

# Expressway Traffic Management System in Korea

March 3, 2025

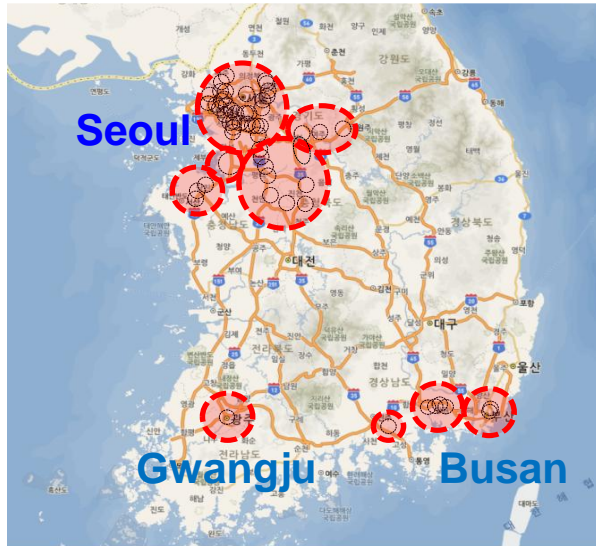
Seungjun Lee, Ph.D.



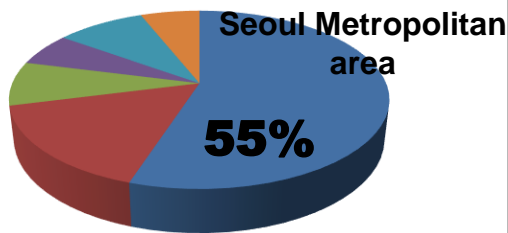
# What is the problem?

# Traffic Congestion on Expressways

## Major Congestion Area



## Travel Demand

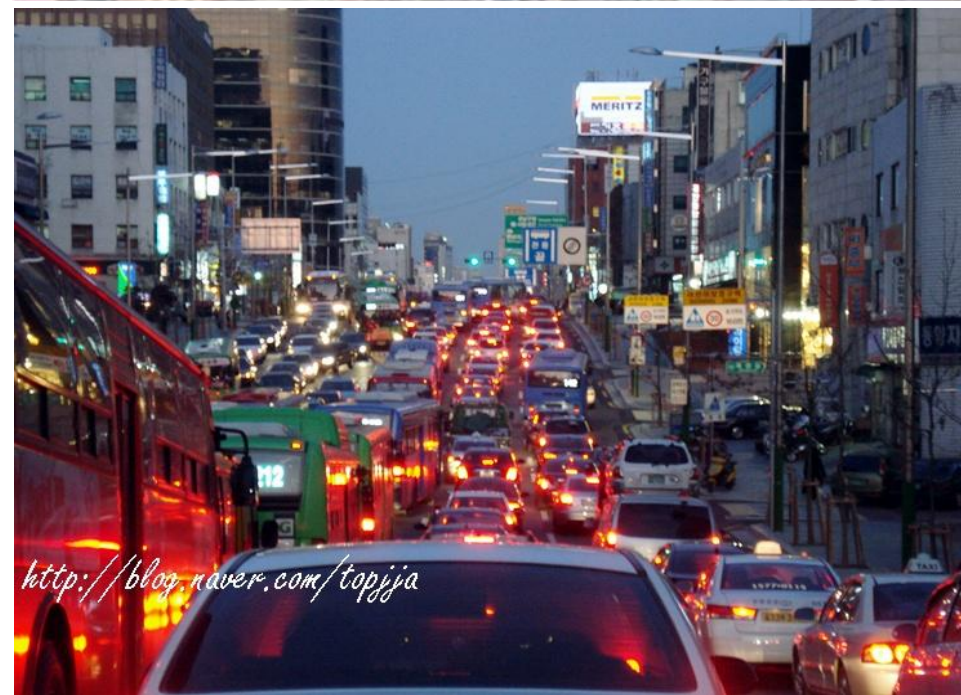


## Trip Characteristics

- ▶ Major congestion occur in urban areas
  - Seoul metropolitan area : 42 sections
  - Other urban area : 21 sections
- ▶ Serious traffic congestion occur in Seoul metropolitan area
  - The length of expressways in Seoul metropolitan area is 19%
  - But, travel demand in Seoul metropolitan area is 55%







# Congestion Management (Examples)

# Congestion Management - Example

3. Mainline Capacity Reduction



Propagation of Severe Congestion

2. Spillback Queue



Busan

Congestion happens

Bottleneck

Giheung IC  
(Samsung Electronics)

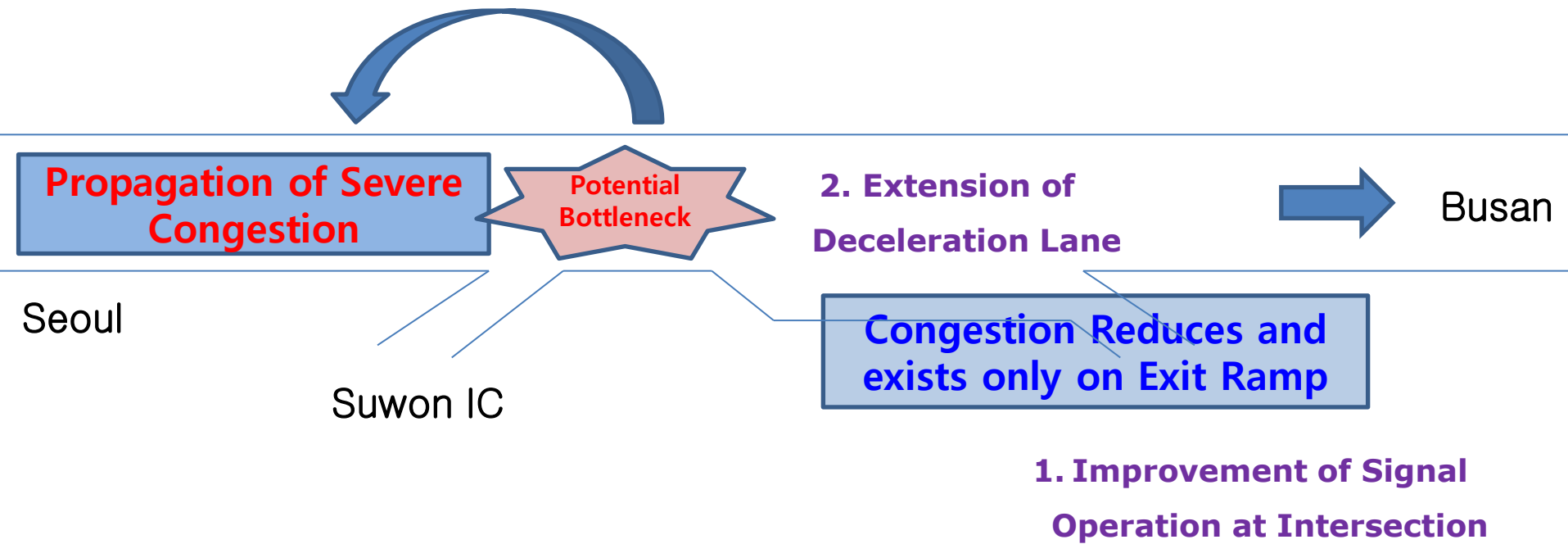
1. System Operation Failure  
- Signal Operation Failure

[ Current State ]

Seoul

Suwon IC

# Congestion Management - Example



**[ Potential Bottleneck by incomplete improvement ]**

# Congestion Management - Example

**No Congestion**



Busan

Seoul

Suwon IC

Congestion Reduces and  
exists only on Exit Ramp

Giheung IC  
(Samsung Electronics)

