SAKURA
Safety Assurance KUdos for
Reliable Autonomous Vehicles

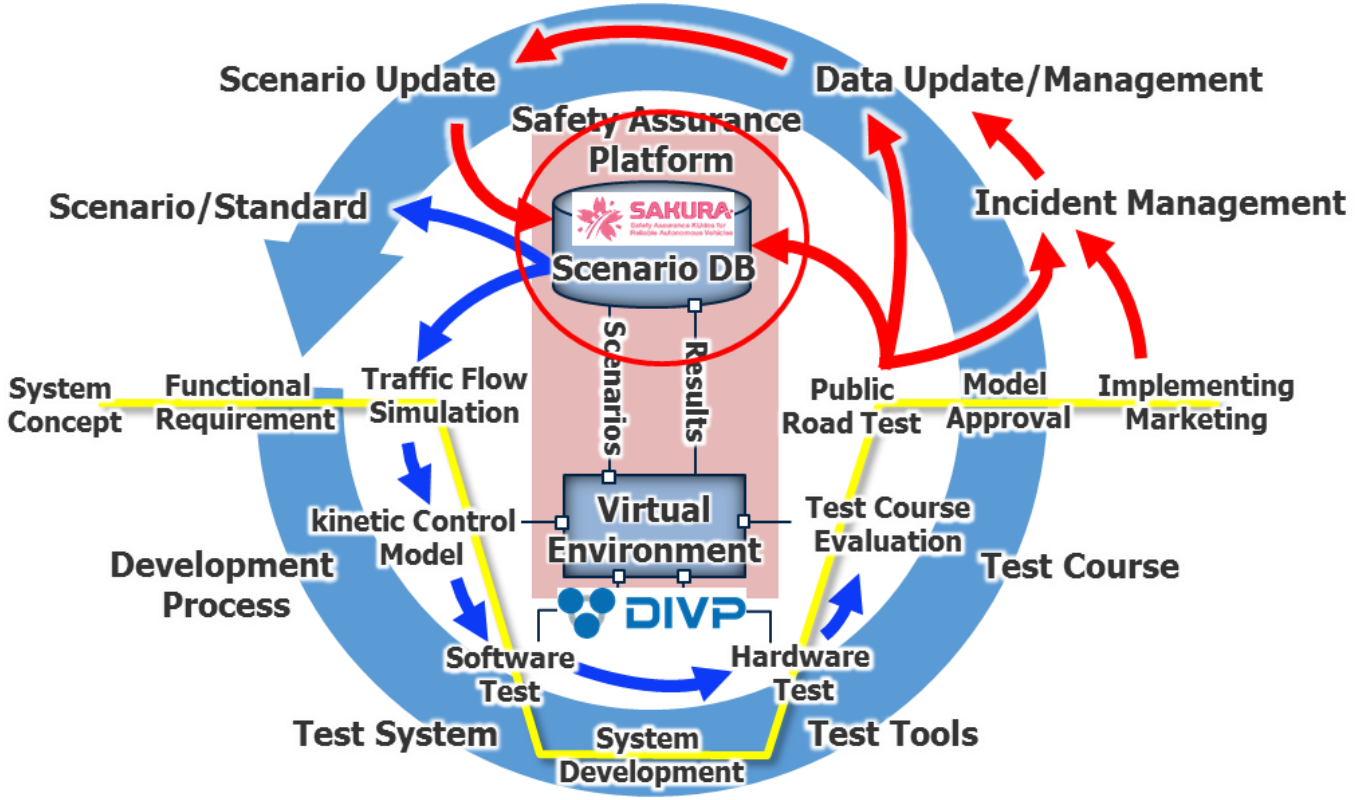
Scenario based safety assurance framework and scenario catalog

MLIT Japan

Overview of Japanese strategy for ADS safety

◆ Scenario based safety assurance in Japan

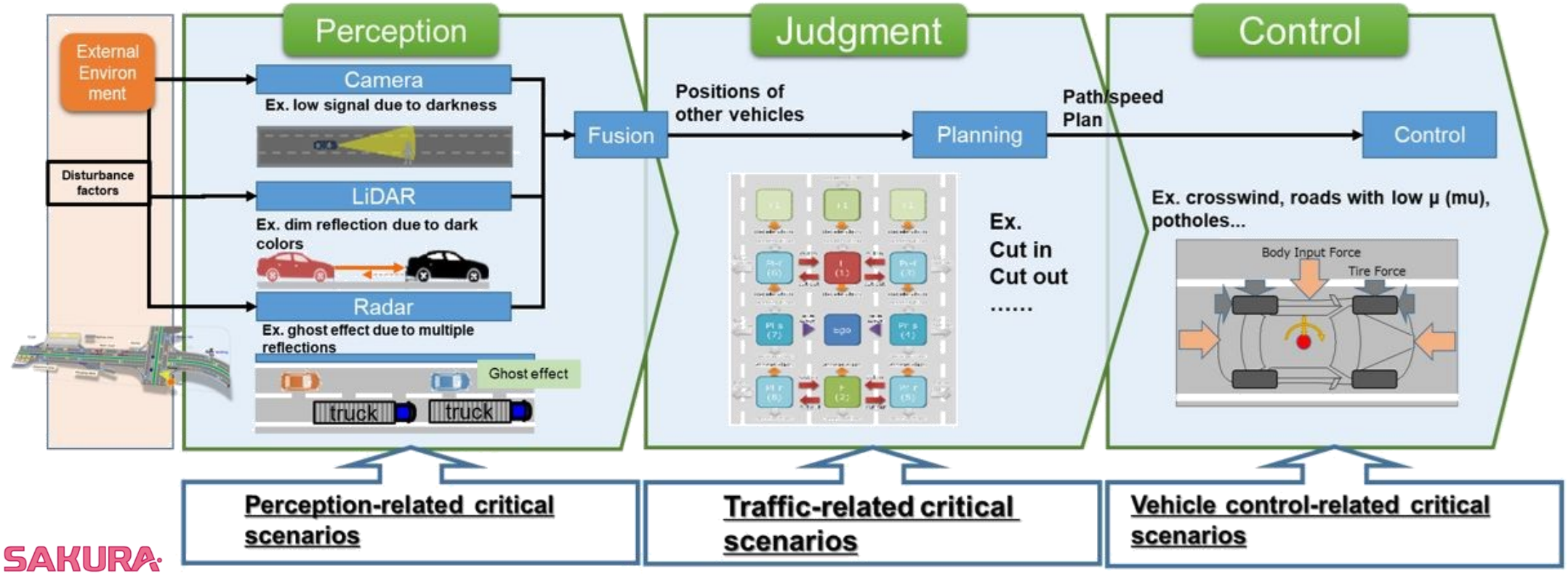
- Japan is considering ADS safety assurance framework
- SAKURA project is developing **scenario catalog** and **scenario database**
- DIVP is developing **virtual testing platform** with detailed **perception models**



