Transforming Engineering:

Implementation of Cross Domain Configuration Management (CDCM) at Bosch

Thomas Schwartzkopff

Dr.

Professional experience

- Over 20 years working as Engineer at Bosch Mobility in various positions (central functions & engineering)
- 7 years Chief Expert for Model-Based Engineering. Responsible for Method Framework, MBSE Trainings, Digital Thread and Engineering Ontologies in the Mobility CTO office.
- PhD in Numerical Methods for Aeroacoustics Simulation, Stuttgart University
- Master Degree in Aeronautical Engineering, Stuttgart University

Expertise

- Systems Engineering
- Model Based Engineering
- Model Based Safety & Security
- MBSE Training & Coaching
- Product Engineering
- Micromechanical sensors (MEMS)
- Numerical Simulation

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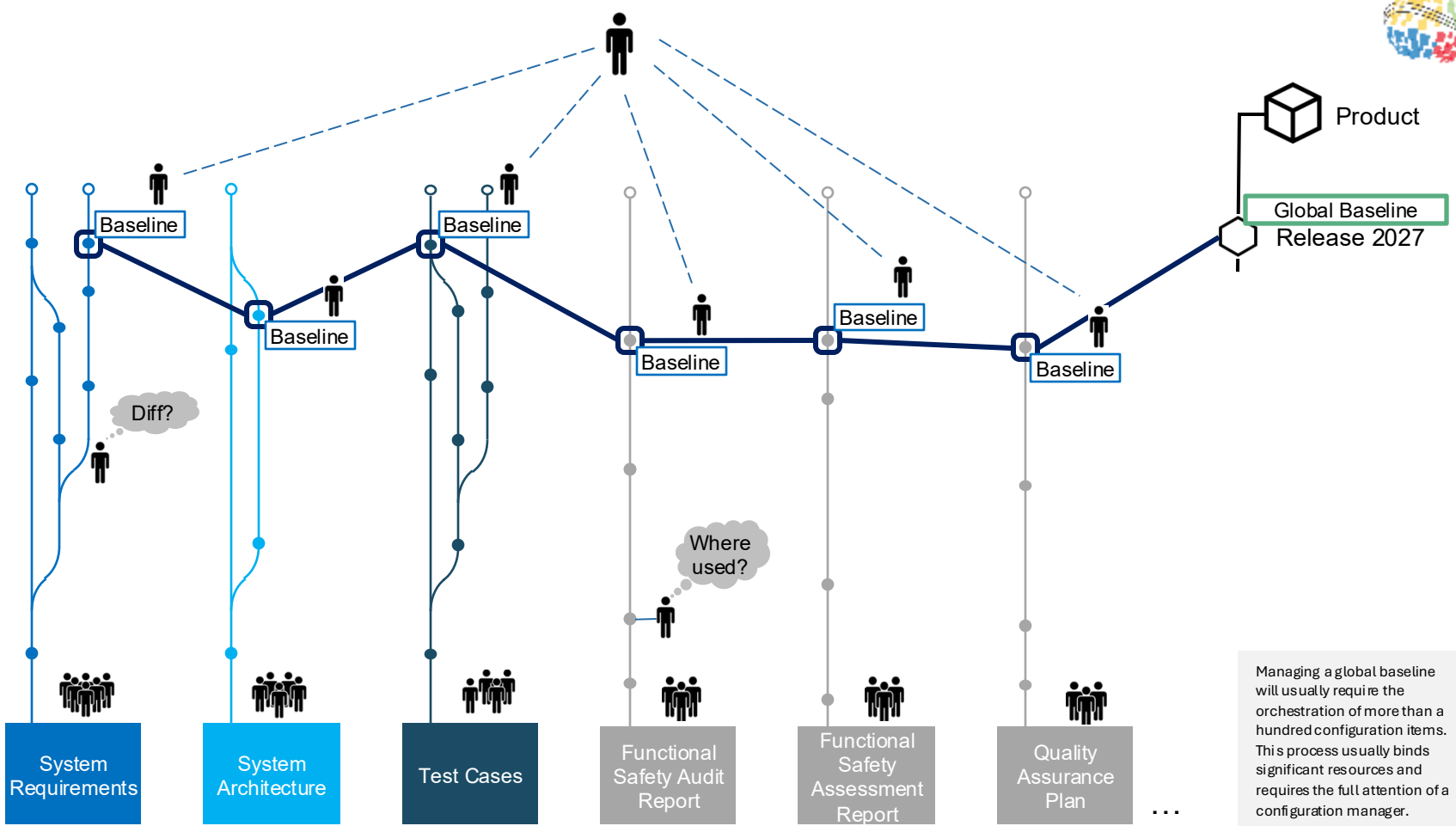
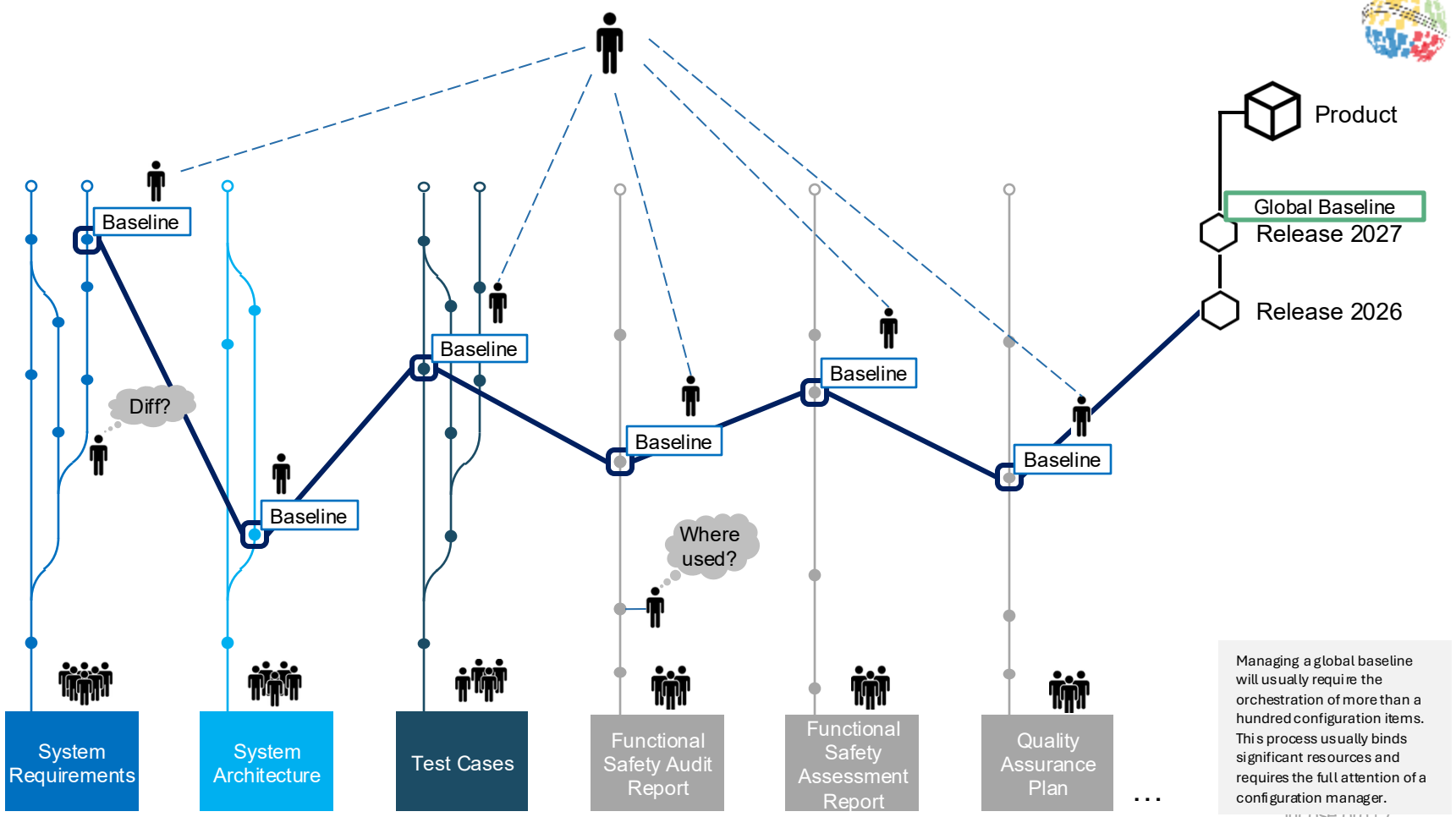
Concept &Tool Overview



