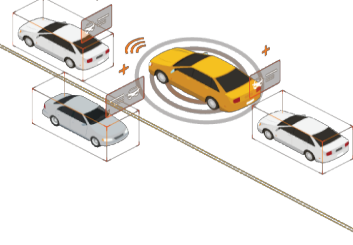




ITS Management Solution

Hypermicron Smart System





Contents

1. Advanced Traffic Monitoring System

Vehicle Detection Solution(VDS) based on AI & Deep Learning Technology

Vehicle Detection Solution(VDS) based on Image Processing Technology

Vehicle Detection Solution(VDS) based on IoT technology

2. Smart Traffic Management System

Unmanned Traffic Enforcement System: Automatic Number Plate Recognition (ANPR) Interval Enforcement System

Portable traffic enforcement System

Smartphone ANPR (Android)

3. Integrated Highway Traffic Control System (IHTCS)

Main Features IHTCS

System Configurations of IHTCS

Communication Technology of IHTCS

4. Toll Gate Control System

5. Weight-in-Motion System (WIM Overloading Vehicle Enforcement System)

6. Smart Intersection Management System

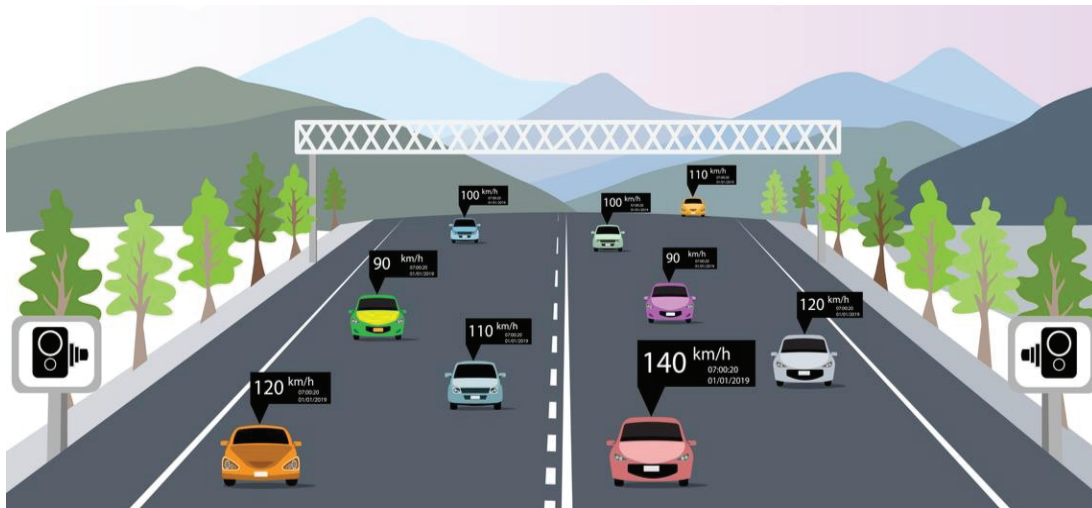
7. Electronic Toll Collection System

Hi-Pass System

Smart Tolling System

Advanced Traffic Monitoring System: monitoring traffic conditions, analyzing vehicle movements

This system is designed to perform tasks such as detecting vehicle, measuring vehicle speeds, calculating traffic volumes and classifying vehicle types for specific sections, identifying over-speeding vehicles, pinpointing areas of congestion and accidents occurred.



measuring
speeds

**Vehicle
Classification by Type**



calculating
traffic
volumes

**Multi-lane
Monitoring**



Classifying
vehicle
types

**Matching of
vehicle numbers**



Video analysis technology.

- Vehicle counting based on video analysis.
- Vehicle classification technology based on video analysis.

Vehicle type database (DB) technology.

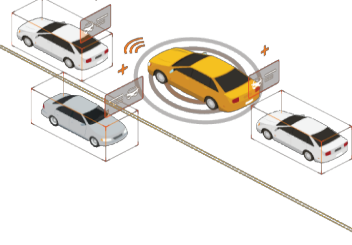
- Analysis of vehicle images.
- Matching using proprietary and Korea Expressway Corporation databases.

Matching of vehicle numbers on both front and rear license plates.

- Combination technology of license plate recognition scores obtained from multiple image acquisitions.
- Verification technology through matching vehicle numbers on front and rear license plates.

Multi-lane monitoring per camera

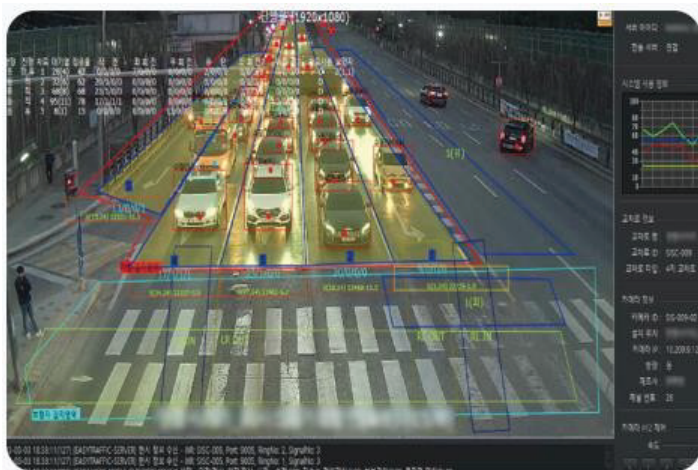
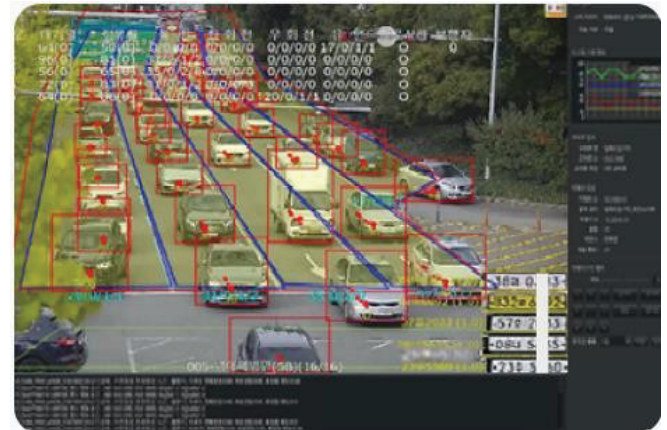
Advanced Traffic Monitoring System



Vehicle Detection Solution (VDS) based on AI & Deep Learning Technology

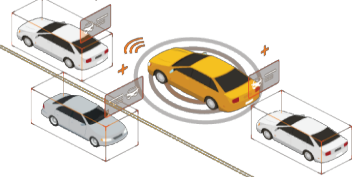
High precision in detecting objects.

