



SINGAPORE 2019

26th ITS World Congress
21-25 October

Smart Mobility, Empowering Cities

www.itsworldcongress2019.com | #ITSWC19



Organised by



Co-hosted by






Intersection Safety Service Pilot Test

Dr. Hyun Seo Oh

ETRI

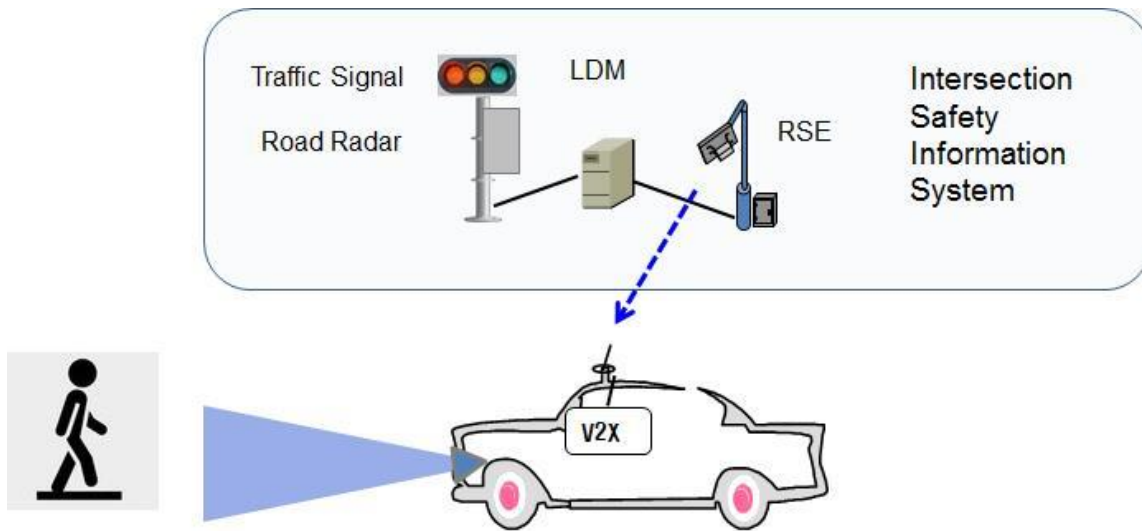
Contents of Talks

- Introduction
 - Service Scenario
 - IoT based System Architecture
 - Korean Pilot Site
 - Concluding Remarks
- 

