

InternetCAR

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Background and Motivation

- “Give and Take” basis helps society.
 - ➔ Automobile has more than one hundred sensors.
 - ➔ If we can collect these data, useful information can be provided.
 - ➔ This kind of application is called as **Probe Car/Floating Car** system
- Frontline base is necessary in emergency situation.
 - ➔ Automobile can move, has battery, can bring heavy/large equipments.
 - ➔ “Communication” is most important capability.

Internet supports Automobiles

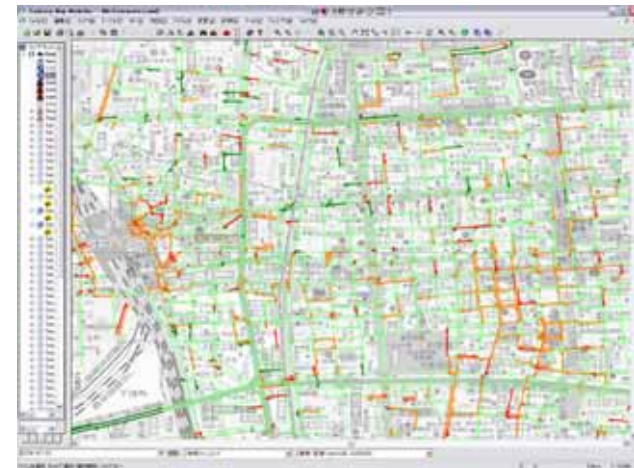
- **Various Services, Various Value**

- **Driver/Passenger**

- Driving Assist (Safety, Routing)
- Amusement (Music, Movie, Communication...)
- Payment (Toll Gate, Drive-through...)
- Remote Diagnosis

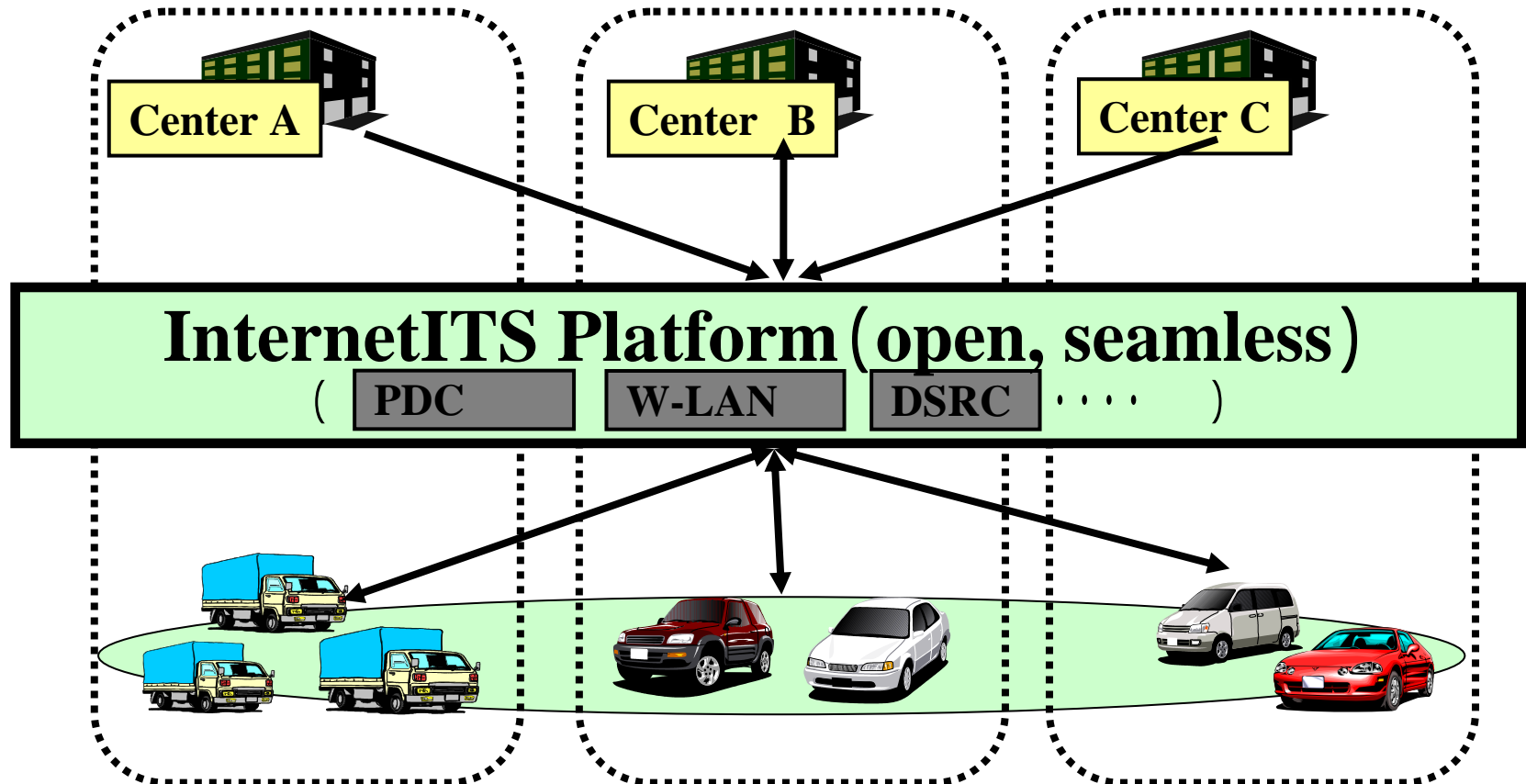
- **Traffic manager/Society**

- Various information (ex. floating car)
- Road maintenance
- Environmental survey (CO2 control)
- Taxi/bus management (location service) : better transportation services
- Marketing/Advertisement distributions



InternetITS Architecture

- ◆ Open and seamless platform by IPv6
- ◆ Separation of communication (media) and service
- ◆ Many players participate at low cost.



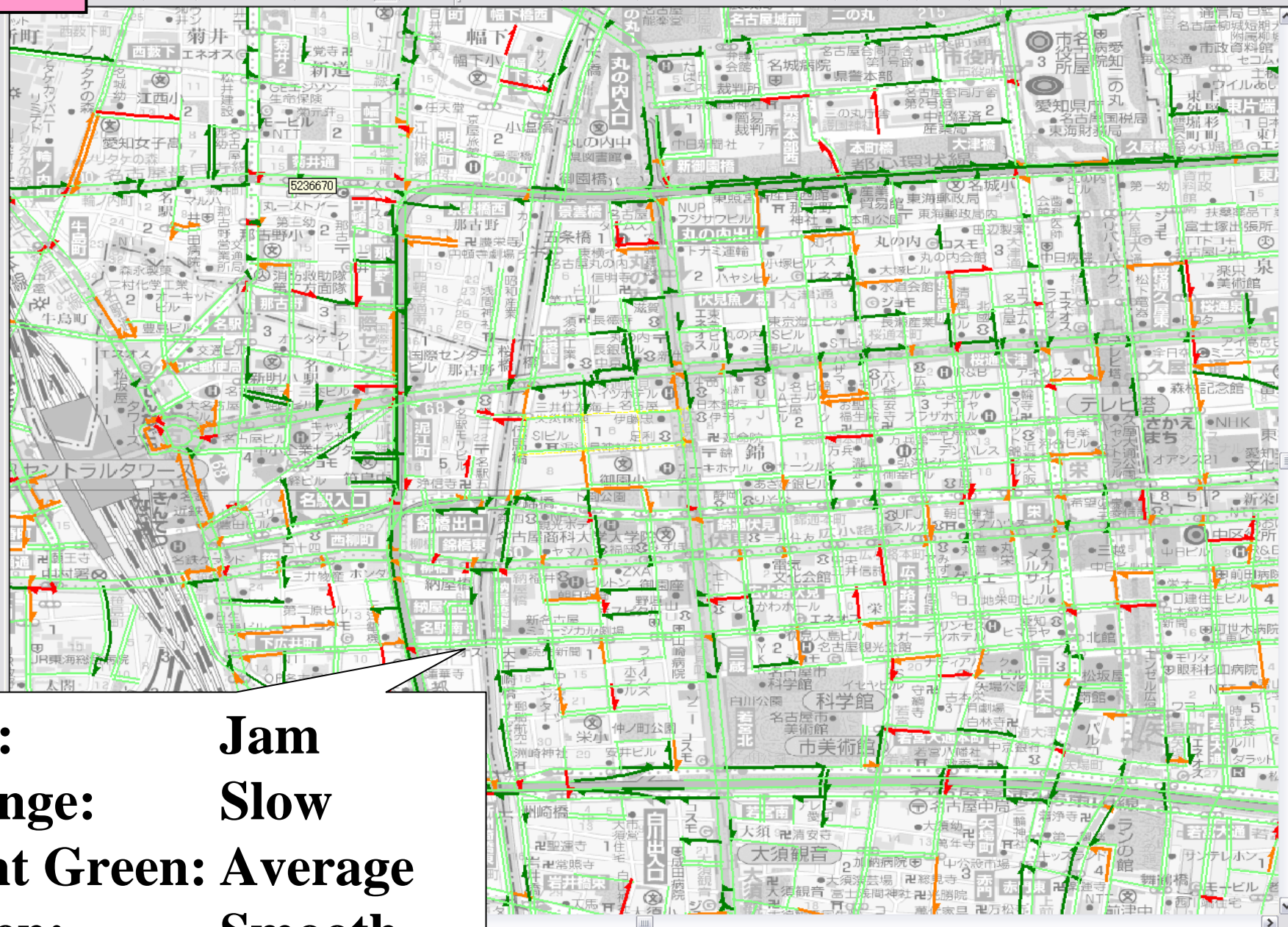
History of InternetCAR Project

FY	Internet CAR(WIDE)			IPCar(JSK)			Internet ITS		
	1996	1997	1998	1999	2000	2001	2001	2002	2003
Characteristic	First testing	Introducing Mobile IPv4	Development of On-board system	Possibility check of Probe Car system	Feasibility study of Probe Car system	Improving accuracy of Probe Car system	Introducing IPv6, Design of Internet ITS Platform	Joint work of more than hundred organization	Interoperability check
# of Cars	1	7	10	10	270	270	1640	9199	1490+30
Location	Fujisawa	Fujisawa	Fujisawa, Nara, Ishikawa	Kouhoku	Yokohama	Yokohama	Nagoya, Kawasaki	Nagoya	Nagoya, Yokohama
Type of Car	• Test Car	• Passenger car	• Passenger car	• Test car	• Taxi • Bus • Commercial car • Truck	• Taxi • Bus	• Taxi • Passenger car	• Taxi	• Taxi • Bus
On-board system	• PC	• Note PC	• sic2000	• Proprietary system	• Proprietary system	• Proprietary system	• Proprietary system	• Proprietary system	• Proprietary system • MR+IPv6 Sensors
Retrieved Information	• Location • Speed • Wiper • Light	• Location • Speed • Wiper	• Location • Speed • Wiper	• Location • Speed • Wiper	• Location • Speed • Wiper	• Location • Speed • Wipers • Side break	• Location • Speed • Wiper • Hired/Vacant	• Location • Speed	• Location • Speed • Camera • Temp. • Humidity • Accelerati
Communication Media	• PDC-P	• PDC-P • PHS • Wireless LAN	• PDC-P • Wireless LAN	• PDC-P	• PDC-P	• PDC-P	PDC-P, cdma1x, PHS, PHS-DATA, WiFi, DSRC	• PDC-P • SWIFTCOM	• PDC-P • Wiper • PHS-DATA

