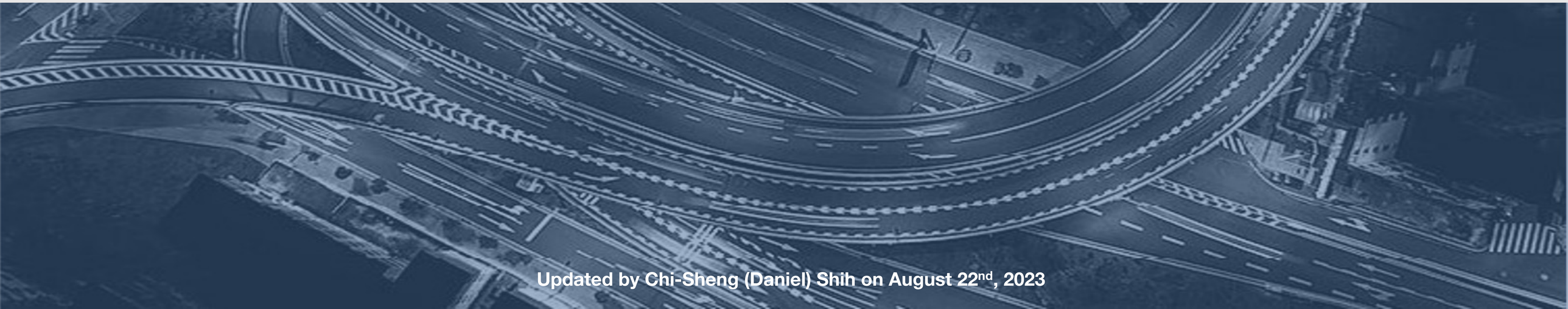
THE AUTOWARE FOUNDATION

The Art of Open Source Reimagines Intelligent Vehicles - The Autoware Foundation

Chi-Sheng (Daniel) Shih

National Taiwan University/Auotware Foundation

