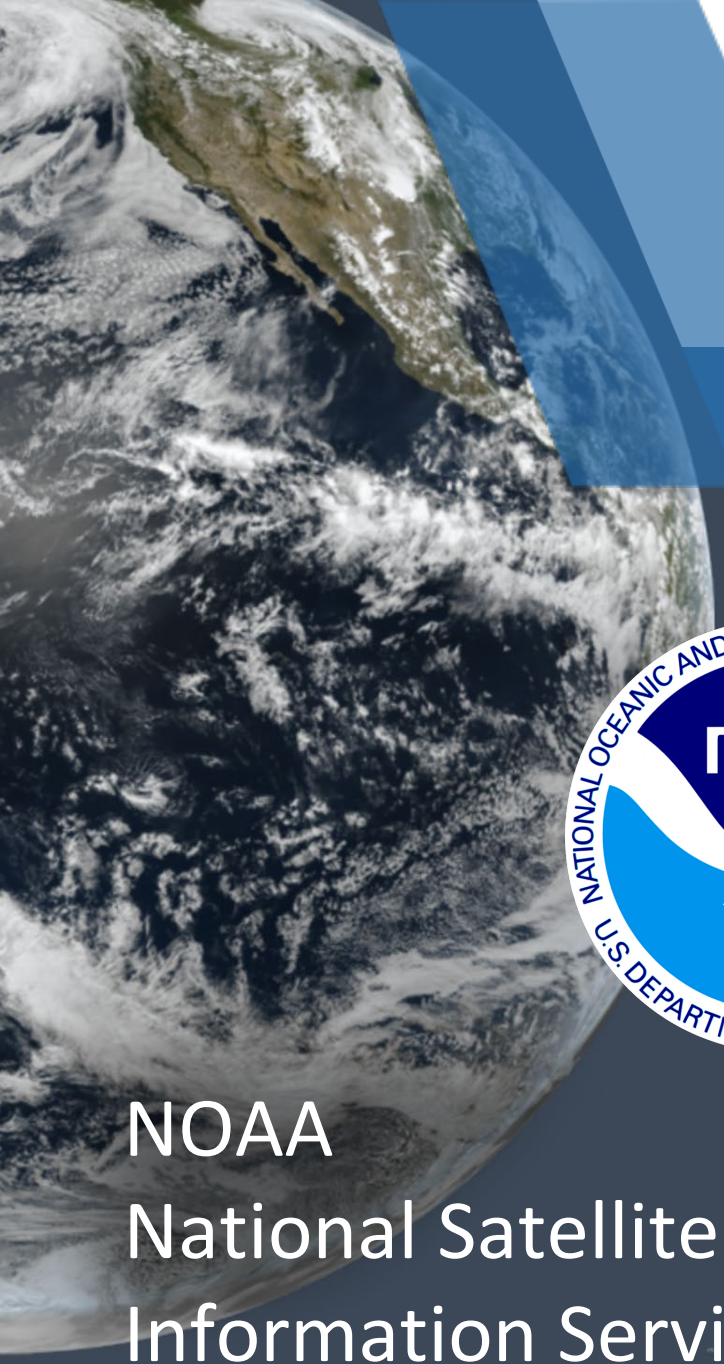


NESDIS Ground Enterprise Evolution: Evaluating Utilization of Commercial Cloud Services for Satellite Mission Operations.

GSAW Annual Meeting 2024

NOAA
National Satellite and Information Service

Justin Gronert, NESDIS Office of Satellite Products and Operations (OSPO)
Ken Watts, *NESDIS Office of Common Services (OCS)*
January 29, 2024

Agenda

- NESDIS Introduction, Vision, and Future Mission Alignment
- NESDIS Enterprise Alignment & Commercial Services
- Cloud Based Command and Control Assessments
- Conclusion

NESDIS Strategic Objectives

NESDIS Reimagined

1 

Advance terrestrial observational Leadership in geostationary and extended orbits

2 

Advance Space Weather observational Leadership in LEO, GEO, and extended orbits.

