

UNCLASSIFIED

**Air Force Life Cycle Management Center
Engineering and Technical Management/Services Directorate**

Providing the Warfighter's Technical Edge

The Emerging Air Vehicle Government Reference Architecture Moving Towards Model-Based Acquisition



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DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.
AFLCMC/PA Approval Date: 10/02/2023 Case Number: 2023-0271



Overview

- **BLUF: Superior knowledge management**
- **Acquisition System MetaModel – Quick Review**
- **ASMM Maps to MBAcq Concept Model**
- **Domain Overlay Example - Airworthiness**
- **Model Organization on LaunchPad**
- **Basic GRA Structure and Features**
- **Maintaining WBS-to-System Separation**
- **Example of GRA Linkage**
- **Architecture of Reference Architectures**
- **Utilizing Branching in GRA Management**
- **Establishing on Standards**



BLUF: Superior Knowledge Management

BLUF: Ultimately the AF wants superior knowledge management, which is what the whole Digital Transformation is all about.

Achieved via:

- model-centric environments
- solid data management processes
- modeling best practices and methods
- reference architectures

The right knowledge in the right hands at the right time that is authoritative and trustworthy.



Acquisition System MetaModel

- 3 distinct model areas
- Business Process
- System GRA
- Program Data

AcquisitionSystemMetaModel

- Start Here
- AcquisitionProgramReferenceMetamodel
 - «model» AcquisitionBusinessModel
 - «model» AirSystemGRA
 - «models» MIL-STD-881 WBS
- «Document» Incoming Requirements
- «extendedRequirements» JSSG-20xx
- «extendedRequirements» SOW_Reqs

req [package] AcquisitionSystemMetaModel [Start Here]

Distribution Statement
Modified: 3/17/2022

*This entire metamodel release is **PRELIMINARY DRAFT** and is incomplete with many notional entries.*

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The model library packages contained herein carry CUI markings to reflect the markings of the related JSSG documents, however none of the CUI content is currently in these models, and the documentation has been moved outside this metamodel space. Therefore, this entire metamodel is Unclassified and Distribution Statement A applies.

MetaModel Concept
Modified: 3/16/2022

*The **AcquisitionProgramReferenceMetamodel** (model of models) is conceived as having several parts. The idea is based on the concept that a process starts, consumes inputs, produces outputs, and ends upon completion.*

*The **AcquisitionBusinessModel** is a placeholder herein to represent that process. The hope is that the DoDI 5000.02 Adaptive Acquisition Framework (and friends) will be modeled in BPMN for eventual acquisition business automation support.*

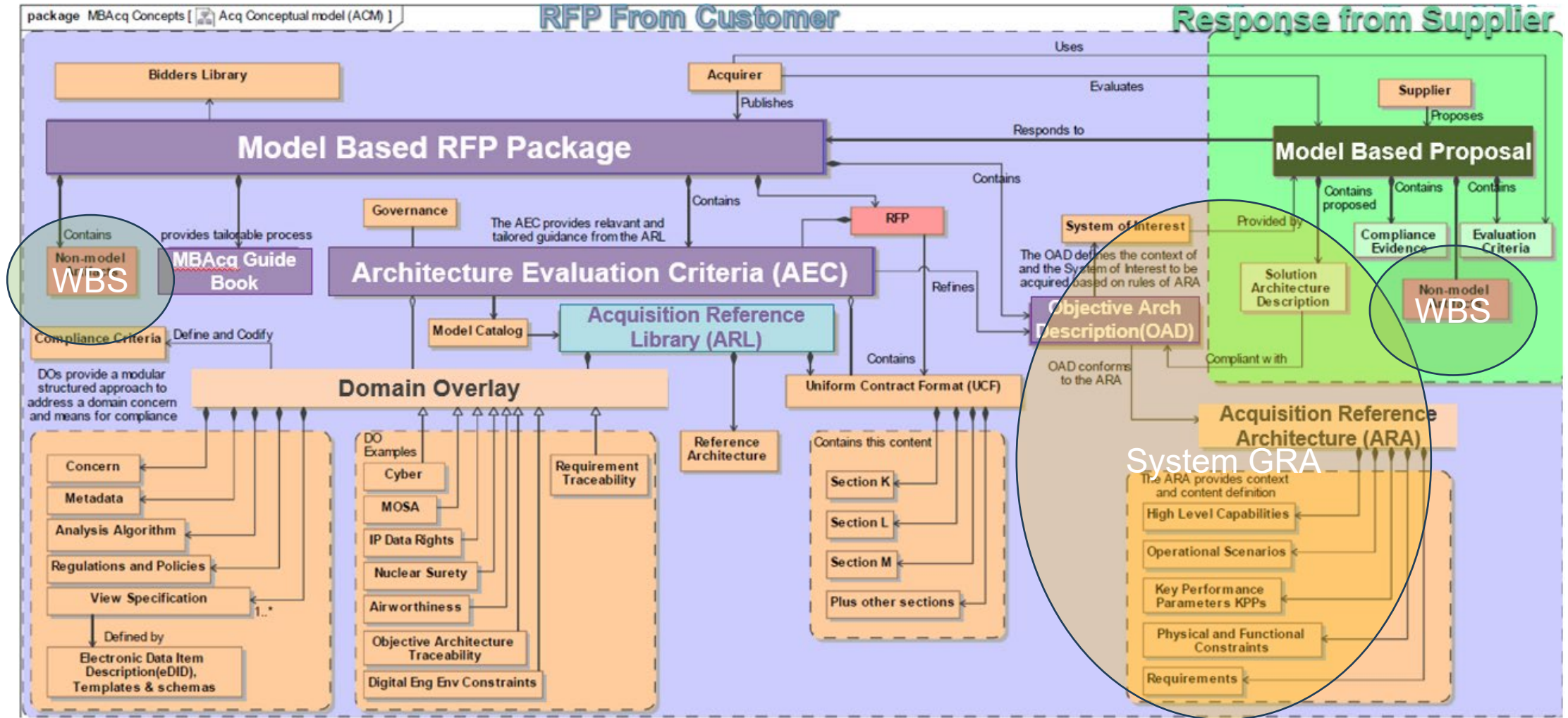
*The **MIL-STD-881 WBS** model provides basic structure we chose to use as the basic structure for the Air System GRA. By modeling the system/subsystem structure in the GRA allows alignment of the contract/business information and the system/subsystem being acquired. This usage is not strict, nor can it be.*

*The **AirSystemGRA** model library is actually a conceptual collection of model libraries based on the Joint Service Specification Guides, which also are loosely based on the basic WBS element architecture. The GRA features reference models that are - or will be - the requirements within the JSSGs in model form, allowing the program office to construct much of the predefined content, while having elements labeled as "TBS" to signal what areas of a model need to be built out to meet program requirements.*

Browsing the HTML output of this model can be via either the navigation links contained in these guidance diagrams, or via the model tree directly located on the left side of the browser output.