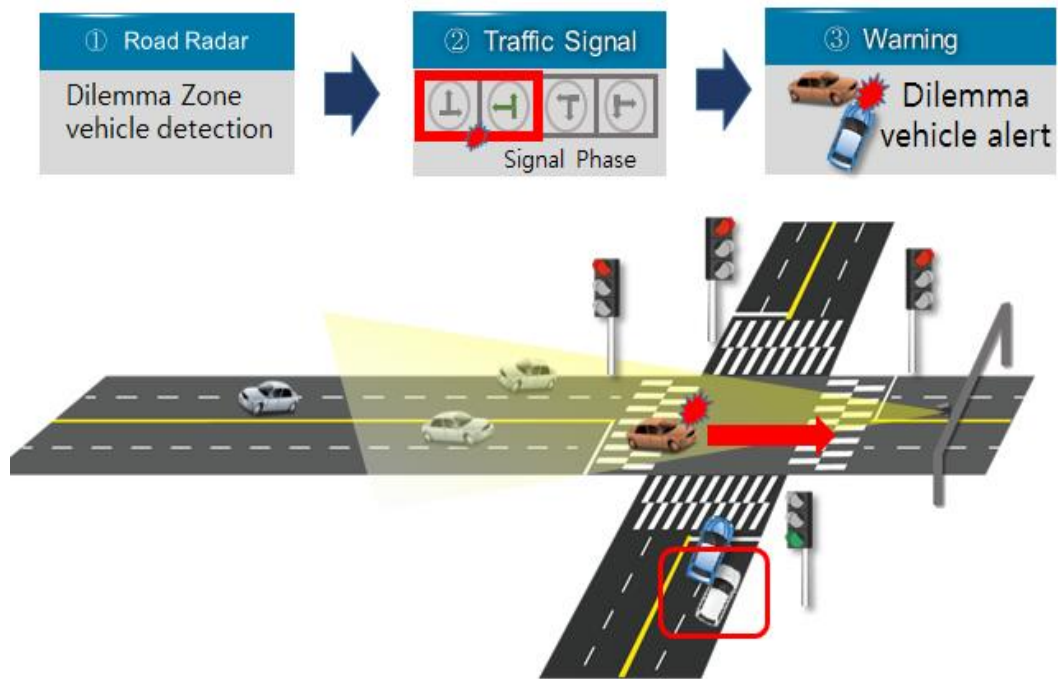
Introduction

Intersection Safety for Urban Driving

- Vehicle sensors has limitation in sensing blocked vehicles and pedestrians at the intersection
- Infra sensors and LDM based Intersection Safety Information System can provide information on vehicles and pedestrians at the intersection to generate warning signal or control command in service terminal.



Service Scenario



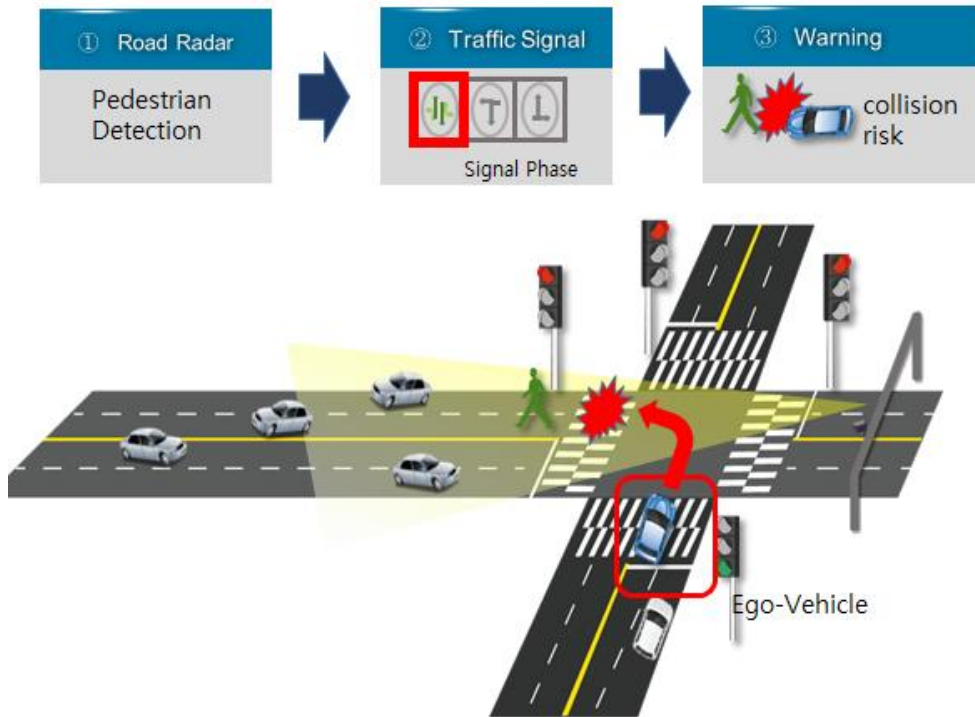
Signal Violation Warning

- The road radar scans the road status in real time. If vehicles are detected, the detected information is sent to ISS with signal phase information. ISS combines two received information and send it to service terminal.
- Service terminal decides whether the moving vehicle will be in intersection zone and cause vehicle collision to left turning vehicle; ego vehicle. Finally, service terminal will generate warning signal.