Managing a global baseline will usually require the orchestration of more than a hundred configuration items. This process usually binds significant resources and requires the full attention of a configuration manager.



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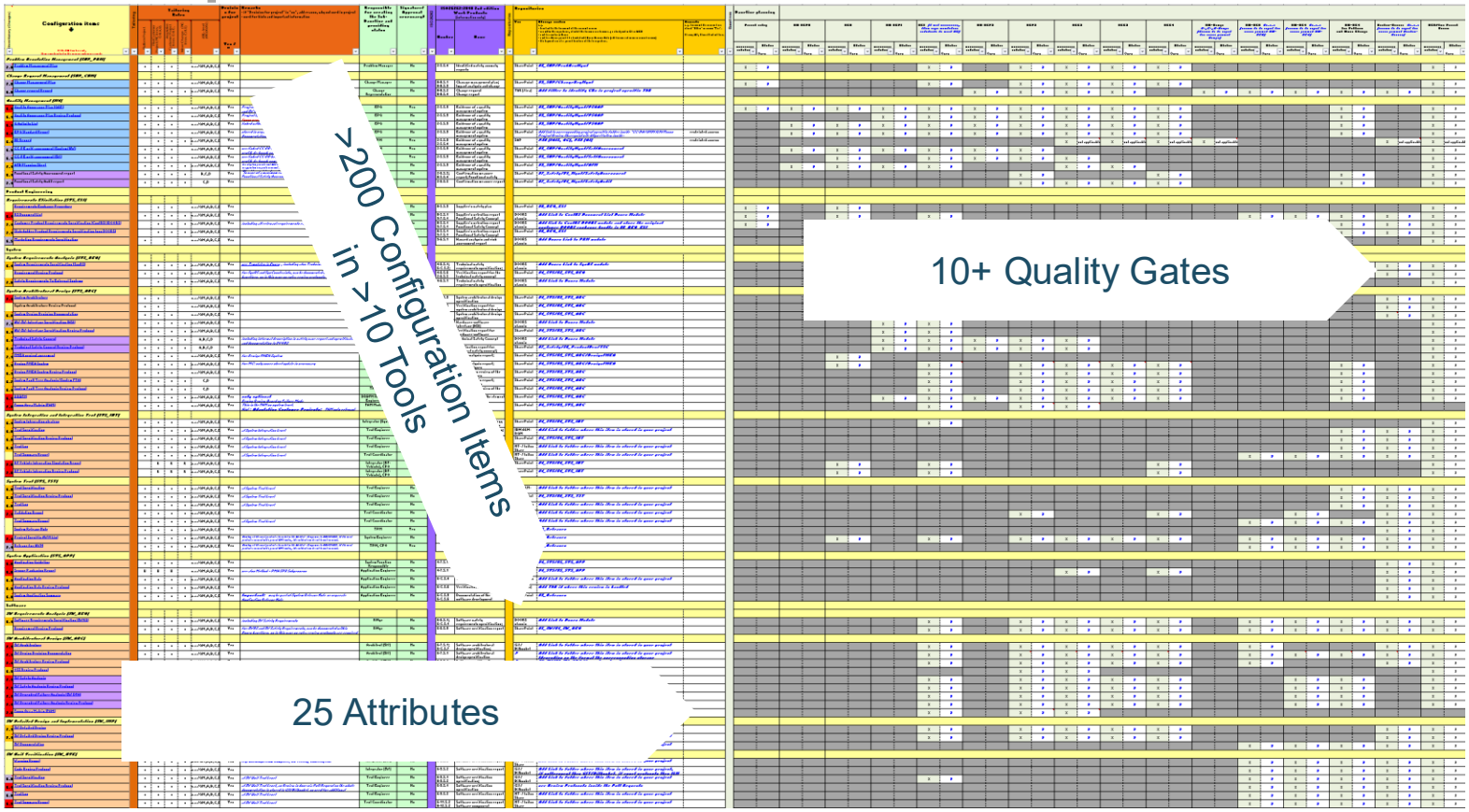
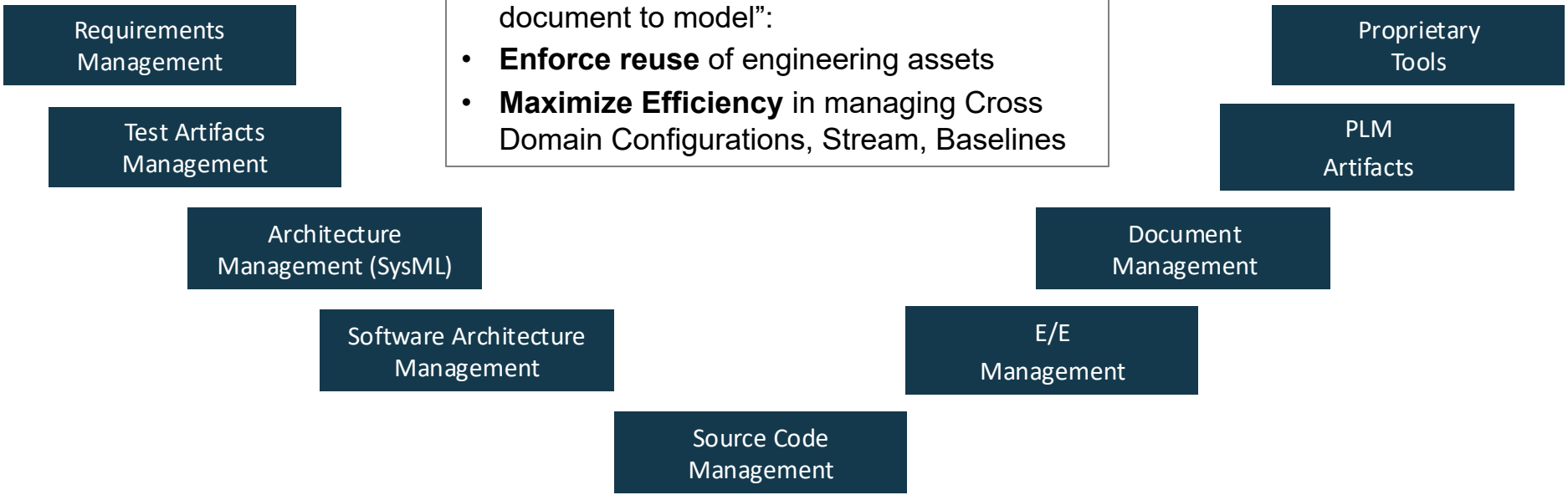