- Calculation of traffic volume per lane.
- Calculation of traffic volume based on vehicle direction.
- Minimizing traffic volume errors due to double detection and false detection.
- Accurate counting enabled by object separation during clustered pedestrian traffic.



Differentiated object detection under special environmental conditions.

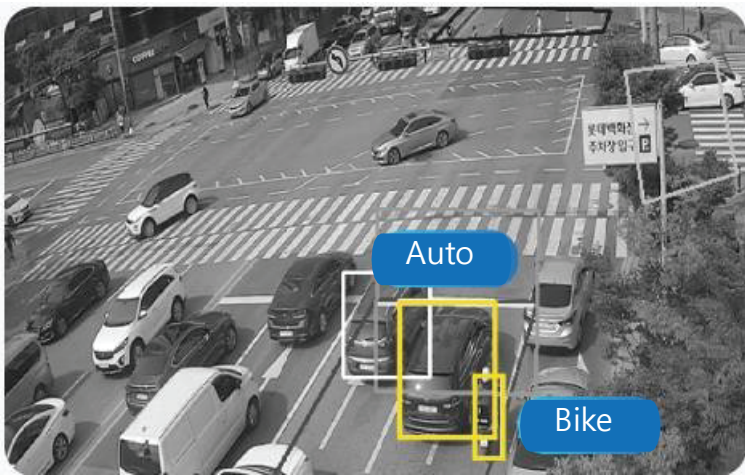
- Ensuring robust detection accuracy even in adverse weather conditions such as daytime, nighttime, rain, snow, and strong winds by utilizing deep learning training data.
- Robustness against variations in light intensity or direction through the application of shadow separation algorithms.



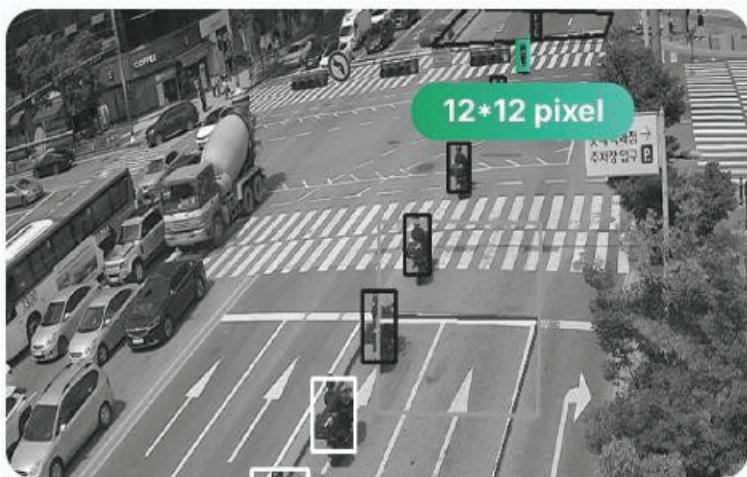
Enhanced detection accuracy through a patent for recognizing and analyzing front and rear objects.



Vehicle detection at long distances, both at the front and rear



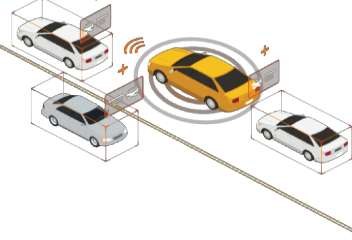
Excellent detection of overlapping objects



Detection of small objects

Advanced Traffic Monitoring System

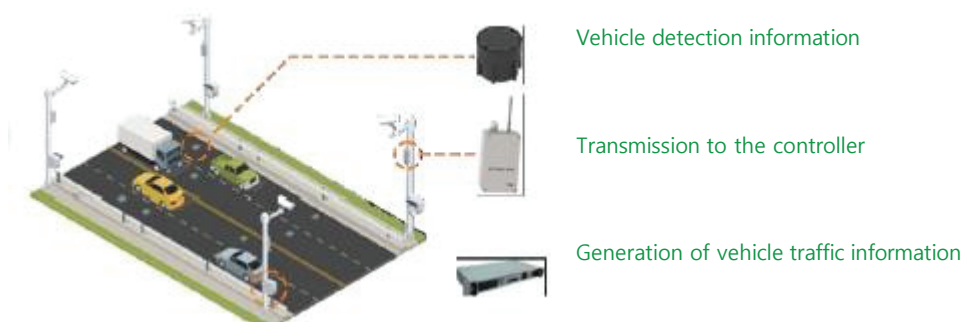
Vehicle Detection Solution (VDS) based on IoT technology



Vehicle Detector based on Geomagnetic Field

Detecting changes of geomagnetic field using an geomagnetic sensor Wireless communication and low-power battery technology

High detection rate, minimizing maintenance costs



underground
burial type



surface
installation
type

IoT communication Technology



- Long Range (LoRa) communication
- 917 ~ 923.5MHz, 10km distance
- Private Network



Geomagnetic Field sensing Technology



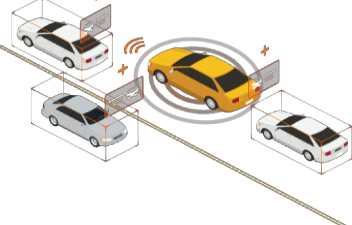
- The Earth's magnetic field is a resource characterized by accuracy, permanence, and stability...
- Technology that separates fine Earth magnetic field signals from surrounding unspecified noise to extract characteristic signals of detected objects.
- As a vehicle detection technology, it is the only indigenous technology in the country.



**Design technology of
Low-power IoT sensor**

Smart Traffic Management System

Unmanned Traffic Enforcement System: Automatic Number Plate Recognition (ANPR)



This System utilizes cutting-edge technologies like CCTV video recognition, radar detection, IoT and AI algorithms to enhance road safety by enforcing compliance with traffic regulations, such as speeding, signal violations, etc., in advance

Most widely in use

Speed Checking by ANPR



Interval Enforcement



Signal Violation & Multi-purpose



Vehicle Detection on multiple lanes with a single CCTV.

- Improved reliability achieved via advanced recognition technology for multi-stage license plates(ANPR) and front-seat driver detection.

Vehicle Speed Accuracy using Radar and CCTV.

- Radar and image information fusion for vehicle speed calculation and verification.
- Technology for differential image acquisition based on vehicle speed.

Automatic Number Plate Recognition (ANPR)

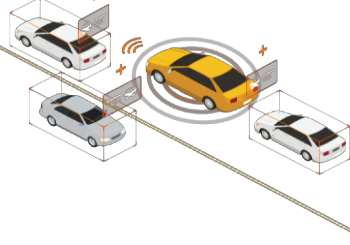
- Recognition Rate: Over 98%
- ANPR camera
- ANPR at speed of over 150km/h

Deployment Technologies .

