NOAA

National Environmental Satellite, Data, and Information Service

NESDIS Cloud Migration: An Enterprise Approach to Cloud Adoption

Kenneth S. Casey, PhD
Acting Deputy Director, Office of Satellite Ground Services
(With Thanks to the Entire NESDIS Cloud Team!)

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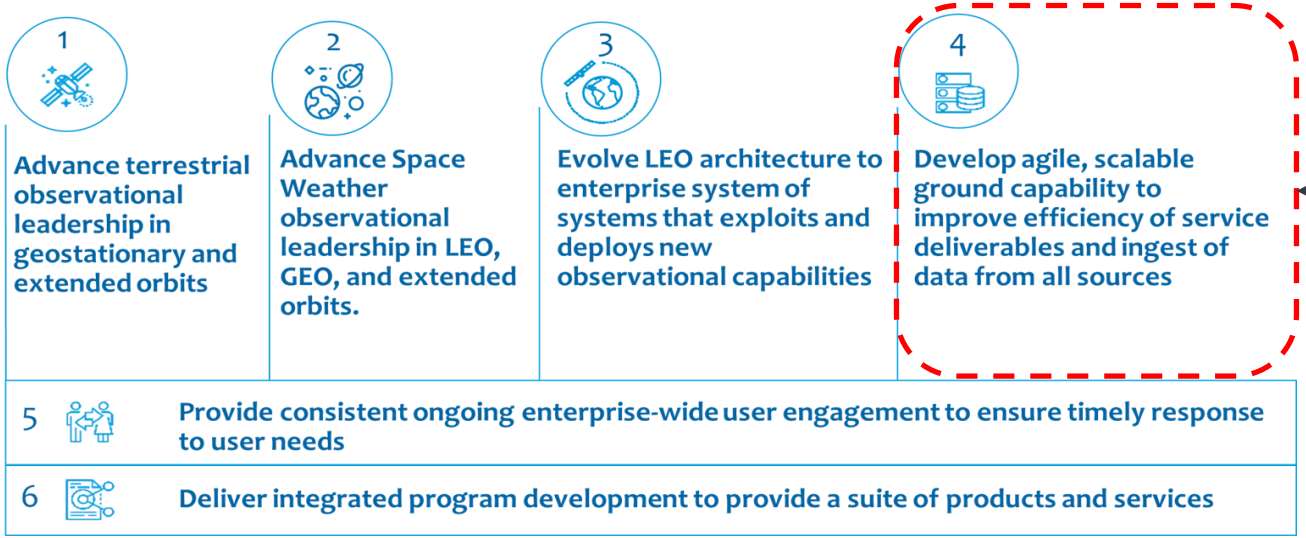
NESDIS Cloud Migration At-a-Glance

- NESDIS is taking an enterprise approach to cloud adoption, avoiding “lift and shift” approaches that would replicate existing “cylinders of excellence” in the cloud
- Over the last two years, NESDIS created a cloud strategy, completed major piloting activities, operationalized our first instantiation of the NESDIS Common Cloud Framework (NCCF 1.0), kicked off a second phase of pilots, and began operationalizing NCCF 1.1
- Goals for today: Update the NOAA satellite community on the NESDIS enterprise cloud effort, provide a few details, and solicit your inputs!

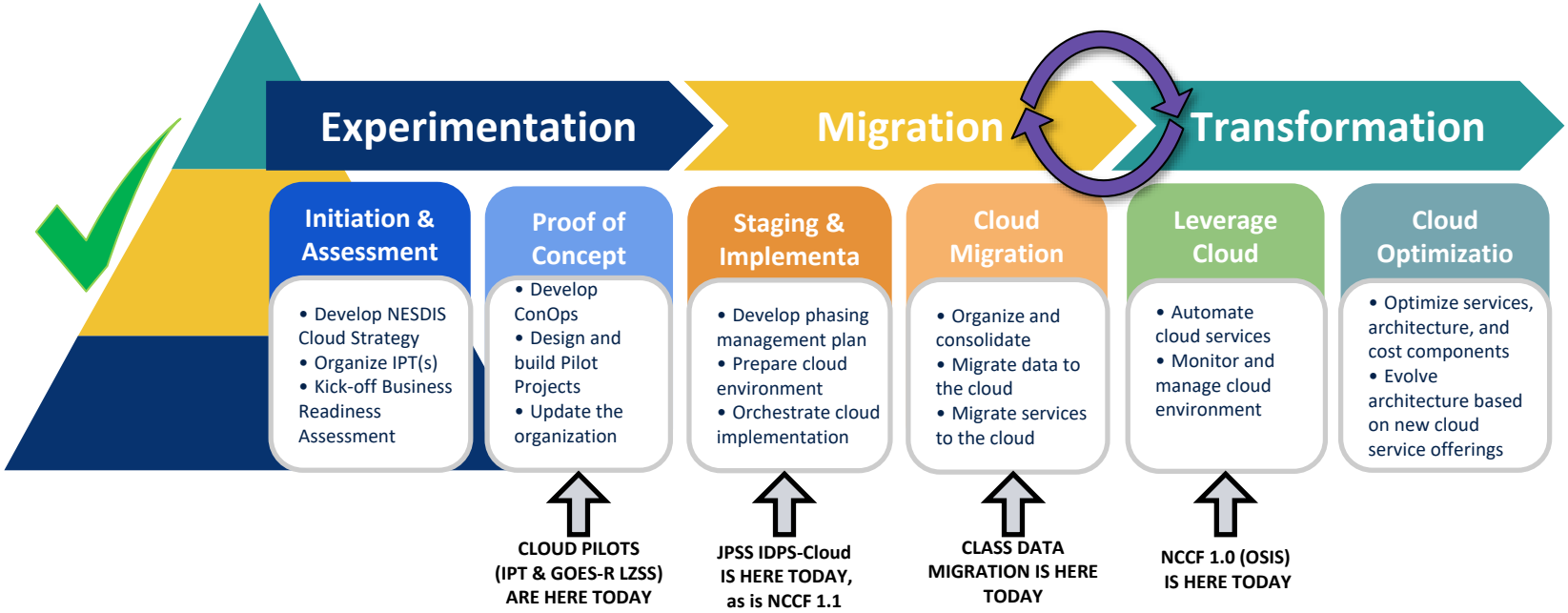
NESDIS Transformation Strategic Objectives



The NESDIS Common Cloud Framework (NCCF) is a key component of NESDIS transformation

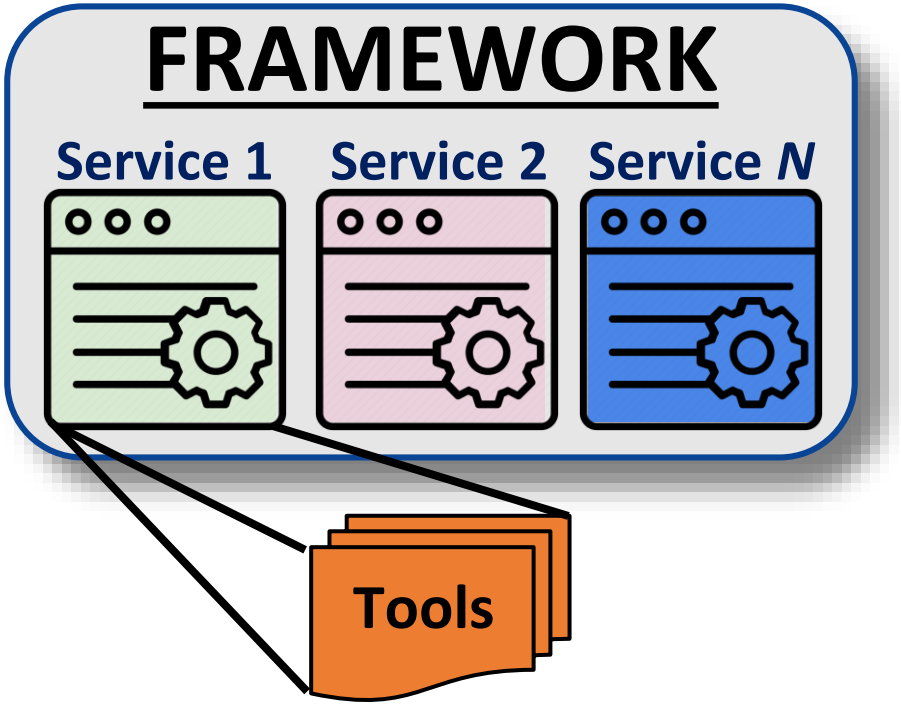
NESDIS Conceptual Cloud Roadmap

NESDIS leadership has determined that **cloud computing is our future**, and the organization is moving intelligently to the cloud