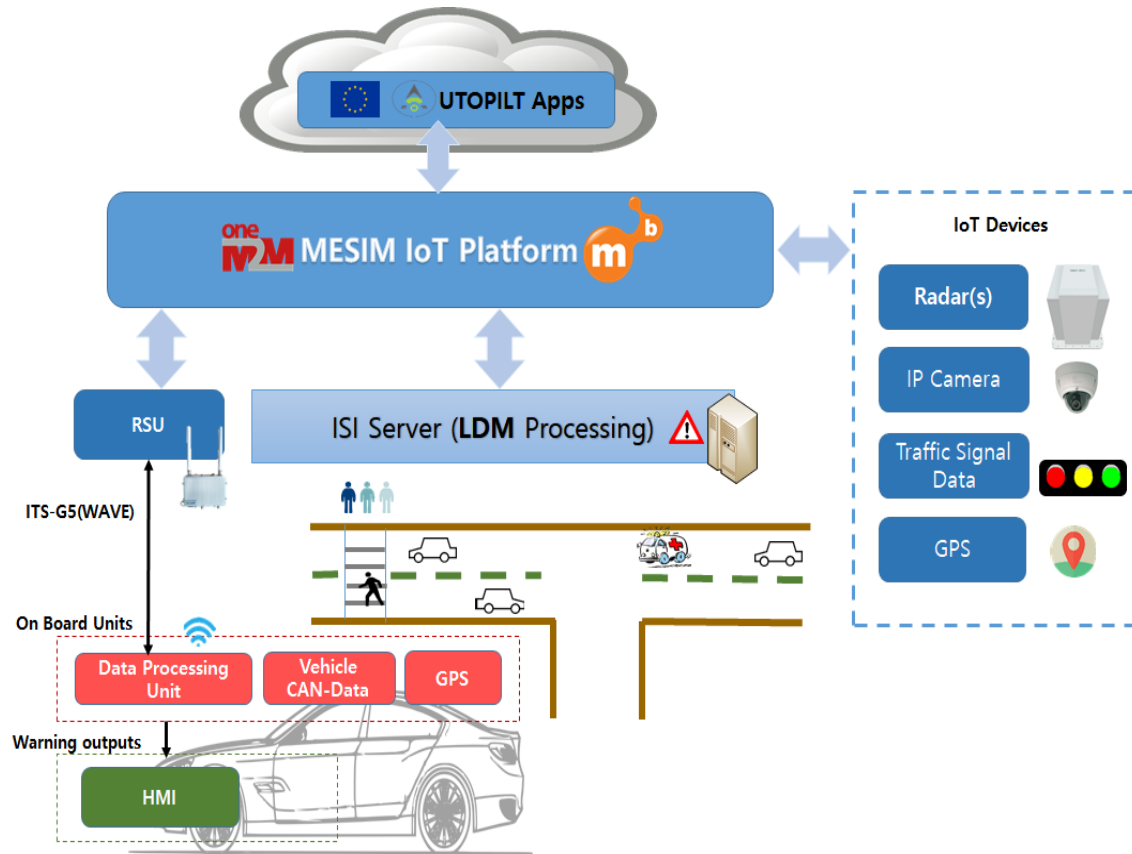
Service Scenario

Pedestrians Warning

- The road radar scans the road status in real time. If pedestrians are detected, the detected information is sent to ISS with signal phase information. ISS sends ISS information to service terminal via V2X communication.
- The service terminal decides whether the pedestrians will be in crosswalk zone and cause pedestrian collision to left turning vehicle; ego vehicle. Finally, service terminal will generate warning signal.

