OpenADx – xcelerate your Autonomous Driving development

Andreas Riexinger | Robert Bosch GmbH
Product Manager Automated Driving

Who am I?

› Product Manager Automated Driving

› ~15 years experience in embedded software development

› Pushing Open Source development and business within Robert Bosch GmbH

› Interest:
  – Creating business with Open Source
  – Combining DevOps/Agile with Open Source

Andreas Riexinger

Robert Bosch GmbH

Chassis System Control – Automated Driving

Autonomous Driving

The car has to mirror a driver's abilities to see, evaluate and act

Sense

Locate

Think

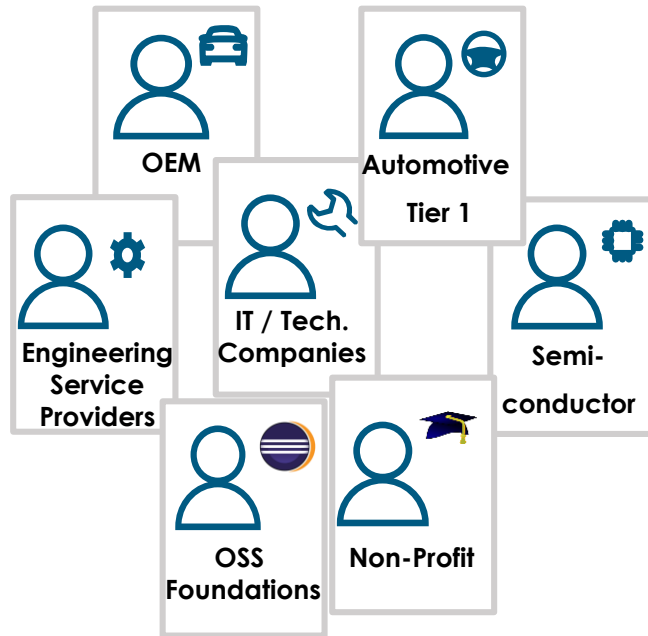Interpret / plan / decide

Trajectory planning & Acting
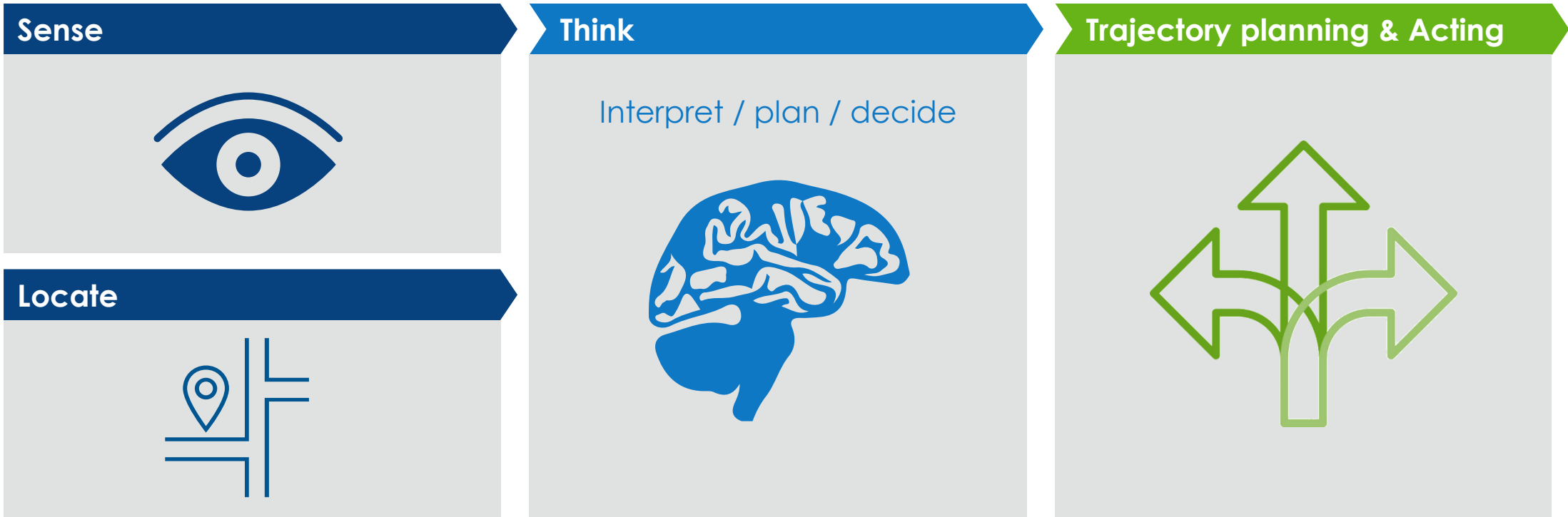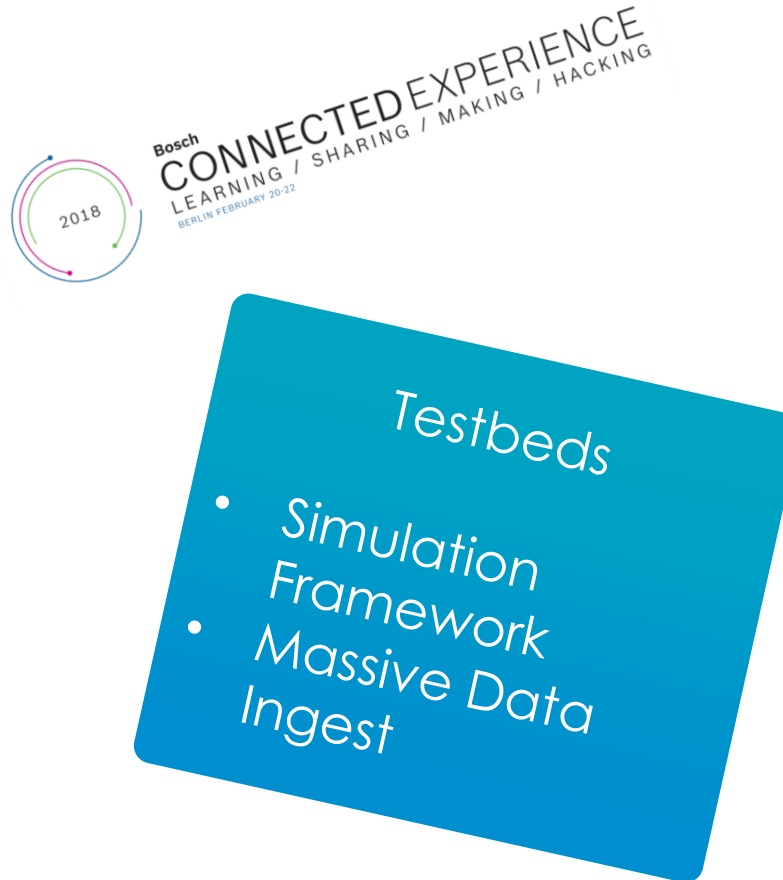
Autonomous driving is a complex challenge

