

NISSAN MOTOR CORPORATION



Autonomous Drive in NISSAN

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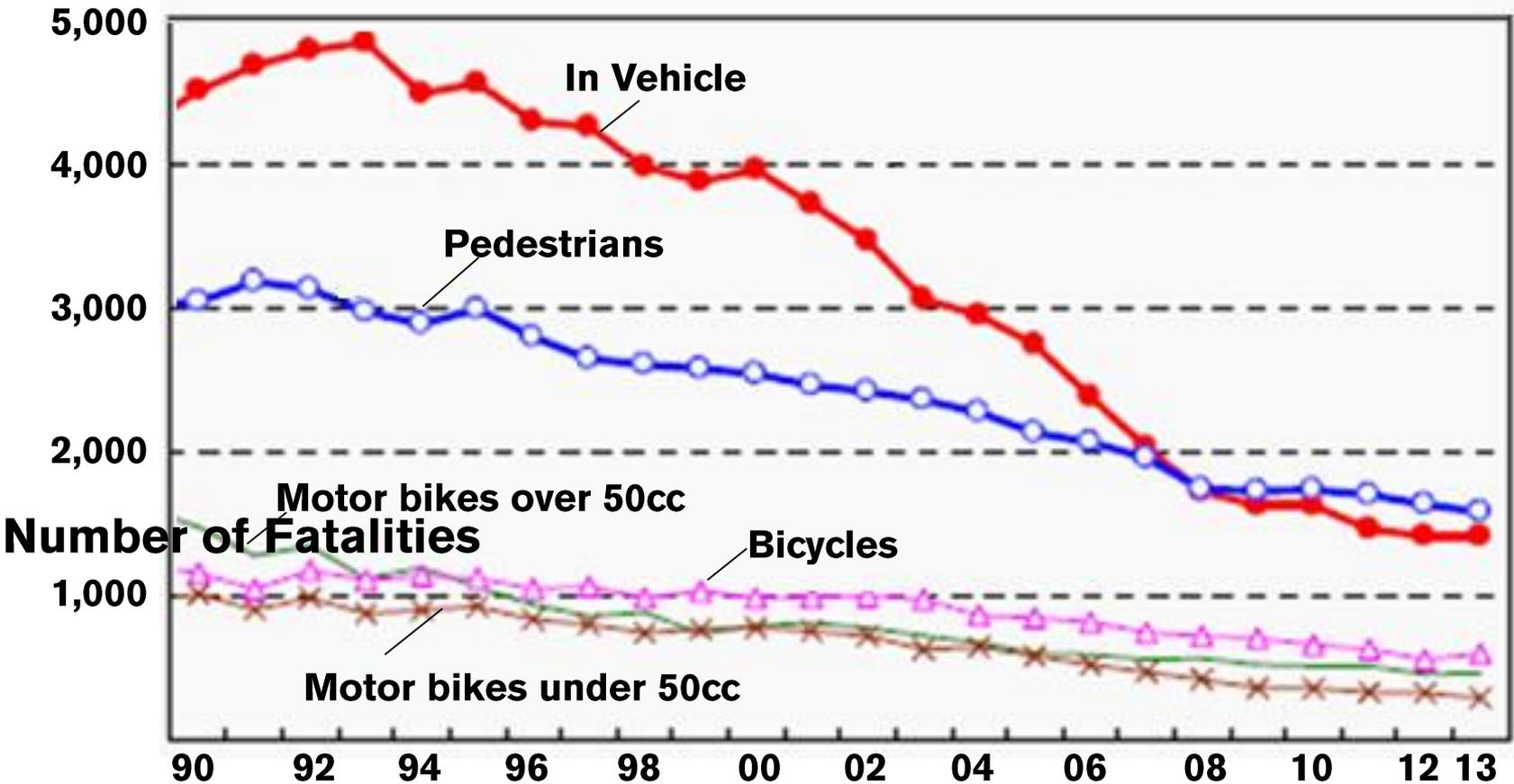
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- Environmental and Safety Technologies
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1. Background