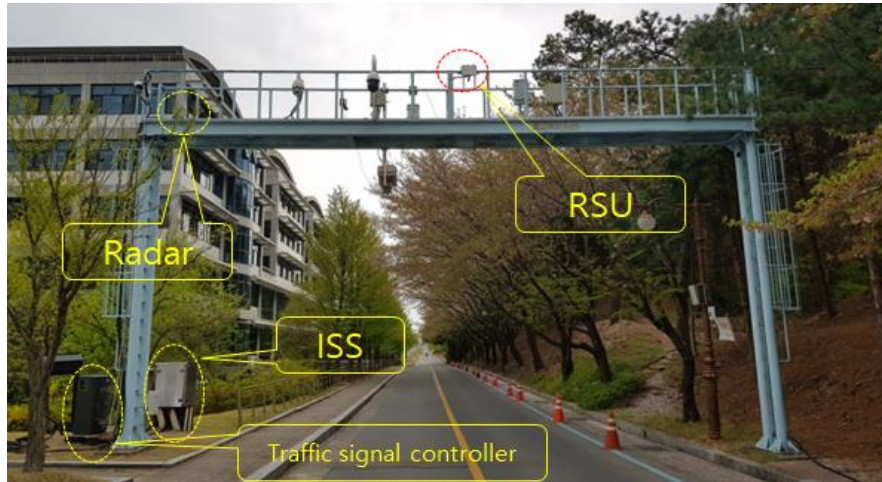


IoT based System Architecture



System Architecture

- OneM2M IoT platform receives information from IoT devices, stores and generates intersection safety information.
- Intersection safety information is transmitted to OBU and other Auto Pilot Platform.
- OBU generates LDM based intersection warning or control command to automated vehicle.

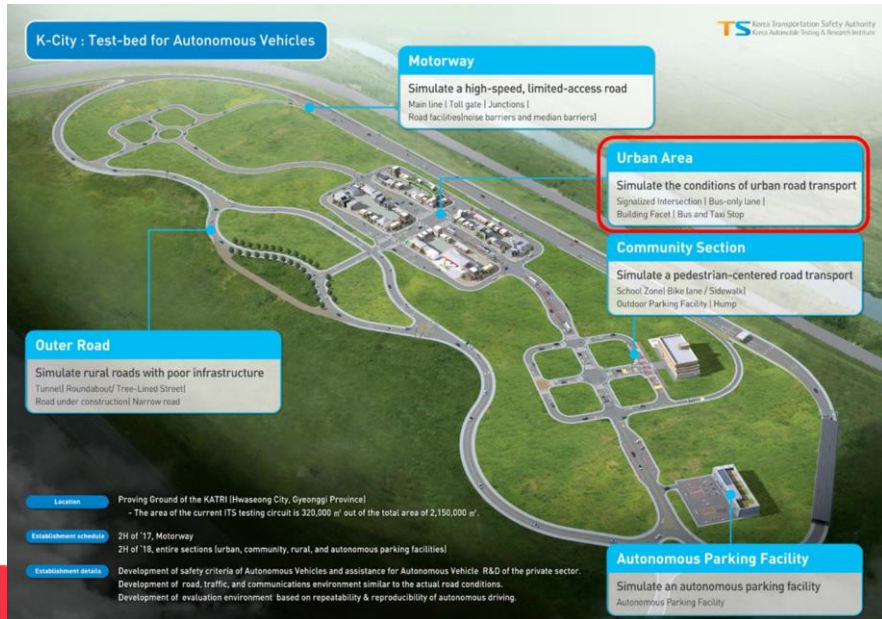


Korean Pilot Site

ETRI & K-city

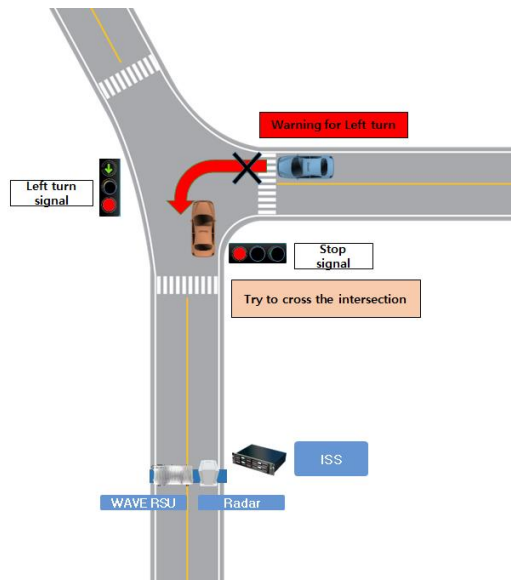
- ETRI pilot site

It is located at ETRI campus and Radar, traffic signal controller, ISS and RSU installed at the intersection zone.



