

자율주행과 도시의 미래 – Smart Mobility

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Aug., 2019

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The Korea Transport Institute (KOTI)

ISO/TC204 WG17 Convenor

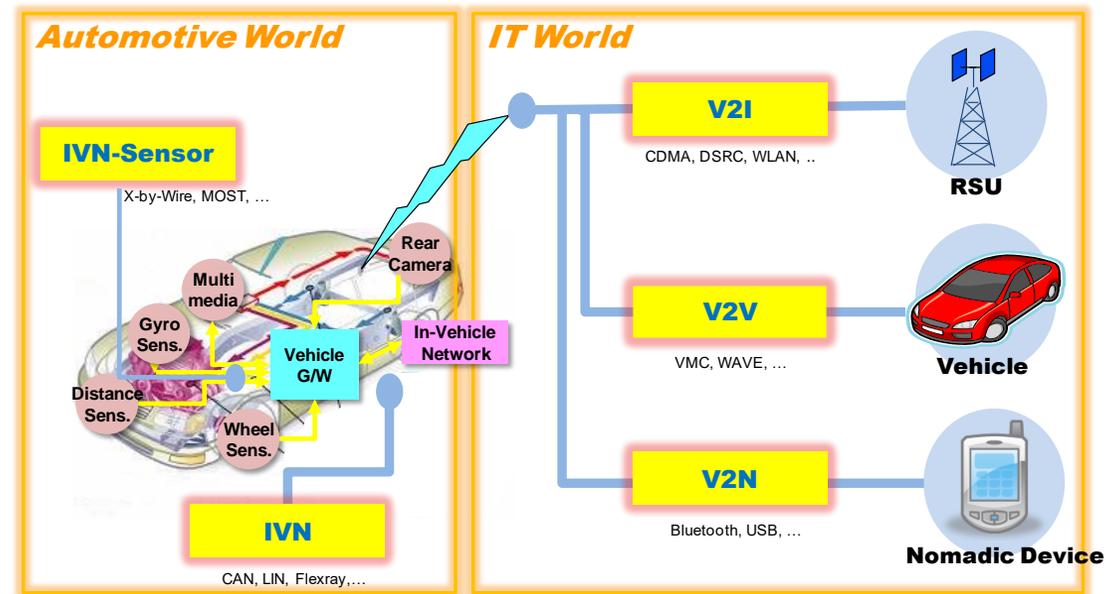
Mobility Issues

Sustainable Mobility for the Future

- To be Safe, Accessible, Affordable, & Environment Friendly
- Paradigm Shifts for Reducing
 - ✓ Congestion, Road Accidents, Emissions & Air Pollutions, Health Problems
 - ✓ by
 - Avoiding the Needs to Travel by Driving
 - Shifting to Sustainable Transport Modes
 - Improving Efficiency of All Transport Modes

