13th Japan ITS Promotion Forum

Impact Assessment (Traffic Accident Reduction)

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SIP-adus International Cooperation Working Group

Japan Automobile Research Institute (JARI)

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Cabinet Office

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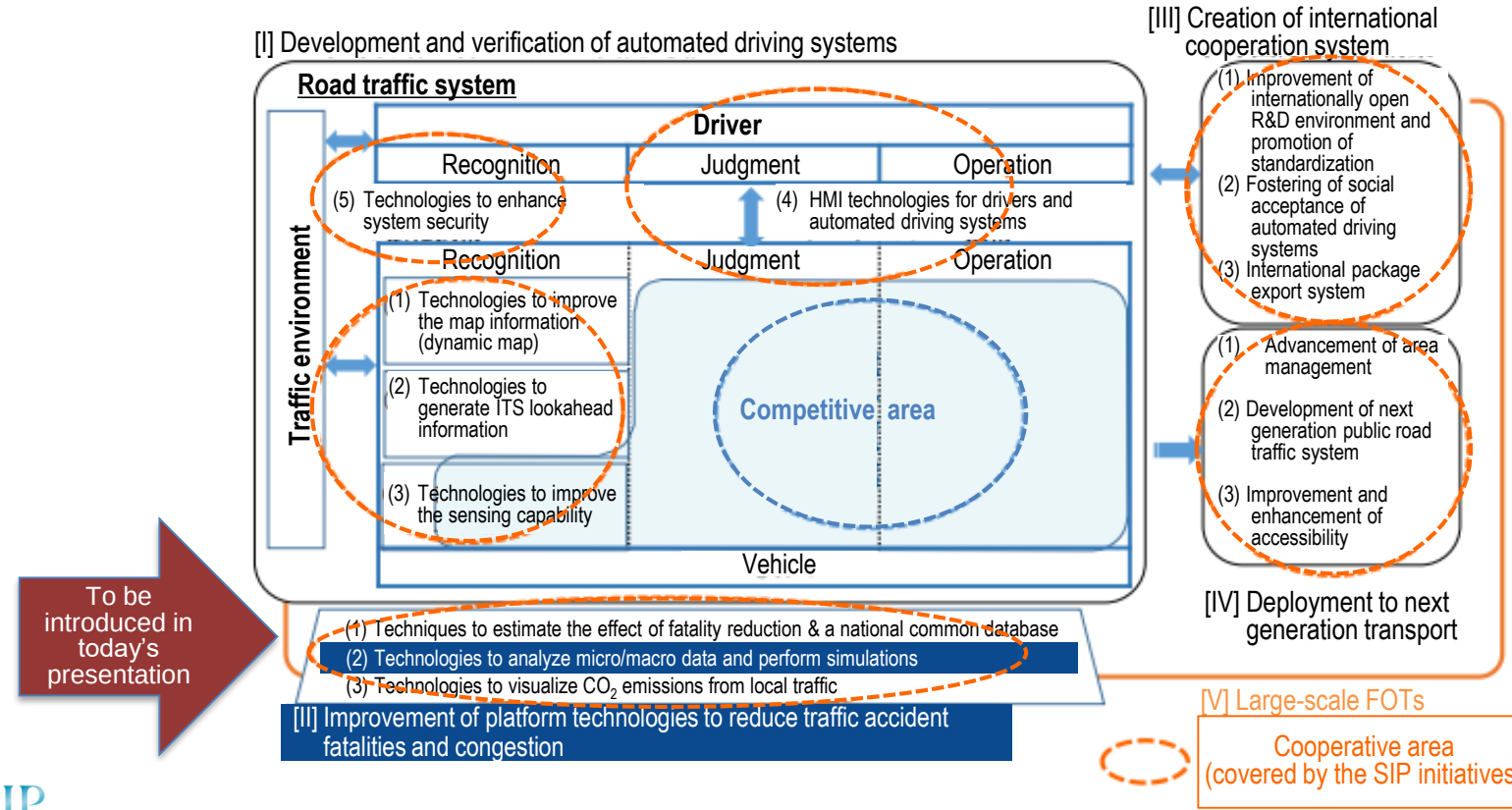
Development of Simulation to Reproduce Traffic Environments

Cross-ministerial Strategic Innovation Promotion Program SIP-adus (1st Phase)

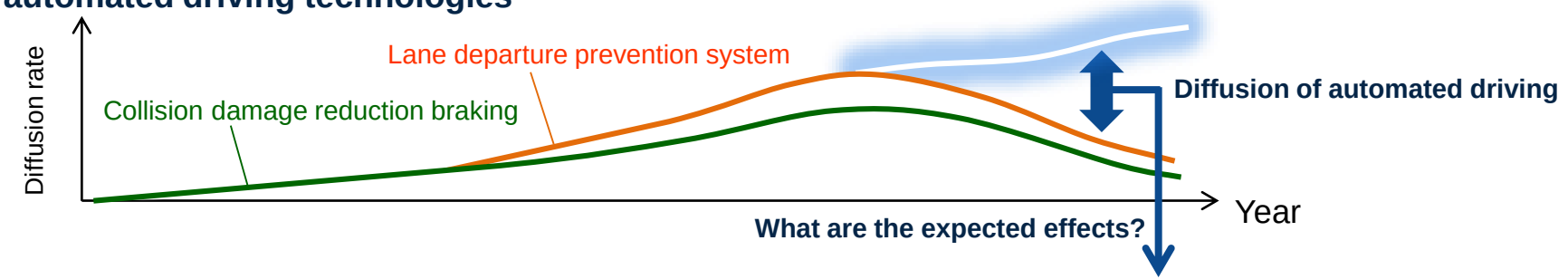
◆ Platform technologies to reduce traffic accident fatalities and congestion (cooperative area)



