Ground System Architectures Workshop (GSAW) 2022

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

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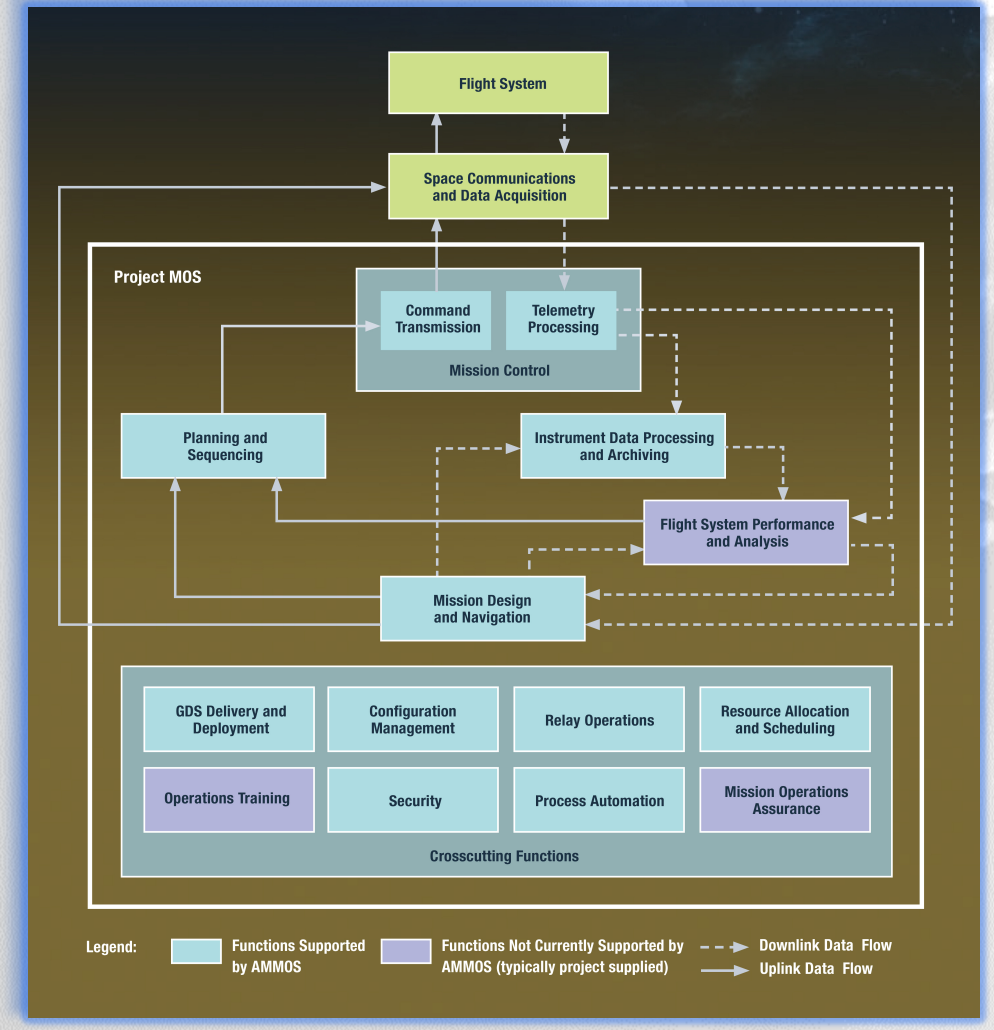
Outline

- 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

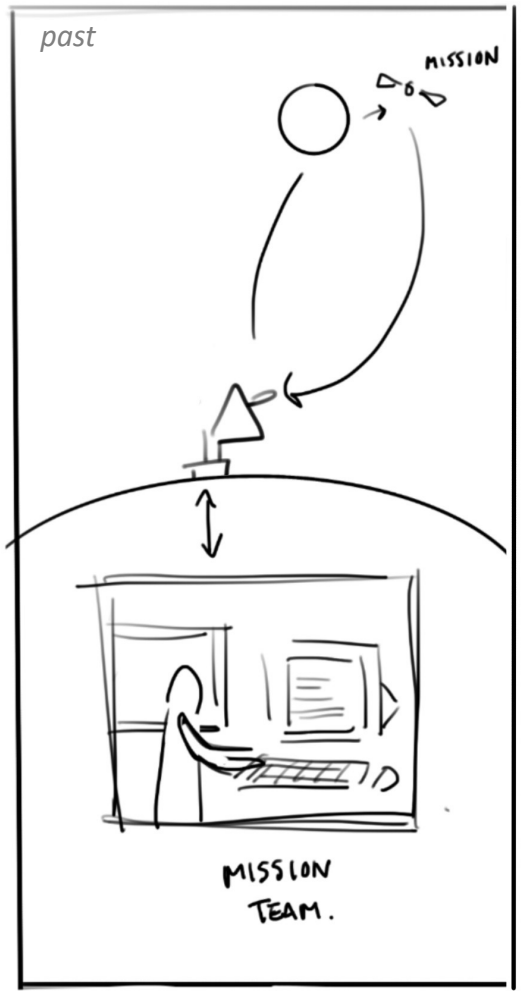
Advanced Multi-Mission Operations System (AMMOS) Context

