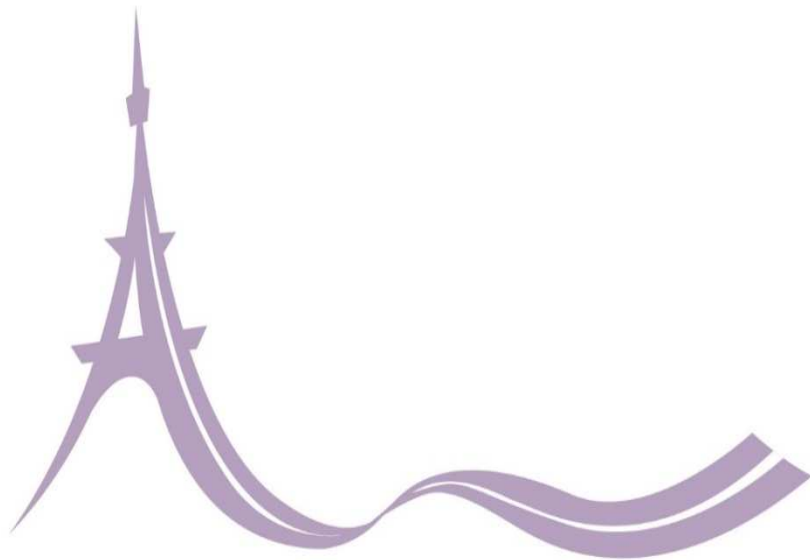


Introduction of SMART Highway Test Bed and Test Results



PAVEMENT PRESERVATION & RECYCLING SUMMIT

PPRS PARIS 2015
FEBRUARY 22-25








Joonsoo
Shin
Korea Expressway Co.



Korea Expressway
Corporation

Contents

-  Overview of SMART Highway Project
-  Best Practices of Developed Technologies
-  Smart Highway Test Bed
-  Test Results
-  Future Plan & Conclusion

OVERVIEW OF SMART HIGHWAY PROJECT | 1

Background



2006.10. 29-vehicle crash
at Seo-hae Grand Bridge
- victims : 60 persons (Killed : 12 persons)

