Automated Driving Development
in Korea

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Outline

I. Key Components for Automated Driving

II. Main Activities for Deploying C-ITS Infrastructure

III. Main Activities for Testing Automated Vehicles

IV. International Cooperation
I. Key Components for Automated Driving

Digital Infrastructure vs. Automated Vehicle

Source: ETSI TS 101 539-3 V1.1.1 (2013-11), Intelligent Transport Systems (ITS);V2X Applications; Part 3: Longitudinal Collision Risk Warning (LCRW) application requirements
Digital Infrastructure vs. Automated Vehicle

- Digital Infrastructure
  - Cooperative ITS(C-ITS) based infrastructure enabling to seamlessly cooperate/connect between transport components (vehicle, road & traffic environment, and users) for safety and efficiency
  - More required for safety applications in urban areas

- Automated Vehicle
  - Advanced technologies enabling to sense, connect, and communicate with considering human factors and safety functions
  - More independently applicable in Expressways

- Others
  - System integration, Standardization, Legal for deployment and installation, User Awareness, Big data

Source: www.comesafety.org
I. Key Components for Automated Driving

- **Cooperative ITS (C-ITS)**
  - **Current ITS**
    - One-way based Center-oriented system with wire comm. between independently deployed RSEs, and partly wireless comm. between RSE and OBU
  - **C-ITS**
    - Two-way based On-site-oriented system with wireless communication between RSE, OBU, and mobile device, and also connected with current ITS
**Automated Vehicle**

### Levels of Vehicle Automation

- Primary (safety) controls: Steering, Braking, Throttle etc.

<table>
<thead>
<tr>
<th>Levels</th>
<th>Definition</th>
<th>Key Descriptions</th>
<th>Keywords</th>
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</thead>
</table>
| 0      | No Automation | • Only driver is in control of the primary vehicle controls  
• Warnings (FCW, LDW, BSM, etc), secondary controls (wipers, headlights, turn signals, hazard lights, etc) | • No primary automated controls |
| 1      | Function-specific Automation | • Driver is solely responsible for safe operation  
• Safety Supporting (cruise control, automatic braking, lane keeping, etc) | • One or more controls, but separately |
| 2      | Combined Function Automation | • Driver cedes primary control on certain limited driving situations, but is responsible for monitoring the roadway and safe operation  
• Hand off and foot off at the same time (lane centering + adaptive cruise control) | • Two more primary controls |
| 3      | Limited Self-driving Automation | • Vehicle enables the drivers to cede full control of all safety-critical functions by monitoring certain traffic or environmental conditions  
• Sufficient comfortable transition time | • Automated monitoring |
| 4      | Full Self-driving Automation | • Vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip  
• Safe operation rests solely on the automated vehicle system | • Both occupied and unoccupied |

Source: NHTSA, US DOT
II. Main Activities for Deploying C-ITS Infra.

- C-ITS Infrastructure

1. ITS Master Plan 2020 ➔ ITS Master Plan 2020 (revision)
   - Key committee: ITS committee with MOLIT
   - Projects for proof of concept, FOT: u-Transportation, Smart Highway
   - Projects for Pre-Deployment: Next-Generation ITS Pilot (‘14~‘17)
   - Project for Pilot Deployment: C-AHS, Cooperative Automated Highway System (‘15~‘20)
   - Focused mainly on V2I
II. Main Activities for Deploying C-ITS Infra.

- **C-ITS Infrastructure: R&D project**

**u-Transportation**

![Map of Seoul and Namnyangju cities with marked segments](image)

- **Uninterrupted Highway Segment**
  - Variable Speed Limit Service (VSLs)
  - Warning Service for Risky Driving (WSRD)
  - Merging Service at Entry Ramp (MSEN)

- **Interrupted Highway Segment**
  - Follow-Me Service (FOMS)
  - Bird-Eye View Service (SEVS)
II. Main Activities for Deploying C-ITS Infra.

- **C-ITS Infrastructure: R&D project**

![Map of Smart Highway](image)

1. Complex Base Station (WAVE+WIFI+DSRC)
2. RADAR Detector (freezing, water film, fallen objects)
3. SMART-I (Array camera)
II. Main Activities for Deploying C-ITS Infra.

- C-ITS Infrastructure: Pilot Deployment project

- **Main Activities**
  - Develop applications and standards
  - Effectiveness analysis

- **Site**
  - Daejeon & Saejong
## C-ITS Infrastructure: Pilot Deployment project

### Service Applications

- 6 sectors, 15 applications

<table>
<thead>
<tr>
<th>Categories</th>
<th>Services</th>
<th>Road Types</th>
<th>Time</th>
<th>Tech.</th>
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<td></td>
<td></td>
<td>Freeway</td>
<td>N-road</td>
<td>U-road</td>
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<tr>
<td>Cooperative Traffic Management</td>
<td>Location-based vehicle data collection</td>
<td>O</td>
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<td></td>
<td>Location-based traffic information provision</td>
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<td>Smart tolling with multi-lanes and non-stop</td>
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<td>Safe Driving Support</td>
<td>Road hazard zone driving</td>
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<td>Road surface-weather information</td>
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<td>Work zone driving</td>
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<tr>
<td>Intersection Driving Support</td>
<td>Signal information provision</td>
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<td>Intersection collision prevention</td>
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<td></td>
<td>Commercial vehicle management</td>
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<td>Transportation poor</td>
<td>School/Silver zone warning</td>
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<td></td>
<td>Pedestrian collision prevention</td>
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<tr>
<td>Designed Tested Services</td>
<td>Car Crash Prevention</td>
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<td></td>
<td>Emergency vehicle priority</td>
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<td>Emergency call</td>
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</table>
II. Main Activities for Deploying C-ITS Infra.