Fatalities change of each mobility

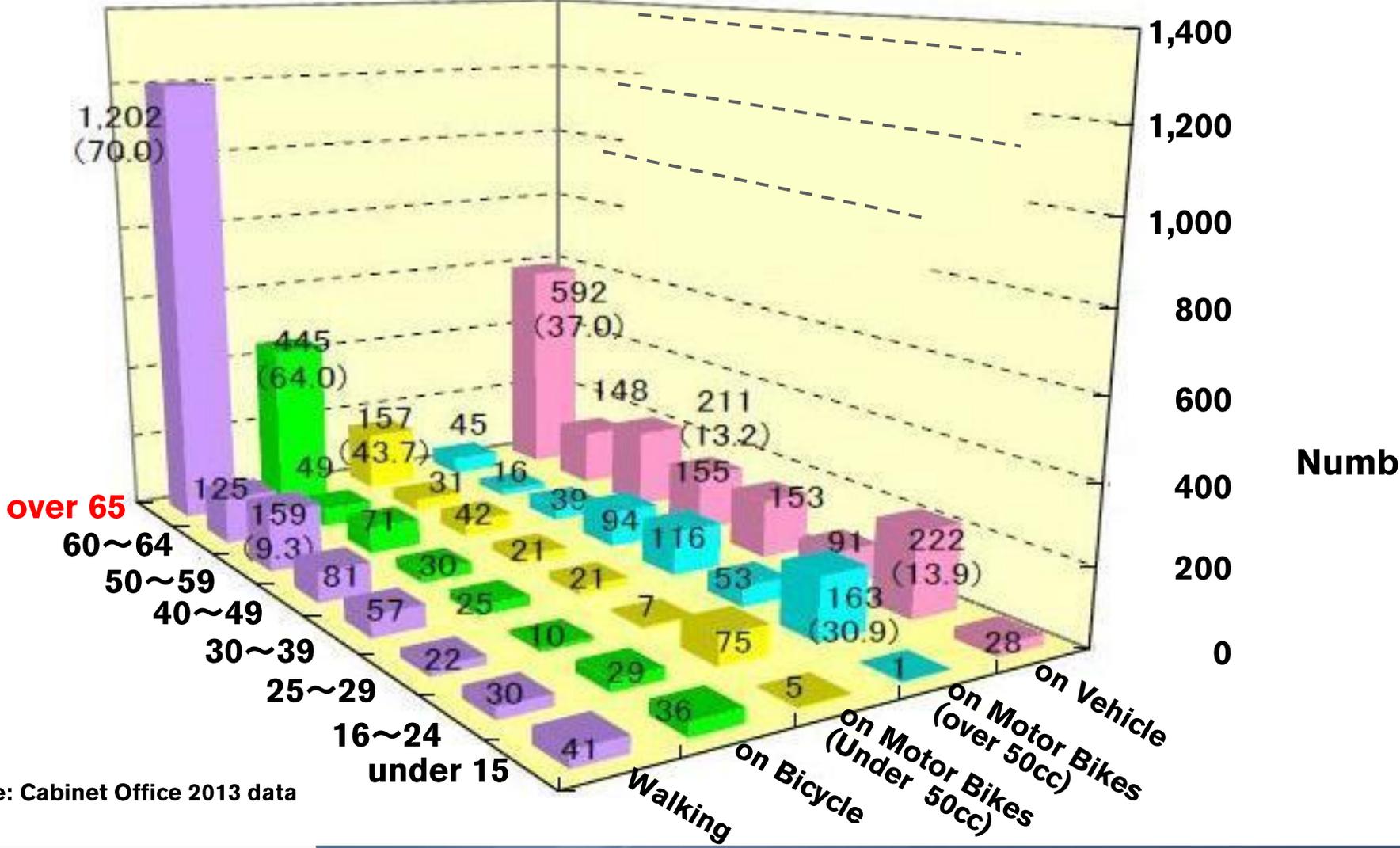
- Fatalities of pedestrian are now higher than those in vehicles.
- Fatalities reduction is levelling out.
- Fatalities especially for elderly people in vehicle have begun to increase.



Source: National Police Agency 2013 data

Fatalities change by each generation & mobility

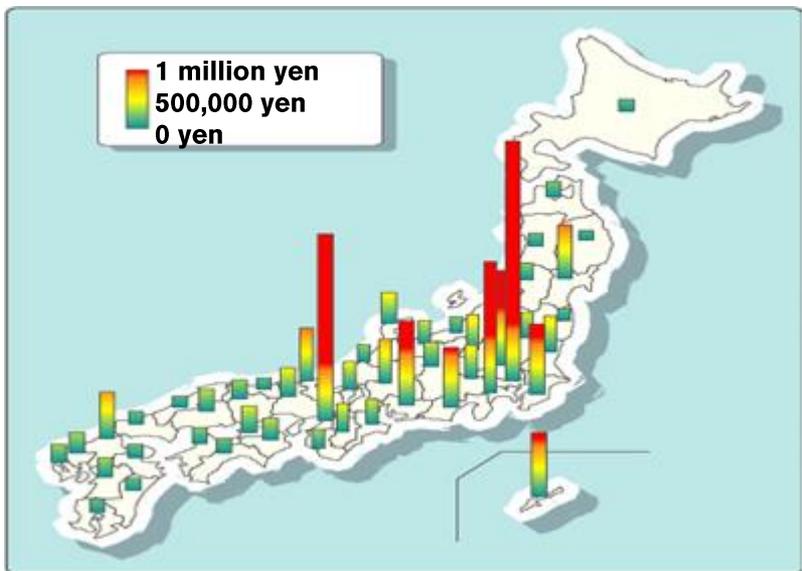
■ The fatality rate of pedestrian/bicycles/driver of elderly people is extremely high.



