# Role of Wide area and Narrow area Communication Systems in CASE age

ITU-T, TTC meeting in Tokyo
2019.7.18

Dr. Hironao Kawashima

- Emeritus Professor, Keio University
  Mobility Culture  Research Center
- Chairman of Management Committee, ITS Info-Communications Forum, ARIB
- Member of working group on Connected Car, TTC
- Expert of WG18 (Cooperative ITS), ISO/TC04 (ITS)

# 1. Introduction

**CASE** (Connected, Autonomous, Shared & Services, Electric) is the keyword of automobile industry.

All the four components of **CASE** is related to communication and information processing. Here “Connected” and “Autonomous” are focused and impacts and influences to traffic flow will be pointed out and further, the role of communication systems will be discussed.

# 2. ODD (Operational Design Domain) and traffic flow

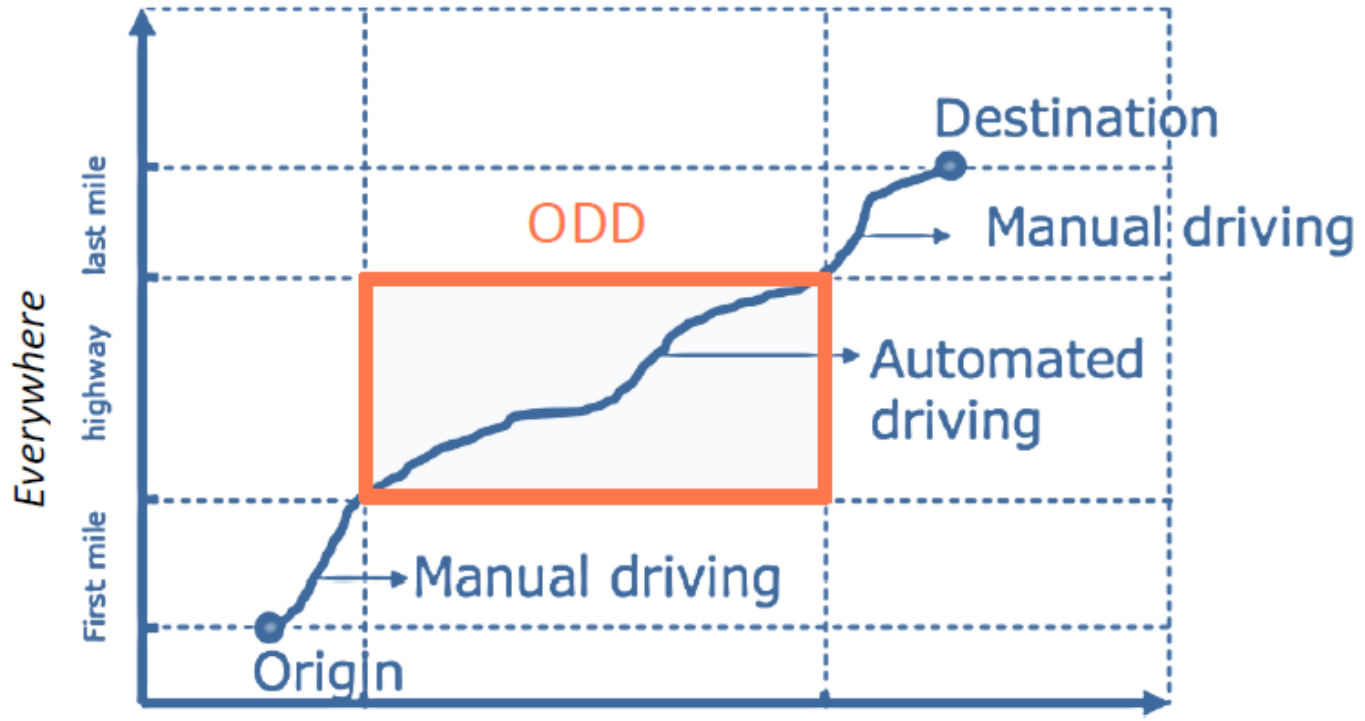
Netherland first announced that their traffic management will be based on ODD for Automated Vehicles by changing ODD according to the road and traffic environment.

ODD was first announced by SAE and the definition of ODD related to road administration is not clear and many discussions are emerging.

[Current definition by Dr. Jaap Vreeswijk;
ODD = (Vehicle Capabilities) X (Geographical Condition) X (Traffic & Situational environment)]

| Level | Name | Narrative definition | DDT | | DDT fallback | ODD |
|---|---|---|---|---|---|---|
| | | | Sustained lateral and longitudinal vehicle motion control | OEDR | | |
| ***Driver* performs part or all of the *DDT*** | | | | | | |
| 0 | **No Driving Automation** | The performance by the *driver* of the entire *DDT*, even when enhanced by *active safety systems*. | *Driver* | *Driver* | *Driver* | n/a |
| 1 | **Driver Assistance** | The *sustained* and *ODD*-specific execution by a *driving automation system* of either the *lateral* or the *longitudinal vehicle motion control* subtask of the DDT (but not both simultaneously) with the expectation that the *driver* performs the remainder of the *DDT*. | *Driver* and *System* | *Driver* | *Driver* | Limited |
| 2 | **Partial Driving Automation** | The *sustained* and *ODD*-specific execution by a *driving automation system* of both the *lateral* and *longitudinal vehicle motion control* subtasks of the *DDT* with the expectation that the *driver* completes the *OEDR* subtask and *supervises* the *driving automation system*. | ***System*** | *Driver* | *Driver* | Limited |
| ***ADS* ("*System*") performs the entire *DDT* (while engaged)** | | | *System* | ***System*** | *Fallback-ready user (becomes the driver during fallback)* | Limited |
| 3 | **Conditional Driving Automation** | The *sustained* and *ODD*-specific performance by an *ADS* of the entire DDT with the expectation that the *DDT fallback-ready user* is *receptive* to *ADS*-issued *requests to intervene*, as well as to *DDT performance-relevant system failures* in other *vehicle* systems, and will respond appropriately. | | | | |
| 4 | **High Driving Automation** | The *sustained* and *ODD*-specific performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*. | *System* | *System* | ***System*** | Limited |
| 5 | **Full Driving Automation** | The *sustained* and unconditional (i.e., not *ODD*-specific) performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*. | *System* | *System* | *System* | **Unlimited** |

