#ibminnovate

Increasing productivity with requirements reuse and variant management with DOORS Next Generation

DRM 1946

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Plans are based on best information available and may change in future.

Outline

- Motivations & Definitions
- Patterns
  - Branch from closest product/component
  - Use common reference assets
  - Negative & positive variability
  - Functional and Temporal Variation
- Enabling capabilities
  - 1. Configuration management
  - Demo
  - 2. Global configurations and product definition
  - 3. Parameterized
  - 4. Integrating feature modeling

Doing more with less in a customizing world

- Trend toward mass customization and shorter product lifecycles
- More embedded software; more complex connected products
- Need to adhere to safety standards, compliance and regulations

Source: http://commons.wikimedia.org/wiki/File:ITPB_health_Club.jpg

Some reuse scenarios…

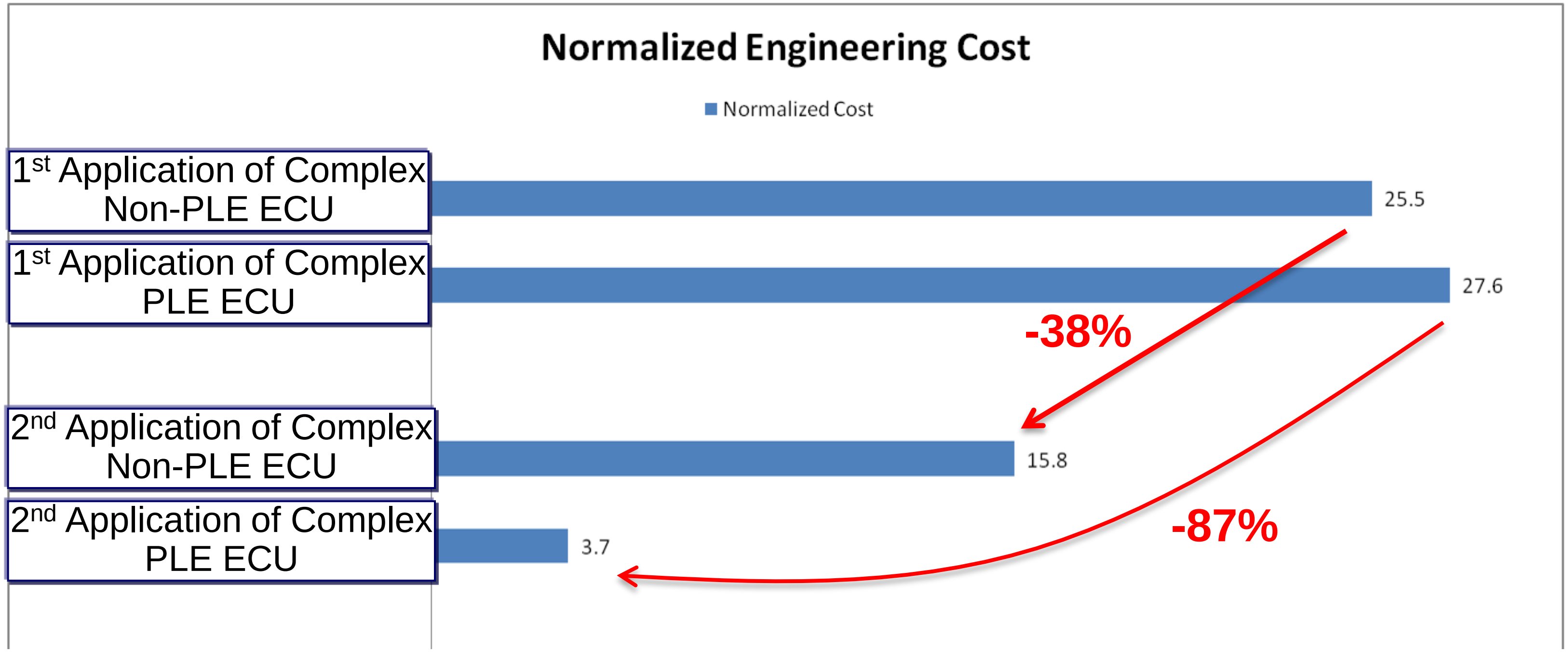
- Managing requirements for a product family e.g.,
  - A vehicle platform
  - A set of insurance claim systems
- Handling supply chain
  - Multiple suppliers with varying components
- Shared requirements across different programs for different customers
- Parallel development of multi-year programs
- Handling requirements for a trade-study prototypes

Product Line Engineering

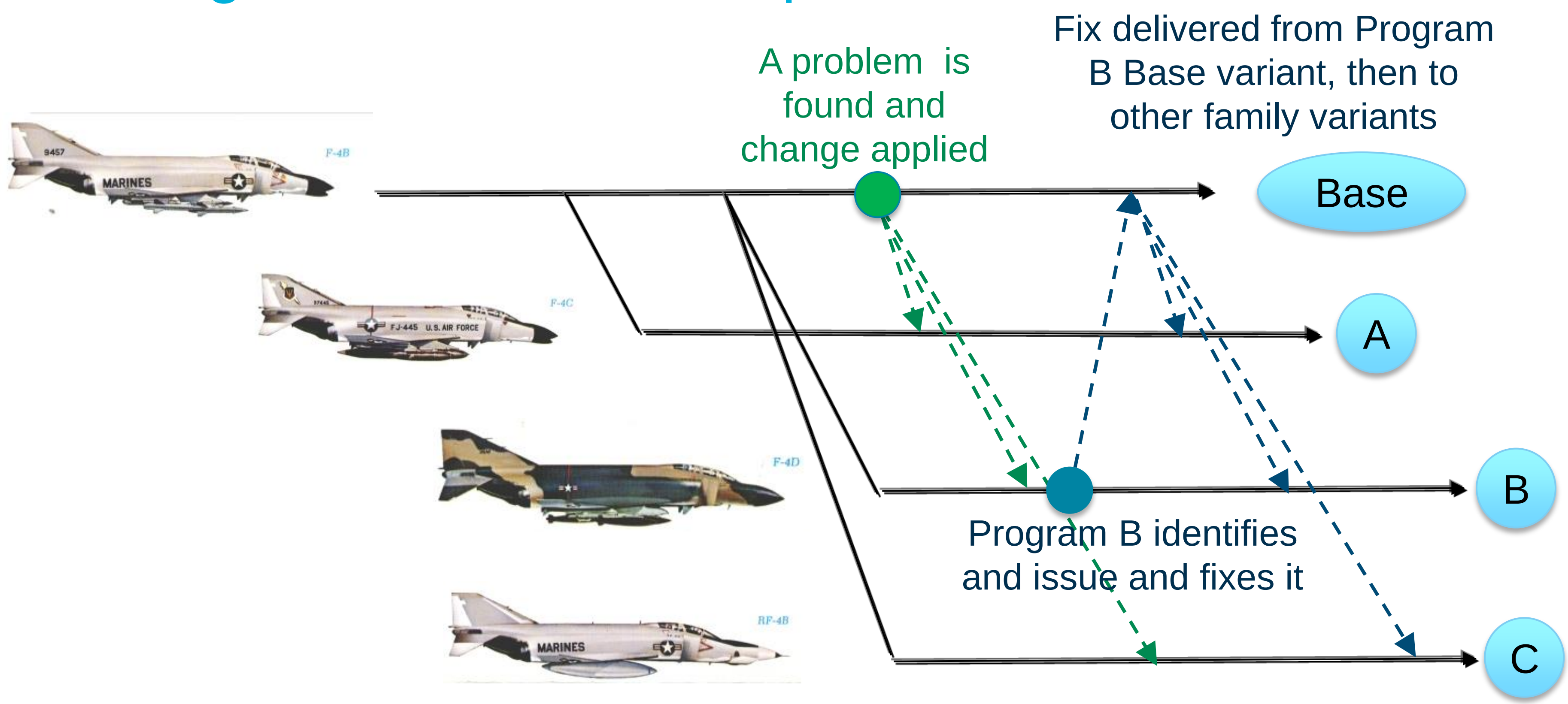
- Business & technical strategy

- Some automotive examples
  - Addressing different geographical markets (OEMs)
    - Safety regulations, Language, Driving side
  - Delivering parts to multiple OEMs (Suppliers)
  - 100s or 1000s of variants … 1,000,000s of combinations

GM started a reuse approach (PLE) in software engineering with impressive results:



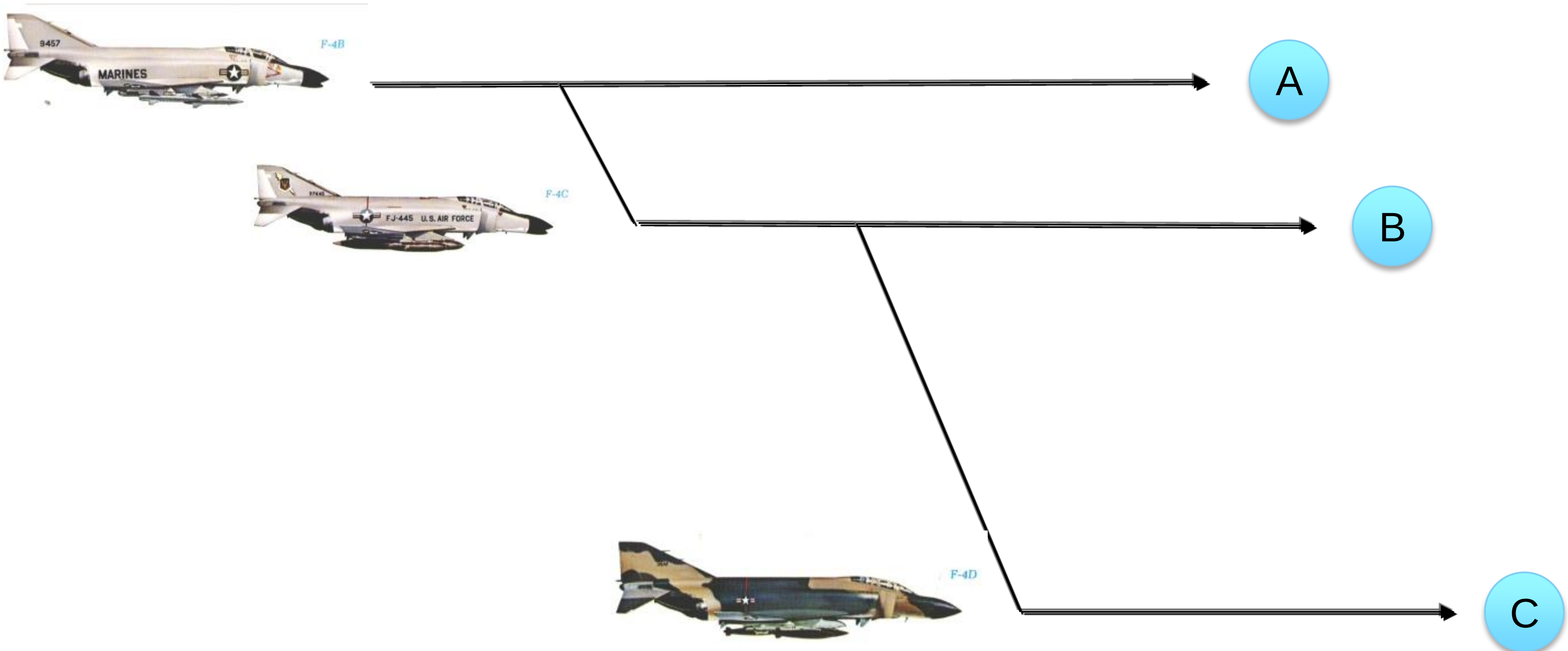
Strategic reuse: the conceptual scenario…



- Management of core platform engineering ("base")
- Enable parallel engineering of platform variants
- Enable controlled reuse and change propagation downstream and upstream

