

Model Based Systems Engineering & Product Line Engineering

Systematic Reuse of Capella Models with pure::variants

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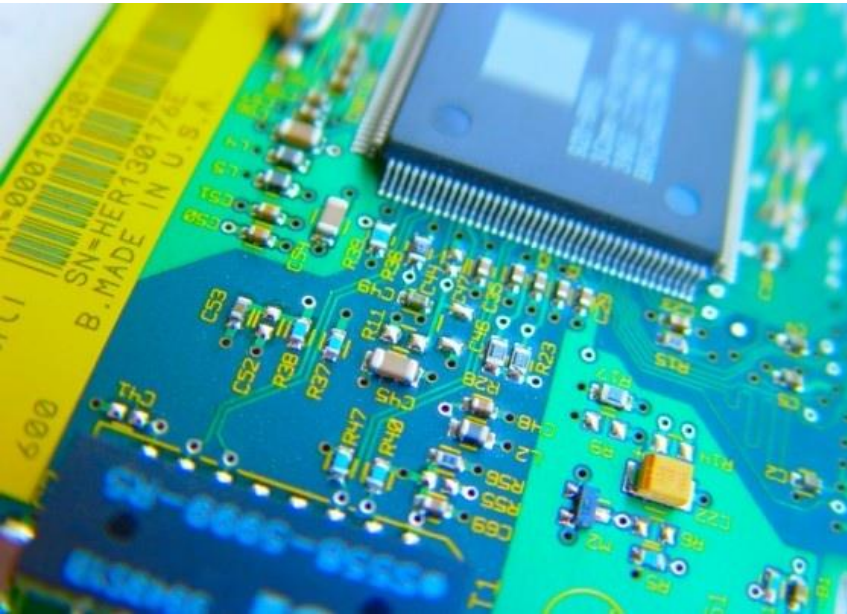
pure-systems Introduction

Established 2001, Privately Held, HQ in Germany

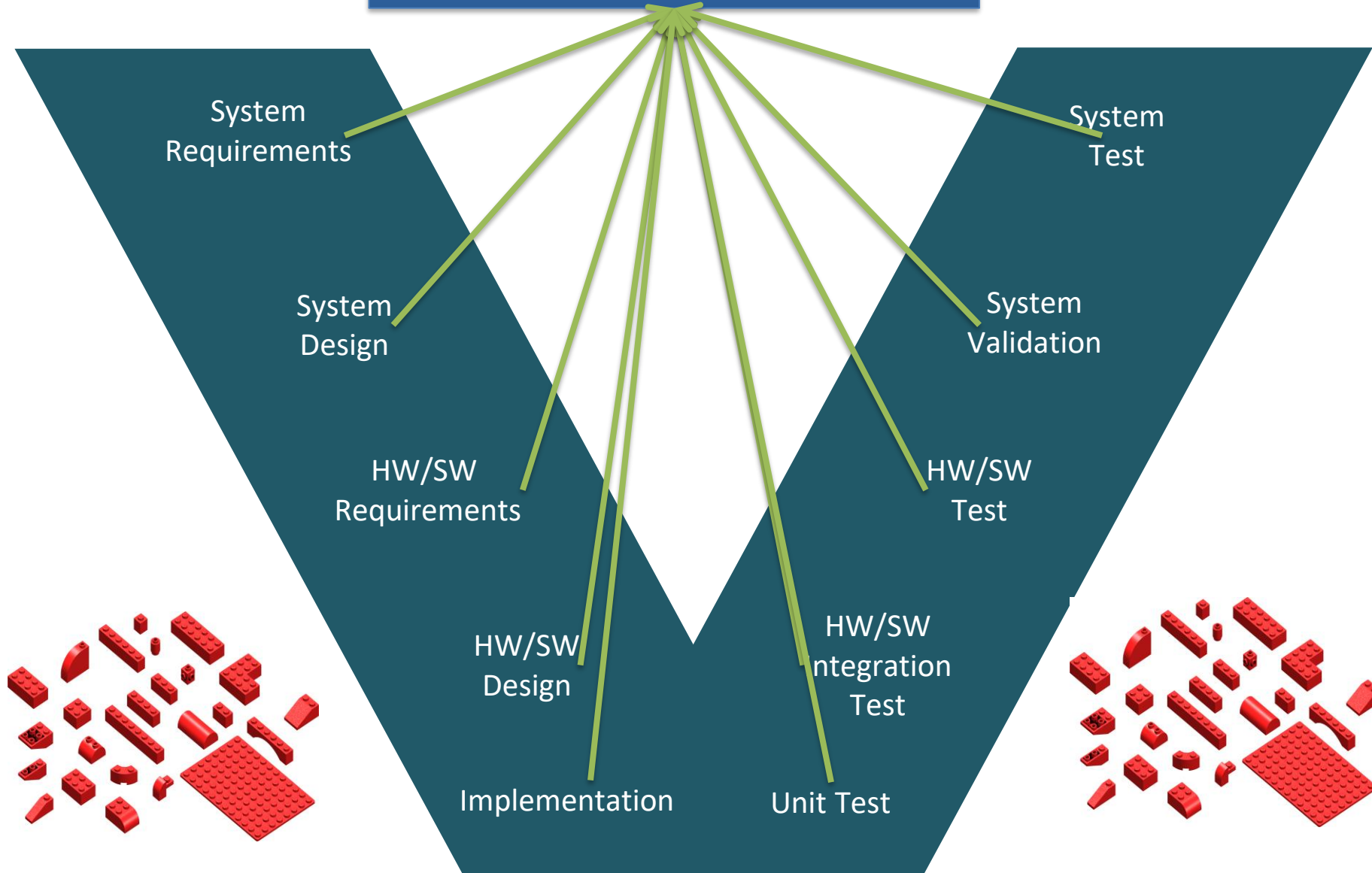
Variant Management and PLE Tools, Solutions, Services for Embedded and Complex Systems & Software Engineering