2011.12. 90-vehicle crash
at Cheonan-Nonsan Expressway
- victims : 30 persons



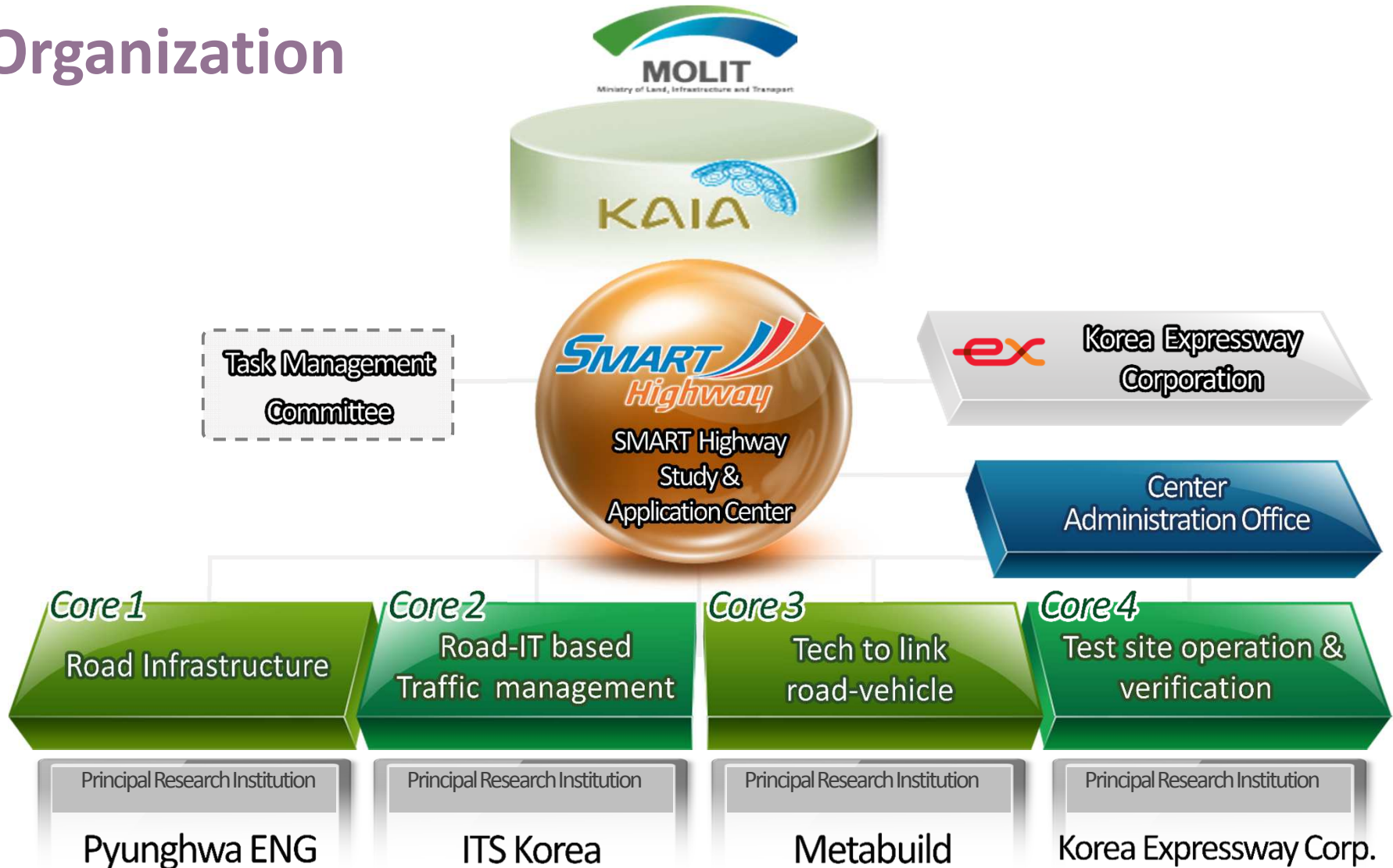
2010. 7. Bus fall-off accident
at Incheon Grand Bridge
- victims : 24 persons (Killed : 12 persons)



- ✓ One of VC-10, national R&D project by MOLIT
- ✓ SMART Highway project to realize “Intelligent Highway”

The diagram illustrates the SMART Highway project components and timeline. At the top center is the "SMART Highway" logo, featuring the word "SMART" in blue and "Highway" in orange, with a stylized road graphic. Below the logo is a large green cylindrical container with leaves, representing a test bed. Three circular icons are positioned around the container: "IT" (blue), "Auto mobile" (purple), and "Infra structure" (blue). Each icon is connected to a corresponding image on a tablet-like screen. The "IT" screen shows a person interacting with multiple computer monitors displaying data. The "Auto mobile" screen shows a white sedan. The "Infra structure" screen shows a