

# **Systematic Reuse Of Capella Assets with pure::variants – How to Capitalize on Your Assets**

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# Why MBSE?



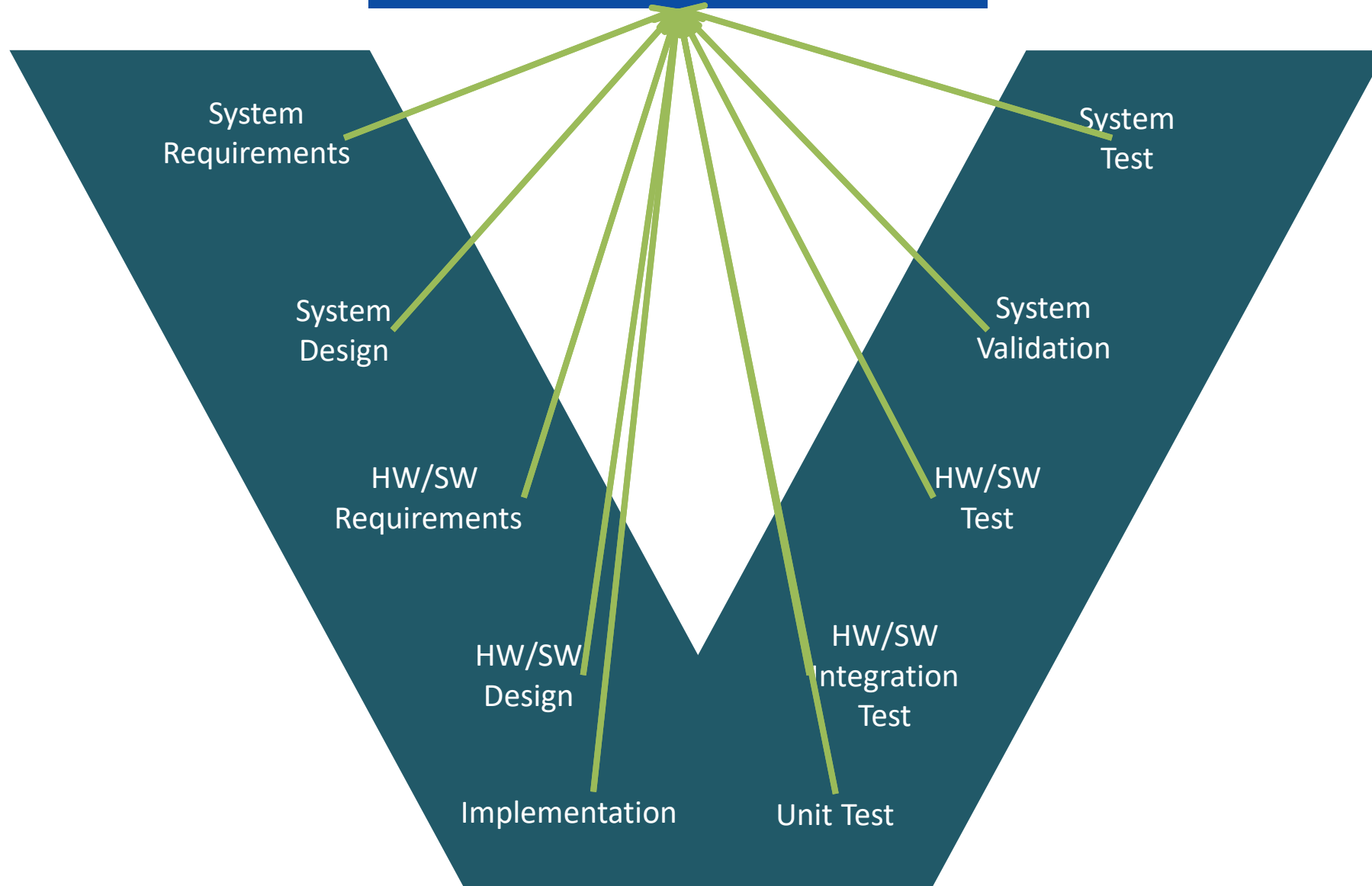
# Why Reuse?