Most Companies do CDCM in Excel



Overall Targets of the to be Built CDCM Platform

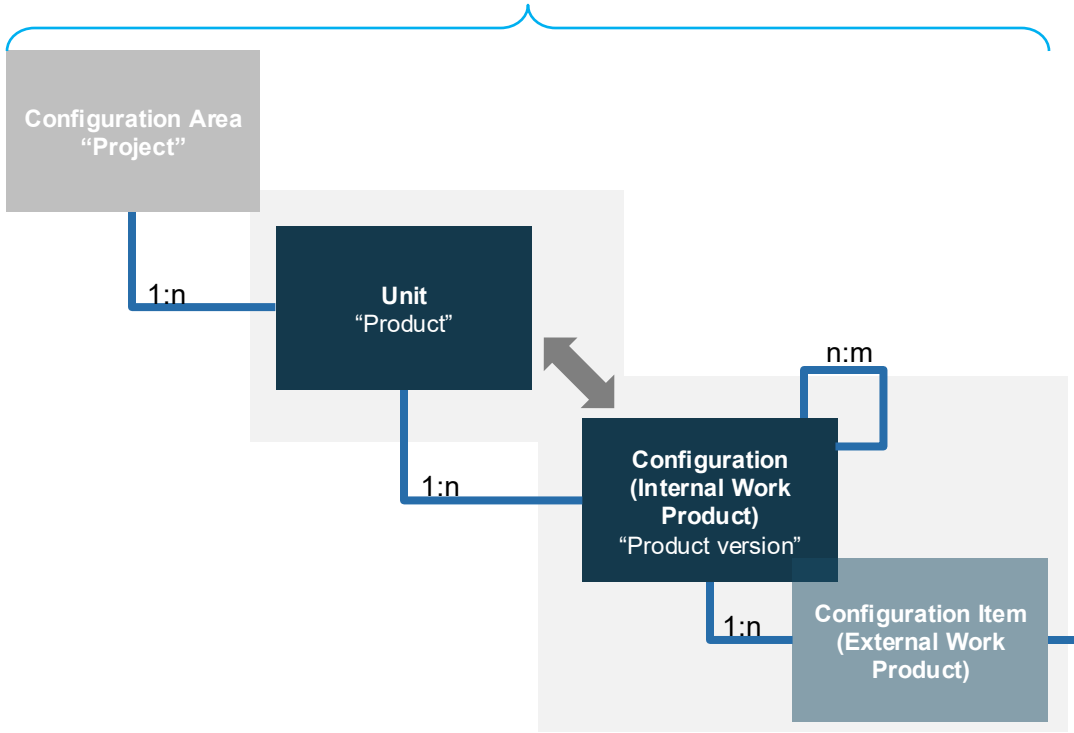
- Define a **comprehensive digital representation** of the product “from document to model”:
- **Enforce reuse** of engineering assets
- **Maximize Efficiency** in managing Cross Domain Configurations, Stream, Baselines