- K-city pilot site

K-city site is located at Hwasung city, which built test road and infrastructure facilities for C-ITS and automated driving vehicle

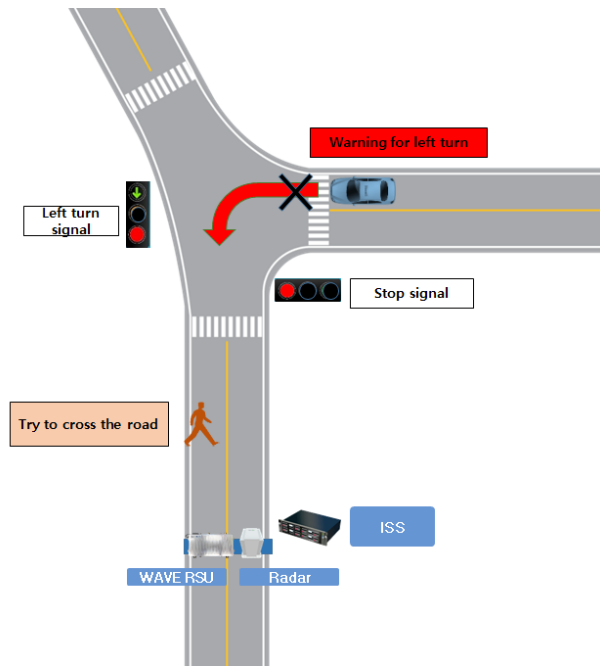


Korean Pilot Site

Signal Violation Warning Test (ETRI Site - vehicle)



- No warning if the approaching vehicle will stop when the traffic signal is changed into red status.
- Warning signal if the approaching vehicle will cross the intersection when the traffic signal is changed into red status.

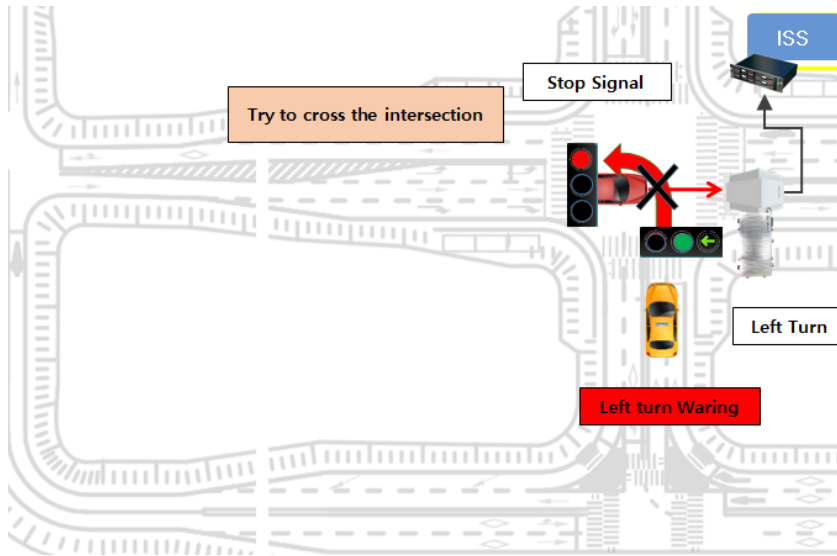


Korean Pilot Site

Signal Violation Warning Test (ETRI Site - pedestrian)

- No warning if no pedestrian is on the road when the traffic signal is changed into left turn status.
- Warning signal if the pedestrian try to cross the road when the traffic signal is changed into red status.