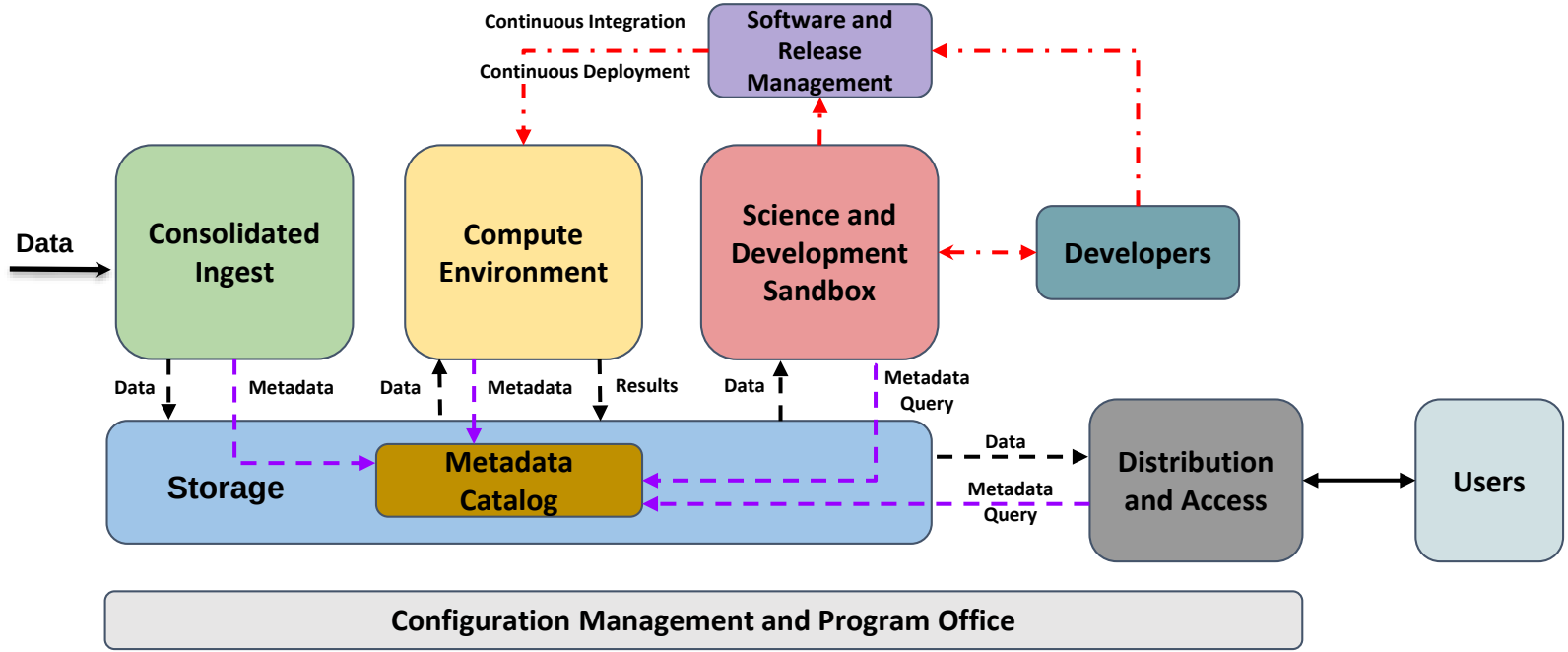


NESDIS Cloud Lexicon

- **Framework:** enables a set of services to work together to deliver the mission value
- **Service:** how to meet the core NESDIS IT functions
- **Tool:** cloud software application(s) used to implement the service



NESDIS Common Cloud Framework

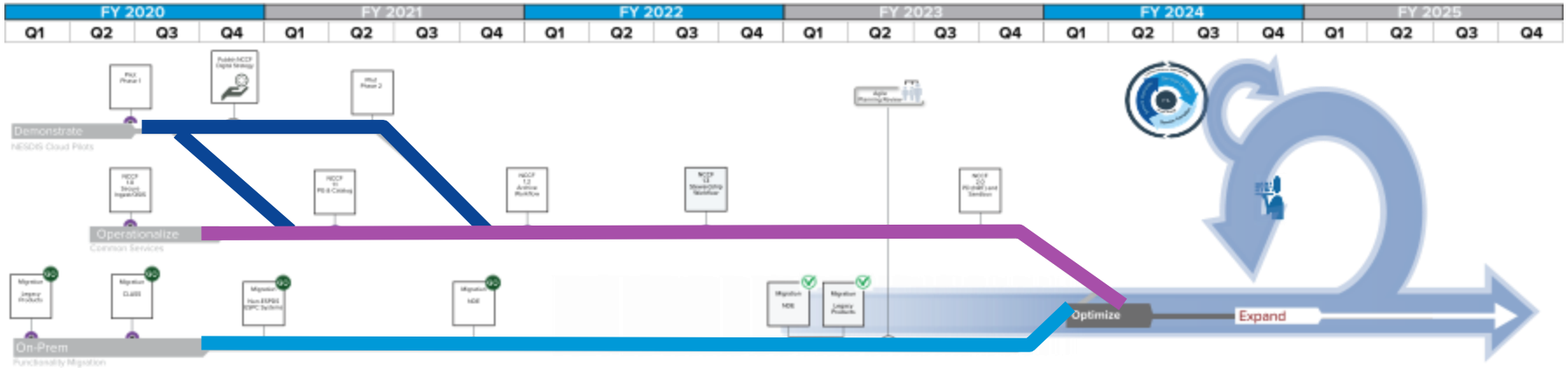


- Cloud provider and data source agnostic enterprise architecture
- Collection of functional tools and services that form a framework
- Enables the end-to-end non-Mission Operations NESDIS Ground Enterprise business functions

NESDIS Cloud Roadmap

On-Prem Functionality Migration View (under development)