3 

Evolve LEO architecture to enterprise system of systems that exploits and deploys new observational capabilities

4 

Develop agile, scalable ground capability to improve efficiency of service deliverables and ingest of data from all sources

5 

Provide consistent ongoing enterprise-wide user engagement to ensure timely response to user needs

6 

Deliver the best value integrated suite of products and services responsive to user needs

Focus on Establishing the Next Generation Ground Enterprise Architecture 2030-2050

Capability Domains: Satellite, Science and Data Operations

Satellite Operations

Space-Ground Communications (SCM)
- Ground Station Operations
- Mission Data Backhaul

Satellite Mission Operations (MOP)
- Mission Planning
- Real-time Satellite Operations
- Trending & Platform Management

Science Operations

Algorithm Operations (AO)
- Algorithm R&D
- Product Cal/Val/Ver

Environmental Information Operations (EIO)
- Environmental Data Stewardship
- Environmental Records Management

Data Operations

Product Operations (PO)
- Data Ingest
- Product Generation
- Data Archive

Data Delivery (DD)
- Real Time Data Delivery
- Near-Real Time Data Delivery
- General Access

Satellite Operations Requires Further Strategic Evolution & Innovation to meet 2030+ Satellite Constellation Needs

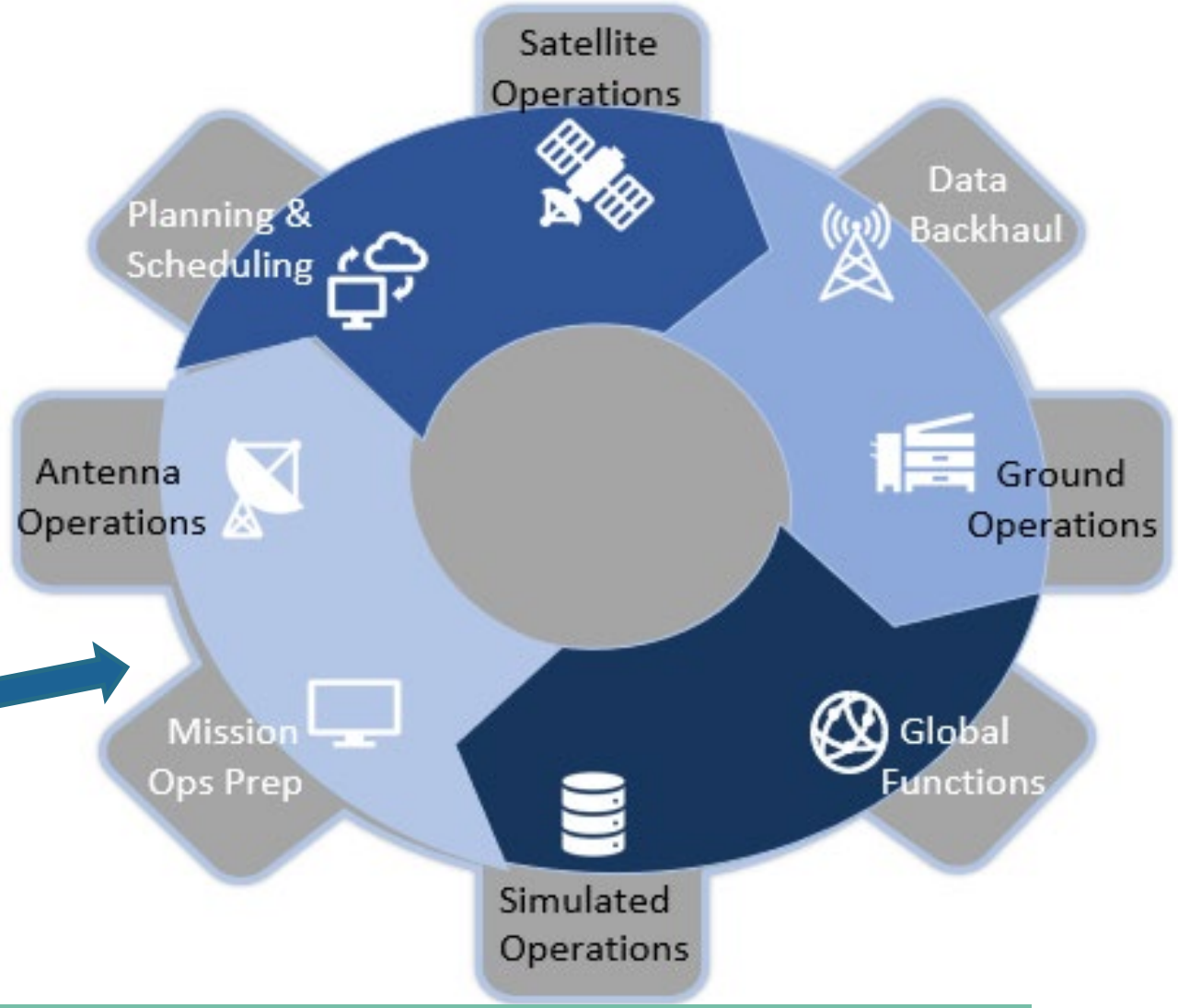
NESDIS Strategic Enterprise Alignment

An SCM/MOP functional capability **supportive of the following**:

- A **Climate Ready Nation** – NESDIS Strategic Plan FY22-26
  - STRATEGIC OBJECTIVE 1.5: Enhance Comprehensive Observations and Monitoring Systems
    - 1.5.3: **Expand Commercial Partnerships** and New Technology
    - 1.5.4: **Improve** Common Source Data Integration and **Common Ground Services**
- NESDIS SIP – Strategic Objective number four:
  - **Develop agile, scalable ground capability** to improve efficiency of service deliverables to support data from all sources
- National Space Weather Policy
  - **Purchase** and use United States commercial space capabilities and services, **to the maximum practical extent**
  - **Prioritize partnerships with commercial industry**
- NESDIS Ground Enterprise Study (NGES) Business Case – aligned with NGES study considerations and capability roadmap
- Expanding External Partnerships – NASA, USSF, etc….
- Ongoing NESDIS IPT Analysis (Weighed against SCM/MOP evaluation criteria)
  - Focusing on **common services** with **Enterprise convergence** potential

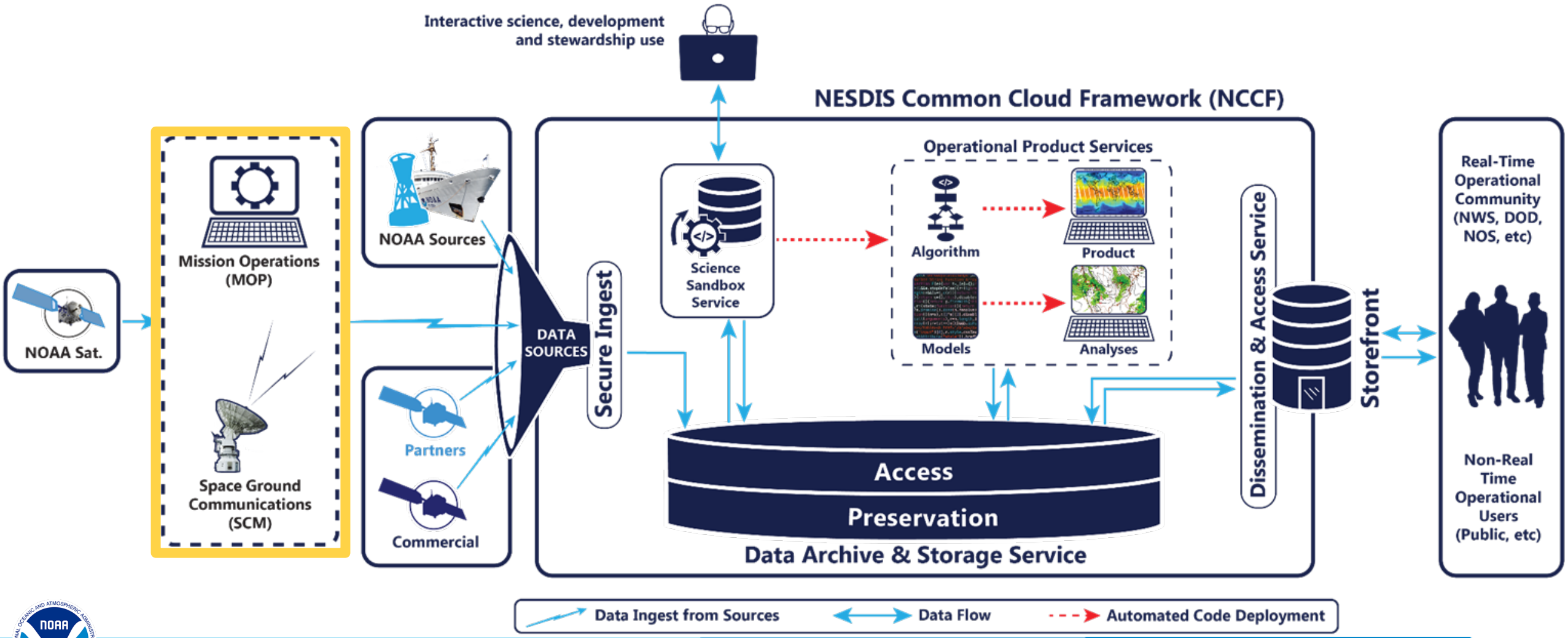
NESDIS Commercial Services Evolution

- The Commercial Services IPT is an **OCS led initiative** formed to:
  - Investigate the commercial sector's ability to support **OCS' establishment of a NESDIS cloud-based common services enterprise ground system**
  - Evaluate suitability for adoption of **enterprise aligned** commercial capabilities into OSGS provided common services
  - Identify a common set of approaches to incorporate **core NESDIS Satellite Communications and Mission Operations (SCM/MOP) capabilities** into the NESDIS Common Cloud Framework (NCCF)



