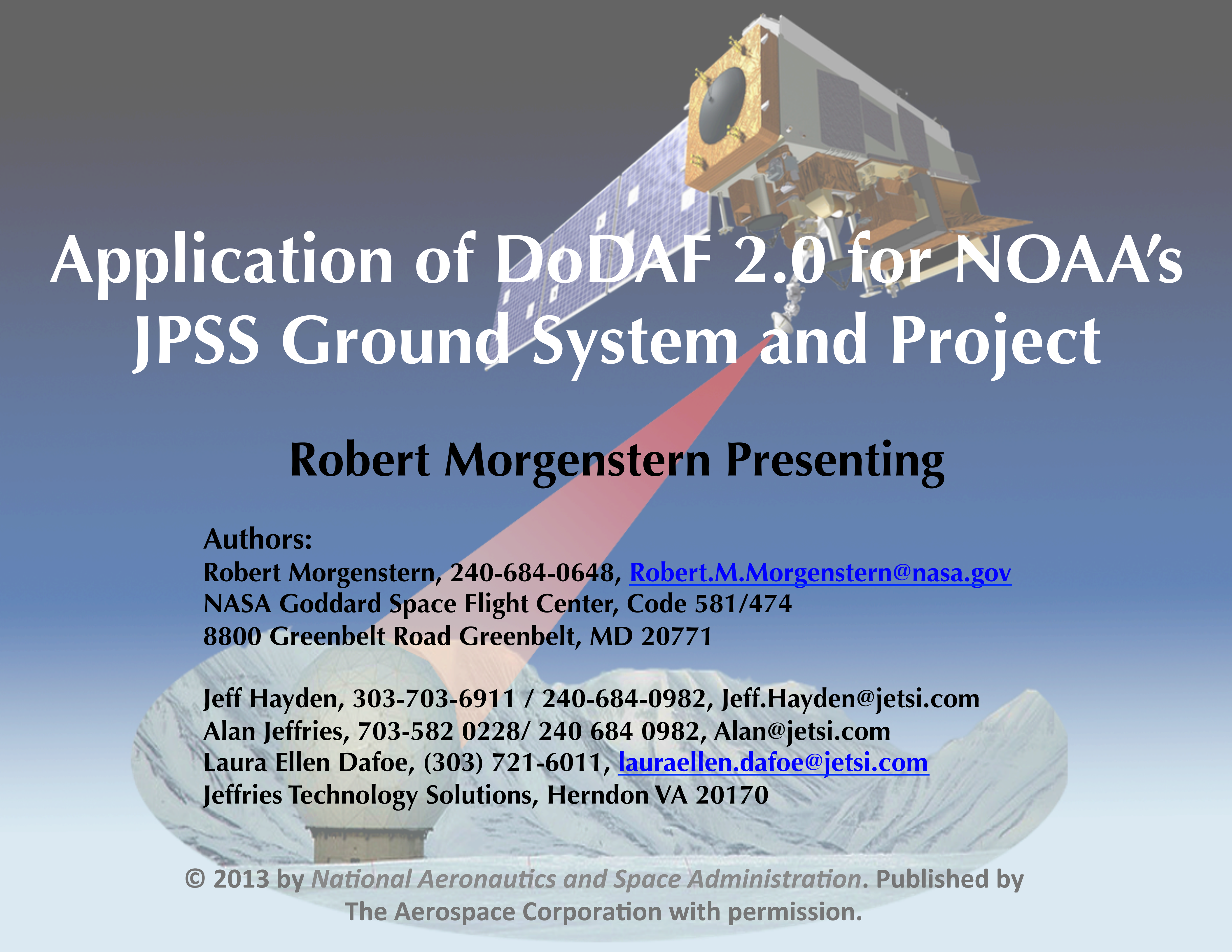

Application of DoDAF 2.0 for NOAA's JPSS Ground System and Project

Robert Morgenstern Presenting

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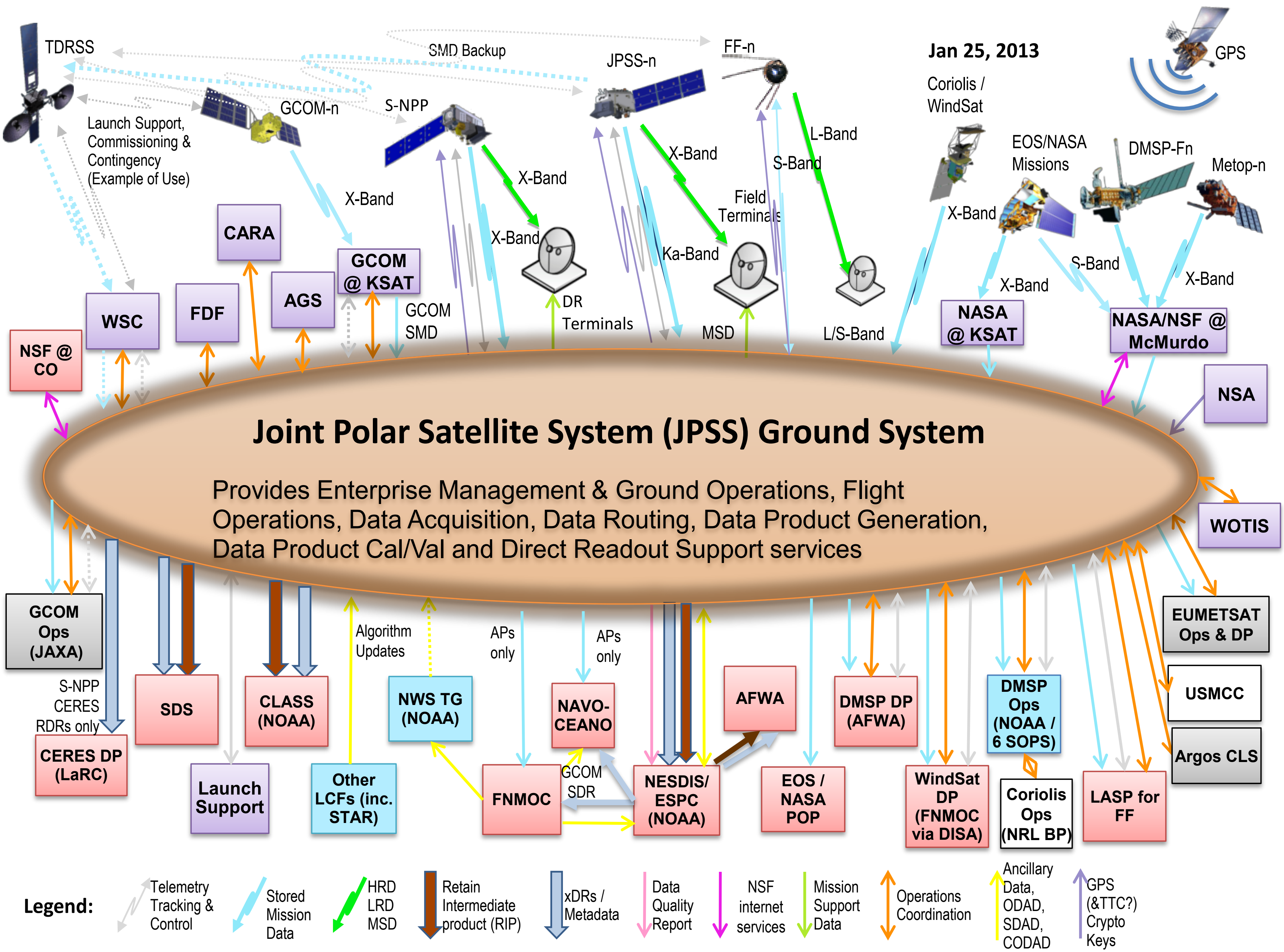
OV-1 JPSS Ground Systems High Level Operational Concept



