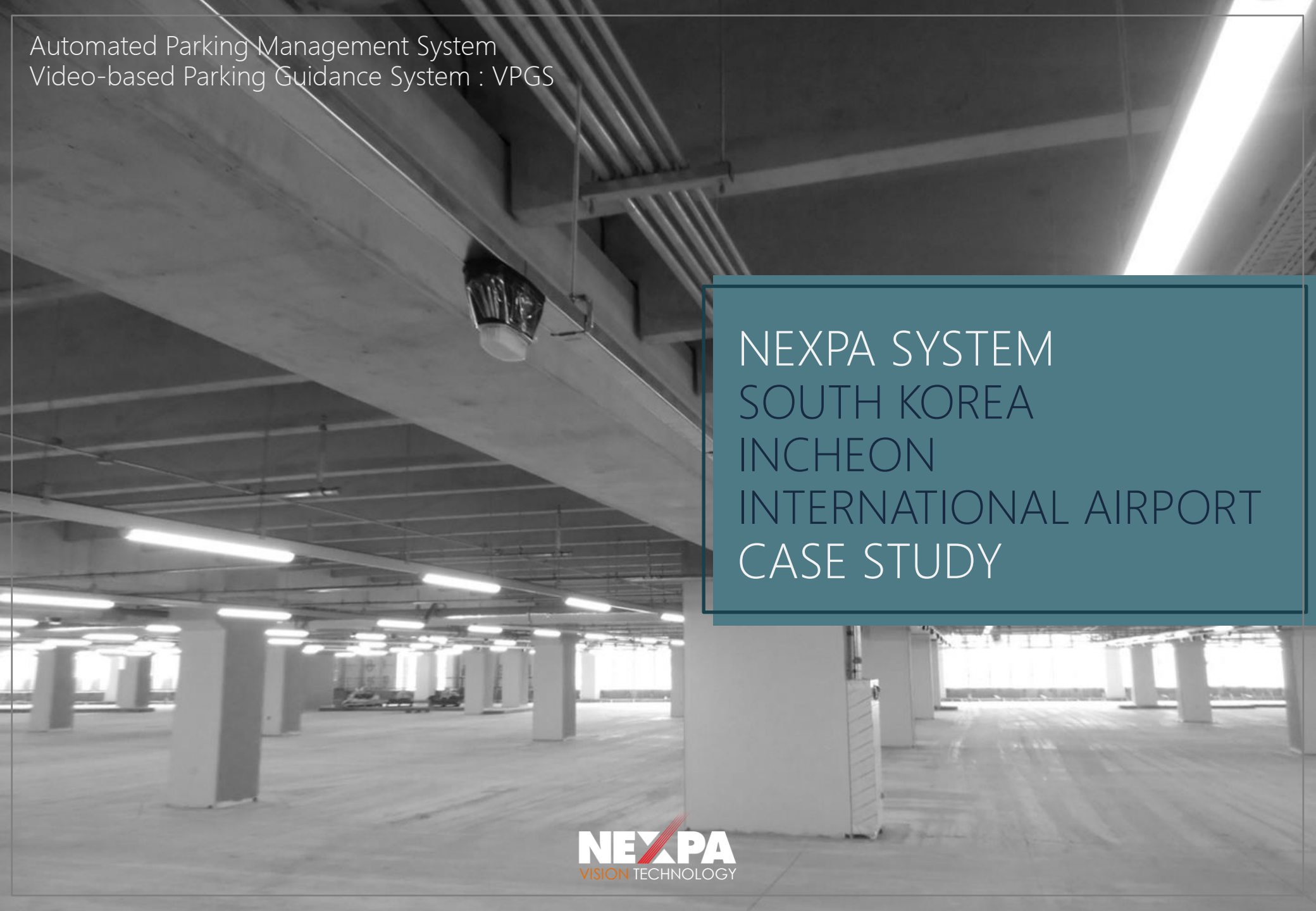
Automated Parking Management System
Video-based Parking Guidance System : VPGS



NEXPA SYSTEM
SOUTH KOREA
INCHEON
INTERNATIONAL AIRPORT
CASE STUDY

NEXPA
VISION TECHNOLOGY

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Introduction

- This case study has a purpose of introducing the project NEXPA has successfully completed for Incheon International Airport in South Korea.

- We, NEXPA SYSTEM, firstly signed the contract for Incheon International Airport Project in 2009 and several other projects followed after successful installation completion by virtue of the system's reliable performance. In 2017, we won a tender of Terminal 1 car park enforcement project for Incheon International Airport again with a highest score competing with other companies.

