



DIVP™

Driving Intelligence Validation Platform

Prof. Hideo Inoue, Kanagawa Institute of Technology

Weather Forecast



AD safety Assurance*



For Validation & Verification Methodology

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- Objective & Motivation

- Project Design

- Achievement

- Automated Driving Safety assurance

About the Cross-ministerial Strategic Innovation Promotion Program (SIP)

This is a program for achieving science, technology and innovation as a result of the Council for Science, Technology and Innovation exercising its headquarters function to accomplish its role in leading science, technology and innovation beyond the framework of government ministries and traditional disciplines.

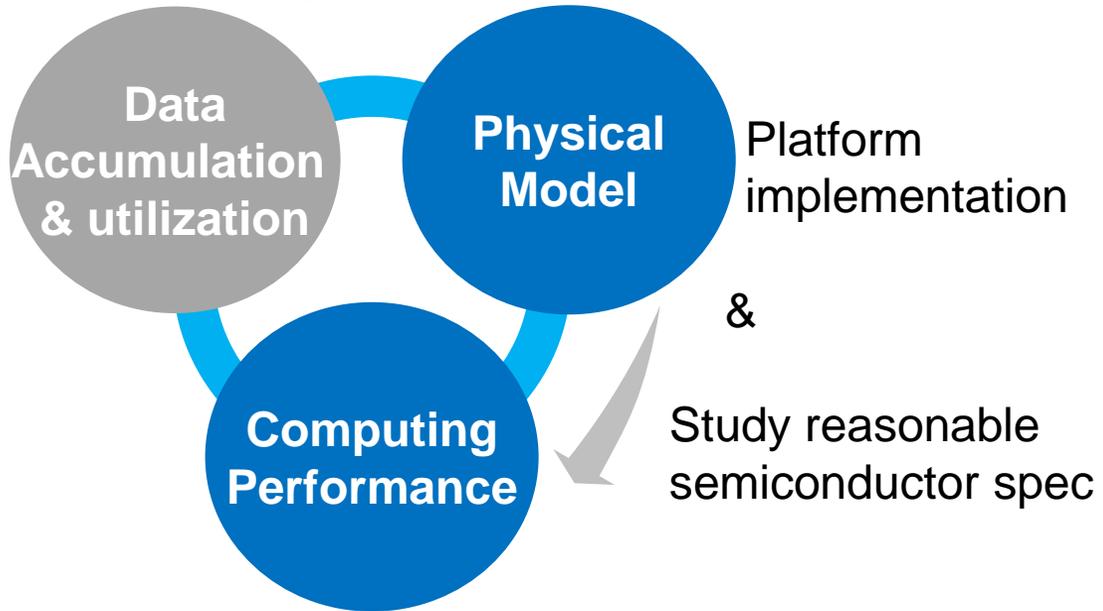
The program strives to promote research and development in a seamless manner from the basic research stage to the final outcome by endeavoring to strengthen cooperation among industry, academia and government under the strong leadership of the Program Director (PD)

DIVP™ scope covers “Physical Model” & “Computing Performance” on Trinitarian approach

Scope & Objectives

DIVP™ scope

Trinitarian approach form weather forecast

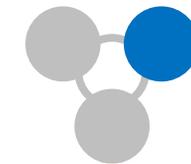


DIVP™ Objectives

- *Open Standard Interface*
- *Reference platform with reasonable verification level*
- *E & S pair model based approach (E : Environmental model, S : Sensor model)*

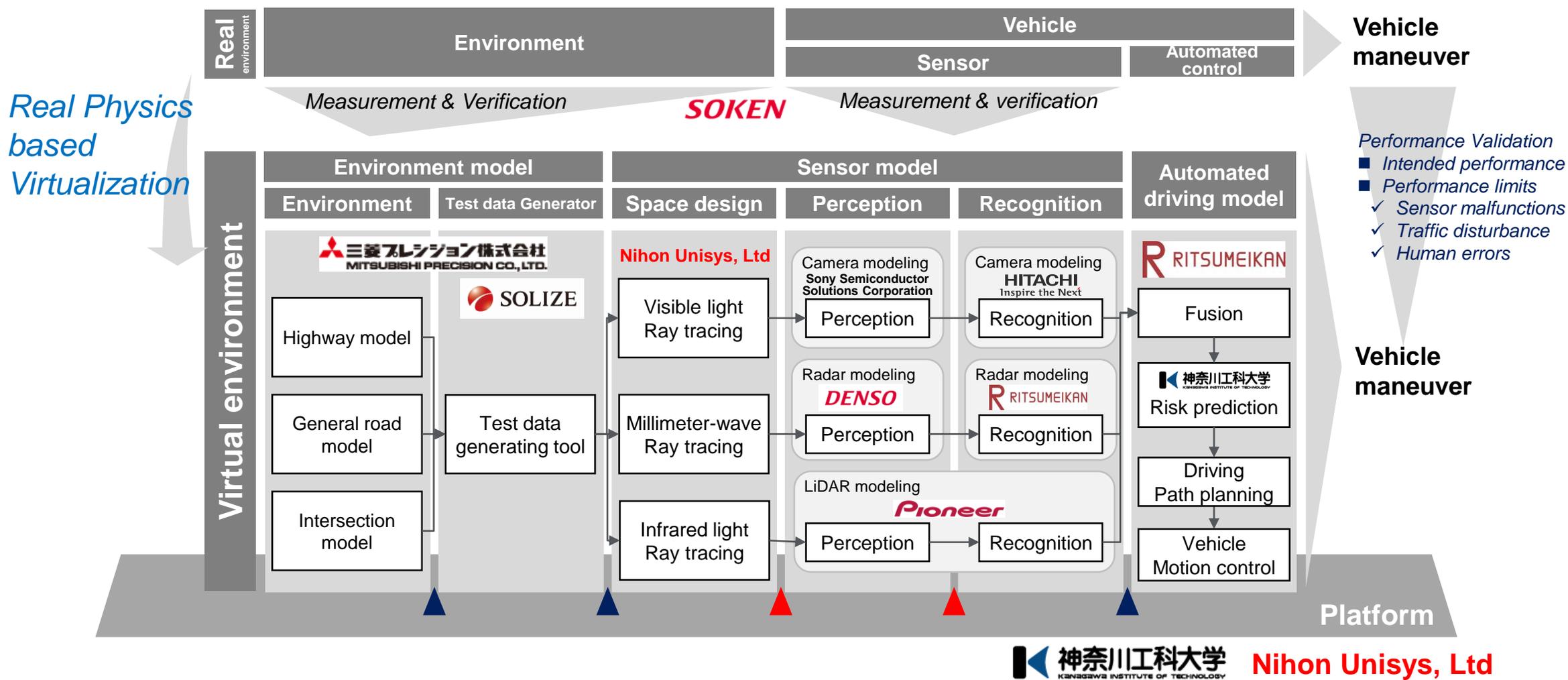
DIVP™ will improve Simulation based AD Safety validation for Consumer acceptable Safety assurance