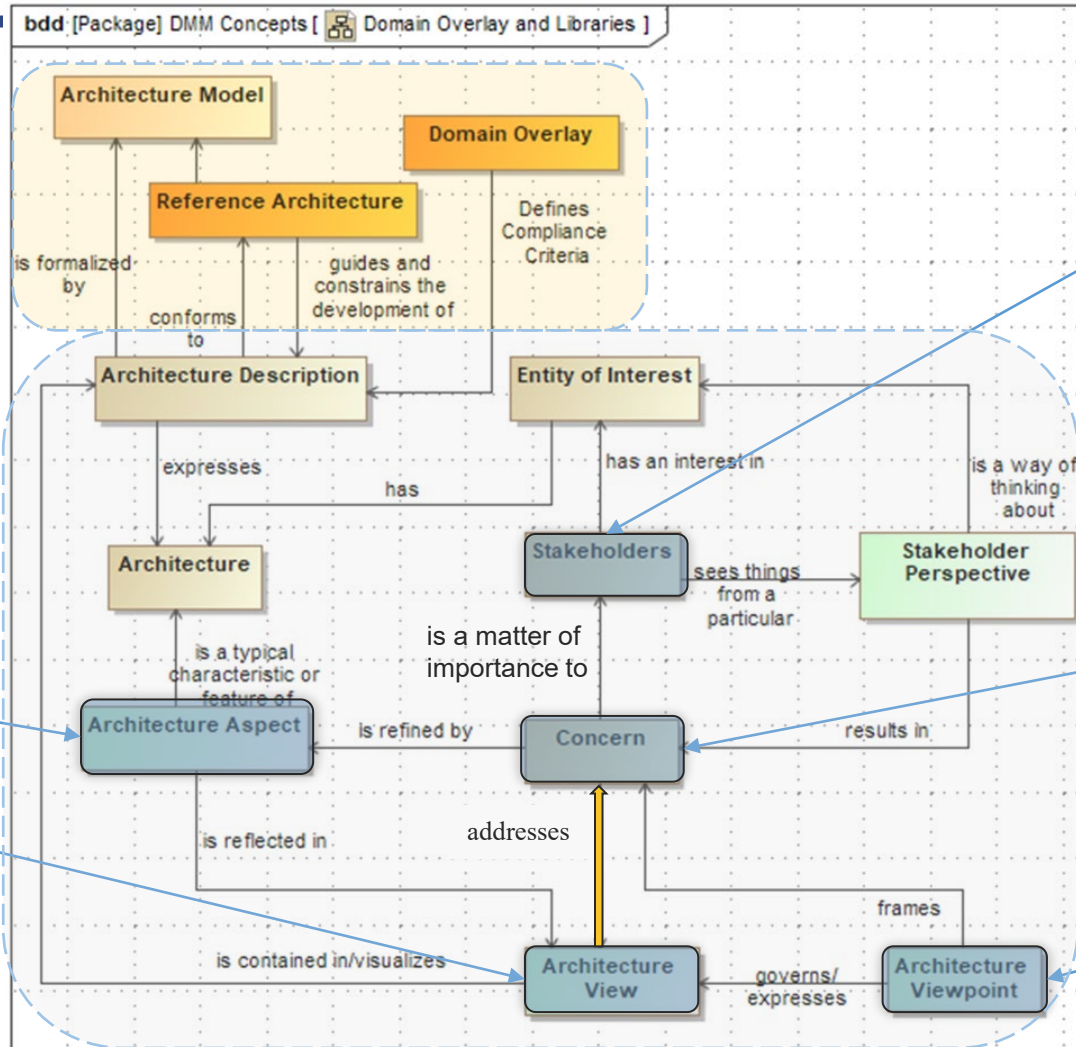


ASMM Maps to MBAcq Concept Model

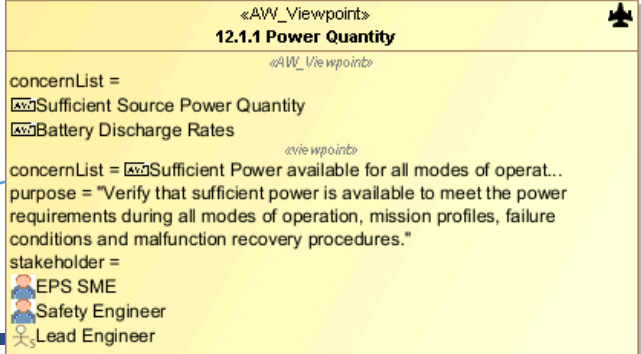
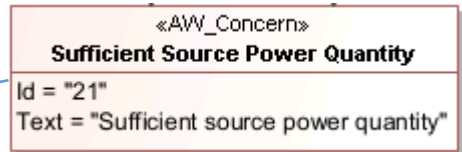
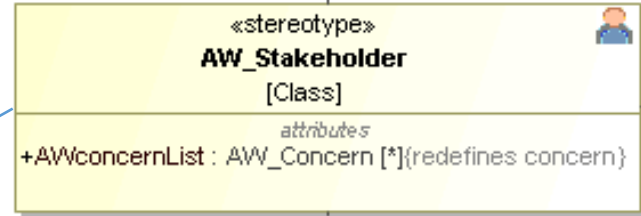




Domain Overlay Example - Airworthiness



«block»
MIL-E-7016:Data:Power Source Analysis Data
references
loadAnalysisData : Load Analysis Data
subject : Electric Power Source [1]
values
operatingConditions : Operating Condition [1..*]
analysisTimeInterval : Time Interval [3]
compositeRatingFactorPerOperatingConditionPerTimeInterval : Composite Rating Factor [1]
intervalRatingACPerOperatingConditionPerTimeInterval : Interval Rating AC [0..1]
intervalRatingDCPerOperatingConditionPerTimeInterval : Interval Rating DC [0..1]
adjustedACCapacityPerOperatingConditionPerTimeInterval : Adjusted AC Source Capacity [0..1]
adjustedDCCapacityPerOperatingConditionPerTimeInterval : Adjusted DC Source Capacity [0..1]
loadRequirementsDCPerOperatingConditionPerTimeInterval : electric current[ampere] [0..1]{unit = ampere}
loadRequirementsACPerOperatingConditionPerTimeInterval : apparent power[volt ampere] [0..1]
growthCapacityPerOperatingConditionPerTimeInterval : Growth Capacity [1]
phaseLoadUnbalancePerOperatingConditionPerTimeInterval : Phase Load Unbalance [0..1]
powerFactorPerOperatingConditionPerTimeInterval : power factor[watt per volt per ampere] [0..1]





Model Organization in LaunchPad

- Separate Reference Architecture and Reference Model Libraries
- Reference Architecture populated/linked with Reference Model elements

The screenshot shows the LaunchPad interface with two tabs: 'Online Projects' and 'Offline Projects'. The 'Offline Projects' tab is active, displaying a tree view of project folders and a table of project details.

