See Far, Go Further

Safe City Solution

Contents

Solution Background

Public Security Maintainance -Increased Criminal Threats

On May 22th 2017, suicide bomb terrorist attacked at Manchester Stadium,22 died, 59 injured.

On November 13th 2015, terrorist attacked at Paris, 132 died, hundreds of people injured.
…

On May 2018, suicide bomb terrorist attacked at Churches & Police, Surabaya, Indonesia

Contents

- Solution Background

- **Solution Overview**

- Solution Design

  Phase 1: City Surveillance

  Phase 2: Intelligent Video Surveillance

  Phase 3: Data Fusion & Hierarchical management

- Case Study

Solution Overview- 3 Phases of Safe City

HIKVISION

Phase 3: Data Fusion & Hierarchical management

Phase 2: Intelligent Video Surveillance

Phase 1:City Surveillance

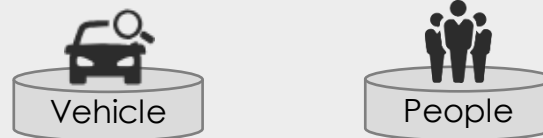| Video Surveillance	GIS Application
Alarm Control	Command & Dispatch

Basic Security Application

Control Center

Video Collection

Target Recognition | Crowd Density Estimation

Target Tracking | Traffic Enforcement | Flow Control

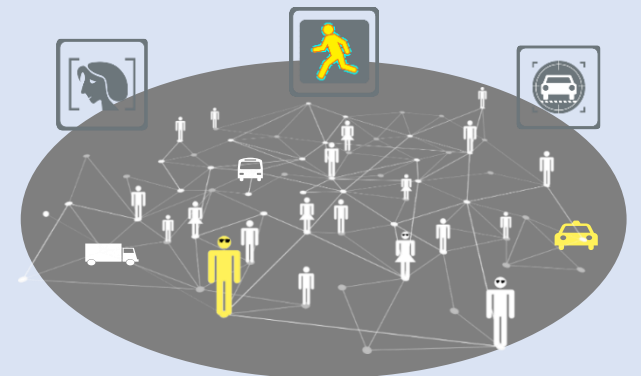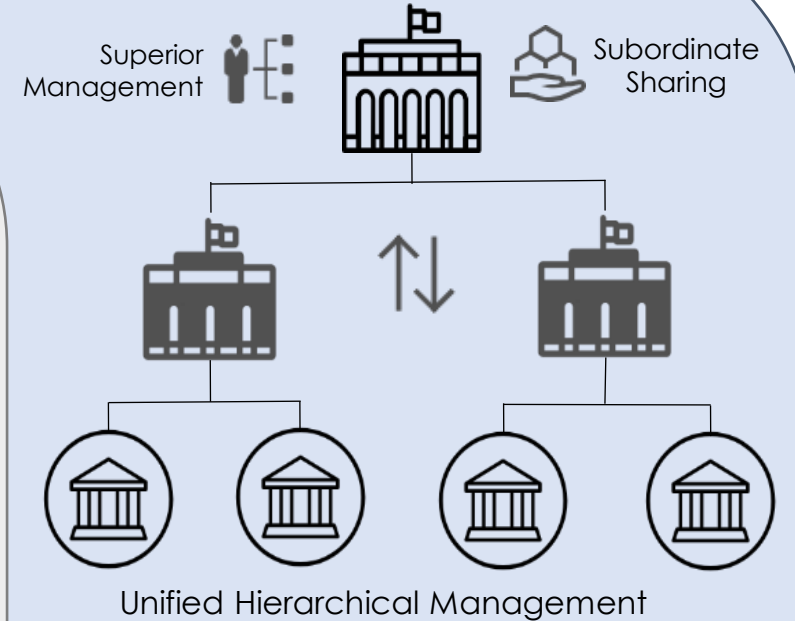Target Control | Incident Detection | Blacklist Arming

Vehicle | People

Valued information

Video | Modeling | Metadata

Deep-learning series Servers
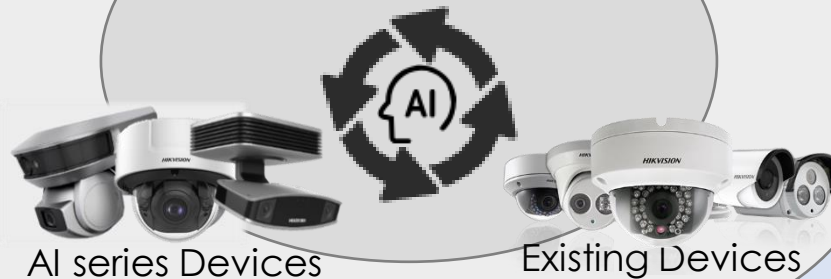
AI series Devices | Existing Devices

Superior Management | Subordinate Sharing

Unified Hierarchical Management

Multidimensional Data Fusion

Solution Overview- The layout design for safe city

HIKVISION

Boundary

Main Road

Key Area

Blind Area

Park

Station

Community

Hospital

School

CBD

POLICE

Government office

Border Checkpoint Face/Vehicle Control

Mobile Enforcement

Main-Road Surveillance

Video Monitoring Target Control Event Detection…
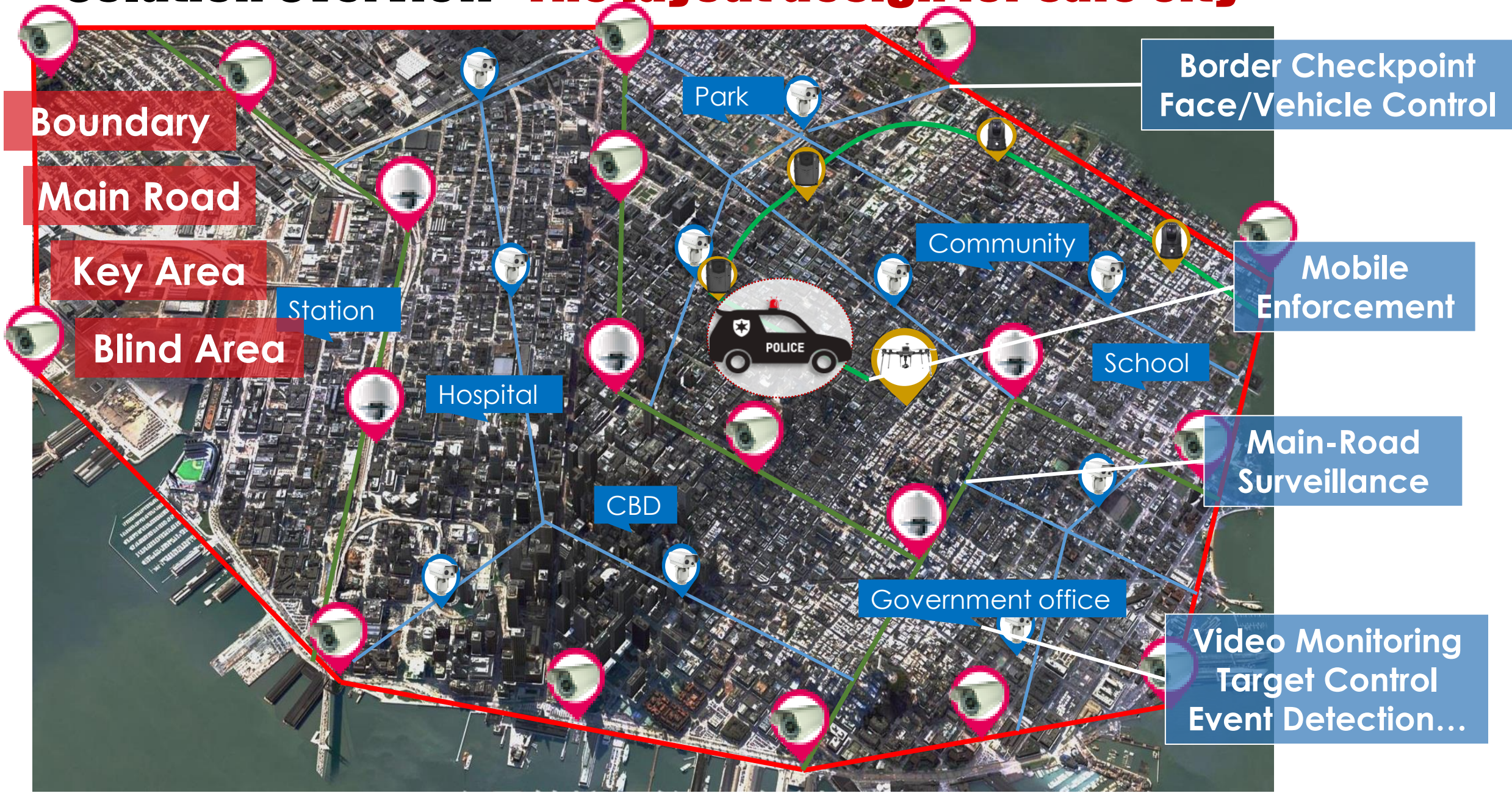
Solution Overview- The monitoring spots design for safe city

COMMERCIAL CENTRE SCENIC AREA CORE OFFICE PUBLIC AREA

Contents

System Topology in Phase 1

Video Surveillance

GIS Application

Alarm Control

Command & Dispatch

Control Center

Central VMS platform

Central Video Storage

TV Screen

System Maintenance

Network

Front-end Layer

Ground Control System

Air Control System

Mobile Control System

Alarm Control System
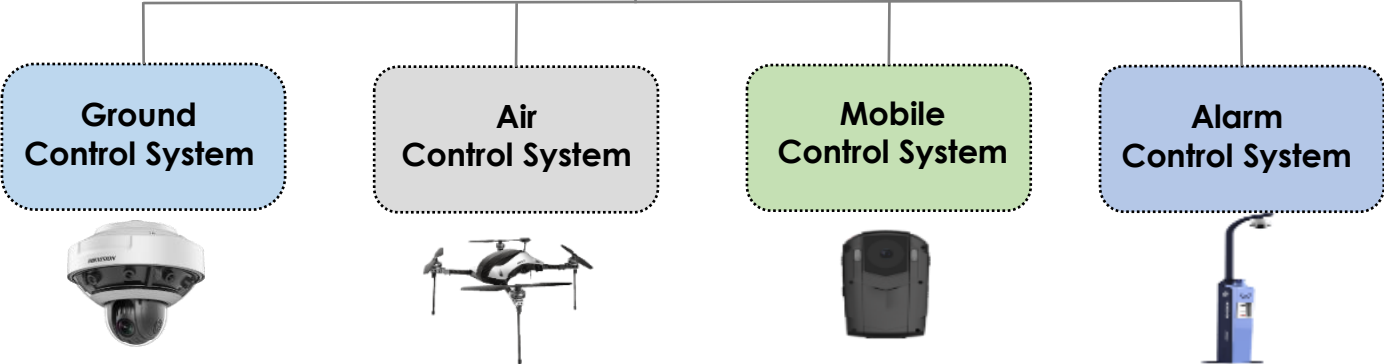
Front-end Layer - Ground & Air Control System

➤ 24/7 full coverage on city key area.

City road, open area, alley, residential and commercial district.

Ground Control System

Air Control System

"the combination of dynamic and static, full view and detail control system"

Front-end Layer - Mobile Control System

Mobile Control System

Network Monitoring Center

Client   Servers

On-board operation

Portable PTZ Dome

POLICE

Wi-Fi, 3G, 4G

INTERNET

Body Cam   Body Cam

Dock Station

Standalone Monitoring Center

12-20-2016 Tue 18:18:07
CW3□TGP
OJ5□XGP
CW3□TGP
DJ5□XGP
VTGP
28° 03'39.0" E
26° 05'0.1" S
Speed: 47.45 KPH
SVs: 10/0.7
Mobile ANPR of SA

Front-end Layer - Alarm Control System
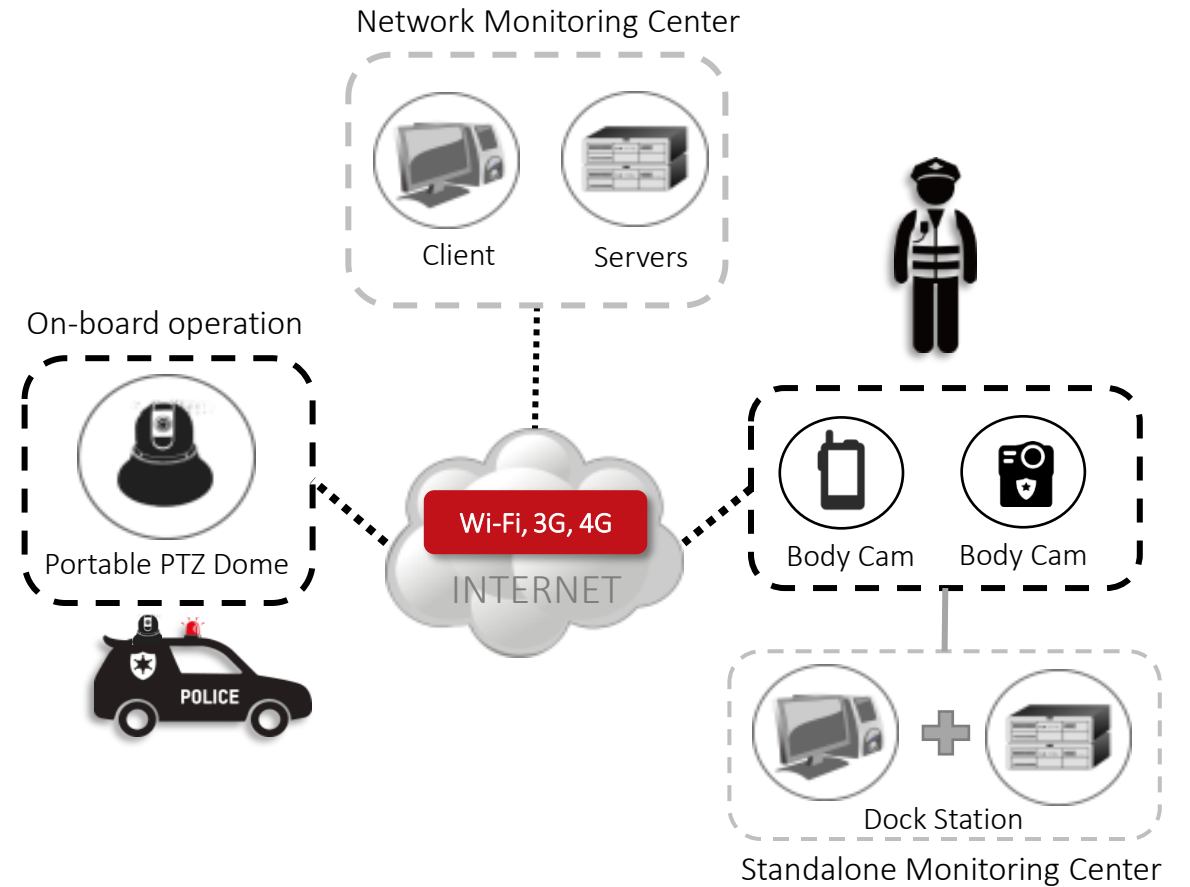
Alarm Control System

