AWS Ground Station

February 2020

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Background

- AWS leading global cloud provider
- AWS cloud offers significant value to satellite data
  - Storage
  - Data processing
  - Machine Learning / AI
  - Application / Algorithm development
  - Data dissemination
- Ground Station antennas co-located with AWS Data Centers
  - Offers low-latency service offerings
  - Incredible power of AWS cloud for satellite data

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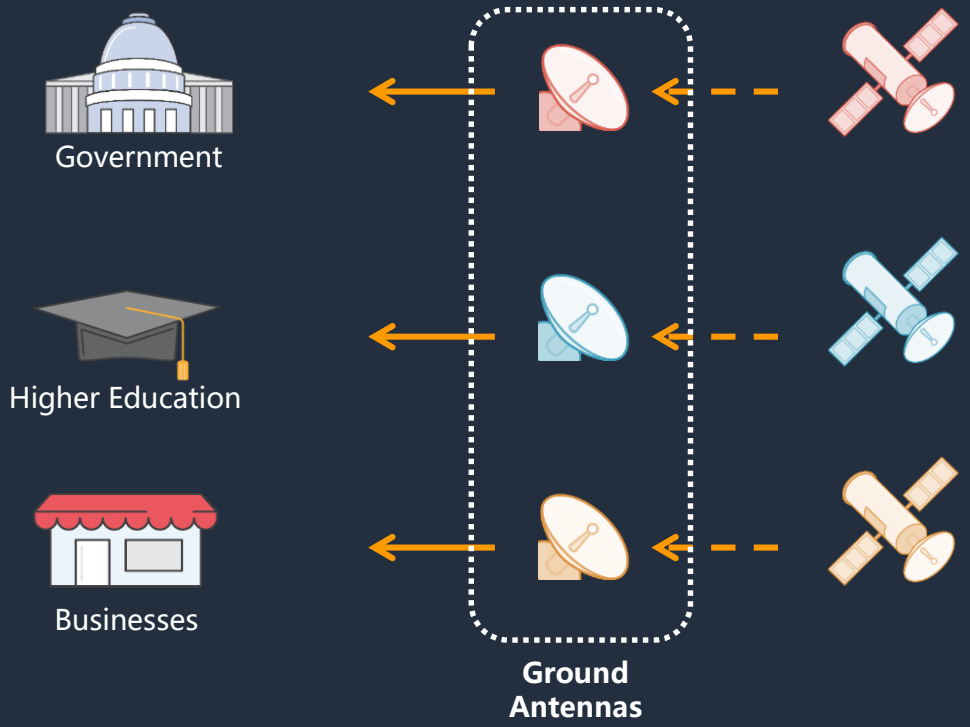
aws

Customer Challenges



- Are expensive to build.
- Are difficult to maintain.
- Require high CapEx investment to scale.
- Support opaque pricing.
- Cause data access latency.
- Have scheduling conflicts.

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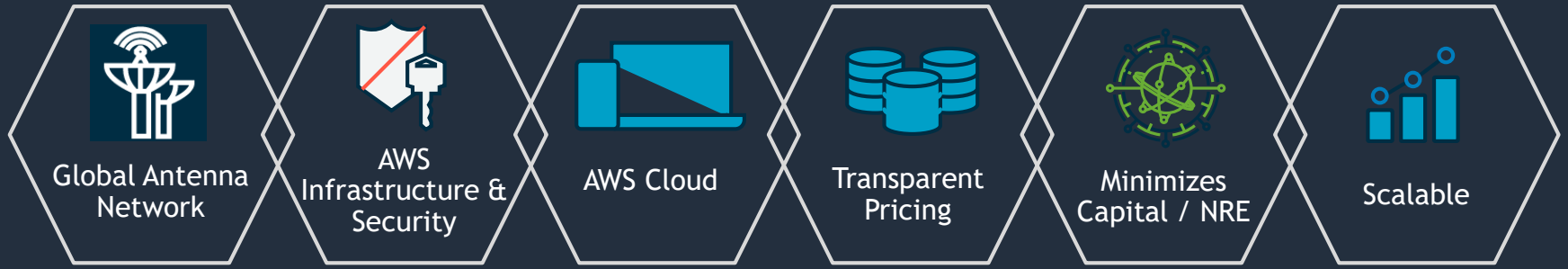
AWS Ground Station Value Proposition



