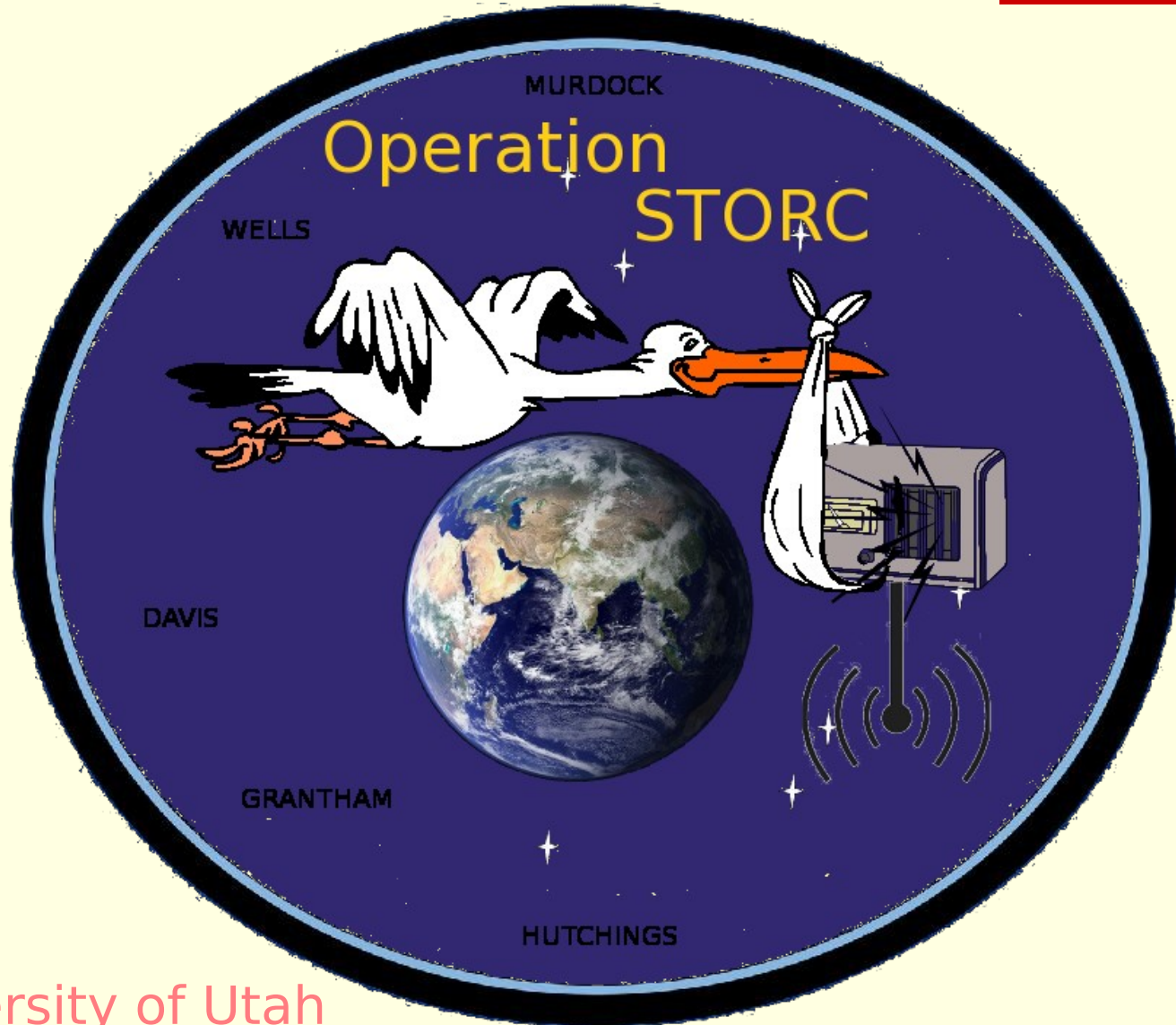# Operation STORC

Operation STORC

by
James Murdock (ECE)
Kyle Hutchings (ECE)
Joe Grantham (EE)
Neil Davis (EE)
John Wells (CS)

