# 2019 Scientific Ballooning Technologies Workshop

## Telemetry Options for LDB Payloads

May 15, 2019

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# Current LOS Telemetry Options

- 1 MHz bandwidth digital transmitter
  - 330 Kbit bi-phase encoded data
  - ≈ 0.5 A @ 28V

- 3 MHz bandwidth digital transmitter
  - 1 Mbit bi-phase encoded data
  - ≈ 1.1 A @ 28V

- Analog video transmitter
  - NTSC
  - ≈ 2A @28V

# Future LOS Telemetry Options

**Ethernet Encoded Telemetry Transmitter**

- Ethernet interface (UDP multicast packets)
  - Can handle multiple data sources with network switch

- Up to 8 Mbps with 10MHz bandwidth allocation

- Up to 12 Mbps with new 15.6MHz bandwidth allocati
  - Currently only in Continental USA

- Flown at 8 Mbps on 4 flights out of FTS FY18 campaign

- Testing at 12Mbps planned for FTS campaign

- CSBF is not currently logging this data, it will be the responsibility of the end user to log all data.

- Science availability possibly in 2020

# Video

SIFT 2018 Live Stream

2018-09-09 01:34:05

2018-09-09 01:34:06

**Show video clip**
**https://youtu.be/XPFDj0PAZvU**

# Current TDRSS Telemetry Options

- Powered by CSBF

- Omni Antenna
  - 6-10 Kbps data
  - CSBF downlinks data in 2041 byte packets

- High Gain Antenna
  - 93 Kbps data
  - No packetizing

- Uplink commanding only available when requested by science
  - CSBF requests 24 hour notice for TDRS commanding requirements
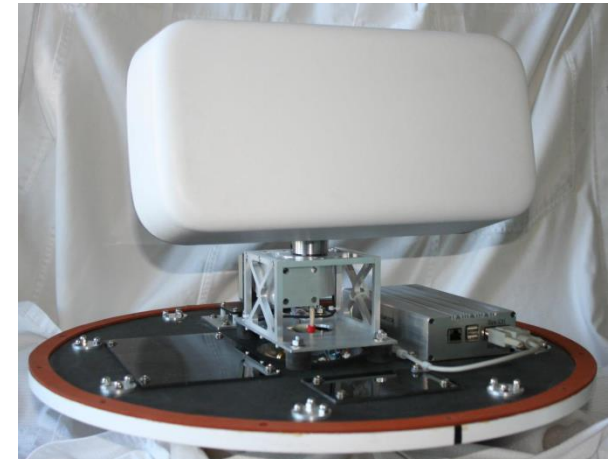
# Current Iridium Telemetry Options

- **Iridium SBD**
  - Email based
  - Always available
  - Uplink commands
    - Commands are checked 1/minute
  - Downlink 255 byte science packet
    - One packet every 1 to 15 minutes (selectable)

- **Iridium Dialup**
  - Usage must be requested
  - Uplink commands
    - Commands received "instantly"
  - Downlink 255 byte science packet
  - Downlink data through "high rate" port
    - The connection is only 2400 baud

- **Iridium Pilot**
  - IP based system
  - Up to 134 Kbps throughput
  - Typical throughput is ≈ 60 to 75Kbps (service is bursty)
  - Connect to system from anywhere in the world
  - Mission success cannot depend on Iridium Pilot link reliability
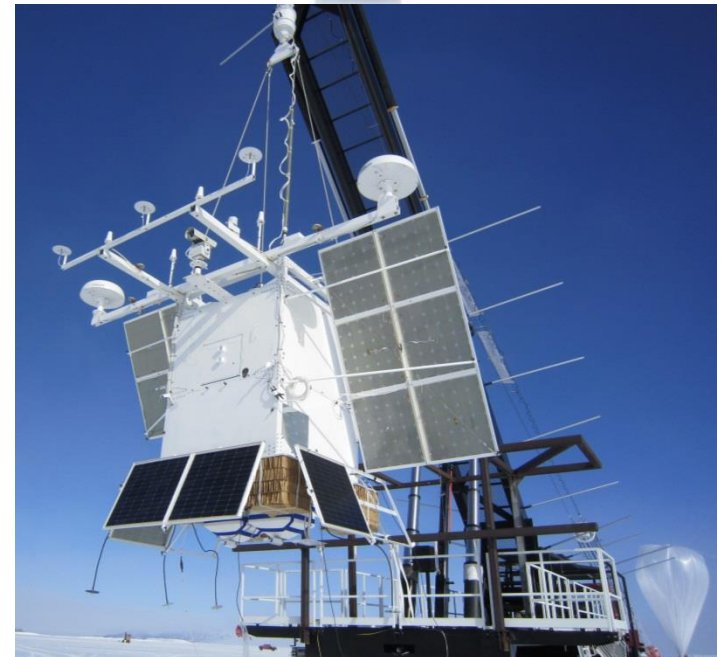
# Future Telemetry Options

## Low Cost TDRSS Transceiver (LCT2)

- Designed and built at WFF

- Variable output power (5-20W)

- Data rates up to 1 Mbps

- Test flights
    - 150kbps – FY15 Ft. Sumner (FLT 667NT)
    - 300kpbs – FY18 FT. Sumner (FLT 689N)