**[ Final Improvement ]**

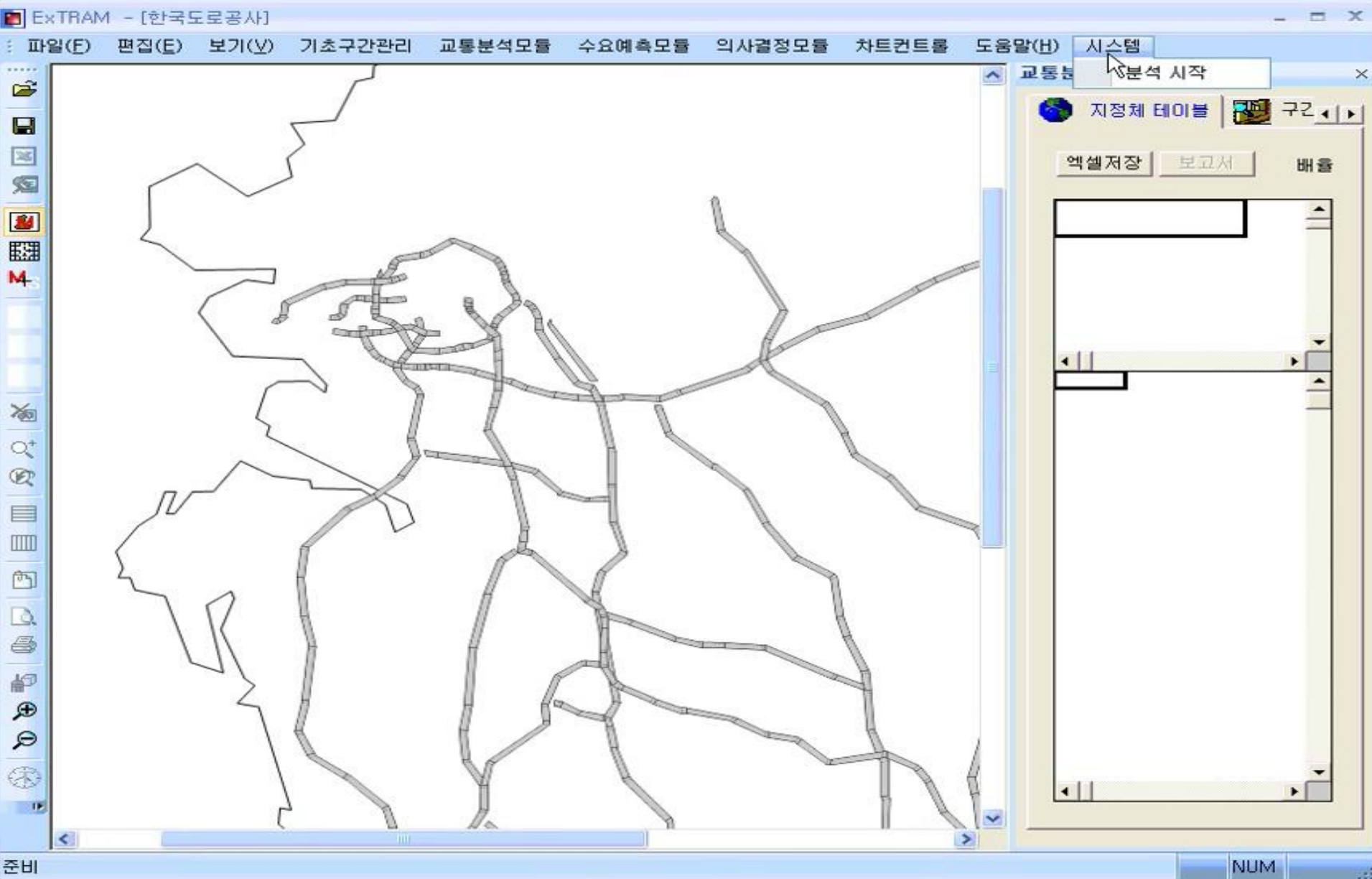
# Prediction of Traffic Condition (Off-Line)

The screenshot displays the ExTRAM software interface, titled "ExTRAM - [한국도로공사]". The main window shows a network diagram of roads. A menu bar at the top includes "파일(F)", "편집(E)", "보기(V)", "기초구간관리", "교통분석모듈", "수요예측모듈", "의사결정모듈", "차트컨트롤", and "도움말(H)". A dropdown menu is open under "교통분석모듈", showing "교통조건입력" and "교통분석".

On the right side, there is a panel titled "교통분석" (Traffic Analysis). It contains two tabs: "지정체 테이블" (Designated Body Table) and "속도 테이블" (Speed Table). Below the tabs are buttons for "엑셀저장" (Save to Excel) and "보고서" (Report), along with a "배율" (Scale) dropdown set to "70%". The main area of this panel is currently empty.

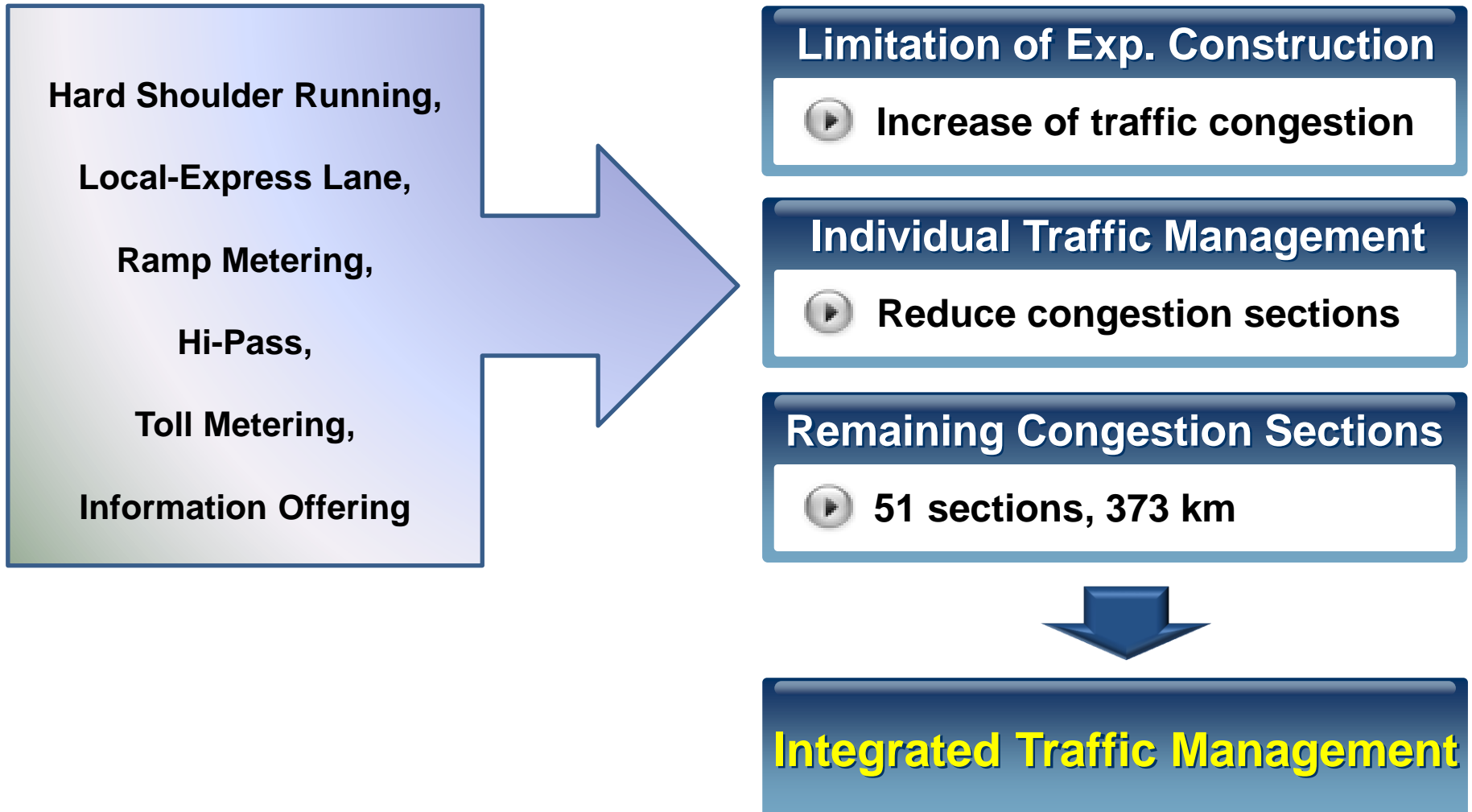
At the bottom right of the window, there is a "NUM" button.