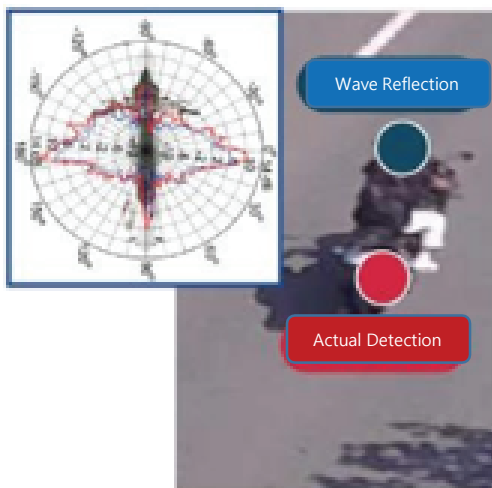
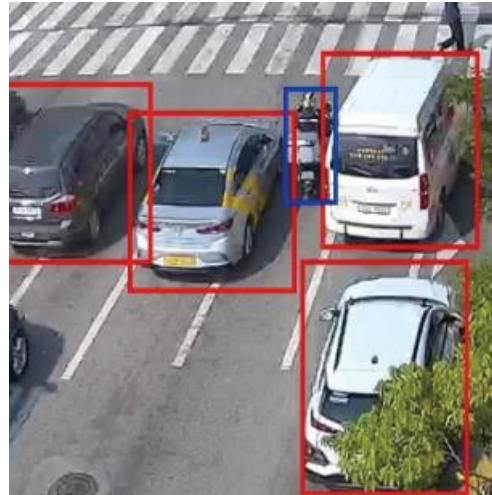
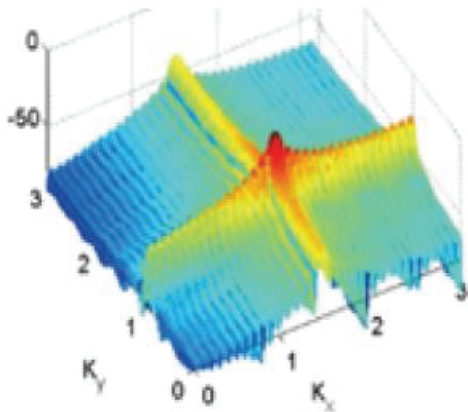
- CCTV Image Processing Technology
- Radar Detection Technology
- AI & Deep Learning Technologies
- IoT sensor technology

Smart Traffic Management System

Unmanned Traffic Enforcement System



Technology for Vehicle Recognition: Radar-based Multi-Object Decomposition Capability Technology



Multi-object decomposition technology using 3D waveforms

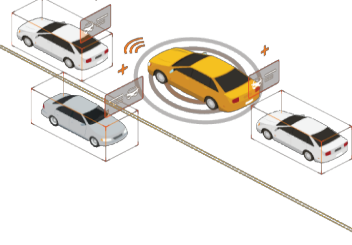
- Excellent separation of objects at the same distance for speed and angle.
- Multi-object separation capability.

Capability of vehicle rear detection through Multi Filter application.

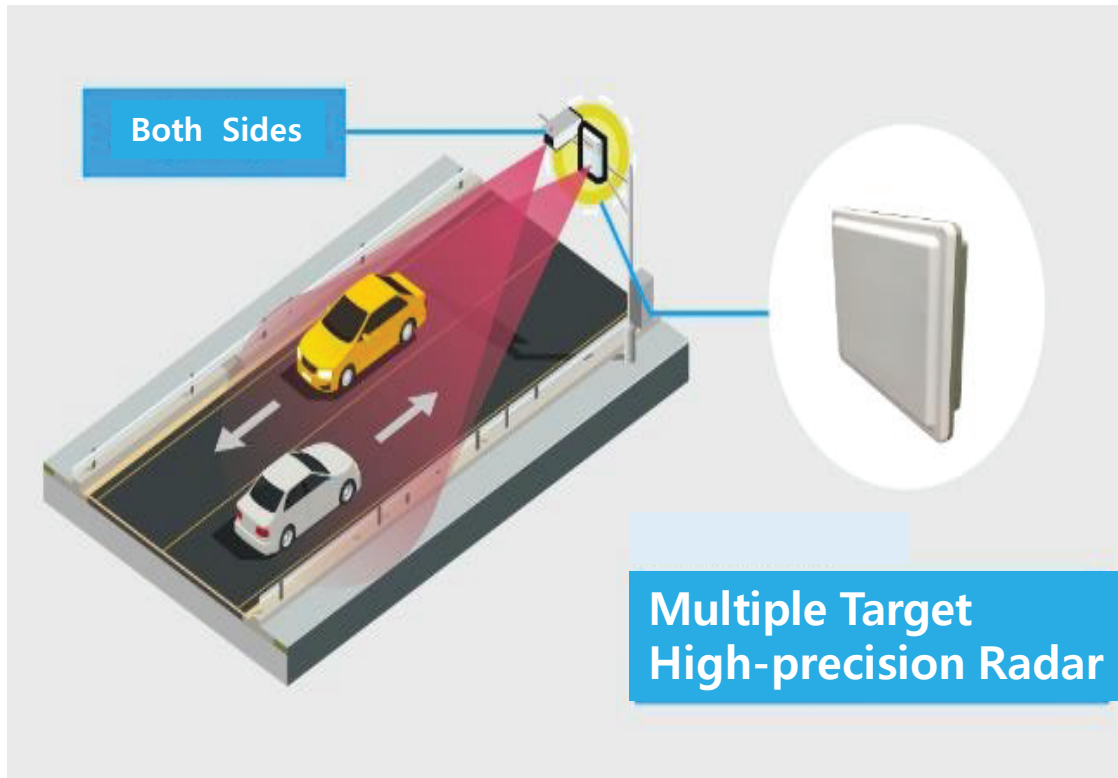
- Application of Adaptive Kalman Filter technology based on Multi Beam.

