

**Technical Session** : CAV technology & Shared mobility

## **Policy for automated vehicle in Korea & K-city**

**KATRI**

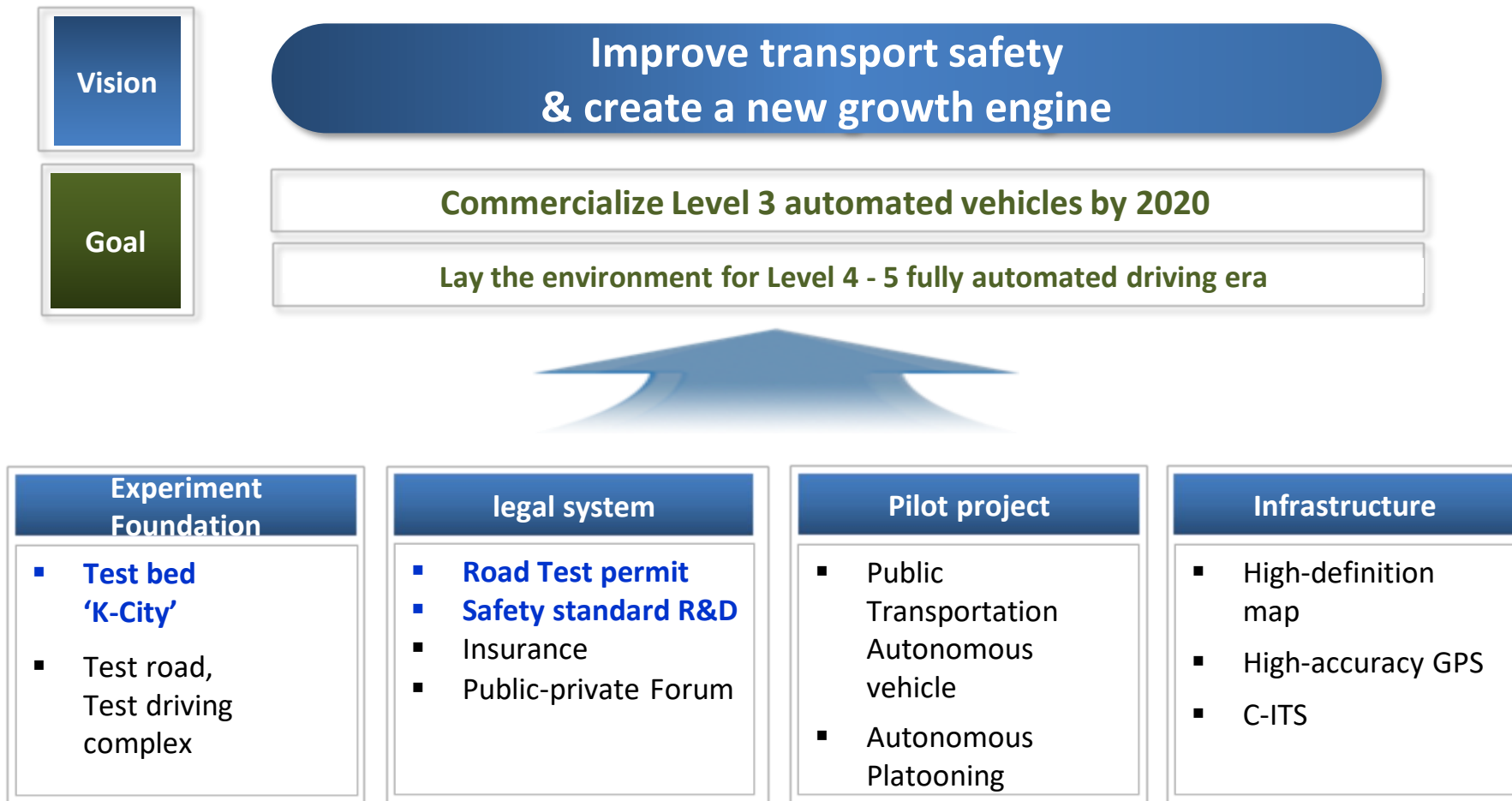
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**Chief Researcher**

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- Policy for Automated Vehicle in Korea
- Regulatory Frameworks
- Public road tentative driving permit
- Public Acceptability
- Business ecosystem
- Main Research Area for AV
- K-City
- Summary Plan

# Policy for Automated Vehicle in Korea

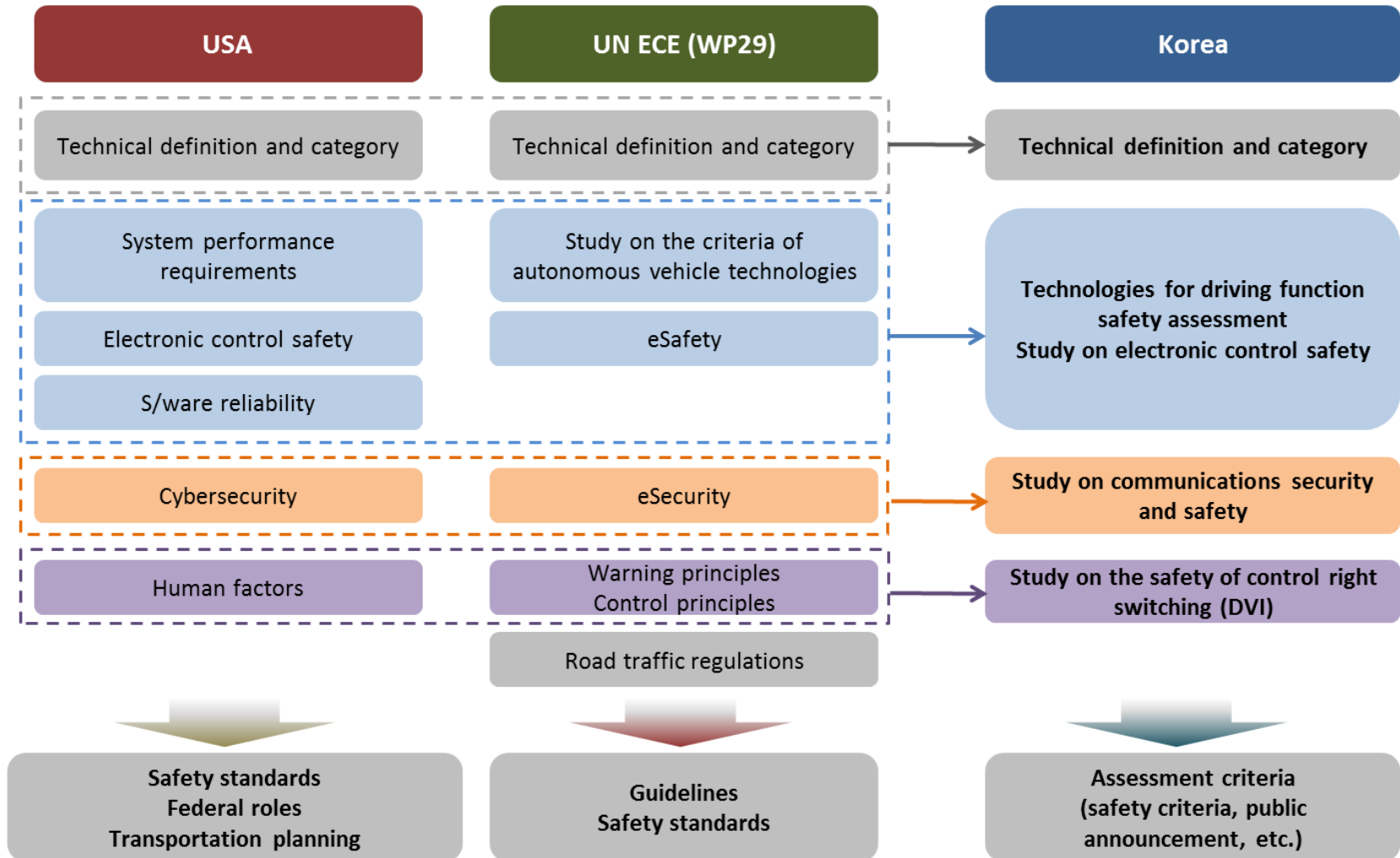
- **Policy for automated vehicle** \* the 3rd Deregulation Promotion Meeting held in May 2015



