S-Band Software Defined Radio Flight Experiment
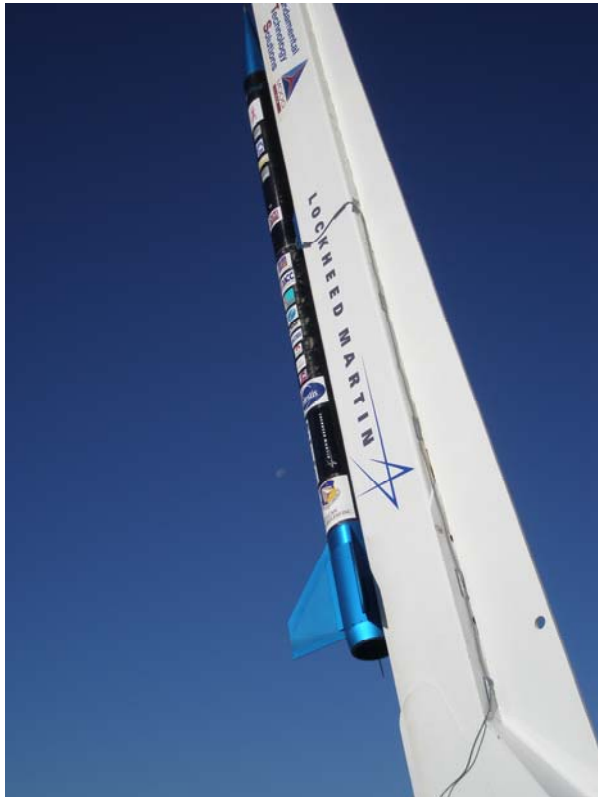
Prepared By: Kevin Lynaugh
Date: 8/6/10
Funded By AFRL/RV and ORS

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- Genesis Black Box Project

- Flight Experiment

- Post Flight Data Analysis

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- **Genesis Black Box Project**

- Flight Experiment

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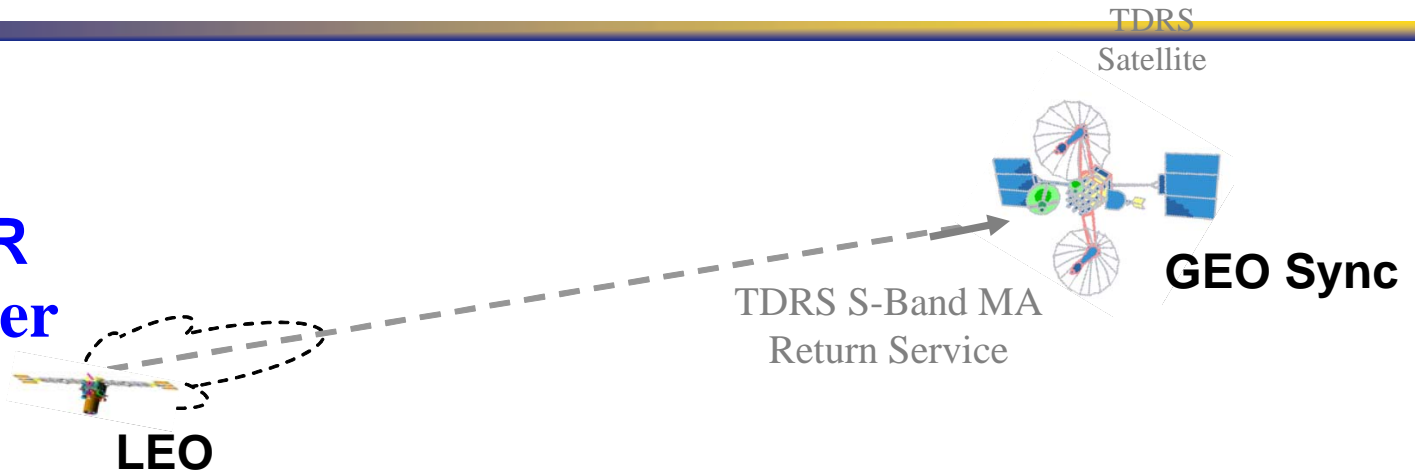
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Genesis Black Box Project

- Genesis Black Box Project originates with AFRL/RV

- Similar to aircraft Black Box functionality

- The Black Box cannot be physically recovered

- Data must be transmitted to ground infrastructure anywhere on orbit.

- Black Box must have small SWaP

- Can be used for both emergency and routine communications with ground controllers.

