Dynamic Map

September 11, 2014

Masao FUKUSHIMA

NISSAN MOTOR CO.,LTD

Cross-ministerial Strategic Innovation promotion Program (SIP)

Dynamic Map for Autonomous Drive

- **Proposal of DM (Dynamic Map) for Autonomous Drive**

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

  - Recognize accurate vehicle position by comparing GPS with DM

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

by Public & Private sectors collaboration.

DM Hierarchical Structure

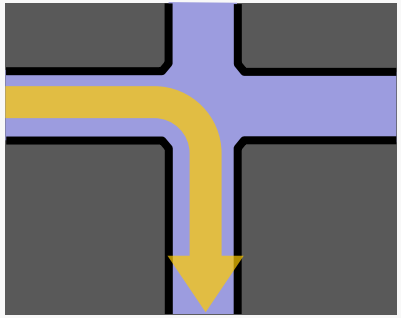
- **Many kinds of information should be included in DM (Dynamic ⇔ Static)**

DM Hierarchical Structure

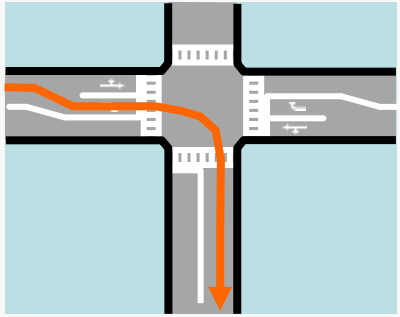
Dynamic < 1 sec	Vehicle current position Surrounding vehicles / pedestrians… Traffic signal info.
Semi Dynamic < 1 min	Traffic accident info. Traffic congestion info. Local weather info.
Semi Static < 1 hour	Traffic regulation info. Road works info. Wide area weather info.
Static < 1 month	Traffic signal / 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.**