7:00

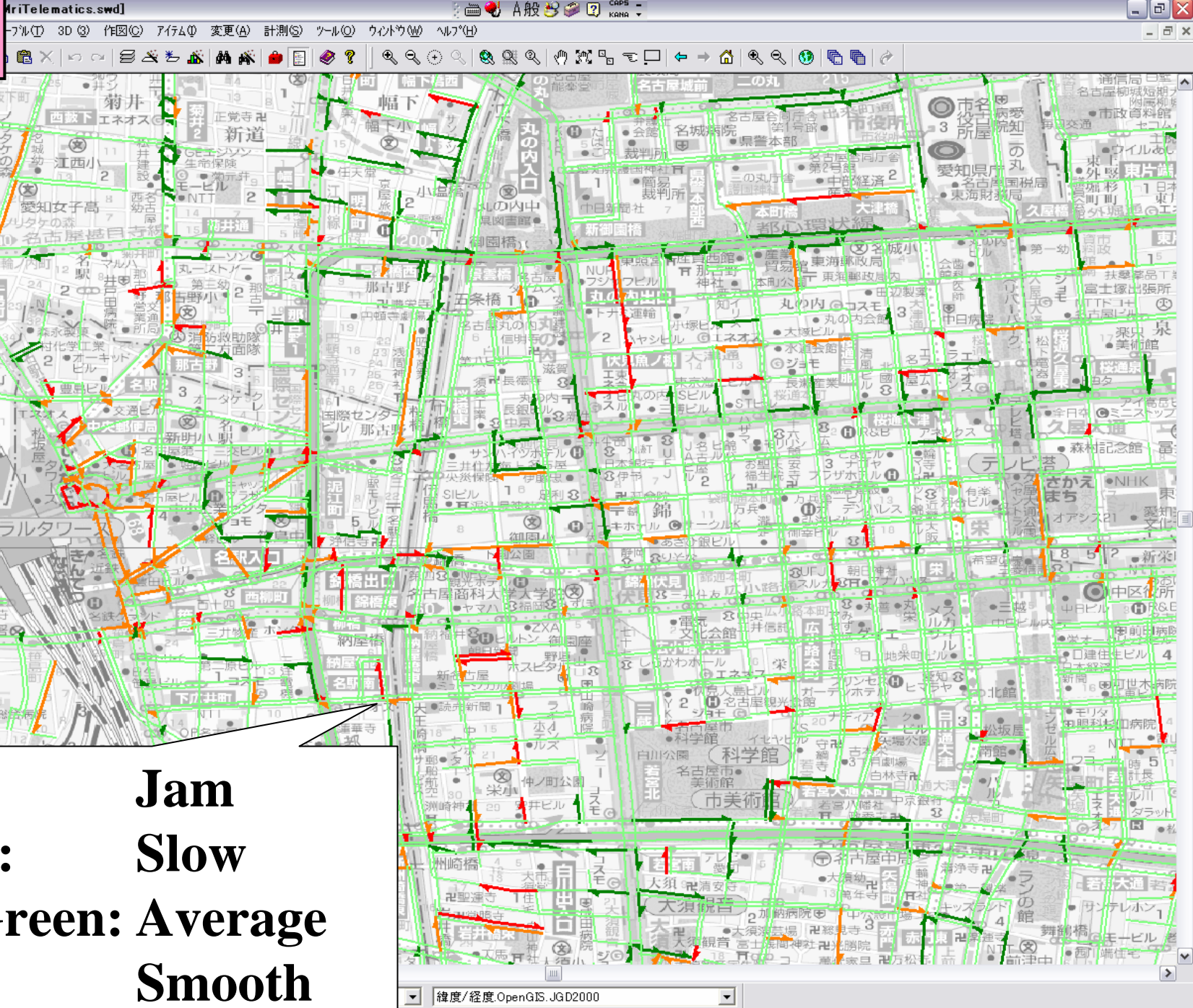


- マップドキモノ
- MriTele
- Netv
- 1/10
- 1/2E
- blanl
- blanl
- 2/cx
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Red: Jam
Orange: Slow
Light Green: Average
Green: Smooth