Project Design

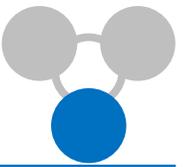


Designed research theme, Precisely Duplicate from Real to Virtual, and Verification of correlation level by 10-experts as DIVP™ Consortium

DIVP™ project design

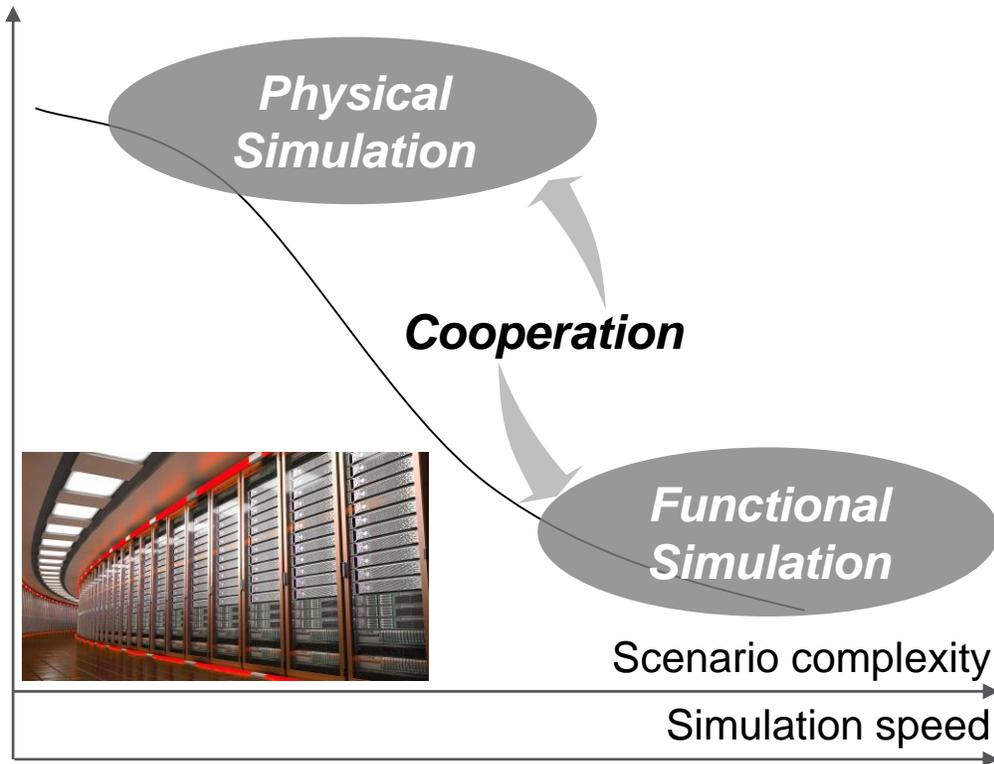


Study Physical & Functional Simulation platform, and cooperate those for multiple user needs in various Industry player