Introduction – Modeling the JPSS GS Architecture with DoDAF 2

- The JPSS Ground System (GS) is a complex, globally operated environmental satellite control, data retrieval, data processing, and environmental data product distribution system. Items of complexity include a large number of:
  - stakeholders,
  - project processes,
  - relationships with development contractors, and
  - architectural modernization.

- The JPSS Ground Project (GP) uses the Department of Defense Architecture Framework version 2.0 (DoDAF 2.0) to manage and coordinate the GS development by identifying:
  - JPSS GS organizational structure and performers;
  - actions performed by the organizational entities;
  - information that must flow among the entities; the systems, functions, and actions that enable realization of the JPSS capabilities; and,
  - information and data exchanged among performers and systems.

- This presentation focuses on the processes for providing the Sensor Data Records (SDRs) and Environmental Data Records (EDRs) that are reduced from the satellite data and distributed to the program customers.

  - A global view of the JPSS GS architecture is given in "Defining the Complex JPSS Ground System in Pieces Using DoDAF 2.0 as Implemented with UPDM", a paper presented at the AIAA Space 2012 in Pasadena, CA.

Using DoDAF 2 with UPDM 2 to Describe JPSS Data Reduction Processes

- In our presentation, a satellite's data is arriving at the Integrated Data Processing System (IDPS) in the NOAA Satellite Operations Facility (NSOF) in Suitland, MD.

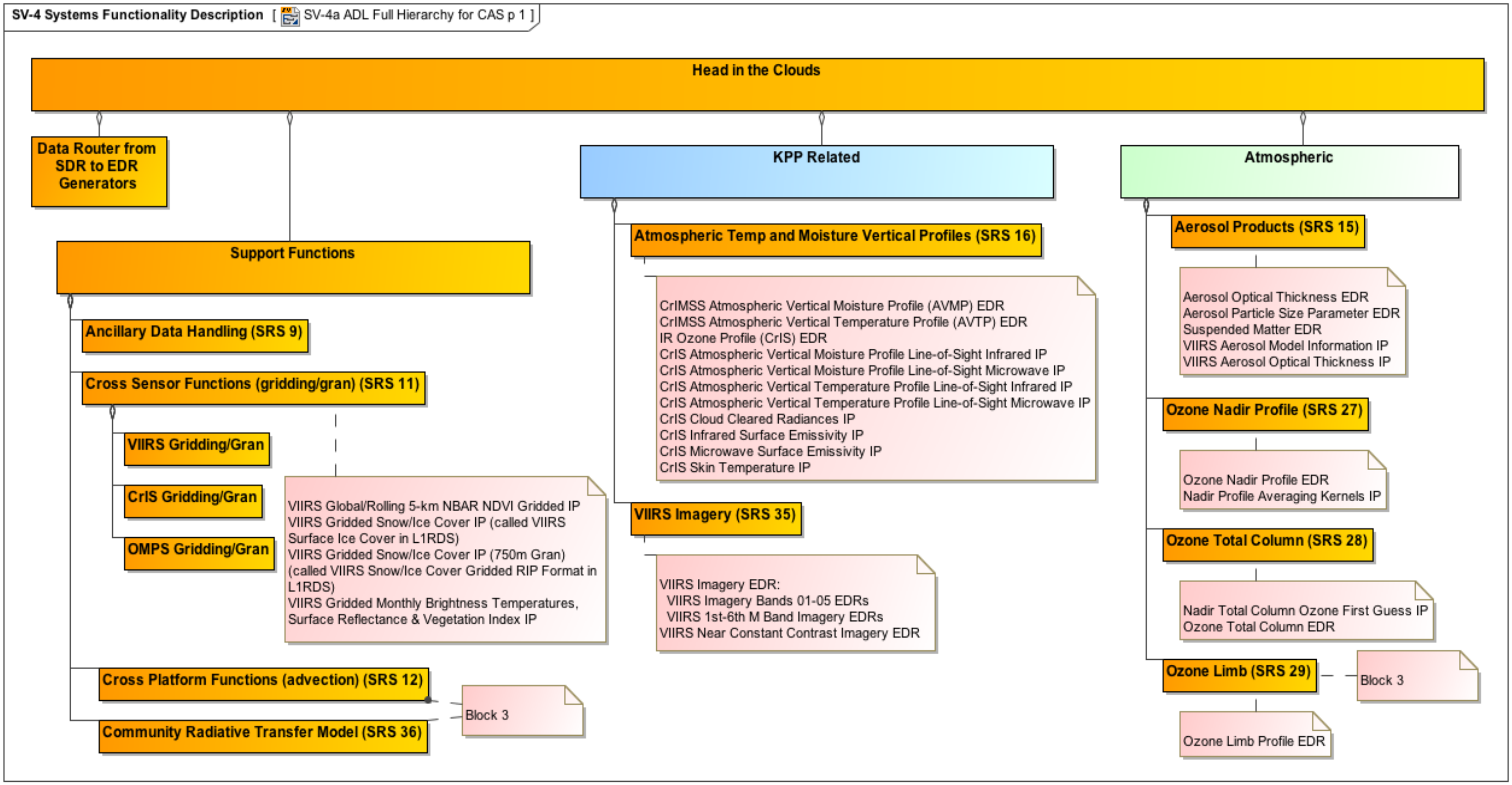
- The systems views needed to describe how the IDPS processes the data are those prescribed by the DoDAF 2 Systems Viewpoint (SV) SV-4 diagrams and SV-6 tables.
  - There are 2 types of SV-4 diagrams: the System Functionality Description describes the hierarchy of systems and system Functions
  - while the System Functionality **Flow** Description shows how the data flows through each system function action that processes the data.
  - Each SV-6 System Resource Flow Matrix line item is a tabular description of each data element exchange between two system function actions in the companion SV-4 flow diagram.

