NASA INTEGRATED MODEL-CENTRIC ARCHITECTURE

NIMA

NDIA SE/M&S MEETING
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Document-centric to a Data/Model-centric Architecture

Advance from our current document-centric engineering practice to one in which model-based data representing the technical designs, as well as Program Management & Systems Engineering information, are integrated and evolve throughout the life-cycle, supporting trade studies, design verification and system V&V.

Today: Document driven & standalone models

Future: Model-based data exchange among disciplines, domains, and partners

To do this we must:
- Enhance the ability to share and exchange information
- Improve workforce knowledge, skills and abilities
- Facilitate the exchange and adoption of model-based practices and technical solutions
MBSE (Model Based Systems Engineering) - A formalized application of modeling to support system requirements, design, analysis, technical management, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases. (17 SE Processes 7123)

MBE (Model Based Engineering) - An approach to engineering that uses models as an integral part of the technical baseline that includes requirements, analysis, design, implementation, and verification of a capability, system and/or product throughout the acquisition life cycle. (NDIA M&S)

MBD (Model Based Design) - Mathematical and visual method of addressing problems associated with designing complex control signal processing and communication systems.

MBPC (Model Based Project Control) - A formalized application of modeling to support schedule, budget, organizational activities related to the system(s) of interest.

MBMO - Model Based Manufacturing and Operations - A formalized application of modeling to support manufacturing and operations.
Model Based Engineering

MBPC
- Management Planning
- Integrated Assessment
- Schedule Management
- Configuration Management
- Resource Management
- Documentation and Data Management
- Acquisition Management

MBE
- System Design
- Requirements Definition
- Technical Solution Definition
- Product Realization
- Design Realization
- Evaluation
- Product Transition
- Technical Management
- Technical Planning
- Technical Control
- Technical Assessment
- Technical Decision Analysis

MBD (CAD, M&S, CASE)
- CDH
- Struc
- Mech
- S/W
- ECLSS
- EPS
- GNC
- TCS
- Prop

MBMO
- Manufacturing
- Operations
- Disposal

Model-Centric

Document-Centric
NIMA-to-Project View
A cross-center team working to enable/facilitate transition from document-centric to data/model-centric process/practices/culture within and across NASA

Enabling Systems
Definition of required enabling capabilities, e.g. workforce training, IT, ...

Guidance
Standards, Requirements, and Guidance for MC Data exchange & management and MC methodologies

App Store
Access to model-centric solutions

Best-in-Class Technical Solutions and Methodologies
(MBE Solutions Capture)

OCE SEWG CoPs
| MBSE | PDLM | M&S | CAD |

Feedback on Solutions

NASA Projects
- Model-based technical solutions and methodologies are available to Project personnel
- Training needed to use NIMA processes and practices are identified and made available to Project personnel
- Enabling IT requirements for resources and capabilities are identified
- Handbooks/Guidelines facilitate adoption of MBE methodologies

Subject Matter Experts & Other Resources

Industry
Academia
Centers (e.g. HR)
Vendors
Surveys of Existing MBE Solutions (vice “Paper” solutions) within:
- Centers
- OGAs
- Industry

NIMA Infusion Pathway

MBE Solutions Catalogue
- Ground Systems SysML Model
- Source Board Access Database
- MBSE Training using Cradle
- NASA Process Based Data Architecture Wiki
- Cradle New Project Startup Schema using NASA Process Based Data Architecture
- SLS Algorithms
- SLS CAD Drawing Integration
- Space Launch System (SLS) to Ground System Development and Operations (GSDO) Command and Data Handling (C&DH) ICD
- Europa Clipper System Model
- OPALS System Model

NIMA Filters, Prioritizes, and Selects MBE Solutions for “Packaging”


NODIS/NEN/NTSP Standards Handbooks Guidelines

Training Modules
- MBE Methodology
- Modules associated with “packaged” MBE Solutions
Initial FY 2014 Focus Areas for AppStore and Standards/Handbooks Content:

• Refinement and utilization of a SE Process Model (based on NPR 7123.1).
  • Drawn from Modeling & Simulation Verification, Validation, & Accreditation Recommended Practices Guide (M&S VV&A RPG)
• Two study efforts, consisting of research, benchmarking, and development of follow-on recommendations:
  • CM/DM of models/databases
  • Contractual language for the exchange of models and electronic data
AppStore

• Provides Submit, Search, and Access to S/W-based Tools, Models, Templates, Algorithms, etc.
  – Incorporates S/W Release Authority (SRA) automated-workflow (NPR 2210.1C)
• Other, similar, S/W Asset Libraries/Catalogues include:
  • NASA S/W Process Asset Library (PAL)
  • DoD M&S Catalog
NASA App Store Screenshot Example
## User Answers Questionnaire

### Software Information
- **Case Number:** ARC-17286-1
- **Software Title Requested:** Simulink Interface Layer for c
- **Version Number:** 14234
- **Version Date:** 11/01/2013
- **Code Type:** Source