DIVP™ focusing simulation structure

Simulation accuracy



■ Physical Simulation for
Accurate duplication of physics but not real-time

■ Cooperate & Balance
Accuracy vs Speed of each simulation

■ Functional Simulation for
System evaluation in real time

Leading Global collaboration in Simulation based Safety Assurance

Achievement

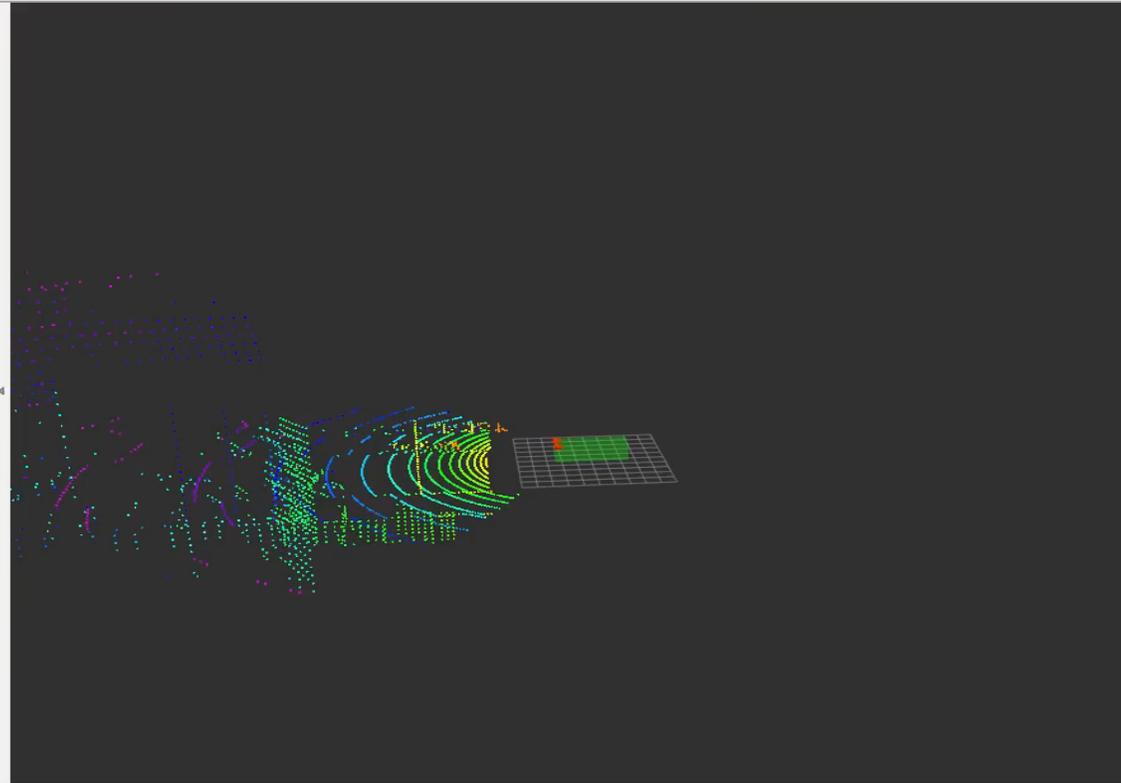
【LiDAR modeling】 Released Initial LiDAR model, duplicated realistic output by simulating environmental principle

DIVP™ LiDAR sample

Pioneer Nihon Unisys, Ltd

DIVP™ LiDAR's

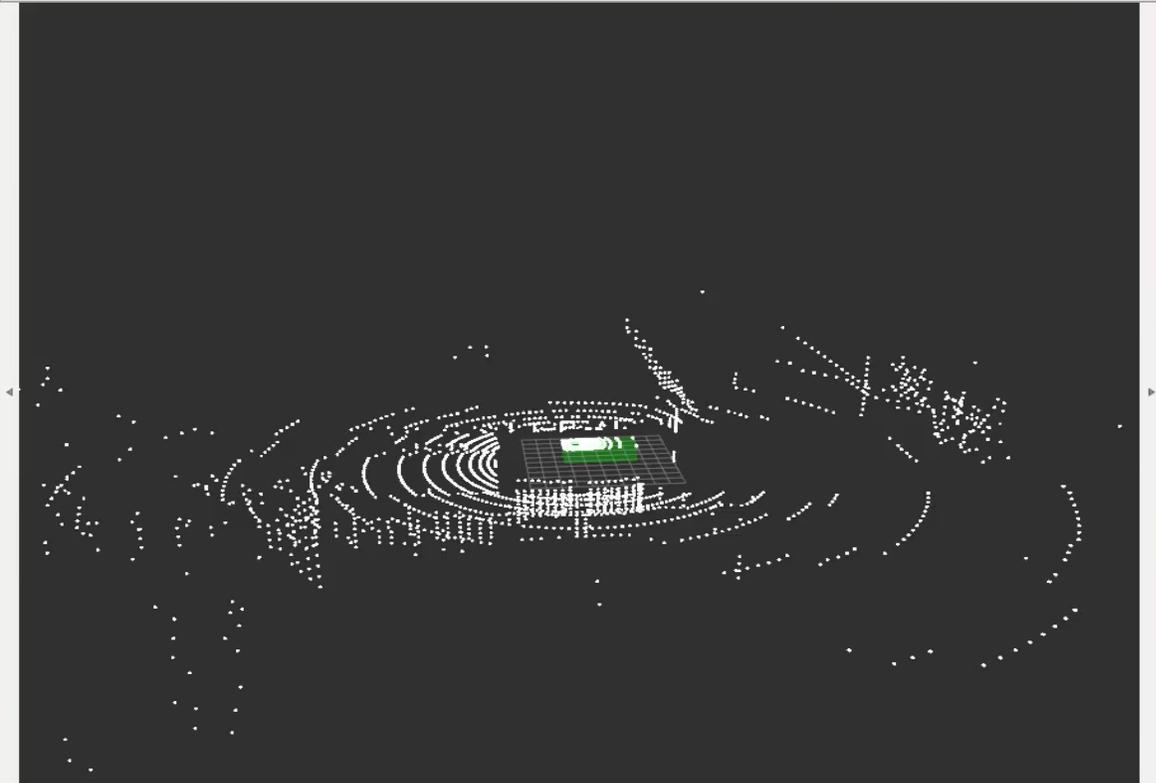
- Duplicate real-LiDAR output with modeling of ambient light and laser attenuation similar to the real situation



Reset Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel: Zoom. Shift: More options. 32 fps

CARLA LiDAR's

- Usual LiDAR output is far from real LiDAR's due by Ideal and unrealistic laser reflection without influence of disturbance etc