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CSR-SDR
Transceiver

TDRS
Satellite

GEO Sync

TDRS S-Band MA
Return Service

LEO

Orbit
Track

- **Similar to aircraft black box transponder**

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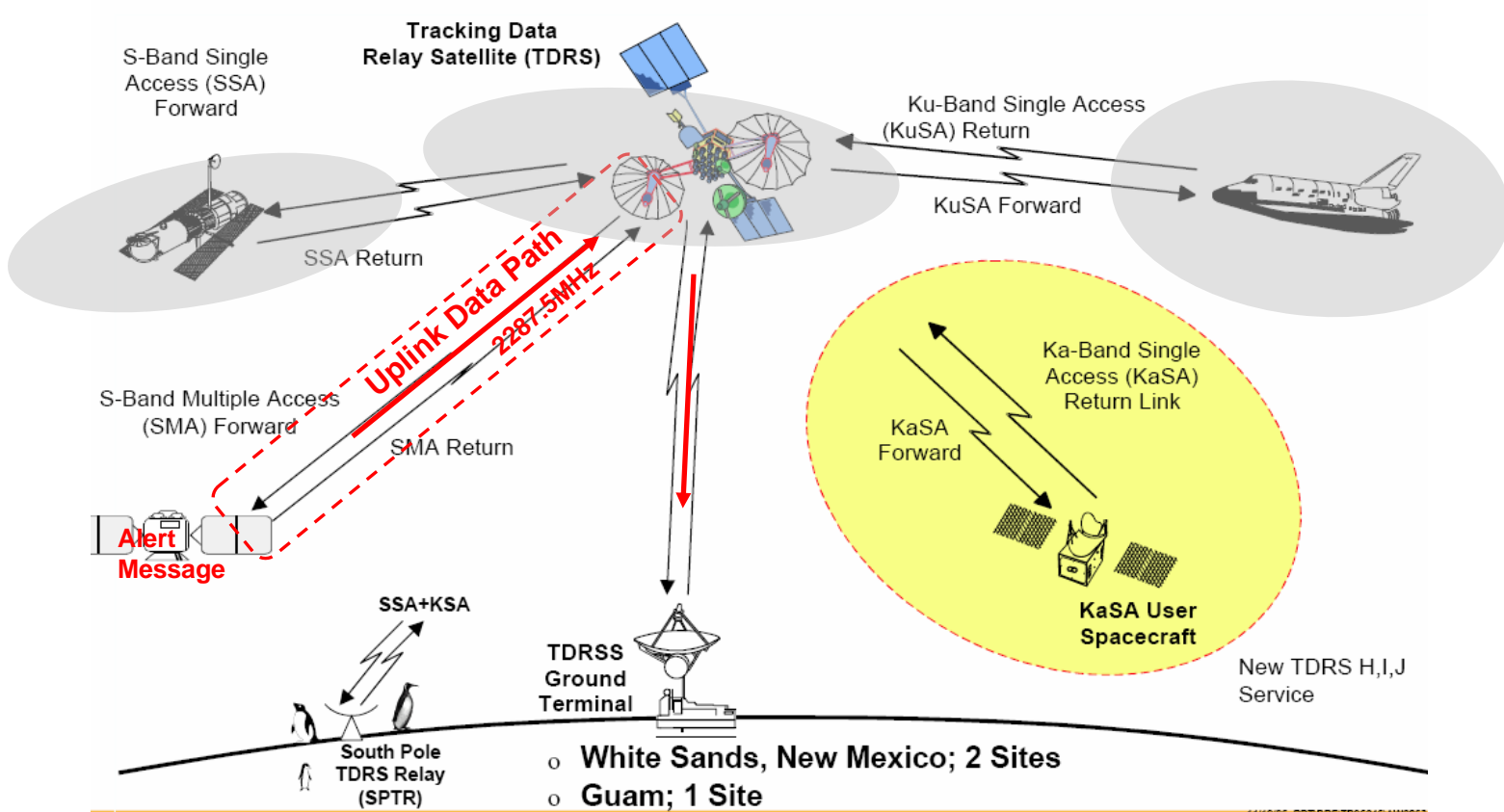
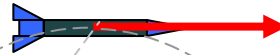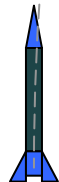- **Uses existing infrastructure (NASA TDRS-MA) for data backhaul**

- **Uses existing infrastructure (NASA TDRS-MA) for data backhaul, including ground terminals**

- **Space Vehicle payload can be very small, low power and light weight (size of a cell phone, example CSR-SDR)**

- **Goal to be compatible with CubSats**

- **Usable for all LEO, MEO and HEO orbits (in view of TDRS)**

- **Message gets out of Space Vehicle independent of major bus failure**

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Flight Technical Challenges

- Low gain antenna system with deep antenna nulls

- Spinning Vehicle (~5.6 rotations per second)

- Range from ½ mile to 100miles

- High rate of speed

- Use CSR-SDR S-Band transmitter for TDRS signal transmission.