# Operational Design Domain (ODD)




Vehicle capabilities

x

Geographical domain

x

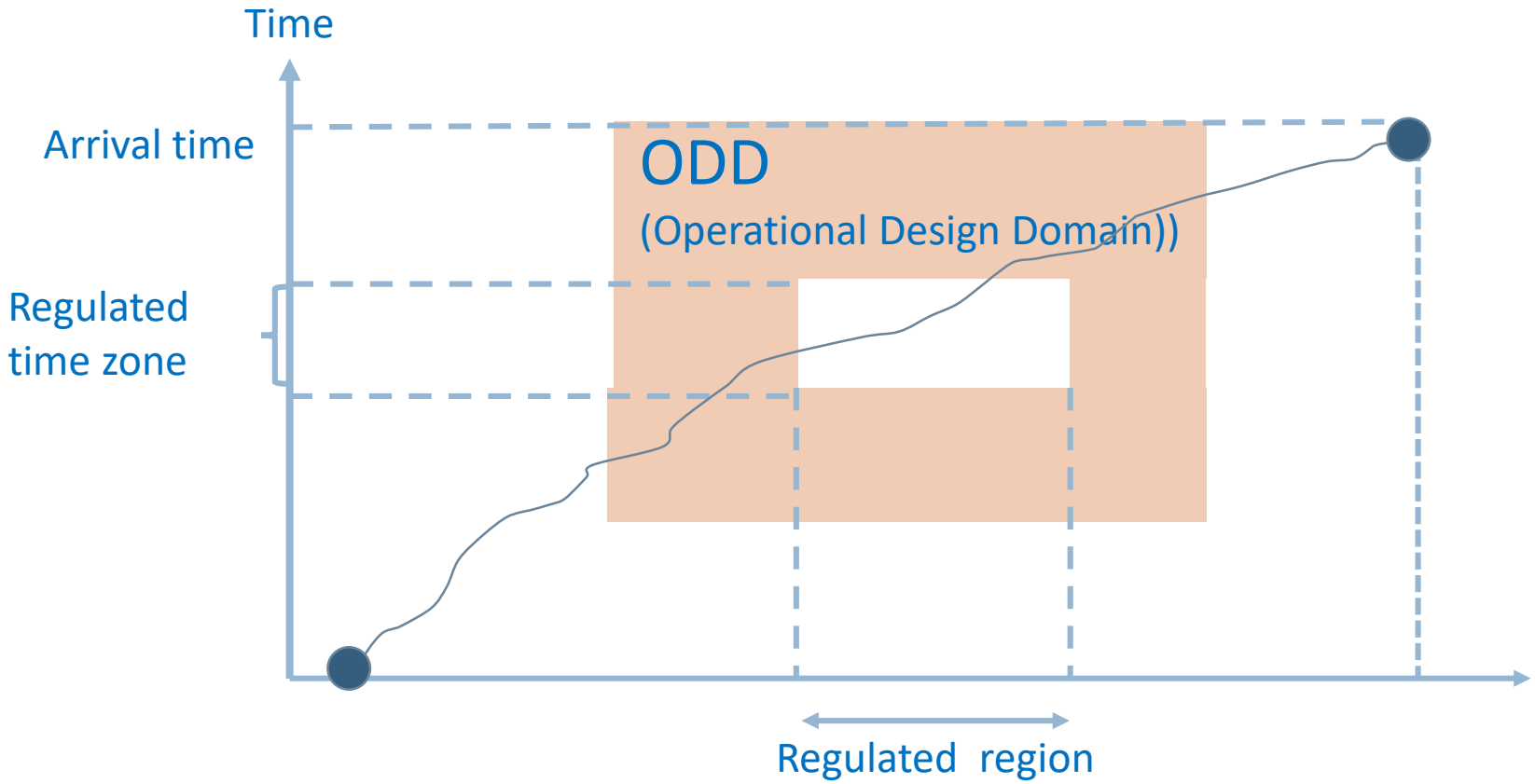
Traffic & situational environment

=

ODD

*Tom Alkim, Rijkswaterstaat, 2017*

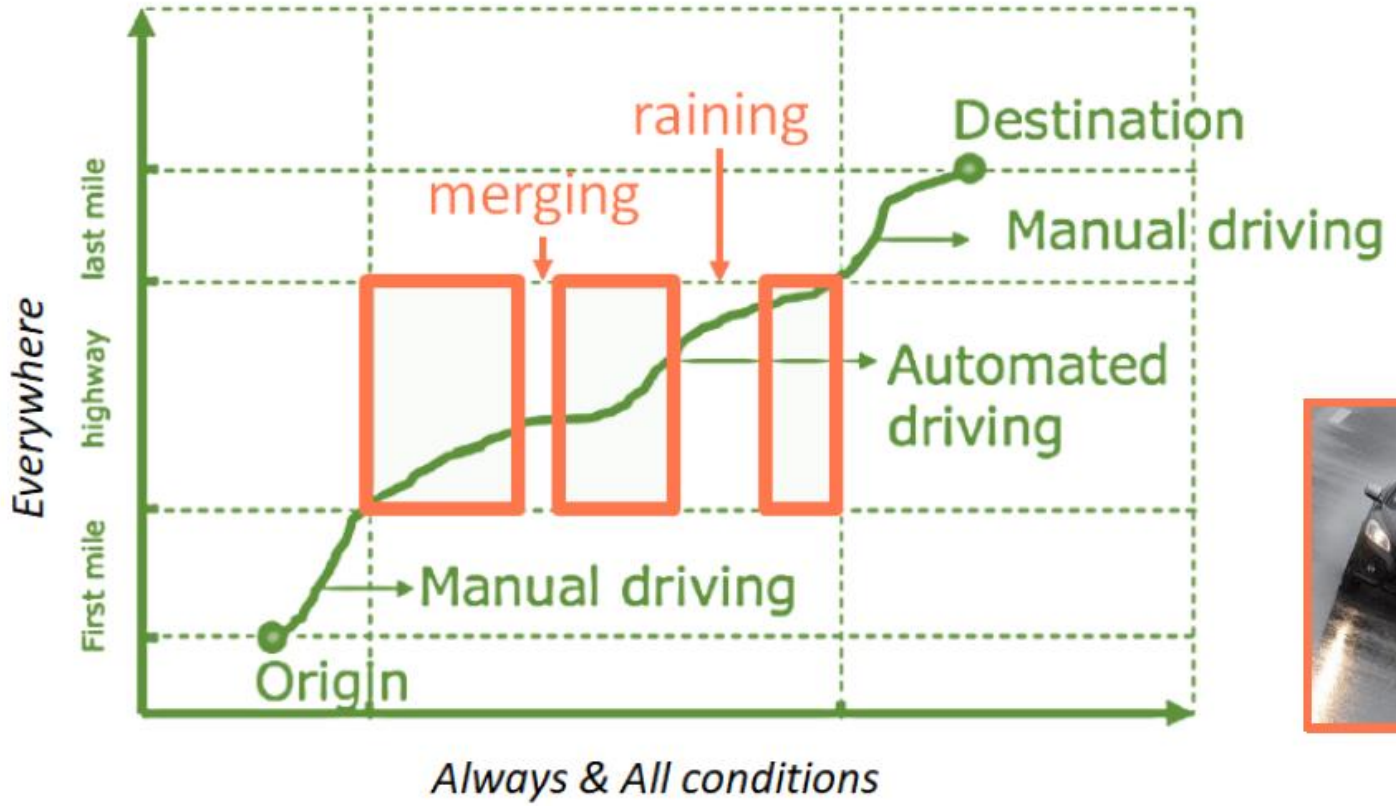
