Ground System Architectures Workshop

The Applicability of NIST Big Data Reference Architecture for Ground System Architectures

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What is a Reference Architecture?

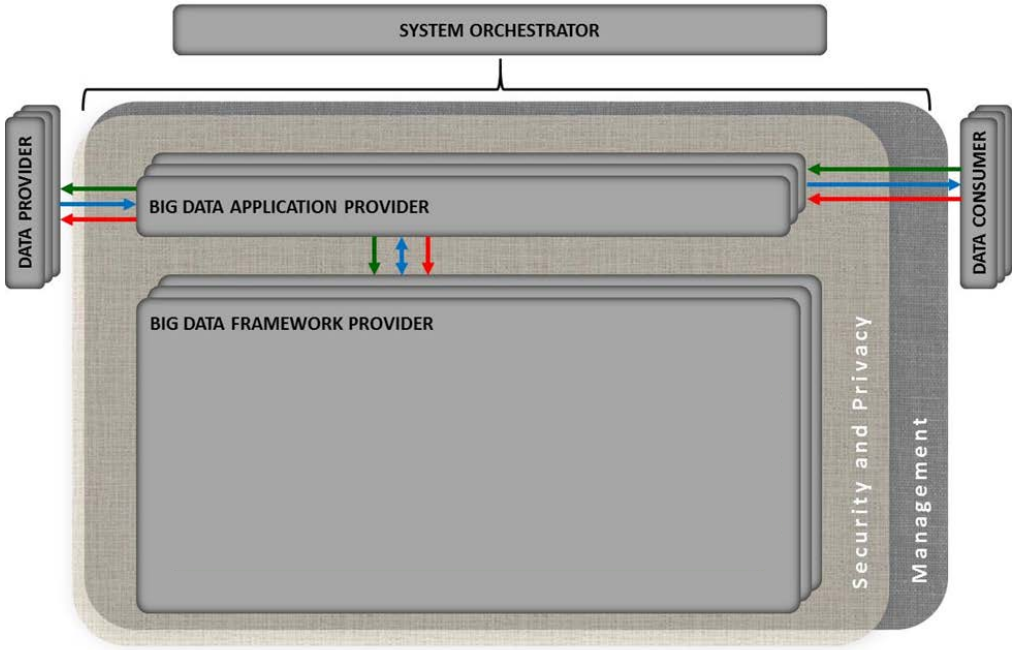
- A Reference architecture provides an authoritative source of information about a specific subject area
- Guides and constrains the instantiations of multiple architectures and solutions
- Generally serves as a foundation for solution architectures
- May also be used for comparison and alignment of instantiations of architectures and solutions

NIST Big Data Reference Architecture (NBDRA)

- An open reference architecture for Big Data
- Provides a vendor-neutral, technology- and infrastructure-agnostic conceptual model
- Provides a common language for the various stakeholders
- Encourages adherence to common standards, specifications, and patterns
- Provides consistent methods for implementation of technology to solve similar problem sets
- Provides a technical reference to understand, discuss, categorize, and compare Big Data solutions

NBDRA serves as a foundation for Big Data solution architectures and helps rapidly deploy Big Data solutions in a variety of business environments