- Incheon International Airport as No. 2 ranked the world's top 100 Airports in 2017 won ASQ Awards for 12 consecutive years. Incheon International Airport considers car park service is one of the important factors to give a good impression to the customers and improve their loyalty. The car park in Incheon International Airport has been innovated every year reflecting the technology development.

- We are sure that this case study would be very informative to whom is considering of new car park project for better, smart, and green environment.

Background NEXPA SYSTEM

- Founded in 2004, NEXPA Systems Co., Ltd. has been developing and implementing revolutionary technologies that drive the world of smart parking and public surveillance to the next level.

- At NEXPA, we constantly test and challenge our technology; we strive to offer smarter and convenient solutions to the businesses. With over 50 patents in video analytics and surveillance systems, we have the expertise and experience to provide solutions tailored to maximize the potential of smart parking solutions, transforming it to a pivotal asset for the business growth.

- Together with global partners like Cisco System, Inc., NEXPA looks to continuously develop advanced parking solutions as one of the key pillars of IoT(Internet of Things) domains. And as part of CIM(City Infrastructure Management) of Cisco Systems, Inc., we work towards the vision of a world with smart cities and communities in the future.

Project Overview

"The is the project for the case study"

Project Name	*VPGS Installation*	*Phase 3* *PMS/VPGS Installation*	*Phase 2* *VPGS Enforcement*
Contract Type	Tender	Tender	Tender
Project Owner	LG CNS	Incheon International Airport Cooperation	LG CNS
System Type	VPGS	PMS/VPGS	VPGS
Specification	1) VPGS	1) Auto Pay System 2) Payment Booth 3) VPGS 4) KIOSK (Find-My-Car) 5) Car Exterior Identification System	1) VPGS 2) KIOSK (Find-My-Car)
Project Scale	Terminal 1 /Short-term car park	Terminal 2 / as a whole	Terminal 1 / Short-term car park
Date of Contract	Jul. 2009	Nov. 2014	NEXPA won a tender for 2nd stage VPGS Improvement Project in 2017
Date of Completion	Nov. 2009	Nov. 2017	

※ First / The biggest / Recent projects

Project Master Plan Review

"OBJECTIVE"

"Global Mega Airport"

Integration

New devices must be integrated with the existing devices to operate the car park efficiently

Cutting-edge Technology

Car park system must be applied with the cutting edge technology (video-analytics) and be high-end solution

User-oriented

The main purpose of this project is to provide the best service to the customers. The system must be user-oriented solution

Site Survey

- Construction of the new passenger Terminal 2 at Incheon International Airport started in September 2013 as part of the airport's phase 3 expansion. And the car park project is one of the construction plan. The biggest concern should be how to provide convenience to the airport visitors as they could have a trouble to find their cars in that large-sized car park.

- No. of parking bay : Total 6,831 parking lots

  - Parking Lots : 6,831 lots
  - Entrances : 17 gates
  - Exits : 21 gates
  - Auto Pay System : 24 EA

Challenges

"Much More Smarter Parking Solution!"

Through the efficient cutting-edge technology convergence, the solution should achieve the smarter parking system and higher level of interactivity. The ultimate goal is to provide the better and best service to the visitors.

Seamless operation must be available from the installation stage allowing progressive installation to operation stage with a reliable and stable solution. The system shall be setup and running step by step and also maintained with prompt action on any matters.

Current car park system must be improved by solution upgrading. We believe that NEXPA's solution is the most suitable for this goal as we adopt the state-of-the-art technology and continue to develop our capability.