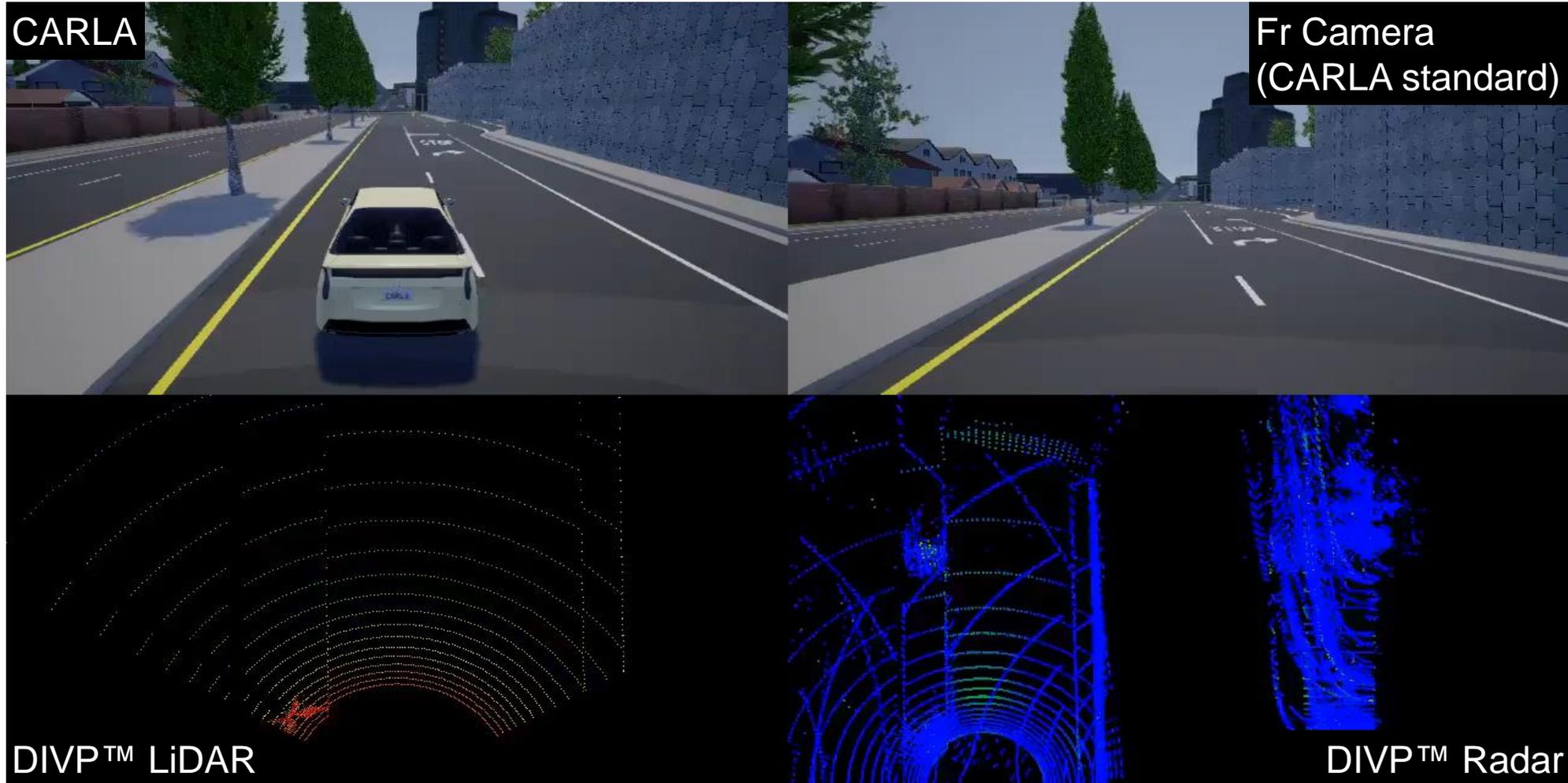
Reset 31 fps

【Sensor modeling】 Released LiDAR & Rader initial model, and Camera model will be toward Joint test in Later FY2019

DIVP™ sensors sample

Hitachi Automotive Systems, Ltd. *DENSO* *Pioneer*

神奈川工科大学 *Nihon Unisys, Ltd*
KANAGAWA INSTITUTE OF TECHNOLOGY



【Simulator Joint check】

Checked switch-ability of each modules because of using ROS interface

Detection and AD-control Simulation output sample*



Nihon Unisys, Ltd

Legend:
Camera detection **RED**
LiDAR detection **Green**

CONTROL:
Throttle
Brake
Steer

STATUS:
Velocity 1.0 [m/s]
Acceleration 4.7 [m/s²]

The simulation shows a first-person view from a vehicle on a two-lane road. A red car is visible in the distance. The road has yellow double lines and white directional arrows. On the left, there is a building with a large overhang. On the right, there is a wooden building and a tree. The sky is clear and blue.

