmable radios should facilitate coordination in an available band segment.

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
SRX	1100	2050	RHCP

S-Band Downlink (2200-2290 MHz)

A COTS GOMSpace NanoCom Lin S/X SDR it is used for High-Rate Telemetry as needed. It is capable of simultaneously offering up to 7.5Mbps in S-Band (TX/RX) and 225Mbps in X-Band (TX). The radio can adjust power, frequency, and modulation/coding in orbit to maximize data throughput. It is CCSDS 131.0-B-4 and DVB-S2 MODCODs compliant. In addition, the mission will employ a low-data telemetry signal with a 144 kHz bandwidth. This signal radiates from the

same AX2150 S-Band TMTC transceiver allowing for the same in-flight reconfiguration as the uplink signal.

Spectrum sharing in the proposed frequencies is feasible because Prodigy and satellites in other similar systems transmit or receive only for short durations while they are within view of an earth station. For harmful interference to occur, satellites from different systems would need to be visible to the same earth station and actively transmitting or receiving using the same frequencies at exactly the same time. In such an unlikely event, the resulting in-line interference could be mitigated by coordinating satellite transmissions to avoid simultaneous operations or changing center channel frequency. Accordingly, there is no mutual exclusivity between Prodigy and other NGSO systems operating in the same frequency band.

SAIC intends to use a channel with a bandwidth not to exceed 8300 kHz. Since payload data is very small due to the nature of the AI/ML processor being tested. Bandwidth requirements for transmission durations are not high. The bandwidth is programable as well as the center channel frequency and Prodigy will always use the minimum bandwidth necessary. The short-term duration of the Prodigy mission, along with the limited duty cycle, and the use of programmable radios should facilitate coordination in an available band segment.

SAIC will coordinate its planned use of the band and its proposed center frequency 2245 MHz with U.S. Federal agencies to ensure that it does not cause harmful interference. The short-term duration of the mission, along with the limited duty cycle, and the use of software defined radios should facilitate coordination in an available band segment.

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization	Peak EIRP (dBW)
STXT	130	2245	RHCP	−16.9
STXHS	8300	2245	RHCP	8.2

X-Band Downlink (8025-8400 MHz)

Prodigy will transmit payload data in the 8025-8400 MHz band. SAIC will use the 8025-8400 MHz band for payload downlinks. SAIC is currently coordinating operations around a center frequency of 8250 MHz.

Spectrum sharing in the proposed frequencies is feasible because Prodigy and satellites in other similar systems transmit or receive only for short durations while they are within view of an earth station. For harmful interference to occur, satellites from different systems would need to be visible to the same earth station and actively transmitting or receiving using the same frequencies at exactly the same time. In such an unlikely event, the resulting in-line interference could be

mitigated by coordinating satellite transmissions to avoid simultaneous operations. Accordingly, there is no mutual exclusivity between Prodigy and other NGSO systems operating in the same frequency band. SAIC will also comply with the technical requirements set forth in Part 25 of the Commission's rules, adhere to applicable ITU rules and recommendations, and complete coordination with the Federal operators as required.

SAIC intends to use a channel with a bandwidth not to exceed 53.3 MHz and the short-term duration of the Prodigy mission, along with the limited duty cycle, and the use of software defined radios should facilitate coordination in an available band segment.

SAIC will seek to operate around the 8250 MHz center frequency in X-band for Prodigy, which SAIC is coordinating with Federal Government spectrum users.

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization	Peak EIRP (dBW)
XTX	53300	8250	RHCP	15.8

Antenna Beam Projections

This section provides the predicted antenna gain contours for the X-band transmit, the S-band transmit, and the S-band receive beams. Contours are depicted on an area map with the beam shown on the surface of the earth with the space stations' peak antenna gain pointed at nadir to a latitude and longitude within the proposed service area. Furthermore, each contour is shown at 2 dB intervals down to 10 dB below the peak gain with additional contours at 15 dB and 20 dB below peak (where applicable).

While the regulation states to show intervals of 2 dB down to 10 dB below the peak gain and at 5 dB intervals between 10 - 20 dB below the peak gain, the nature of many of the antennas, and orbital altitude of the spacecraft limit the visibility of the contours in the schematics. Specifically, the UTX beam has low peak antenna gain (0 dBi) to effectively perform as omni-directional antenna. As such, no antenna beam gain contours fall onto the Earth's surface meaning that all contours project beyond the limb of the Earth. Similarly, the STX1 and SRX1 beams have a peak antenna beam gain of 7 dBi such that only the -2, -4, -6, and -8 dB contours intersects the Earth's surface. All other contours project beyond the limb of the Earth. Finally, the STX2 and SRX2 beams have a peak antenna beam gain of 2.3 dBi such that only the -2 dB contour intersects the Earth's surface with all other contours extending beyond the limb of the Earth.