Market: Automotive, Aerospace & Avionics, Defense & Security, Rail & Transportation, Industry Automation, Semiconductor

Application Domains



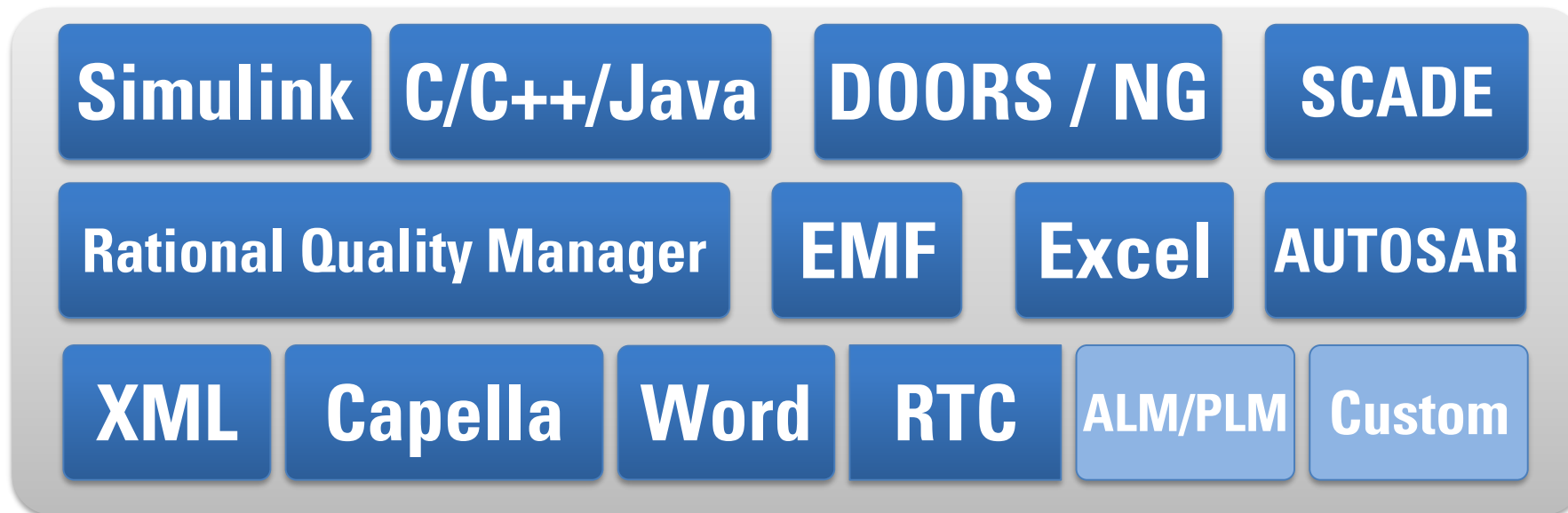
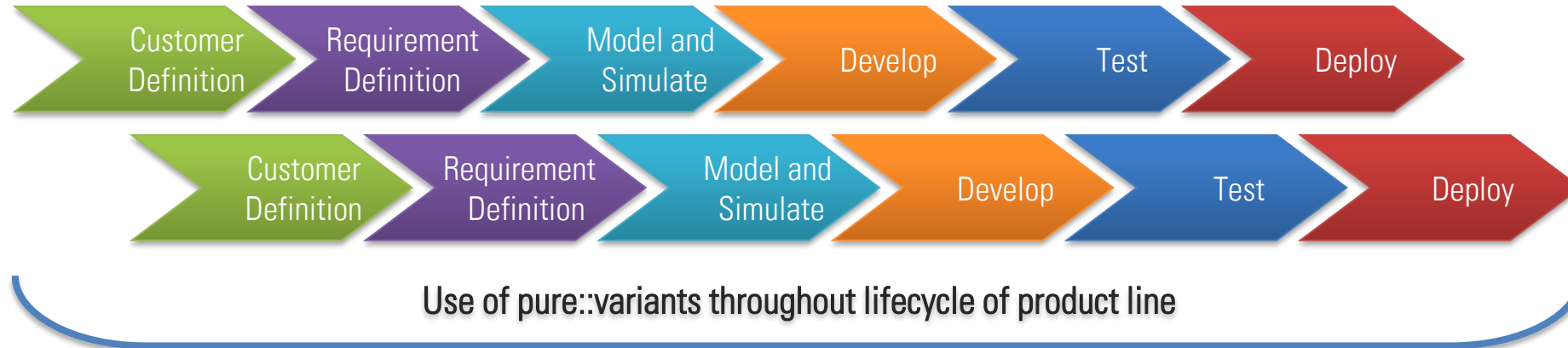
Everything is potentially reusable