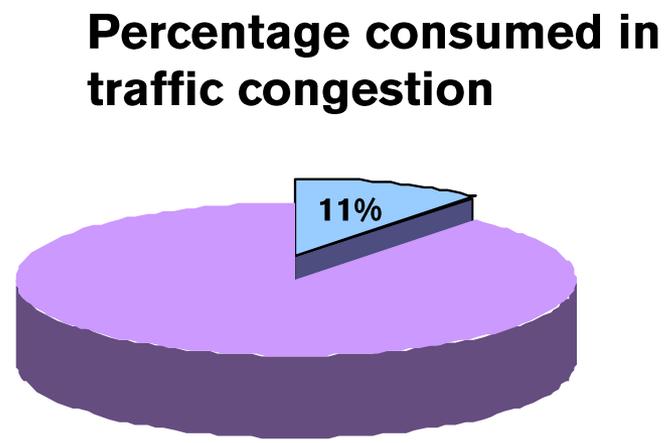
Source: Cabinet Office 2013 data

Government's Goal for Smooth Traffic

- A 50% reduction in traffic jam by 2020 compared with 2010.
- We are having huge economic loss from traffic congestion.
 - Economic loss from traffic congestion 12 trillion yen/year
 - Fuel consumption by vehicles 11% consumed in traffic congestion



Amount of loss due to traffic congestion
Measures to Ease Traffic in Metropolitan Areas, Ministry of Land, Infrastructure and Transport, 2003



Fuel consumption by vehicles

Source: Energy Conservation Center, Japan

2. Nissan Systems

Nissan's Autonomous Drive Prototype

- Nissan full EV, LEAF, is used for autonomous drive prototype.



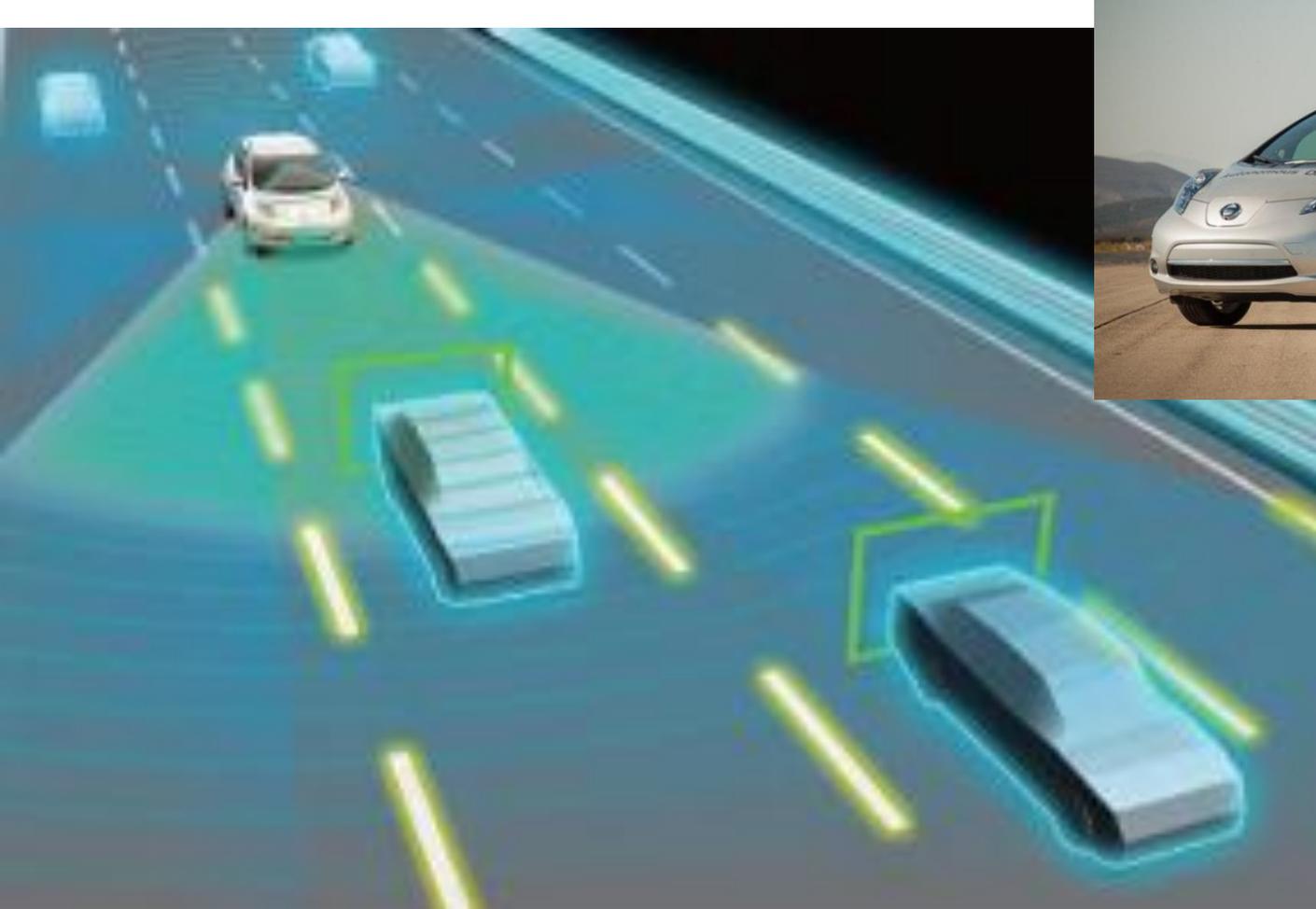
**Autonomous Driving on Highway
and Parking**