Satellite Architecture Growth

Sensor data drives business growth

Scalable Ground, Processing & Storage

EC2, S3, SageMaker, CloudFront

Economies of Scale

The more you use, the less you pay

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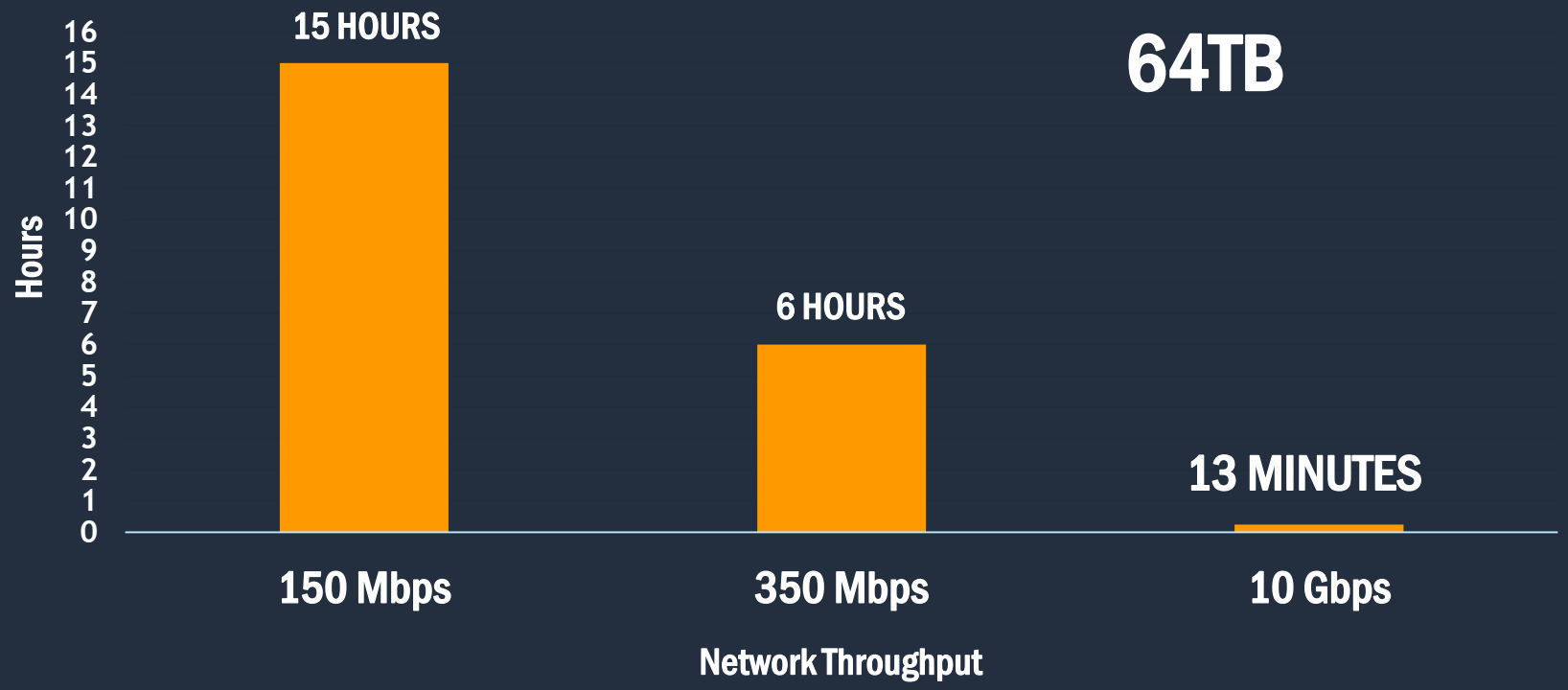
High Throughput, Low Latency



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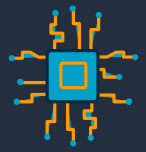
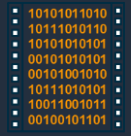
Direct Access to AWS



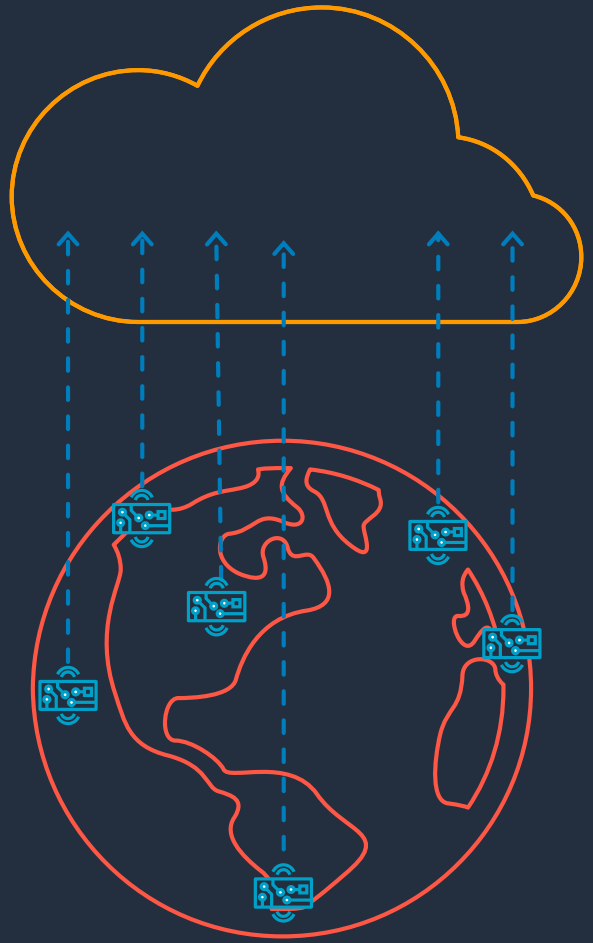
Elastic Cloud Compute (EC2)