### Requester Information
- **Requester's Full Legal Name (Including Middle Name):**
- **Country of Citizenship:**
- **If U.S. Permanent Resident, Alien Registration Number:**
- **Are you a Civil Servant?** Yes/No
- **Agency Name:**
- **Agency Address/Mail Code/City/State/Zip Code:**
- **Agency Division/Department:**
- **Do you work for a U.S. Company or University?** Yes/No
- **Company/University Name:**
- **Company/University Address/Mail Code/City/State/Zip Code:**

### Use Information
- **Are you the final recipient of the Software?** Yes/No
- **Do you plan to use the software only in-house?** Yes/No
- **Will there be other users of the software?** Yes/No
- **Indicate which users will have access to the software:**
  - Civil Servants
  - Contractors
  - Employees
  - Students
Workflow is Initiated for SRAs

Email to SRA Pool at the Appropriate Center

From: Workflows@docs.nasa.gov [mailto:Workflows@docs.nasa.gov]
Sent: Friday, September 06, 2013 10:29 AM
To: ARC-SRAs@docs.nasa.gov
Subject: New Cloudrepo task: SRA Review – ARC-17286-1 Simulink Interface Layer to cFE/cFS

Date: 09/06/2013
Please keep this email for your records.

An SRA Review is required for the software request identified below. You will need to review and approve or disapprove the request. Log into the NASA OCE App Store and select the appropriate item from your approval queue.
View your review queue -or- Track this workflow

Please do not reply to this system-generated message. Address any questions or issues concerning completing your review to the Responsible NASA Official shown below or to ARC-SRA@lists.nasa.gov.

Dashboard for Submission and Request Workflows

Click Link to see Queue or Workflow

Approve/Reject Requests
If Approved, User gets access to “Shrink Wrap” Software

Email to Requester

From: Workflows@docs.nasa.gov [mailto:Workflows@docs.nasa.gov]
Sent: Friday, September 06, 2013 10:29 AM
To: John.Doe@nasa.gov
Cc: ARC-SRAs@docs.nasa.gov
Subject: SUA Approved: SRA Review – ARC-17286-1 Simulink Interface Layer to cFE/cFS

Dear John Doe,

A Software Usage Agreement for Project Release between NASA Ames Research Center and Seagull Technologies Inc. for software Simulink Interface Layer for cFE/cFS (SIL) Version 14234 was signed on April 3, 2014.

You may download the software and use the SIL software and associated documentation required to implement SIL at your discretion.

A copy of the Non-Disclosure and Software Usage Agreement is attached as a reference.

Reference No. SUA2-00xx

...
Option to Auto-Generate Government Purpose Only (GPO) Software Usage Agreement (SUA)

This Agreement Is NOT A License

NONDISCLOSURE AND SOFTWARE USAGE AGREEMENT
(Government Purposes Only - Intra-NASA Release)

WHEREAS, [NASA Receiving Center] (hereinafter "RECIPIENT") has requested that Ames Research Center (hereinafter "NASA") release certain COMPUTER SOFTWARE, and

WHEREAS, NASA Policy Directive (NPD) 7120.4 and NASA Procedural Requirement (NPR) 2110.1 authorize NASA to release SOFTWARE:

NOW THEREFORE, NASA and RECIPIENT (together "PARTIES") agree as follows:

1. DEFINITIONS. For purposes of this Agreement,
   A. "NASA SOFTWARE" is defined as the COMPUTER SOFTWARE, except EXCLUDED INFORMATION, described as follows:
      - Name: Simulink Interface Layer for cFE/cFS
      - Version: 14234
      - NASA Case No.: ARC-17285-1
      - Code Type: Source
   B. "TECHNICAL DATA" is defined as any DATA, except EXCLUDED INFORMATION, necessary for the development, production, or use of the NASA SOFTWARE, and includes the following:
      - Simulink Interface Layer Detailed Design: Interface Between cFE and Simulink User’s Guide
      - LADDEE Onboard Flight Software cFE-Simulink Interface Layer L5 Requirements & Design
   C. "NASA POINTS OF CONTACT (POC)" is identified as the following:
      - NASA Technical POC: NASA Software Release Authority
      - Karen Gundy-Burtel: Martha del Abo
      - Mail Stop: 269-3: Mail Stop: 20A-3
      - Moffett Field, CA 94035: Moffett Field, CA 94035
      - 650-804-4475: 650-804-4485
      - Karen.Gundy-Burtel@nasa.gov: Martha.E.DelaAbo@nasa.gov
   D. "RECIPIENT SOFTWARE CUSTODIAN/USER" is identified as:
      - Name: John Doe
      - Address: 1111 Greenbelt Rd, Greenbelt
      - City-State-Zip: MD-20770
      - Phone: 301-556-1212
      - E-mail: john.doe@nasa.gov
   E. "AUTHORIZED USERS" is defined as (1) RECIPIENT’s employees and (2) RECIPIENT’s contractors, subject to Section III.B, below.
   F. "CONTRACTOR RECIPIENT" is defined as those AUTHORIZED USERS who are RECIPIENT’s contractors, subject to Section III.B, below.