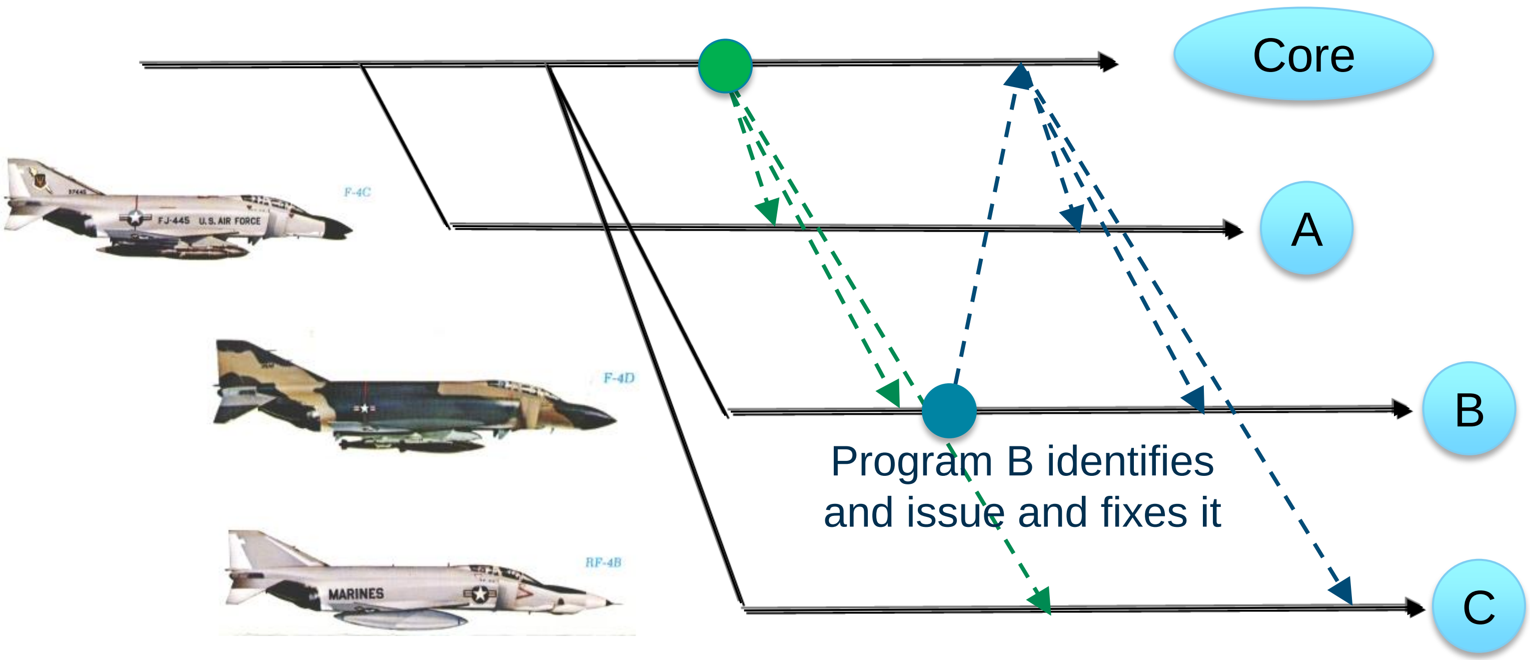
Patterns of reuse

- “Branching” from closest product / component
- A more tactical reuse approach…



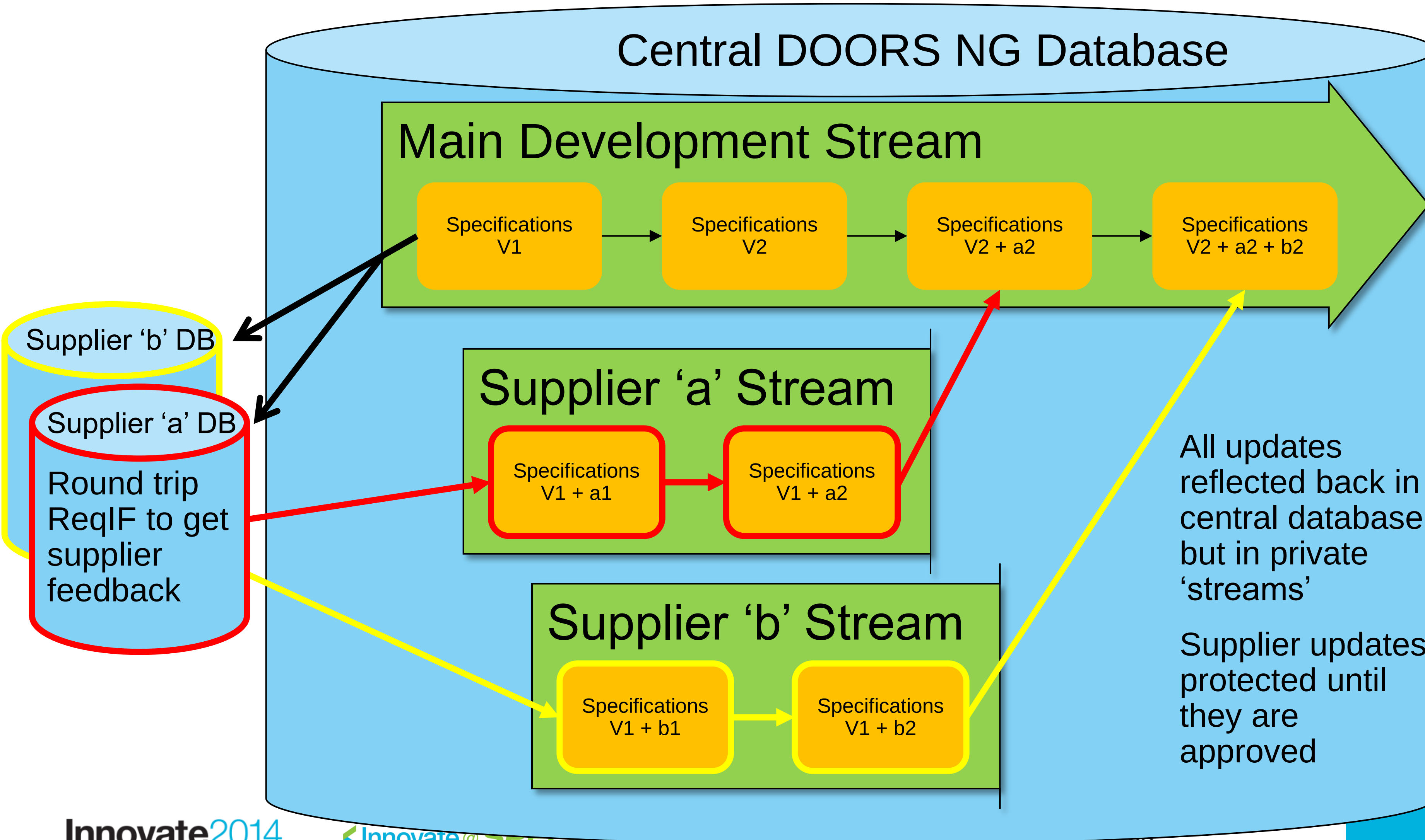
Patterns of reuse

- Core assets pattern



Example scenario: supplier communications

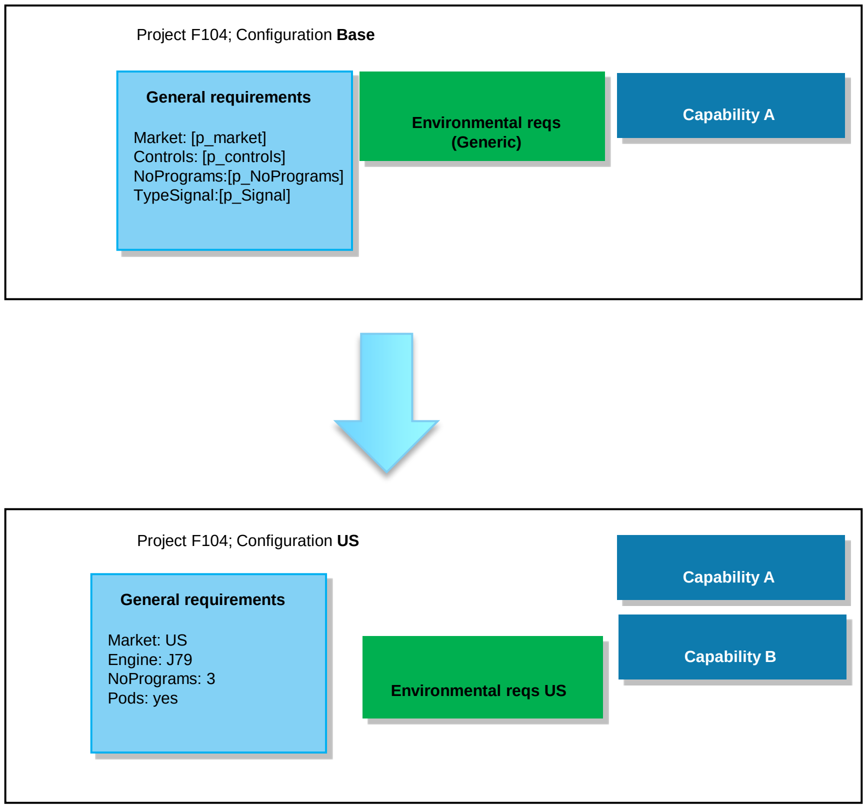
ReqIF with requirements configuration management



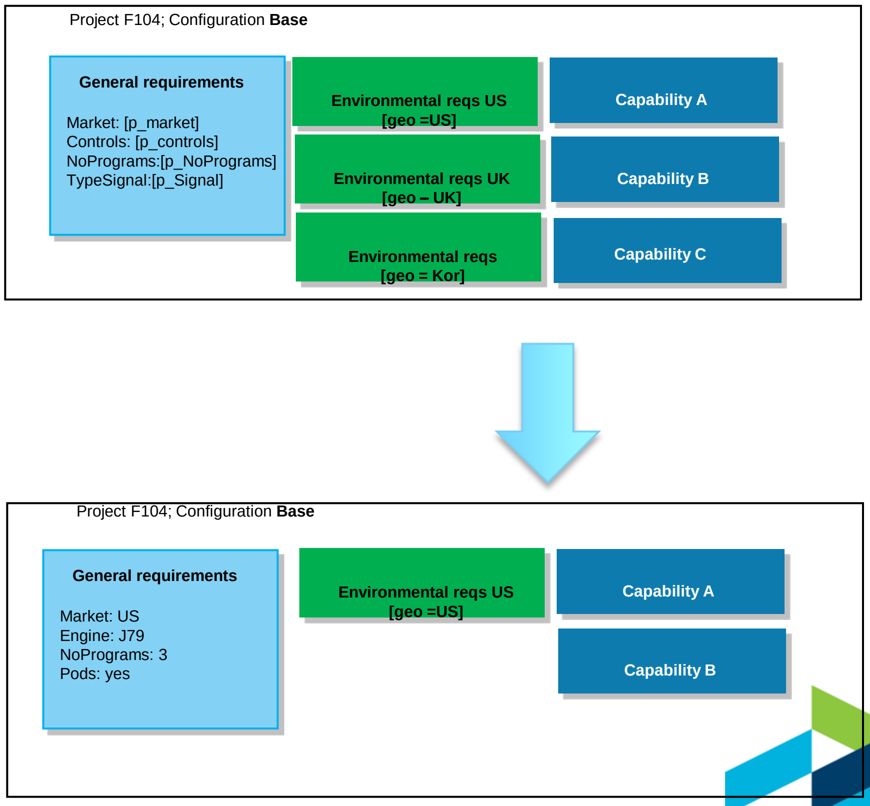
Patterns of reuse (3)