SAKURA
Safety Assurance KUdos for Reliable Autonomous Vehicles

Concept of safety evaluation framework

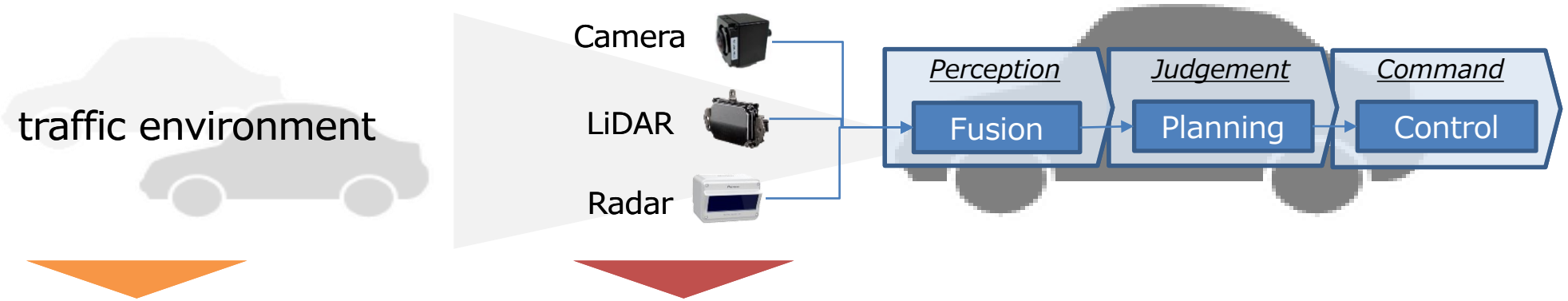
- Divide driving tasks into 3 independent tasks
- Define critical situations (scenario source) for each task
- Combination of 3 tasks are defined as “scenario” to be evaluated
- This framework is reflected in ISO 34502



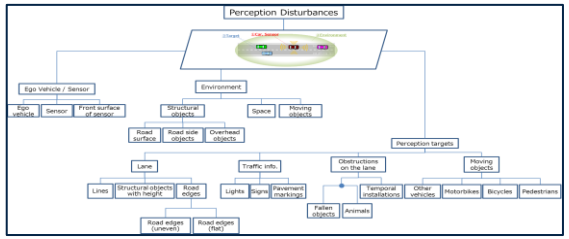
SAKURA
Safety Assurance KUdos for Reliable Autonomous Vehicles

Perception scenarios

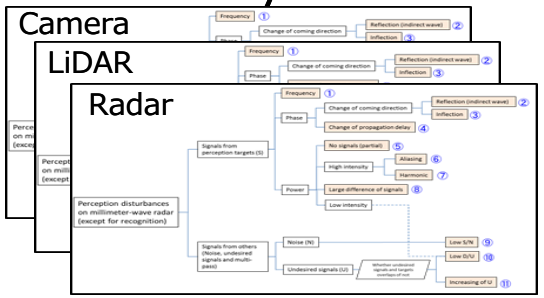
- **Define safety critical scenarios by causal factors and sensor principles**



