



Using NASA's Reference Architecture: Comparing Polar and Geostationary Data Processing Systems

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Introduction



- The JPSS and GOES-R programs are housed at NASA GSFC and jointly implemented by NASA and NOAA to NOAA requirements. NASA's role in the JPSS Ground System is to develop and deploy the system according to NOAA requirements. NASA's role in the GOES-R ground segment is to provide Systems Engineering expertise and oversight for NOAA's development and deployment of the system.
- NASA's Earth Science Data Systems Reference Architecture is a document developed by NASA's Earth Science Data Systems Standards Process Group that describes a NASA Earth Observing Mission Ground system as a generic abstraction.
- The authors work within the respective ground segment projects and are also separately contributors to the Reference Architecture document. Opinions expressed are the author's only and are not NOAA, NASA or the Ground Projects' official positions.



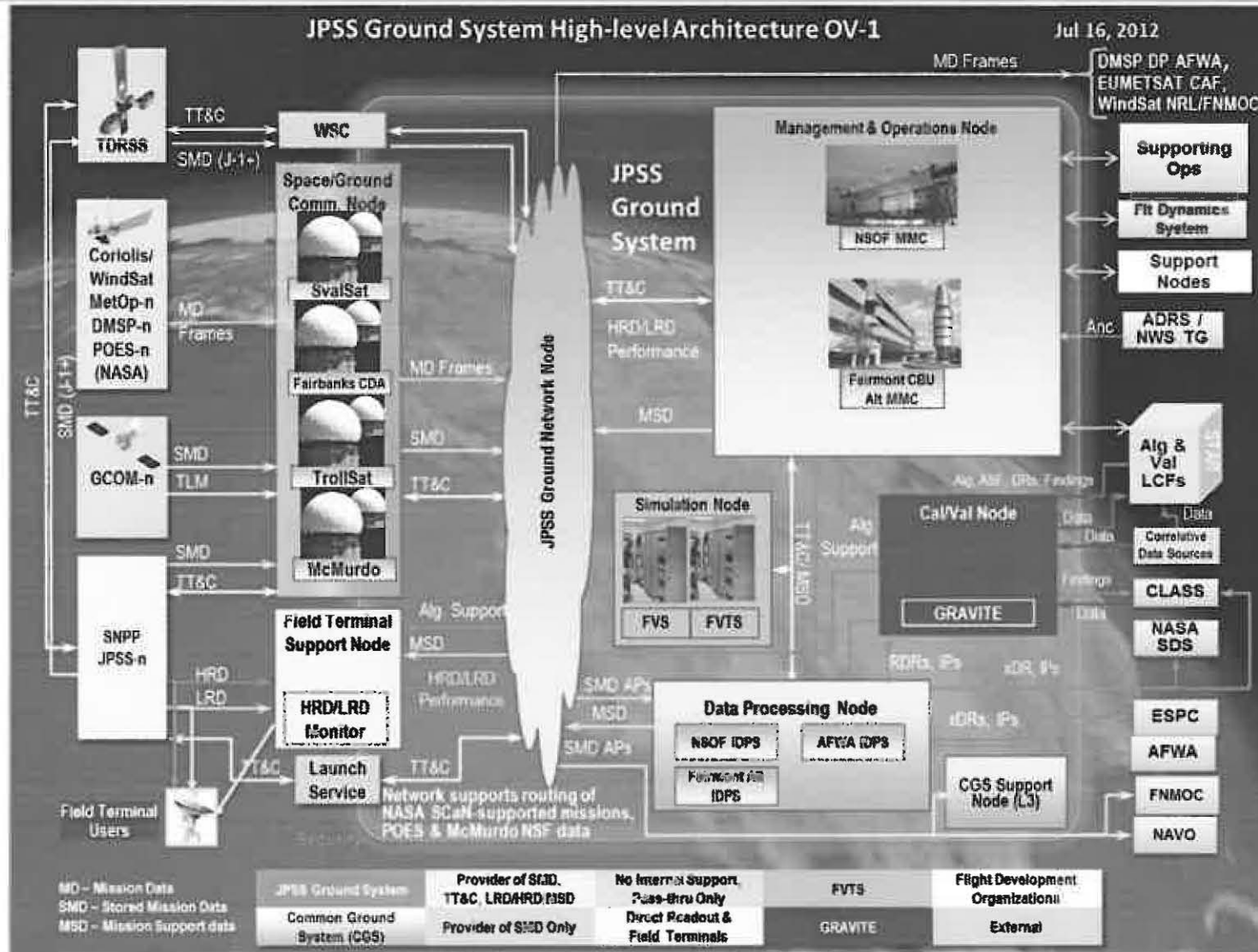
NASA's ESDS Reference Architecture



- **Source**
 - NASA's Earth Science Data Systems Working Group (ESDSWG) Standard Process Group (SPG)
 - "ESDS Reference Architecture for the Decadal Survey Era"
 - A data model, a set of functions and services that are common among data systems that operate on NASA's Earth Science data
 - Provides individuals and teams with a concrete strategy for the development and implementation of higher-level design.
- **Intent of the Reference Architecture**
 - Establish a common "language" to describe the problem- and solution-space of NASA's Earth Science Data Systems
- **Approach**
 - Define "Reference Architecture" and its role/usage
 - Identify Stakeholders
 - Establish basis of the problem
 - Regular vetting within NASA's ESDS community
 - Conduct a workshop, collect feedback

