2016 Scientific Ballooning Technologies Workshop

Telemetry Options for LDB Payloads

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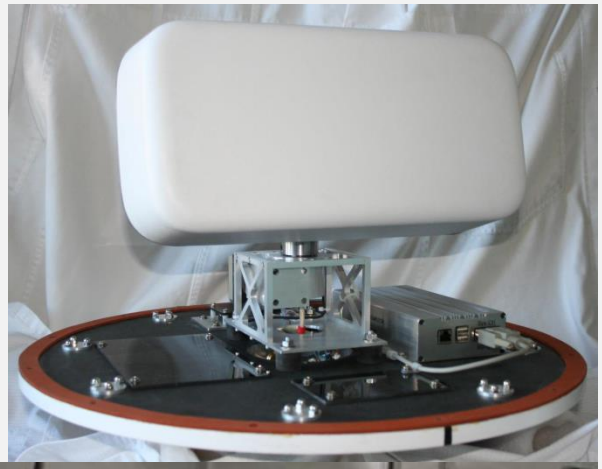
Current LOS Telemetry Options

- 1 Mhz bandwidth digital transmitter
  - 330 Kbit biphase encoded data
  - 740 Kbit randomized NRZ-L encoded data
  - ≈ 0.5 A @ 28V
- 3 Mhz bandwidth digital transmitter
  - 1 Mbit biphase encoded data
  - 2.24 Mbit randomized NRZ-L encoded data
  - ≈ 1.1 A @ 28V
- 6 Mhz bandwidth digital transmitter
  - 2 Mbit biphase encoded data
  - 4 Mbit randomized NRZ-L encoded data
  - ≈ 1.1 A @ 28V
- Analog video transmitter
  - NTSC
  - ≈ 2A @28V

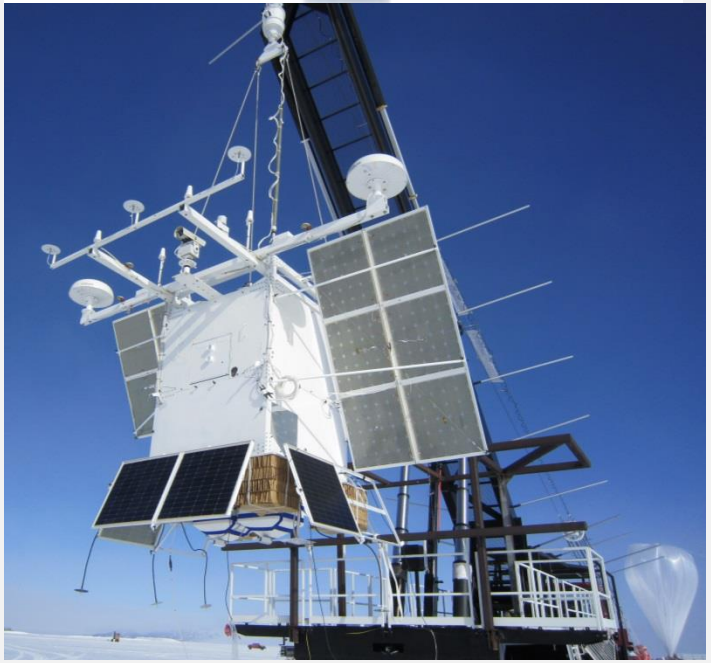
Current TDRSS Telemetry Options

- Powered by CSBF
- Omni Antenna
  - 6-10 Kbps data
  - 115,200 baud RS232 interface
  - CSBF downlinks data in 2041 byte packets
- High Gain Antenna
  - 93 Kbps data
  - 115,200 baud RS232 interface
  - No packetizing



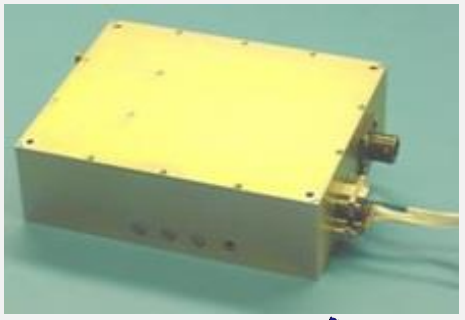
Current Iridium Telemetry Options

- Iridium SBD
  - Email based
  - Continuously 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 ≈ 75Kbps (service is bursty)
  - Connect to system from anywhere in the world

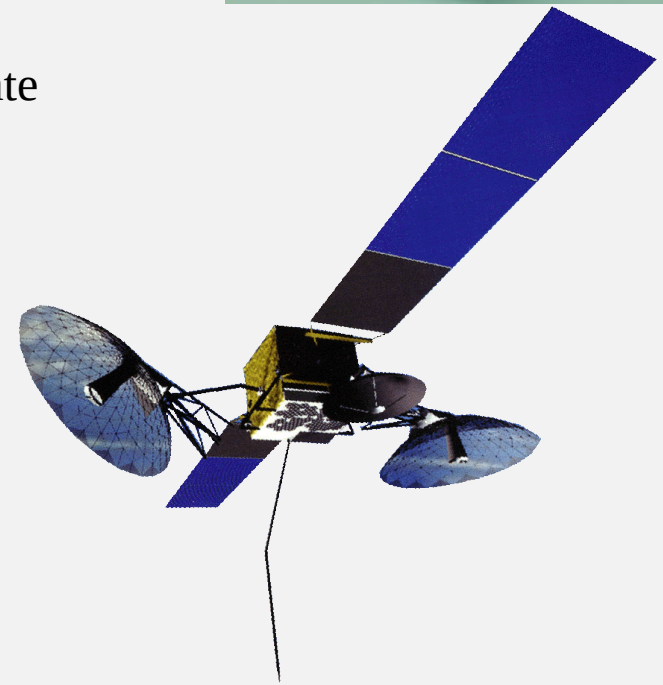


Future Telemetry Options

Low Cost TDRSS Transceiver (LCT2)