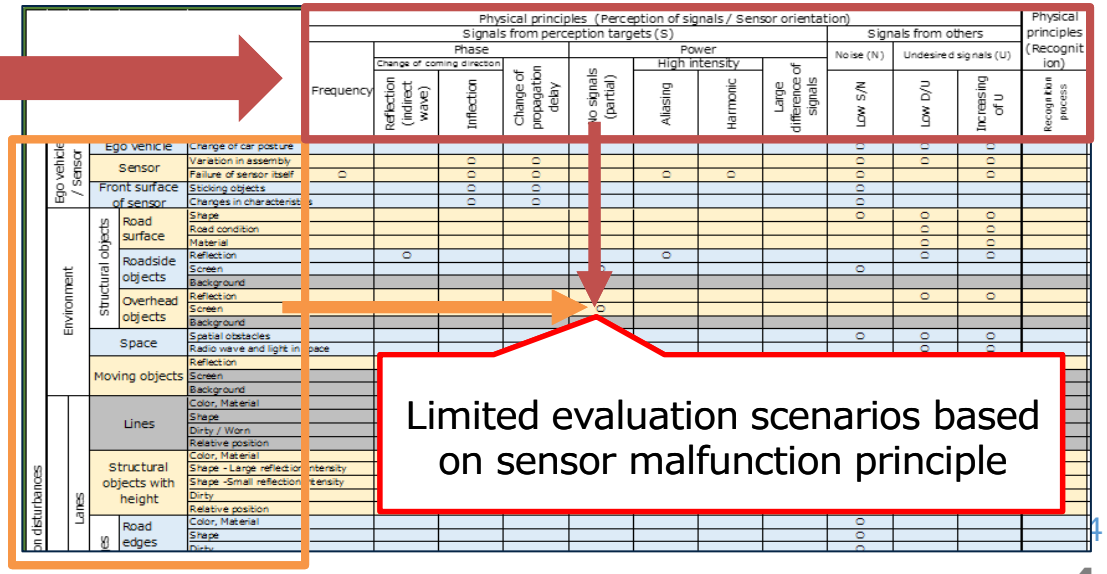
Environmental factor



Sensor Physical Principle



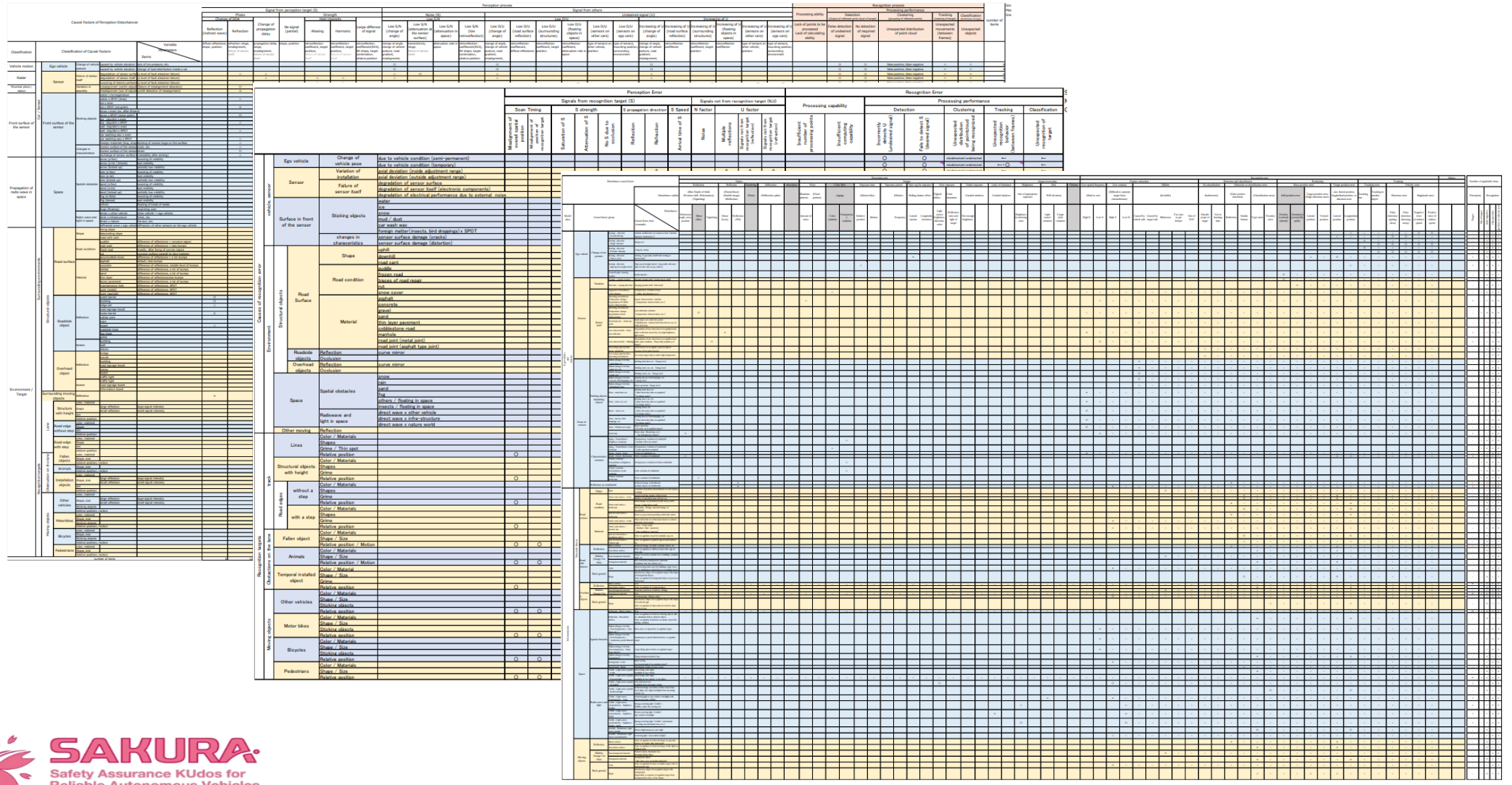
Evaluation scenario



SAKURA
Safety Assurance KUdos for Reliable Autonomous Vehicles

List of perception scenarios

- Scenarios for Camera, LiDAR, Radar are listed

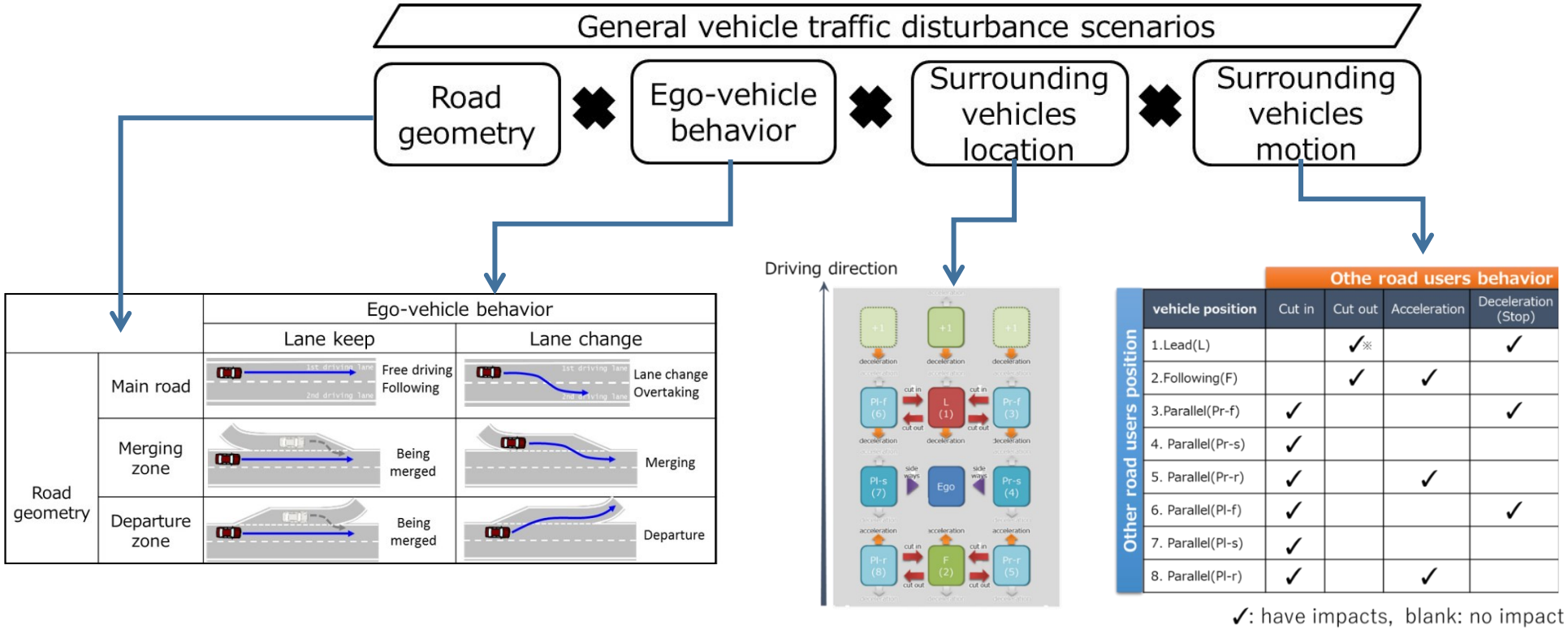


SAKURA
Safety Assurance KUdos for Reliable Autonomous Vehicles

Traffic disturbance scenarios

Traffic scenarios organize and **combine physical factors related to safety**

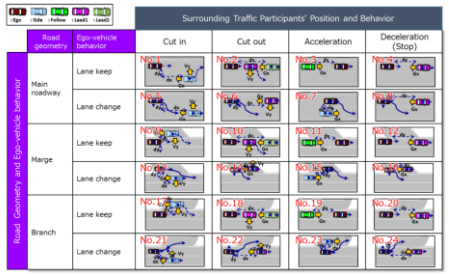
- Extract exhaustive and finite scenarios