Autonomous Driving in City

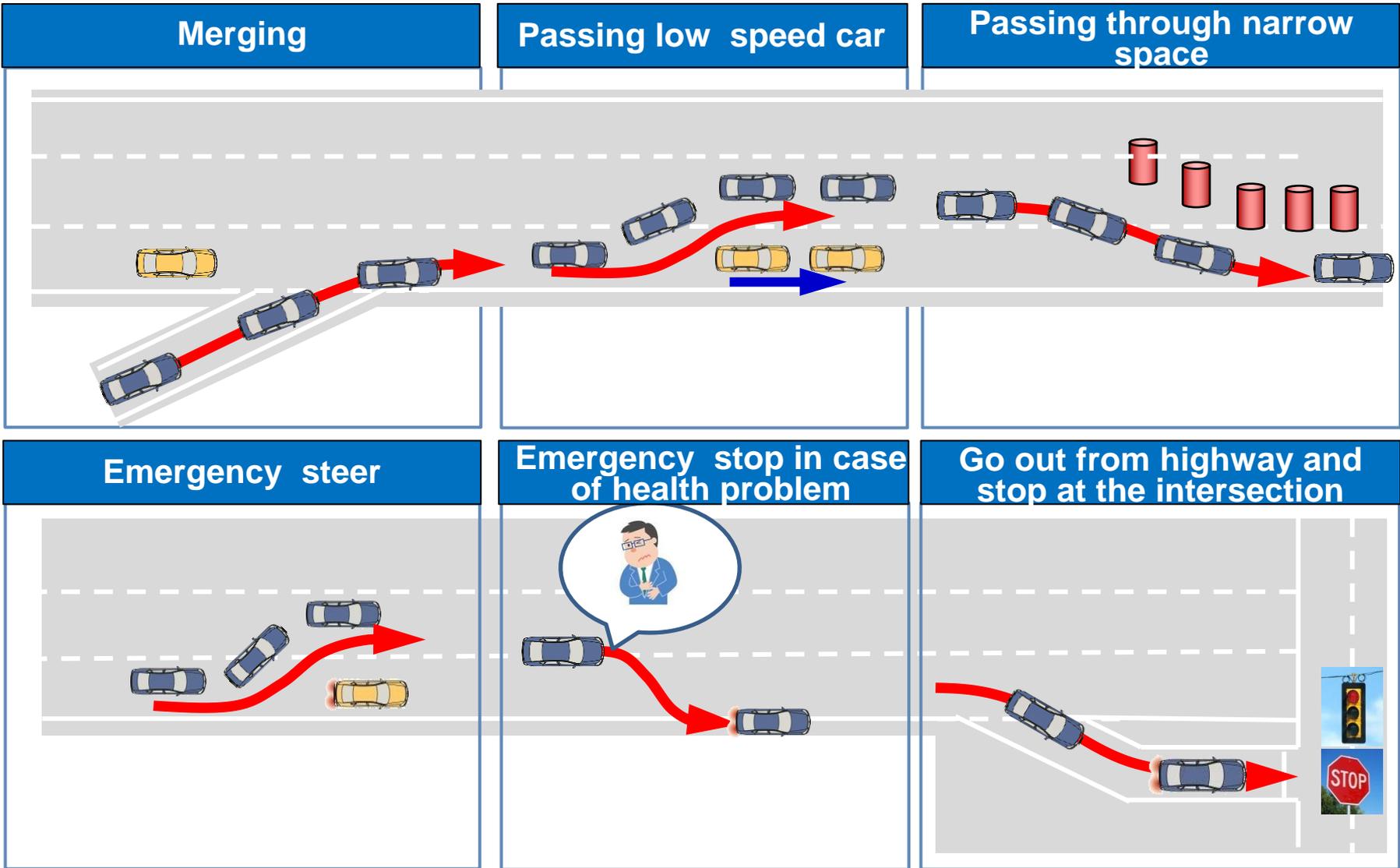
Autonomous Drive on Highway

- The system recognize lane, traffic condition around the vehicle, traffic sign and traffic signal.
Vehicle runs autonomously by calculating suitable route.