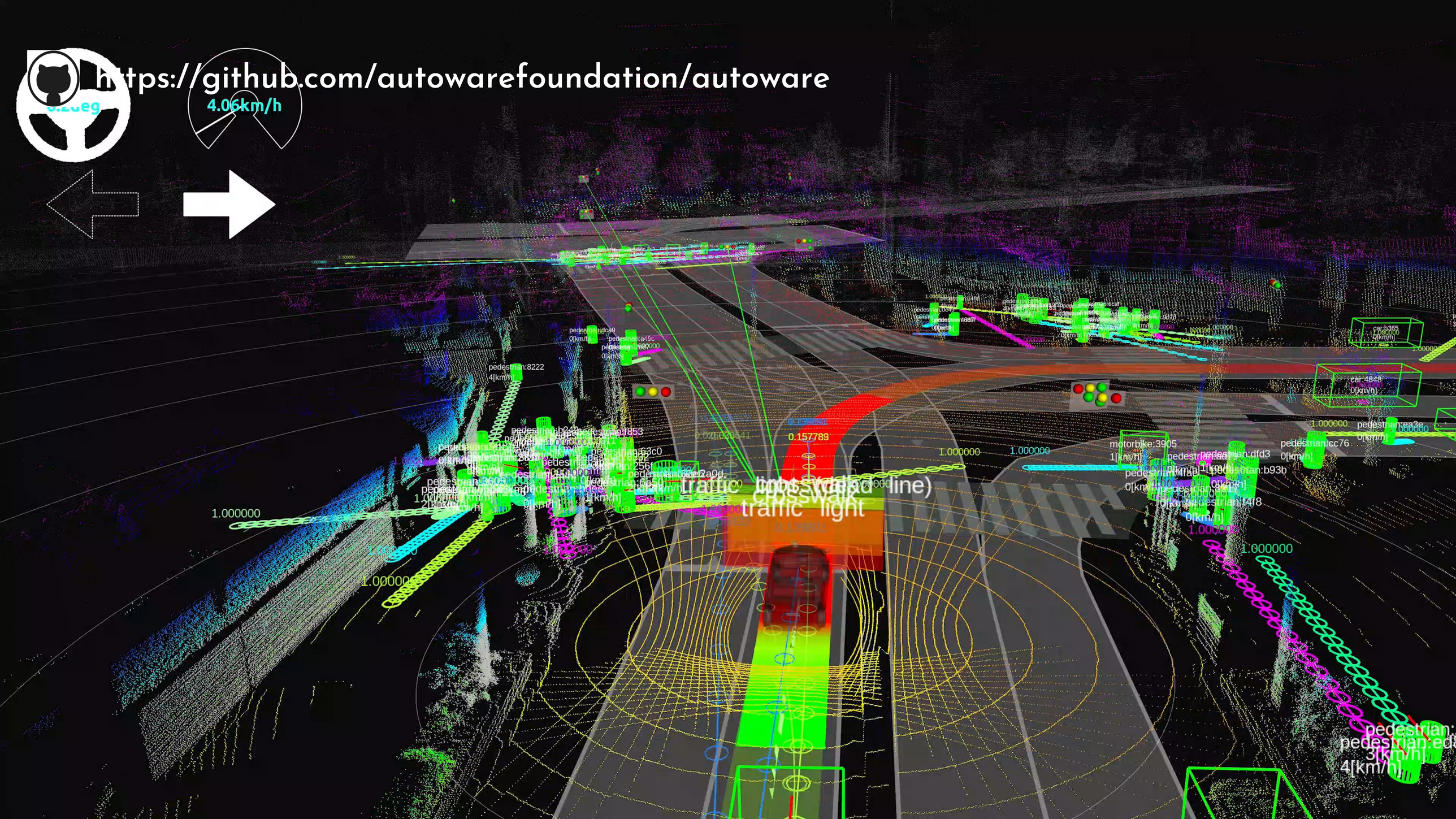


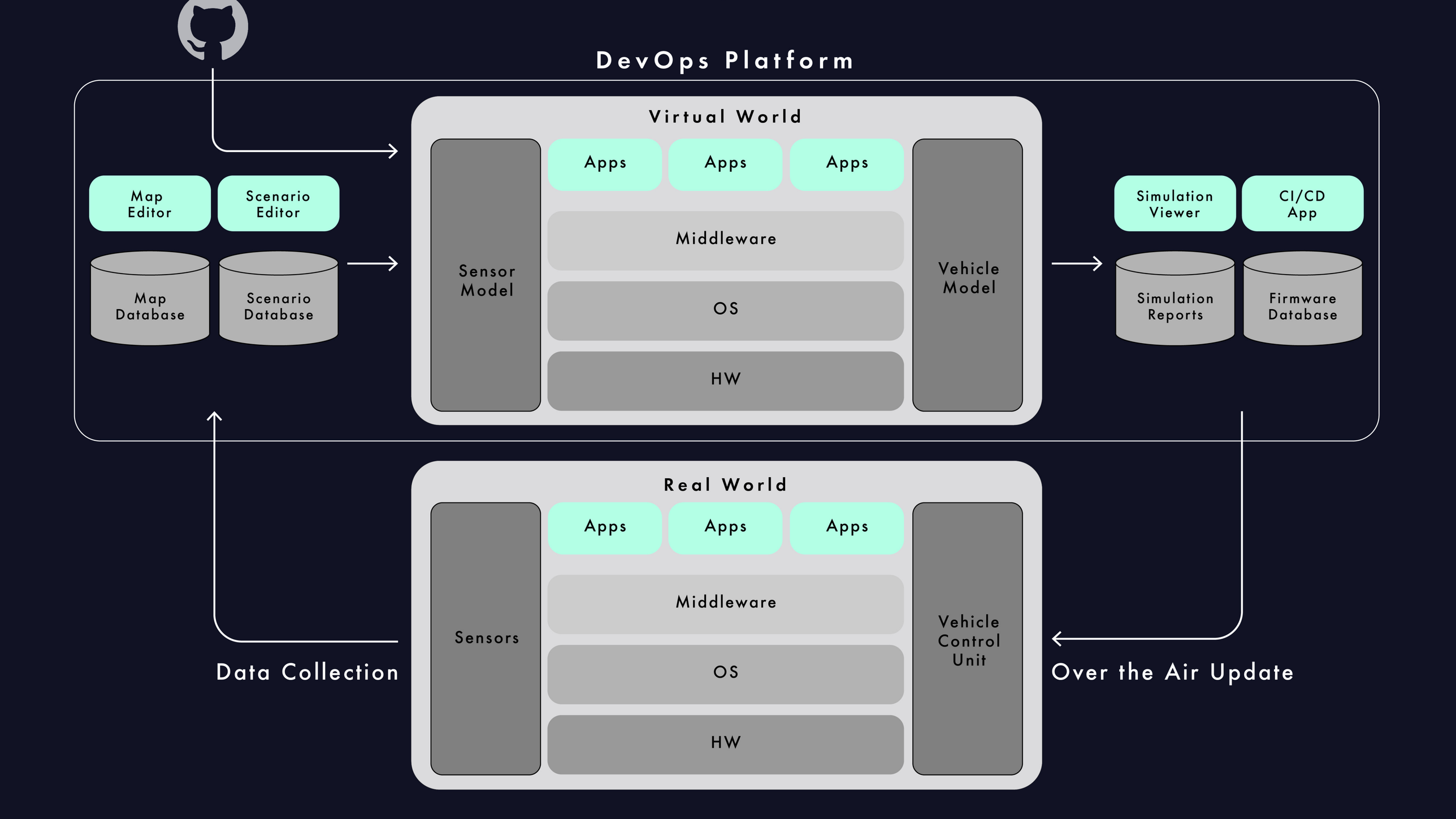
Updated by Chi-Sheng (Daniel) Shih on August 22nd, 2023

https://github.com/autowarefoundation/autoware

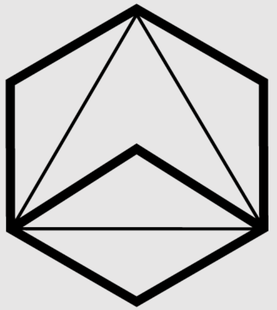
What are there missing pieces?