Tailored Market Research in service of NESDIS Tactical and Strategic Objectives

NESDIS Common Cloud Framework Expansion (SCM/MOP)



Commercial Services (CS) Integrated Product Team (IPT)
Cloud-Based Command and Control (C2) Assessments

CS IPT Market Research *(Circa 2021)*

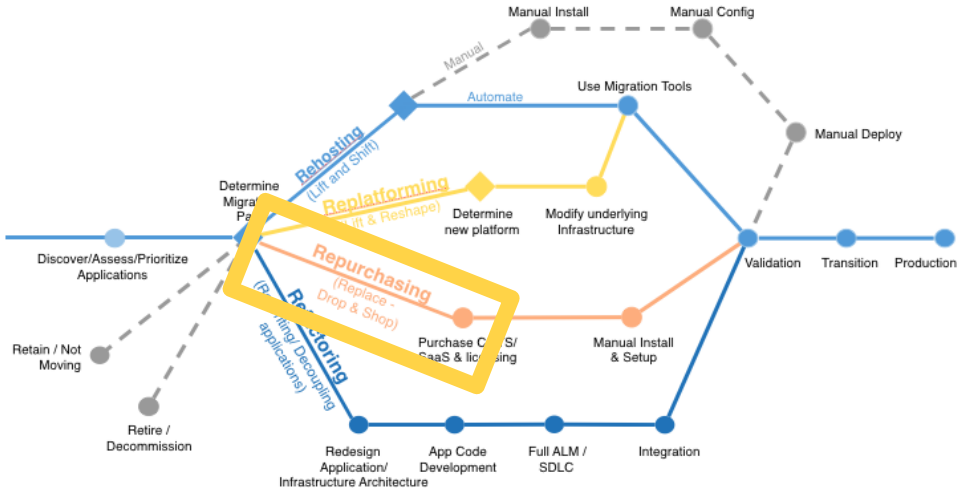
- The POES Extended Life (EL) Ground System Request for Information (RFI) was Open from May 17th to July 30th 2021
  - Goal was to understand from both academia and industry on potential frameworks for Cloud Based Command & Control (C2) functionality
    - Given the existing POES CRADA and its already developed material, the POES Mission was selected as a valid candidate for the RFI
  - Market Research from the RFI fed into further NESDIS Cloud Discussions
- The Commercial Services IPT Reviewed all RFI Respondents and found two viable alternative Command, Control and Communications (C3S) areas:
  - **Cloud Native Software as a Services (SaaS) - Cloud Native Ground Software Components**
  - **Ground System as a Services (GSaaS) - Complete Ground System Service**
- All Vendors identified utilization of Commercial Ground Stations (e.g. KSAT, Atlas, Viasat, AWS, Microsoft Azure, etc…)

NESDIS Enterprise Common Ground Capabilities on SCM/MOP
(circa 2021)

Function	Capability Title	Demonstrated Viability
SCM: Data Backhaul	Data Accounting	Varies/Viable
	Data Routing	
SCM: Antenna Operations	Satellite Acquisition	Mature
	Data Acquisition	
	Data Transmit	
	Satellite Ranging & Tracking	
MOP: Simulated Operations	Contingency Planning	Limited
	Concurrent Operations	
	Routine Operations	
MOP: Planning & Scheduling	Fleet Planning & Scheduling	Mature
MOP: Satellite Operations	Observatory Management	Emerging/Viable
	Telemetry Operations	
	Command Management	
MOP: Ground Operations	Ground Equipment Monitoring	Emerging
	Ground Equipment Management	
MOP: Mission Operations Preparation	Training	Not Evaluated
	Procedure Development	Not Evaluated
Global Function	Flexible Role Based Access	Mature