Classification of R&D themes in SIP-adus (Cabinet Office)

To Achieve the Safest Traffic Environment in the World

◆ Preliminary evaluation to promote early implementation and diffusion of driving assist technologies and automated driving technologies



Aim: Evaluation of the driving assist system

Specific accident scenario simulation

- Specify the road users in the periphery
- Assume limited settings/times
- Verify sensor specifications and control logic
- Verify micro-level damage reduction effects

Issues (examples):

- ✓ Evaluation of effects before hazards materialize
- ✓ Mix of vehicles with and without the systems in the traffic

Aim: Strategy for diffusion of the automated driving systems

Traffic environment reproduction type simulation

- **Multi-agent**
  Road users act independently and have mutual impacts
- Assume various settings/times
- Conduct verification by reproducing the traffic flow
- Verify macro-level damage reduction effects

Development is necessary for diffusing automated driving.

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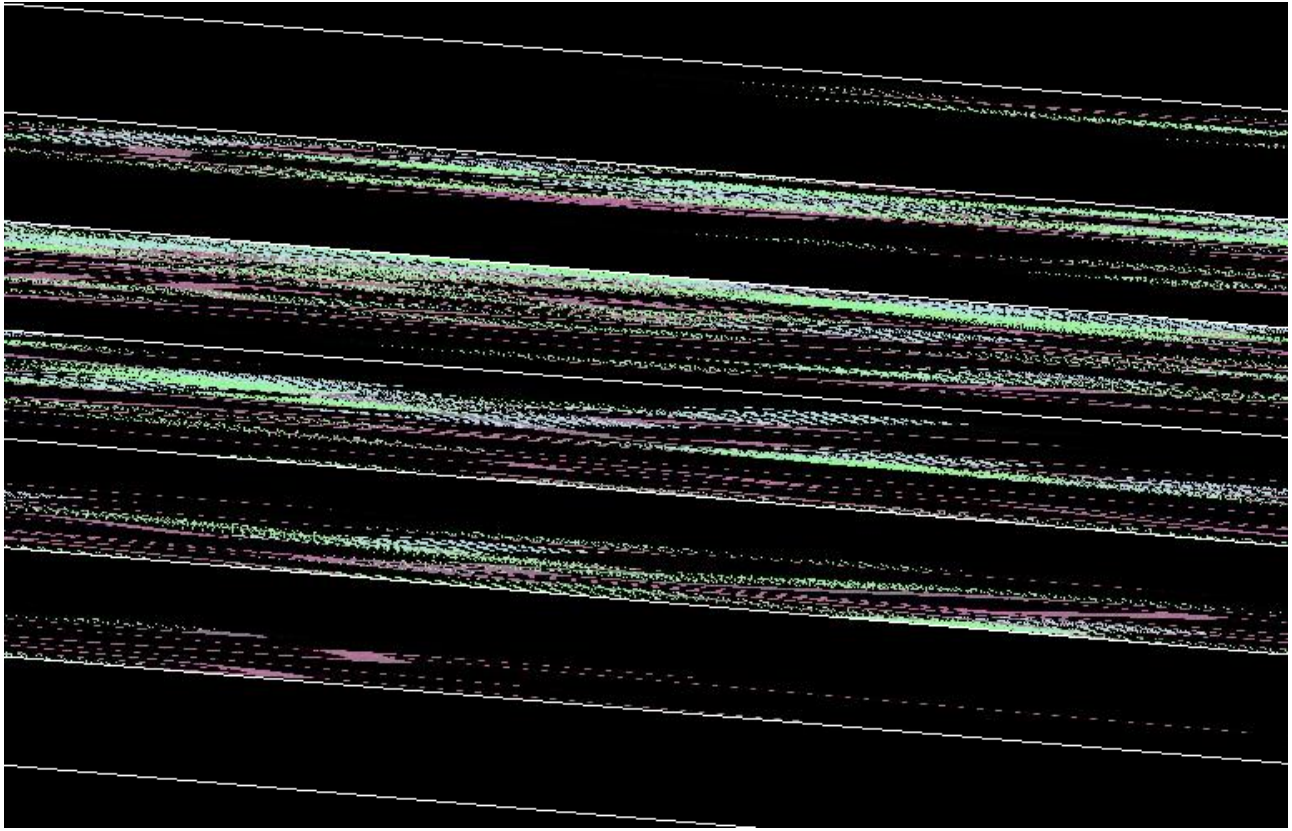
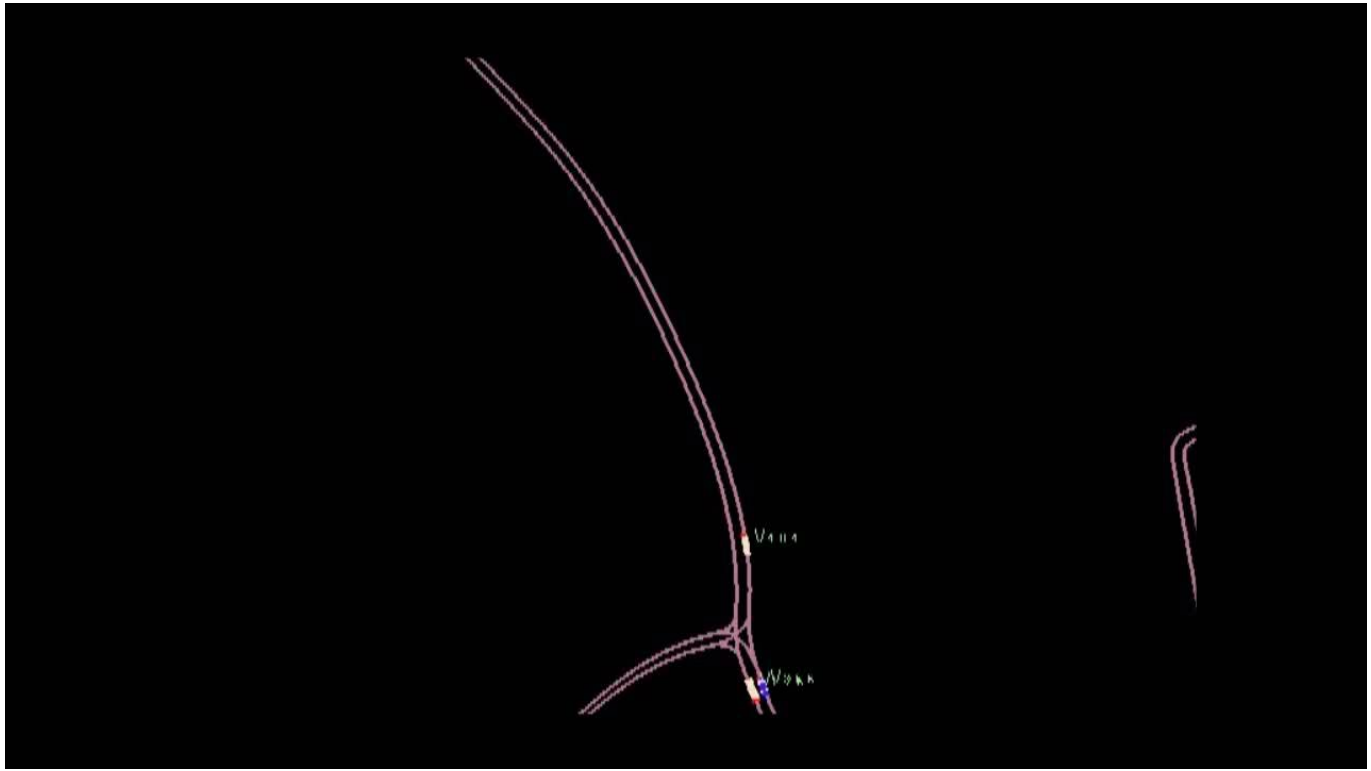
(Reference) Simulation Screen