A Built-in Camera

B Intercom and broadcast

C Waterproof /anti-thunder /vandalism –proof

D Support 3G/4G communication

Alarm Column

Alarm Box
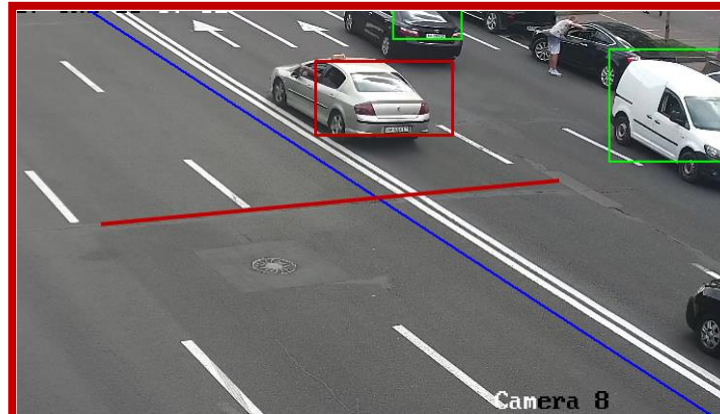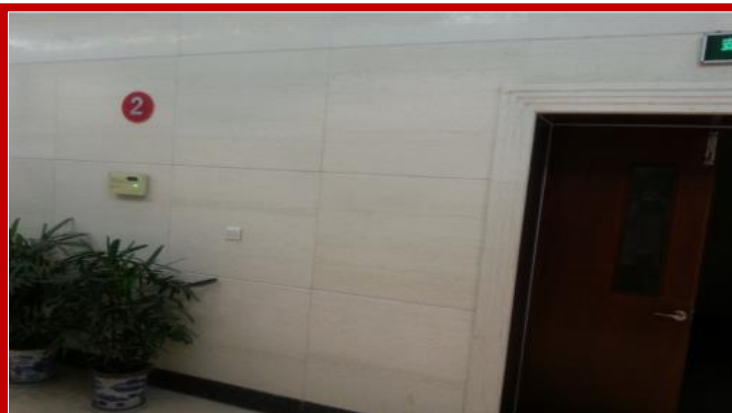
Front-end Layer - Alarm Control System (VCA)
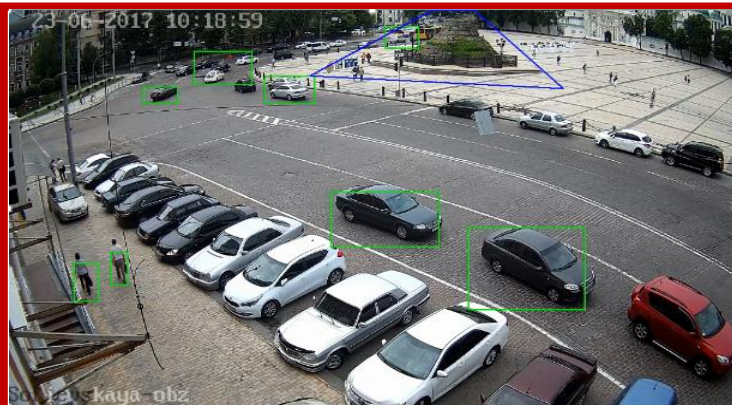
Intrusion Detection

Line Crossing Detection
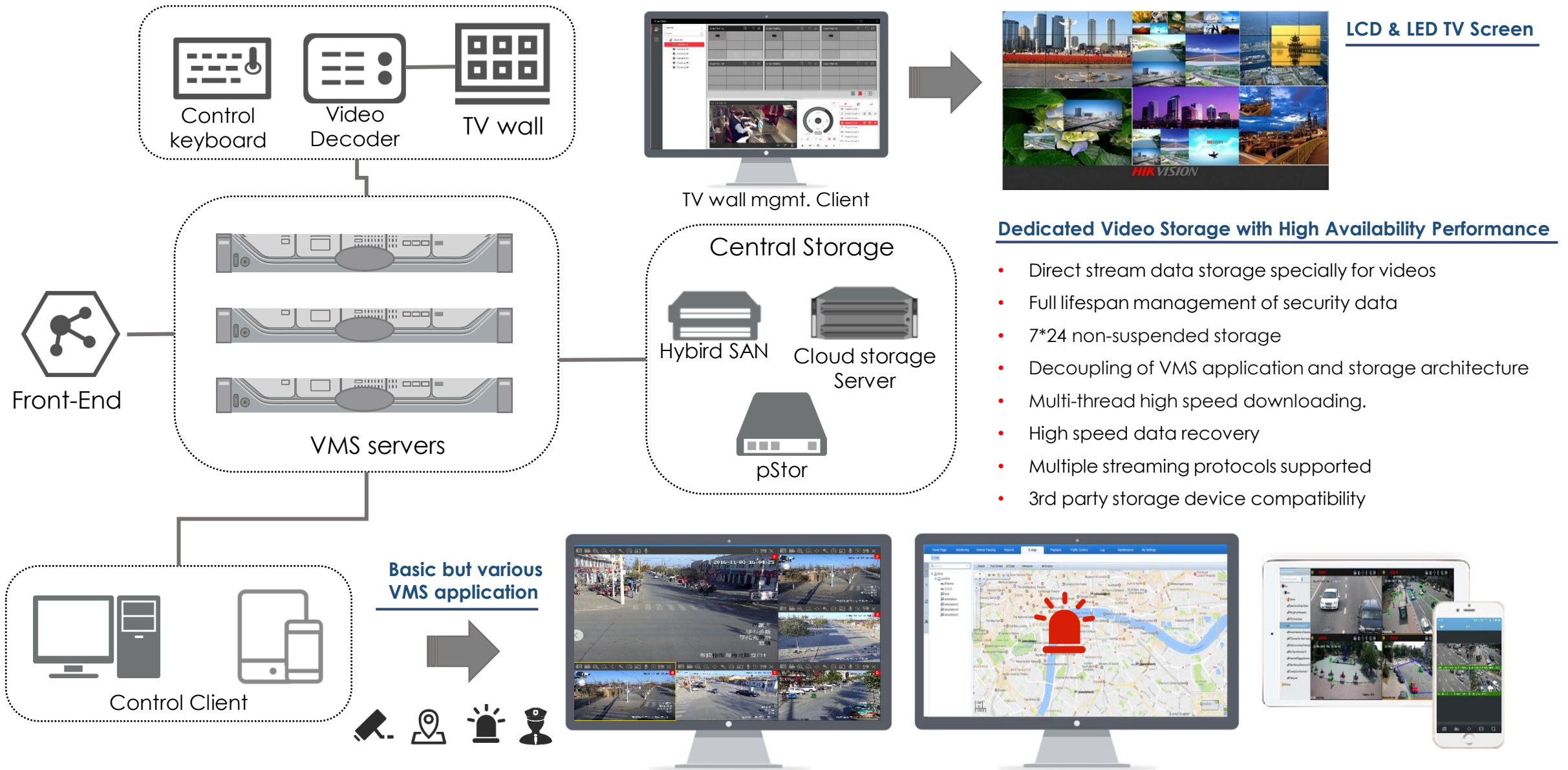
Movement Detection

Sudden Scene Change

Defocus Detection

Offline alarm

Normal alarm detection by HIKVISION **Deep-Learning Camera/NVR**

Control Center- Basic Function introduction

Control keyboard / Video Decoder / TV wall

Control keyboard

Video Decoder

TV wall

TV wall mgmt. Client

LCD & LED TV Screen

Dedicated Video Storage with High Availability Performance

Central Storage

Hybird SAN

Cloud storage Server

pStor

- Direct stream data storage specially for videos
- Full lifespan management of security data
- 7*24 non-suspended storage
- Decoupling of VMS application and storage architecture
- Multi-thread high speed downloading.
- High speed data recovery
- Multiple streaming protocols supported
- 3rd party storage device compatibility

Front-End

VMS servers

Basic but various VMS application

Control Client

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Phase 2: Intelligent Video Surveillance

5 Hours

Only 5 Seconds

Unvalued data

Valuable data

Unstructured raw resource

Video/Image

Interested target

| Personnel | Vehicle | Object | Scene | Behavior | Event | Others |

Structured data

| Body | Dressing | Number plate | Position | Time | Color | Vehicle body | Shape | Behavior | Event |

Others

Deep learning

Video and image Structured Description:
➤ Turn the video and image into structured text by AI technology that can be understood by computers.

Benefits:
- Reduce the operation time to find the target.

- Promote the security system from the incident handling to incident precaution.

- To realize the data comparison and alarm warning.

- Data relationship deep mining.

- All of the structured data can be stored and will be the basis of video big data application in the future.

System Topology of phase 2

VMS Servers

Control Client

Central Storage

Hybird SAN

Cloud storage Server

pStor

Video & image analysis Server

GPU

Big data storage

Video & image Storage

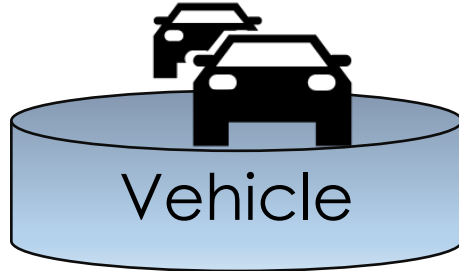Metadata

Network

Video

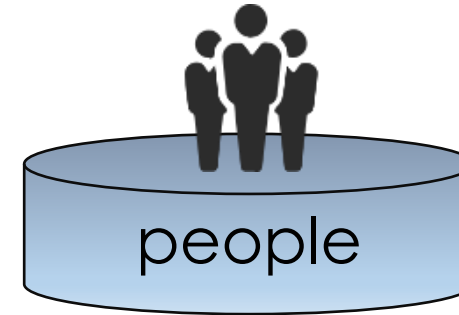Video & image & Event

Normal cameras
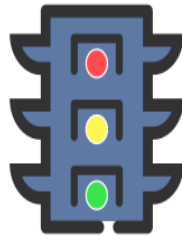
Deep-learning cameras
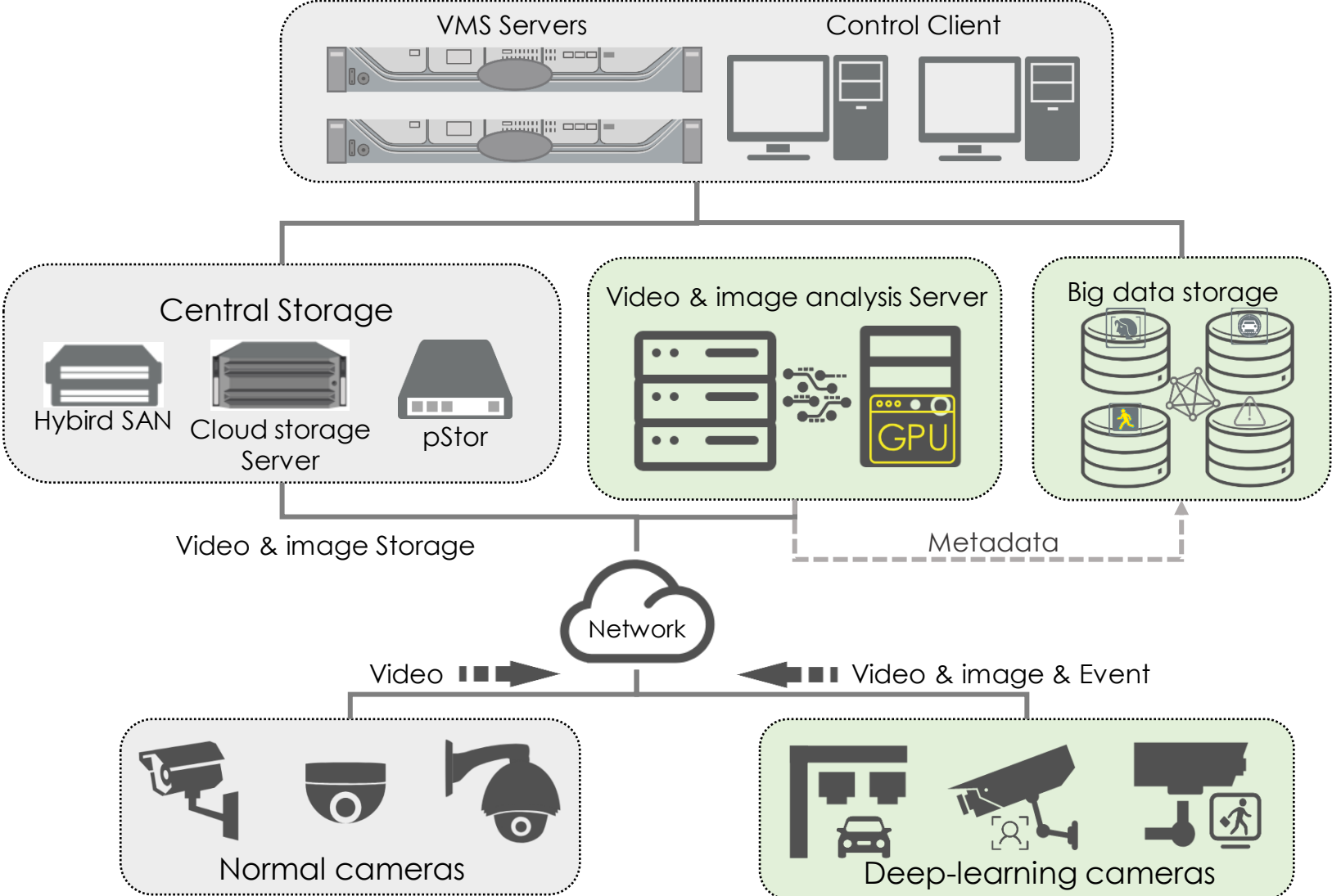
Business Category of phase 2

