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Economic Cooperation

Advancing  
Free Trade for Asia-Pacific  
Prosperity

# Chinese Taipei's ITS Plan and Connected Motorcycle

22 04 2018 – Seoul, Korea

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Presented by  
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# Agenda



- Chinese Taipei ITS Plan
- Connected Motorcycle
- Open Field Test

# Three major transport problems

High traffic-  
related injuries  
and deaths

Annual cost US\$ 16 billion  
About 3% of GDP



Recurrent road  
congestion in  
main corridors

Taipei-Yilan corridor in  
Northern Area of Chinese  
Taipei



Insufficient public  
transport service  
in rural areas

Transport disadvantage  
cause social exclusion



# Opportunities



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- Internet of Things
- Sharing Economy

## ICT Industries

- **over 80% ICT service** penetration rate & Internet usage rate

Household  
Computer Adoption



88.4%

Household  
Internet Adoption



84.8%

Household  
Broadband Adoption



81.6%

Smartphone  
Adoption



65.4%

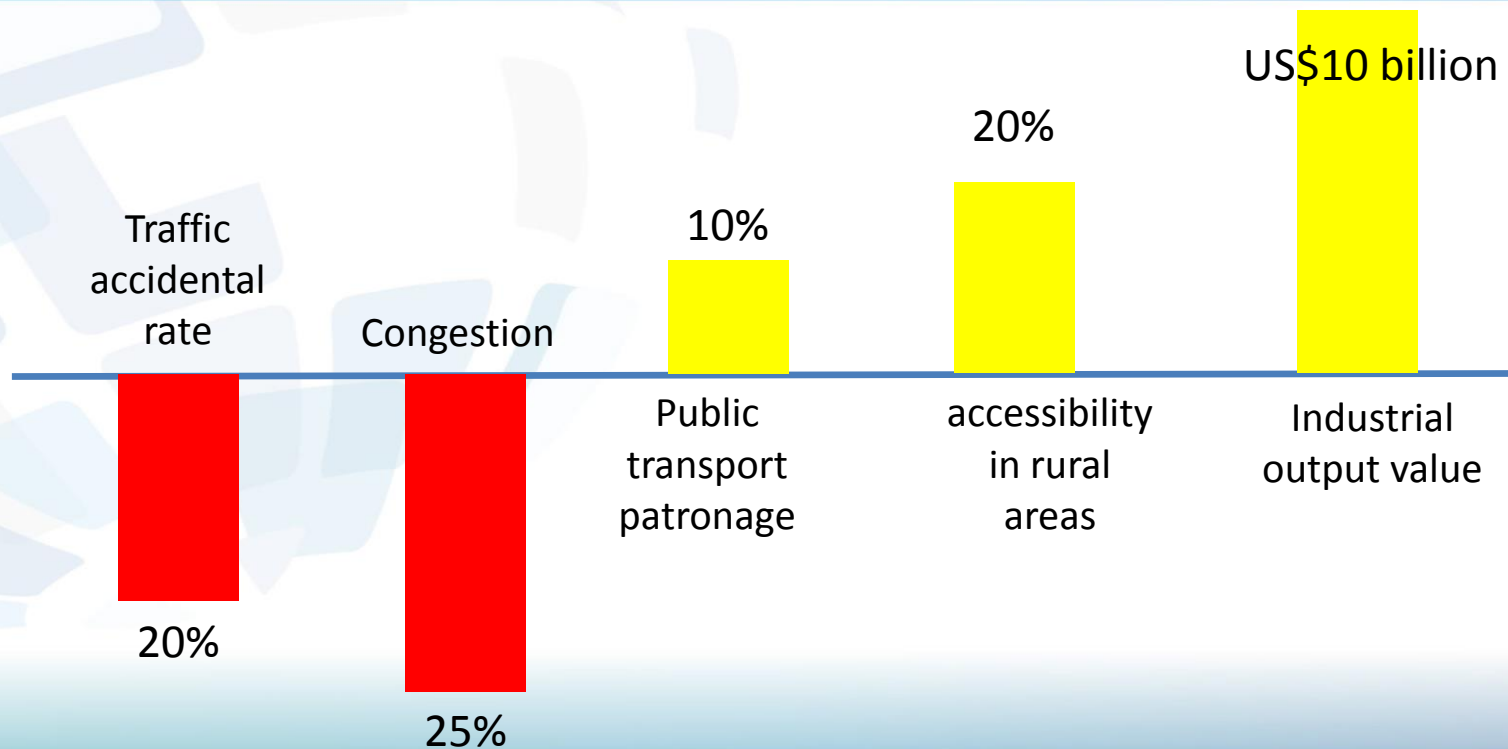
- ICT hardware market share ranks **World No. 1**