Vision 2035 names Fragmentation of Disciplines and Cross Domain Integration a major challenge

Core Data Model

Concept Types
All concepts can be defined in meta model, user interface and behavior.
E.g. product as engineered versus off-the-shelf product

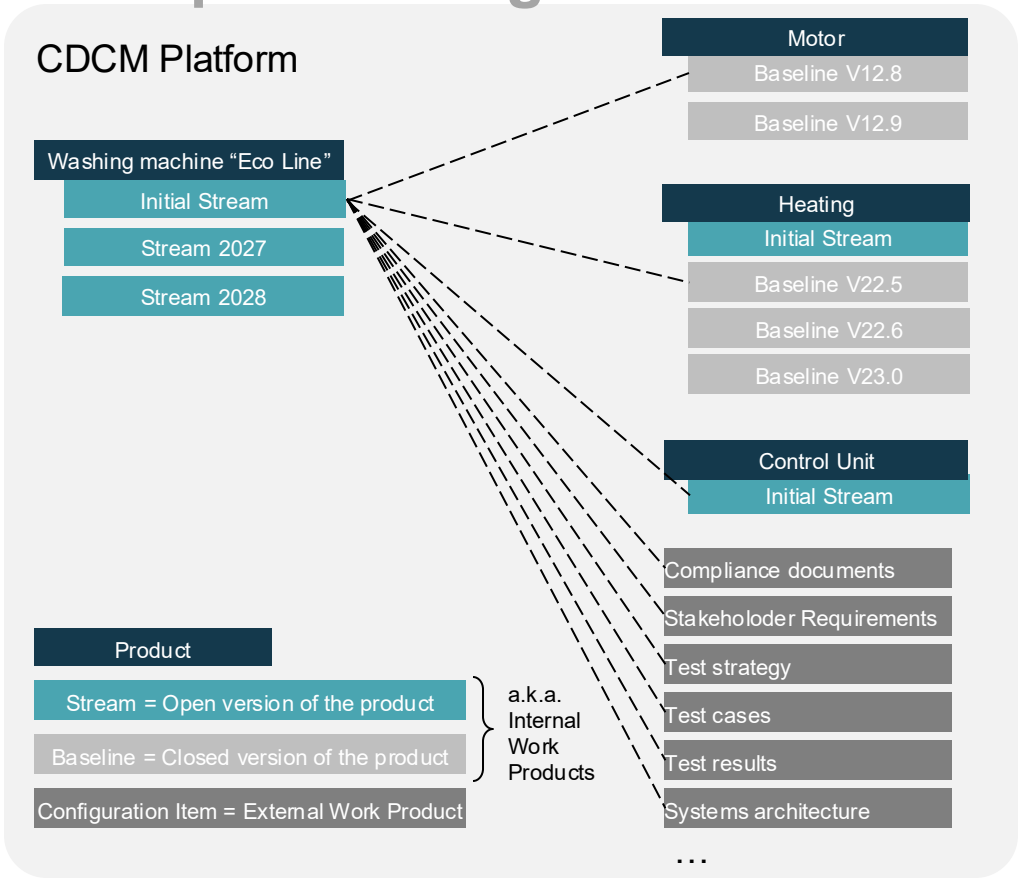


Authoring Tools

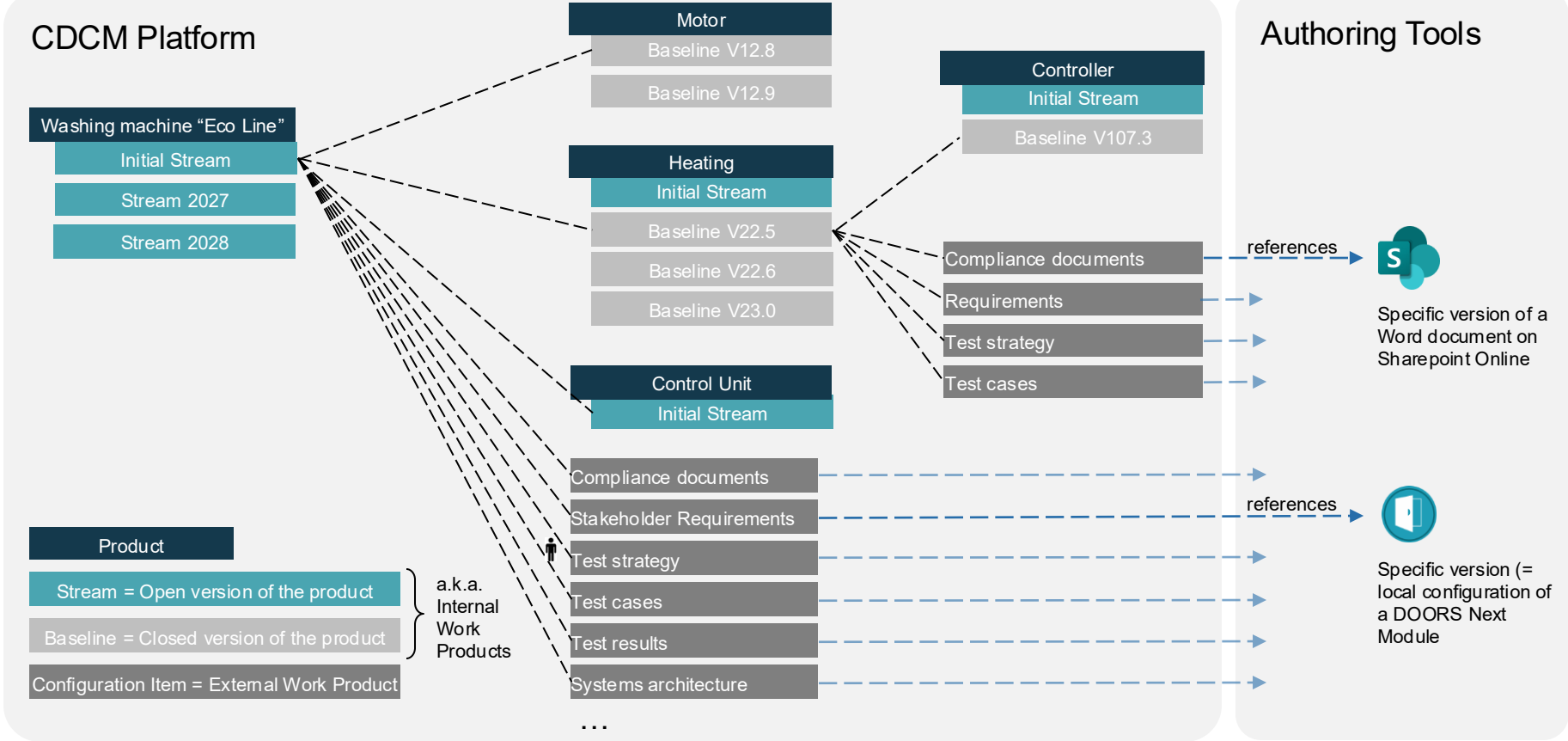
Connectors available today

- Codebeamer
- Codebeamer Documents
- DOORS 9.x
- GIThub Cloud
- GIThub Enterprise
- Jama Connect
- IBM ELM - DOORS Next
- IBM ELM - ETM
- IBM ELM - RMM
- PREEvision
- Pure Variants*
- Sharepoint Online Documents
- Smartfacts
    - Cameo Systems Modeler
    - Enterprise Architect
    - Matlab Simulink
    - Rhapsody
- Teamwork Cloud

Example Washing Machine



