Raytheon Technologies

Building a Digital Engineering Ecosystem using Syndeia

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Digital Engineering Terminology

- The DoD defines digital engineering as an integrated digital approach that uses authoritative sources of system data and models as a continuum across disciplines to support lifecycle activities from concept through disposal.
- The DAU Glossary defines a digital engineering ecosystem as an interconnected infrastructure, environment, and methodology (process, methods, and tools) used to store, access, analyze, and visualize evolving systems' data and models to address the needs of the stakeholders.
- Digital threads are extensible analytics frameworks to connect models and all associated data, software, and functional support governing more than one system lifecycle phase with one-to-one real-world traceability.*
- Challenge: Different tools (data repositories) are used in the design, development, deployment and sustainment of a system. Many/Most of these tools do not integrate with each other, so we need an integration platform (or a digital engineering ecosystem) that can interconnect these tools.

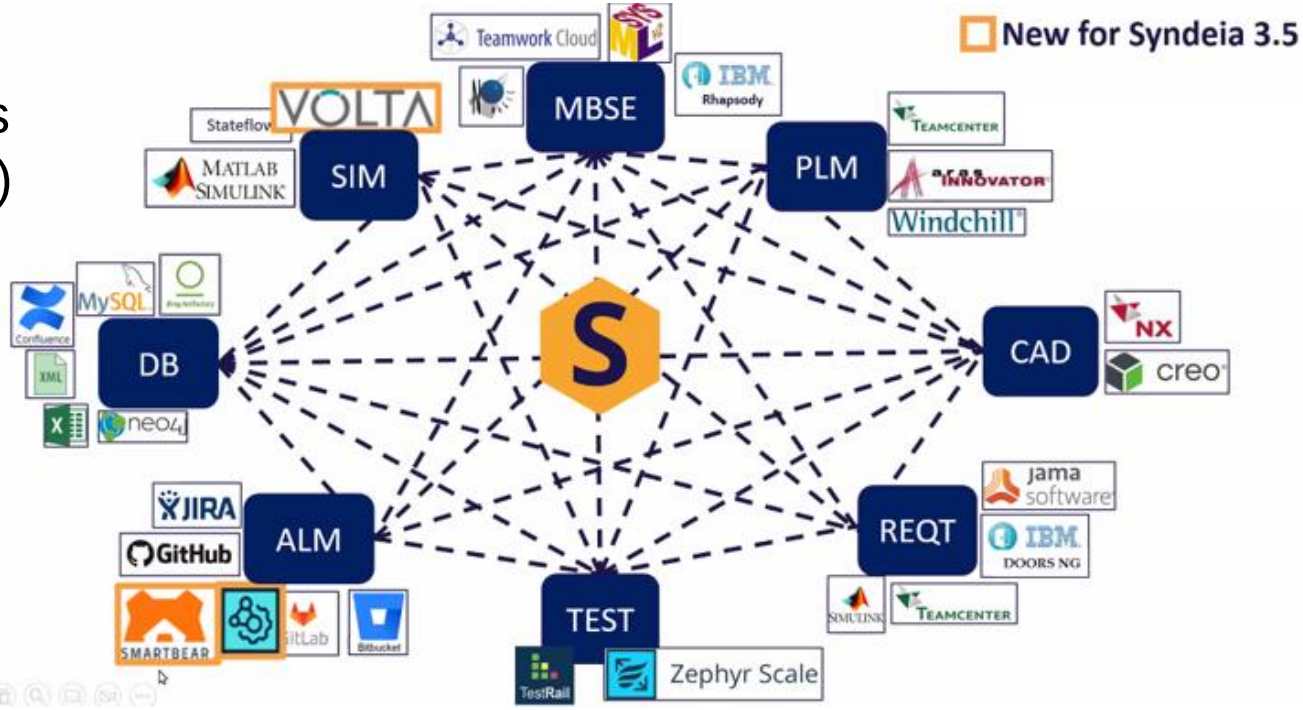
*Dr. Will Roper, There is no Spoon: The New Digital Acquisition Reality