8:00

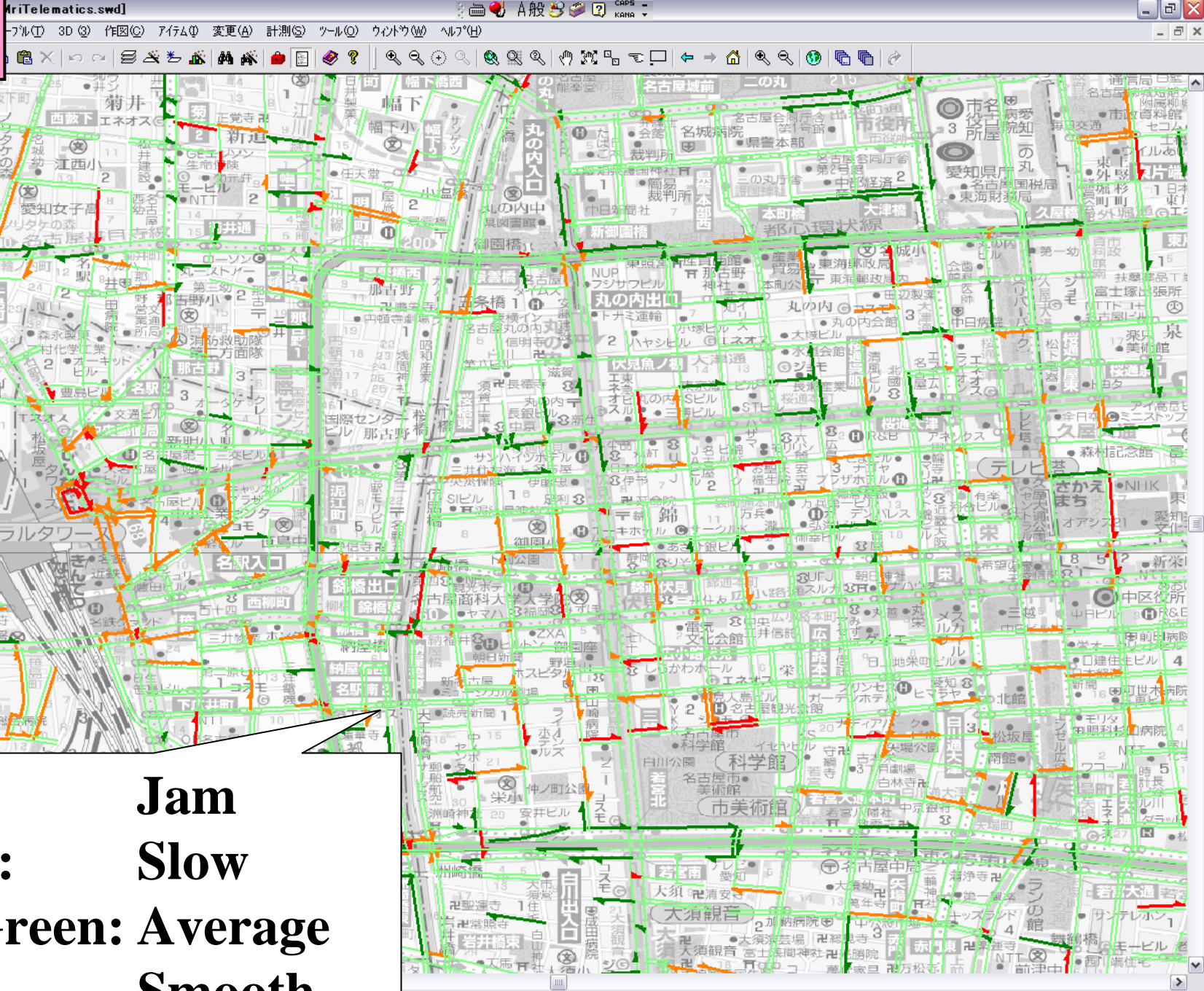


Red: Jam
Orange: Slow
Light Green: Average
Green: Smooth

緯度/経度 OpenGIS JGD2000

0 0 3.6km 1:10,948

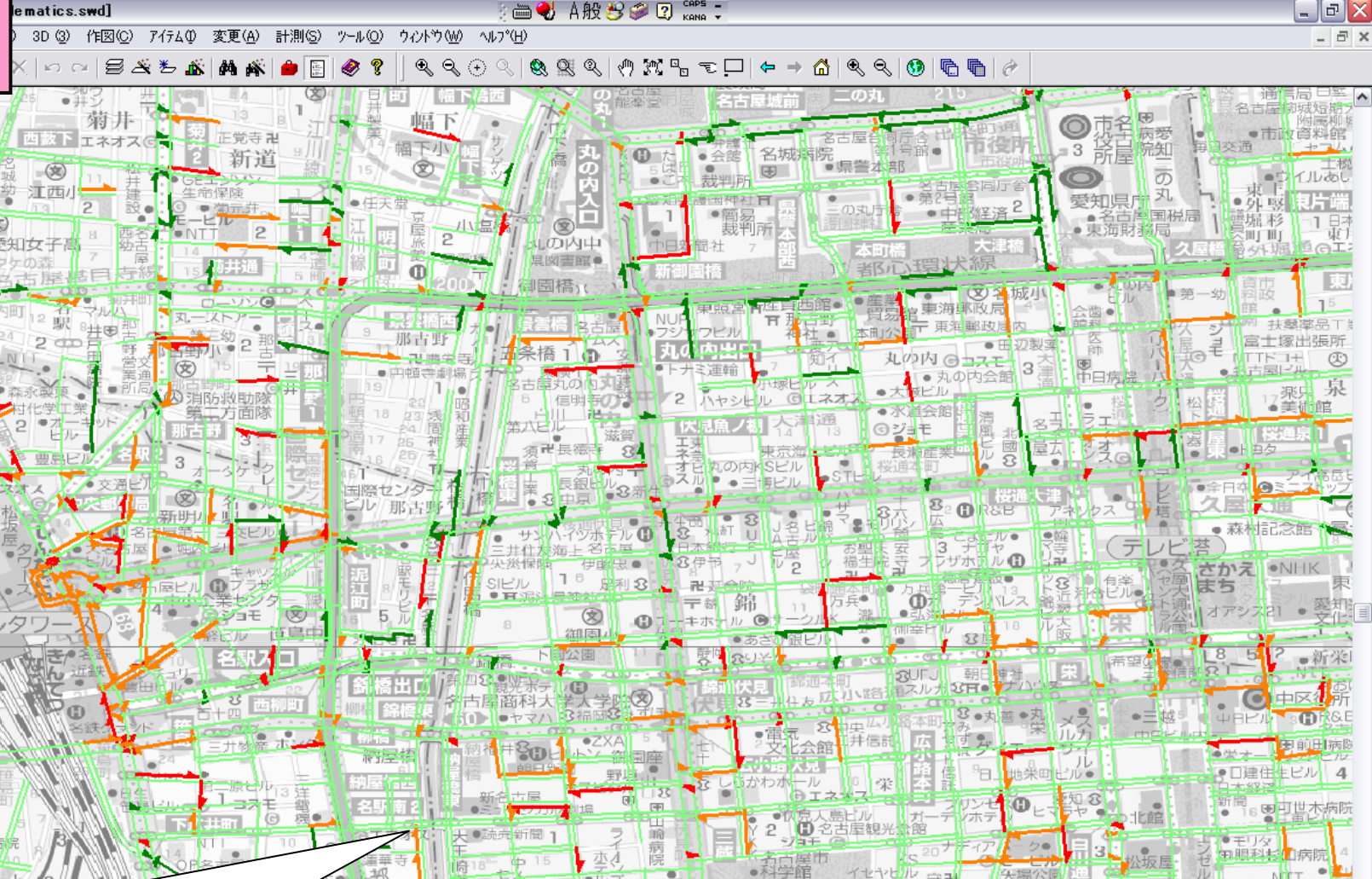
9:00



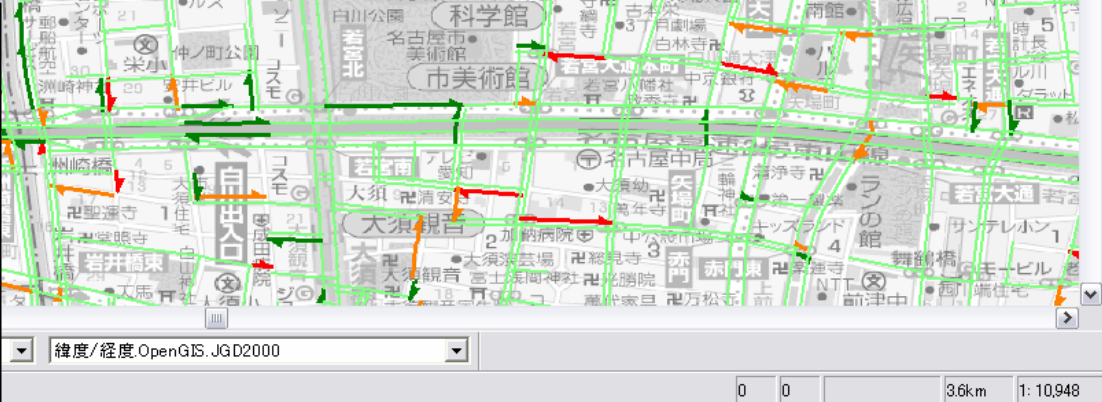
Red: Jam
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緯度/経度 OpenGIS.JGD2000

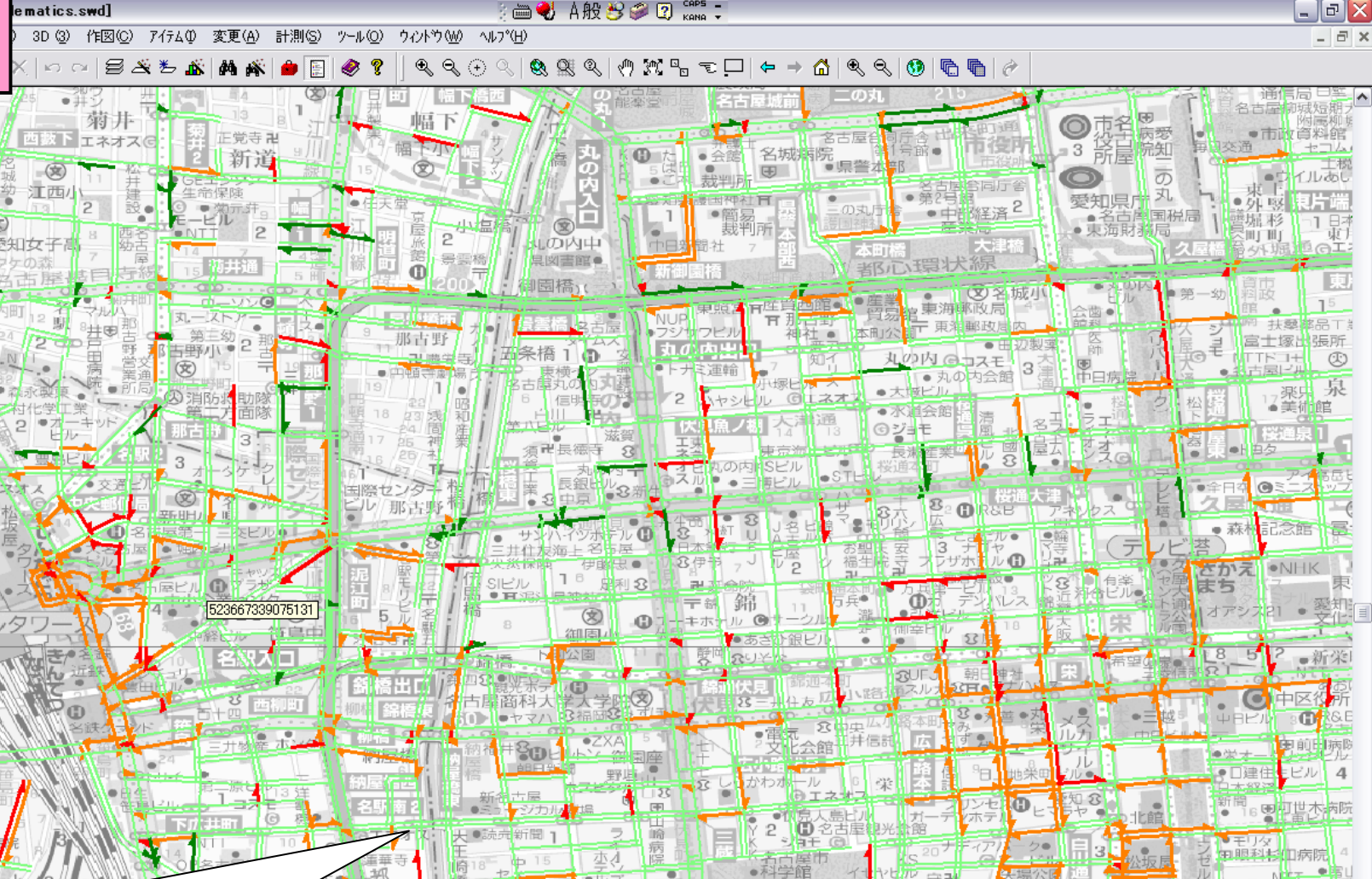
10:00



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Orange: Slow
Light Green: Average
Green: Smooth

