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미래로, 세계로, 국민속으로

# ITS to Smart Mobility in Korea: Lessons & Future Direction

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## I. Introduction of ITS in Korea



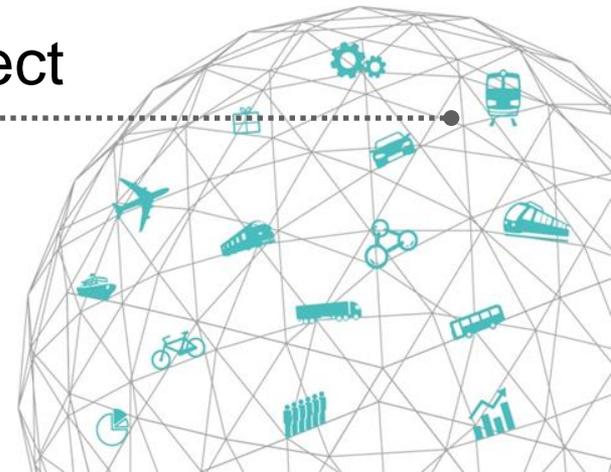
## II. Lessons for Future Transport Systems



## III. Mobility Revolution: Smart Mobility in Smart City



## IV. Smart Mobility R&D and Pilot Project



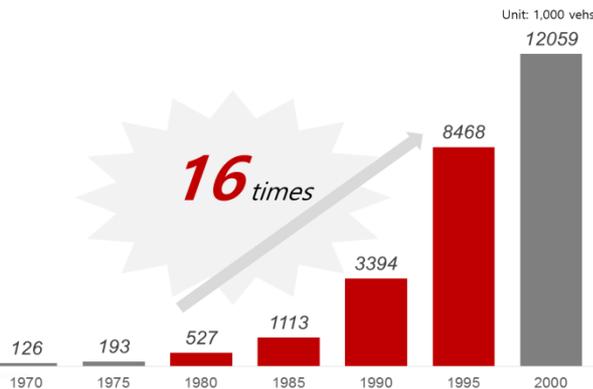
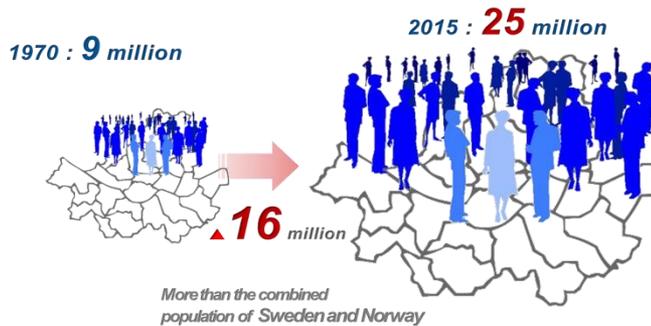
# I. Introduction of ITS in Korea



# Rapid Urbanization & Motorization

- Tremendous increase in the number of vehicles and rapid growth of urbanization
- Traffic congestion, accident, air pollution, and other problems

Seoul Metropolitan Area Population



# Various Policies & Strategies



## Construct new roads

- Needs huge amount of cost & time.
- Derive more traffic demand.