Smart Traffic Management System

Unmanned Traffic Enforcement System

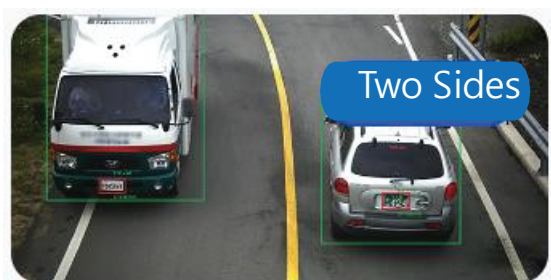


Technology for Vehicle Recognition: radar technology for both front and rear detection



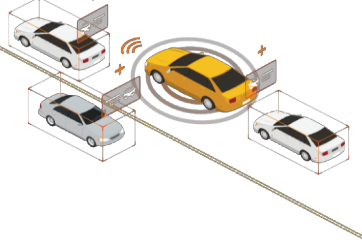
Key features:

- Real-time vehicle speed calculation.
- Matching radar and camera image information.
- Bi-directional triggering.
- Generation of vehicle information for up to 3 lanes.
- Bi-directional vehicle monitoring with a single camera.
- Front and rear monitoring (including two-wheeled bicycles).

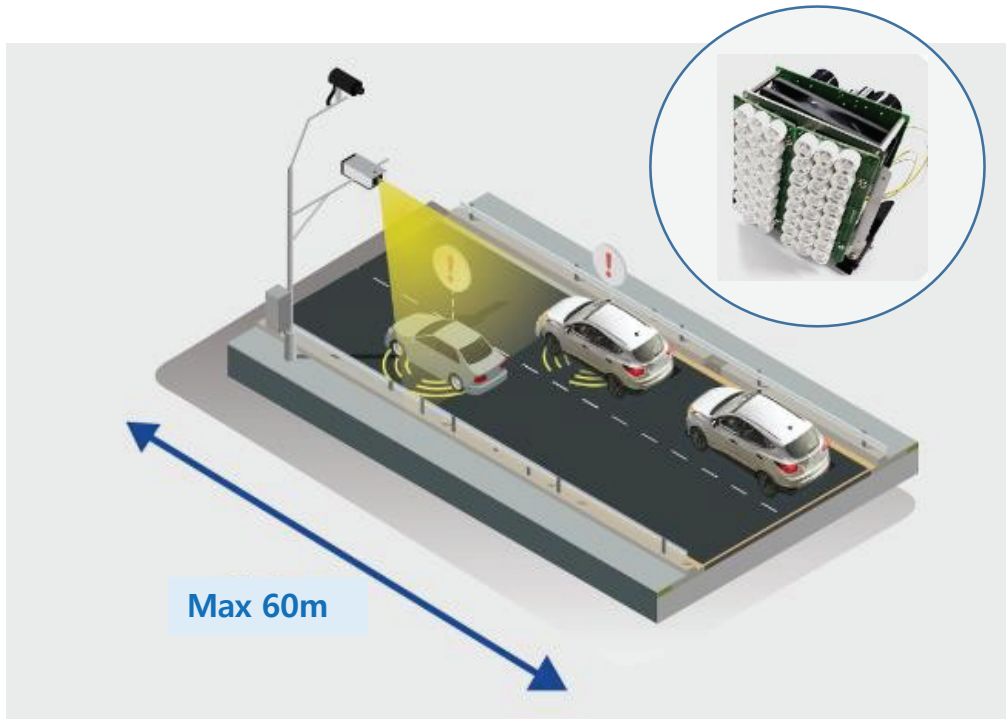


Smart Traffic Management System

Unmanned Traffic Enforcement System



Technology for Vehicle Recognition: Application of high-efficiency IR LED lighting



High-efficiency
IR LED lighting
with a lifespan
of 2.5 billion
cycles

High-efficiency
lighting device
capable of
recognizing vehicle
license plates at a
distance of 60
meters

Multi-object decomposition technology using 3D waveform

Operating condition: Duration- 1ms, Duty Cycle- 30 Hz

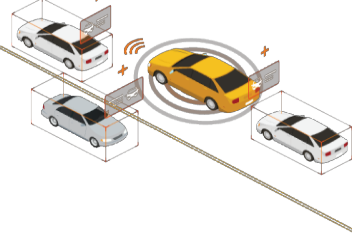
48 High Power LEDs

Uniform emission pattern

Compact Design: Operating voltage- 24V / 1A

Smart Traffic Management System

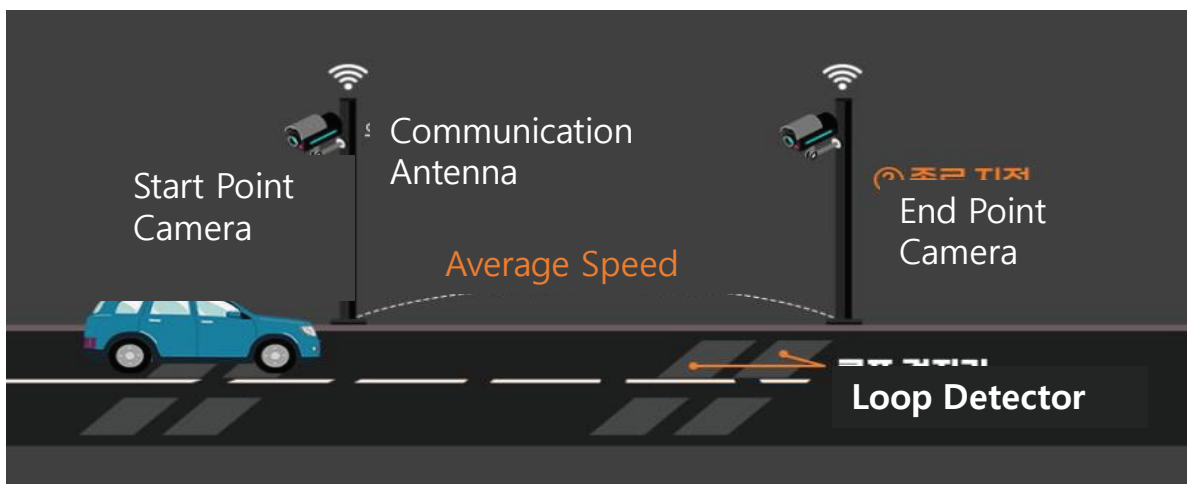
Unmanned Traffic Enforcement System



A method of enforcing speed limits by measuring the average speed of vehicles over a certain section of the highway, enforcing traffic regulations for traffic safety and environmental protection.



The system aims to monitor speeding vehicles based on the 'interval-average speed' of a specific road section, aiming to address the issue of only decelerating in areas where enforcement cameras are installed.



Acquisition of clear images of drivers and vehicle license plates using high-resolution cameras.

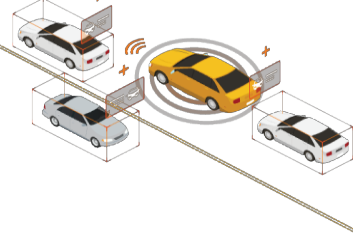
Ability to distinguish between the speeds of freight vehicles and passenger vehicles for enforcement on highways.