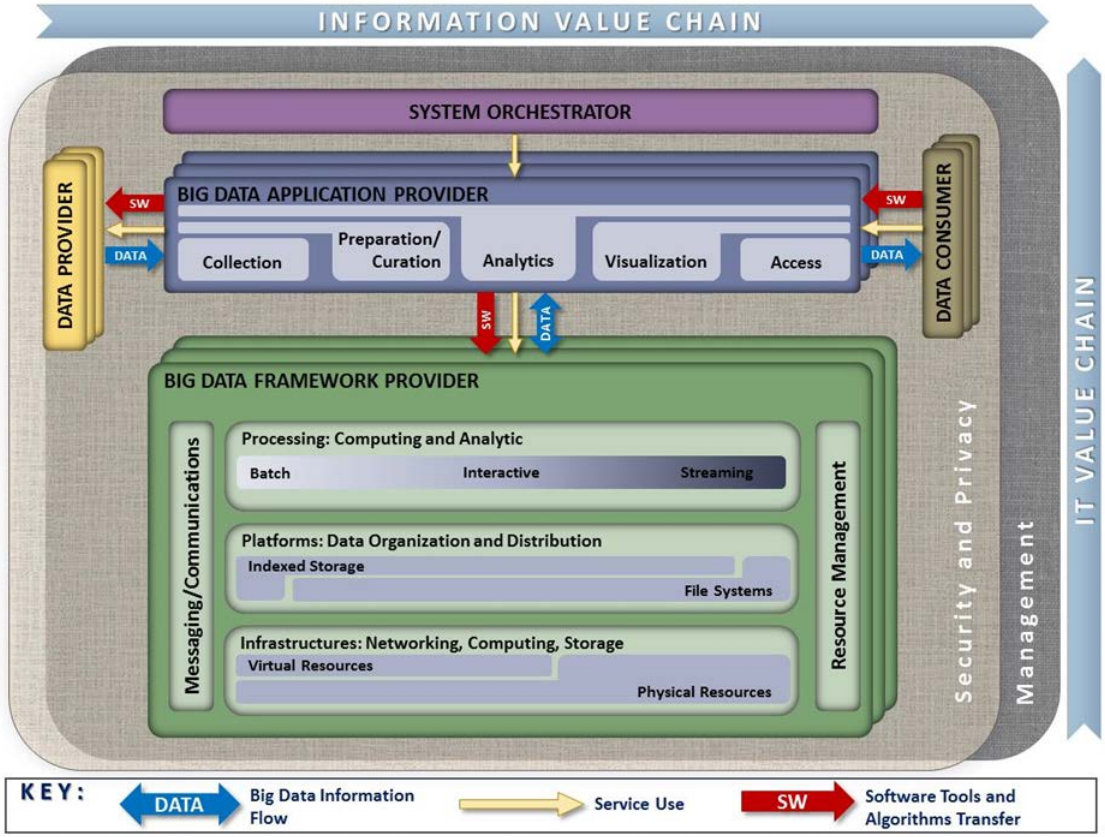
NBDRA Roles and Fabrics



Source: Draft NIST Big Data Interoperability Framework: Volume 6, Reference Architecture

- Five main roles perform specific activities that are implemented via functional components
  - *System Orchestrator, Data Provider, Big Data Application Provider, Big Data Framework Provider and Data Consumer*
- Two Fabrics provide services and functionality to the five main roles
  - *Management Fabric and Security and Privacy Fabric*