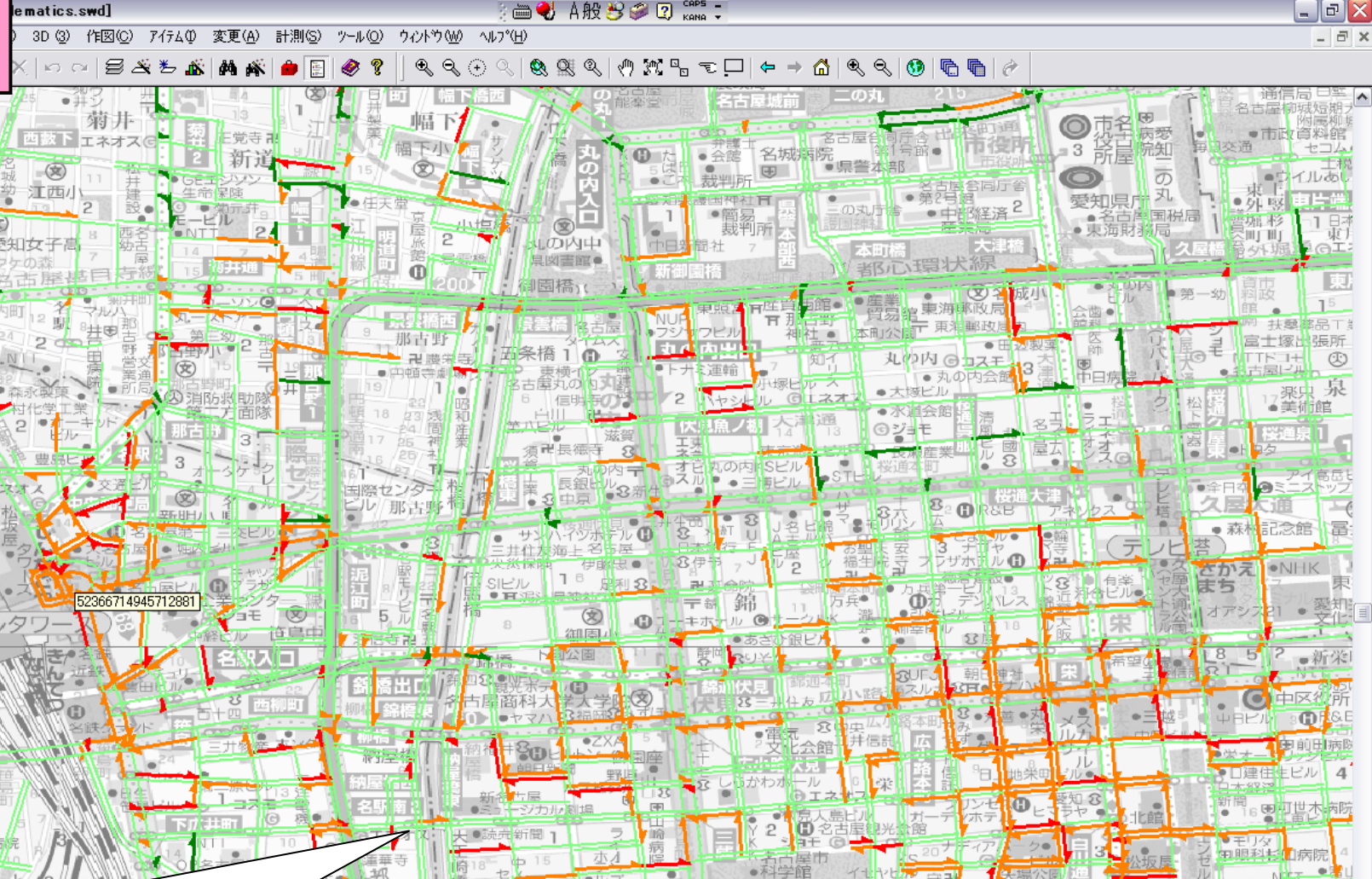


16:00



Red: Jam
Orange: Slow
Light Green: Average
Green: Smooth

17:00

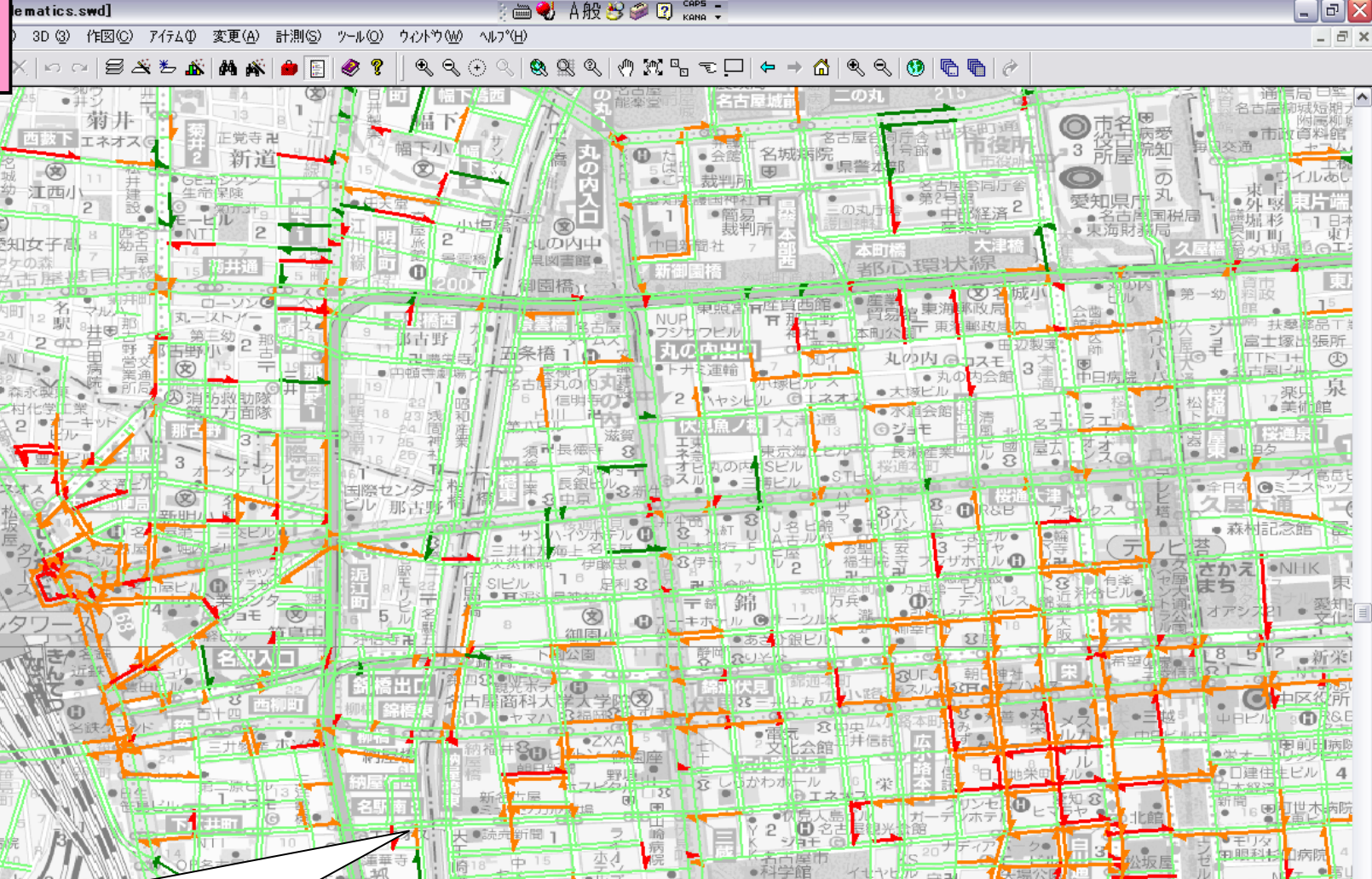


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Green: Smooth

緯度/経度 OpenGIS, JGD2000

0 0 3.6km 1:10,948

18:00

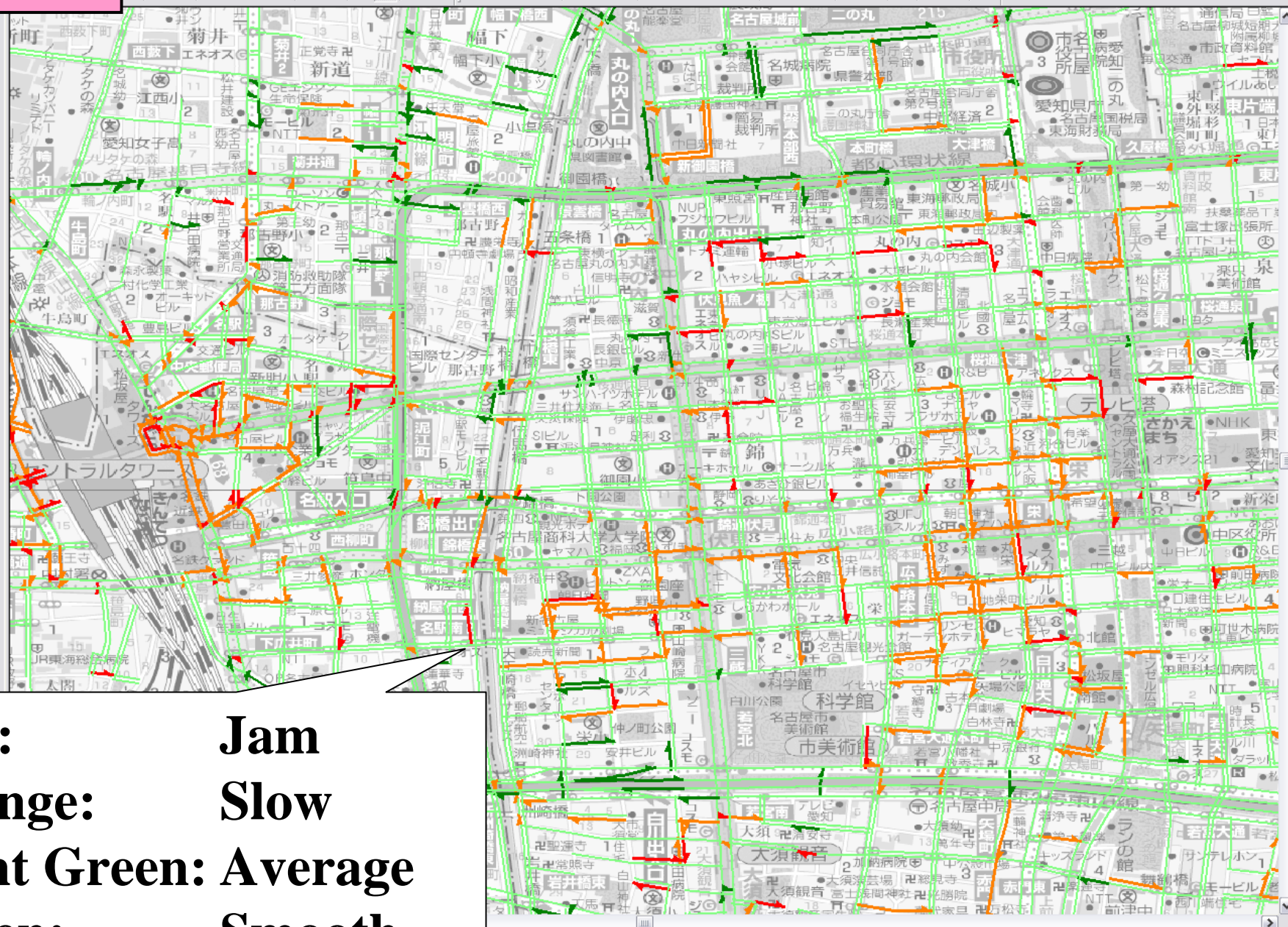


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緯度/経度 OpenGIS JGD2000

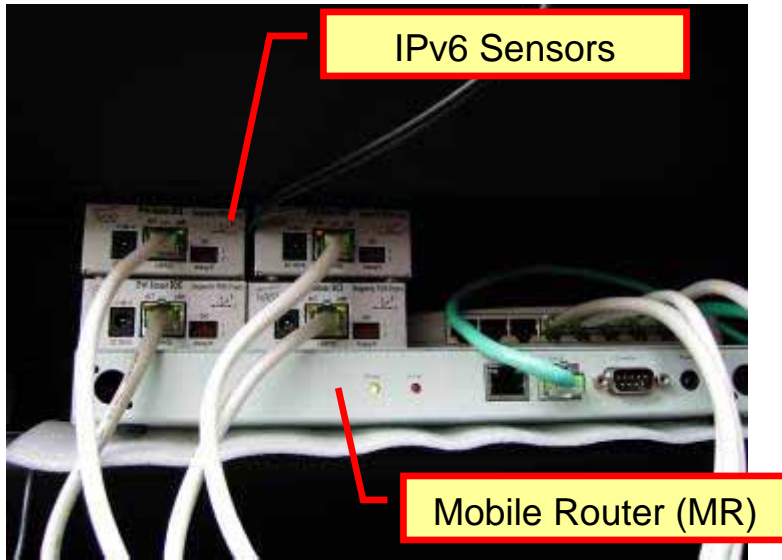
20:00

- マップドキュメント
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- 1/25