**Create an environment to maximize the private sector innovation capability**

# Policy for Automated Vehicle in Korea

## ● Direction of Policy in Korea



## ● Enactment of the AV act

- **「Act on promotion and support for commercialization of autonomous vehicles」** (enacted on 5.1.2019, enforcement from 5.1.2020)
  - The act provides more detailed definition of AVs in accordance with the level of technology development
  - Provides regulatory exemptions in the designated '**Pilot Operation Areas**' so that new technology can be tested and AVs can be more widely used for business purpose
  - Designates 'Autonomous Driving Safety Sections' so that the MOLIT prioritize infrastructure investment to ensure safety of Lv.3 AVs
- **The MOLIT will prepare subordinate legislations before the enforcement**
  - Detailed procedural process for designation of 'Autonomous Driving Safety Sections' and 'Pilot Operation Areas'
  - Detailed conditions for operating new types of AVs that don't meet existing safety standards

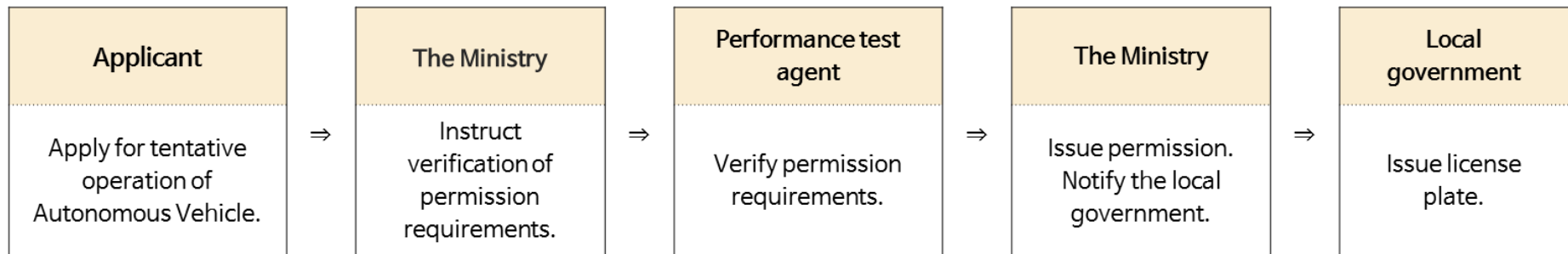
## ● Safety Standard for Lv.3

- **The MOLIT will establish safety standards for level 3 AV and introduce insurance for AVs so that level 3 AVs could be commercially available**
  - The safety standards provide standards for how AVs should move in normal driving status, malfunctioning and emergencies
  - Legalize an insurance system that prioritizes protecting victims, and introduce an accident inspection system to clarify responsibilities
- **The MOLIT actively participate in international cooperation to create global standards for AVs in UN/ECE/WP.29\***

\* WP.29 : World Forum for Harmonization of Vehicle Regulations)

## ● Public road tentative driving permit \* February, 2016

- (Law) For tentative operation, drivers shall conform to safety operation requirements and acquire permission of the Minister of Land, Infrastructure, and Transport (Motor Vehicle Management Act, Article 27)
- (Enforcement decree) Increase of tentative operation permission period for Autonomous Vehicles (2 years to 5 years) (Article 7)
- (Enforcement Rule) Provision of procedure for permitting tentative operation (Article 26-2)
- (Public announcement) Provision of safety operation requirements: Insurance subscription, prior test driving, and installation of indication/fault/speed-limiting devices



- Implementation of tentative operation permission system for R&D for the commercialization of Autonomous Vehicles (2016.2.12)
- Implementation of deregulation for promoting various field-test projects

Pangyo/Gyeonggido

Operation of driverless autonomous vehicle shuttle cars for the public (2017.12)

Pyongchang

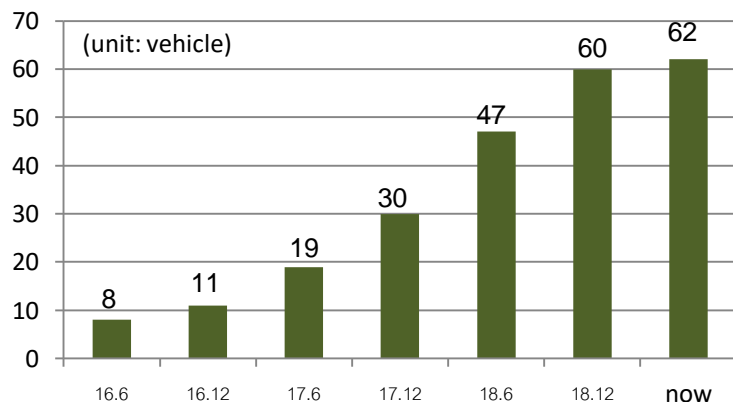
Pilot operation in preparation for the operation of autonomous vehicle shuttle cars for the Winter Olympiad (2017.12)

# Public road tentative driving permit

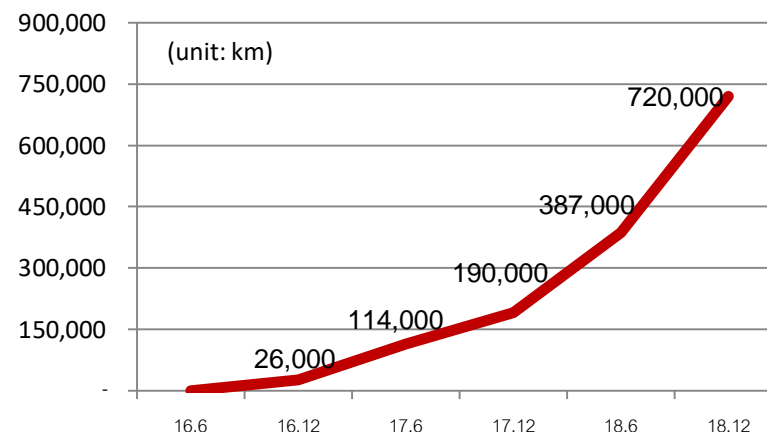
## ● Current state

- As of now, 62 AVs from 27 entities received the permits and distance driven reached 720,000 km

- Vehicle Manufacturers (23)
- Component Manufacturers (2)
- Universities (9)
- IT/Telecoms Company (5)
- Electronics (7)
- Research Institutes (10)
- Etc., (6)



< Temporary Permits on AV >



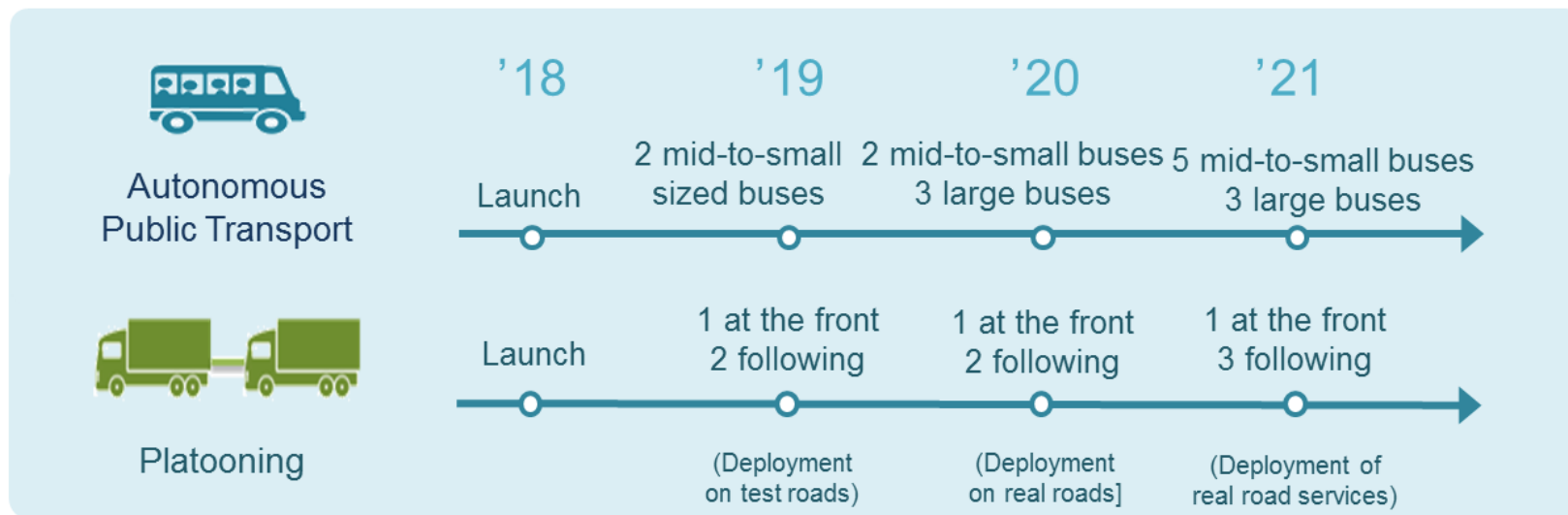
<Distance Traveled in AV Test Drives >

- Permit issuing procedure will be updated to accommodate more innovative designs and level 4, 5 vehicles