Extremely challenging to verify and validate its functionality,
because virtually unlimited sorts of technologies are employed.
That said, it looks like just a system executing real-time processes,
where many computers are connected to many sensors.


https://github.com/autowarefoundation/autoware
4.06km/h
0.157789
1.000000
pedestrian:8222
car:b365
car:4848
motorbike:3905
pedestrian:cc76
pedestrian:b93b
pedestrian:f4f8
pedestrian:ea3e
pedestrian:dfd3
traffic light
crosswalk
line)


DevOps Platform
Virtual World
Apps
Apps
Apps
Middleware
OS
HW
Sensor Model
Vehicle Model
Map Editor
Scenario Editor
Map Database
Scenario Database
Simulation Viewer
CI/CD App
Simulation Reports
Firmware Database
Real World
Apps
Apps
Apps
Middleware
OS
HW
Sensors
Vehicle Control Unit
Data Collection
Over the Air Update

The Autoware Foundation



THE
AUTOWARE
FOUNDATION

The first all-in-one open source
software for autonomous driving

Autoware Deployments

THE
AUTOWARE
FOUNDATION

Autoware Ecosystem

Infrastructure

Insurance

Communication
LTE / 5G

MAP

Government

Road Regulation

Inspection
Scheme

Super City
Planning

THE
AUTOWARE
FOUNDATION

Technology

Sensor / Silicon

ECU
manufacture

By-wire / EV
OEM

Apps on
Autoware

MaaS Service

Cloud Service

Service Provider

The Autoware Foundation (AWF) Members

Premium

Driving strategic direction and business, financial, technical priorities for Autoware. Premium members hold one voting seat on the Technical Steering Committee

ADASTEC — Automated, Shared, Connected
ADLINK — Leading Edge Computing
AMD
arm
AutoCore™ — Intelligent Vehicle Platform
DANLAW
eProsima — The Middleware Experts
eSOL
F1TENTH
FOXCONN
ITRI — Industrial Technology Research Institute
LEO DRIVE
MAP IV
-MORAI-
ROBOTEC AI
Spring Cloud
TIER IV
tomtom
CAR
whale dynamic 鲸动科技

Academic & Non-Profit

Facilitating cross organizational collaboration with other research teams. Academic & Non-Profit members propose project activities to the Technical Steering Committee

ARTC
自主智能驾驶实验室
CLEMSON
Poznan University of Technology
HD MAPC — High Definition Maps Research Center
名古屋大学 Nagoya University
open robotics
Florida Polytechnic University
埼玉大学
Sant'Anna
東京大学
JSAE
TAL TECH
utbm — Université de technologie Belfort-Montbéliard

Boğaziçi University
Turkey
System Verification & Validation
Property-based testing and beyond for autonomous systems

Clemson University
USA
Verification & Validation
Open autonomy, Verification & Validation frameworks

Czech Technical University
Czech Republic
RTOS and Optimization for AVs
Optimization algorithms and real-time support for autonomous vehicles

Florida Polytechnic University
USA
Validation & Verification
Polymath: Autoware-based open-source V&V toolchain

Nagoya University
Japan
Driving Behaviour & Sensor Signal Processing
Full-stack autonomous driving

National Taiwan University
Taiwan
Real-time AV Stack
Collaborative autonomous systems

Poznań University of Technology
Poland
Perception & SLAM
Perception, planning and SLAM for autonomous vehicles

Technical University of Munich
Germany
Path & Behavioral Planning
Simulation-focused development of full-stack autonomous vehicle software

University of Delaware
USA
Real-time Systems
Real-time operation systems for cyber-physical vehicles

University of Pennsylvania
USA
Learning-based Safe Autonomous Systems
Perception, planning and control for safe autonomous systems

University of Waterloo
Canada
AV Control, Learning and Logic-based Testing
Bridging the SimReal gap in autonomous vehicle testing

Industry & Government

Influencing strategic direction and business and technical priorities for Autoware. Industry & Government members propose project activities to the Technical Steering Committee