# Variations Everywhere



# Everything is potentially reusable





**Reuse Complexity**



**Quick Time To Market**

**Engineering Efficiency**

**Best Solution: Use Product Line Engineering**

**High Quality**

**Match for Market Needs**

# How to do PLE with Capella?

# It Is A Simple Equation

**N x Similar Product Engineering**

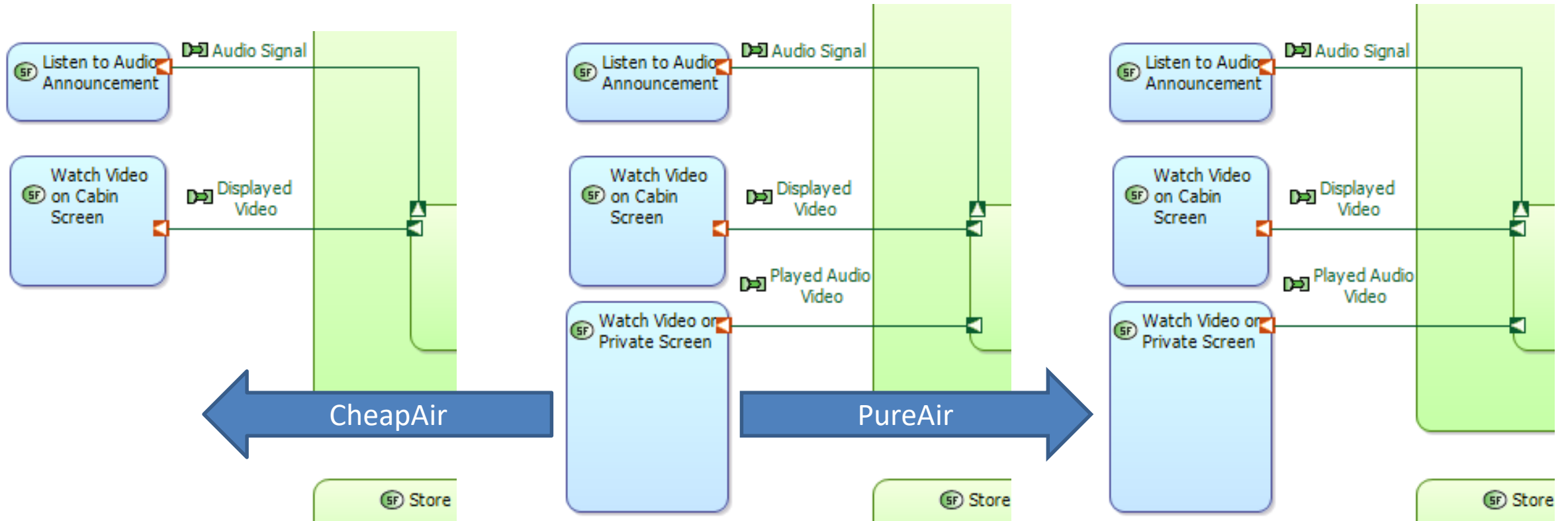


**Systematic Variant Management**

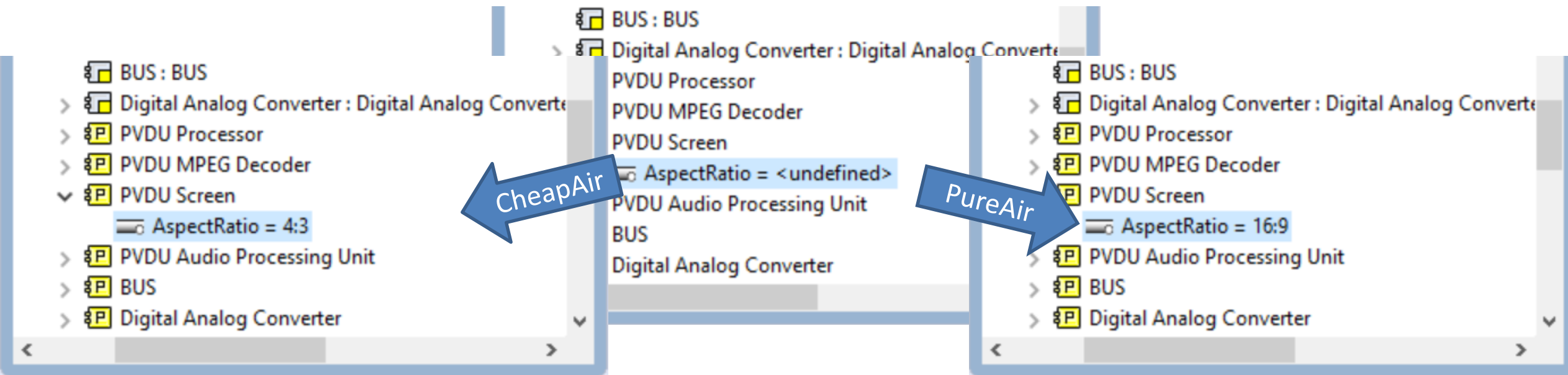


**Product Line Engineering (PLE)**

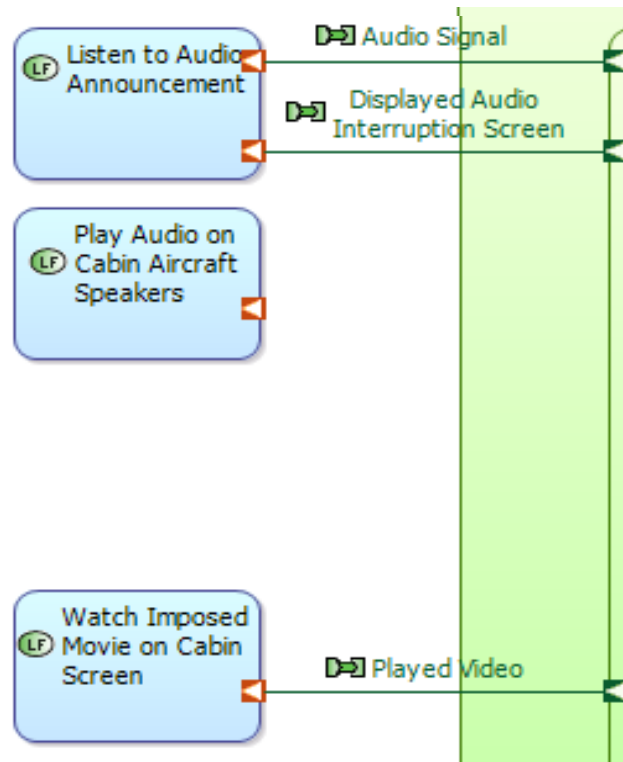
