Deep Learning-based Urban Traffic Congestion Prediction

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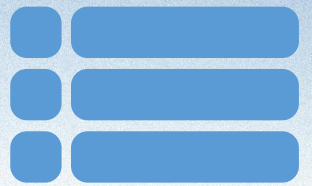
Deep Learning-based Urban Traffic Congestion
Prediction and Signal Control Solution System



- Introduction
- Deep Learning and Prediction
- Traffic Signal Control System
- Summary

The Document of Social Issue Definition for R & D

➢ Research Subject: Traffic congestion cost problem not improved

As is	To Be
• Even with the introduction of many advanced technologies, traffic congestion costs are still not improving	• Expansion of traffic service capacity mainly in the main congested roads of the city

➢ Problem Definition

- For congested urban roads, Comprehensive solutions that integrates **real-time monitoring, control, and simulation using the weather, time zone, surrounding environment, traffic flow and so on** should be considered rather than one-stop solutions

➢ Expected Benefits

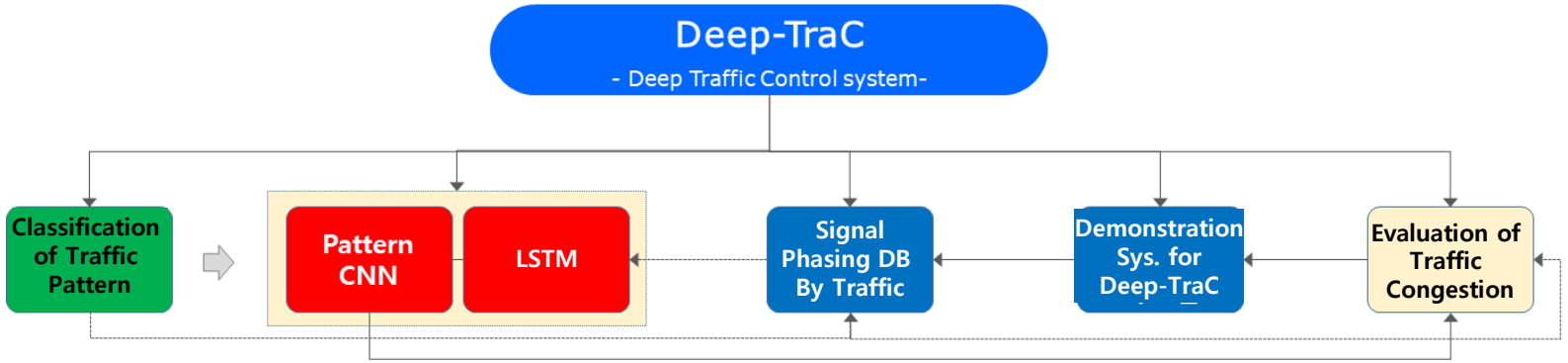
- If the congestion problem is solved by the research, it will be **a starting point** for solving the national-wide traffic congestion cost problem.

➢ Solutions : Development of urban traffic signal control technology through intelligent innovation of transportation infrastructure

Goal

- Research Subject: Deep-Learning-based Estimation for the traffic congestion cost
  - Development of Convolutional Neural Network(CNN), Long-short Term Memory, Network(LSTM), and Mixture Model of CNN and LSTM (CNN+LSTM),
  - Development of “Deep-TraC” of a comprehensive prediction software,
  - Development of recognition method of urban congested intersection based on traffic pattern analysis,
  - Development of urban traffic flow control solution module based on traffic congestion prediction
- End Product : Deep-TraC
  - Deep Traffic Control Solution
  - Deep-TraC (SW for Server) 및 신호제어 솔루션 시스템 (SYS for Server)