B (local city): Joso City



(Reference) Simulation Screen

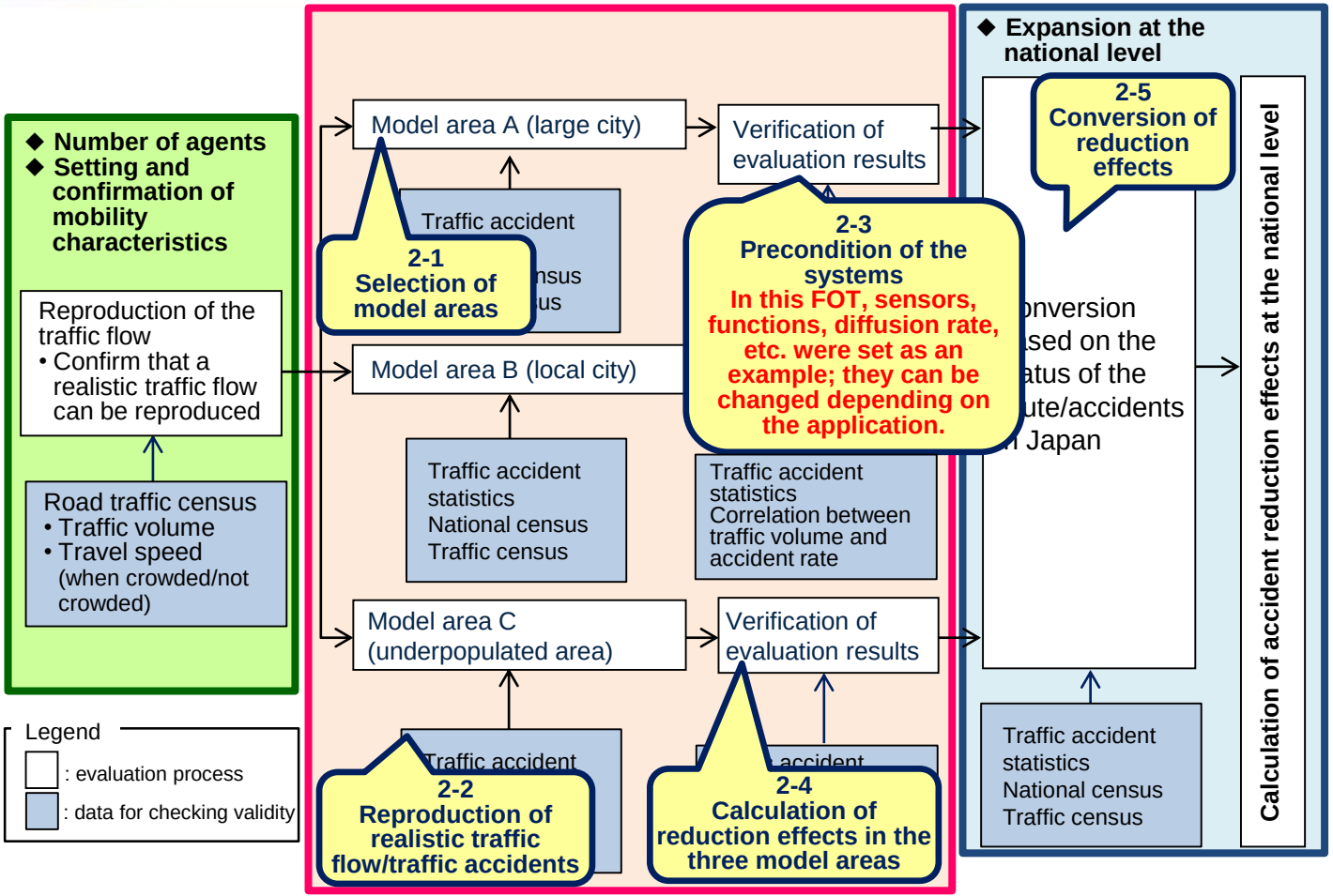
Accident reproduction: lane departure



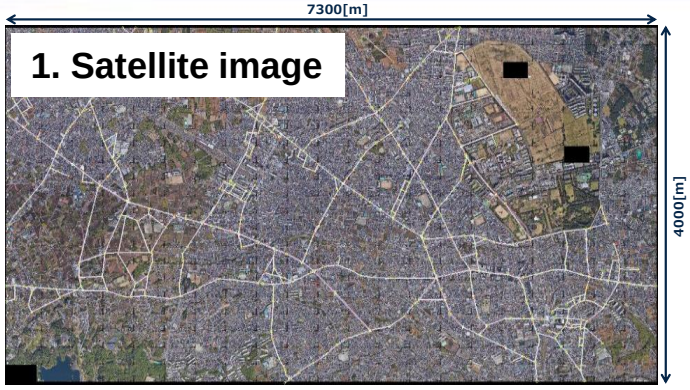
2

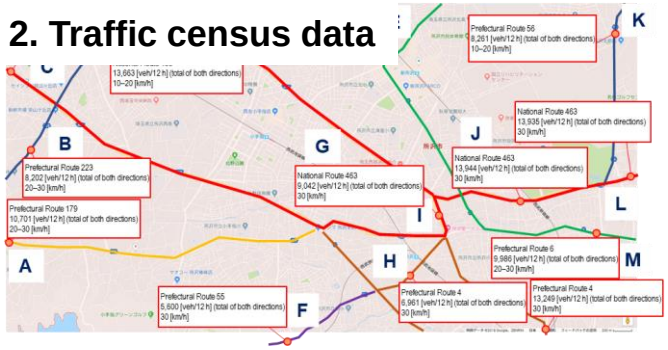
Process of Estimating the Effect of Automated Driving Systems

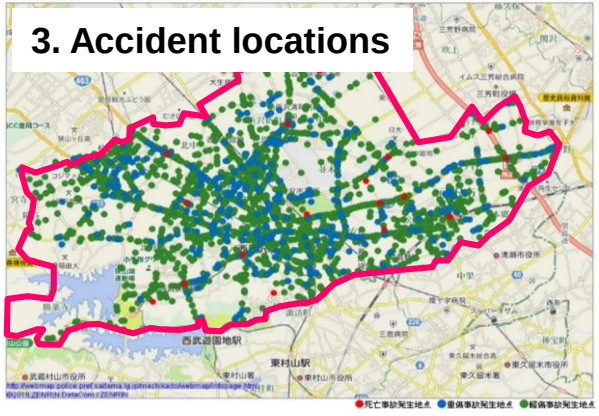
