

# Sandia SSA R&D Capability



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# Overview



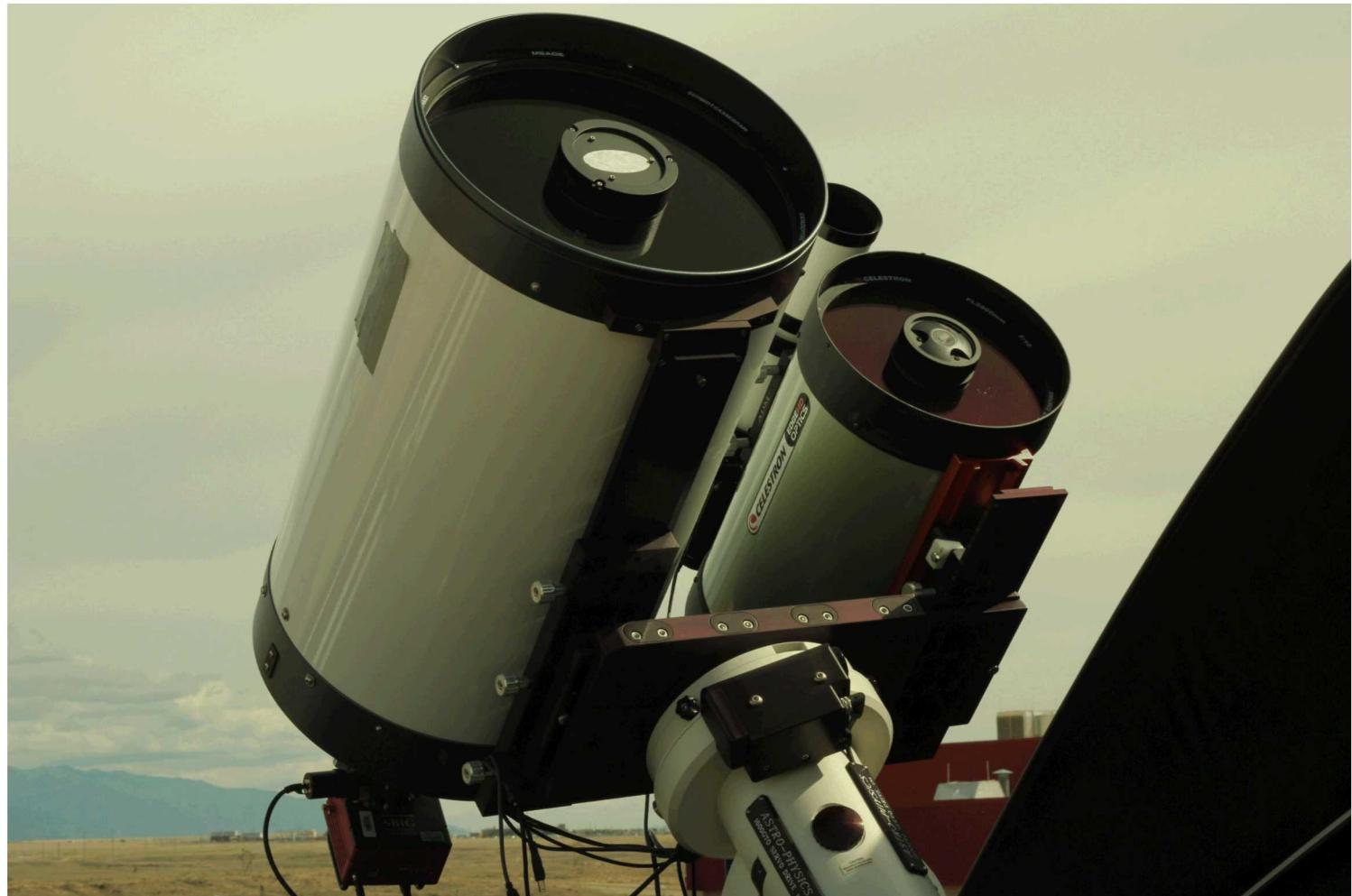
Sandia Engineering Nights Goals

Sandia SSA Capabilities

- Background
- Facilities
- Sensors
- Data Storage and Dissemination

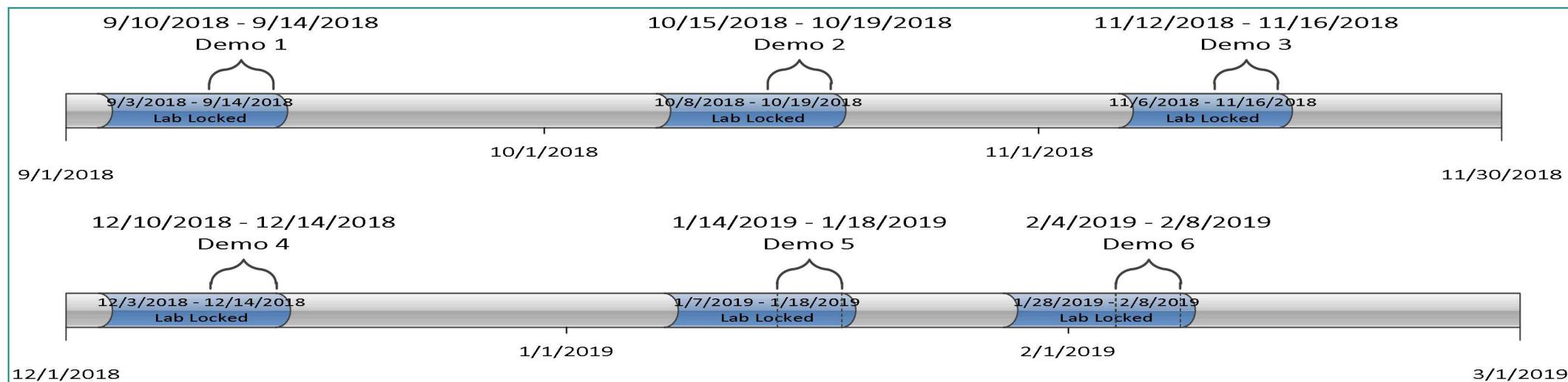
Engineering Nights Implementation Plan

Conclusions

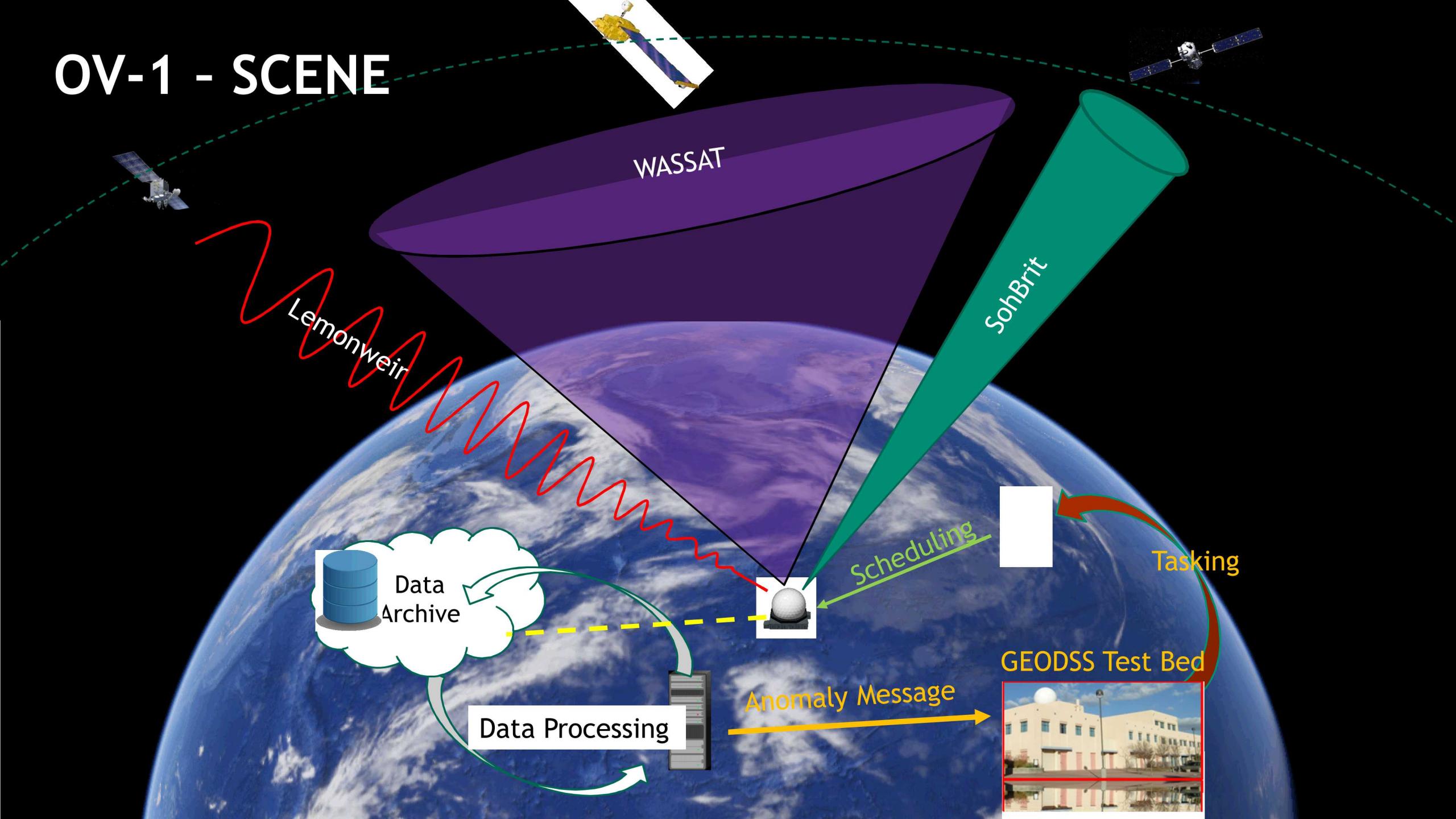


### 3 Sandia Engineering Nights Goals

- Goal 1:
  - Collect on GEO satellites using Sandia designed wide area search sensor
  - Store and process images, correlate results against satellite catalog
  - Notify GEODSS testbed of anomalies
- Goal 2:
  - Sandia identifies anomaly, notifies GEODSS testbed
  - GEODSS confirms anomaly, updates Sandia
  - Sandia tasks RF antennas, SOHBRT responsive telescope
  - Collect data in RF and filtered optical



# OV-1 - SCENE



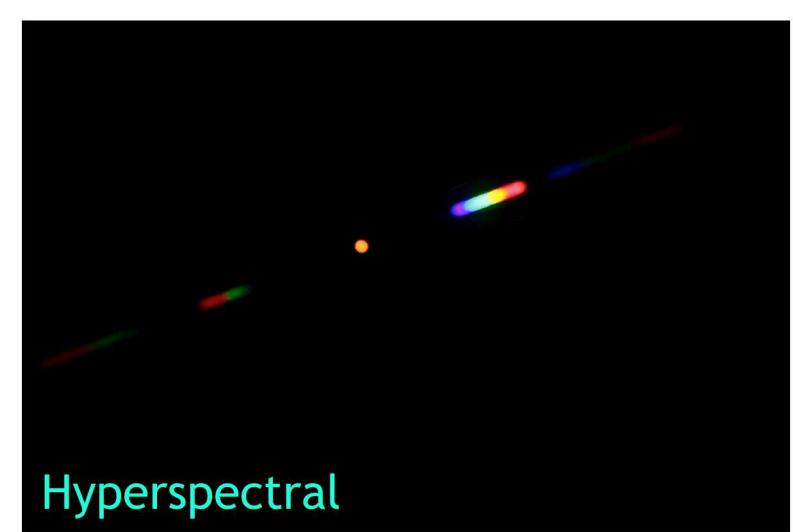
# Sandia SSA Capabilities - Background



- 2013: Intern project using Celestron telescope
- 2014: Acquired dome, first automated collections
  - Human Intervention during collects
- 2015: Successful full streak collects of LEO targets
- 2016: Acquired new dome and mount
- 2017: First fully automated collections, paper published
- 2018: Data storage/dissemination system integrated