- How are core assets reused: negative vs. positive variability

Positive: Branch, Add, Modify

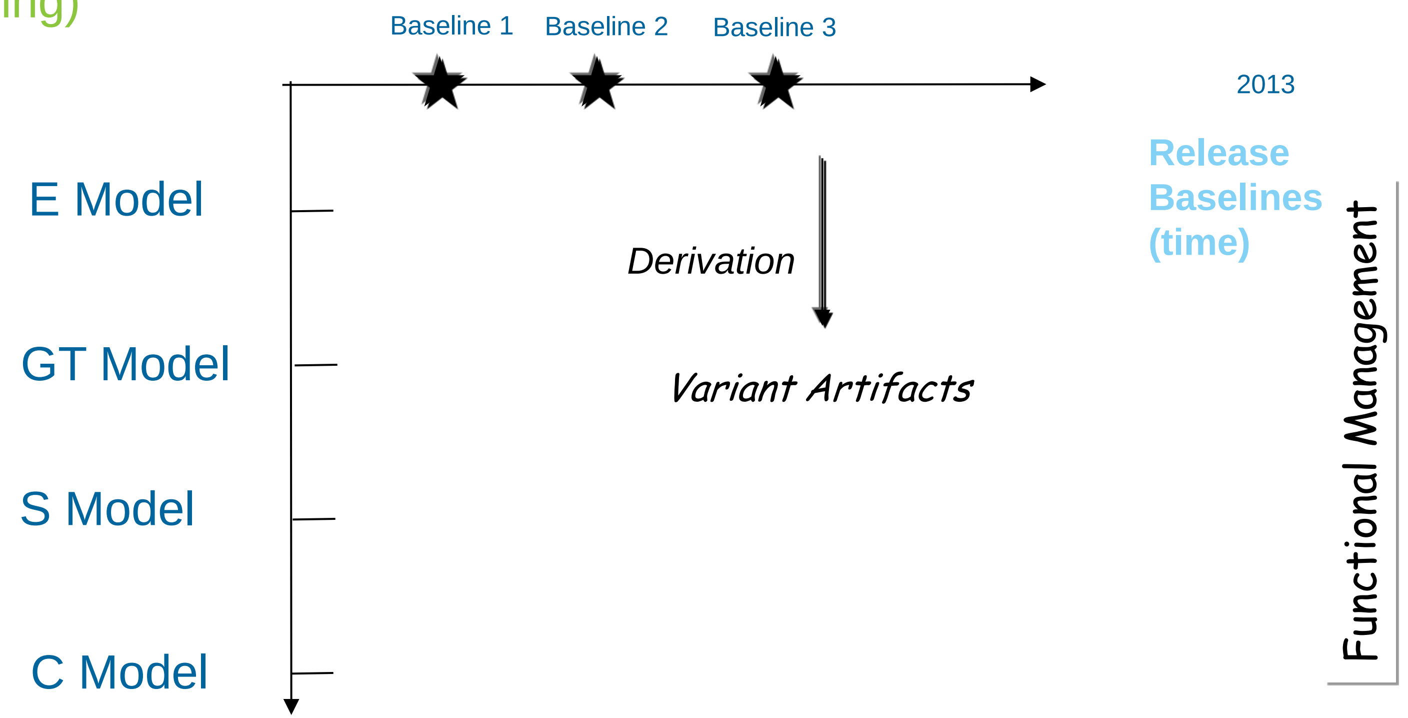


Negative: Filter, Branch + Derive



Variability dimensions: functional variability

Product Development (AKA product engineering)



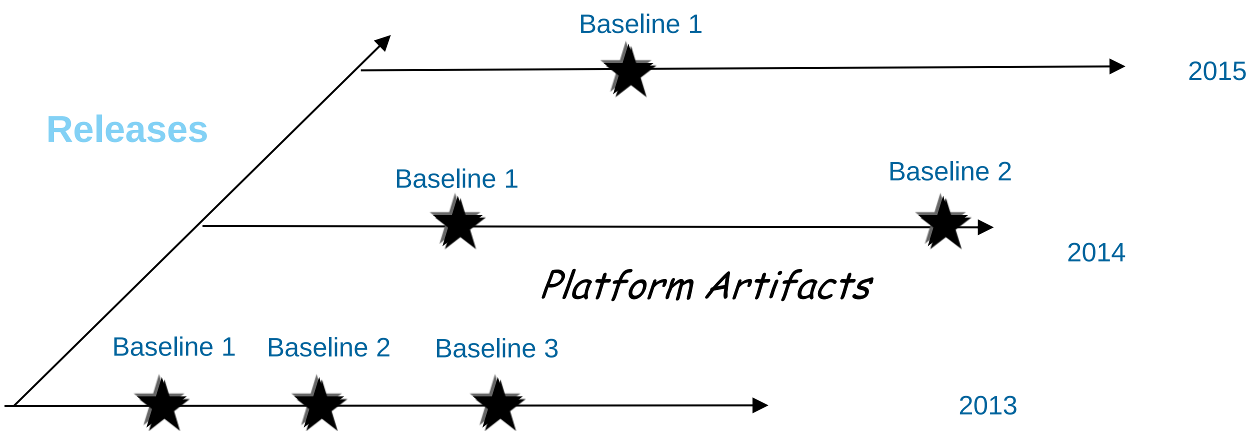
Functional Variants

Note: Feature models & profiles evolve over time and are also temporally managed

Variability dimensions: temporal variability

- Parallel configurations representing different temporal plans
- E.g – different annual plans, different iterations

Platform Development (AKA Domain Engineering)



The temporal dimension is needed if there is parallel engineering overlap between temporal targets. This is not always the case for requirements engineering. Sometimes it is needed for the V&V info.

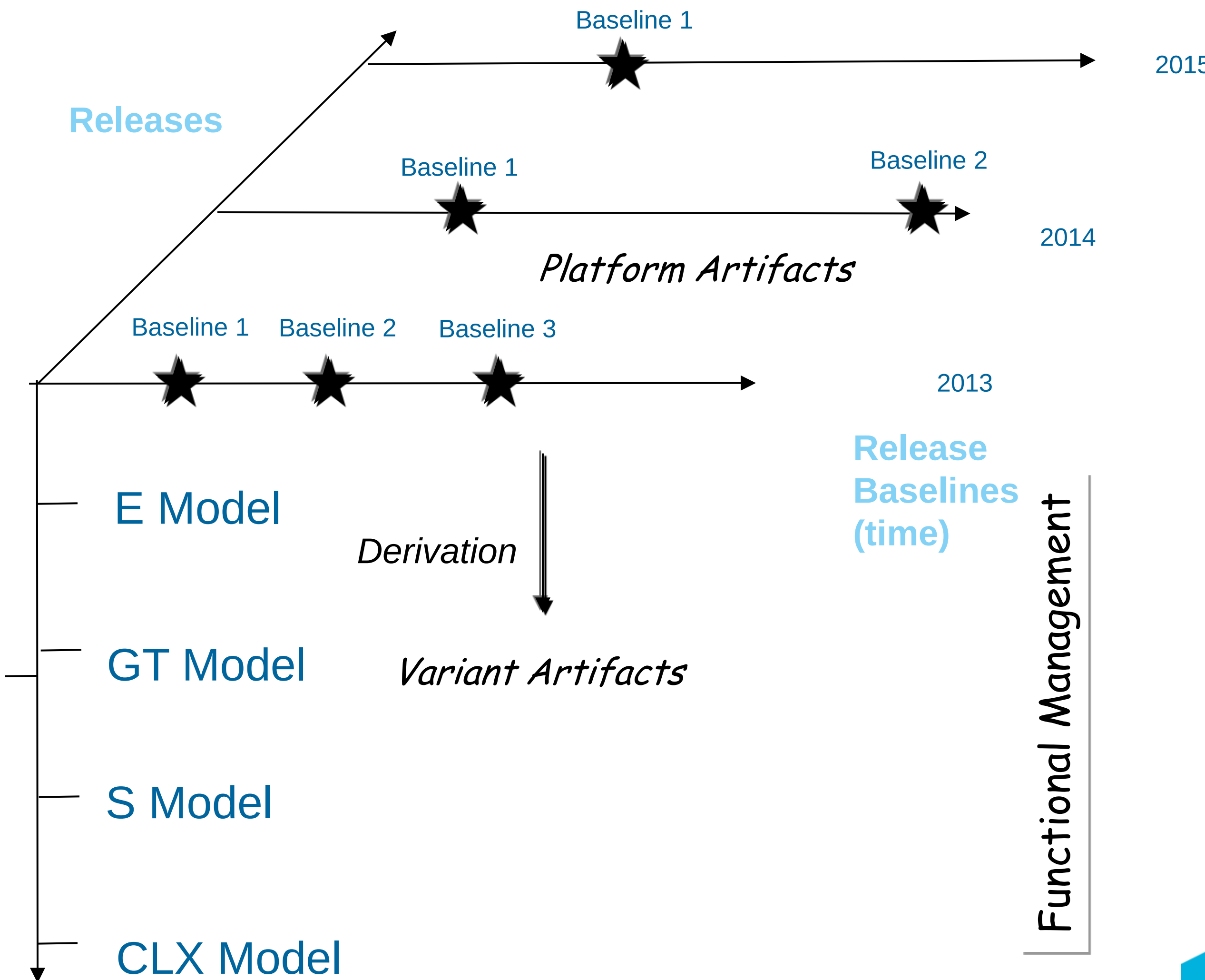
Note: Feature models & profiles evolve over time and are also temporally managed

Combining variants with parallel development…

Platform Development (AKA Domain Engineering)

Product Development (AKA product engineering)