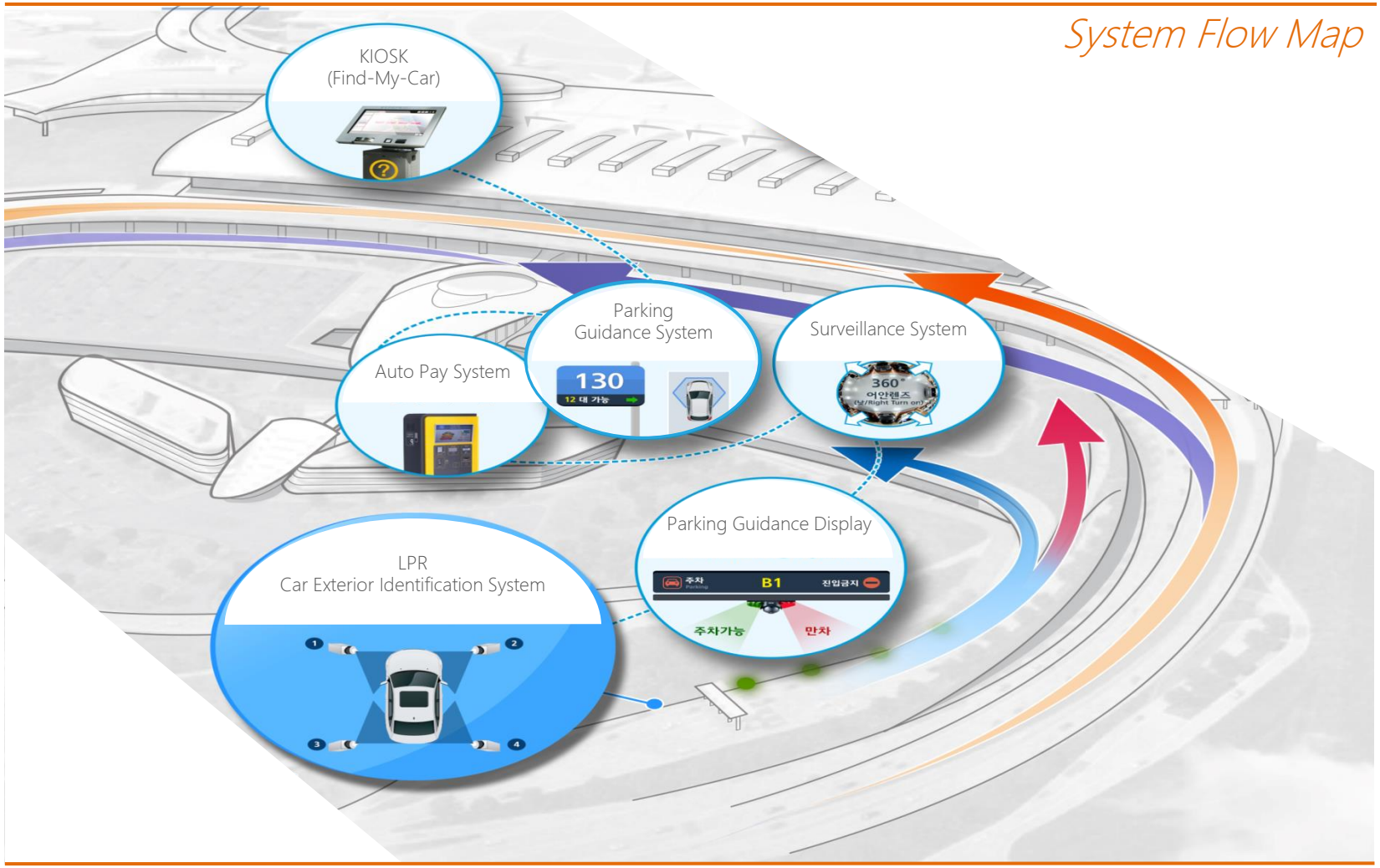
The proposed solution must be integrated with the existing system. NEXPA has been participating in car park projects for Incheon International Airport from the initial stage so the integration can be done very easily. Also NEXPA has a know-how to integrate with any other systems.

NEXPA Proposed Solution Features

SMART	Automatic payment solution enables ticketless parking system
State-of-the-art Technology	NEXPA's solution deploys the state-of-the-art devices developed by our proprietary technology
Security	IP camera for LPR has also surveillance camera feature not allowing any uncovered area. Also car exterior identification system makes car park users feel safe from any accidents which can be arisen
Expandability	NEXPA's solution has the feature of expandability to interface new system with the existing devices and application to make easy to manage the entire system
Customer Satisfaction	NEXPA's solution is easy to run for car park operator and convenient to use for car park visitors.