Objectives
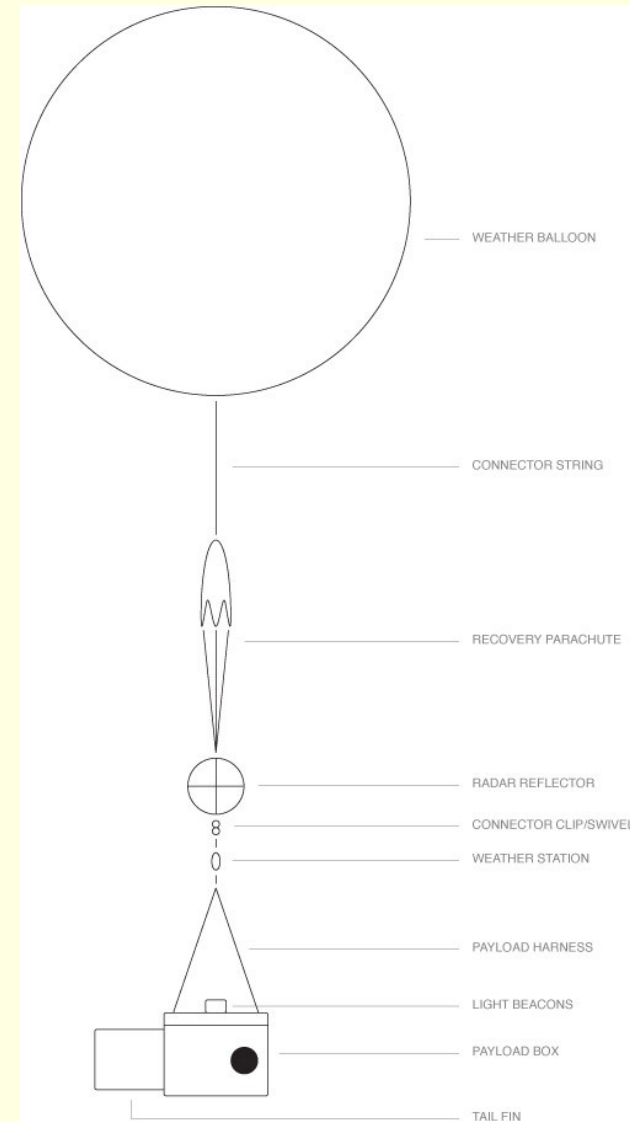
- Functional Description
- Preliminary Overview
- Implementation
- Tasking
- Interface
- Bill of Materials (BOM)
- Risk Assessment
- Questions

Functional Description

- Weather Balloon
- Payload
- Ground Station
- Radio Communication

WEATHER BALLOON

CONNECTOR STRING

RECOVERY PARACHUTE

RADAR REFLECTOR

CONNECTOR CLIP/SWIVEL

WEATHER STATION

PAYLOAD HARNESS

LIGHT BEACONS

PAYLOAD BOX

TAIL FIN

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Preliminary Overview

- **Hardware**
  - ✓ Software Defined Radio (SDR)
    - FPGA
      - ○ SmartFusionSOC (A2FXXX)
    - MCU
      - ○ CortexM3 (Included with A2FXXX)
    - Board Design
      - ○ Michigan University (provided by Dr. Schmid)

Preliminary Overview (cont)

- ✓ SDR
  - Antenna
    - Wire of X length to be tuned to desired frequency
- ✓ Balloon / Payload
- ✓ Sensors
  - Position (GPS)
  - Temperature
  - Acceleration

Preliminary Overview (cont)

- **Software**
  - ✓ FPGA
    - Community code provided by gnuradio.org to be modified per our specifications
  - ✓ MCU
    - C or Assembly code to interface with
  - ✓ Launch Predictions
    - Using weather data from weather.gov
    - Real-Time position adjustments

Preliminary Overview (cont)