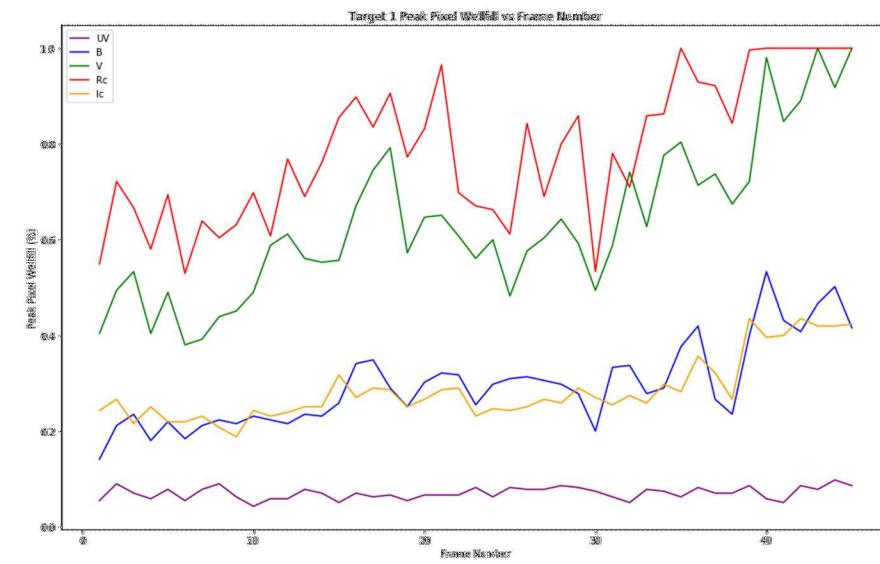


Manually-captured image streak of the International Space Station (ISS) (~2013)



## Past publications

AMOS 2017: Sohbrit: Autonomous COTS System for Satellite Characterization



# Sandia SSA Capabilities - Facilities

## Automated dome at Sandia Area IV Facility

- Automated AstroHaven 12' Dome
- Weather Station
- Astro Physics Mount
  - Slew up to 5° /second
- Numerous cameras
- 80mm, 11in, 16in telescopes
- Filter wheel
  - UV, B, V, Rc, Ic, Hyperspectral



# Sandia SSA Capabilities –WASSAT Sensor

Prototype sensor used for Geosynchronous satellite belt stare collections

Four COTS EO cameras (1/4 used for Engineering Nights)

- Provides 20/80 degrees of coverage

Engineering Nights Use:

- Primary cueing sensor for Phase I anomaly detection
- Sensor performs collect and saves data to file
- Anomaly detection and position algorithm run on data set
- Data populated into Anomaly message
- Message sent to GEODSS Test Bed

# Sandia SSA Capabilities – Sohbrit Sensor

## 11-inch Schmidt-Cassegrain Telescope

- Primarily used to characterize GEO satellites through extended observation
- 16 inch and 3 inch telescopes also available

Performs automated collection, processing and dissemination

## ASI 1600MM Camera

Wide Open, U, B, V, Rc, Ic and hyperspectral grating filters rotated through filter wheel



Astro-Physics 1600GTO

- German Equatorial Mount
- Load Capacity 210 Lbs.