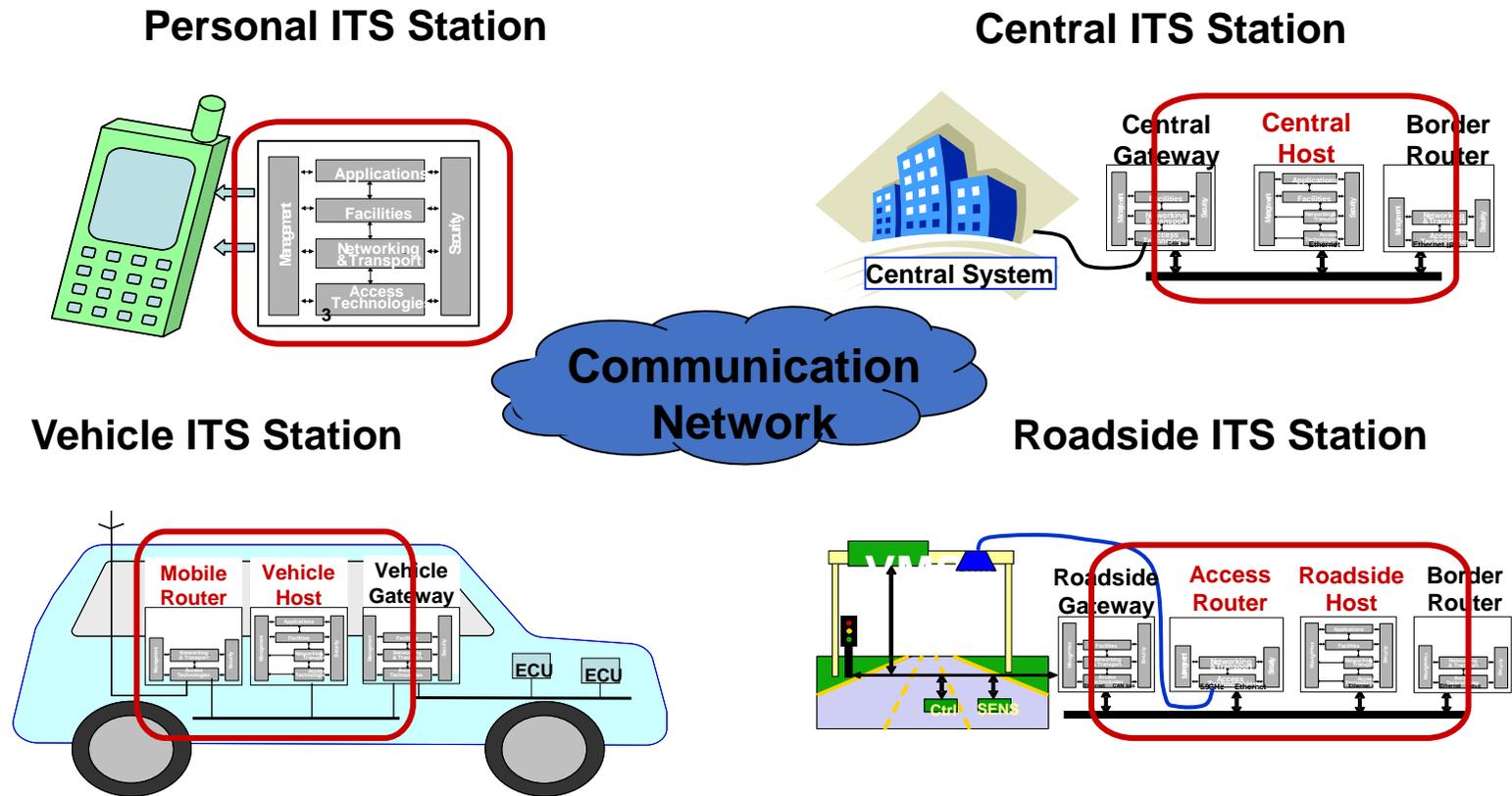
Digitalization in Transport Systems

- Vehicle & ICT Convergence for V2X (V2I, V2V, V2N, V2P) Connectivity
- Cooperative Intelligent Transport Systems (C-ITS)



Digitalization in Transport Systems

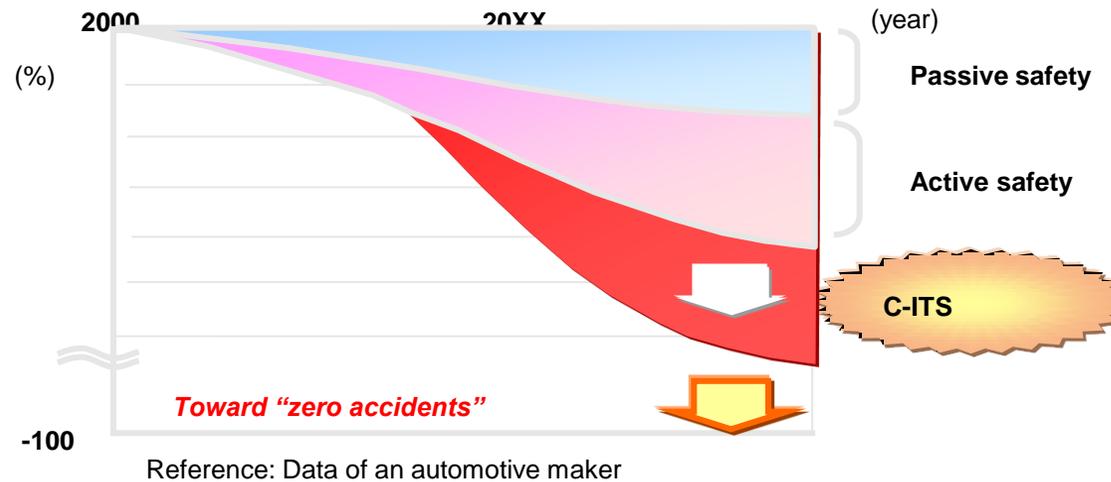
- ❖ Cooperative ITS (C-ITS) Architecture in ISO/TC204