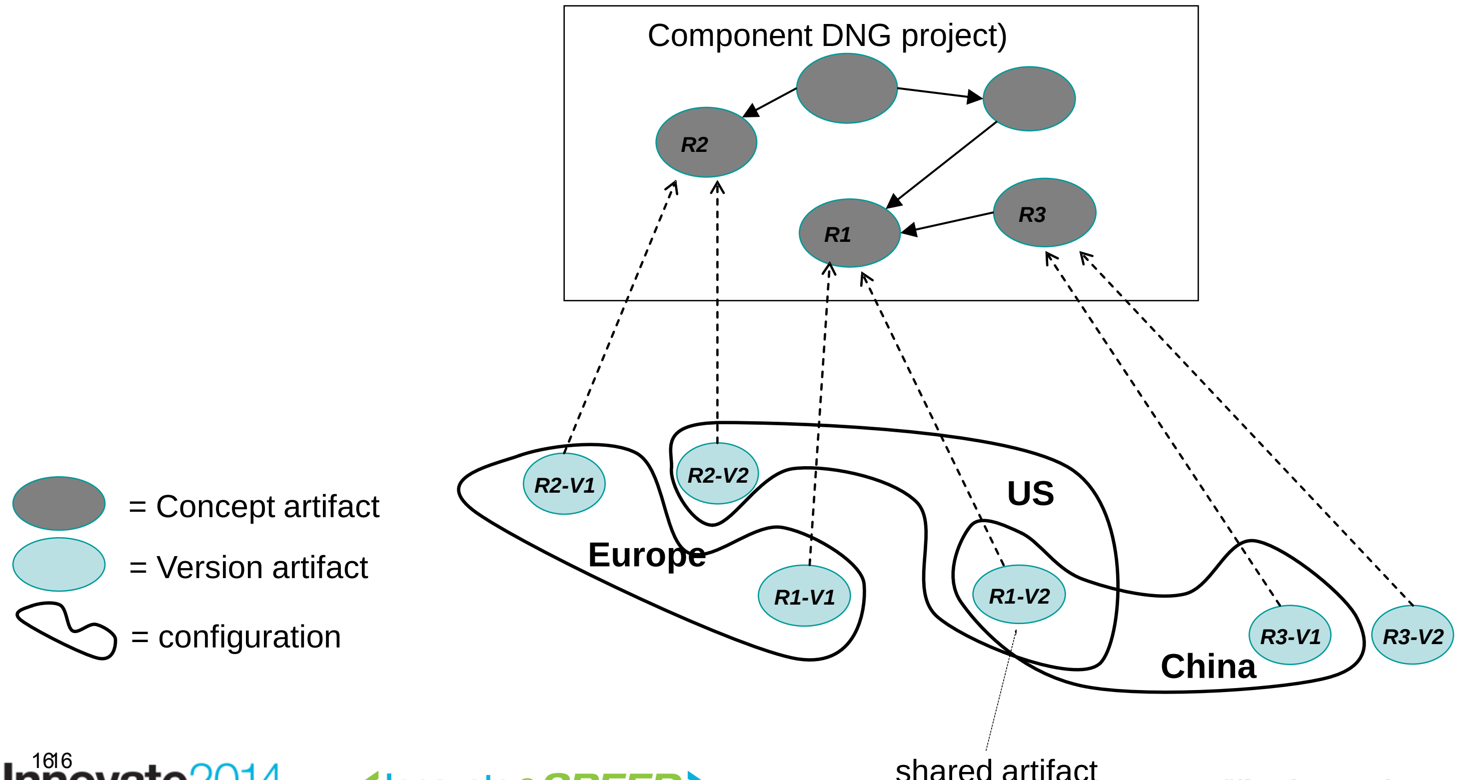
Functional Variants



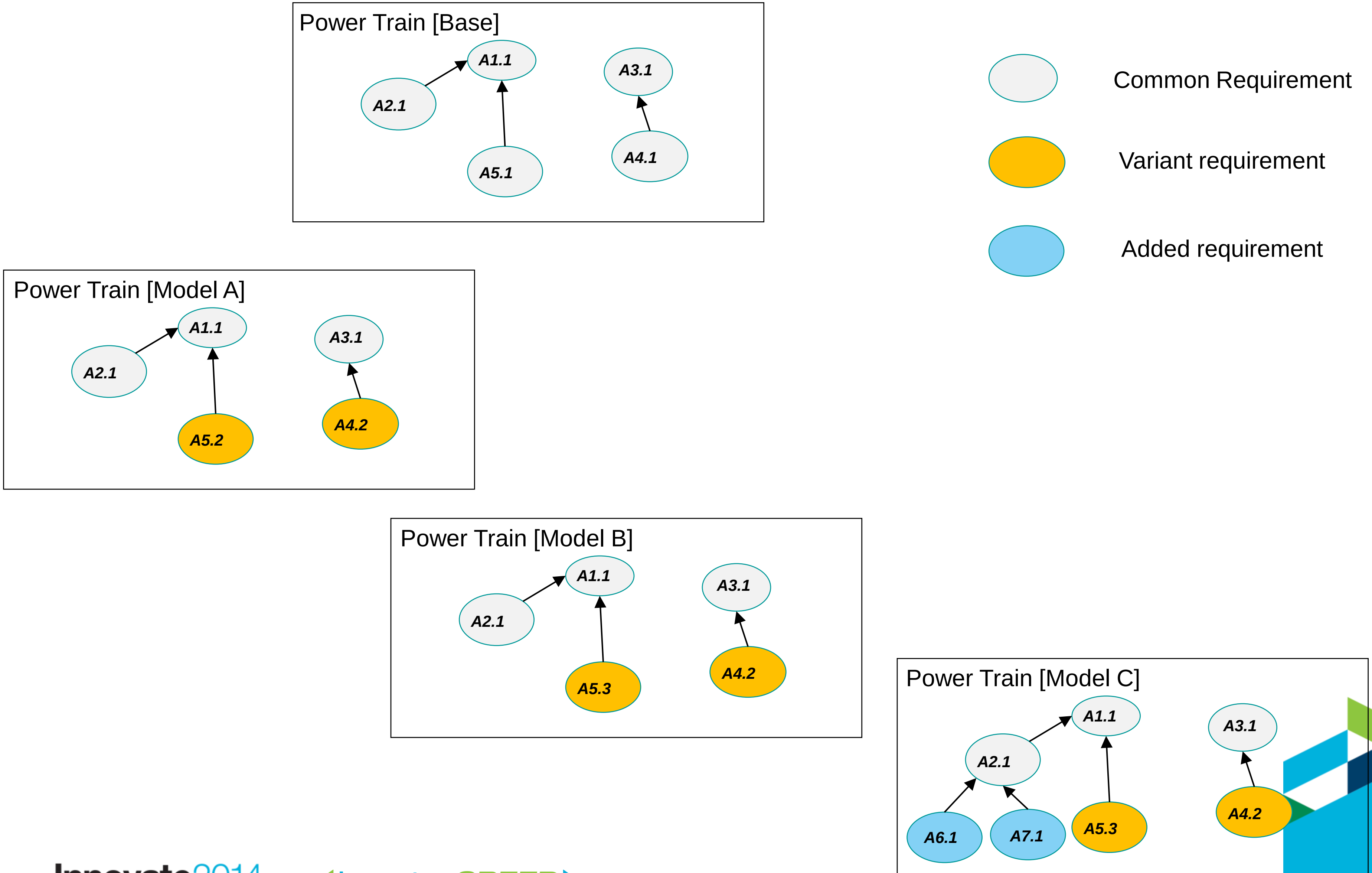
Note: Feature models & profiles evolve over time and are also temporally managed

Components and configurations

- Components are collection of logically related artifacts from a particular domain
- Artifacts have versions
- A (component) configuration specifies the included artifacts and their versions
- Configurations can share common artifacts and manage variability of other artifacts
- Configurations can be mutable (stream) or immutable (baseline)

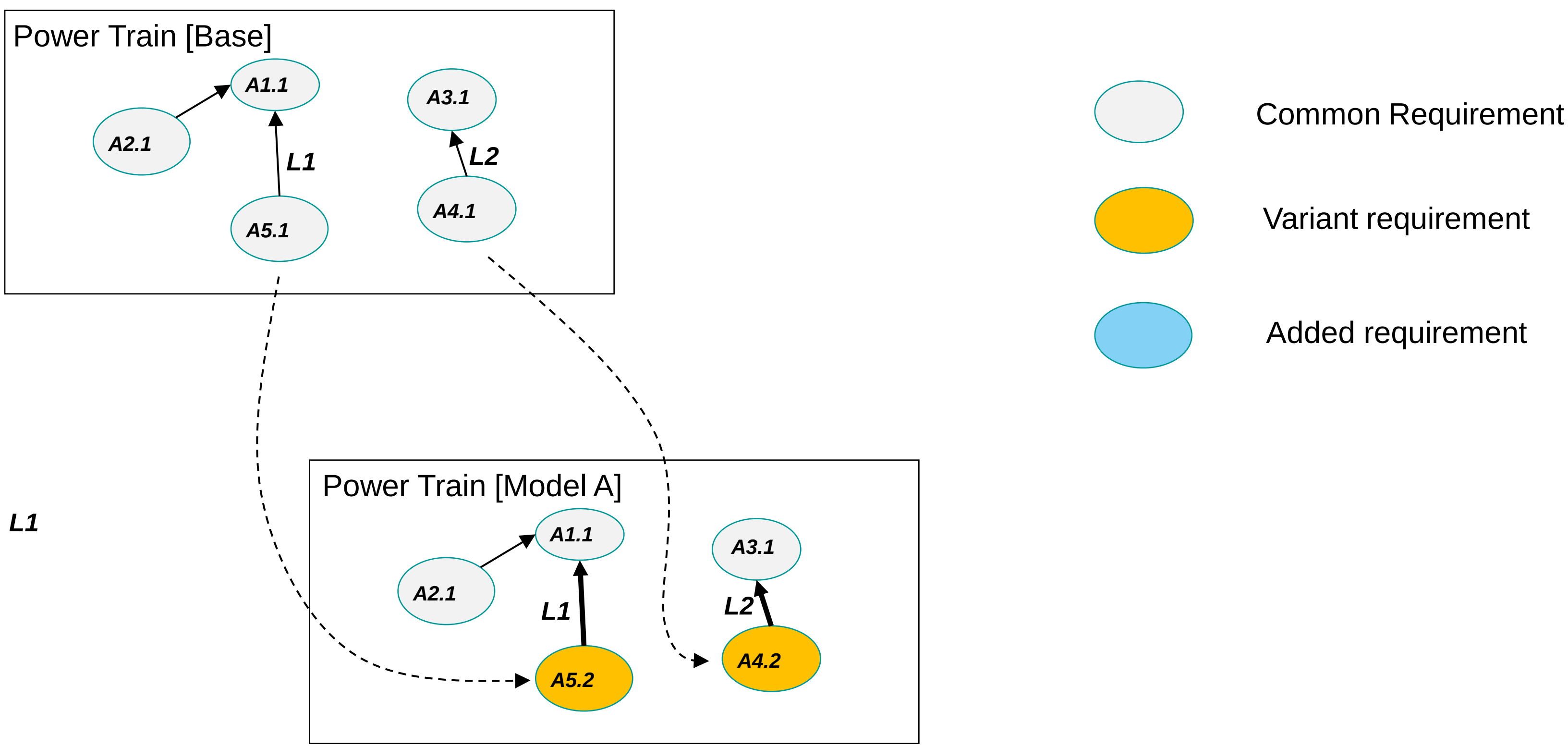


Example: Components and configurations



Conceptual Links

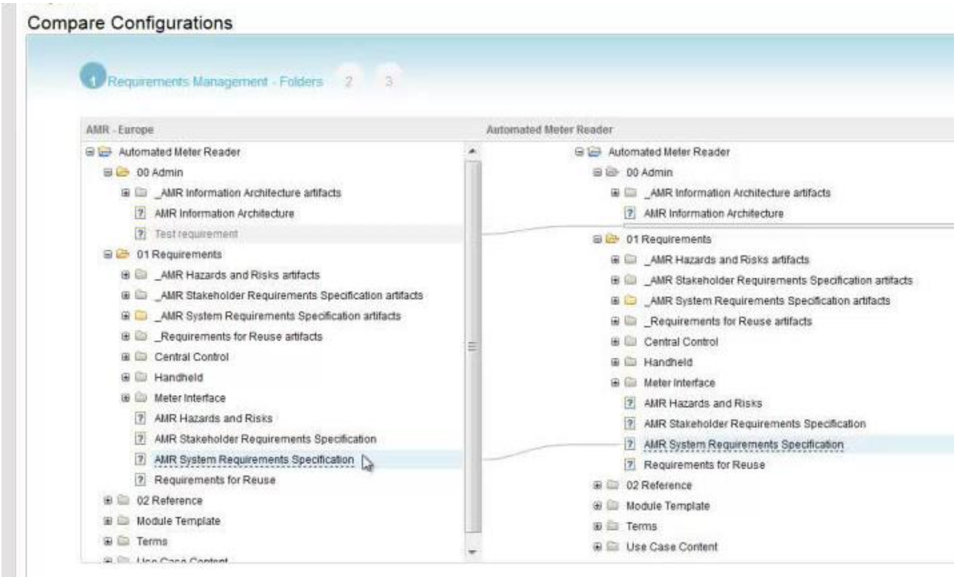
- What happens to links when we create new versions of requirements?
  - Conceptual links are defined relatively to conceptual requirements e.g. A1, A2, A3, A4, A5