Vehicle

Vehicle management

- Vehicle application in public security
- Traffic enforcement Application
- Traffic order management

people

People management

- Intelligent Human analysis application
- Incident detection and early warning

Vehicle management-3 Main Businesses

Traffic Enforcement Application

Traffic big data analysis can predict traffic flow in advance to avoid the traffic jam...

Traffic Order management

Traffic big data analysis can predict traffic flow in advance to avoid the traffic jam, effective signal control and guidance…

Vehicle application in public security
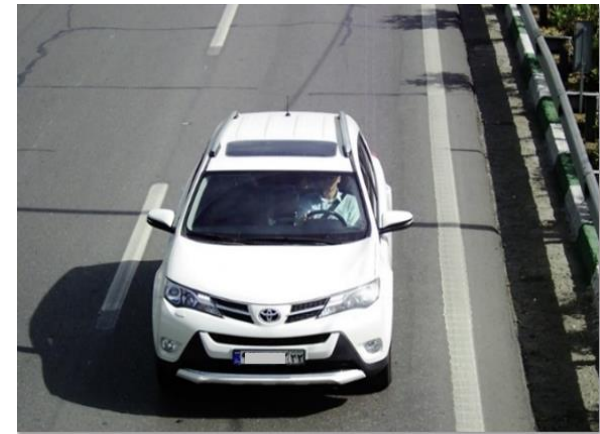
Based on ANPR and feature analysis algorithm to help the police push incident investigation close…

Vehicle Management- Traffic Enforcement

"To keep the City traffic safety and more efficient"

- **Running the red light**
- **Reverse driving**
- **Driving against guidance**
- **Illegal lane line changing**
- **Illegal parking**
- **Over-speed**
- **Unfasten seatbelt**
- …..

Traffic Enforcement- Violation Event Detection by Front-End Analysis

Violation event base on the **front-end detection**

Checkpoint system

Intersection violation system

illegal parking system

Mobile system

Running Red Lights

Dangerous Driving Behavior

Unfasten Seatbelt

Over Speed

illegal Parking

Helmet Detection

Calling while driving

illegal restriction

Personnel overload
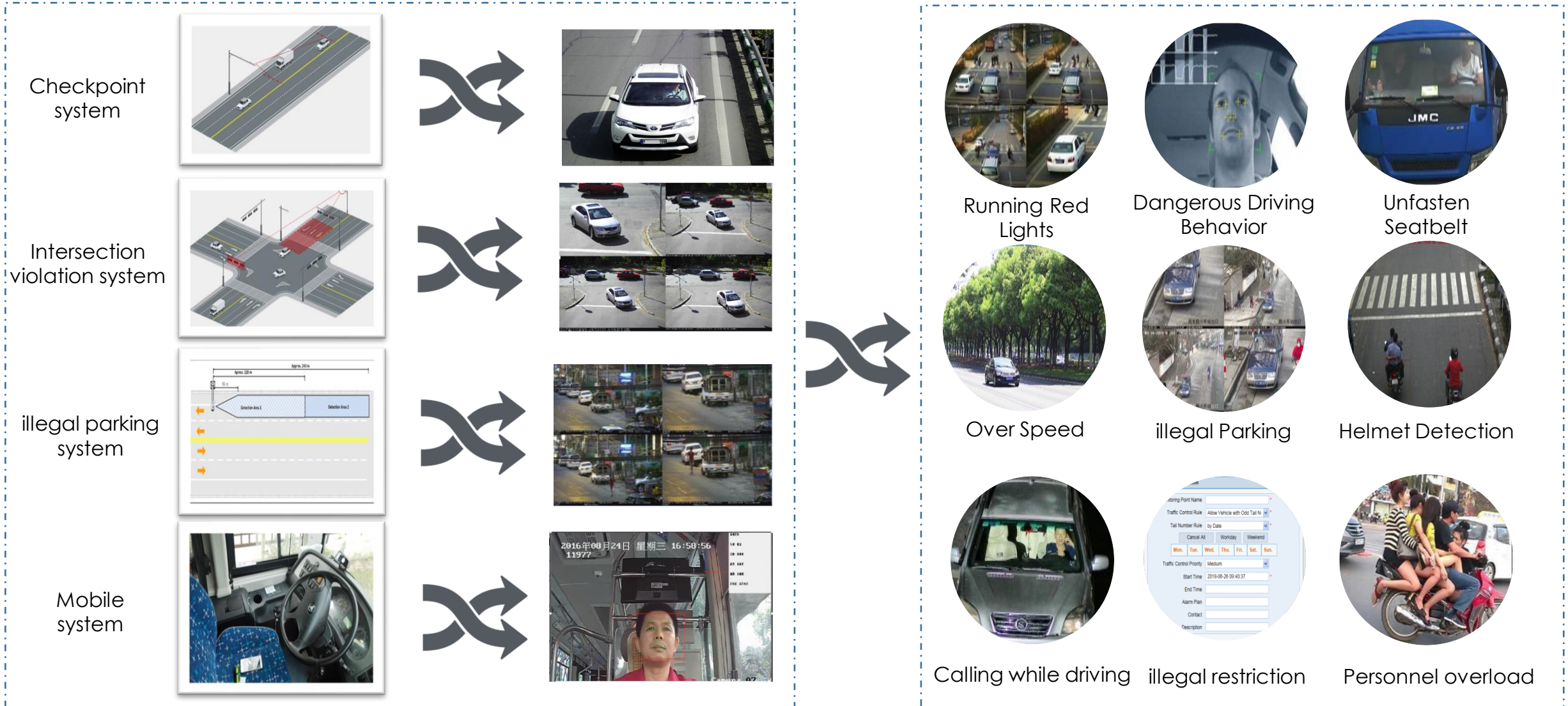
Traffic Enforcement - Violation Event Detection by Secondary Analysis

Central server secondary analysis brings richer vehicle properties and higher accuracy.

Camera analysis

Vehicle Type

Vehicle Color

License plate number
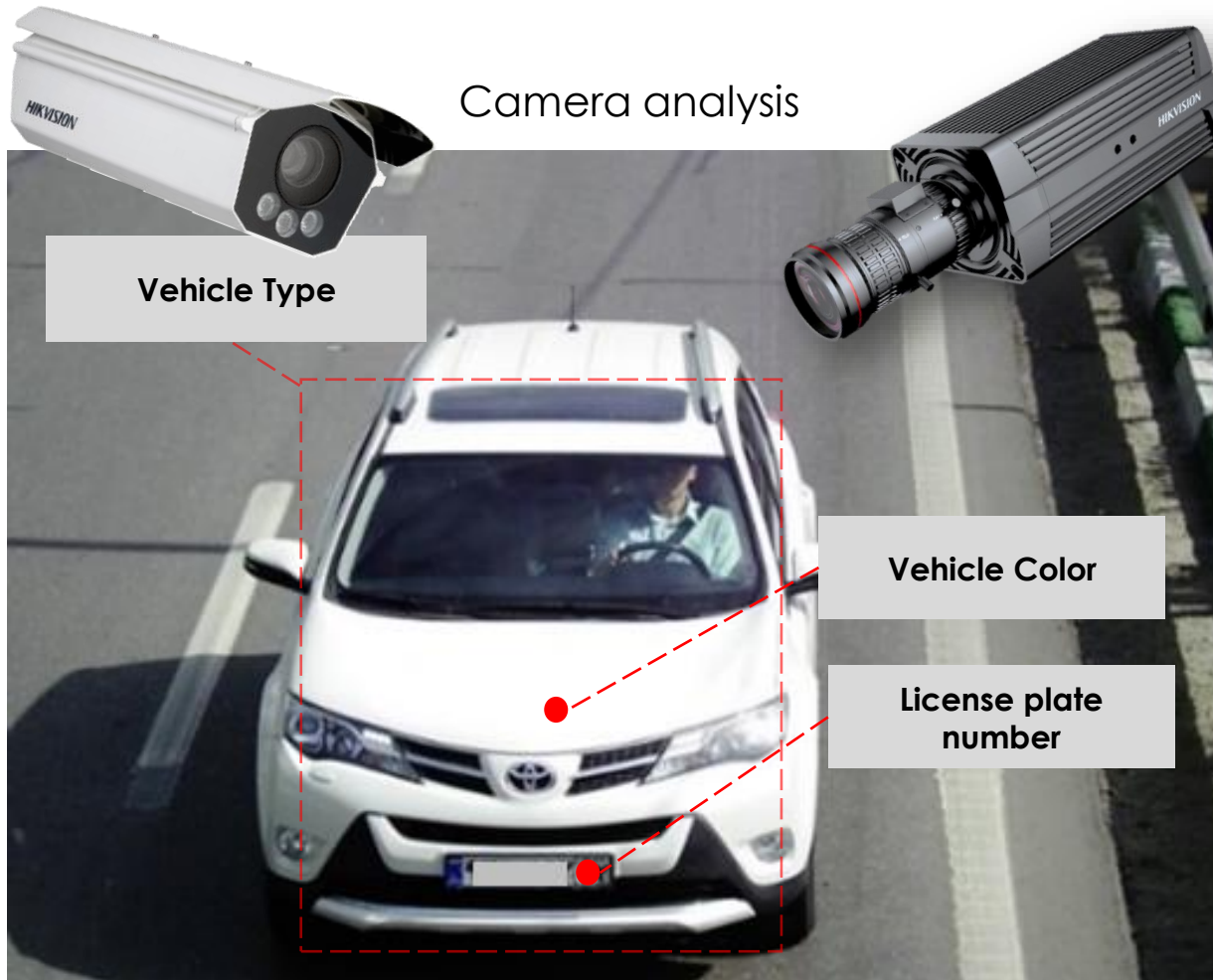
Vehicle analysis server

- LPR
- 9 vehicle colors recognition (white, grey(silver), black, red, purple, blue, yellow, green, brown,)
- 4 kinds of vehicle type recognition: car van truck bus..
- Front vehicle brand recognition: over 65 brands.
- Seatbelt Detection(driver, co-pilot)
- Phone Call Detection

Each accuracy increases up to 5~30%!

Traffic Enforcement-Violation Event Detection by Big data Analysis

More violation events can be detected by big data analysis based on the vehicle structured data

Capture unit

pic

Vehicle analysis server

More character and model

🚗 Vehicle feature

【Plate number】　【Seat-belt】

【Color】　【Phone holding 】

【Vehicle type 】　【Main brand】

Forward /backward feature and model

Big Data server

If the same license plate on the vehicles with different features , the system will judge if this is a duplicated license event as well

Deck vehicle

Base on the big data collision , If the same license plates is detected on the 2 vehicles from 2 areas with the closed timestamp, the system will judge this is a duplicated license event.