Goal and Contents of The Project by Year

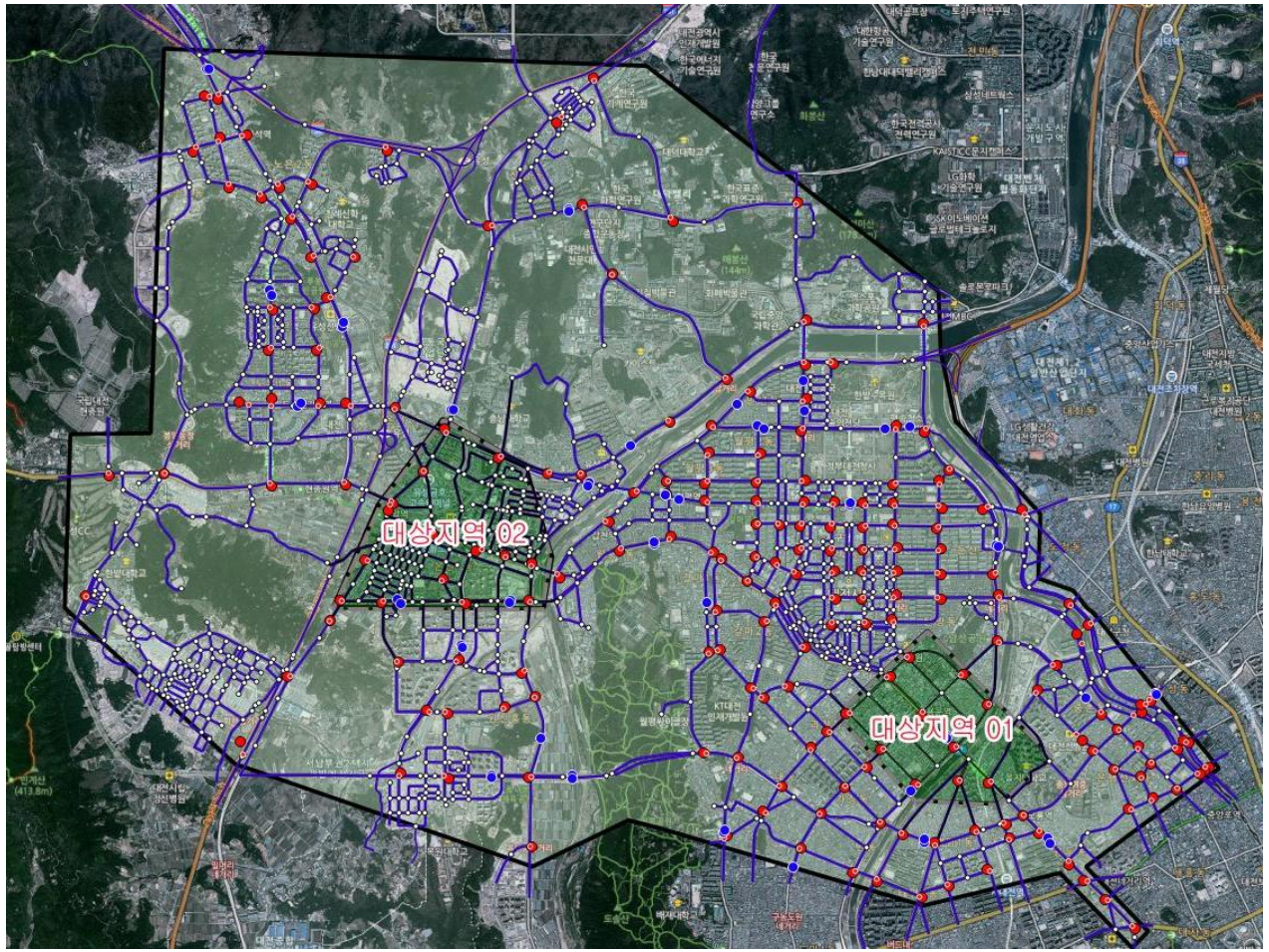


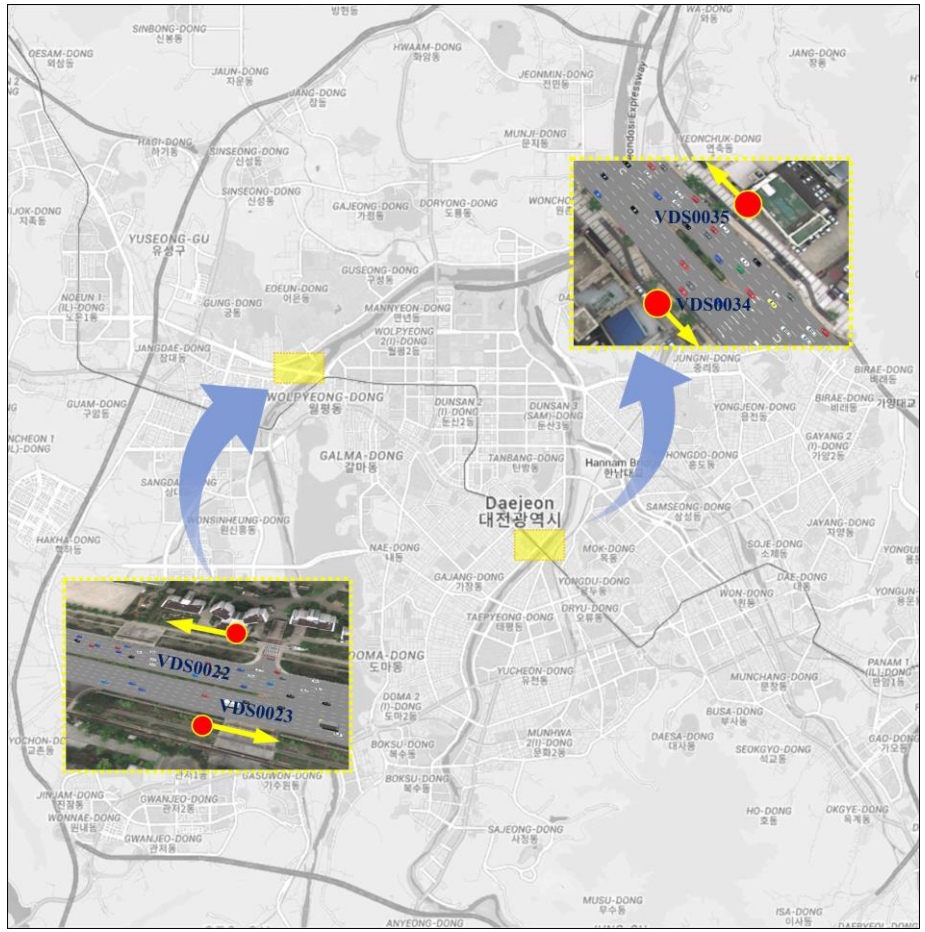
Year	Deajeon Metropolitan City	Main Org.: KISTI	Participating Org.: KOTI	Participating Org.: BlueSignal Corp.
	Signed MOU to solve traffic congestion problem in Daejeon Metropolitan City			
1st Year (2018)	Providing RSE/VDS Data of Deajeon	POC of Deep-TraC Development of Deep-learning LSTM	Identification of congested intersections in urban area	Control of traffic volume in urban areas Simulation for testing
2nd Year (2019)	Providing RSE/VDS Data, Cooperating to build and demonstrate the Deep-TraC	Development of Prototype Evaluation of efficiency of optimal solution	Generation of route-based traffic information Classification of Traffic condition patterns	Virtual traffic signal controller Demonstration model development
3rd Year (2020)	Providing RSE/VDS Data and site for Test-bed Cooperating to operate the testbed	Build and application of Comprehensive SW	improving Generator of Route-based traffic information and classifier of Traffic pattern	Virtual traffic signal controller Advanced demonstration model

Practical application and verification of developed Deep-TraC system through test-bed, and suggestion of improve plan of traffic congestion