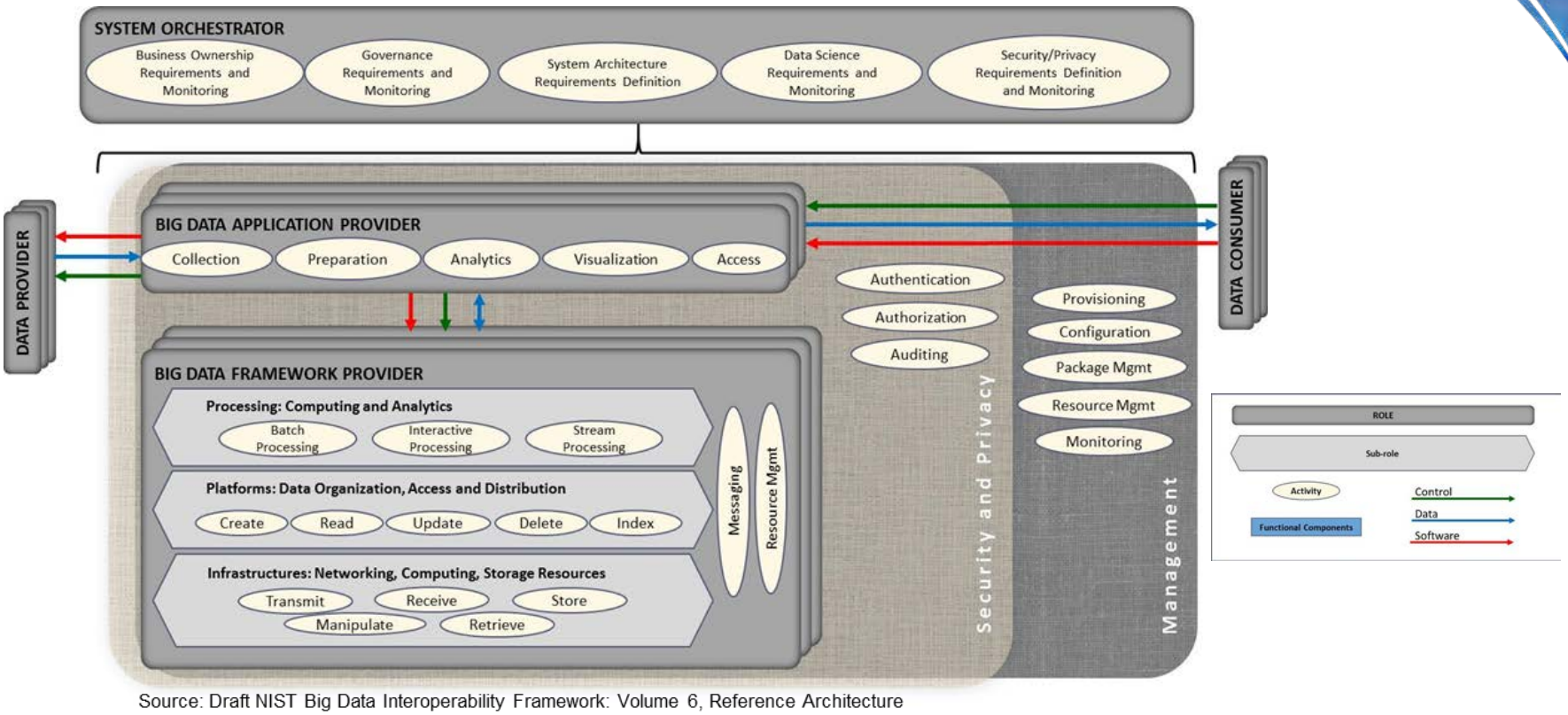
NBDRA Conceptual Model



Source: Draft NIST Big Data Interoperability Framework: Volume 6, Reference Architecture

- Vendor-neutral, technology- and infrastructure-agnostic model
- Provides a framework to support a variety of business environments by enhancing understanding of Big Data solutions