Digitalization in Transport Systems

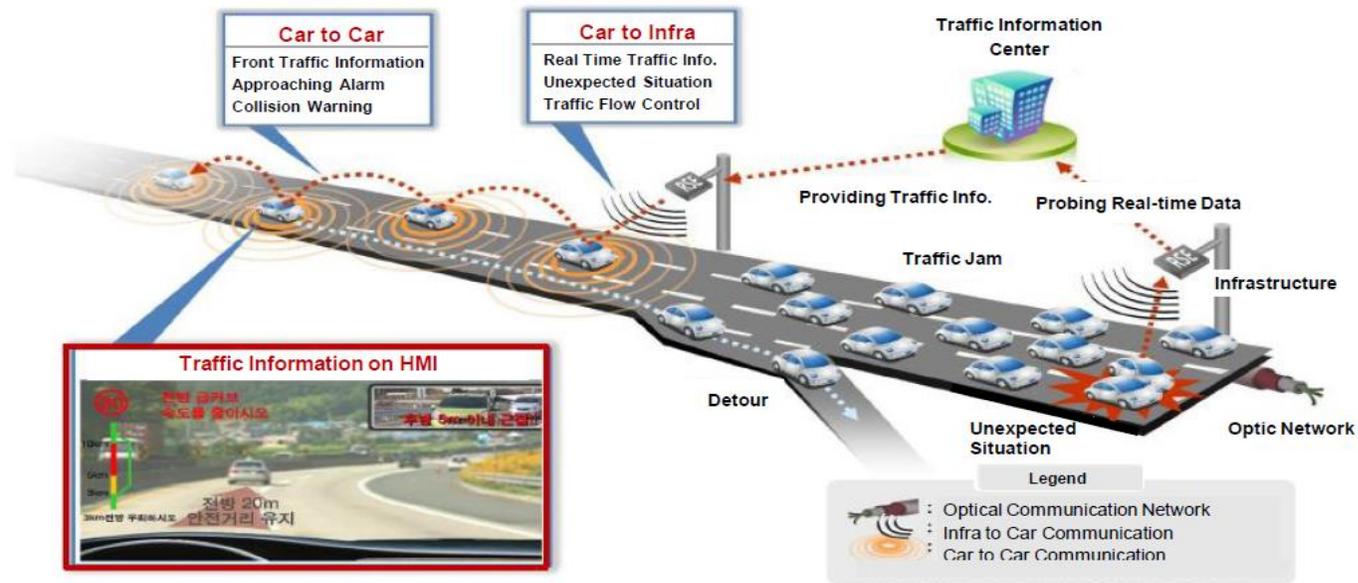
❖ C-ITS Benefits

- Safety
 - Zero Fatality in Accidents
- Mobility
 - Double Capacity on Highway
- Sustainability
 - Low Emission in Transport Sector



Digitalization in Transport Systems

- ❖ 우리나라 C-ITS 시범사업: 국토교통부 주관
 - 안전성, 이동성 및 친환경성 향상 목표
 - 차량-차량(V2V) & 차량-인프라(V2I) 통신체계 구축, 오픈 플랫폼 기반 정보
 - Pilot Project (2014-2017, 세종-유성), 구축사업(2018: 서울&제주, 2019: 울산&광주)



Digitalization in Transport Systems

Challenges of a resilient investment environment for transport systems

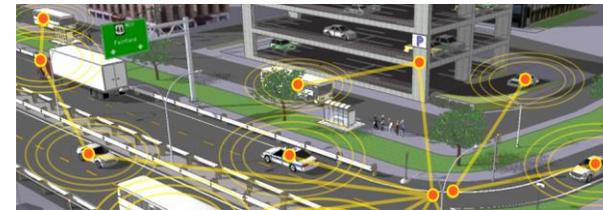
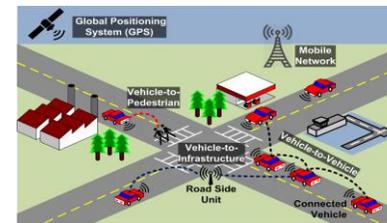
Intelligent Transport Systems (ITS) (1990s-2010s)

- Information Collection & Provision**
- Vehicle Detection System (VDS)
 - Road Surveillance & Monitoring
 - Variable Message Signs (VMS)



Cooperative ITS (C-ITS) (2020s-2040s)

- Information Collection & Provision**
- Digital Infrastructure by ICT (V2X)
 - Mobile & Nomadic Devices
 - Big Data & AI for Connected & Automated Driving



Digitalization in Transport Systems

▪ V2X Issues for Connected & Automated Driving System



Sources : Qualcomm, 2016

ICT changes Transport

Societal Forces Driving Innovation of ITS

- Higher Investment & Maintenance Costs in Conventional ITS
 - Cases for ITS in Korea
 - Global Climate Change & CO2 Emissions
 - Approx. 20% due to Transportation
 - Aging Population (> 65 years) up to 20% in 2025
 - Shared Economy
- ☞ Adopting a new Measure of Effectiveness (MoE) as “Green”
- ☞ Changing Travel Behavior and Trip Patterns to be “Smart”