Prodigy plans to only transmit and receive signals to and from a single earth station outside the United States and therefore the antenna beam projections are provided for the Svalbard, Norway site only.

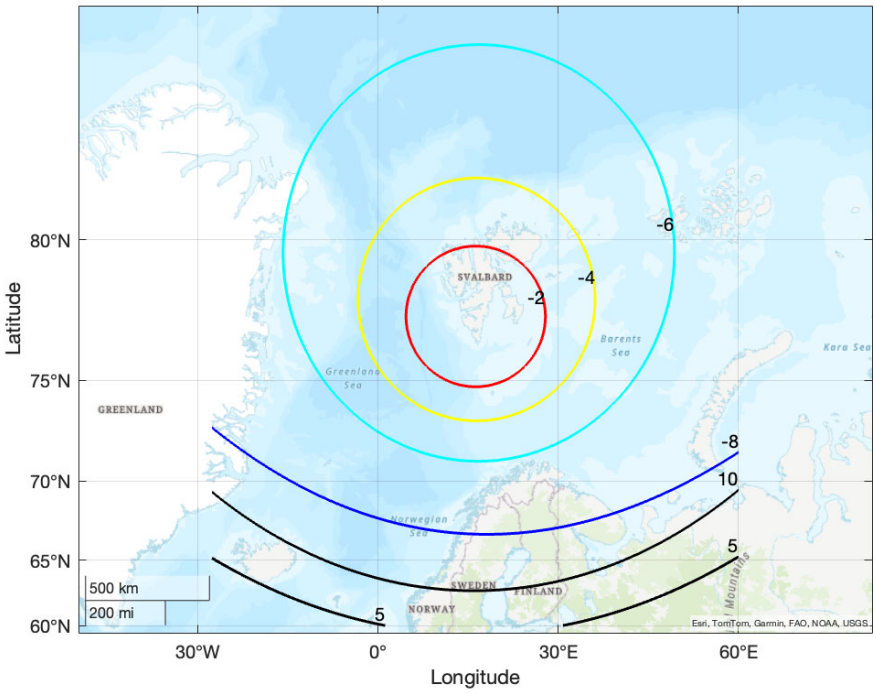

Figure 2 S-band receive uplink (SRX1) gain contours over Svalbard, Norway (510 km)

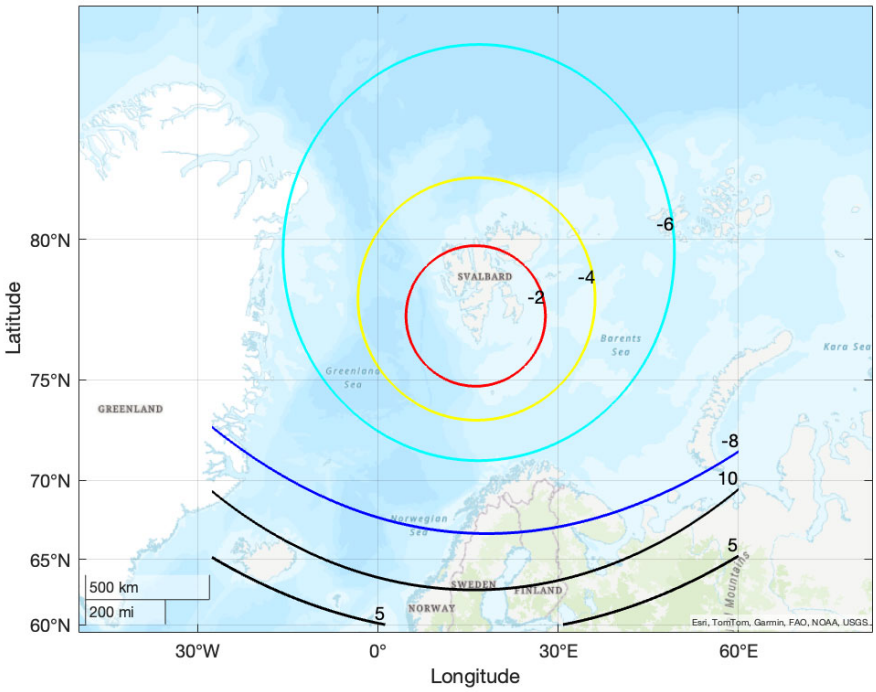

Figure 3 S-band transmit downlink (STX1) gain contours over Svalbard, Norway (510 km)

