

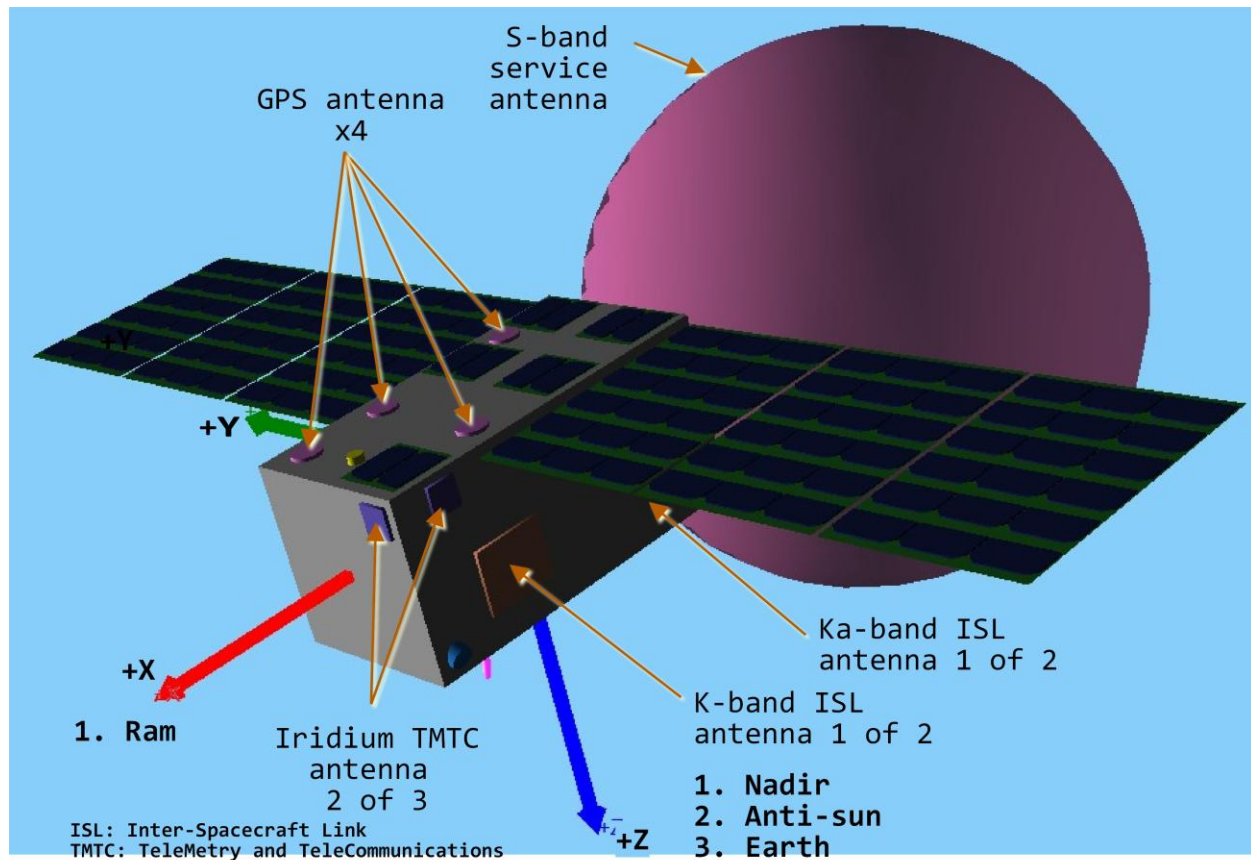
CTC-1 Satellite Technical Description

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).