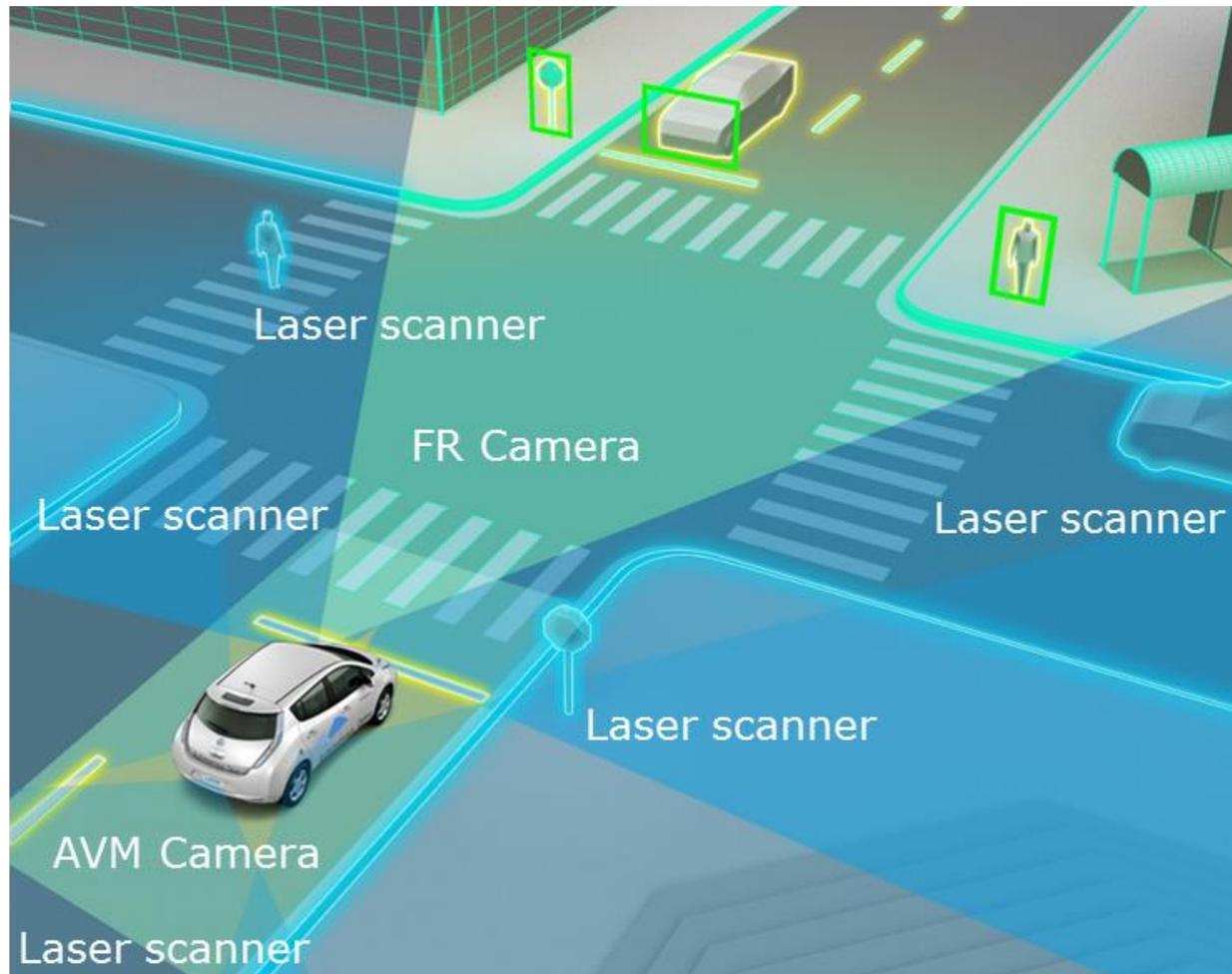
Autonomous Drive on Highway

■ System provides a support at 6 stressful driving scenes.



Autonomous Drive in City

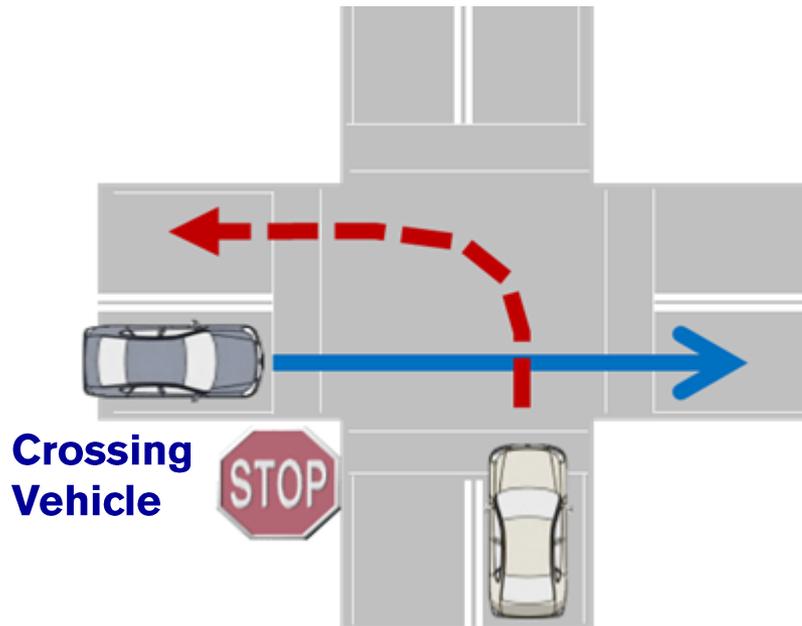
- System has been developed for the city scenes such as intersection, stop signs, parked cars, on-coming cars, etc..