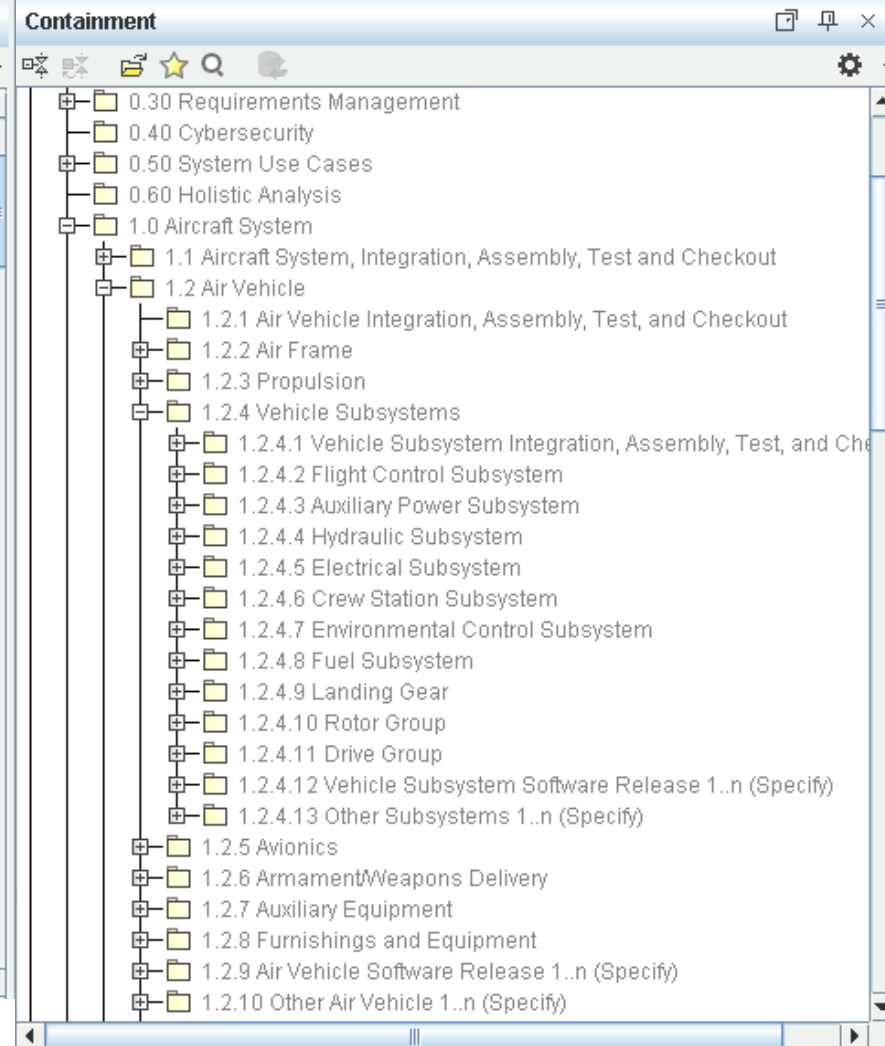
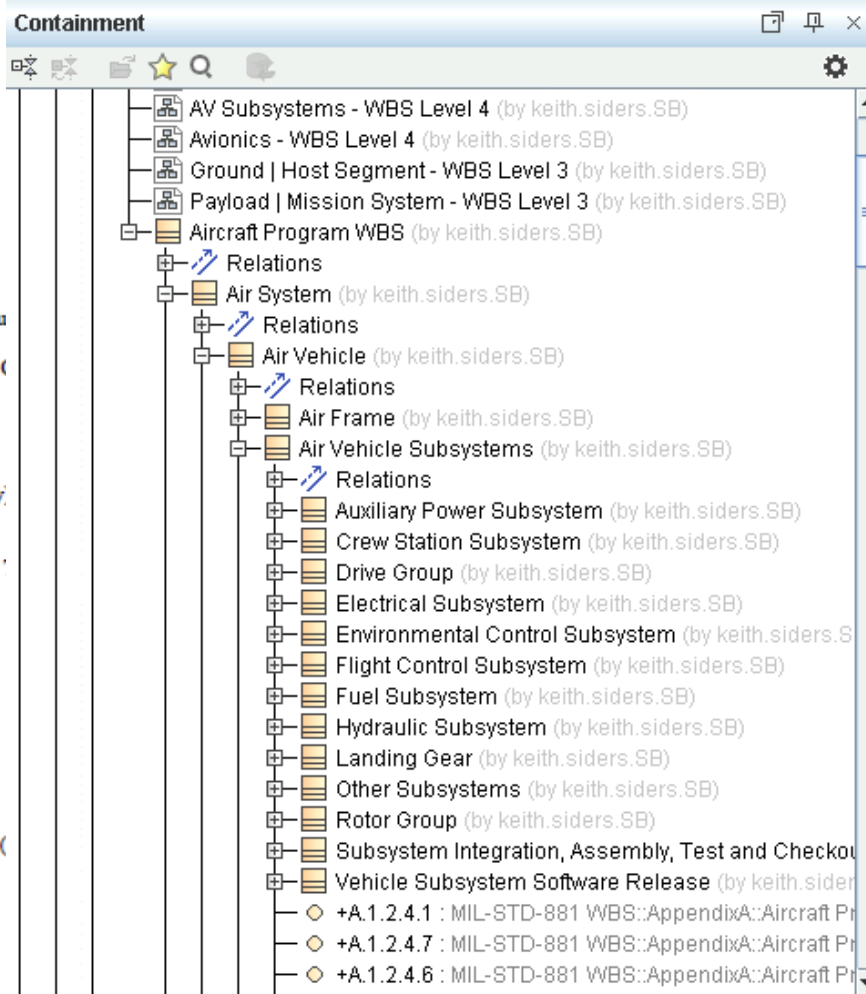
Name	Last modified	Branch
Reference Architecture Library		
Acquisition Process Data		
Air Systems		
AV GRA	Thursday, September 14, 2023 4:55:...	trunk
AV GRA Profile	Friday, September 22, 2023 2:22:28 ...	trunk
Reference Materials	Tuesday, September 19, 2023 1:54:1...	trunk
Generic Materiel System		
Ground Systems		
Sea Systems		
Space Systems		
Weapons GRA 3.4 (31 July 2023)		
JCA_UJTL	Wednesday, June 14, 2023 7:28:08 PM	trunk
Reference Model Library		
Air Force Guide Specifications		
Code of Federal Regulations (FAA)		
Development		
Interface Standards		
Joint Service Specification Guides		
Military Detail Specifications		
Military Handbooks		
Military Performance Specifications		
Military Specifications		
Military Standards		
MIL-STD-461	Monday, August 14, 2023 4:53:01 PM	AS-115 migrate 7. Data Models
MIL-STD-464	Thursday, September 14, 2023 4:08:...	trunk
MIL-STD-704	Monday, August 7, 2023 12:44:30 PM	trunk
MIL-STD-810	Thursday, September 14, 2023 3:59:...	trunk
MIL-STD-7080	Thursday, September 14, 2023 3:50:...	trunk

At the bottom of the interface, there is a search bar with the text 'Type here to filter projects' and a set of buttons: 'Open', 'Rename', 'New', 'Clone', and 'Remove'.