## Reduce Traffic

- Travel demand management
- Alternative transport mode

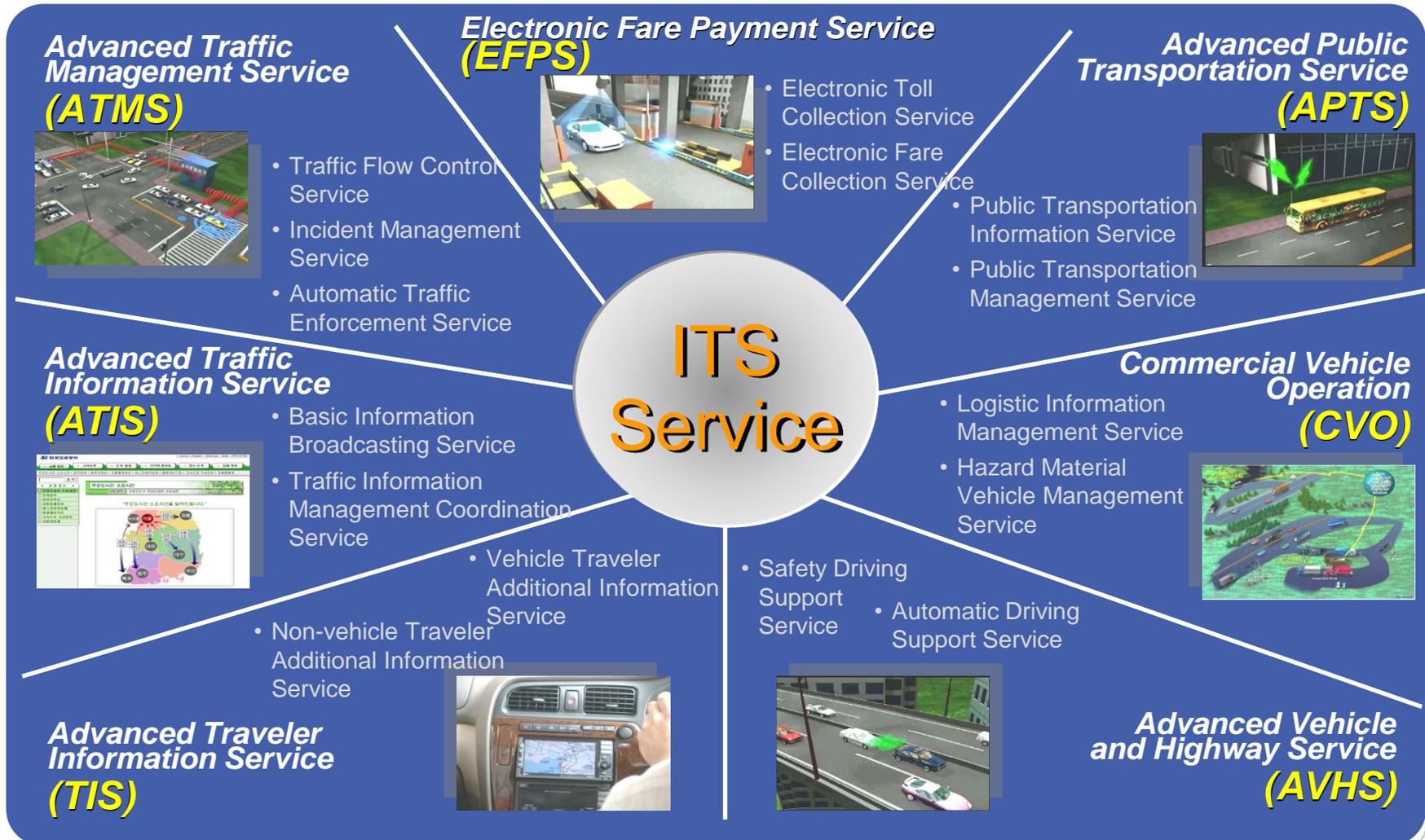


## Increase existing infrastructure capacity

- Uses intelligent transportation systems (ITS).

## Resolving transportation problems by introducing ITS

# ITS Services in Korea

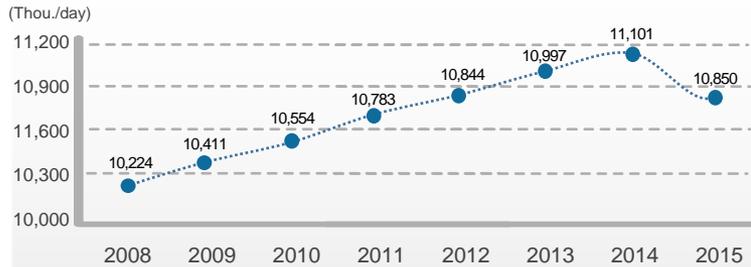


# ITS Effects & Benefits in Korea

## Improvement



### No. of Public Transportation Passengers



## Economic



### High-benefit cost ratio



Use only 1% of road construction costs to reduce 20% of traffic jams B/C for ITS deployment by each city : 2.2~6.2

Seoul 2.27, Daejeon 5.2, Ulsan 4.64, Suwon 2.39, Jeonju 2.9, Jeju 6.2

### \$11.8B worth of Social benefits per year



Increase travel Speed by 15~20%

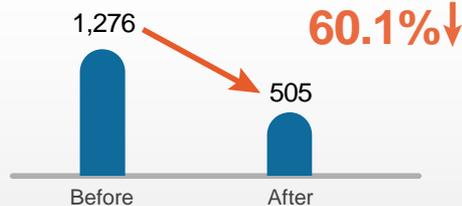


Effect on Hipass  
Tollgate passing time : 14sec to 2 sec.  
reduce (improvement of 85.7%)  
Social benefit : USD 9.6M/year

## Safe



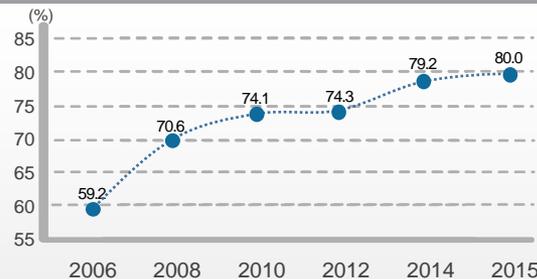
### No. of fatal accidents



## Convenience



### Citizens Satisfaction



## Eco-friendly



### Reducing greenhouse gas & oil consumption

Reducing greenhouse gas and oil consumption based on decrement of traffic congestion and idling

Per 1,000km of road covered with ITS

- ▶ Annually 19,000 tons reduced Through Hipass(ETCS) service
- ▶ Annually 2.3 tons reduced

