

Joint GDA & M2M Workshop Day 1, 1.13

SCaN Digital Twin and Modeling

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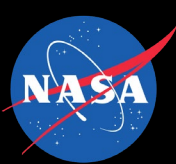
12/05/2023





SCaN Digital Twin and Modeling

Developed under the direction of SCaN PSE Director Jim Armitage and guided by Exploration and Space Communication (ESC) Division Systems Engineer (DSE)/ SCaN GSFC PSE K. Michelle Bonzo



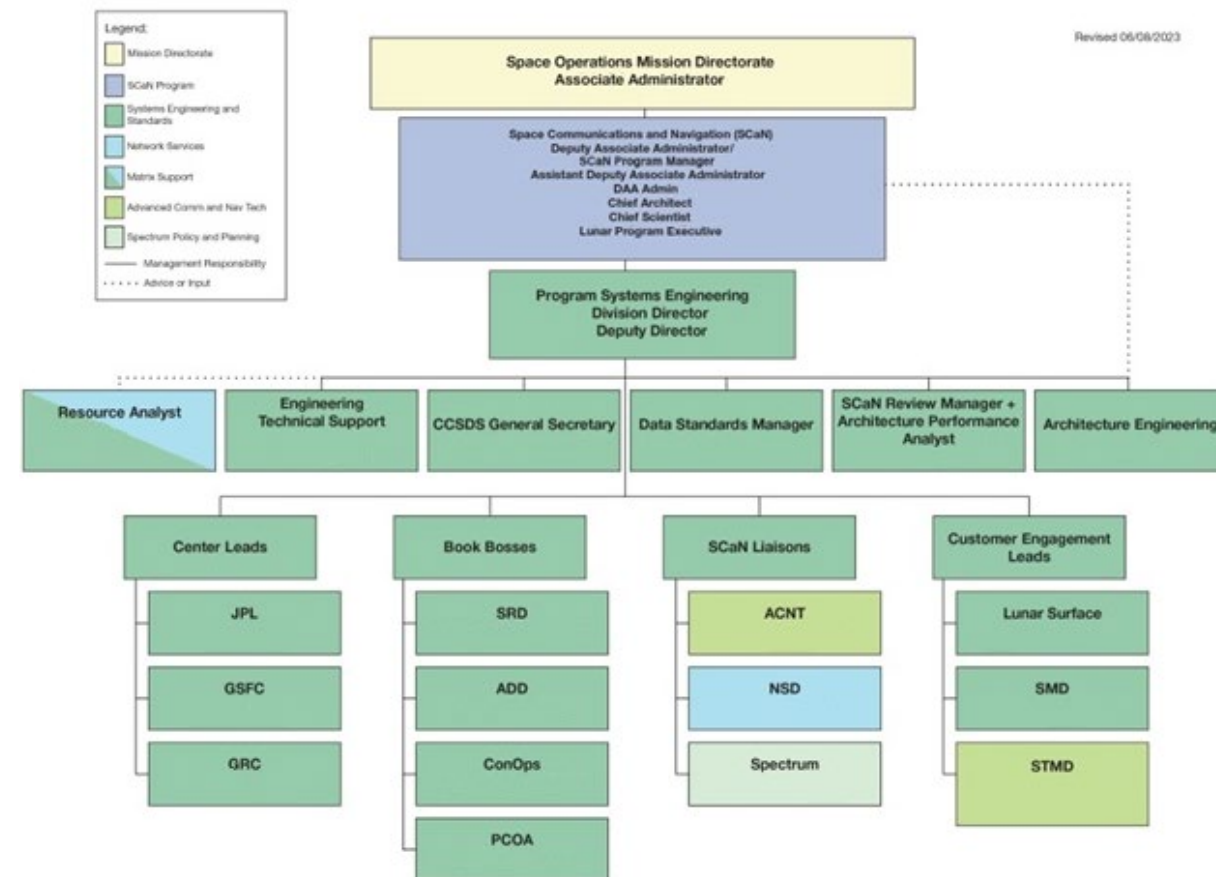
Outline of Topics

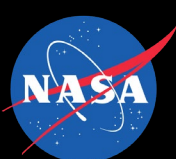


- **Topics**
 - Organizational Role and Digital Engineering
 - Digital Engineering Environment, Tools, and Users
 - Data Types, Sources, and Products
 - Update since 2022 and Future Work