# An example of ODD in Japan




Source; Keio University, Mobility Culture Research Center, 2018

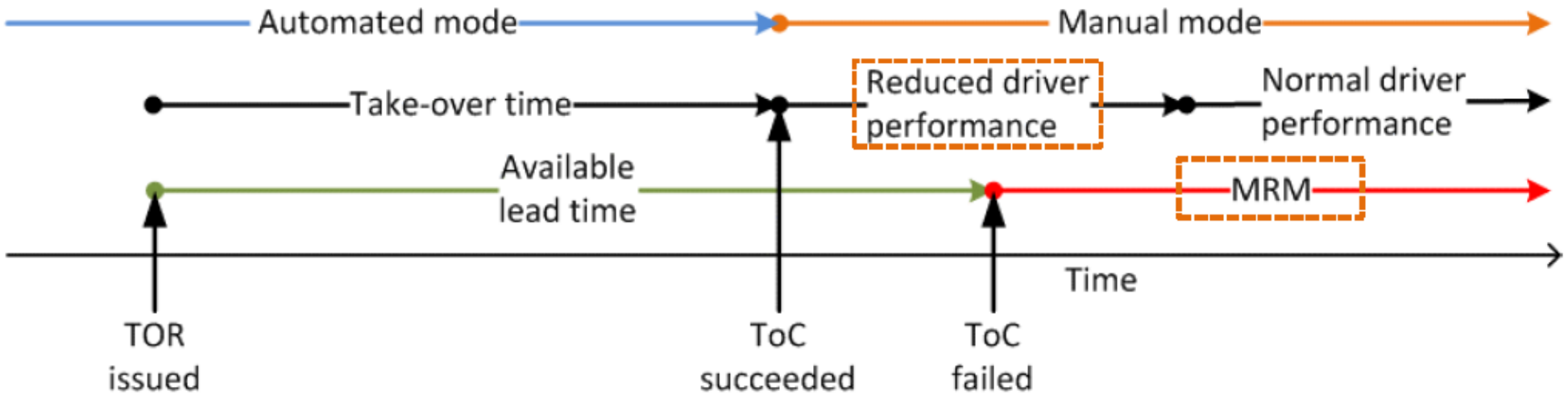
# INTERRUPTIONS = TRANSITIONS

25TH ITS WORLD CONGRESS COPENHAGEN 17 – 21 SEPTEMBER 2018
Quality of life
TransAID MAVEN
Funded by H2020 GA No. 690727 and 723390