Korean Pilot Site

Signal Violation Warning Test(K-City)

- No warning if the approaching vehicle will stop when the traffic signal is changed into red status.
- Warning signal if the approaching vehicle will cross the intersection when the traffic signal is changed into red status.



```
I/LDM_DATA_INFO: ISI Message is received : length 338
I/LDM_DATA_INFO: intersection data process
I/LDM_DATA_INFO: vehicle data process : 202
I/LDM_DATA_INFO: signal data process : 49
I/LDM_DATA_INFO: signal data process : 50
I/LDM_DATA_INFO: signal data process : 51
I/LDM_DATA_INFO: OBD speed data process : 0km/h
I/LDM_DATA_INFO: OBD speed data process : 0km/h
I/LDM_DATA_INFO: ISI Message is received : length 338
I/LDM_DATA_INFO: intersection data process
I/LDM_DATA_INFO: vehicle data process : 202
I/LDM_DATA_INFO: signal data process : 49
I/LDM_DATA_INFO: signal data process : 50
I/LDM_DATA_INFO: signal data process : 51
I/LDM_DATA_INFO: OBD speed data process : 0km/h
I/LDM_DATA_INFO: ISI Message is received : length 338
I/LDM_DATA_INFO: intersection data process
I/LDM_DATA_INFO: vehicle data process : 202
I/LDM_DATA_INFO: signal data process : 49
I/LDM_DATA_INFO: signal data process : 50
I/LDM_DATA_INFO: signal data process : 51
```

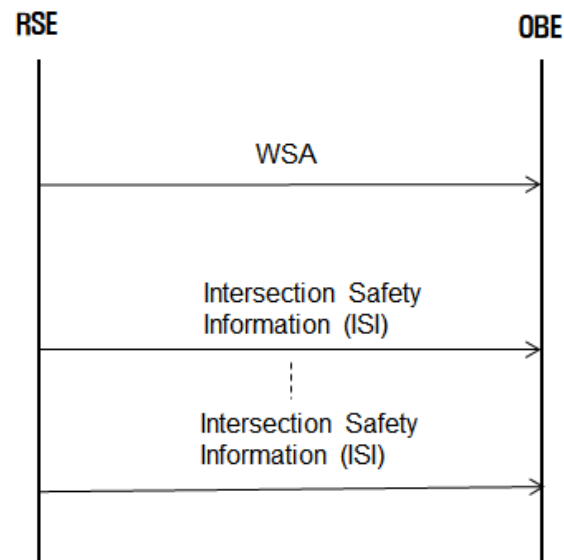
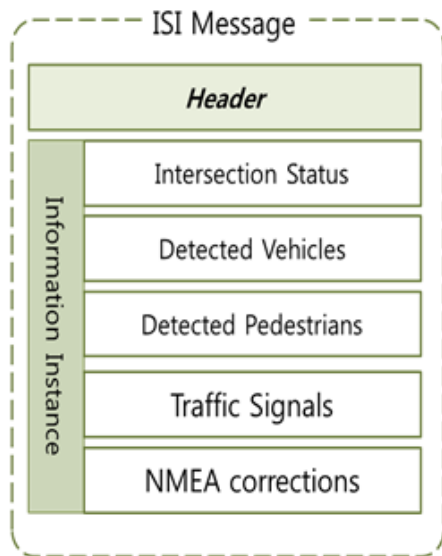


Korean Pilot Site

Performance Testing Results

- Radar: detection rate > 90%, detection period = 100msec
- ISS information transmission rate(latency): > 5 messages/1 second.
- WAVE communication: PER < 10% and packet latency = 100msec


Standardization



Intersection Service Communication Protocol

- V2X communication protocol between RSE and OBE
- Message format on intersection situation information, vehicle and pedestrian, signal phase and position data compensation referred to SAE J2735.

Concluding Remarks

- The usefulness and effectiveness of intersection safety depends on the message latency and detection reliability on IoT sensors.
 - And synchronization on combined event information is very important factor.
 - Certification and standardization work will be followed for commercial usage.
- 

The background features three stylized trees. Their trunks are solid light pink, while their canopies are composed of a dense network of thin, white, branching lines that resemble a circuit board or a neural network. The trees are positioned on the left, center, and right sides of the frame. The overall background is a gradient from dark red at the top to a lighter orange-red at the bottom.

Smart Mobility, Empowering Cities