## ● Demonstrations and Test Operations

- Diverse demonstration events to engage the public ('18~)
  - Providing opportunities to reduce concern over AVs and increase acceptability so that AVs would be welcomed in the market
- Demonstration and test operations will be expanded to public transportation and truck platooning



## ● Partnership with the private sector

- **Cooperative autonomous vehicle industry symposium ('18~)**
  - a public-private joint meeting to promote cooperation and technical exchanges between companies, more than 200 companies participating
- **Data sharing center ('18~)**
  - 21 companies/universities/institutes jointly collect and share videos and images for AI input, developing data transaction standards
- **AV future forum ('16~)**
  - an advisory council where experts from diverse fields gather to discuss the future of AV based society and identify key policy issues



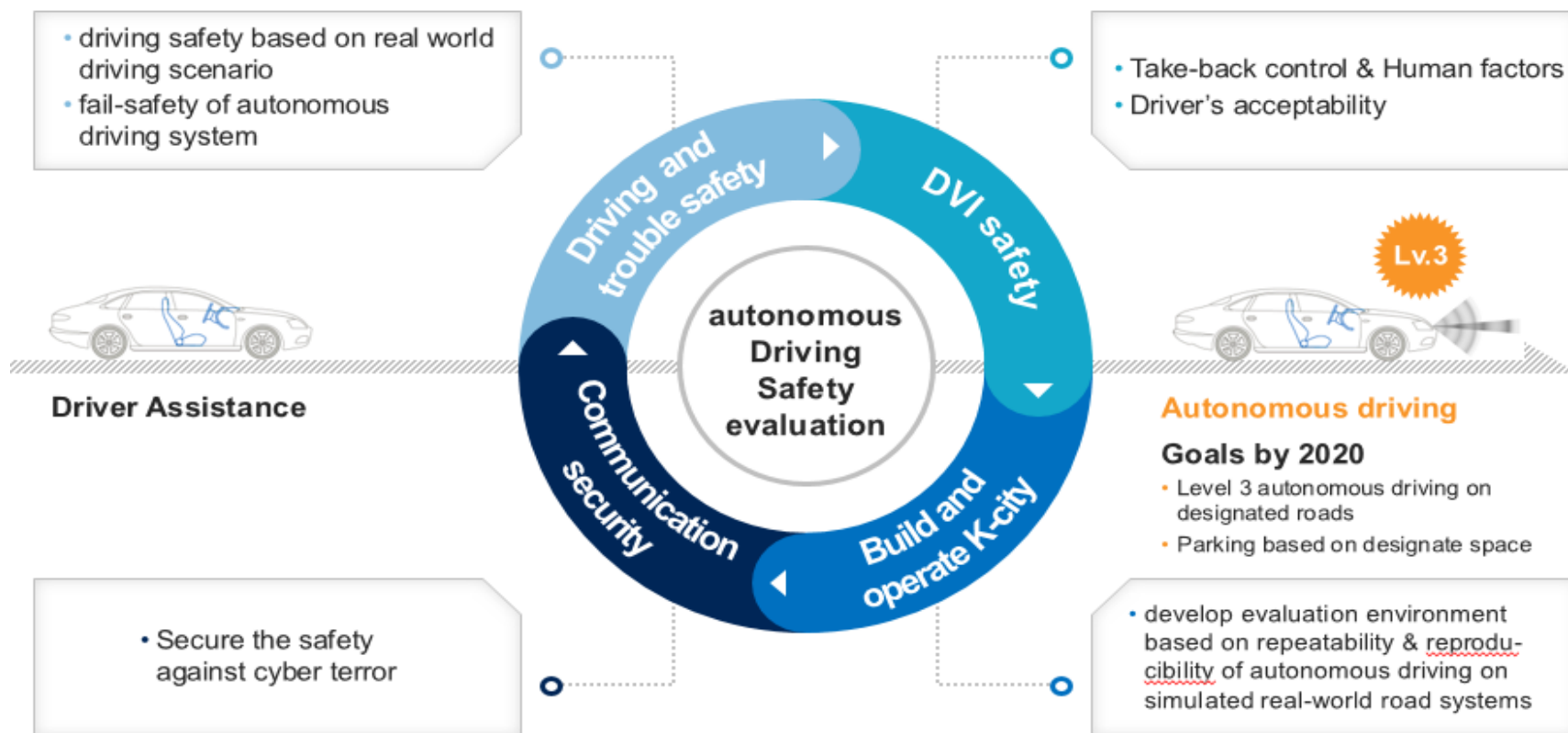
## ● New activities

- **Build industrial complexes in 「4<sup>th</sup> Industrial Revolution Supporting District」 ('19~'21)**
  - 37,000 m<sup>2</sup> industrial complex near K-City for 4<sup>th</sup> industrial revolution related industries such as autonomous vehicles, ICT, and drones
  - Create and provide 30,000 m<sup>2</sup> first in '19, and expand gradually
- **AV contests for University student to nurture professional talent ('19~)**
  - Provide expert education curriculum and programs
  - Students try to complete various missions with self-made vehicles

## ● Main Research Area for AV



### Roadmap to reach the level 3 in autonomous vehicle by 2020



## ● Scientific Technological Needs

- (Goal) Development of safety test technology and actual road environment for repetition and reproduction for the technologies to be commercialized by 2020

### Test bed development

- ✓ Insufficient research infrastructure with Level 2 test environment
- ✓ Unitary and limited test environment
- ✓ Using test roads for individual performance



- ✓ Improved research capabilities by developing Level 3 test environment
- ✓ Autonomous driving through integrated technology tests
- ✓ Development of dedicated autonomous driving experiment city (K-City)



### Safety test technology

- ✓ Test criteria of Level s 0 to 1 ADAS technology  
\* ABS, ESC, BAS, FCW, LDW, ACC, AEB, BSD, LKAS, etc.
- ✓ Concern for accidents caused by system failure, unexpected situations, and road conditions



- ✓ Test criteria of Level s2 to 3 autonomous driving technology  
\* LGS+ACC, PAS, V/Parking., T/I/Assist, H/pilot, etc.
- ✓ Reliability through verification
- ✓ Improved safety against failures and dangerous situations





## Project 1 : Development of assessment technologies for Automated vehicle

### Study overview

- Study period: 2016. 6. 29 – 2019. 6. 30 (36 months)
- Total study cost: KRW 19.9 billion (government sector – KRW 17.7 billion, private sector – KRW 2.2 billion)
- Participants: 15 organizations including KOTSA, KATECH, KOTI, Seoul National University, Kookmin University, Mobis, and SKT, etc.