FY2020 FY2021 FY2022 FY2023 FY2024 FY2025



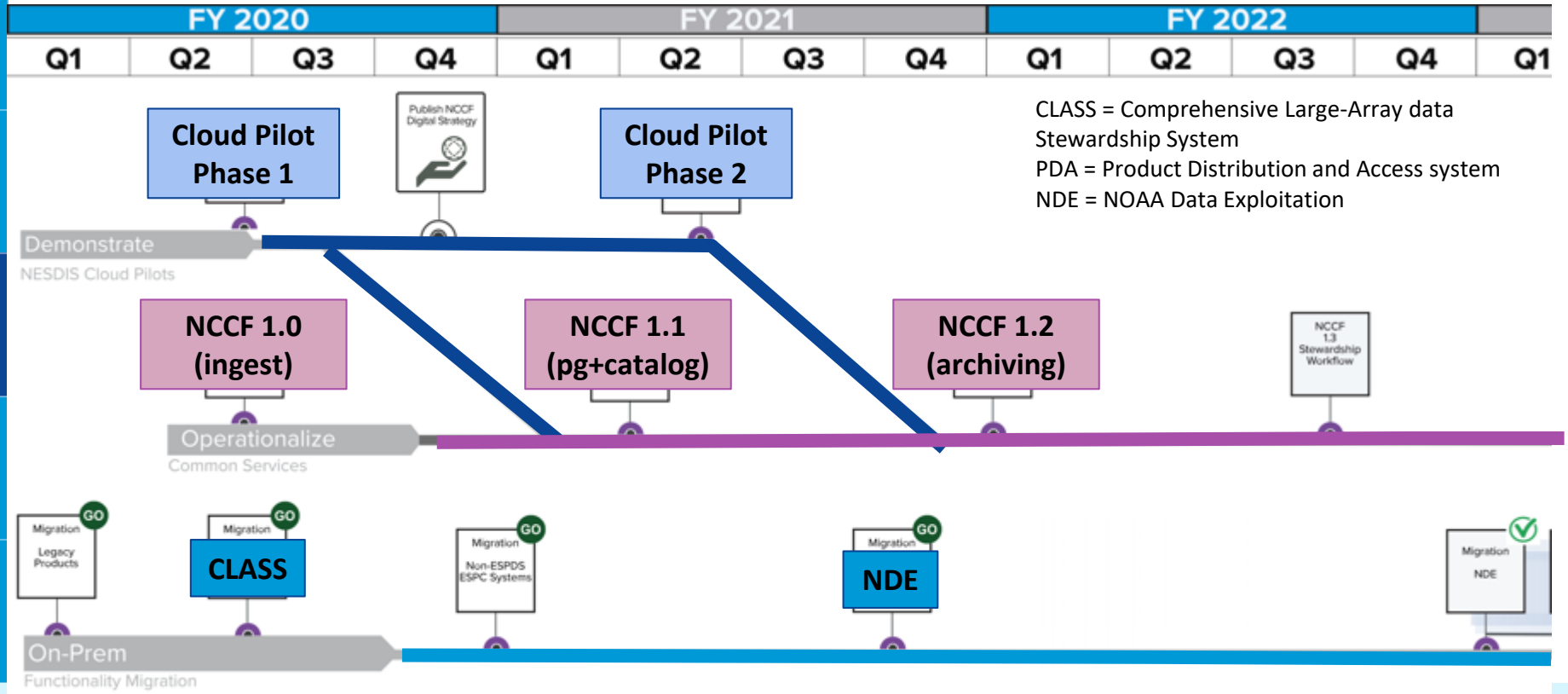
Demonstration

Operationalization

On-prem Migration

NESDIS Cloud Roadmap

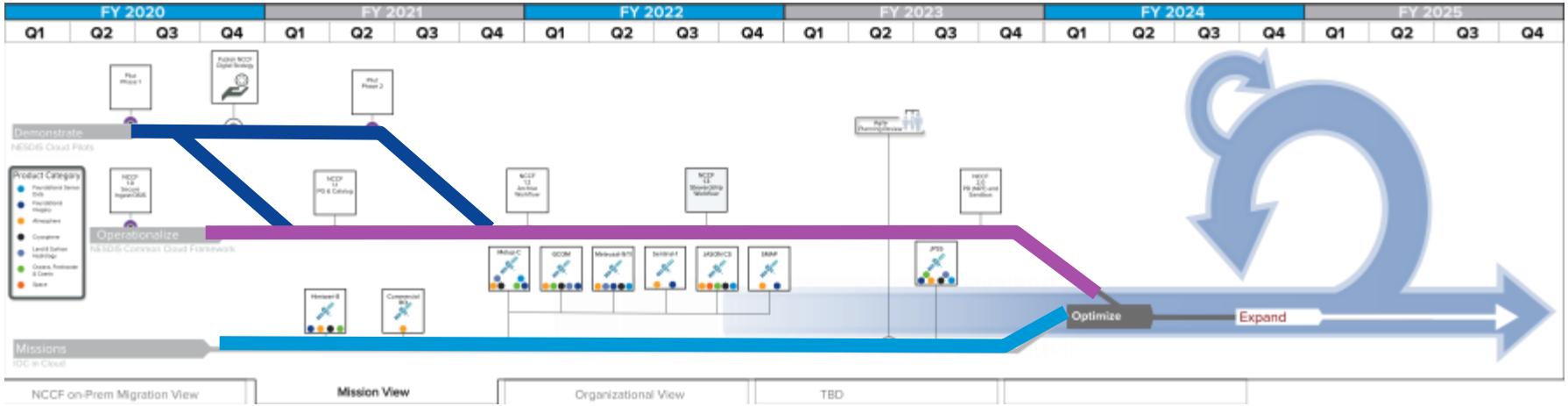
On-Prem Functionality Migration View (under development)



CLASS = Comprehensive Large-Array data Stewardship System
PDA = Product Distribution and Access system
NDE = NOAA Data Exploitation

NESDIS Cloud Roadmap
Mission View

(under development)



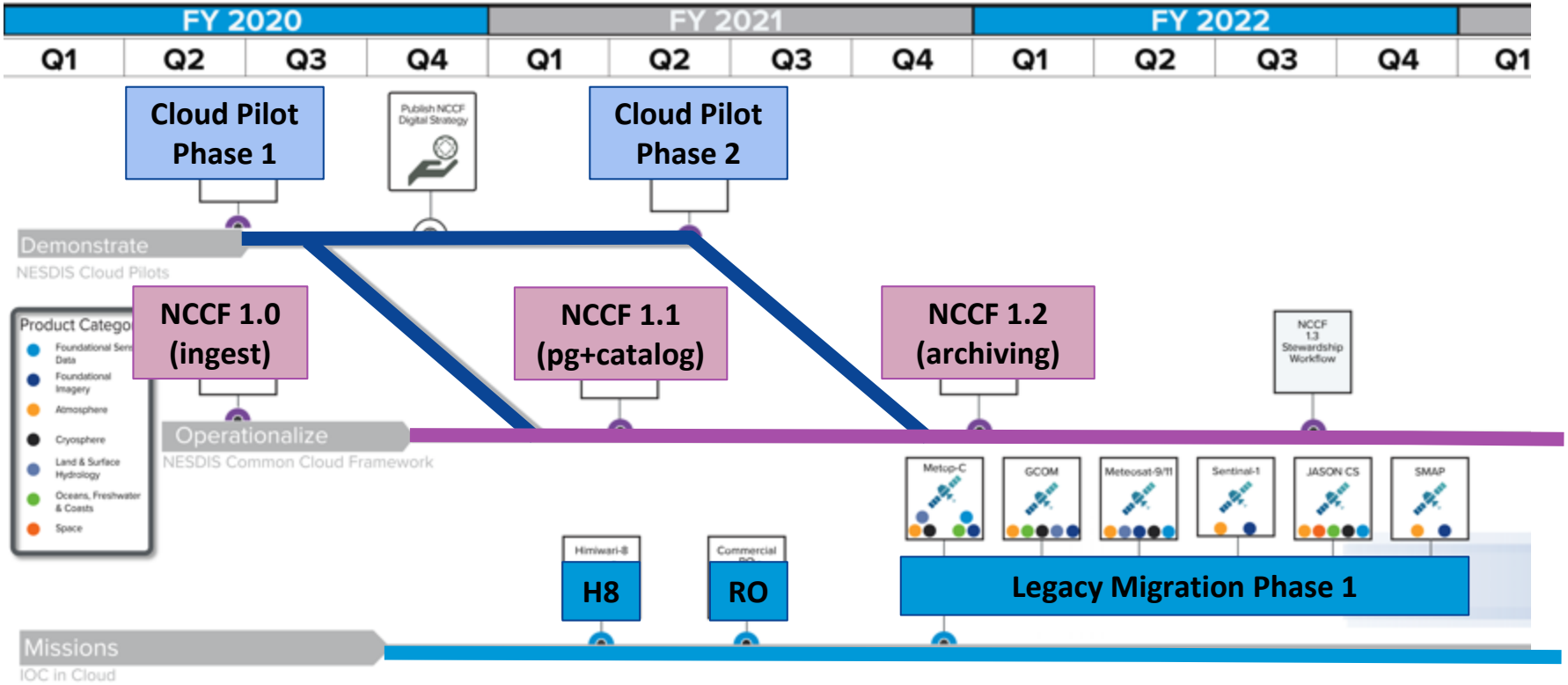
Demonstration

Operationalization

Mission Implementation

NESDIS Cloud Roadmap
Mission View

(under development)