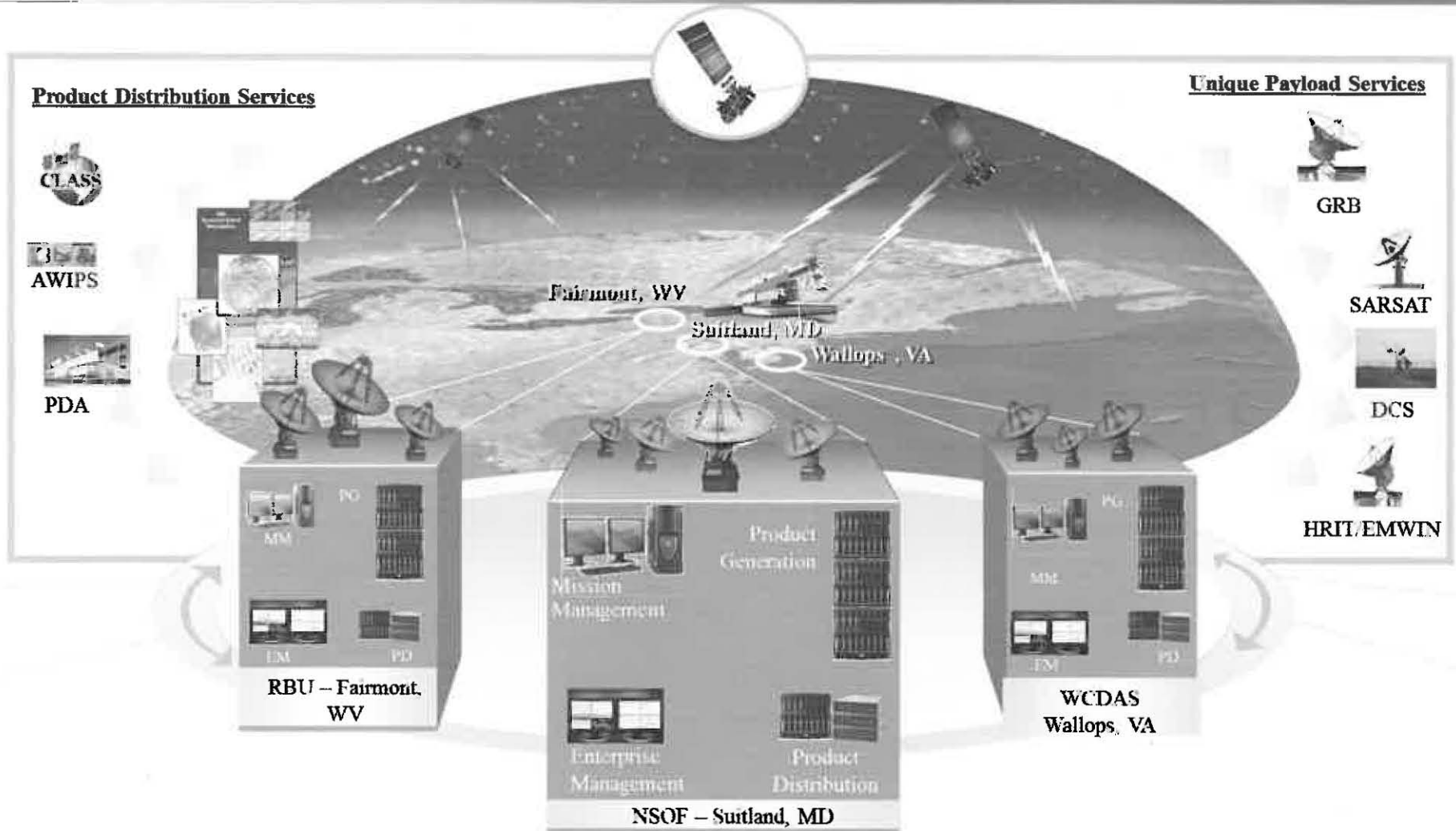


JPSS Ground System Architecture





GOES-R Architecture





Reference Architecture Overview



- **Drivers**
 - SPG Efforts (Identify common components, interfaces among components and standards)
 - Build a common understanding of NASA's ESDS's
 - Decadal Survey Missions
 - Interoperability momentum within NASA
- **Six High-level Use Cases (Business Use Cases)**
 - Six High-level (Business Use Cases)
 - Receive Sensor Data
 - Develop Products
 - Distribute products
 - Develop Predictions
 - Manage Remote Sensor/Instrument
 - Data Stewardship
- **Views**
 - Functional View
 - Information View
 - System Service View
 - Technology View
- **Mappings between views (as appropriate)**