modern, illuminated highway structure at night. At the bottom, a blue banner contains a calendar icon with the number "22", the text "2007 ~ 2014", a stack of money icon, and the text "88 million US \$".

Organization



BEST PRACTICES OF
DEVELOPED TECHNOLOGIES | 2

SMART IDS(Automatic Detecting System)

- ✚ Radar H/W : frequency (34.5GHz)
 - ◆ detect range : max. 1km, 5 lane road
- ✚ Data analysis S/W :
 - ◆ real-time data analysis
 - ◆ decision of incident situation



Road radar





Operation SW (Traffic center)

Camera View

Radar View

Traffic Info

일반	주의	장고	동계
고정물체	W1010	테스트#국지서버#도로감시레이더	
		135.9m	2014-01-03 10:06:11 2014-01-03 10:06:17
이동물체	V1148	테스트#국지서버#도로감시레이더	
		136.5m	2014-01-03 10:05:49 2014-01-03 10:06:17
고정물체	W1010	테스트#국지서버#도로감시레이더	
		135.9m	2014-01-03 10:05:48 2014-01-03 10:06:10
고정물체	W1010	테스트#국지서버#도로감시레이더	
		13m	2014-01-03 10:05:46 2014-01-03 10:05:47
고정물체	W1010	테스트#국지서버#도로감시레이더	
		13m	2014-01-03 10:05:37 2014-01-03 10:05:45

In Vehicle

Smart Device (WAVE)

전방 120m 1차로
차선변경이 있습니다.

