Field Operation Tests in SIP-adus

SIP-adus: Cross-Ministerial Strategic Innovation Promotion Program
Innovation of Automated Driving for Universal Services

July 11, 2017
Hajime Amano
President, ITS Japan
Chair, International Corporation WG, SIP-adus
Technologies for Automated Driving

On-board Technologies
- Perception
- Decision
- Operation

Precise digital map
V to X
Built-in sensors
Camera
Lider
Rader
GNSS

HMI
Human Machine Interface
Coordination

Security, Simulation, Shared database, etc.
Framework for Dynamic Map

Data Collection
- Public Agencies
  - Congestion
  - Accidents
  - Road conditions
  - Traffic regulations
  - Road signs
- GSI, Road Authorities
  - Structural data
- Private Sectors
  - Field survey
  - GNSS
  - MMS

Compilation as ‘Dynamic Map’
- Common database
- Customization

Service Operations
- Map database
- Probe Data
  - Location
  - On-board sensing
  - Image
- Map database
- Probe Data
  - Location
  - On-board sensing
  - Image
- Operation Service X
- Operation Service Y
- Subscriber
- Subscriber

Structured Database
Dynamic Data
Static Data
Map Supplier A
Map Supplier B
Alliance
**Development of Operational Framework**

**Dynamic Map Platform Co., Ltd.**

Founded in June 2016 to establish technologies and business scheme to build and maintain the Dynamic Map for automated driving and other applications. The company has been transformed to a business entity as of June 13, 2017.

<table>
<thead>
<tr>
<th>Survey and digital map providers</th>
<th>Auto manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitsubishi Electric Corporation</td>
<td>Isuzu Motors Limited</td>
</tr>
<tr>
<td>Zenrin Co., Ltd.</td>
<td>Suzuki Motor Corporation</td>
</tr>
<tr>
<td>Pasco Corporation</td>
<td>Subaru Corporation</td>
</tr>
<tr>
<td>Aisan Technology Co., Ltd.</td>
<td>Daihatsu Corporation</td>
</tr>
<tr>
<td>Increment P Corporation</td>
<td>Toyota Motor Corporation</td>
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<tr>
<td>Toyota Mapmaster Incorporated</td>
<td>Nissan Motor Co., Ltd.</td>
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<td>Hino Motors, Ltd.</td>
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<td></td>
<td>Honda Motor Co., Ltd.</td>
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<td></td>
<td>Mazda Motor Corporation</td>
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<tr>
<td></td>
<td>Mitsubishi Motors Corporation</td>
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</tbody>
</table>
Cooperation across the sectors

Format and Contents of the Dynamic Map

International Counterparts

Proposal on Landmarks

JAMA
Japan Automobile Manufacturers Association

SIP-adus
Dynamic Map Taskforce

Dynamic Map Platform Co., Ltd.

Prototyping for Field Operation Tests

Investigation of Communication Technologies

JAMA
Japan Automobile Manufacturers Association

Use case, Requirements

Technology Options

ITS Info-communication Forum
(Association of Radio Industries and Businesses)
Connected and Automated Systems

### Built-in Assist (Built-in)
- Passive Safety
  - Seatbelt
  - Airbag
  - Body Structure
- Active Safety
  - Pre-crush Braking
  - Speed and Distance Control
  - Lane Keeping Assist

### Cooperative Assist (V2I, V2V)
- Traffic Information, Warning
- Obstacles detection
- Merging Assistance
- Dynamic Route Guidance

### Available in the market
- Advanced Driving Assist
  - Lateral and Longitudinal Control
  - Platoon Control

### Fully Automated Driving
- Automated driving
Electronic Toll Collection and Connected Services

**Equipment**
- **Roadside**
- **On-board**

**Basic Services**
- **Toll Collection**
- **Safety Assistance**
- **Traffic Information**
- **Dynamic Route Guidance**

Nationwide operation since 2011.

Source: Ministry of Land Infrastructure, Transport and Tourism
Traffic Signal Prediction Systems (TSPS)

- **Green Signal Timing Advisory**: Timing of green light to move.
- **Red Signal Timing Advisory**: Timing to decelerate to stop at red signal.
- **Speed Harmonization**: Speed suggestion to pass intersections without stopping.