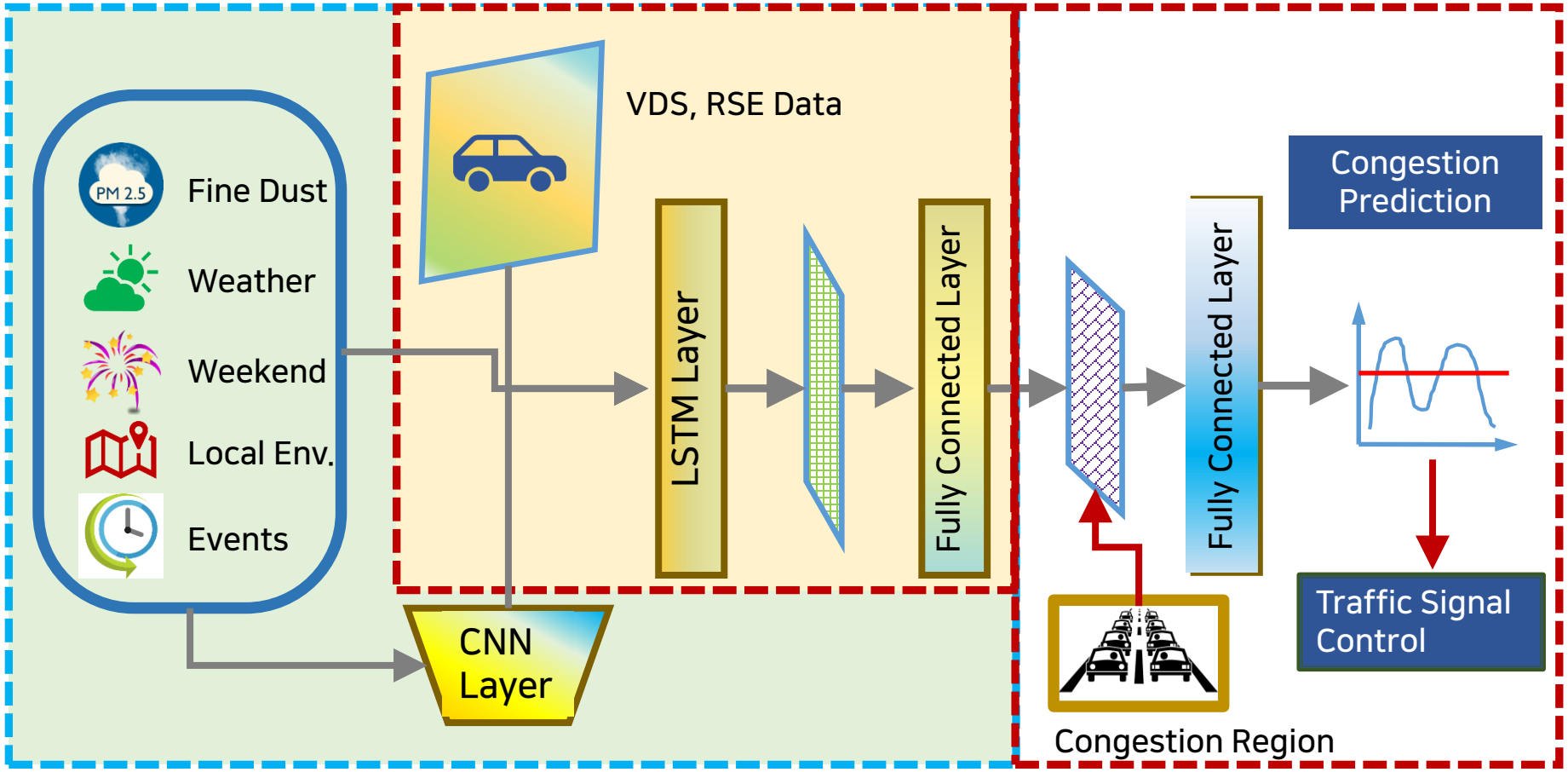
VDS DATA-BASED TRAFFIC VISUALIZATION

VDS 181개 RSE, 48개 VDS, 924개 (신호, 비신호) 교차로 포함

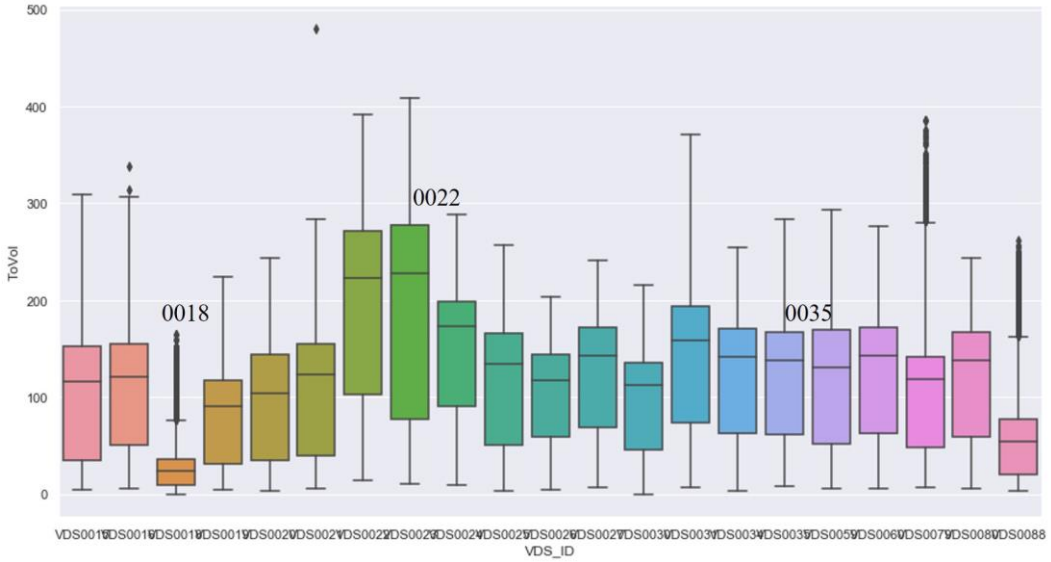