- **Software**
  - ✓ Launch Predictions
    - Recovery Location (Landing Zone)
  - ✓ Radio Communication Protocol
    - APRS with AX.25
    - The method of transmitting packets between radios and radio to computer

Objectives

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Implementation

- Hardware
  - ✓ Consulting from L3, Amatuer Radio Enthusiasts, and University Staff
  - ✓ Weather Balloon Enthusiasts
- Software
  - ✓ ECE / CS Combined Efforts
  - ✓ University Staff
- Sponsorship and Donations

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Tasking

- May 1, 2012 – SDR Design (High Risk)

- June 1, 2012 – Debug/Implement/Test SDR

- June 8, 2012 – MCU/Sensor Design and Development

- June 24, 2012 – Debug/Implement/Test MCU

- August 1, 2012 – Software Design

- September 1, 2012 – Debug/Implement/Test GUI and Entire Project Integration

- October 1 thru November 30, 2012 – Finalize Project

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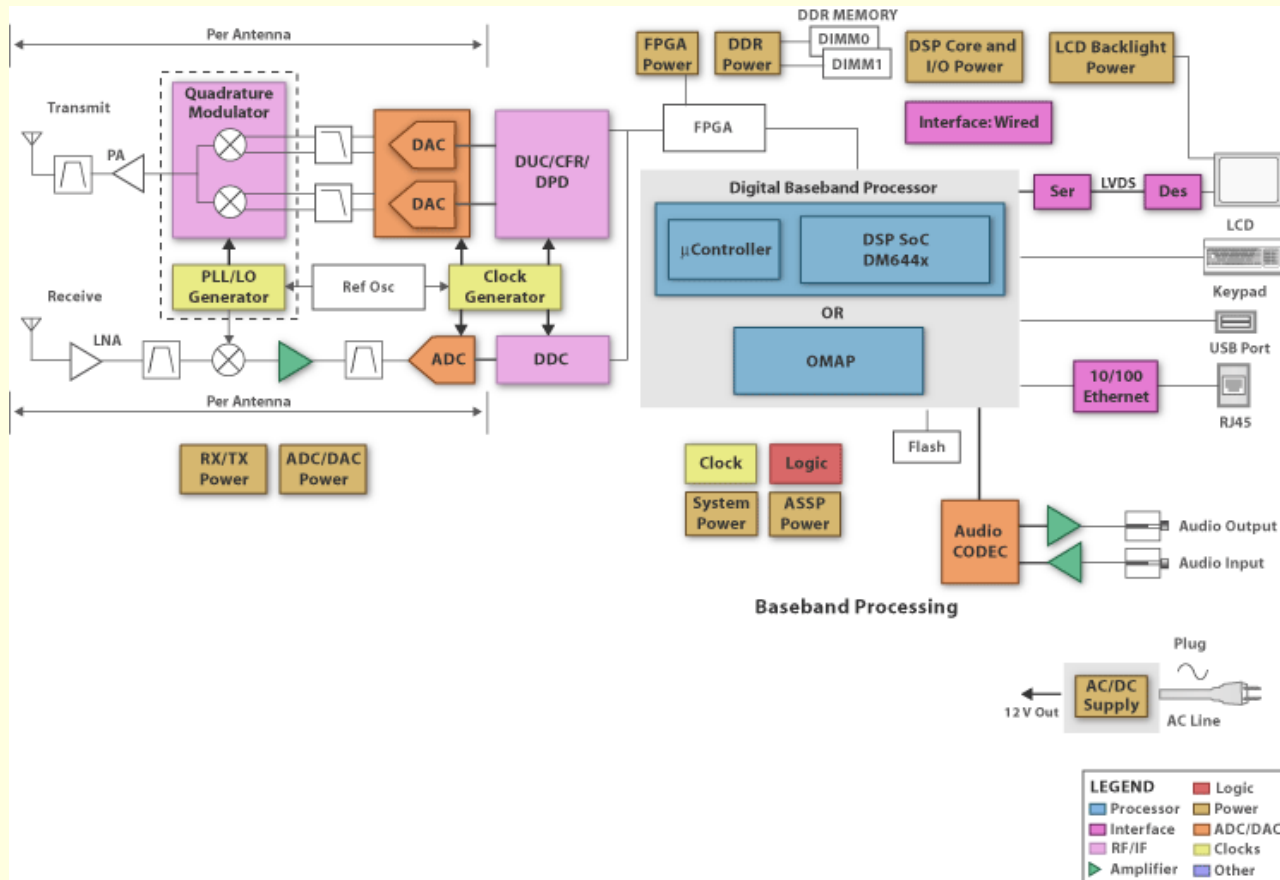- Bill of Materials (BOM)
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Interface