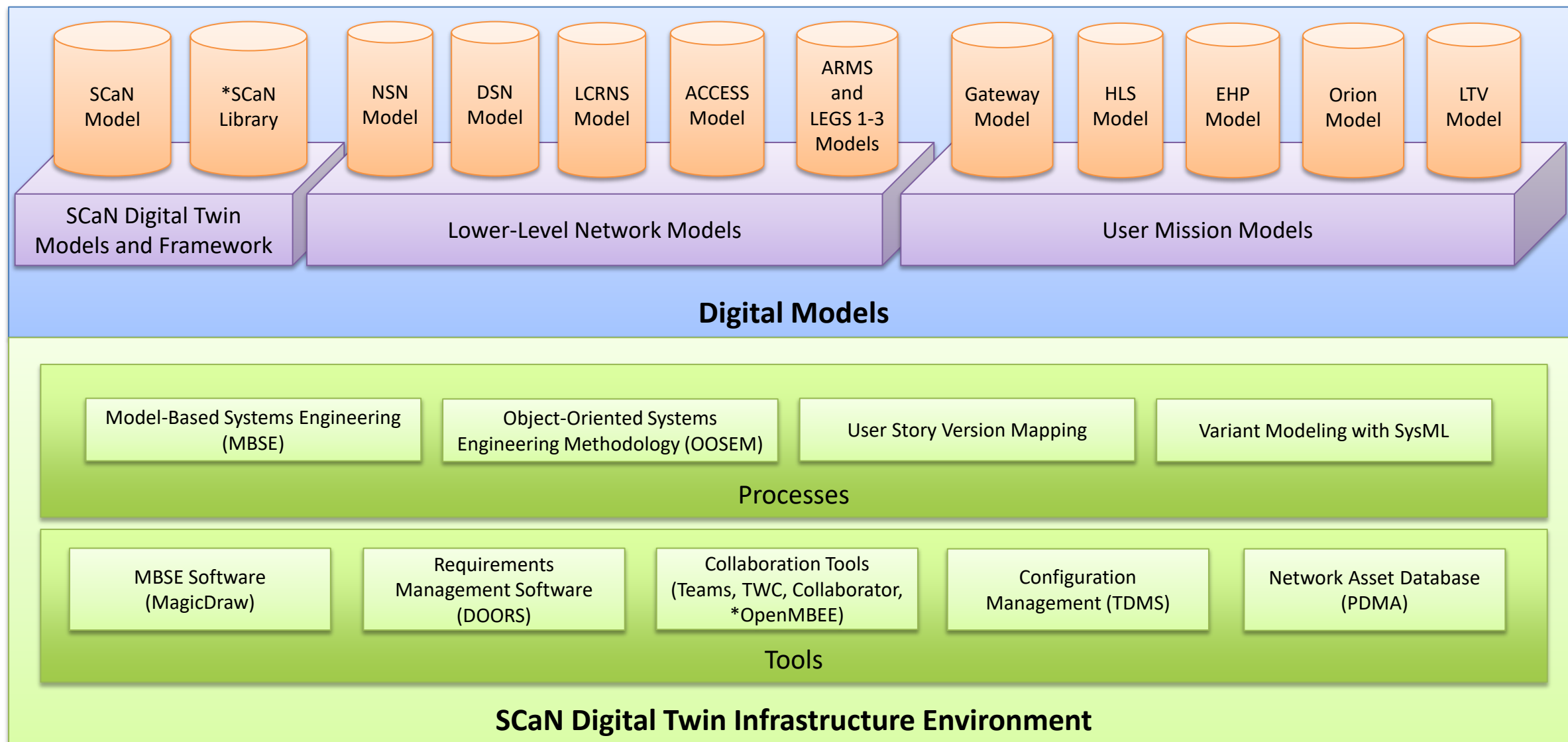


- **SCaN PSE's organizational role is to create a nationally and internationally interoperable space communications architecture – strategic objectives include:**
 - Define the Next Generation Architecture, including necessary standards
 - Support Science and Exploration programs and initiatives to define needed SCaN capabilities
 - Develop the next generation of SCaN systems engineers
 - Develop the necessary standards
 - Identify with ACNT and PSC high leverage technologies and plan infusion with NSD into the program architecture
 - Maintain the SCaN Technical Baseline
 - Engage stakeholders, national and international partners in SCaN architecture planning
- **SCaN PSE's digital engineering objectives all revolve around architecture development:**
 - Define and maintain SCaN architecture
 - Connect and integrate lower-level and external Communication and Navigation (C&N) architectures
 - Leverage digital environment to perform network analyses