Simultaneous monitoring of vehicles in two lanes

Smart Traffic Management System

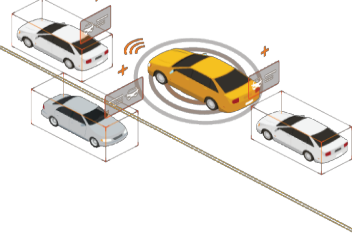
Variable Message Sign

- Innovative post and enclosure design, available with multiple mounting options and allows for colour customisation of the assembly
- Ste/aluminium fabrications are designed to withstand the rigours of the weather.
- System architecture is based on the latest Internet of Things (IoT) compatible protocols while remaining compatible with UTMCI, and legacy interfaces



Smart Traffic Management System

Unmanned Traffic Enforcement System



By moving the 'handy license plate recognition and speed checking system, the portable traffic enforcement system can enhance the driver awareness through speed control and promote driver safety, applying video recognition technology, laser detection technology, and AI algorithms to efficiently operate enforcement resources as well.



Equipment configuration

- Vehicle detection unit, image acquisition unit, data processing and control unit
- LCD touch monitor configuration

Convenience of equipment mobility

- Built-in battery type (up to 6 hours)
- Integrated enforcement and lighting equipment

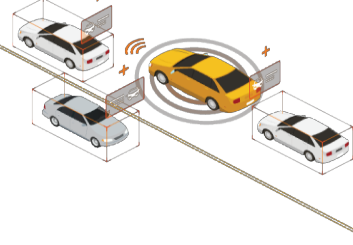
Specialized technology

- Enhanced detection capability with world's first dual laser technology
- Strengthened night enforcement with 740nm 72 LED modules

Optimized for Portability

Smart Traffic Management System

Smartphone ANPR (Android)



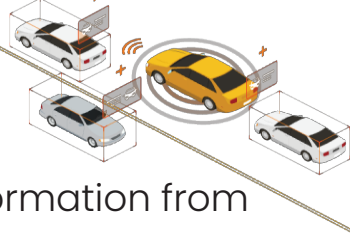
Smartphone ANPR is an advanced license plate recognition solution that utilizes image processing on smartphones to automatically read vehicle plate numbers captured by the smartphone camera.

This solution is effective for various purposes such as parking fee collection, illegal parking enforcement, untaxed vehicle enforcement, and more. It achieves this by connecting in real-time with a database (DB) through WiFi, LTE, CDMA, or other available means, linking directly to the server

System Configuration

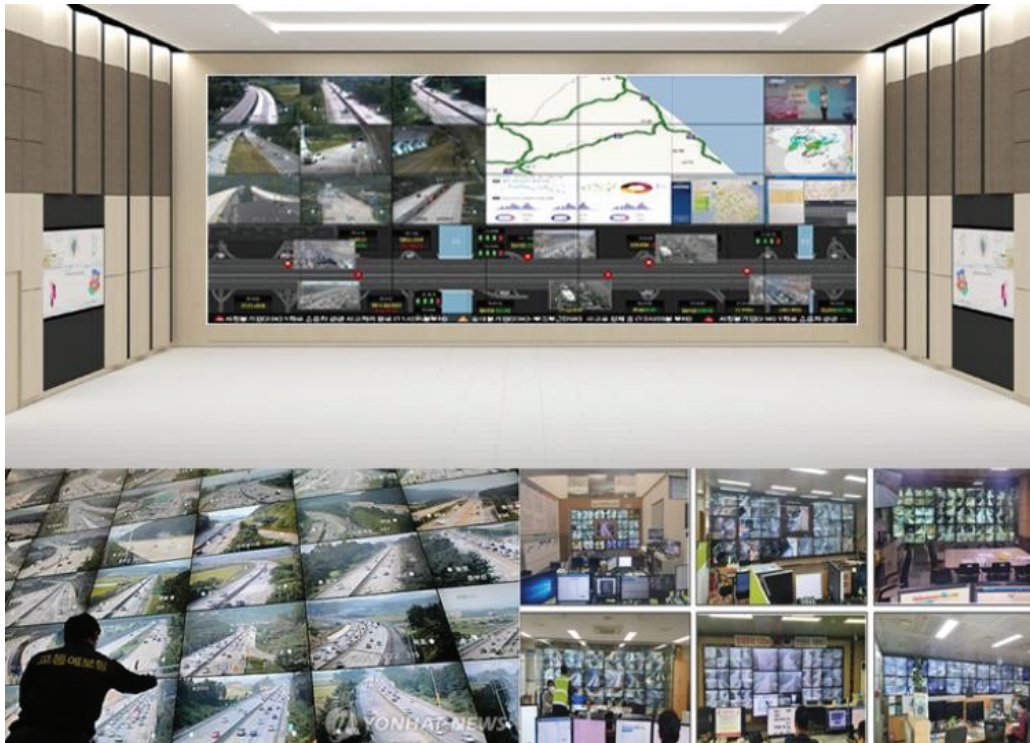


Integrated Highway Traffic Control Systems(IHTCS)



The traffic control system receives real-time CCTV video information from roads (expressways, national highways) to monitor traffic conditions and coordinates with emergency response systems to respond to accidents and disasters, supporting smooth traffic flow for vehicles.

Implemented in 28 highway traffic control centers and 18 national road control centers (Korea).



Multi-Display

Multi-display technology utilizing LED Direct-View Display (DID), DLP Wall, and other methods.

Control Scenarios

Tailored operational scenarios for different situations such as normal, emergency, inspection, and special transport scenarios

Customized scenarios to meet the specific requirements of operators and administrators for response across various situations

System Operation

Information collection, processing, display, and linkage technologies for efficient traffic management

Improving traffic control efficiency through real-time integration with the emergency response system

Integrated Highway Traffic Control Systems (IHTCS)

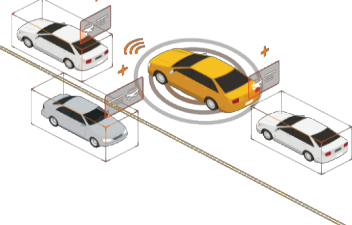
Main Features IHTCS



- Functionality for real-time monitoring of highway conditions from the control center.
- Automatic detection and response to congestion/incident situations on highways.
- Tailored highly reliable highway traffic management system.
- Real-time monitoring of on-site operations and system status.
- Support for various operating environments including Unix and Windows.
- Efficient management of long-term data storage using relational databases.
- System environment conducive to easy integration with other systems.
- Generation of reports in various formats to meet user and administrative demands.
- Capabilities for providing various information to highway users via ARS, web, mobile phones, and PDAs, including video/text.
- Support for monitoring functionality using the web.
- Real-time information gathering of traffic conditions/system operation information.
- Real-time processing of collected information for operators and drivers.
- Prompt response to sudden situations such as accidents, natural disasters, and congestion.
- Real-time provision of traffic information for drivers.
- Real-time provision of road/system operation information for operators.