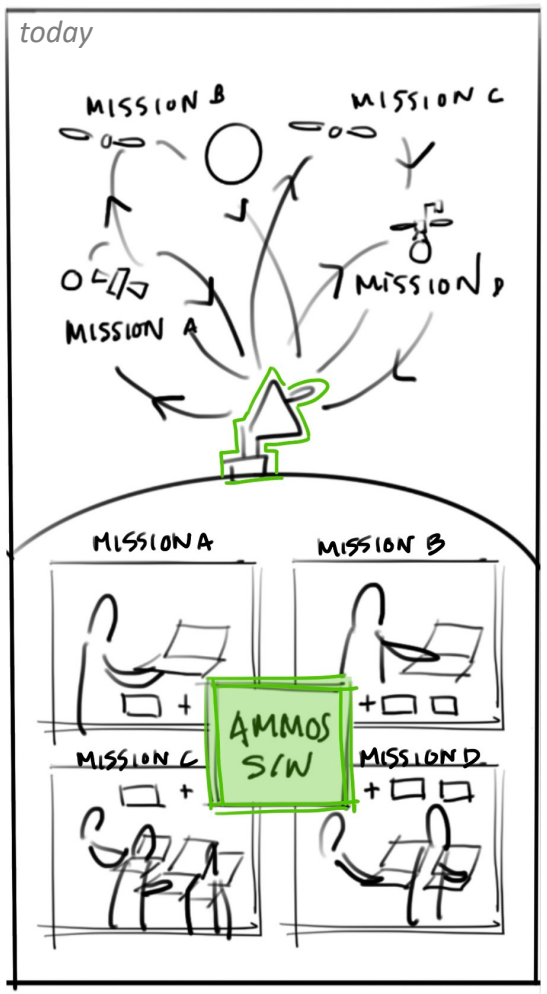


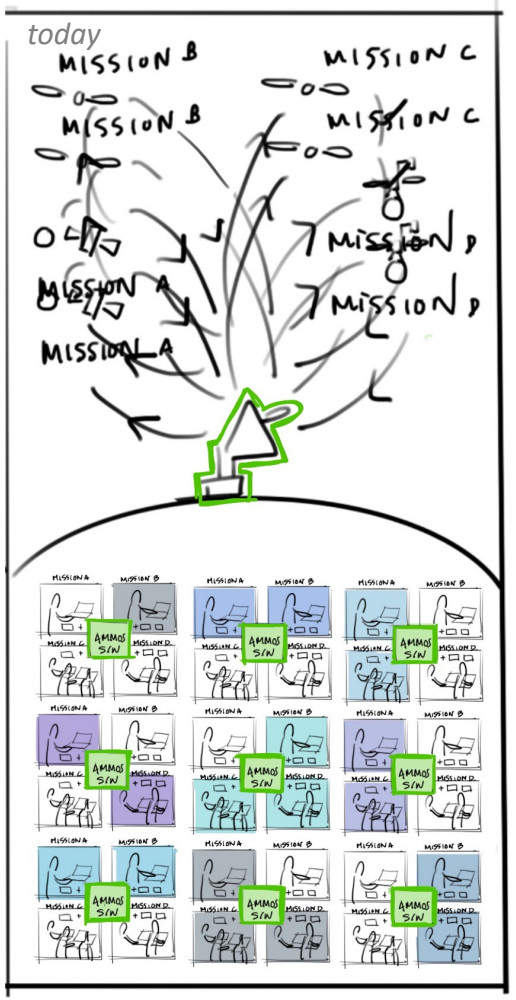
- NASA's recommended provider of multi-mission products and services for NASA space science missions, particularly missions exploring our solar system and beyond
- Portfolio of 50+ products and services supporting 80+ missions
- Provides support for the following mission operations functions:
  - Mission 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

