SMC: SCENIC MODEL CONTROL
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Presentation Agenda

• Motivation
  ▪ SCaN
  ▪ SCENIC
  ▪ Model Based Systems Engineering

• Overview of Project SMC

• Modeling
  ▪ About MagicDraw
  ▪ Structural Diagram
  ▪ Functionality
  ▪ Internal Architectural Diagram

• Simulation
  ▪ Interaction between components
  ▪ User Interface inside MagicDraw
SCaN manages and directs:

- The ground-based facilities and user services provided by the **Near Earth Network (NEN)** and **Deep Space Network (DSN)**;
- The ground- and space-based facilities and user services provided by the TDRSS **Space Network (SN)**
SCaN future objectives:

- Integration of existing NASA SCaN assets, building a single NASA-wide space communications and navigation network;
- Implementation of data communication protocols for Space Exploration missions that are internationally interoperable.
- Meets the future needs and commitments to provide space communications and navigation services to missions.
SCENIC Mission Statement: Provide a strategic center for education, networks, integration, and communications to collaboratively define and address the needs of future NASA communications.

Modeling and Analysis Goals

- Development of current SCaN Network models that are expandable, verifying proposed future architectures;
- Capacity Modeling of the existing and future SCaN Networks;
- Simulation of the network communication and navigation infrastructure space and ground networks.
Why Model-Based Systems Engineering?

- Enables system-level model capture
  - Formal, accurate, authoritative single source
  - Contains elements, relationships, interactions
  - Multiple compatible views, e.g. physical/functional
  - Requirements verification and traceability

- Enables integration of models and simulations
  - Connect system-level model to analytical tools (STK, OPNET, MATLAB etc.)
  - Execute dynamic simulation of end-to-end mission
  - Identify failure to satisfy requirements
  - Accommodates re-evaluation when design changes occur

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SysML Model of a System

Analytical Tools
Project Mission:
To develop a SCaN network model with its architectural elements in an evolutionary and expandable format. SMC is a framework utilizing a modular approach with MagicDraw as the primary User Interface Software.

SMC Task Objectives:
• Model SCaN ground networks and desired user missions in SysML
• Perform capacity modeling and coverage analysis of SCaN Network assets based on SCaN Mission Loading.
• Integrate the developed tools and wrappers thru a custom MagicDraw User Interface.
• Development of a Control Module which facilitates transfer of model information and generated reports via custom XML communication schema.
SMC Capacity Modeling Tools

End Products of SMC:

- Optimized User Mission Schedule for modeled mission set generated by STK Scheduler
- Link Budget Reports between satellites and a Ground Stations using STK
- Network performance reports between Satellites and Mission Operation Centers (MOC) using OPNET
SIP Project questions:

– How does one integrate the NEN and SN ground station information within a single database?

– How does one seamlessly integrate simulation tools for the purpose of performing future capacity modeling?

– How do changes in the configuration of SCaN networks and spacecraft missions impact future system performance and requirements?
Selected MBSE tool: MagicDraw by No Magic Inc.

- Present a high level architectural framework of the system components
- Act as the User Interface to initiate processes inside the system
- Integrate databases and software such as STK and OPNET via a custom developed plugin.
SMC Structure

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Functionality of SMC

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MagicDraw Plugin (developed using Java And Eclipse IDE)

Web hub to interface application tools

Simulation tools
Block Definition Diagram

SMC Block Diagram as viewed by the SMC project user
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Internal Block Diagram (IBD) captures the structure, behaviors and interactions between the elements.
SMC Element Interaction

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User Interfaces for data access

Plugins and Interfaces

Analytical Tools
- OPNET
- STK

MAGICDRAW INTERFACE

ESCMM Satellite Selection UI

PLUGIN
- Pulls data from model
- Presents real-time updates
- User toggled simulation components
- Receives generated reports

CONTROL MODULE WEB INTERFACE
AGI’s Systems Tool Kit (STK) simulates:

- Orbital Dynamics
- Link Access
- Propagation Delay
- Bit Error Rate
- Noise Interference

Link Budget Calculations and other reports sent to OPNET via XML for further Analysis
OPNET Radio Transceiver Pipeline

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**Simulation**
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- Builds network simulation model
- Generates network model based on ground network and mission simulation parameters
- Schedules tasks provided by STK to simulate networking between modeled objects
- Modified OPNET radio transceiver pipeline to utilize link budget reports from STK, rather than OPNET calculations, for propagation delay and bit error rate (BER) parameters
Questions / Comments / Snide Remarks?

THANK YOU IAC

Glenn Research Center
Lewis Field