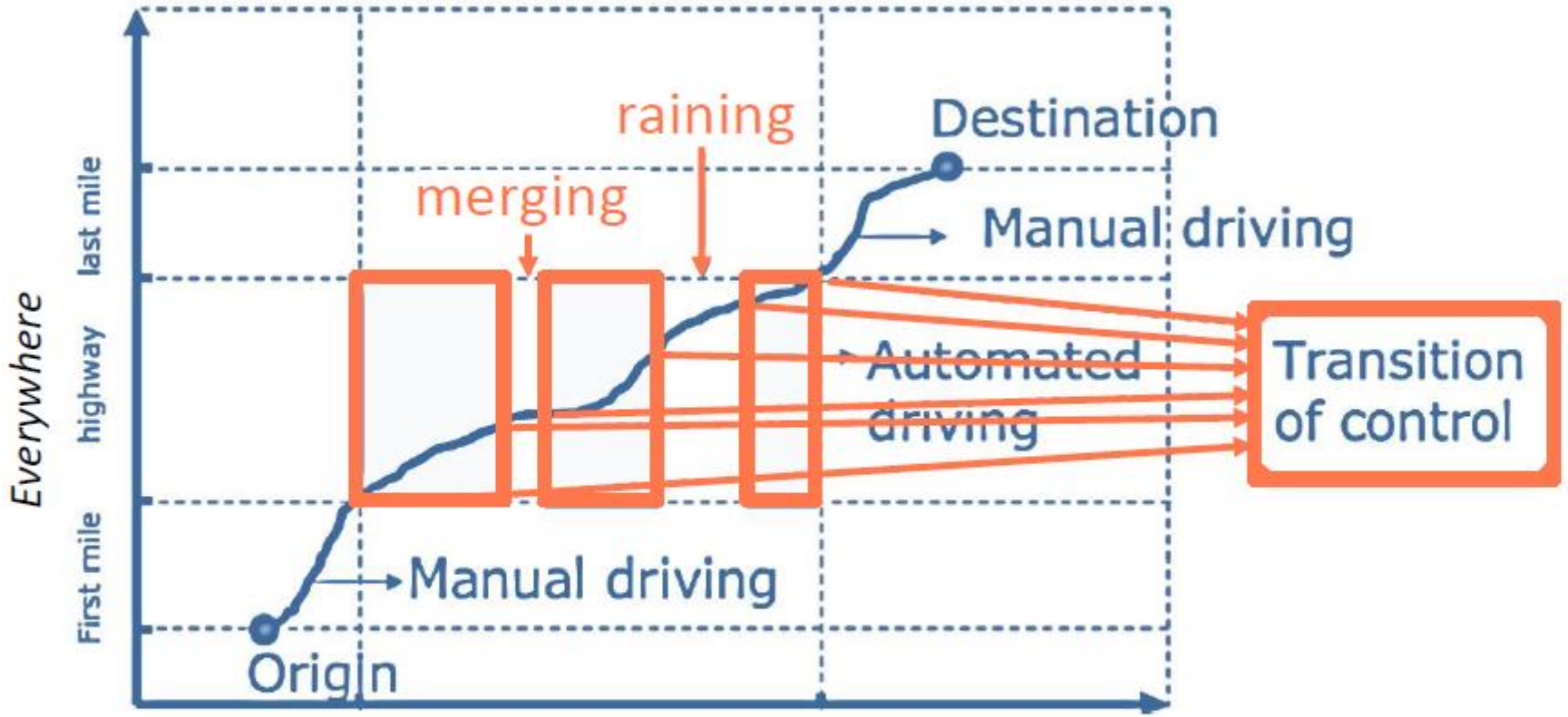

*Tom Alkim, Rijkswaterstaat, 2017*

# ToC and MRM process (deactivations)




MRM minimum risk condition = stop or park safely

# ODD >> ToC / MRM >> Transition areas (TAs)




*Tom Alkim, Rijkswaterstaat, 2017*

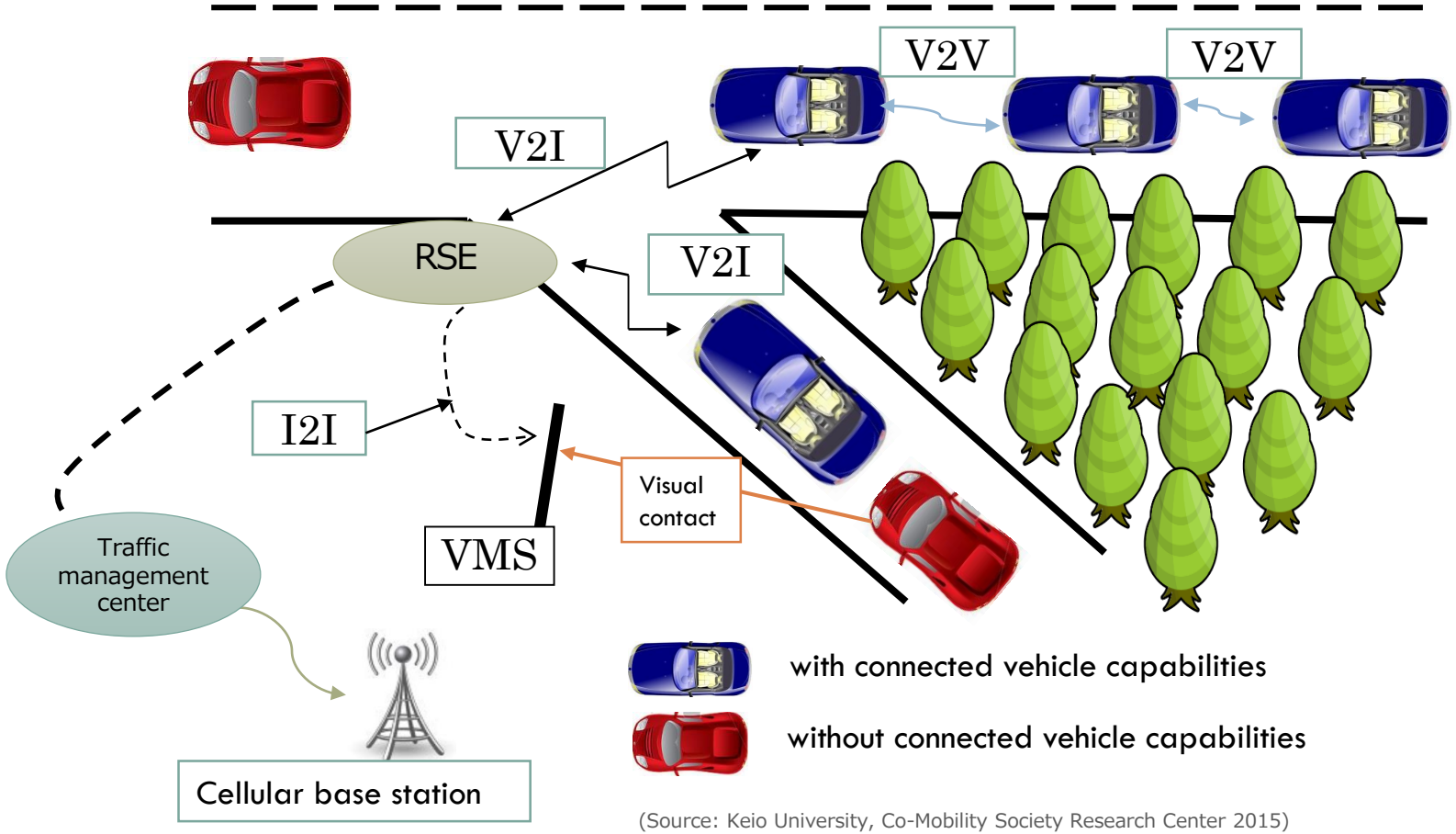
# Examples of European activities related to ODD

- The INFRAMIX project organized a workshop titled “Preparing road infrastructure for the introduction of Automated Driving”
- The EU EIP (European ITS Platform) project will organize a workshop on ODD on the first of October in Turin.
- INFRAMIX and the Trans AID project agreed to co-organize a workshop on the 8th of October in Graz. ODD, infrastructure classification, traffic management strategies and mixed traffic will addressed.