Source: National Police Agency
Right Turn Collision Warning

<table>
<thead>
<tr>
<th>Display</th>
<th>Sound</th>
<th>Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>Clear</td>
</tr>
<tr>
<td>B</td>
<td>-</td>
<td>In coming vehicle/s detected</td>
</tr>
<tr>
<td>C</td>
<td>beep</td>
<td>Turning against in coming vehicle/s</td>
</tr>
</tbody>
</table>

Detection of shielded approaching cars
Detection of pedestrians on the crosswalk

Source: National Police Agency
Research Projects in 2016 (1 of 2)

**Dynamic Map:**
- Surveys and Investigations for Prototyping and Evaluation Toward Construction of a Dynamic Map
- Surveying and investigation toward development of a common platform for dynamic maps
- Construction of the traffic regulation information management system for realization automated drive
- Investigation into the International Standardization of Dynamic Map and Overseas Trends
- Survey on utilization of satellite positioning information for realization of automated driving system
- Study and consideration to construct the "Dynamic Map Service Platform"

**Connected Vehicles:**
- Establishment of technology for providing traffic signal information towards the realization of automated driving
- Establishment of technology for providing vehicle/pedestrian detection information towards the realization of automated driving
- Creation of an internationally open research and development environment
- Development of V2V,V2I Communication Technology Toward the Automated Driving Systems
- Task II Development of Vehicle-to-pedestrian Communication Technology
- Development of Infrastructure Radar System Technology
- Next-Generation Intelligent Transport Systems (ITS) utilizing Information and Communication Technology (ICT)

**Human Factors:**
- Human Factors and HMI Research for Automated Driving

**Impact Assessment:**
- Study on analytical methodology to estimate the effect of automated driving technology on reduced number of traffic accident fatalities in order to achieve the government target
- Development and substantiation of simulation technology for estimation of traffic accident reduction detailed effects
- Development of an impact assessment method for Automated Driving System on CO2 emissions
### Research Projects in 2016 (2 of 2)

<table>
<thead>
<tr>
<th>Next generation Transport:</th>
<th>Cyber security:</th>
<th>Other:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Studies of sensing technologies relating to an precision docking control in a next-generation urban transportation system</td>
<td>- Prototyping and Evaluation of Server Functions and Map Update Procedure Toward Construction of a Dynamic Map</td>
<td>- Research and Study regarding the Promotion of International Cooperation Activities on an Automated Driving System</td>
</tr>
<tr>
<td>- Research on the speediness and the safety of the Advanced Rapid Transit</td>
<td></td>
<td>- Analysis of social and industrial aspects involved in the effort to develop more advanced automated driving systems and ensure their widespread use</td>
</tr>
<tr>
<td>- Research and examination with public participation concerning congestion/traffic jam predictions aiming for world standard accessibility</td>
<td></td>
<td>- Development and evaluation of construction technology for driving pictures database</td>
</tr>
<tr>
<td>- Survey and Investigation of Reducing Boarding Times in Public Transport</td>
<td></td>
<td>- Field Operational Tests toward Achieving Level 3/4 and Investigation toward Commercialization</td>
</tr>
<tr>
<td>- A research of the pedestrian support system common platform in a consideration of problems and solutions to realize automated driving systems</td>
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Objectives of Field Operation Tests

Verification of research results in 5 integrated themes

- Dynamic Map
- Human Machine Interface (HMI)
- Cyber Security
- Pedestrian Accident Reduction
- Next Generation Transport

International cooperation sharing the test fields and the data sets

- International participants already signed up (OEMs, suppliers and research institutes)
- Concrete evidence acquired through the tests on the common grounds
- In-depth discussions on the specific research topics
- Identification of shared challenges and direction to overcome them

Business model investigation
Outline of the Operation

Conditions:  - Large scale field operation tests on public roads will start in 2017.
- Test facilities and operation management will be provided by the government.
- Dynamic Map data for the test sites will be provided for free and participants are required to use the data and to submit evaluation reports.
- Participants who test their vehicles are required to arrange all other resources by themselves.