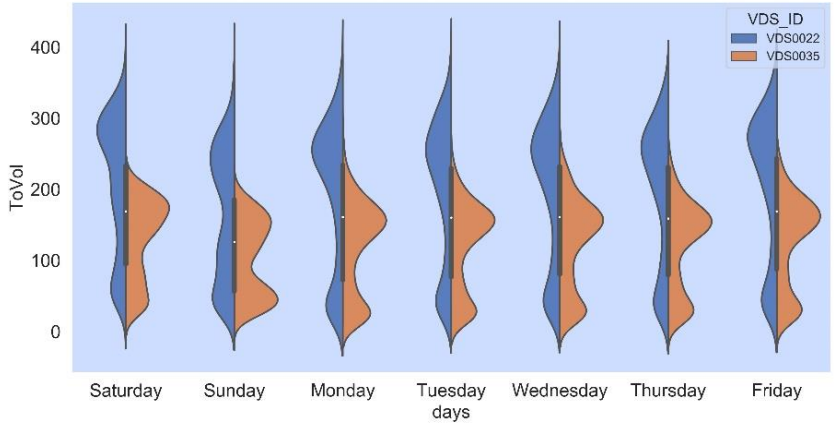


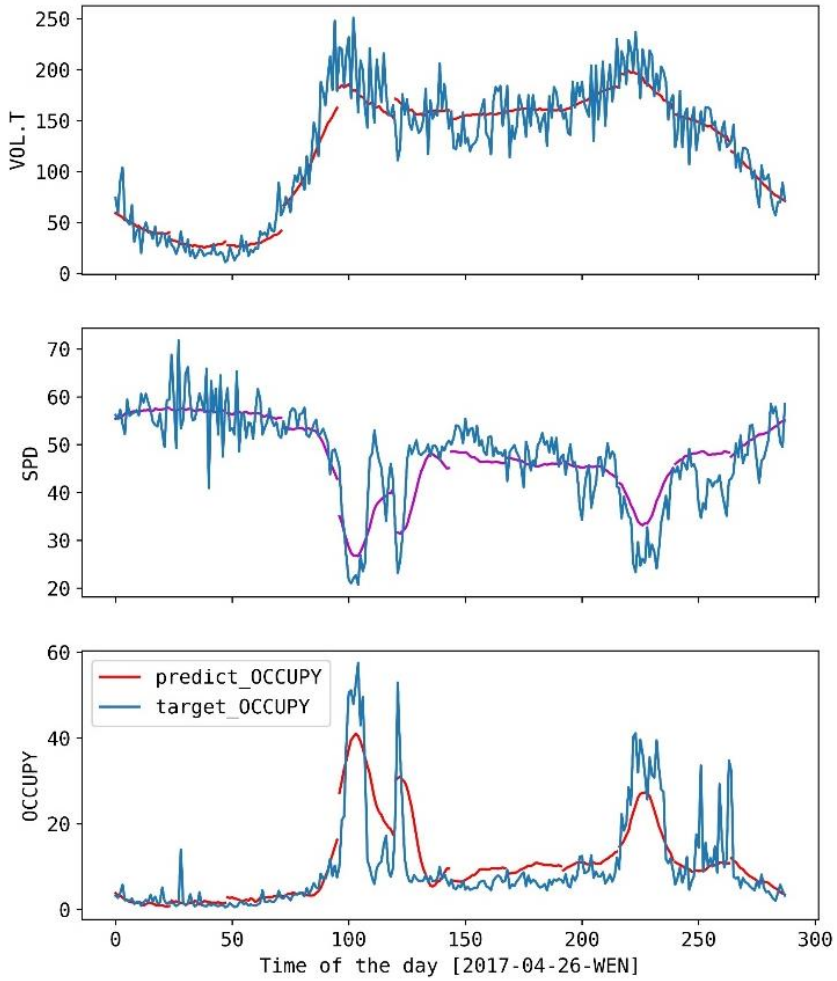
Traffic Congestion Prediction with Deep Learning