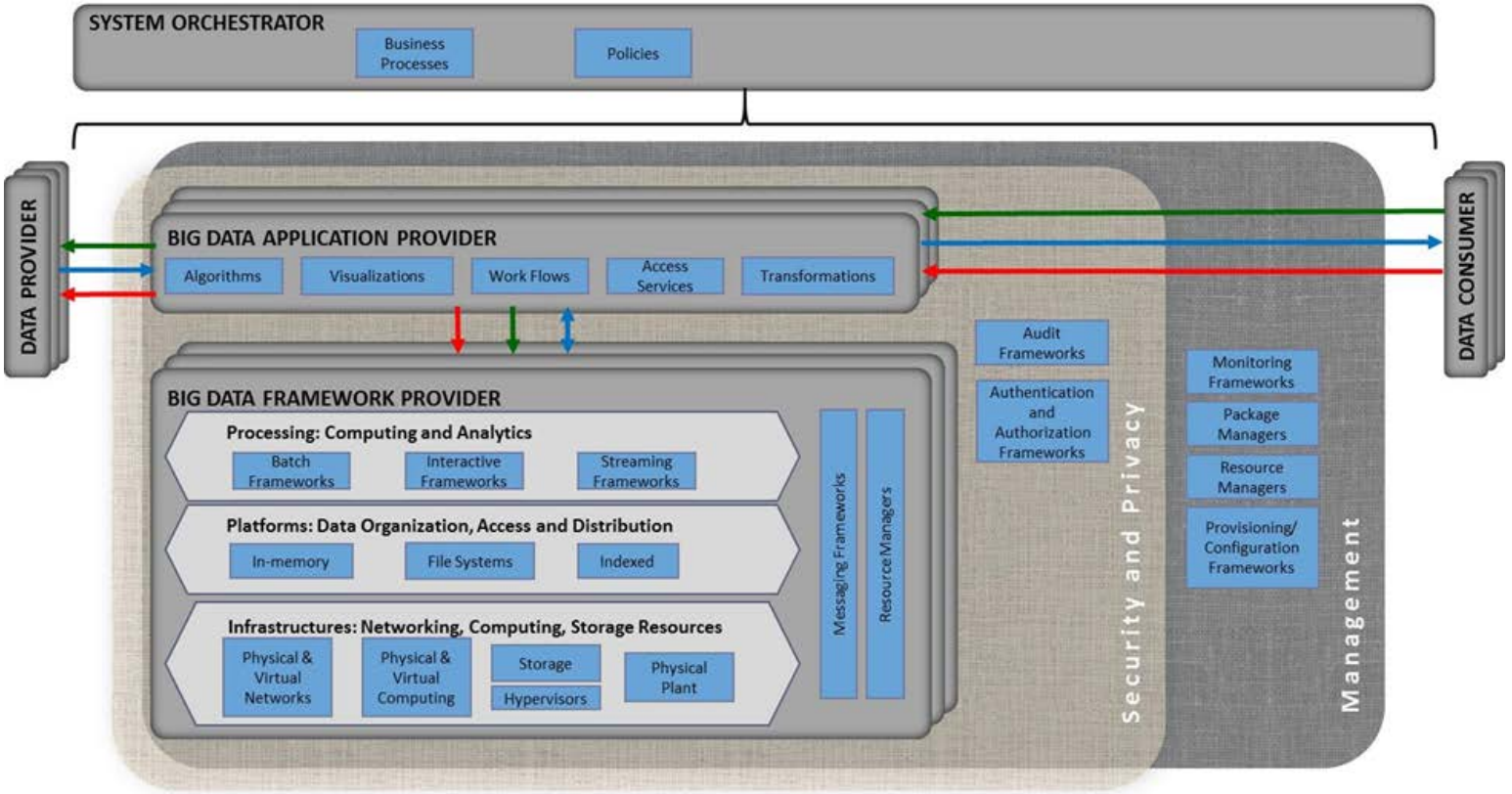
NBDRA Activities View



Source: Draft NIST Big Data Interoperability Framework: Volume 6, Reference Architecture

- Describes what is performed or accomplished by various roles in the Big Data system
- Each activity of the Big Data Application Provider can be implemented by independent stakeholders and deployed as stand-alone services