Basic GRA Structure and Features

WBS#	Level 1	Level 2	Level 3	Level 4	Level 5
1.0	Aircraft System				
1.1	Aircraft System, Integration, Assembly, Test and Checkout				
1.2	Air Vehicle				
1.2.1	Air Vehicle Integration, Assembly, Test and Checkout				
1.2.2	Air Frame				
1.2.2.1	Airframe Integration, Assembly, Test, and (
1.2.2.2	Fuselage				
1.2.2.3	Wing				
1.2.2.4	Empennage				
1.2.2.5	Nacelle				
1.2.2.6	Other Airframe Components 1...n (Specify)				
1.2.3	Propulsion				
1.2.4	Vehicle Subsystems				
1.2.4.1	Vehicle Subsystem Integration, Assembly, (
1.2.4.2	Flight Control Subsystem				
1.2.4.3	Auxiliary Power Subsystem				
1.2.4.4	Hydraulic Subsystem				
1.2.4.5	Electrical Subsystem				
1.2.4.6	Crew Station Subsystem				
1.2.4.7	Environmental Control Subsystem				
1.2.4.8	Fuel Subsystem				
1.2.4.9	Landing Gear				
1.2.4.10	Rotor Group				
1.2.4.11	Drive Group				
1.2.4.12	Vehicle Subsystem Software Release 1...n (
1.2.4.13	Other Subsystems 1...n (Specify)				
1.2.5	Avionics				