AISAN TECHNOLOGY CO.,LTD.
AXELL CORPORATION
cadence
dSPACE
eve auto
embotech
Fast Label
FIXPOSITION
HESAI
HEXAGON
HITACHI Inspire the Next
HITACHI Inspire the Next — ©Hitachi Industry & Control Solutions, Ltd.
interplai
JDL 京东物流
MACNICA
MARVELL
MINGSHANG
NTT DATA — NTT DATA MSE Corporation
NXP
OUSTER — OKAYA & CO.,LTD.
POLYEXPLORE
pix moving
Quanta Computer
robosense
Robotis 3d
smartmicro
TREND MICRO
U-POWER
Vecow — Smarter AIoT Solution Services

Affiliated Organizations

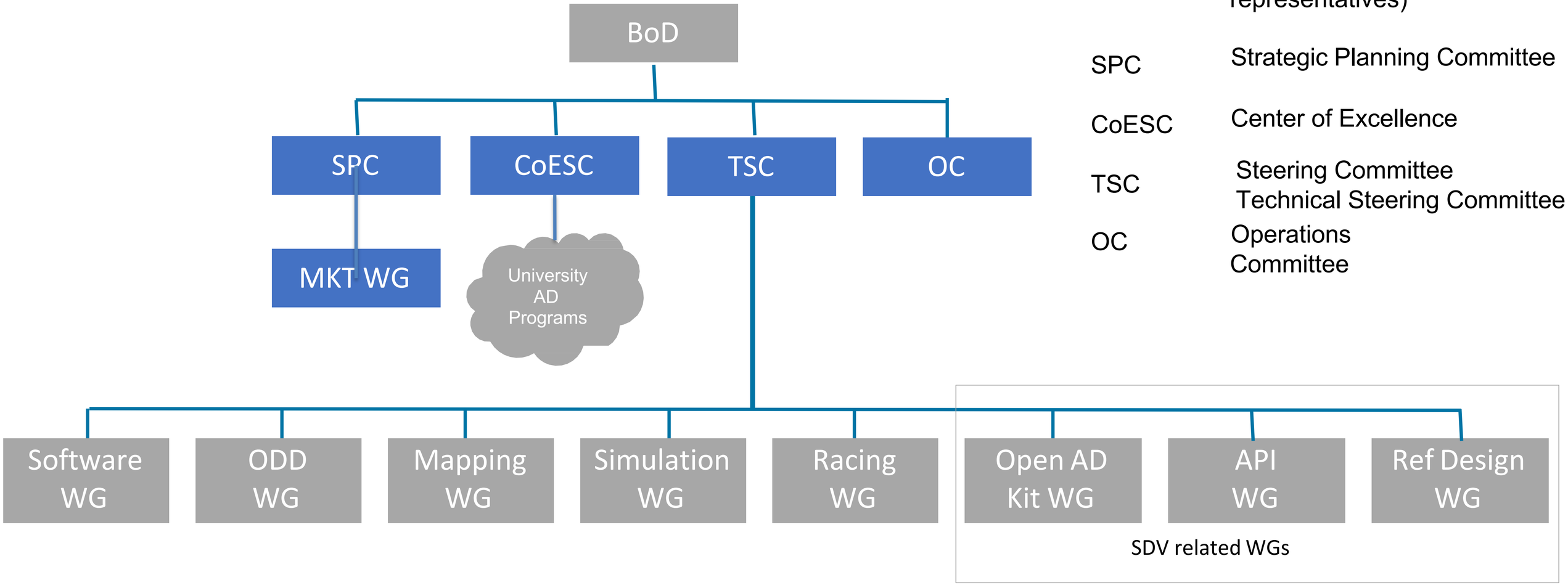
Autoware Foundation is working with alliance partners to collaboratively build autonomous driving solutions.

AVC CONSORTIUM
eSync ALLIANCE
eclipse iot
MIH
OpenADx
seL4 FOUNDATION
SOAFEE

Autoware Foundation (AWF)

Organization Overview

AWF Members | Public



BoD	Board of Directors (independent representatives)
SPC	Strategic Planning Committee
CoESC	Center of Excellence
TSC	Steering Committee Technical Steering Committee
OC	Operations Committee