평균 속도: 82 km/h
통행량: 8 대/m
발생 이벤트: 4 건/m

남하물감지 및 정보 제공 서비스

Field test & verification

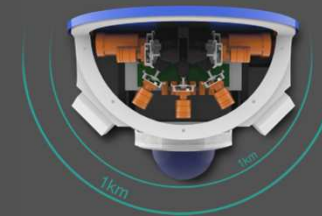


Seohae Grand Bridge

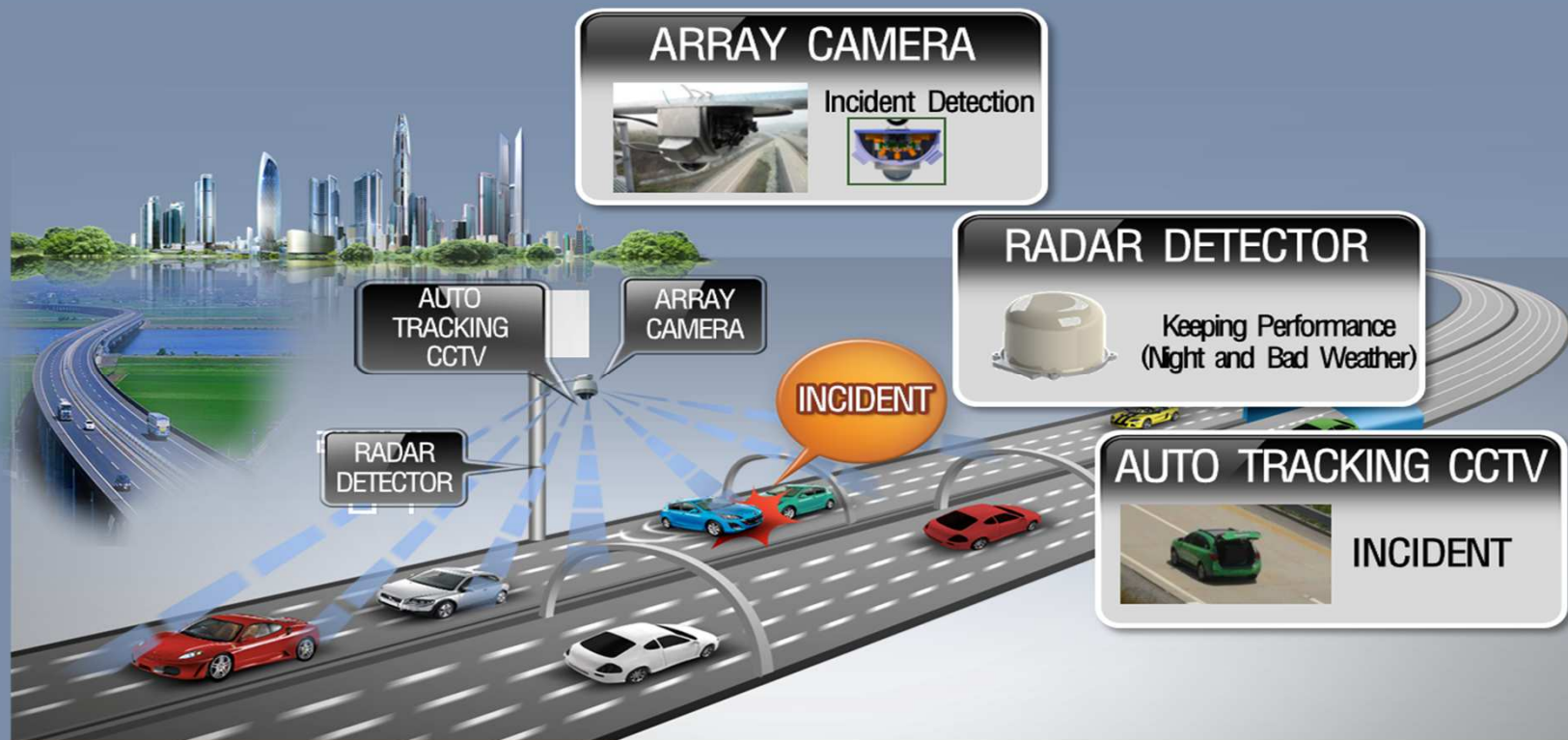


SMART-I(Automatic Detecting System)

- Array camera
- Tracking CCTV
- Radar



Array camera Road radar



Trial Product



Array Camera

✂ 7 cameras inside

- detect unexpected event
 - fallen object
 - car driving wrong way
 - car in sudden stop

coverage : 1km



Auto-tracking CCTV

Field test & verification



SMART Tolling(Non-stop, multi-lane tolling system)

- Wireless communication(DSRC, WAVE)
 - DSRC (Dedicated Short Range Communication)
 - WAVE (Wireless Access in Vehicular Environment)
- Any media (smart phone, wave terminal)



Test & Verification on highway



WAVE Tolling terminal Smart phone tolling App.



- ✚ Seamless communication through the V2V & V2I
- ✚ Providing vehicle safety services

