Utilizing MBSE to Modularly Architect the NESDIS Ground Enterprise

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The power of Model-Based Systems Engineering (MBSE) lies in the relationships built between the systems, activities, and functions in the model. Flat diagrams and spreadsheets can only tell a two-dimensional story and do not have the interweaving relationships and live architecture sense that using MBSE provides when architecting a system of systems. The JPSS Common Ground System is currently modeled in such a way as to completely define all operational activities and systems (including backup and testing). The rigorous modeling effort has expedited and ensured accuracy down through the test and verification phase. Working closely with the system vendor as well as JPSS ground project management, the model is able to maintain a high level of accuracy true-to-form for the system being built. Any changes to the system during design reviews, from additional/changing requirements or otherwise, are documented and adjusted in the model immediately to keep the model always current and accurate.

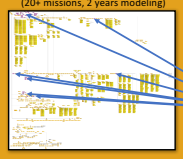
The NESDIS Ground System was also modeled using MBSE to document and visualize the as-is state of the current ground system. The model was crafted with a variety of input from existing architecture schematics, engineering personnel, system databases, and subject matter experts in each of the respective "stovepipe" subsystems. Each mission that NOAA operates was added to the model as well as missions which are partnered with NOAA. External entities, end users, international organizations, and universities were also incorporated. The JPSS mission is a small subset of what the NOAA ground system comprises. In order to maximize reusability, traceability, robustness, and accuracy, the JPSS model can be linked to the NESDIS ground architecture model. It would act as a plug-n-play piece to NOAA's ground architecture. This would create an updated view of the NESDIS enterprise and lead the way for plugging in other missions, partners, and external entities in a similar fashion.

Creating this enterprise level model for NESDIS and its partners would also greatly enhance NOAA capabilities to understand their enterprise upgrade needs. Metadata can be stored for all systems in the model such as processing capacity of systems, cost of operations/hardware, lifecycle milestones, etc. This metadata can then be sorted or filtered to produce lists of systems ready to be refreshed, those which can be consolidated, and those at end of lifecycle. The NESDIS Ground System consists of segregated systems, operations, networks, and facilities. This amalgamation of systems and system of systems is often referred to as the NOAA "stovepipes." With the transition of GOES-16 and JPSS-1 operations to NOAA, we will see an increase in the complexity of the overall NESDIS Ground System. The addition of hundreds of systems, servers, and network nodes make understanding the system as a whole a daunting task. Modern architecture tools and disciplines, such as Model-Based Systems Engineering, can be used to clearly define the as-is state of a ground system regardless of complexity.

System Hierarchy

- All model elements are stored in these hierarchies
- JPSS system complexity represented in two dozen NGE systems
- NGE model should not duplicate work; rather link to existing

NGE Hierarchy
(20+ missions, 2 years modeling)



JPSS Hierarchy
(1 mission, 5 years modeling)

Systems Modeling

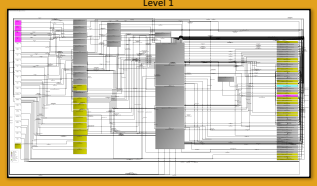
- Both JPSS and NGE modeled using DODAF 2.0 and UPDM
- Difference in leveling approach
- JPSS model significantly more detailed (Level 4-5)
- Models based on implementation layout and reviewed with SMEs for accuracy

DoDAF V2.0

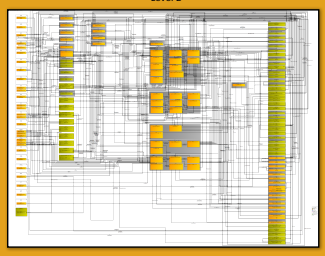
UPDM

NOAA Ground Enterprise Modeling

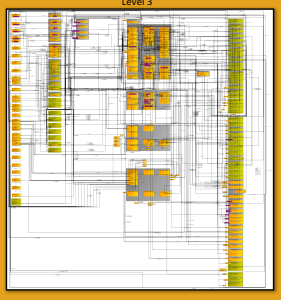
Level 1



Level 2



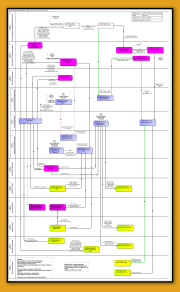
Level 3

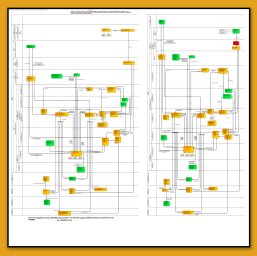


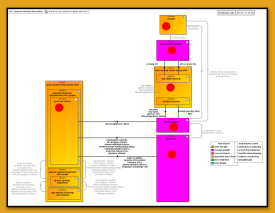
Level 1 : NGE Ground systems at the facility and external entity level
Level 2 : Systems grouped into common areas
Level 3 : Individual missions systems broken out. JPSS denoted in purple
Level 4 (not shown) : Software level modeling

236 distinct Level 3 systems. All NOAA missions, external partners, facilities, and data elements.
Dozens of stovepipes create difficulty in operations cost, maintenance, and architectural documentation.

JPSS CGS Modeling







- SV-1s capture high level system interfaces
- OV-5bs describe the operational processes of the Common Ground System (CGS)
- SV-4s developed as test scenarios for operational activities (OV-5bs)
- Thousands of requirements added to model; linked to systems
- Test scenarios used to develop test procedures for ground equipment/data flow
- Hundreds of unique Level 3 and Level 4 systems and functions

MBSE Benefits

- NGE architecture model could be the basis for all mission models
- Existing models could be linked/shared into the NGE model
- New missions could develop a plug-n-play architecture model
- Reduces rework, increases accuracy, and enables robust and informed decision making

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