› AD requires a multifaceted development process incorporating a variety of software tools

› But none of these tools were ever designed to work together

› This costs the industry all time and money

› We lessen this problem by creating the leading automated driving ecosystem ➢ **OpenADx**

› We leverage open collaboration and open source to
- Accelerate time to market
- Increase efficiency
- Focus on customers

OpenADx – Community Build-Up

Identify target partners to initiate ecosystem ✓

OEM

Automotive Tier 1

Engineering Service Providers

IT / Tech. Companies

Semi-conductor

OSS Foundations

Non-Profit

Current Partners

Microsoft · BOSCH · TESIS · ZF · Elektrobit
MathWorks · itemis
DASSAULT SYSTEMES · DLR · RENESAS · eclipse · cea
energie atomique · energies alternatives

Common open activities to establish cooperation ✓

Bosch CONNECTED EXPERIENCE
LEARNING / SHARING / MAKING / HACKING
BERLIN FEBRUARY 20-22
2018

Testbeds
- Simulation Framework
- Massive Data Ingest

Open source activities by ecosystem partners ✓
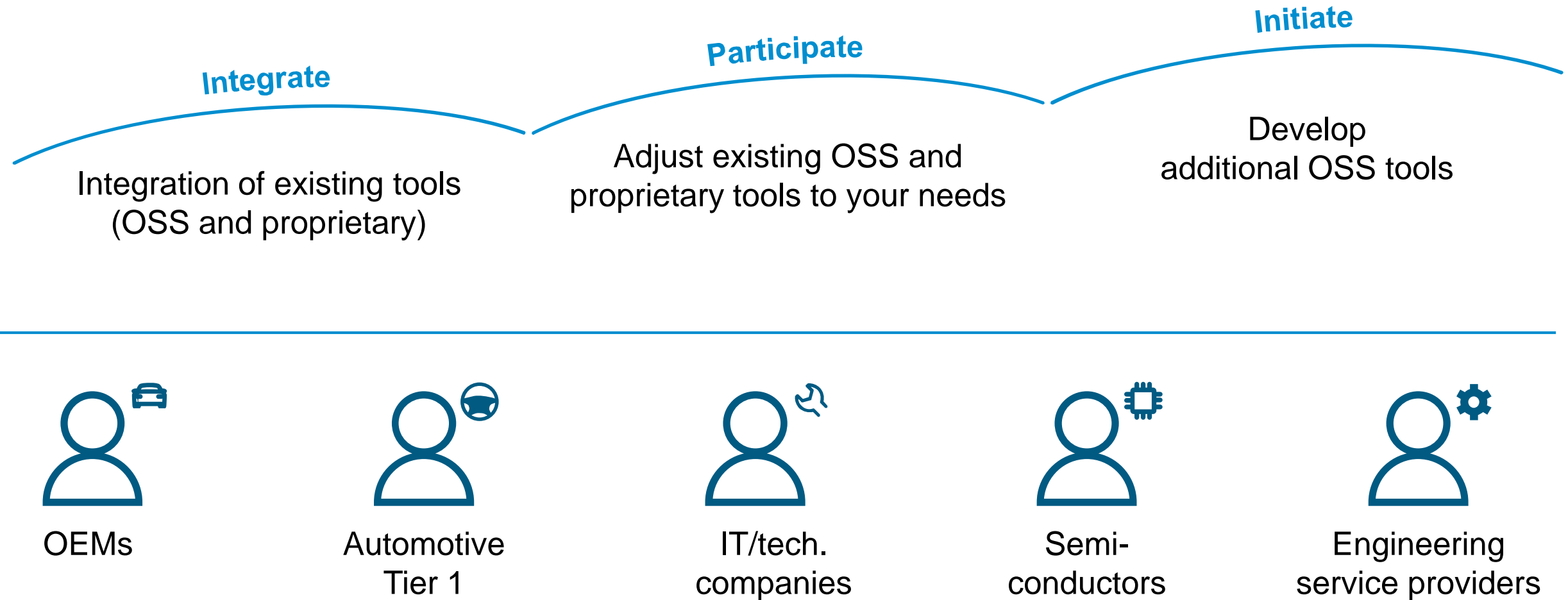
eclipse

ROS.org

- ROS2
- RVIZ2
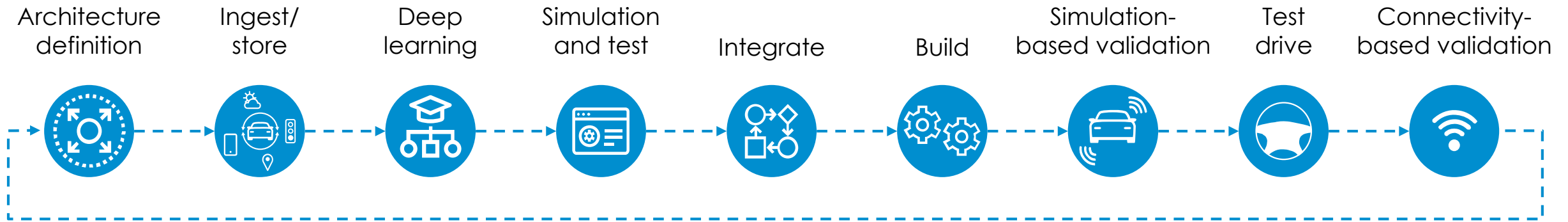- ROSBAG for ROS2

Microsoft AirSim Simulator Platform

OpenADx - Beneficial for OEMs, Tier1s and technology providers

The AD tool chain: Seamless integration and leads to increased development efficiency

Initiate

Participate

Integrate

Integration of existing tools
(OSS and proprietary)

Adjust existing OSS and
proprietary tools to your needs

Develop
additional OSS tools

OEMs

Automotive
Tier 1

IT/tech.
companies

Semi-
conductors

Engineering
service providers

OpenADx

Focus: AD Toolchain

Architecture definition • Ingest/store • Deep learning • Simulation and test • Integrate • Build • Simulation-based validation • Test drive • Connectivity-based validation

