# Hera Systems 1HOPSat-TD Technology Demonstration Satellite
# Technical Description

Exhibit for FCC OET Special Temporary Authority Application

The overall goal of Hera Systems' 1HOPSat Technology Demonstration (1HOPSat-TD) spacecraft is on-orbit demonstration, risk reduction, test, and characterization of key avionics and optical components for the 1HOPSat-1 prototype. Many of the key hardware functions of the 1HOPSat-TD will be demonstrated and flown in their objective design configurations.

The satellite will be launched in August 2019. It will be deployed in an orbit near 555 km altitude and 37 degrees inclination. Transmission will begin about 45 minutes after deployment. The operational mission will last not more than 6 months. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs within 14 years after deployment. See the Orbital Debris Assessment Report for details.

The satellite contains an imaging telescope payload for recording images and video of the Earth. Images and telemetry will be transmitted to Earth through one ground station over a single carrier X-band radio downlink. Image data and telemetry can also be transmitted to a single C-band ground station over the spacecraft's C-band transceiver. Commanding will be implemented with the same C-band transceiver. Commanding and telemetry are supplemented with an Iridium™ short burst data (SBD) radio providing two-way low rate commanding and data via the Iridium constellation.

Spacecraft dimensions are consistent with CubeSat standards. It is a 2 x 2 x 3-unit configuration, with nominal dimensions of 22.6 cm x 22.6 cm x 34.5 cm. The total mass is 19 Kg.

The satellite contains the following systems:

**On-board Computer System (OBCS):** The OBCS is a single-board computer system designed to incorporate command and data handling (C&DH), data processing, and subsystem command and telemetry functions. The OBCS receives commands from Earth via either the C-band radio or Iridium radio. The OBCS also controls the imager payload, transfers imager data to storage, sends commands to the ADCS system, and collects and stores spacecraft health and status data from the electrical power subsystem, ADCS, storage devices, and payload.

**Electrical Power Subsystem (EPS)**: The EPS is designed to handle power states for the satellite. It incorporates photovoltaic arrays, batteries, load shedding, nominal subsystem power switching, subsystem power and temperature state of health data collection, and the Iridium radio command and telemetry interface. In Figure 1 it can be seen that the photovoltaic array (PVA) arrangement for the 1HOPSat-TD spacecraft is comprised of five body mounted panels and one deployable panel array facing –Z (located on a protective hatch that covers the telescope aperture during launch).

**Attitude Determination and Control System (ADCS):** The spacecraft uses an integrated 3-axis ADCS system. The ADCS includes a star tracker, sun sensors, magnetometer, inertial measurement unit, electro-magnetic torque rods, reaction wheels, GPS, and dedicated computer.

**Radio Frequency Communication Subsystem (RFCS):**

The RFCS includes an X-band downlink transmitter, C-band command control and telemetry (CC&T) transceiver, and a L-band transceiver (Iridium). The radios are controlled by the OBCS. Communications to the Iridium radio from the ground via the Iridium constellation can be used to

turn other radios off. Communication via the C-band transceiver can be used to turn the Iridium off. The X-band antenna is an array, the C-band antenna is helical, and the Iridium antenna is a patch. Nominal orientation of the spacecraft will place the Iridium patch antenna in a zenith facing orientation. A ground station at Santa Clara University in California will send and receive C band data. The X band receive-only ground station is located at and operated by, The University of Miami.

**Thermal Control Subsystem (TCS):** The TCS is passive. It utilizes radiators, surface treatments, and component conductivity properties to control temperatures.

**Structure Subsystem:** The spacecraft structures are predominantly aluminum alloys. Titanium components are also used. Fasteners are predominantly stainless steel.

**Optical Subsystem (Payload):** The optical subsystem is a catadioptric telescope of proprietary design with an imaging sensor (camera).

**Propulsion Subsystem:** No propulsion subsystem is included in the 1HOPSat-TD mission.

**Figure 1 1HOPSat-TD 12U Satellite Configuration, Deployed**

Figure 1 shows the placement of the Iridium and GPS antenna assembly on the –Z face (top pf image). X-band and C-band antennas point nadir on the +Z hatch face when the protective hatch is opened. The aperture above the half solar panel is the star tracker. The imager payload aperture is open to the nadir, +Z, direction when the telescope aperture hatch is open and imaging is taking place.