Integrated Highway Traffic Control Systems (IHTCS)

System Configurations of IHTCS



SUB SYSTEM	COMPONENT	DESCRIPTION
Integrated control system.	Main computer server Integrated operations terminal Network equipment, etc.	-Periodic processing/statistical analysis of collected detector data -Automatic detection of communication status and sudden/emergency situations - Monitoring of various system operational statuses and database management.
Dashboard system.	Situation board (DLP, LCD) Wall Controller, etc.	System that displays all operations/situations performed within the system for operators and others to view.
Vehicle detection system.	Loop detector Video detector Ultrasonic detector, etc.	System that collects real-time traffic data such as traffic volume, occupancy, and speed at road sites and transmits it to the center.
Road sign system.	Road traffic sign(signage) VMS server.	System that collects/provides real-time video footage from the road through variable message sign boards.
Video collection system.	CCTV camera CCTV server	System that collects/provides real-time video footage from the road via CCTV.
Emergency phone system.	On-site emergency phone	System that allows drivers to immediately contact the traffic information center in case of emergencies.
ARS/Web system.	ARS/Web server	System that provides various traffic information to drivers in real-time via automatic response calls and the internet.

Integrated Highway Traffic Control Systems (IHTCS)

Communication Technology of IHTCS: DSRC

DSRC (Dedicated Short-Range Communication) utilizes short-range dedicated communication technology in the 5.8GHz frequency band to collect traffic information from in-vehicle OBU devices, transmit it to the control center, and provide analyzed traffic information to drivers.



Numerous projects for Korea Expressway Corporation

5.8GHz

Real Time OS

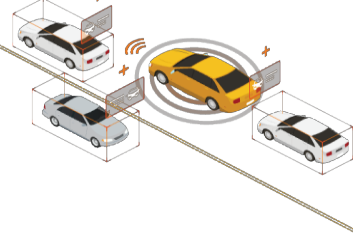
150m

- Technology of short-range communication (10-150m) to provide ITS services, operating at 5.8GHz frequency with a transmission speed of 1Mbps.
- Communication system consisting of in-vehicle terminals (OBU) and small roadside units along the highway
- Communication setup allowing one antenna to communicate with multiple OBU terminals in a 1:n configuration.
- Implementation of communication environment capable of maintaining Line of Sight.
- Real-time collection and provision of traffic information in a Real-Time OS environment.



DSRC Dedicated Short-Range Communication

Toll Gate Control System



This system aims to prevent evasion of toll fee and unauthorized vehicle passage, checking traffic volume as well, by capturing images of vehicles' license plates with the recognition rate of 98.85% or higher by the standards of the Korea Expressway Corporation.



Vehicle license plate recognition technology.

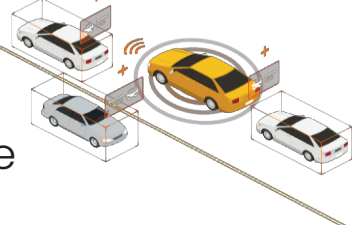
- Automatic recognition of passing vehicle license plates.
- Capable of recognizing all domestic license plates.
- Vehicle's license plate recognition on multi-lanes.

System control.

- Automatic determination of surrounding environment such as day and night to control lighting device ON/OFF.
- Obtaining optimal images through appropriate lens control according to changes in surrounding environment
- Storing and setting storage cycles for images of each vehicle type transmitted from local field controllers.
- Transmission of information in Korea Expressway Corporation standard format.

Diverse Applicability

- Unpaid, discount, exemption, suspicious(crime) vehicle



Weight-in-Motion System (WIM Overloading Vehicle Enforcement System)

The System detects and enforces overweight vehicles traveling at high speeds, which can lead to the damages of road pavement and significant accidents.

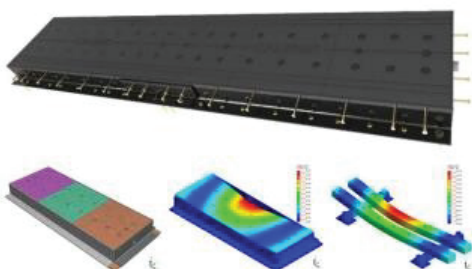
WIM Diagram



Weight-in-Motion System (Overloading Vehicle Enforcement System)

WIM Features

- Detection of wheel load or axial load of vehicles
- Measurement of high-speed dynamic vehicle weight
- Measurement of axle weight, gross weight, vehicle plate recognition, speed, and data processing
- Automatic alarming and real-time display on electric signboard
- Automatic trigger signal processing
- Integration of AVC(Automatic Vehicle Classification) functions for vehicle model classification, lane number, violation code, and checkpoint name
- Implementation of WIM system for measuring and recording weights of wheels, axles, and vehicles
- Utilization of AI for measurements at normal traffic speeds
- Core technology focusing on WIM sensor design, construction, and manufacturing to minimize external factors' influence
- Application of WIM as an unmanned dynamic weighing system for road and bridge protection

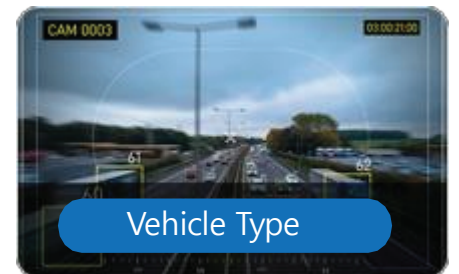
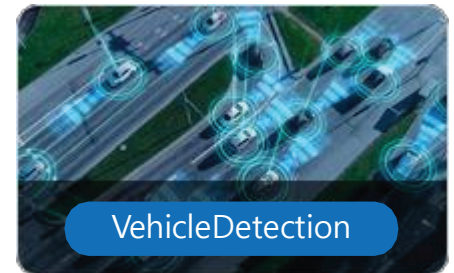


WIM sensor platform



Smart Intersection Management System

The system applies artificial intelligence-based algorithms and generates optimal signals based on big data extracted from directions and vehicle types at intersections, contributing to real-time improvement of traffic flow on roads.