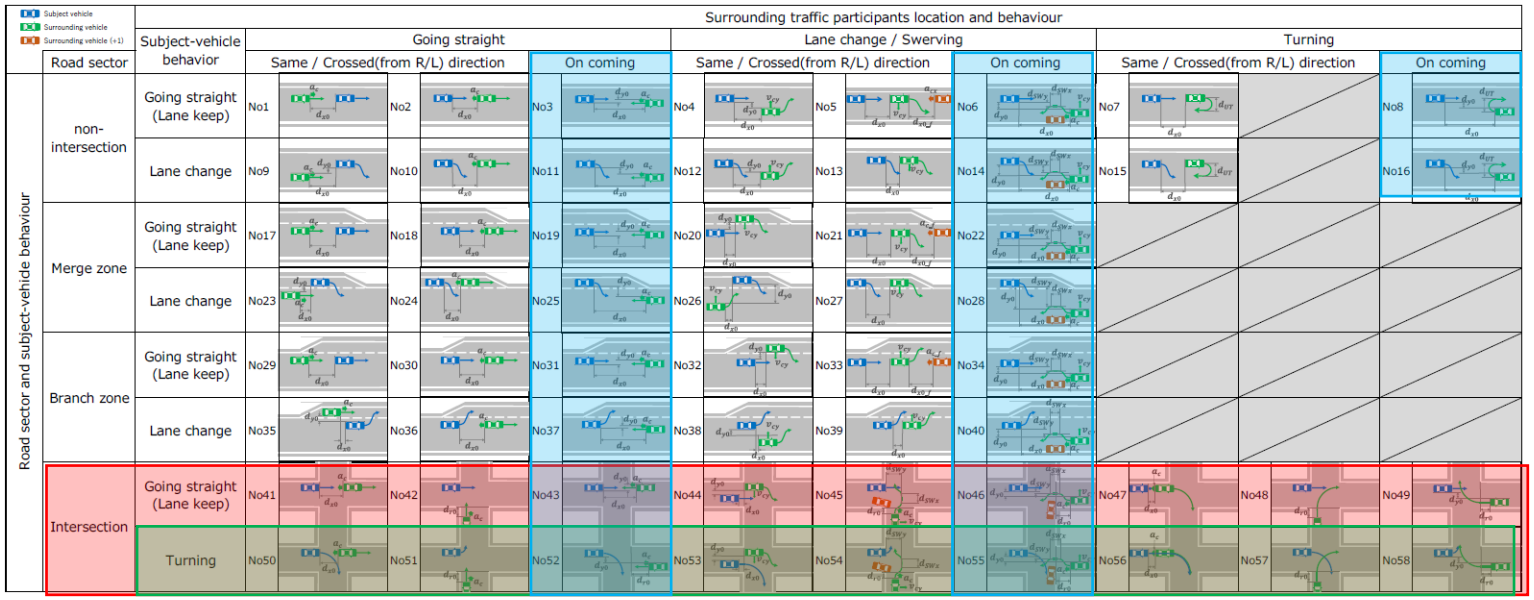
Vehicle specific traffic-related critical scenario structure schematic

Traffic disturbance scenarios (Car to Car)

- Categorize interactions with other traffic participants into finite patterns as Functional Scenario
- All patterns on the public roads are covered
  - e.g. roundabout is considered as sub-categories of merging or branch