# Prediction of Traffic Condition (On-Line)

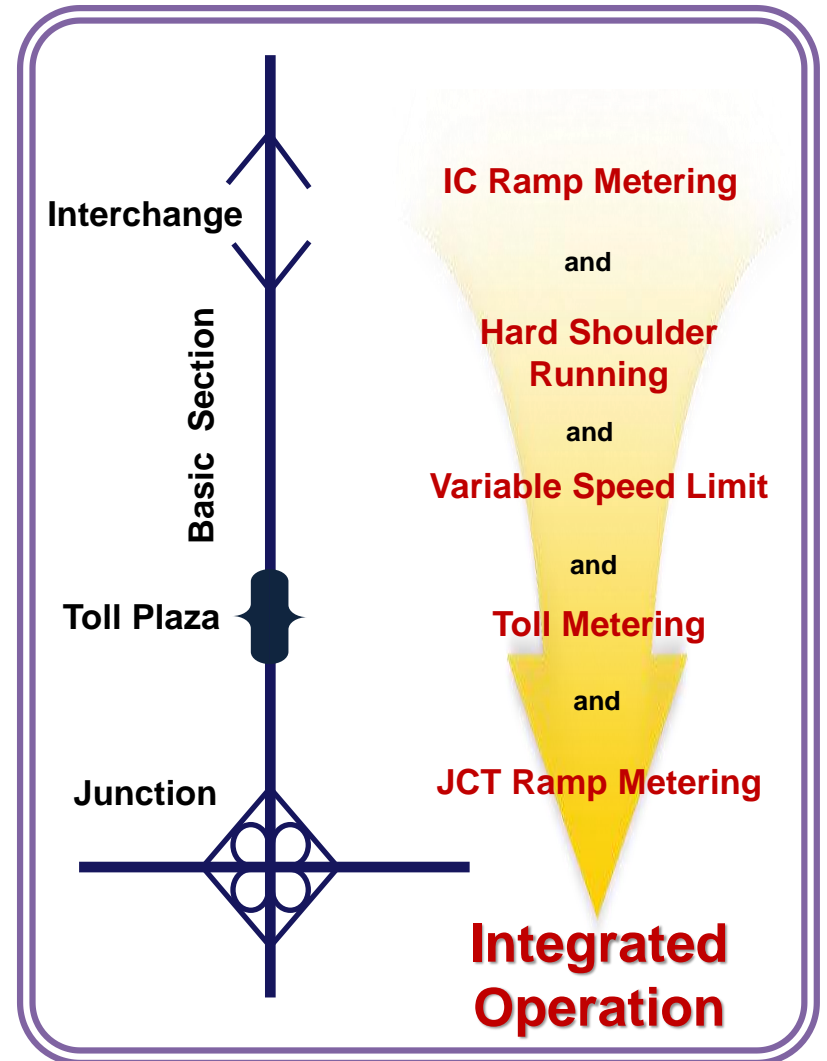
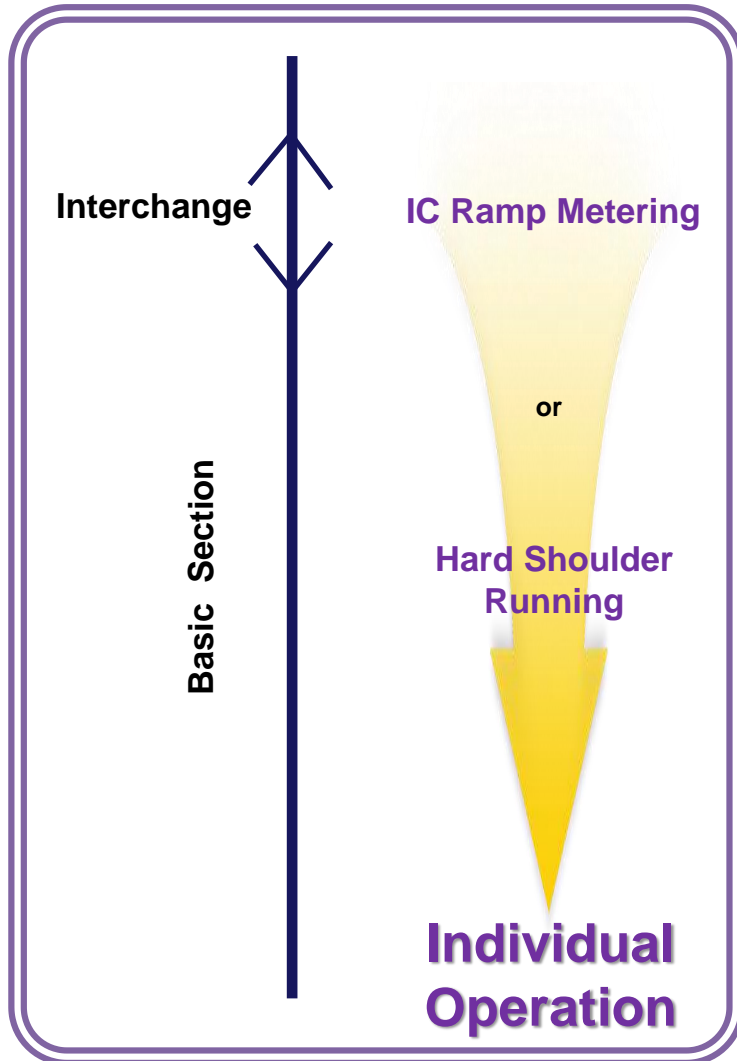


# Integrated Traffic Management (ITM)

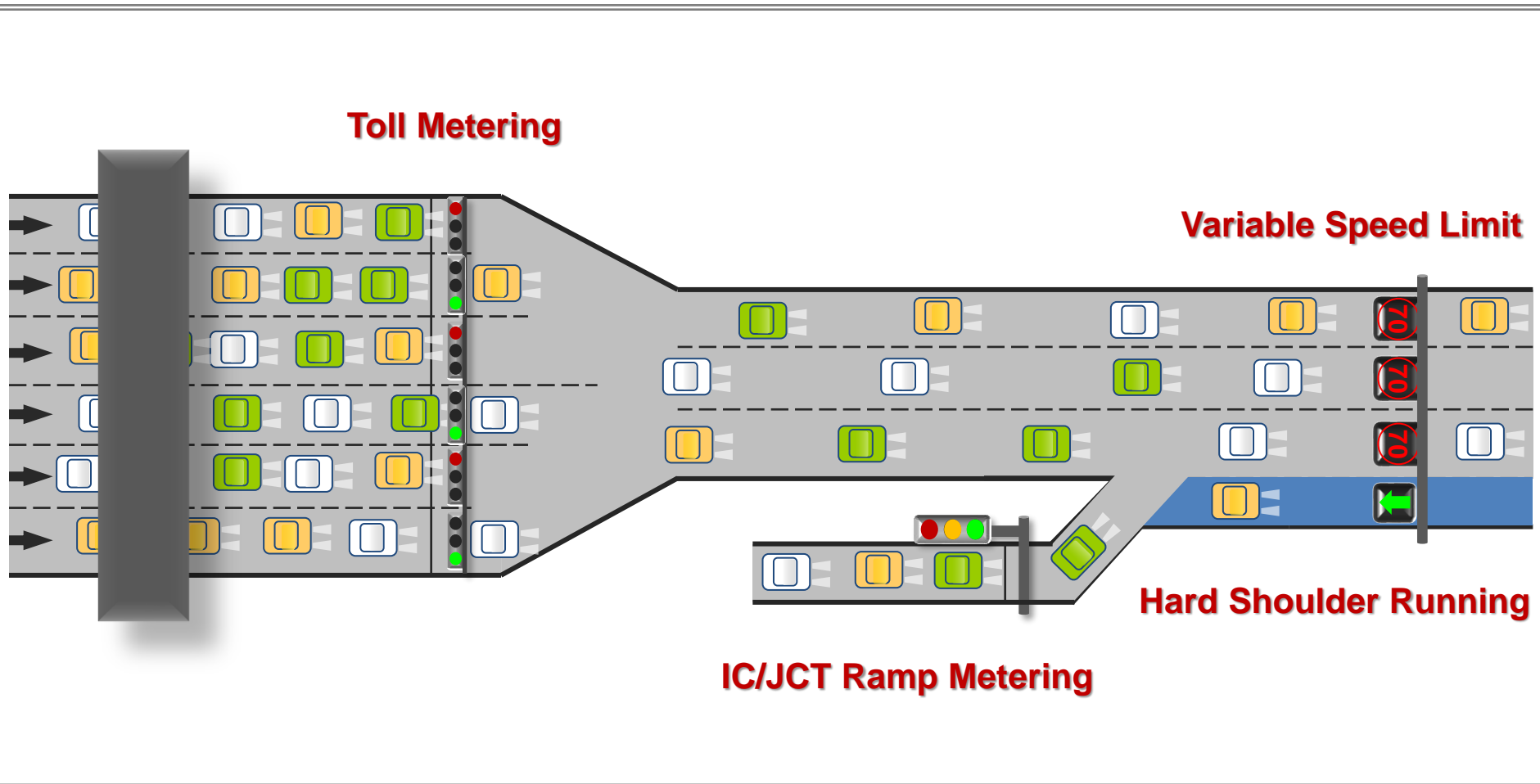
# Necessity of Integrated Traffic Management