# Sandia SSA Capabilities – Lemonweir Sensor

Passive RF sensor capable of monitoring RF emissions from satellites

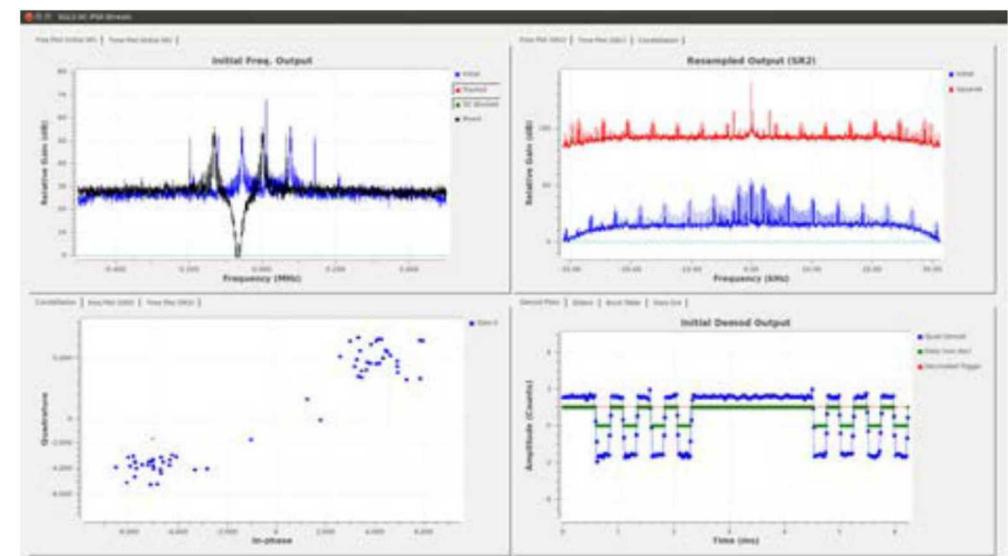
- Array of four 14-foot dishes and one 8-foot dish
- Operates in space operations band (2.2-2.3 GHz)

Determine if satellite is in view / out of view

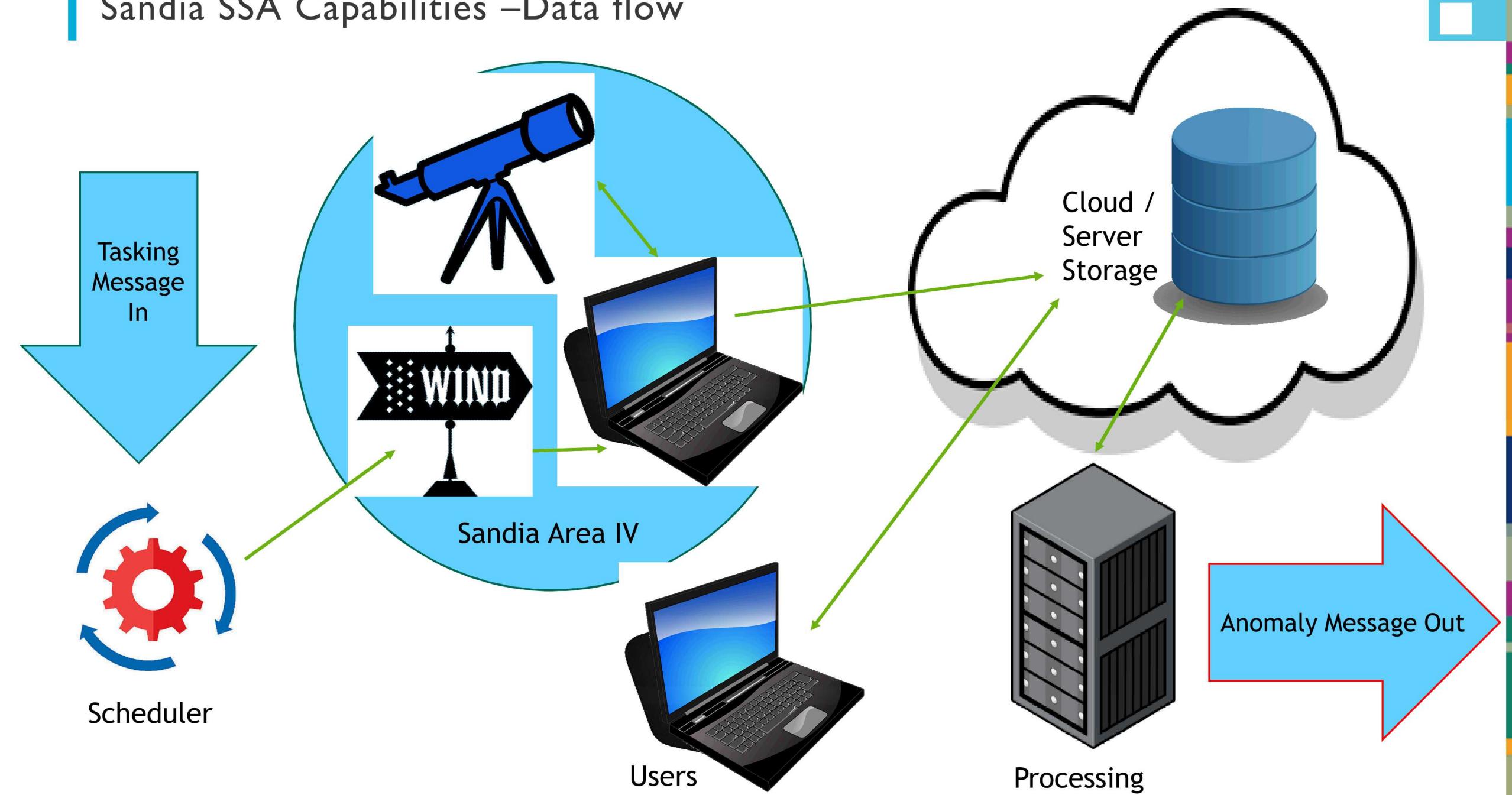
- Based on SNR of received signal using differing beamwidth antennas

