



MBSE & PLE

Systematic Reuse in Engineering

18.09.2023

Introduction





Robert Hellebrand

Principal Field Application Engineer robert.hellebrand@pure-systems.com (+49) 0391 544569-38

pure-systems at a glance – HQ in Magdeburg



ISC



purevariants



Established 2001, Privately Held, HQ in

prostep ivip,

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Automotive, Aerospace/Avionics, Defense/Security, Rail/Transportation, Industry Automation, Semiconductor



pure::variants is fully compliant with ISO 26580, a standard for Feature-based **Product Line** Engineering



Research projects SAFE, SPES-XT, VARIES, REVaMP²



Today's Challenges

- Modern world requires product variants suited to specific needs.
- The complexity of products is constantly increasing.
- Customer expects improvements along the entire product lifecycle.
- New business models aim to upsell new features & services for products which are market-ready.





Variability in SysML V2

SysML v2



Variability **v**2



- Vehicle family is the superset model (150%)
- Variation points represent elements that can vary
 - Can be applied to all definition and usage elements
- A variant represents a particular choice at a variation point
- A choice at one variation point can constrain choices at other variation points
- A system can be configured by making choices at each variation point



Source: https://github.com/Systems-Modeling/SysML-v2-Release/blob/master/doc/Intro%20to%20the%20SysML%20v2%20Language-Graphical%20Notation.pdf

SysML v2



Selected Vehicle Configuration



- Vehicle_a subsets vehicleFamily to represent a particular design configuration
- Selected parts must satisfy variability constraints
 - O Model is inconsistent if constraints are not satisfied
 - Variability modeling applications can automate the selection of valid configurations



Source: https://github.com/Systems-Modeling/SysML-v2-Release/blob/master/doc/Intro%20to%20the%20SysML%20v2%20Language-Graphical%20Notation.pdf



Product Line Engineering

ISO 26580 | pure::variants

Product Line Engineering with pure::variants



		Domain Engineering		₽ v ID	Contents	pvRestriction
		Domain Engineering		574	·1 Head Lights	
6	ID	Contents		575	The beam pattern must fulfil the Federal Motor Vehicle Safety Standard 108.	USA or Canada
	994	-1 Head Lighte		577	-1.1 High Beam	
	995	The beam pattern must fulfil the Federal Motor Vehicle Safety Standard 108		578	The high beam is activated if the user presses the high beam lever and the light mode switch is set to full light mode.	NOT(AutomaticLight)
	996	11 Ligh Deam		579	The high beam is deactived temporarily if incoming traffic is detected by the camera.	HighLowBeamDetection
	997	The birth beam is estimated if the wave encourse the birth beam laws and the firth made switch is estimate full firth made		580	The beam must conform to R98 — Headlamps equipped with gas-discharge light source	HighBeamXenon AND not(USA OR Canada)
	1002	The high beam is activated in the user presses the high beam lever and the light mode switch is set to full light mode.		581	The beam must conform to R112 — Headlamps emitting an asymmetrical passing	HighBeamHalogen AND NOT(USA OR
	1003	The high beam is dynamically adjusted if the wight is not balanced.			beam and/or a driving beam and equipped with filament bulbs.	Canada)
	1007	1.2 Low Beam		582	The high beam is activated if the user presses the high beam lever and either the ligh mode switch is set to full light mode or light mode switch is to automatic and light conditions require full light.	AutomaticLight AND NOT(HighLowBeamDetection)
	1008	Front for large have to provide a wide, has shaned been of light with a share outoff at the top, and are generally simed and resulted law		583	The high beam is activated if the user presses the high beam lever and the light mode switch is set to full light mode or light mode switch is to automatic and light conditions require full light.	AutomaticLight AND HighLowBeamDetection
	1000	From tog lamps have to provide a wide, bat-shaped beam of light with a sharp cutoff at the top, and are generally almed and mounted low.				
	1009	They may be either white or selective yellow.		584	The high beam is dynamically adjusted if the wight is not balanced.	
	1010	A Assistance Systems	n 🗆	585	-1.2 Low Beam	
	1011	Assistance systems		586	The beam pattern must conform to R98 — Headlamps equipped with gas-discharge light source.	LowBeamXenon AND NOT(USA OR Canada)
	1014	• 2.1 Cornering Light		587	The beam must confom to R112 — Headlamps emitting an asymmetrical passing beam and/or a driving beam and equipped with filament bulbs	LowBeamHalogen AND NOT(USA OR Canada)
	1015	The day running light as the side of the car is activated when the stearing apple is above (/15° the vahiole is moving, and the vahiole append is at least 10m/s	ם ור	588	-1.3 Fog Lights	FogLight and BeamConfiguration
	4047	The bay fullning light on the side of the car is activated when the steering angle is above -++15, the vehicle is moving, and the vehicle speed is at least rollys.		589	Front fog lamps have to provide a wide, bar-shaped beam of light with a sharp cutof at the top, and are generally aimed and mounted low.	
	1017	2.2 Automatic Hazard Warning		591	They may be either white or selective yellow.	
	1018	Automatically activate the hazard warning lights under heavy breaking or if the vehicle is involved in an accident.		592	·2 Assistance Systems	LightAssistance
	1019	-3 Indicator Lights		593	-2.1 Cornering Light	CorneringLights
	1020	-3.1 Turn Lights		594	-2.1.1 Adaptive Forward Lighting	AdaptiveForwardLighting
	1021	All turn lights on a side must flash simultaneously with a frequency of 1.5 Hz when the indicator lever for the respective side is activated.		595	The adaptive forward lighting system is activated only when high or low beam is operating in full light mode.	
	1022	All turn lights must flash simultaneously for as long as the hazard warning light switch is activated. The blinking flash frequency is 1.5 HZ.		596	-2.1.2 Static Cornering Light	CorneringStaticLights
	1023	3.2 Daytime Running Light		597	The day running light on the side of the car is activated when the steering angle is above -/+15°, the vehicle is moving, and the vehicle speed is at least 10m/s.	DRL
	1026	The LED pulse frequency must be above 50kHz.		598	The fog light on the side of the car is activated when the steering angle is above	FogLight and not(DRL)
		> ✓ 💥 🕞 North America	_	609	-/+15°, the vehicle is moving, and the vehicle speed is at least 10m/s.	
				810	2.2 Automatic Hazard warning	
				010	Automatically activate the nazard warning lights under heavy breaking or if the	1
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Product Line Engineering with pure::variants





Consistent Reuse across the Lifecycle







MBSE & PLE

pure::variants Connector for Cameo Magic & Cameo No Magic

🔀 MagicDraw 19.0 - CarLight.mdzip [C:\Users\pure-systems\pure-variants-workspace-5.0\Assets\MagicDraw\CarLightExample\]

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- Product Line Engineering (PLE) is complementary to Systems Engineering
- PLE externalizes dependency knowledge to feature models
- PLE applies dependency knowledge consistently across engineering assets and tool borders in order to implement a holistic reuse of engineering assets
- PLE is standardized in ISO 26580 (worked out by INCOSE PLE Group)
- pure::variants as a PLE tool comes with Connectors for ALM / MBSE / Functional Safety Tools, Code, ...

Thank you!



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