# Integrated Traffic Management (ITM)



# Integrated Traffic Management (ITM)



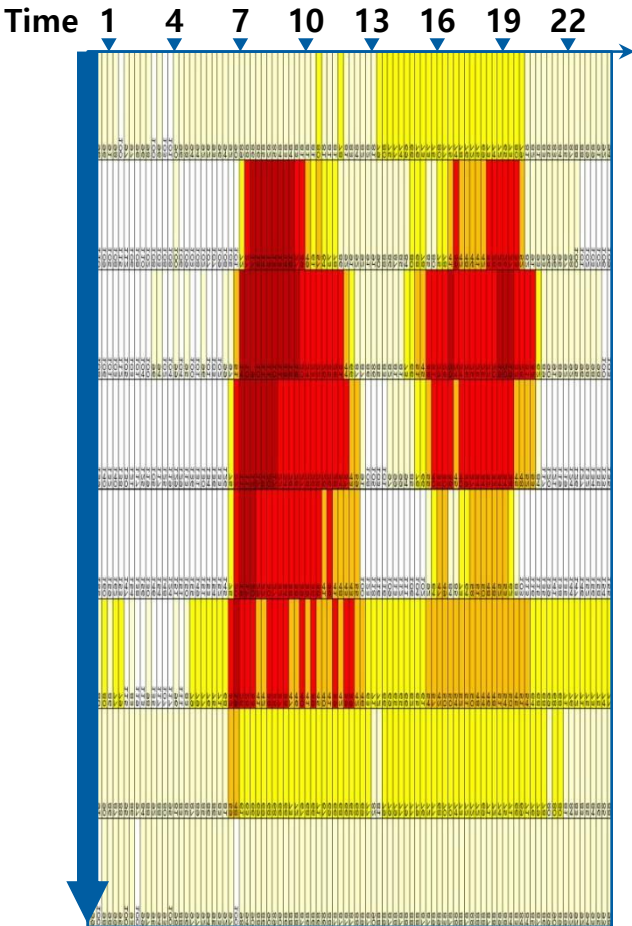
# Integrated Traffic Management Section

❖ 14 Sections, 440km

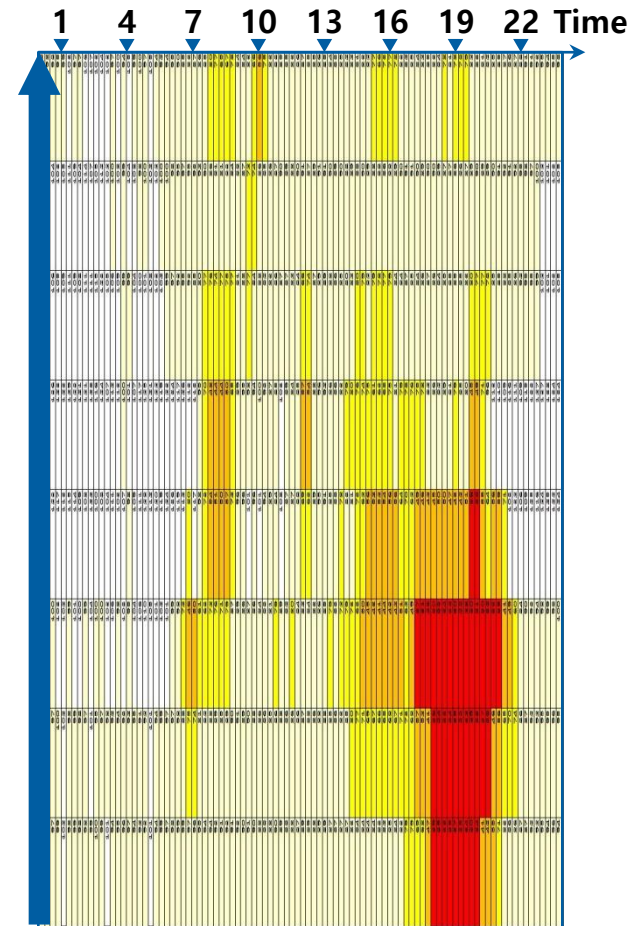
Expressway	Section	Direction	Length (km)	ADT (vehicle/day)	Level of Management goal	Period
Line #100	<b>Kimpo ↔ Siheung</b>	<b>Both</b>	<b>20</b>	<b>254,819</b>	<b>Congestion reduction</b>	<b>Test Project</b>
	Toigyewon ↔ Hanam	Both	14	192,274	<b>Congestion removal</b>	Short-term Project
Line #1	Seoul ↔ Ansong	Both	39	189,440	Prevention of existing congestion increase	
Line #15	Seopyungtaek ↔ Jonam	Both	44	193,753	<i>Congestion reduction</i>	
	Haemi → Haengdam	Seoul	38	72,010	<b>Congestion removal</b>	
Line #50	Singal ↔ Gunja	Both	31	154,103	<b>Congestion removal</b>	
	Manjong → Hobeob	Incheon	50	133,811	Prevention of existing congestion increase	
Line #10	Naengjeong → Gupo	Busan	22	92,772	<i>Congestion reduction</i>	Short-term Project
Line #104	Naengjeong → Sasang	Busan	34	102,068	<i>Congestion reduction</i>	