CS IPT Cloud Based Services Breakout

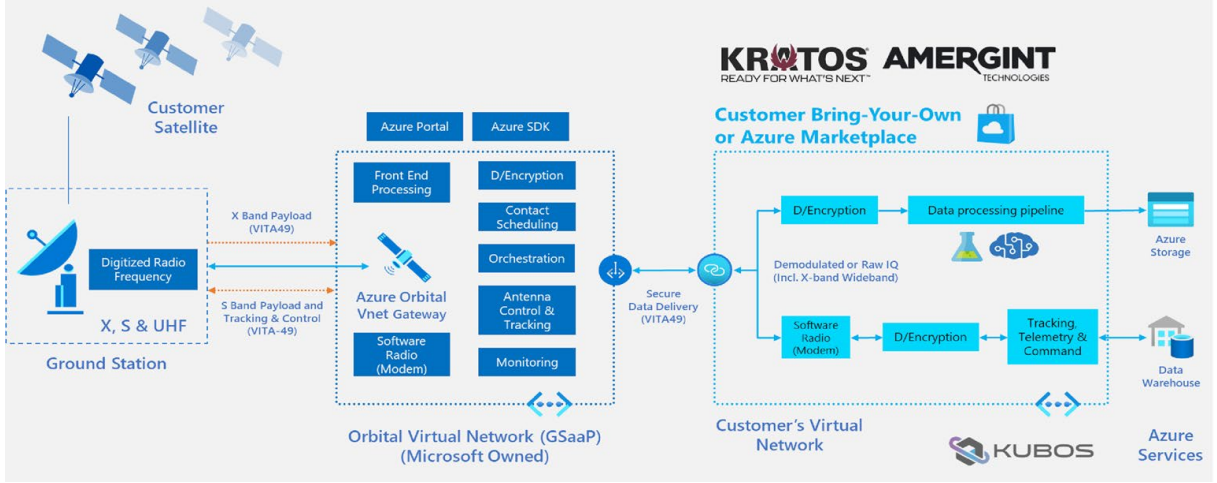
- Cloud Based Services fall into four distinct areas:
  - **Rehosting** – Lift and Shift of On-Prem Capabilities (e.g. JPSS IDPS)
  - **Replatforming** – Lift and Reshape On-Prem Capabilities to better utilize Cloud Backend Infrastructure
  - **Refactoring** – Lift and Rewrite On-Prem Capabilities to be Cloud Native
  - **Repurchasing** – Replace/Drop outright On-Prem with Cloud Native Solutions
- Existing NESDIS C2 Capabilities were identified as not easily refactorable into New Cloud Architectures; yet possible
- Commercial Services IPT recommend further Market Research of Commercially Available Repurchasing (e.g. Cloud Native Solutions) Functionality



Azure Orbital CRADA Overview

- NOAA entered into a CRADA to demonstrate Microsoft Azure Orbital Commercial Command, Control and Communication (C3) Capabilities on July 13, 2021; completed on April 7, 2022
  - NOAA-18 was selected to support any POES CRADAs due to its minimal risk to ongoing POES Operations and Technical Capabilities (e.g., unencrypted commanding, zero propellant).
  - Azure Orbital utilized its Quincy Washington Microsoft Ground Station and West Coast Azure Cloud Environment
  - Azure partnered with KUBOS, now Xplore, to utilize their MajorTom Command and Control (C2) services
- As a demonstration, MS Azure successfully interfaced with NOAA OCIO's Azure Active Directory to provide enterprise ICAM Identity and ERAV VPN into the CRADA's Cloud Instance
- CRADA activities executed with Azure Orbital provided invaluable insights to support future cloud-based activities
  - Azure actively utilized the CRADA to validate its capabilities and to further enhance its platform

CRADA Scope		
Objective 1	Demonstrate the ability to support mission control	August 2021 ✓
Objective 2	Demonstrate RF Uplink and Downlink Compatibility with NOAA-18	January 2022 ✓
Objective 3	Demonstrate the ability to conduct mission operations	April 2022 ✓
Objective 4	Build upon the CRADA to include payload data and other assets	-