Example: Cross-Domain Configuration of a Washing Machine



Configurability & Extensability

Meta Data Level

- For each concept (unit, configuration, configuration item) multiple **types** can be defined with varying meta model
- Each concept type has its own **state machine**. Each state transition triggers a free to be defined java script code

UI-Level

- **User interfaces** and OSLC delegated UIs of all concepts can be freely configured
- **User interface behavior** can be defined, syntactical and logical validations are configurable

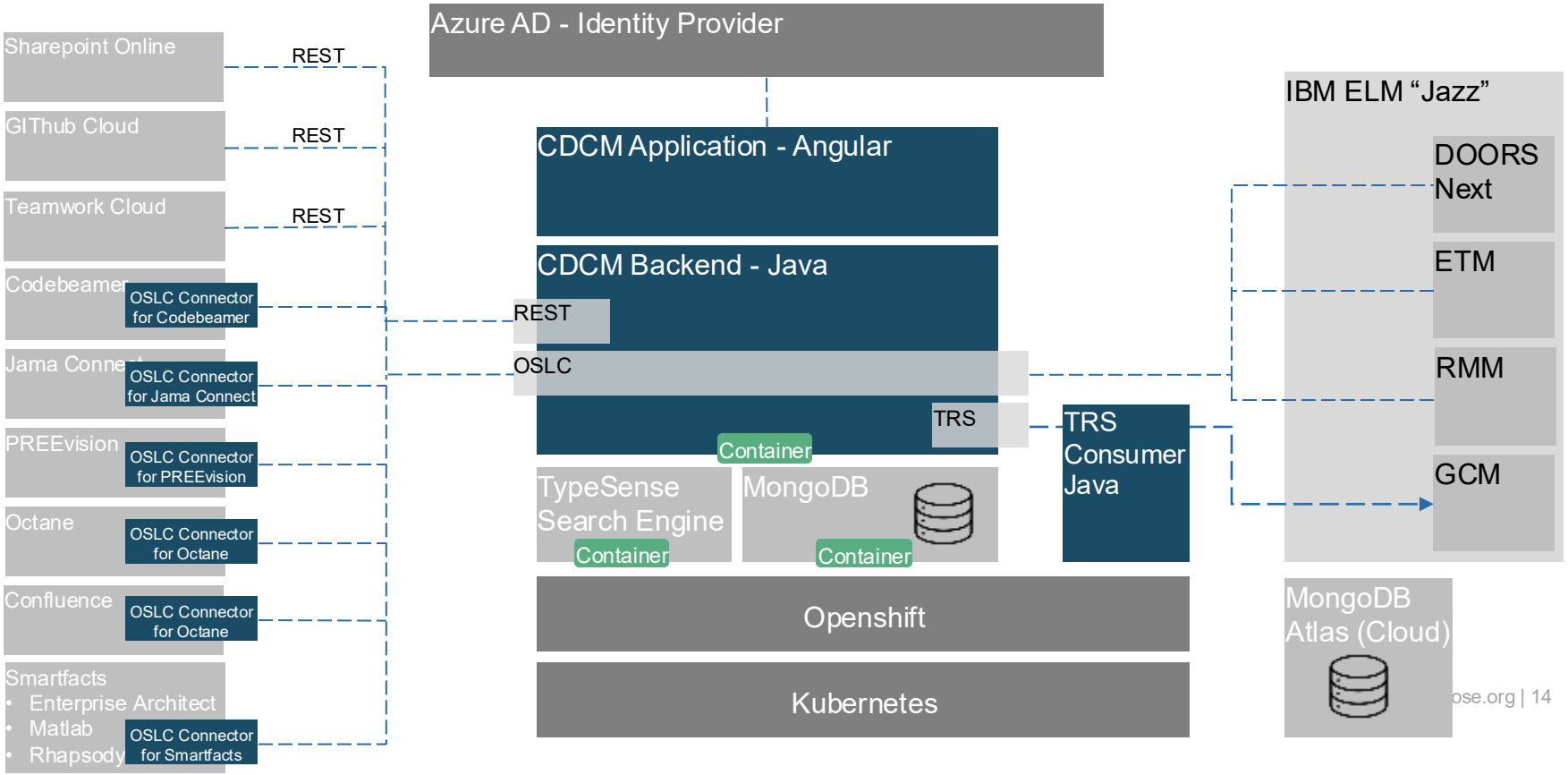
Data Level

- **Master Data** can be integrated, maintaines via REST and referenced in the user interface
- **VEL compliance** allows to define variant points in configurations and configuration items.