- The DoDAF 2 views are presented using the Unified Profile for DoDAF and MODAF version 2.0 (UPDM 2).
  - The modeling tool used is MagicDraw UML version 17.0.3 with UPDM 2 version 17.0.3.
  - DoDAF 2 was selected when JPSS was initiated to take over for the NPOESS program

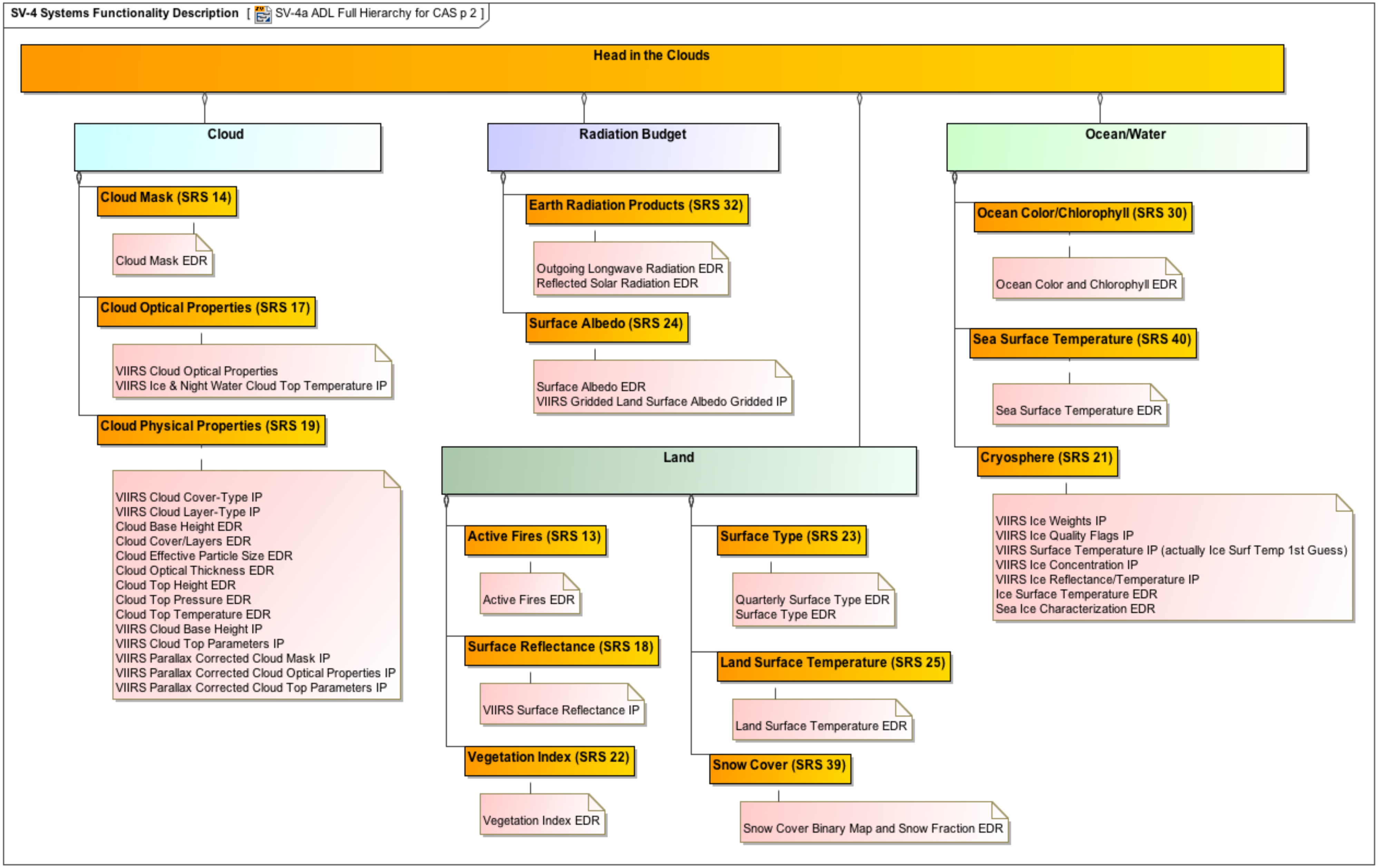
SV-4 System Functionality Description Diagrams