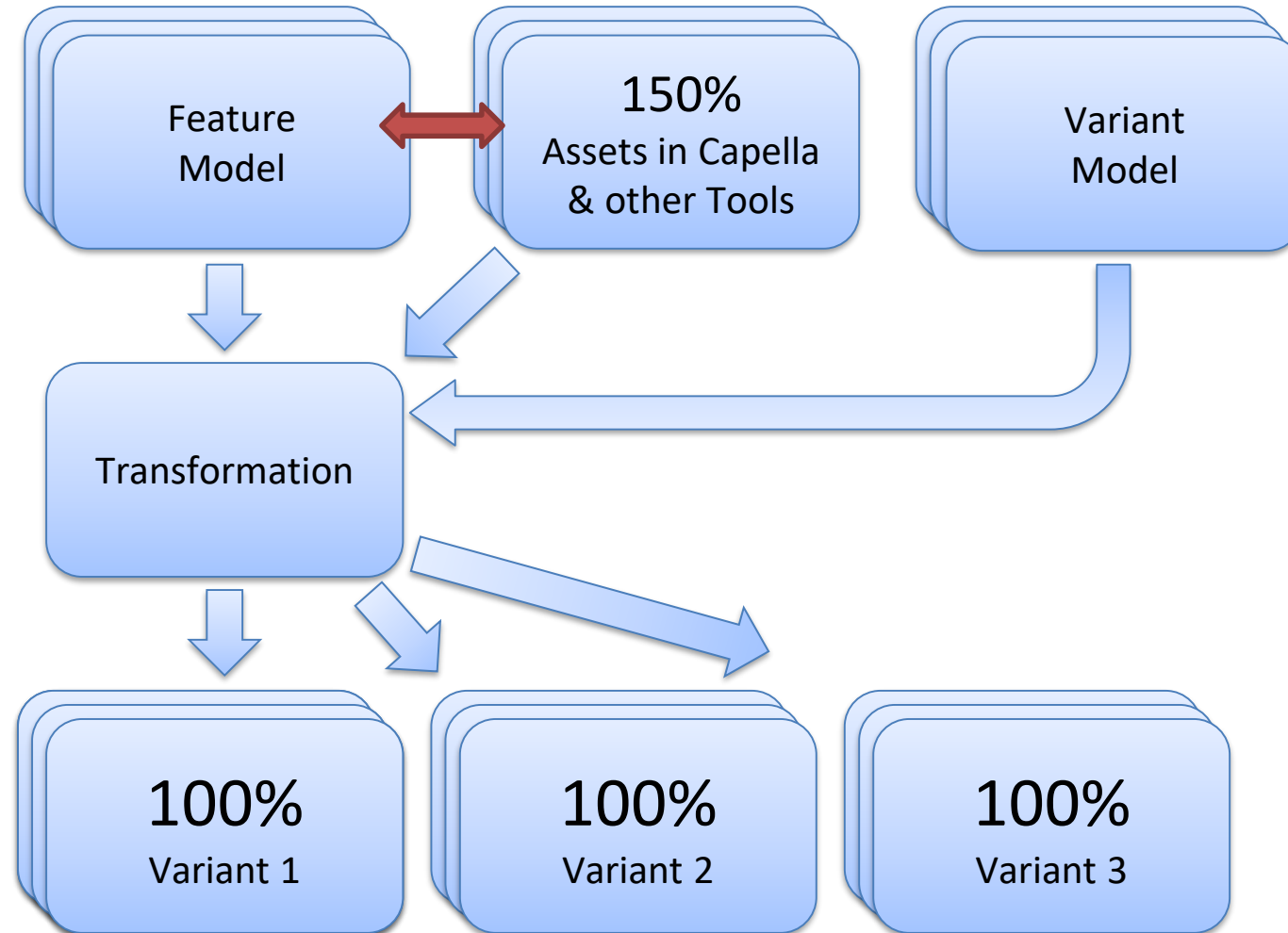


**Growing complexity of assets,
systems and interdependencies**

pure::variants & PLE positioning



PLE in a Nutshell

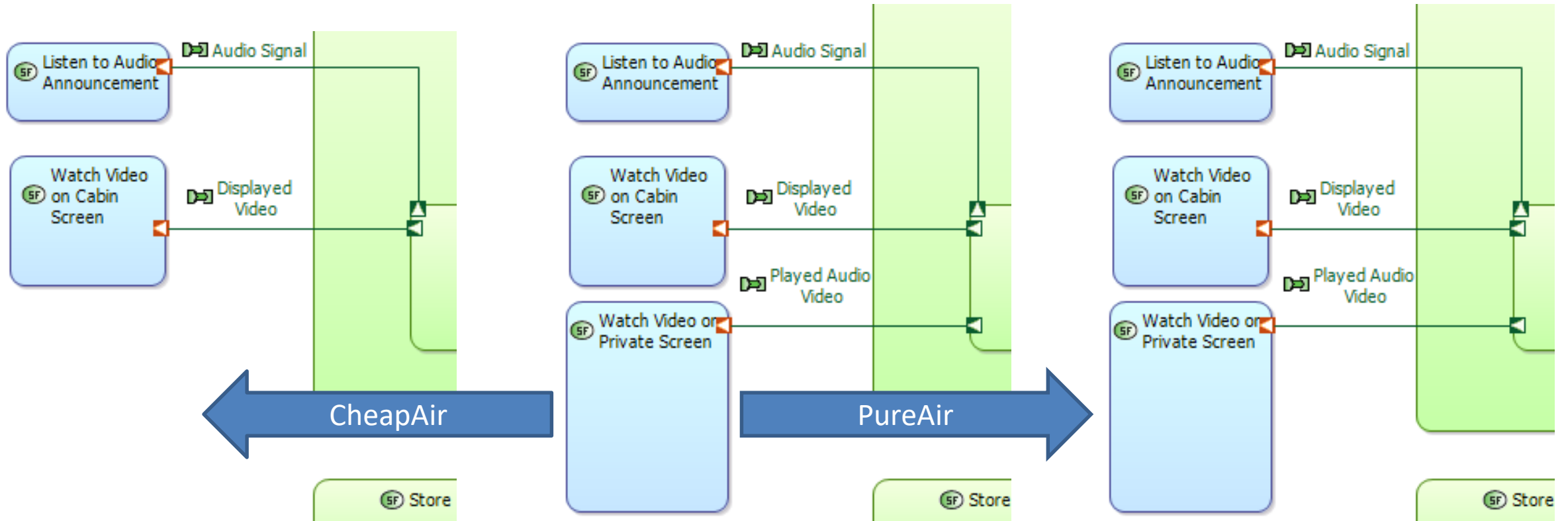


Example: Entertainment System