# Basic Variation Concepts – Existence



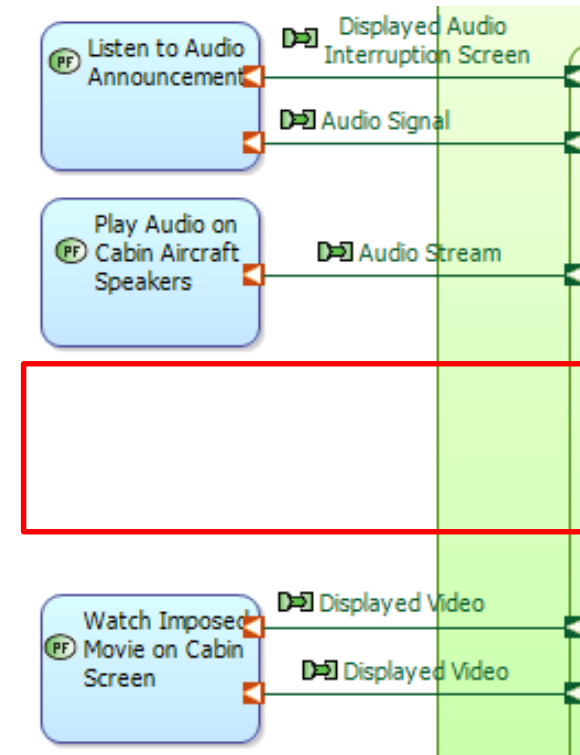
# Basic Variation Concepts – Parametric Variation



# Helpful Variation Concepts – Propagation




Logical Architecture







Physical Architecture

# Controlling Variation with Feature Models

# Feature Model – Inflight Entertainment Domain

 In Flight Entertainment

**Legend:**  = Mandatory  = Optional  = Alternative  = Or



# From Feature Model to Variants

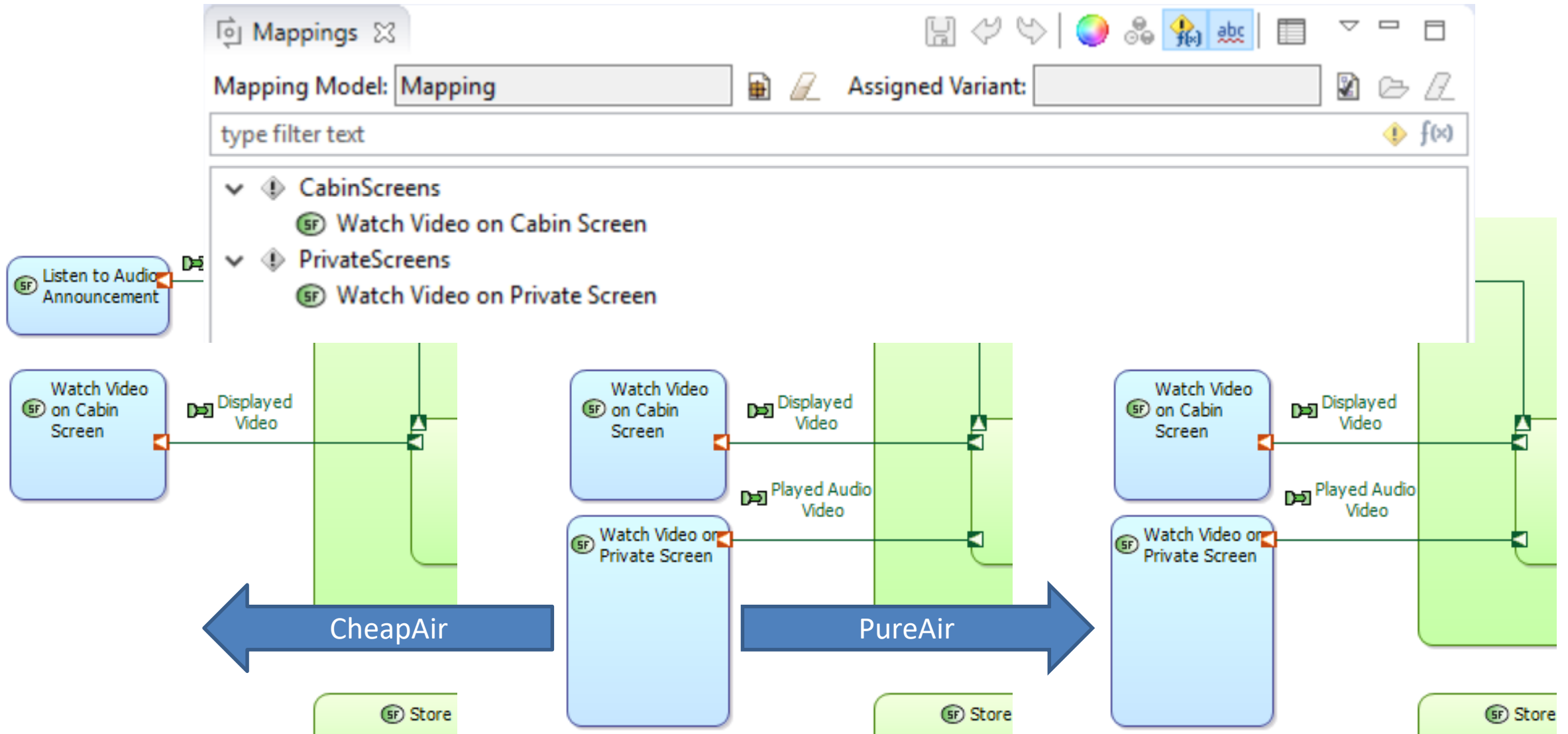
In-Flight Entertainment.xfm \*InFlightVariability