# 3. ODD and back born communication systems
## 3.1 Merging section

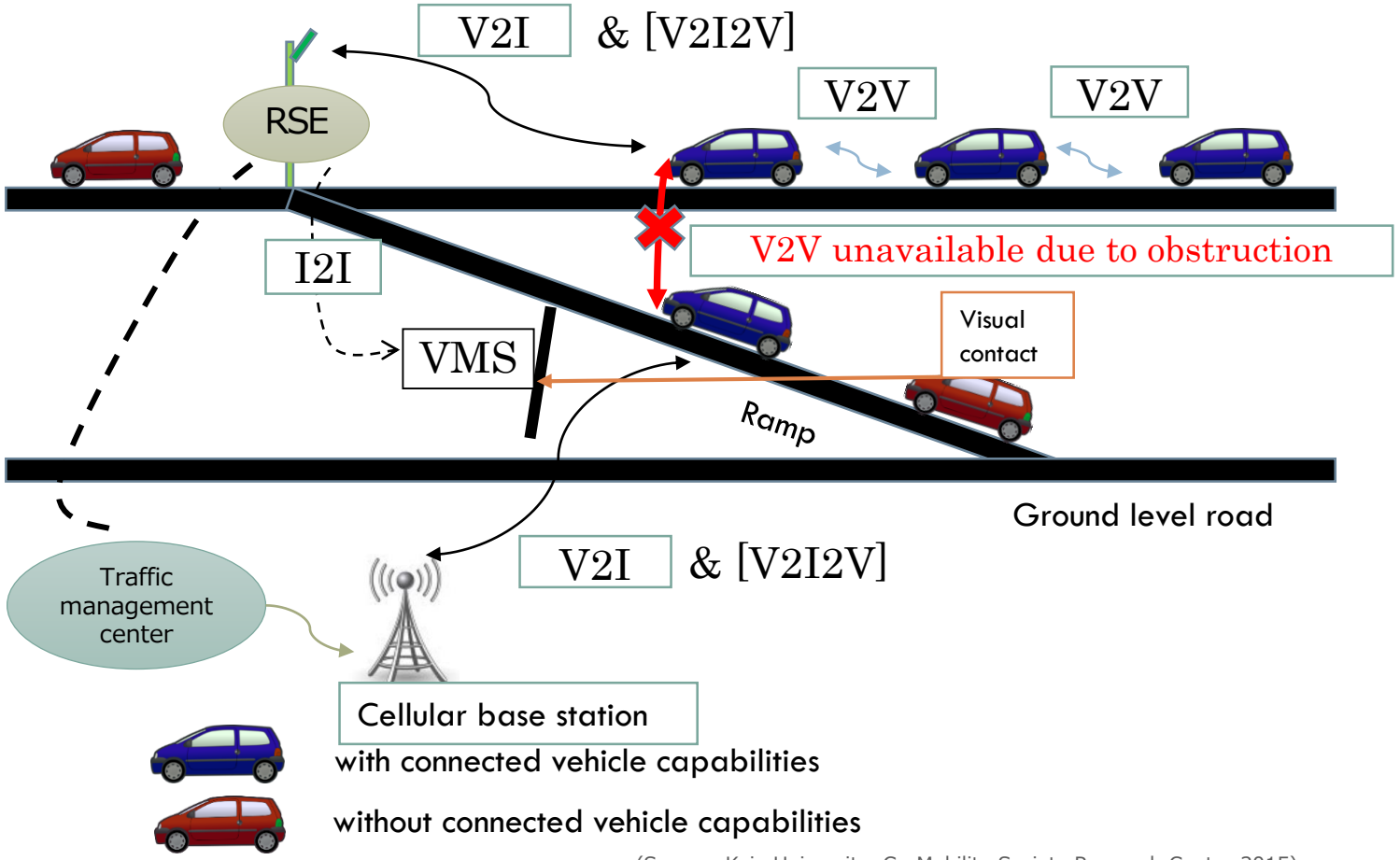
At current stage, merging sections in expressways, for example are excluded from ODD. However, these sections are the places where drivers need help.
Some kind of orchestration of related vehicles at the merging section is needed but the problem is who and how can we orchestrate the movement of vehicles to keep smooth traffic flow.
For this purpose, precious location tracking of related vehicles is necessary. Although the orchestration will be operated at very limited section the location data generated by automated vehicles will need to comply with data protection rules as far as personal data processing is concerned.

# ICT for Microscopic Management at flat lane rampway




(Source: Keio University, Co-Mobility Society Research Center 2015)

# ICT for Microscopic Management at a rampway with elevated lane

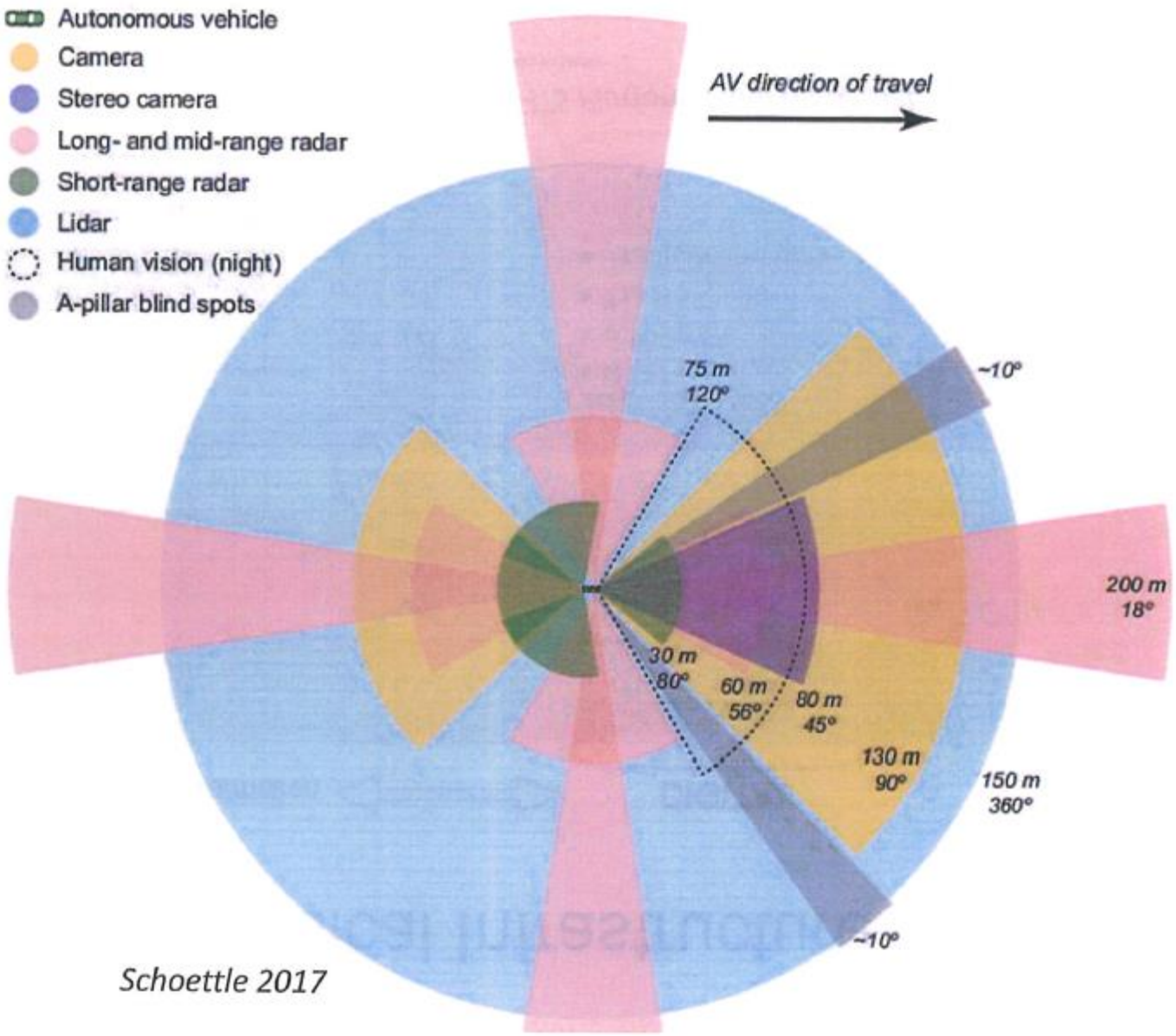



(Source: Keio University, Co-Mobility Society Research Center 2015)

# 3.2 Difference between current I2V and future I2V

- Vehicle sensors can detect very limited area and when weather condition is bad the sensing area will be 1/3 or less.
- I2V is necessary at long curves and bad visibility sections of the roadway.
- Future I2V will become M2M communication but road authorities are not ready to prepare for this innovation.