Highway
24 Scenarios



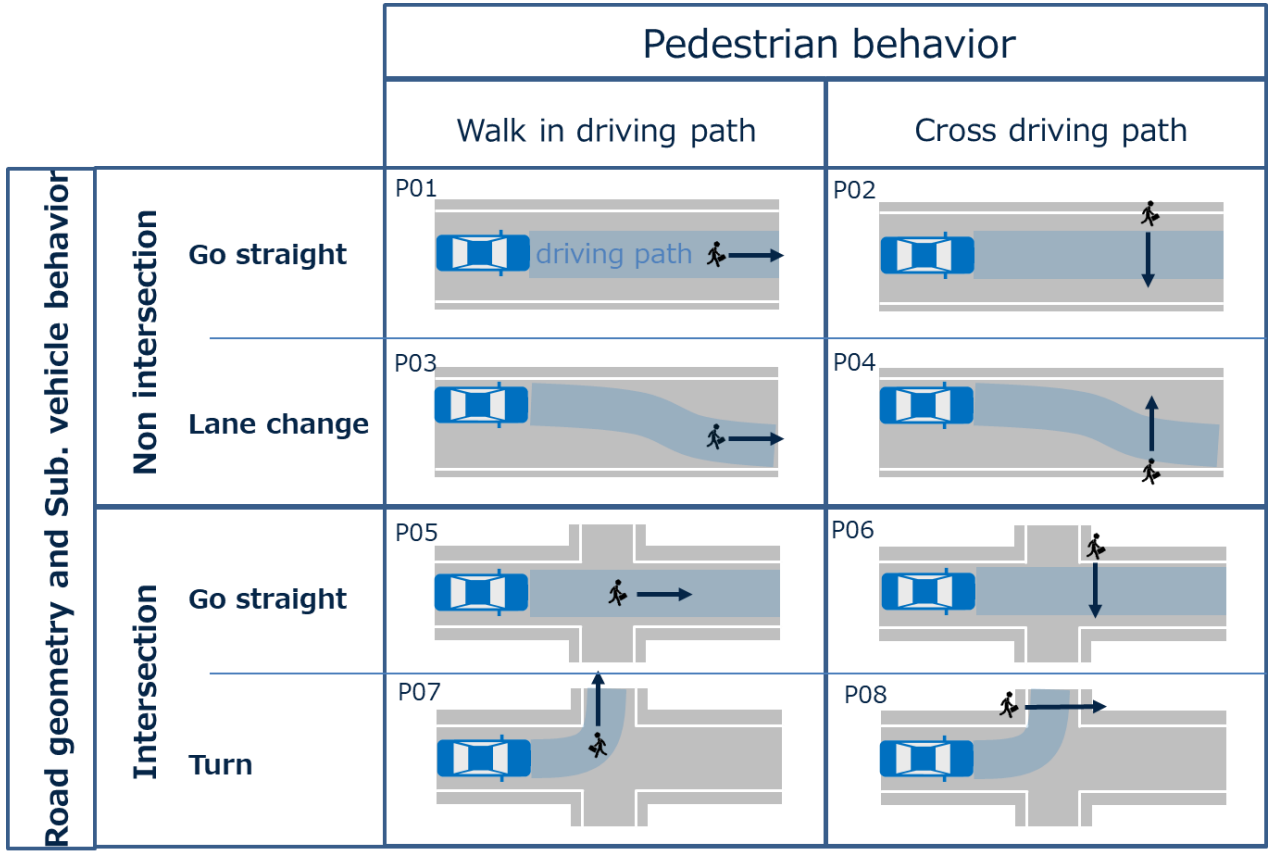
Urban 58 Scenarios

Add physical factors (**turning maneuver**, **oncoming vehicle**, and **intersection**)

SAKURA
Safety Assurance KUdos for Reliable Autonomous Vehicles

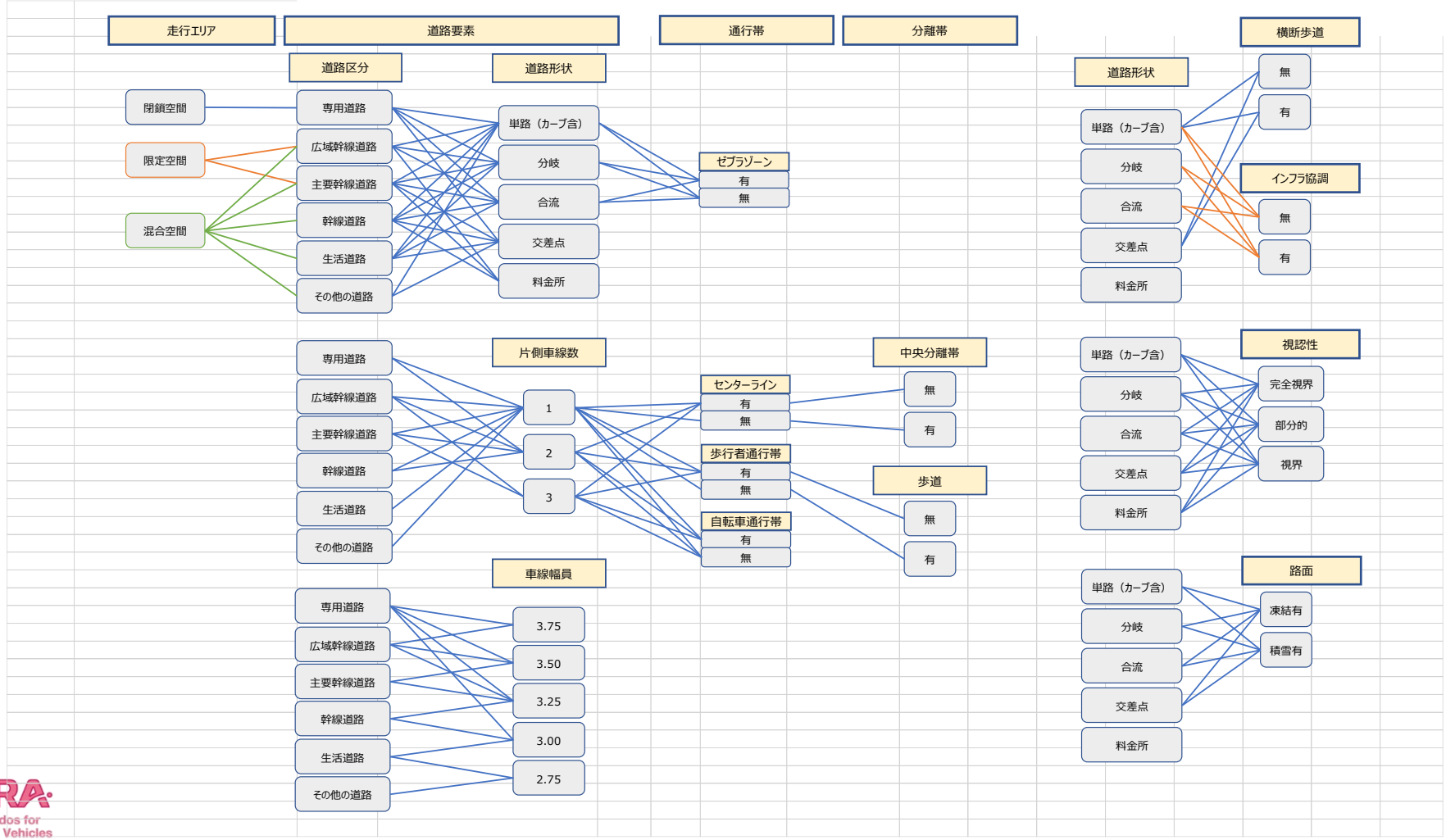
Traffic disturbance scenarios (Car to VRU)

◆ Pedestrian behavior is simplified into 2 patterns



Structuring entities for detailed scenarios (in progress)

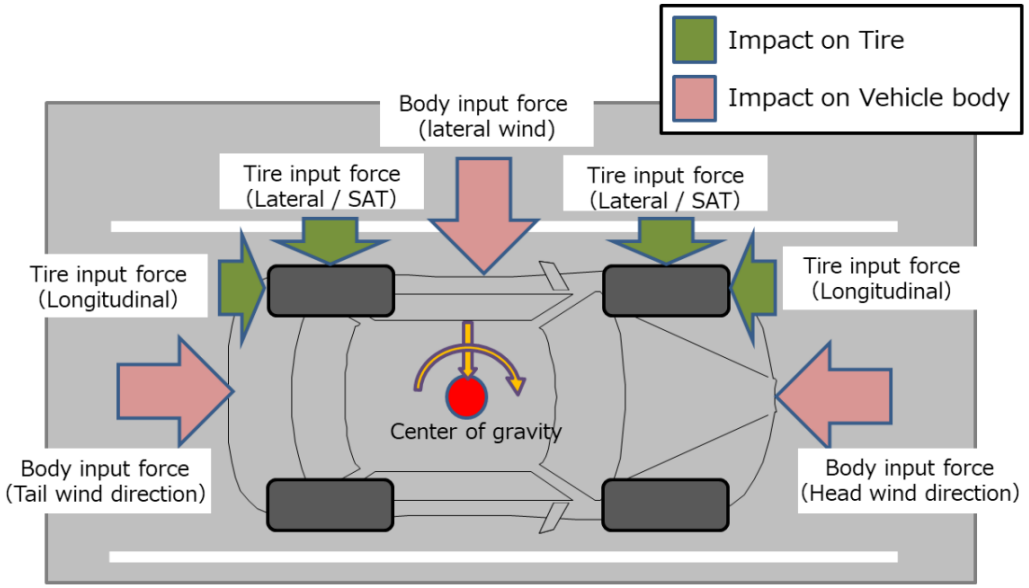
- **Entities listed on ISO 34504 are structured to define detailed Abstract/Logical/Concrete Scenarios from Functional Scenarios**