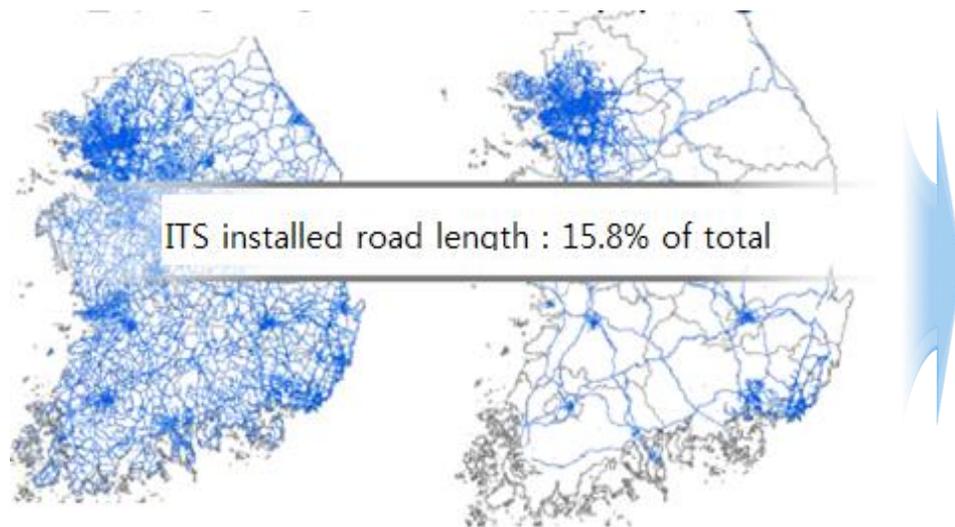


## II. Lessons for Future Transport Systems



# ITS Investment in Korea

- ✓ Investment cost for ITS deployment
  - 1<sup>st</sup> Stage 2005~2010: 1,184 million USD
  - 2<sup>nd</sup> Stage 2011~2015: 1,183 million USD
  - 3<sup>rd</sup> Stage 2016~2020 (plan): 1,179 million USD



Road Type	Road Length (km)	ITS Installed (km)	Percent (%)
Expressway	4,114	4,114	100
National Highway	13,587	2,633	19.6
City Road	67,788	6,711	9.9
Total	85,165	13,458	<b>15.8</b>

※ Needs huge ITS investment to cover all the roadways in Korea and even more for maintenances in the near future.

# Transport Challenges

- Increase of traffic congestion even though continuous ITS investment
  - Total cost of traffic congestion (2015): 29.0 billion USD (2.13% of GDP)



- Higher traffic fatalities & injuries
  - Total fatalities (2017): 4,185 persons/year



- Inconvenient public transportation
  - Independent fare policy & payment system (ex. independent reservation/ticketing/payment)
  - Insufficient investment for vulnerable people (ex. Demand responsive transit)

- Severe air pollution from vehicle emissions

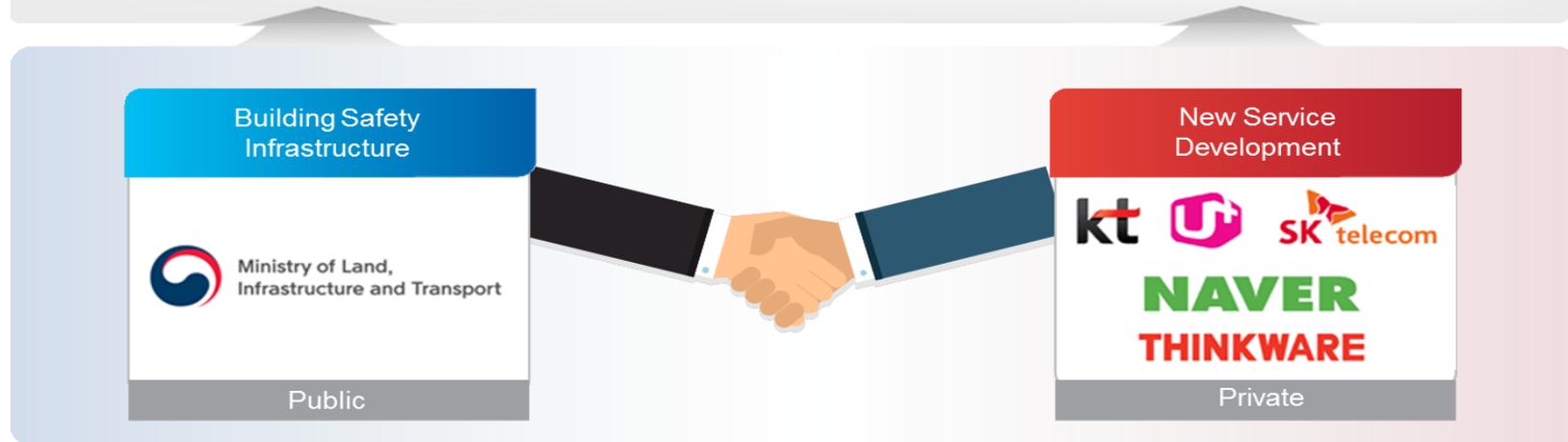


# Public-Private Cooperation on Traffic Information

## Public-private collaboration in ITS

- (Early expansion of ITS network) Secure 49,500km of ITS unequipped road by using private services.
- (Budget reduction) Save about 1.2 billion USD to be spent for additional ITS deployment.
- (Focus on safety) Public concentrates on ITS service for safety issues