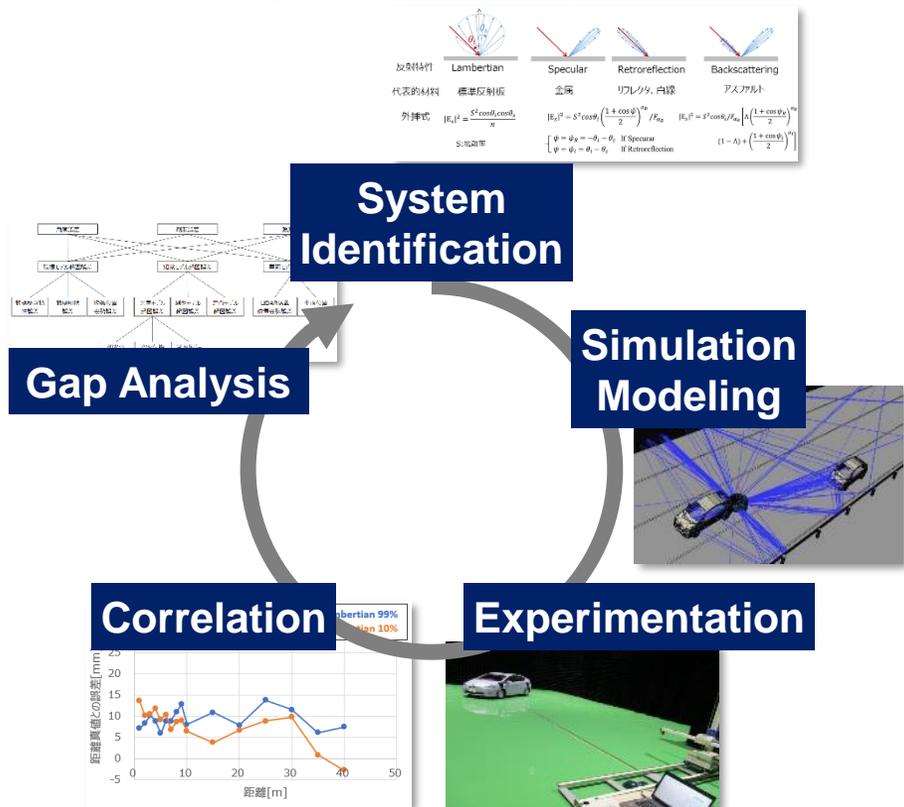
* Movie was combined individual simulation results

Source : KAIT

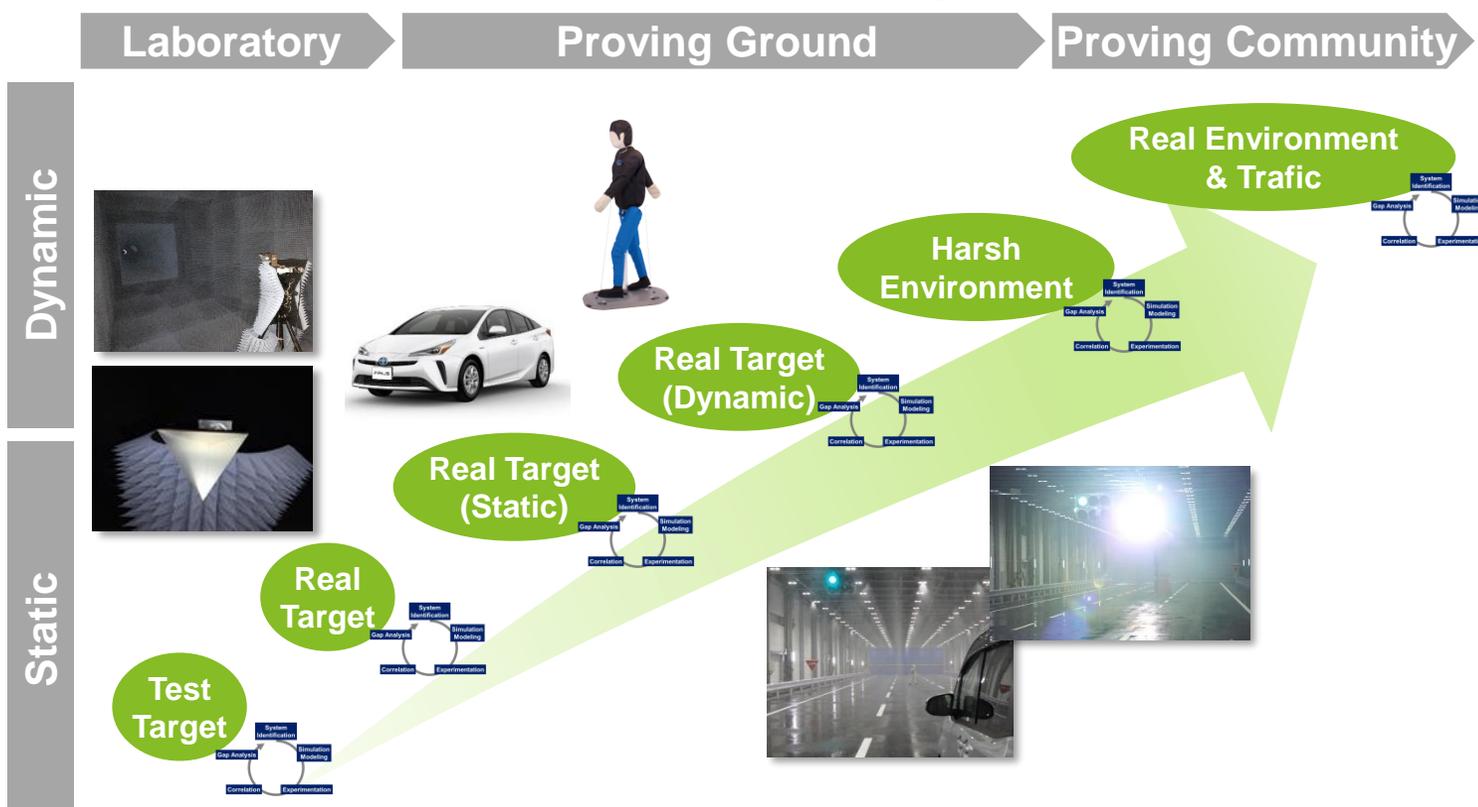
Physical modeling frame work, modeling Real physics from actual measurement and verify & validate Virtualized model to make sure of consistency