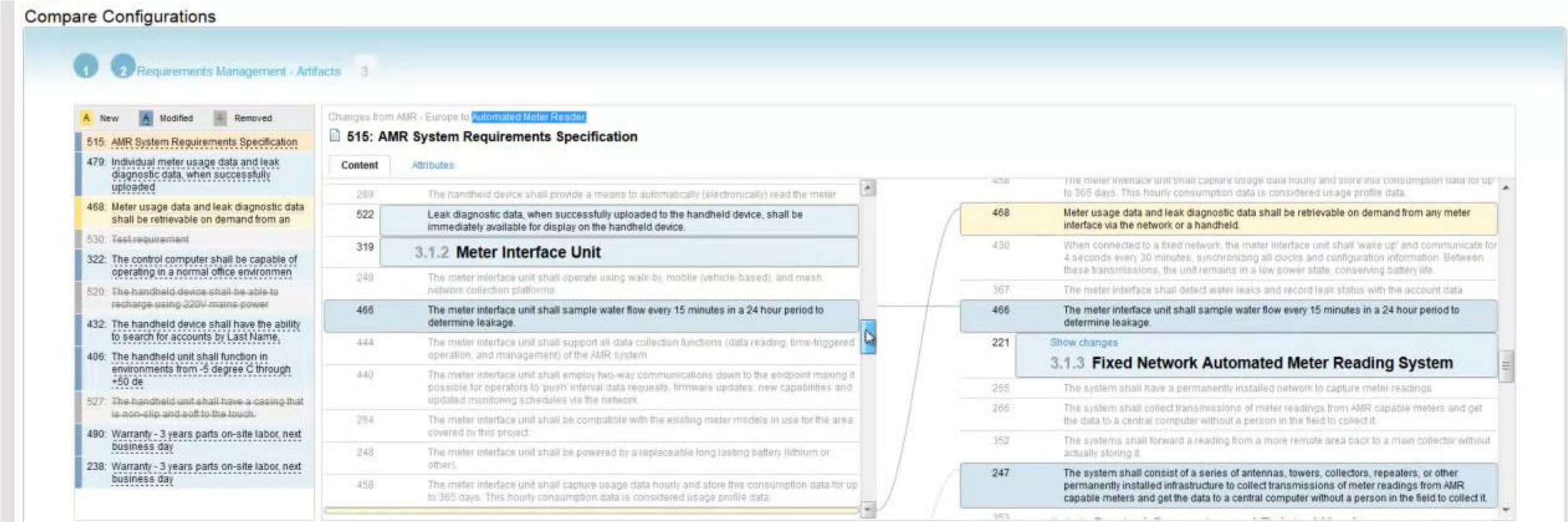


Conceptual Links persist when versions of objects are replaced in a configuration

Example: Requirement configurations DOORS NG

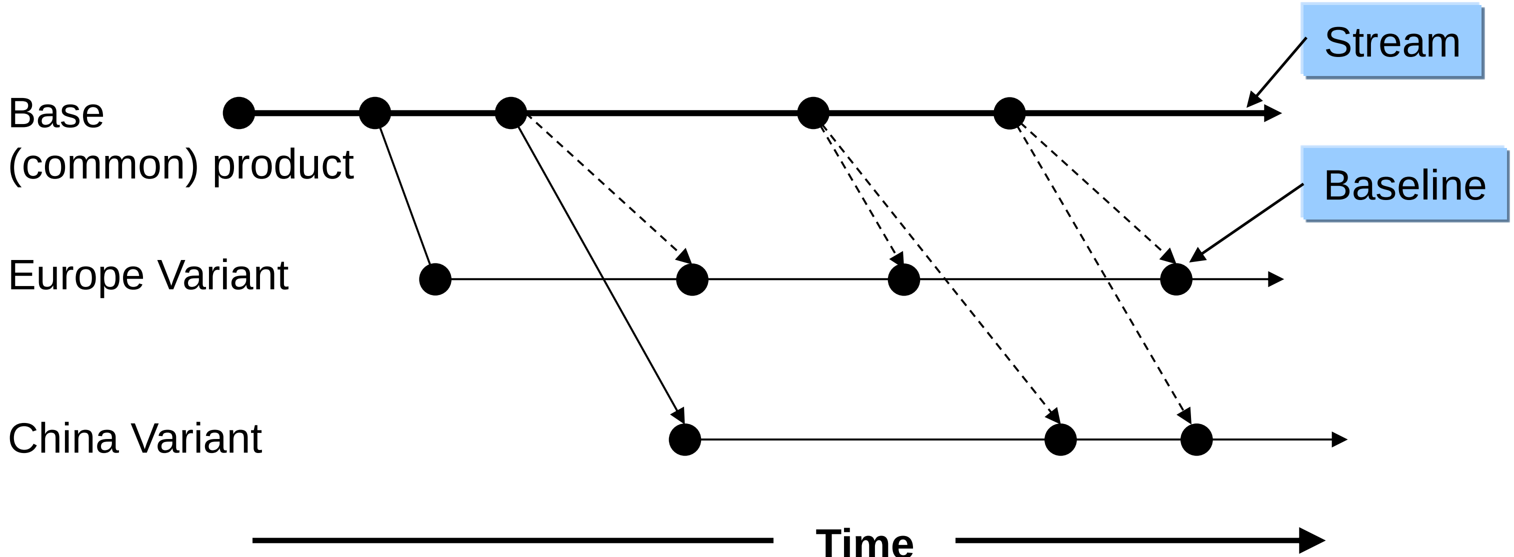
- Diff contents of two configurations
- Diff contents of module in two configurations





Realizing variant management with streams

- Each product variant is a branch of evolving artifacts
  - A stream or “workspace” – A mutable configuration
  - Streams are associated with baselines – Immutable configurations
- Common artifacts are shared across branches
- On one branch, evolution is a sequence of baselines
- New variants can be branched from existing variants
  - Can evolve in parallel
- Branches can update other branches using workspace delivery

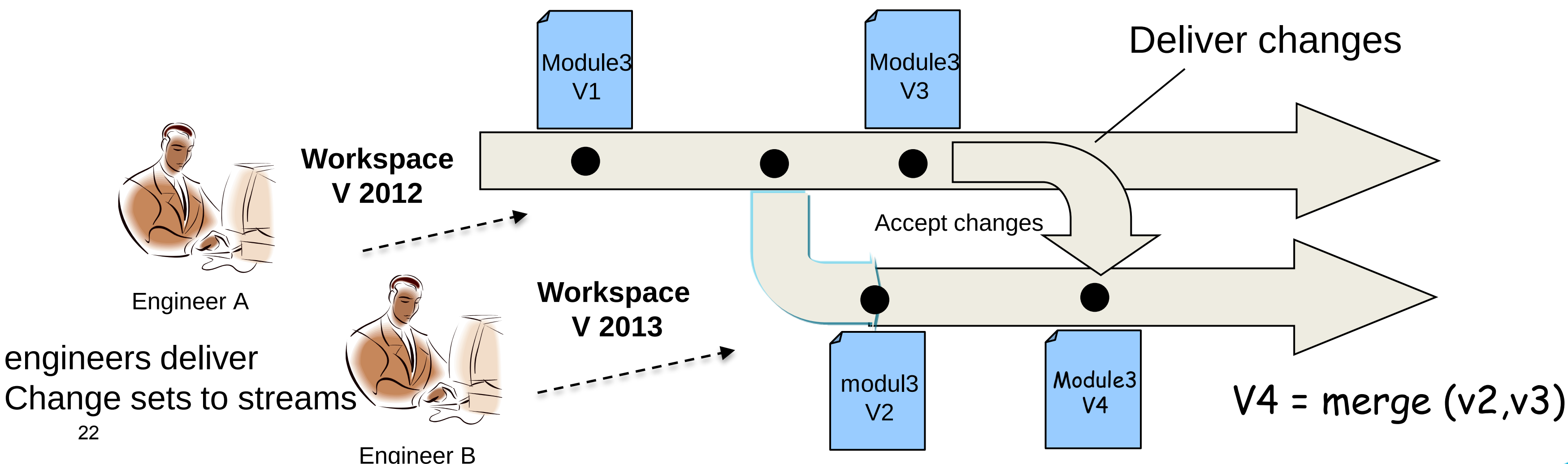


Some essentials for reuse scenarios

- Changesets – a logical grouping of requirement changes that can be assocated – e.g. with a change request
- Changeset Delivery, Delivery Targets
- Rebasing
- Key reuse patterns
  - Creating a new variant – create a child stream
  - Updating common requirements from the base stream to a variant – Rebasing
  - Updating the base with changes already in the variant – deliver changes
  - Looking at a difference between two variants – compare streams
  - Handling “conflicting” changes - merge

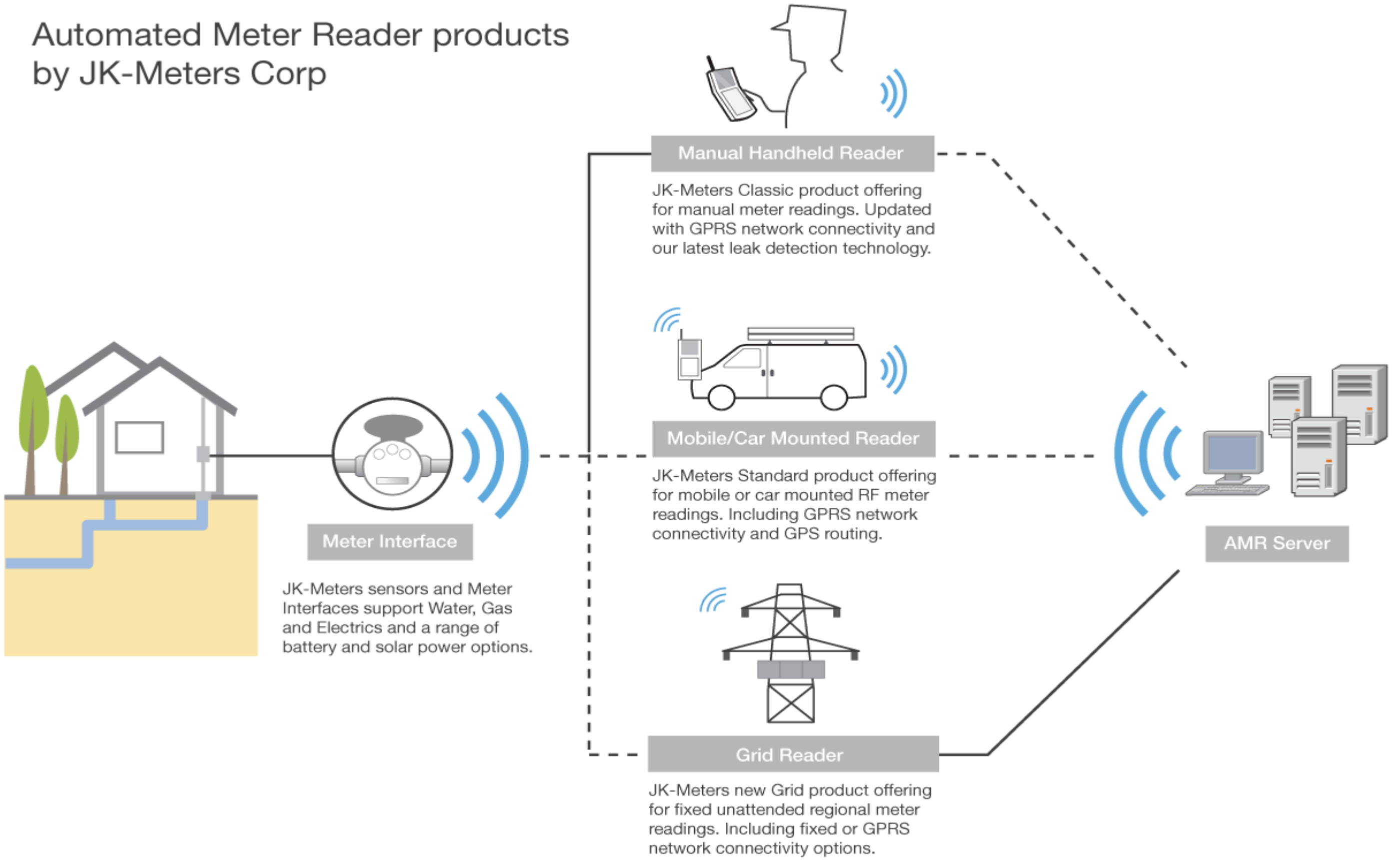
Parallel development of components with streams

- Streams are mapped to **workspaces** in the various domain tools
- Changes to artifacts are shared into streams as ***change-sets***
- Changes can be delivered across streams
- Deliveries may result in conflict detection that leads to a **merge**