WAVE Communication(V2I, V2V) Various wireless communication WAVE, DSRC, Wi-Fi



WAVE Terminal

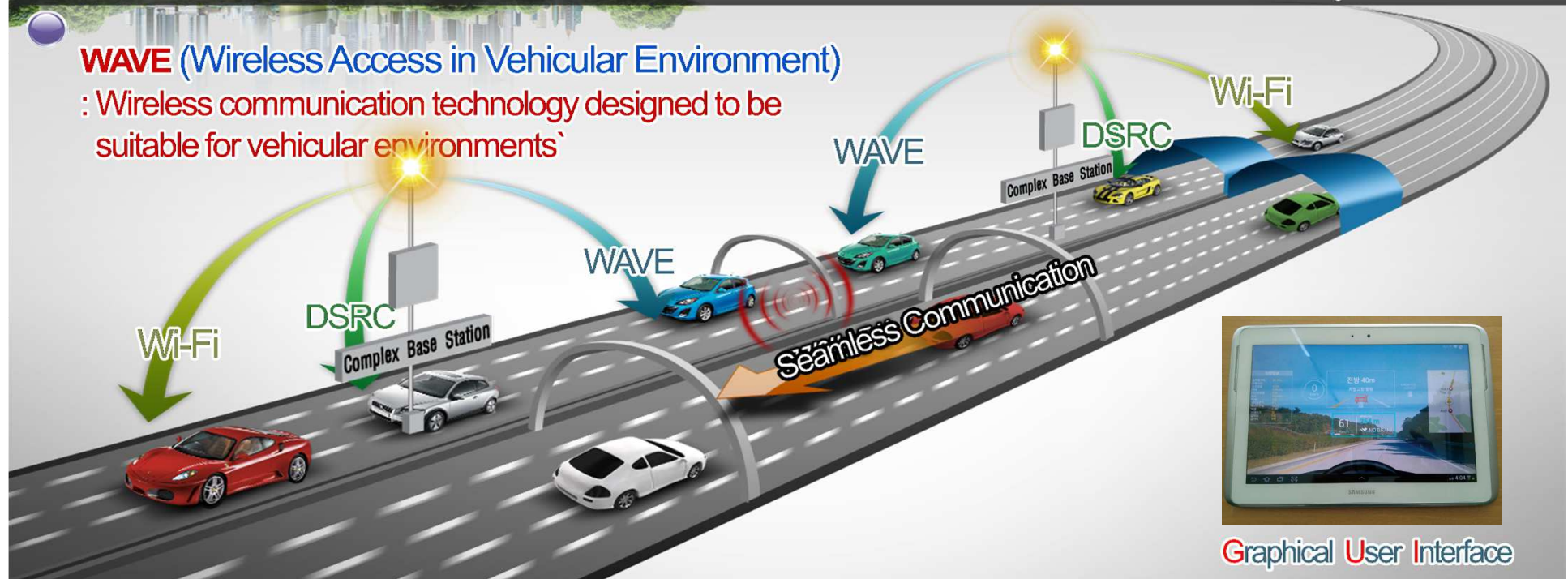


WAVE module



Complex base station

WAVE (Wireless Access in Vehicular Environment)
: Wireless communication technology designed to be suitable for vehicular environments`



SMART HIGHWAY
TEST BED | 3

Test Bed

Description

Construction background

- Verification of SMART Highway development technologies on the actual road
- Collection and provision of traffic information in real driving environment

Construction Section

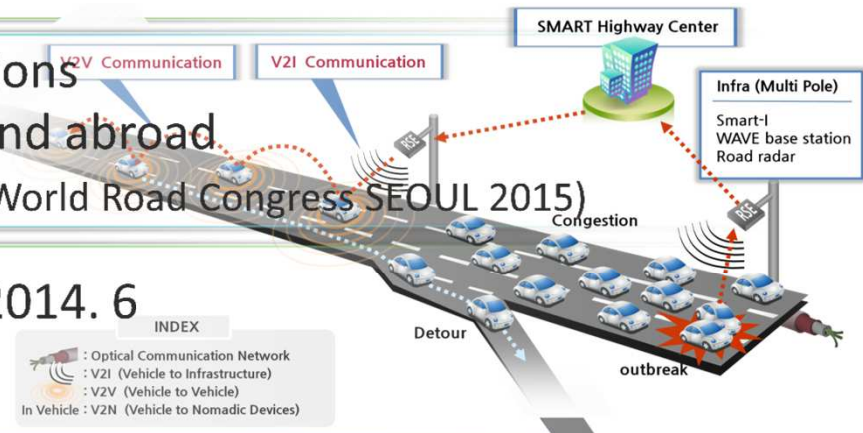
- Gyeongbu Expressway : Seoul TG-Suwon IC (length : 11km)

Selection background

- Chronically congested sections
 - Easy to promote in Korea and abroad
- (Technical demonstration site for World Road Congress SEOUL 2015)