- Provide hierarchical views of the systems with their included functions.
- Documentation of the systems and functions are captured in the properties of those systems and functions.
- Show the lower level system and software functions used to process the data captured by the JPSS Project.
- Identify the system and software functional process flows that generate each deliverable data product.
- Assist in Systems Engineering requirements tracking.
- Identify the lower level specifications and verification plans defined in the Software Requirements Specification (SRS) that govern the JPSS data products.
- Identify the software algorithms contained in the lower level specifications

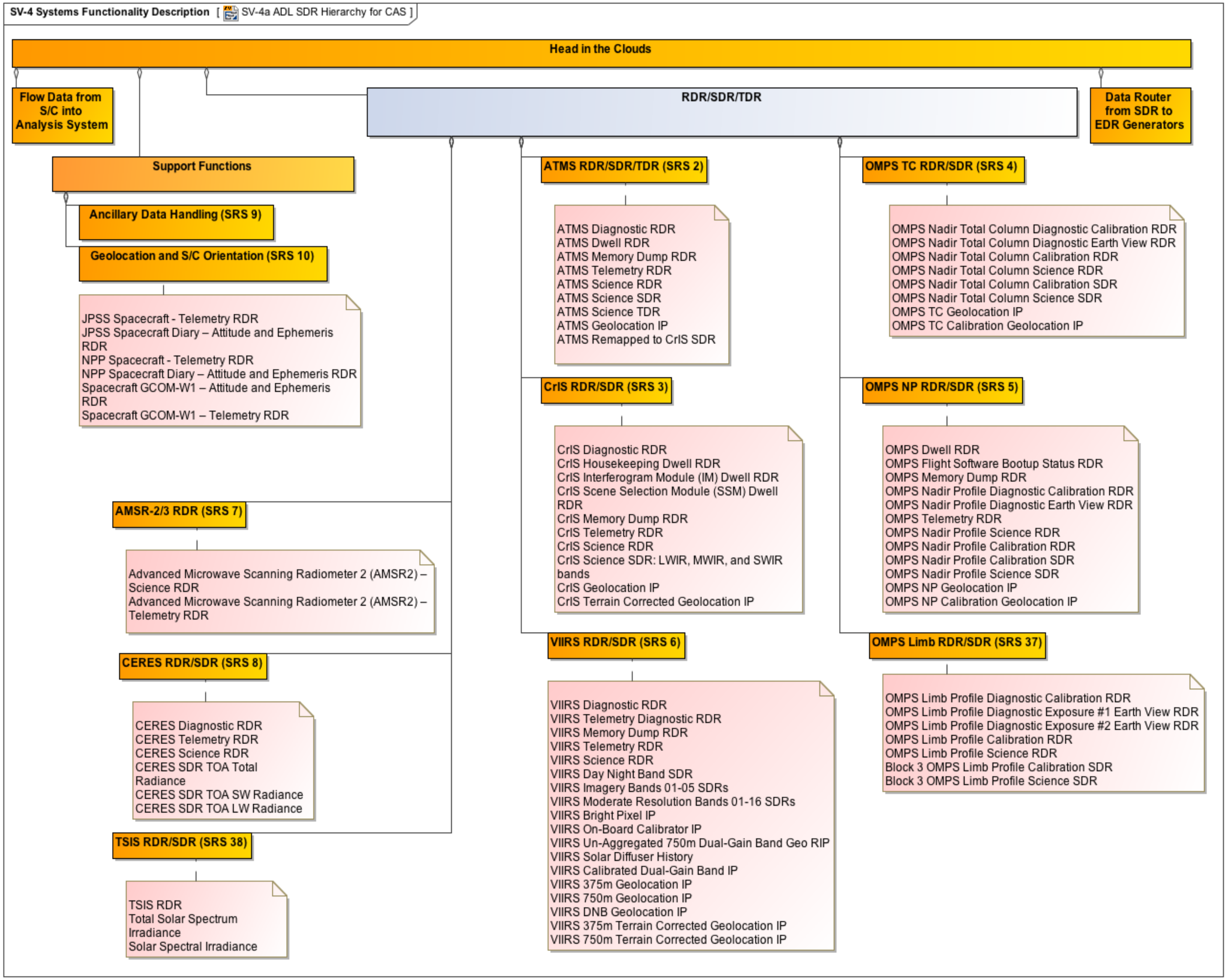
SV-4 System Functionality Description, ADL Full Hierarchy (1)