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Testing Environment



MR and IPv6 Sensor



IPv6 based on-board equipment



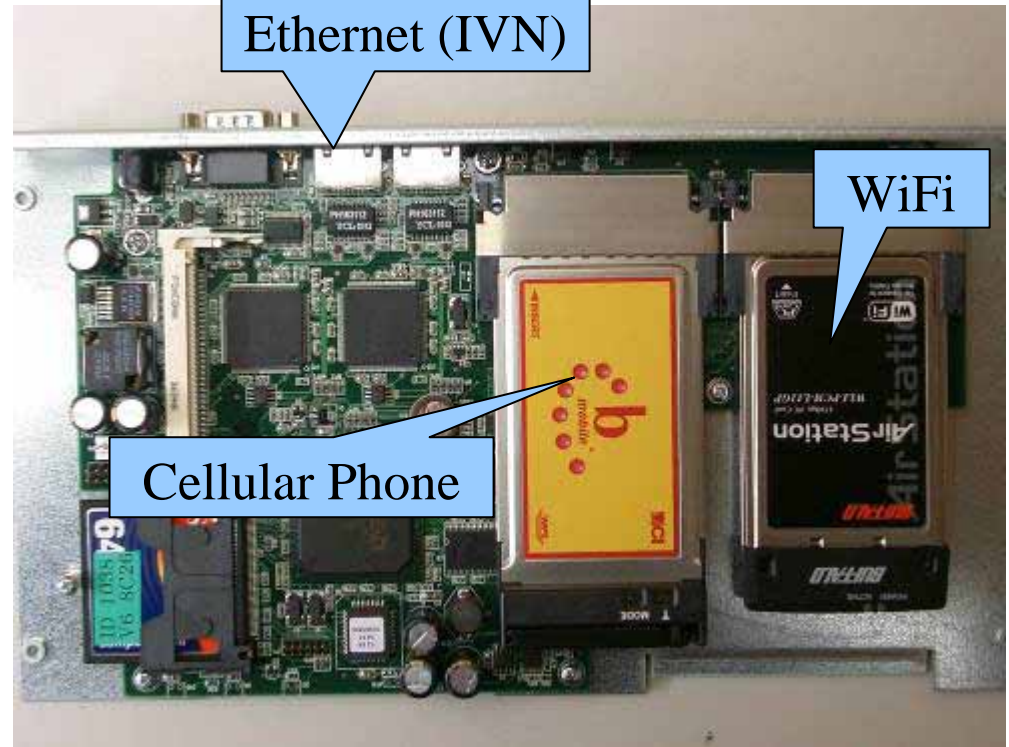
Vehicle information can be retrieved using SNMP/IPv6

Testing Environment

WiFi Antenna



Ethernet (IVN)

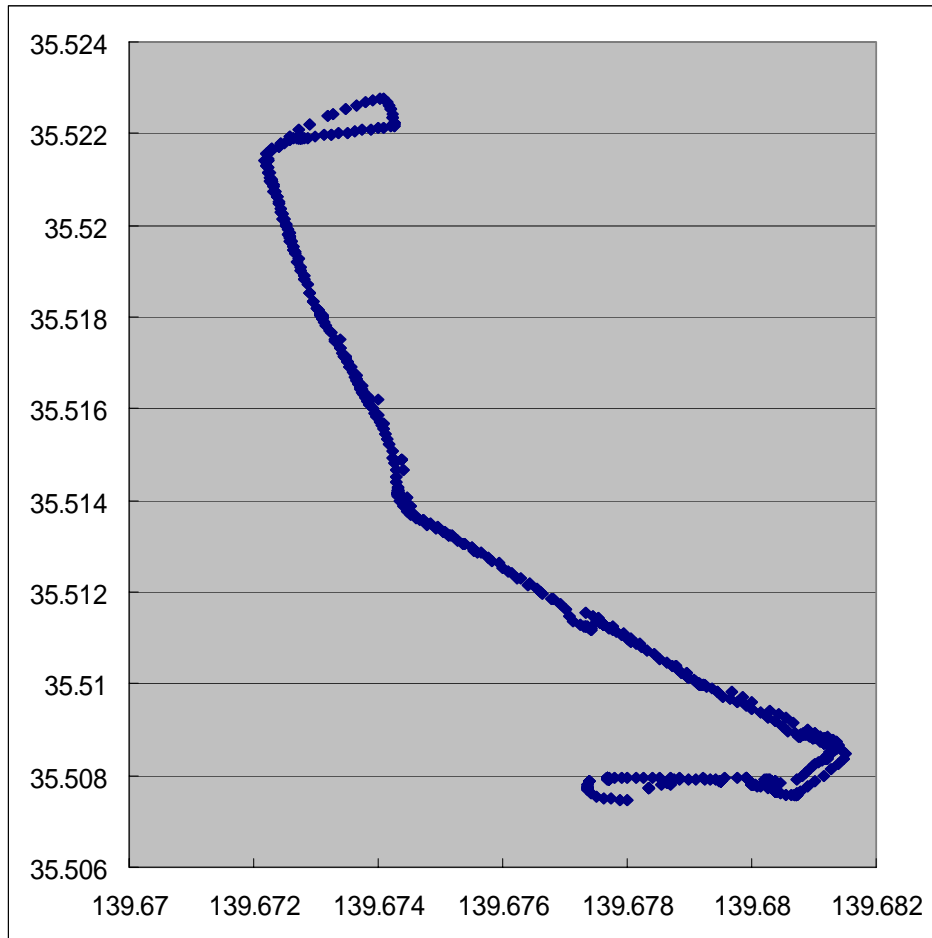


WiFi

Cellular Phone

Mobile Router
(OS:

location information from GPS



map creation by excursion of Automobile (from GPS sensor)

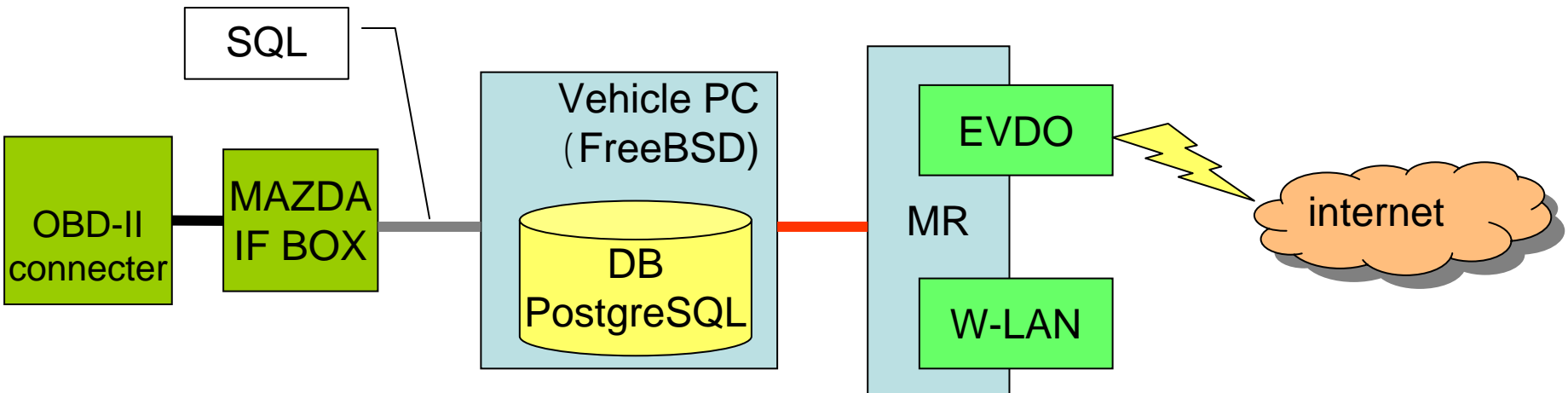
Generation of Emergency indication by Probe Car system