### Study objective

To establish technologies for assessing safety and to establish verification facilities for ensuring safety of Autonomous Vehicles

#### Safety assessment technologies

- Technologies for assessing driving safety
- Technologies for assessing autonomous-parking
- Technologies for assessing fault safety (fault safety actions)
- Technologies for assessing communications security and safety

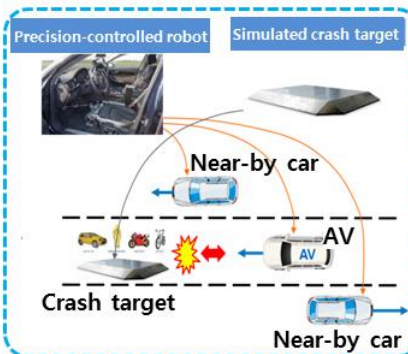
- ✓ Safety criteria/public announcement
- ✓ Manufacturer's guideline on technical development
- ✓ Development environment of autonomous vehicle technologies

#### Assessment environment and system

- Test bed (K-City) and operating scenario
- Assessment system
- Virtual K-City
- On-road verification



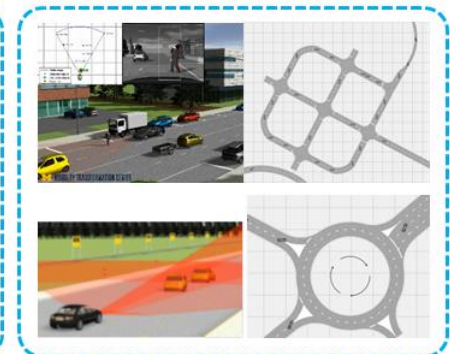
〈Autonomous Vehicle〉



〈Assessment system〉



〈K-City〉



〈Virtual K-City〉

## Project 2 : Development of assessment technologies for driver-vehicle interface and social acceptance

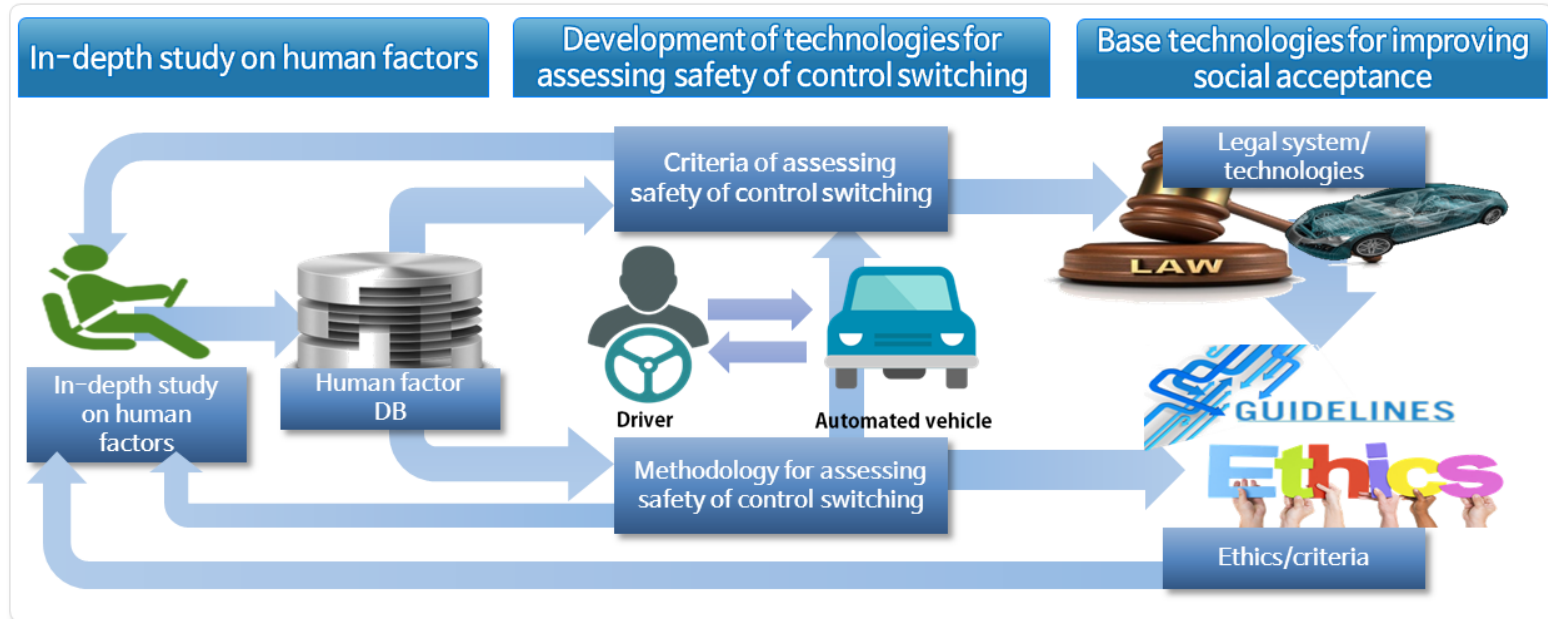
### Study overview

- Study period: 2017. 4. 1 – 2020. 12. 31 (3 years and 8 months)
- Total study cost: KRW 15.7 billion(government sector - KRW 13.9 billion, private sector - KRW 1.8 billion)
- Participants: 18 organizations including Korea Transportation Safety Authority, ETRI, Korea Transport Institute, Kookmin University, Ajoo University, and KAIST

### Study objective

**To establish assessment criteria for ensuring safety of car-driver control switching**

- ☞ To reduce traffic accidents by 50% through preventing human errors that account for 94% of the total traffic accidents