Contrasting Polar and Geostationary



- The obvious
 - Science products similar (sensor physics, Earth physics, science)
 - Product, Spatial Extent, geometry, resolution differences.
 - Constellations are different, orbit, communications, etc.
 - Data Collection Ground Sites (polar international, versus temperate domestic)
 - Delivery of data to those sites (constant v. episodic bursty)
 - Production work flow rules similar (dependencies, triggers, timeliness)
 - Communications and computer technology (same state of art).
- Effects on Ground and Data Systems
 - Facilities divergence (sites)
 - Networking divergence, (sites, peaks)
 - Product pipeline differences (product queuing, geometric/geographic relationships among granules)
 - Capacities
 - Latency differences due to practical limitations and use cases



Reference Architecture Use Cases



- The NASA ESDS reference architecture has identified a set of mission-level use cases that represent the common scope of all NASA ESDS's.
- NOAA's JPSS and GOES-R observatory ground data processing systems both share the ESDS use cases.

Use Case	Name	Description	Dependencies
UC-1	Receive Sensor Data	Receive sensor data and process data to correct for errors.	System Architect Data Architect Project Scientist Data Provider
UC-2	Develop Products	Using algorithms and other services, data is transformed into higher value products.	System Architect Data Architect Project Scientist Data Provider Program Management
UC-3	Distribute Products	Generated products are made available to end users. This includes the discovery and access of data using tools, as well as the actual delivery of data to end users.	System Architect Data Architect Data Provider Program Management
UC-4	Develop Predictions	Using data products and models, predictions are generated. Limit and model products through the system must be used for other data products.	System Architect Data Architect Research Scientist Policy Management
UC-5	Manage Remote Sensor/Instrument	The control and command of remote sensing systems.	System Architect Project Scientist Program Management Risk Management
UC-6	Data Stewardship	Keep data resources preserved and available for the long term (decades or more).	System Architect Data Architect Data Provider Risk Management

Similarities

- Distribute products
 - GOES-R and JPSS have substantially similar customers for product distribution.
- Develop Predictions *(not applicable)
 - The NOAA observatory ground systems are responsible for reporting observations and not for developing predictions, but observations produced *do* feed predictions
- Manage Remote Sensor/Instrument
 - While every instrument and observatory is different the work flows for managing them are substantially similar between JPSS and GOES-R.
- Data Stewardship *(not applicable)
 - The NOAA observatory ground systems are not directly responsible for long-term stewardship, but rather are producers serving the same CLASS archive system

Differences

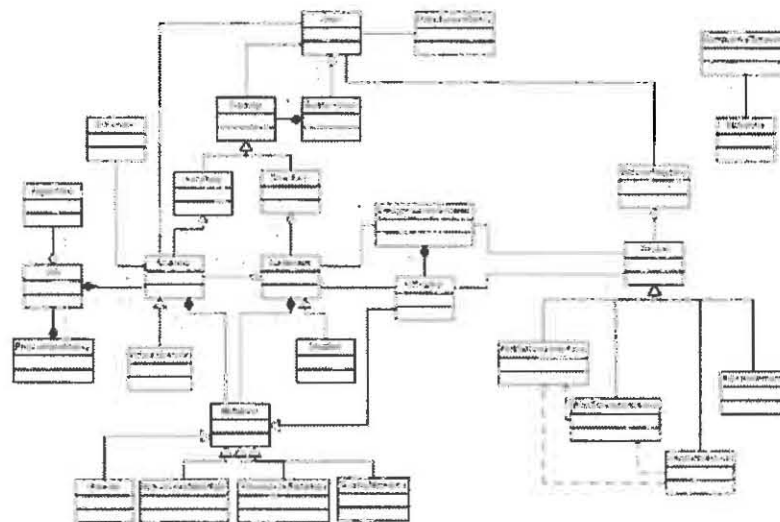
- Receive Sensor Data
 - The location of ground stations and the technology for receipt are significantly different and require completely separate infrastructure and communications routing
 - Direct Broadcast and GOES Rebroadcast respectively are dissimilar, driving different antenna design and data use cases.
- Develop Products
 - While environmental products are similar, the geometry of observation and the streaming and queuing of raw data are considerably different. These differences may drive different optimizations within the production system.



Reference Architecture Information Architecture View



- The Information Architecture View is intended to identify the high level information entities that are implemented within, and exchanged between systems that implement the reference architecture. It also defines the relationships between those information entities.