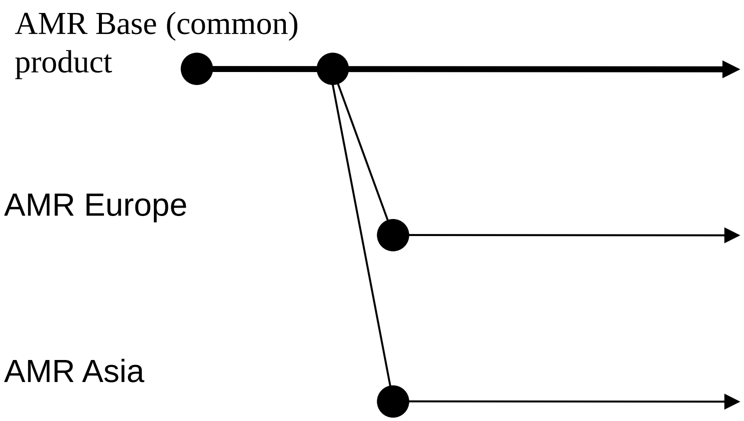


DEMO

Example: Automated Meter Reader Scenario

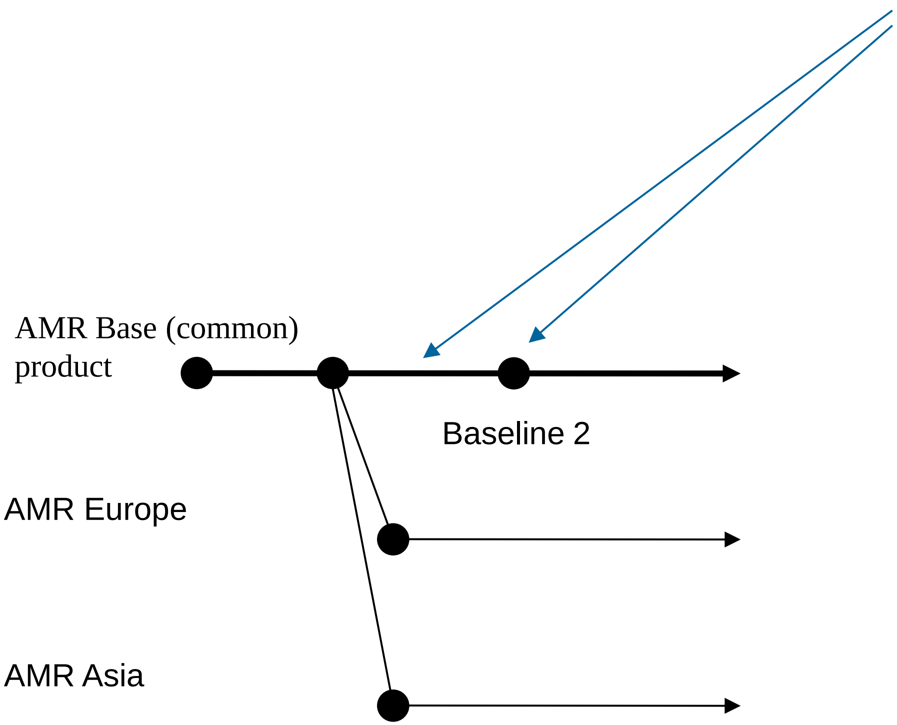


Demonstration scenario - 1



1. **Initial setup: AMR Base, AMR Europe, AMR Asia**
2. Add new Requirements in the AMR Base Configuration. Create an explicit baseline.
   – Compare the new baseline with the old one
3. In AMR Europe, rebase configuration on the new baseline from step 2
   – Show that changes are present in AMR Europe, not present in AMR Asia.
4. Derive a new configuration - AMR South America using the baseline from step 2
   – Show that AMR Europe and AMR South America are identical
5. In AMR Europe, make changes to a common requirement using a change set linked to a work item and deliver change to AMR Base.
6. Baseline AMR Europe.
7. Baseline AMR Base.
8. Rebase AMR South America to new Global Baseline.

Demonstration scenario - 2



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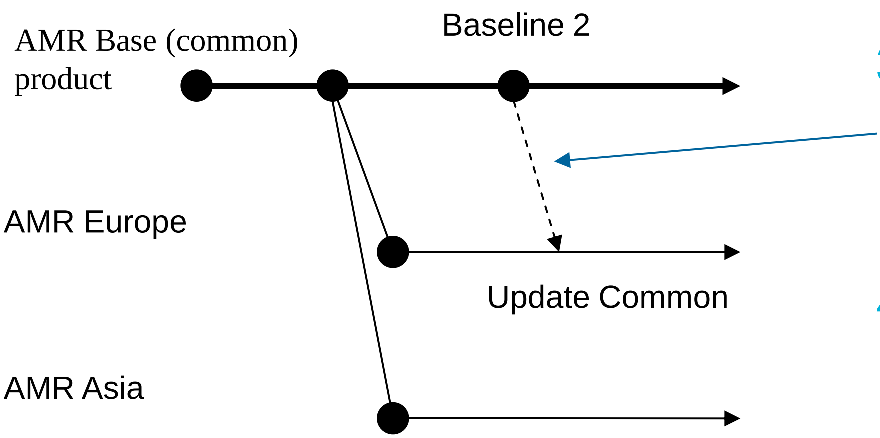
Demonstration scenario - 3



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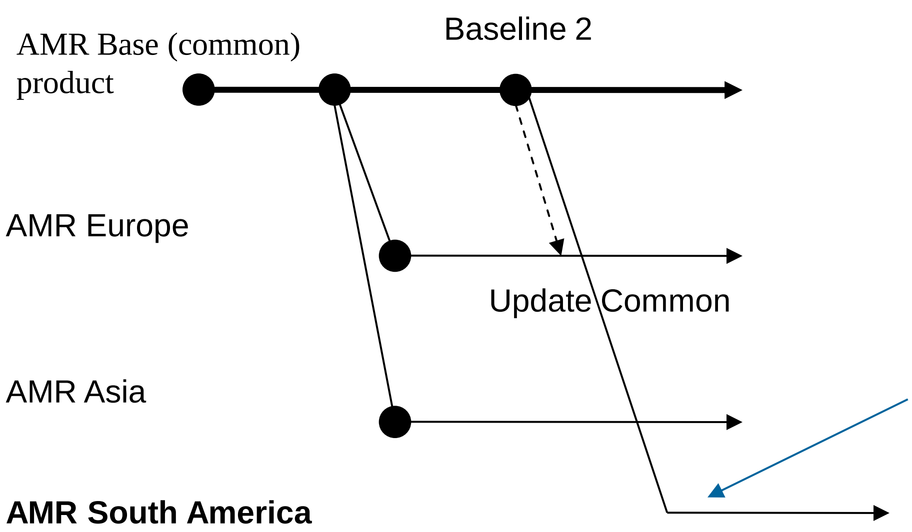
Demonstration scenario - 4



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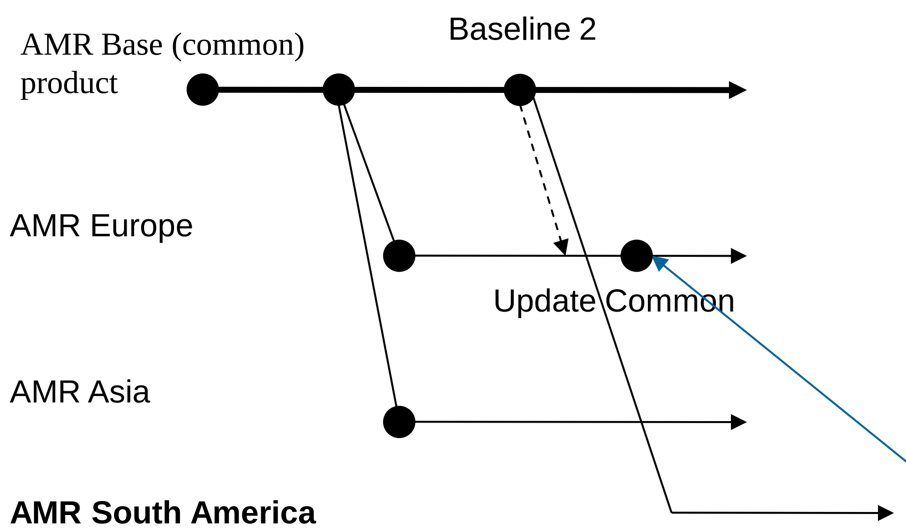
Demonstration scenario - 5



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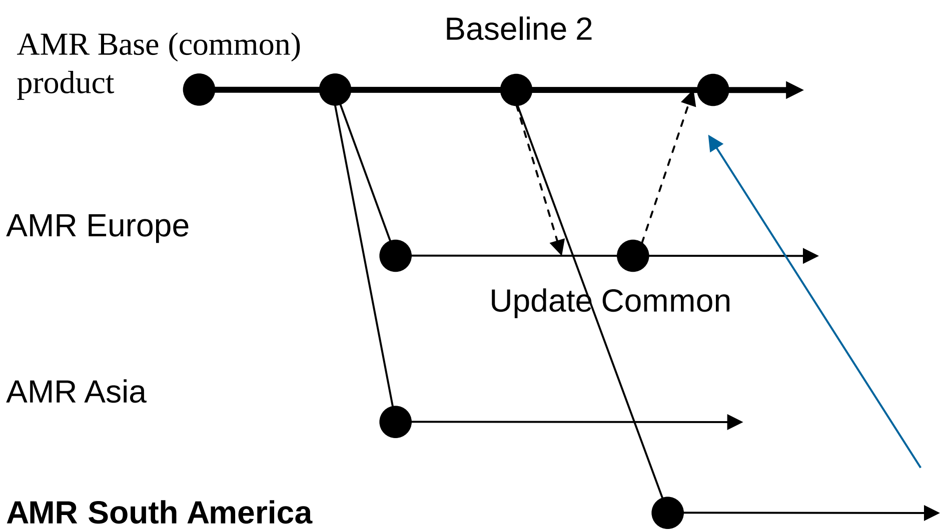
7. Baseline AMR Base.
8. Rebase AMR South America to new Global Baseline.

Demonstration scenario - 6



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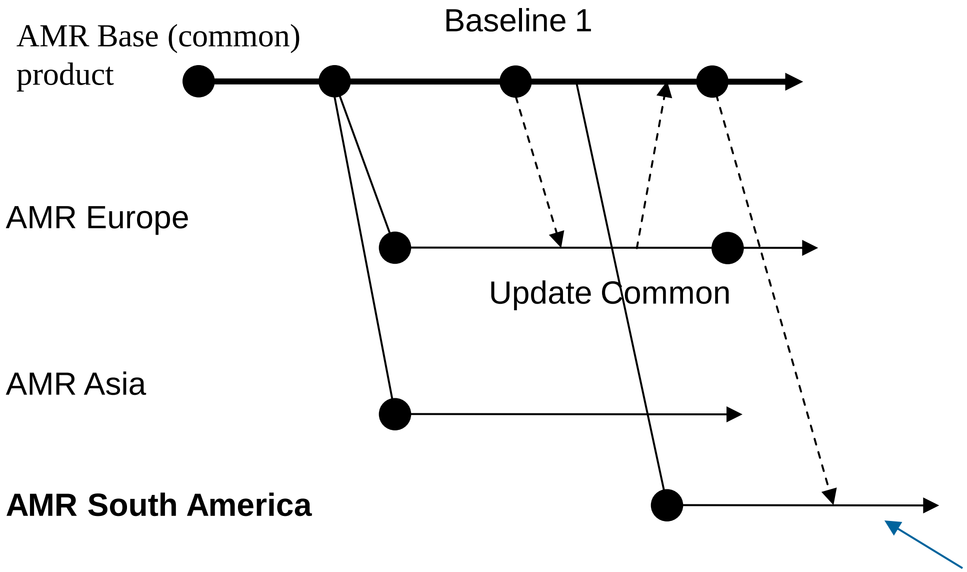
6. **Baseline AMR Europe.**
7. Baseline AMR Base.
8. Rebase AMR South America to new Global Baseline.