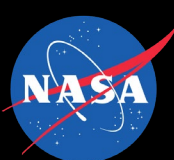


Digital Engineering Environment, Tools, and Users

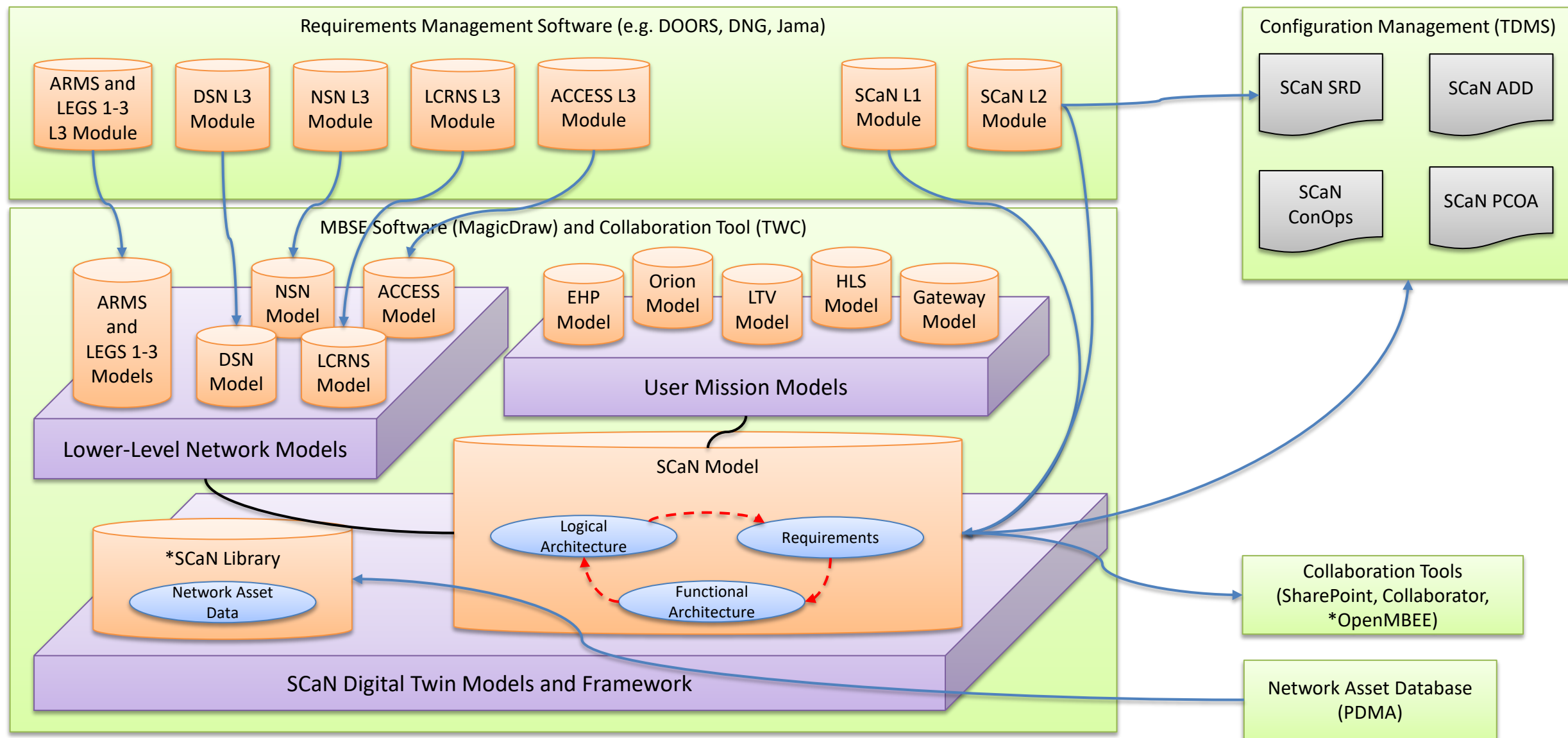


**Development item – not fully implemented*

Update the marking appropriately
for your content and per your program's export control

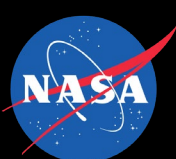


Digital Engineering Environment, Tools, and Users



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Digital Engineering Environment, Tools, and Users



What is your current Digital Engineering Environment?

