# CTC-1B Satellite Technical Description

The overall goal of the CTC-1 mission, is to Demonstrate a 5th Generation (5G) communications Non-Terrestrial Network (NTN) with spacecraft in a Non-Geostationary Orbit (NGSO).

Three identical satellites, CTC-1A, -1B and -1C, will be launched as a secondary payload aboard SpaceX Transporter-15, from Vandenberg Space Force Base, No Earlier Than 1 October 2025; this application is for CTC-1B. It will be inserted into a circular SSO orbit at 510 km, on an inclination from the equator of 97.4 degrees. Transmission will begin approximately two minutes after deploy and cease at the end of the mission. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs less than 5 years after the end of the mission. See the Orbital Debris Assessment Report for details.

The spacecraft has nominal dimensions of 16U stacked 10 cm X 10 cm X 10 cm CubeSat modules (giving an overall dimension of 20 cm X 20 cm X 40 cm.) The total mass is about 21.3 Kg.

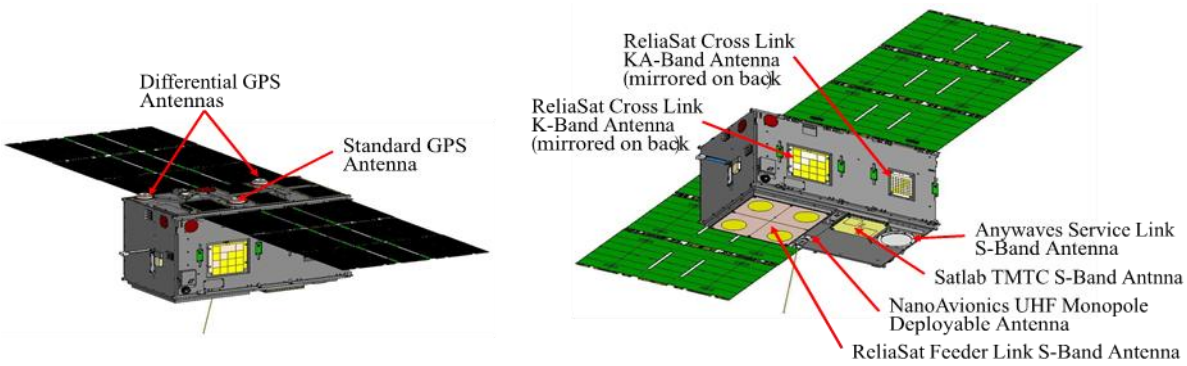


**Figure 1 CTC-1B Antenna Placement**

The satellite contains the following systems:

**Attitude Determination and Control System (ADCS):** The attitude determination and control system controls the 3-dimensional attitude of the spacecraft. The system consists of four reaction wheels for momentum, and 3 magnetorquers mounted on the structure for canceling environmental torques and unloading the momentum of the reaction wheels. The critical components are the magnetorquers, dual triaxis magnetometers, Earth horizon sensor, fine sun sensors, and reaction wheels. Additional hardware being flown but not required for flight control includes three GPS receivers providing differential GPS measurements.

**Command and Data Handling (CDH) Subsystem:** The CDH subsystem consists of the computer in the detumble module, and the Single Board Computer (SBC) of the payload. The SBC processes commands from the ground station to the ADCS module, the inflatable antenna modules, and the UHF and S-band radios.

**Communication Subsystems:**

There are two distinct communications subsystems on the CTC-1 satellites – bus and demonstration.

Bus Comms Subsystem: The bus communications subsystem consists of a two-way UHF radio and its deployable antenna, a two-way S-band radio and its patch antenna.

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Demonstration Comms Subsystem: The demonstration communications subsystem consists of a four transmit and four receive channel baseband SDR that directly generates the RF for the feeder and service links. The feeder link carries data to and from ground stations. The service link carries data to and from end user devices. Operation of both links will be consistent with the guidance of the 3GPP Rel.17 standards, which establish the properties of signals supporting communication between a gateway earth station and a mobile device outside of areas serviced by terrestrial networks.

This radio also delivers the IF for frequency up/down conversion for the Inter Satellite Link (ISL) via the Reliasat converters. The ISL supports communication among the 3 satellites in the CTC-1 group. Two ISL transceivers on different frequencies are included, so that the middle satellite in the string can communicate with each of the others simultaneously.

| Radio subsystem | Manufacturer | Part number |
|---|---|---|
| UHF radio | Nanoavionics | SAT2RF1-1D |
| S-band TMTC | SatLab | SRS-3 |
| Demonstration Feeder Link and Service Link | Cesium Astro | SDR-1001 |
| Demonstration ISL Link A | Reliasat | UDC300 |
| Demonstration ISL Link B | Reliasat | UDC400 |

The UHF radio is employed for low data rate TeleMetry and TeleCommand (TMTC) with a ground station. The S-band radio is employed for high data rate TMTC with a ground station.

In conformance with § 5.107 Transmitter control requirements, all transmission from the satellite can be terminated by telecommand over the UHF and S-band TMTC uplinks.

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The following table shows ground station locations and functions:

| Ground Station City, Country | UHF | S-Band TMTC | Feeder Link | Service Link |
|---|---|---|---|---|
| Svalbard, Norway | | X | | |
| Tromsø, Norway | | X | | |
| Troll, Antarctica | | X | | |
| Awarua, New Zealand | | X | | |
| Mingenew, Australia | | X | | |
| Jeju, South Korea | | X | | |
| Absheron, Azerbaijan | | X | | |
| Punta Arenas, Chile | | X | | |
| Kandy, Sri Lanka | | X | | |
| Mon Loisir, Mauritius | | X | | |
| Santa Maria, Azores, Portugal | | X | | |
| Unst, UK | X | X | | |
| Melbourne, FL | X | | | |
| Upland, IN | X | | | |
| Lagos, Nigeria | X | | X | X |

**Electrical Power Subsystem**: The Power Subsystem is a direct energy transfer system using a solar array producing approximately 65 W of orbit average power to charge the 325.6 W-hr battery system. The solar arrays utilize standard NSL photovoltaic cells; the batteries are COTS NSL Lithium-Ion cells battery packs. The OBC sends signals to the Power Distribution Module to control load switching. The power subsystem has flight heritage (FH), flexible arrays 10 years FH, batteries have 5 years FH, EPS has 5 years FH.

**Thermal Subsystem:** Thermal subsystem controls hardware temperature with passive cooling via conduction to the spacecraft chassis and conductive coupling to radiators in the +Z (ram), -Z (anti-ram), and -Y (nadir) faces to dissipate heat loads under high power payload operation. Payload subsystems will operate during eclipse in conjunction with heaters to provide stable operating temperatures. Temperature sensors are located throughout the spacecraft and connect to the bus computer, which hosts thermal control algorithms to control the heaters and provide feedback to the payload control system.

**Structure Subsystem:** The structure is fabricated of anodized T6061 aluminum.

**Propulsion Subsystem:** No propulsion subsystem is included on this mission.