Vehicle Management- Traffic Order Management

- Traffic Flow detection and Guidance

- Traffic signal control

- Traffic event detection

Traffic Order Management-Traffic Flow detection and Guidance

Video vehicle detector

1. L: Lane Number
2. F: Traffic Flow, passed vehicle counting
3. M: Vehicle Size
4. V: Vehicle speed, km/h
5. S: traffic status
6. Q: Vehicle Waiting Length
7. C: Virtual loop status
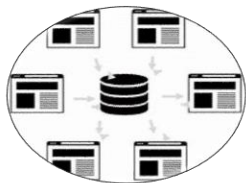
Checkpoint   E- Police   Third-party data

Edge Nodes will collect the traffic information like traffic flow, speed, vehicle features, etc..
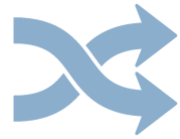
Cloud Center or Edge Domain will analyze info by the traffic big data algorithm and demonstrate the real-time traffic status on the simulation system

Traffic information release system will release the relevant road status on the traffic guidance screen on each intersection to improve the traffic efficiency

Traffic Order Management-Traffic Signal Control

Point

Line

Area
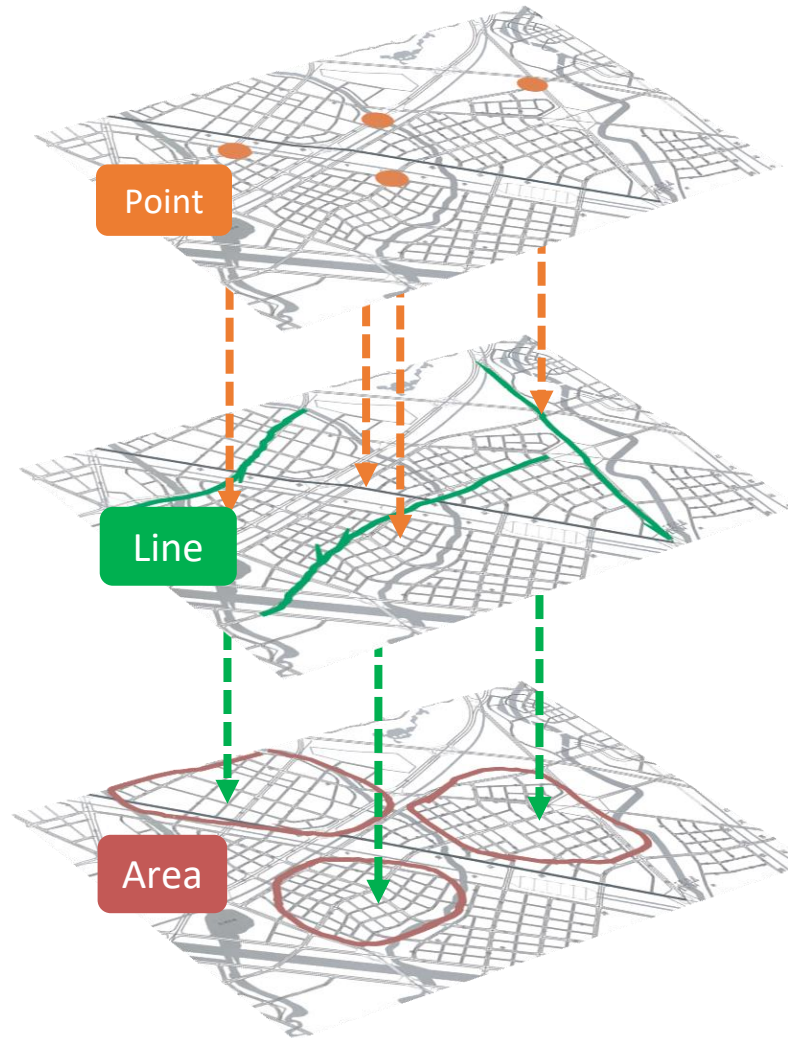
Traffic data of Intersection

Base on the traffic analysis of a single intersection, the system can select corresponding control mode to adapt to instant changes of traffic flow.

Traffic data of Backbone

Base on the traffic analysis of a particular road, the system can coordinate all green lights on a backbone road during peak hour; Or carry out the traffic ban by red lights in advance to relieve the traffic congestion.

Traffic data of Region

Base on the big data analysis of an area, the system can coordinate the whole area to offer the most effective traffic management with the least resources.

Signal Control Device

✓ Using ARM9 series 32bit chip, which can provide strong calculate and communication ability;

✓ Using controllable silicon to control the signal light，keeping the device stable;

✓ Equipped with control and display panel, which can real-time monitor and manually adjust the signal status;

✓ Auto monitor for the status of communication devices and light device, it will alert when problem happens and react automatically;

Traffic Order Management-Traffic Event Detection

The Traffic safety and smooth is always the essential concern of traffic management departments. Based on the video streaming analysis technology, the operator can **predict or early-warning the incident instead of post-search or post-investigation**

- **Incident detection:** Illegal parking, reverse driving, **pedestrian**, driving on the lane line, illegal lane change, **objects dropped down**, **occupy emergency lane, congestion**, flow, roadblock, construction.
- **Traffic parameter Detection:** Vehicle type, lane traffic flow, lane vehicle speed, space headway, time headway, lane time occupancy, lane space occupancy, queue length, lane traffic status, etc.

Traffic Camera

Normal Camera

Traffic Event Detection Server

Traffic Jam Prediction

Reverse driving

Pedestrian Detection

Vehicle Management-Vehicle Application for Public Security

- **Vehicle Search & Statistics**

- **Vehicle Big Data Applications**

Vehicle application-Vehicle Search & Statistics
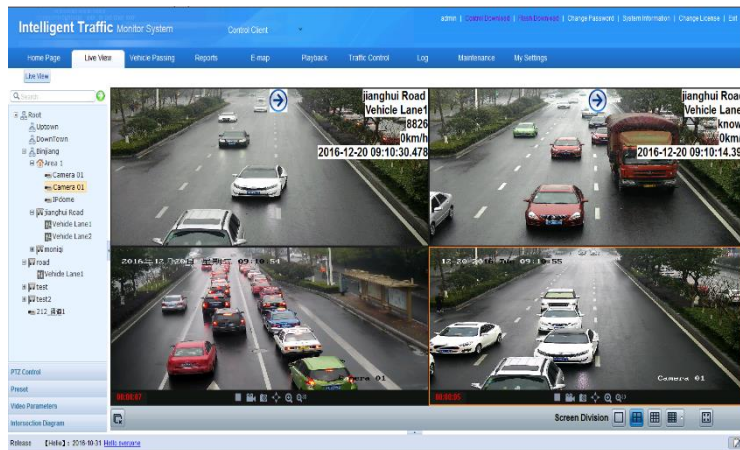
Vehicle Living View/Playback

Vehicle Alarm Pushing
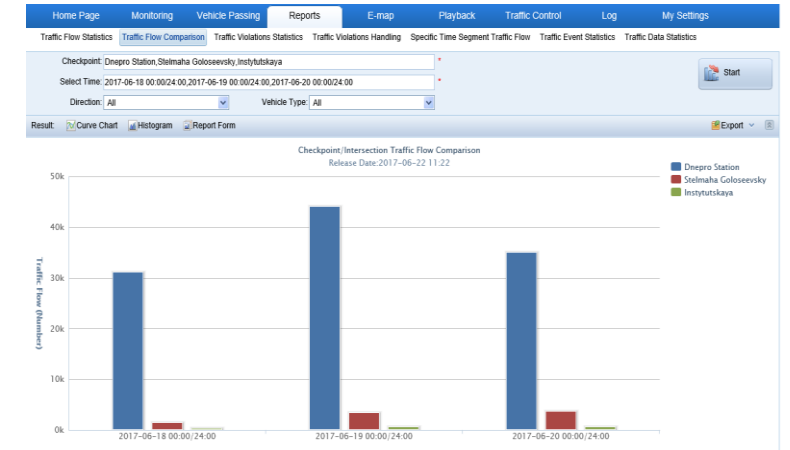
Multi-dimensional Statistics

Real-time Vehicle Passing
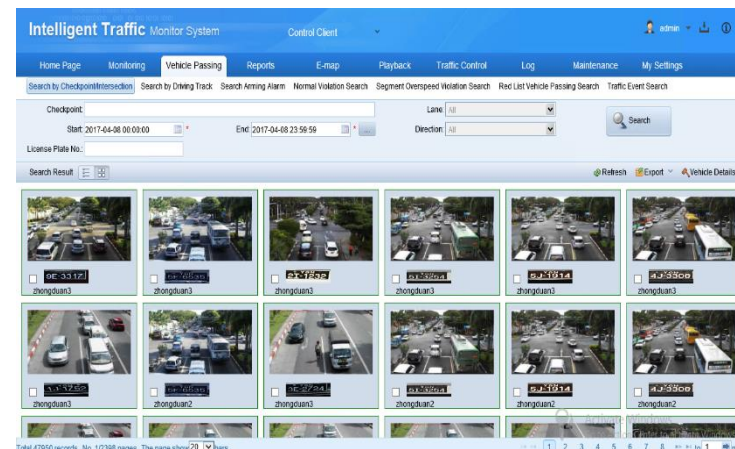
Multi-dimensional Vehicle Search

Vehicle Detail Display

Vehicle application-Big Data Applications

Area collision vehicle analysis

Vehicles driving along analysis

Driving pattern analysis

Vehicle driving direction analysis

Vehicle in special-hour analysis

similar image matching

➤ **Various of vehicle applications based on the intelligent and big data analysis**

Vehicle Application-Vehicle Similar Image Matching
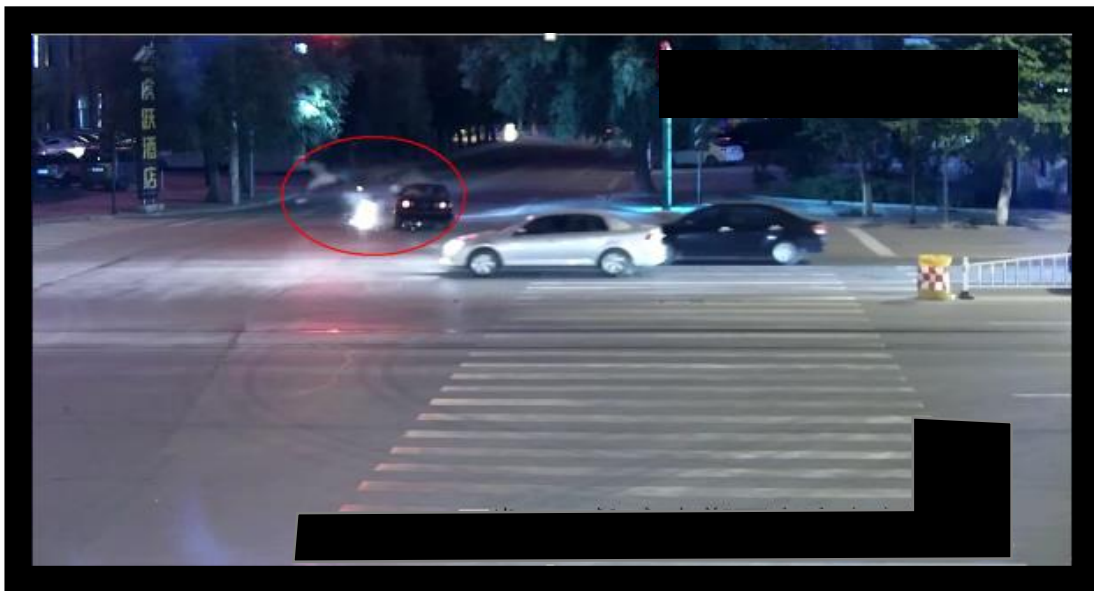
- ✓ Basic passing information
- ✓ Vehicle Color
- ✓ Vehicle type
- ✓ Vehicle Brand
- ✓ Vehicle Features
- ✓ Other Stuff modeling

CD disk shielded Vehicle

Step1:locate the unique features of this vehicle

Step2: Vehicle big data search by this unique feature

Step3: Confirm the historical picture with unblocked license plate of target

Vehicle Application-Driving Pattern Analysis

The historical vehicle data analysis, the operator can get the clear information about the real-time trajectory of the target and prejudge the destination of movement
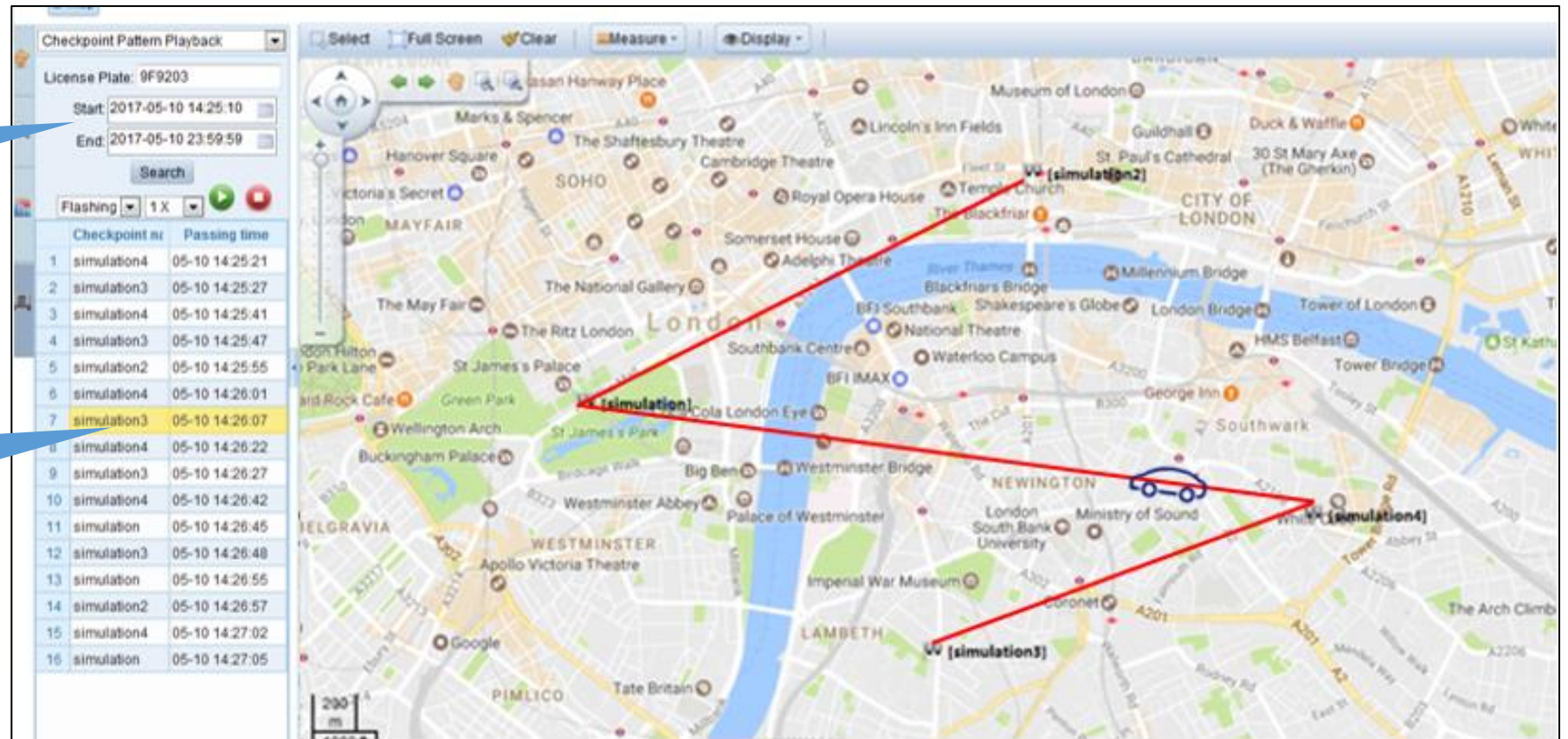
Time + Plate Number