Demonstration scenario - 7



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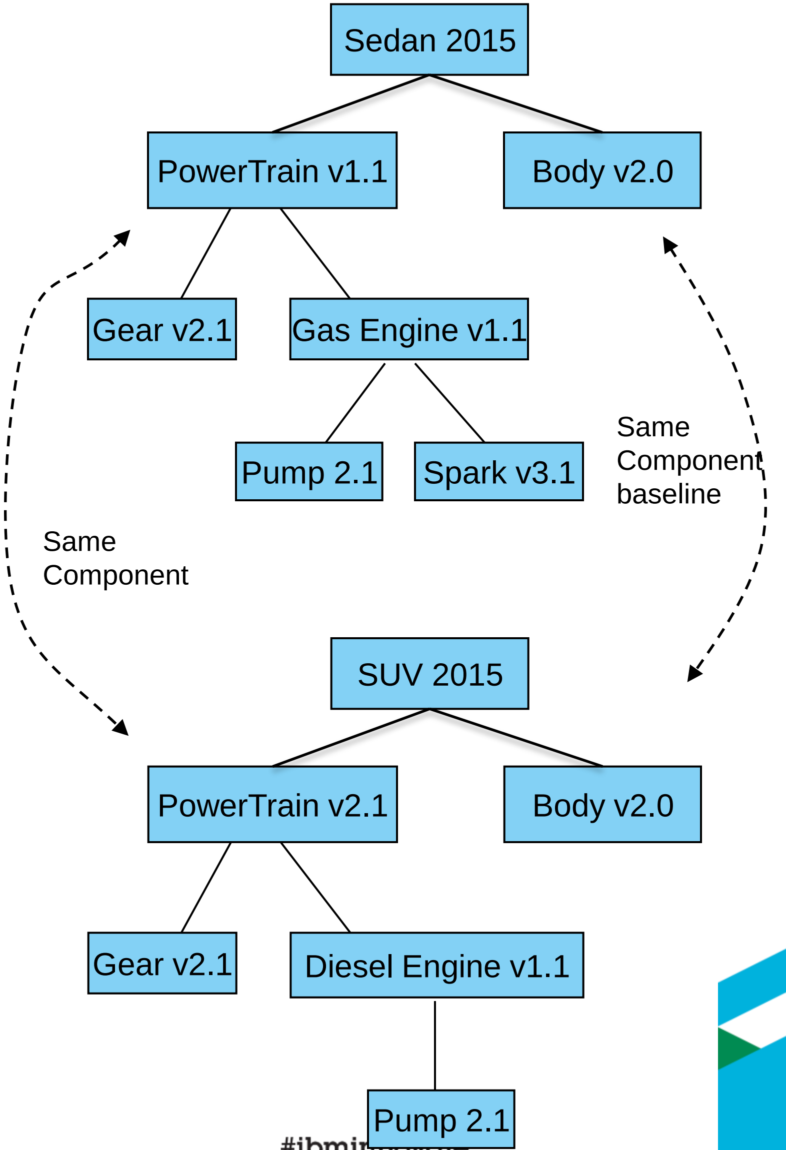
6. Baseline AMR Europe.
7. **Baseline AMR Base.**
8. **Rebase AMR South America to new Global Baseline.**

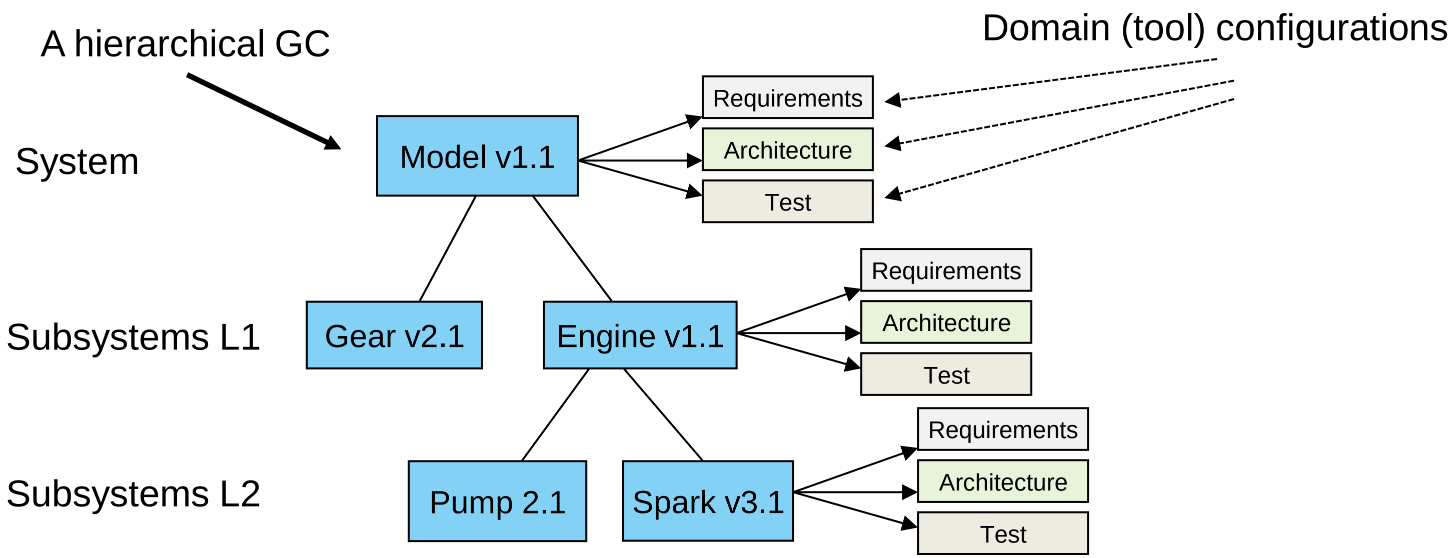
Handling multiple components - component dependencies

- To enable higher reuse, it is useful to organize requirements in multiple *components*
- Initially, DNG uses projects as component boundaries
  - To be refined in 2015
- Component configurations are linked using dependencies
  - Essentially imply a hierarchical structure
- A “component” can be part of multiple products
  - At same or different baseline

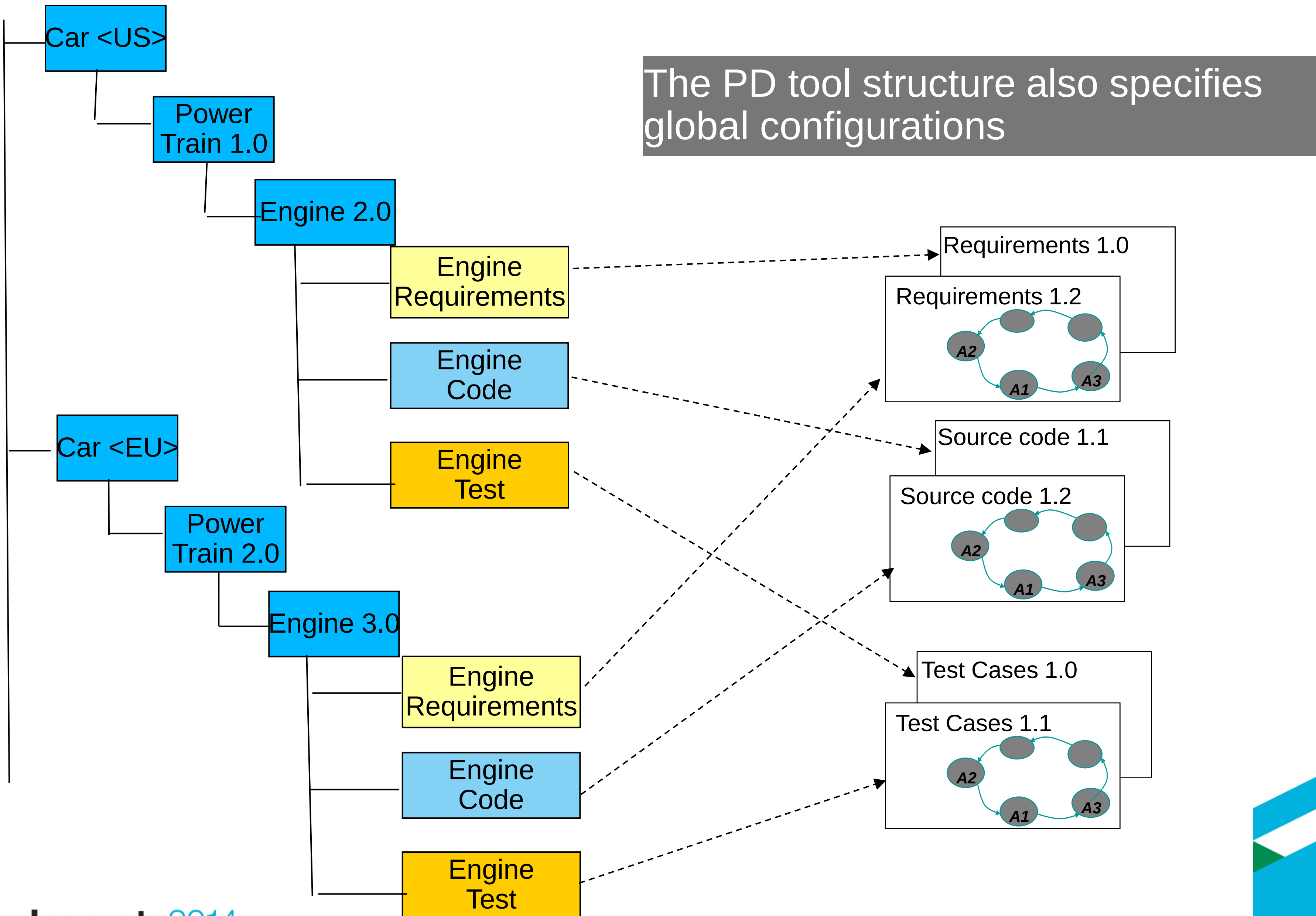


The bigger picture – global configurations

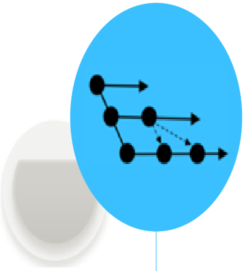
- How do we configure *requirements* along with the respective *tests*, *architecture*, and *code*?
- Global configurations (GCs) create compositions of configurations into multi-domain composite configurations
- GCs are part of OSLC configuration management
- GCs can be hierarchical
- GCs can also be mutable (global streams) or immutable (global baselines)



Using the product definition tool to manage global configs

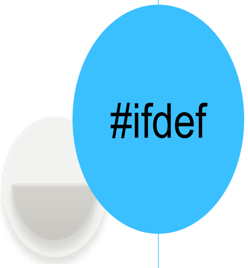


Future outlook: more on reuse patterns



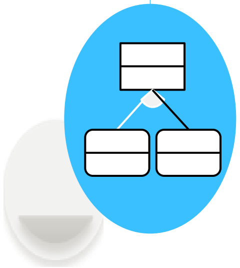
Multi-stream

- Using requirements versions and component streams to realize variants
- What we've discussed so far…