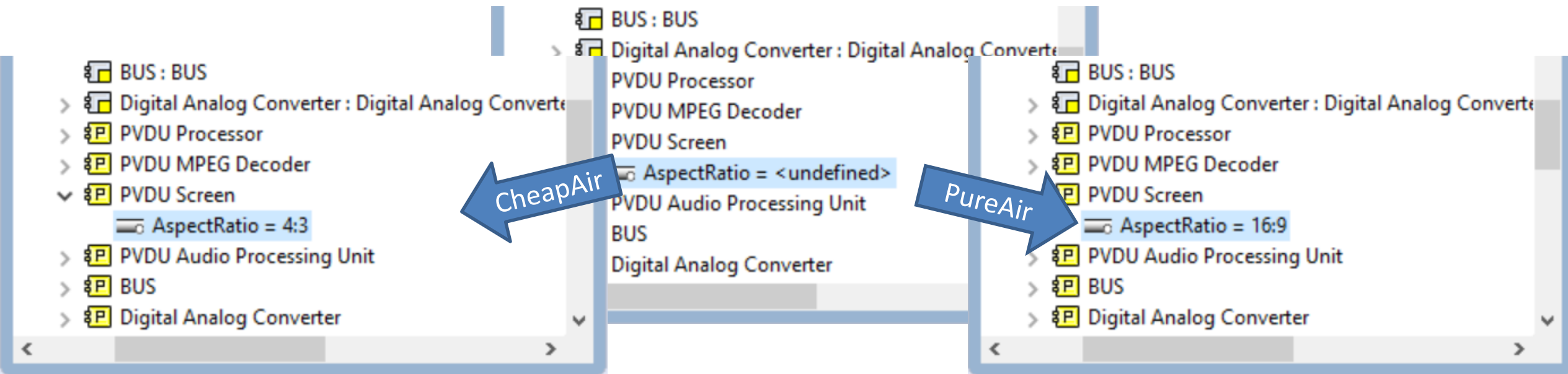
Variations Everywhere



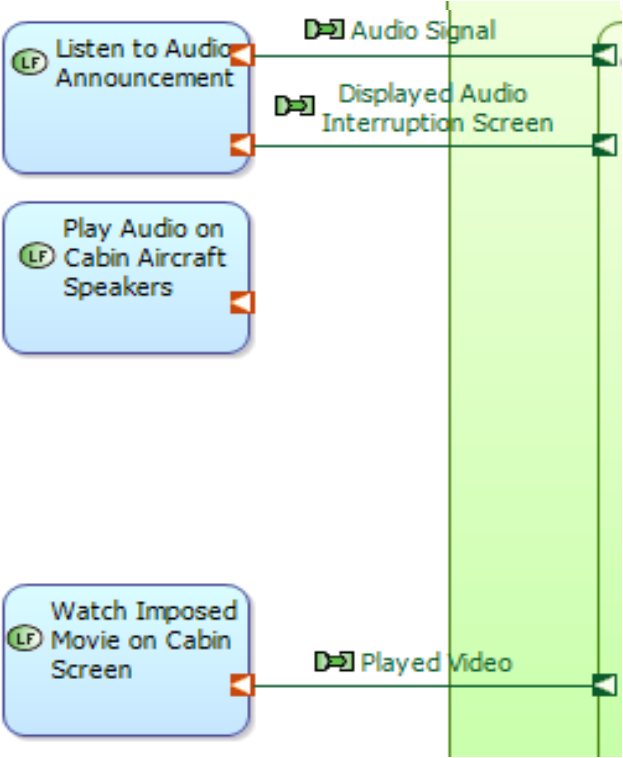
Basic Variation Concepts – Existence



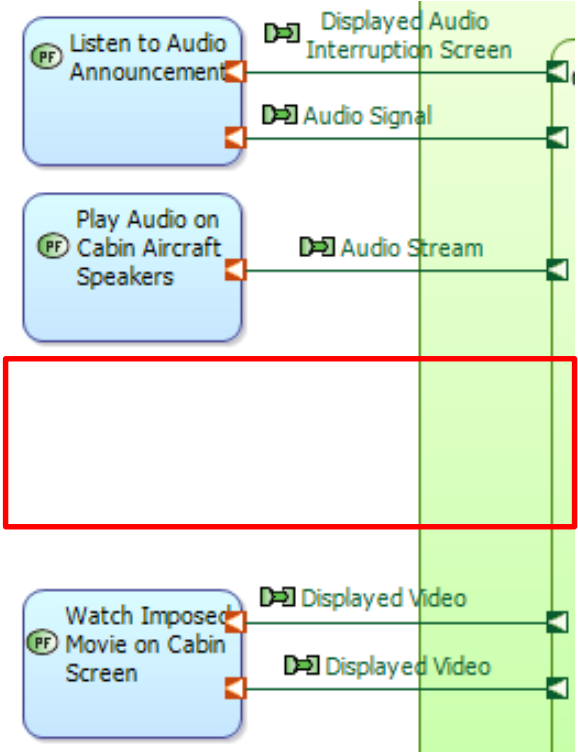
Basic Variation Concepts – Parametric Variation