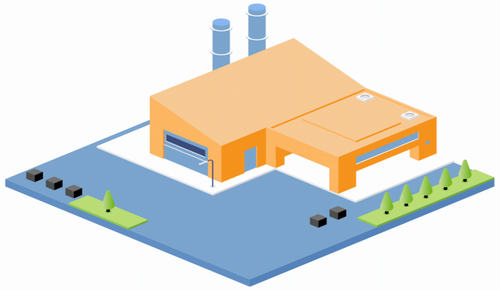
THE AUTOWARE FOUNDATION

Autoware High Level ODD Roadmap

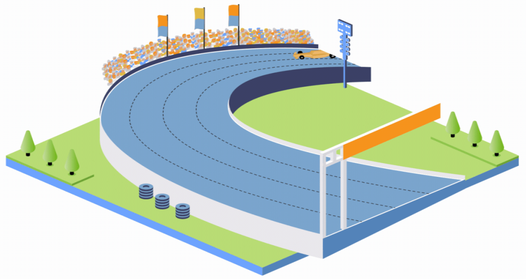
2020	2021	2022	2023

Autonomous Valet Parking (AVP) support in Autoware.Auto v1

Cargo Delivery support in Autoware.Auto v2



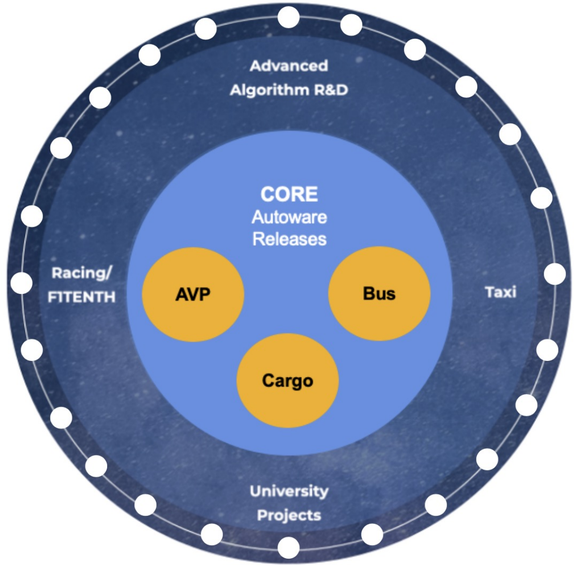
Autonomous Racing
Autoware base package for IAC



Bus on predefined route support developed in Autoware.Universe

Autonomous Racing
Autoware running on F1TENTH

AVP, Cargo and Bus support in Autoware.Core



Taxi use case development in Autoware.Universe

- Improved Object Detection
- High speed highway driving
- Dense urban driving scenarios
- Autoware usability enhancements
- Open AD Kit 3.0

THE AUTOWARE FOUNDATION

Autoware Open AD Kit

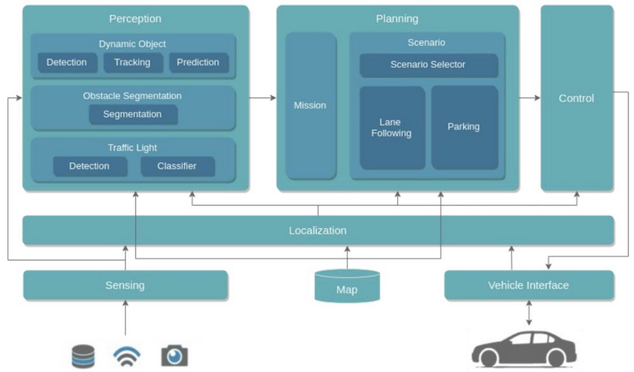
Collaboration with Autoware Foundation Alliance partners to enable cloud-native DevOps of AD solutions for Software Defined Vehicles

