



Jet Propulsion Laboratory
California Institute of Technology

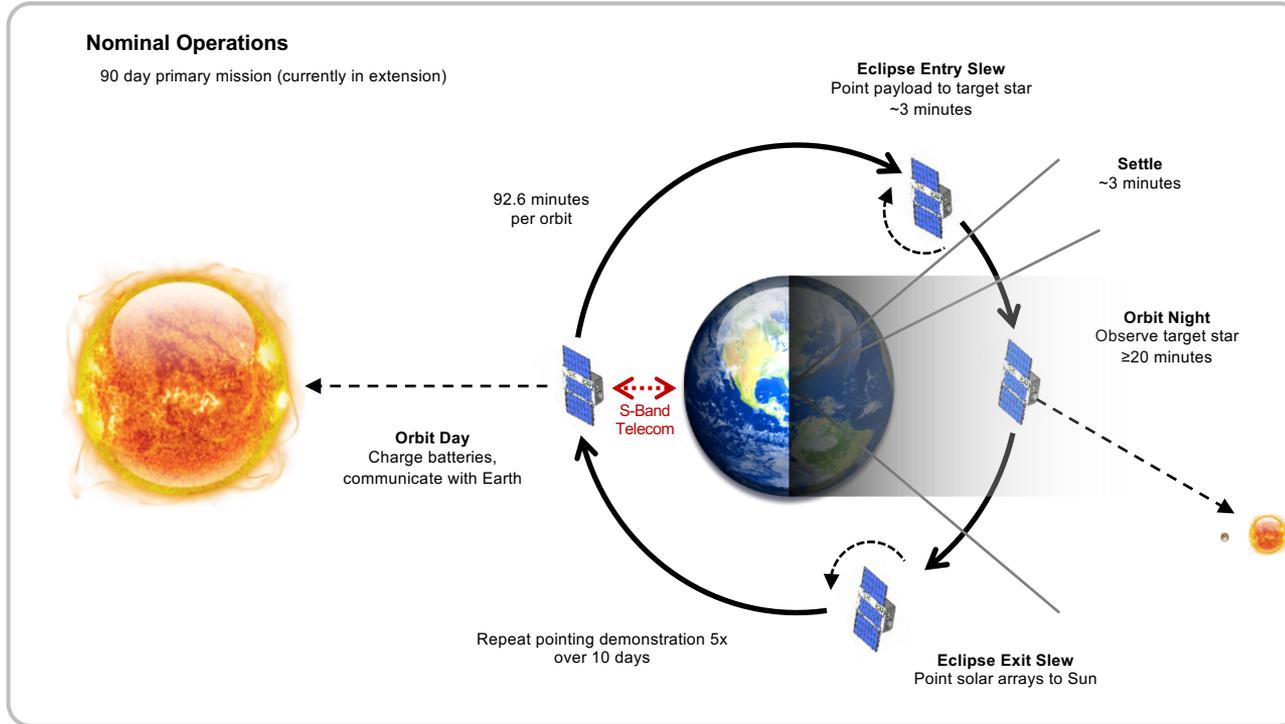
Arcsecond Space Telescope Enabling Research in Astrophysics (ASTERIA)