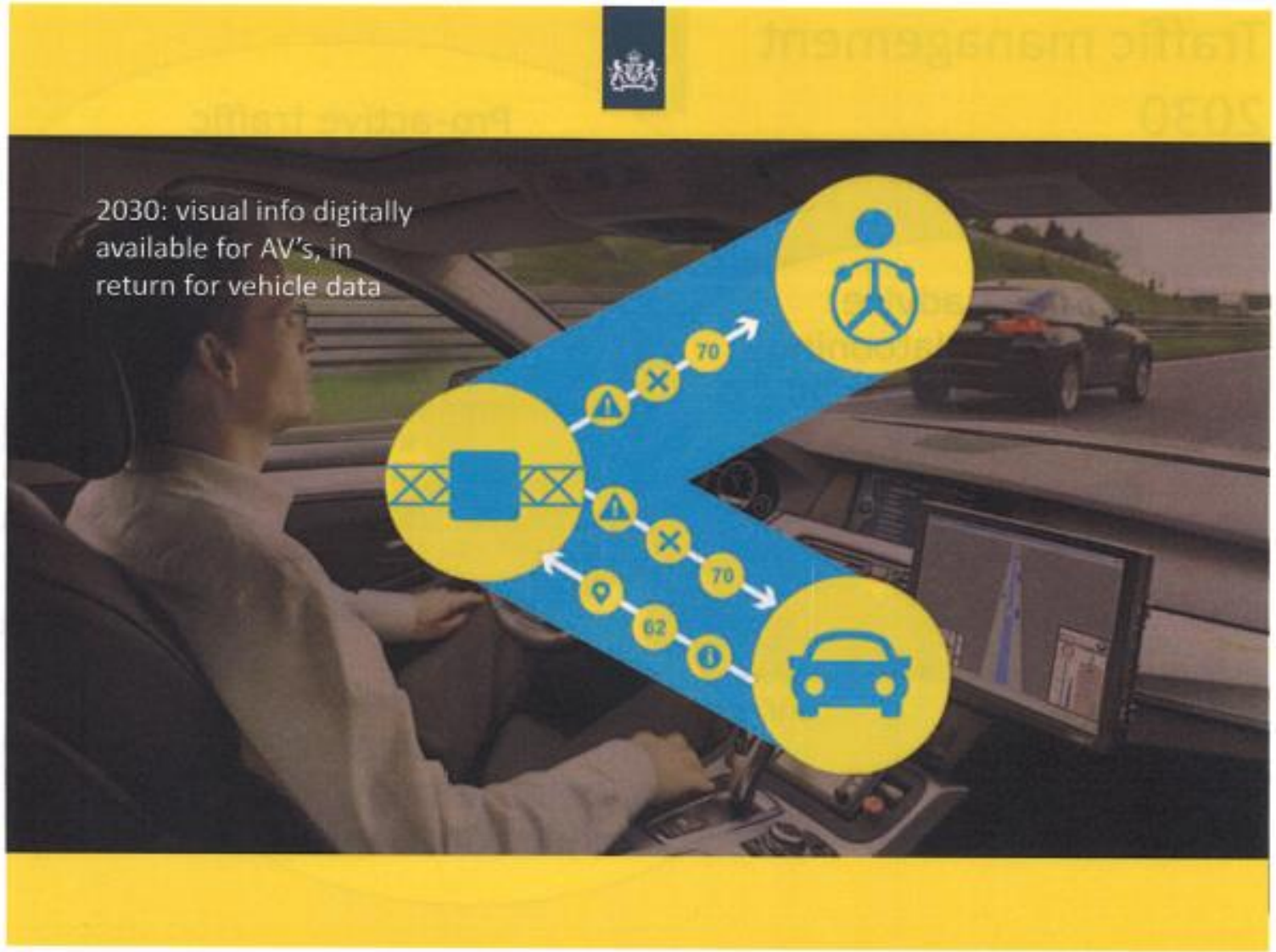
# Need for electronic horizon & digital infra: Sensor ”sight” distances



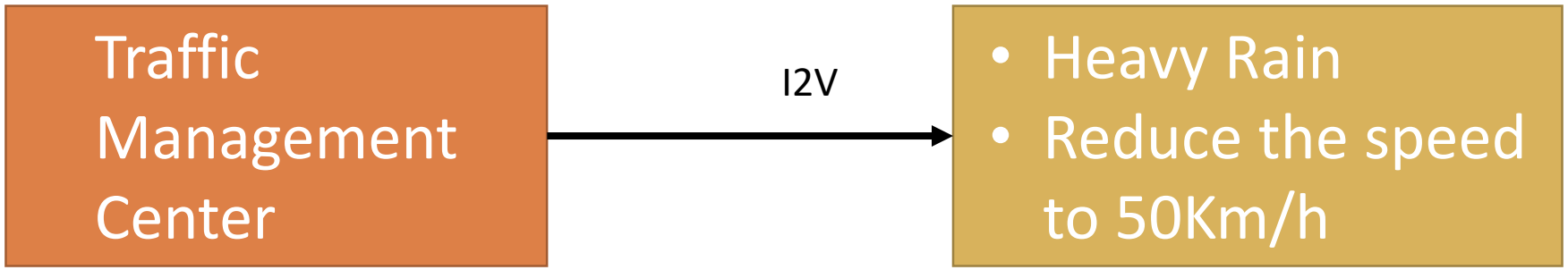

Schoettle 2017

# Current I2V (Source; Rijkswaterstaat)

# Future I2V & V2I (Source; Rijkswaterstaaat)

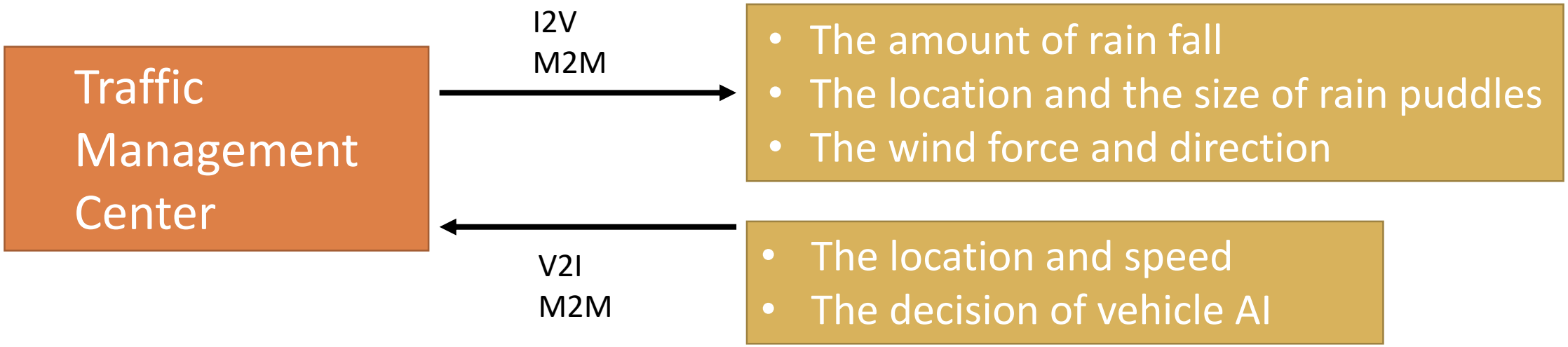


# Examples of current I2V and Future I2V & V2I
## Current I2V




Basic assumptions that the driver will see the message from TMC by navigation system or smart phone etc., and then driver decides the next action