- Use embedded C&DH capabilities in CSR-SDR

- Coordinate with NASA, WSMR, SDTW, AFRL, ORS, Up Aerospace and ITT

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Sounding Rocket Experiment

Objective of Experiment

- CubeSat Software Defined Radio

- Host on Hypersonic Flight Vehicle

- Demonstrate Space Vehicle Black Box Transponder Capability

- Close Link to GEO TDRS-MA

- Provided Real-Time Payload Telemetry to Ground

- S-Band Frequency

Launched 6:45am May 5th 2010 from Space Port America
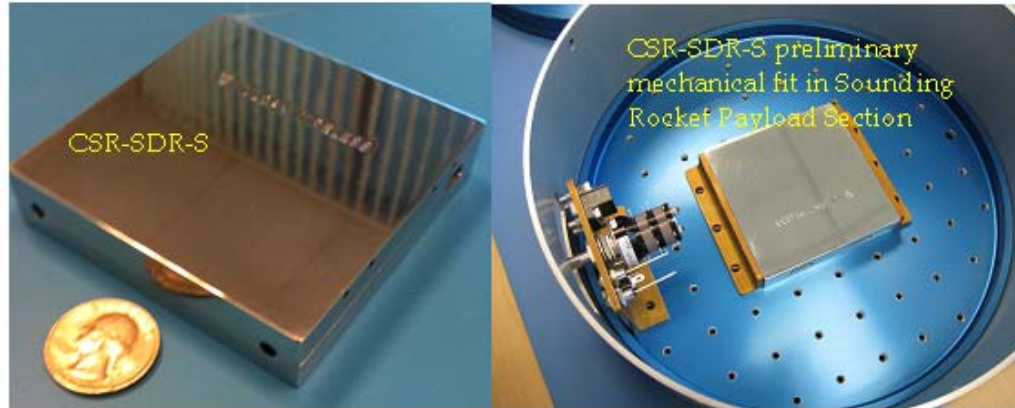
Achieved 115km altitude

Met all Objectives
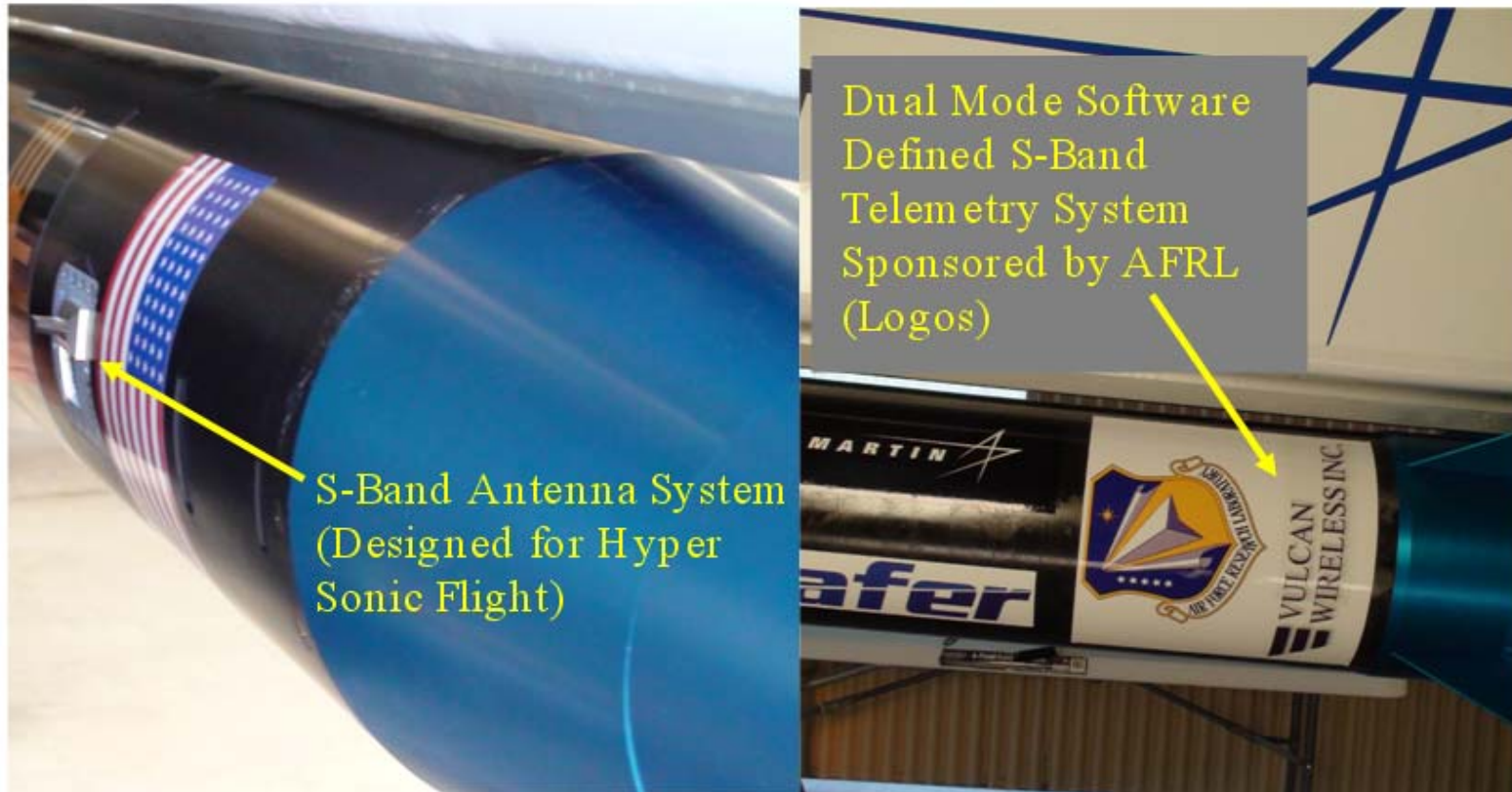
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Payload Configuration CSR-SDR