NEXPA Proposed Solution System Specification

System Flow Map



NEXPA Proposed Solution System Specification

PMS : Single / Dual Camera LPR System

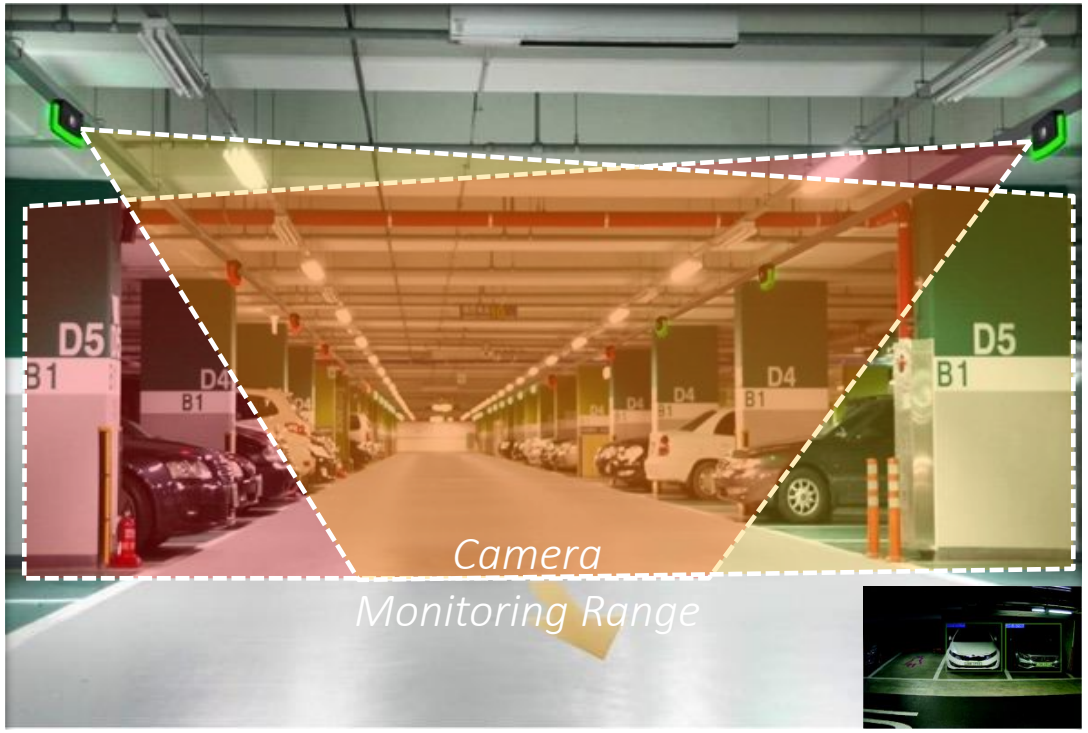
LPR System is an automated control / management system that minimizes car congestion at the entrance and exit of the car park. The system identifies cars' license plate number within a single second, with more than 98% accuracy. The system uses the plate number as an identification for billing and security purposes. The computerized system reduces the need for consumables such as tickets.

PMS : Bi-Directional LPR Technology

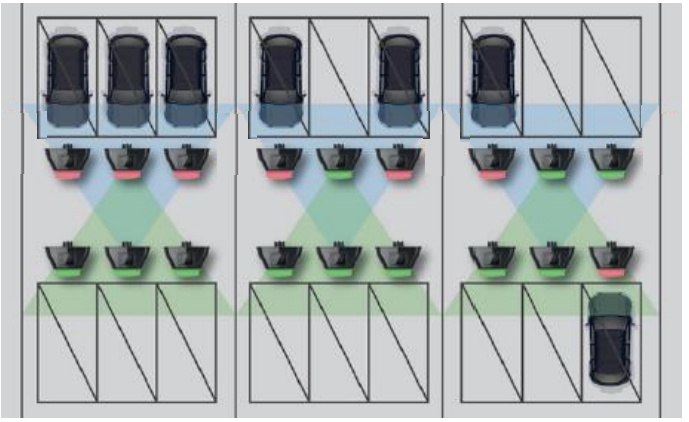
The Dual Camera LPR System, with the bi-directional LPR technology, detects the rear license plate in the event of damaged or bent front license plate. It significantly reduces error rates with recognition rate of more than 99%

NEXPA Proposed Solution System Specification

PGS : IP Camera (Uni-directional)



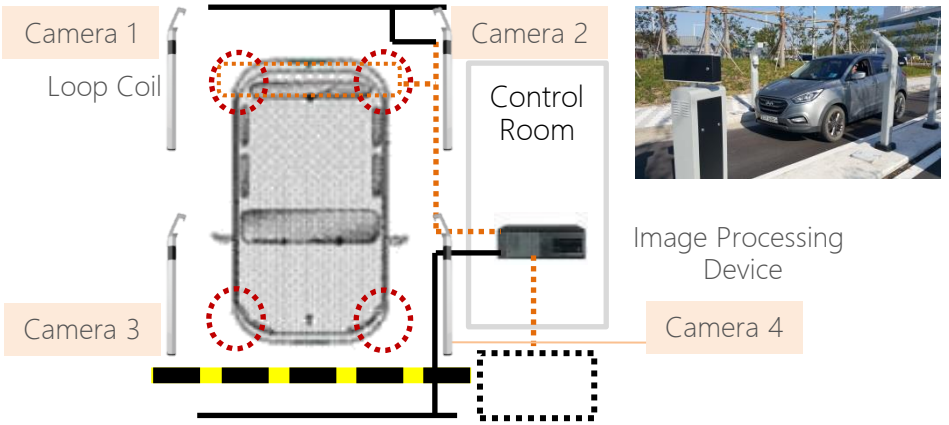
Each uni-directional IP camera covers up to 3 lots detecting cars in those 3 lots and recognizing plate numbers. Built-in LED indicates the status of parking lot, which designed for individual parking lot with additional LED light.