Artificial Intelligence Technology

- AI-based guidance for dispersing traffic flow
- Intelligent control of signal systems based on AI
- Enhancement of pedestrian safety based on AI

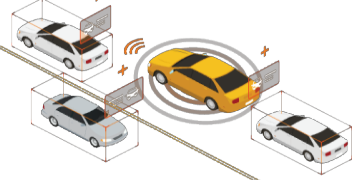
Big Data Technology

- Collection and processing of traffic information by vehicle type and direction at intersections
- Integration of video information, traffic information, and private traffic information into a traffic database

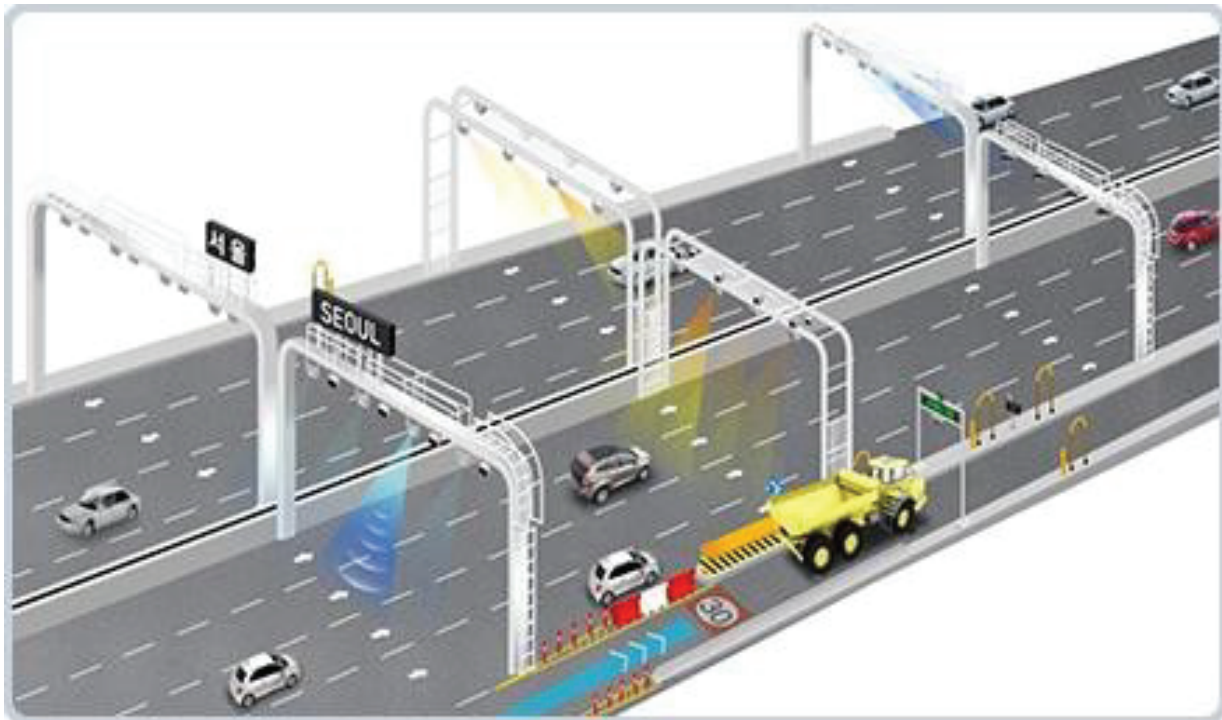
Interconnected System

- (Information Collection) AI CCTV, LPR, VDS, DSRC
- (Communication Network) IEEE 1609 DSRC, 5G NR / 4G LTE mobile communication network

Electronic Toll Collection System



The system uses wireless technology to automatically collect the toll fees from vehicles passing through toll gates, without requiring them to stop or slow down. Hence, the system can reduce traffic congestion, fuel consumption, air pollution, and transaction costs associated with manual toll collection



Accurate toll collection.

- Ensuring precise toll collection through vehicle classification accuracy of over 99.9%.
- Various payment methods.
- Payment options including cash, credit cards, and prepaid passes.

Efficient toll collection.

- Rapid and accurate toll collection without the need for vehicles to stop.

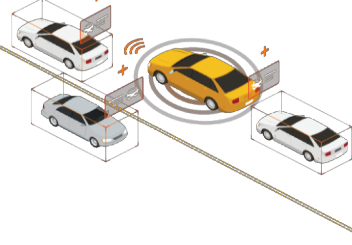
Enhancing user convenience.

- Minimization of operating costs and environmental pollution.
- Minimizing operational costs by unmanned toll collection.
- Reducing environmental pollution caused by vehicle idling.

Electronic Toll Collection System

Hi-Pass System

Hi-Pass is a state-of-the-art electronic toll collection system that allows you to pay the toll without stopping by using wireless communication (DSRC) between the vehicle terminal (OBU) and the toll booth equipment after inserting the Hi-Pass card (prepaid or postpaid) into the terminal.

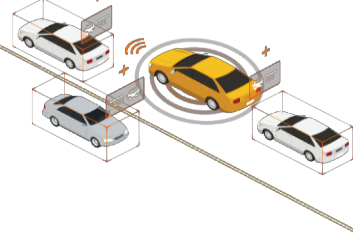


Hi-Pass Features

- A wireless toll payment system for highways and toll roads in Korea
- Uses DSRC (*Dedicated Short-Range Communication*) to automatically charge tolls without stopping
- Offers two payment methods: prepaid and postpaid
- Dedicated Hi-Pass lanes for faster and smoother traffic

Electronic Toll Collection System

Hi-Pass System: Evolvement of Hi-Pass System

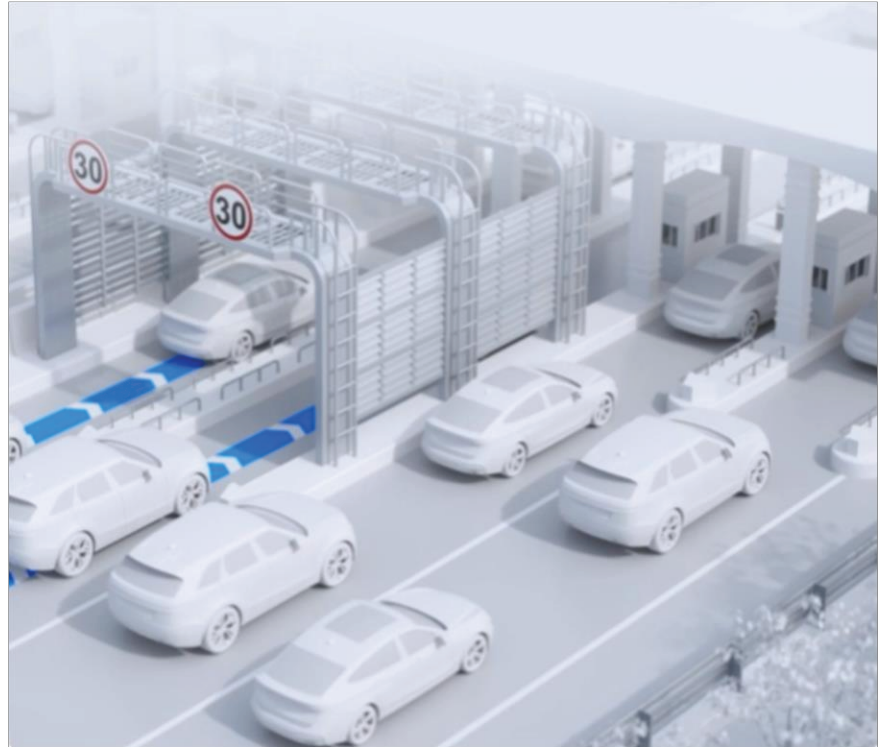


Single lane Hi-Pass (Past)

Speed limit: 30km/h

Risk of accidents increase due to traffic congestion and speeding.