Extensive REST-Layer

- An **extensive REST API** supports integration and automation scenarios
- **Extension point for tool integrations** allows to easily build more tool integrations even to proprietary tools

CDCM Technology Stack



Features of CDCM 07 / 2025

Highly Configurable

- Data Model
  - Properties based on primitive data types with syntactical validation
  - Records = multi value properties
  - Master Data = externally synchronized
  - Calculated Fields
- User Interface
  - UI areas to be customized via forms builder
  - Fields can be masked
  - Master data selectors
- Behavior
  - Guards allow multi-field validations
- Data
  - Master Data can be maintained via REST

Integration Mechanisms

- Public REST layer providing 100+ endpoints
- Externally defined editors can be integrated
- OSLC TRS provides a TRS stream of Units, Configurations and Configuration Items
- OSLC Config Management is used to integrate authoring tools (OAuth1.0a / OAuth2)
- Integration with OIDC enterprise authentication providers
- Support of VEL (Variability Exchange Language)*

Rich Functionality

- Definition of hierarchical Units, Configurations
- Templates for creating new Units with pre-defined configuration items
- Branching, Baselining, Partial Baselining
- Search, where-Used, analysis can be stored
- Tagging of Units abd Configurations
- Compare functionality
- Configuration Clash / Skew
- Audit Trail / Derivation History
- Favorites / Recents
- Internal and external Delegated UIs for Units and Configurations
- Configuration picker Integration via OSLC
- CDCM exposes a CDC picker for authoring tools to pick a global context

CDCM - Cross Domain Configuration Management

Modern Deployment

- Containerized web application
- Automated deployment via helm charts on Kubernetes or Openshift
- Update from online container repository
- Database can be MongoDB onPrem or Atlas in the cloud
- Made for large scale operations: 10.000+ users

Large Variety of Tool Integrations

- IBM ELM applications DNG, ETM, RMM
- Sharepoint Online
- MagicDraw / Cameo / Teamwork Cloud
- GIT
- Codebeamer
- PREEvision
- Octane
- DOORS Classic

Basis for Advanced Analytics

- Traceability management
- Link Validity
- Odata Interface to analytics database

Tool Demo

Units

+ Add Unit

Type	Name	Created ↓
		From / To
Product	Dryer	Aug 18, 2024, 9:49:02 PM
Product	Dish Washer	May 26, 2024, 1:13:35 PM
Off-the-Shelf Product	ECU	May 24, 2024, 1:25:08 AM
Off-the-Shelf Product	Keyboard	May 24, 2024, 1:24:57 AM
Off-the-Shelf Product	Display	May 24, 2024, 1:24:42 AM
Off-the-Shelf Product	Power Supply Bluetooth	May 24, 2024, 1:13:41 AM
Off-the-Shelf Product	Memory	May 24, 2024, 1:13:11 AM
Off-the-Shelf Product	Oscillator	May 24, 2024, 1:13:01 AM
Off-the-Shelf Product	Antenna	May 24, 2024, 1:12:45 AM
Off-the-Shelf Product	Processor	May 24, 2024, 1:12:31 AM
Off-the-Shelf Product	Micro Controller	May 24, 2024, 1:12:14 AM
Product	Motor	May 24, 2024, 1:02:51 AM
Product	Heating	May 24, 2024, 1:00:05 AM
Off-the-Shelf Product	Power Supply	May 24, 2024, 12:59:38 AM
Off-the-Shelf Product	Piping	May 24, 2024, 12:59:19 AM
Off-the-Shelf Product	Pump	May 24, 2024, 12:58:06 AM
Product	Control Unit	May 24, 2024, 12:50:41 AM
Product	Bluetooth module	May 24, 2024, 12:47:48 AM
Product	Transceiver	May 13, 2024, 7:32:41 PM
Product	Washing Machine "Eco Line"	May 7, 2024, 4:26:03 PM

Staged Baselines

Motor
[Motor] - Baseline 1, Configuration
0% 100%

Control Unit
[Control Unit] - Baseline, Configuration
0% 0%

Display
[Display] - Baseline, Configuration
100% 100%

Keyboard
[Keyboard] - Baseline, Configuration
100% 100%

ECU
[ECU] - Baseline, Configuration
100% 100%

CDCM is Much More Than Managing Configurations

Traceability

Cross Tool Traceability in the Context of Configurations

Analysis

Definition of **Data Marts of Engineering Lifecycle Data** for Analysis, Reporting & AI by Configuration Areas

- Define a **comprehensive digital representation** of the product “from document to model”:
- **Enforce reuse** of engineering assets
- **Maximize Efficiency** in managing Cross Domain Configurations, Stream, Baselines

Digital Twin

Lay the Foundation for the **digital type twin** in development

Variant Management

Introduction of **holistic variant management** based on VEL

Questions?

