ASAM OpenX An Overview

Ben Engel Global Technology Manager, ASAM e.V.

August 18, 2020 OpenADx SC Meeting





Association for Standardization of Automation and Measuring Systems

About ASAM Who we are and what we do



ASAM - Introduction

- Not for profit standardization within the Automotive Industry
- Focus on implementation level standards (rather than the process level standards of e.g. ISO/SAE)
- ASAM standards are recommendations, they do not have an impact on regulatory framework
- Open, non-competitive standard development groups
- Membership driven standardization projects

https://www.asam.net/home/about-asam/compliance.html



ASAM Membership

More Than 290 Member Organizations Develop and Apply ASAM Standards

OEMs												Tier-1 Su	ppliers								
0000	٢		DAIMLER	Find	<u>GM</u>	Өніна	HONDA The Power of Diseases	JAGUAR	LAND- ROVER			AISIN	• A P T I V •	BOSCH	Continental 3	Contention	Delphi Technologies	DENSO		CJ I	e.GO
		\bigcirc	Q	PSA BROUPE	LAC MOTOR	SEAT	SKODA	I SUBARU	ΤΟΥΟΤΑ	VIESMANN		FPT	HITACHI Inspire the Next Hitachi Automotive Systems	HUAWEI	KEĬHIN	MARQUARDT		mtu 🦰		NVIDIA.	🚭 unity
	S	@ YAMAHA		TALL								Æ									
Tool Vendors / Service Providers																					
	<u>20</u>		S VR	ASD Company. Limited		ATI	FACONEXT	ACTIA®	ADIC			¢ces	ALIARO		AlphaDrive Inc.	AMiq	amium	AMS A Matho Dave S manage	ANNECY	ANSYS	apicom
O Applied Intuition			Atos	Automotive Safety		AVL 🐝	b - plus	8	中国浸研 CAERI			Brüel & Kjær 🛶	BTC andediging	CAN CANsystem	CNINAL	Communication A rt T echnology Systems			CONTROLTEC	🔆 cruden	CSM 🛞
S DASSAULT	deepen	DERIVE		DEWETRON	digitali di		dSPACE	DTS INSIGHT	D WC.technology	ODSG	e-SYNC			83		emotive	ess get it right*	Gerol	ET/ S	FDTech	FEV.
FIXE	foretellix	FuelCon Internet a transport	E FUTAVIS	GAilogic	GAIO TECHNOLOGY	GEMS	GLIWA	GOD IT SOURCING	GRYFTEC Embedded Systems	Prenscia	HEAD acoustics	HGL	RHighQSoft	HINS	HORIBA		L.C.M. Inc.	Monthe Breakly & Delaway	miav	îmc	
	innofas II.	INTEMPORA	CONTROL SYSTEMS	IP Camp	IPETRONIK	5 IPG	SYST	Ž SYSTEM	itk	Karakun.		KISTLER measure. analyze. innovate.	🖌 Kithara	KPIT	kratzer AUTOMATION	10000 A CO	KVASER	ST LANDTOP ##	LATENT LOGIC	LAUTERBACH	LiangDao
		All Protects	A MathWorks	meas	Mechanical Simulation B B B oterment functions	MEIDEN	H	MICRONOVA Software und Systeme		MÜLLER-BBM VibroAkustik Systeme	MATIONAL INSTRUMENTS		NorCom	нттоата	ONO SOKKI	DEED	Parkopedia	PEAK SOLUTION			pico Technology
	pls	PMSF IT Consulting	C Polytec	PVMSUS Efficiency Grouph Independent	QTronic	🔮 Quint Safety	AN SOME LAND	പ)) red-ant	🥖 ReliaTec	Ô	HJ. Schlaßthelmer	scienlab	SCSK	SesKion	SGE	SGS	Same	SIEMENS	SIERRA	SIATEC
SKYTECHNOLOGY	SMART	sodius	softing	SOHATE	Sontheim 🛆	speedgoat	STAR COOPERATION®	STIEGELE Datensysteme GmbH	STRONG	Symption	Synchrotek	Synopsys"	CONSULTANCY SERVICES	Caylor Dynamionister	🕽 technica		Tencent 講派		TESIS	7 TOYO Corporation	
tracetronic	Tllech		Uber ATG	Uno Tre 2010 - Athenia	unguli ge	C United Technologies Research Center	Varavez	VECTOR >			Vigem	VIRES	VirtualcitySYSTEMS	Visu	weapata		🚸 WEISANG	whitepine		Xioworks	Xiylon
YOKOGAWA																					
Universit	ies / Resea	arch Institu	ites																		
	ika rwnwaden		OSC S	PVR BATH	()		CATAPULT	Сти		S		Fraunhofer	FZI	GF al	HI//	H L R IS	Jap		GARI	۲	JOANNEUM
				NCES		D THE OBIO STATE UNIVERSITY	Ostfalia University of Applied Sciences	System×	Technology Arts Sciences TH Köln		HOCHSCHULE TRIER	۲	TICHNISCHE UNIVERSITÄT DARMSTADT	MA	🛞 Universität Stuttgart	VETC	virtual 💮 vehicle	vti	WMG	झ्ब	
																		S	Status M	arch 16	6, 2020