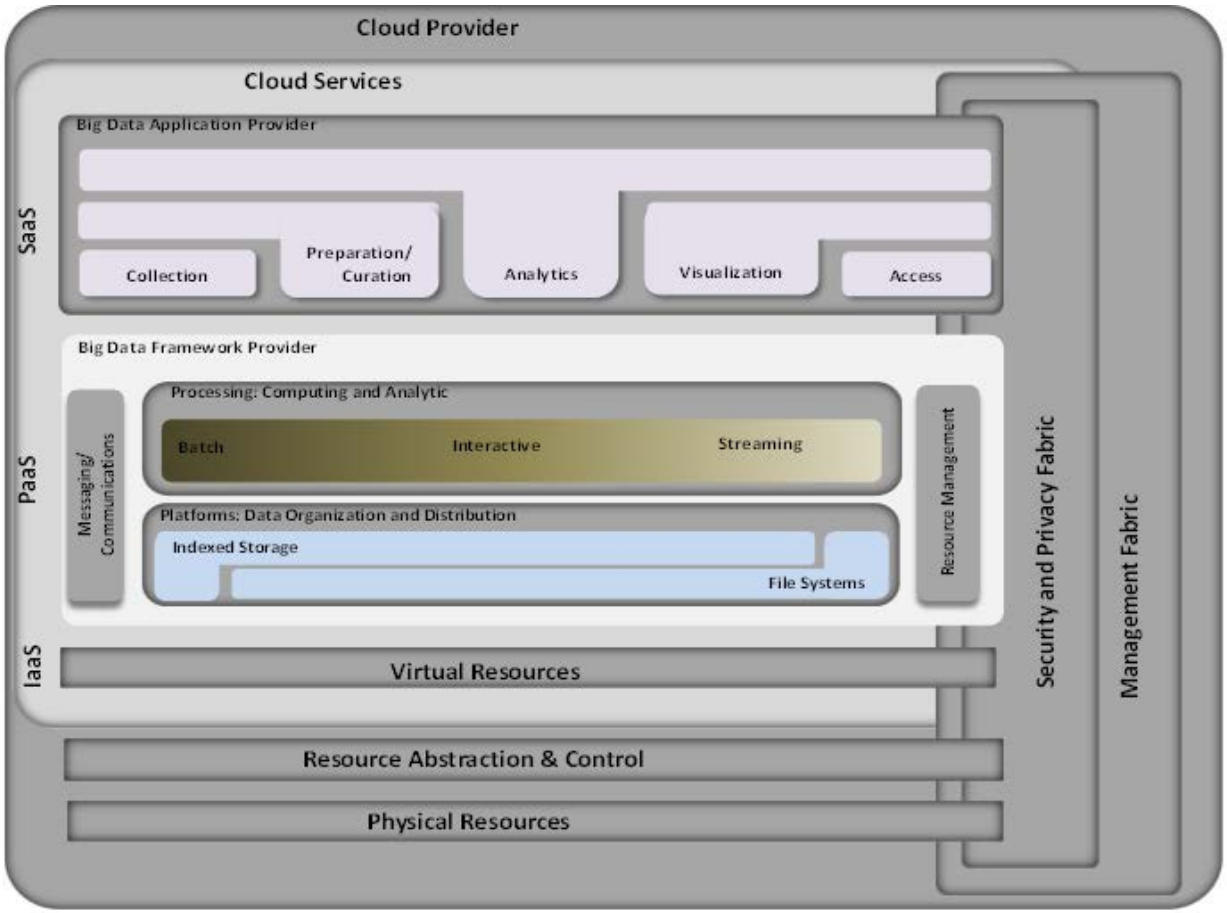
NBDRA Functional Component View



Source: Draft NIST Big Data Interoperability Framework: Volume 6, Reference Architecture

- Defines and describes the functional components that perform the various activities outlined in the activities view
- Activities and functional components need not map one-to-one
  - *Many functional components may be required to execute a single activity*
  - *multiple activities may be performed by a single functional component*

NBDRA Framework Deployment Options



Source: Draft NIST Big Data Interoperability Framework: Volume 6, Reference Architecture

Loosely coupled architecture and distributed nature allows the framework to be deployed using multiple configurations (Physical resources, IaaS, PaaS, SaaS)

