Cloud-Based Planetary Ephemerides

NORTHERN ARIZONA UNIVERSITY
School of Informatics, Computing, and Cyber Systems

Team: Austin Carlile, Nicholas Gonzalez, Noah Schwartz, Minuka Trikawalagoda

Client: Christine Kim, Adam Paquette, Kelvin Rodriguez, Amy Stamile
USGS Astrogeology Center, Flagstaff, AZ

Team Mentor: Scott LaRocca

What is the Problem?

IMPROVING THE EFFICIENCY OF NASA SATELLITE DATA

NASA's current dataset has a couple problems within it

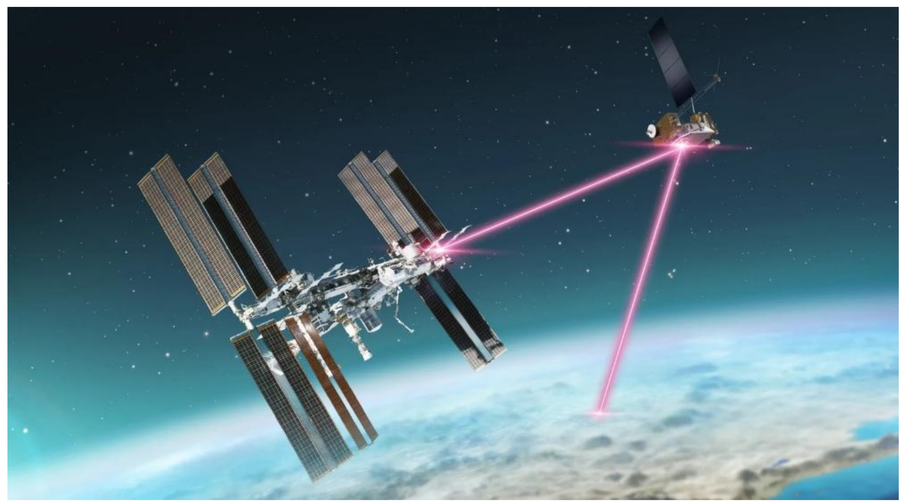
- Cost
- Performance
- Time
- Data size

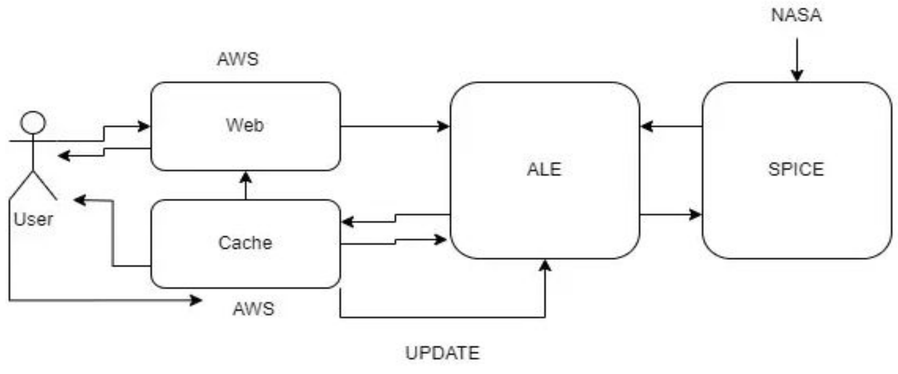
NASA's Spacecraft Planetary Instrument C-Matrix Events (**SPICE**) database is used to generate Image Support Data (**ISD**) which is used to match images to satellites. The current process requires users to download large datasets (up to a terabyte) and also costs USGS upwards of $10,000 a month.

Plans, Goals, Stretch Goals

- **Efficient Data Retrieval**: Develop a RESTful web service for quick access to ISD, reducing the need for large data downloads.
- **Scalability**: Use AWS for handling up to 200,000 simultaneous requests, leveraging caching to improve response times.
- **Core Functionality**: Web service to generate ISD on demand, using FastAPI and AWS ECS with DynamoDB for performance.
- **Optimized Data Transfer**: Use compressed JSON to minimize data size, reducing transmission times and storage costs.
- **Queryable Cache**: Enable users to search cached ISD, bypassing new data requests.
- **Automated Cache Updates**: Auto-update cached data upon SPICE dataset changes, ensuring accuracy.

Our Proposed Solution





Solution Overview

Our solution is a web service that generates ISD images and stores them in a caching server for quick retrieval

- Web Service that generates and returns ISDs to user
- Use ALE for ISD generation
- Caching Server that stores ISDs for quick retrieval
- Utilizes Amazon ECS container

Feasibility

Key Technologies:

- **RESTful Web Service:** Fast API enables high performance, scalability, asynchronous requests, and auto-generated documentation.
- **Cloud Hosting:** Amazon ECS offers versatile, scalable management for handling high user requests.
- **Caching Solution:** Amazon DynamoDB reduces response times by storing pre-generated ISD data.
- **Data Format:** Compressed JSON minimizes data size for faster, interoperable transmissions.
- **Testing Framework:** Docker ensures consistent, isolated environments for effective large dataset processing.

Technologies Planned

- **Amazon ECS (EC2)**
- **Amazon DynamoDB**
- **EventBridge**

- **ALE (Abstraction Layer for Ephemerides)**
- **ISIS (Integrated Software for Imagers and Spectrometers)**