NEXPA Proposed Solution System Specification

Car Exterior Identification System

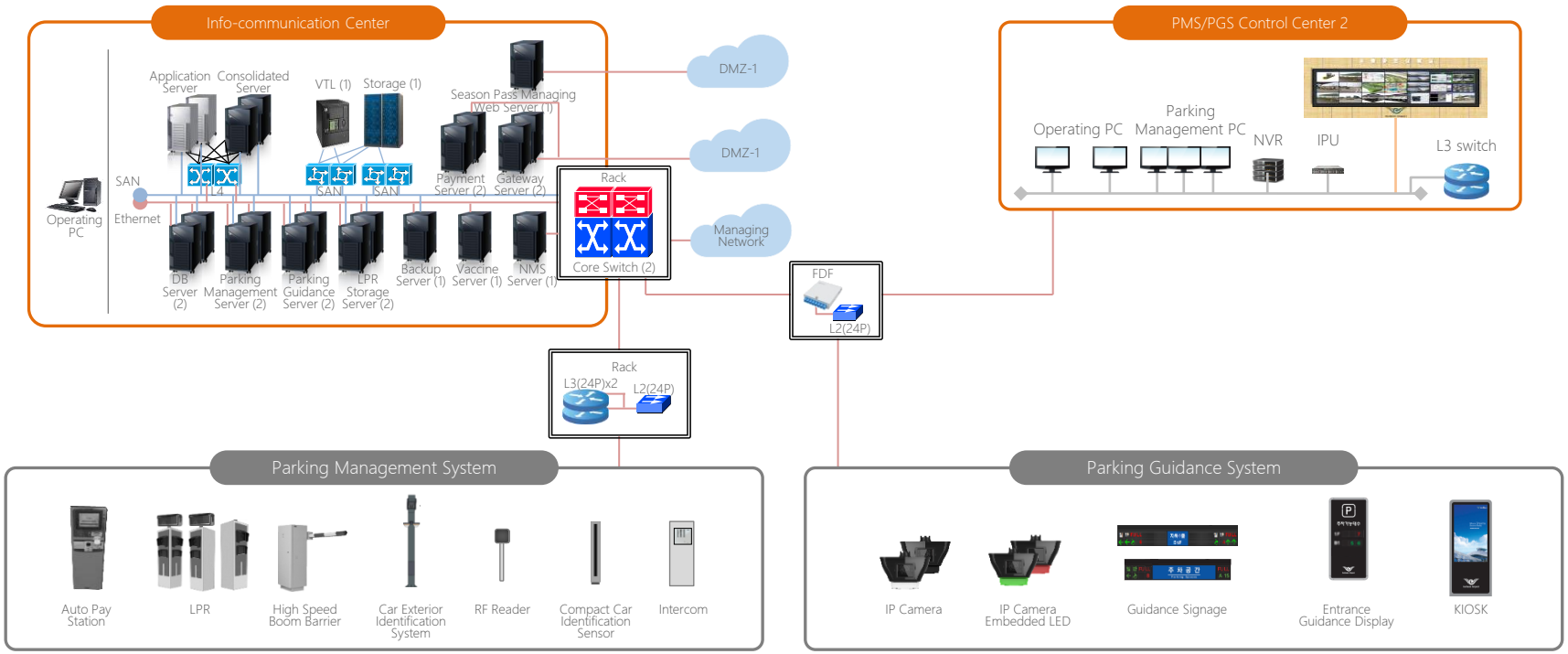
Car Exterior Identification System provides clear evidences of unknown cause of any accident in the car park.
4 cameras are installed at both entrance and exit.



- 1.3Mpx IP camera
- Retrieve 4-sides images of a car captured at the entrance and exit by entering license plate number

NEXPA Proposed Solution System Specification

System Architecture



- Car Park User Waiting Area
- Taxi Waiting Area (Entry/Exit)
- Bus Waiting Area (Entry/Exit)
- Long-Term Car Park (Entry/Exit)
- Short-Term Car Park (Entry/Exit)
- Valet Car Park (Entry/Exit)
- Terminal 2 Car Park (Entry/Exit)

- Level 2
- Level 2.5
- Level 3
- Level 4

NEXPA Proposed Solution System Specification

Center Operation

Application Server #1	Application Server #2	Parking Management Server #1	Parking Management Server #2	LPR Storage Server #1	LPR Storage Server #2
Payment Consolidated Server #1	Payment Consolidated Server #2	DB Server #1	DB Server #2	PGS/Car Location Finder Server #1	PGS/Car Location Finder Server #2
Vaccine Server	Backup Server	Parking Management PC #1	Parking Management PC #2	Parking Management PC #3	Season Pass Managing Web Server
NMS	Gateway Server #1	Gateway Server #2			