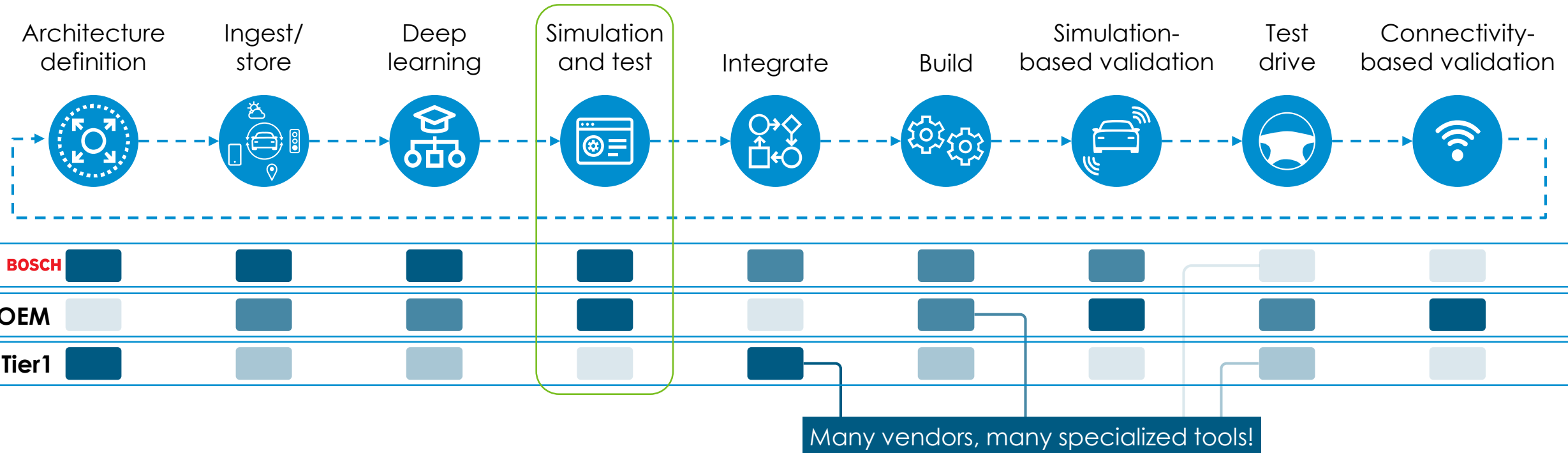**GOAL**

› Industry-wide accepted definition of the AD toolchain
› Foundation for reference architecture
› Key to ensure efficient implementation and interoperability
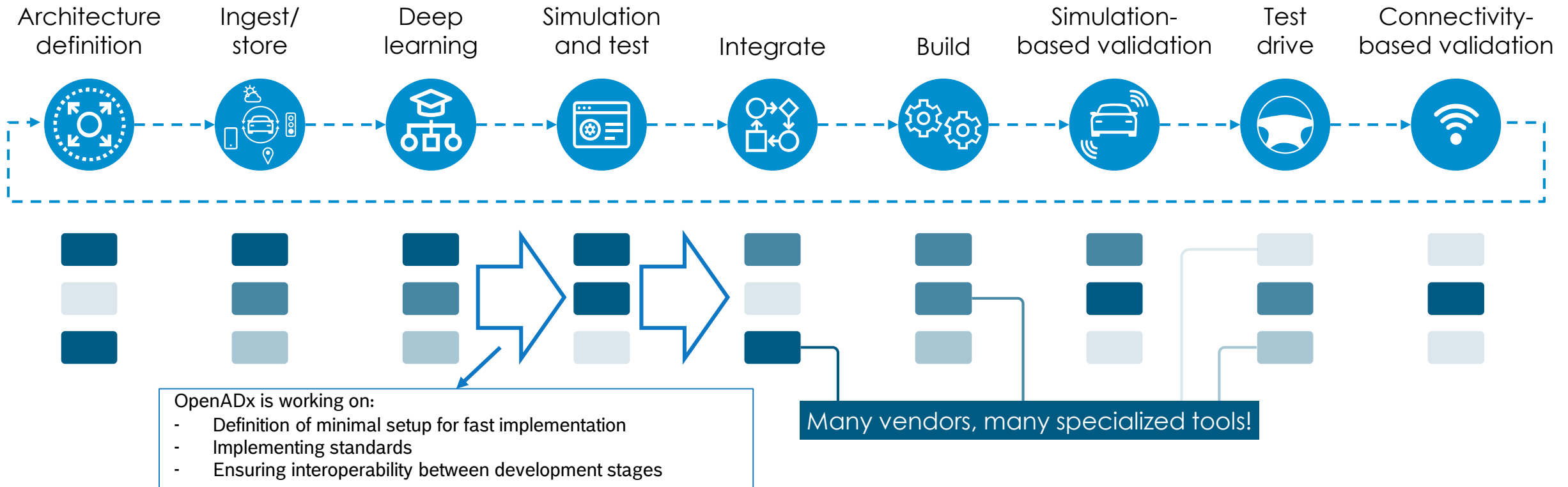
OpenADx

Tool Landscape

	Architecture definition	Ingest/ store	Deep learning	Simulation and test	Integrate	Build	Simulation-based validation	Test drive	Connectivity-based validation

BOSCH

OEM

Tier1

Many vendors, many specialized tools!