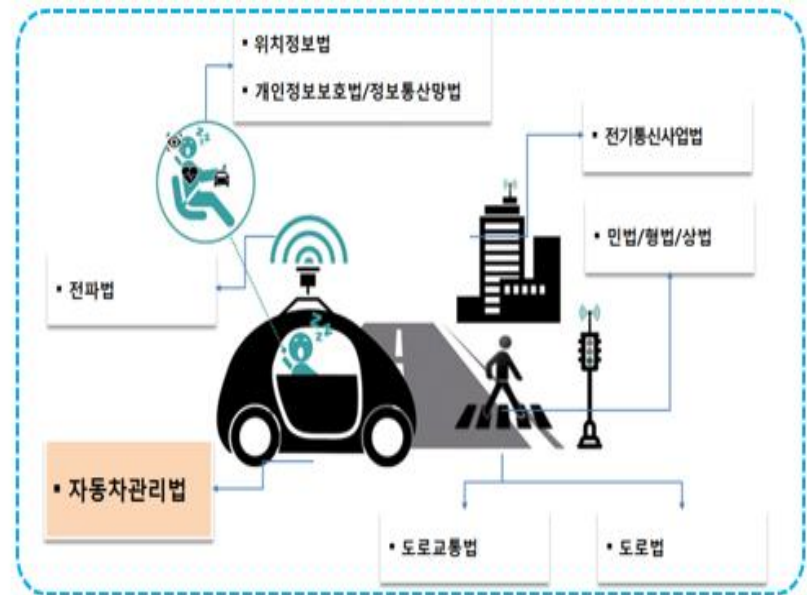
# Main Research Area for AV



〈Autonomous Vehicle〉



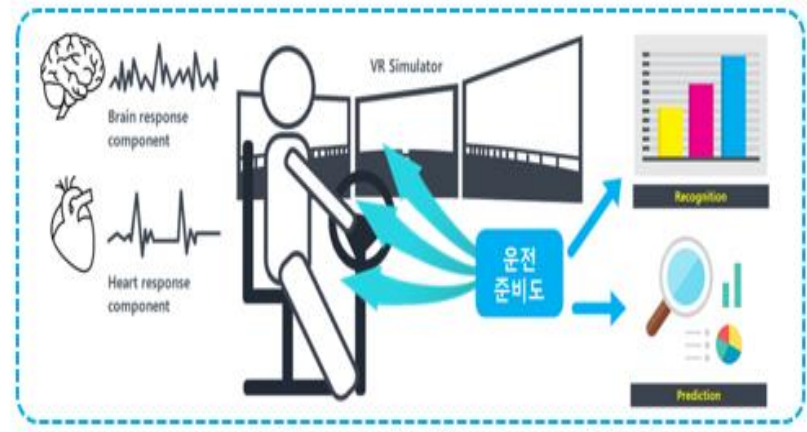
〈Driving Simulator〉



〈Improving Social Acceptance〉



〈Take-Over Scenario & Evaluation Technology〉



〈Driver Availability Recognition〉



## Project 3 : Development of Infrastructure

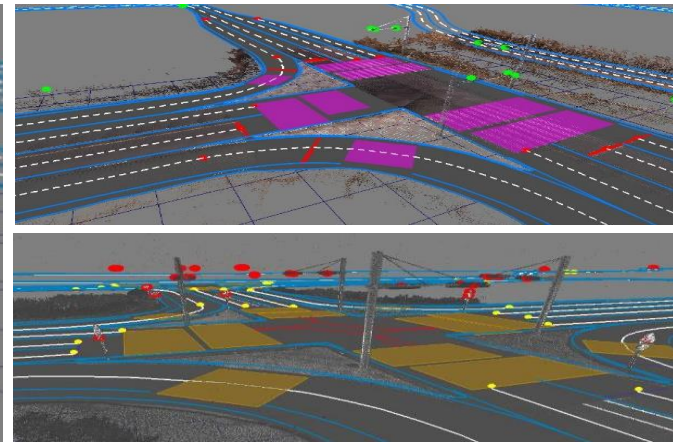
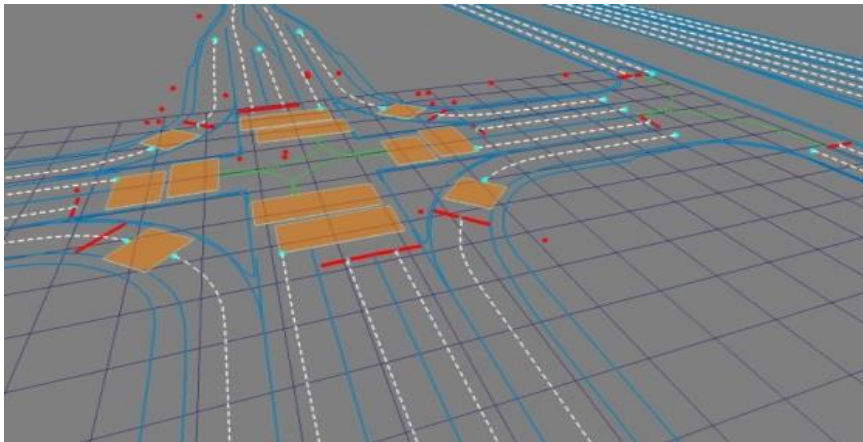
- **C-ITS** (Cooperative Intelligent Transportation System)
  - C-ITS supports AV by sharing real-time traffic information through V2 communication
  - **The MOLIT has been developing C-ITS technology and infrastructure through Daejeon~Sejong Pilot Project ('14~'17) and various R&Ds ('15~'20)**
  - Deployment projects on expressways and in urban areas are initiated to test diverse C-ITS communication methods and equipment
  - Introduced an VPKI(Vehicle Public Key Infrastructure) based security system to prevent cyberattack



< C-ITS Concept Map >

## - High Definition road maps

- Precise positioning is one of the key task for autonomous driving, MOLIT provides high definition map (HD map) to AV developers
  - NGII (National Geographic Information Institute) produces and distributes HD maps without charge since 2017
  - NGII will finish producing HD maps of entire expressway systems in 2019
- Joint Public/Private co-producing committee was launched in 2017 to share the cost between public and private entities and ensure timely update



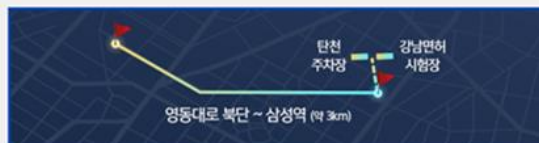
## Project 4 : Demonstration work



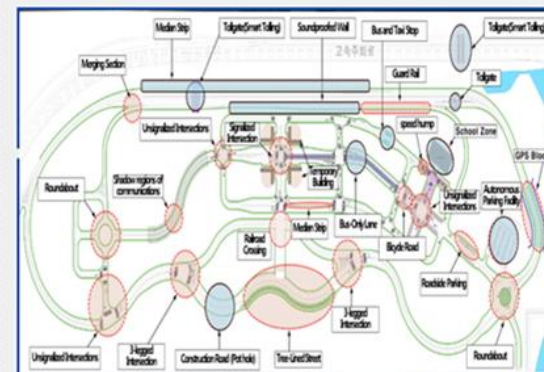
### Demonstration Event in Pyeong- chang Olympic ('18. Feb.)



### Demonstration Event with Citizen in Seoul ('18. Jun.)



## Demonstration Event with AV in K-City ('18. Oct.)





## Project 5 : AV Competition for College students in K-City

- **(Objective)** To train the basic engineer by providing basic education and experience training programs for college students ('19.9)
- **(Business Contents)** Personalized Technical Training
  - **(Online basic education program)** The education program is organized so that anyone interested in autonomous driving technology can obtain technical information
  - **(Offline technical training)** Selection of the final participating teams after completion of training as basic training for autonomous driving technology implementation



(Step #1. in Education)



(Step #2. in Competition)



(Higher Level Competition  
sponsor by Hyundai Motors)

## ● KATRI Layout

### Proving Ground Advanced tracks

Total cost  
\$1.242bn

Total length  
28.5km

#### Test track layout features

- Natural drain through existing reservoir
- Maintain original topography
- Increase Vehicle safety & Minimize R&D test track
- Easy access to every track (close entrance)
- Maximize efficiency of Test facility management
- Economic and easy to construct

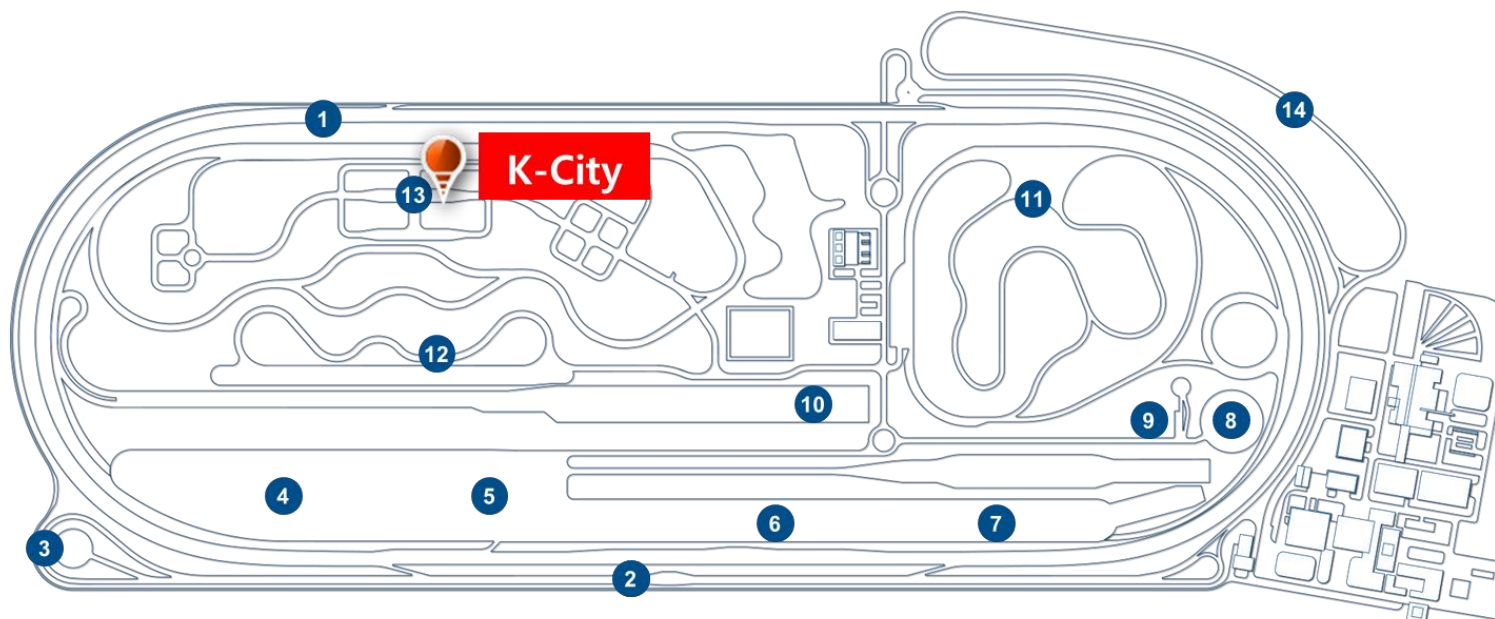
### Test Facility 10 of the Facility

- Construction Equipment Inspect Facility
- General Test Facility
- Environmental Test Facility
- Driving and Braking Test Facility
- Impact Test Facility
- Crash Test Facility
- Noise&EMC Test Facility
- Advanced Vehicle Test Facility
- Tire Assessment Test Facility
- Construction Equipment Safety Defect Test Facility