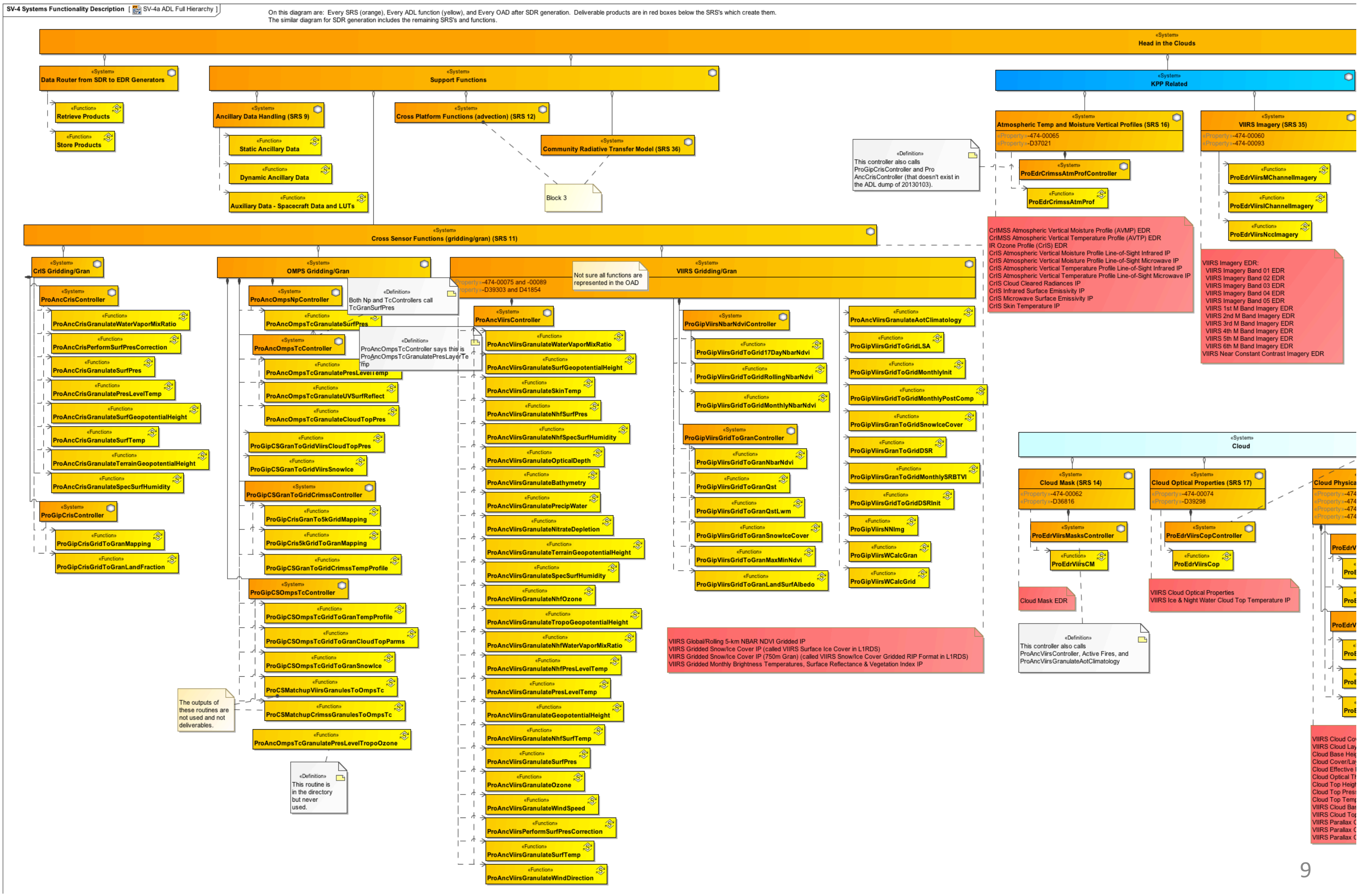
SV-4 System Functionality Description, ADL Full Hierarchy (2)s



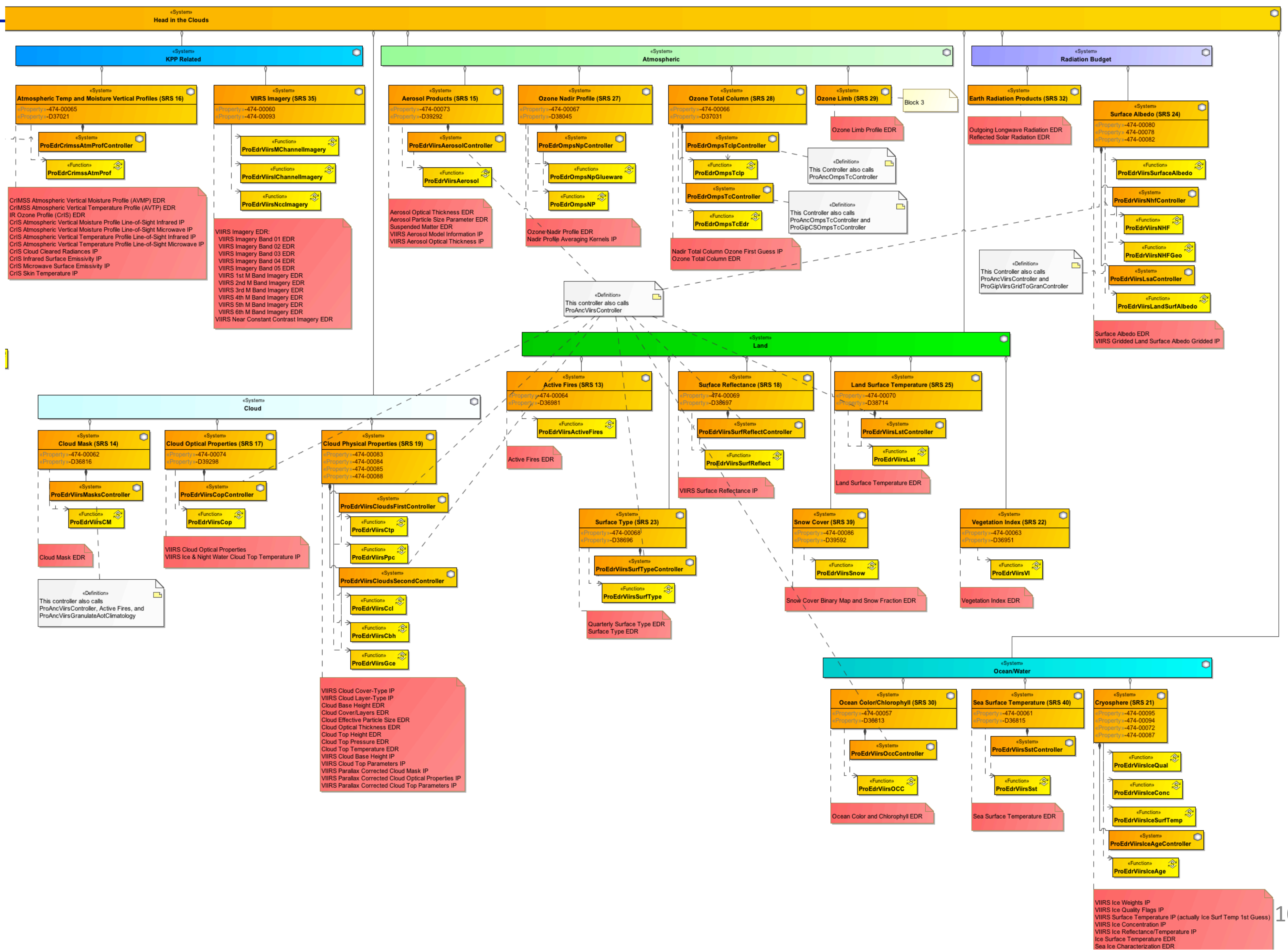
SV-4 System Functionality Description, Sensor Data Record (SDR) Hierarchy