Driving history

Vehicle Application-Area Collision Analysis

Based on the vehicle big data analysis, the operator can define the various of condition combinations (such as time based, area based, time+area based, event-based, time+event based) to search the target so as to significantly improve the efficiency of investigation processing

People management

Human body Feature Analysis	Abnormal behavior Analysis	Human Face recognition	Unexpected events Prediction
Based on the real-time video analysis algorithm to detect and modeling the human body data as the valued information…	By using the deep-learning technology to detect such as sudden running, hover, intrusion…	Combining with the dedicated face camera, to realize the face blacklist arming, similar face image matching…	The people density detection can timely locate some unexpected incident or avoid panic stampede...
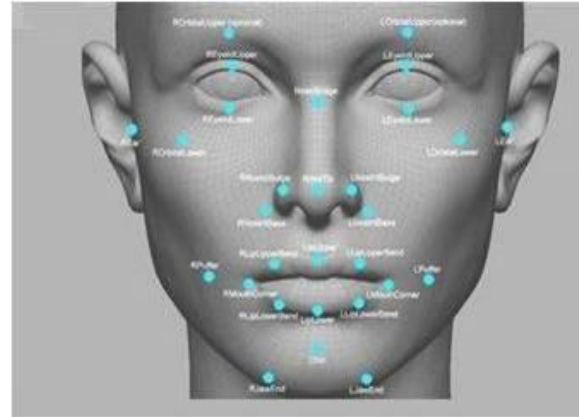
People management-Human body feature and behavior analysis

- High-density GPU chipsets
- Deep-learning technology
- high-performance server

Streaming

Video Analysis Server

"The bridge between original monitoring and intelligent analysis."

Panoramic camera   Traditional camera

Perimeter/Abnormal Behavior detection

Fast moving/Hover around
Region intrusion
Cross the line...

Human body Feature Analysis

Gender   Hair length
Dress color   Glasses or not
Hat or not   Ride or not
Backpack or not ...
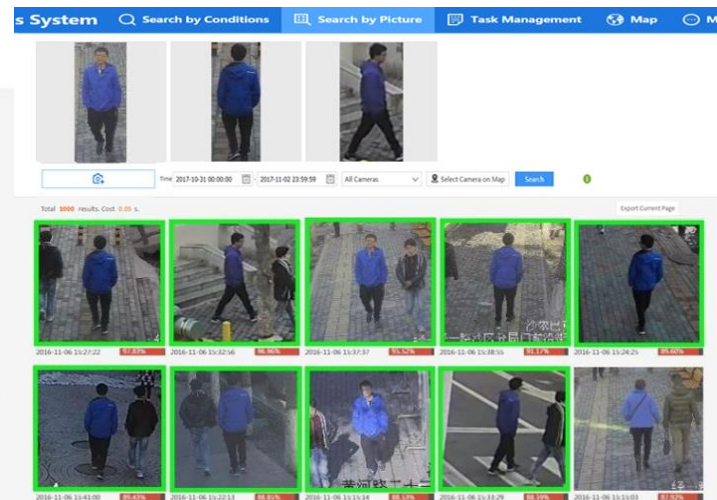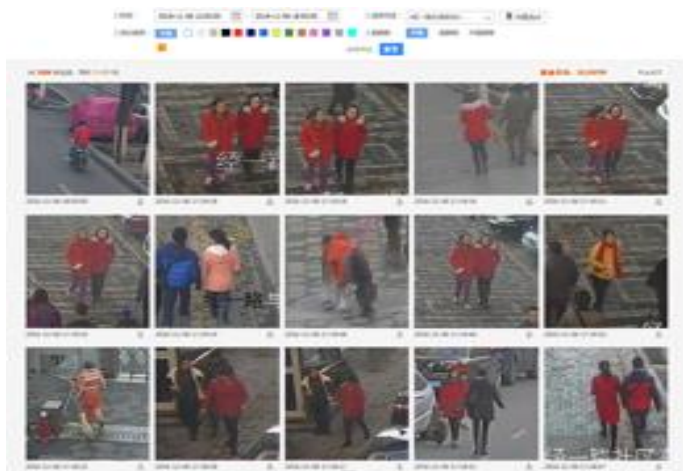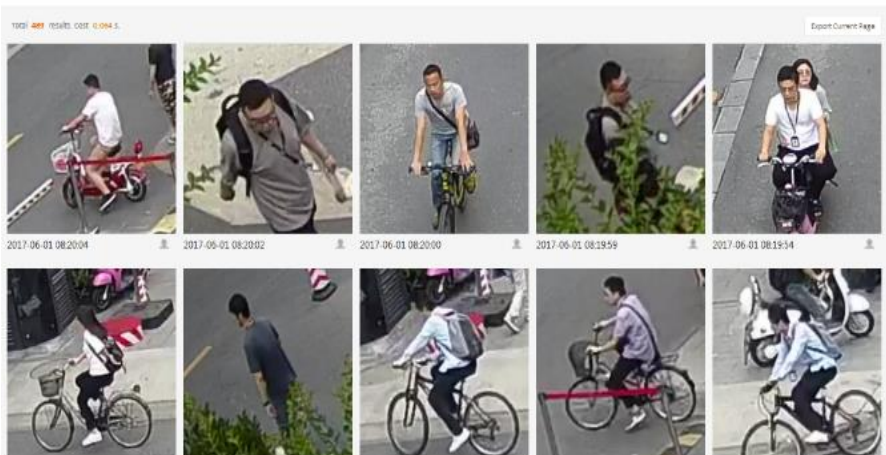
Human body feature analysis- Application Case
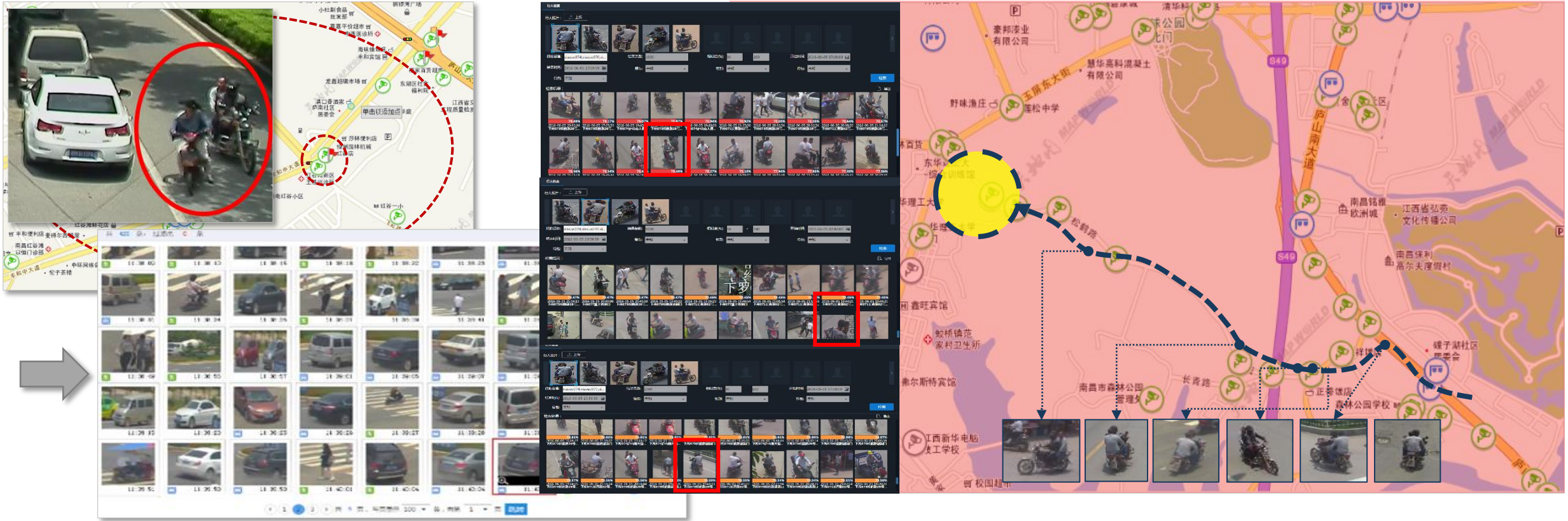
Operation Flow

According to the timestamp and location info, the preliminary image of the suspect are obtained by camera at the crime scene

More images of suspect are obtained by human features search in massive data from surrounding area (Identify the suspect)

Lock up the main area of activity for this suspect by big data search at the wider range area

Activate the arming control on facial recognition edge nodes in the area

Once the suspect occurs, the system can track the suspect and prejudge the destination.

People management-Face Recognition and Application

Face recognition

Face capture camera

Traditional camera

Face image

Video stream
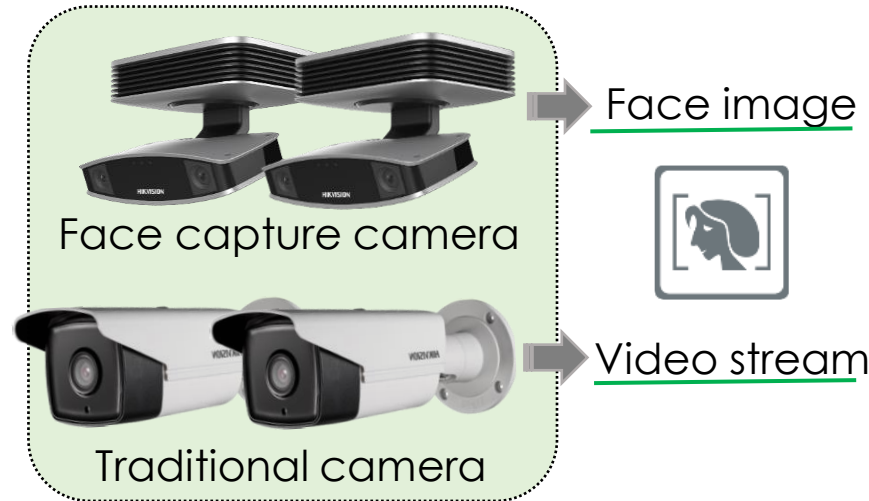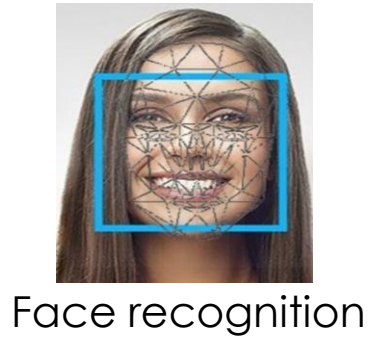
- High-density GPU chipsets
- Deep-learning technology
- Face extraction from video
- Face modeling and recognition
...