- Designed and built at WFF
- 300 to 500 Kbps through HGA
- Flown at 150 Kbps
  - Flt 667NT – FY15 Ft. Sumner
- Test flight planned for FY16 Ft. Sumner at higher rate
- Science availability possibly in 2017
  - Science interface TBD



Future Telemetry Options

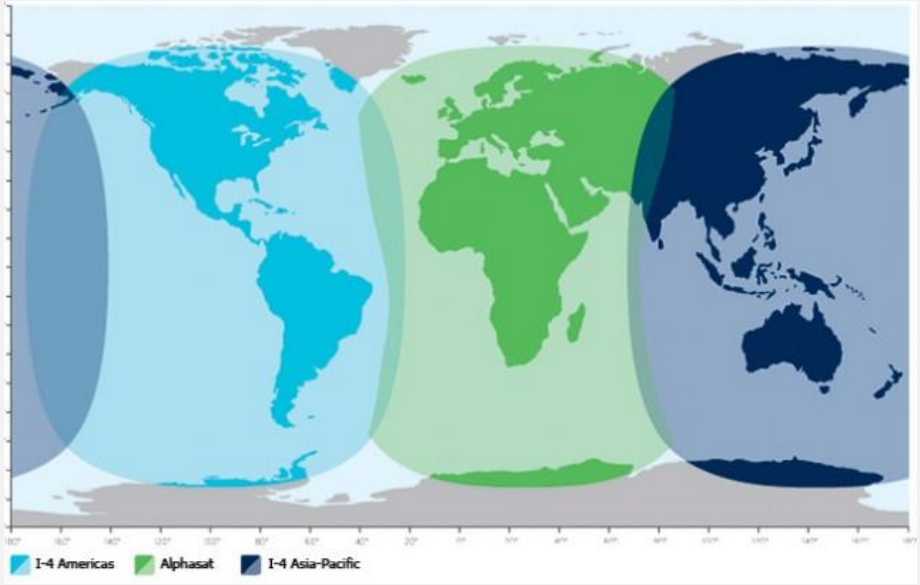
Iridium Certus

- IP based system similar to Pilot
- Up to 1.4 Mbps downlink
- Up to 512 Kbps uplink
- Availability likely sometime in 2017
- Cost TBD
  - Hopefully similar to Pilot
- Truly global system

Future Telemetry Options

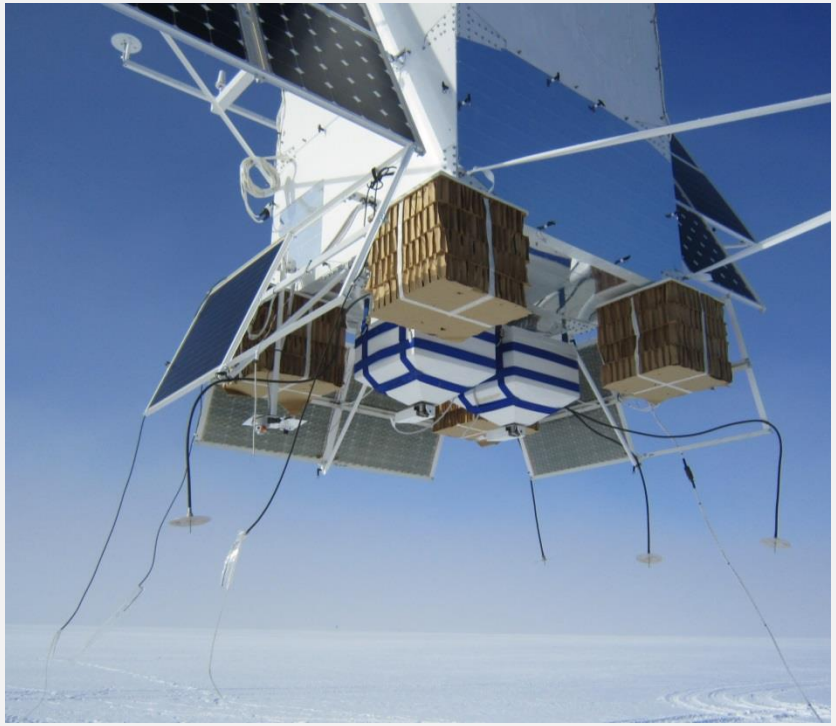
Inmarsat BGAN

- IP based system
- Up to 448Kbps throughput
- Very expensive
  - ≈ $2.54 / MB
  - ≈ $740,000 for a 100 day flight at 300 Kbps rate
- Connect to system from anywhere in the world
- NOT AVALIABLE AT THE POLES



Lower Antenna Requirements

- LOS antenna hang below the gondola
- Standard SIP configuration
  - 2 - UHF antennas
    - 1” wide X 27” long
    - Typically on opposite sides of the gondola
  - 2 - L-Band antennas
    - 5” diameter X 3” long
    - Typically on opposite sides of the gondola
- Standard Science configuration
  - 1 - L-Band antenna
- 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 SIP 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 as large of separation as possible
- Iridium Pilot
  - 23” diameter X 8” tall
  - 28 lbs