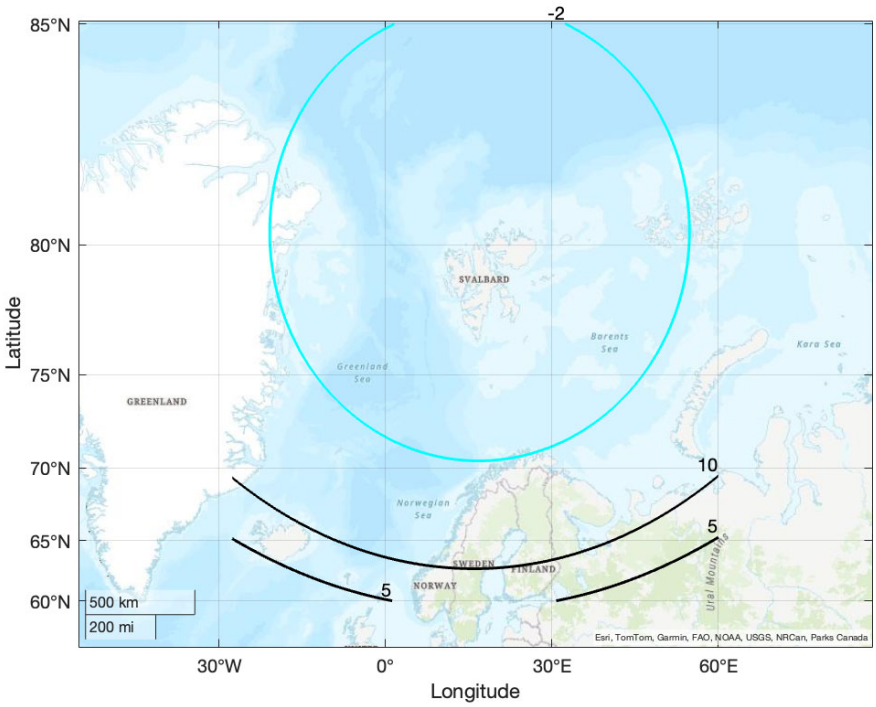

Figure 4 S-band receive uplink (SRX2) gain contours over Svalbard, Norway (510 km)

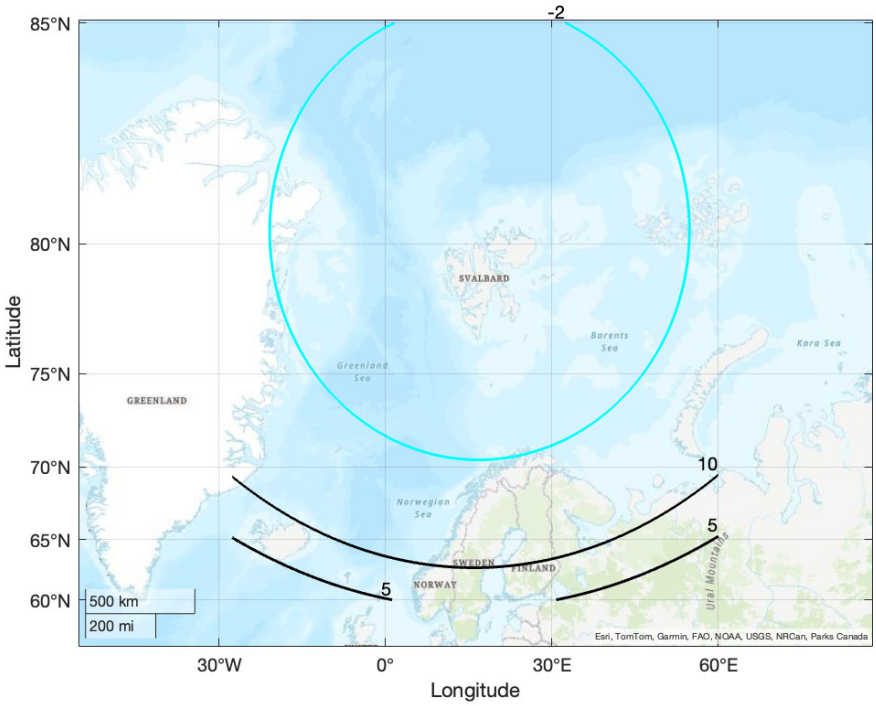

Figure 5 S-band transmit downlink (STX2) gain contours over Svalbard, Norway (510 km)