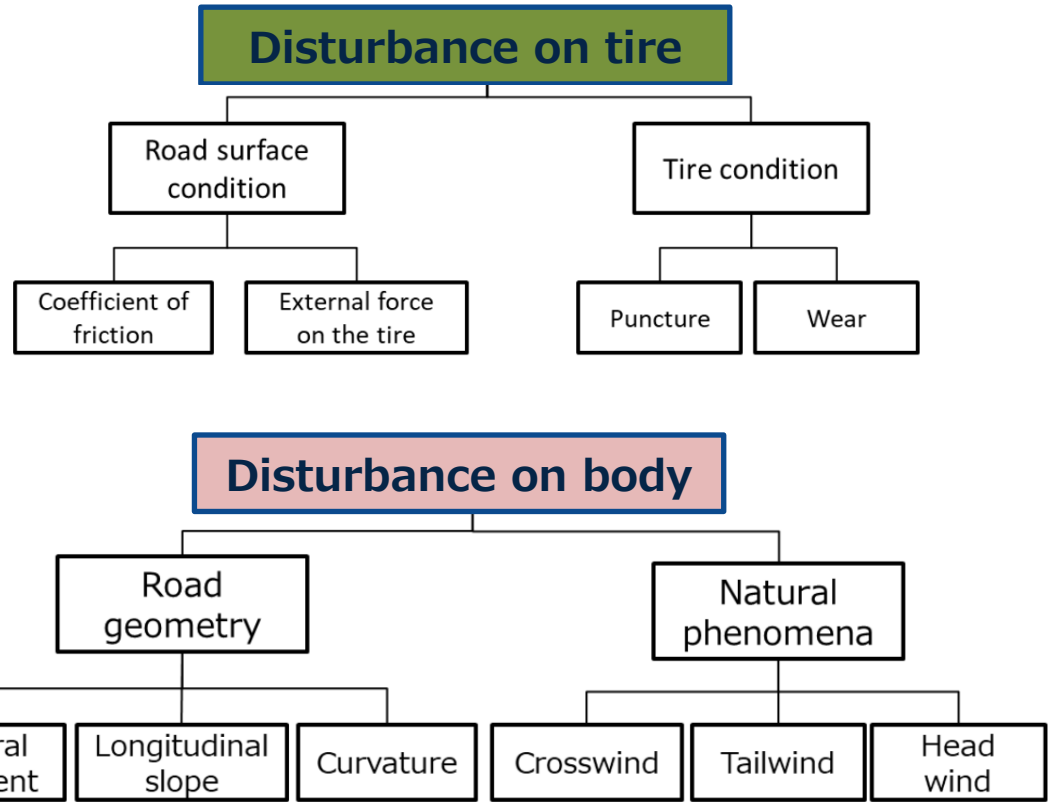
SAKURA
Safety Assurance KUdos for Reliable Autonomous Vehicles

Vehicle stability disturbance scenario

◆ Scenario is divided into 2 main categories: tire and body



physical principle of vehicle dynamics



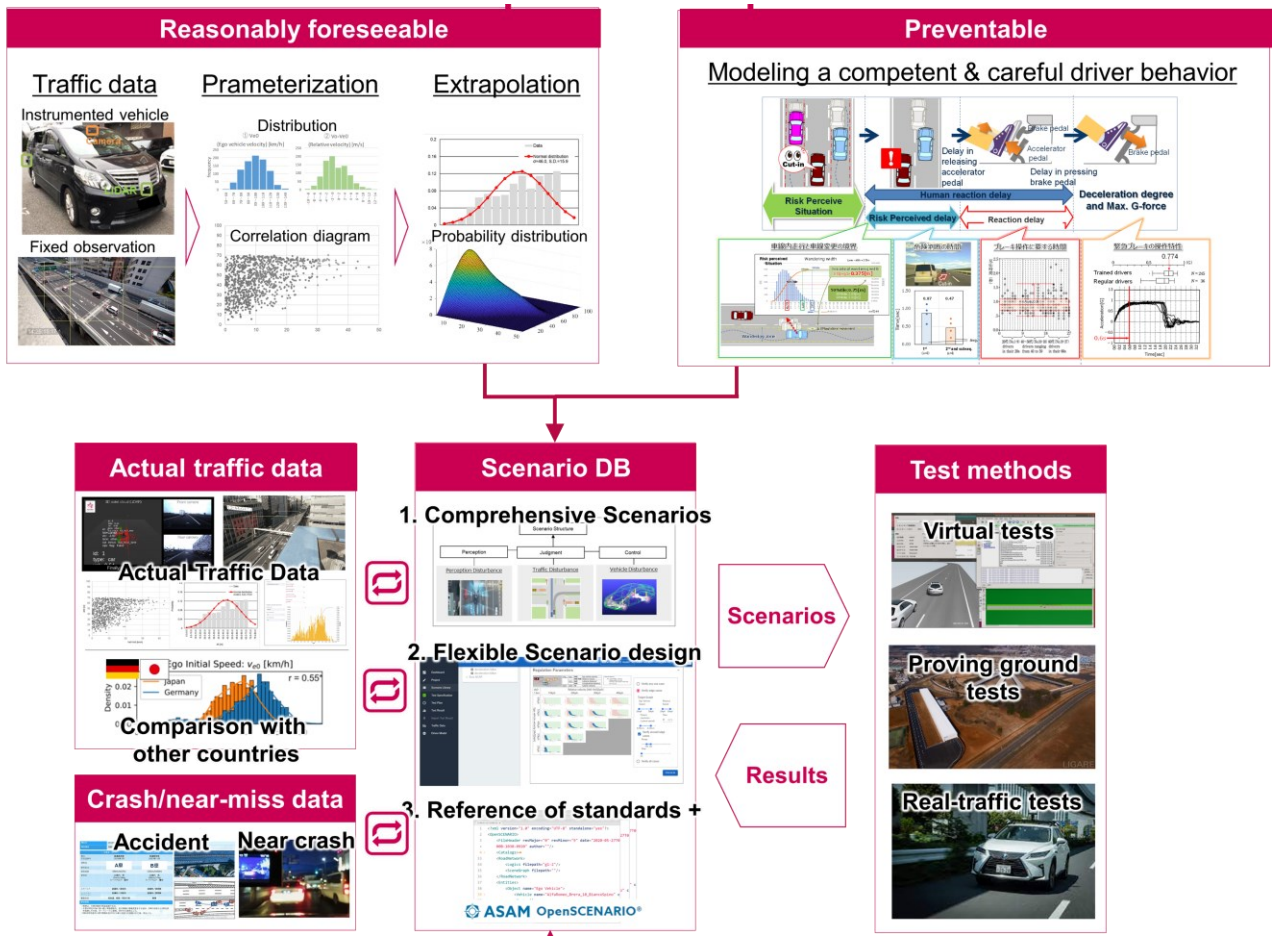
SAKURA database in the context of SA toolchain