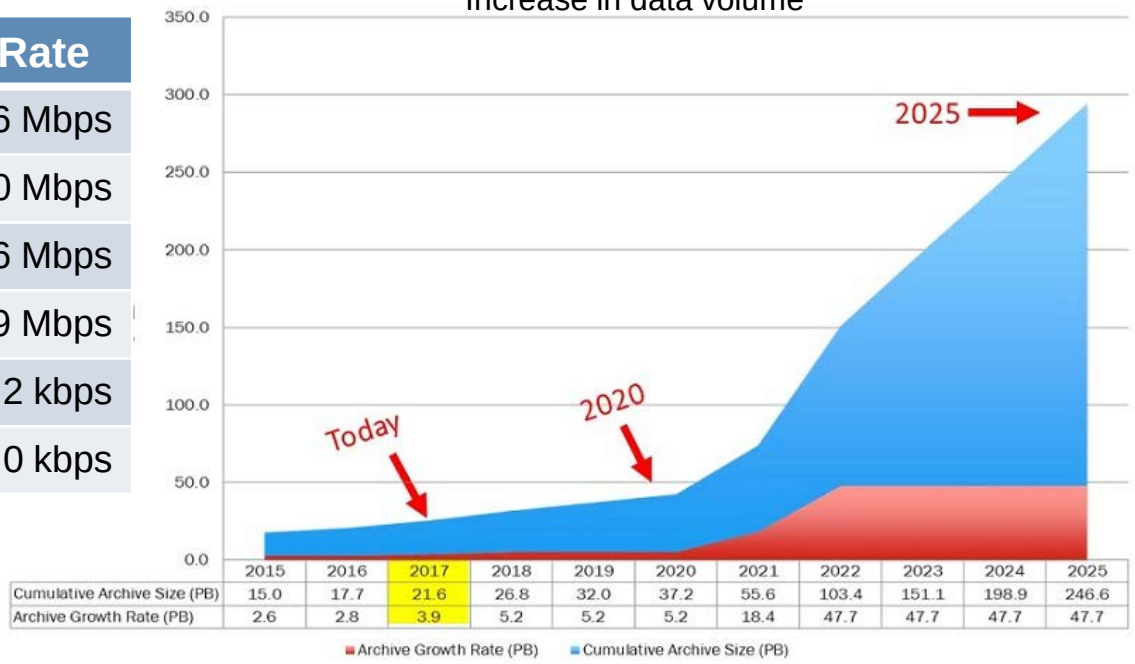
Relevance of NBDRA to Ground Systems

Increase in data rate

Instrument	Data Rate
GOES-N series Imager	2.6 Mbps
GOES-R Series Imager	66.0 Mbps
POES Imager	0.6 Mbps
JPSS Imager	5.9 Mbps
POES MW Sounder	3.2 kbps
JPSS MW Sounder	20.0 kbps

Source: NOAA

Increase in data volume



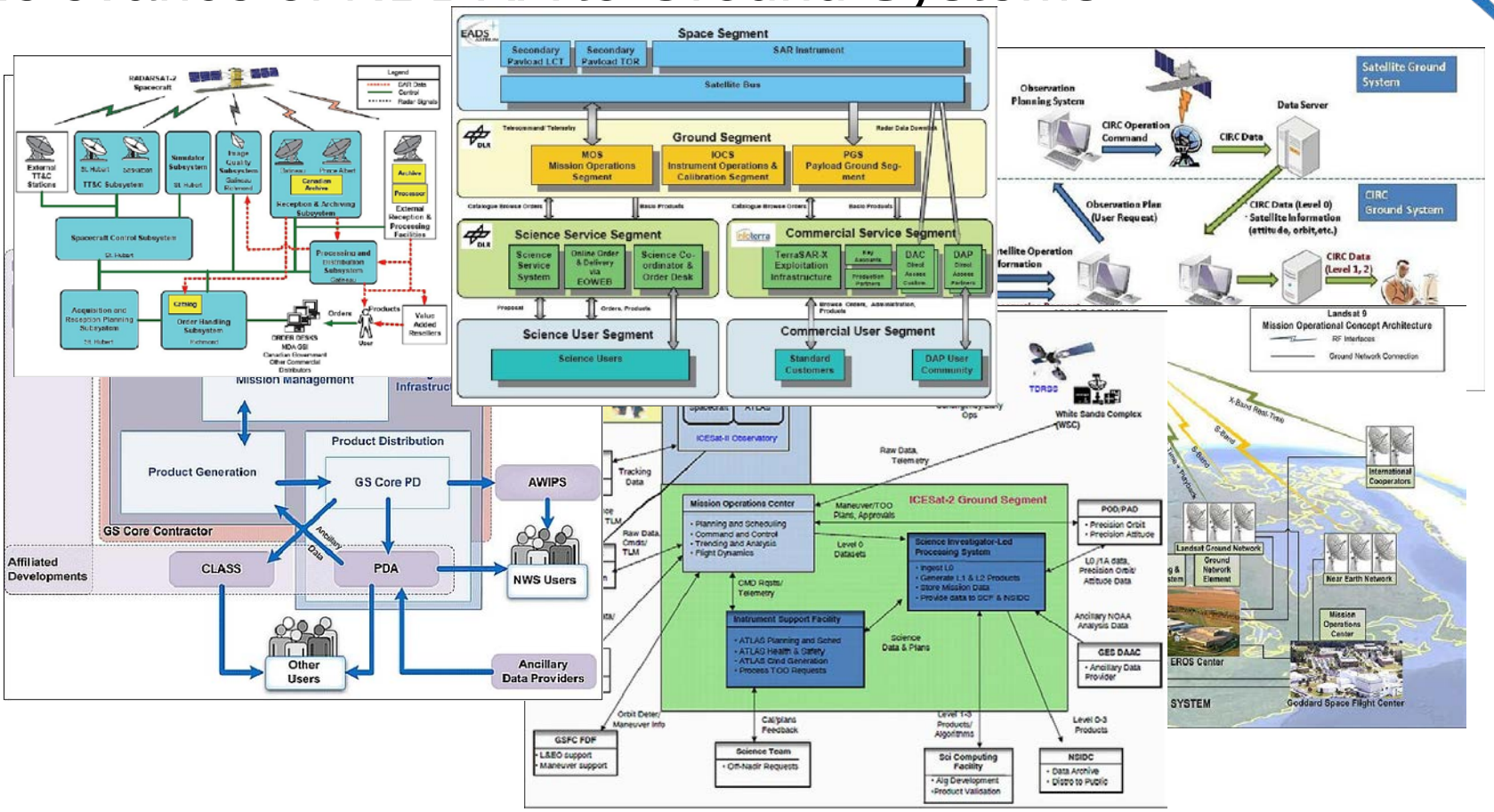
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Cumulative Archive Size (PB)	15.0	17.7	21.6	26.8	32.0	37.2	55.6	103.4	151.1	198.9	246.6
Archive Growth Rate (PB)	2.6	2.8	3.9	5.2	5.2	5.2	18.4	47.7	47.7	47.7	47.7