## Building a Safe Traffic Environment through Public-Private Collaboration



# ICT Changes Transport

- ✓ Provide various transport services integrated with ICT



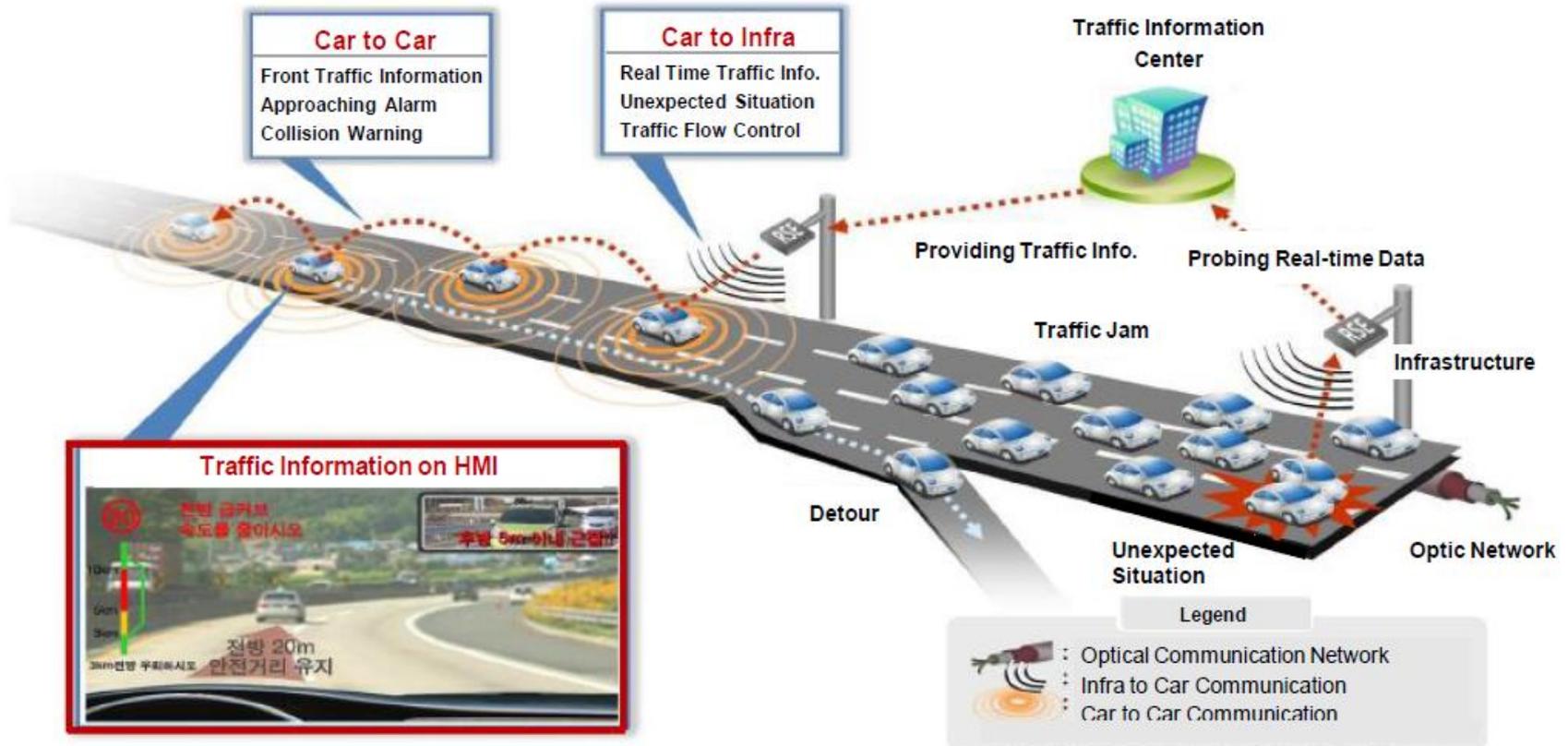


## III. Mobility Revolution: Smart Mobility in Smart City



# Cooperative ITS (C-ITS)

- New Paradigm for next-generation ITS focusing on Safety, Mobility, Sustainability.
- Improving Road Safety by V2V, V2I and V2P communication



# Automated Shuttle Service

Easymile



2getthere



WEpods



Robosoft



Navya



IBM-Watson IoT Alliance



City	Functions	Features
<b>Lyon, France (Navly)</b>	Circulation shuttle for employees and visitors in industrial complex and exhibitor	<ul style="list-style-type: none"> <li>• Vehicle: Navya vehicle applied</li> <li>• Section: Circulating road section in the 2nd borough</li> <li>• Period: Sep. 5, 2016 -</li> <li>• Timetable: 7am ~ 7pm, Speed: 20km/h</li> </ul>
<b>Las Vegas, USA (Arma)</b>	Transport for tourists and the public	<ul style="list-style-type: none"> <li>• Vehicle: Navya vehicle applied</li> <li>• Section: Fremont St(Las Vegas Blvd. ~ 8th St)</li> <li>• Period: Jan. 11 - 20, 2017</li> <li>• Timetable: 10am ~ 6pm, Speed: 20 km/h</li> </ul>
<b>Rotterdam, Netherlands (ParkShuttle)</b>	Last/First Mile connection transport	<ul style="list-style-type: none"> <li>• Vehicle: ParkShuttle vehicle applied</li> <li>• Section: 1.8km near Rivium business park</li> <li>• Period: Sep. 2008.09. -</li> <li>• Timetable: Peak hour, Speed: Max 32km/h</li> </ul>
<b>Trikala, Greece (Robucity)</b>	General transport pilot in the city	<ul style="list-style-type: none"> <li>• Vehicle: Robosoft vehicle applied</li> <li>• Section: approximately 3km from Trikala</li> <li>• Period: Nov. 10 2015 - Feb. 29, 2016</li> </ul>
<b>Vantaa, Finland (EZ10)</b>	During Housing Fairs, Last/First Mile connected transport	<ul style="list-style-type: none"> <li>• Vehicle: EasyMile vehicle applied</li> <li>• Section: Kivisto station ~ Housing Fair site</li> <li>• Period: Jul 10, 2015 - Aug. 10, 2015 Timetable: Housing Fair operating time, Speed: Max 40km/h</li> </ul>
<b>Wageningen Univ. Campus, Netherlands (WEpods)</b>	Campus circulating shuttle	<ul style="list-style-type: none"> <li>• Vehicle: EasyMile vehicle applied</li> <li>• Section: Wageningen Univ. Campus</li> <li>• Period: Jan. 28, 2016 -</li> <li>• Timetable: Rush hours, in bad weather, except for night time</li> <li>• Speed: Max 25km/h</li> </ul>