Dr. Thomas Schwartzkopff: thomas.schwartzkopf@de.bosch.com

Christoph Bergner: c.bergner@mid.de

Visit us at the Smartfacts booth 611 opposite the INCOSE Village

Next Steps

- Configuration validation
- Classifications and Characteristics
- Notifications and subscriptions
- Holistic variant definition as a configuration item
- Holistic variant management VEL based
- Integration of TypeSense search engine

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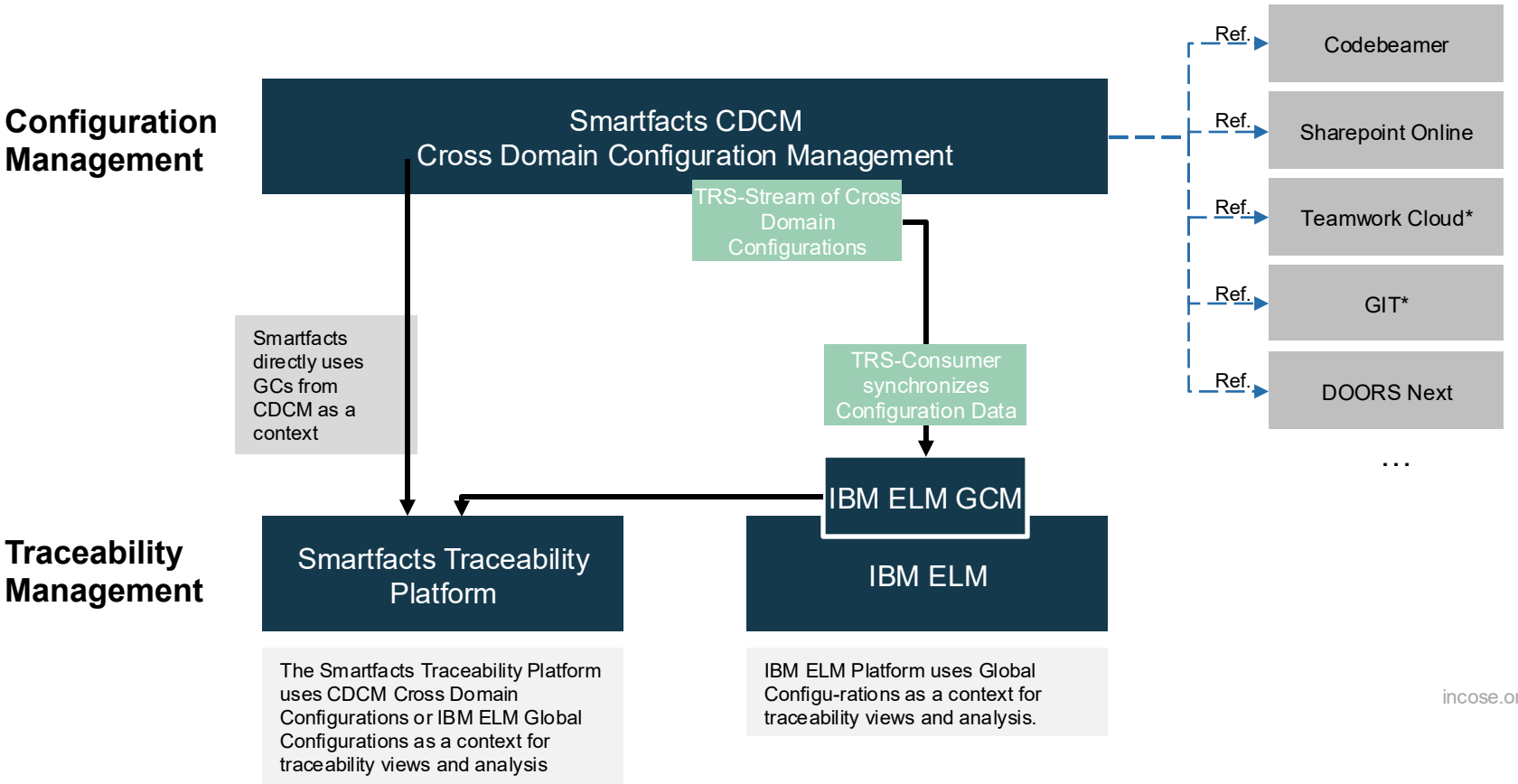
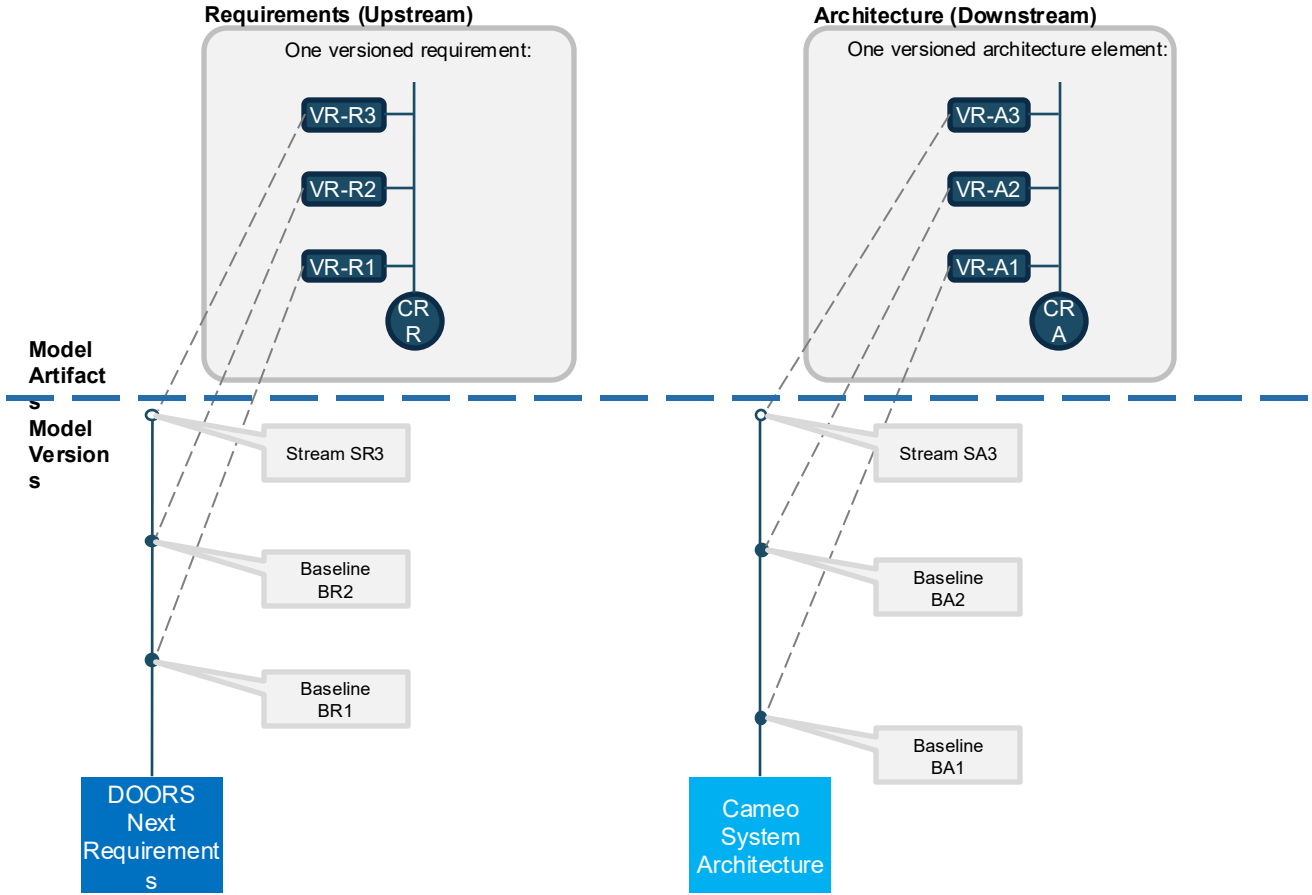
Backup