Azure Orbital CRADA Timeline

2021-07-21
CRADA Kickoff

2021-09-01
Start of CoVisibility Contact Monitoring

2021-10-21
First Recorded Contact

2022-01-03
NOAA-18 STA for Quincy approved

2022-01-15
First non-CoVisability Downlink S-band Contact

2022-02-01
Improved Azure Gateway to process additional NOAA-18 Telemetry

2022-02-17
First Commanding Contact

2022-03-10
Improved Azure Antenna Sweeping Functionality

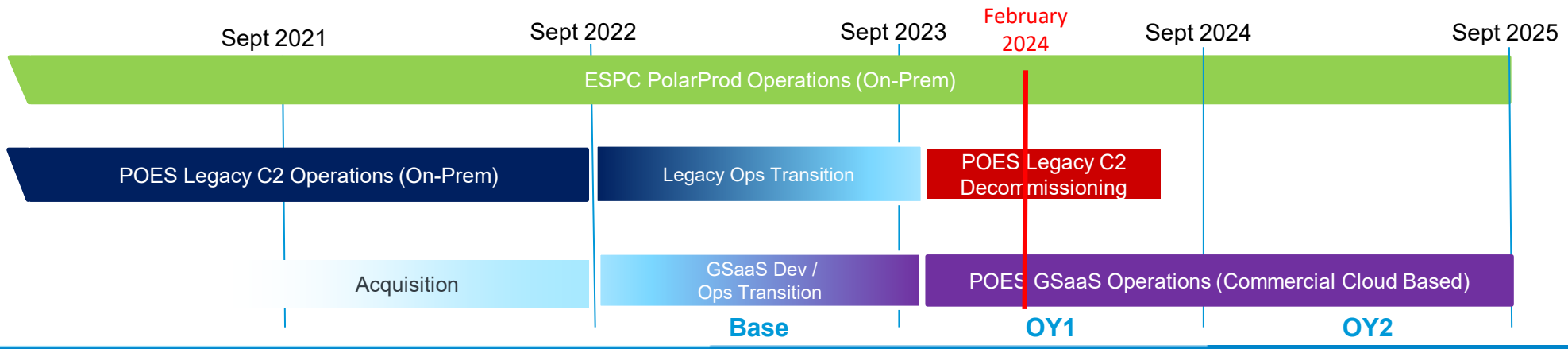
2022-04-05
Successful Commanding Attempt

POES Cloud-Based Mission Extension

- The POES Constellation and Ground System was initially forecasted to be decommissioned by the end of CY22.
- In November 2021 NESDIS Leadership approved the POES Extended Life (EL) Approach of which required the outsourcing of Command and Control (C2) Capabilities to an Commercial Entity for “Best Effort” Science Data Operations
- Goal was to Incentivizing growth of Commercial Industries Cloud Based Command and Control Capabilities, to further understand approaches to achieve Strategic NESDIS Cloud Development Goals

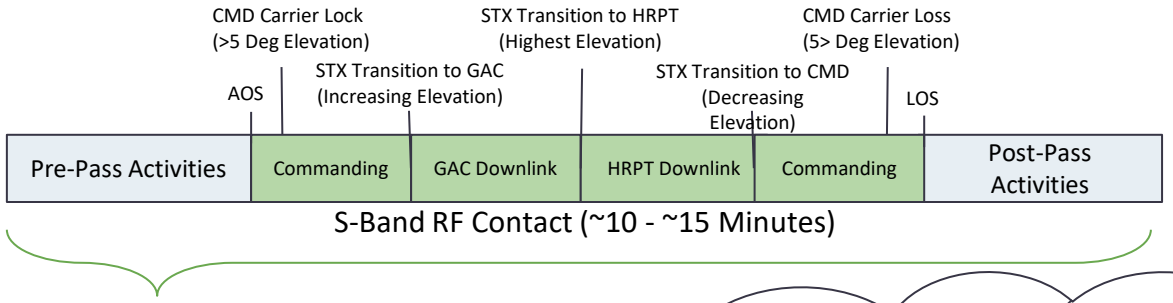
POES EL Contract - Commercial Ground System as a Service (GSaaS) Command and Control Capability