Determine if satellite is transmitting telemetry

- Center frequency (same or different/new)
- Modulation type (same or different/new)
- Length of transmission (typical or atypical)
- Data Rate (same or different/new)
- Data Patterns (same or different/new)
  - Framing / Sync Use (same or different/new)
- Communications Mode
  - Streaming, Bursting, Tracking signal only



# Sandia SSA Capabilities –Data flow



# Sandia SSA Capabilities – Data Storage and Dissemination

## A Multi-Phenomenology Big Data Architecture

The diagram illustrates a multi-phenomenology big data architecture centered around the Firebird system. At the top, the Firebird logo is displayed with a background of binary code and the words 'BIG DATA' and 'SEARCH'. The architecture is represented by a central white upward-pointing arrow containing a stylized 'F' logo. Surrounding this central node are five colored boxes representing different data sources: 'Overhead Persistent Infrared' (orange), 'Seismic' (red), 'Synthetic Aperture Radar' (purple), 'Optical' (blue), and 'Radio Frequency' (green). Each source box has a corresponding icon: a satellite dish for infrared, a seismic wave for seismic, a plane for synthetic aperture radar, a telescope for optical, and a radio antenna for radio frequency. From the central node, blue lines radiate outwards to each source box. The text 'Search single source or across multiple sources' is positioned below the central node. On the left, a box titled 'Firebird Enables Knowledge Discovery' lists six bullet points: 'Consumes multi-phenomenology data', 'Standardizes data for integrated analysis', 'Enables data forensics', 'Captures chain of custody and data lineage', 'Exploits data in both horizontal and vertical directions', and 'Cloud deployment allows for collaboration and data exposure to multiple user communities'.

**Firebird Enables Knowledge Discovery**

- Consumes multi-phenomenology data
- Standardizes data for integrated analysis
- Enables data forensics
- Captures chain of custody and data lineage
- Exploits data in both horizontal and vertical directions
- Cloud deployment allows for collaboration and data exposure to multiple user communities