## ● KATRI Proving Ground Layout



1 High Speed Circuit



2 Straight Road/Noise Test track



3 EMC Test Site



4 Road Safety Features Test Ground



5 Steering Pad



6 Universal Road



7 Low Friction Track



8 Skid Pad



9 Hill Test Track



10 Wide Low Friction Track



11 Handling & Stability Track



12 Durability Track



13 ITS & Ride Comfort Track (K-city site)



14 Off-road Test Track

## ● Overview of K-City

- **(Goal) Provision of various on-road environments (road, traffic, and communications)**
  - Simulated testing of possible accidents (crashing) that may happen during the driving
    - ▶ Simulate real world and simulation to support technologies development
    - ▶ Verify safety of automated vehicles
- **(Location) KATRI P.G. (Hwaseong City, Gyeonggi Province)**
  - **The area of the current ITS testing circuit is 360,000 m<sup>2</sup>** out of the total area of 2,150,000 km<sup>2</sup>
- **(Budget) Total 1.9M\$ (Government 1.7M\$, Private 0.2M\$)**
  - K-City Construction costs 1.1M\$
- **(Schedule) Aug. of '17, Groundbreaking for K-City**
  - Nov. of '17, Motorway Open
  - Dec. of '18, entire sections Open





## ● Bird eye-view of K-City





- Road, traffic, and communications environment similar to the actual road conditions will be established.

## Motorway

Dedicated road for high-speed driving



## Urban-center road

Environment of urban-center road traffic



## Community & Automated parking

pedestrian-centric road and parking facilities.



## Rural road

rural road where infrastructure is insufficient



## Motorway



## Urban Center Road



## Community Section



## Autonomous parking





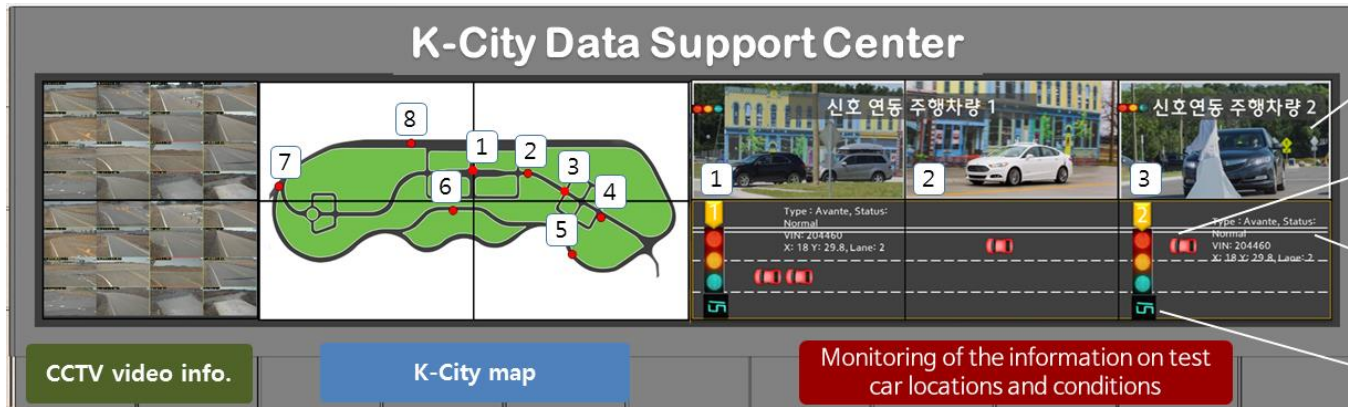
## ● K-City Data Support Center

- Center-based control of traffic systems and test cars
- Monitoring of the information on test car locations and conditions (CCTV video, and GPS location-based)
- Construction of an integrated DB
  - Integration of data for test cars and infrastructure (synchronization)
  - (Assessor certification and encryption) Collected data are available only for assessors, and illegal spill of collected data is prevented.



※ The existing functions of the driving test control center will be expanded.

### (Operating example of K-CITY monitoring)



Display of test car video information (CCTV)

Display of test car position information (by lane)

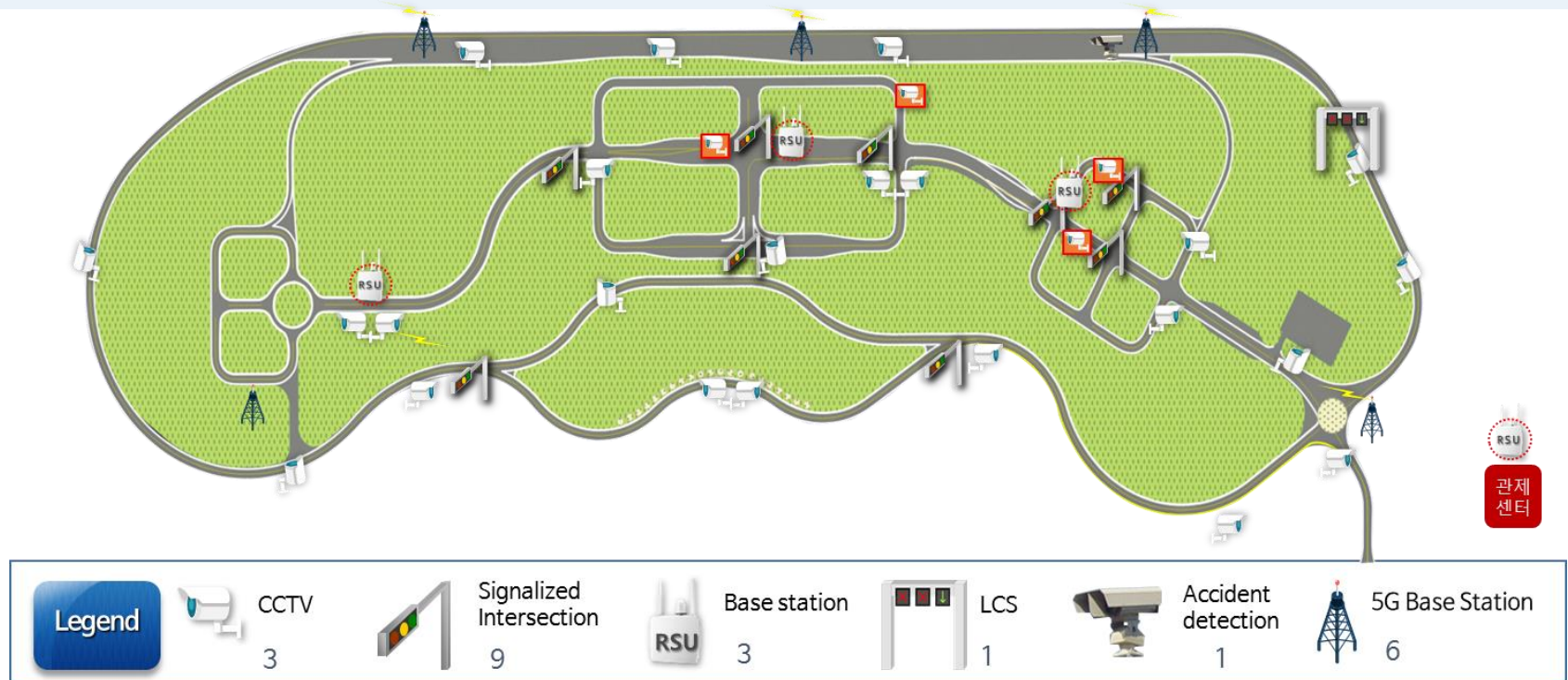
Monitoring of information on test car condition (When car information collecting devices are mounted)

Display of information on traffic system control (signal control, LCS, etc.)

