Ground System Architectures Workshop (GSAW) 2022



On-demand Ground Data System (GDS) using a Cloud Architecture

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Outline

- NASA's Advanced Multi-Mission Operations System (AMMOS) Context
- Evolution of Deep Space mission operations
- On-demand GDS concept description
- Benefits of On-demand GDS in the Cloud
- Technical solution
- Provisioning process
- Enabling future deep space mission operations

Advanced Multi-Mission Operations System (AMMOS) Context



- NASA's recommended provider of multi-mission products and services for NASA space science missions, particularly missions exploring our solar system and beyond
- Portfolio of 50+ products and services supporting 80+ missions
- Provides support for the following mission operations functions:
 - Mission Design and Navigation
 - Mission Planning, Sequencing and Analysis
 - Mission Control System
 - Instrument Data System and Archiving
 - Set of cross-cutting capabilities (e.g. security, automation, testing, etc.)
 - Targeted technology investment program to evolve the AMMOS
- Based on a simple idea: For those elements of a mission operations system that are common to multiple projects, build them once rather than duplicate that development and maintenance effort for each project
- Open-source: github.com/nasa-ammos

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Large Expansion of Deep Space Mission suite over next decades

• Need for agile and efficient operations for spacecraft across the Solar System



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On-demand GDS Concept



Benefits of On-demand GDS in the Cloud

- 1. "One-click provisioning" for GDS core applications with sensible defaults
 - Anyone with a Cloud environment can deploy
 - Resources can be provisioned and torn down as needed
- 2. Support Autonomous Spacecraft
 - Spacecraft-initiated contact request with the ground
- 3. Lower the barrier of entry (i.e. cost) for Small/CubeSats and other mission capabilities
 - Well tested and documented common GDS architecture
 - Common structure makes it easier to reuse ground automation processes and procedures
- 4. Increase interoperability, data sharing and exchange
- 5. Leverage the strengths of open-source community
 - Easy to partner with other Agencies, Industry and the Academia
- 6. Leverage latest Cloud-native security, logging, scalability and replication solutions
 - Metrics collection capabilities instrumental for operations cost estimation
- 7. Maintain registry of mission adaptation implementations
 - Reduce "re-inventing the wheel"
 - Expand multi-mission core by including adaptations used repeatedly by multiple missions



GDS ready to process incoming data on the cloud.



Technical solution using AWS Cloud

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Services (AWS) solution	s architects and AWS Partners. Quick Starts	View deproyment guide		dei	
can reduce hundreds of	ogles on AWS according to AWS best practic				
can build and start usin	g your environment within minutes.	This Quick Start deploys NASA's Advanced Multi-Mission Operations System (AMMOS) suite of			
		capabilities for small satellite, CubeSat, and instrument missions. The AMMOS SmallSat Toolkit			
		offers advanced sequence generation, command uplink and downlink, telemetry processing, and	AMMos	AWS Cloud	
		system (GDS) that is built on mission-proven capabilities and maintained by NASA. The AMMOS	Advanded Multe-Missoon Operations System	Availability Zone 1	
Clear all filters	Q space	suite comprises open-source products that are available in the NASA-AMMOS GitHub repository,	This Quick Start was developed by	VPC	
 Content Type 	1 (1) Sort	where contributions are welcomed and encouraged.	NASA Multimission Ground Systems and Services (MGSS	Public subnet	
AWS Quick Starts		The toolkit includes the following:	collaboration with AWS.		
 AWS Solutions Implementations 	SATELLITE	 AMMOS Instrument Toolkit (AIT), a Python-based software suite that handles GDS, electrical around support equipment (EGSE) commanding, telemetry unlink and downlink, and 		L.	
 Technology Category 		sequencing.	This Quick Start suppo	Bastion host	
Analytics		Open Mission Control Technologies (Open MCT) software, providing visualization and	All'S GovCloud (U) Region among other		
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Cost Management	Built by NASA Multimission Ground Systems	 Instructions for adapting the deproyment for your operations needs both at laurch and as your mission evolves. 		C	
Databases	Deploys NASA's AMMOS suite of				
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End User	~			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
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- AMMOS SmallSat Toolkit (AST)
 - Downlink and uplink data processing
 - Sequence generation
 - Data visualization
- Bring your own configuration, or start with defaults for reference



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Provisioning process

1. User clicks on AMMOS card in AWS QuickStarts

- a) Prepares mission specific config (telemetry dictionaries, etc.)
- b) Uploads to an S3 bucket
- c) Sets other deployment config (cpu/memory, network options, etc.)
- d) This step can be automated in the future
- 2. Deployment is launched
- 3. Apps are installed and configured for each mission
- User can interact with deployed apps from web GUI's, a terminal, or an AWS Console (GDS provisioning system is a future capability)
- Easy to "sleep" or completely tear down (only pay when using)



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End-to-end demand access operations for deep space missions



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