Test sites  - Expressways (relatively controlled environment)
- Arterial roads (with pedestrians and bicycles)
- Test facilities (separated from the general traffic)

Expected participants (both domestic and international)
- Auto manufacturers and parts suppliers
- Universities and research institutes
- Government agencies

General public and journalists will be invited to foster social acceptance through proper understanding of the technologies and implications.
Field Operation Test Sites

Expressway

300 km stretch in Tokyo Area
• Joban expressway
• Tokyo Metropolitan expressway
• Tomei expressway
• Shin-Tomei expressway

Test facility
Japan Automobile Research Institute

Arterial roads
Tokyo waterfront city area
Guidelines for Public Road Testing of Automated Driving Systems

May 2016, National Police Agency

Public road test of AD is available regardless of time and place as long as:

✓ the vehicle complies with the requirements of the Safety Regulation for Road Vehicles (including those specially approved by the Director of a District Transport Bureau),

✓ The person who assumes the role of the driver is seated in the driver’s seat, monitors the surrounding traffic as well as the vehicle’s condition at all times, and operates the vehicle in the event of an emergency as necessary in order to ensure safety and thus prevent damage to others, and

✓ The test vehicle is driven in compliance with the relevant laws including the Road Traffic Act

The guideline shows other notes including basic responsibilities of implementing entities, test driver’s requirements etc.

Source: Plenary Session, ITS Asia-Pacific Forum 2017, National Police Agency
The public road testing of Driving Automation System with Remote Control Technology (DAS-RCT) is regarded as the action which can be implemented with the permission for use of roads. With this permission, implementing entity will be able to test DAS-RCT on public road in Japan (the driver has not to be inside the vehicle).

Stating the case where one driver drives multiple vehicles, etc.

Based on the international discussion at WP.1 (UNECE)

WP1-72 (April 2016)

The Group was of the opinion that there was no need for amendments to the 1949 and 1968 Conventions on Road Traffic for foreseeable types of experiments (i.e. “where there is a person who is ready, and able to take control of the experimental vehicle(s); this person may or may not be inside the vehicle”).

Source: Plenary Session, ITS Asia-Pacific Forum 2017, National Police Agency
4th SIP-adus Workshop on Connected and Automated Driving Systems 2017
SIP-adus: Innovation of Automated Driving for Universal Services

Organizer:
Council for Science, Technology and Innovation,
Cabinet Office, Government of Japan

Date: November 14-16, 2017

Venue: Tokyo International Exchange Center

Topics:
1. Dynamic Map
2. Connected Vehicles
3. Human Factors
4. Impact Assessment
5. Next generation transport
6. Security

Special Information Session on SIP-adus
- Field Field Operation Tests starting 2017
- Achievement of SIP-adus activities
4,500 acres
24/7 operation
800+ customers
450+ employees

• Operated by TRC, Inc. (501c3)
• Managed by The Ohio State University
• Home to NHTSA’s Vehicle Research & Test Center

SMART Belt Coalition

A selection of European Members
State Automated Vehicle activities

Maxime Flament, ERTICO – ITS Europe
Amsterdam Declaration – Follow up

- Declaration to strengthen cooperation in the field of connected and automated driving
- Signed by EU Transport Ministers on 14 April 2016
- MS driven in cooperation with EC & Industry
- Informal HL meetings (2/year)
  - 15 February 2017 (Amsterdam)
  - 14-15 September 2017 (Frankfurt)
- Working agenda
  - Data sharing
  - V2X Communication technologies
  - Cross Border Testing
  - Coherent regulation
  - Joint European Approach
Overview

• Selection of National activities
  • Germany
  • France
  • UK
  • Sweden
• Selection of EU-funded activities
  • AUTOPILOT
  • L3Pilot
• What is next
Germany

A9 Digital Motorway Test Bed
Lower Saxony Testfield
Baden-Wurttemberg Testfield
A9 Digital Motorway Test Bed

Basic Infrastructure

• Complete high-speed mobile communications coverage
• Communication via vehicle Wi-Fi
• Fast LAN connection
• Mobility Data Marketplace as standardized interface
• Highly precise map
• Road markings
• Adaptive traffic control systems
A9 projects and experiments

- Mobile Edge Computing
- Platooning project
- Interconnection and expansion of traffic data collection (iRoute)
- RWW and Probe Data cooperative systems (C2I)
- Telematics systems to warn of wrong-way drivers
- Replacement of emergency telephone infrastructure
- Innovative HGV parking guidance
- Intelligent bridge monitoring
- Intelligent road ice forecasting
- Road weather online
- Service stations and rest areas of the future
- Optimization of roadworks ("intelligent merge-in-turn")
- Safe pullover for stationary checks
Test Area “Lower Saxony”

- High precise digital map
- Virtualized traffic signs
- Track with sensors and communication modules
- AIM Braunschweig

City (AIM)  |  Country Road  |  Highway  |  Freeway
France

Nouvelle France Industrielle (NFI)
Autonomous Driving French National Plan
FRANCE: COLLABORATION TOPICS UNDER NFI