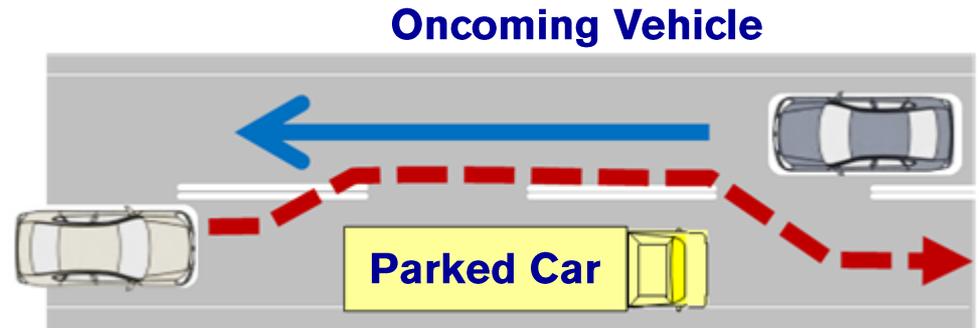
Autonomous Drive in City

- Advanced AI logic reads the movement of the obstacles on the road especially in 2 difficult scenes below.

Driving through Intersection



Overtaking a Parked Car



Video



**Autonomous Driving on Highway
and Parking**



Autonomous Driving in City



Perception

- Camera may have better perception than human eyes in some cases.



The camera can recognize small changes at high speed like slow-motion

Judgment

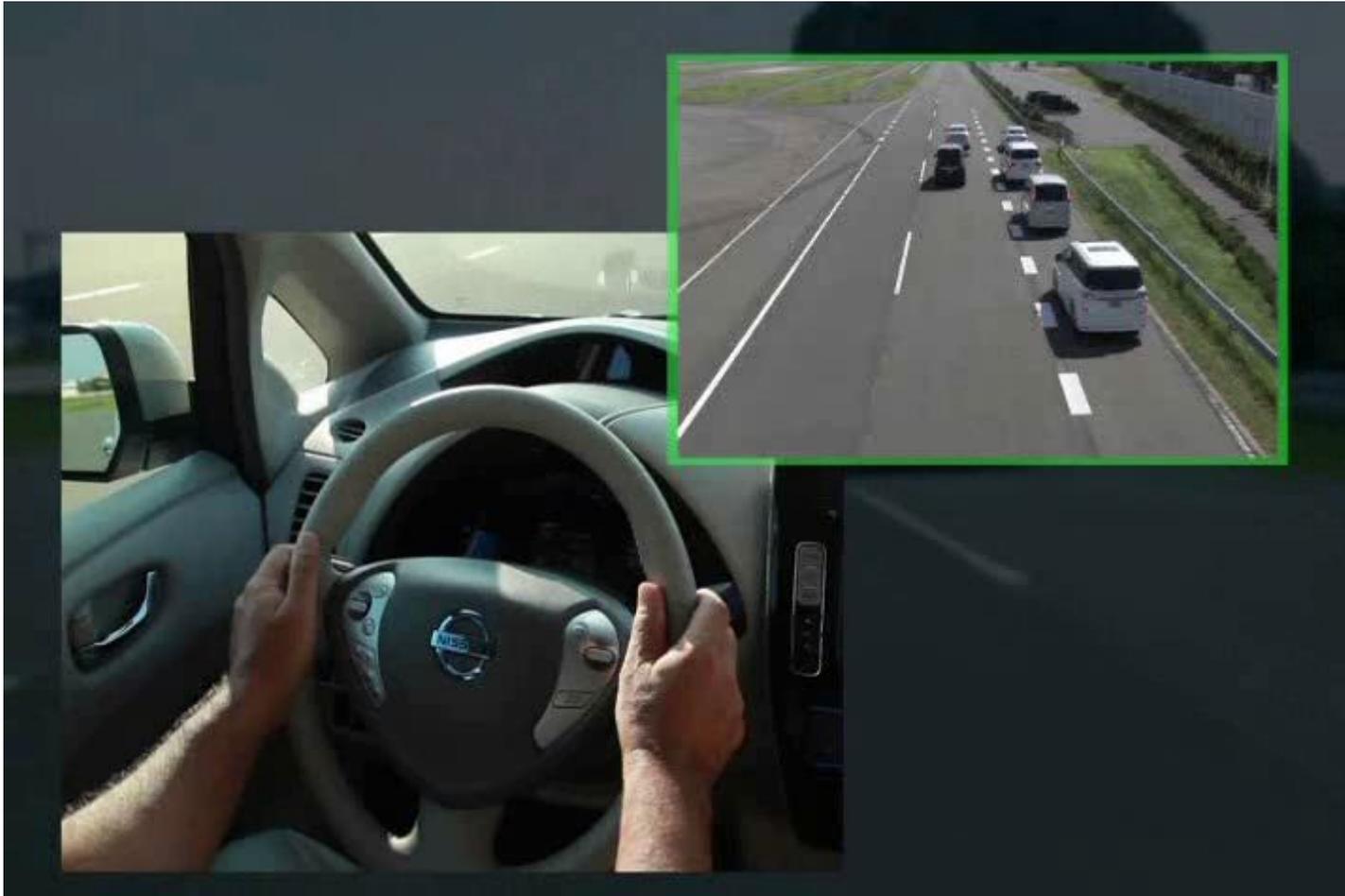
- In order to recognize objects, camera may make a better judgment than human eyes in some cases.