## **5 S- Safe, Smooth, Seamless, Sharing, Sustainable**

- About US\$100 million new budget will invest in ITS development between 2017-2020
  - Smart Traffic Safety Program
  - Smart Integrated Corridor Management Program
  - Rural Area ITS Application
  - MaaS (Mobility as a Service)
  - Connected vehicles and automated vehicles
  - ITS R&D

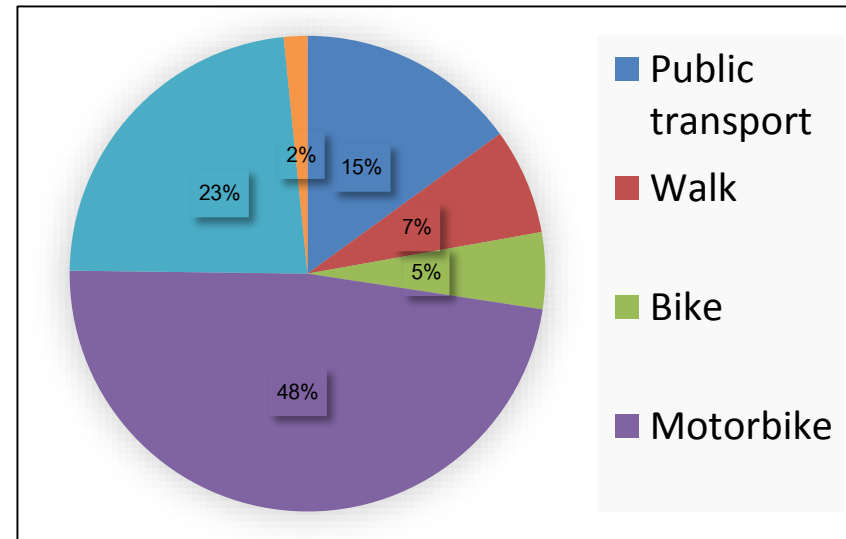
# Key Performance Index (2020)



# Motorcycle in Chinese Taipei traffic composition

- Motorcycle traffic composition has 40%-70%
- On the corridor to suburban, traffic composition of motorcycle is to 80% during peak hour

Modal split in Chinese Taipei (2015)



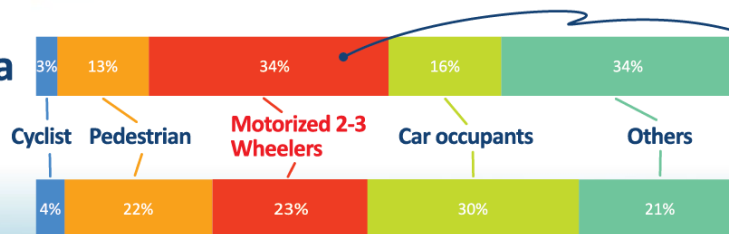
## Motorcycle ownership top 1 to 5 over the world (2013)

Owned (thousands people)



## Road traffic deaths by type of road users

South-East Asia



World

The road deaths proportion of **Motorized 2-3 wheelers** in *South- East Asia* is more than the average of the world.