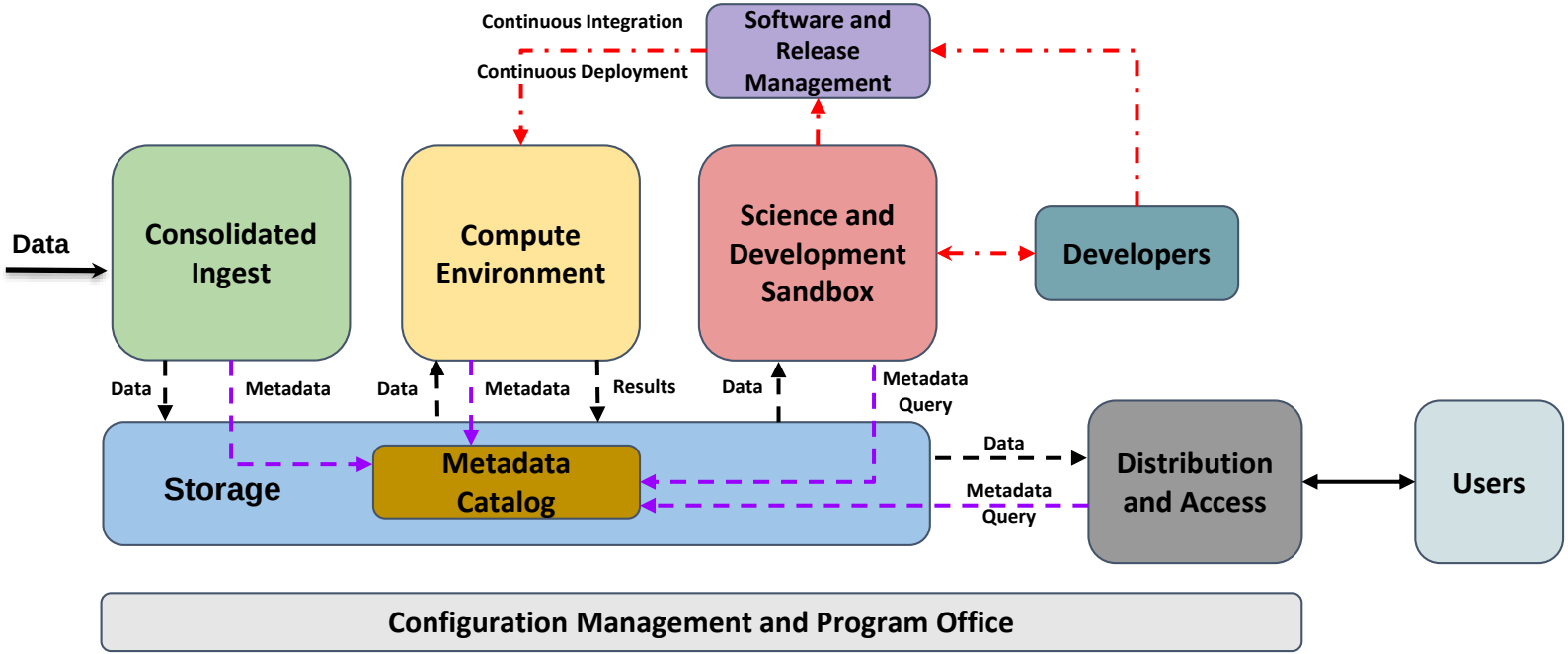
NCCF on-Prem Migration View | **Mission View** | Organizational View

NESDIS Cloud Development

- NCCF is supported by the Cloud Pilot Integrated Pilot Team (IPT) and the Cloud Program Management Office (PMO)
- Cloud Pilot IPT
  - Phase I: March, 2019 - March, 2020
    - Demonstrated a cloud-enabled, end-to-end, data-source agnostic ground service capability
  - Phase II: April, 2020 - December, 2020
    - Adding functionality to the NCCF and exploring cloud optimization
- Cloud PMO
  - Helping to define governance for cloud operations, transitioning capabilities to operations, ensuring compliance with security requirements, and coordinating on-ramping of capabilities to the cloud

… all leading to the Data-source Agnostic Common Services (DACS) capability

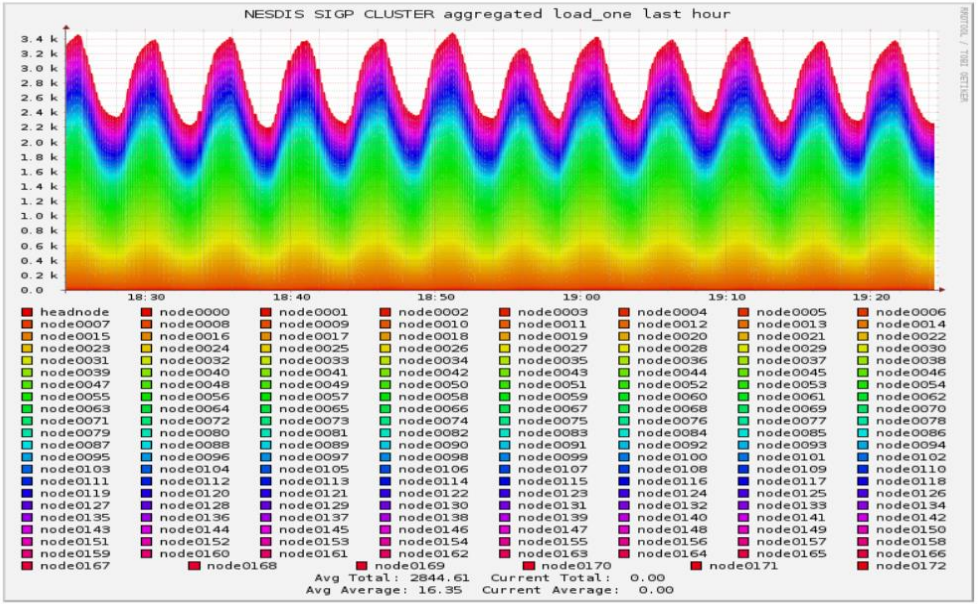
Results and Status of the Cloud Pilots



- Remember, the NCCF consists of a set of loosely coupled functional components or services
- Cloud Pilot Phase 1 demonstrates capabilities in each of these service areas