- I2C
- Serial
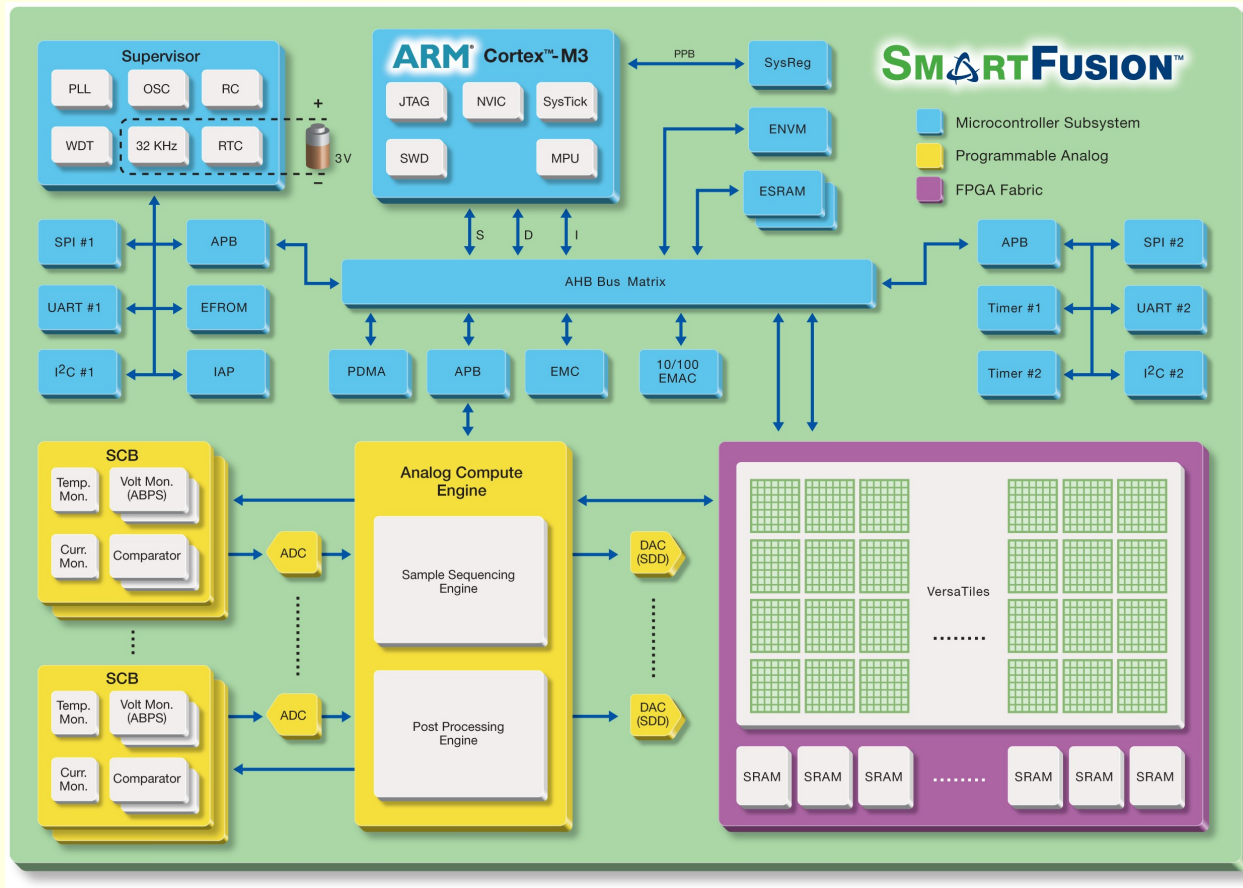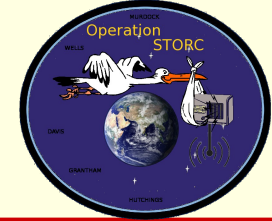- APRS / AX.25 Protocol
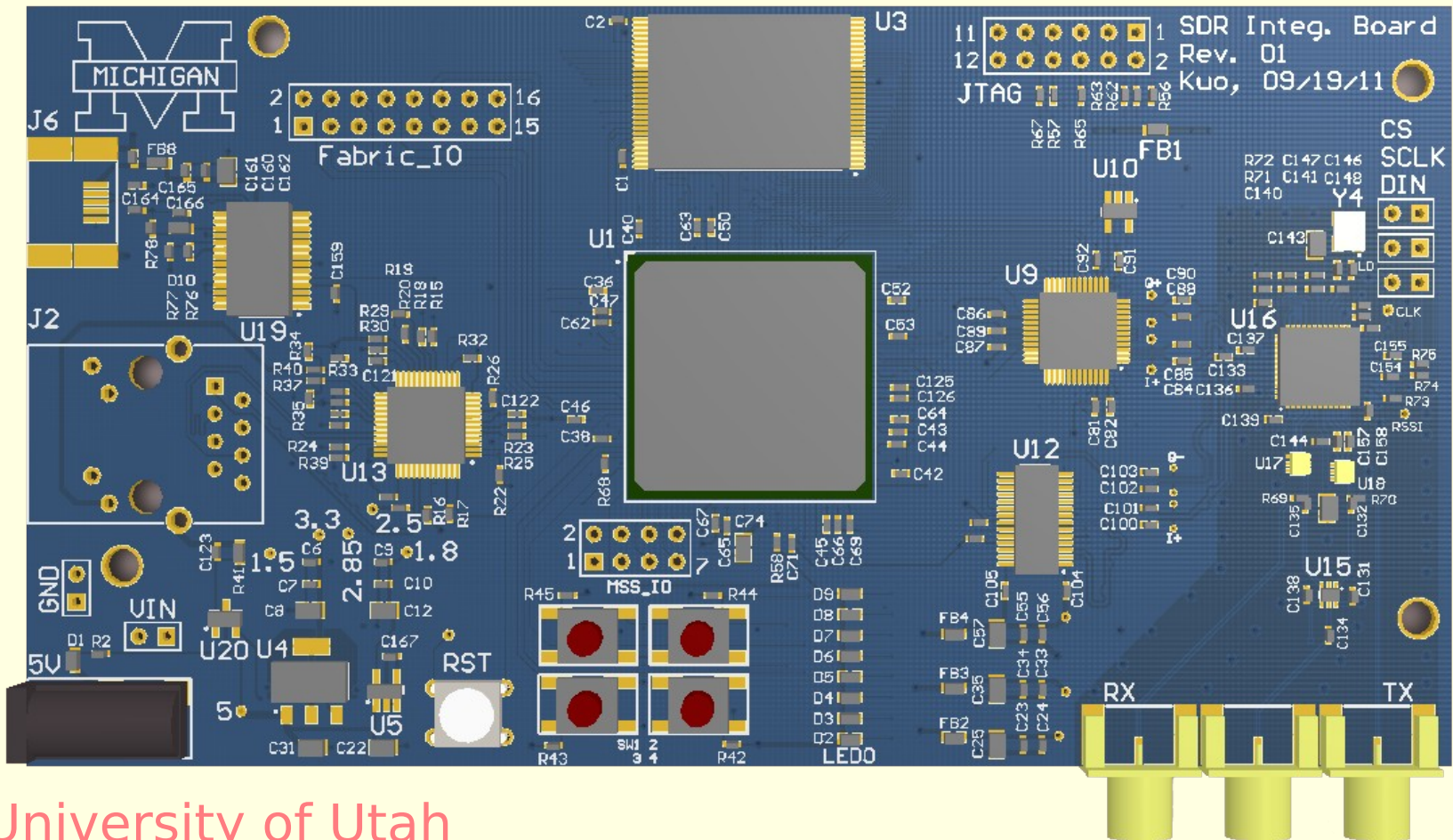
Interface (cont)