◆ Quantify foreseeable and preventable for traffic disturbance scenario

- **Measurement of traffic data**
  - Validate functional scenarios
  - Estimate parameter distribution
- **Modelling C&C driver behavior**
  - Preventable boundary
- **Near crash/Accident scenarios**
  - ※under development

◆ Integrate with testing methods

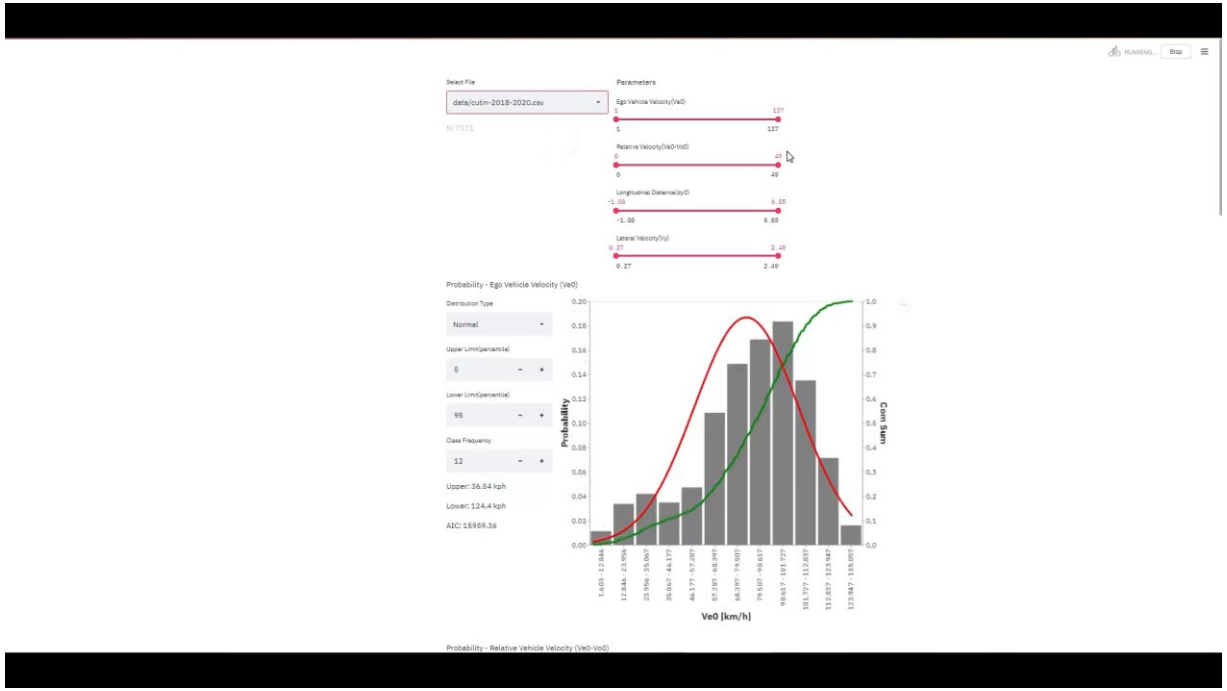
- **Provide relevant exposure**
- **Output concrete scenarios**



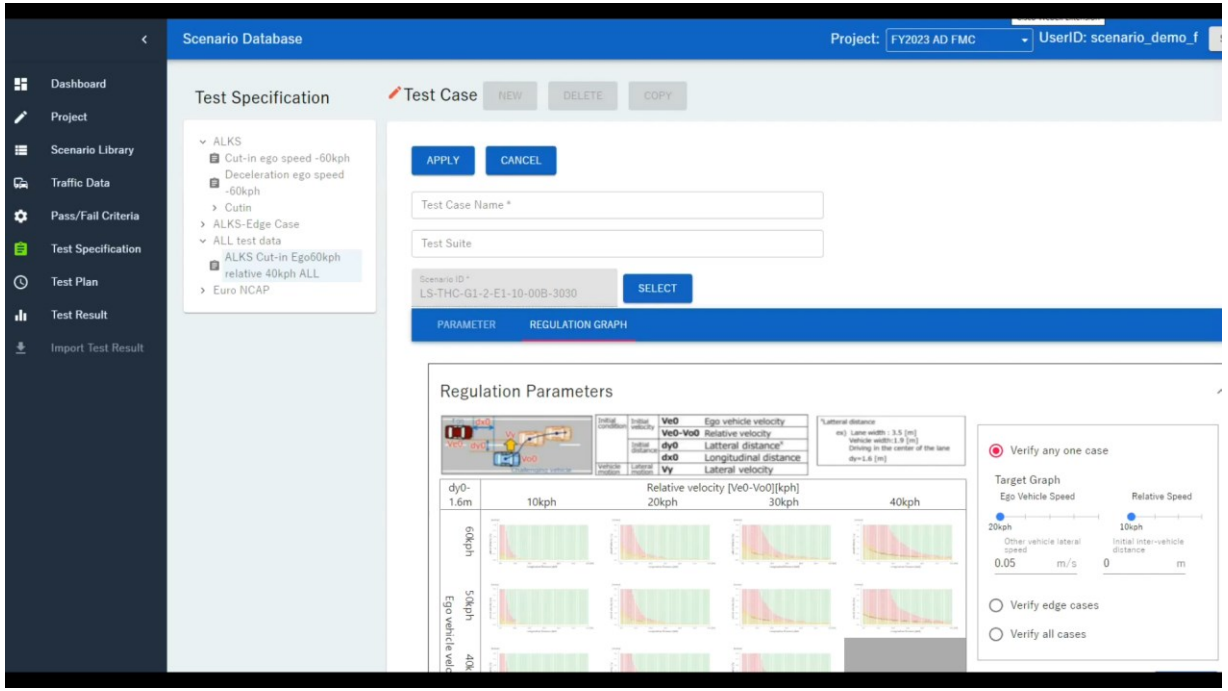
SAKURA
Safety Assurance KUdos for Reliable Autonomous Vehicles