- Payload Consists of CSR-SDR configured to S-Band Transmission.

- CSR-SDR also contains UHF SDR Transceiver, but not used in this experiment

- Integrated Launch Detection, power switch and battery system

- Added system control software for flight.

- Demonstrated multi-waveform capabilities.

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Dual Mode Software Defined S-Band Telemetry System Sponsored by AFRL (Logos)

S-Band Antenna System (Designed for Hyper Sonic Flight)

Vulcan Wireless CSR-SDR-S Payload on Space Loft XL (5/3/10)

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Launch

Successful Launch and Demonstration of CSR-SDR-S Payload on May 4th 2010 at 6:45am

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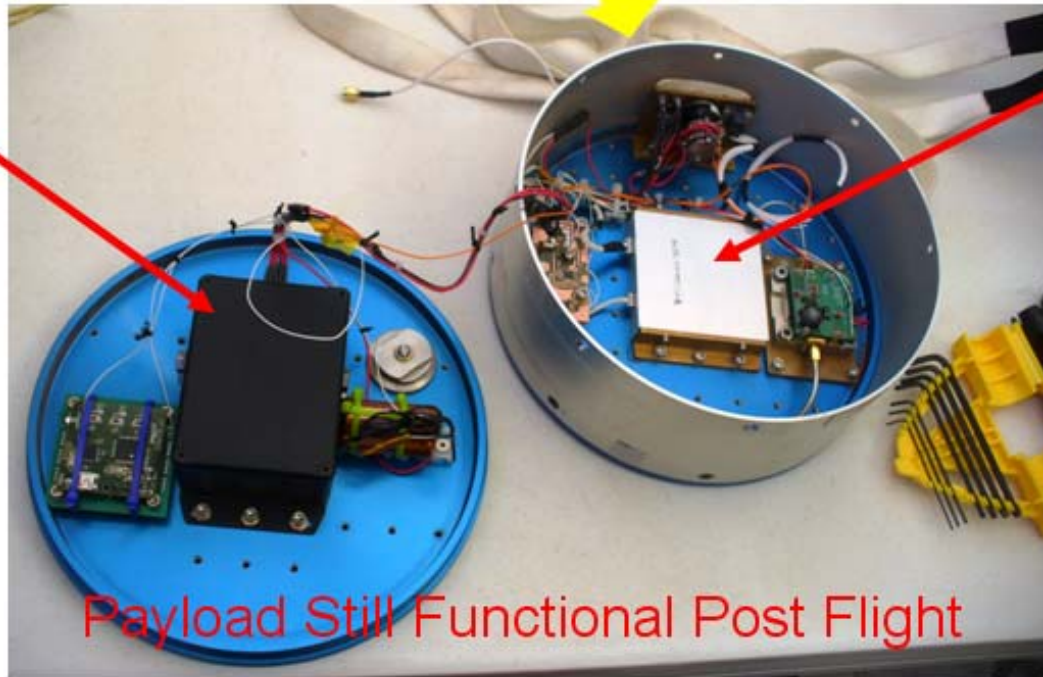- **Post Flight Data Analysis**