C-ITS Infrastructure: Master Plan

Long-term Strategies (tbd)

- **2014~2020**
  - Introduction

- **2021~2025**
  - Expansion

- **2026~2030**
  - Maturity

**Main Activities for Deploying C-ITS Infra:**

- **Expressways**
  - Level 1&2
  - Expressways National roads
  - Urban roads

- **National roads**
  - Level 3&4
  - Expressways National roads

- **Urban roads**
  - Level 4&5
  - Autonomous road and veh.

**V2I and V2V based on safety in metropolitan**
- Equipped for commercial veh.
- Control Interfaced
- Level 3&4
- Expressways National roads
- Urban roads

**V2V+V2P based on safety in urban areas**
- Equipped for passenger veh.
- Autonomous road and veh.
- Level 4&5
- Expressways National roads
- Urban roads

- **$3.6 billions**
  - traffic accident death Zero

- **Introduction**
  - Basic type for market
  - Mainly V2I based on safety in expressways

- **Level 1&2**
  - Expressways National roads
  - Urban roads

Level 3&4
- Expressways National roads
- Urban roads

Level 4&5
- Autonomous road and veh.

Level 4&5
- Expressways National roads
- Urban roads

- **2026~2030**
  - Maturity

- **2021~2025**
  - Expansion

- **2014~2020**
  - Introduction

- **Control Interfaced**
  - Equipped for commercial veh.
  - Level 3&4

- **V2I**
  - Equipped for commercial veh.
  - Control Interfaced

- **V2V**
  - Autonomous road and veh.
  - Level 4&5

- **V2P**
  - Expressways National roads
  - Urban roads
Law Revision for Testing AV

- Definition of the AV

- Permission of tentatively driving the AV on the public roads only for testing
  - Procedures to request tentative driving the AV

- AV requirements for safe-driving conditions
  - AV limited to the passenger cars
  - AV functions controlled by driver
  - AV malfunction detected and warned automatically
  - AV required of installing the driving recording device
  - AV marked for notifying other drivers
  - AV tested only on designated roads
  - Others

III. Main Activities for Testing Automated Vehicles
III. Main Activities for Testing Automated Vehicles

- Law Revision for Testing AV

- Testing Roads designated for driving the AV

- Designation criteria
  - Consider both driving safety and testing efficiency
  - Consider homogenous physical design and easy maintenance

- Designated testing roads (tbd)
  - Expressways: 2 sections of C–ITS Pilot project, and 2 sections of C–AHS
  - National roads: 5 sections of national roads
Cooperative AHS (C–AHS)

- **Cooperative Automated Driving Highway System (C–AHS)**
  - Periods: 2015~2020 (5 years)
  - Goal: Development of Smart C–AHS Technologies
  - Key subsystems: Infrastructure, Operation, Cooperation, Testbed

"Key Values"

- Development of Smart C-AHS Technologies
- Mobility
- Safety
- Cooperation
- Convenience

Infrastructure Technologies
Traffic Operational Technologies
Connectivity Technologies
Testbeds Applications
Automated Driving with C–ITS: Key Roadmap

~2015: Level 2
- Law revision to make it possible to drive the AV for testing on the public roads
- Improving GPS accuracy
- Infrastructure (e.g., C–ITS Pilot)
- Road designation for testing the AV
  (e.g., Expressways, National roads)

~2018: Testing of Level 3
- Lane-based road map
- Cooperation between Infrastructure and the AV (e.g., C–AVHS)
- Key services during the Pyeongchang Winter Olympic

~2020: Product of Level 3
IV. International Cooperation

- Global Harmonization

  - Korea & US
    - MOU sign: August 2012
    - TOR sign with Working Groups (WGs): July 2013
    - Drafts of WGs’ action plans: January 2015

  - Steering Group
    ITS JPO Director, OST-R
    ITS Division Director, Road Bureau

  - Technical Task Force
    ITS JPO, OST-R
    The Korea Transport Institute

  - Safety WG
    ITS JPO, OST-R
    Korea Expressway Corporation

  - Standards WG
    ITS JPO, OST-R
    ITS Korea

  - Pilot WG
    ITS JPO, OST-R
    The Korea Transport Institute
IV. International Cooperation

- **Global Harmonization**
  - **Korea & US (Cont.)**
    - Regular Meetings: TRB Annual Meeting, ITS World Congress
    - Conference Call and WG meeting
  - **Others**
    - Steering Group an Working Group of EU–US or EU–US–Japan
    - Standards Harmonization, Automation, Probe Data, Sustainability, etc.
Q & A

Thank you