Physical modeling Flame work

Real physics based approach



Enhancement roadmap



DIVP™ propose to collaborate Metrics leveling to meet to user demand

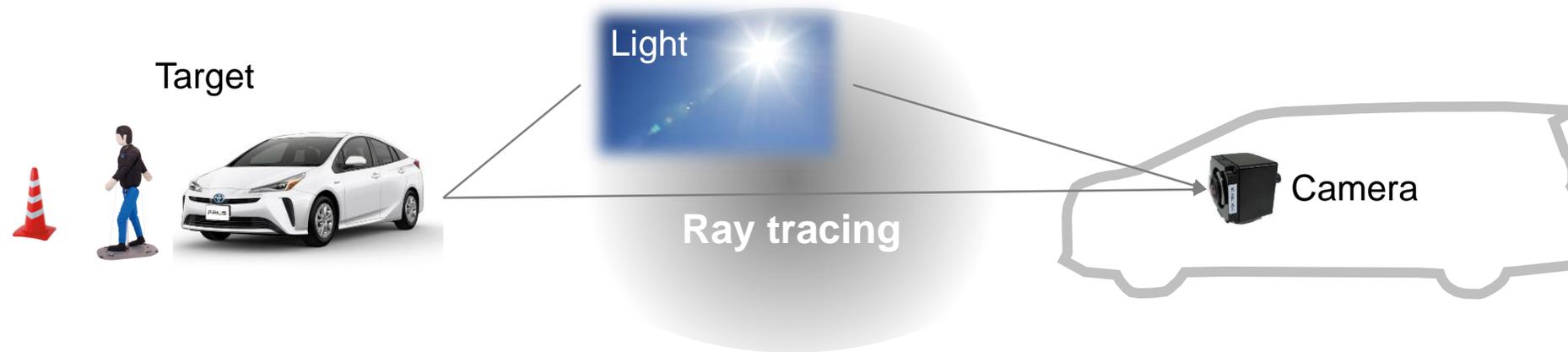
【Sensor principle verification】

Checked connectivity of Interface from Environmental model thru Recognition model

Camera

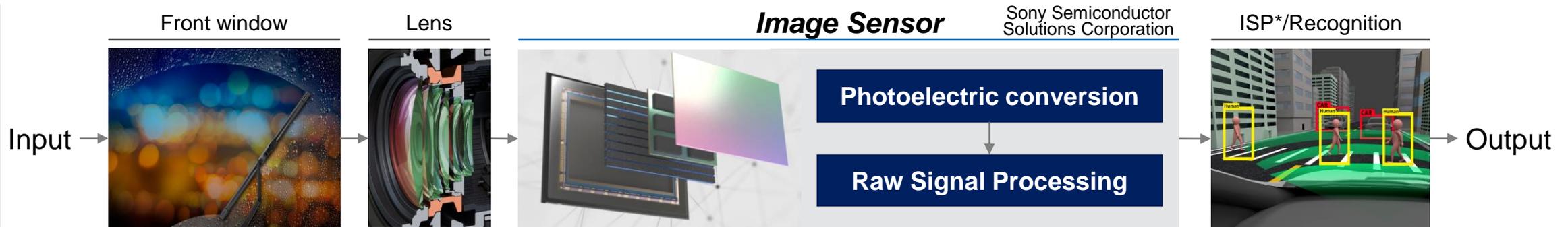
Sony Semiconductor Solutions Corporation **HITACHI**
Inspire the Next

Environmental image



Next Step is to Virtualize Image sensor for precise Perception

In-Camera detail



* Image Signal Processor
Source : SOKEN, INC, Sony Semiconductor Solutions Corporation
DIVP™ Consortium

【Sensor principle verification】

Sensor Real/Virtual Consistency verified with basic objects in some indicator

Rader

DENSO

LiDAR

Pioneer

Test environment

Corner Reflector



Anechoic Chamber



Sample Rader



Results

Distance	OK
Angle	OK
Intensity	No result (Next step)
Computational load	Heavy

Test environment

Reference Reflector



Laboratory



Sample LiDAR



Results

Distance	OK
Angle	OK
Intensity	Larger Gap in longer distance

Next step is to verify consistency with more complexity & reality objects, and study combination both Physical model & Statistical model

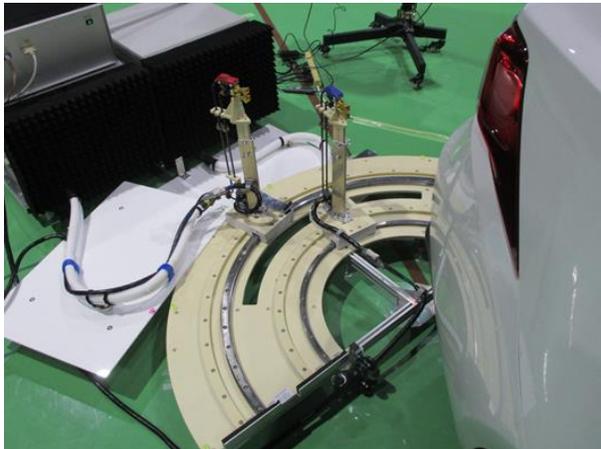
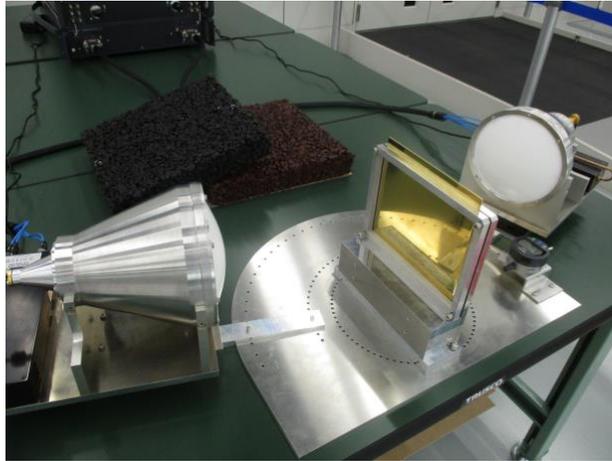
【Virtual-PG implementation for sensor】