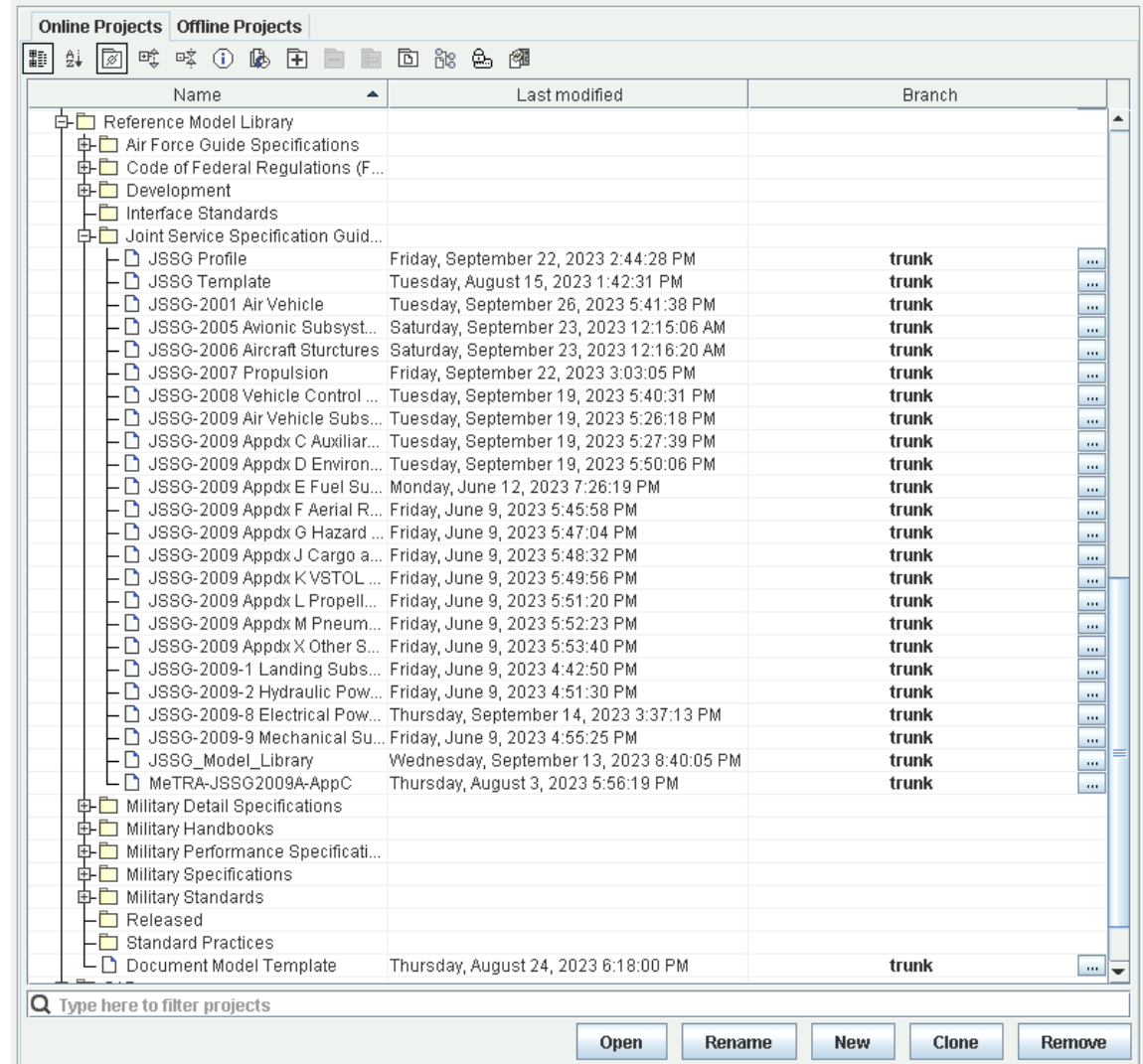


Basic GRA Structure and Features

- Basic structure mimicked in JSSGs

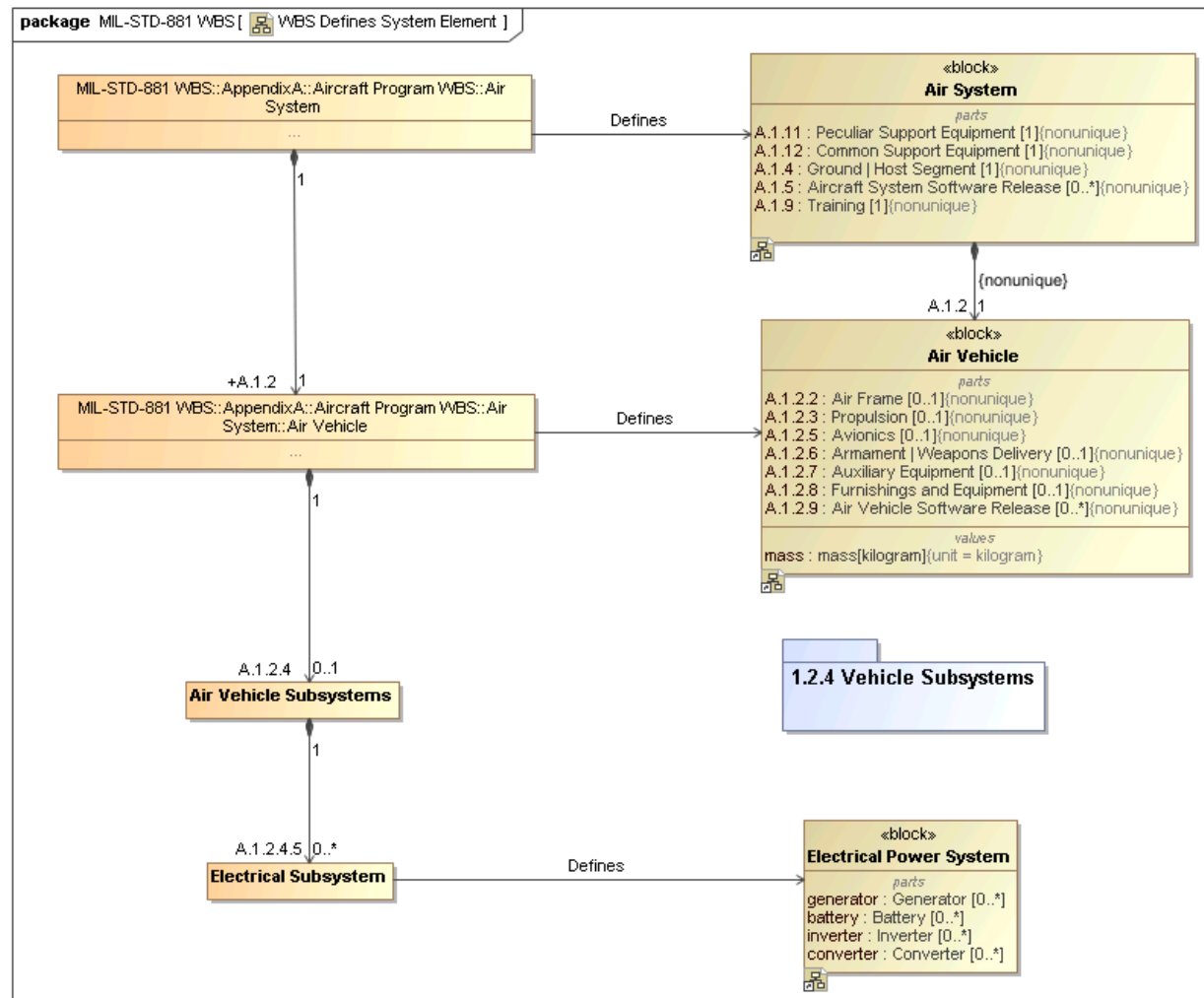
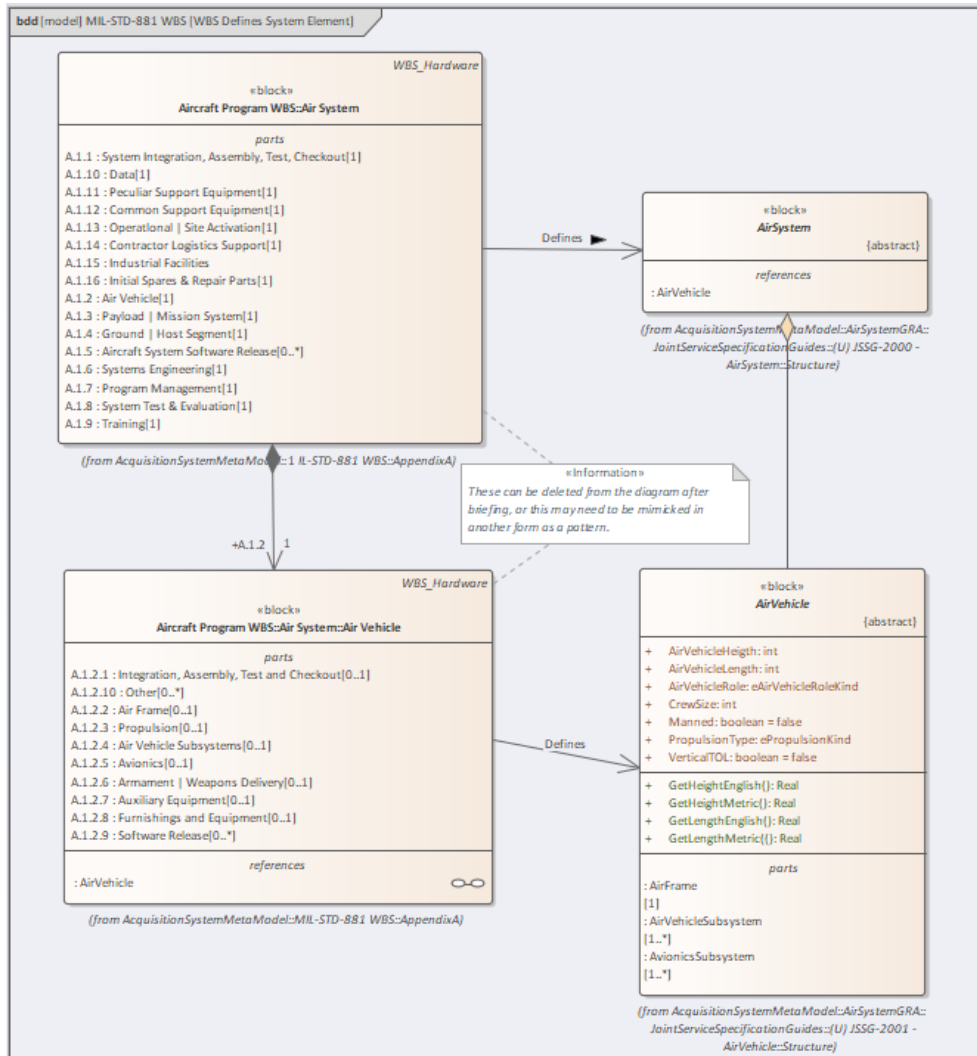
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1.2.1	Air Vehicle Integration, Assembly, Test and Checkout				
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1.2.2.1	Airframe Integration, Assembly, Test, and CI				
1.2.2.2	Fuselage				
1.2.2.3	Wing				
1.2.2.4	Empennage				
1.2.2.5	Nacelle				
1.2.2.6	Other Airframe Components 1...n (Specify)				
1.2.3	Propulsion				
1.2.4	Vehicle Subsystems				
1.2.4.1	Vehicle Subsystem Integration, Assembly, T				
1.2.4.2	Flight Control Subsystem				
1.2.4.3	Auxiliary Power Subsystem				
1.2.4.4	Hydraulic Subsystem				
1.2.4.5	Electrical Subsystem				
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1.2.4.11	Drive Group				
1.2.4.12	Vehicle Subsystem Software Release 1...n (S				
1.2.4.13	Other Subsystems 1...n (Specify)				
1.2.5	Avionics				

- MIL-HDBK-516 follows similar structure
- Basic common architecture





Maintaining WBS-to-System Separation





Maintaining the WBS to System Separation

- Keeping WBS information linked but separate
- MIL-STD-881 model “uses” AV_GRA
- Linkages (“defines”) maintained in WBS model, not Air Vehicle