ASTERIA & AWS GaaS

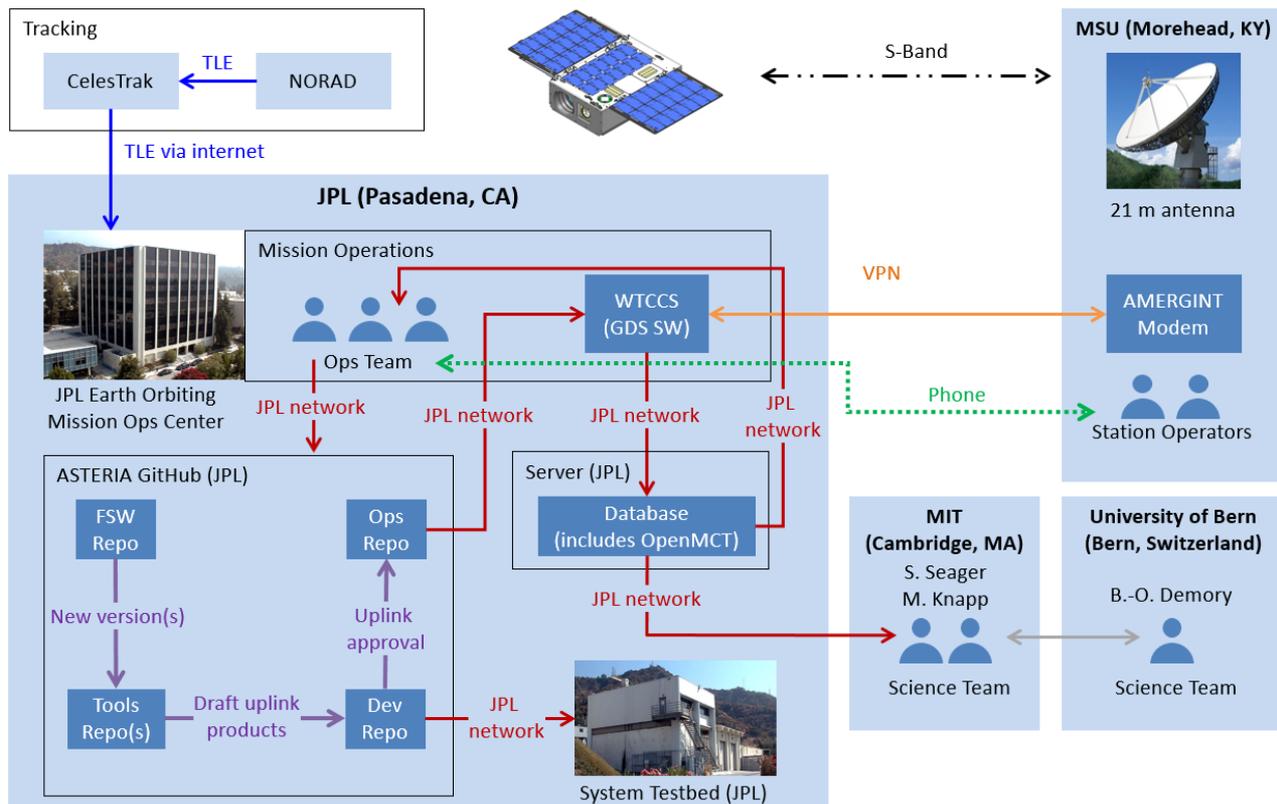
Status on Amazon Web Services' Ground Station preview

Presented by Kyle Hughes

Concept of Operations

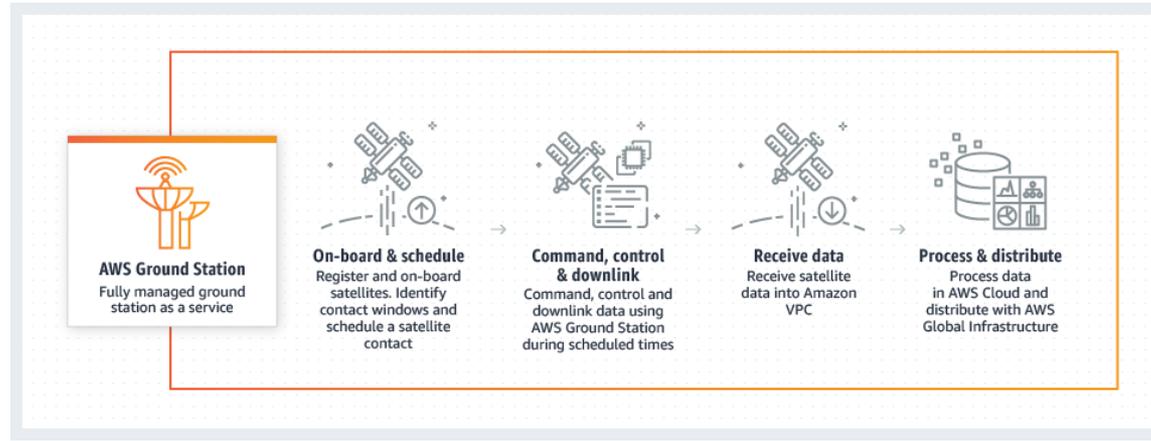


Daily Pass Uplink & Downlink Operations



Intro to AWS Ground Station as a Service

- Sneak preview in November 2018, general availability in May 2019
- Fully managed and automated ground station service
- Direct pipeline to AWS cloud services for mission ground and operations system applications
- AWS GS console provides many useful visualizations to monitor Antenna Control Unit (ACU) positioning and faults, along with spacecraft carrier signal strength during tracking