The camera can recognize multiple moving objects at the same time

Response and Operation

- System can react more precisely and quickly than human eyes.



Precise and quick reaction.

Announcement

By the end of 2016

Nissan will make available the next two technologies under its autonomous drive strategy.

- (1) a traffic-jam pilot, a technology enabling cars to drive autonomously and safely on congested highways.**
- (2) fully-automated parking systems available across a wide range of vehicles.**

In 2018

Multiple-lane controls, allowing cars to autonomously negotiate hazards and change lanes.

By the end of 2020

Intersection-autonomy, enabling vehicles to negotiate city cross-roads without driver intervention.”

3. V2X support for Autonomous Drive

V2X for Autonomous Drive

- V2I is expected for autonomous driving.
Stand alone basically.

V2I is also expected at the following driving scenes, if possible.
Merging vehicle info.,
Road surface condition ahead, Traffic jam and accident,
so on



Source: Ministry of Land, Infrastructure, Transportation and Tourism AUTO PILOT Committee 2013

Dynamic Map for Autonomous Drive

■ Proposal of DM (Dynamic Map) for Autonomous Drive

<Drive Route>

Create detailed drive route based on precise map information and traffic regulation information

<Position Accuracy>

Recognize accurate vehicle position by comparing GPS with DM

<Vehicle Surrounding Condition>

Grasp vehicle surrounding condition by combination of map and traffic / road information

by Public & Private sectors collaboration.

DM Hierarchical Structure

- Many kinds of information should be included in DM (Dynamic ↔ Static)

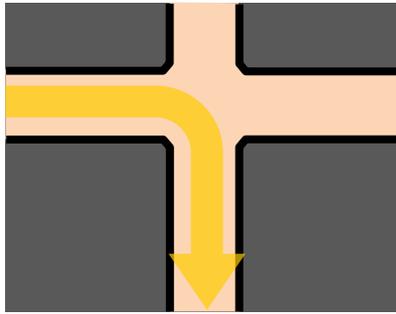
DM Hierarchical Structure

Dynamic < 1 sec	Vehicle current position Surrounding vehicles / pedestrians... Traffic signal info.
Semi Dynamic < 1 min	Traffic accident info. Traffic congestion info. Local weather info.
Semi Static < 1 hour	Traffic regulation info. Road works info. Wide area weather info.
Static < 1 month	Traffic signal / Landmark position (3D) Road location / traffic sign position (3D) Road section ID / Intersection ID Road shape (Local roads) Road shape (Main roads)

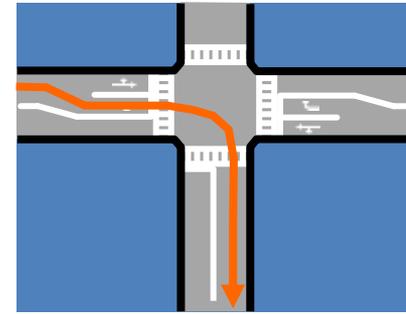


DM Usage Example 1

- Create detailed drive route based on precise map information and traffic regulation information.