NEXPA Proposed Solution Major Components

[Dual Camera LPR (Built-in LED Display)]

Automatically recognize the vehicle license number on both front and rear-sides plates after detecting a vehicle, which enables to implement non-ticket and non-stop parking system with immaculate recognition rate

[Boom Barrier]

Control the access(entry/exit) of vehicles at the car park. The barrier gate opens automatically by opening signal from a loop coil and close automatically by the signal from another loop coil after vehicles pass through over it

[Automatic Payment Station]

Stand type, Color 20" touch screen, Intel Quad core i7 3.4GHz, 8GB memory, 1TB HDD, Windows 7 Pro O/S, TCP/IP, IP Intercom, Web camera embedded

[Car Exterior Identification System]

1 set (4EA) of car exterior identification system captures the image of car exterior with 4 different angles' images at the entry and/or exit to identify the condition of car exterior. This system enables to figure out the cause of the incident in the car park

NEXPA Proposed Solution Major Components

[Uni-directional IP camera – 12MP (A Type)]

Uni-directional IP camera recognizes vehicle license plate number and support the security surveillance. It covers 3 parking lots and is installed in the opposite side of the parking lot where should be recognized to capture the image. A type is LED indicator embedded IP camera. LED indicator shows the occupancy of the parking lot underneath of the camera with the different color (Red: Occupied/Green: Available)

[Uni-directional IP camera – 12MP (B Type)]

Uni-directional IP camera recognizes vehicle license plate number and support the security surveillance. It covers 3 parking lots and is installed in the opposite side of the parking lot where should be recognized to capture the image. B type has no LED indicator and is installed at a place where there is no parking lot underneath of the camera

[Parking Lot LED Indicator]

Parking lot LED indicator has the same appearance with IP camera not to spoil the beauty of the car park. It shows the occupancy of the parking lot underneath of the camera with the different color (Red: Occupied/Green: Available)

[Entrance Guidance Display]

Display available spaces for whole floors of car park at Entrance

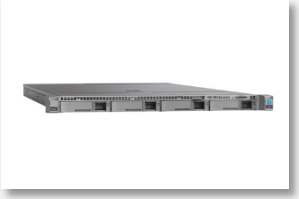
NEXPA Proposed Solution Major Components

[PoE Switch]

Supply power to 24ea of 802.3af IP devices by PoE power support. PoE is a device which can optimize power and configures network devices like wireless AP, Voice over IP(VoIP), IP surveillance camera

[Backbone Switch]

Switching capacity 2Tbps, Throughput 960Mpps, 8 Slot chassis, Hot swapping, Modular Jack included, 1Gbps fiber optic interface 48 ports, 10Gbps fiber optic interface 8 ports, 10/100/1000Mbps RJ-45 interface 48 ports, VLAN, IEEE802.1Q Tag, IEEE802.Is, IEEE802.1W Spanning Tree Protocol, VRRP Layer3 Redundant Protocol



[IPU(Image Processing Unit) / NVR(Network Video Recorder) Server]

Process images from IP camera to detect car and recognize vehicle license plate number in a parking lot and store video image of parking lot

[DB Server]

Store the related data of parking recognition device and send the parking history data to KIOSK and management PC

Installation

In case of arising any accidents, it is available to check the original vehicle's condition by "Car Exterior Identification System" installed at the entrance

Main entrance guidance display shows the real-time car park occupancy by Level of the entire car park