<https://aws.amazon.com/ground-station/>

AWS Ground Station Experiment Milestones

1. Signal lock to AWS GS (done)
2. Frame sync with AWS GS (done)
3. Telemetry Processing and Verification of Downlink (done)
4. Setup of RTLogic Modem in Virtual Private Cloud (done)
5. Downlink to backup MOC through Ground Station in parallel with MSU (soon)
6. Uplink through AWS Ground station (Requires license)

Separately:

1. Complete Licensing with NTIA for uplink via AWS GS (3-6 months)
2. Transition from GS preview into uplink & downlink operations (Summer 2019)
3. Transition to Govcloud implementation of Ground Station (TBD)
4. Document the AWS GaaS Ground Data Systems (GDS) design and identify steps that need to be completed for other NASA project adaptations

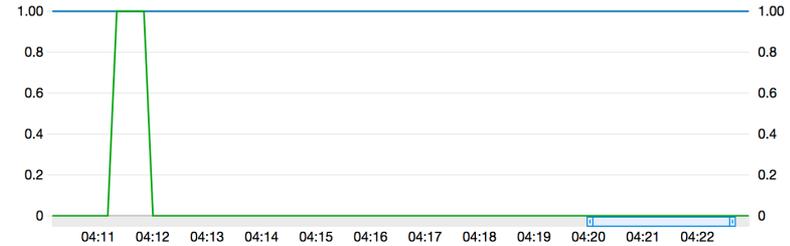
Status of current experiment confirms that AWS Ground Station can provide downlink services for future SmallSat missions

AWS Console Views of I/Q and Signal During Pass

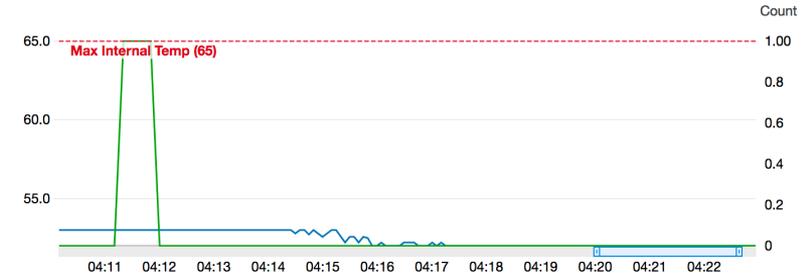
SpectralNet 1 (S-band Digitizer)

Health

1=Healthy; 0=Not Healthy



Temperature (°C)



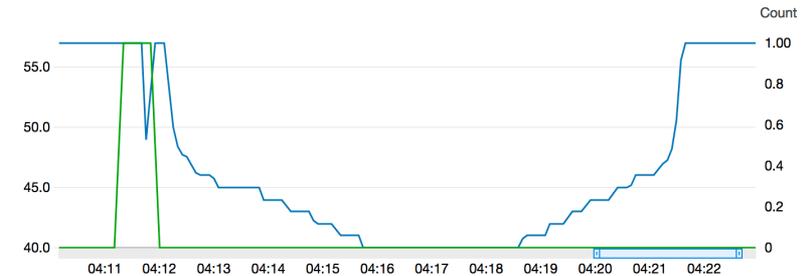
Signal Input

This section contains metrics related to the RF signal entering the SpectralNet device on the ADC path.