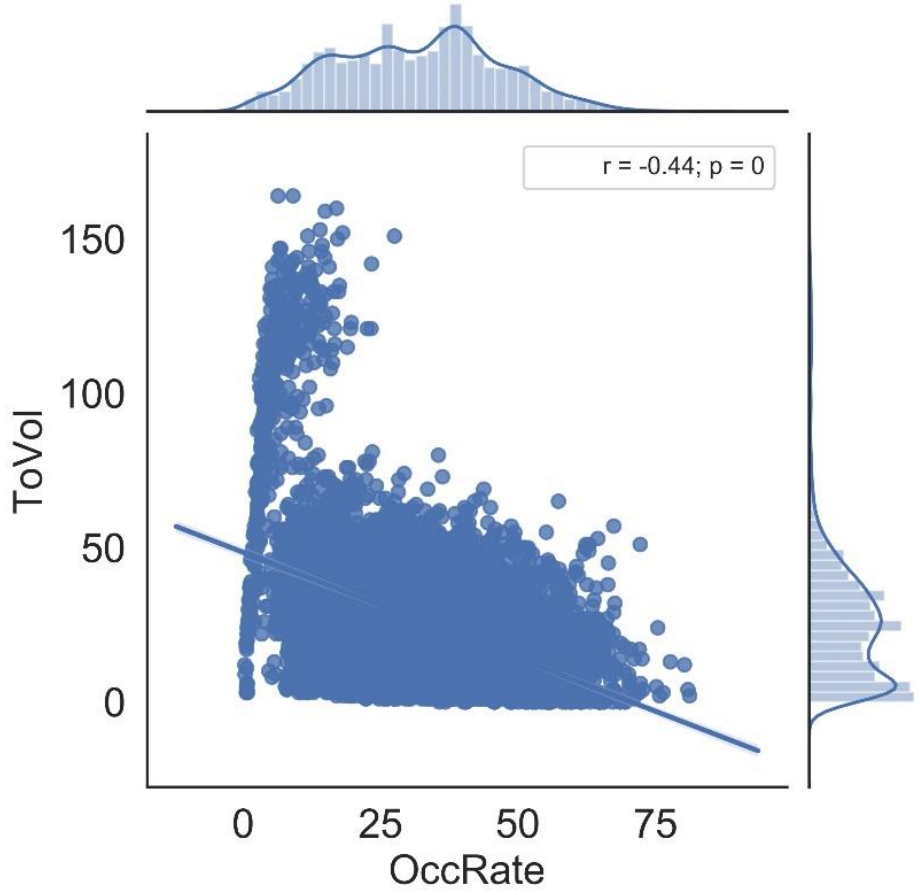


Data Analysis





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ToVol
OccRate
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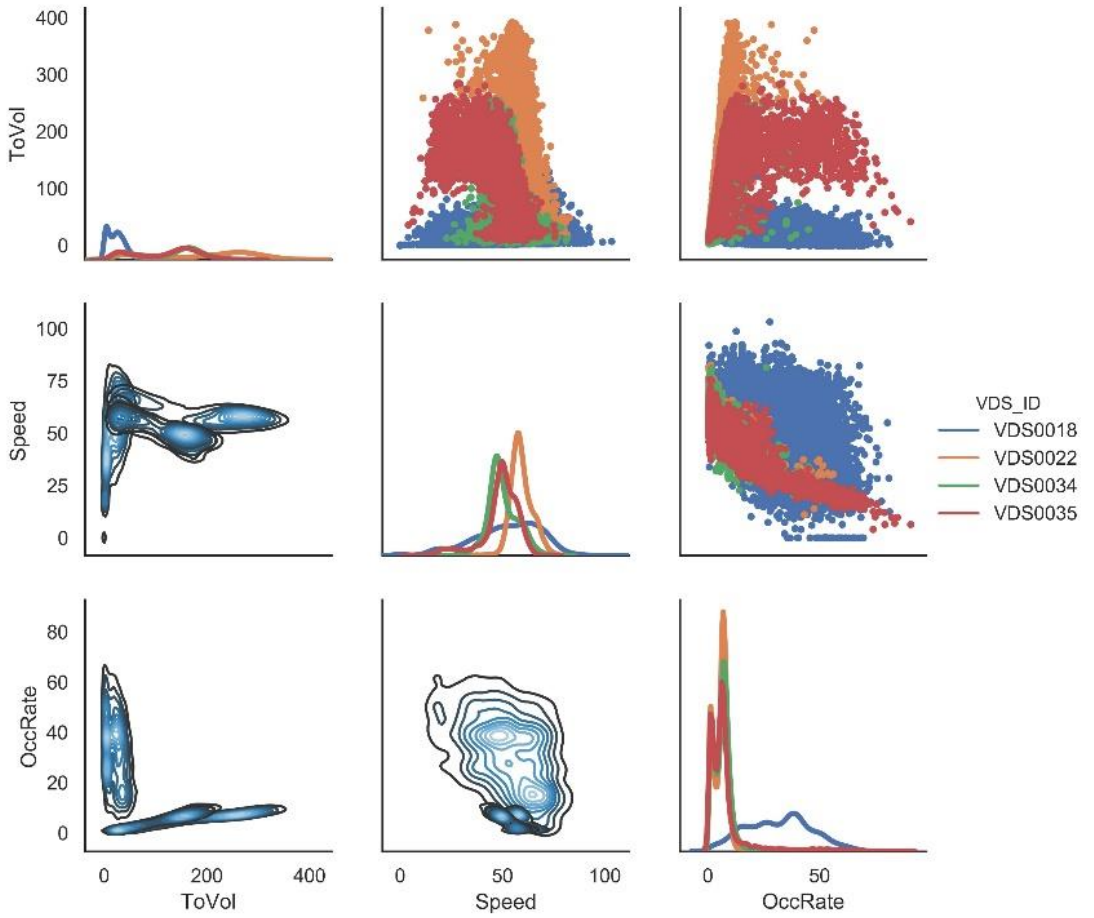