Digital Engineering Use Case

- Provide system stakeholders with visibility into the system.
- For example….
  - *Determine Impact of a Change to the System (e.g., Requirement, Model, Part)*
  - *Determine Impact of Simulation to the System (e.g., Validate or Invalidate a Requirement)*
- To do this, I will need a digital engineering ecosystem that …
  - *Enables the integration of data repositories, i.e., requirements database, SysML model, PLM system*
  - *Provides a framework for creating digital threads across data repositories*
  - *Provides a mechanism for Querying / Visualizing Digital Threads*
  - *Provides a way to Compare/Sync Data Repositories*
  - *Is able to perform model/data transformations, e.g., DOORS-Next Requirement -> SysML Requirement*

Intercax's Syndeia Digital Engineering Platform

- Syndeia is a software that uses a SysML System Architecture model as the mechanism to coordinate with other models in other engineering tools (e.g., Creo, DNG) and data repositories (Simulink, MySQL)
- Syndeia provides capabilities for building, managing, analyzing, querying, and visualizing the digital thread of the product/system through its lifecycle.
- Syndeia builds on open standards (e.g. REST/HTTP, JDBC, and OSLC) and production ready APIs



Why Syndeia ?

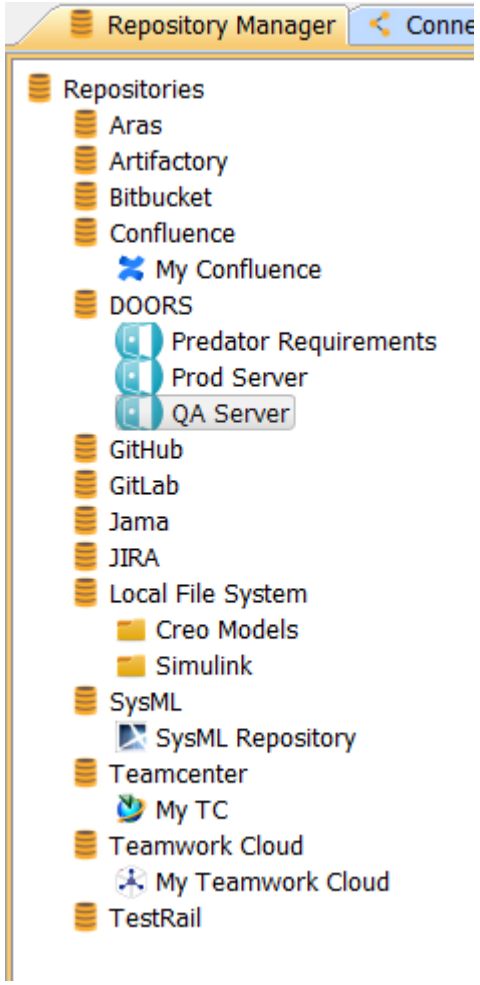
- Syndeia satisfied the program's digital engineering requirements
- Provided out-of-the-box integrations with the desired tools in our digital engineering environment
  - Cameo System Modeler, DOORS-Next, Creo, Teamcenter, others
- Not many commercially available digital engineering ecosystems to choose from in late 2020
- Intuitive user interface
- Lots of videos and tutorials for getting started

Syndeia Services

Syndeia Services	Description
Search	Query the entire digital design for related elements based on the search criteria. The search returns a list or graphical representation of design elements in each repository.
Connect	Create a persistent connection between selected design elements within their respective configuration controlled repository.
Access	Allow the user to access the design element in its native format and tool if the user has the required access permissions.
Transform	Transform a design element from one format to another. For example, a transform allows a user to create SysML requirements from DOORS-NG requirement modules.
Compare	Allows the user to compare a digital thread with the current design data in the SSoT identifying differences.
Synchronize	Allows the user to accept and update one design element based on a change in another element. For example, if the current requirement in DOOR-NG has changed, the user can accept and update the corresponding requirement in the SysML model.