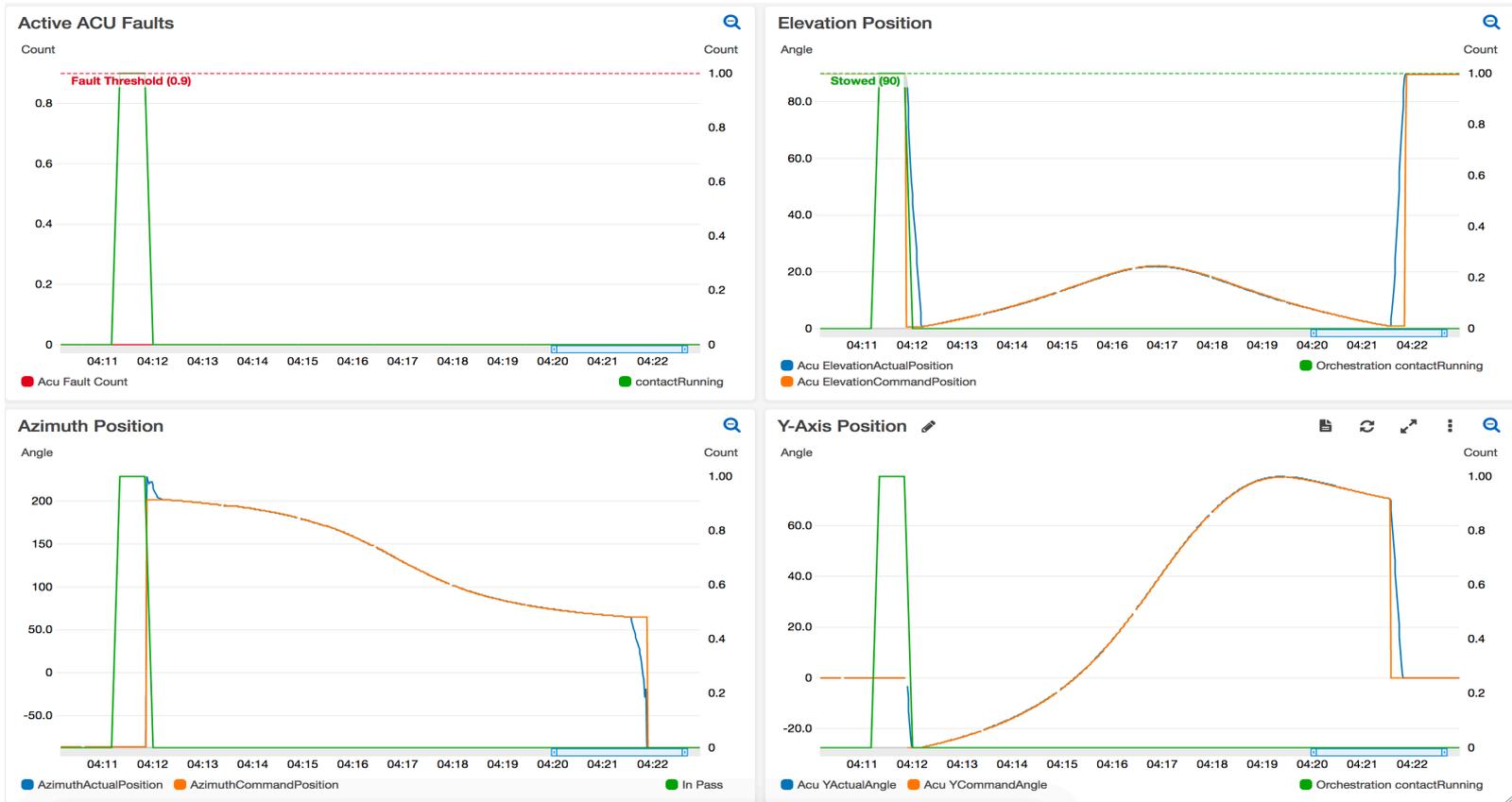
Received Power (dBm)



Input Gain (dB)



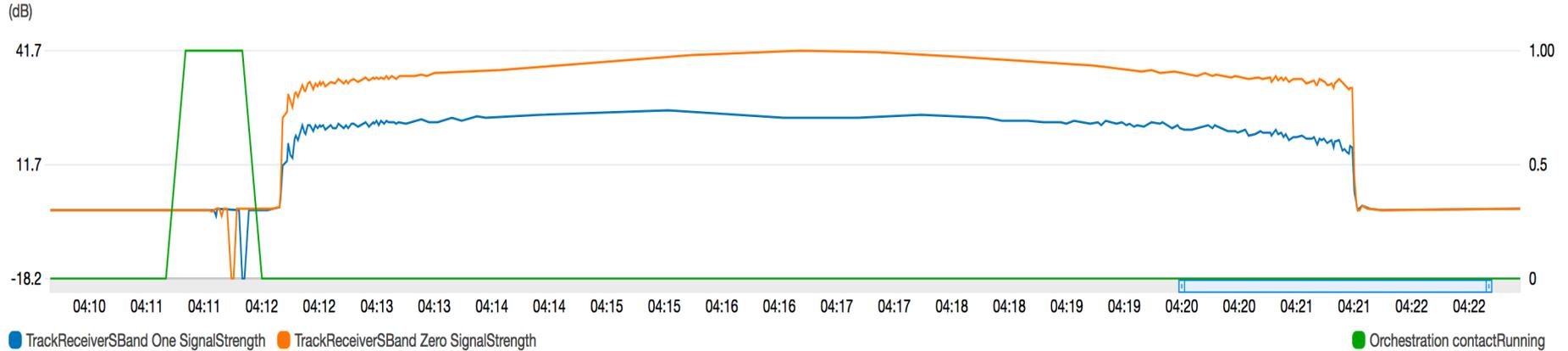
AWS Views of Antenna Control Unit During Pass