2. Validation and Calculation of Reduction Effects at the National Level

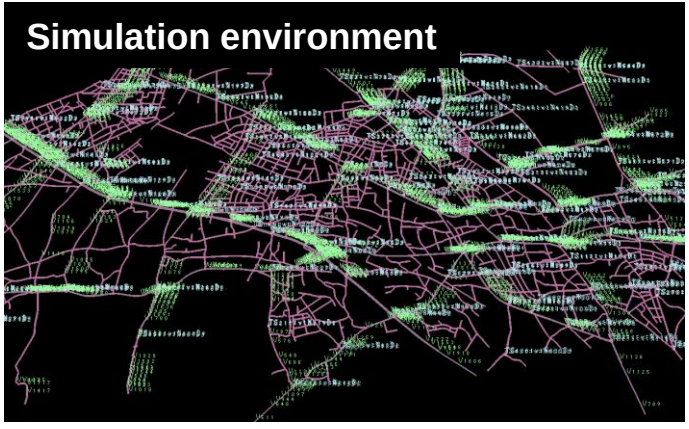


A (Large City)：Road Network and Traffic Flow in T City







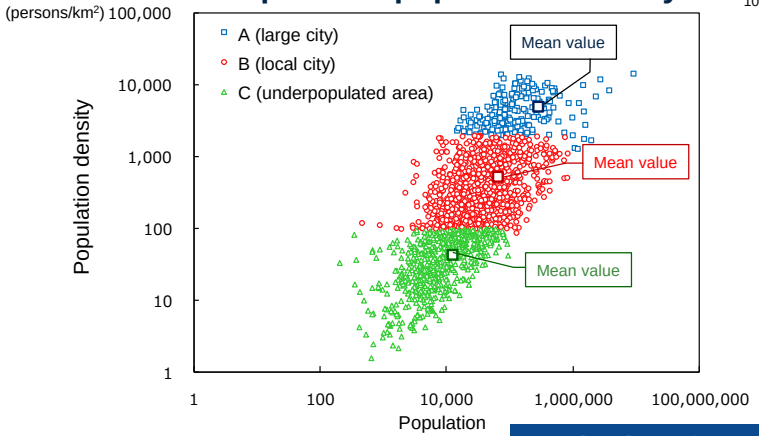


Build the main road network in each model city, and reproduce the traffic flow and traffic accidents