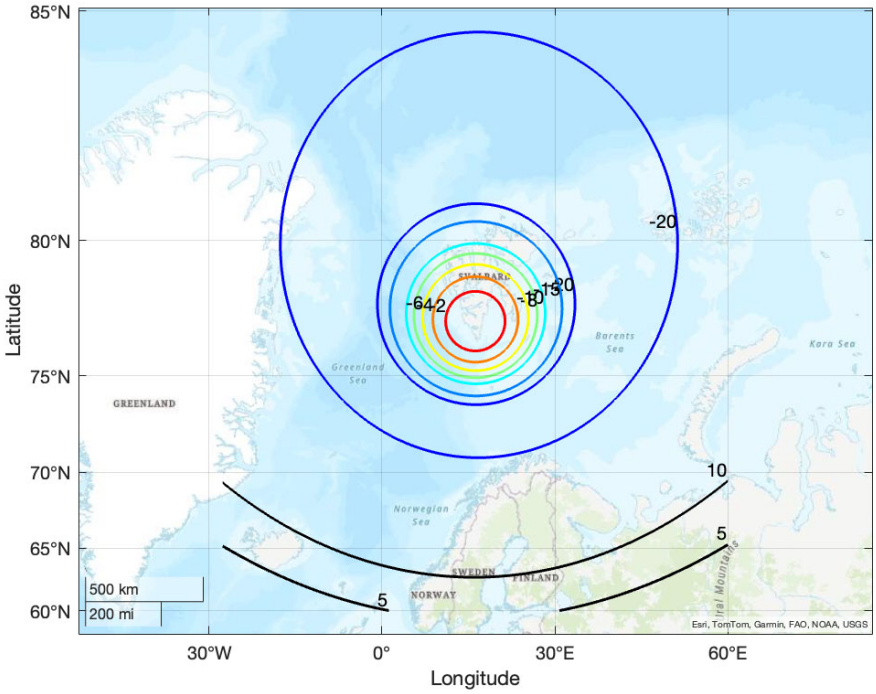

Figure 6 X-band transmit downlink (XTX) gain contours over Svalbard, Norway (510 km)

Interference Showings

400.15-401 MHz

Prodigy will have the ability to reduce the power and power density of its downlink transmissions as it descends in altitude. SAIC will actively manage and reduce power as needed to ensure compliance with applicable coordination limits.

2200-2290 MHz

The Commission's rules do not specify a PFD limit for the 2200-2290 MHz band. However, No. 21.16 of the International Telecommunication Union (ITU) Radio Regulations does. SAIC has calculated the maximum PFD levels for transmissions from Prodigy in accordance with these ITU PFD limits.

Figure 5 below represents the PFD of the two S-band emissions from the nominal altitude of 510 km.

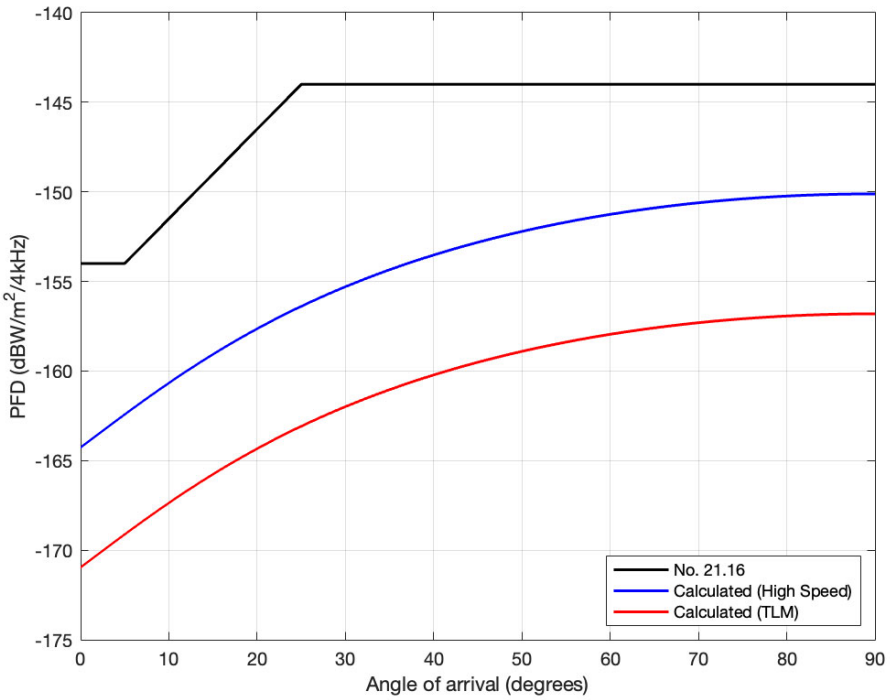

Figure 5 S-band PFD from 510 km Orbit Altitude

8025-8400 MHz

The Commission's rules do not specify a PFD limit for the 8025-8400 MHz band. However, rule No. 21.16 of the International Telecommunication Union (ITU) Radio Regulations does. SAIC has calculated the maximum PFD levels for transmissions from Prodigy in accordance with these ITU PFD limits.