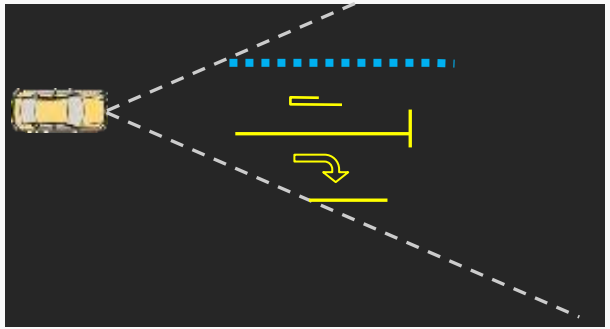


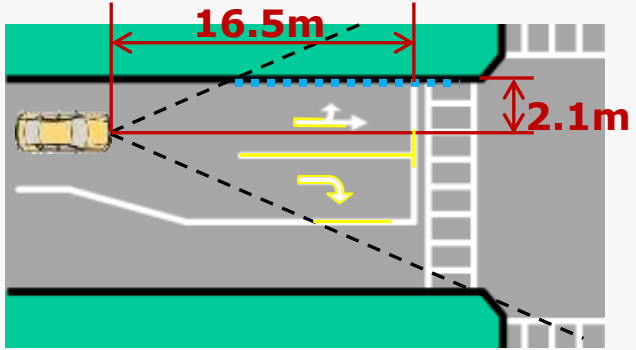
Car Navigation
Route Guide



Autonomous vehicle
Drive Route

- **Recognize accurate vehicle position by comparing GPS with DM.**

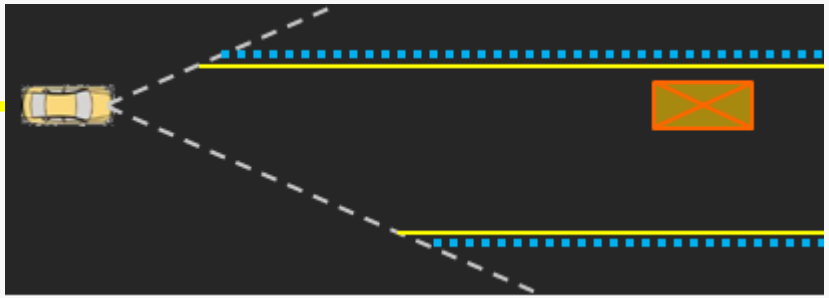




DM Usage Example 2

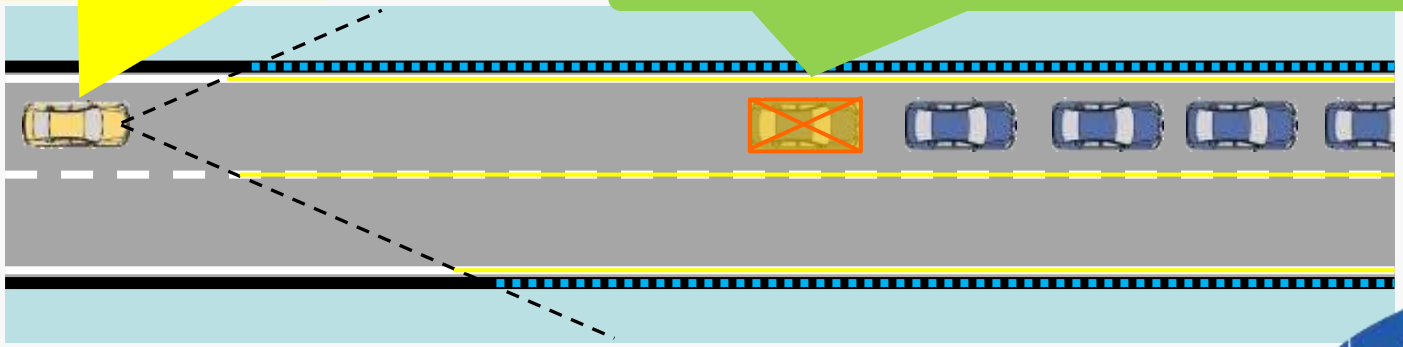
- **Grasp vehicle surrounding condition by combination of map and traffic / road information.**

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!



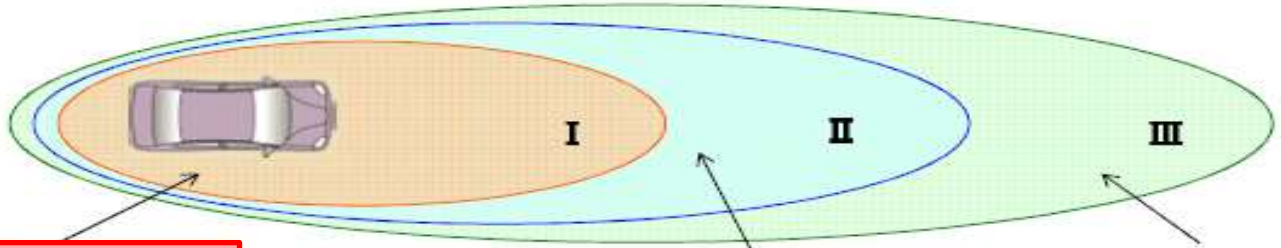
Enhancement of Outside Condition Sensing

- **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)	✓	✓

Proper Information

- **Outside data sources are used properly depending on the distance from the autonomous vehicle.**

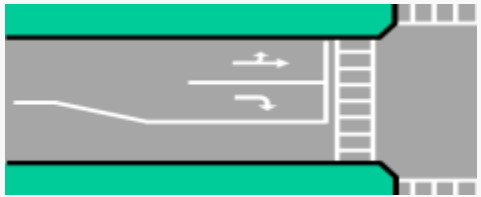


Lane Keep
Distance Control
Collision Avoidance

Traffic Light Following
Speed Adaptation for
Smooth Traffic Flow

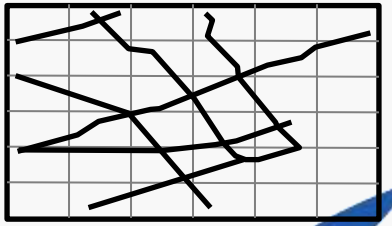
Route Planning
Detour Taking
Congestion Avoidance

Geometrical Data



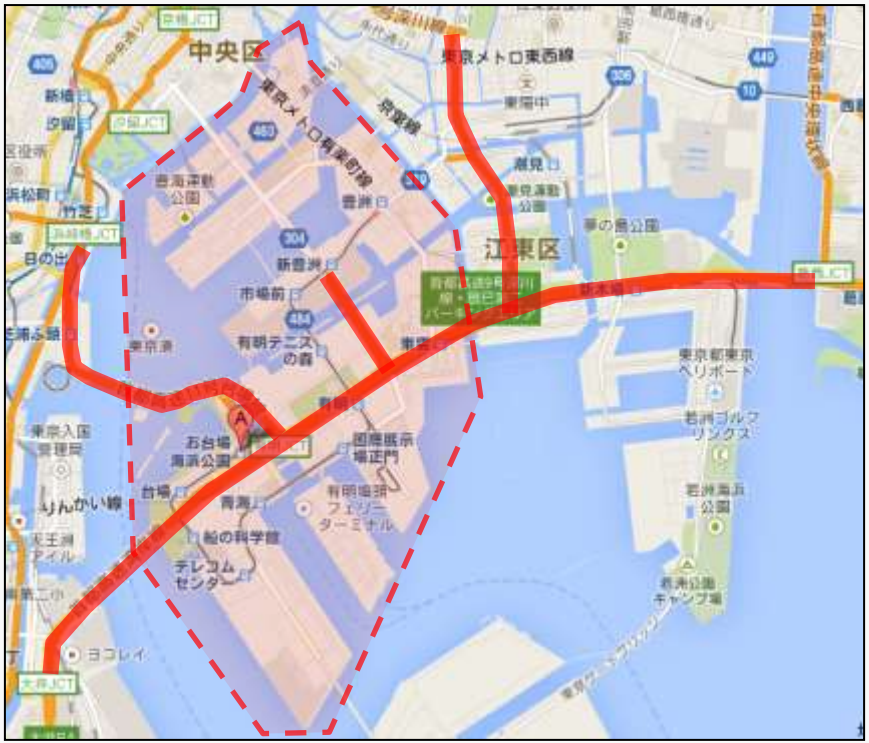
	Area Ⅰ	Area Ⅱ	Area Ⅲ
Distance	Near		Far
Precision	Fine		Coarse
Time	Present		Future