100
50
0
0
25
50
75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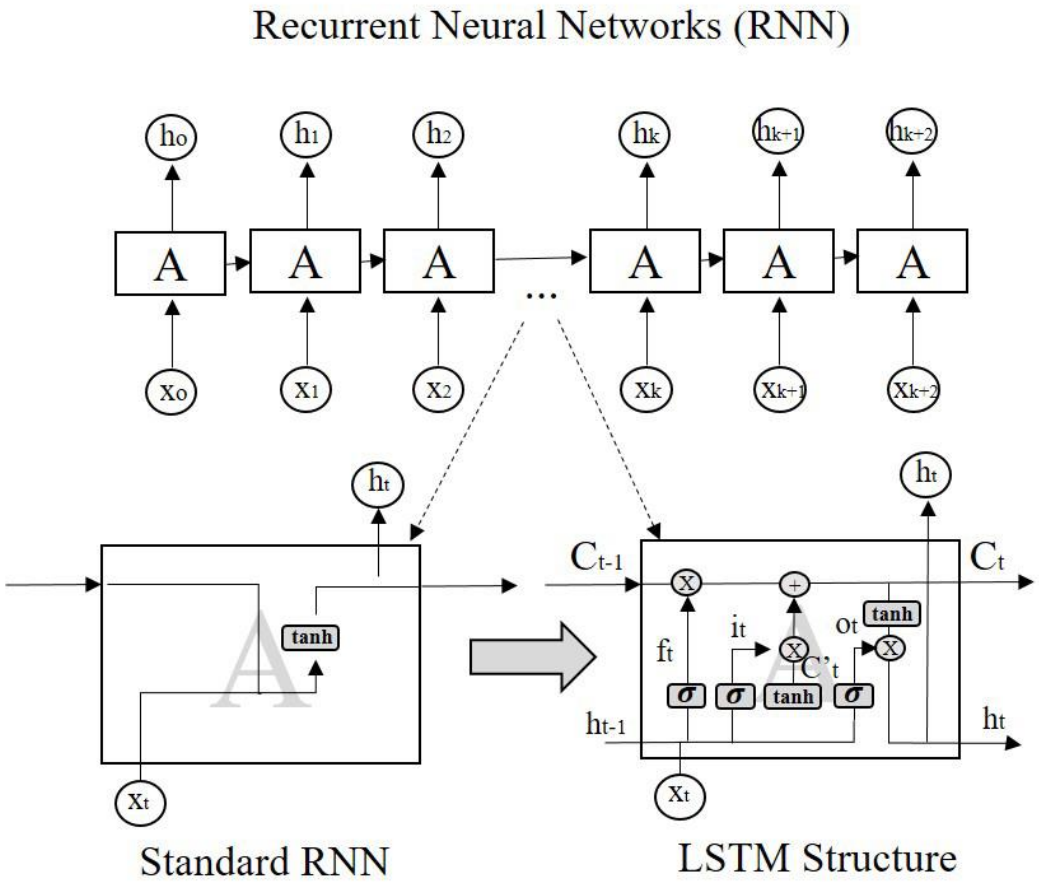
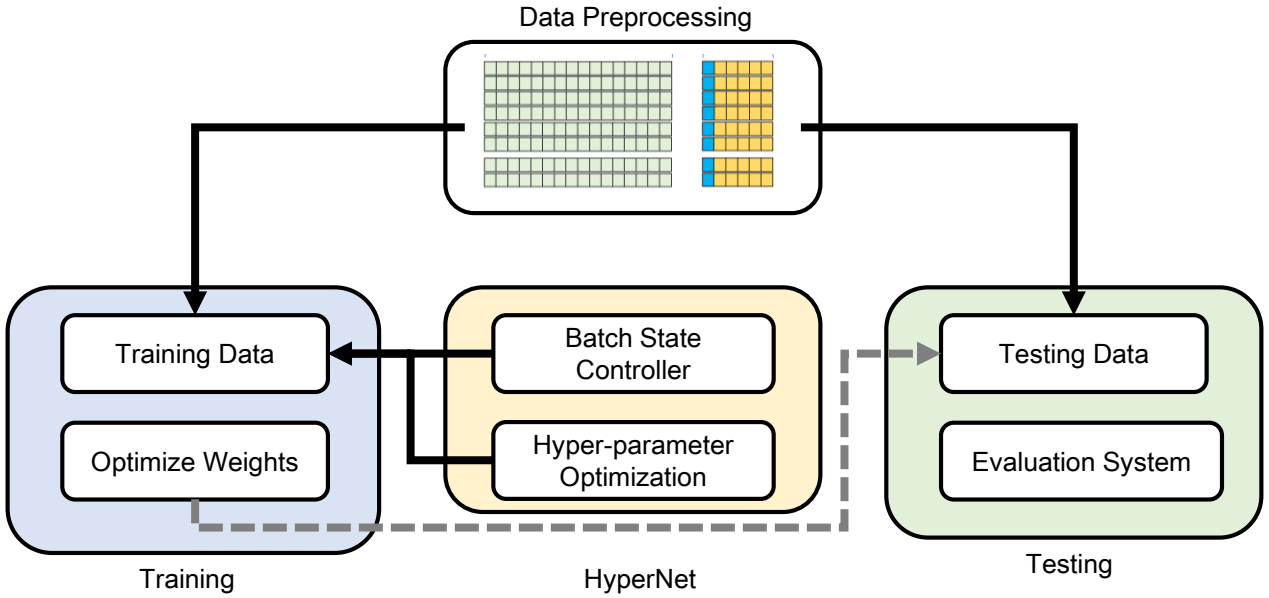
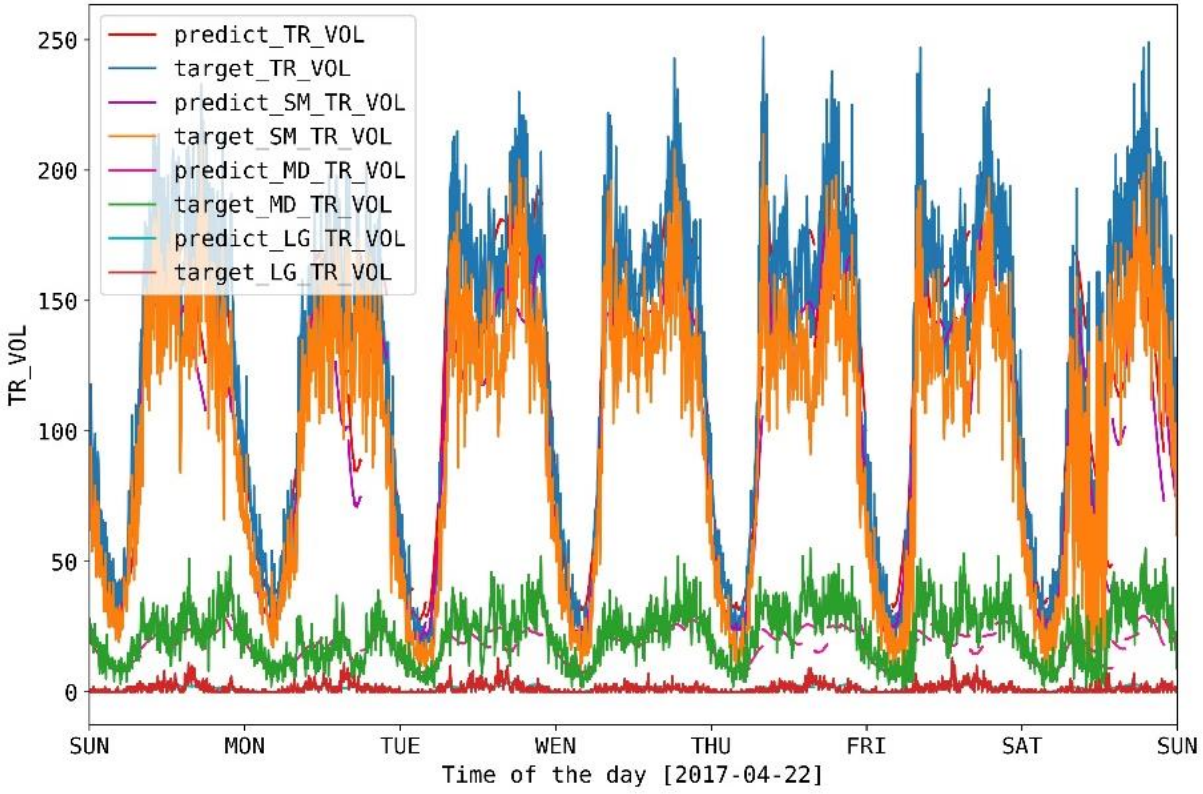
LSTM Architecture