Note) The monitoring and traffic system control will be carried out mainly for the movement lines of the test cars.

## ● C-ITS in K-City

- Establishment of connected environment by means of V2X (WAVE) communications system
- Establishment of C-ITS-related traffic system  
Integrated and centralized control of signal controllers, LCSs, and accident detectors.
  - Real-time provision of system control information (signals, and contingency information)
- Integrated provision of traffic system operation information and vehicle movement information





## ● Establishment of various communications systems

### • Various communications systems for 5G, 4G(LTE), WAVE, and Wi-Fi

#### 5G

- Realization of ultra-high speed/large-capacity data collection



(Reference)  
5G demonstration(KT)

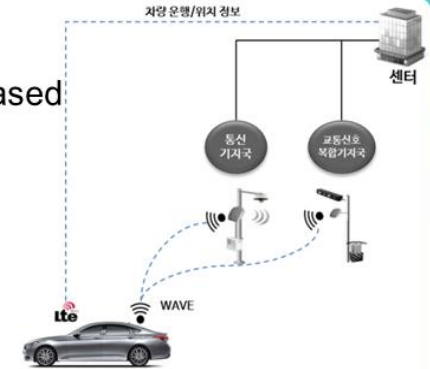


(Reference)  
5G demonstration(SK Telecom)



#### 4G(LTE)

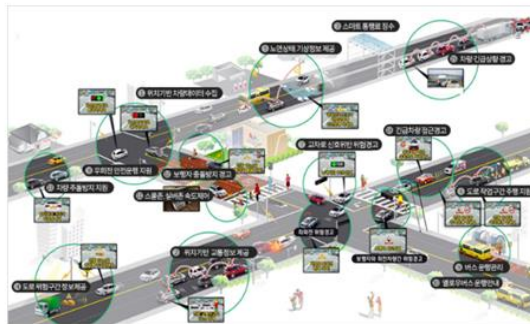
- Collection of position-based vehicle information



(Reference) Collection 4G-based vehicle information

#### WAVE

- Provision of traffic information
- Provision of region-specific information



(Reference) C-ITS service (WAVE-based)

#### Wi-Fi

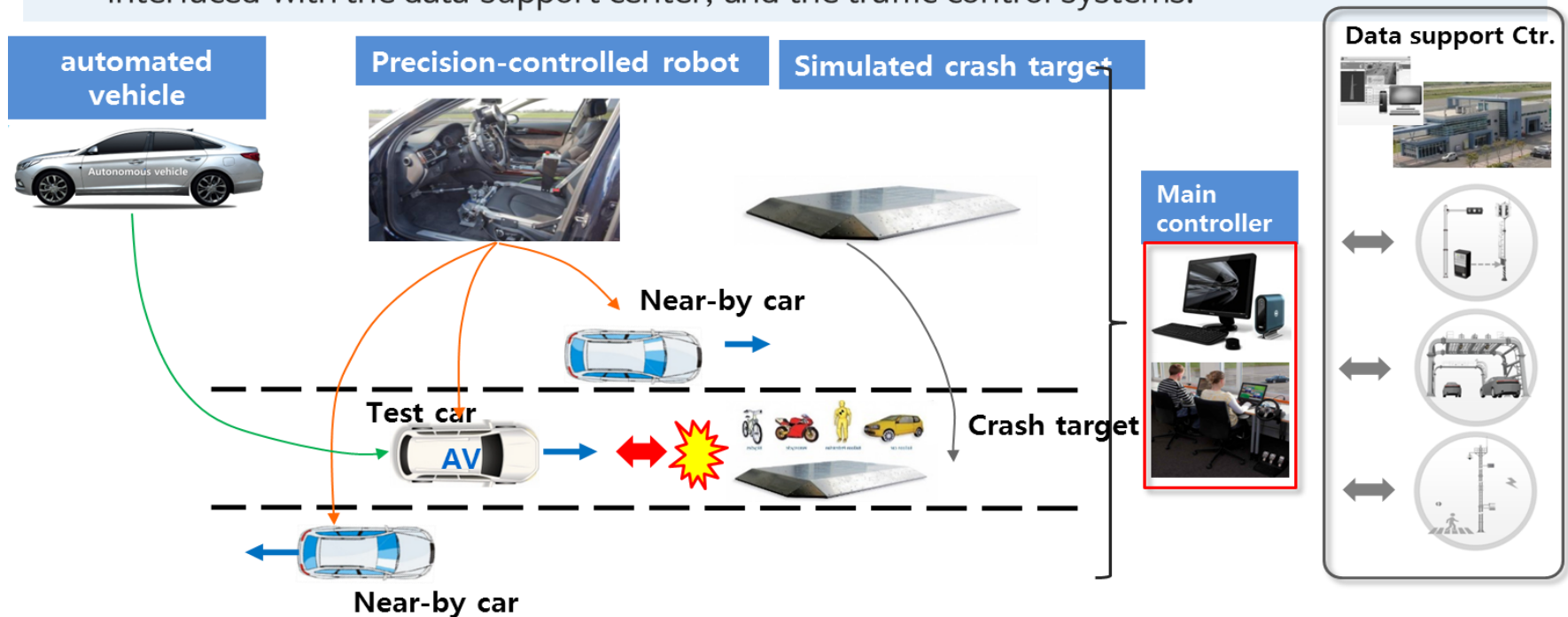
- Synchronization of assessment systems
- Synchronization of Automated Vehicles



(Reference) Communications for Automated Vehicle assessment systems (Wi-Fi)

## ● Next-generation multi-target testing equipment

- Simulated testing of possible accidents (crashing) that may happen during the driving of automated vehicles
  - Automated assessment systems will be established for carrying out various scenarios as interfaced with the data support center, and the traffic control systems.



- Example) When the automated vehicle (test car) is in driving,
- Near-by cars (2) will be placed for simulating traffic conditions.
  - And a crash target (1) will be placed for simulating direct crash.

## ● Plan for enhancing K-City (~2022, USD 28M)

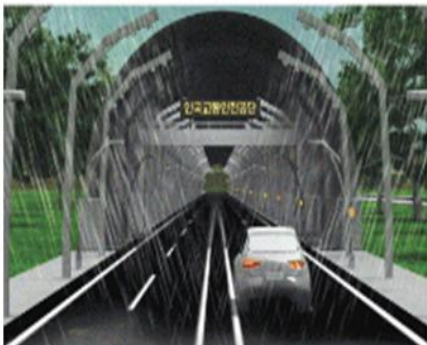
- (Contents) To boost AV deployment,
- Weather Simulation, GPS Jamming System, Technical Park, etc.,