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"/>

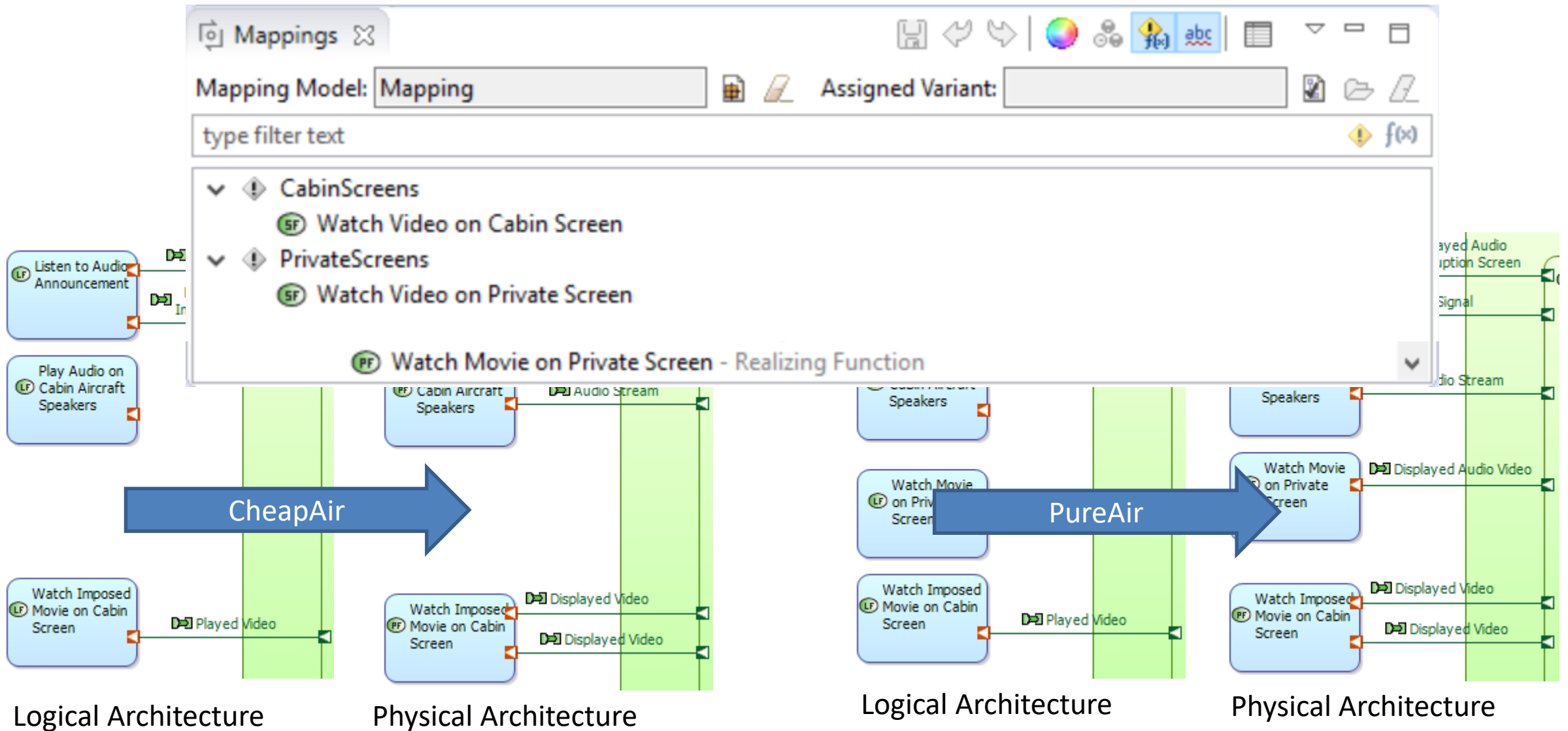
Matrix

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

# Basic Variation Concepts Revisited – Existence



# Helpful Variation Concepts Revisited – Propagation



# Propagation Challenges

Passenger

IFE System

# Basic Variation Concepts Revisited – Parametric Variation

\*Mappings

Mapping Model: Mapping Assigned Variant: CheapAir

type filter text

- ⚠ CabinScreens
  - Ⓢ Watch Video on Cabin Screen
- ⚠ PrivateScreens
  - Ⓢ Watch Video on Private Screen
- f(x) IF Wide THEN '16:9' ELSE '4:3' ENDIF = '4:3'