Parameterized

- Parameterizing components and artifacts for reuse



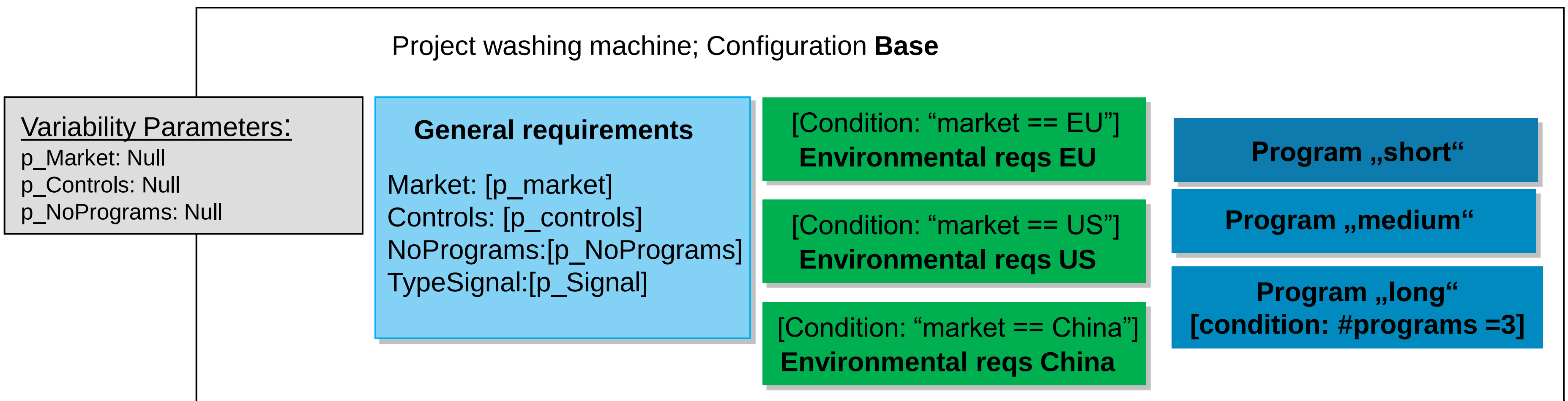
Feature-driven

- Deriving requirements configurations by feature selection
- Integrate with feature modeling tools

Parametric Variant Management

- Parametric components enable artifact reuse by parameterization
- Actual parameter settings derive concrete configurations of the parameterized artifacts
  - Conditional inclusion
  - Value substitution

Example: a parameterized component



Example: Washing machine – derivation using parameters

Project WashingMachine; Configuration **Europe**

<u>Variability Parameters:</u>
p_Market: Europe
p_Controls: Both
p_NoPrograms: 2

General requirements

Market: Europe
Controls: Both
NoPrograms: 3

Environmental reqs EU

Program „ Short“

Program „Medium“

Project WashingMachine; Configuration **US**

<u>Variability Parameters:</u>
p_Market: US
p_Controls: Sensor
p_NoPrograms: 3
p_Signal: Both
p_Color: Black

General requirements

Market: US
Controls: Sensor
NoPrograms: 3

Environmental reqs US

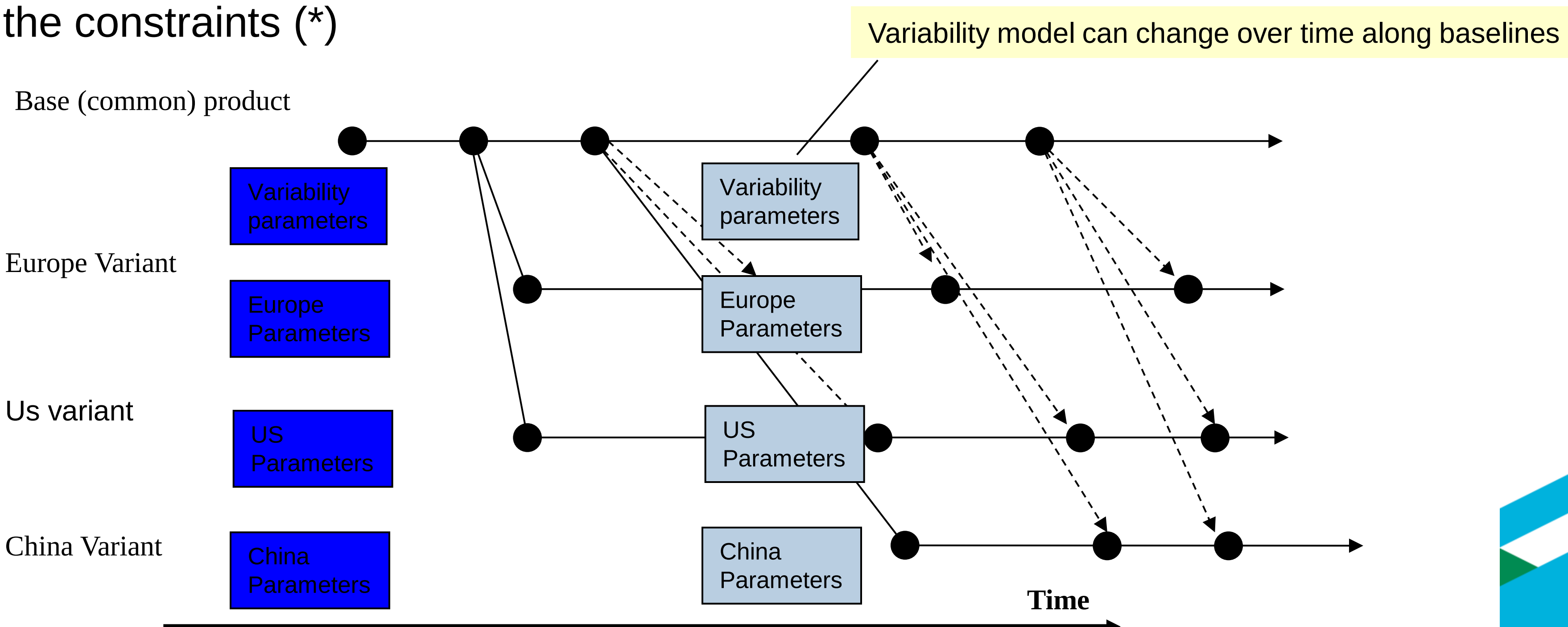
Program „ short“

Program „Medium“

Program „Long“

Parametric variant management and product streams

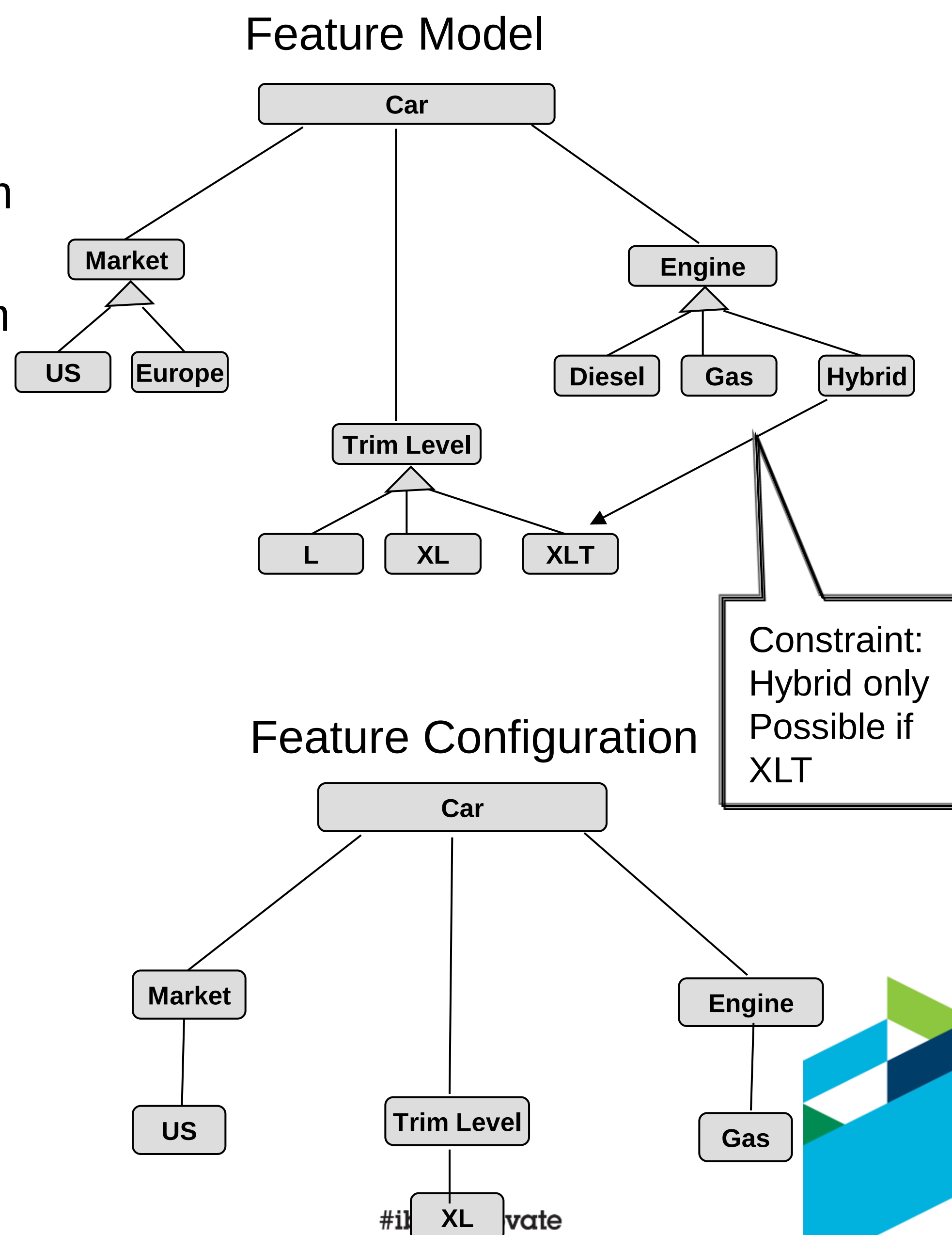
- The base configuration introduce a document with a set of properties serve as the variability parameters (variability model)
- variant configuration assign different parameter values to those defined in the base
- Automation scripts modify the content of artifacts in variant configurations according to the assigned values (*)
- In new platform baselines artifacts are pushed to variant configurations and variability update is calculated again
- Constraints can be checked using filters (query based) or scripts that check the constraints (*)



(*) These steps are still subject to salability of the scripting engine

Feature Models

- Feature models represent the “problem domain” abstraction of the product line
- Capture a functional view of the system components and their variabilities from a product line management standpoint
- Feature models have configurations called *feature profiles*, which drive the variability parameters of the solution
  - In our case they can be mapped to dimension and dimension values
- We plan to enable 3rd party feature modeling tools to integrate with the platform PLE services
  - E.g. BigLever or PureVariants

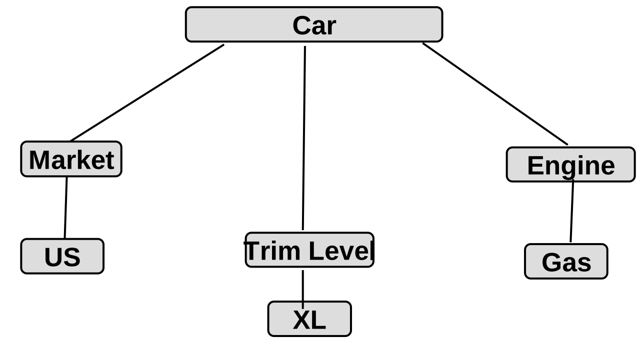


Adding feature management to drive product configurations

Feature selection

Variant/ Feature	Market	Trim	Engine	…	…
Variant 1	EU	L	Diesel		
Variant 2	US	XL	GAS		
Variant 3	US	XLT	GAS		

OR



Parameters configuration

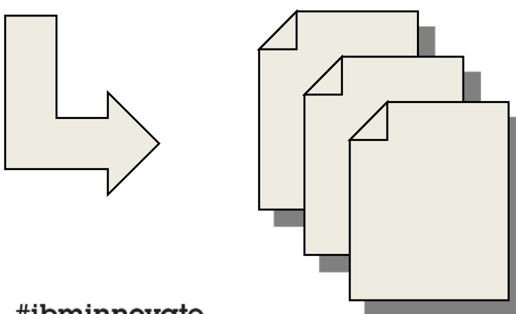
Engine = Gas

Trim = XL

Geo = US

Parameterized Artifacts

Product Artifacts



Summary

- Configuration Management benefits
  - Isolated changes with controlled propagation
  - Reuse without copying
- Streams (workspaces) can express product versions and variants
- Propagate changes
  - In the common requirements by delivering them to the variant configurations
  - In a variant and deliver to the common stream
- Consider parametric and feature-driven approaches where you have a large variability space
- Start exploring now
  - Download the DOORS NG with CM open beta from jazz.net

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