Search single source or across multiple sources

Overhead Persistent Infrared

Seismic

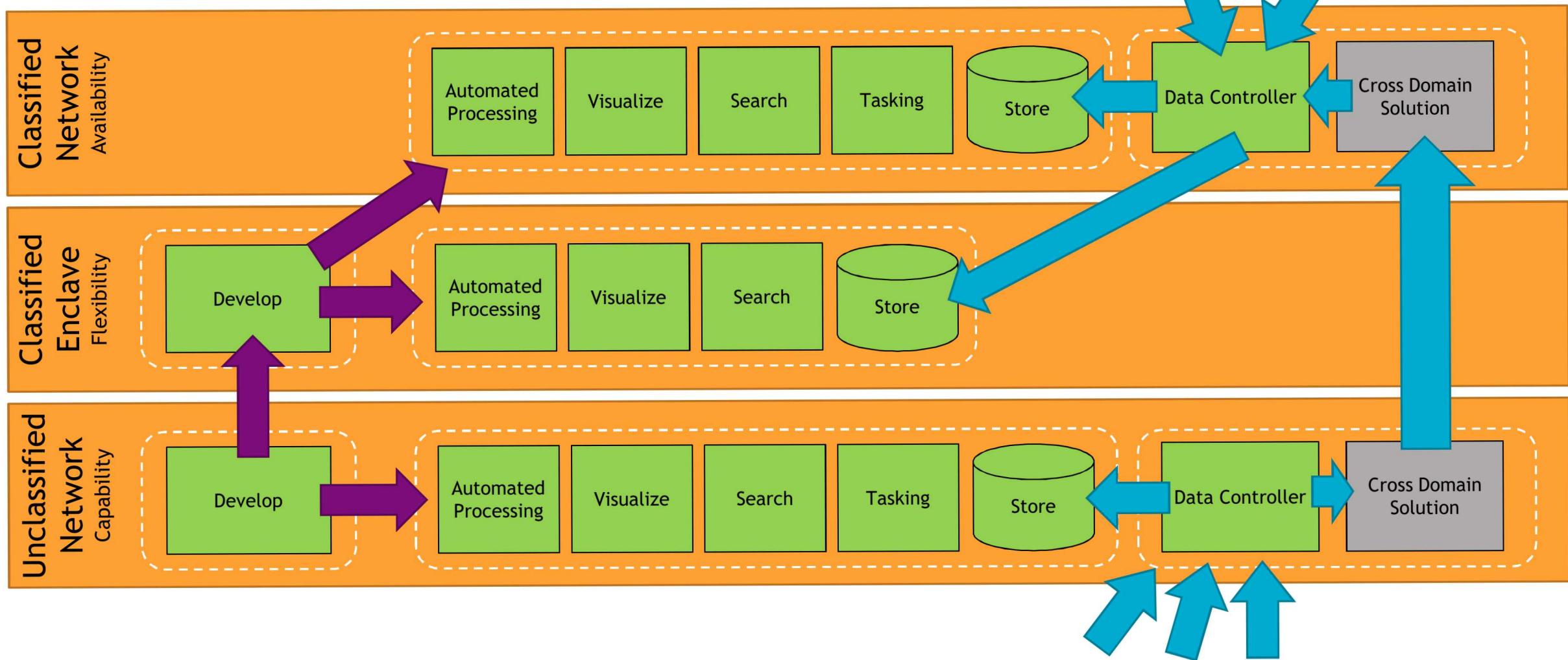
Synthetic Aperture Radar

Optical

Radio Frequency

# Space Situational Awareness Data Collection and Exploitation Environment (SSADCEE)

Other Sensor  
Other Dataset



Sohbrit

Wassat

Lemonweir

# Engineering Nights Implementation Plan

## Engineering Nights Implementation Plan

### Phase 1: Satellite Position Anomaly Notification

- Collect imagery of GEO satellite using WASSAT wide area search capability
- Detect satellite position anomaly
- Calculate position error
- Populate anomaly message and send to GEODSS Test Bed through SATCHAT

### Phase 2: Conduct Follow-up Passive RF and Multi Spectral Collects based on Cueing from GEODSS Test Bed

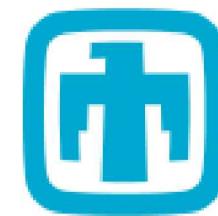
- Send initial anomaly message to GEODSS Test Bed for a specific satellite
- Receive tasking message from GEODSS Test Bed
- Task and collect passive RF and multi-spectral collects based on follow-up tasking



Please contact [dpwoodb@sandia.gov](mailto:dpwoodb@sandia.gov) with any additional questions or concerns.



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## Back-Ups

