GLOBAL SCIENCE & TECHNOLOGY, INC.

Partnering for Success

U.S. Air Force Weather Satellite (WeatherSat)

Project Highlights

Task Areas

- **Requirements Development**
- **Calibration Process Development**
- **Weather Data Products Development**
- **WeatherSat Data Validation**
- **On-Orbit Maintenance**
- **Data Dissemination**

Benefits to USAF

- 30 years supporting weather satellites
- Highly specialized workforce of engineering, technical, and scientific experts
- Capabilities in sensor engineering, calibration and validation, meteorology, science algorithms, software engineering, and satellite communications
- Directly relevant work with NOAA's major satellite programs including JPSS and GOES

GST Support for AF WeatherSat

GST supported the Air Force Research Laboratory (AFRL) to develop Weather Satellite (WeatherSat) sensor data processing algorithms, perform calibration/validation of sensor data, and provide image processing in support of the AFRL small satellite weather mission. WeatherSat requirements addressed critical capability gaps in collecting global weather data and multispectral images in the visible and infrared bands from a dawn-dusk sun-synchronous orbit. GST supports a successful mission by producing Sensor Data Records (SDRs) and Environmental Data Records (EDRs) from Raw Data Records (RDRs) for use by end users.

Background: Air Force Research Laboratory (AFRL) awarded a phase II SBIR contract to GST for developing Weather Satellite (WeatherSat) sensor data processing algorithms, perform calibration/validation of the sensor data, and provide image processing in support of the AFRL small satellite weather mission. GST designed and built the WeatherSat Image Generation System, (WIGS), which is an event-based streaming workflow processor that generates weather satellite imagery in near real time. It is designed to handle an arbitrary number of asynchronous data streams. The application is horizontally scalable and cloud ready.

WIGS Product Summary: The WIGS application is designed to receive input files in a generic file container format that stores data in tagged chunks. The WIGS input processor serializes the data into uniform chunks. Each chunk of data is associated with a message; the messages are placed in a queue which is read by the workflow processor. Rules are created to implement the workflows; the workflows are executed by assembler actions and transition actions. An "assembler" collects all observations from a single sensor stream and group the data according to time boundaries. A "translator" takes a single message and generates a new type of message from it to trigger the next stage of data processing in the workflow.

WIGS makes use of Apache Cassandra for high-speed scalable intermediate product store, Apache Zookeeper for action locking, and RabbitMQ for horizontal scalability with parallel WIGS Engine pods. It uses Kubernetes for orchestration and deployment, making it functional in most cloud environments. It also uses InfluxDB for monitoring times series telemetry from the payload and the data processing ground system. Grafana is used to visualize telemetry data.

The microservice architecture is implemented using Google's gRPC. All messages are implemented using Google's Protobuf (Protocol Buffer) 3 standard, making it suitable for scientific and numerical data applications. The WIGS system can be adapted to solve new problems because the microservice architecture is configurable and extensible. The system adapting process requires understanding of the input data stream format to ingest the data, the desired output to create the rules and workflows, and any data transformations to program the algorithm plug-ins.

GST achieved WIGS Initial Operational Capability (IOC) in an AWS architecture and successfully fulfilled system requirements within objectives for speed, storage, automation, and scalability.

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