# Automated Shuttle Service - Pangyo

## Dimension

전장(mm)	5160
전폭(mm)	1850
전고(mm)	2700
실내고(mm)	1900
최저자랑고(mm)	150
축간거리(mm)	3200
윤거(전)(mm)	1570
윤거(후)(mm)	1570
공차중량(kg)	2100
총 중량(kg)	3000
승차인원	11
좌석수	9



## Technical Data

조향장치	위치	전륜
	타입	?
구동장치	위치	후륜
	타입	15KW AC Motar
제동장치	전륜	유압 디스크 브레이크
	후륜	유압 디스크 브레이크
?기장치	전륜	?
	후륜	?
타이어		205/70415
	충전기	가정용 220V 콘센트 + 무선충전(연충)
구동용	타입	리튬이온 72V
	용량	29.8
자율주행용	타입	리튬이온 48V
	용량	4.4
안전최고속도		25
	최대	10
성능	1회 완충시간	7
	공조?	냉방/난방

**Pangyo Zero-City Project Overview**  
 Location: area of Geumto-dong, Siheung-dong Sujeong-gu, Seongnam City  
 Area: 426,000 m<sup>2</sup> (1<sup>st</sup> stage: 68,000 pyeong, 2<sup>nd</sup> stage 61,000 pyeong)  
 Project Period: Nov. 2015~Dec. 2019  
 (1<sup>st</sup> stage completion – Dec. 2017, 2<sup>nd</sup> stage completion – Dec. 2019)  
 Owner: Gyeonggi-do, Seongnam City, LH(65%), SDC(35%)

### 판교제로시티 내부 노선

- 1단계구간 : 약 1km
- 2단계구간 : 약 1.5km

### 판교제로시티 외부 노선

- 시험주행구간 : 약 5.5km



# Shared Transport Service

- Reduction of traffic congestion, no vehicle ownership, not many parking spaces needed
  - One shared vehicle can replace 13 owned vehicles, thereby mitigating traffic congestion and parking space shortages in large cities
    - \* Won, Dong-ho (2016), "Future of automobile market thru the combination of car sharing and autonomous driving"
  - It will be possible to automatically transfer the vehicle to the next user through the app for the smart phone and the addition of the self-driving function in the future, and the convenience will be maximized with no need for driving



# e-Mobility Service

## e-Micro Mobility



[Upright type]



[e-Bicycle]



[e-Motorcycle]



[Smart-Mobility]

## e-Vehicle



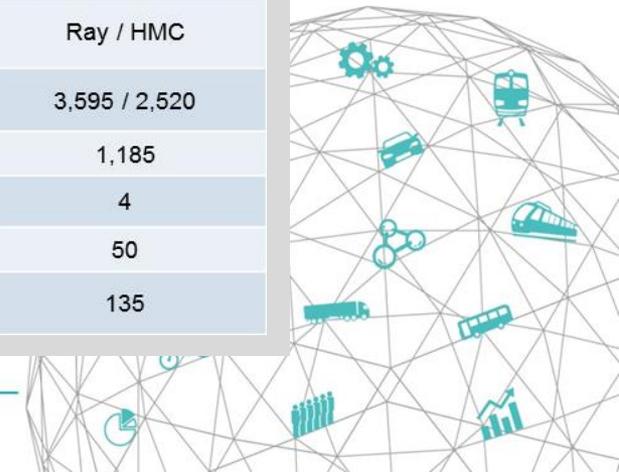
[EV, FCEV, Hybrid]

## Automated e-Transit



[Automated e-Shuttle]

	Smart Mobility (New Segment, Sub-A level)			Ratio	Mini EV (Ray), A level
Vehicle					
Model / OEM	i-Road / Toyota	Twizy / Renault & Nissan	Hiriko / Spain Gov., MIT, etc.	-	Ray / HMC
Length/Width [mm]	2,350 / 1,700	2,338 / 1,237	2,630 / 1,750	x 1.4	3,595 / 2,520
Weight [kg]	300	350	400	x 3.4	1,185
Seats [Number]	2	2	2	x 2	4
Power [kW]	4	15	15	x 4.4	50
Max. Speed [km/h]	45	45, 80	70	x 2.1	135



# On-demand e-Bus Service

- ✓ Demand responsive bus service by real-time or pre-reservation via internet or smartphone
- ✓ Optimal bus routes & stops for passengers who have same departure times, origins & destinations (e.g., commuting, shopping, etc.)