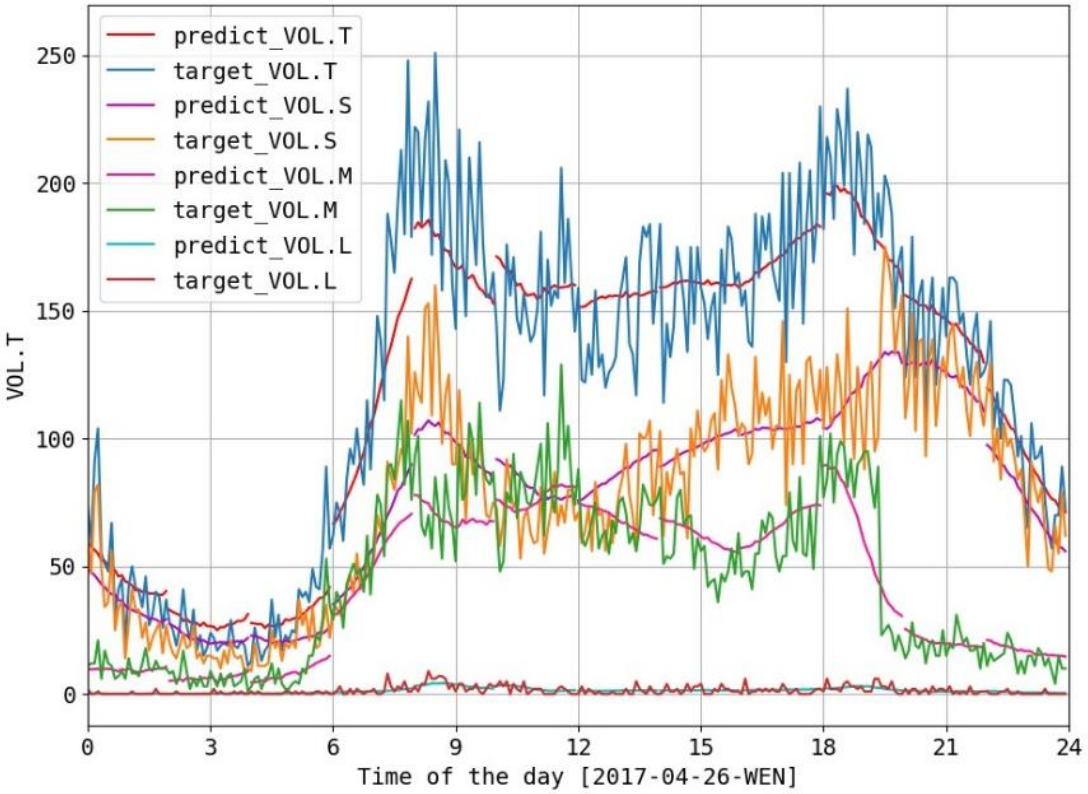




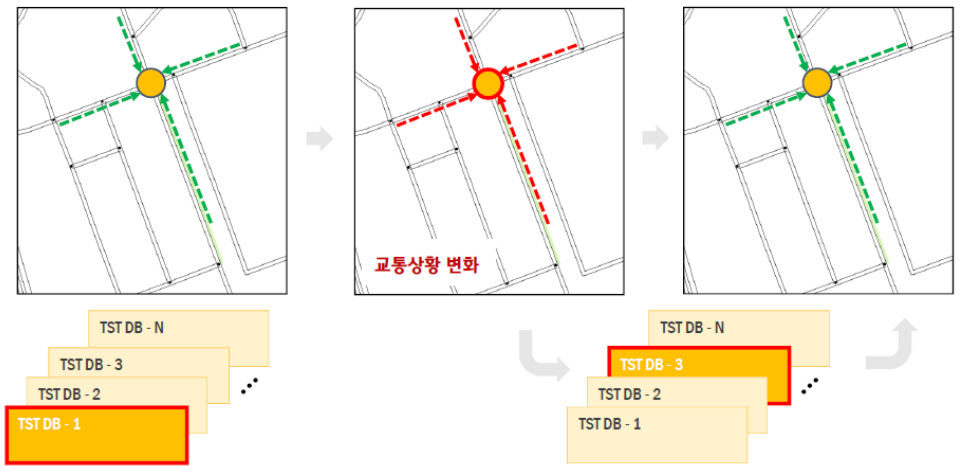
Ref. “Implementing A Deep Learning Framework for Short Term Traffic Flow Prediction” (Hongsuk Yi, WIMS 2019 conference)