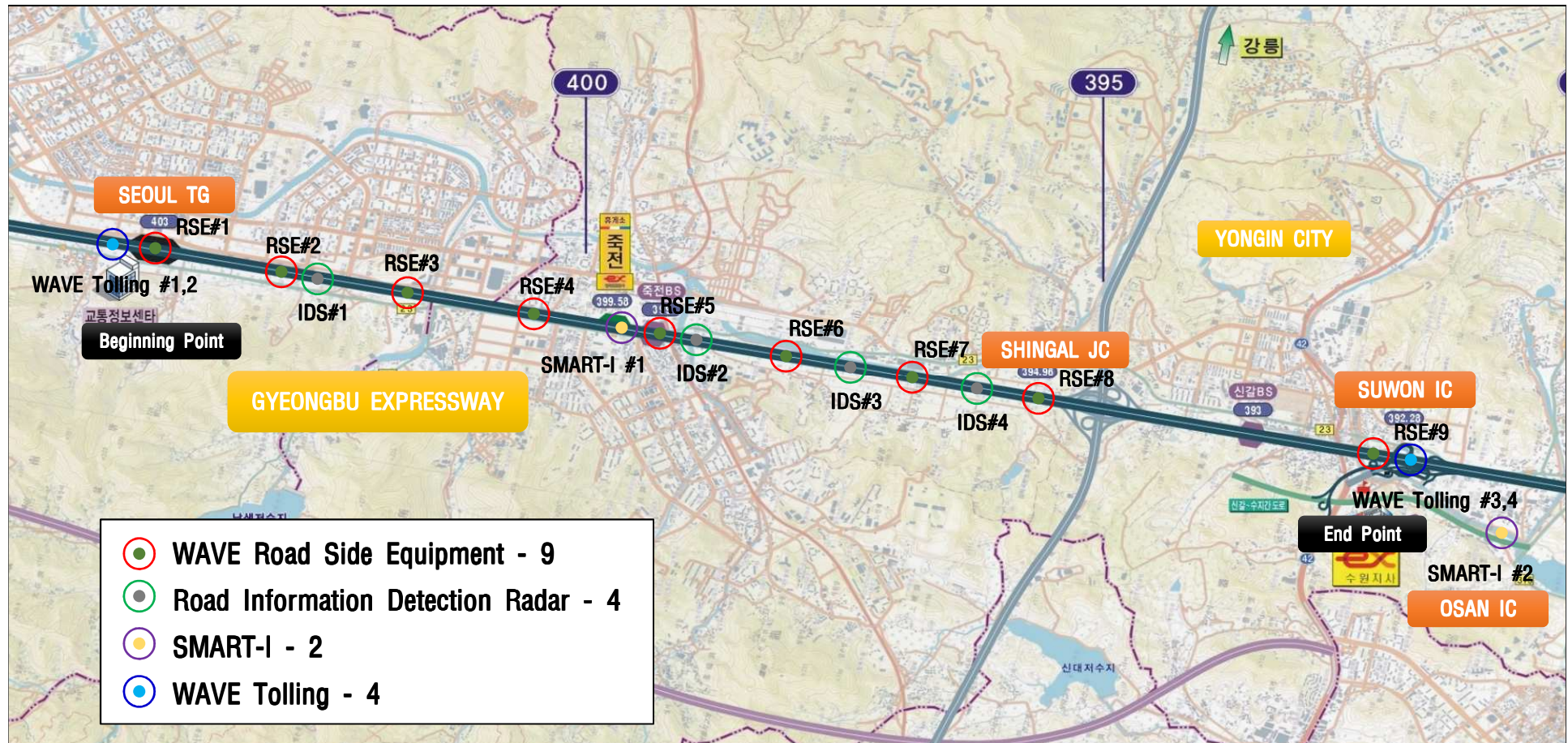
Construction & Operation period

- Construction : 2013. 12 ~ 2014. 6
- Operation : 2014. 7 ~



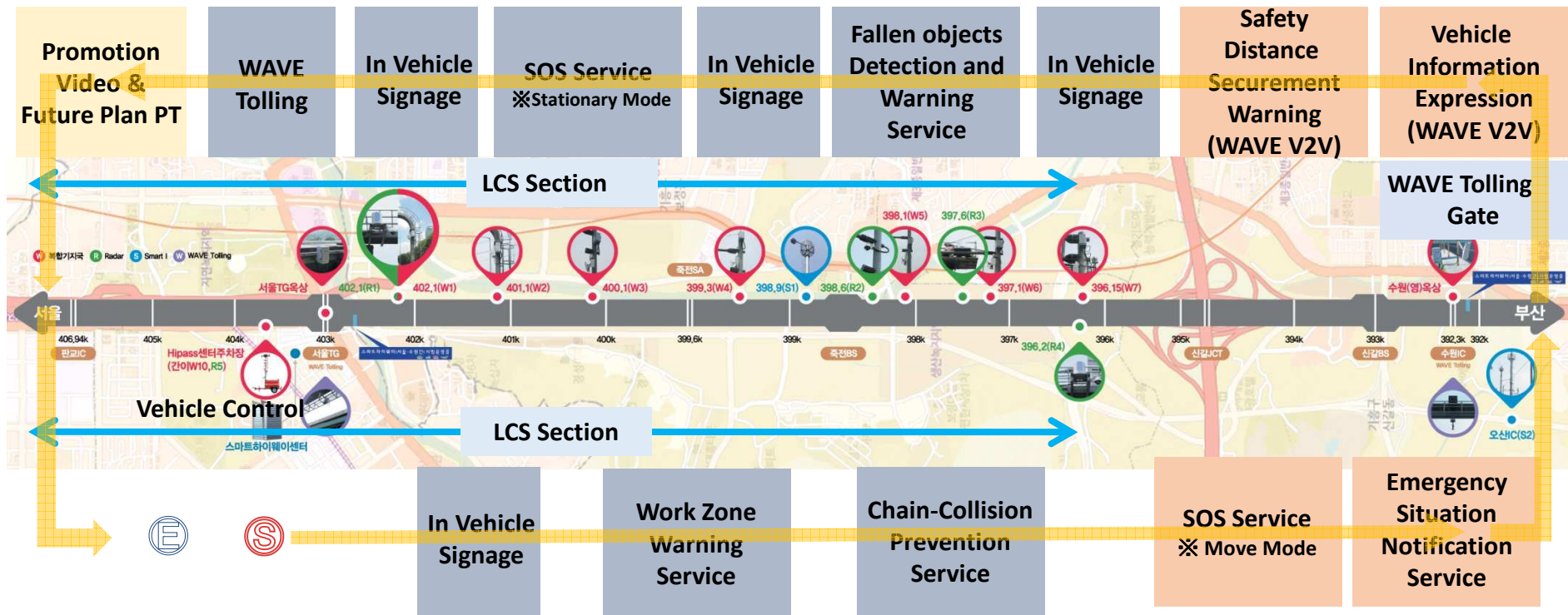
Realizing early commercialization through real road verification of SMART Highway development technologies

Map of SMART Highway Test Bed



Demonstration course and scenario

V2I
V2V



<Center>

- Briefing of SMART Highway
- SMART-Tolling

- SMART-I, Radar
- WAVE Communication Explanation

Safety Services

Work Zone Warning



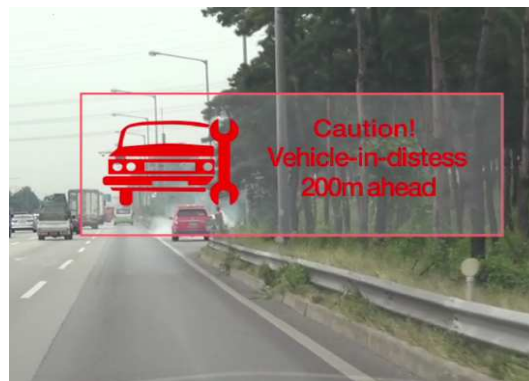
Obstacle Warning