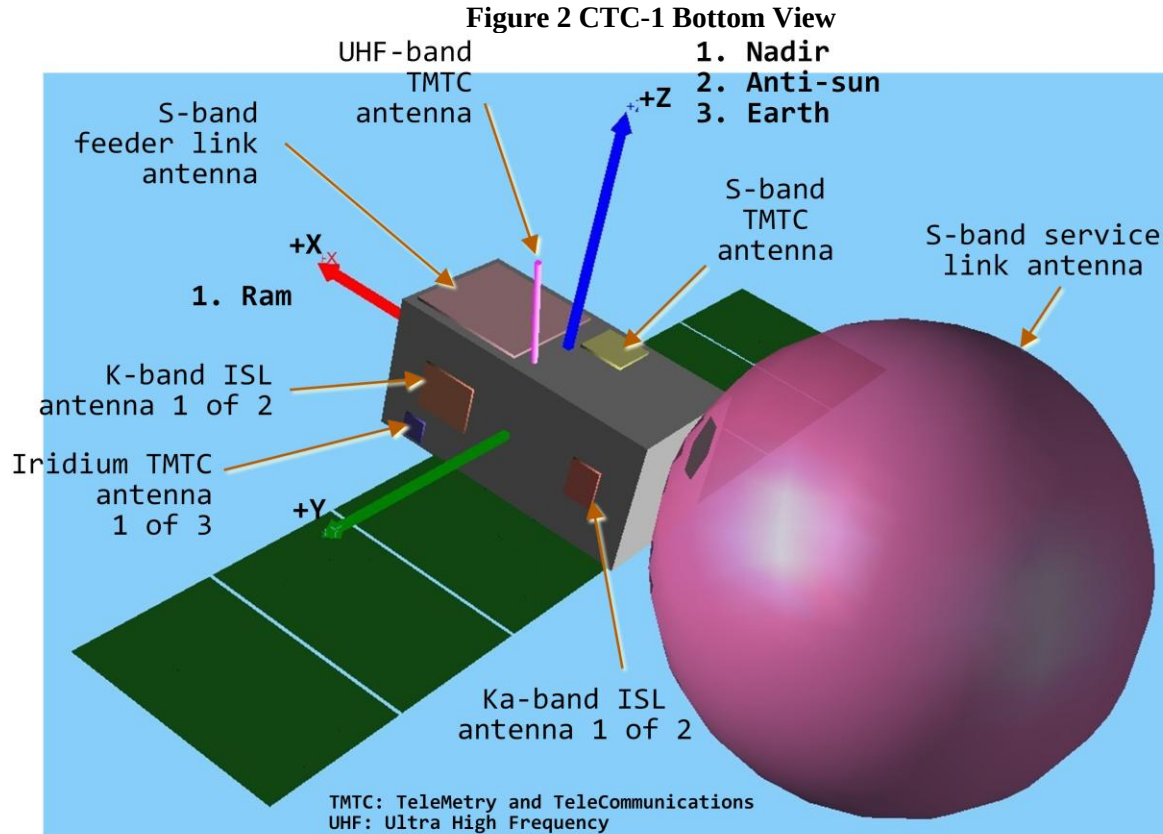
Three identical satellites, CTC-1A, -1B and -1C, will be launched as a secondary payload aboard SpaceX Transporter-15, from Vandenberg Space Force Base, No Earlier Than 1 October 2025. It will be inserted into a circular SSO TBD orbit at 510 km, on an inclination from the equator of 97.4 degrees. Transmission 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 about 1.5 years after launch. See the Orbital Debris Assessment Report for details.

Each 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 of each spacecraft is about 25 Kg.

Figure 1 CTC-1 Top View



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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 payload.

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, and three Iridium radios and their respective patch antennas.

Payload Comms Subsystem: The payload communications subsystem consists of a four transmit and four receive channel baseband SDR that directly generates the RF for the feeder and service link antennas and also delivers the IF for frequency up/down conversion for the ISL via the Reliasat converters.

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Radio subsystem	Manufacturer	Part number
UHF radio (1)	Nanoavionics	SAT2RF1-1D
S-band TMTC (1)	SatLab	SRS-3
Iridium transceivers (3)	Near Space Launch	Eyestar-S4
Payload baseband (1)	Cesium Astro	SDR-1001
Payload ISL Link A (1)	Reliasat	UDC300
Payload ISL Link B (1)	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. The Iridium radios are employed for very low data rate communications through the Iridium satellite constellation for the downlink of select TM channels such as critical events, and uplink of direct commands to the electric power subsystem, to control power distribution.

In conformance with § 5.107 Transmitter control requirements, all transmission from the satellite can be terminated by telecommand over the 24/7 Iridium network as well as the UHF and S-band TMTC uplinks.

The antennas associated with the radios above are listed in the table below:

Antenna Subsystem	Manufacturer	Model number
UHF Radio	Nanoavionics	NA-UHFAS-AST-R3
S-band TMTC	Satlab	SAS-2
Iridium Transceivers	Taoglass	TW1600
Feeder Link	Freefall Aerospace	CTC1-SCP-MOD1-REV3
Payload Service link	Freefall Aerospace	CTC1-IAS-REV3
ISL High Band	Reliasat	PAN-7053-64-KA
ISL Low Band	Reliasat	PAN-8498-64-K

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The following table shows ground station locations and functions:

Ground Station City, Country	UHF	S-Band TMTC	Feeder Link	Payload Service Link
Svalbard, Norway		X		
Tromsø, Norway		X		
Troll, Antarctica		X		
Awarua, New Zealand		X		
Mingenew, Australia		X		
Jeju, South Korea		X		
Bridgetown, Barbados	X		X	X
Cane Vale, Barbados	X		X	X
Lagos, Nigeria	X		X	X
Prey Veng, Cambodia	X		X	X
Absheron, Azerbaijan		X		
Punta Arenas, Chile		X		
Kandy, Sri Lanka		X		
Mon Loisir, Mauritius		X		
Santa Maria, Azores, Portugal		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, flexible arrays 10 years of flight heritage (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.