- SDR Block Diagram

Interface (cont)

- **SmartFusion Block Diagram**

- Michigan University SDR

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BOM

- GPS $38 Argent Datat – Serial Interface
- FPGA $42 SmartFusion 500 LBGA 500k (w/ CortexM3 MCU)
- Accelerometer $8 Digikey 80XL346 I2C Interface
- Digital Thermometer $6 Digikey DS620 I2C Interface
- PCM $54/each 4 layer @ Qty 5 from PCB Universe
- Helium $0.69/cu ft
- Balloon 350g $40
- Parachute 36" $15, Rocketchutes.com
- Batteries 30137-0 Li-Polymer 3.7V 2400mAh $7, All-Battery
- Radar Reflector SD152 $50, landfallnavigation.com
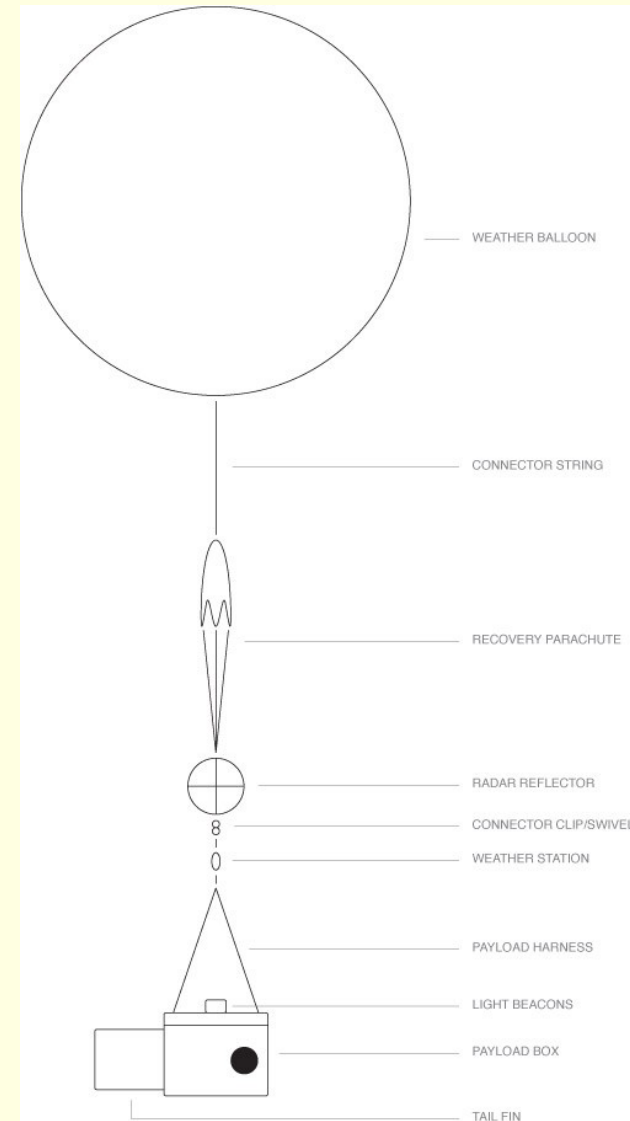- Digital Latch (build)

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Risks

- SDR Complexity
- Budget Constraints
- Falling Object
- Payload Loss / Destruction
  - ✓ Drift
  - ✓ Crash and Burn
- Malfunction

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Questions?

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