“the Slip hazard map” from vehicle’s ABS signal

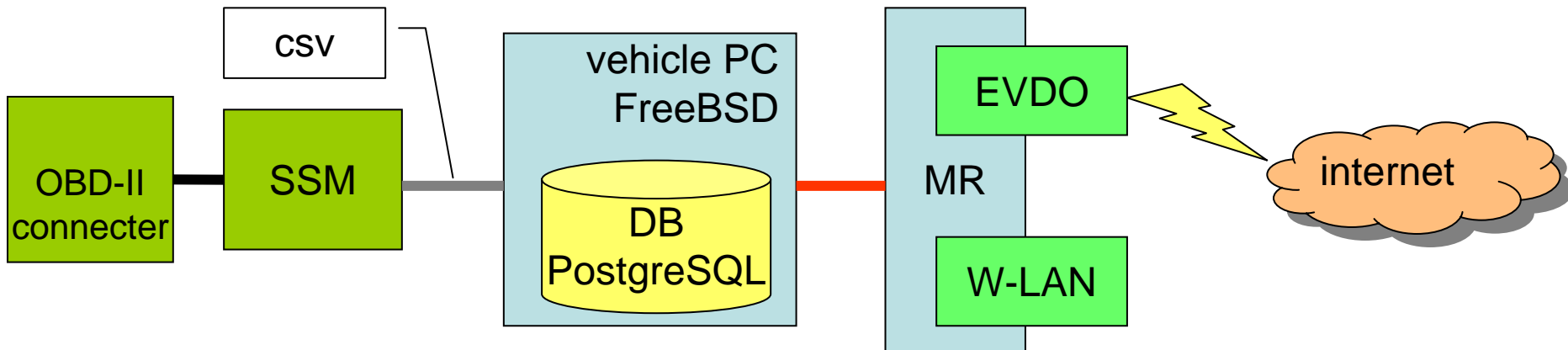
- Activation of anti-lock braking system (ABS), which indicates slippery (black ice/poor road traction/dangerous) place.
- It is possible to generate "the Slip hazard map" by collecting “activation of ABS” through the Internet from many vehicles with a position.
- We experimented in the test course using two probe vehicles.



experimental vehicle 1 (MAZDA)

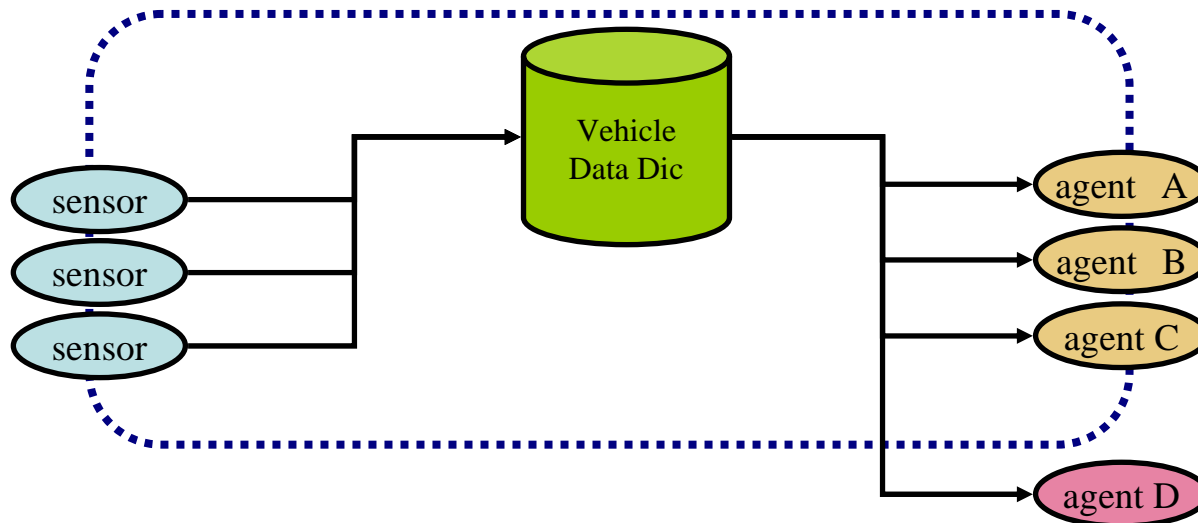


experimental vehicle 2 (SUBARU)



Data architecture

- Service Platform: 「Data Dictionary」
 - Vehicle Information Interface
 - Unified information gathering independent of vehicle type
 - Can easy use vehicle information from the outside/inside
 - “name” always means one unique unit (format)
 - Standardization: ISO/TC204/WG16



Information of acquisition from vehicle

Basic info (from IP Sensors)

Temperature

Humidity

Latitude

Longitude

Altitude

Direction

Acceleration (front - rear)

Acceleration (left - right)

8 info

Vehicle 1 (mazda)

Battery voltage

Velocity

Engine rpm

Acceleration pedal maneuver(%)

Cooling Water temperature

Intake Air temperature

Activation of ABS

Activation of parking-brake

Head light status(4steps)

Wiper status(4steps)

Activation of door open sensor

Gear Position

(8) + 12 = 20 info

Vehicle 2 (SUBARU)

Battery voltage

Velocity

Engine rpm

Acceleration pedal maneuver(%)

Cooling Water temperature

Intake Air temperature

Activation of ABS

Activation of parking-brake

Head light status(4steps)

Wiper status(4steps)

Activation of door open sensor

Gear Position

Activation of Air-bag system

Activation of seat belt sensor

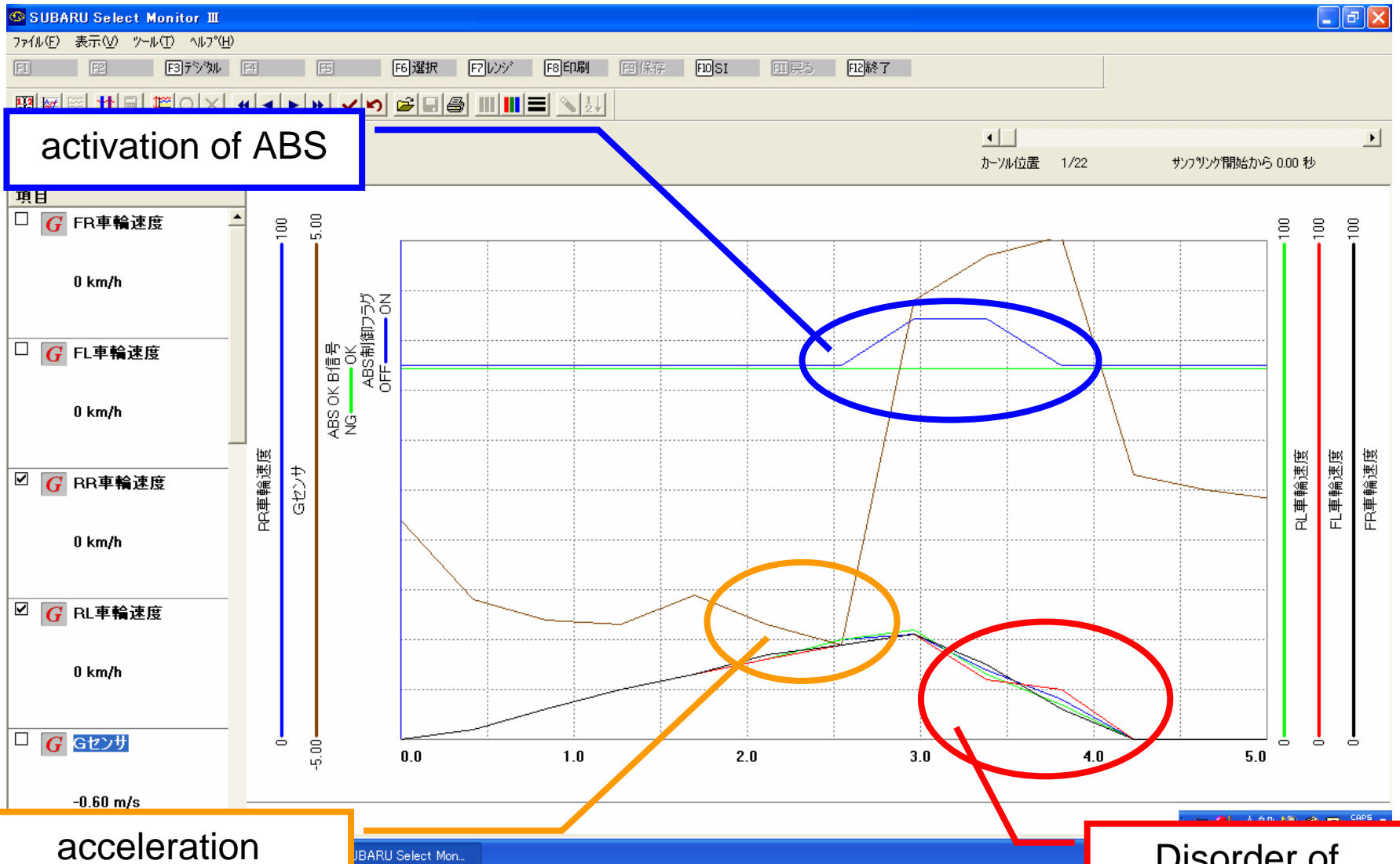
Ignition status

Activation of seat sensor

Activation of Hazard lamp

(8) + 17 = 25 info

ABS information from vehicle connector (OBD-II and CAN: Controller Area Network)