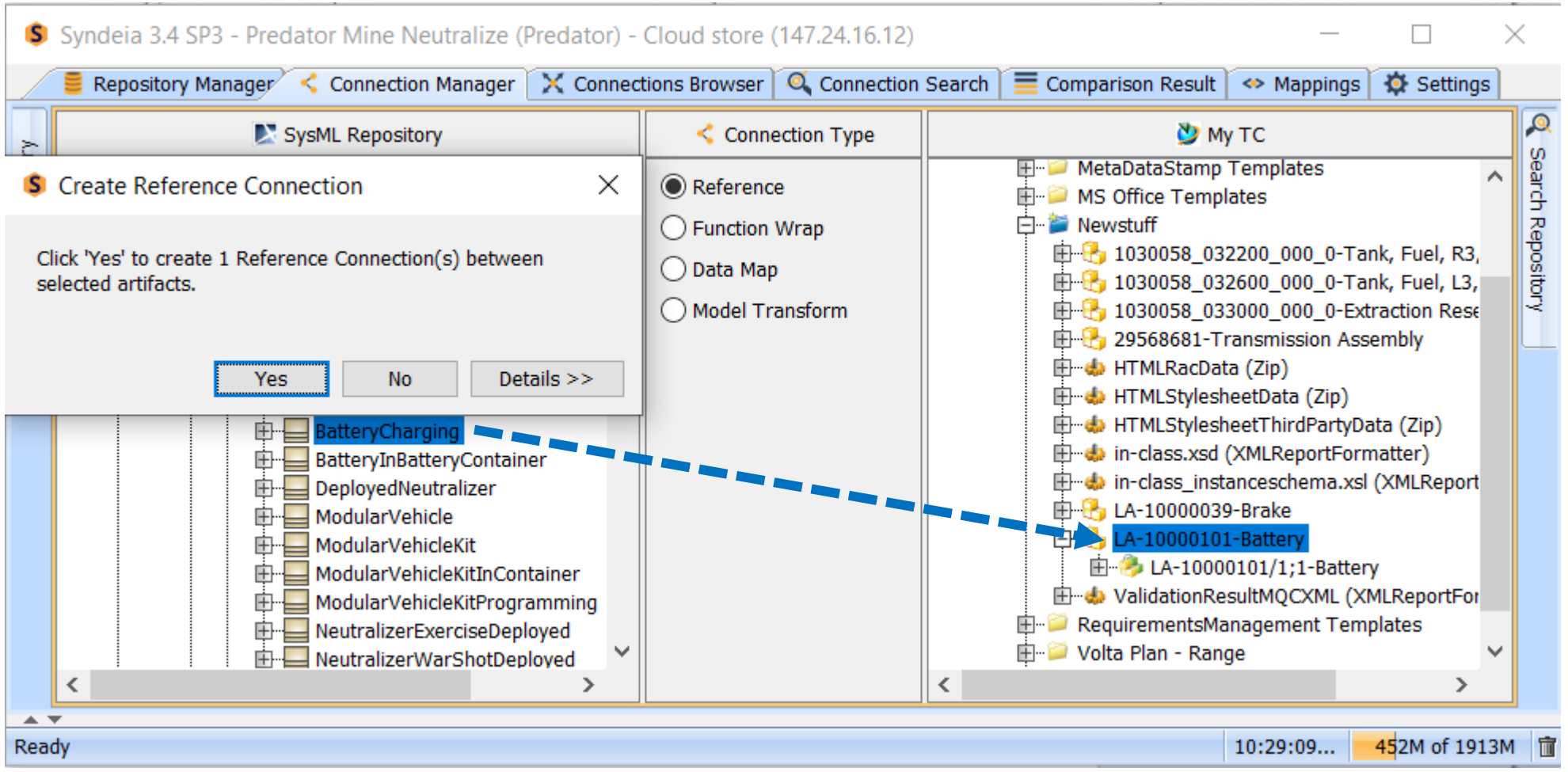
Syndeia Digital Ecosystem Environment

- Syndeia v3.4 MagicDraw Plugin and Syndeia Cloud
- Program's Data Repositories
  - Cameo EA and Teamwork Cloud
  - DOORS-NG
  - Teamcenter
  - Creo
  - Jira
  - GitHub
  - MySQL
  - Volta (MDAO) coming in v3.5
  - Matlab/Simulink
  - Excel