# Traffic Condition (Test Project - Line #100)

South bound



North bound



# Traffic Control Strategy

## ITM Strategy

Hard Shoulder Running



IC Ramp Metering



JCT Ramp Metering



Toll Metering



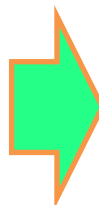
VSL

Traffic Volume Increase

Merging Volume Increase

Queue on Ramp

Speed Difference between Flows



## Test Project Strategy

No Hard Shoulder Lane

IC Ramp Metering



JCT Ramp Metering



Toll Metering



VSL

Mainline and Merging Volume Increase

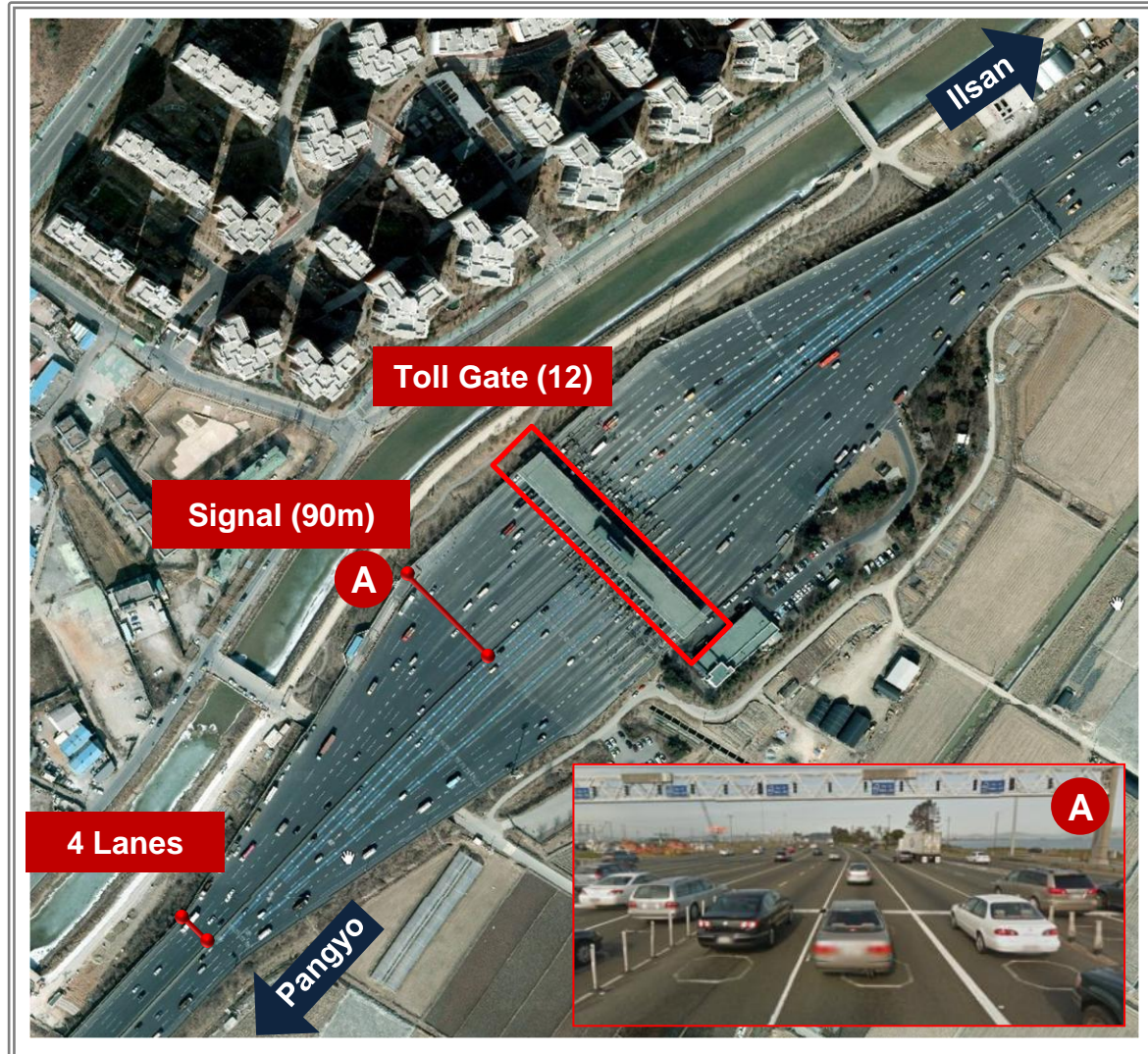
Queue on Ramp

Speed Difference between Flows

# Ramp Metering (Test Project - Seoun JCT)



# ■ ■ ■ Toll Metering (Test Project – Kimpo Toll Plaza)



# Variable Speed Limit (Test Project – Jungdong)

Line #100 – Jungdong IC (Southbound 1km)

장수분기점  
3km 정체

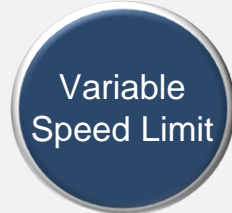
70

70

70

70

# Traffic Simulation (Test Project - Line #100)



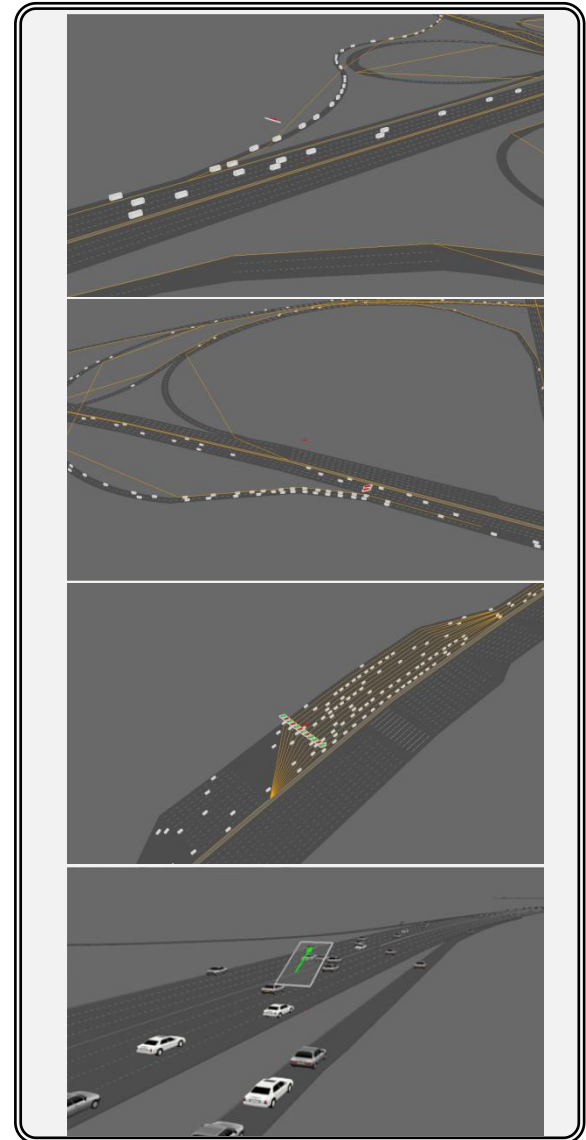
( Time Period : 2~9 pm, Friday )

**Present Condition**  
(individual ramp control)

**Prevention of existing congestion increase**  
(low level of integrated control)

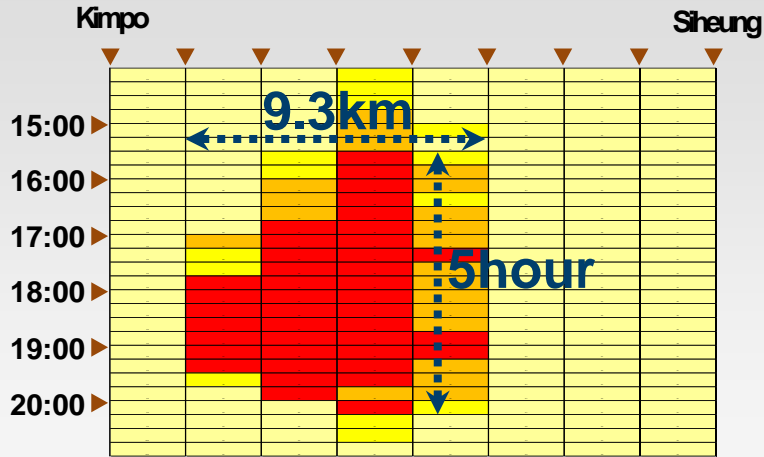
**Congestion reduction**  
(intermediate level of integrated control)