GOAL › Ensure transparency and make complex tool landscape more easily accessible for enterprise users

OpenADx

Tool Landscape

Architecture definition | Ingest/ store | Deep learning | Simulation and test | Integrate | Build | Simulation-based validation | Test drive | Connectivity-based validation

OpenADx is working on:
- Definition of minimal setup for fast implementation
- Implementing standards
- Ensuring interoperability between development stages

Many vendors, many specialized tools!

GOAL

› Ensure transparency and make complex tool landscape more easily accessible for enterprise users

OpenADx

From testbed to open source and standardization

Testbeds

› Validation of solution blueprint, combination of exiting products/technologies
› Small, loosely coupled ecosystem of partners who play well together
› Strong Go-To-Market focus (example: IIC Track & Trace, first customer in <12 months)
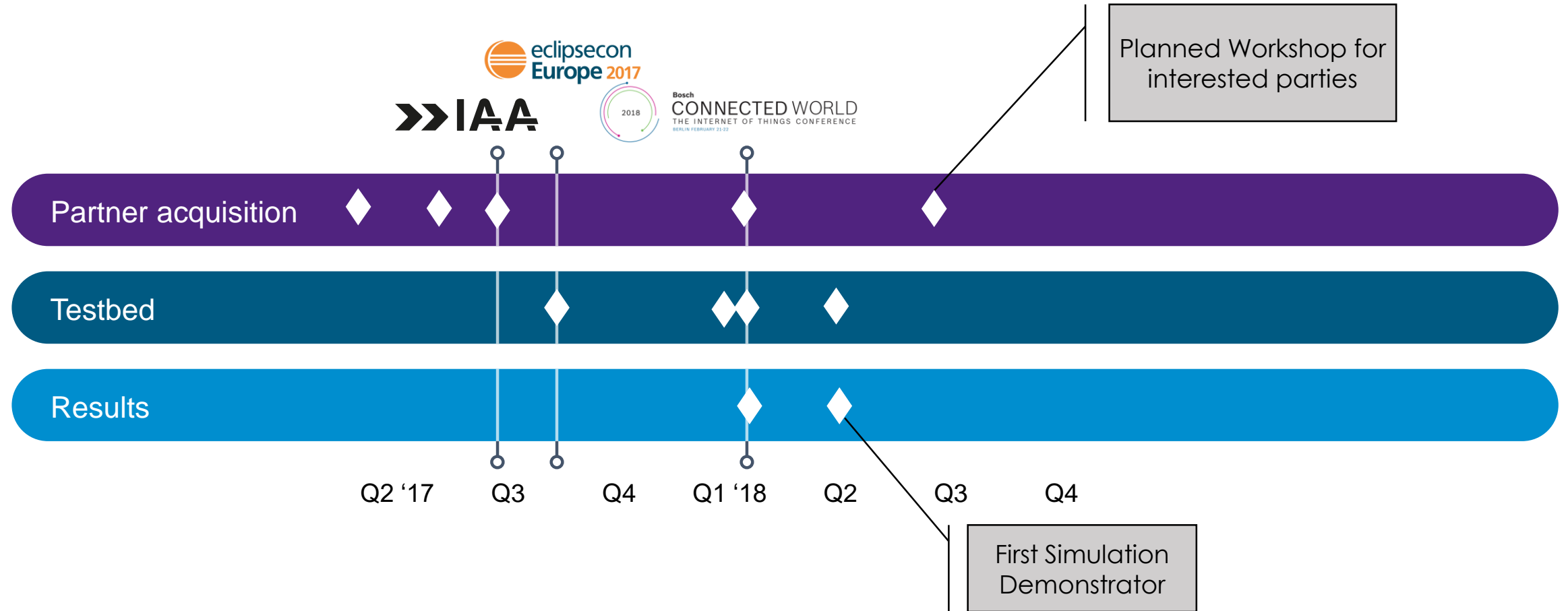
Open Source Project

› Result of testbed (in addition to market validation) can be a joint open source project
› Sometimes new solutions
› Sometimes the "glue" required to tie together existing (closed source) solutions