Archive Growth Rate (PB) Cumulative Archive Size (PB)

Source: https://earthdata.nasa.gov/about/eosdis-cloud-evolution

Significant increase in the variety, volume, and velocity of ground systems data requires the use of Big Data solutions for ground systems

Relevance of NBDRA to Ground Systems



Source: https://directory.eoportal.org/web/eoportal/satellite-missions

- Several ground system architectures were analyzed to evaluate the applicability of NBDRA to ground systems
- Ground segments have not (to date) been built to a common framework - limiting the capability to provide common services

Relevance of NBDRA to Ground Systems

Collection	Handles the interface with the Data Provider
Preparation	Handles data transformation and quality control
Preservation	***Ensure information value remains accessible and usable***
Analytics	Implements the techniques to extract value from the data
Visualization	Prepares output for presentation to the Data Consumer
Access	Handles the interaction with the Data Consumer

Further analysis of several ground system architectures also revealed that a new activity (Preservation) must be added to the Big Data Application Provider role

Ground System Deployment Considerations

- The loosely coupled and distributed nature allows ground systems to be deployed using different configurations
- The two most common deployment configurations are:
  - *Directly on physical resources*
  - *On top of an IaaS cloud computing framework*
- Cloud providers also offer Big Data Frameworks under a Platform as a Service (PaaS) model
  - *Ground system implementer is freed from the need to establish and manage the complex configuration and deployment of Big Data Framework components*
  - *Ground system implementer simply needs to specify the size of the cluster required*
  - *The cloud provider manages the provisioning, configuration, and deployment of all the framework components*
- Ground System Software as a Service (SaaS) applications that implement the Ground System Big Data Application Provider functionality could also be implemented

Summary

- NBDRA provides:
  - *a vendor-neutral, technology- and infrastructure-agnostic conceptual model*
  - *a framework to efficiently categorize the activities that the Big Data system will perform*
  - *the functional components which must be integrated to perform those activities*
- Each activity of the Big Data Application Provider can be implemented by independent stakeholders and deployed as stand-alone services
- Standardizing application interfaces and data content standards is key to successfully leveraging NBDRA for ground systems
- An analysis of several ground system architectures and the data characteristics substantiates the relevance of NBDRA to ground system architectures
- The loosely coupled and distributed nature allows ground systems to be deployed using different configurations


Thank you