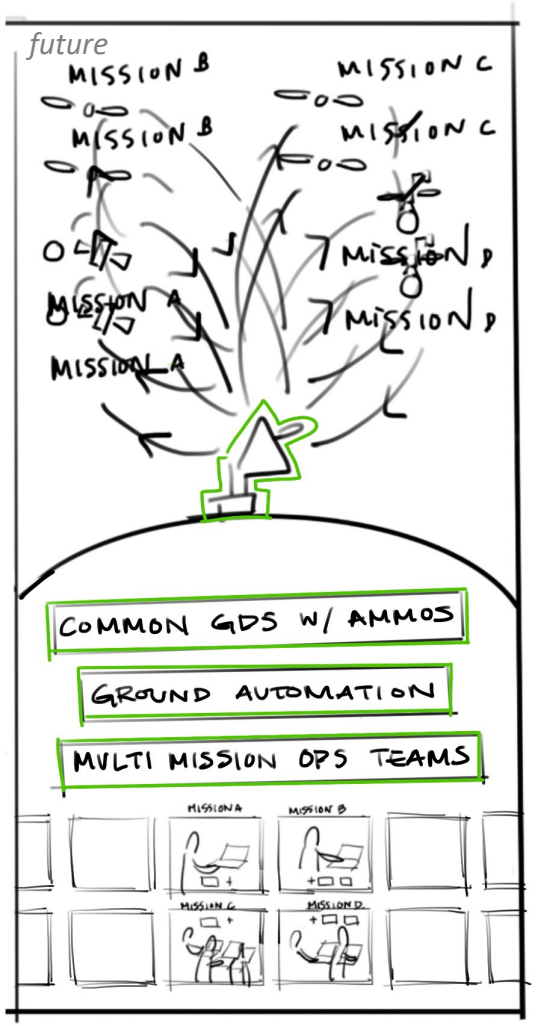
Large Expansion of Deep Space Mission suite over next decades