THE AUTOWARE FOUNDATION

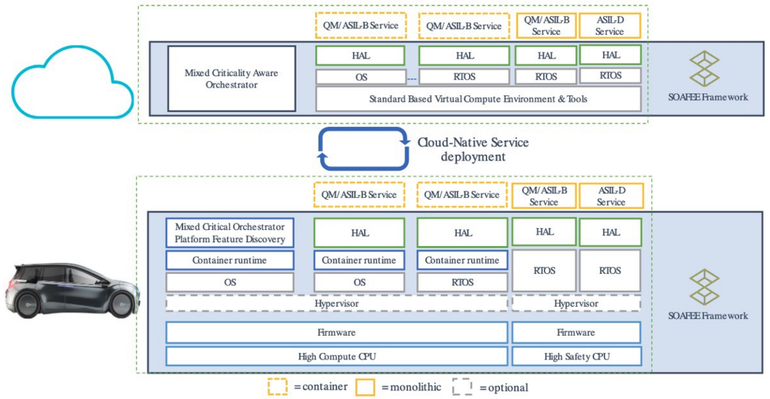
SOAFEE

eSync ALLIANCE

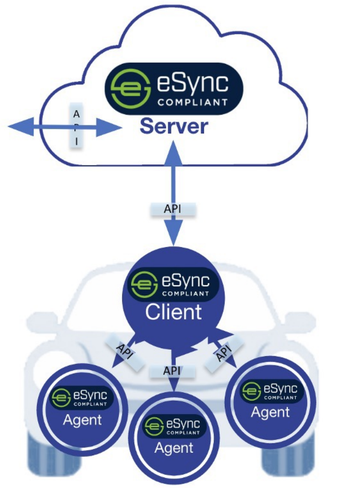
MIH



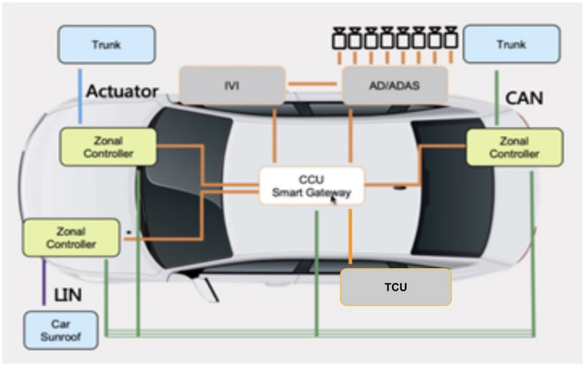
Full OSS stack for Autonomous Driving



SDV architecture with cloud/edge parity of containerized Automotive Applications



Specifications for OTA updates in Automotive

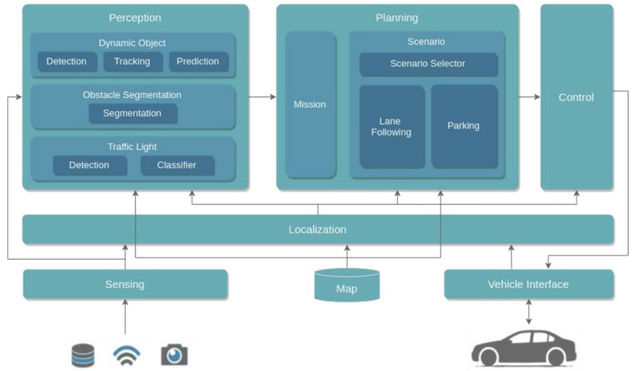


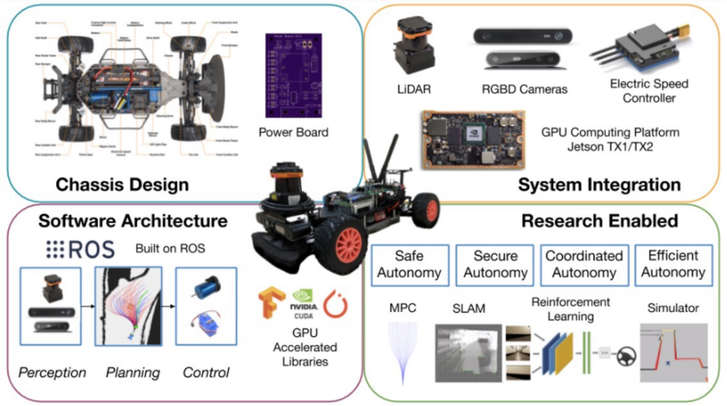
Open specifications for integration and verification of Automotive Functions

THE AUTOWARE FOUNDATION

Autoware on F1TENTH

THE AUTOWARE FOUNDATION + F1 TENTH





AWF and F1TENTH are collaborating to enable Autoware.Auto on F1TENTH HW Platforms:

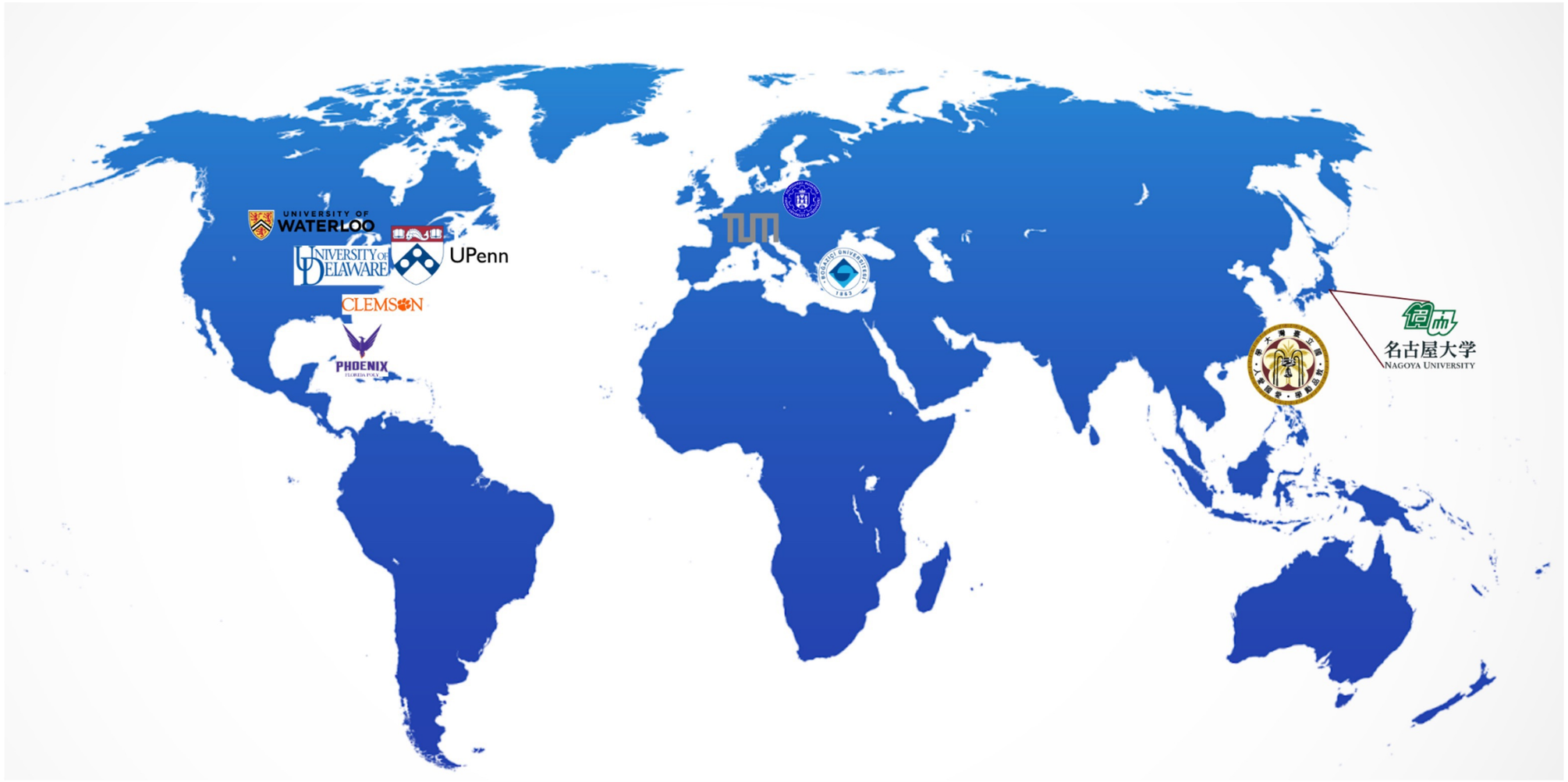
- Racing simulation at 1/10 scale with seamless evolution to full scale University training programs based on Autoware
- Racing events for 1/10 scale and full scale racing (e.g. Indy Autonomous Challenge)
  Autoware ODD testing with F1TENTH HW

ODD Testing

1/10 Scale Racing

Full Scale Racing

Autoware Center of Excellence Network



Autoware CoE Common Mission:
Make Autoware easy and efficient for new users to adopt and new contributors to contribute.

Autoware CoE Team

Rahul Mangharam
UPenn

Learning-based Safe Autonomous Systems

Weisong Shi
UDel/WSU

Operating Systems for AV

Venkat Krovi
Clemson University

Verification and Validation for AV

Rahul Razdan
Florida Poly University

Advanced Mobility Framework for Autonomous Systems

Doğan Ulus
Bogazic University

System Verification & Validation

Krzysztof Walas
Poznan University of Technology

Perception & SLAM

Chi-Sheng Shih
National Taiwan U

Real-Time AV Stack Driving Behavior & RTOS and Optimization

Alexander Carballo
Nagoya University, Japan

Sensor signal processing for Autonomous Vehicles

Zdeněk Hanzálek
Czech Technical U, Prague

Autonomous Testing

Yash Pant
University of Waterloo

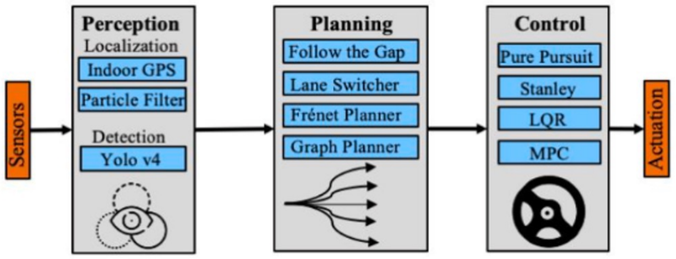
AV Control, Learning

Johannes Betz
TU Munich

Path & Behavioral Planning

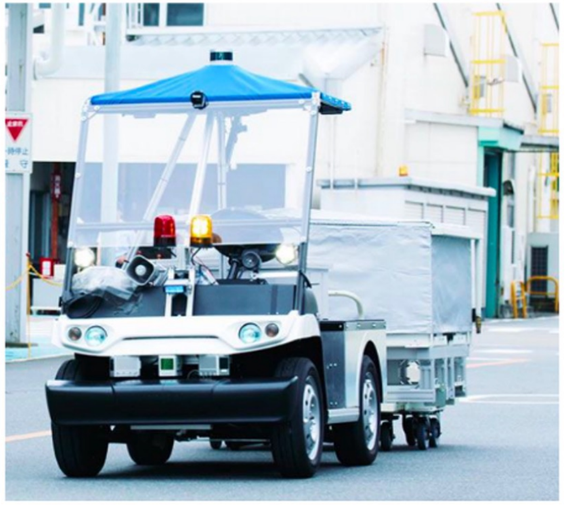
Autoware Center of Excellence at Pennovation