- BUS : BUS
- > Digital Analog Converter : Digital Analog Converter
- > PVDU Processor
- > PVDU MPEG Decoder
- ▼ PVDU Screen
  - AspectRatio = 4:3
- > PVDU Audio Processing Unit
- > BUS
- > Digital Analog Converter

CheapAir

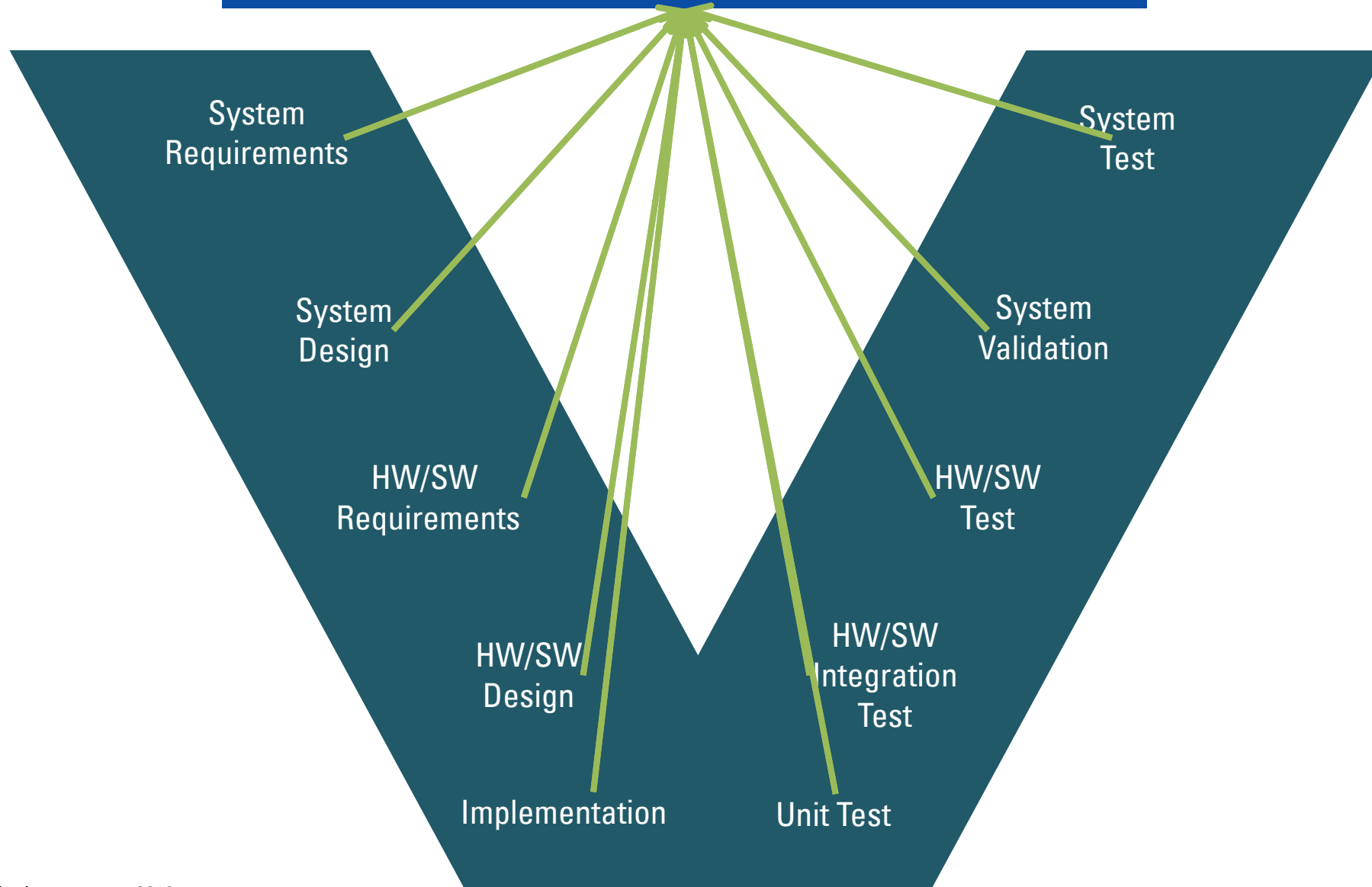
- value : EString
- PVDU MPEG Decoder
- PVDU Screen
  - AspectRatio = <undefined>
- PVDU Audio Processing Unit
- BUS
- Digital Analog Converter