1. AV Experimentations
   - Use case Roadmap
   - Demonstration
   - Experiments

2. AV Ecosystem
   - Legal
     - For Experimentation
     - For Deployment
     - Liability
     - Insurance
   - Regulation
     - Driver Monitoring
     - Minimum Risk Manoeuver
     - Take Over Time
     - AD Data recorder
   - Test
     - AD Test track
     - Type Approval
     - EuroNCAP

3. TECHNOLOGIES
   - Embedded intelligence technologies
   - Safety Demonstration
   - HMI & Human Factor
   - Critical Scenario Database (simulation)
   - Infrastructure
   - Connectivity

M. Flament | AVS | July 2017
<table>
<thead>
<tr>
<th>AV Experimentations</th>
<th>01/2016</th>
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<tbody>
<tr>
<td>Order for experimentation</td>
<td>12</td>
<td>28</td>
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<tr>
<td>&gt;10000 Kms roads</td>
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<td>21 Working Groups launched</td>
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<td>Declaration of Amsterdam</td>
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<td>International coordination @ G7</td>
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<td>Transportation Nagano</td>
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<td>France Germany Cross border Experimention site</td>
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<td>ITE Vedecom</td>
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<tr>
<td>IRT SystemX</td>
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<td>#FranceIA</td>
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French-German cooperation on automated and connected driving

- Objectives: Jointly assess challenges and impacts of automated and connected driving on:
  - safety
  - traffic management
  - interactions with infrastructure and other road users
  - mobility and the environment
  - through
  - exchanges of experiences, studies and research
  - a common test site
  - allowing research and industry to conduct tests in various real traffic situations
United Kingdom

InnovateUK projects
Centre for Connected and Automated Vehicles
**INSIGHT**

£2.2m project to develop and trial driverless shuttles with advanced sensors and control systems focussed on improving urban accessibility for disabled and visually impaired people in Birmingham. Runs from 2016-2019.

**CITE**

£5.6m project equipping urban roads, dual-carriageways and motorways in Coventry with combinations of 3 “talking car technologies” and LTE-V to establish benefits of connected and autonomous vehicles through connectivity. Runs from 2016-2019.

**i-Motors**

£1.7m project to deliver a connected vehicle-to-anything (V2X) system via a mobile platform as a proof of concept.

**flourish**

£5.5m project to help develop innovative new tools to improve the understanding of user needs and expectations of connected and autonomous vehicles. Runs from 2016-2019.

**RDM GROUP**

£1m project to reduce the cost of testing and evaluating autonomous control systems in a safe repeatable controlled and scientifically rigorous environment. Runs from 2018-2018.

**UK Autodrive**

£19 million project to demonstrate road-going cars and low speed pods in Milton Keynes and Coventry.
GATEway - Highlights

Specific trails are:

- **Automated passenger shuttles**: exploring the use of automated shuttle vehicles as a small scale transport service.
- **Automated urban deliveries**: using automated vehicles for last mile transportation; potentially from a local delivery depot to a residential neighbourhood.
- **Additional traveller needs**: exploring the benefits of automated vehicles for people with additional travel needs.
- **Remote teleoperation**: where a human operator must intervene to recover a fully automated vehicle to a safe mode of operation.
- **High-fidelity simulator tests**: to investigate how drivers of regular vehicles respond and adapt their behaviour to the presence of automated vehicles on the roads.

- **Technology**
  - The safe and efficient integration of sophisticated automated transport systems into complex real world smart city environments
  - A validated test bed in the heart of London for the evaluation of next generation automated transport systems, including the detailed testing protocols and benchmark data for independent verification of automated systems
- **Human Behaviour**
  - Understand cultural and social challenges
- **Legal**
  - Understand legal challenges
- **Impact**
  - Inspire industry, public bodies and the wider public to engage with autonomous transport technology
  - UK PLC at the forefront of the global connected and autonomous vehicle marketplace, encouraging inward investment and job creation
- **Deployment**
  - Valuable, exploitable knowledge of the systems required for the effective validation, deployment, management and integration of automated transport within a smart city environment
Sweden

DRIVE ME
Sweden4Platooning
Mobility as a Service
100 ‘normal’ families will experience self-driving Volvo XC90s on public roads in Gothenburg

- The project was kicked off in 2013, and the pilot begins in 2017
- Similar pilots will later be run also in London and China
Sweden4Platooning