Consolidated Ingest Service

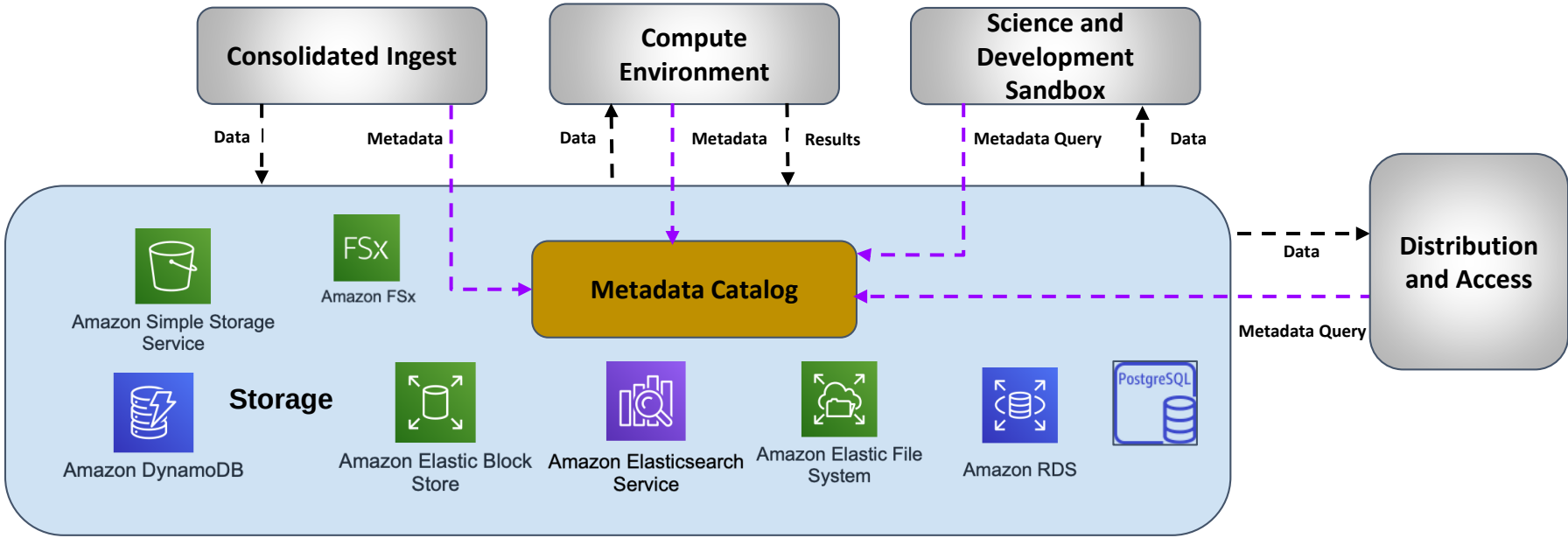
- Single point of entry for all NESDIS data types and protocols
- Customized security screening based on source and business agreements
- Highly available, fault tolerant, and scalable gateway to the NCCF



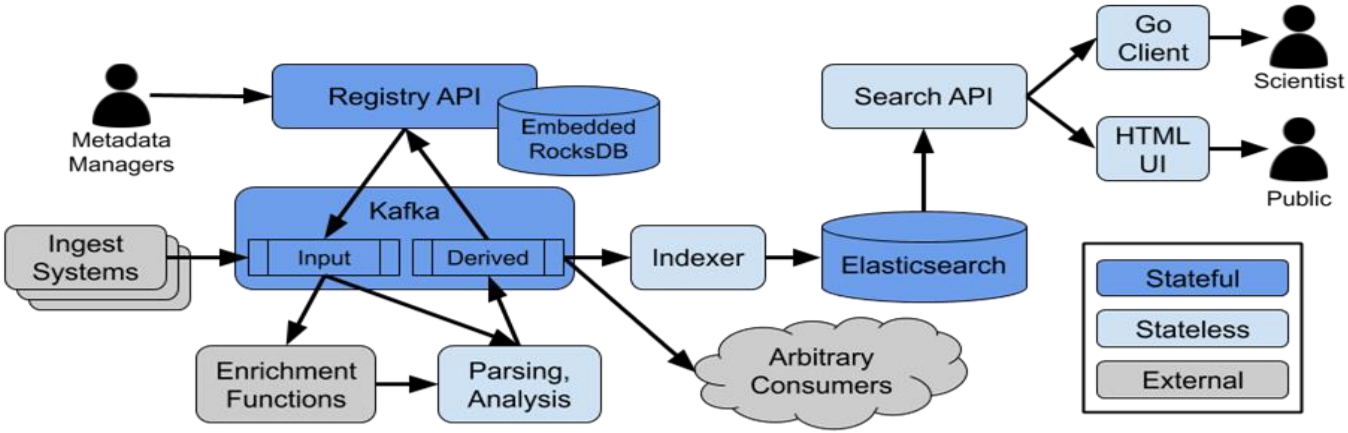
- Demonstrated that automatic scaling architecture **scales without impact to performance**
- Provisioned 4000 vCPUs to **simultaneously ingest** 2.3 million files (36.57 TB) - no data loss or performance degradation

Enterprise Storage Service

- Scalable and centralized data repository capable of storing all types of NESDIS data
- Supports the full data lifecycle - from ingest through archive
- Leverages all types of cloud vendor provided storage and underpins the entire NCCF



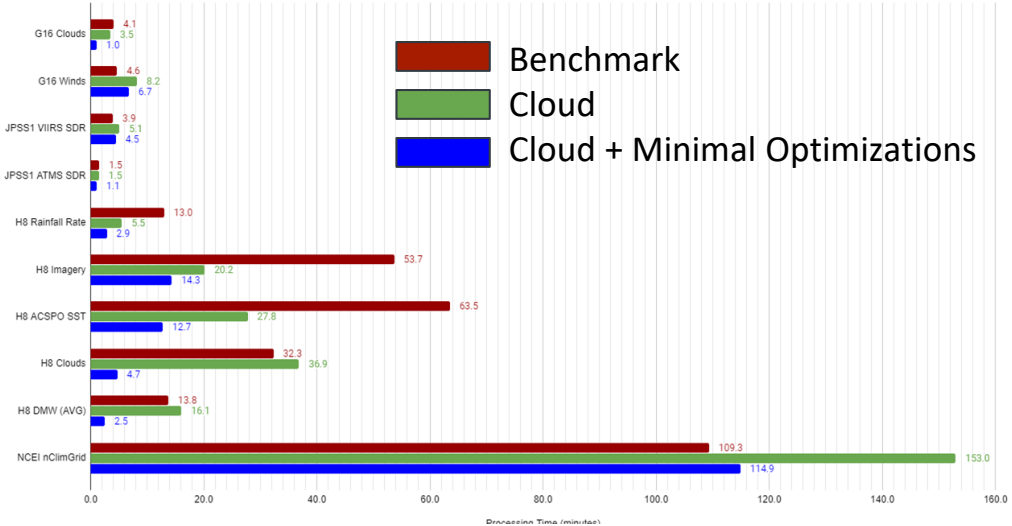
Metadata Catalog Service



- Selected NOAA OneStop as core of catalog service based on an AoA
- Scales easily and cheaply to manage billions of records, demonstrated over 111 million records per day
- Agnostic to data type - satellite/in situ
- Supports both real-time and retrospective cataloging requirements
- Search queries are fast and scalable