- Environment is comprised of a variety of digital models: SCA_N DT and framework, lower-level network models, and user mission models
- Requirements source-of-truth for SCA_N and its lower-level networks is in DOORS
 - One-way sync to MagicDraw models
- SCA_N Requirements and logical/functional architecture are fully traced in SCA_N MagicDraw model
 - Same is done for lower-level network models via project usage
- SCA_N model and its diagrams are exported to collaboration tools and used in program documentation

Who are your users and admins?

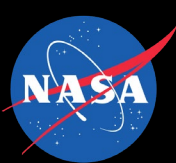
- Administrators:
 - SCA_N GSFC PSE: Patrick Barnes (DOORS), Keenan Murabit (MagicDraw)
- Users:
 - SCA_N PSE
 - Lower-level networks (e.g. NSN, DSN)
 - User missions (e.g. Gateway, Orion, HLS)

What are your digital tools (COTS, custom), and where are they hosted (Cloud or on-premise)?

- Requirements management: **DOORS**
 - Hosted on GSFC DOORS server
- MBSE: **MagicDraw**
 - Hosted on NASA TeamWork Cloud (TWC) server
- CM: **Technical Data Management System (TDMS)**
 - Hosted on GSFC server
- Collaboration: **Microsoft Teams**
 - Hosted on NASA server
- Network asset data: **Program Data Management & Analysis (PDMA)**
 - Hosted on NASA server

Where and how do you collaborate amongst your team?

- Regular working group meetings (via Teams) are used to collaborate within the SCA_N PSE team as well as with external stakeholders, separately
- ACD Modeling Coordination Working Group is used as the primary avenue for collaboration with lunar missions, with separate meetings scheduled on an as-needed basis with the individual projects
- Collaborative modeling is accomplished via TWC server models



Data Types, Sources, and Products



Describe your data, products, and sources?

- Data:
 - Requirements (text and associated attributes)
 - System architecture (logical and functional elements and their interfaces)
 - Network asset and user mission attributes
 - Concept of operations (network services)
 - Traceability (allocations within and between requirements, logical elements, and functions)
- Products:
 - Full network model
 - Architecture analyses outputs
 - Program documentation
- Sources:
 - DOORS (requirements)
 - MagicDraw (other network and system models)

Where are the data stored (repository, or collocated with tools like PLM)?

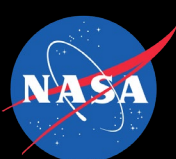
- Requirements data stored in DOORS (GSFC DOORS server)
- System architecture data stored in MagicDraw (NASA TWC server)
 - Network asset attributes stored in PDMA (NASA server)
- Program documentation stored in TDMS (GSFC server)

Where in the Life Cycle are they needed (milestone reviews, ops)?

- SCA Digital Twin data, products, and sources are implicated at all life cycle phases from pre-formulation through operations

How are you exchanging data with your vendors, customers, and stakeholder orgs (within Gateway, M2M)? Any integration needs?

- While regular collaboration and coordination is accomplished via working groups, data exchange occurs within the MagicDraw tool via TWC server models
- Needs from SCA user missions include sharing system models – including requirements traceability
- The goal is to create a complete Artemis C&N architecture starting with SCA-specific capabilities and expanding to include other lunar exploration systems



Update Since 2022 and Future Work



<p><i>What are major accomplishments since 2022?</i></p> <ul style="list-style-type: none">• Baselined DT v1.0<ul style="list-style-type: none">• Established connections to user mission and lower-level network models• Captured and traced all derived requirements and their attributes• Defined complete architecture at SCaN level with traceability• Enabled requirements impacts analysis feature Suspect Links to track against changes to SCaN requirements	<p><i>What were/are the challenges and lessons learned?</i></p> <ul style="list-style-type: none">• Common framework for modeling and collaboration• Data sharing access and permissions• Incompatible software/tools• Prevailing solution for most challenges has been further diligence and collaboration – increasing stakeholder involvement in the process
<p><i>What is your plan for forward work and goals?</i></p> <ul style="list-style-type: none">• Future versions of DT<ul style="list-style-type: none">• Higher fidelity impacts analysis (performance measures)• Requirements reconciliation to assess user mission requirements not met by SCaN services<ul style="list-style-type: none">• NSN generalized mission architecture and attributes• Develop views for collaboration via OpenMBEE• Continue to establish external model connections• Develop projected SCaN architecture variants• Incorporate network loading study to inform user missions on network availability	<p><i>What are your key needs from other programs/projects/org?</i></p> <ul style="list-style-type: none">• C&N models and capabilities from Artemis components• Continued involvement from lunar missions in C&N modeling• Further buy-in to leverage current SCaN DT use cases and help mold future use cases



Backup