Standardization

› Focusing on the APIs developed in the OSS project
› Usually slower moving

OpenADx

Timeline

Partner acquisition

Testbed

Results

Planned Workshop for interested parties

First Simulation Demonstrator

Q2 '17   Q3   Q4   Q1 '18   Q2   Q3   Q4

OpenADx embraces other initiatives and does not compete

OpenADx is …

| Open Environment | Integrative | Focussing on Organizational Needs |

OpenADx as a Portal to Autonomous Driving

› OpenADx embraces open solutions

› The OpenADx AD Portal
  › Internet portal to share information about Autonomous Driving
    – Toolchain proposals
    – Cookbooks
    – HowTos

› OpenADx targets to realize open solutions
  › Eclipse based open projects

› <u>But:</u> OpenADx integrates exciting solutions from anywhere
  › Any quality solution be it commercial or open independent of the license will be considered
  › Described in toolchain proposals and cookbooks for anyone to use as is or adapted as needed

State of Partnership

› Initiated by Microsoft and Bosch

› Interested parties from many domains like automotive, IT, tool vendors, technology providers, governmental organizations

› Officially listed parties are:

› Participation of additional companies in workshops

› Ongoing talks with companies and organizations about collaborations
  › Especially in the area ROS

› Creation of first demonstrators along the way

OpenADx launched at BCW18

Testbed Simulation Demonstrator

Emergency
Braking Algorithm

Introspection/
Visualization

Object List

Throttle/Brake/
Steering

Simulation
Data

DDS

Vehicle Movement

Environment

Vehicle
Model/Behavior

Environment
Setup

Scenario
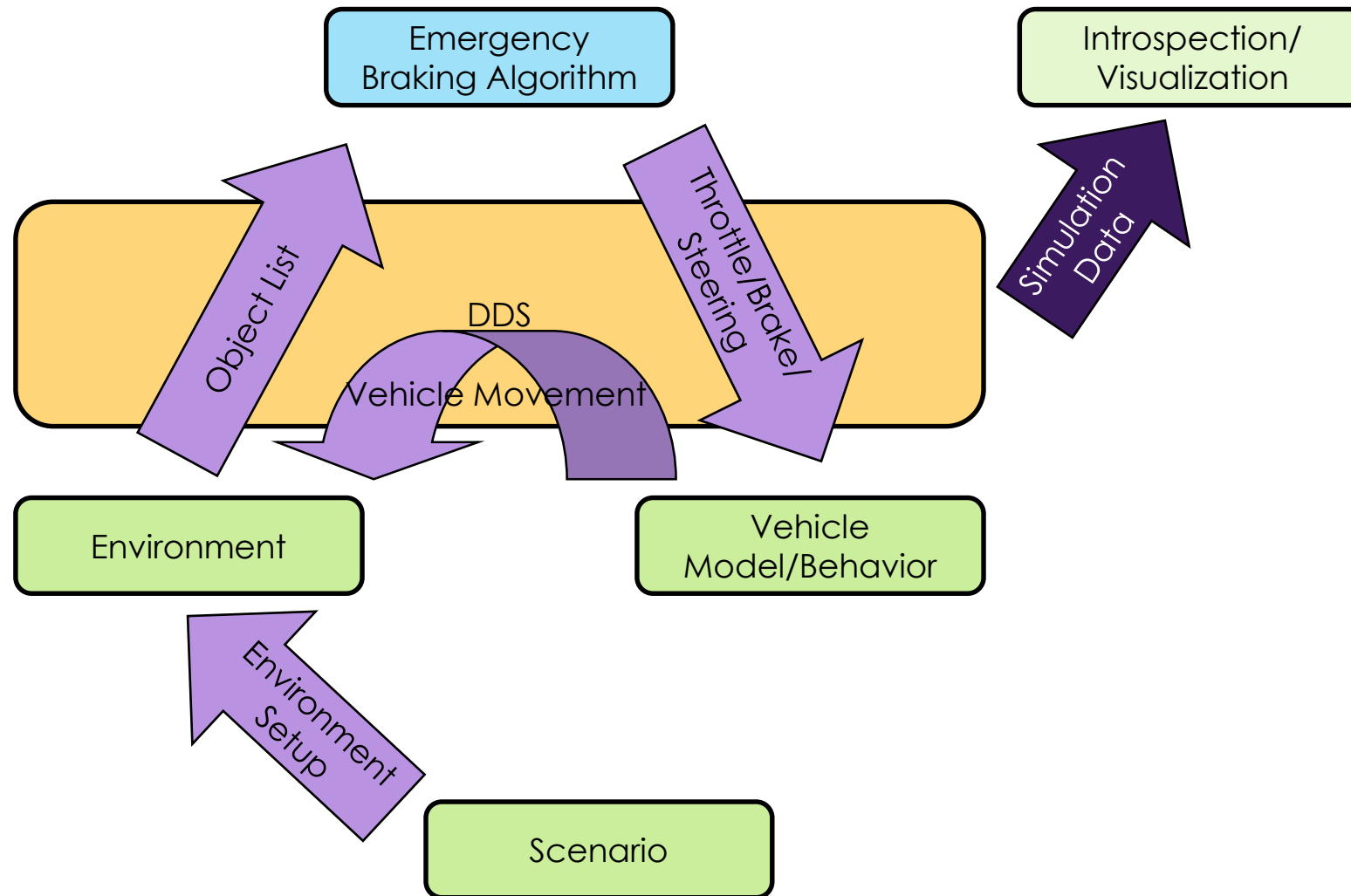
› Messages and
Data Structures reused