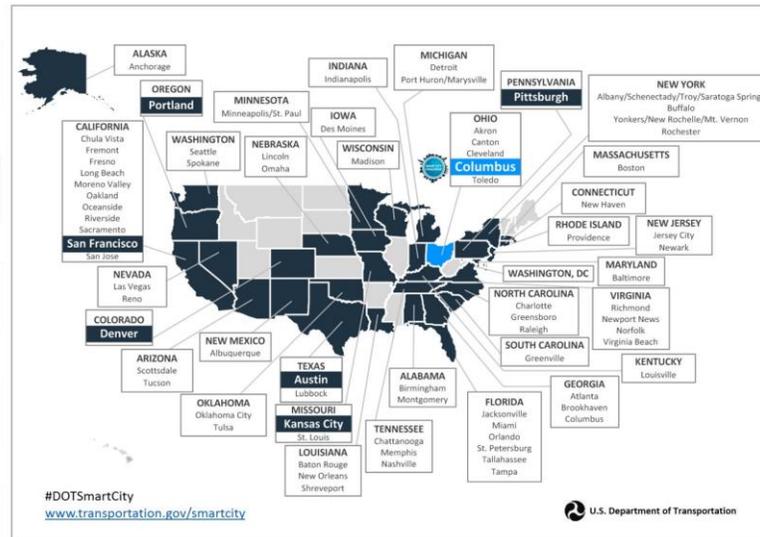
Smart City Challenges

◆ USDOT Program : Smart City Challenges

✓ “Urban Automation & Mobility on Demand”

- 미국 내 모든 도시들의 미래상에 대한 아이디어 경쟁과 지원
- 2015년 12월 7일 공시, 2016년 6월 23일 최종도시 (오하이오 콜럼버스) 선정 발표
- 78개 도시 경합, 7개 도시 1차 선정 후 최종제안서 선정에 각각 10만불 지원

The Smart City Challenge Applicants



Smart City Challenges



Advanced Technologies and Smart Cities

Connected-Automated Vehicles

Connected Vehicles

Vehicle Automation

Internet of Things

Machine Learning

Big Data

Sharing Economy



Smart Cities

Benefits

- Order of magnitude safety improvements
- Reduced congestion
- Reduced emissions and use of fossil fuels
- Improved access to jobs and services
- Reduced transportation costs for gov't and users
- Improved accessibility and mobility