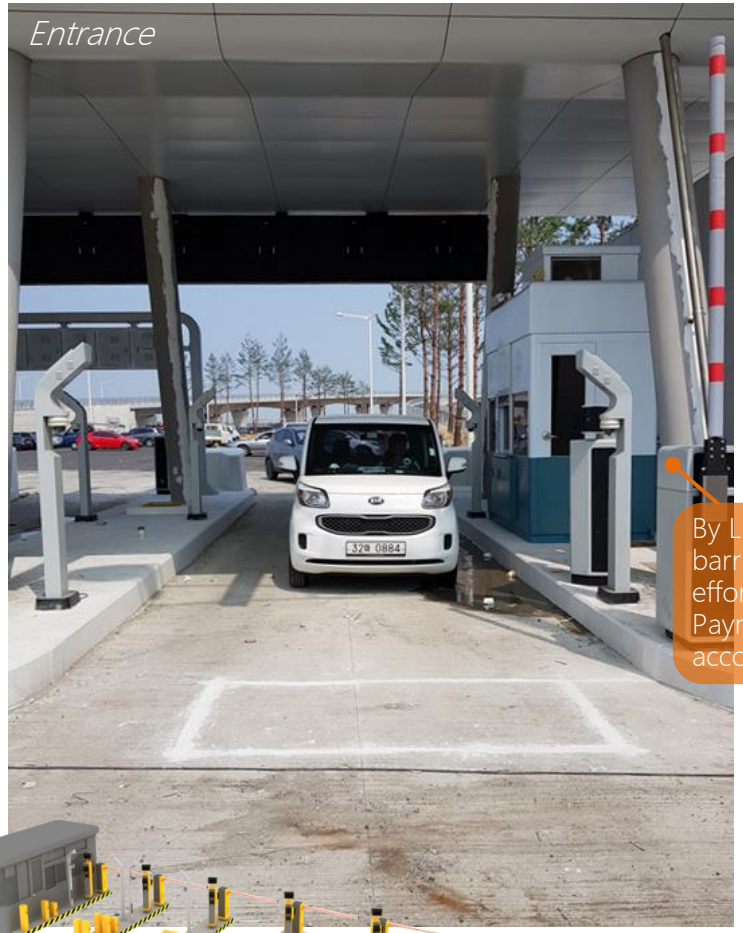
January 2014 ~ June 2017

PMS / 99% of Accuracy Rate

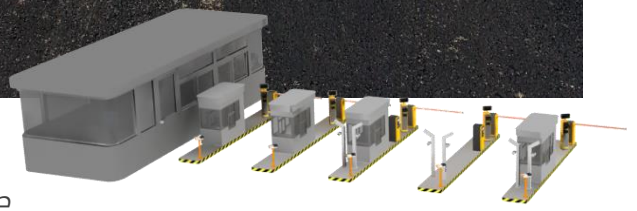
Installation

January 2014 ~ June 2017
PMS / 99% of Accuracy Rate

Installation



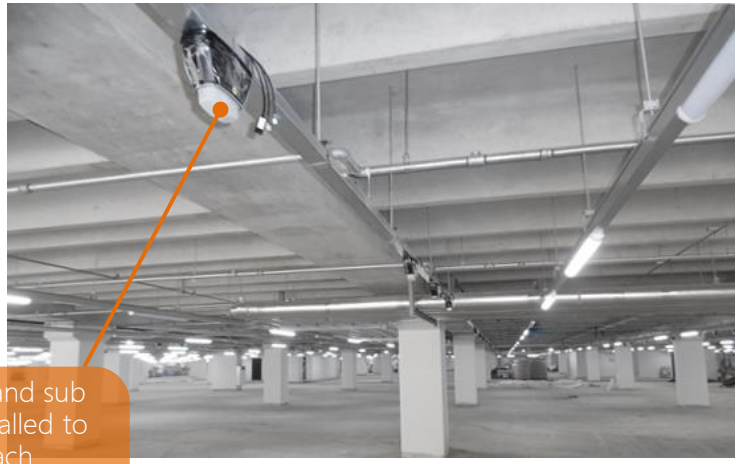
By LPR, auto pay system, boom barrier, car park operator run an effortless ticketless system. Payment booth can be added according to customer's needs



January 2014 ~ June 2017

PMS / 99% of Accuracy Rate

Installation

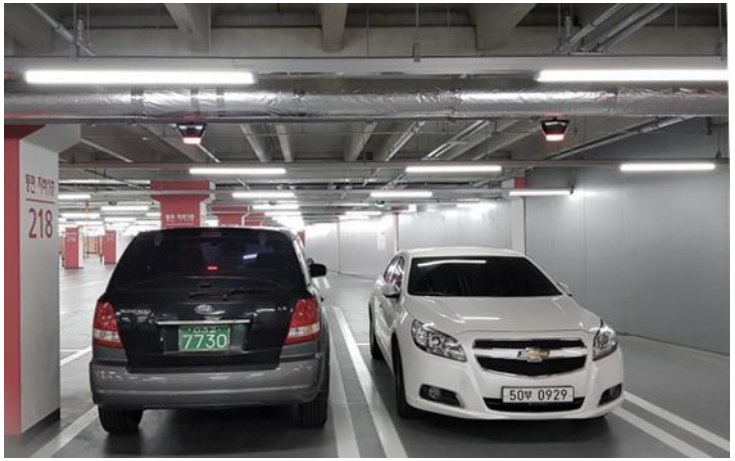


Uni-directional cameras and sub LED lights have been installed to show the availability of each parking lot to car park users. Sub LED light is connected to nearest IP camera for power and network