Simple Storage Service (S3)

SageMaker Machine Learning

CloudFront – Data Distribution



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Hardware Specifications

AWS Ground Station Specifications Sheet		
For the 5.4m Antenna Systems		
Tracking		
Orbit	LEO > 250 km, GEO	
Inclinations	All	
Pointing	0.05° rms BRE	
Bands	X-Band	S-Band
Polarization		
Receive	Simultaneous LHCP & RHCP	Selectable LHCP/RHCP
Transmit	N/A	Selectable LHCP/RHCP
Frequency		
Receive	7750 to 8400 MHz	2200 to 2300 MHz
Transmit	N/A	2025 to 2120 MHz
G/T	30.5 dB/K	16.0 dB/K
EIRP	N/A	53 dBW
Bandwidth	125 kHz to 500 MHz	125 kHz to 54 MHz
Channels		
Receive	2	1
Transmit	N/A	1
Symbol Rates		
PSK	10 Msps to 600 Msps x 2 channels	7 sps to 5.0 Msps
DVB-S2	10 Msps to 250 Msps x 2 channels	N/A
Digital Interface		
Digital Stream Format	VITA-49 Demodulated / Decoded Data; OR VITA-49 RF-over-IP	VITA-49 RF-over-IP
Modulation	BPSK, QPSK, SQPSK, UAQPSK, OQPSK, 8PSK, 16/32 APSK, MSK, 16QAM	GMSK, BPSK, QPSK, SQPSK, UAQPSK, OQPSK
Forward Error Correction	Convolutional, Interleaving, Reed-Solomon, LDPC, 4D-8PSK-TCM, Viterbi	Viterbi, Reed-Solomon
Data Processing	CCSDS frame processing (VCDU/APID), Programmable frame syncs	CCSDS, CORTEX

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AWS Security

- AWS provides several security capabilities and services to increase privacy and control network access.
- AWS continually tests its infrastructure, the results of which are summarized in our compliance reports

Virtual Private Network
- Network firewalls
- Web application firewall
- Control access to instances and applications

Encryption
Customer controlled encryption in transit with TLS across all services

Automatic encryption of all traffic on the AWS global and regional networks between AWS secured facilities

Data encryption capabilities available in AWS storage and database services – S3, EBS, Glacier, RDS and Redshift

Identity & Access Control
Define, enforce and manage user access policies
- Identity and Access Management
- Multi-Factor authentication

Compliance
- NIST 800-53
- ISO 27001
- FedRamp
- DoD CSM
- PCI DSS

DoD Requirements
- AWS approved cloud service provider
- DoD SRG Impact levels 2 – 5 at US East and US West
- Impact level 6 at Secret Region

C2S Top Secret/SCI

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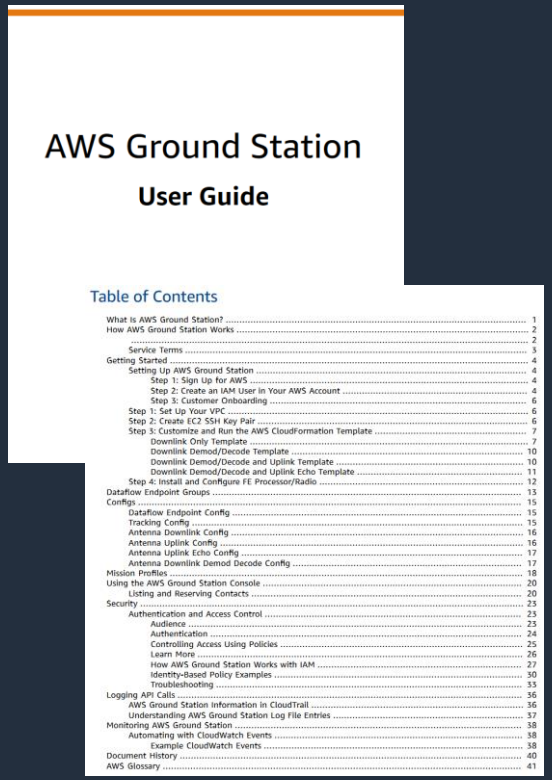
Ground Station User Guide