SV-4 System Functionality Description, Full Hierarchy (1- Left)



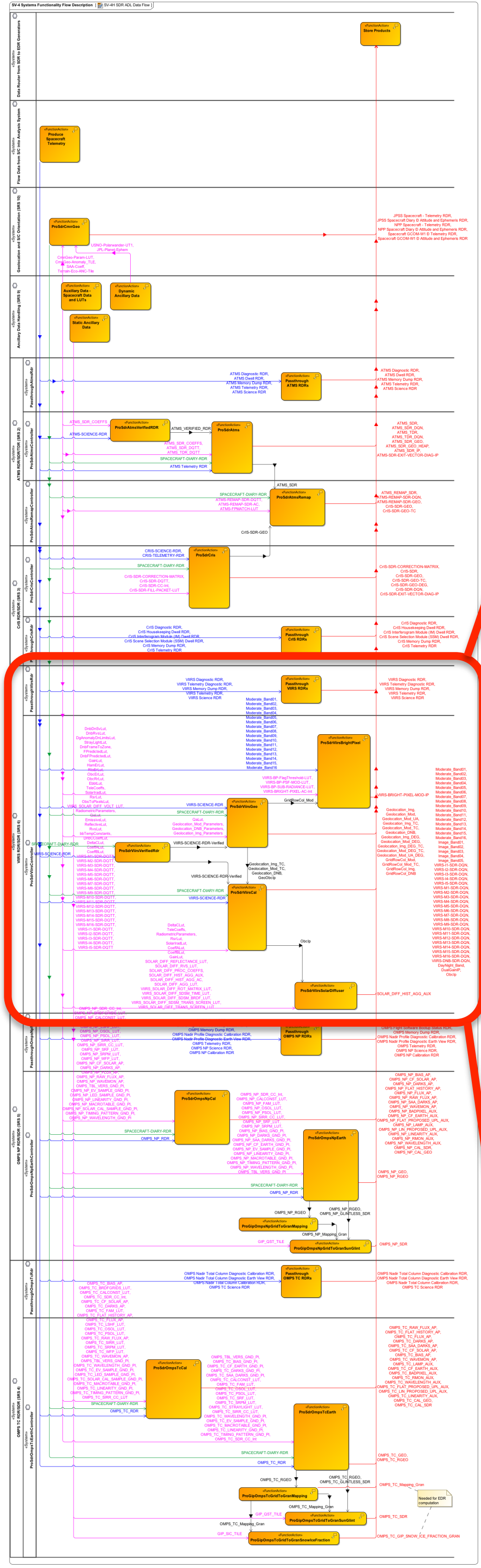
SV-4 System Functionality Description, Full Hierarchy (2- Right)