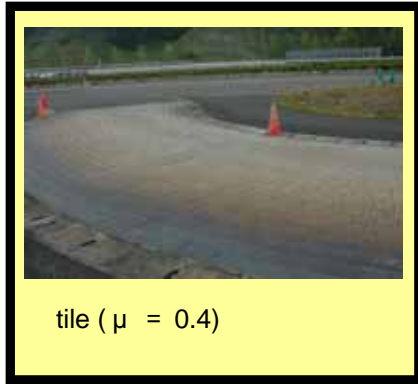


activation of ABS

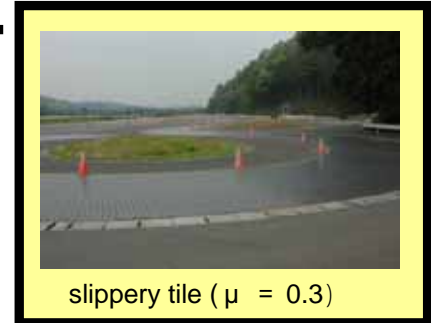
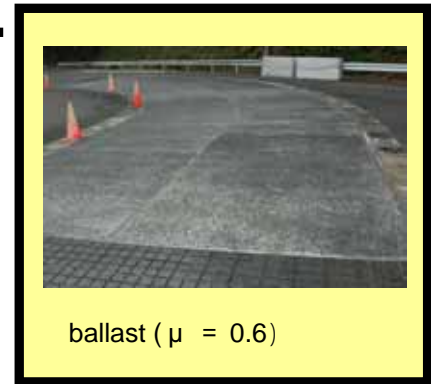
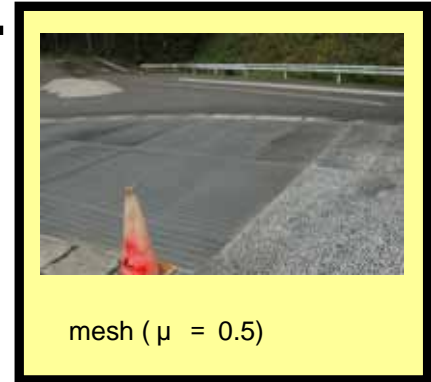
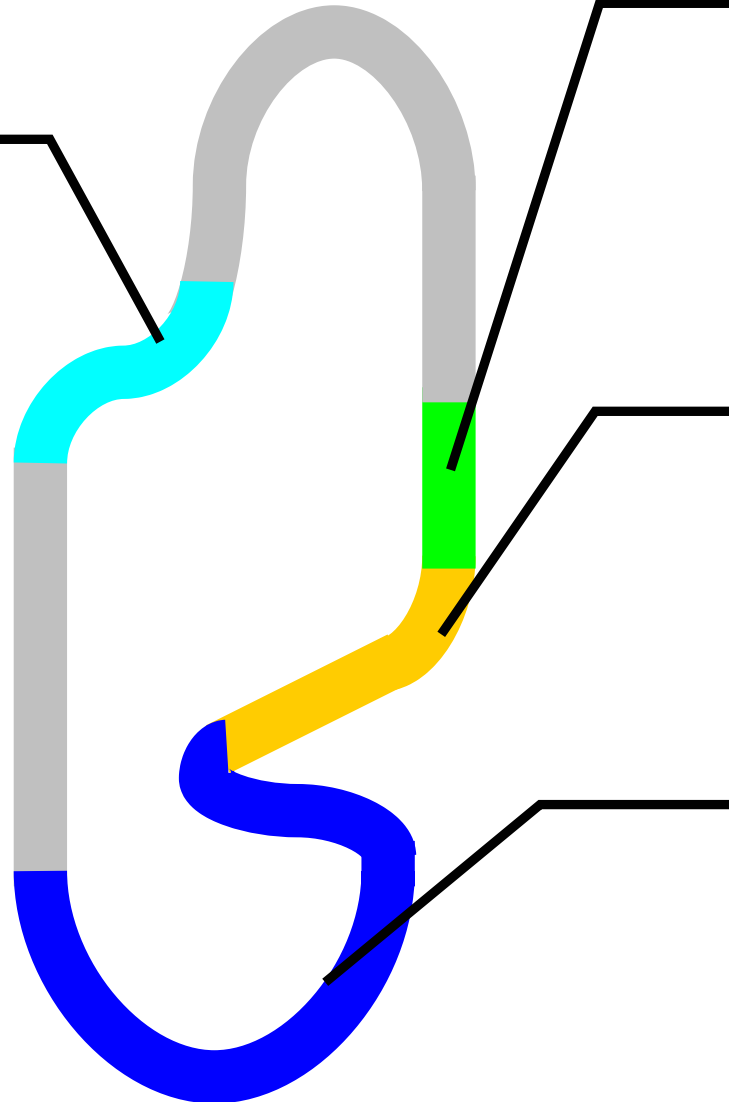
acceleration from G-force sensor

Disorder of wheel velocity

slippery course



course equipped sprinkler!!

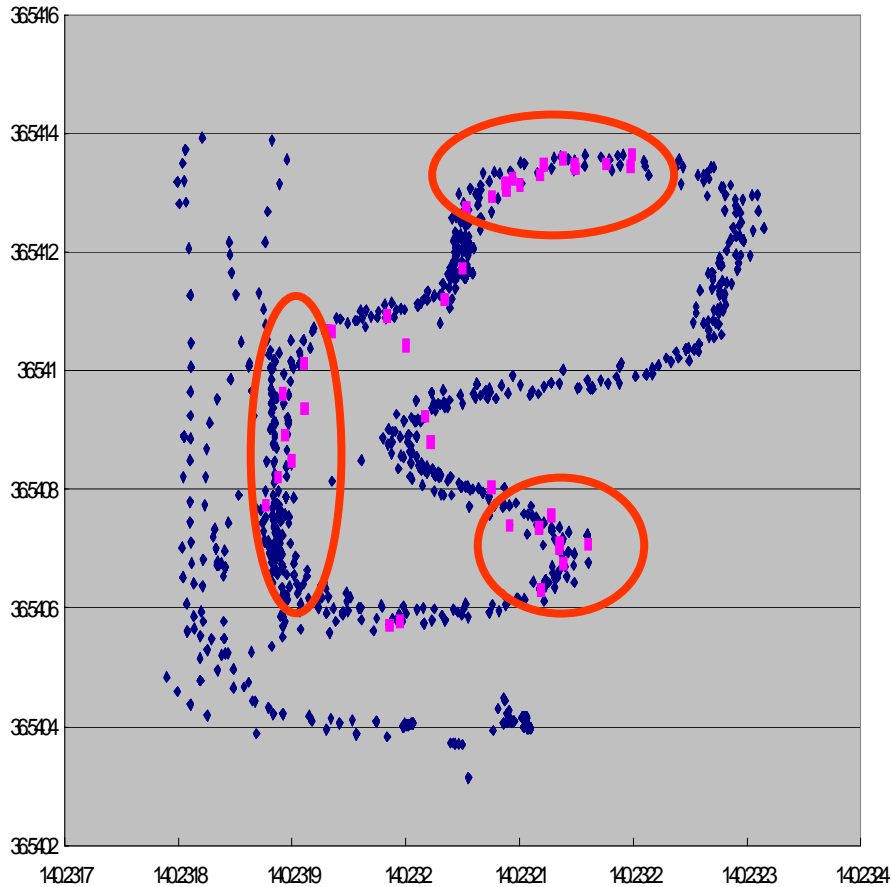


Experimentation

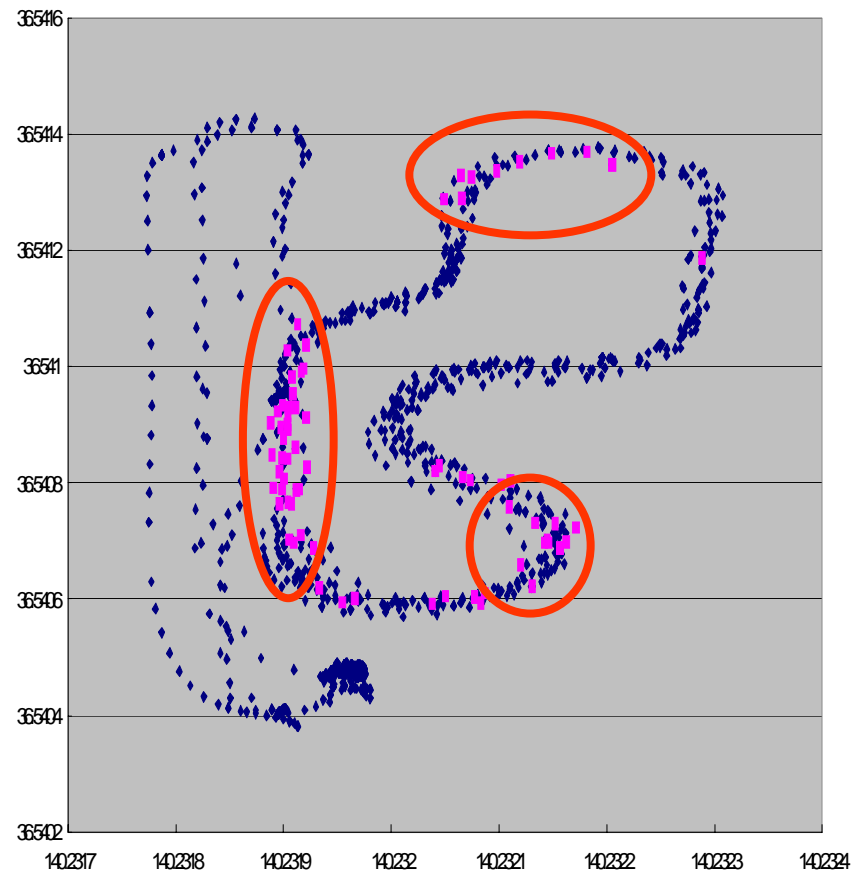


Result (All the collected information)