**Congestion removal**  
(high level of integrated control)

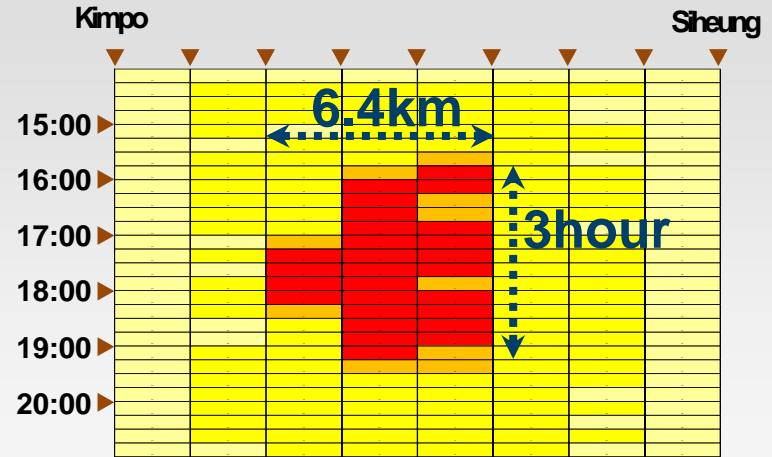


# Simulation Results (Mainline)

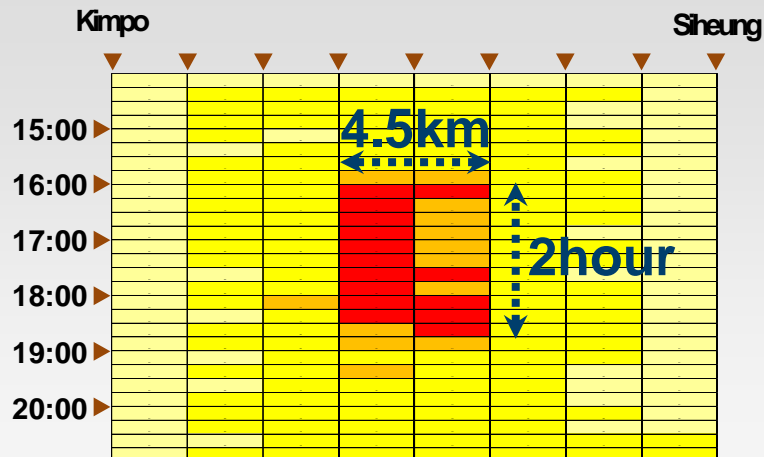
## Individual Ramp Control



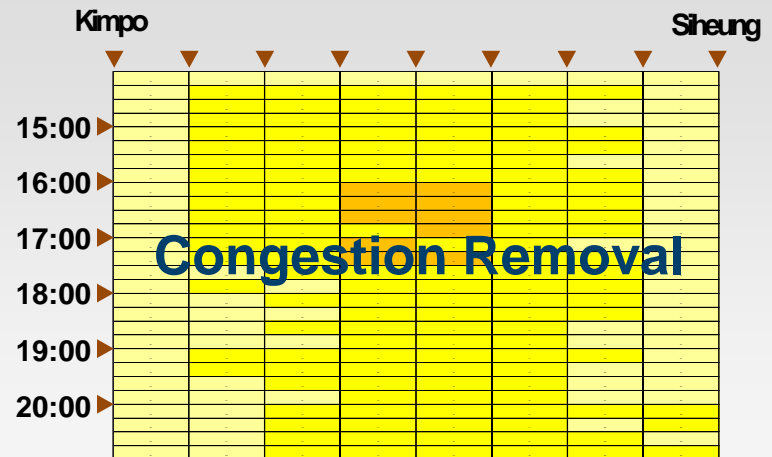
## Low Level of Integrated Control



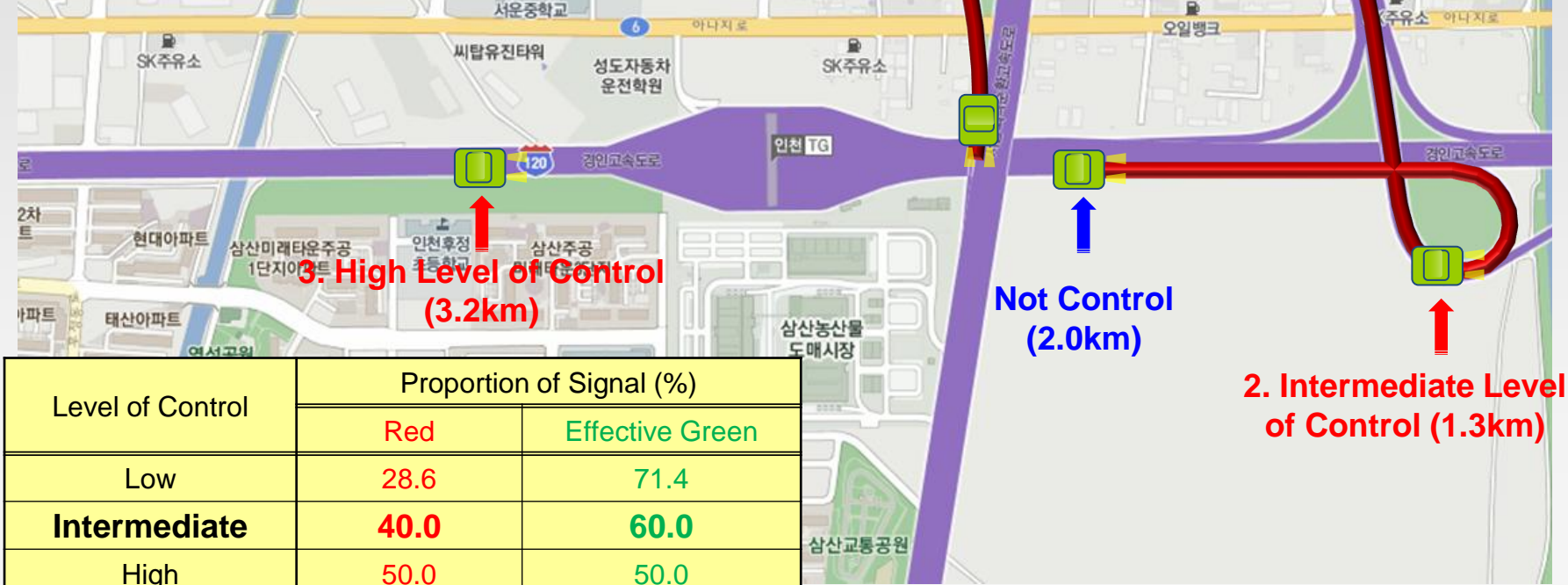
## Intermediate Level of Integrated Control



## High Level of Integrated Control



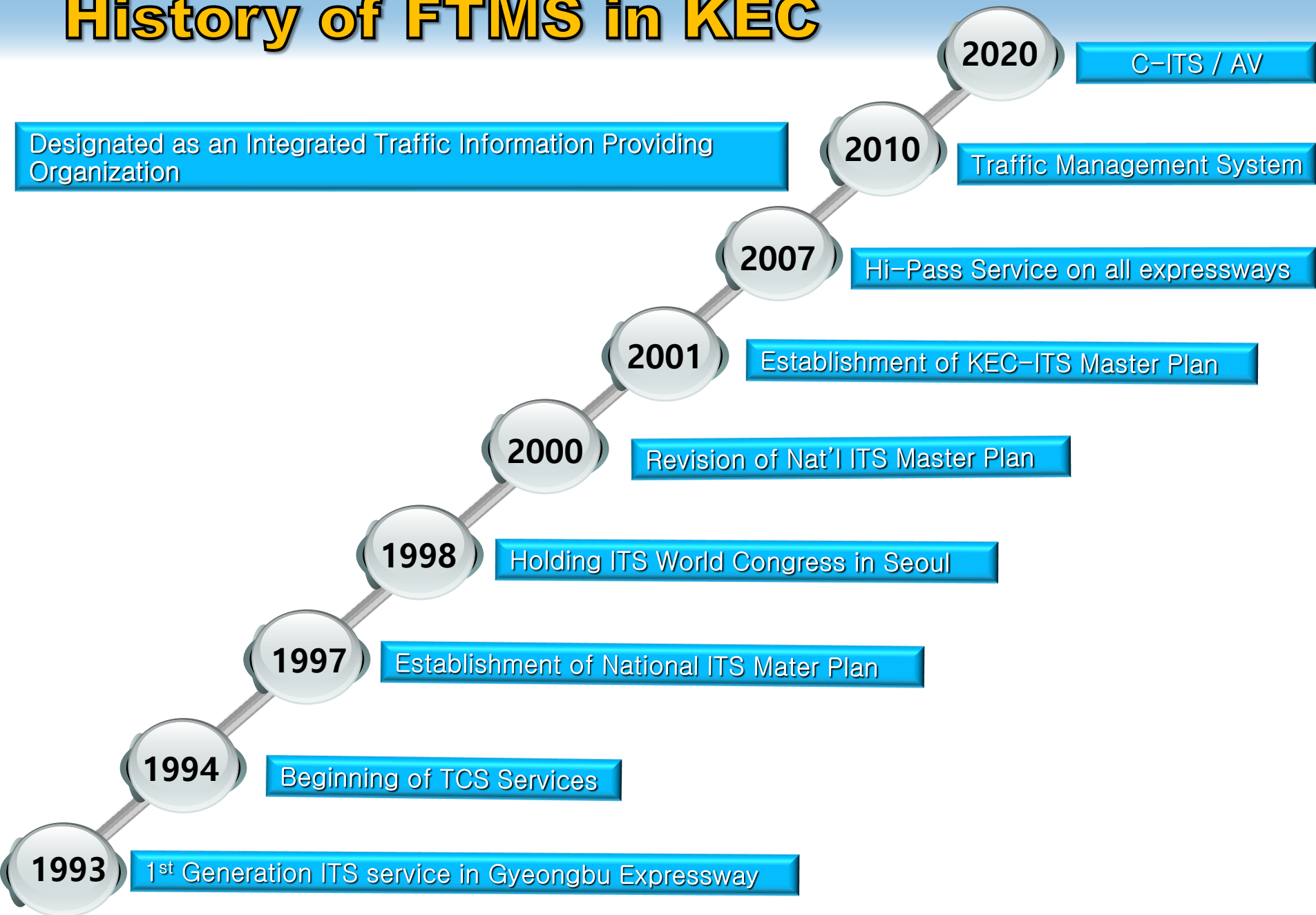
# Simulation Results (Queues on Ramp)



Level of Control	Proportion of Signal (%)	
	Red	Effective Green
Low	28.6	71.4
<b>Intermediate</b>	<b>40.0</b>	<b>60.0</b>
High	50.0	50.0

# FTMS in Korean Expressways

# History of FTMS in KEC



# Traffic Data Collection System

## VDS(Vehicle Detection System)

### Image Detector



- The Image Processing Technology
- Easy to Install and Fix
- Low Reliability

### Loop Detector



- The changing of Magnetic Field of Loop Coil
- High Reliability(97%)
- Hard to Manage and Fix