Figures 6 below represents the maximum transmitted EIRP at both the nominal orbit altitude of 510 km for the X-band downlinks.

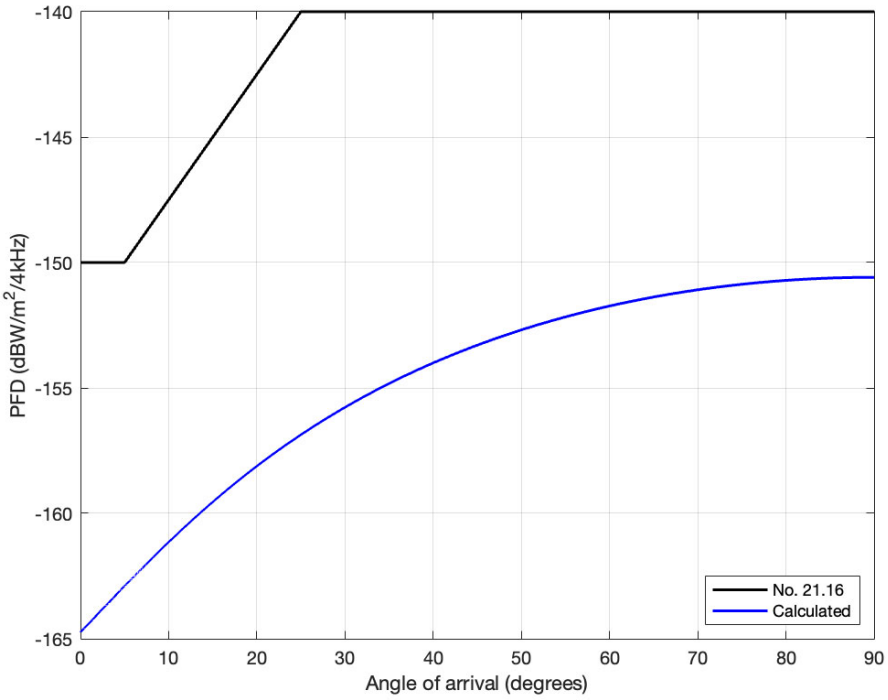

Figure 6 X-band PFD from 510 km Orbit Altitude

SAIC operations are compliant with Recommendation ITU-R SA-1157-1. This Recommendation specifies a maximum allowable interference power spectral flux-density ("PSFD") at the Earth's surface to protect ground receivers in the deep-space research band operating in the 8400-8450 MHz frequencies.

SAIC calculates a maximum PSFD at the Earth's surface of –256.8 dB(W/m^2/Hz) at the nominal altitude, which is below the maximum allowable interference power spectral flux-density level, –255.1 dB(W/m^2/Hz).

The maximum interference PSFD was calculated as follows:

- Maximum PFD (at the nominal altitude) = –186.8 dB(W/m^2/Hz)

- Total Attenuation at 8400 MHz relative to the center frequency (filtering and guard band) = at least 70 dB
- PSFD = PFD – Attenuation = −186.8 – 70 = at least -256.8

ITU Cost Recovery Letter

SAIC has prepared the ITU Advance Publication Information submission for its proposed system and is contemporaneously providing this information to the Commission under separate cover. A signed ITU cost-recovery declaration is submitted with this application.

Orbital Debris Mitigation

SAIC has designed the Prodigy satellite to comply with the Commission's orbital debris regulations and affirms that all operations will comply with 47 C.F.R. 5.64 of the Commission's Rules. Below, SAIC provides an overview of how Prodigy will meet the Commission's orbital debris rules, including the provision of an Orbital Debris Assessment Report that demonstrates that SAIC's satellite will not exceed any of the limits set forth by the Commission rules.

SAIC affirms that Prodigy will be identifiable by a unique signal-based telemetry marker, distinguishing it from other space stations, and that its tracking will be passive. SAIC will register with the 18th Space Defense Squadron ("18th SDS") and will share information regarding initial deployment and ephemeris data. In the event of a conjunction event, SAIC will take all necessary precautions to mitigate a potential collision including providing ephemeris data.

Orbital Debris Assessment Report

SAIC has provided an Orbital Debris Assessment Report (ODAR) with this application and has also included debris mitigation strategies related to debris release, small debris, accidental explosions, collision risks with large objects, trackability, planned proximity operations and its post-mission disposal plans. Prodigy will be compliant with all elements for Section 5.64 of the Commission's rules.