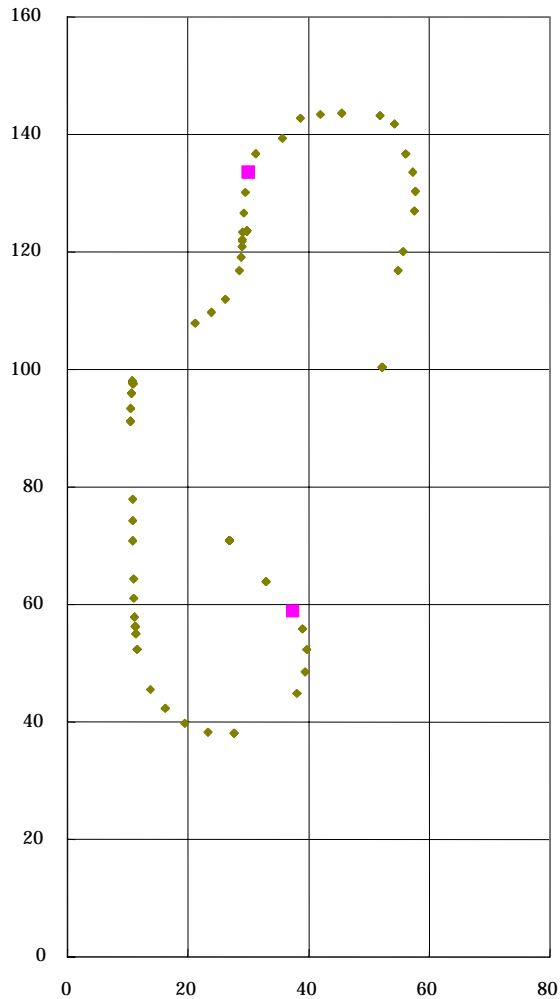
- vehicle 1



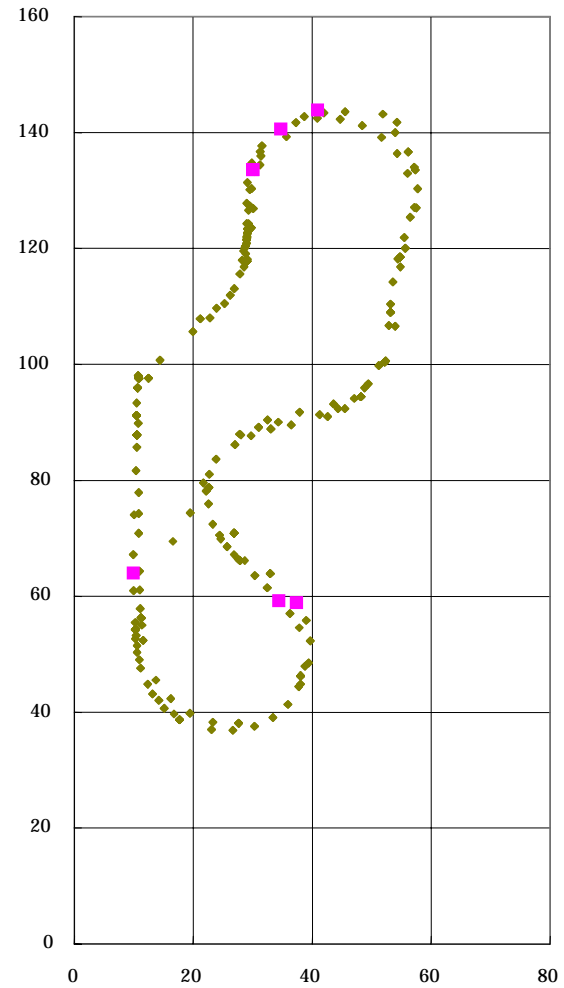
- vehicle 2



ABS signal on 10km/h

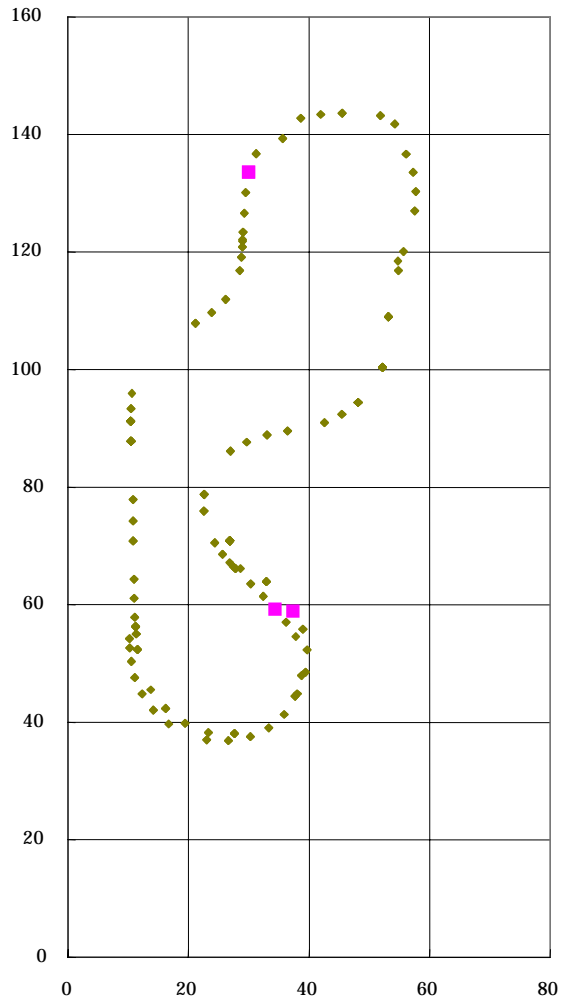


1 round by 10 km/h

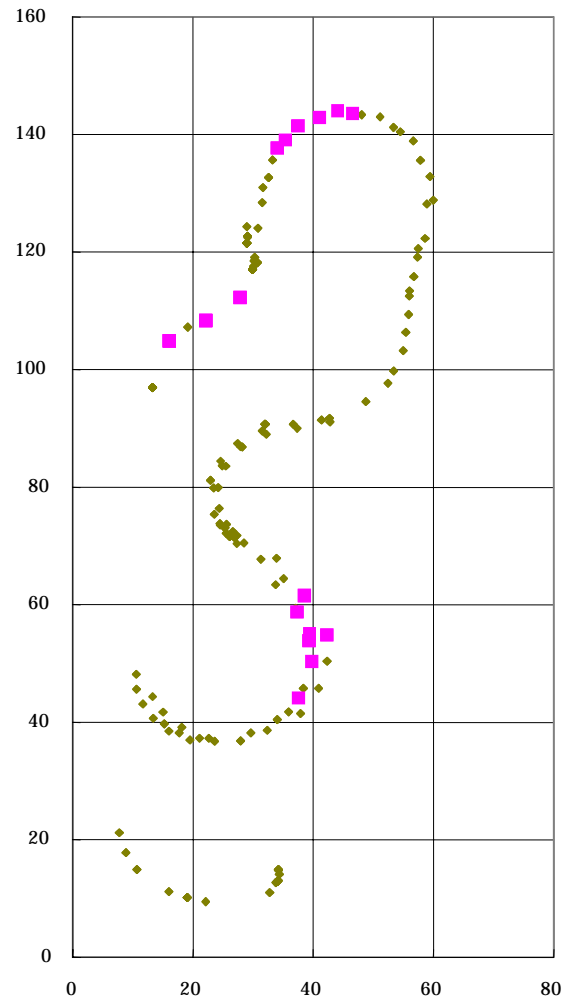


3 rounds by 10km/h

ABS signal on 20km/h

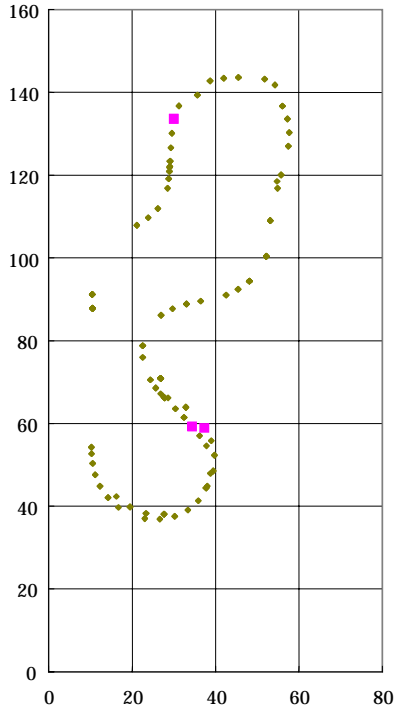


1 round by 20 km/h

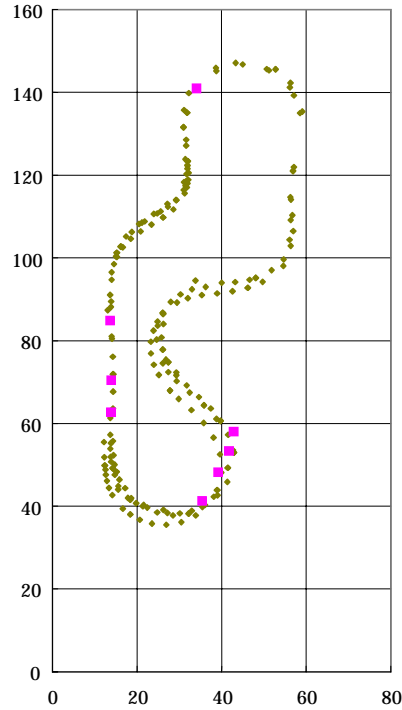


3 rounds by 10 km/h

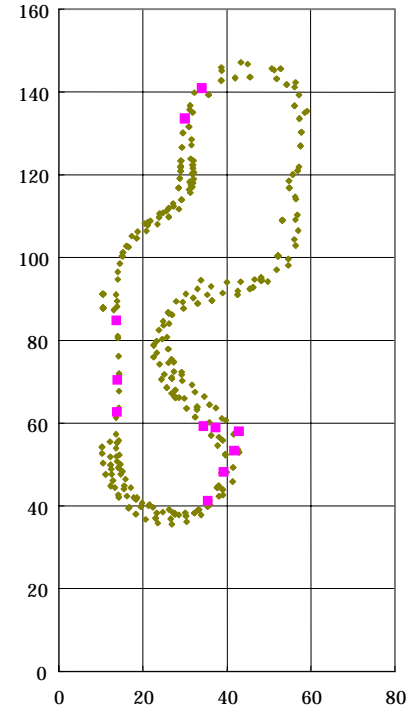
Composition of collected information



+



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vehicle 1 information

vehicle 2 information

Conclusion

- Since 1996, the InternetCAR WG have worked on connecting vehicles to the Internet and building a communication infrastructure.
- Network Mobility is the mobility support technology to connect vehicles to the Internet.
 - MR supporting Network Mobility assigns a permanent mobile network prefix to the vehicle and leads the vehicle network without awareness of its visited network changes.
- Data-dictionary-model makes it possible to normalize the average error and accuracy of car-information.
- Result of our feasibility study in Slippery Circuit
 - It has been confirmed that gathered ABS signal from different two vehicles to "the Slip hazard map" could be created.