Real time face recognition alarm and demonstration

Trail tracking based on Face Recognition

Face Recognition-Application on Mobile APP

Capture face image VS Face library
Get the personal information in time

Searching result

92.99%

Name: Mike
Gender: Male
ID: 100**118
Birth: 1990-01-01
Residence: X city

Mike 92.99% Mike 92.99% Mike 69.91%

Alarm detail

111

Capture Time: 2018-03-05 14:38:02
Capture location: Lobby02

Blacklist arming and auto-alarm pushing
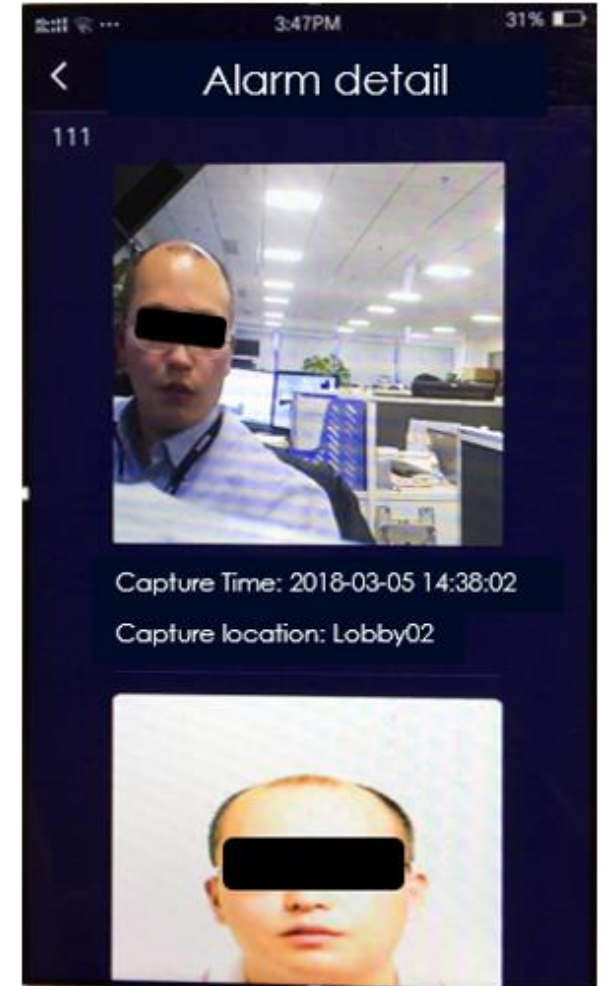
Face Recognition- Application Use Case

In Jan 1st 20XX, an arson attack case was happened in New Valley, X city, the local police found the suspect by watching the surveillance record.
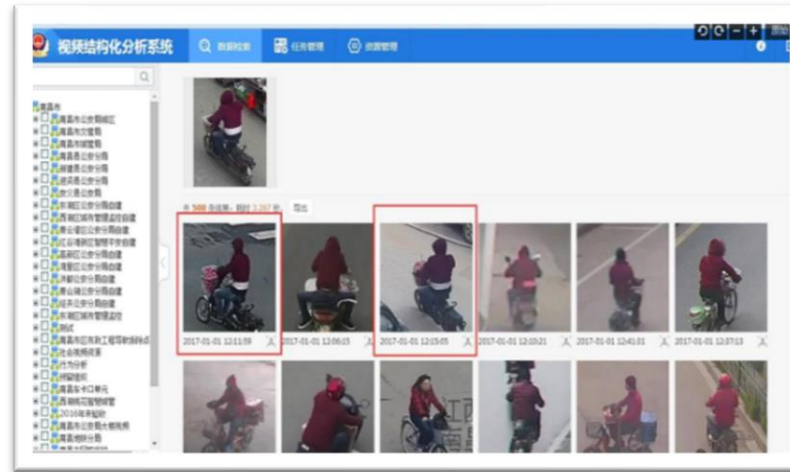
Using the video structural analysis function to found out the track of suspect

Using the face capture camera which by the side of the track to find the clear face image
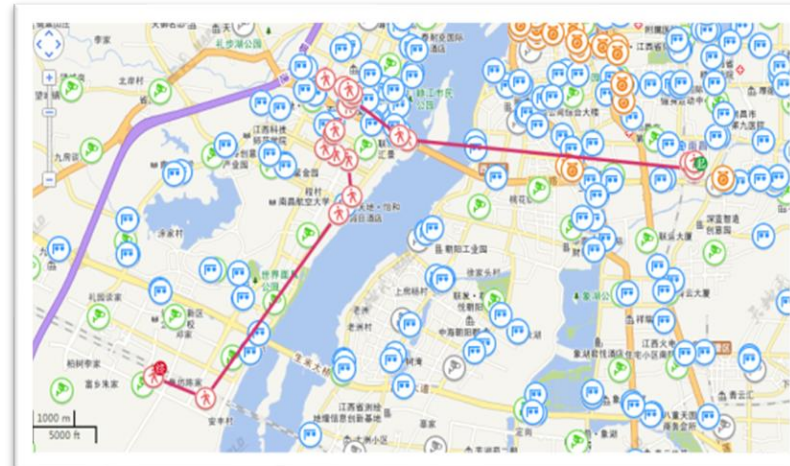
Generate the trajectory of the suspect by system

Face comparison, to identify the suspect from the Face library

People management-Crowd Density Prediction

⚠️ "Establish and improve the emergency plan and people crowded places control counseling programs, to prevent the occurrence of crowded stampede."

Video stream

Video stream

Traditional Camera
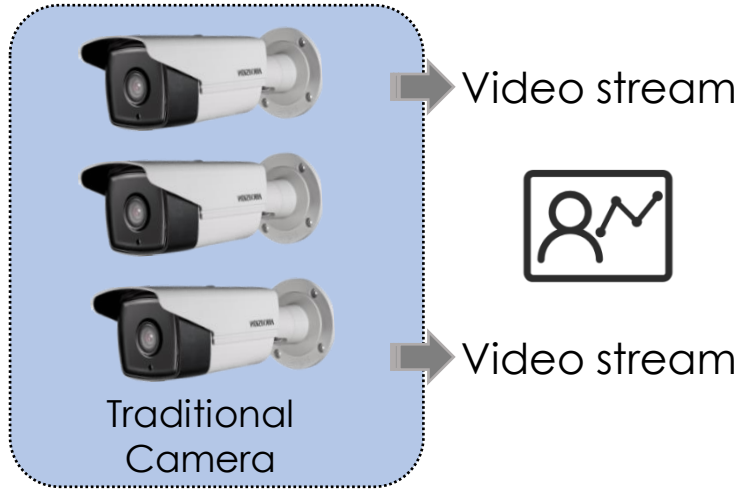
- ✓ High-density GPU chipsets
- ✓ Deep-learning technology
- ✓ Crowd density algorithm
- ✓ Video streaming analysis
...

Crowd Report

Number of People

—○— 120_Camera1

High Level（>3）
Middle Level（2-3）
Low Level（1-2）
Normal（<1）

Month

Time

2017-05-07   2017-05-08   2017-05-09   2017-05-10   2017-05-11   2017-05-12   2017-05-13

D W M   2017-05-12   Search   Export
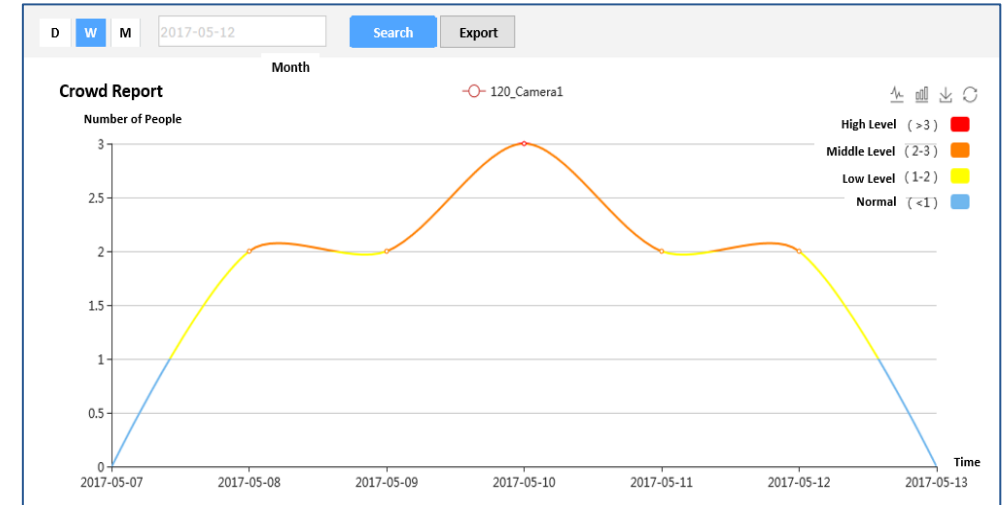
Features and Deep application

- Support 4CIF to 3M pixel streaming analysis.
- Support set the alarm threshold of crowd for different level.
- Support trigger the alarm to VMS client.
- Support display different color of alarm level.
- Multiple type of statistics.
- Support display the Flow, Alarming, history curve and report forms.
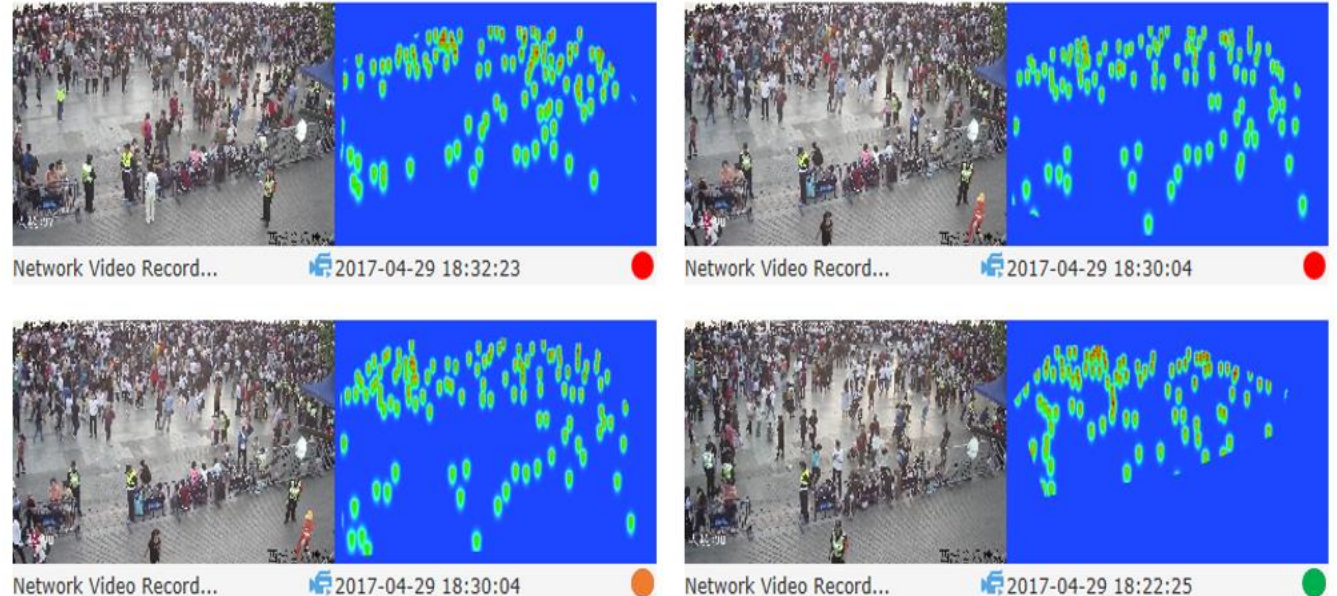
Network Video Record...   2017-04-29 18:32:23

Network Video Record...   2017-04-29 18:30:04

Network Video Record...   2017-04-29 18:30:04

Network Video Record...   2017-04-29 18:22:25

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  Phase 1: City Surveillance

  Phase 2: Intelligent Video Surveillance

  Phase 3: Data Fusion & Hierarchical management

- Case Study

Multi-dimensional Data fusion and association

Along with the increasing of multi-dimensional data collection, using the single category data(such as **Vehicle big data, Human face big data, Human Body features big data**) can not fulfill the complex application needs anymore, therefore how to solve the data isolation problem, how to fuse the different Multidimensional data together, will be the first thing that need to be figured out in safe city construction.

Isolated Business big data

Unified Big Data Pool
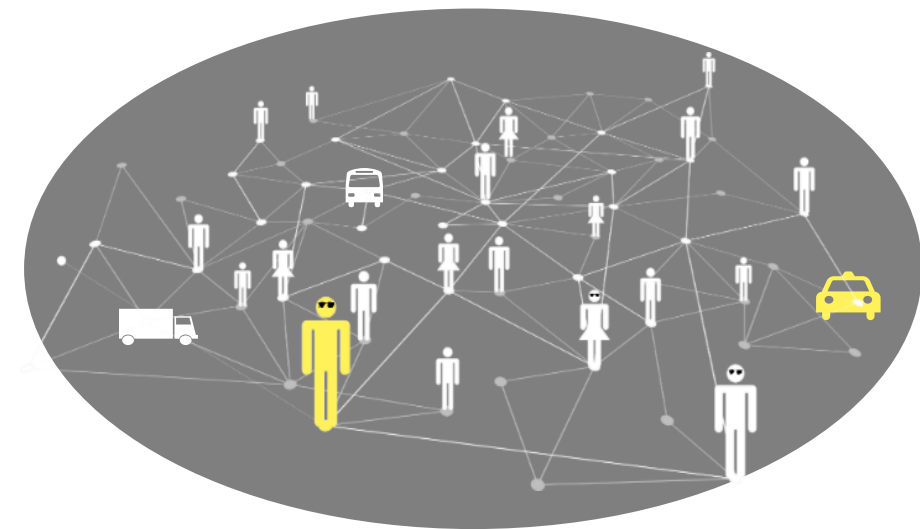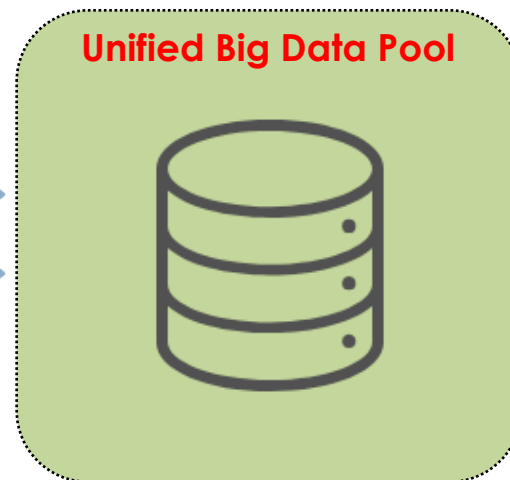
Multi-dimensional Data fusion and association

Data fusion and association-Application Introduction

➤ **Human body and human face** association while the video streaming analysis based on the unified big data pool to realize data fusion analysis.