Similarities

- JPSS and GOES-R Ground Projects share a common information view. Though neither implements all elements, the subset of elements between them is similar.
- The NOAA information architecture emphasizes institutional use cases that differ somewhat from those emphasized by NASA. In particular, NOAA's first-class user is the focused on observational application use and prediction systems, while NASA's is focused on researcher access.

Differences

- JPSS information architecture requirements were set in FGDC content standard and were influenced by multiple agencies without a common encoding standard. Implementation was completed before 2005 with design predating wide adoption of ISO standards.
- GOES-R information architecture requirements were fully informed by NASA EOS experience with FGDC content and EOS encoding; NESDIS experience with netCDF3, COARDS and CF conventions; and the OAIS reference model. Design and implementation of the GOES-R Metadata Model (GMM) is ongoing and strongly influenced by published ISO standards.



Reference Architecture System Service View



- The System Service View of the ESDS Reference Architecture is intended to identify the key system-level services that are implemented within ESDS's. This representation is based on the Service-Oriented architecture pattern.

Service Name	Port	Description
Authentication	11	Provides authentication services for users and applications. This service is used by the ESDS systems to verify the identity of users and applications. It is implemented by the ESDS systems.
Discovery	12	Provides discovery services for users and applications. This service is used by the ESDS systems to discover the location of data and services. It is implemented by the ESDS systems.
Subscription	13	Provides subscription services for users and applications. This service is used by the ESDS systems to manage subscriptions. It is implemented by the ESDS systems.
Access	14	Provides access services for users and applications. This service is used by the ESDS systems to provide access to data and services. It is implemented by the ESDS systems.
Authorization	15	Provides authorization services for users and applications. This service is used by the ESDS systems to authorize users and applications. It is implemented by the ESDS systems.
Accounting	16	Provides accounting services for users and applications. This service is used by the ESDS systems to track usage and billing. It is implemented by the ESDS systems.
Configuration	17	Provides configuration services for users and applications. This service is used by the ESDS systems to manage configuration. It is implemented by the ESDS systems.
Logging	18	Provides logging services for users and applications. This service is used by the ESDS systems to log events and errors. It is implemented by the ESDS systems.
Monitoring	19	Provides monitoring services for users and applications. This service is used by the ESDS systems to monitor system health. It is implemented by the ESDS systems.
Reporting	20	Provides reporting services for users and applications. This service is used by the ESDS systems to generate reports. It is implemented by the ESDS systems.
Administration	21	Provides administration services for users and applications. This service is used by the ESDS systems to manage the system. It is implemented by the ESDS systems.

Similarities

- In general, these services are common between JPSS and GOES-R ground systems.
- Both systems leverage other enterprise systems to provide some of the services (e.g – ESPDS and CLASS for access, discovery and subscription)

Differences:

- BroadcastData carries data at differing process levels. (observation vs. Level1b)
- GOES-R leveraging ESPDS for security-oriented services
- JPSS data to ESPDA through NDE
- Implementations & interfaces

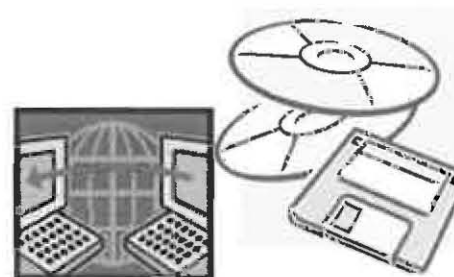


Reference Architecture Technology View



- The Technology View of the ESDS Reference Architecture provides guidance on the role and selection of technologies and standards. [However], the lifecycle of technologies and standards is not easily congruent with any Reference Architecture.

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Similarities:

- GOES-R and JPSS Ground systems share the same needs for technologies and standards as outlined in the reference architecture.
- Generally both systems have been driven by the state of the art in communication signal processing, r/f link management, networking, computer hardware and software practices.

Differences:

- The two ground systems have been developed without specific regard for the choices one or the other has made.
- Different standards or vendors were chosen based on engineering judgment, preferences or pricing.



Next Steps



- **Given significant overlap in the problem-space**
 - Conduct detailed analysis of the JPSS and GOES-R solutions
 - How they leverage NOAA enterprise-level services
 - Opportunities for common interfaces
 - Software and Human
 - Adaptors and/or Facades
 - Operational impacts
 - Leveraging common standards
 - Identify opportunities for new standards
- **For the evolving enterprises**
 - Recommended approaches to maximize commonality
 - Isolate and clarify appropriate differences
 - Opportunities for efficiency of programs and investments
- **Provide feedback to NASA's ESDS Reference Architecture**



References



- <http://earthdata.nasa.gov/our-community/esdswg/standards-process-spg/spgfolder/nasa-esds-reference-architecture-v11>