Helpful Variation Concepts – Propagation



Logical Architecture



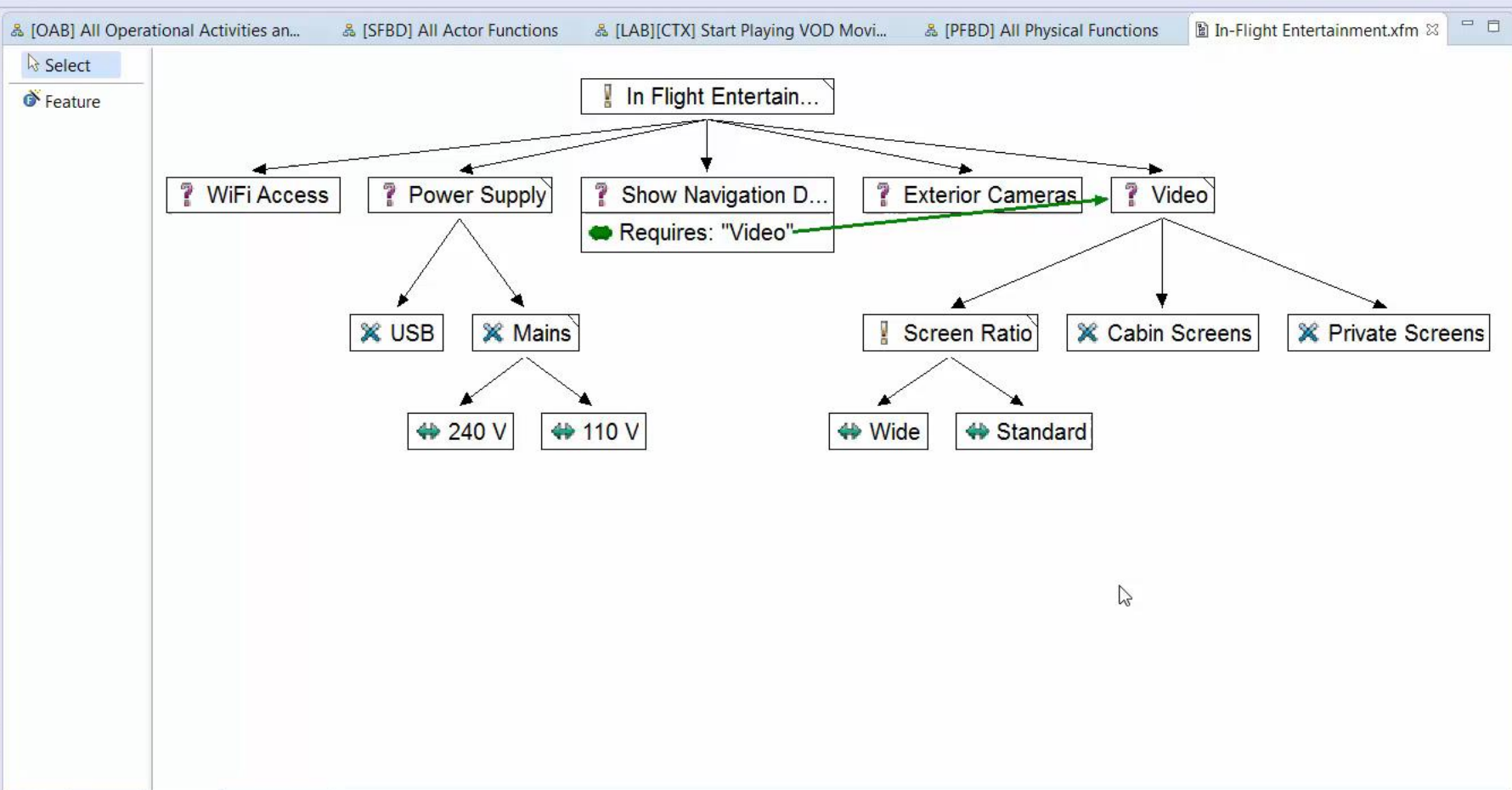
Physical Architecture

Controlling Variation with Feature Models

Role: Product Line Engineer

Variant Projects

- In-Flight Entertainment System
 - In-Flight Variability
 - InFlightVariability
 - CheapAir.vdm
 - PureAir.vdm
 - input
 - output
 - In-Flight Entertainment.xfm
 - Mapping.ccfm



Quick Access

Relation... Result

- Children (2)
 - 110 V
 - 240 V
- Parent (1)
 - Power Supply

Outline Visualization

Label
In Flight Entertainment
Screen Ratio
110 V
240 V
Standard
Wide
Exterior Cameras
Power Supply
Show Navigation Data
Video
WiFi Access
Cabin Screens
Mains
Private Screens
USB

Tree Table Graph Constraints

Properties Bookmarks Problems

Properties are not available.

Configuring a Variant

Role: Variant Configurator

Variant Projects

- In-Flight Entertainment System
 - In-Flight Variability
 - InFlightVariability
 - CheapAir.vdm
 - PureAir.vdm
 - input
 - output
 - In-Flight Entertainment.xfm
 - Mapping.ccfm

Outline Visualization
An outline is not available.

Model Elements	Level	CheapAir	PureAir
InFlightVariabilityFeatures			
In Flight Entertainment		▼	▼
Power Supply	1	<input type="checkbox"/>	▼
USB	1.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Mains	1.2	<input type="checkbox"/>	▼
240 V	1.2.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
110 V	1.2.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Video	2	▼	▼
Cabin Screens	2.1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Private Screens	2.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Screen Ratio	2.3	▼	▼
Wide	2.3.1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Standard	2.3.2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
WiFi Access	3	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Show Navigation Data	4	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Exterior Cameras	5	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Mapping			
Mapping		✓	▼
vel:name		'Mapping'	'Mapping'
vel:admindata: Mapping_ROOT	1	▼	▼
vel:version		'1'	'1'
vel:specialdata: propagation_settings	2	▼	▼

Matrix Properties Bookmarks Problems

Properties are not available.

Restricting Capella Assets

Role: System Architect

Variant Projects

- In-Flight Entertainment System
 - In-Flight Variability
 - InFlightVariability
 - CheapAir.vdm
 - medAir.vdm
 - PureAir.vdm
 - input
 - output
 - In-Flight Entertainment.xfm
 - Mapping.ccfm

[OAB] All Operationa... [SFBD] All Actor Fun... [LAB][CTX] Start Play... [PFBD] All Physical ... In-Flight Entertain... InFlightVariability medAir.vdm

- In Flight Entertainment
 - Power Supply
 - USB
 - Mains
 - Video
 - Cabin Screens
 - Private Screens
 - Screen Ratio
 - Wide
 - Standard
 - WiFi Access
 - Show Navigation Data
 - Requires: "Video"
 - Exterior Cameras

Quick Access

Relation... Result

- Children (5)
 - Exterior Cameras
 - Power Supply
 - Show Navigation Data
 - Video
 - WiFi Access

Outline Visualization

Label

- Cabin Screens
- In Flight Entertainment
- Screen Ratio
- Show Navigation Data
- Standard
- Video