➤ The identity of the driver by **face recognition associates with the relevant vehicle information** (such as LPR) based on the unified big data pool to realize data fusion analysis. (the original image capture needs the additional supplement light for front-end capture camera)

Input body image for search
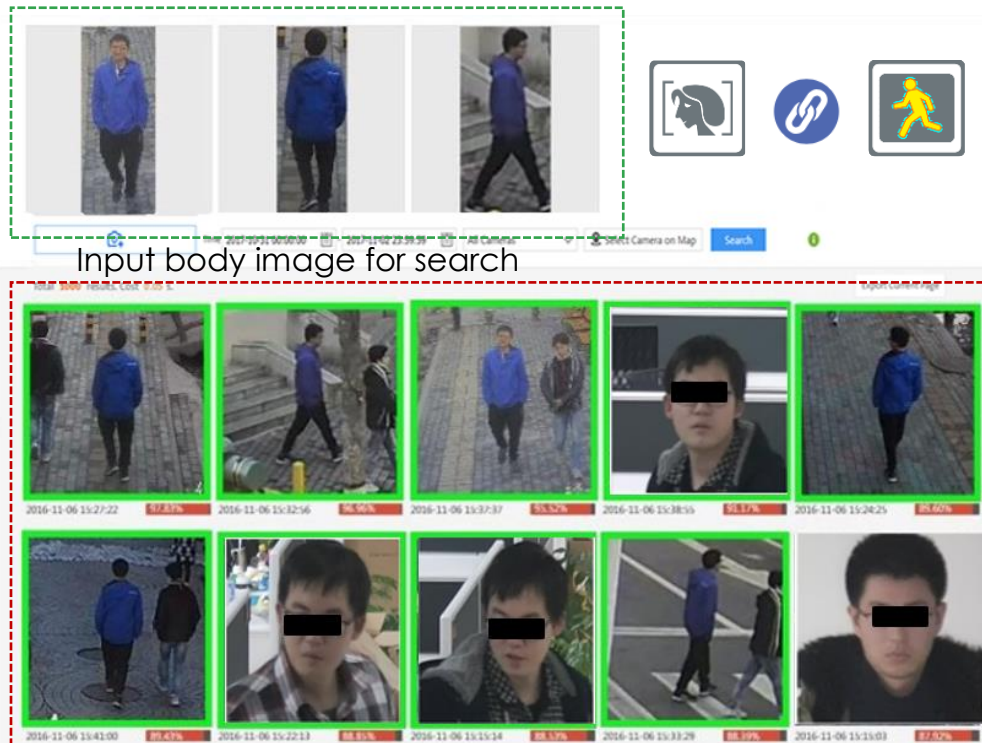
Output the similar body image associating with face image

"Greatly enrich the system application by using multi-dimensional data fusion "

Associated face image

Mike J Male Age:36
76.34%

Charlie Male Age:45
71.98%
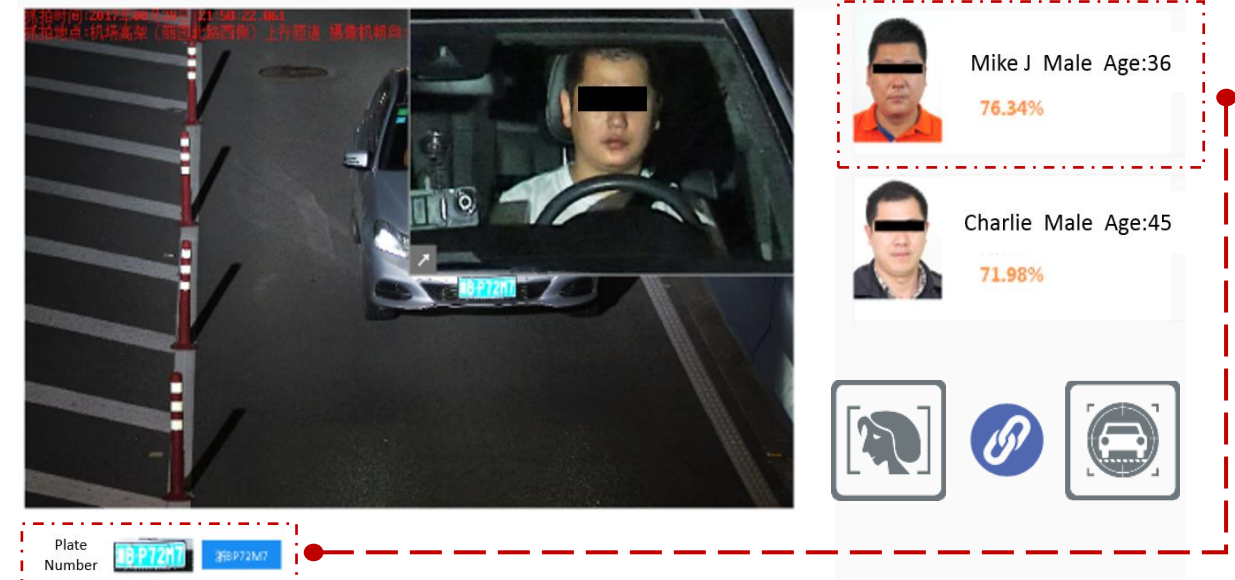
Plate Number

License plate number

Application Introduction-Trail Tracking based on data fusion

Suspect flees from crime scene by car, and the checkpoint captures license plate and system generates the passing trail.

Vehicle

HIK12345

Then suspect ditches the car and walks, the facial checkpoint system associates vehicle with human face together, the passing trail continues

Human Face

Once the suspect is out of facial recognition area, the system gets human body features by video analytics

Video

A comprehensive application based on the big data fusion from multi-data resources like vehicle data,Human face data,Human body feature data together
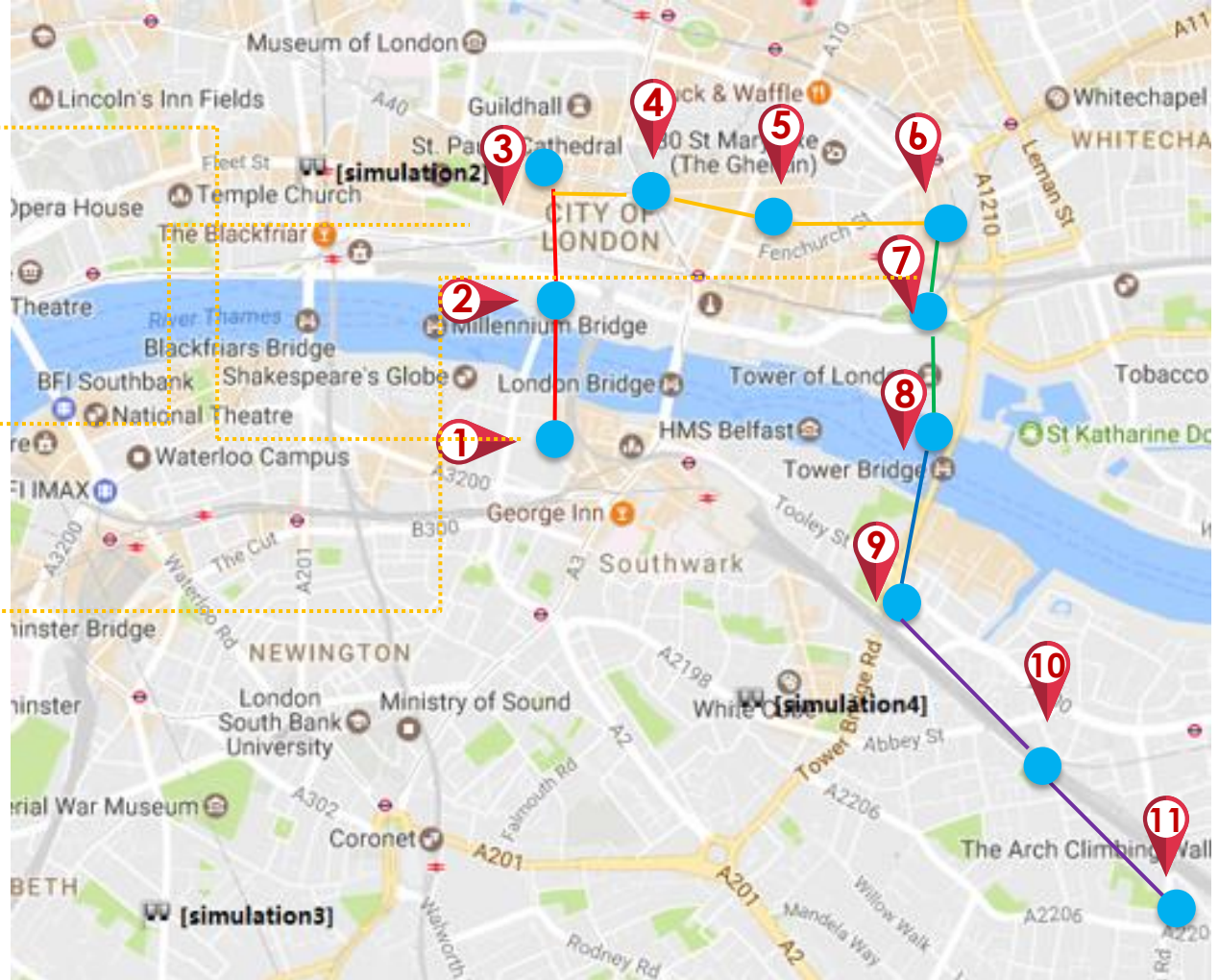
Hierarchical Management

Along with the deepening of safe city construction, the national or upper administrative unit needs hierarchical coordinate and manage all the resource from different cities

Cloud center focuses on multidimensional data fusion & big data analytical application.

- **Business applications** (e.g. Prediction & warning, multidimensional analysis) | response on demand

Edge Domain focuses on data storage, intelligent processing association analysis & rapid response.

- **Business application** (e.g. Trail tracking, command scheduling, etc.) | Timely response

Edge Node focuses on multidimensional data collection and front-end intelligent processing.

- **Business application** (e.g. Facial attendance, personn/vehicle barrier control, etc.) | Real-time response

Data Gathering on Demand

Upper level

Data   Video

Resource sharing

Image/Data

Province/City   Cloud Center

Image/Data

County/District Police Station

Edge Domain

Video/Image/Data

Front-end   Front-end

Edge Node
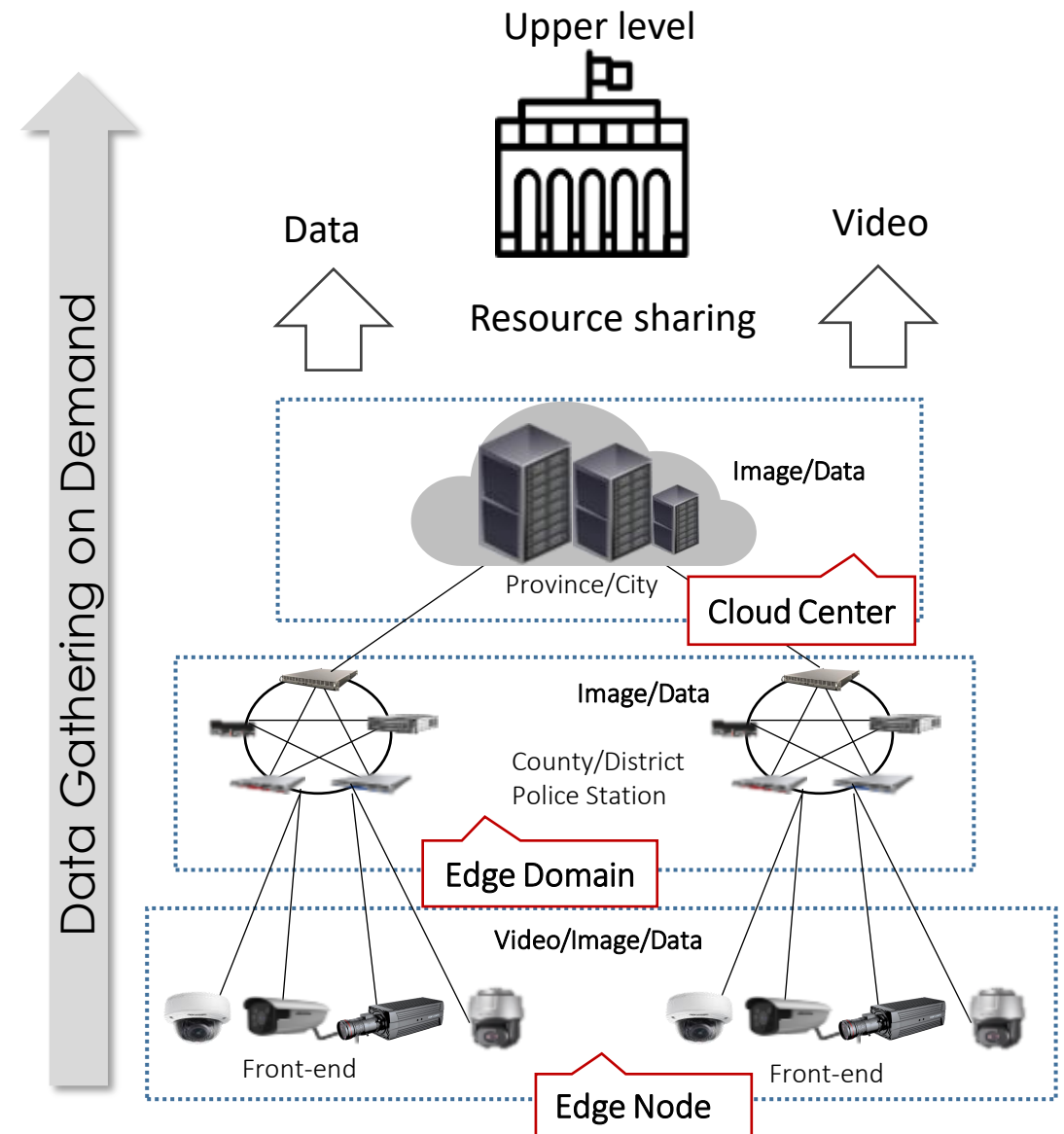
Open Ecosystem for Smart City

Hikvision provides the scalable Safe City solution to fulfill the different development phases of end-users, meanwhile we also provide the complete open ability to supervision for our partners to build the ecosystem together for the **Smart City**