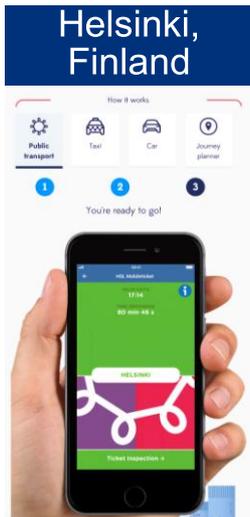


# Integrated Mobility Service

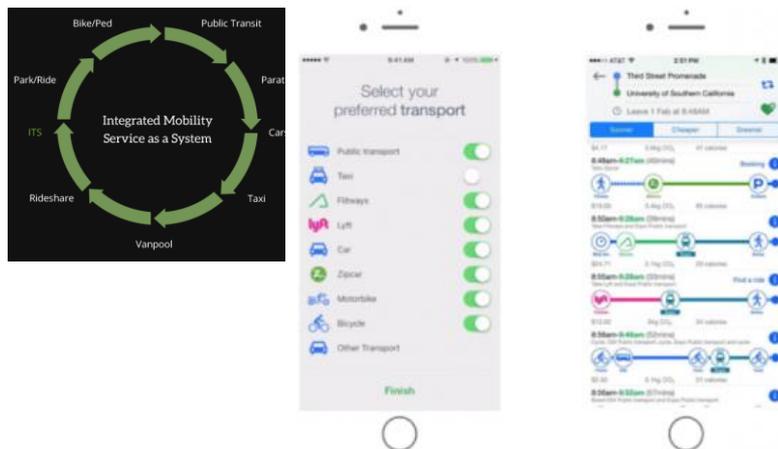
- Search, reservation and payment services for transportation through a single smartphone application
- Improved convenience of using public transportation and improved mobility by connecting to first-mile and last-mile



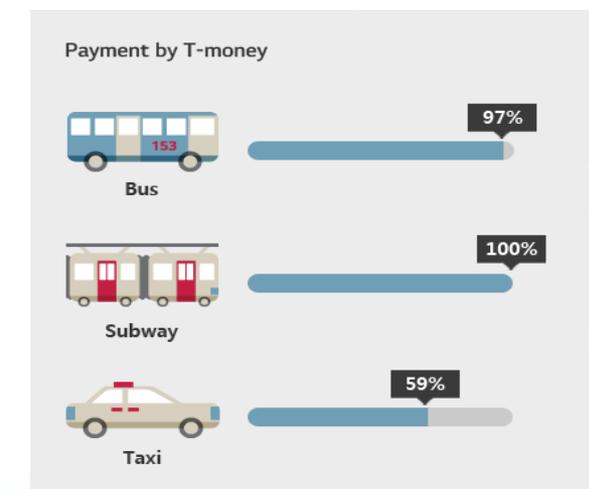
(Frost & Sullivan, 2016)



## Los Angeles, United States



## Seoul, Korea



# Integrated Mobility Service (cont'd)

- ✓ 'GO PyeongChang Service' during 2018 Winter Olympic Games



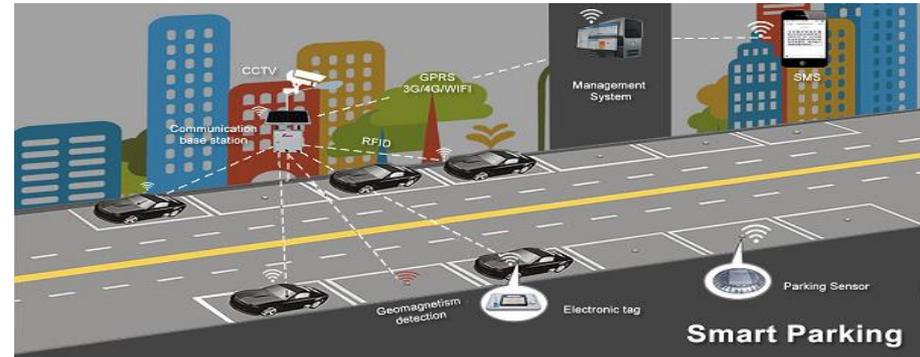
The screenshot displays a mobile application interface for a travel service. It shows a route from Seoul Station Gyeongbu Line to Alpensia Biathlon Centre, departing on 15 Feb 2018 at 15:07. The app provides three route options:

- Long distance:** 2h 55min (15:07-18:02). Route: KTX (1h 25min) > Shuttle bus TS-04 (22min) > On foot (12min). Price: W21,800.
- 3h:** 3h (15:07-18:07). Route: Line 1 (23min) > KTX (1h 9min) > Shuttle bus TS-04 (22min) > On foot (12min). Price: W21,550.
- 3h 30min:** 3h 30min (15:07-18:37). Route: Line 1 (23min) > Intra-city bus 2311 (15min) > KTX (1h 3min) > Shuttle bus TS-04 (22min) > On foot (12min). Price: W21,250.

The interface also includes a map of the competition area with various facilities marked, such as Alpensia Cross-Country Centre, PyeongChang Olympic Stadium, Alpensia Ski Jumping Centre, Alpensia Biathlon Centre, Olympic Sliding Centre, and Yongpyong Alpine Centre. There are also sections for 'Competition Main facilities', 'Bookmarks', and 'Recent destination'.

# Smart Parking Service

- Real-time parking space sensing



Source : News Vision

- Route guidance based on a reserved parking space



Source : KOTRA

- Automated parking payment



Source : Parkingbak

# Smart Drone Monitoring

- Real-time control using a drone equipped with LTE-based navigation system and image transmission device
- Marine and coastal accident prevention and on-site response service (Provide information to 119 Rescue Center and maritime police through the user service view)

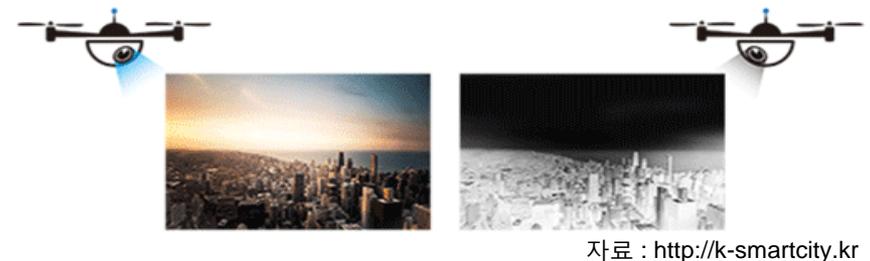


## Real-time HD video monitoring



An LTE-based real-time video transmission system that transmits HD live video for local disaster control