Feature Models VEL Configuration Family Models

Properties Bookmarks Problems

In Flight Entertainment

General	Unique ID	iOrgMFbp-esvPKxLT
Description	Unique Name	InFlightEntertainment
Rationale	Visible Name	In Flight Entertainment
	Class/Type	ps:feature ps:feature
	Variation Type	<input checked="" type="radio"/> Mandatory <input type="radio"/> Optional <input type="radio"/> Alternative <input type="radio"/> Or

15 : 17 21 (3) 186M of 2204M

Transformation of 100% Capella Models

Role: Variant Configurator



Variant Projects

- In-Flight Entertainment System
 - In-Flight Variability
 - InFlightVariability
 - CheapAir.vdm
 - medAir.vdm
 - PureAir.vdm
 - input
 - output
 - In-Flight Entertainment.xfm
 - Mapping.ccfm

[OAB] All Operation... [SFBFD] All Actor Fu... [LAB][CTX] Start Pla... [PFBD] All Physical ... In-Flight Entertain... InFlightVariability CheapAir.vdm

- In Flight Entertainment
 - Power Supply
 - Video
 - WiFi Access
 - Show Navigation Data
 - Exterior Cameras

Quick Access

Relatio... Result

Outline Visualization

Label

- Cabin Screens
- In Flight Entertainment
- Screen Ratio
- Standard
- Video

Feature Models VEL Configuration Family Models

Properties Bookmarks Problems

Properties are not available.

Summary

From Feature Model to Variants

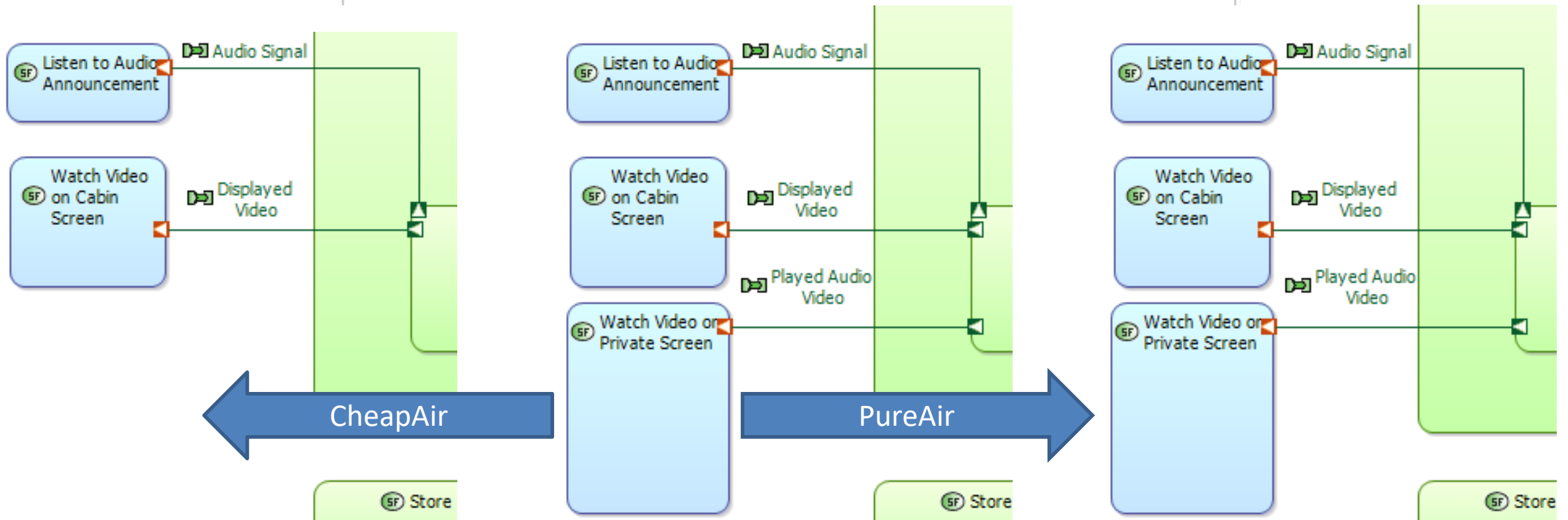
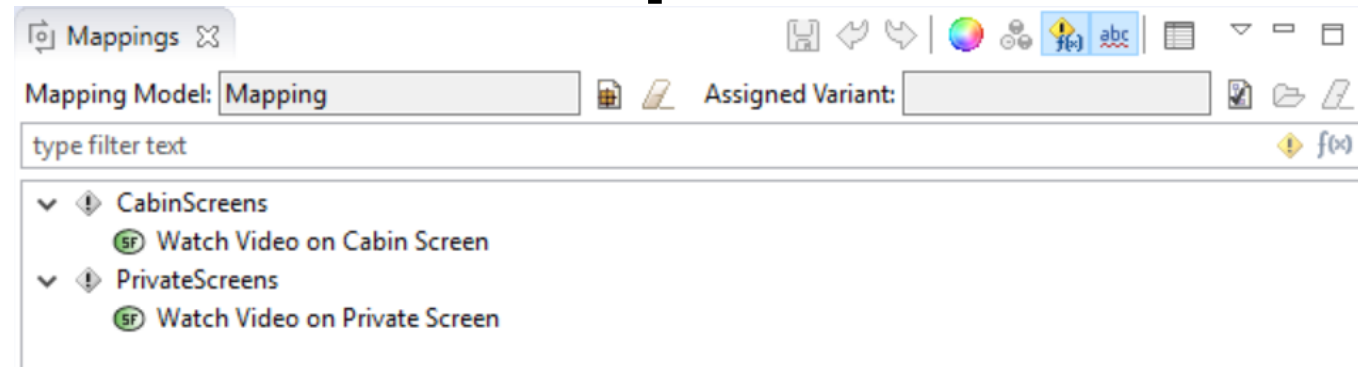
In-Flight Entertainment.xfm *InFlightVariability