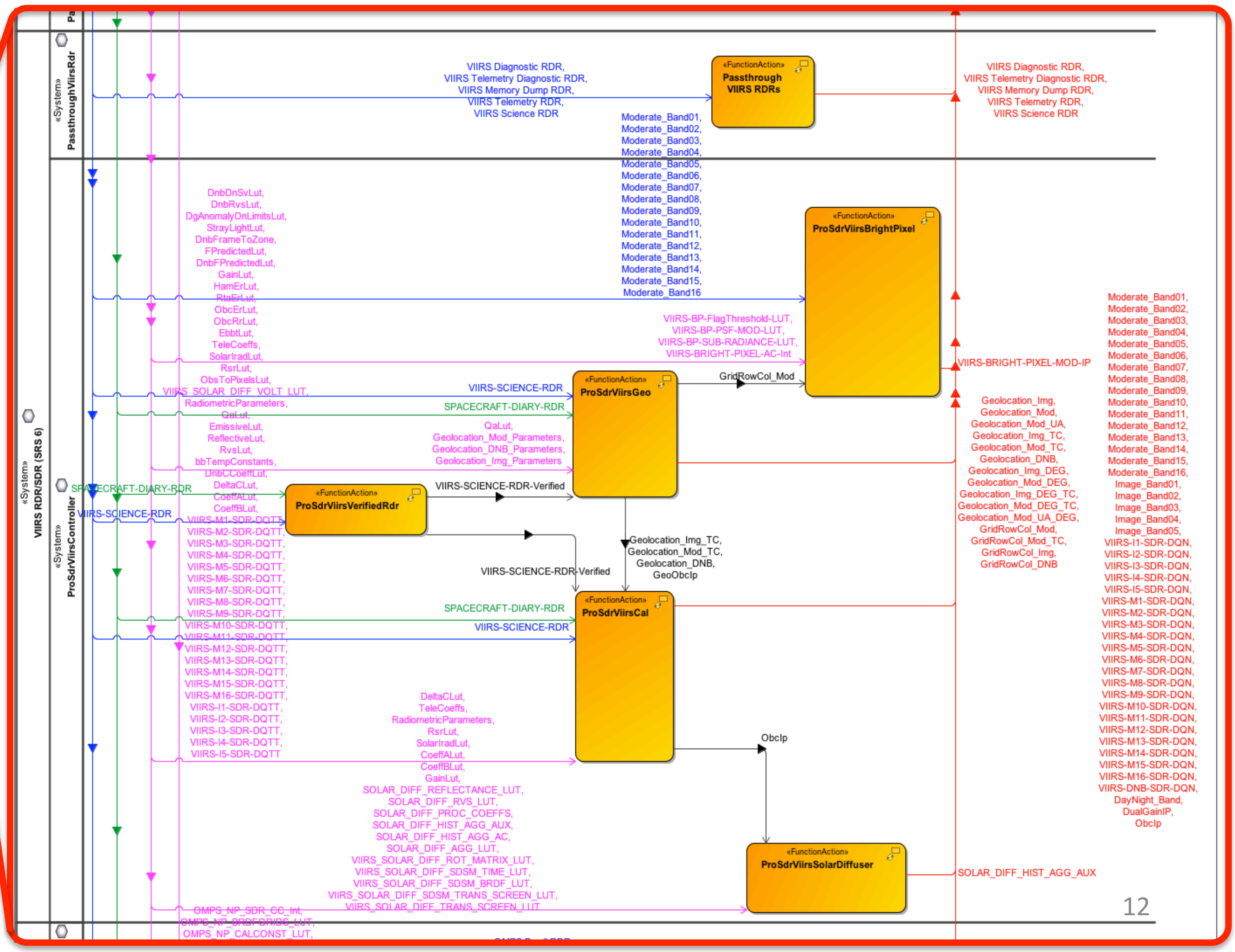
SV-4 System Functionality Flow Diagrams

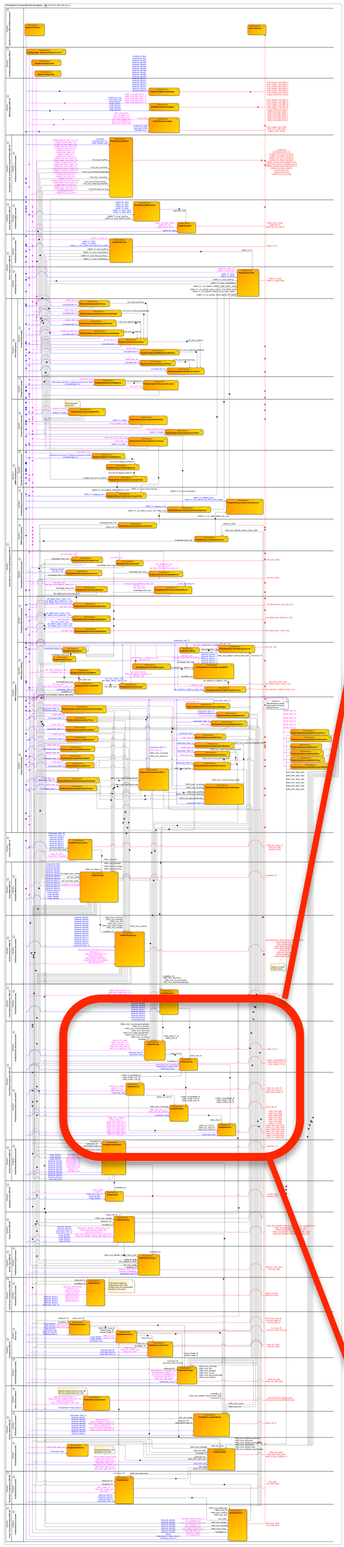
- Used to describe system and software functional process flow to assist management and end user understanding of end product production.
- Inputs, outputs, and interdependencies are shown for each software process.
- Each horizontal swim lane is a system identified by the specification in the swim lane header
  - Input data flows from the top processes to each specification's swim lane.
  - The data production process flows from FunctionAction (software object) to FunctionAction to produce each swim lane's data products
  - The deliverable products are at the far right of each swim lane.
- The SDR flow shows the analysis chain through SDRs, and the EDR flow shows the remainder of the chain through to the data products to be delivered to the Comprehensive Large Array-data Stewardship System, (CLASS).
  - Analysis of the interdependencies among the systems, software, and functional flows help to identify downstream impacts when considering the scope of proposed changes or product degradation.