PureAir

- BUS : BUS
- > Digital Analog Converter : Digital Analog Converter
- > PVDU Processor
- > PVDU MPEG Decoder
- ▼ PVDU Screen
  - AspectRatio = 16:9
- > PVDU Audio Processing Unit
- > BUS
- > Digital Analog Converter

**pure::variants**

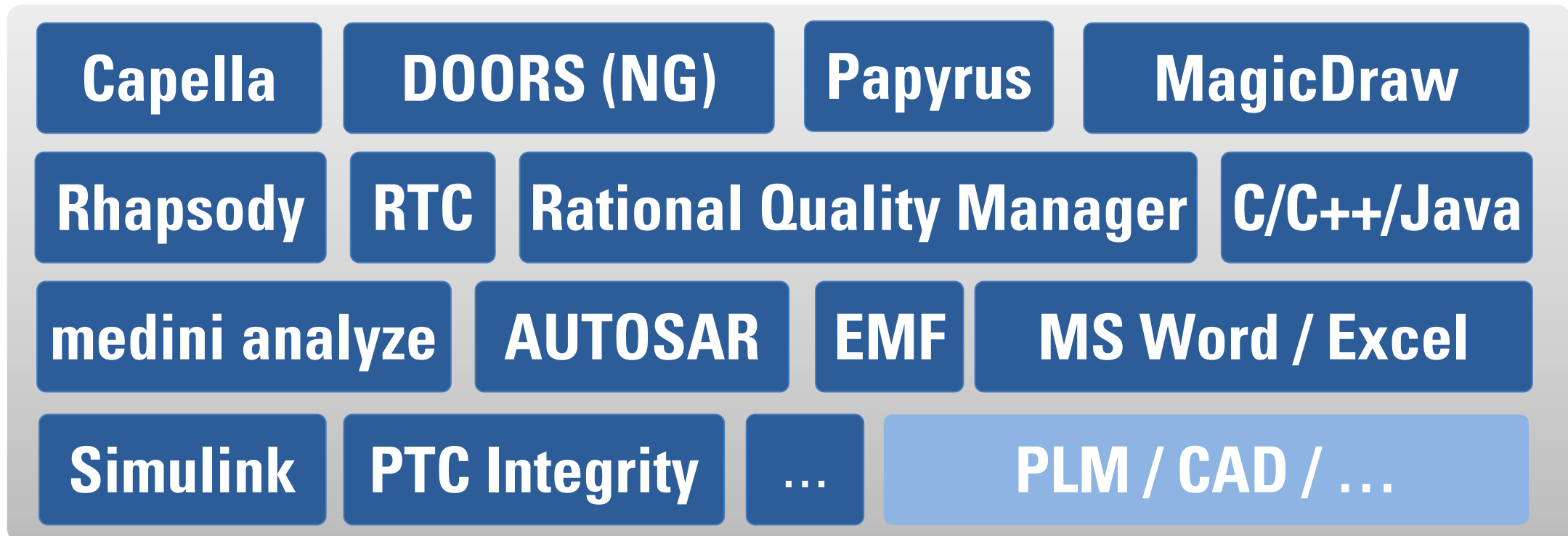
# Holistic Variant Management orchestrated by pure::variants