Model Elements	Level	CheapAir	PureAir
InFlightVariabilityFeatures			
[-] ! (F) In Flight Entertainment		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
[-] ? (F) Power Supply	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
X (F) USB	1.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
[-] X (F) Mains	1.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>
↔ (F) 240 V	1.2.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
↔ (F) 110 V	1.2.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>
[-] ? (F) Video	2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
X (F) Cabin Screens	2.1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
X (F) Private Screens	2.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>
[-] ! (F) Screen Ratio	2.3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
↔ (F) Wide	2.3.1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
↔ (F) Standard	2.3.2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
? (F) WiFi Access	3	<input type="checkbox"/>	<input checked="" type="checkbox"/>
? (F) Show Navigation Data	4	<input type="checkbox"/>	<input checked="" type="checkbox"/>
? (F) Exterior Cameras	5	<input type="checkbox"/>	<input checked="" type="checkbox"/>

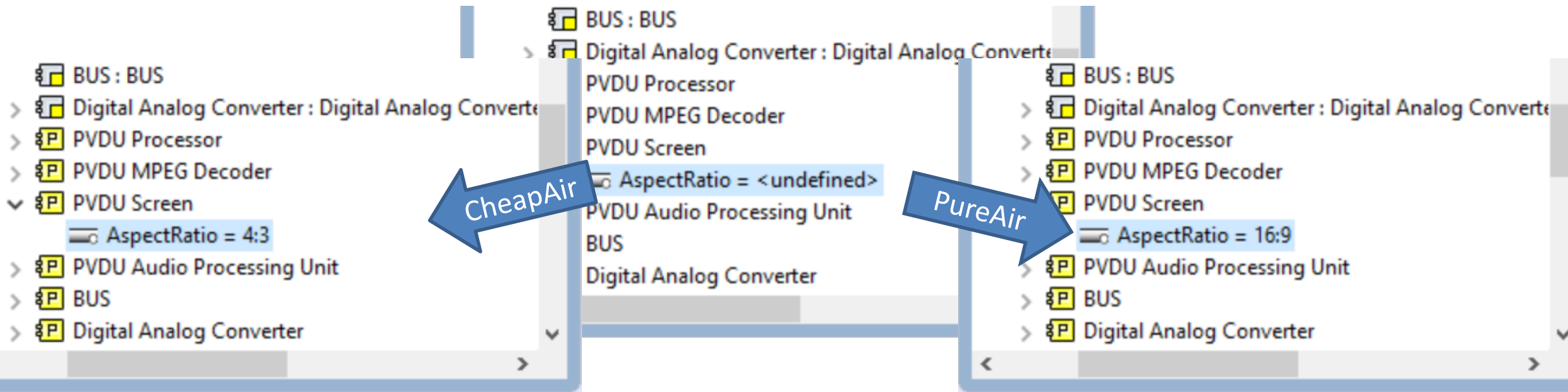
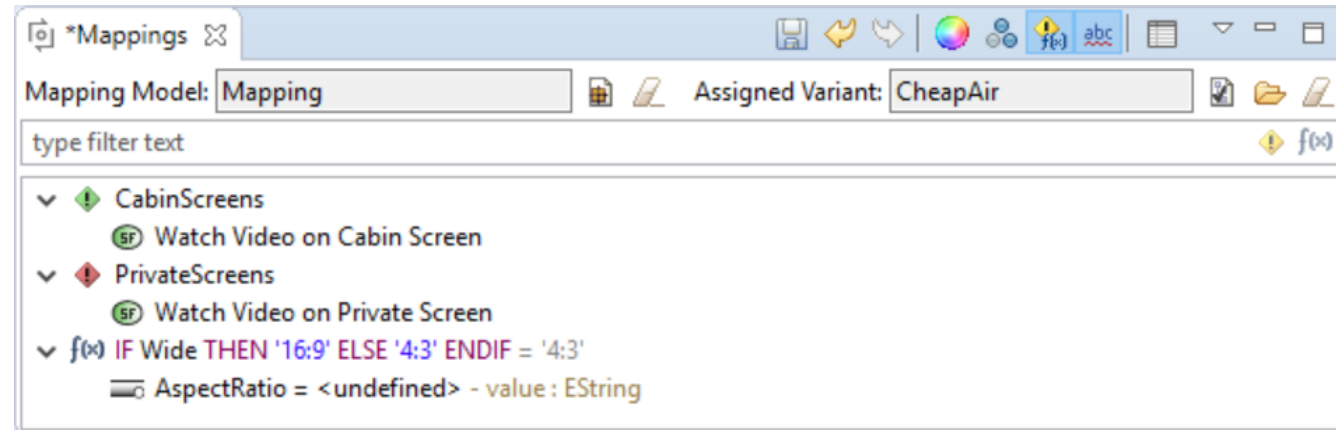
Matrix