- AWS Ground Station User Guide Document
  - Getting started w/ Ground Station
  - Setting up your VPC
  - Creating Cloud Formation Template
  - Configurations – Data flow, Endpoint configs
  - Mission Profiles
  - Using the Ground Station Console (or your own Mission Planning s/w via APIs)
  - Security (Authentication and access control)
- Available at: https://docs.aws.amazon.com/ground-station



AWS Ground Station

User Guide

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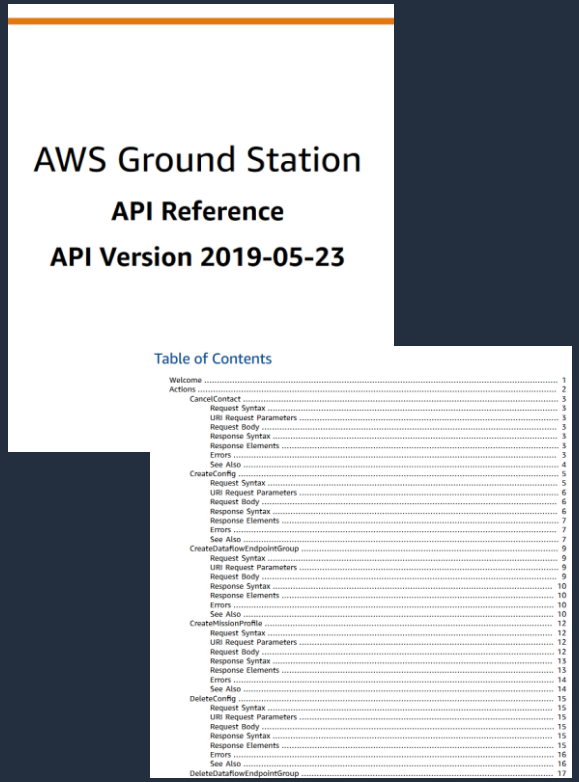
Mission Planning S/W Integration - APIs

- AWS Ground Station API Reference Document
  - Allows for actions (e.g., Contacts, configurations, data flows)
  - Data types (e.g., Antenna congiruations, Demod/Decode, Security)
  - Common Parameters
  - Common Errors
- Language-specific SDKs available
  - AWS CLI, .NET, C++, Go, Go-Pilot, Java, JavaScript, PHP V3, Python, Ruby V2
- Available at: https://docs.aws.amazon.com/ground-station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API Reference

API Version 2019-05-23

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Pricing Model

- Affordable, Transparent, Pay by the minute pricing model
- No contracts or long term commitments.
- Standard pricing across all regions
- Reserved minute contacts
  - May be reserved up to 21 days in advance
  - Can be rescheduled up to 1 day prior to a scheduled contact
  - Minimum of 150 minutes per month, for 12 months
  - Pricing based on time of connectivity, not amount of data received
- Pricing reflected in USD, more details available here

	Narrowband (≤54MHz)	Wideband (>54 MHz)
On Demand	$10/min	$22/min
Reserved	**$3/min**	**$10/min**

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Satellite Onboarding Process

Customer Approval to Begin Process

Spacecraft Onboarding Questionnaire

AWS Account & VPC Formation

Spectrum Licensing (varies by location)

Mission Planning and TT&C Integration (via APIs)

Schedule Command & Downlink Opportunities

VITA-49 Data into EC2 Instances and S3

Functionality Requested	**Downlink Only**
Does customer have command and/or control authority over the satellite?	**No**
Primary use case	**[GIS (Geographic Information System)]**
Constellation size	
Satellite names and NORAD ID	**28702**
Satellite Launch Date	
Satellite Lift Expectancy	
Satellite Launch Provider	
Orbit type	**[GEO]**
TLE (Two Element Line Set)	
Number of carriers (re: WB downlink)	
Commercial or Classified?	**[Commercial]**
Data delivery endpoint (which region hosts customer VPC)	**[US East (Ohio) us-east-2]**
Downlink Frequency Center Frequency (List all that apply)	**4040 MHZ**
Downlink Frequency Bandwidth (List all that apply)	**High**
Downlink Frequency Polarity (List all that apply)	**[RHCP]**
Uplink Frequency Center Frequency	
Uplink Frequency Bandwidth	
Uplink Frequency Polarity	**[]**
What modulation and coding schemes does the customer use?	**[Downlink 1 (X-Band) = DVB-S2 with ACM or VCM using QPSK, 8PSK, 16PSK, 32PSK]**
What protocols does customer use? E.g. CCSDS.	**[CCSDS]**
Where is customer satellite currently authorized to operate and at what frequencies	
What licenses does each customer satellite have (FCC, ITU, etc.)	
Location of Ground Station interest	
What type of authorization do you have to downlink in each AWS GS location	
Does customer hold the license for this satellite?	**No**

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Summary

Leverage a Global Network

AWS Security

Affordable Pricing Model

Low Latency access to additional AWS products

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