# pure::variants Integrates With Market Leading Engineering Tools

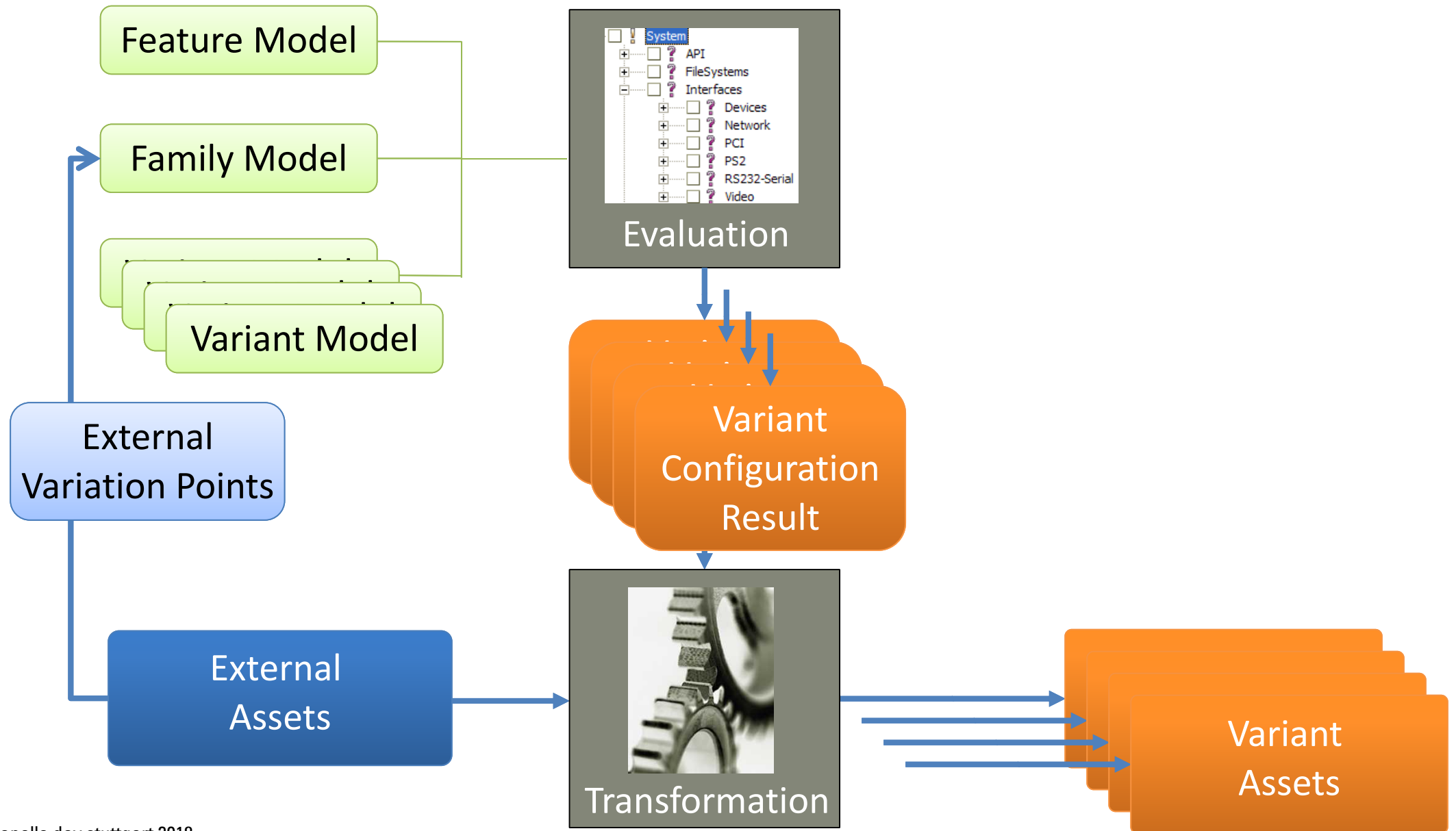


Integrate engineering tools and management systems throughout lifecycle of product line