ASAM Standards Portfolio

Currently seven Domains (Status March 2020)





Goal of the simulation domain

Enable and support the automotive industry in furthering the state of the autonomous driving, especially with respect to (virtual) validation and/or verification.



Why ASAM & OpenX?

• High market coverage

→ OpenX standards are already in use by a large number of tool vendors, research groups & OEMs across the globe

- Development speed → Essential for the extremely rapidly developing world of AV and ADAS
 - Fast integration of new members into development process
 - Flat hierarchy
 - Public approval & review process
- Direct support by ASAM representatives
 - Technical direction
 - Logistics
 - Coordination amongst project members
 - Modern development & collaboration infrastructure (tools, approaches, etc.)



About the Standards (those released so far)





ASAM OpenX: Overview

The OpenX Domain so far:

OpenSCENARIO

• Dynamic scene description

OpenDRIVE

• Static road network

OpenCRG

Detailed Road surface description

Open Simulation Interface

• Generic interface between sensor models & ground truth

OpenLABEL

• Object and scenario labelling format

OpenODD

ODD description format

OpenXOntology

• Extendable domain ontology for OpenX



ASAM OpenX Standards for Automated Driving: An Example



An example of a scenario-based testing (SBT) workflow

OpenX activities in an SBT workflow

 $\overline{}$

Postprocess

OpenLABEL

Labeling format with

labels for objects

& scenarios

Indexed DB

OpenLABEL

Labels & metadata

for scenarios



OpenDRIVE

- OpenDRIVE: <u>Open Dynamic Road Information for Vehicle Environment</u>
- File format for the description of road networks.
- Used for simulators in the area of
 - Drive simulation
 - Traffic simulation
 - Sensor simulation
- Based upon XML and a hierarchical data model.
- Basic elements:
 - Roads
 - Junctions
 - Controller
- Not covered: entities acting on or interacting with the road network.









OpenCRG

- OpenCRG: <u>Open</u> <u>C</u>urved <u>R</u>egular <u>G</u>rid
- File format and source-code for the **detailed description of road surfaces**.
- The file format of OpenCRG is integrated in OpenDRIVE.
- Used for the description of patches of road surfaces in a very detailed manner, so that it can be used for:
 - Tire simulation
 - Vibration simulation
 - Driving simulation, etc.
- Source-code included:
 - · C API for data read/write and evaluation
 - MATLAB API for data read/write, evaluation, generation, modification and visualization
 - Library of sample data





OpenSCENARIO

- File format for the description of dynamic content in driving simulation applications.
- Currently: focus on drive maneuver description.
- Used for driving simulators.
- Description elements:
 - Maneuver (complex maneuver descriptions that involve multiple cars)
 - Trajectory (polyline, clothoid, nurbs)
 - Vehicle (geometry, type, axes, performance)
 - Driver (appearance)
 - Environment (weather, time of day, road condition)
- Based upon XML.





- OSI: Open Simulation Interface
- A generic interface for the environment perception of automated driving functions in virtual scenarios.
- Contains an object-based environment description using message formats for two types of data:
 - GroundTruth: gives an exact view on the simulated objects in a global coordinate system.
 - SensorData: describes the objects in the reference frame of a sensor for environmental perception.