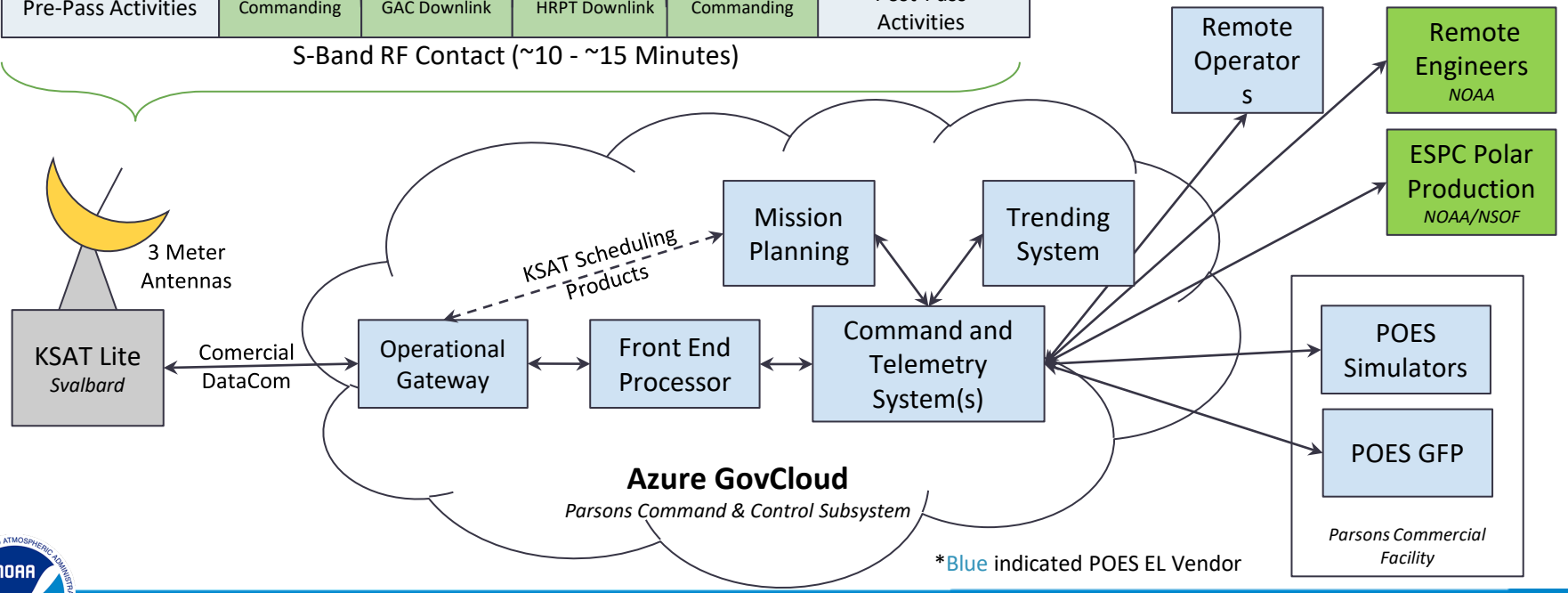
- **Contract Type: FFP GSaaS and Operations w/ Labor Hour Transition Component**
- **Contract Ceiling: $16.5M w/ 3 Year POP; Options exist to decrease cost due to Satellite Failure**
- **Parsons provided a commercially delivered C3 Solution, including Operations and Maintenance, within a secure Azure GovCloud Environment**
- **Antenna Services will be provided in full by Commercial Vendors (e.g. KSAT, Parsons Corporate)**

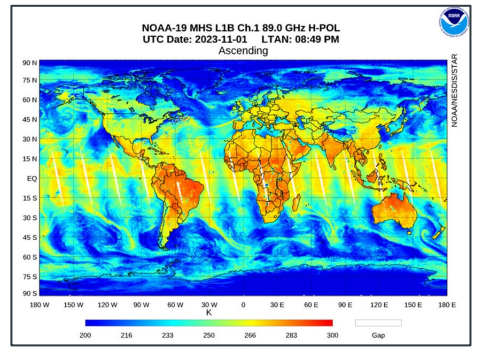


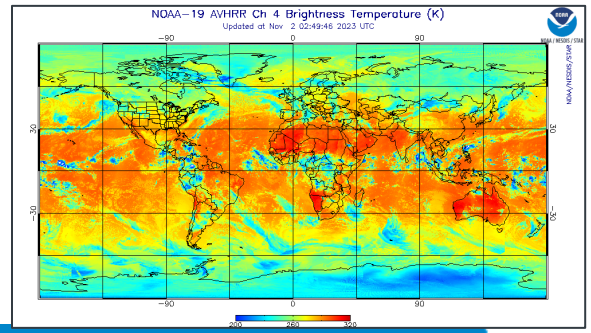
POES Extended Life – Concept of Operations

- POES Extended Life is a Significant Change from the legacy POES Concept of Operations; Key Highlights Include:
  - Integration of POES into the existing Enterprise Parsons Ground Architecture supporting other Missions
  - Migration of the Command and Control Subsystem into an Primarily Microsoft Azure Cloud Environment
  - Migration from an L-Band Science Mission Downlink to an S-Band Command & Control + Science Mission Downlink Profile
  - Transition to 9x5 Operations, with No Performance or Latency Requirements levied on POES EL Science Data Collection