Main Theme: Autoware for OpenEV Platforms



Autoware on 1/10th scale
F1Tenth

Autoware on 1/2 scale
AV EV GoKart

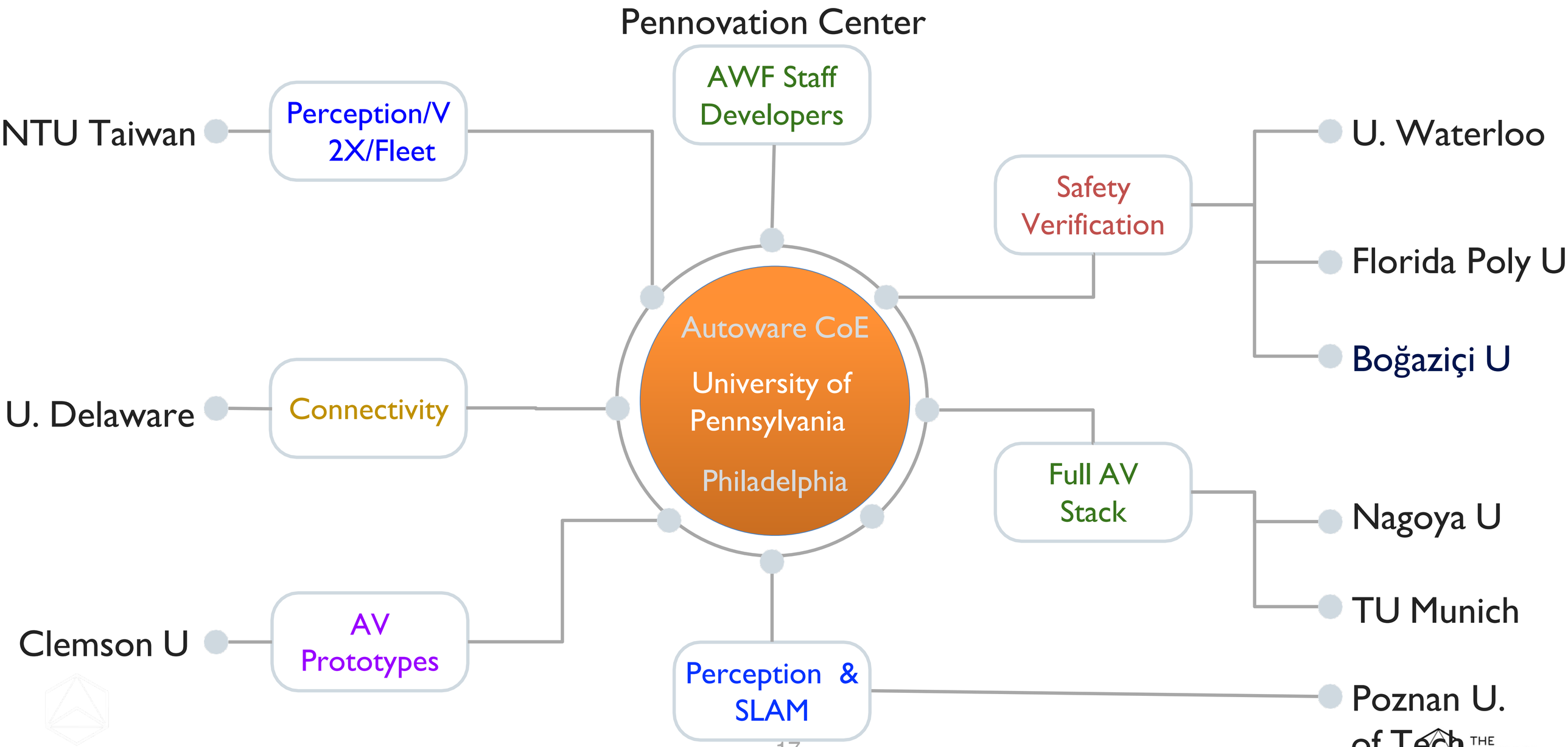


Autoware on EV

Target development of perception, planning & control

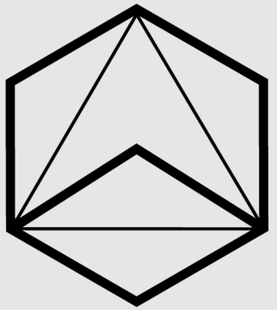
1. Implicit Map Representation and Localization with Invertible Neural Networks
2. Physics-Informed Motion Prediction and Dynamic Planning for Overtaking
3. Learning introspective control for multi-surface autonomous racing

Autoware CoE Network Focus Areas




Look forward to seeing
YOU
At The Autoware Foundation Activities

Thank You



THE
AUTOWARE
FOUNDATION

The first all-in-one open source
software for autonomous driving