Emergency Vehicle Warning



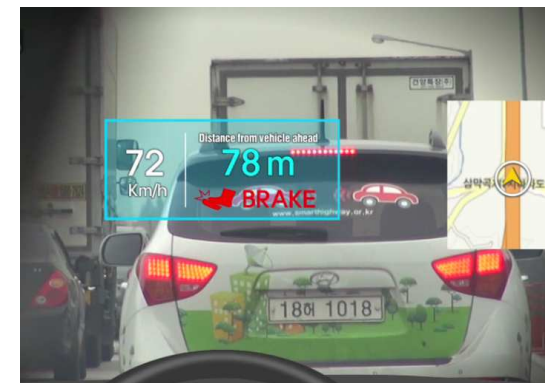
SOS Service



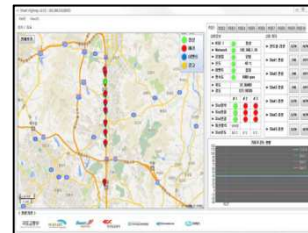
In Vehicle Signage



Chain Accident Prevention



Center Operation



<WAVE RSE>



<Smart IDS(Radar)>



<SMART-I>

Manage & Monitor System

Collect & Analyze data

Provide traffic safety

Information to vehicles through smart terminals



SMART Terminal

WAVE Terminal



User Interface



TEST RESULTS | 4

Test Results

- WAVE Communication Range
 - Range : V2I : Max. 1.4km, I2V : Max. 1.4Km
 - Avg. Latency (Goal : within 100ms)