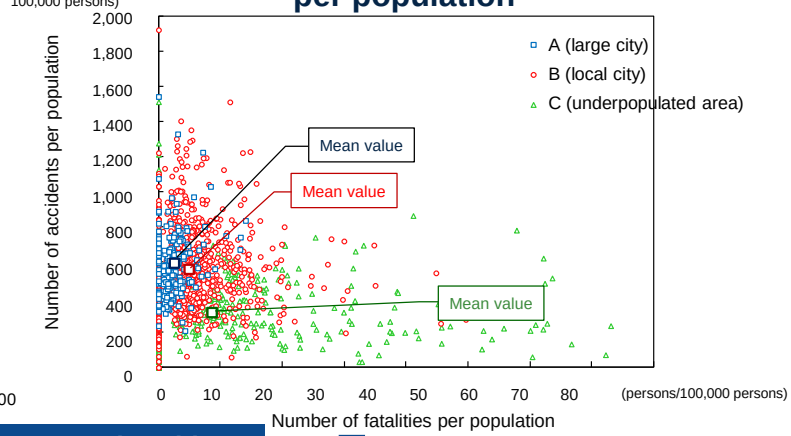
2.1 Selection of Model Areas for Predicting the Effects

◆Selection based on city size and status of accidents (mean value by area)

Population/population density



Number of accidents and fatalities per population



Selection of representative cities by city size and status of accidents by model area

Candidates of A (large city)

Prefecture	Municipality	Popu-lation	Population density
Saitama Prefecture	**T City**	**34.2**	**4,750**
Kanagawa Prefecture	H City	26.1	3,846
Saitama Prefecture	K City	32.3	5,411

Candidates of B (local city)

Prefecture	Municipality	Popu-lation	Population density
Yamaguchi Prefecture	S City	6.5	485
Ibaraki Prefecture*	**J City**	**6.5**	**529**
Nagano Prefecture	T City	6.2	518

Candidates of C (underpopulated area)

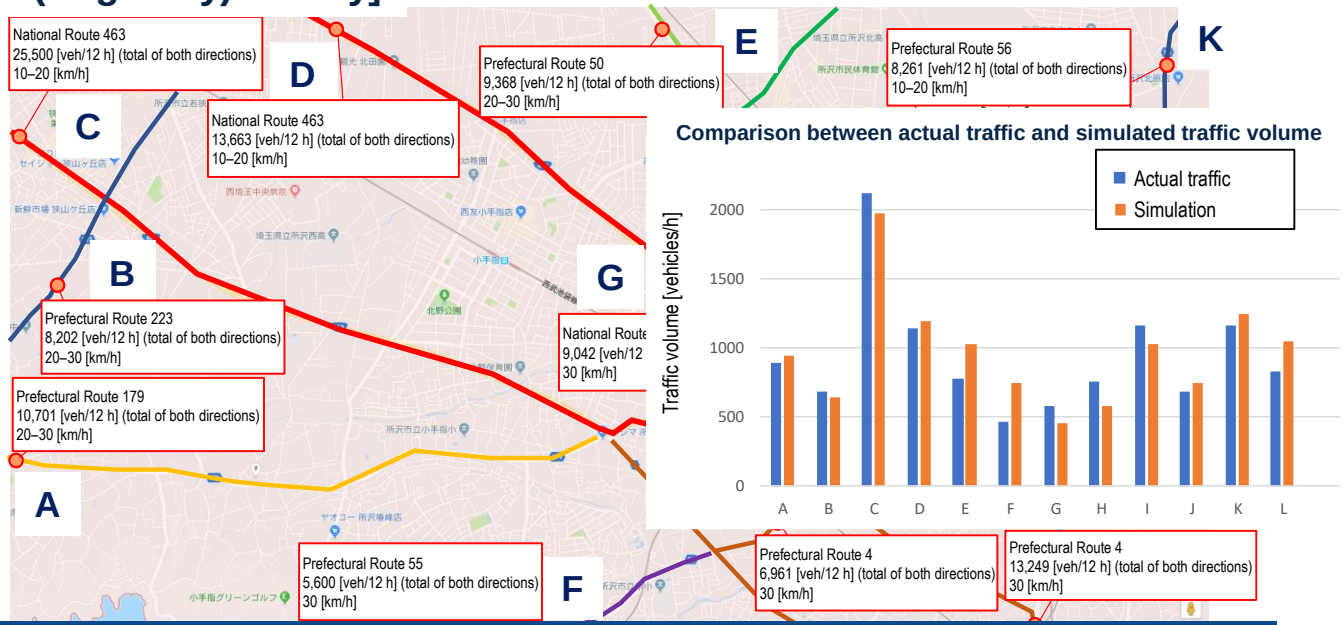
Prefecture	Municipality	Popu-lation	Population density
Aomori Prefecture	A Town	1.1	33
Nagano Prefecture*	**Y Town**	**1.4**	**51**
Akita Prefecture	G Town	1.1	49

- No statistical information for investigating accident locations was available for Yamaguchi and Aomori Prefectures. Thus, we selected Ibaraki and Nagano Prefectures for which statistical information was available.

2.2 Reproduction of Realistic Traffic Flow

Confirmation of reproducibility of traffic flow by using road traffic census data

[A (large city): T City]



We confirmed that the traffic flow, which reflected the characteristics of traffic volume of 12 hours during the daytime at the main points within the scope of the simulation, was reproduced.