Sensor principle based measurement & modeling for Asset catalog

Measurement facility example

SOKEN

Reflection measurement



Environmental Assets Catalog

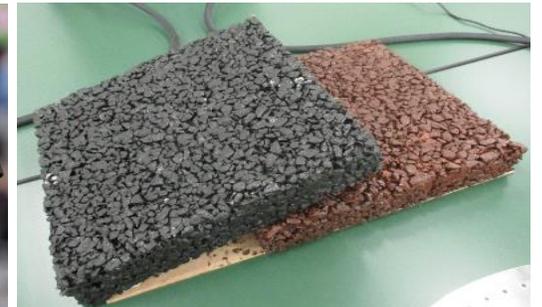
Car



NCAP Dummy



Road objects



【Virtual-PG implementation for sensor】

Measured Real-PG*1 using MMS*2 for Sensor simulation Virtual-PG

Measurement scene

SOKEN 三菱プレシジョン株式会社
MITSUBISHI PRECISION CO., LTD.

Jtown



MMS



Specific Environment Area



Rain



Road construction



Versatile Urban Area



Backlight



Under Path



Junction with poor visibility



V2X Urban Area



*1 PG : Proving ground、*2 MMS : MitsubishiMobilMapSystem
Source : JARI home page, SOKEN, INC, MitsubishiPrecision Co.,LTD.
DIVP™ Consortium