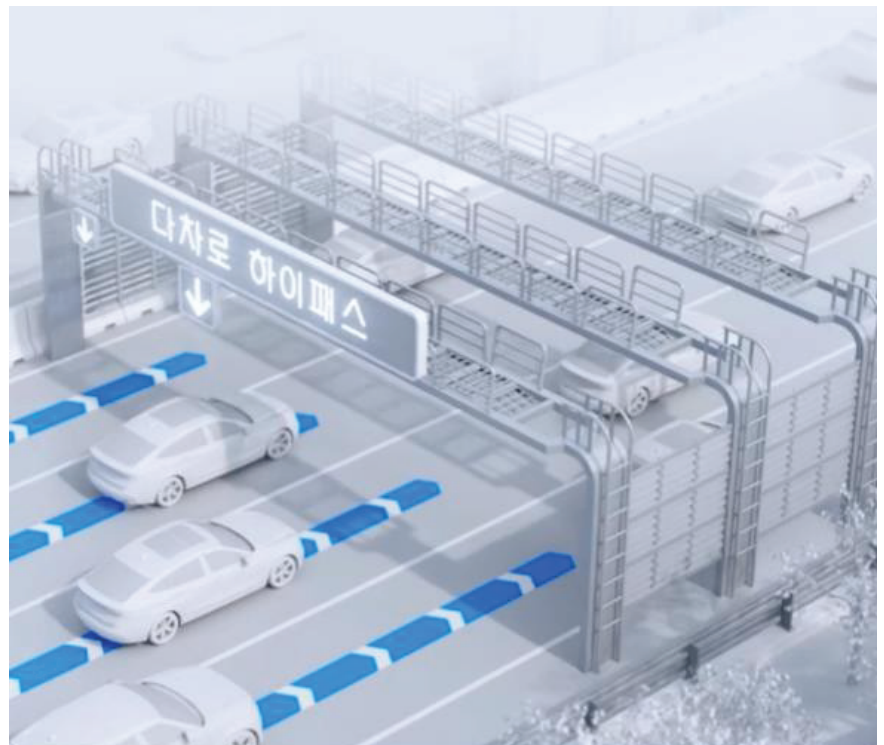
Compliance rate with speed limits is below 6%.



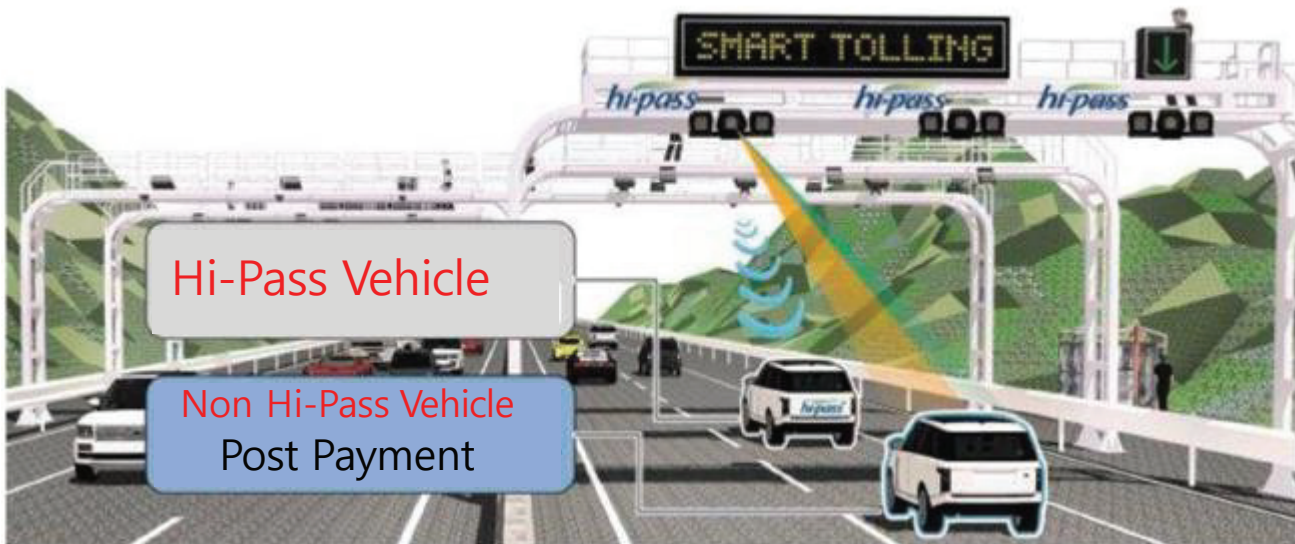
Multi lane Hi-Pass (Ongoing)

Speed range: 50-80km/h

Fuel savings effect. Congestion diminishes. Risk of accidents decrease at toll booths.



Smart Tolling System: The system is a most advanced type of electronic toll collection technology to automate and streamline toll payment, becoming a future toll collection system.



System overview

Not the traditional tollgate method. Vehicles pass without stopping.
Improving traffic flow. Reducing vehicle congestion. Cost-saving effect.
No speed limit(technically)

Image recognition system

License plate recognition system using cameras and image processing algorithms.
Automatic recognition of vehicle license plates. Used for collecting tolls from vehicles without DSRC tags

Central data processing system

Processing, storing, and managing collected data and toll information.
Performing tasks such as user account management, fee payment processing, etc

Integrated toll management system

Integrated management of various toll collection methods: electronic tags(RFID), cash, cards, etc.

Facilitates users' toll payments and settlements

Real-time traffic monitoring and management

Monitoring and managing traffic flow in real-time to reduce traffic congestion
Supporting efficient traffic management

Dedicated Short-Range Communication (DSRC).

Wireless communication between electronic tags installed in vehicles and roadside readers. Identifies vehicles and collects tolls through wireless communication.
When a vehicle passes through the tollgate, the reader detects the tag's signal and calculates the toll.