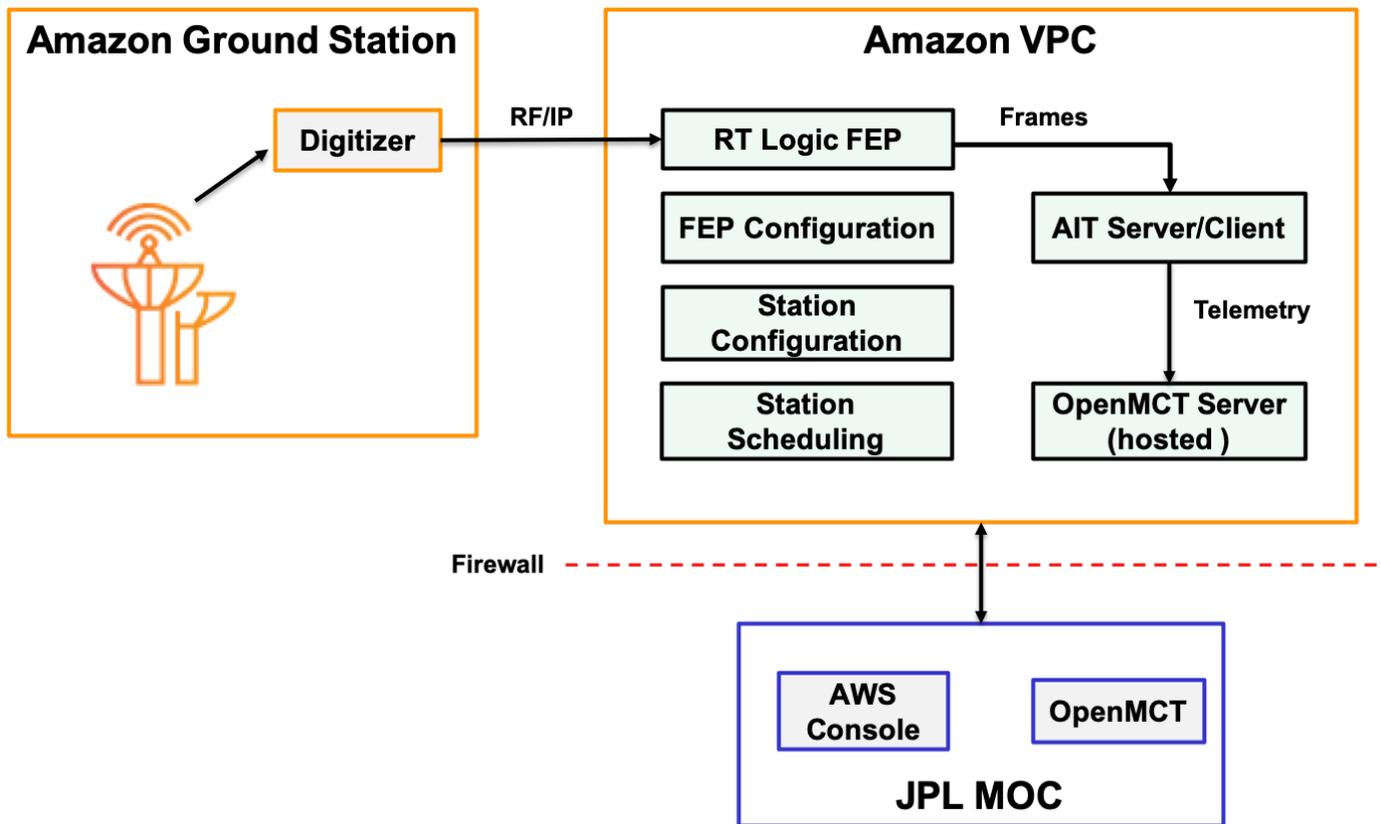
Track of S-Band Signal Strength Over Pass