Source: Ministry of Land, Infrastructure, Transport and Tourism: A national survey on the status of traffic on roads and streets – Summary sheet of a general traffic volume survey

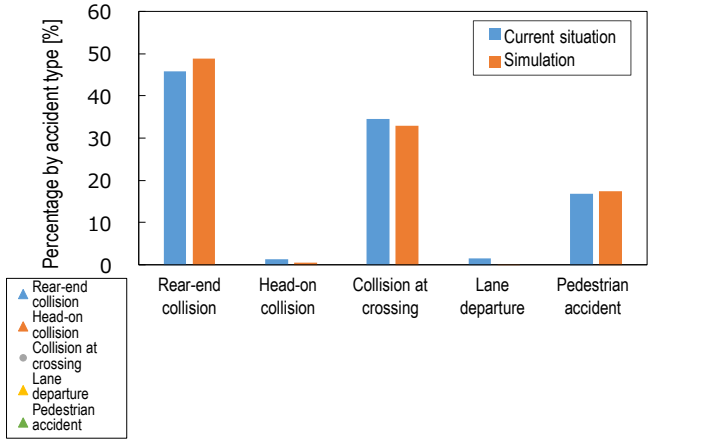
2.2 Reproduction of Realistic Status of Accidents

[A (large city): T City】

Traffic accident statistics (accident locations)

Simulation results (accident locations)

Comparison of percentage by accident type (five main types)



Confirmation of validity based on comparison between the accident locations in the traffic accident statistics (2015–2017) and the simulation results

Source: Saitama Prefectural Police: Crime/Accident map

2.3 Preconditions for Estimating the Effects (Diffusion Scenario)

Diffusion scenario

Six scenarios: current status (100% manual), overall diffusion rate 25%, 50%, 75%, and 100%

Scenario		0	1	2	3	4	5
Overall diffusion rate of the systems		Current status	25%	50%	75%	100%	Upper limit
Manual driving		100%	75%	50%	25%	-	-
Driving assist system	Warning/AEB (Level 1)	-	20%	20%	15%	10%	-
	Warning/AEB Cruise control/adaptive cruise control Lane keep (Level 2)	-	5%	20%	25%	15%	-
Automated driving system	Conditional automated driving (Level 3)	-	-	10%	25%	50%	-
	Advanced automated driving (Level 4)	-	-	-	10%	25%	100%

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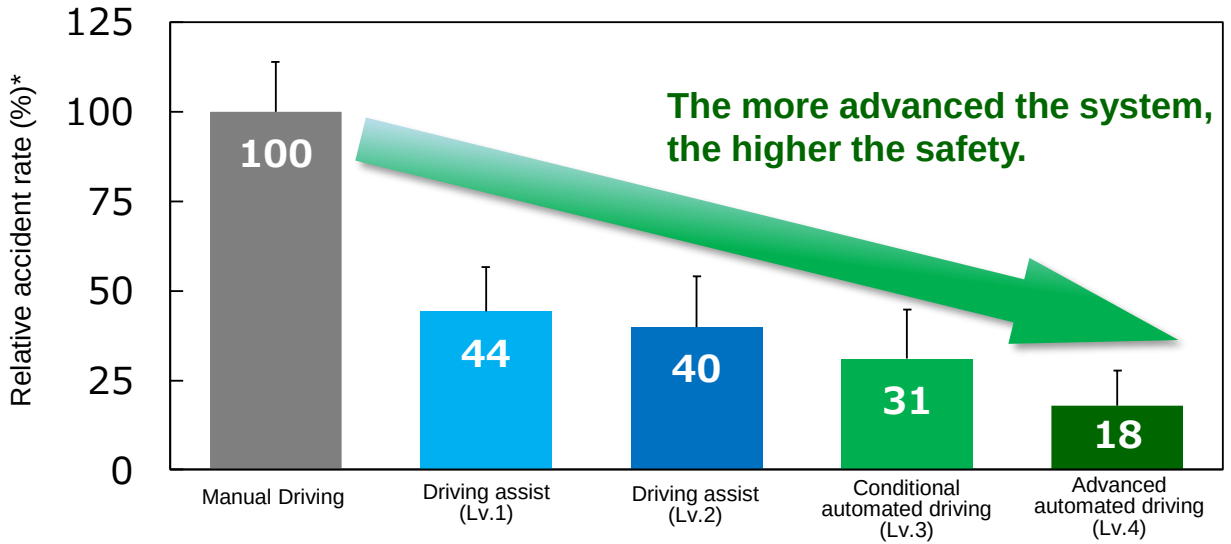
Calculation of the accident reduction effects in the diffusion scenario with both the driving assist and automated driving systems

Evaluation of Relative Accident Rate of Manual Driving and Various Systems



Evaluation of the safety of each system based on comparison with the accident rate of manual driving

- **Driving assist system: reduced by about 50–60%**
- **Automated driving system: reduced by about 70–80%**

Each system was safer than manual driving.