U.S. Department of Transportation

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Smart City Challenges



USDOT Vision Elements

TECHNOLOGY ELEMENTS



Vision Element #1
Urban Automation



Vision Element #2
Connected Vehicles



Vision Element #3
Intelligent, Sensor-Based Infrastructure

INNOVATIVE APPROACHES TO URBAN TRANSPORTATION ELEMENTS



Vision Element #4
User-Focused Mobility Services and Choices



Vision Element #5
Urban Analytics



Vision Element #6
Urban Delivery and Logistics



Vision Element #7
Strategic Business Models & Partnering

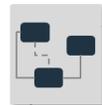


Vision Element #8
Smart Grid, Roadway Electrification, & EVs



Vision Element #9
Connected, Involved Citizens

SMART CITY ELEMENTS



Vision Element #10
Architecture and Standards

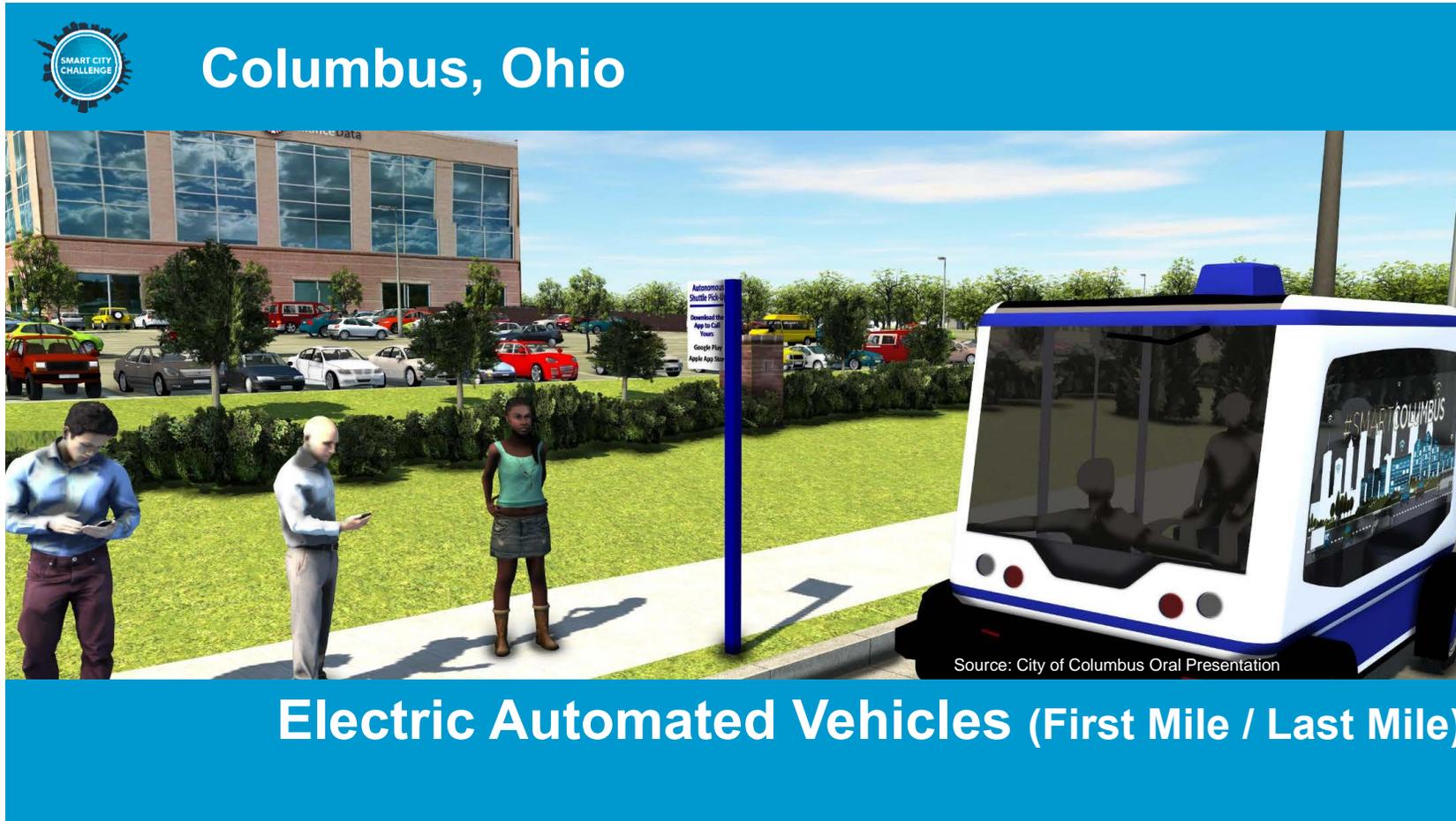


Vision Element #11
Low-Cost, Efficient, Secure, & Resilient ICT



Vision Element #12
Smart Land Use

Smart City Challenges



Connected Automated Driving System (CADS)

- 자율주행의 두가지 길

- 승용차 자율주행 : High Speed & Designated Motorways

- 2020년대 초반 Level 3 상용화로 중형승용차급 시장 진입 (OEM 중심)

- 도심형 자율주행 : Low Speed & Urban Mobility

- 2017년 Level 4 (무인운전) 공유형 전기버스셔틀 각 도시에 경쟁적 도입



Connected Automated Driving Systems (CADS)

- 자율주행을 위한 차량과 도로인프라 관계
 - Level 2는 차량기술과 도로인프라의 일부 지원으로 실용화 가능
 - Intelligent Transport Systems (ITS) 인프라 활용
 - Level 3 & 4 실용화는 도로인프라의 연계 및 운영/관리/제어 필요
 - Level 3: Cooperative ITS (C-ITS) 인프라 필요
 - Level 4: Automated ITS (A-ITS) 인프라 필요
- 차량 스스로 도로인프라 정보를 인식하면 Level 3 실현 가능
 - Google Car : 차량에 부착된 각종 레이더센서 및 관련 정보화 장비 약 2억원



	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
SAE	No Automation	Driver Assistance	Partial Automation	Conditional Automation	High Automation	Full Automation
NHTSA	No Automation	Function Specific Automation	Combined Function Automation	Limited Self-Driving Automation	Full Self-Driving Automation	
KOTI	Vehicle	Vehicle	Vehicle & Road Assisted (ITS)	Vehicle & Road Cooperated (C-ITS)	Vehicle & Road Automated (A-ITS)	

Connected Automated Driving System (CADS)

- L4 : Automated ITS (A-ITS) 도로인프라
 - 인공지능형 도로운영/관리/제어: 스마트 SOC



Sources : AUVSI 2014, San Francisco

Smart Mobility

◆ 통합모빌리티 (Mobility Integration) 서비스

✓ **Networked Smart Journey (Trip) Planner** (스마트 통행서비스)

- 모바일 기반 예약 + 지불 + 정보 서비스 통합 (유럽 MaaS, 미국 MoD)
- 대중교통과 공유교통 등 모든 교통수단의 이동성 통합 (이용자 중심)
- IoT 기반 초연결성 확보(차량, 도로/시설인프라, 모바일기기 등)



Smart Mobility

❖ Integrated Smart Mobility based on Connected & Digitalized Travelers

- A User-Centric Approach to Mobility-as-a-Service
- Enabling real-time (on-demand), door-to-door, multi-modal transport services
- Bringing convenience, time & cost savings to mobility users