Compute Environment Service

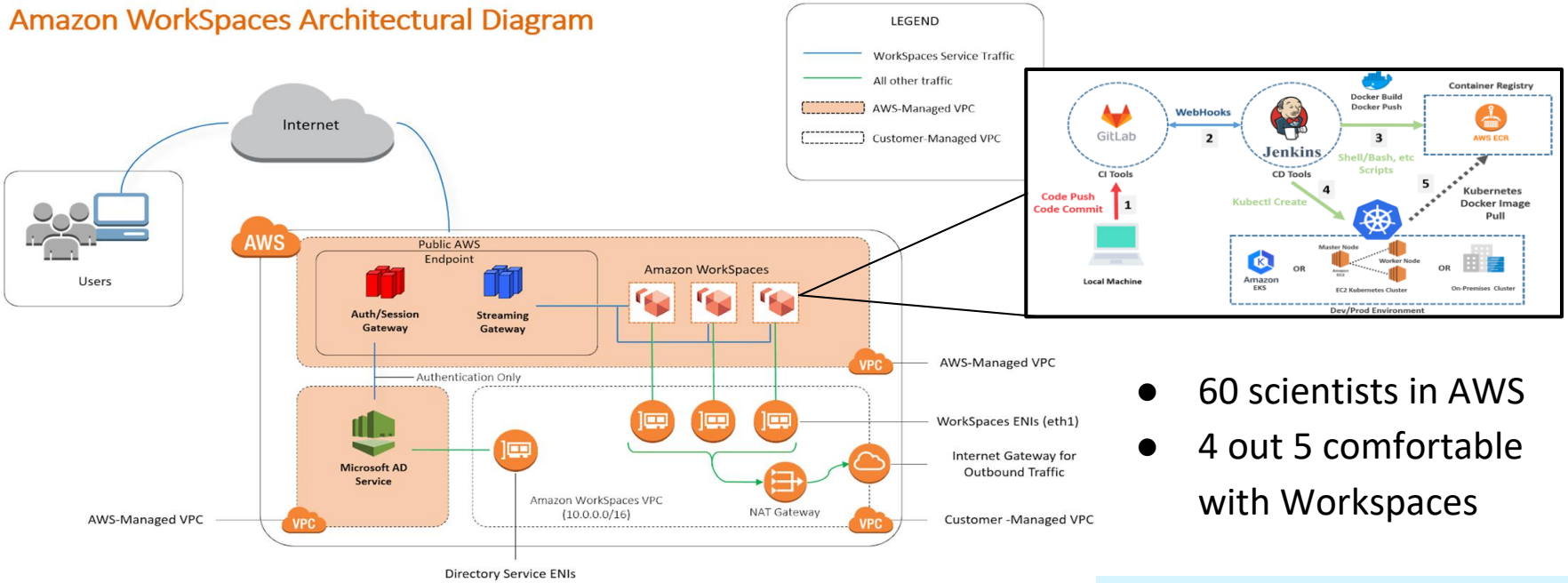
- Scalable, fault tolerant, and data agnostic high performance compute service
- Supports all NESDIS compute needs
- Supports scientific data processing and development
  - 17 science algorithms integrated into NCCF from STAR and NCEI
  - Scalable infrastructure to support current and future product generation needs
- Even limited optimizations can significantly reduce time/cost in cloud



Comparison of Processing Times for Ten Algorithms

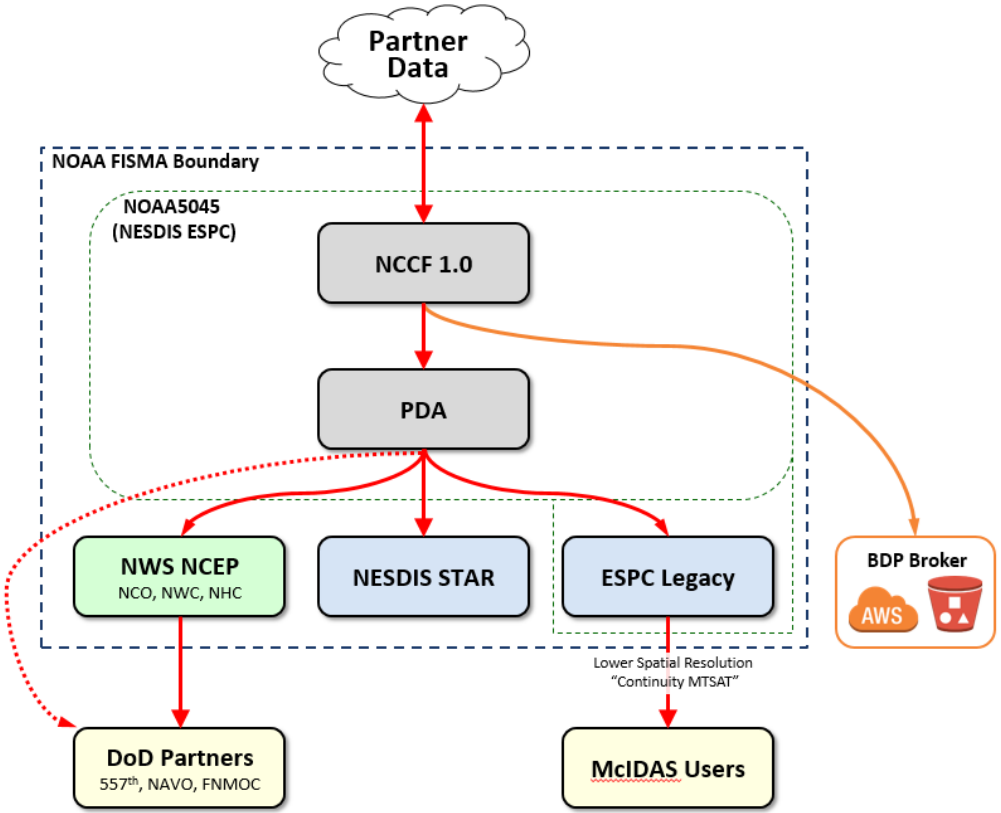
Science & Development Sandbox Service

- Secure and scalable scientific development environment
- Provides streamlined integration between developers and scientists
- Supports data visualization tools



- 60 scientists in AWS
- 4 out 5 comfortable with Workspaces

Distribution & Access Service



- Provides all required NESDIS data delivery pathways:
  - Low-latency push/pulls
  - Cloud-to-cloud transfers using Big Data Program (BDP) in ~2 seconds
  - Public access capabilities
- Demonstrated ability to leverage the PDA system until the NCCF distribution service is complete and users are ready for the cloud too

Cloud IPT Phase I Outcomes

Security

Documented and approved cloud security policies and processes

Common Services

Enterprise solutions for Data Ops, Data Stewardship, and Science Ops

+

Robust Solutions

Highly available, fault tolerant, and scalable end-to-end services

Flexibility

Cloud provider and data source agnostic enterprise architecture

Working Solution for the NESDIS Ground Enterprise

- Framework of functional services that meet the needs of the NGE
- Working code that processes near real-time data flows
- Services that can adapt to changing user-requirements
- End-to-end holistic approach that ensure the NESDIS mission success into the future

NCCF Independent Technical Evaluation

- Objective of independent review was to validate that the NCCF has met the following success criteria in both design and demonstrated functionality
- The review panel of IT leaders and experts from USAF, NASA, USGS, OAR, and OCIO recommended the following:
  - Pursue development and adoption of the NCCF
  - Improve the Cloud Cost modeling to include total cost of ownership
  - Promoted inter-agency collaboration with an emphasis on complimentary datasets
  - Move toward Continuous Authority to Operation (ATO) process
  - Formulate a data backup strategy
  - Establish robust governance processes, especially for the Science & Development Sandbox service