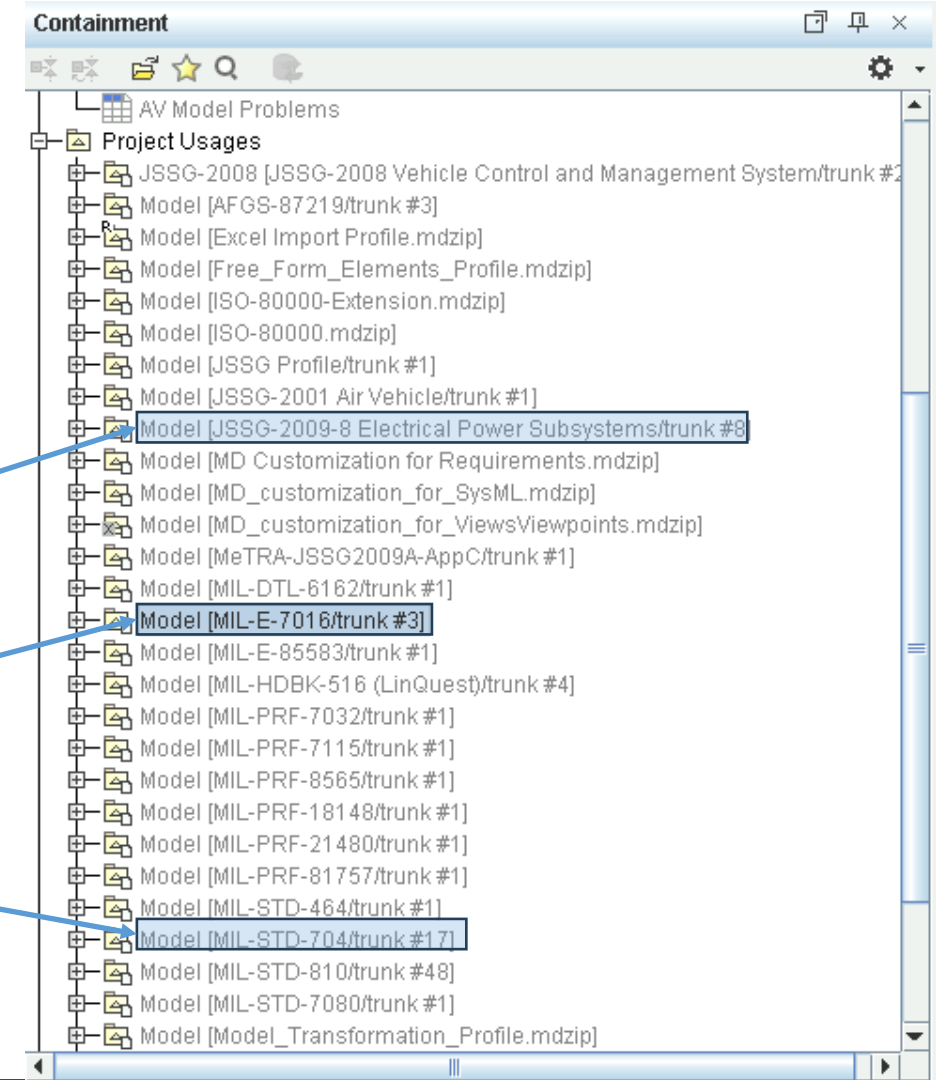
The screenshot displays a software interface for managing a Reference Architecture Library. On the left, a tree view shows the library structure, with 'MIL-STD-881' highlighted under 'Acquisition Process Data'. The main window shows a 'Containment' view of the 'MIL-STD-881 WBS' model, which is linked to 'AV_GRA_Library_Integration'. The model structure includes 'Relations', 'EA_PrimitiveTypes_Package', 'EAUML', 'FEAF', 'thecustomprofile', and 'UAFF'. Below the model, 'Project Usages' are listed, including 'AV Model [AV_GRA/AV_GRA_Library_Integration #19]' and various other models like 'JSSG-2888' and 'Model [AFGS-87219/trunk #3]'. The interface also shows a table of items with columns for name, date, and type (trunk).

Name	Date	Type
GEIA-STD-0007	Thursday, September 14, 2023 9:57:16 PM	trunk
JSSG-2009A-2 Hydraulic Po...	Monday, September 25, 2023 4:16:11 PM	trunk
MIL-STD-881	Wednesday, September 13, 2023 9:35:54 PM	trunk
Procurement Data Schema	Thursday, September 14, 2023 9:23:58 PM	trunk
AV_GRA	Friday, September 22, 2023 10:09:32 PM	AV_GRA_Library_Integration



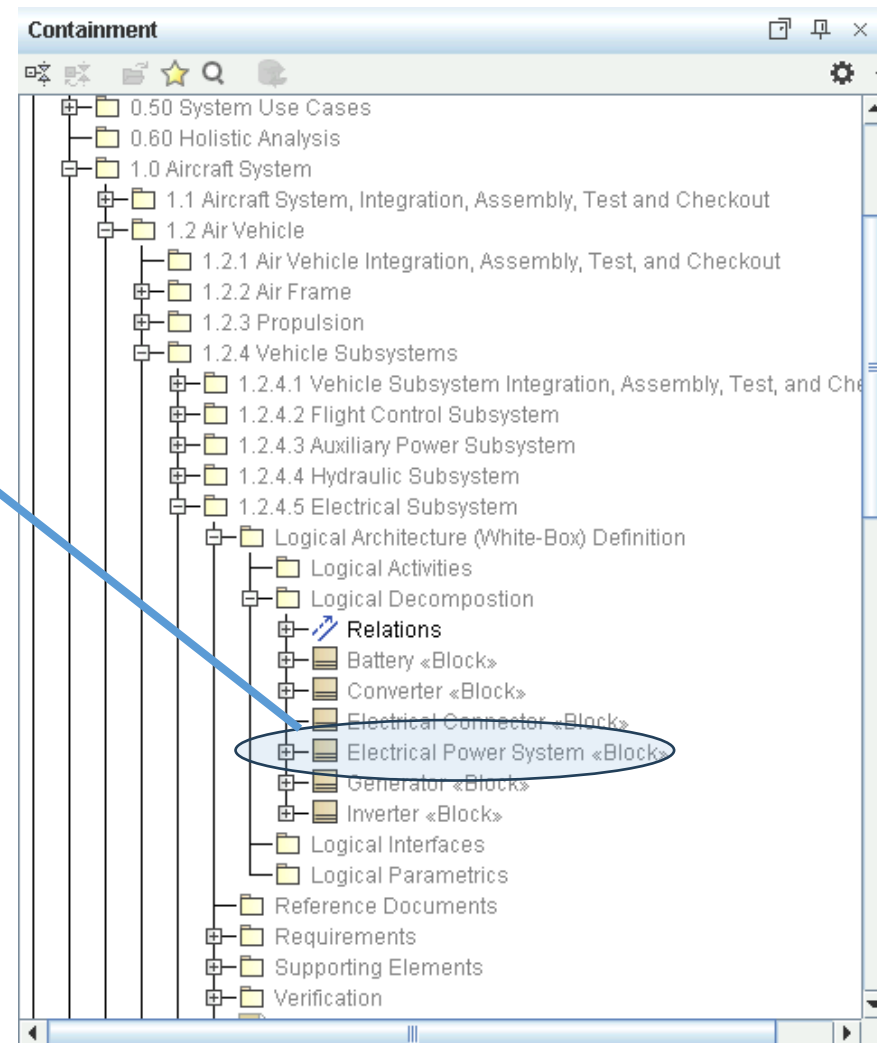
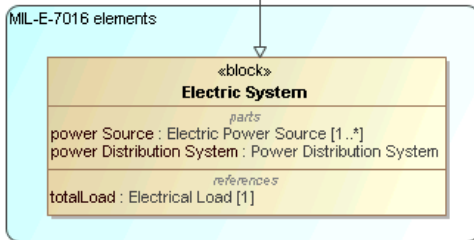
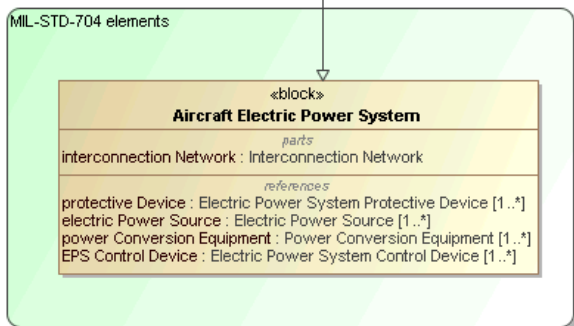
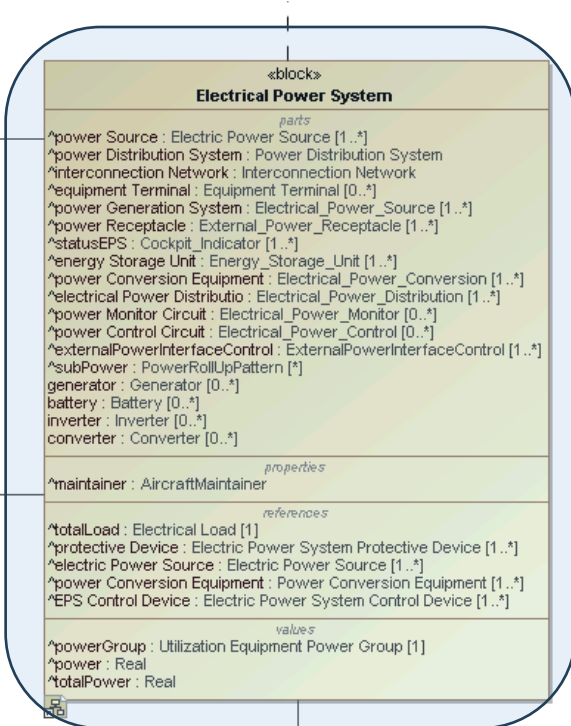
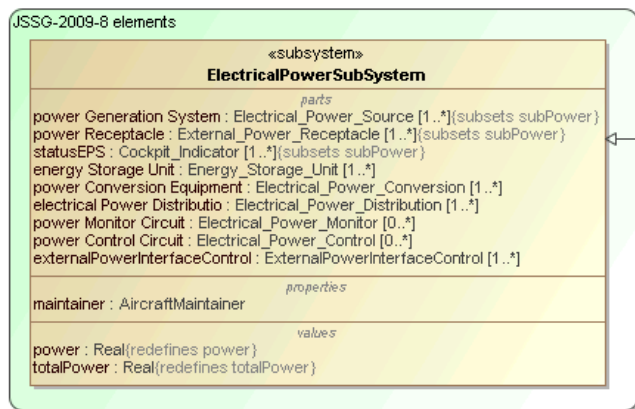
Example of GRA Linkage