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



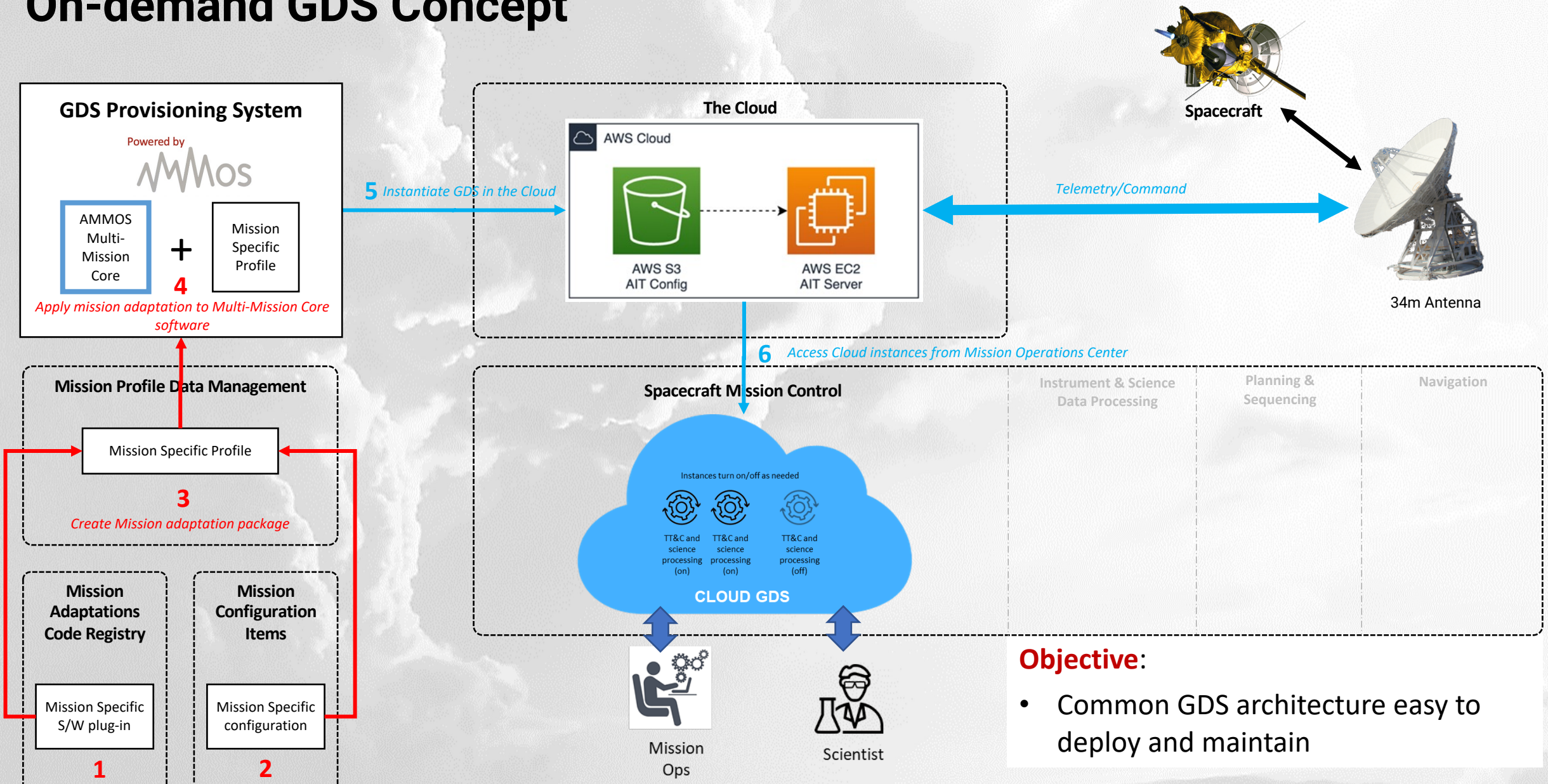






* Green means multi-mission

On-demand GDS Concept



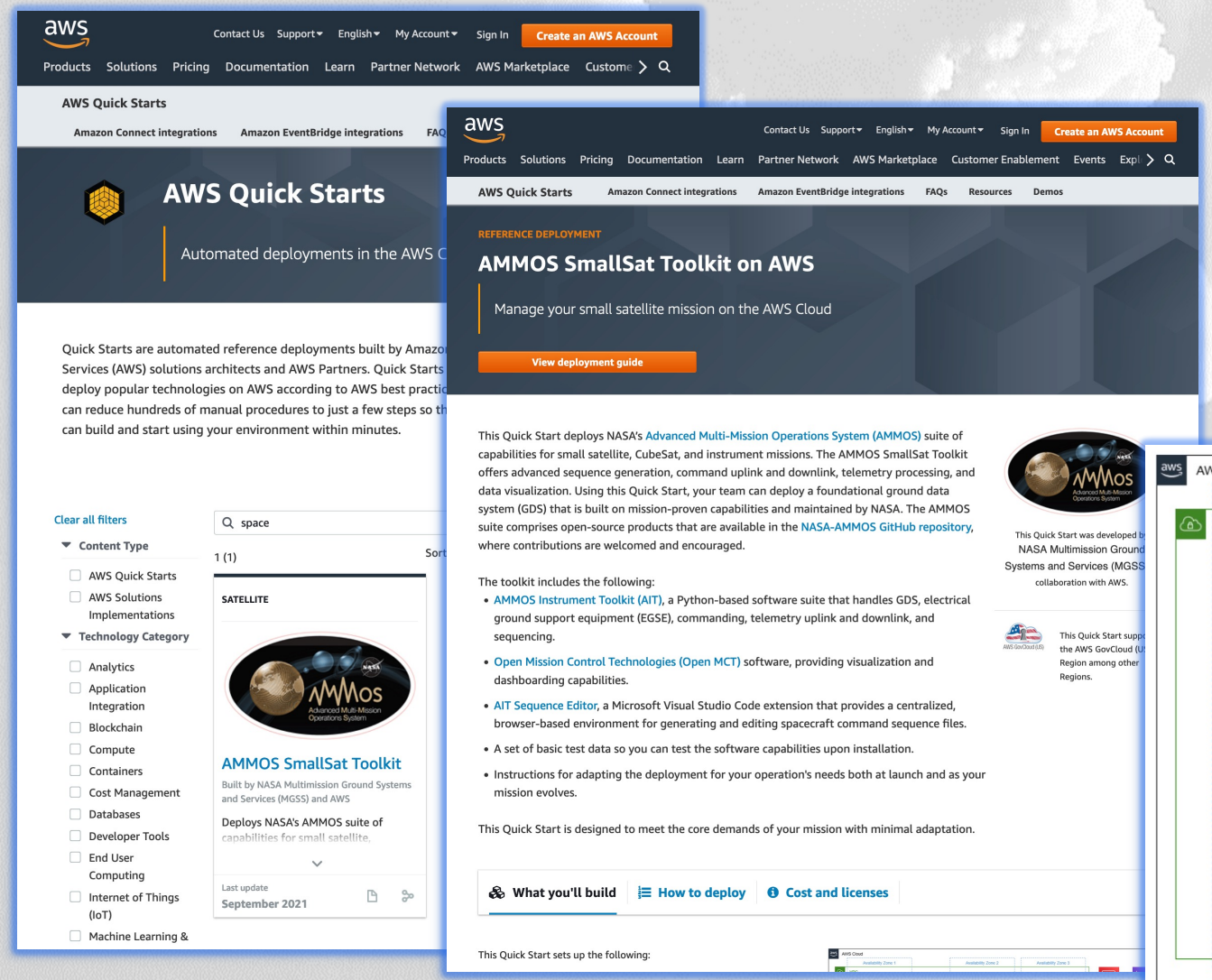
Objective:

- Common GDS architecture easy to deploy and maintain

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

Technical solution using AWS Cloud

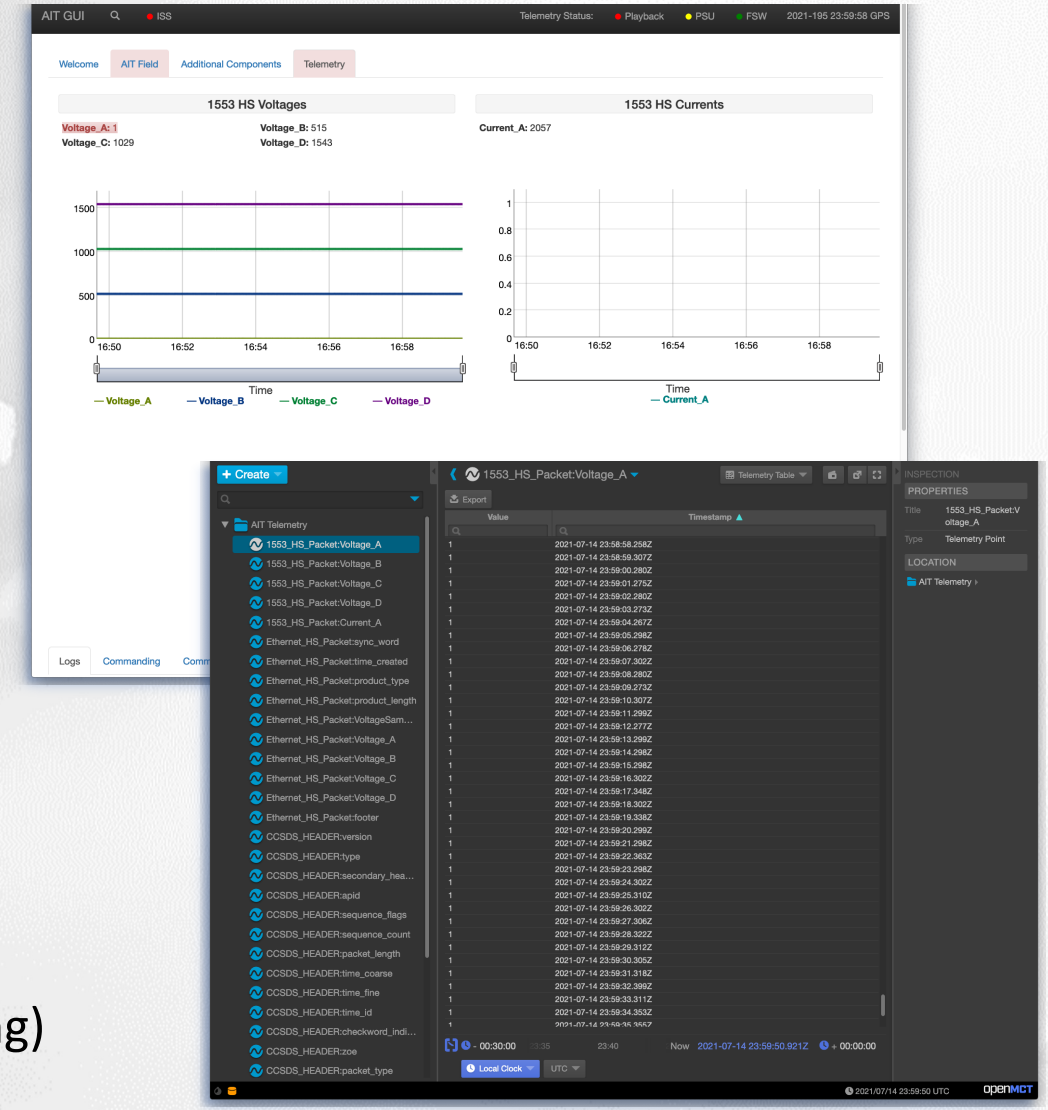


- **AMMOS SmallSat Toolkit (AST)**
  - Downlink and uplink data processing
  - Sequence generation
  - Data visualization
- Bring your own configuration, or start with defaults for reference