Track Receiver

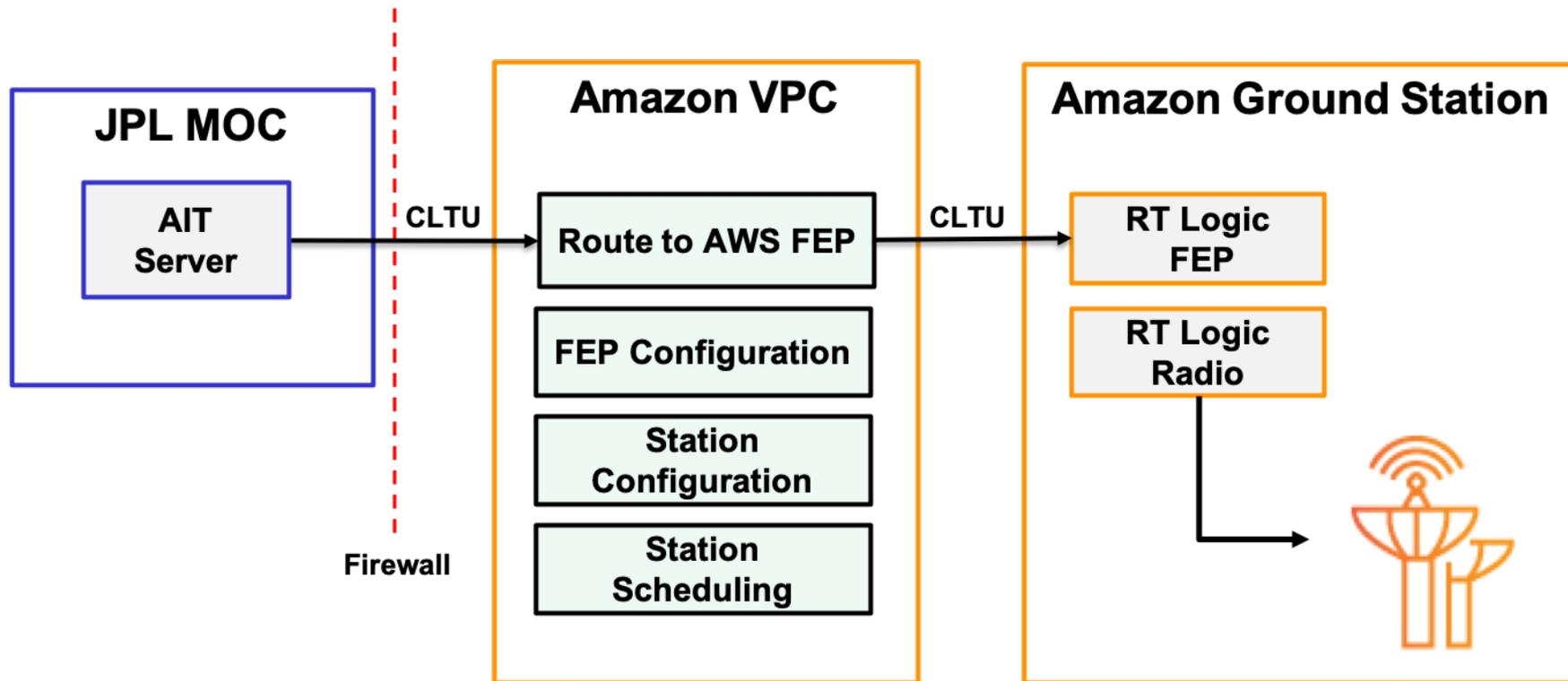
S-Band Signal Strength



ASTERIA & AWS GaaS Downlink Architecture



ASTERIA & AWS GaaS Uplink Architecture



Value of AWS GaaS to Daily Operations

- Ground station availability and flexibility is crucial for a successful mission operations concepts, regardless of size or class
 - AWS GS scheduling enables both pre-planned passes weeks to months in advance, along with sudden requests for pass support on short notice
- Small satellites typically have lower priority scheduling than larger satellites, which can cause scheduling headaches for traditional ground station services
 - The more options for SmallSat's, the better – AWS GaaS has high station availability, but that is bound to change as it transitions out of preview
- SmallSat/CubeSat teams that leverage AWS GaaS can focus on developing the spacecraft, not managing their interface to the ground station
 - No physical lines to install to the stations
 - Tested and consistent network between station and AWS Cloud
 - No installing antennas or building out entire amateur UHF systems

Blockers, Challenges, and Lessons Learned

- Licensing continues to be a significantly **long** process
 - Presentations such as [Radio Spectrum Considerations for CubeSats](#) by the National Science Foundation warn “*Some aspects of satellite coordination can require very long lead times, especially for major long-term systems*” remain relevant, and SmallSat missions in development should start the licensing process early
- Ground testing still requires **some** physical equipment
 - Typically, SmallSat missions perform station testing either at the ground station or with station emulation equipment
 - AWS GaaS will require some form of testing equipment for SmallSat project teams to integrate & test their telecom systems
- SmallSat mission’s associated with the federal government **must** consider and abide by export control regulations before using AWS GS as a service

Questions?



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