- **Library Reference Models**
 - Listed as Project Usages
 - Maintains model federation
- **Combined using inheritance**
- **For this example, using**
 - **JSSG-2009-8 Electrical Power Subsystem**
 - **MIL-E-7016 Electrical Loads Analysis**
 - **MIL-STD-704 Aircraft Power**





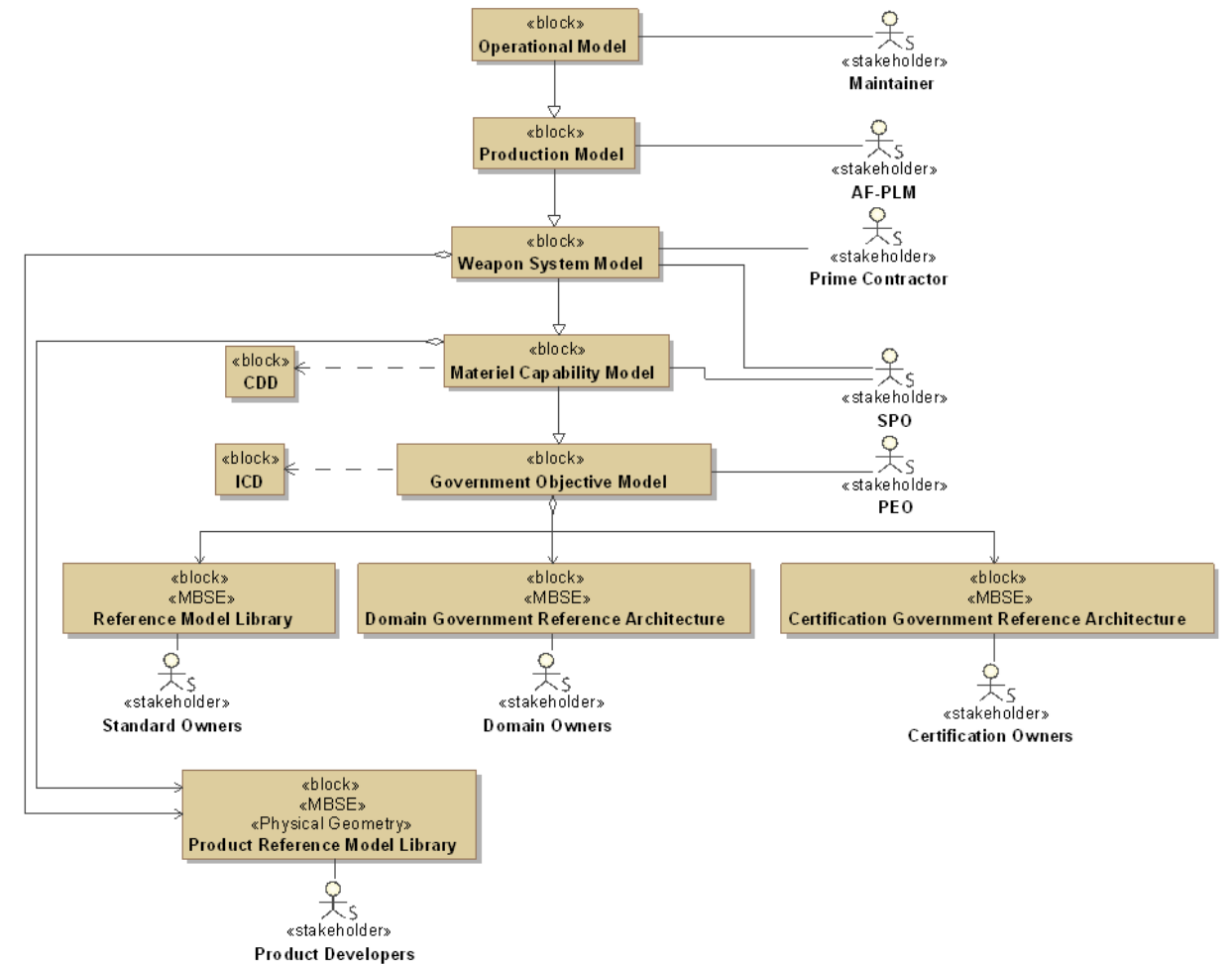
Example of GRA Linkage





Architecture of Reference Architectures

- Hierarchical Architecture of Reference Architectures
- How to use?
- How to maintain?