# Future I2V & V2I with M2M capability

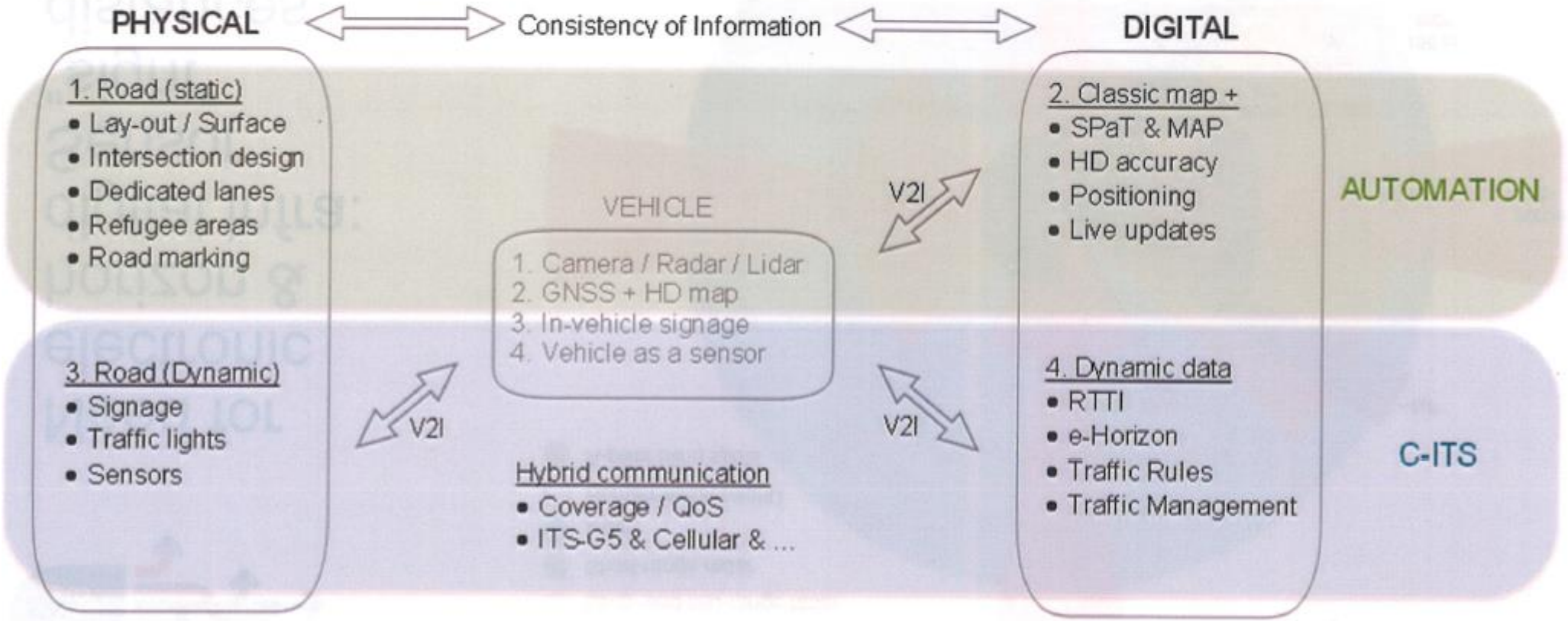



TMC can send location data of the rain puddles etc., but the driver can not use these data for their action. On the other hand, TMC can receive the actual reaction of vehicle by V2I such as the decision parameter of the vehicle at certain rain puddle. However, most of the road authorities are not ready to prepare for constructing data base to assist Automated Vehicles.

# 4. Concluding remarks

- There are already various proposal about wide area and narrow area communication systems including the combination of these two.
- The next diagram is an image of rough design of wide area and narrow area communication systems for expressway traffic management.
- The important thing is that for everyday operation of traffic management the personal data is not needed. Only aggregated (mean value, maximum, minimum etc.) data for certain time period at certain section are needed.
- OD (Origin and Destination) data is used for determining road planning and fare policy of toll roads and private sectors are interested for their marketing. But this sould be considered by additional mechanisms.