Intermodal Transportation

+

ICT Technology

e.g., wireless Comm.,
smart devices, (Big) data mining

+

New Mobility System

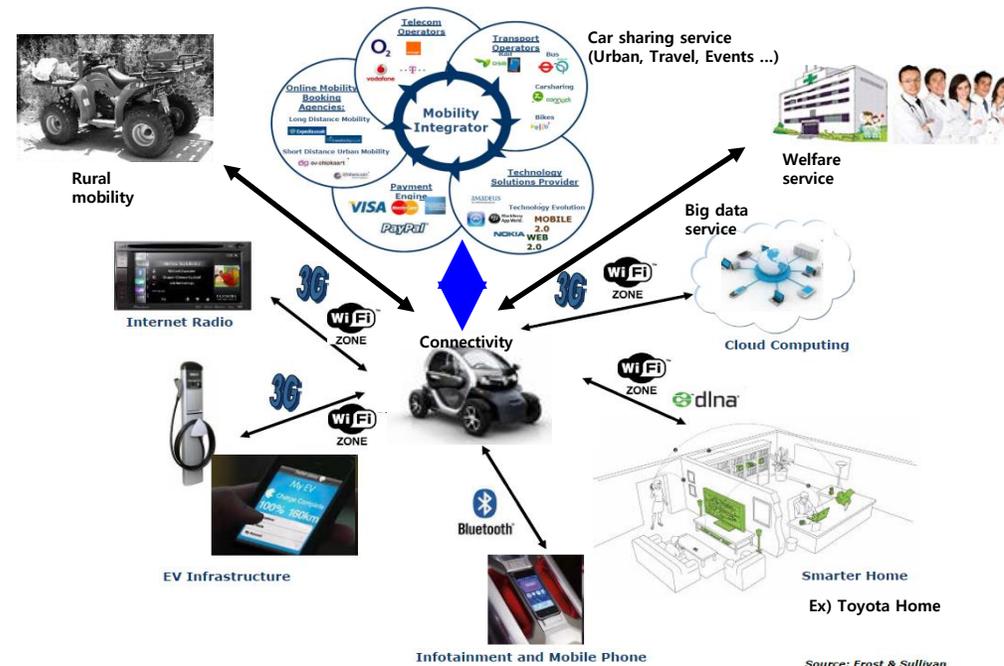
e.g., e-Mobility, AV

Smart Mobility

◆ 공유형 자율셔틀 도심교통체계 (Electric Automated Shuttle)

✓ “Smart Mobility in Smart City”

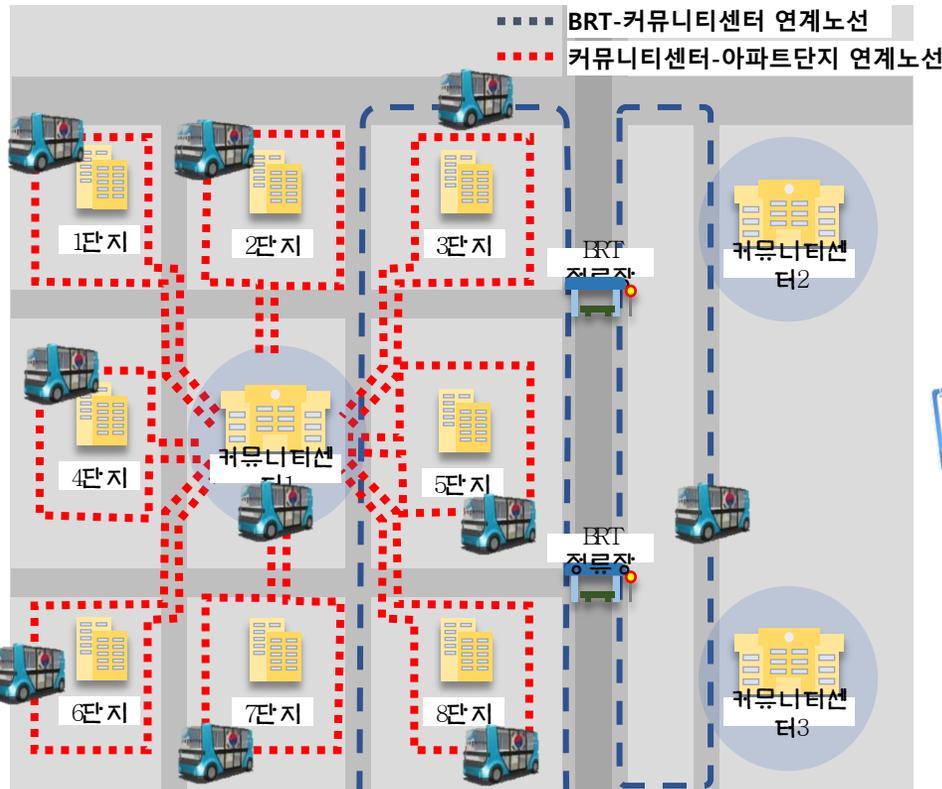
- 다수단 다중시설 연계환승네트워크(Hub & Spoke Connectivity) 구축
- 전기차 기반 공유형 도심자율주행 연결 (First/Last Mile)
- 스마트모빌리티 클라우드 운영센터 구축



CADS & Smart Mobility

◆ 세종시 마을 주거단지별 생활문화공간 연결 자율주행셔틀 보급 개념

- 세종시 국가혁신클러스터 R&D 추진으로 기반 구축 중
 - 마을단위 복합커뮤니티센터와 주거(아파트) 단지 간 연결 및 BRT 교통연계
 - 모든 단지의 역세문화권 형성