Legend: ! = Mandatory ? = Optional ↔ = Alternative X = Or

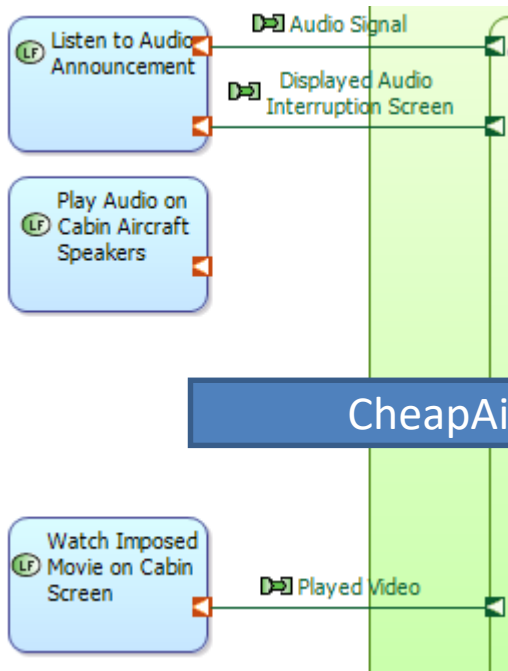
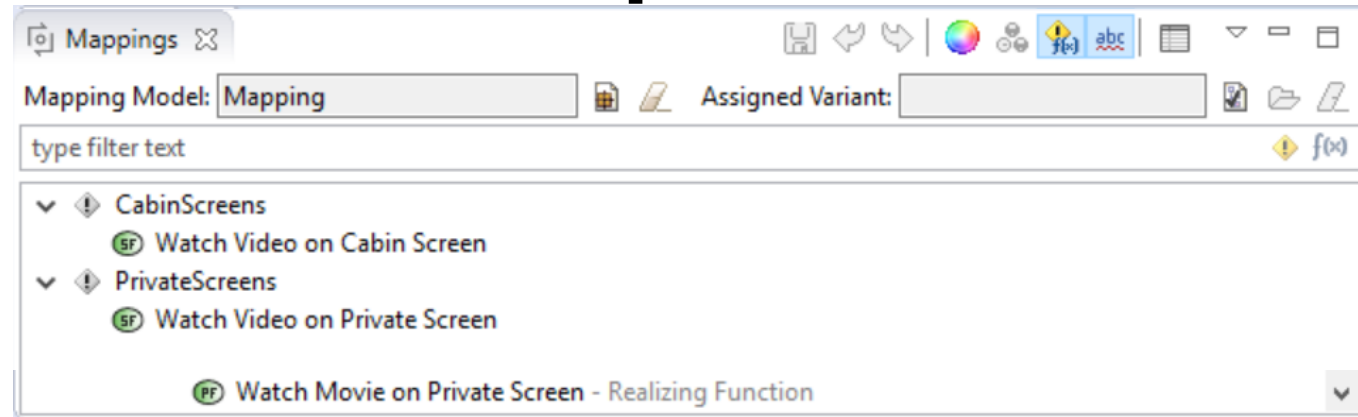
Basic Variation Concepts Revisited – Existence



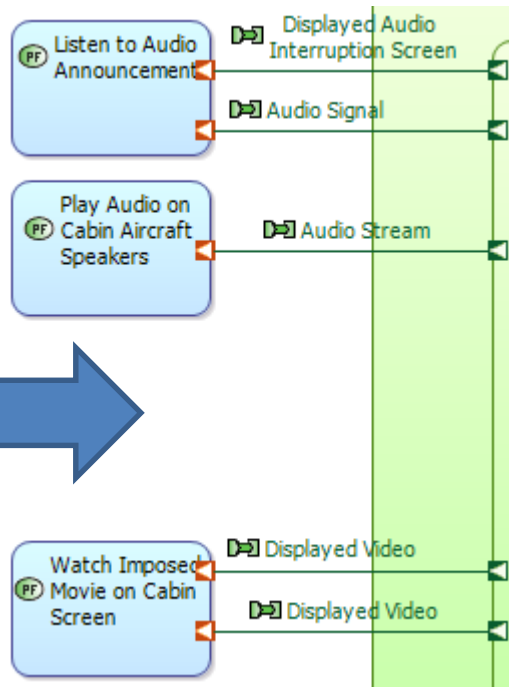
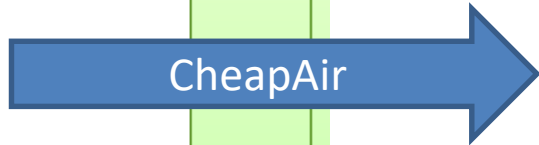
Basic Variation Concepts Revisited – Parametric Variation



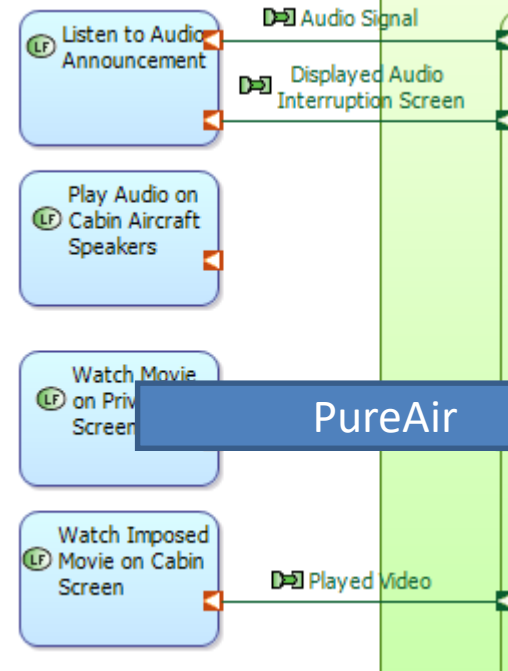
Helpful Variation Concepts Revisited – Propagation



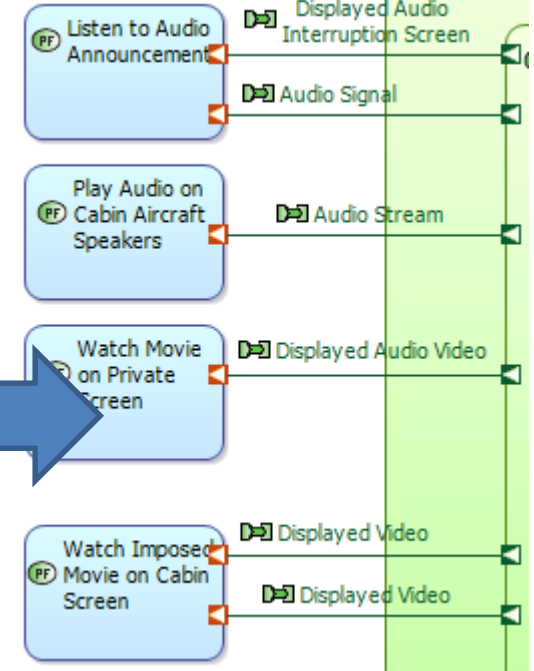
Logical Architecture



Physical Architecture



Logical Architecture



Physical Architecture

Thank You