2019 Scientific Ballooning Technologies Workshop

Telemetry Options for LDB Payloads

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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 allocation
  – 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
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)
  - 300kbps – 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
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