## Real-time thermal imaging monitoring



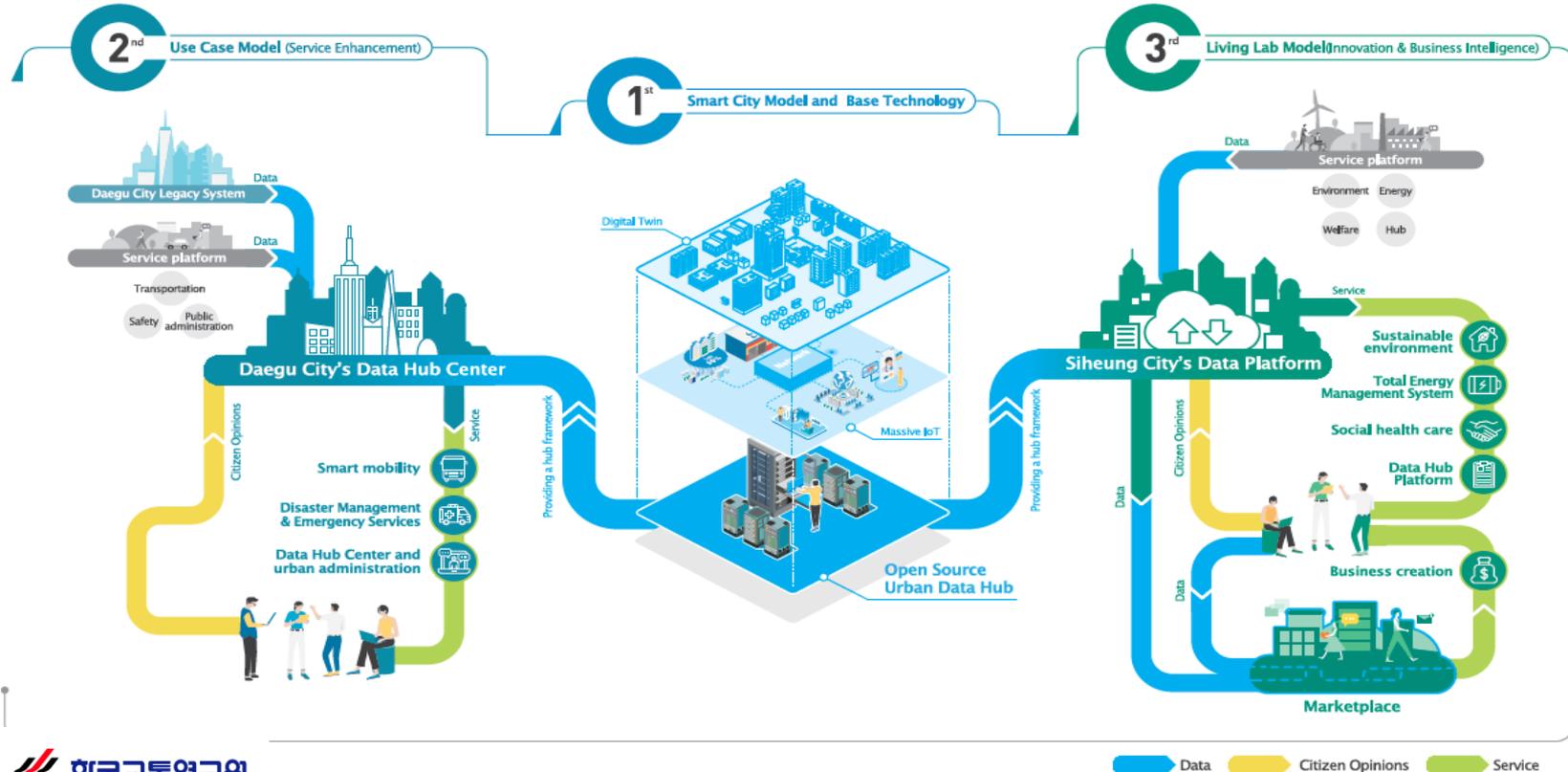
A real-time video transmission system based on LTE capable of HD video / thermal video transmission for day / night integrated control

## IV. Smart Mobility R&D and Pilot Project



# National Smart City R&D Program

- ✓ Vision: realize a data-driven sustainable smart city & improve citizen's life quality
  - Smart City Model and Base Technology Development Project
  - 2 Demonstrative Projects for Use Case & Living Lab being Interconnected