SAKURA database as practical pipeline

- **Database provides quantitative thresholds for safety assurance**
  - **Reference for reasonably foreseeable parameter range**
  - **Pass/Fail Criteria based on C&C driver behavior**



Traffic parameter database

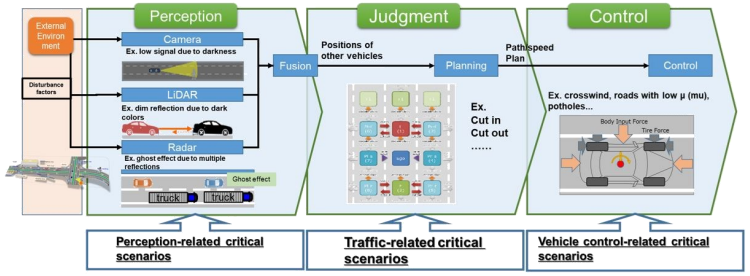


Traffic criteria database

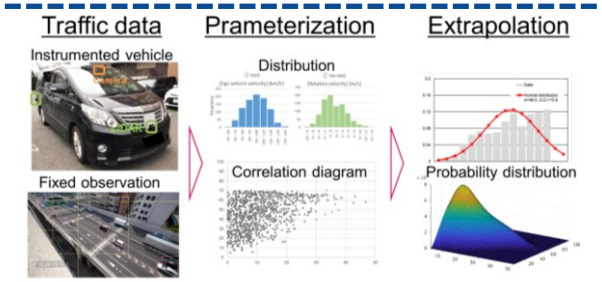
SAKURA
Safety Assurance KUdos for Reliable Autonomous Vehicles

Overview of SAKURA Framework

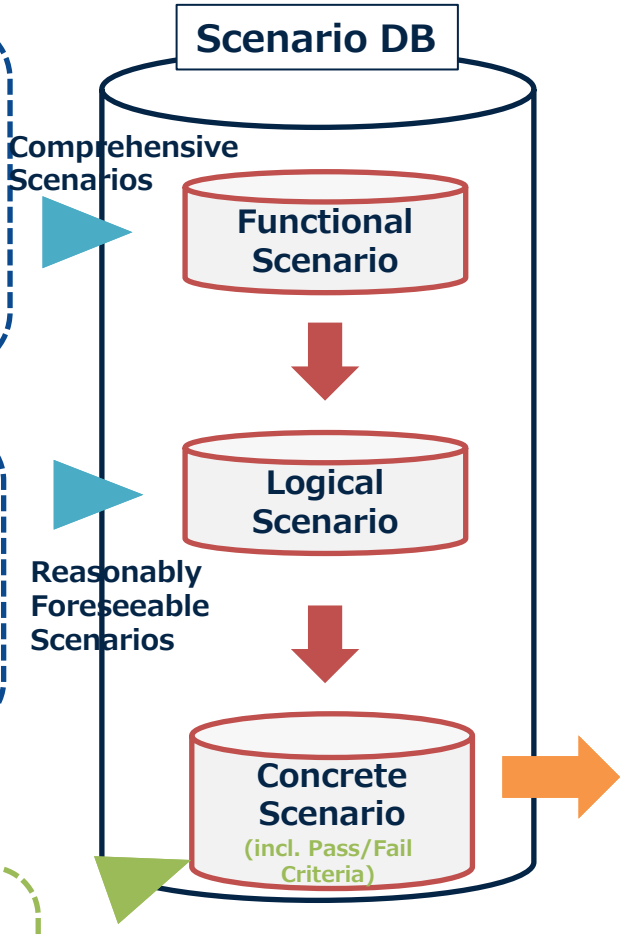
Functional Scenario Catalog



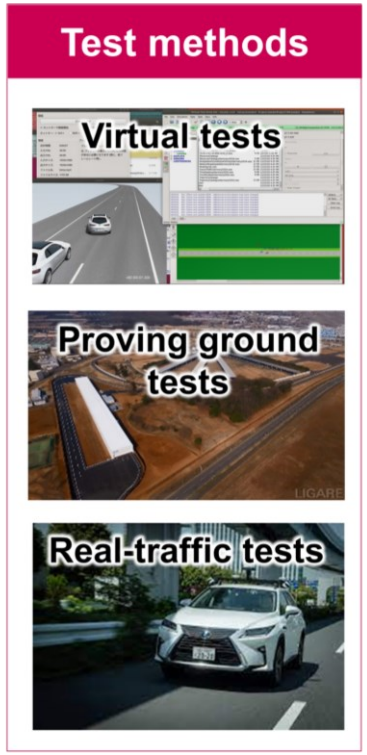
Real Traffic Analysis (based on ODD)



C&C Driver Model



Pass/Fail Criteria (Preventable boundary)



SAKURA
Safety Assurance KUdos for Reliable Autonomous Vehicles

Summary

- **Scenario catalog is being developed to define necessary and sufficient test scenarios**
  - Japan framework is intended to cover **all safety critical scenarios** which ADS may exposed on real traffic

- **Safety critical scenarios for each driving task are structured**
  - Perception scenarios determine **sensor weakness situation** based on **environmental causal factors** and **sensor detection principles**
  - Traffic disturbance scenarios are defined with **behaviors of traffic participants** and **road geometry** to cover all possible interaction

- **SAKURA Scenario database is being developed**
  - To bridge the gap between methodology and practical test platform (including virtual simulation) SAKURA database is developed to provide **quantitative threshold of reasonably foreseeable and preventable boundary** of traffic disturbance scenarios

SAKURA
Safety Assurance KUdos for Reliable Autonomous Vehicles