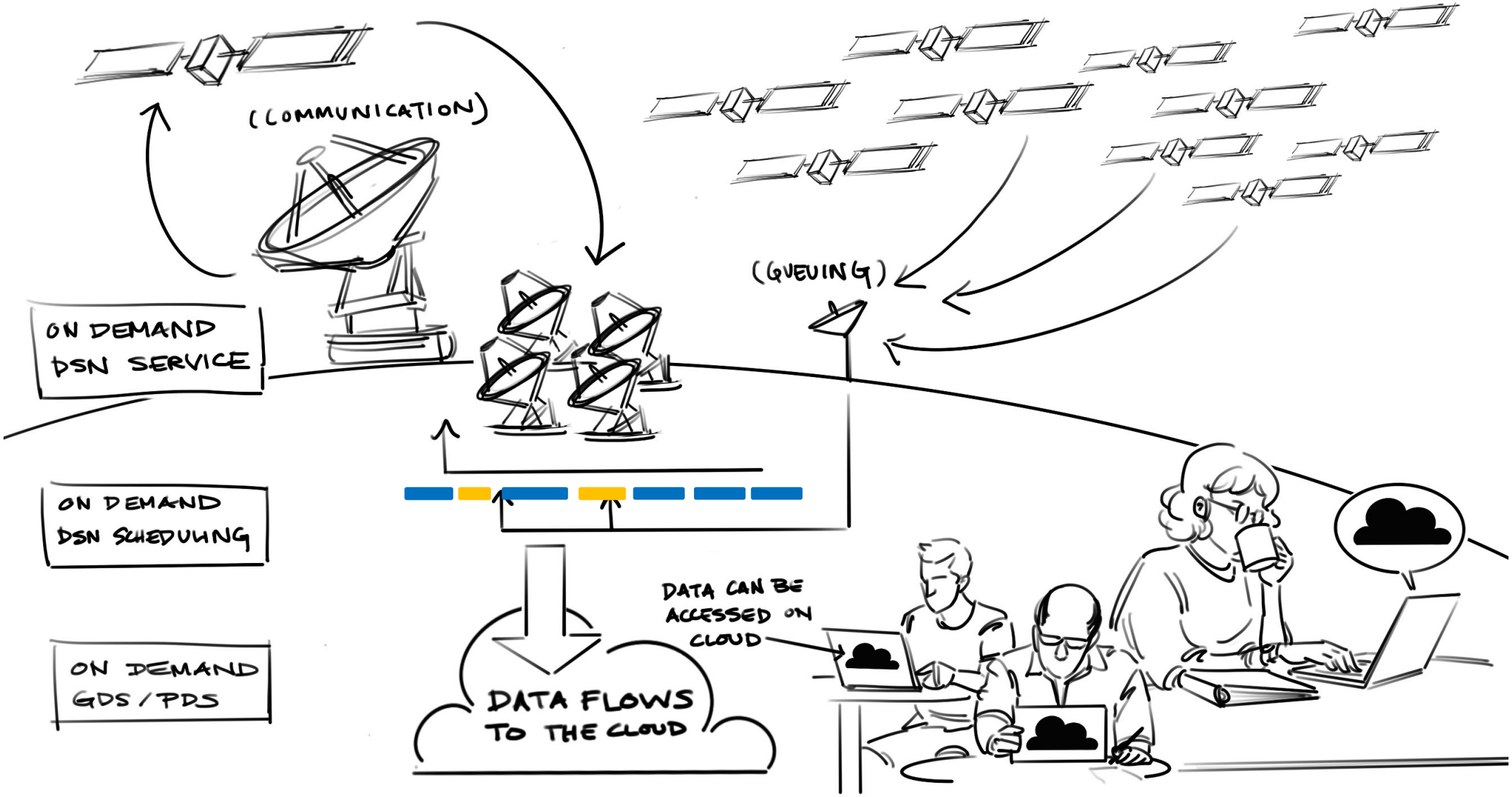
Provisioning process

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)



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



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