- Test flight planned for FY19 Ft. Sumner at 1Mbps

- Science interface
    - 6 kbps – 75 kbps: SIP High Rate interface (RS232)
    - 100 kbps – 1 Mbps: Ethernet (UDP packets)

- Only one LCT2 can operate on one satellite at data rates above 150kbps

- Limited Science availability possibly in 2020
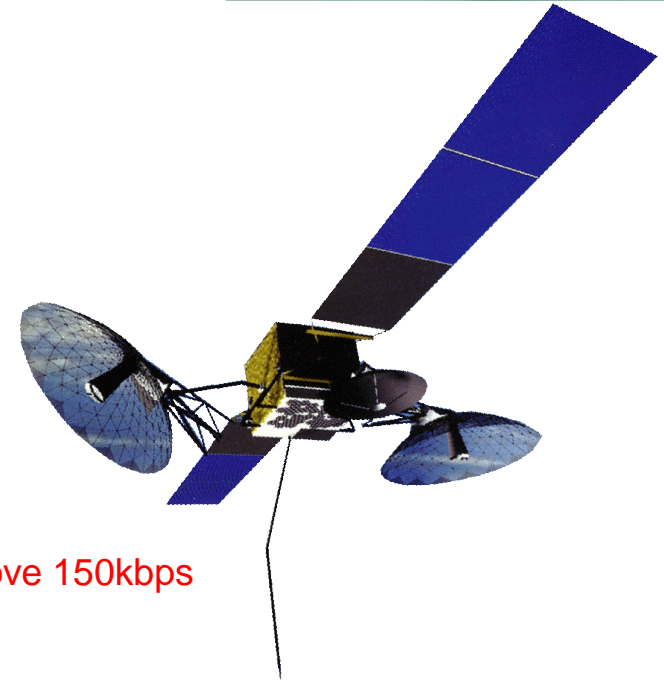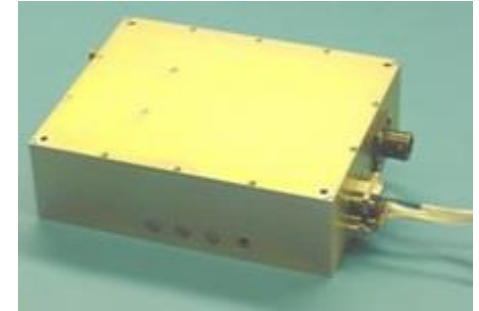
# Lower Antenna Requirements

- LOS antenna hang below the gondola (minimum 1ft)

- Standard CSBF configuration
    - 2 - Receiver antennas
        - 1" wide X 27" long
        - Typically 24" separation
    - 2 - transmitter antennas
        - 5" diameter X 3" long
        - Typically 24" separation and away from receiver antennas

- Standard Science configuration
    - 1 – transmit antenna for Sci TM
    - 1 – transmit antenna for Sci Video

- FAA transponder antenna
    - 5" diameter X 3" long
    - NOT USED IN ANTARCTICA

# Upper Antenna Requirements

- Upper antennas need an unobstructed view of the sky; they should be the highest objects on the gondola

- Standard LDB configuration
  - 3 GPS antennas
    - 4" diameter X 1" tall
  - 3 Iridium antennas
    - 3" diameter X 7" tall
    - 2 feet separation between radiating antennas
  - TDRSS Omni
    - 7" diameter X 12" tall (mid-latitude)
    - 7" diameter X 27" tall (Antarctic)
    - 2 feet separation between radiating antennas

- TDRSS HGA
  - 24" diameter X 16" tall
  - 25 lbs
  - Requires two additional GPS antennas with a minimum separation of 8' (minimum 2 feet from any Iridium antenna)

- Iridium Pilot
  - 23" diameter X 8" tall
  - 28 lbs
  - 3 feet separation to any other antenna

# Science to SIP interface

- Two Low Rate Science ports (one per SIP flight computer):
  - RS232: Baud Rate = 1200
  - Downlink telemetry 255 Byte packet, uplink commanding
  - Extended commanding available (up to 255 bytes per transmission)
  - Commanding through both SIP flight computers is required.
  - GPS position, time, and pressure altitude can be requested through this port.
- Two High Rate Science ports (one per SIP flight computer):
  - RS232: Baud Rate = up to 115,200 (configurable)
  - Must allow for different "effective" bit rates.
  - TDRSS – 6 kbps to 75 kbps (depending on link margin and antenna)
  - Iridium – up to 2 kbps max
- TDRSS Direct
  - RS232: Baud Rate = 115,200
  - Data Rate = 92 kbps
- IRIDIUM Pilot
  - Cat-5 Ethernet connected
  - port configurable
- Science Stack (control and TM) providing:
  - Analog and Digital input channels
  - Command outputs
  - Optically isolated and powered by Science

# Science to CSBF ROCC/OCC Interface



- Two Science ports each to the LDB OCC and ROCC computers are required.

  - data port at 115,200 baud (configurable)
  - commanding port at 2400 baud

- Third port required for TDRSS HGA (TDRSS Direct Data – 93kbps) at OCC