3 year FFI project with Scania, Volvo, Royal Institute of Technology, SICS Swedish ICT, DB Schenker AB and the Swedish Transport Administration

Main goals:

Pilot Multi-Brand CACC (longitudinal control of trucks) at haulage company

Demonstrate Multi-Brand platooning (lateral and longitudinal control of trucks) at suitable test site
Drive Sweden – Self-driving, electric and shared vehicles

This project includes testing fully automated and electrified minibuses in reality, in specific areas in the cities of Stockholm and Gothenburg; streamlining existing electrified buses using automated functions; enabling a car-sharing service to a large fleet of passenger cars and to digitalise a number of traffic signals to enable optimization of online and automotive vehicles.
More active EU Member States

• The Netherlands
• Austria
• Spain
• Greece
• ...
New EU-funded activities

AUTOPilot
L3PILOT
EU project Autopilot: Internet of Things for AV

Demonstrate added value of Internet of Things for Automated Driving

Innovation Action - 3 Years: 01/01/2017 – 31/12/2019

44 beneficiaries

Coordinator: ERTICO

Project costs: €25 million - EU contribution: €20 million
Europe
Brainport, NL
- Automated Valet Parking
- Highway pilot
- Platooning

Korea
Tampere, FI
- Automated Valet Parking
- Urban Driving

Versailles, FR
- Automated Valet Parking
- Urban Driving
- Platooning

Daejeon, KR
- Urban Driving

Vigo, SP
- Urban Driving
- Automated Valet Parking

Livorno, IT
- Urban Driving
- Highway pilot

6 AUTOPILOT IoT for AV sites
H2020 – New large-scale demo – L3 Pilot

- large-scale piloting of SAE Level 3 functions, with additional assessment of some Level 4 functions
- Overall objective: test and study the viability of automated driving as a safe and efficient means of transportation, explore and promote new service concepts to provide inclusive mobility.
- 11 countries, 100 vehicles, 1000 test drivers involved in the testing
- Tested functions cover wide range from parking to overtaking, and urban intersection driving.
- Cross-border tests are planned for automated driving systems on highways (e.g. traffic jam assist, highway assist)
- 34 partners (OEMs, suppliers, research, SMEs, insurers, authorities and user groups)
- Start: September 2017 (48 months)
- Budget: €47 Mio (EC funding: €36 Mio)
Other highly relevant European projects

• Validation projects
  • PEGASUS (DE)
  • ENABLE S3 (EU)

• HMI and Human Factors
  • ADAS&ME (EU)
  • InterACT (EU)

• Infrastructure for AV
  • MAVEN (EU)
  • SAFE STRIP (EU)

• End-user acceptance
  • TrustVehicle (EU)
  • BRAVE (EU)

• Mixed traffic operation
  • INFRAMIX (EU)
  • TransAID (EU)
  • CoExist (EU)

• Big Data and Machine Learning
  • VI-DAS (EU)
  • Cloud - LSVA (EU)

• Positioning
  • INLANE (EU)

• Parking
  • Park4U (EU)
Other topics coming up in H2020
Work programme 2018-2020

- Testing, validation and certification procedures for highly automated driving functions
- Human centred design of AV
- Assessment of impacts, benefits and costs of CAD systems
- 5G for connected and automated driving
- Cloud Computing
- Big Data
- Artificial intelligence

- Large-scale demonstrations of
  - Automated heavy duty vehicles in real logistics operations
  - Highly automated driving functions for passenger cars
  - Shared automated vehicles in urban areas
H2020 - Planned large-scale Demos

Urban systems

- Shared AV fleets in urban areas (planned)
- Fully automated urban road transport (planned)

Truck Platooning

- Multi-Brand Platooning (planned)
- Automated trucks in real logistics operations (planned)
- AutoPilot

Passenger cars

- 5G for CAD (planned)
- L3 Pilot
- Highly Automated Vehicles (planned)
- AutoPilot

M. Flament | AVS | July 2017
Conclusions

- There are hundreds of activities at European level on Automated Vehicles
- More funding is planned over the next three years
- Funding from EU Members State level is much larger than at European level
- Need to consolidate a knowledge base to capitalise on all results
- Need to map and categorise the AV activities (early attempt with wiki not scalable enough)
  - Meta-data: Start-end, duration, size, partners, etc
  - Main focus, Expected outcomes
  - Technical and non-technical challenges addressed
Thank you!

Maxime Flament, ERTICO – ITS Europe
m.flament@mail.ertico.com