- 마을 단위 복합커뮤니티센터와 BRT 정류장 연결 전용자율주행셔틀 운영
 - 마을 단위 교통연계 형평성 보장
 - 보행 이동거리 감소
- 마을 내 각 단지와 복합커뮤니티센터 간 단지 전용 자율주행셔틀 운영
 - 단지 별 생활문화연결 형평성 보장
 - 커뮤니티센터 활성화 및 교류 확대

Design the Future ... 2050

From Yesterday



To Tomorrow

City



Skyscrapers in Land & Ocean

Figures : VENUS Project, USA

Design the Future ... 2050

From Yesterday

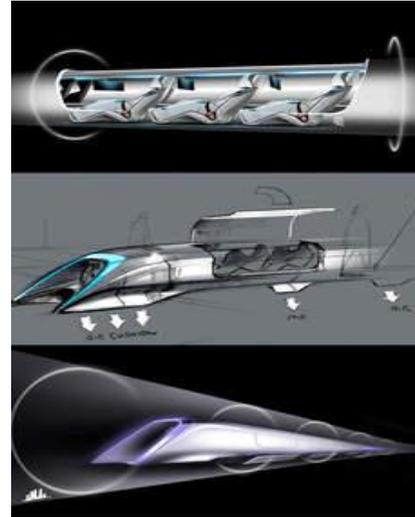


To Tomorrow

- Regional: High-speed Train
- Local: Public or Private Vehicle

Transport

- Regional: Mag-Lev or Hyperloop
- Local: VTOL or PAV



Mag-Lev or Hyperloop

Vertical Take-off & Landing (VTOL)
or Personal Air Vehicle (PAV)

Figures : Google & VENUS Project

Design the Future ... 2050

From Yesterday



To Tomorrow

- 2 Dimensional Roadways
- 자유도 (DoF) : 1
- ITS & Inter-modal Transit

Transport
Infra.

- 3 Dimensional Roadways
- 자유도 (DoF) : 2 or 3(?)
- CADS in Space

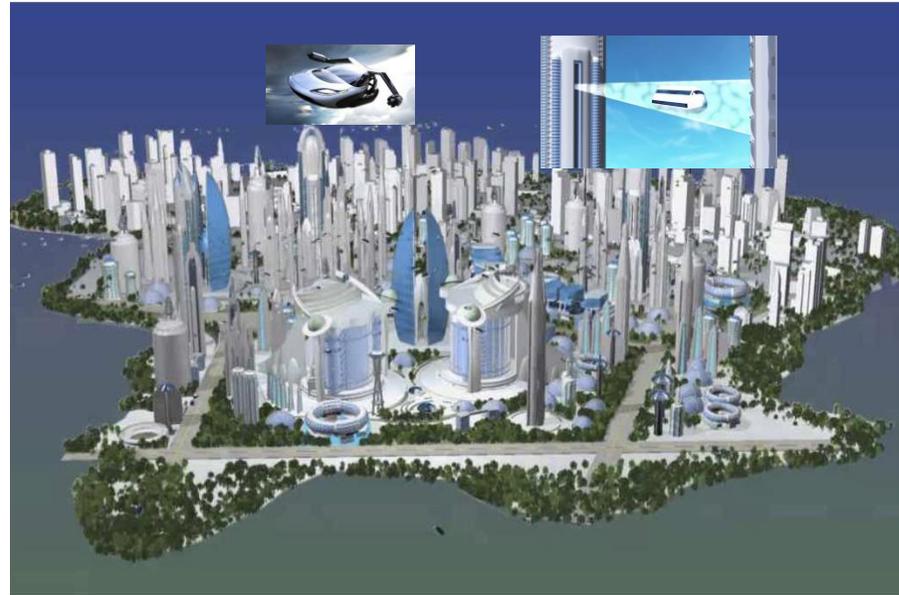
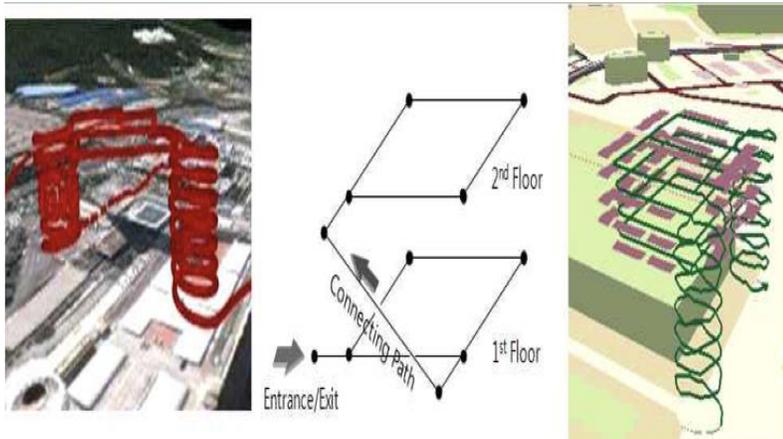