January 2014 ~ June 2017

PGS / 99% of Accuracy Rate

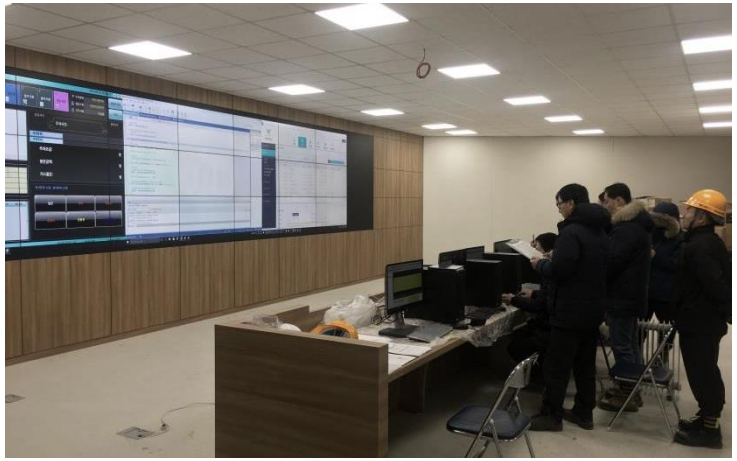
Installation



January 2014 ~ June 2017

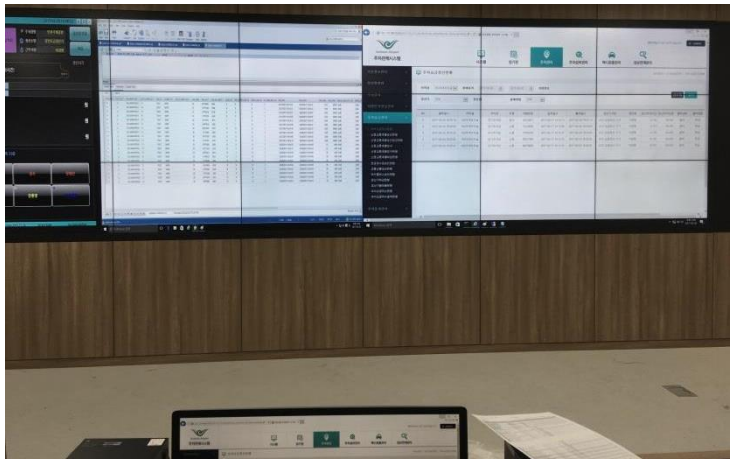
PGS / 99% of Accuracy Rate

Operation



Management(Control) Center

Management(Control) Center



Management(Control) Center

Server Room

Benefits

Car park User

Can move into the car park **without delay**

Ticketless system using LPR technology enables to enter into and leave the car park without delay decreasing waiting time to get a parking ticket and pay to the cashier booth. This is hassle-free solution.

No more wasted time

Car park users can get the real-time information of car park's occupancy by entrance/level/zone guidance display and LED indicator. They do not need to go around to look for an available parking lot. Just follow the guidance of car park system. That is enough.

Can find where the car parked **very easily**

Car park users do not need to remember where they parked any more. Just entering the vehicle license number on KIOSK, they can get the information of parking location and the optimal way to reach there.

Car park Operator

Can manage the car park efficiently by **system connection**

In this kind of huge-sized car park, many other systems are also existing. To manage efficiently all the system, the connection is the most important. NEXPA's solution interferes with existing devices and application properly so the car park operator can improve their work efficiency.

Can **deal with any accident smoothly**

In Korea, if the cause of accident in car park is not found out, the car park owner should pay for fixing. But NEXPA's PMS/PGS solution enables to monitor and record the real-time situation and it reduces the costs and risks of managing car park accidents.

Reports helps to operate car park effectively

NEXPA's PMS/PGS solution provides traffic reports of car park use by zone/floor/time and etc. Car park operator can use this reports to operate the car park effectively and improve the service quality for the airport visitors.

Conclusion

- In 2016, Incheon International Airport handled 57.7 million passengers. Terminal 2 started its operation from the end of 2017 that will bring the airport's total capacity up to 72 million passenger. This increasing capacity requires advanced technology and that is why Incheon International Airport chose NEXPA for their project

- Incheon International Airport is currently working on the phase 3 car park project. And NEXPA is the only one solution provider who participated in the entire phases of the car park project for Incheon International Airport. Also, NEXPA is the only one leading solution provider who participated in the huge projects of both for No. 1 and No.2 international airports in the World.

- NEXPA continues to develop our ability and will prepare to participate in 4th stage of car park expansion project for Incheon International Airport keeping studying our past works