City Brain

Gov. Service

Related Division

Personnel Data

Data of
Operation & Maintenance

Data of
Construction Effect

Business Data

Vehicle Data

Data of
People Flow

Statistics &
Analysis
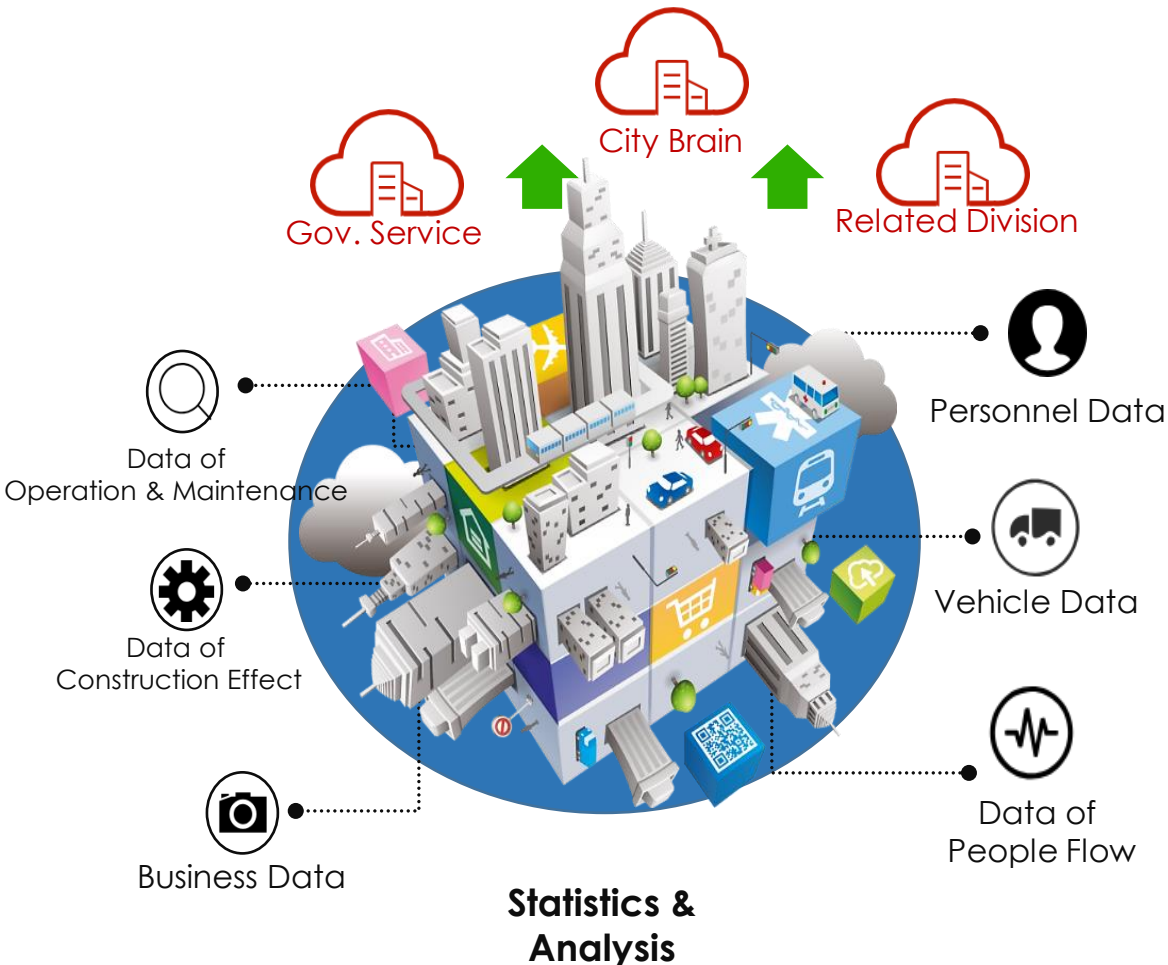
✓ Open Infrastructure(for 3rd-Party HW or System)

✓ Open Application Interface

✓ Open Data Resource

✓ Open Platform Service

✓ Open Video resource

✓ Open 3rd algorithm integration

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Contents

- Solution Background

- Solution Overview

- Solution Design

  Phase 1: City Surveillance

  Phase 2: Intelligent Video Surveillance

  Phase 3: Data Fusion & Hierarchical management

- Case Study

Public Security in China

In the experience of China's safe city construction, new technology can help improve the efficiency of law enforcement, reduce crime rate, and build a safe and stable social environment.

We can see the importance of video monitoring for urban security and social progress via below data.

Crime Rate	Claim Settlement Rate	Police Response Time	Citizen Satisfaction
Average reduce more than **30%**, violent crimes reduce more than **15%**	Promote from **15%** to **60%**, more than **4 times**	Shorten from **10 minutes** to **4.5 minutes**, more than 50% efficiency	Promote from **60.2%** to **98.3%**

Singapore safe city Project

Project Introduction

➢ Singapore safe city project involves more than 100,000 monitoring points and 11,550 NVRs/DVRs for storage around city public key area.

➢ HIKVISION designed the solution that integrated with the existing third-party system, and also integrated massive video or valued data to big data back-end for further application.

➢ HIKVISION designed the system and provided multiple analytic algorithms at the both side of front and back-end, to ensure the massive video information will be fully utilized.

Value of the solution

➢ HIKVISION provided the solution aims to availability, reliability and stability of municipal public security. It contains a series of advanced technologies, with regard to various security subsystems of industries, central operation & integrated security platform so as to respond fast and effectively. All of devices, facilities, software and services involved Safe City would reinforce municipal administration , improve people's lifestyle and boost substantial development in the long run.

G20 Summit Hangzhou security, China

The 11th G20 Summit, which is an most important international summit held in Hangzhou of China in 2016. The requests of security of G20 is highest level in the world. During the summit, HIKVISION acted as a leading role with a series of advanced technologies and integrated security solution, and helped Hangzhou's government and civil police to implement the security tasks successfully. HIKVISION were highly praised by Chinese government after G20 Summit.

G20 Summit Hangzhou security, China

➢ A series of new technologies , such as deep learning and big data ,have been successfully used in G20's safety & security system.

➢ HIKVISION's advanced products (like UAV/PanoVu/face recognition cameras ,etc.) were deployed at related significant area to provide a real-time, integrated security system.

➢ Independent 70000+ video surveillance sites and 4000+ checkpoints which were constructed by domestic police and 30000+ social video surveillance cameras were completely integrated on HIKVISION's iVMS platform in 2016.

➢ HIKVISION upgraded six sets video security systems of police branches in Hangzhou.

➢ HIKVISION assigned 200+ engineers supported on site for 18 months during the G20 Summit's preparation to guarantee the overall system properly.
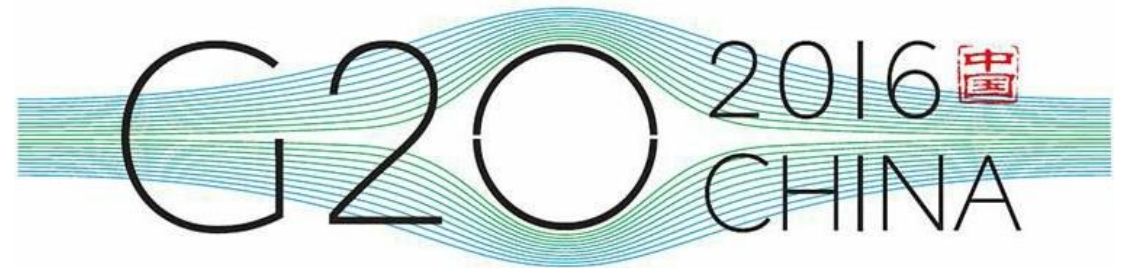
Yangon ITS Project, Myanmar

Challenges:

◆ Reduce traffic congestion situation in Yangon

◆ Reduce non-compliance with traffic rules，especially for running red lights

◆ Traffic accident growth, responsibility is vague

◆ Criminals escape in vehicle, couldn't be traced in time

Solution Highlights:

◆ Deployed 154 adaptive networked signal control system

◆ 380 traffic surveillance sites, Built-in ANPR algorithm and traffic data collection 60 Road monitoring Ultra-low Light Smart PTZ Cameras, 40 Video Vehicle detectors

◆ 50 Intersection violations detection sites, cover 800 vehicle lanes

◆ 40 Radar over-speed Checkpoints, cover 160 vehicle lanes

◆ 30 Road violations (illegal parking) detection sites

◆ 30 LED traffic guidance screen

◆ Construction of command and control center, Including cloud storage, traffic big data, IVMS

Yangon Myanmar introduction
Location: The former capital and largest city of Myanmar
Area: 598.75 square kilometers.
Population: 4.4M

DICTCS Area
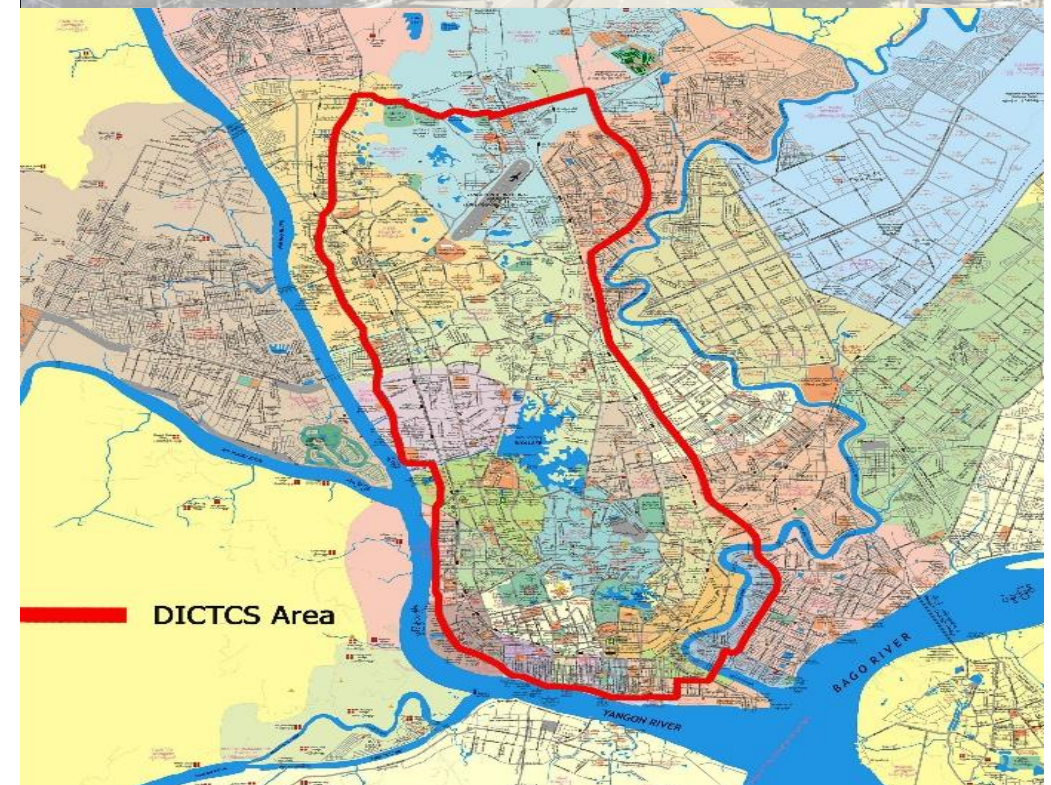
Yangon ITS Project, Myanmar

Benefits:

◆ 6PB or more video/image mixed cloud storage，2500 lanes or more， huge data volume.

◆ Integration of data collection, traffic signal control, public information & dissemination system, reduce traffic congestion.

◆ Combined with traffic surveillance, over-speed Checkpoints, intersection violations and road violations detection system, punish traffic violations and crack down on criminals.

◆ Integration of all video resources, construction standard traffic management command center platform.

◆ Combined with the traffic control management, to meet the demand of command and dispatch.

↓ Yangon ITS Project effect was reported in 2017 by CGTN(China Global Television Network) , which is the biggest China international media organization.

CGTN   ► LIVE | More
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China helps Yangon to ease its traffic congestion

Updated 2017-11-18 19:47 GMT+8

By Zhang Nini

Myanmar's economic reforms have been a boon for many. Among the 10 fastest growing economies in 2017, the country's rapid development leads to another set of rising figures: The number of cars on the country's roads, which has almost doubled since the

New traffic signal project in place to regulate Yangon traffic./CGTN Photo

With years of experience in harnessing its own traffic, China's new traffic command center has been put into full operation in Yangon. It's the first time a Chinese traffic signal project has been constructed in a foreign country.

24/7 high-resolution cameras capture road conditions and stream them back to the command center for analysis. Monitoring traffic at 154 different intersections, the traffic command center will make good use of information and come up with integrated traffic solutions.

MANY THANKS !

HIKVISION is Your Partner in Success!