# pure::variants Dataflow



# **pure::variants Connector for Capella**

# AiO – Capella and pure::variants

Capella - platform:/resource/In-Flight%

File Edit Diagram Navigate Search

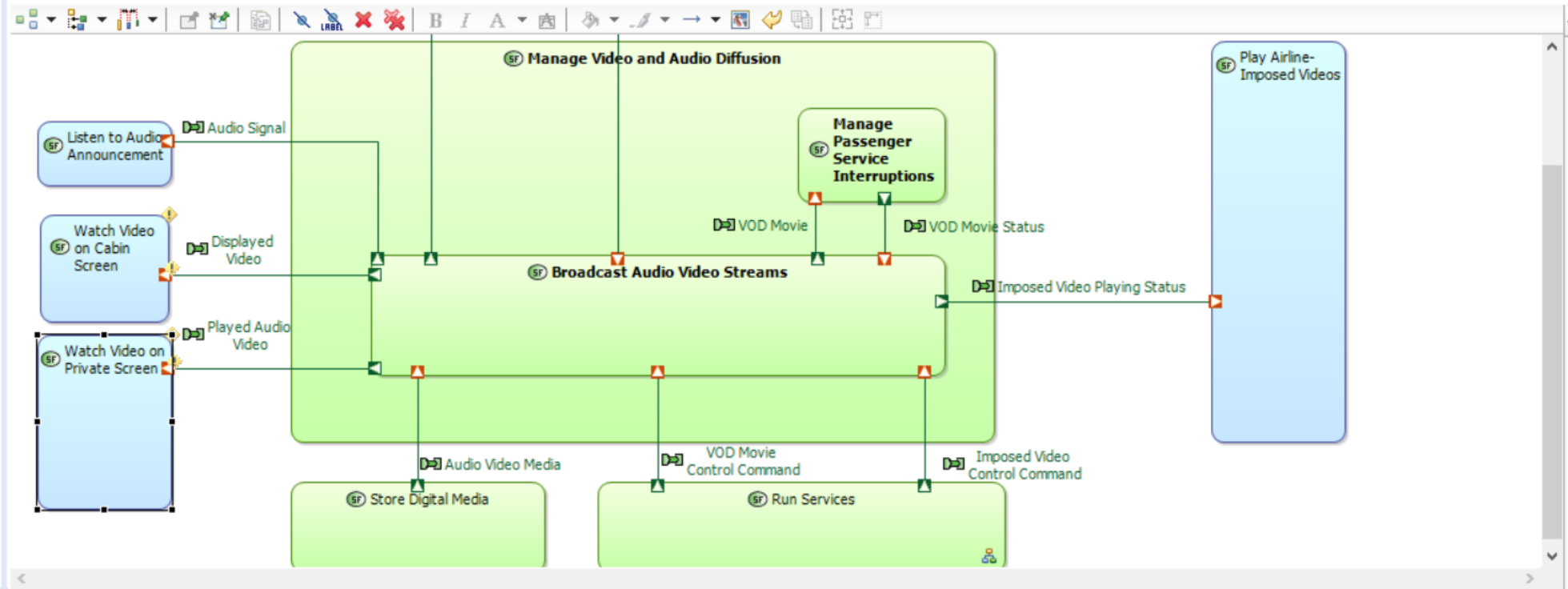
Capella Project Explorer

Select a name to find  
? = any character, \* = any string

type filter text

- In-Flight Entertainment System
  - In-Flight Entertainment System.afm
  - In-Flight Entertainment System.aird
    - In-Flight Entertainment System
    - Representations per category
  - In-Flight Entertainment System.melodymodeller
- In-Flight Variability
  - InFlightVariability
  - input
  - output
  - In-Flight Entertainment.xfm
  - Mapping.ccfm

[SAB] High L... [SDFB] Top L... [LAB] [BUIL... [LAB][CTX] ... [OAB] All O... [SDFB] [CTX]... [SDFB] [CTX]... [SFBD] All A...



Properties Fast Linker Semantic Browser Error Log

[System Function] Watch Video on Private Screen

Referencing Elements	Current Element	Referenced Elements
<ul style="list-style-type: none"><li>Allocating Actor<ul style="list-style-type: none"><li>Passenger</li></ul></li><li>Functional Chains<ul style="list-style-type: none"><li>Resume VOD Movie</li><li>Start Playing VOD Movie</li><li>Watch Imposed Video on Privat</li></ul></li><li>Incoming Functional Exchanges<ul style="list-style-type: none"><li>Played Audio Video</li></ul></li></ul>	<ul style="list-style-type: none"><li>Watch Video on Private Screen<ul style="list-style-type: none"><li>Parent<ul style="list-style-type: none"><li>Entertain with IFE System</li></ul></li><li>All Related Tables</li><li>System Functions - Operatic</li><li>All Related Diagrams<ul style="list-style-type: none"><li>[ES] Start Playing VOD Movi</li><li>[SAB] High Level System Ov</li></ul></li></ul></li></ul>	<ul style="list-style-type: none"><li>Realized Operational Activities<ul style="list-style-type: none"><li>Watch Movie</li></ul></li></ul>

Mappings

Mapping Model: Mapping Assigned Variant: PureAir

- type filter text
- CabinScreens
    - Watch Video on Cabin Screen
  - PrivateScreens
    - Watch Video on Private Screen
  - f(x) IF Wide THEN '16:9' ELSE '4:3' ENDIF = '16:9'
    - AspectRatio = <undefined> - value : EString

Variant Projects

- In-Flight Entertainment System
  - In-Flight Variability
    - InFlightVariability
      - input
      - output
      - In-Flight Entertainment.xfm
      - Mapping.cfm

Outline Visualization

An outline is not available.

Model Elements	Level	CheapAir	PureAir
InFlightVariabilityFeatures			
In Flight Entertainment			
Power Supply	1	<input type="checkbox"/>	<input type="checkbox"/>
USB	1.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Mains	1.2	<input type="checkbox"/>	<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	<input type="checkbox"/>	<input type="checkbox"/>
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	<input type="checkbox"/>	<input type="checkbox"/>
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		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
vel:admindata: Mapping_ROOT	1	'Mapping'	'Mapping'
vel:version		'1'	'1'
vel:specialdata: propagation_settings	2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
vel:data: com.ps.consul.eclipse.ui.capella.transform.VerticalRealizingFunctionAdapter	2.1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
vel:data: com.ps.consul.eclipse.ui.capella.transform.FunctionalChainAdapter	2.2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
vel:data: com.ps.consul.eclipse.ui.capella.transform.HorizontalPortAdapter	2.3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
condition-CabinScreens	3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
vel:name		'condition-Ca...	'condition-Cab...
CabinScreens	3.1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
vel:name		'CabinScreens'	'CabinScreens'

Relations Result

- Parent (1)
  - Video

Properties Bookmarks Problems

**Private Screens**

**General** Unique ID: iTB5rVSYxgPskQqxo

**Description** Unique Name: PrivateScreens

**Rationale** Visible Name: Private Screens

Class/Type: ps:feature

Variation Type:  Mandatory  Optional  Alternative  Or

Default Selected:  Range: [1,n]

Proudly made in Magdeburg, Germany, since 2001



# Final Words

# Summary

**Strong Capella semantics ease variation**

**Feature models good match for Capella**

**pure::variants brings together MBSE and PLE in Capella**

**Modularization ongoing topic for Reuse in Capella**

The logo for 'variant WORLD.2018' features a stylized globe icon on the left, composed of several curved lines in shades of blue and orange. To the right of the icon, the word 'variant' is written in a bold, orange, lowercase sans-serif font. Below 'variant', the words 'WORLD.2018' are written in a bold, blue, uppercase sans-serif font.

# variant WORLD.2018

April 17 and 18,  
Leipzig, Germany

