Mission Statement

Cryptosat, Inc. ("Cryptosat") is a trailblazer in space-based confidential computing. A California-based company, Cryptosat seeks to revolutionize cryptographic applications by creating Trusted Execution Environments ("TEE") in low Earth orbit. On November 9, 2023, Cryptosat launched its third experimental satellite, Crypto3, on the SpaceX Falcon 9 Transporter-9 mission, pursuant to a German satellite license.[1] Following discussions with the State Department and Federal Communications Commission ("FCC") Space Bureau staff, Cryptosat herein submits this application for six months' special temporary authority ("STA").[2] Cryptosat respectfully requests waiver of Section 5.61(a)(2) for good cause and to the extent necessary for the expeditious approval of this application.[3]

Overview

The Cryptosat satellite system represents the next advancement in the radio art—utilizing the unique properties of satellite networks to power cryptographic applications to guarantee ultimate trust and transparency. Each Cryptosat satellite contains an advanced computation module that serves as a TEE for novel implementations of cryptographic applications, including trusted setup ceremonies and random beacon use cases such as Verifiable Random Functions ("VRF") and Verifiable Delay Functions ("VDF").

The deployment of TEEs on orbit—instead of terrestrially—generates unparalleled security benefits for users. The space-based Hardware Security Module ("HSM") on the Cryptosat satellites creates an unprecedented air gap for networks; requiring any would-be attackers to traverse a massive physical barrier—the roughly 500 km vacuum of space—before being able to gain access to the victim network, and thereby significantly reducing the likelihood of undetected tampering. Furthermore, by its very nature, a space-based HSM eliminates the risk of exposure to infrastructure-based attacks: power is generated through onboard solar panels and encrypted communication occurs over the air, ensuring complete isolation from ground-based threats. This innovative approach not only enhances security but also offers a cost-effective solution with minimal operational requirements upon launch.

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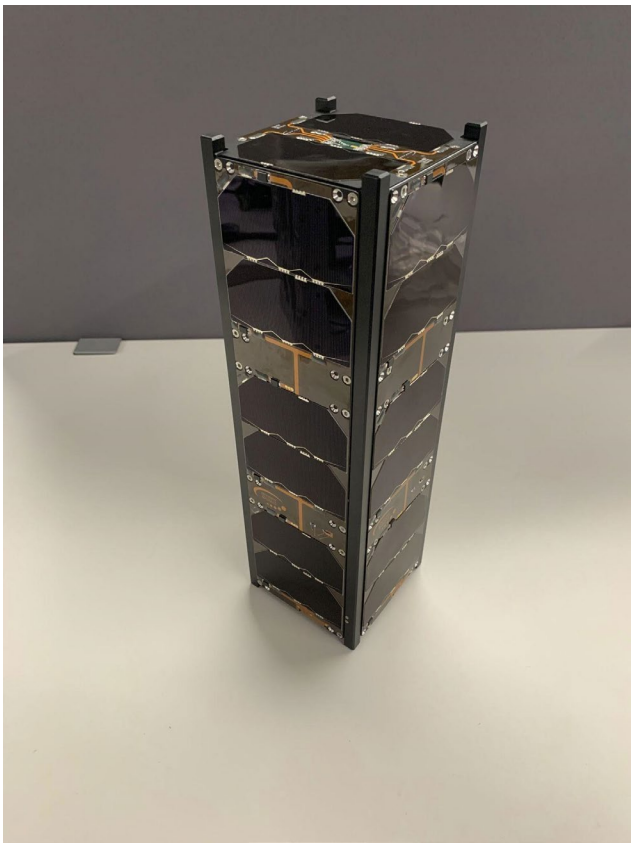
[1] *See* Cryptosat Inc., Assignment of Orbit and Frequency Usage Rights, Usage Right No. 009-2023/BNetzA (223) (granted Oct. 1, 2023).

[2] *See* 47 C.F.R. § 5.61(a). Cryptosat will subsequently file a request for full experimental authority pursuant to Section 5.61(c) or commercial authorization pursuant to Section 25.114, as appropriate, during the term of the STA.

[3] *See* 47 C.F.R. § 5.61(a)(2). The Commission may waive any of its rules if there is "good cause" to do so. In general, waiver is appropriate if (1) special circumstances warrant a deviation from the general rule; and (2) such deviation would better serve the public interest than would strict adherence to the rule. Generally, the Commission would grant a waiver of its rules in a particular case if the relief requested would not undermine the policy objective of the rule in question and would otherwise serve the public interest. *See* 47 C.F.R. § 1.3. *Northeast Cellular Tel. Co. v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990); *WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969). Crypto3 is duly licensed by the Government of Germany and authorized for launch. In this instance, the subsequent request by the FCC to license the Crypto3 satellite in the U.S. following the launch of the Crypto3 satellite supports a finding of good cause to justify the waiver of the requirement to file requests for STA at least ten days prior to the proposed operations.

The Crypto3 Mission



The Crypto3 mission leverages Cryptosat's in-house manufacturing capabilities, including use of proprietary flight hardware and commercial-off-the-shelf subsystems, to create a 3U cubesat capable of servicing confidential computing applications. Specifically, the Crypto3 mission seeks to build on the success of Cryptosat's previous two missions by demonstrating:

1. Orbital Capabilities and Availability: Conducting orbital simulations and control stability studies to ensure 24/7 availability of the Cryptosat platform, while exploring satellite-to-satellite communication solutions for maintaining service and data rate during orbital variations.