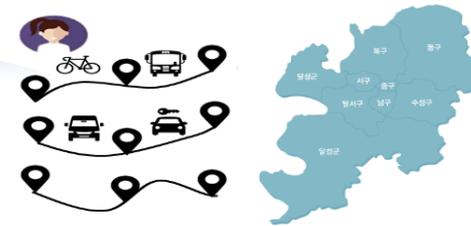


# Smart Mobility Service

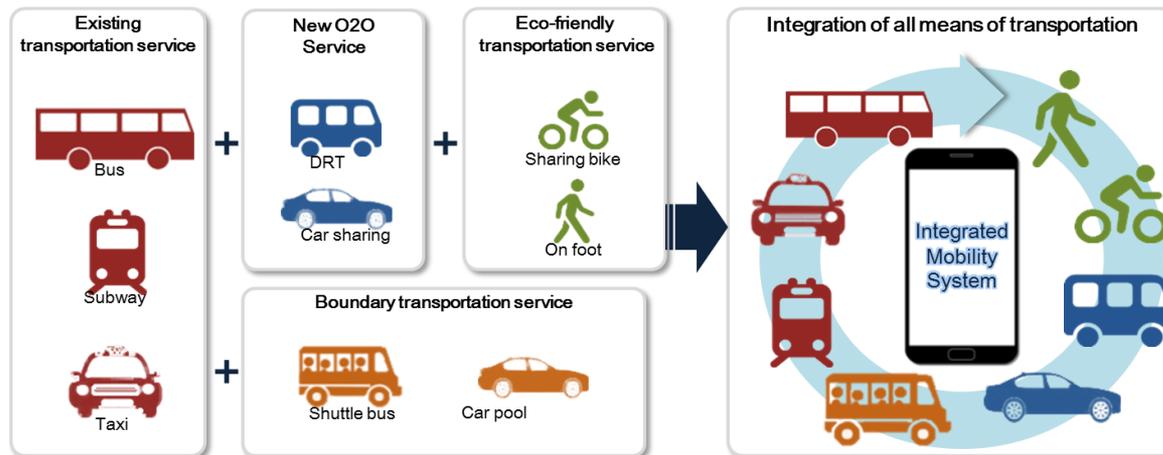
## Development of various technologies for providing integrated smart mobility service

- Develop smart mobility service scenarios
- Develop data collection technologies for real-time traffic situation and transportation information
- Develop user-tailored transport data analysis technologies and optimal path algorithm
- Develop personalized smart mobility service provision technologies

## Demonstration of smart mobility service to Daegu Metropolitan City



- Operate service demonstration and system in Daegu Metropolitan City
- Verification and evaluation of demonstration scenario



# National Smart City Pilot Project

## Sejong 5-1 District



### Goal

Livable, workable and sustainable city for human well-being

### Key Elements: 7 elements

- **Smart Mobility**
- Smart Health Care
- Smart Education
- Smart Energy & Environment
- Smart Culture & Shopping, and so on

## Busan Eco Delta District



### Goal

Sustainable city model based upon water circulation and renewable energy

### Key Elements: 10 elements

- Smart Water
- Smart Energy
- **Smart Mobility**
- Smart Safety
- Smart Education & Living, and so on



# National Smart City Pilot Project – Smart Mobility



AI-based Smart Signal & C-ITS



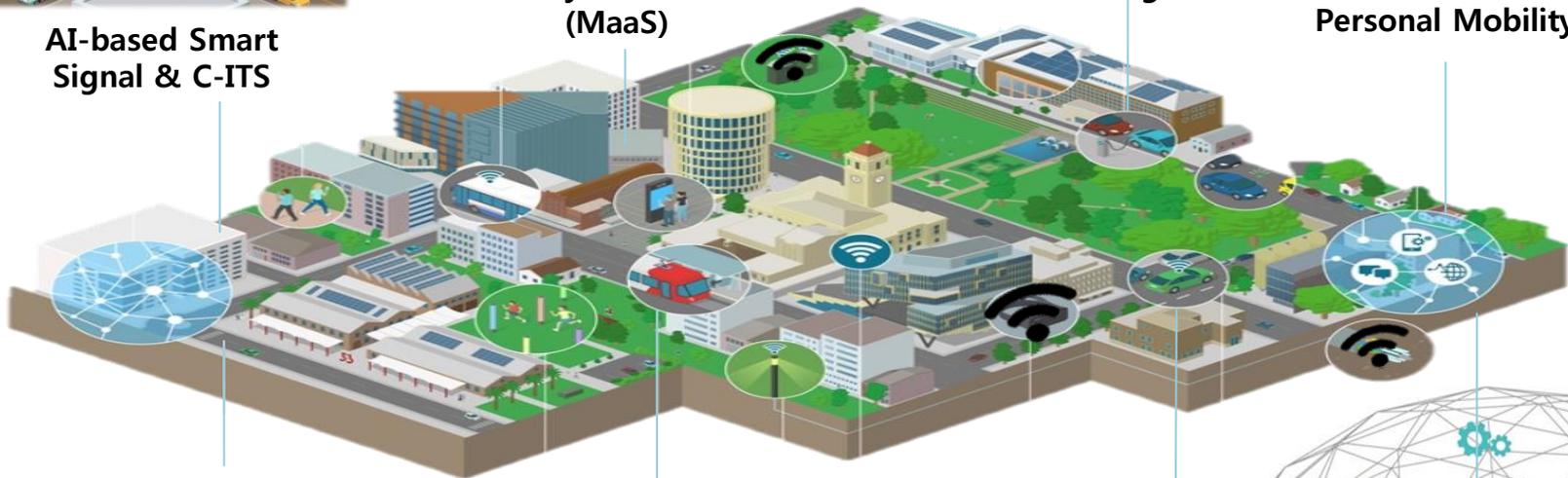
Mobility-as-a-Service (MaaS)



Smart Parking



Personal Mobility



Smart Pedestrian Crossing



Demand Responsive Transport (DRT)



Car-sharing



Automated Shuttle



**KOTI enriches the future by securing harmony among humans, the environment and transport.**