  › ROS

  › Open Simulation
Interface mapped to
DDS

› Partners:

AVL

BOSCH

Microsoft

DASSAULT SYSTEMES

EB Elektrobit

TESIS

RENESAS

MathWorks®

UNIVERSITY OF OULU

Testbed Simulation Demonstrator

DDS

Detected objects - visualized in RViz

AEB Active 1
Brake Pedal Command 1,0
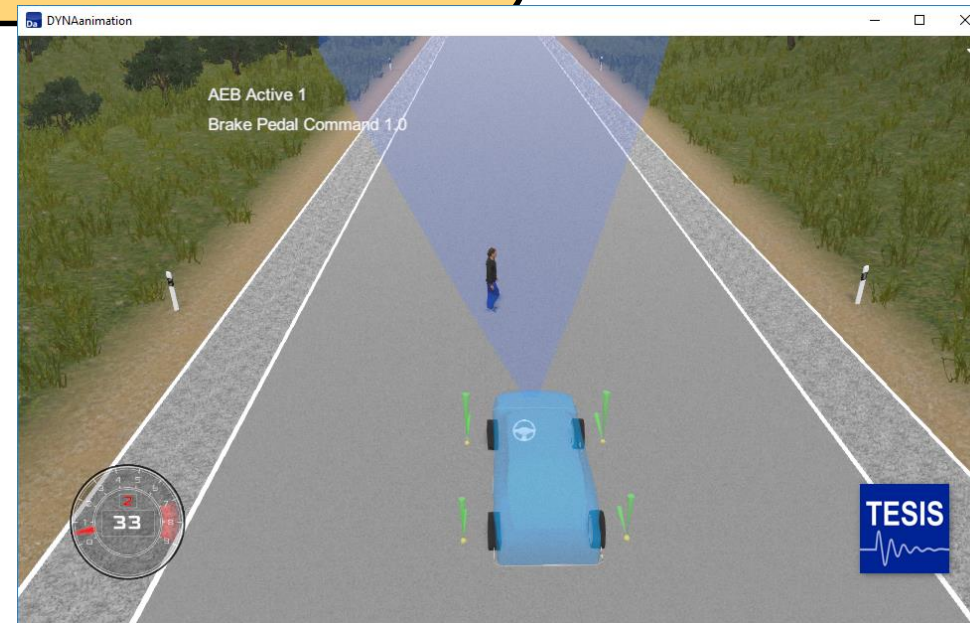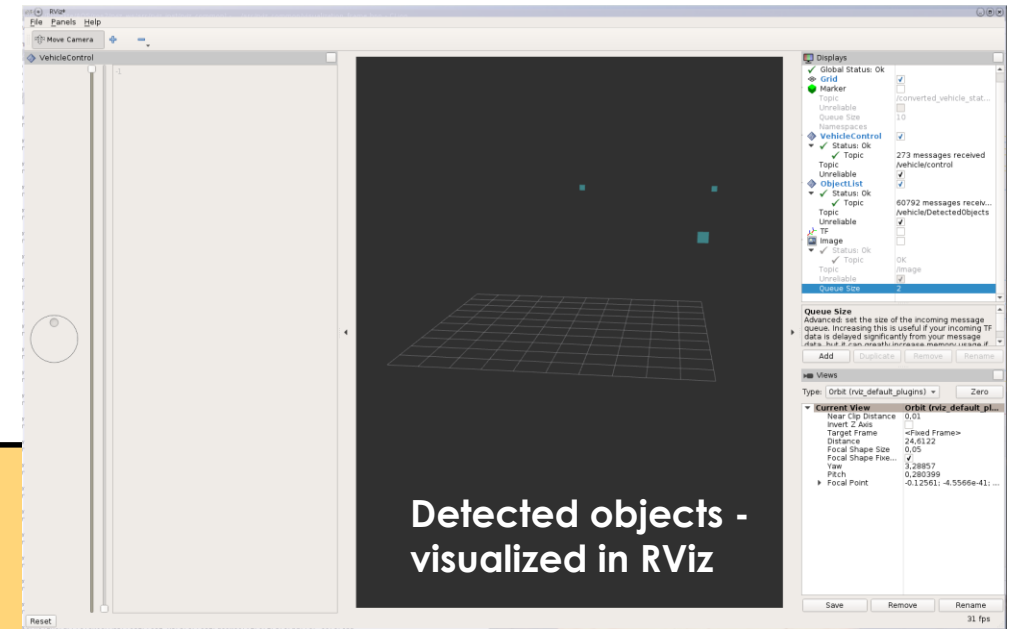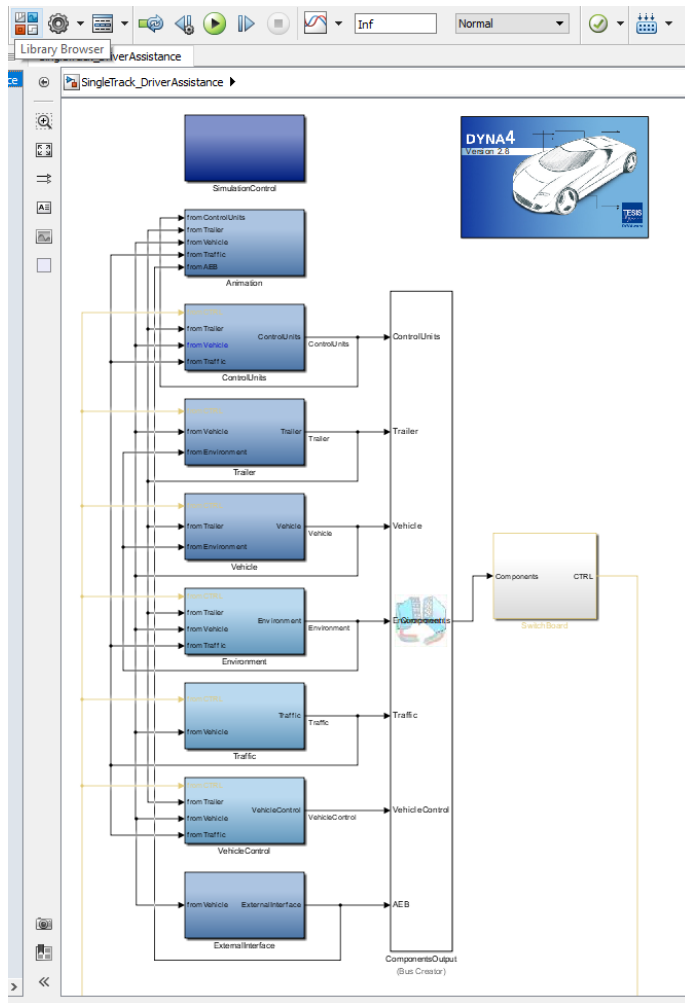
Testbed Massive Data Ingest