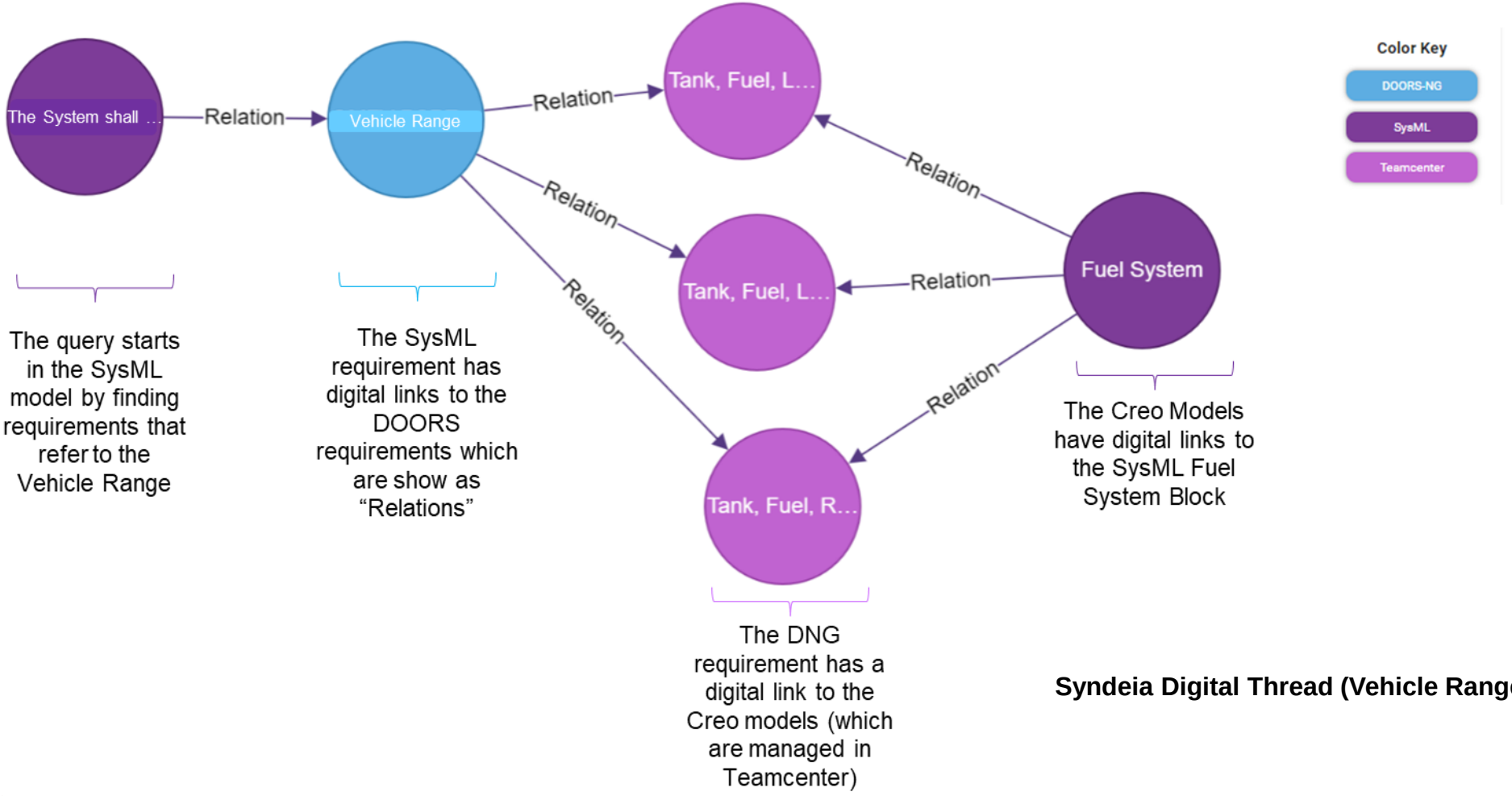
Syndeia Reference Connections

- Drag and Drop Reference Connection aka Digital Threads are created between engineering artifacts. For example, a Creo model or part (managed in Teamcenter) and a SysML block.