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Ground Terminal

Fixed Ground Terminal

Antenna System

Base Support

To Wolf Com Server

Receiving UNIT

LAN

PC GND

Receiver or

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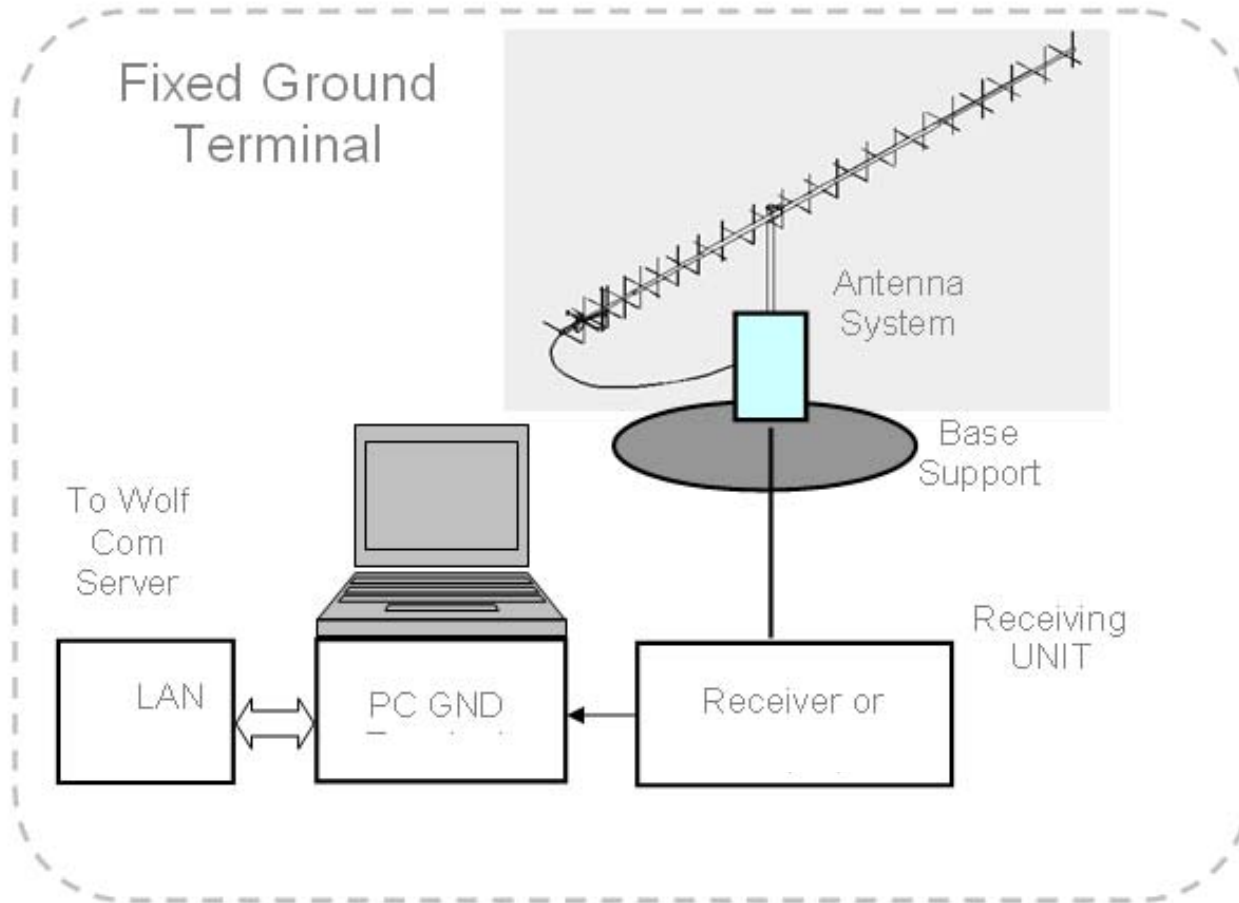
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Post Flight Payload Recovery

Flight Antenna

CSR-SDR Software Defined Radio

Flight Battery

Payload Still Functional Post Flight

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Summary

- Main objectives were met
  - Demonstrated CubeSat flight hardware into payload
  - Conducted electrical and environmental qualification of flight hardware
  - NASA TDRS-MA received signals and estimated SNR
  - Space Port America received and decoded real time flight telemetry
  - Space Test Wing tracked flight vehicle

- Problems
  - Need better coordination between sites

- Future
  - Develop Fully Integrated Payload

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