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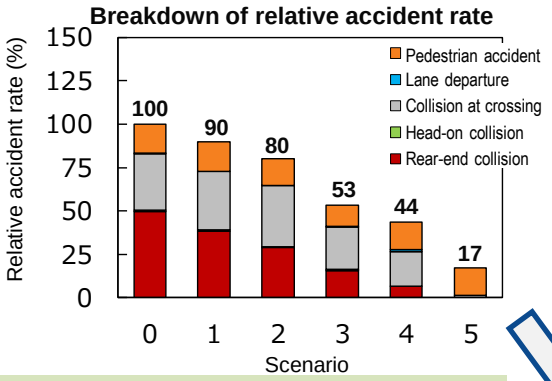
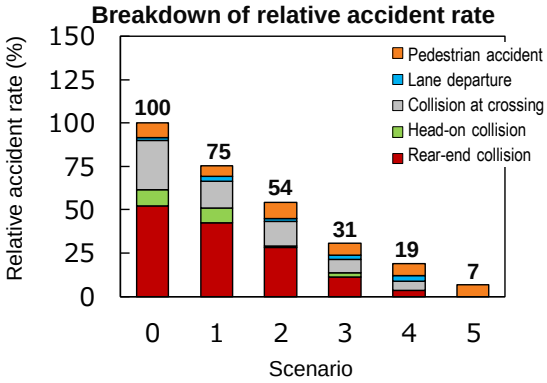
* The relative accident rate (%) was calculated based on the assumption that the accident rate of manual driving (i.e., total number of accidents/total mileage) in Scenario 0 (100% manual driving) is 100%.

2.4 Calculation of Traffic Accident Reduction Effects in Three Model Areas

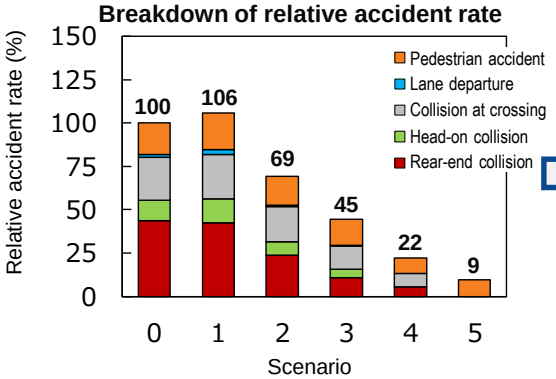
◆A (large city): T City



◆B (local city): J City



◆C (underpopulated area): Y Town

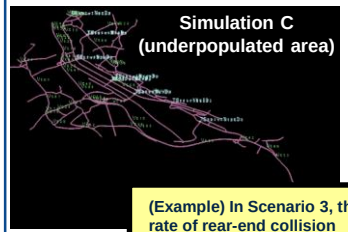


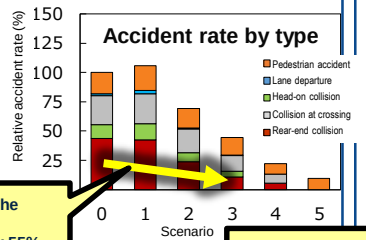
(1) The accident reduction coefficient was calculated for each diffusion scenario/accident type in each model area based on the simulation results.

(2) The calculated accident reduction coefficient was used to estimate the effects of reducing the number of accidents.

2.5 Conversion of Traffic Accident Reduction Effects

(1) Acquisition of accident reduction coefficient by accident type





(Example) In Scenario 3, the rate of rear-end collision accidents was reduced by 55%.

The accident data by municipality was compiled, and the position of the model city was checked.

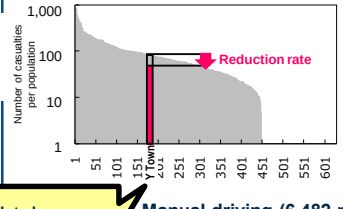
Log data analysis/injury evaluation

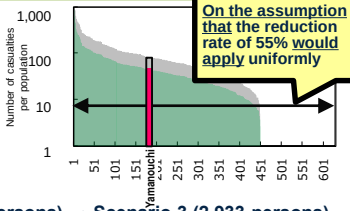
Accident rate (overall/by type) Injury risk

(Details: next page)

(2) Calculation of reduction effects using the accident reduction coefficient

C (underpopulated area): Reduction effects of rear-end collision accidents in Y Town





On the assumption that the reduction rate of 55% would apply uniformly

Manual driving (6,482 persons) → Scenario 3 (2,933 persons)