2. Adoption of Commercial Processors: Investigating the integration of commercial off-the-shelf processors into the space environment, including the evaluation of different processing architectures for radiation resistance, thermal management, and energy efficiency.

3. Proof of Concept: Designing and developing software for the hardware security modules which can operate as an API in accordance with industry standards. This will facilitate the provision of services such as key generation, data signing, and reliable entropy generation.

Space-based HSMs offer a competitive alternative to terrestrial Software-as-a-Service solutions, which are known for high reliability and fast response time. The success of the Crypto3 mission will not only prove the technical feasibility of space-based HSMs but also demonstrate the competitive and complementary value add of space-based HSMs in security infrastructure, thereby enhancing the safety and reliability of our telecommunications networks.

The Crypto3 satellite will operate in the radio frequency bands outlined in the table below. Satellite transmissions can be turned on and off by issuing a command through an intersatellite link in compliance with the Commission's rules.[4]

[4] The signals received through the intersatellite links can fully terminate all transmissions from the satellite in satisfaction of 47 C.F.R. § 25.207. However, out of an abundance of caution, Cryptosat requests a waiver of Section 25.207 to the extent the rule is read to require a direct ground-to-satellite capability to terminate emissions. Good cause exists for this waiver as the satellite, as previously authorized by Germany, is already in orbit and is not capable of receiving such signals from a ground-based system. Such waiver would also be consistent with Commission precedent, wherein the FCC previously determined that good cause exists "where the satellite was already launched and could not be modified"

Type of Link and	Transmission Direction	Frequency Range
Satellite TT&C and Data Transmission	Space-to-Space (via Iridium constellation)[5]	1618.725 – 1626.5 MHz
Payload Data Uplink	Earth-to-Space (outside the U.S. only)	2046.25 – 2048.75 MHz
Payload Data Downlink	Space-to-Earth (outside the U.S. only)	2258.75 – 2261.25 MHz

Crypto3 has been integrated with a pair of Iridium 9603 transceiver modems to enable communication with the Iridium satellite constellation.[6] The transmissions consist of cryptographic primitives such as zero-knowledge proofs and random numbers, as well as satellite commands and telemetry. As explained in the Iridium companion application (ELS File No. 0427-EX-CN-2023), the space-to-space communications between the systems otherwise conform to Iridium's authorized operating parameters and should be authorized consistent with Commission precedent.[7] Out of an abundance of caution, Cryptosat requests a waiver of Section 2.106 of the Commission's rules to allow communications between Crypto3 and the Iridium system in the 1618.725-1626.5 MHz band.[8] Transmissions between the spacecraft will only occur on frequencies assigned by Iridium to the spaceborne Iridium modems, consistent with Iridium's coordination agreements in the band, ensuring there is no harmful interference.[9]

Crypto3 will conduct data uplink and downlink transmission in the 2046.25-2048.75 MHz and 2258.75-2261.25 MHz bands, respectively. All S-band transmissions are of limited duration, which will occur only outside of the United States and only when the satellite is in view of a coordinated earth station described in Attachment A.

The Crypto3 satellite was launched as a rideshare payload on SpaceX's Falcon 9 Transporter-9 mission on November 9, 2023. The satellite was initially deployed at 525.5 km apogee, 514.1 km

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and "the satellite had a limited useful life." *See*, *e.g.*, Empresa Brasileira de Telecomicações S.A., Order, File No. SAT-PDR-20000111-00047, DA 00-2878 (IB 2001).

[5] *See* Attachment G, Iridium Confirmation Letter; *see also* ELS File No. 0427-EX-CN-2023 (filed March 2023).

[6] Call sign S2110.

[7] *See*, *e.g.*, Capella Space Corp., Stamp Grant with Conditions, ICFS File No. SAT-LOA-20200914-00108 (2020) ("Capella Grant") (permitting Capella-2 through 4 to communicate via intersatellite links with the Inmarsat system using BGAN terminals onboard space stations).

[8] *Id*.

[9] *See* Attachment G, Iridium Confirmation Letter. In considering requests for such non-conforming spectrum uses, the Commission has indicated that it would generally grant waivers "when there is little potential for interference into any service authorized under the Table of Frequency Allocations and when the non-conforming operator accepts any interference from authorized services." *See*, *e.g.*, Capella Grant, Condition 5 (authorizing non-conforming space-to-space MSS in the L-band); *Fugro-Chance, Inc.*, 10 FCC Rcd. 2860, ¶ 2 (IB 1995) (authorizing non-conforming MSS in the C-band); *Motorola Satellite Communications, Inc.*, 11 FCC Rcd. 13952, ¶ 11 (IB 1996) (authorizing service to fixed terminals in bands allocated to MSS).

perigee, 97.5° inclination and 22:30 LTAN. At this altitude, the satellite is expected to fully decay naturally within five years following the end of the operational mission. Crypto3 does not have on-board propulsion.

For all of the above reasons, Cryptosat respectfully requests that the Commission expeditiously grant this STA.

ATTACHMENT LIST:

A. Ground Segment

B. Orbital Debris Assessment Report

C. NTIA Space Record

D. ITU Cost Recovery Letter

E. Stop Buzzer

F. Antenna Patterns

G. Iridium Confirmation Letter