› Problem: Ingest and manage petabytes of data

› Current solution idea: Provide an Apache Hadoop based data structure for data storage
  › Enable big data solutions on top of Hadoop to be usable with the data

› Current focus: Get the data from the different formats available into Hadoop using open solutions

› Issues:
  › Driven by Bosch only, so interested companies are invited to join forces here
  › Area is polluted with IP protected data format standards

Publicly Funded Activities

› Goal: Realize results of publicly funded activities as Open Source to promote common solutions
  › Standardization often done in standard bodies which require membership to use the IP
  › Blocks open solutions and prevents integration of such solutions with open industry solutions
  › Excludes companies who do not participate for whatever reason

› Transform the way of cooperation from IP protected closed initiatives to open eco-systems

› Example: European Funded Research Project Appstacle
  › Eclipse Kuksa as good example of an open approach to make public money funded solutions available for the public

Summary and Outlook

› OpenADx is an industry wide initiative to accelerate the development of Automated Driving

› Currently the ecosystem build up is the primary focus

› Collaboration is done in the form of testbeds as prototypes for potential open source projects

› This year will show some initial results in the form of demonstrators built out of testbeds

We invite you!

› Website: https://wiki.eclipse.org/OpenADx

› Mailing List: https://accounts.eclipse.org/mailing-list/openadx

› OpenADx in Blogs: https://blog.bosch-si.com/developer/5-things-you-should-know-about-openadx

Thank you!

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