Utilizing Branching in GRA Management

- **Two Basic Methods (from Software Development)**

- Release Branching: develop on trunk, keep a branch for each release
- Feature Branching: develop each feature in a separate branch, only merge once stable

- **Model Branching Uses Modified Hybrid Method**

- Release Branch Establishes Baseline
- Option 1: Customizations/Features Developed on Branch
- Option 2: Maintain Branch separately using Inheritance
- Either Option: Merge Recommendation to owners of more generic model
- Either Option is Recursive
- Option 2 Provides Greater Flexibility

To Do: Compare Option 1 and Option 2 for pros and cons of each option



Utilizing Branching in GRA Management

- **AFLCMC/EN-EZ Releases AV GRA**
 - Uses Release Branching Method
- **PEO Branches AV GRA Release Version**
 - **Creates Generic Platform GRA**
 - Direct Modification of AV GRA Branch, or
 - Inheritance from AV GRA Branch
 - **PEO manages changes from AV GRA for its branch baseline**
 - CM process to decide what changes to incorporate, if any
 - Maintains AV GRA branch based on accepted changes
 - Inheritance method allows incorporated/approved baseline changes
 - Direct Modification method requires direct merging of changes
- **Program Office Branches Generic Platform Release**
 - Same process as PEO, except managing the Platform-specific baseline



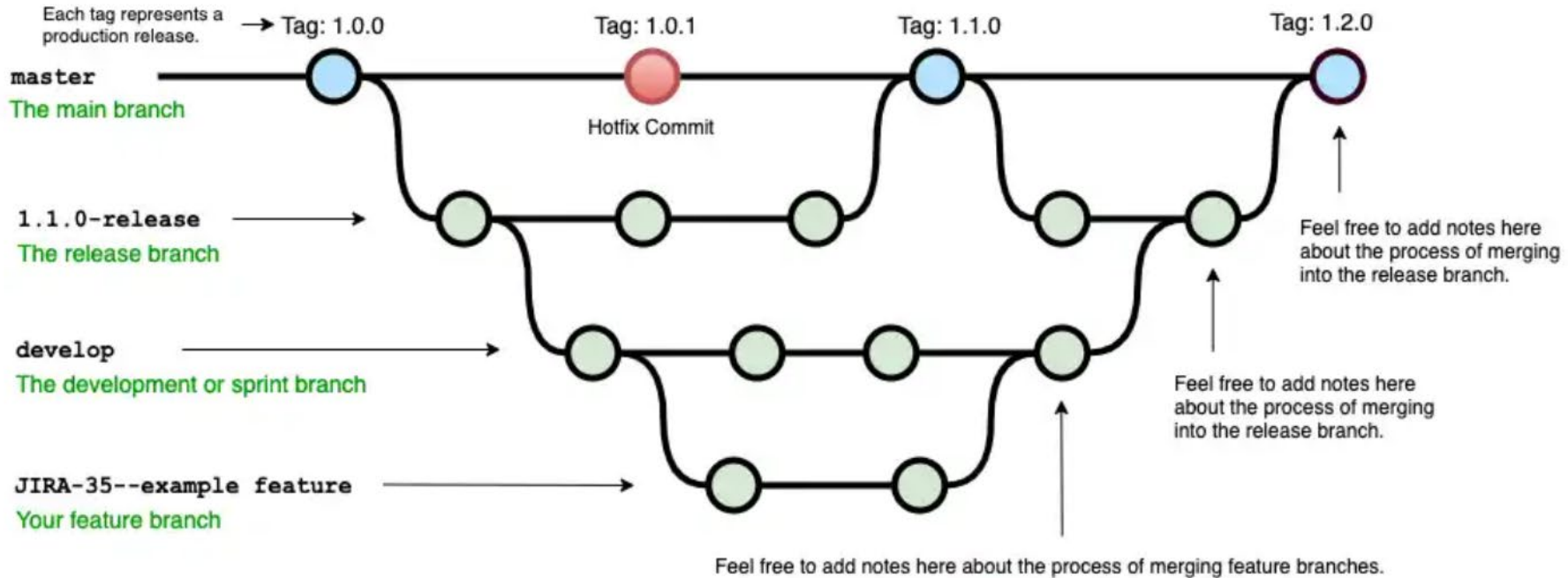
Utilizing Branching in GRA Management

Example Git Branching Diagrams

<https://www.bryanbraun.com/2020/04/24/drawing-git-branching-diagrams/>

Example diagram for a workflow similar to "Git-flow" :

See: <https://nvie.com/posts/a-successful-git-branching-model/>



Software Example is Simpler than Model Release Management; Only One Configuration in the Master



Establishing on Standards

- **ISO 42010:2022 Architecture Description**
 - [iso-iec-ieee 42010:2022 definitions \(free view\)](#)
- **ISO 42020:2019 Architecture Processes**
- **ISO 42030:2019 Architecture Evaluation Framework**
- **ISO 15288:2015 System Life Cycle Processes**
- **Others as appropriate (examples)**
 - **ISO 24744:2014 Metamodel for Developmental Methodologies**
 - **ISO 24765:2017 Vocabulary**

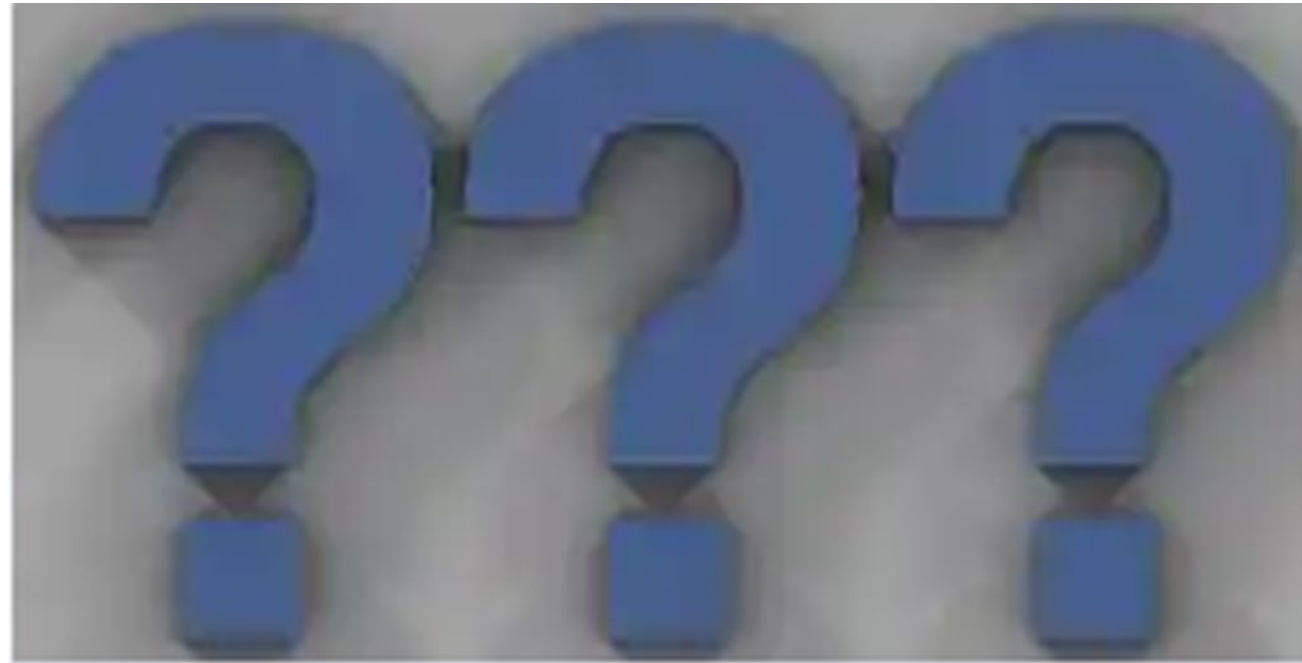


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Questions / Comments / Feedback





Backup Slides



<https://itsecurity.blog.fordham.edu/2017/10/24/backup-all-of-your-devices-and-do-it-often/#prettyPhoto>