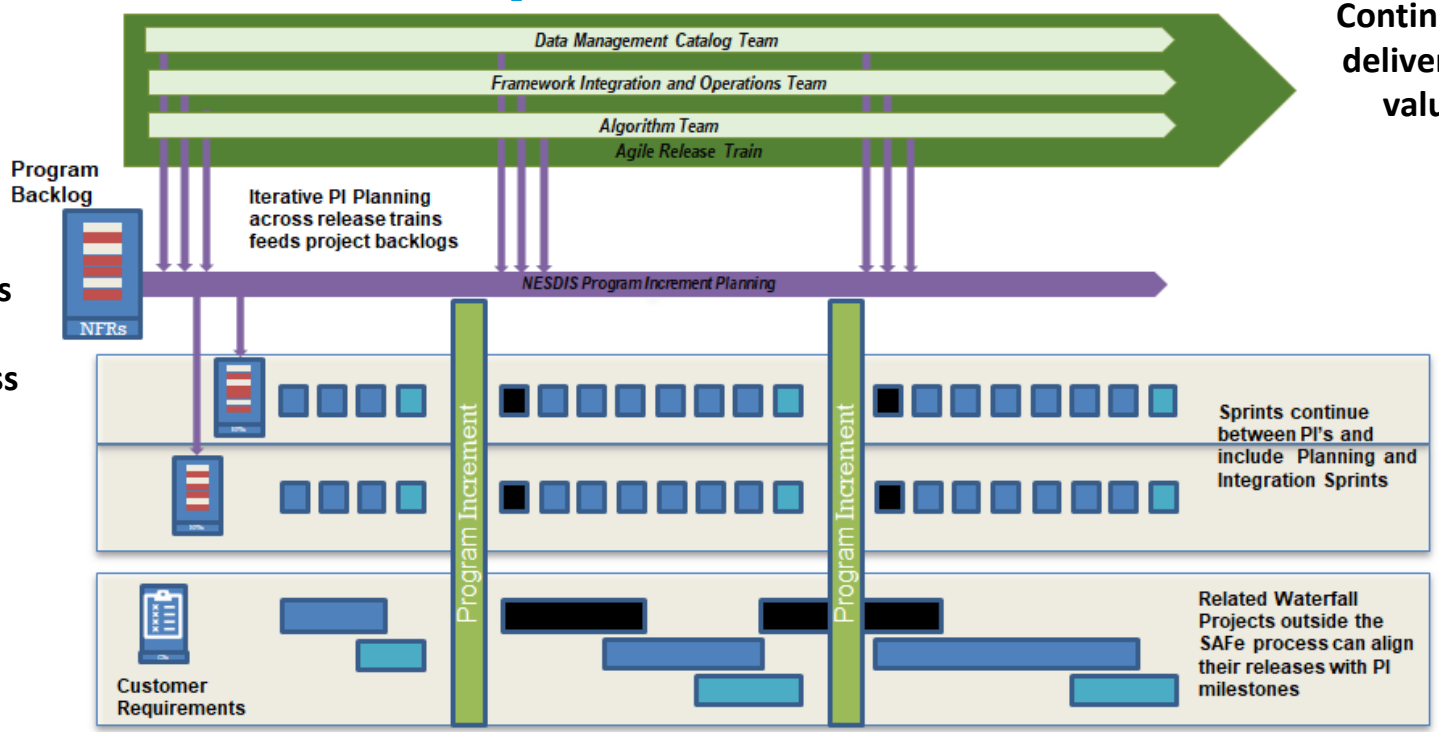
Pilot Phase 2 Vision & Direction

- Expand upon the NCCF functionality
  - Demonstrate Product Distribution and Access **(PDA) interface to operational user** functionality
  - Demonstrate feasibility of OSPO Satellite Analysis Branch **(SAB) visualization workflows**
  - Expand the science development environment to additional science teams
  - Demonstrate the archive and metadata stewardship process
- Determine the **value of cloud-native optimization** for NESDIS
  - Select a sample set of algorithms to optimize in order to quantify the return on investment for increased cloud efficiency
  - Investigate cloud-optimized file formats such as Zarr
- **Explore partnership collaboration opportunities,** including: access to mission data by anomaly analysts, science instrument teams, and other potential weather science communities
- Evaluate end-to-end ground architecture cloud migration benefits based on trade studies, cost-benefit analysis, **transformation efforts**, and enterprise risk assessment(s)

Cloud PMO and Operational NCCF

- Established “Cloud PMO 1.0”, now implementing Scaled Agile Framework (SAFe) to manage transition of pilots, capabilities, and legacy functions to the NCCF
- Operationalized NCCF 1.0, enabling secure ingest of non-NOAA data - March 2020
- NCCF 1.1 team established within the CPMO and working to operationalize product generation and data cataloging capabilities - December 2020 is target for “MVP”
- Advanced planning with the Cloud IPT to prepare for the outcomes of Cloud Pilot Phase 2 and quickly operationalize NCCF 1.2 (archiving workflows) later in FY21
- Initial Governance and ConOps drafts now being updated and made “fit for purpose” for FY21 and FY22 - part of the overall culture and business practice evolution...

Scaled Agile Framework (SAFe) Adoption at NESDIS



Continuous delivery of value

User stories drive process

Learning - based increment planning and execution

Connection with legacy waterfall

Agile Release Train Process

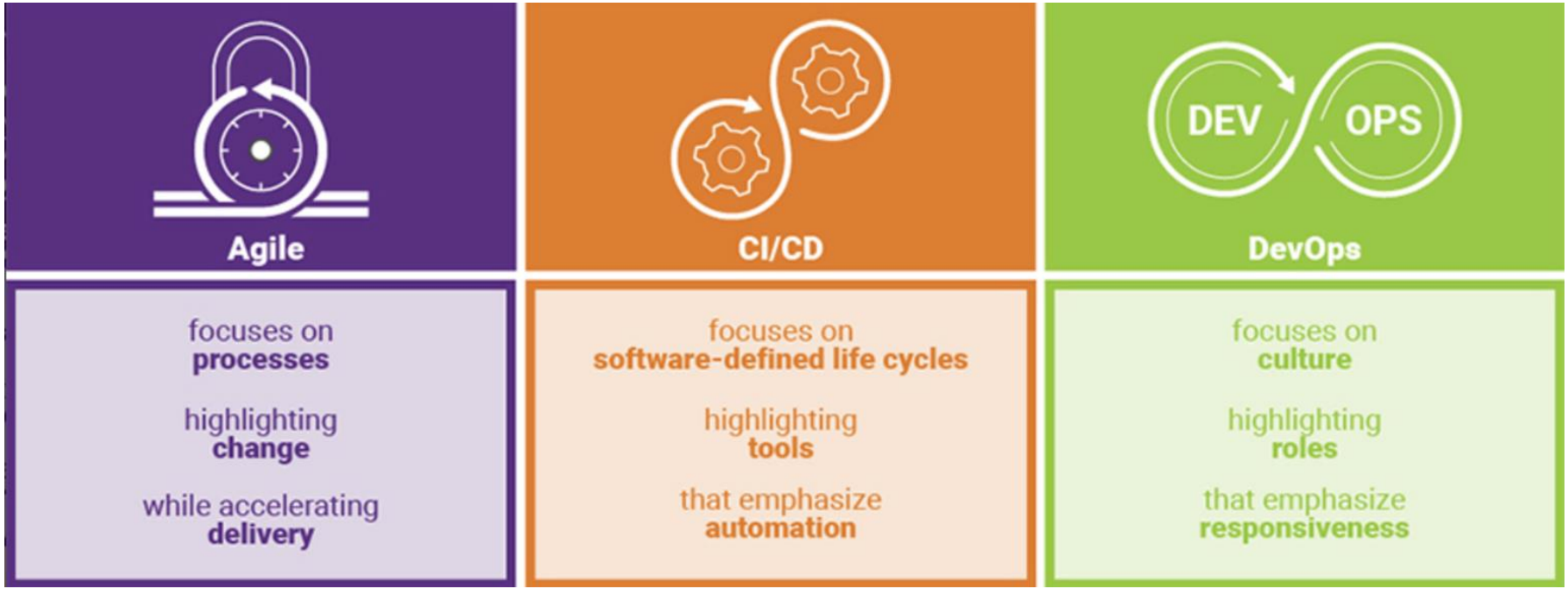
Scaled Agile Definition of DevOps

"DevOps is a mindset, a culture, and a set of technical practices. It provides communication, integration, automation, and close cooperation among all the people needed to plan, develop, test, deploy, release, and maintain a Solution."