5 min

Smartfacts CDCM as GC Provider to Smartfacts and IBM ELM



Leveraging Cross Domain Configurations in Traceability Management

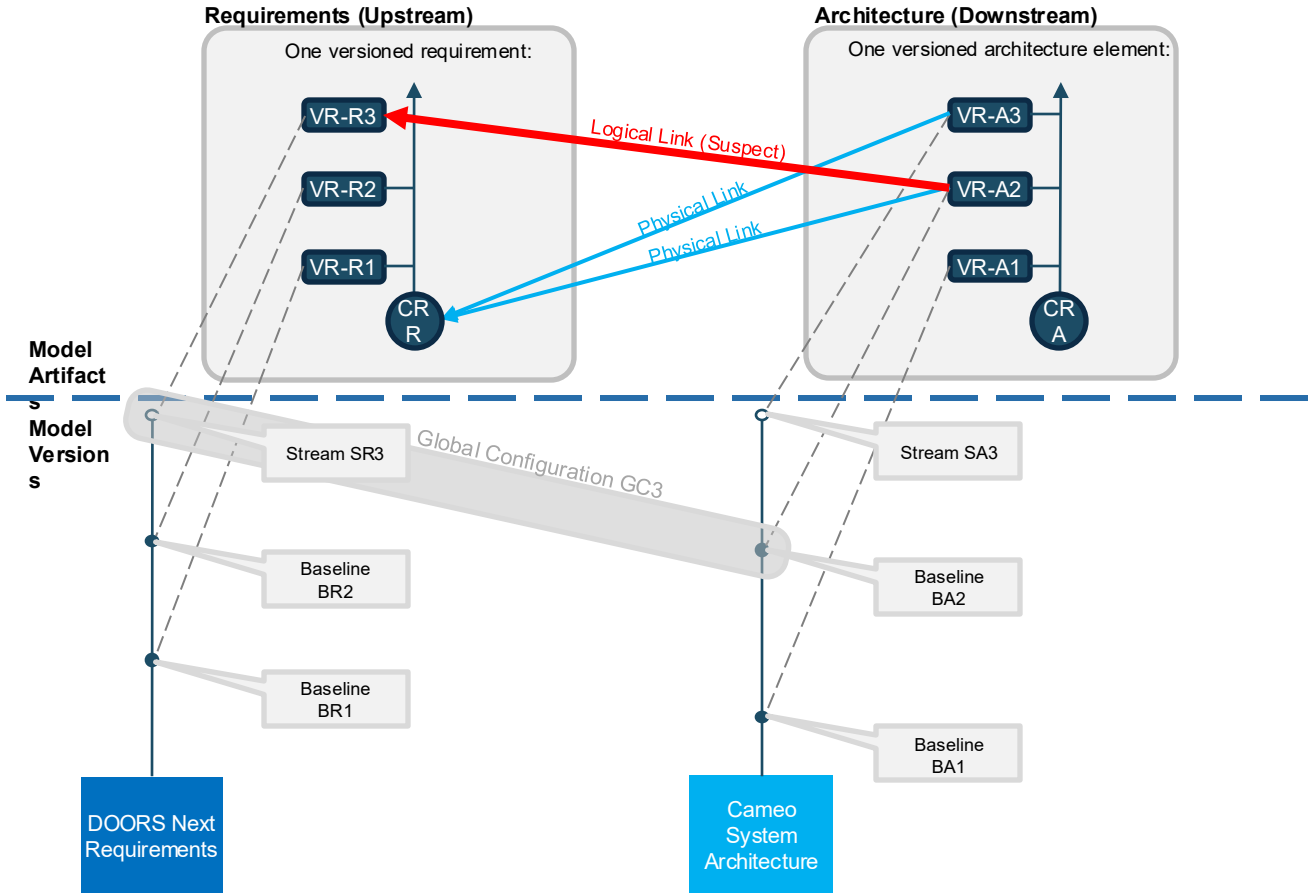


Looking into a Local Configuration, we find artifacts. An artifact consists of a Concept Resource (CR) which is stable across all local configurations and Version Resources that may differ by local configuration.

The Concept Resource contains all attributes of the artifact that never change, such as the ID, Created By, Create Date, etc.

The Version Resources contain attributes that may change across Local Configurations, such as title, description, changed by, change date, etc.

Leveraging Cross Domain Configurations in Traceability Management



Now we switch our Global Context to Global Configuration GC3 which includes architecture Baseline BA2 and requirements Stream SR3.

In addition, the user changes the requirement in version resource VR-R3.

This means:

1. The link between the architecture element and the requirement is there under the global context of GC3: A logical link exists
2. The status of the link is now suspect under GC3, but the same link (page before) would be valid under GC2

The Purpose of CDCM: Enforce the Re-Use of Engineering Information