Current Projects & Activities





Timeline 2020 / 2021

	Dec	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Мау	
ASAM OpenDRIVE	V1.6.0 Conce) ept proje	ect										Nexts	standaro	d develc	pment			
ASAM OpenCRG	Furthe	er devel	opment																
ASAM OpenSCENARIO	V1.0.0 Conce) ept proje	ect				Furthe Furthe	er devel er devel	opment opment	: V′ : V2	1.x 2.0								
ASAM OSI							Furthe	er devel	opment	project									
ASAM OpenLABEL					Conce	ept proje	ect					New sta	andard	develop	ment				
ASAM OpenXOntology							New s	standaro	d or con	cept de	velopme	ent							
ASAM ODD									New s	tandarc	l or con	cept dev	velopme	ent					
Whitespot Analysis: Test Case Description										White	espot ar	nalysis							
3D Modelling & Material Data											News	standaro	develc	pment					
	ASAM Internation Conference	al e 2019		Release ASAM O ASAM O ASAM O	s: penDRIV penSCEI penSCEI	E 1.6.0 NARIO V ² NARIO Co	1.0.0 oncept		Rel AS AS	leases: AM Open AM Open AM Open	ICRG ILABEL C	Concept							



ASAM OpenSCENARIO





ASAM OpenSCENARIO 1.x



Harmonization & Maintenance	 Alignment with other OpenX standards Fixes and clarifications to V1.0.0
Parameters & Conditions	 more parameters and conditions for more complex scenarios Parameter ranges & distributions
Actions & Controllers	 More actions (e.g. parking, traffic) Increase flexibility of action definition & remove strong dependency on runtime positioning
Runtime & System Boundaries	 Clarify runtime interaction between actions, entities and controllers Define clear system boundaries between OSC & tooling



ASAM OpenSCENARIO 2.0

- Proposal Link
- 55 participating companies
- >1300 days committed
- 105.000 EUR budget
- June 2020 July 2021 (1 year)



Language Concepts	 Define a domain specific language to be used for OpenSCENARIO Semantics, syntax & structure Extendibility Migration with 1.x Library concepts Measurement and success criteria (KPIs, observers, etc.)
Usage & Pragmatics	 Analyse the different scenario creation & testing workflows described by the use cases in the proposal Provide guidelines and documentation on the use of OpenSCENARIO in these workflows
Domain Model	 Define the underlying domain model for OpenSCENARIO Guidelines on extending the domain model Interface with the OpenXOntology project to investigate feasibility of representing this via an ontology
Feature Subsets	 Investigate the feasibility of and define the division of OpenSCENARIO into multiple feature subsets for compatibility E.g. a subset that defines all the features of 1.x or for a specific use case



ASAM OSI

•	Open source development	Sensor modelling	Extend OSI with support for higher fidelity models, this includes:Stochastic sensor models				
	(contributions from non-members & individuals allowed)	Traffic participants &	 Physics based sensor models Add support for bi-directional exchange between any traffic participant and a simulator framework 				
•	Proposal Link 23 participating companies >600 days committed June 2020 - Nov 2021 (1.5 years)	Performance & packaging	 Increase OSI performance for high data rates and real- time applications Improvements to the encoding layer (e.g. support for Flatbuffer) Guidelines on using OSI for performance critical applications Allow for more control on the data being transmitte (e.g. delta encoding) 				
		Harmonization with OpenX	Ensure alignment and closer integration with the other OpenX standards & activities				









ASAM OpenLabel

Life of the recorded data



- April 2020 October 2020
- > 40 companies participating
- Focus on the HOW to label

 \rightarrow Provide labeling formats that can be linked to e.g. an ontology for the WHAT

- Allow for labels of objects of interest & scenarios
- 2 deliverables:
 - Concept paper for OpenLABEL
 - List of requirements for the ASAM OpenXOntology project



ASAM OpenXOntology

- Goal: Link OpenX standards through a common domain model, represented by an ontology
 → increased inter-compatibility
- June 2020 June 2021 (1 year)
- 20 participating companies
- >350 committed days
- 59.500 EUR budget
- Proposal link





ASAM OpenODD

- Concept Project starting mid August
- Ideation Workshop end of April 2020
- High interest 100 Participants
- Standardised format for definition of Operational Design Domains (ODDs)
- Proposal link



ASAM Coordination Group: Simulation









Benjamin Engel Global Technology Manager, ASAM e.V.

Email: benjamin.engel@asam.net