# Traffic Data Collection System

CCTV(Closed Circuit Television)



Traffic Monitoring(TMC)



Broadcast



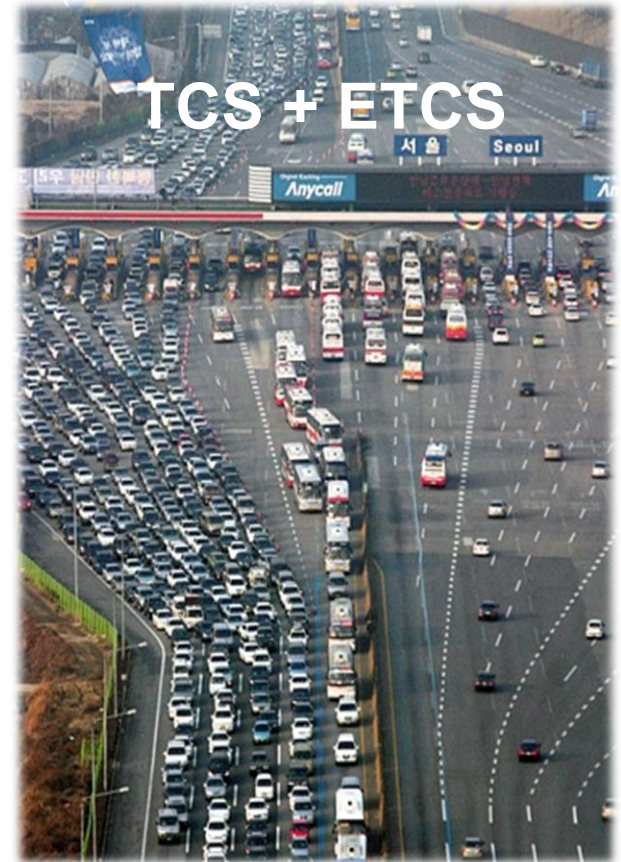
WEB(Internet)



Application(Mobile)

# Traffic Data Collection System

TCS(Toll Collection System) / ETCS(Electronic Toll Collection system)

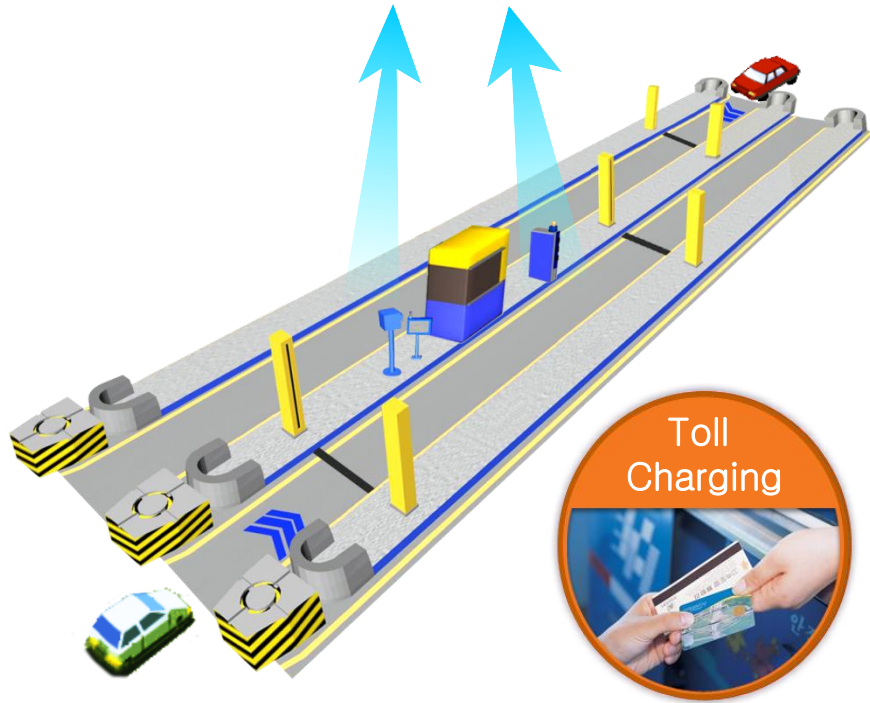


# Electronic Toll Collection

## TCS Vehicle Process

Toll Center

TCS Charging Data

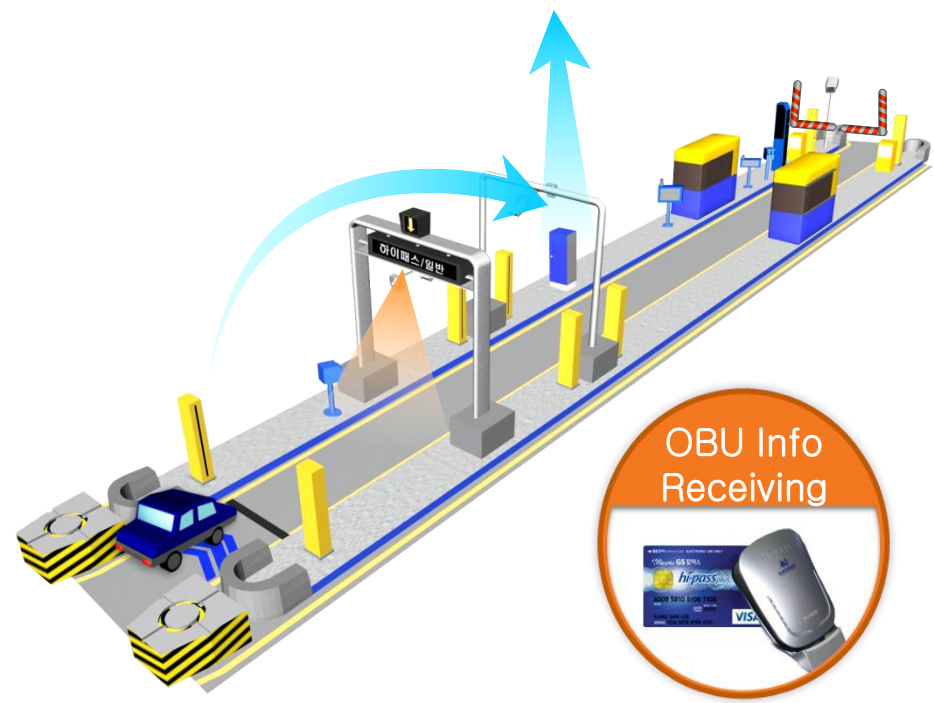


" TCS capacity: 450 vehicles /hour "

## ETCS Vehicle Process

Toll Center

ETCS Charging Data



" ETCS capacity: 1,800 vehicles /hour "

# Traffic Management System

## LCS(Lane Control System)

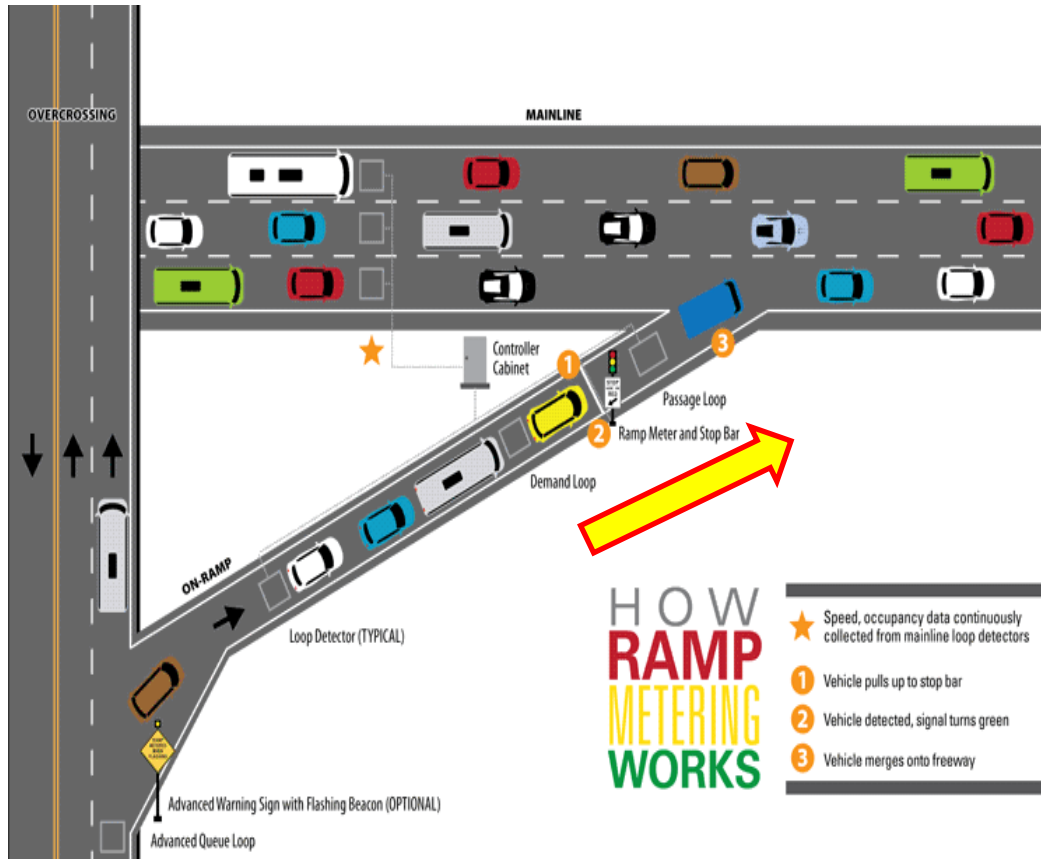
- Controlling Lane usage to increase capacity during congested condition
- Improving Safety in tunnel