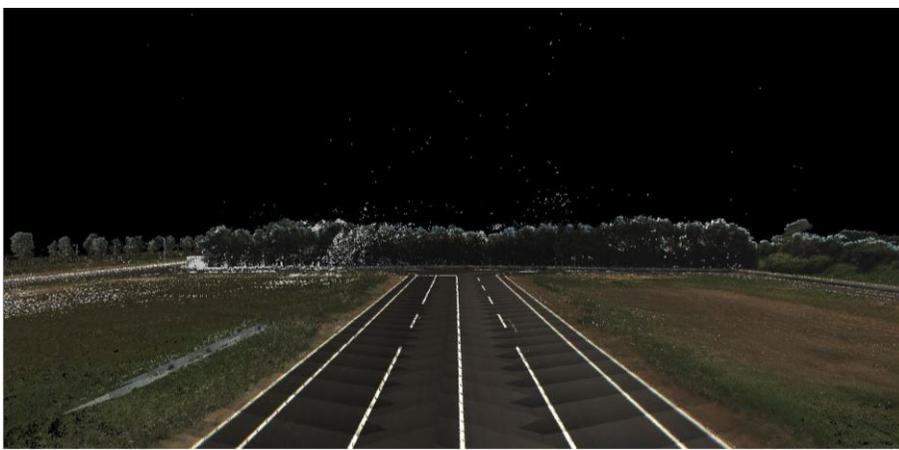
【Virtual-PG implementation for sensor】

Implemented Hi-definition 1cm-order 3D-data for sensor consistency enhancement

JARI Jtown MMS measurement results



Versatile Urban Area



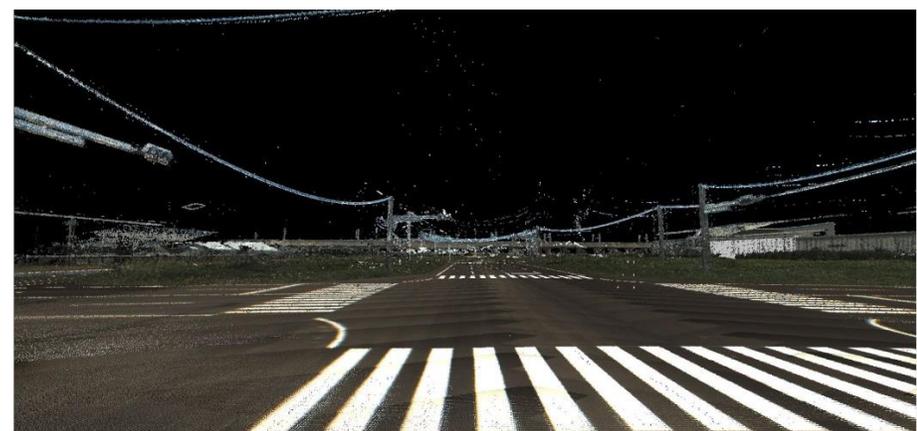
Versatile Urban Area



Specific Environment Area

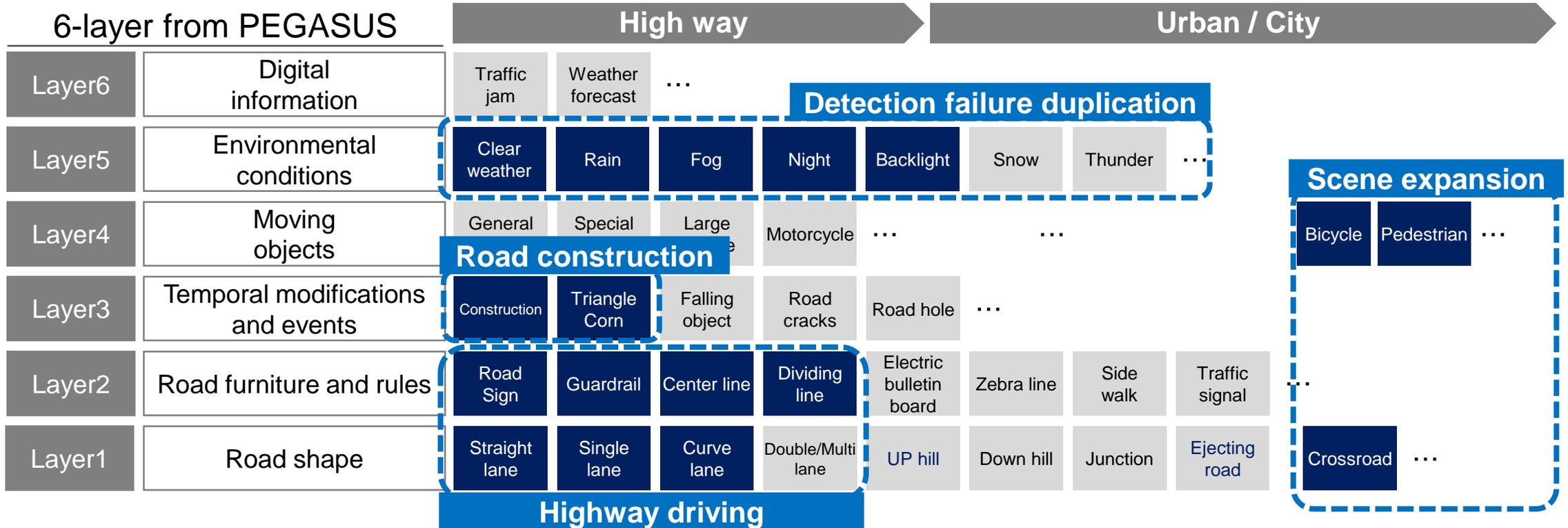
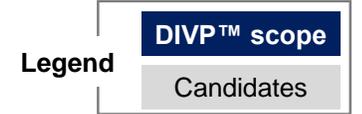


V2X Urban Area



1st priority Assets in 2-year project as a base toward Virtual-Proving & Community Ground

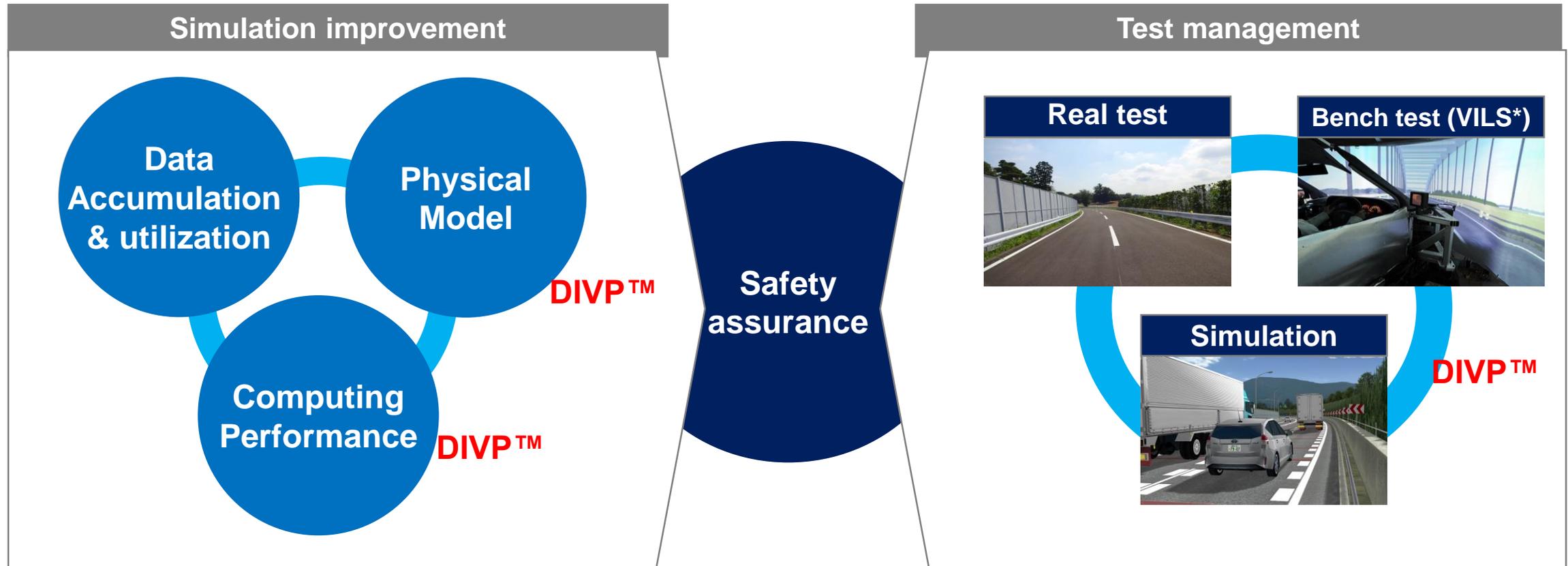
DIVP™ Asset catalogue



Automated Driving Safety assurance

Simulation improvement & Test management are both Wheel for Safety assurance

Safety Assurance ECO-system



Implementation of Total ECO system realize AD Safety assurance

* VILS : Vehicle in the Loop
Source: Mitsubishi Precision Company, Limited, SOKEN, INC, KAIT home page
DIVP™ Consortium

END

Tokyo Odaiba FOT area → Virtual Proving Community Ground