The System Flow Diagram of the proposed LSTM



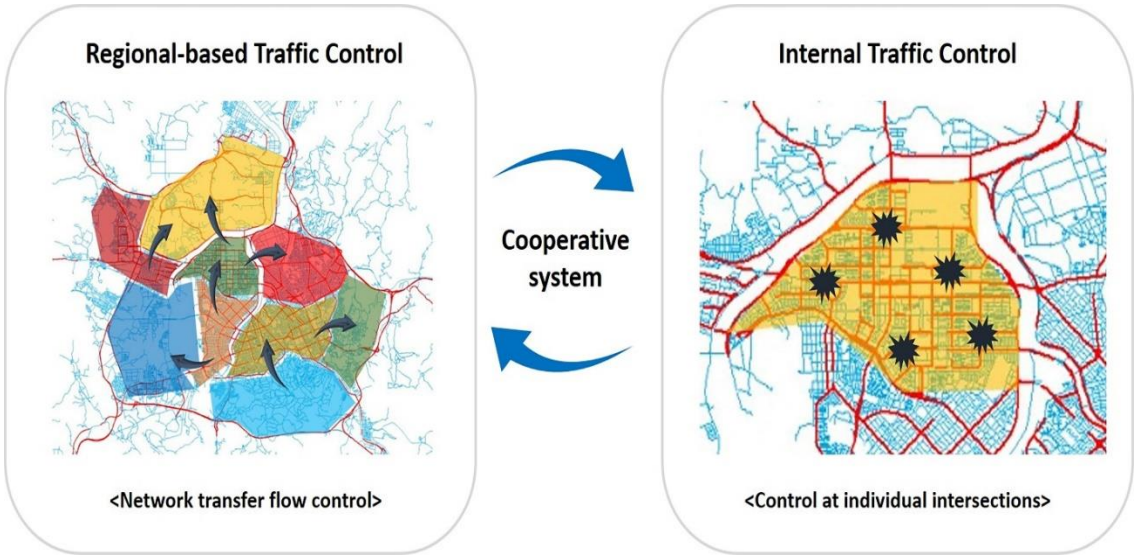


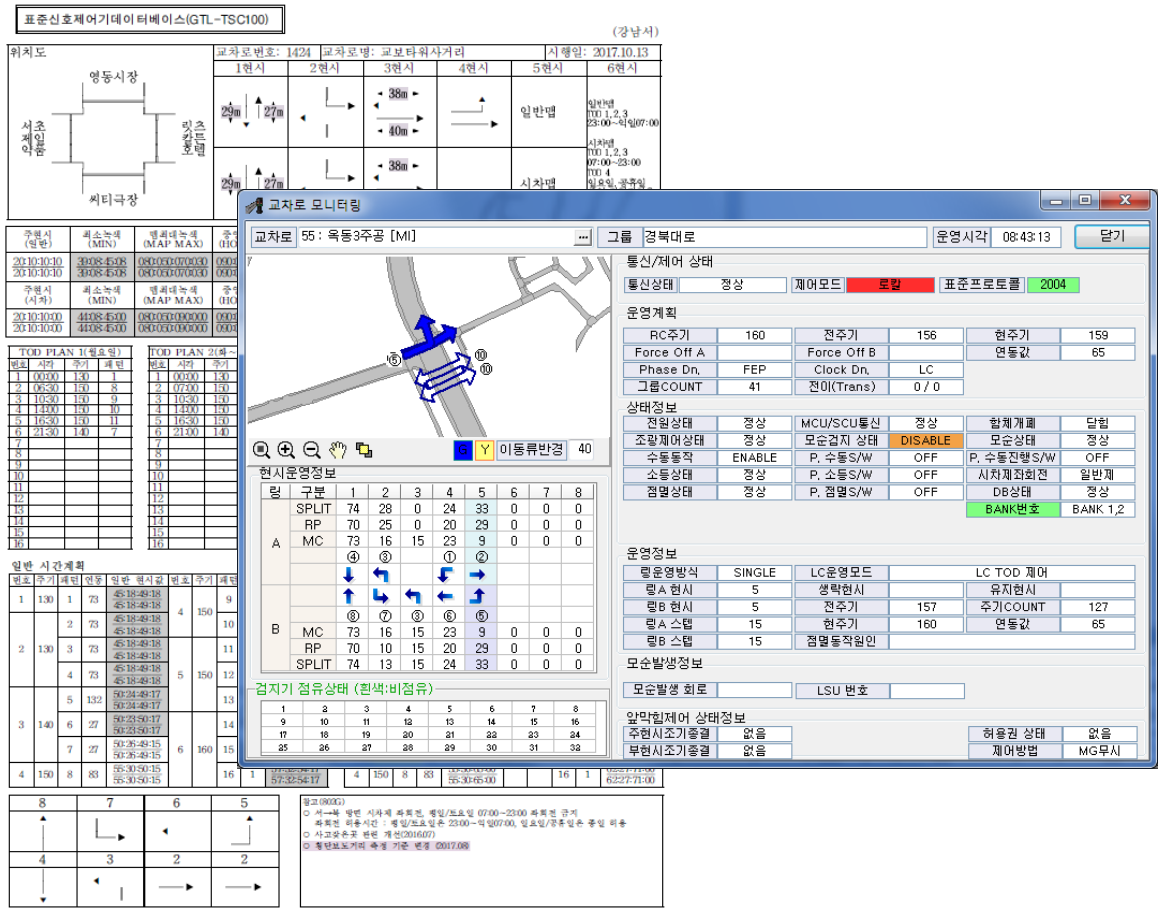
거시적 모형을 이용한 신호제어



새로운 교통상황 패턴 ⇒ 패턴 맞춤형 DB 선택

| 현재의 교통패턴에 맞는 신호시간 운영 중
| 교통 패턴의 변화 발생으로 현 신호운영의 효율 저하
| 새로운 교통 패턴에 최적화된 신호시간 DB 선택

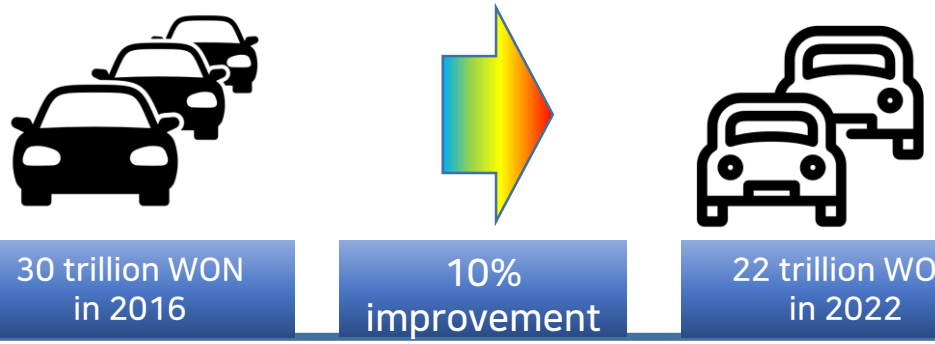




Expected Benefits

National expectation : Innovation Responding to 4th Industrial Revolution

Announced by the President's direct 4th Industrial Revolution Commission in Dec. 2017



Economic and industry: Improvement of traffic congestion cost by 10%

- Creation of new added value by presenting AI traffic signal management plan
- AI-based traffic signal control expects traffic congestion cost to improve by 10%

Social expectation : System solution service for citizens

- Reducing of unnecessary signal latency and providing convenience for the public
- Reduction of living expenses and social benefits due to traffic congestion reduction

Technology: Global technology for deep running predicting / controlling

- World-leading technology competitiveness in deep-learning-based urban traffic flow prediction and control platforms
- development of AI-based traffic condition prediction and control server development technology

Thank you!