### Weather Simulator

**Budget** ■ Tot : USD 12M

**PERIOD** ■ By 2021

- rain, fog, sunlight
- Bad weather condition

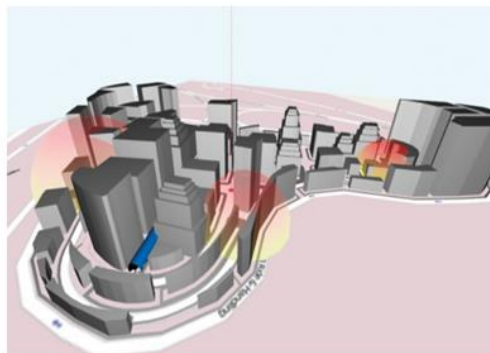


### GPS Jamming

**Budget** ■ Tot : USD 3.6M

**PERIOD** ■ By 2021

- Downtown bds, Tunnel, Underpass, etc



### Tech. Park

**Budget** ■ Tot : USD5.3M

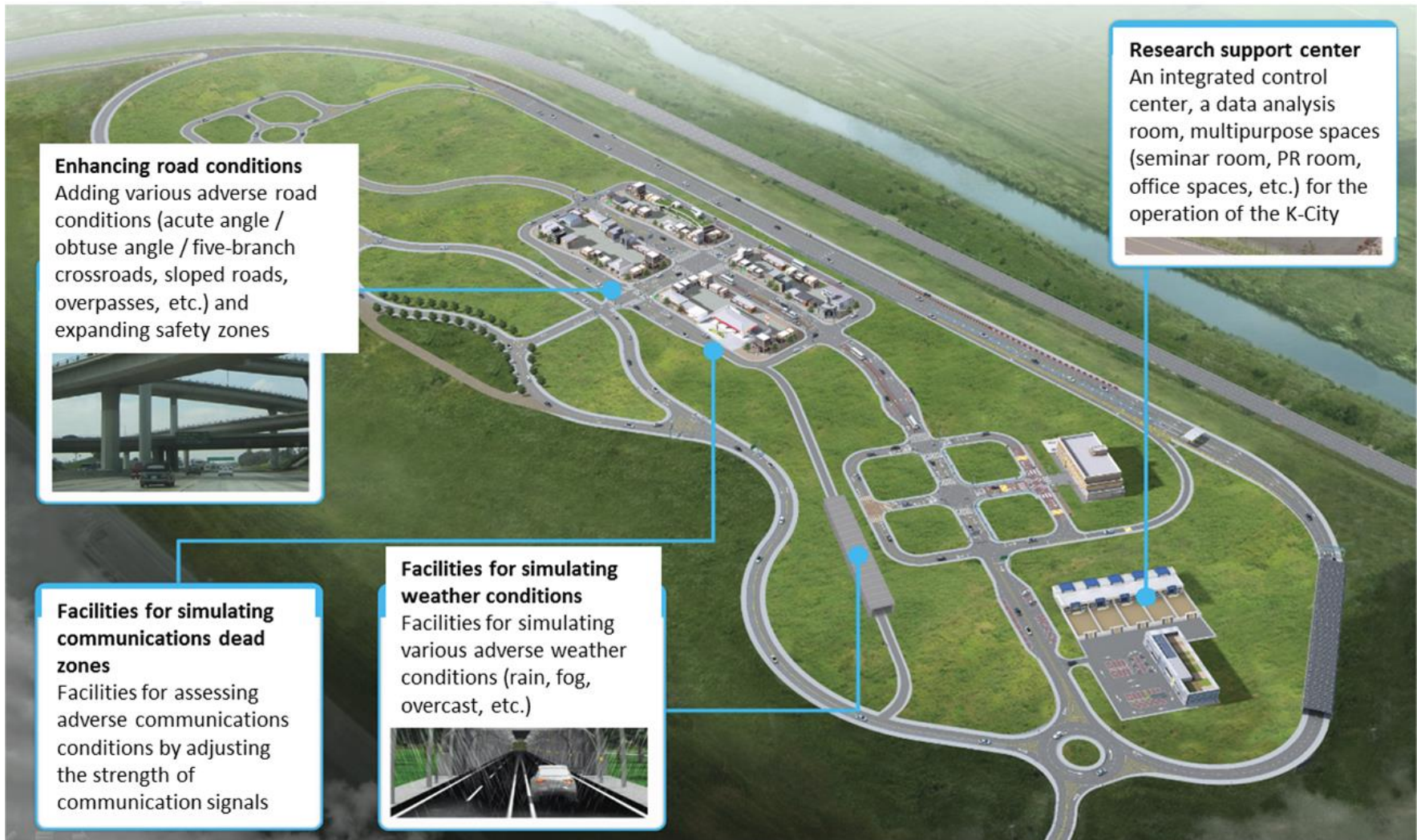
**PERIOD** ■ By 2022

- Workshop, Meeting Rm
- Office, Auditorium, etc.,





## ● Plan for enhancing K-City





## ● How to utilize the K-City

### Building K-City

### Safety performance assessment technologies

### Test bed establishment

### Utilization method

#### National certification facilities for Automated Vehicles

- Verification of car safety criteria
- Assessment of car safety levels
- Safety criteria harmonized with international criteria

#### Research infrastructure

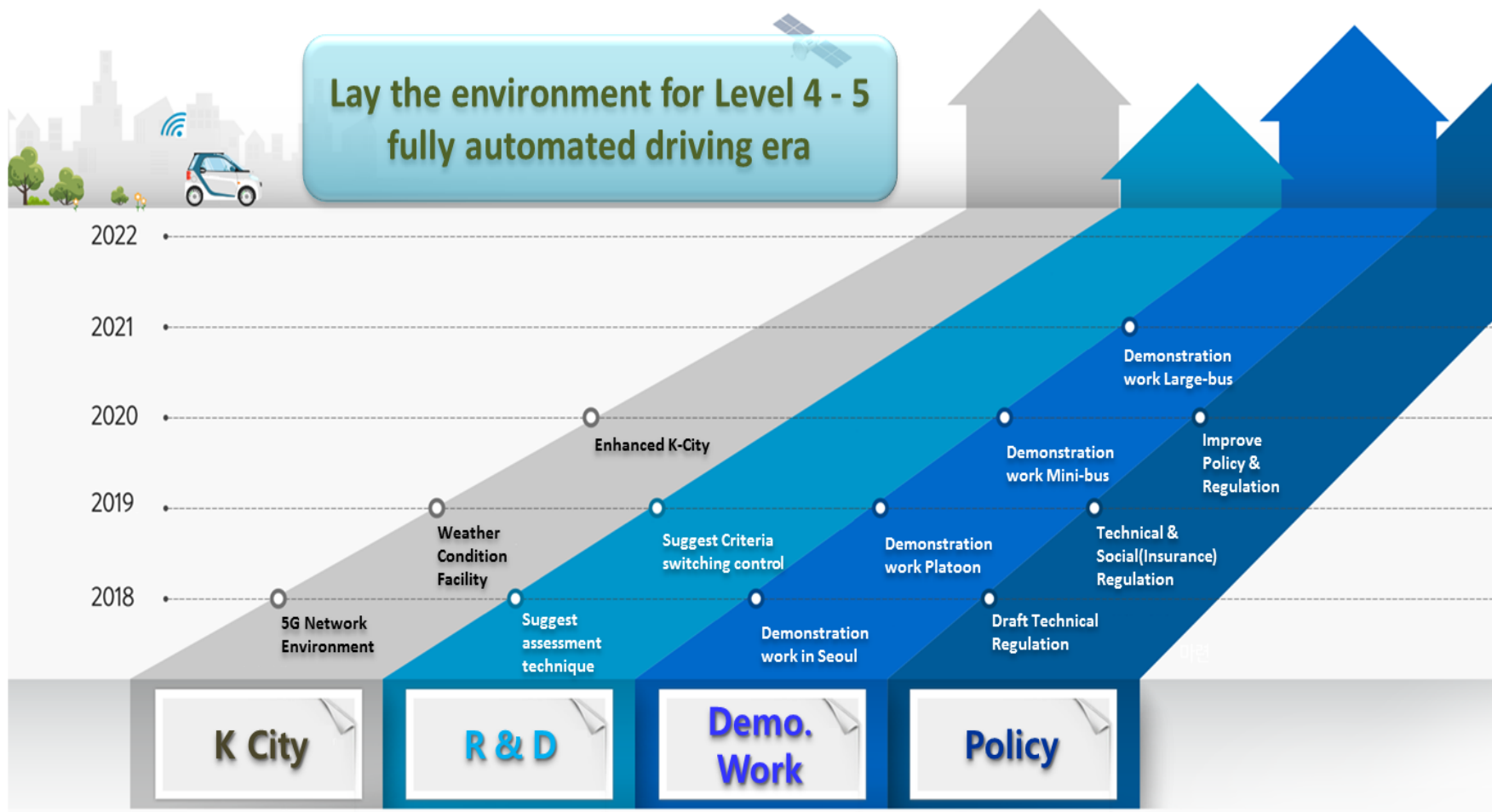
- Utilized by manufacturers, universities, etc. in technical development
- Support for technical development utilizing the test bed

➔ Preparation of various operating support methods including a **K-City Partnership** program.

- Provision of opportunities to industries, research institutes, and the academia for direct utilization
- Implementation of joint researches with industries, research institutes, and the academia

# Summary Plan

## ● Summary Plan





# Thank you for your attention

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