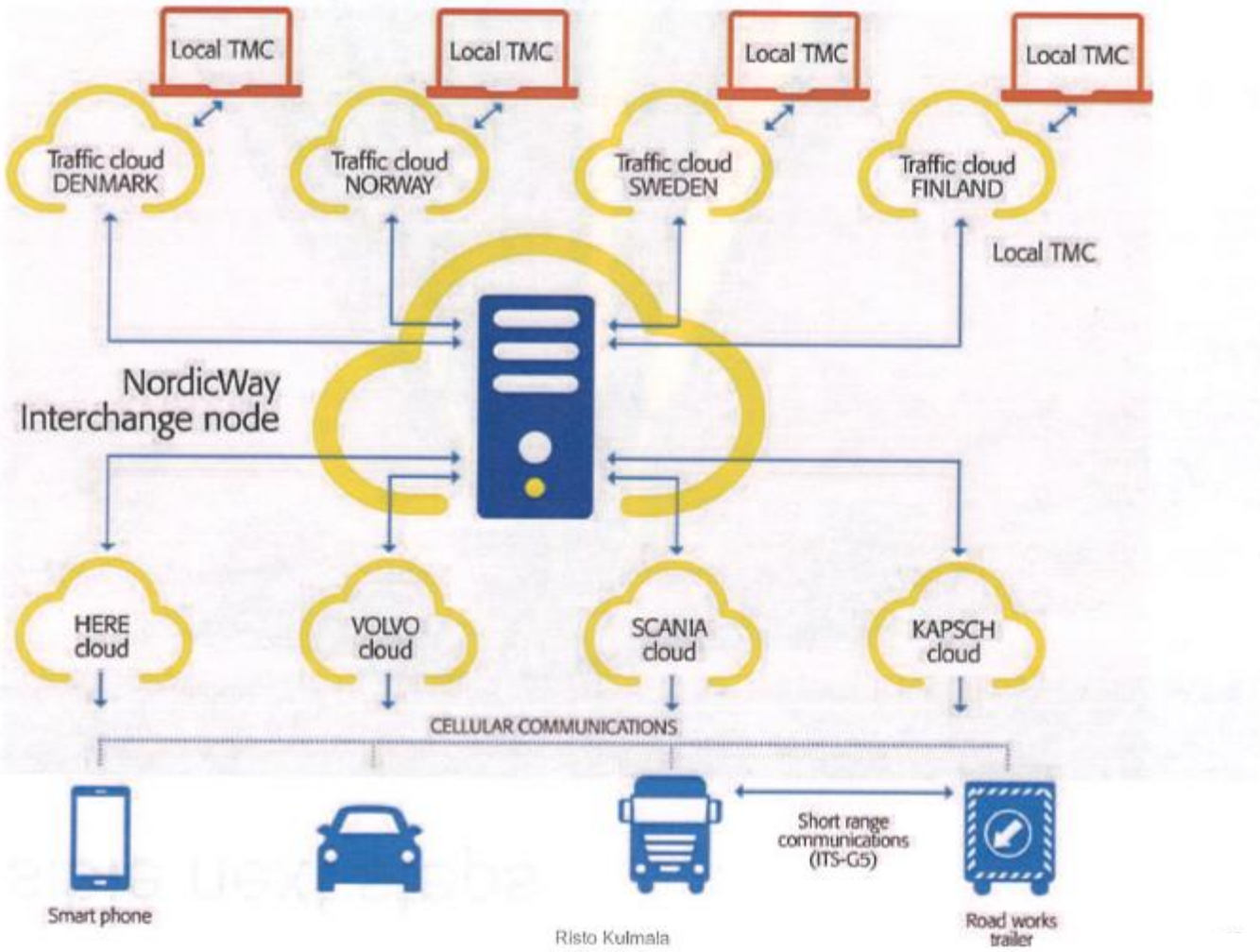
# Digital and Physical Infrastructure




*C-ITS Platform Final report September 2017*

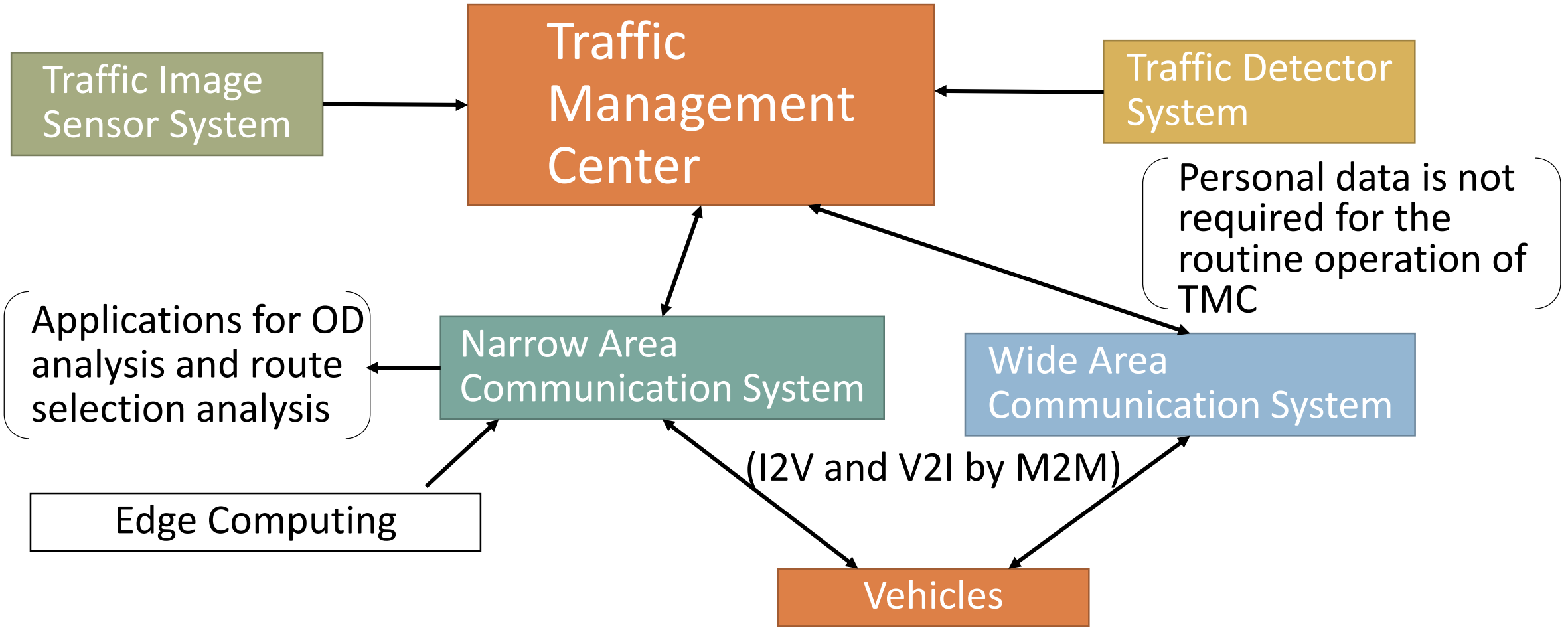
# Data sharing: NordicWay interchange node

Real-time sharing of safety related data via cellural networks by incorporating a ”neutral server”




Co-financed by the European Union
Connecting Europe Facility

# Wide and Narrow area communication systems for the Expressway ODD Management



# Future activities and related topics

- Road authorities, automobile manufacturers and telecommunication companies do not know each other. For example, road authorities do not know the requirements of automobile manufacturers because they do not have standardize requirements to road authorities. Therefore, road authorities do not know their potential data to help automated vehicles and how the related data base should be developed by future investments.
- ITU seems to have good position to start discussion with automobile manufacturers and road authorities although there will be multiple realization of back born communication systems for ITS and Automated Vehicle but in any case it will be the combination of wide area and narrow area communication which is the home ground of ITU.

# Future activities and related topics

- Dr. Moon of KOTI and Keio University are planning Ad-hoc meeting of the Plenary Meeting ISO/TC204 (ITS) in Singapore, October this year, about the same topic. I hope this will be another start among WGs of ISO.
- PIARC (World Road Association has announced short reports on Automated Driving. Examples are;
  - Fully Automated Driving
  - Vision of Automated Highways
  - Vision of Smart Network Operations
  - Data Ownership and Sharing
- Standardization of ITS is published by JSAE every year in Japanese and English.