SV-4 Function Flow Diagram for Sensor Data Record (SDR) Algorithm Processing



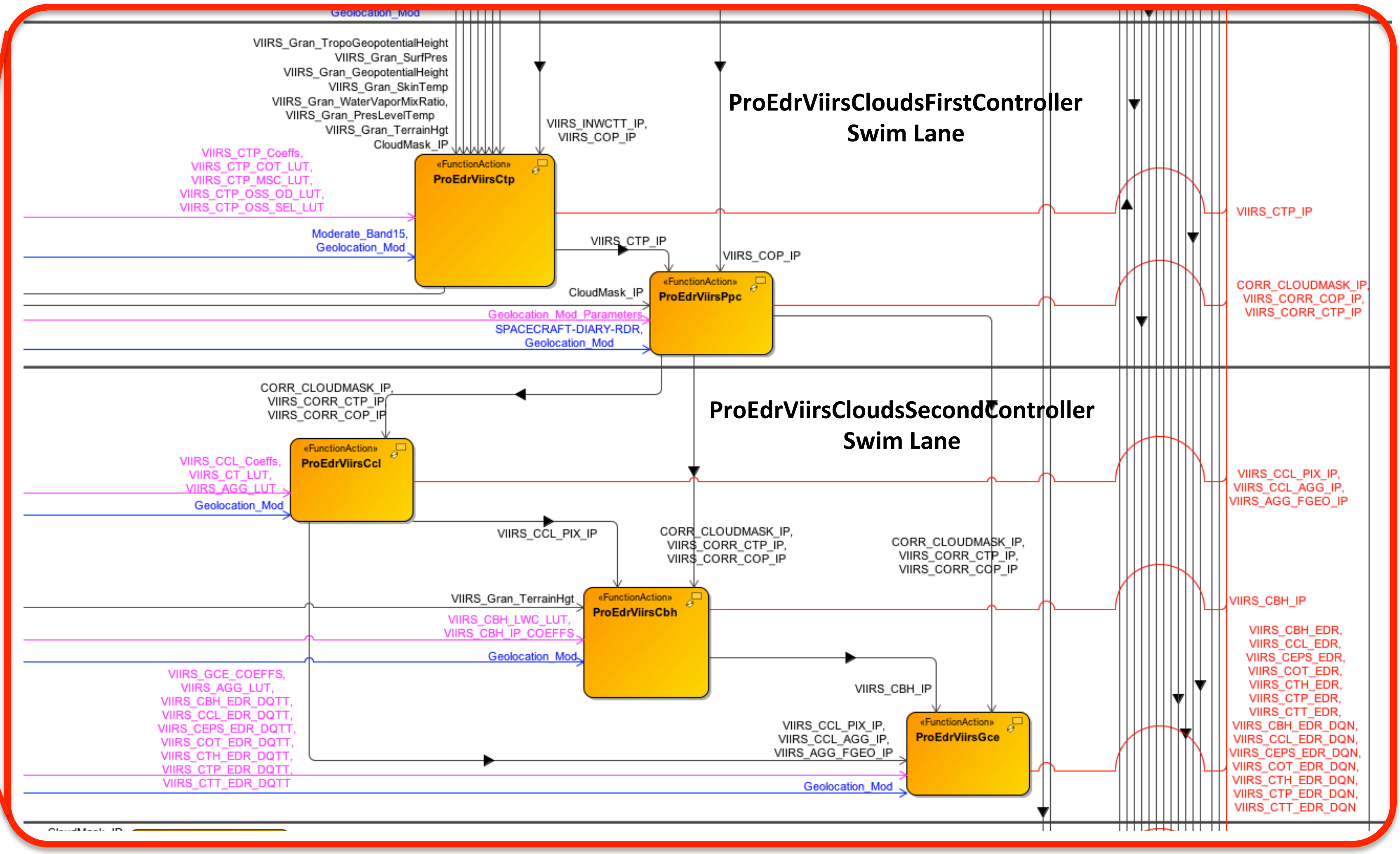
VIIRS Processing





SV-4 Function Flow Diagram for Environmental Data Record (EDR) Algorithm Processing

Cloud Physical Properties portion of the diagram

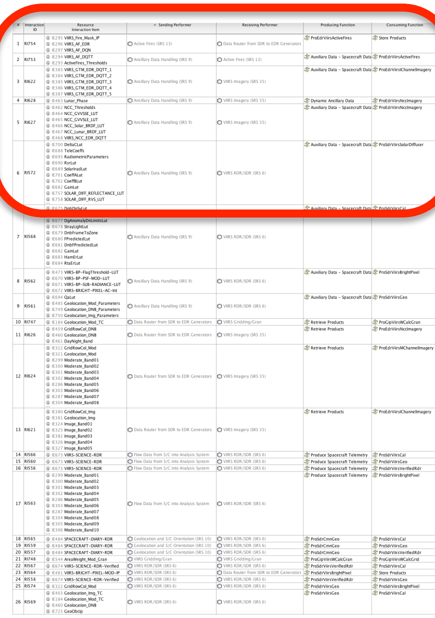


SV-6 Systems Resource Flow Matrix

- Provides a tabular representation of the cross-swim lane resource traffic.
- Tracks resource flows from one swim lane's FunctionAction to a FunctionAction in a different swim lane.
  - The flowing resources are identified
  - The resource producing and consuming swim lanes are identified as well as the producing and consuming FunctionActions.
- The SV-6 provides a human-readable format of the input and output dependencies for each algorithm module.

SV-6 For VIIRS SDR (SRS 6)

#	Interaction ID	Resource Interaction Item	Sending Performer	Receiving Performer	Producing Function	Consuming Function
1	RI754	IE295 VIIRS_Fire_Mask_IP IE296 VIIRS_AF_EDR IE297 VIIRS_AF_DQN	Active Fires (SRS 13)	Data Router from SDR to EDR Generators	ProEdrViirsActiveFires	Store Products
2	RI753	IE294 VIIRS_AF_DQTT IE293 ActiveFires_Thresholds	Ancillary Data Handling (SRS 9)	Active Fires (SRS 13)	Auxiliary Data – Spacecraft Data	ProEdrViirsActiveFires
3	RI622	IE383 VIIRS_GTM_EDR_DQTT_1 IE384 VIIRS_GTM_EDR_DQTT_2 IE385 VIIRS_GTM_EDR_DQTT_3 IE386 VIIRS_GTM_EDR_DQTT_4 IE387 VIIRS_GTM_EDR_DQTT_5	Ancillary Data Handling (SRS 9)	VIIRS Imagery (SRS 35)	Auxiliary Data – Spacecraft Data	ProEdrViirsIChannelImagery
4	RI628	IE463 Lunar_Phase	Ancillary Data Handling (SRS 9)	VIIRS Imagery (SRS 35)	Dynamic Ancillary Data	ProEdrViirsNccImagery
5	RI627	IE462 NCC_Thresholds IE464 NCC_GVVSSE_LUT IE465 NCC_GVVSLE_LUT IE466 NCC_Solar_BRDF_LUT IE467 NCC_Lunar_BRDF_LUT IE468 VIIRS_NCC_EDR_DQTT	Ancillary Data Handling (SRS 9)	VIIRS Imagery (SRS 35)	Auxiliary Data – Spacecraft Data	ProEdrViirsNccImagery
6	RI572	IE700 DeltaCLut IE688 TeleCoeffs IE693 RadiometricParameters IE690 RsrLut IE689 SolarIradLut IE701 CoeffALut IE702 CoeffBLut IE682 GainLut IE757 SOLAR_DIFF_REFLECTANCE_LUT IE758 SOLAR_DIFF_RVS_LUT ...	Ancillary Data Handling (SRS 9)	VIIRS RDR/SDR (SRS 6)	Auxiliary Data – Spacecraft Data	ProSdrViirsSolarDiffuser



Summary

- The JPSS GS weather data processing architecture is very, very complex
- Identifying and managing all levels of product dependencies to ensure product performance has been a challenge
  - Previous attempts to capture have quickly fallen out of date as the massive data flow and algorithm architecture evolved.
  - Flight system Cal/Val is scheduled to span months of data capture, reduction, analysis and adjustment
- The application of DoDAF 2/UPDM 2 has provided a mechanism to capture and manage this complex data processing architecture.
  - Traces algorithm and data back to L1/L2 weather/climate performance metrics
- The tool automatically manages dependencies which used to be managed by engineering/scientific analysis.
- The application of DoDAF 2/UPDM 2 will lead to a more structured process at significantly reduced resource costs, enabling more efficient and faster evolution and progress.