- Culture of Shared Responsibility
- Automate Everything
- Lean Flow
- Measure Everything
- Recover -- Enable Low-risk Releases

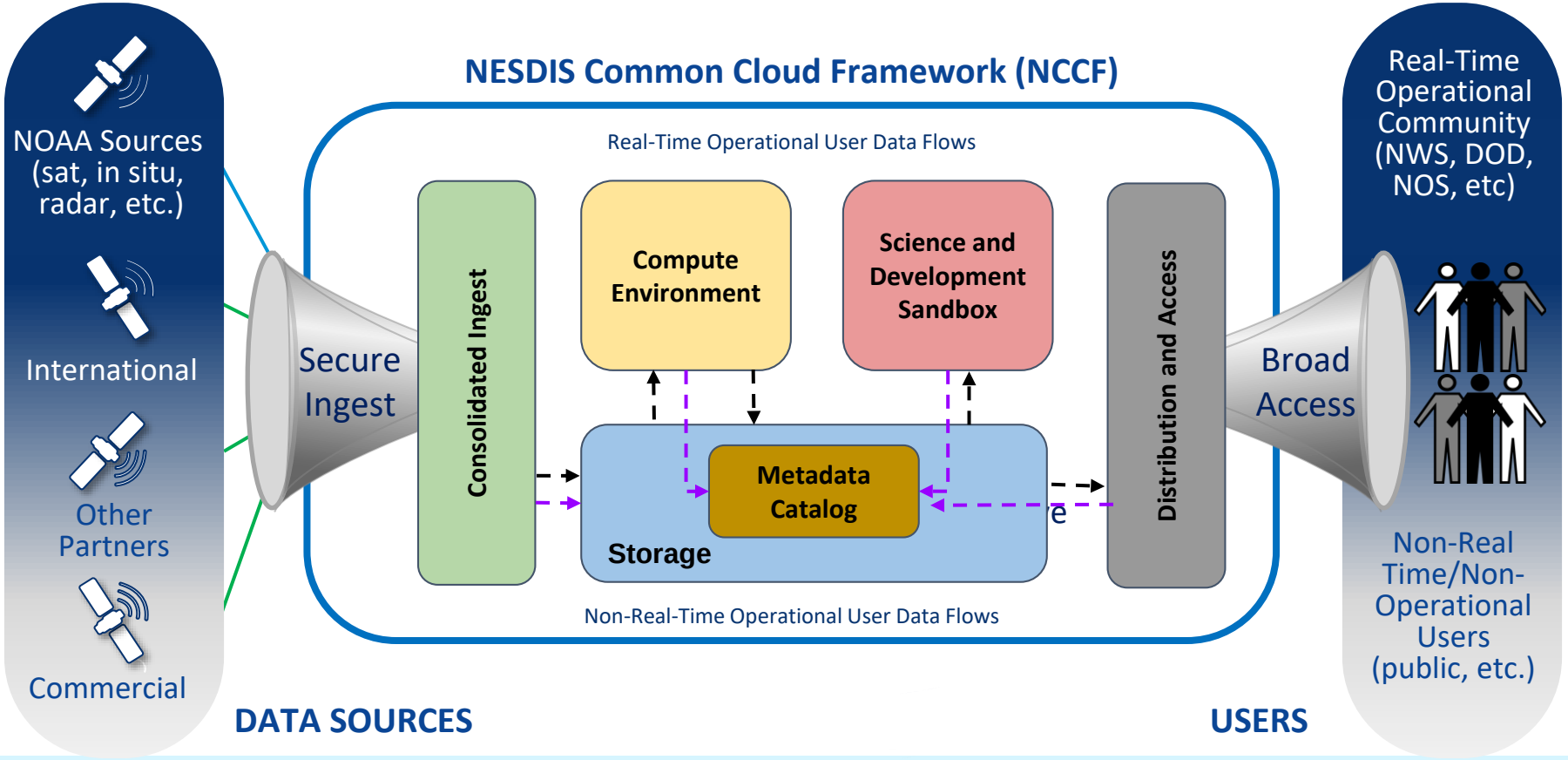
www.scaledagileframework.com/devops/

DevOps, Agile, and CI/CD



synopsys.com/blogs/software-security/agile-cicd-devops-difference/

Data-source Agnostic Common Services

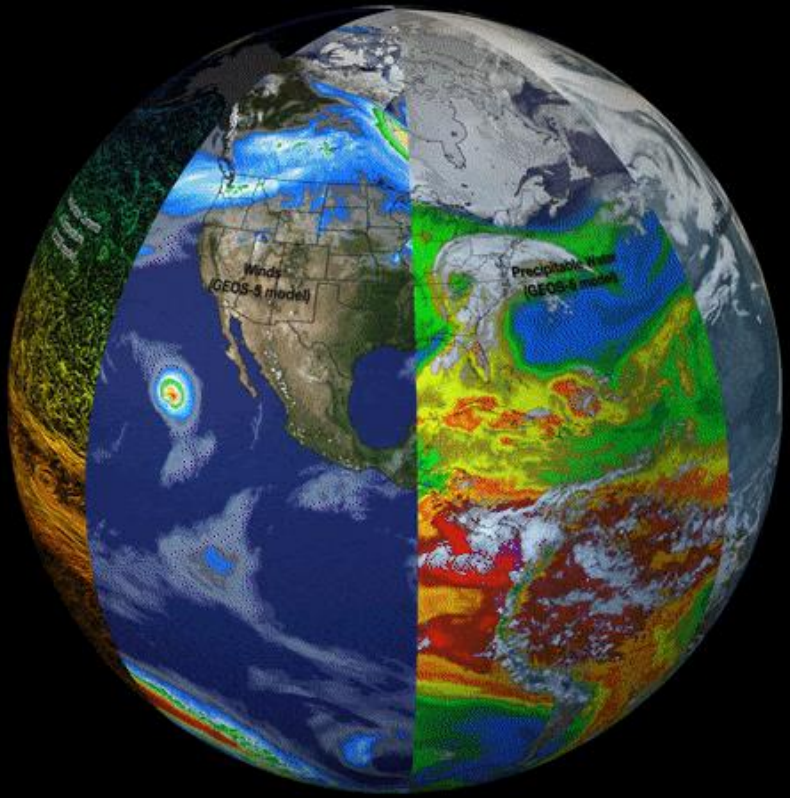


DACS Budget Initiative

- FY 2021 President's Budget requests $5M in funding to further operationalize the NCCF and enable NOAA to utilize data and observations from a diverse array of partner and commercial systems

- DACS initiative will transition new and legacy products and services to the NCCF to increase end-to-end efficiency and advance processing capabilities by:
  - Transitioning on premise hardware and software functions the cloud
  - Exploiting IT innovation, such as artificial intelligence and machine learning
  - Increasing cloud infrastructure capacity to ingest, process, distribute, and archive

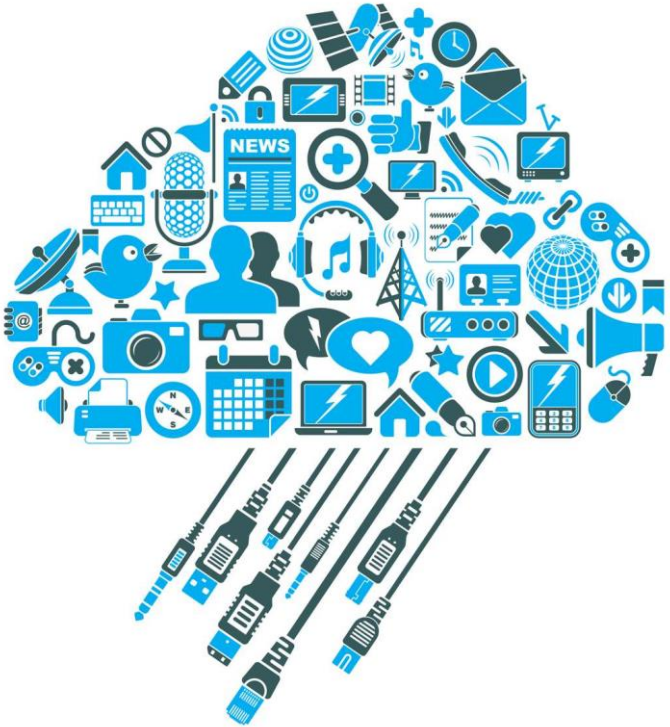
An Integrated, Digital Understanding of Complex Earth Systems



Federal Cloud Transformations

Studies illustrate that **80%** **of transformation efforts fail** because of complexity and approach to challenges

NESDIS aims to stay in the **20%** success category because it is **planning** for the transformation complexities **today**



Source: 2018 CGI Group, Inc.

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Questions?

NESDIS.Cloud@noaa.gov