# Traffic Management System

## RMS(Ramp Metering System)

- Mitigate traffic congestion on mainline
- Keep mainline volume below capacity by controlling ramp volume



# Traffic Management System

## Enforcement System

- Automatic enforcing violation vehicles (Speed Limit, Bus Lane, Over-Weighted Truck)



# Traffic Management System

## Traffic Analysis System

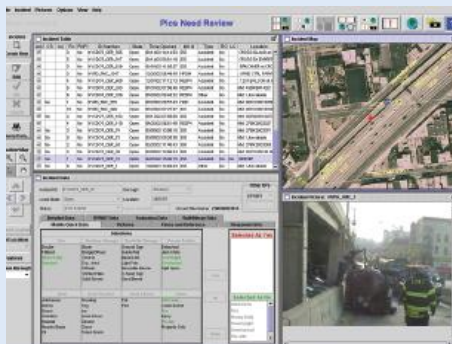
### Details

- Develop an integrated monitoring system for highway, traffic and disaster
- Develop a traffic simulator and an automated incident detecting program
- Develop an integrated traffic information system for Nat'l EWY's and Nat'l HWYs

### Effects

- Organized management of highway, traffic and disaster
- Automated traffic operation
- Provide high quality of information on estimated traffic condition

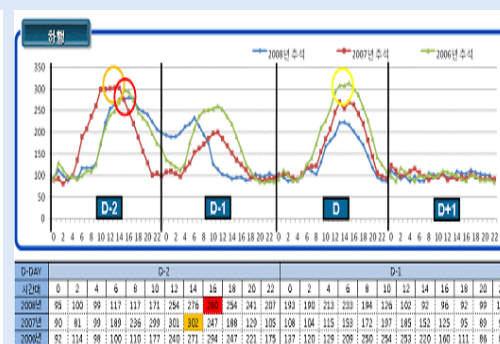
Integrated monitoring system



Travel time forecasting



Traffic condition estimation



Traffic simulation



# Traffic Information Delivery System

## VMS(Variable Message sign)

- Providing drivers with a various traffic information including fast route
- Installation Site : 2~3km ahead of Interchanges and Junctions
- Providing Information : Traffic Congestion, Travel Time, Incidents, etc



# Traffic Information Delivery System

## WEB/APP

- Function : Providing Traffic Information(Congestion, Travel time, Travel speed)  
Video Clip by CCTV
- Type : WEB([www.roadplus.co.kr](http://www.roadplus.co.kr)), APP(Mobile Application)



WEB([www.roadplus.co.kr](http://www.roadplus.co.kr))



APP(Mobile Application)

# Traffic Management Center



Traffic Condition Monitoring

Traffic Management

Broadcasting

Traffic Information Service

# Traffic Information System

## Traffic Data Collection

### VDS



### CCTV



### hi-pass(TCS), DSRC (Fiber Optic)



### Patrol car, Call



## Traffic Data Processing

### Traffic Management Center



Network

Network

## Traffic Management & Traffic Information Delivery

### LCS, RMS



### VMS



### (Fiber Optic) Traffic Broadcast, Call Center

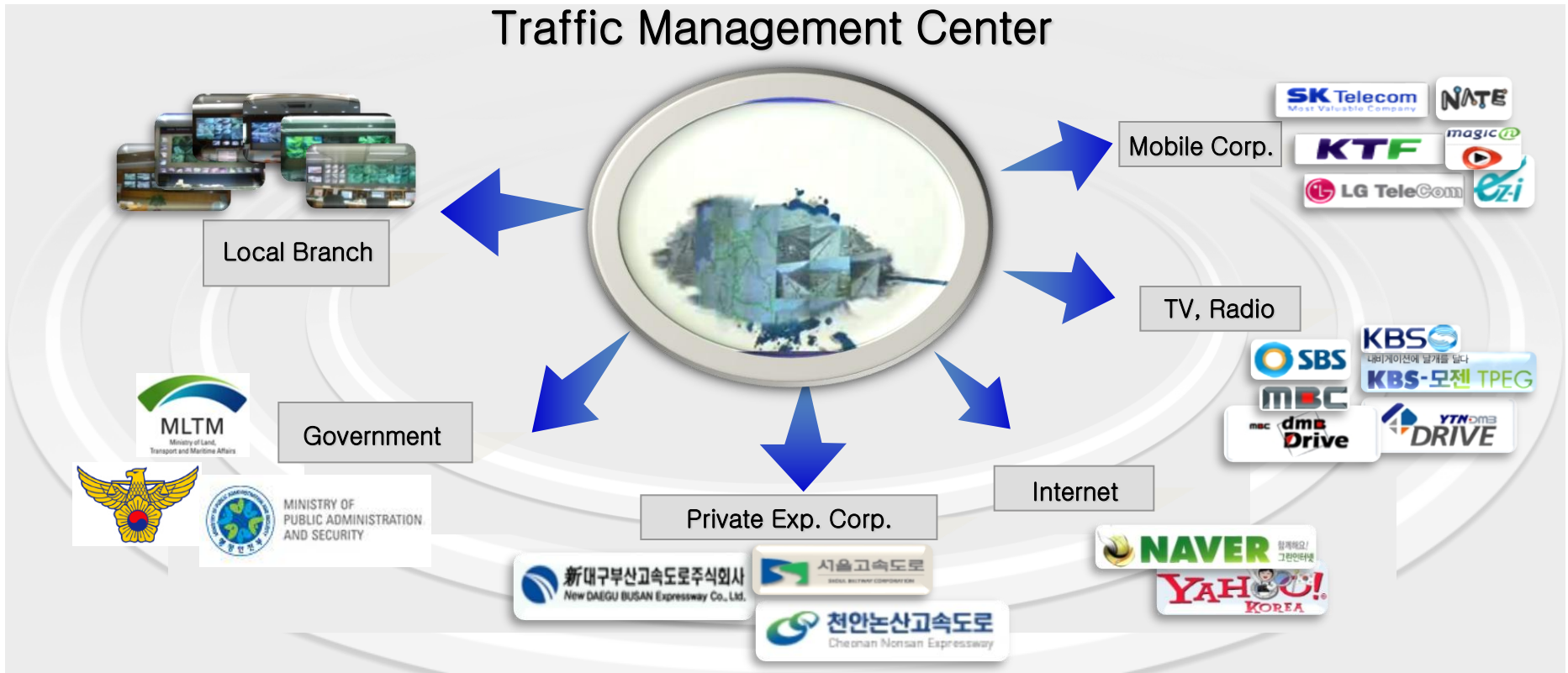


### WEB, App(Mobile)



**Less than 2 Minutes**

# Distribution of Traffic Information



## Shares Data

- 6 Branch centers
- Local government (Provinces, Cities)

## Provides Information

### TV & Internet

- Broadcasting (KBS, MBC, SBS, YTN)
- Roadplus

### Phone

- ARS (1588-2504)
- Mobile Comm. (SKT, KTF, LGT)

### Vehicle Equipment

- Car Navigation System
- Digital Multimedia Broadcasting

## Manages Disaster

- Ministry of Land, Transport and Maritime Affairs
- Ministry of Public Administration and Security
- Expressway Police Patrol



# Thank You !