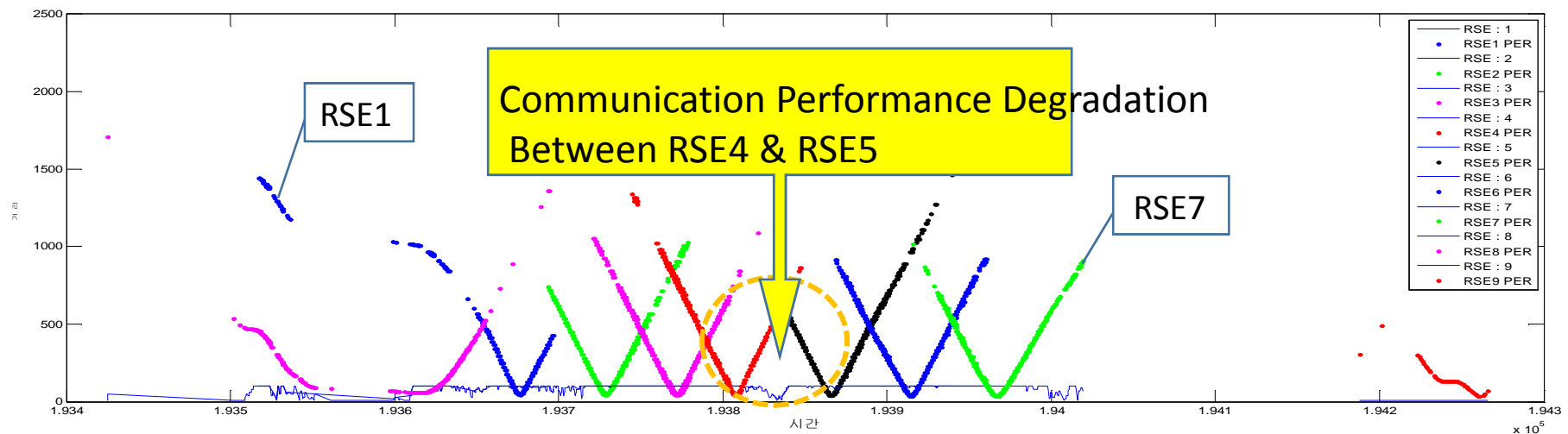
Service	Avg. Latency
BSM(Basic Safety Message)	1.65ms
Chain-Collision Prevention	1.50ms
Emergency Situation Notification	2.06ms

Service	Avg. Latency
SOS	1.81ms
Work Zone Warning	2.48ms
Fallen Object Detection & Warning	1.42ms

- PER(Packet Error Rate) : 7.33% (Goal : within 10%)
- SMART-IDS(Road Radar) : accuracy 96.6%, detecting range 1km
- WAVE Tolling : accuracy 99.05%

Test Results

○ Test Results of Communication Environment Inspection



- Communication Performance Degradation between RSE4 & RSE5
- Speculating Geological Factor & Antenna Beam Pattern

○ Modification Plan

- Modification of Antenna Beam Pattern
- Adjusting antenna angle, after modifying antenna beam pattern

FUTURE PLAN
AND CONCLUSION | 5

Future Plan & Conclusion

- Advancement of V2X(V2I, V2V) Communication Technologies
- Extension of SMART Highway Test Bed
 - ✚ Youngdong Expressway Singal JC ~ Hobup JC : 35km
 - Tunnel(2EA), IC(4EA), JCT(2EA)
- Application of SMART Highway technologies on the entire expressway throughout the verification on the test bed



25th World Road Congress(SEOUL)

- Date/venue : 2-6 November 2015/COEX in SEOUL
- Theme : Roads and Mobility – Creating New Value from Transport
- Expected Number of Participants
 - About 3,500 experts from over 120 countries
 - Over 1,200 government officials
 - Ministers/Vice-ministers from over 50 countries



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