Topological Data



DM Prototype

- **DM prototype will be prepared and tested by end of this fiscal year. (March 2015) The test result is reflected to the first version of DM specification.**

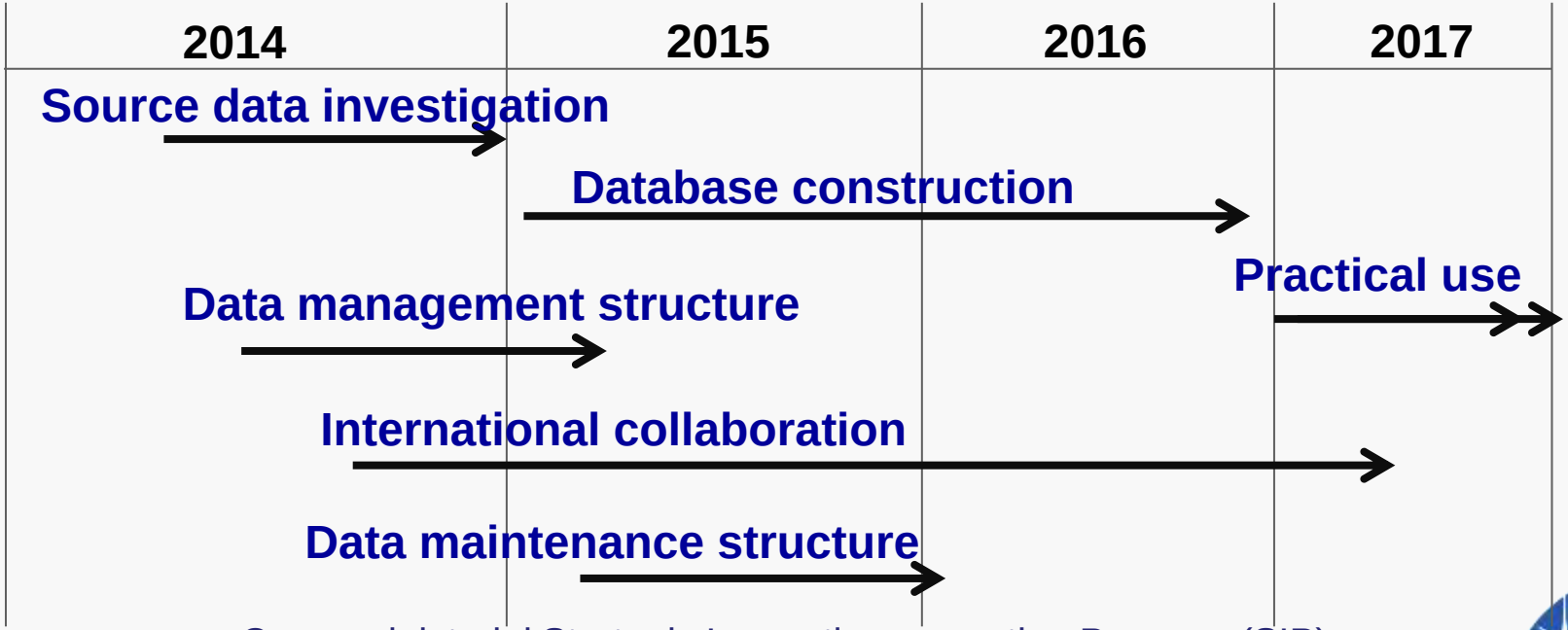


Test area includes,

busy traffic on ordinary road,
busy intersections,
shopping streets,
express ways,
several highway interchanges,
tall (ETC) gates.

Schedule

- **Public & Private sectors collaboration has already started.**
  - **2014: Preliminary investigation phase**
  - **2015-16: Development phase**
  - **2017: Practical use**



Summary

- **In order to realize highly smarter autonomous drive, map data-base having not only static information but also dynamic information is necessary.**

- **Public & Private sectors collaboration has already started. DM (Dynamic Map) hierarchical structure has been under discussion.**

- **Expected schedule is as follows,**

  2014: Preliminary investigation phase
  2015-16: Development phase
  2017: Practical use

Thank you for your attention.

Masao FUKUSHIMA

masao-f@mail.nissan.co.jp