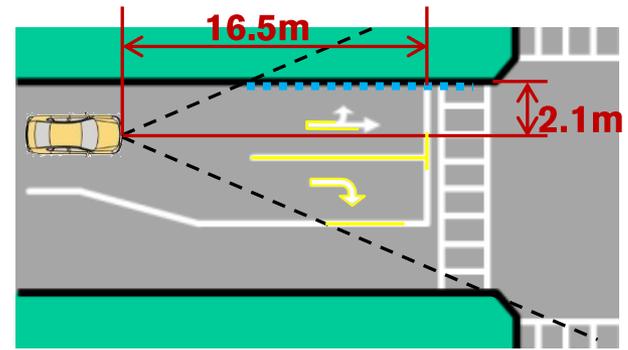
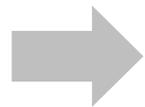
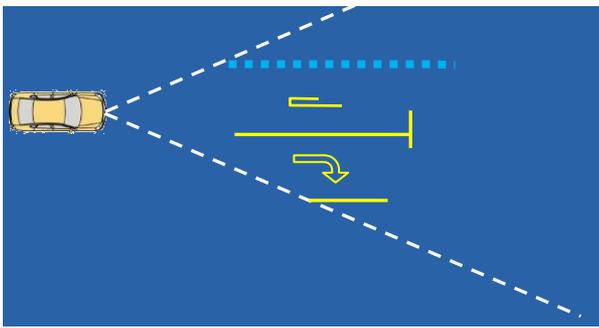


**Car Navigation
Route Guide**



**Autonomous vehicle
Drive Route**

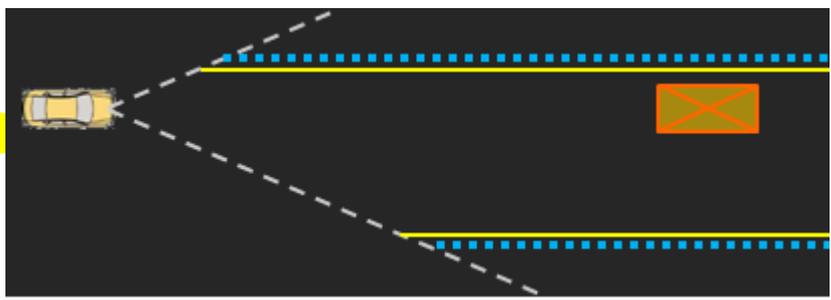
- Recognize accurate vehicle position by comparing GPS with DM.



DM Usage Example 2

- Grasp vehicle surrounding condition by combination of map and traffic / road information.

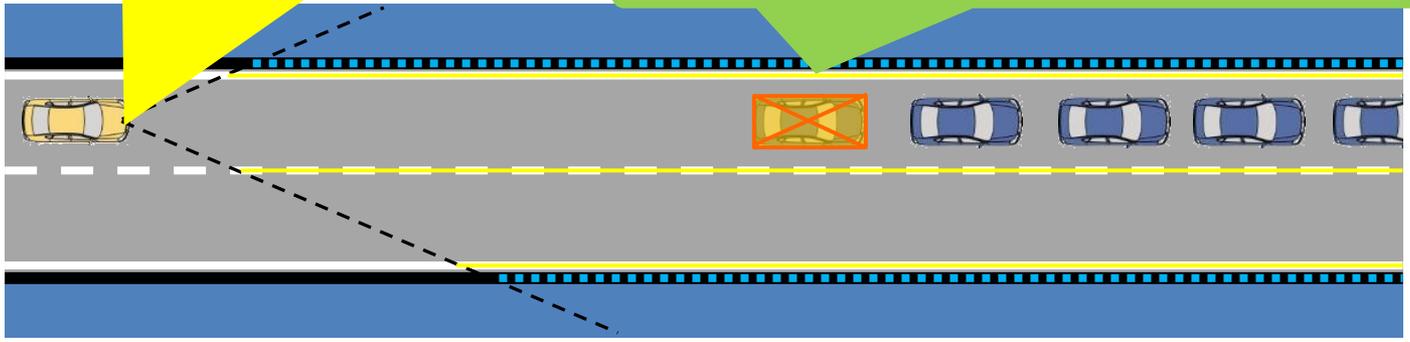
System cannot know a vehicle ahead is parking or in the end of queue



System understand a vehicle ahead is in the end of queue. Never overtake this car.



Traffic Jam! End of queue is here!



Enhancement of Outside Condition Sensing

- Get more reliable outside information by double source, map and on-board sensors.

		By DM Including V2X	By on-board sensors
Dynamic < 1 sec	Vehicle current position Surrounding vehicles / pedestrians... Traffic signal info.	(✓) ✓ ✓	✓ ✓ ✓
Semi Dynamic < 1 min	Traffic accident info. Traffic congestion info. Local weather info.	✓ ✓ ✓	(✓) (✓)
Semi Static < 1 hour	Traffic regulation info. Road works info. Wide area weather info.	✓ ✓ ✓	
Static < 1 month	Traffic signal / Landmark position (3D) Road location / traffic sign position (3D) Road section ID / Intersection ID Road shape (Local roads) Road shape (Main roads)	(✓) (✓) ✓ (✓) ✓	✓ ✓ ✓ ✓

4. Summary

Summary

- **Nissan will launch vehicles which have advanced autonomous drive technologies.**
- **Developed technology will be used not only for realizing autonomous drive but also for enhancing the existing driver assistance systems in order to help solve problems as a result of motorization.**

Thank you for your attention

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