Syndeia Digital Thread Example

This Syndeia digital thread query shows the digital thread for the Vehicle Range from its system requirement, to the DOORS-Next performance requirement to the digital design models (e.g., Creo) to the physical block in the SysML model. Note that the Creo models are configured managed in Teamcenter. This digital thread is used to conduct impact analysis. For example, if the vehicle requirement changes, we can understand the downstream impacts.



Syndeia Digital Thread (Vehicle Range Example)

Impressions

- Syndeia is good at connecting artifacts across different engineering repositories, e.g., DNG, Teamcenter, etc.
- Meets the current needs of our programs.
- Cameo is being used as the main user interface to coordinate with other models in other engineering domains, e.g., DNG, Creo, etc.
- Syndeia Web Console is the main user interface to visualize digital thread
- “Local Repositories” should not be used (because they are local!)
- Besides Syndeia Reference Connections (digital threads), Syndeia provides a useful model transformation between DNG requirements and SysML requirements
  - Syndeia provides other types of transformations, such as SysML IBD <-> Simulink but this may blur the lines between which model is the source of truth
- Defined process for creating “reference connections” is required
  - Who creates and manages the links
  - so that directionality of the link is consistent (or it gets confusing when you are visualizing the graph)
- Syndeia provides a lot of videos and training material

Digital Engineering Lessons Learned

- Define the process for creating “reference connections”
  - Who creates and manages the links
  - Directionality of the link are consistent. Note: SysML is always identified as the source of the link.
- Identify what types of links (digital threads) you want to create. For example:
  - Create reference connections from DOORS-NG functional requirement(s) to its SysML <<functional>> block to show a <<satisfy>> relationship
  - Create reference connections from a Teamcenter part/item/assembly to a <<physical>> SysML block to show a <<satisfy>> relationship
- Establish operational and QA environments for Syndeia
  - For testing out new patches and upgrades
  - QA environment for training / experimentation
- Use caution if using “Local Repositories” (because they are local!)
- Configuration manage your data repositories
  - Teamwork Cloud for Cameo
  - Global Configuration Management (GCM) for DOORS-Next

Digital Engineering Lessons Learned (continued)

- Use Syndeia Dashboard for adding repositories and defining reference connections
  - Syndeia Dashboard uses URLs to connect to data repositories
  - Creating reference connection is drag and drop action
- Use Syndeia Web Console for visualizing digital threads.
  - Syndeia Web Console uses web interface to connect to data repositories
  - Creating reference connections is based on a series of menu items (that can be confusing)
- Once you get a data repository connected it will show up in both the Dashboard and the Web Console.
- Customer wanted “digital thread” as a deliverable, but customer did not have or would have Syndeia as part of its digital acquisition environment. Workaround was to export reference connections in Excel and deliver that.

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Bio

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Abstract

A Digital Engineering (DE) ecosystem provides the interconnected infrastructure used to store, access, analyze, and visualize evolving systems' engineering artifacts (models and data) throughout its lifecycle. It is comprised of interconnected digital models, data repositories and engineering environment that enables the creation of the systems' digital thread. Model Based Engineering (MBE) is a critical component to our DE approach. MBE is an integrated engineering approach that uses authoritative sources of system data and models as a continuum across disciplines to support lifecycle activities from concept through disposal. This presentation will discuss creating a digital engineering ecosystem using Syndeia from Intercax and the associated digital engineering use cases and processes for creating the digital thread.

Thank you.