Figures : Google & VENUS Project

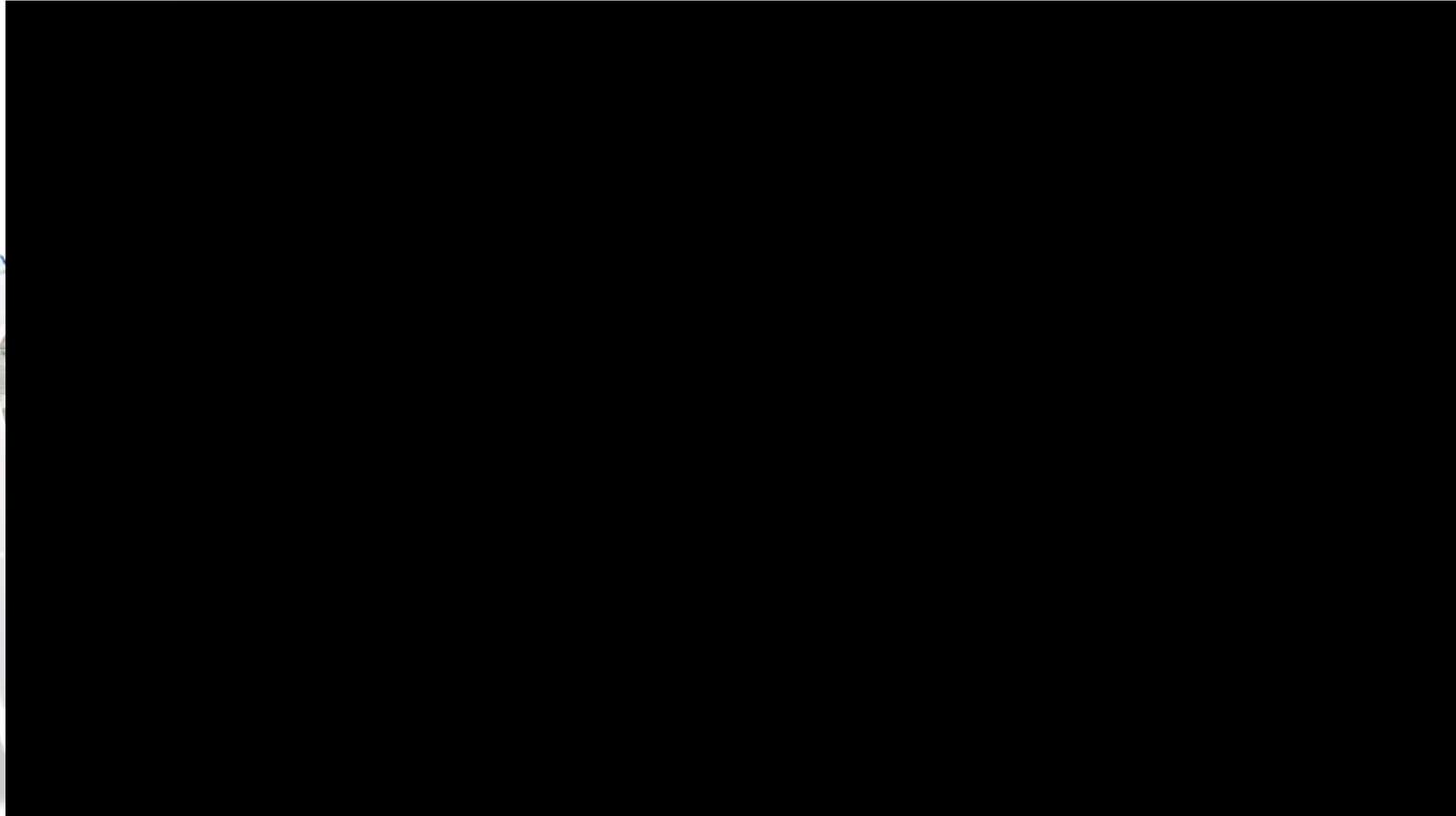
3D Transportation Infrastructure

➤ Virtual Roadways for 3D Transport Infrastructure

- Dynamic Generation/Extinction on Demand
- 3D Spatial HD Map, Network Operation & Management System, etc.



It's time to imagine ...



Issues for Future Mobility System

- **What to do for Future Mobility to 2050**
 - **Follower until 2010:** ICT, Intelligent Transport Systems (ITS)
 - **Fast Follower until 2030:** V2X, Digital & Logical Infrastructure, CADS, Smart Mobility
 - **Potential Creator from 2030 to 2050**
 - 3D Transport Infrastructure, 3D Network Operation & Management
 - 3D Spatial HD Map, CADS in Space by V2X (5G?, or 6G~10G?)
- **How to do now?**
 - Incubating a collaboration research for ideation, feasibility, preliminary design, etc.
 - Launching a Mega Project R&D when a detail plan is ready, e.g., after 5-10 years.

Thank you very much!

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