Reduction of casualties by 3,549

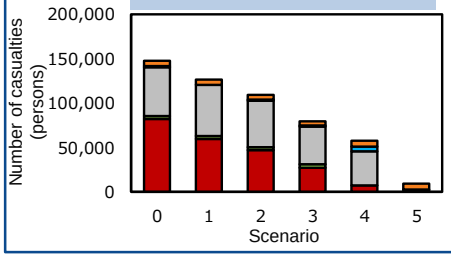
Reduction effects by area/accident type

Number of accidents Number of fatalities Number of injured persons

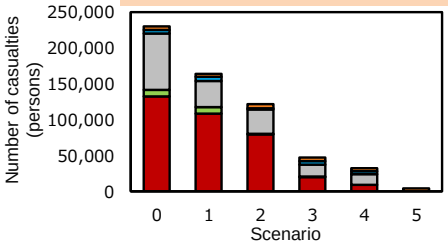
Number of casualties

(3) Estimation of accident reduction effects at the national level

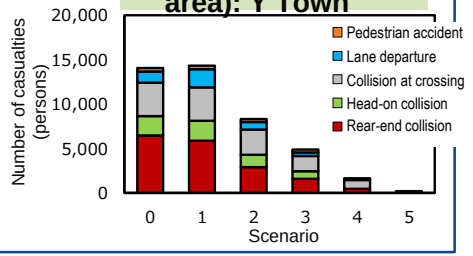
A (large city): T City



◆B (local city): J City



C (underpopulated area): Y Town



Integration of the reduction effects in Areas A, B, and C for finalization

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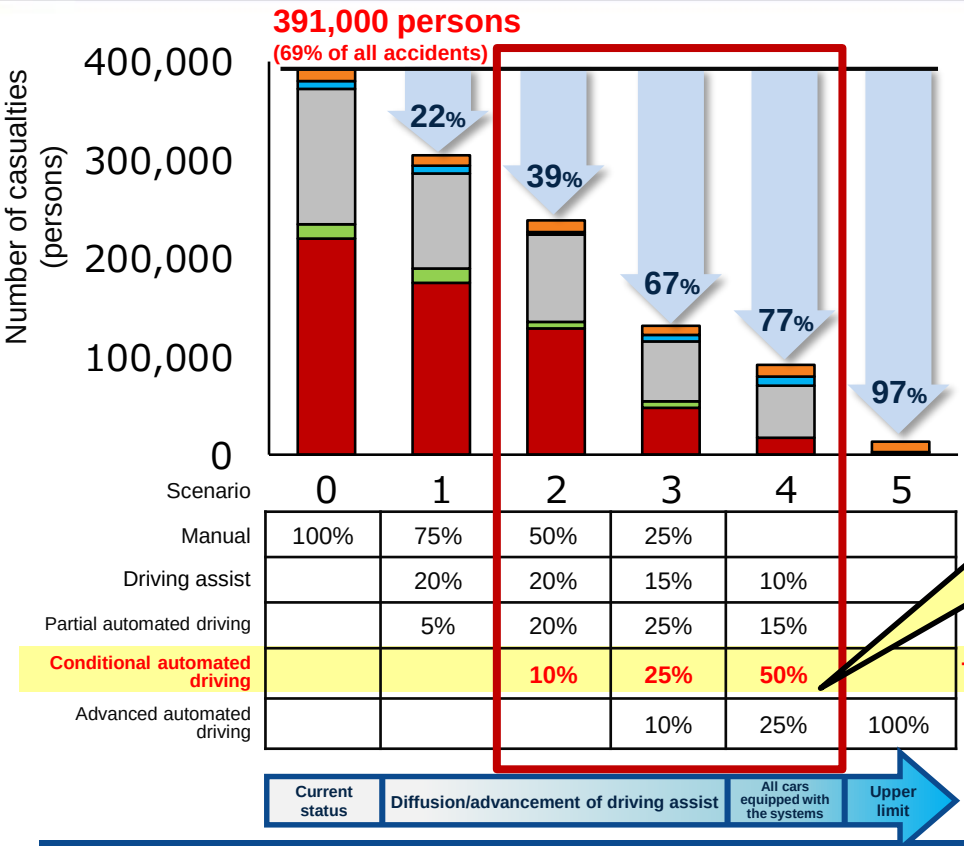
Results of Estimating the Accident Reduction Effects at the National Level

3. Summary of Traffic Accident Reduction Effects at the National Level



Scenarios 2, 3, and 4

It is necessary to take into account the impact in case the driver does not take over properly.

There may be a negative impact.

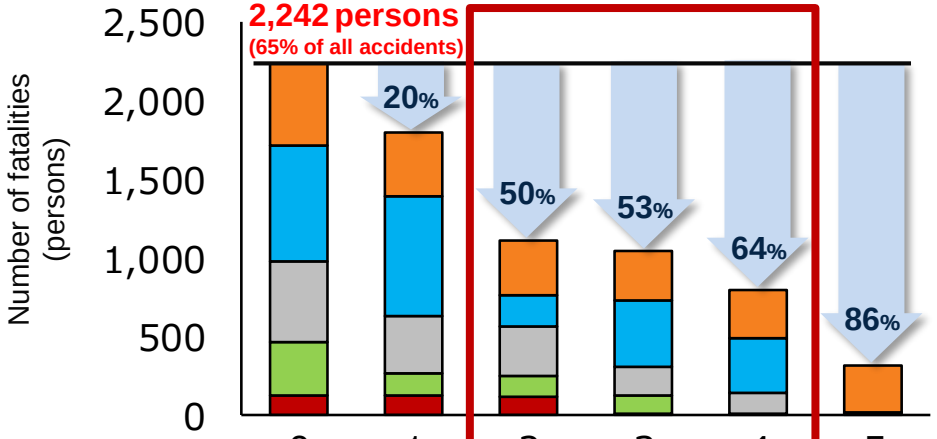
It was confirmed that the reduction effects at the national level can be calculated validly on condition that various automated driving systems diffuse in stages

* The trial calculation results were obtained based on specific conditions. To ensure the stability of the results, it is necessary to conduct simulations for a longer period.

3. Summary of Traffic Accident Reduction Effects at the National Level

Number of casualties

Number of fatalities



Scenario	0	1	2	3	4	5
Manual	100%	75%	50%	25%		
Driving assist		20%	20%	15%	10%	
Partial automated driving		5%	20%	25%	15%	
Conditional automated driving			**10%**	**25%**	**50%**	
Advanced automated driving				10%	25%	100%

Scenarios 2, 3, and 4

It is necessary to take into account the impact in case the driver does not take over properly.

There may be a negative impact.

Current status → Diffusion/advancement of driving assist → All cars equipped with the systems → Upper limit

It was confirmed that the reduction effects at the national level can be calculated validly on condition that various automated driving systems diffuse in stages

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* The trial calculation results were obtained based on specific conditions. To ensure the stability of the results, it is necessary to conduct simulations for a longer period.

4

Summary

4. Summary

- **Development of multi-agent traffic simulation and calculation of reduction effects**

  We selected three model areas and verified that the actual traffic flow and traffic accidents can be reproduced.
  We confirmed that the accident reduction effects can be estimated at the national level, using an example in which various automated driving systems are diffused in stages.
  The tool can calculate the effects by changing the preconditions for different applications as appropriate, and is expected to be used for various purposes.

- **Future usage**

  We will investigate the needs and make proposals for usage to promote utilization in respective fields.

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Thank you