POES Extended Life – C2 Cloud IT Security Approach

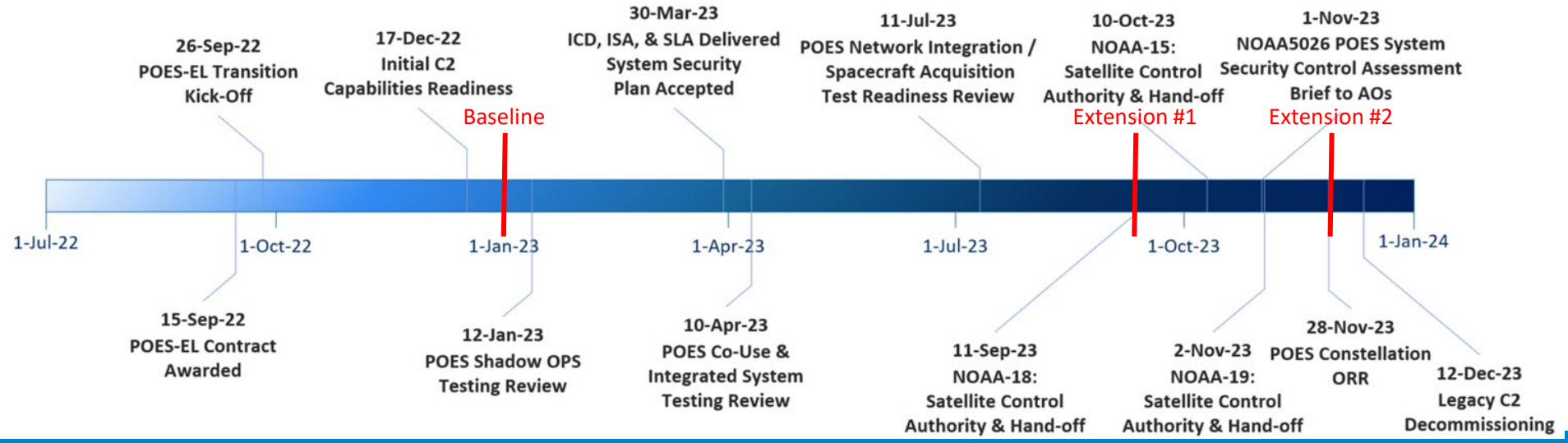
- NESDIS ACIO developed an approach so an Commercial Cloud-Based Ground System could comply with NOAA Security Requirements while remaining outside of an NOAA FISMA Boundary

	POES EL Approach	
IT Security Function	**Contractor-Owned Approach (POES EL)**	**NOAA Controlled Approach**
Governing Framework	NIST Risk Management Framework (RMF)	
System Security Plan	Contractor Owned, Government Reviewed	Government Owned, Government Approved
IT Security Control Compliance	ISO/IEC 27001 or **NIST 800-53 Rev 5**	NIST 800-53 Rev 4/5
Continuous Assessment & Accreditation	Contractor Performed, Government Reviews Artifacts	Government Owned, Government Executed
Continual Security Monitoring	Contractor Performed, Government Accessible	Government Owned, Government Executed
Required Deliverables	Service Level Agreement (SLA) Interface Control Document (ICD) Information Security Agreement (ISA) Government visibility into Contractors' Continuous Monitoring (CM) dashboards	System Security Plan (SSP), Government-led annual assessments (SSA) and continuous monitoring (CM) Business Impact Assessment (BIA) Business Continuity Plan (BCP) Etc….

POES Extended Life – Transition Execution Summary

- The POES Extended Life Contract expected an transition be completed 6 Months from Contract Award, but was ultimately extended through 14 Months.
  - **Baseline** (Award to 6 Months)
    - Commercial Authority to Operate(ATO) Issuance
    - Initial Standup of the Command and Control Azure Instance
    - Initial End-to-End testing from the Azure C2 Instances to KSAT Lite Antennas
  - **Extension #1** (6 to 12 Months)
    - Completion of Ground System Verification Activities
    - Completion of the Spacecraft Concept of Operations Testing
    - Transition of the NOAA 18 Spacecraft
  - **Extension #2** (12 Months to 14 Months)
    - Transition of the NOAA 15 and NOAA 19 Spacecraft(s)
    - Decommissioning of the Legacy POES Command and Control Ground System

- **Constraints and Delays** that impacted the Transition, included:
  - Integration of Legacy Capabilities (e.g Simulators, Ground System Configurations, Mission Planning, etc…)
  - Operations Validation of the POES EL Concept of Operations
  - Azure Cloud Network Configuration
  - Ramp Up of Resources around Award



Conclusion

- Current Satellite Operations capabilities requires further strategic Evolution and Innovation to meet NESDIS Forecasted Constellations

- Emerging technologies and business practices offers a potential path forward
  - Cloud-based solutions offer significant redundancy and expandability
  - New technologies improve asset utilization through multi-mission use
  - Buying commercial services reduces up front investment and ongoing sustainment costs while providing operational scalability

- NESDIS is planning on performing further demonstrations and analysis in viable Cloud-Based Architectures to support the replacement of existing SCM & MOP Capabilities

Questions?

Backup