Source: WHO(2015) Global Status Report on Road Safety

# Existing Situation of Segregated Traffic



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- Segregated Traffic concept to substitute for mixed flow concept, more than 15 years
- Segregated Traffic Countermeasures dominate the street layout design in Chinese Taipei
- Segregated Traffic measures is now involved into traffic law and traffic regulation devices guideline



Canon EOS 400D DIGITAL FS.0 1/400s ISO1600 Photo By E.B.C.



# Accident Type of Motorcycle



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Type	Vehicle-Vehicle Side-swipe	Vehicle-Vehicle Others	Vehicle-Vehicle Back-up	Vehicle-Vehicle Rear end	Vehicle-Vehicle Other angled	Vehicle-Vehicle Right-angle	Vehicle-Vehicle Head-on sideswipe	Vehicle-Vehicle Head-on	Out of control	Vehicle-Pedestrian	Total
Fatal accident	0.22%	0.35%	0.12%	0.15%	0.22%	0.30%	0.16%	1.00%	0.68%	0.53%	0.30%
	35	107	2	23	122	45	5	14	91	19	463
Injured accident	91.62%	89.91%	60.61%	86.71%	92.92%	94.51%	89.26%	90.40%	97.78%	98.29%	91.85%
	14,301	27,361	997	13,012	51,654	14,142	2,866	1,271	13,021	3,498	142,123
Property damage accident	8.16%	9.74%	39.27%	13.13%	6.86%	5.19%	10.59%	8.61%	1.53%	1.18%	7.86%
	1,273	2,965	646	1,971	3,816	777	340	121	204	42	12,155
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
	15,609	30,433	1,645	15,006	53,592	14,964	3,211	1,406	13,316	3,559	154,741

Vehicle-Vehicle Other angled is the most

# Smart Motorcycle Research

	<b>Safety</b>	<ul style="list-style-type: none"><li>• Two-wheeler and Pedestrian road safety assistance device</li><li>• Emergency and disaster response technology</li></ul>
	<b>Health</b>	<ul style="list-style-type: none"><li>• Connect V2X device with wearable device</li><li>• Record weather, air condition, UV... to make sure the riding is good for health.</li></ul>
	<b>Social Network</b>	<ul style="list-style-type: none"><li>• Share the riding experience (road condition, route, weather, air condition, UV... )</li><li>• Online real-time video stream transmission</li></ul>
	<b>Big Data</b>	<ul style="list-style-type: none"><li>• Vehicle, Road, People, Cloud Integration</li><li>• IoV expert system and UBI</li><li>• Local Dynamic Map</li></ul>
	<b>Security</b>	<ul style="list-style-type: none"><li>• eLock system for rental or sharing economy</li><li>• Vehicle Security Gateway</li></ul>

# Smart Motorcycle Research



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- Rider assistance and position
- V2X/ IoV
- Riding record
- eLock system

- ADAS (radar, camera...)
- Road conditions sensing and sharing

- Energy management
- Equipment monitoring



# Rider's Behavior Analysis



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## Sensor Log

### Gyroscope

not available

### Linear acceleration

$$a_x = -0.04 \text{ m}\cdot\text{s}^{-2}$$

$$a_y = 0.00 \text{ m}\cdot\text{s}^{-2}$$

$$a_z = 0.03 \text{ m}\cdot\text{s}^{-2}$$

$$|a| = 0.05 \text{ m}\cdot\text{s}^{-2}$$

### Rotation vector

$$\phi_x = -0.01$$

$$\phi_y = 0.01$$

$$\phi_z = 0.93$$

$$\Phi = 0.93$$

## Position

### Magnetic field

$$B_x = 26.7 \mu\text{T}$$

$$B_y = -29.2 \mu\text{T}$$

$$B_z = -18.1 \mu\text{T}$$

$$|B| = 43.5 \mu\text{T}$$

### Orientation

$$\alpha = -0.2^\circ$$

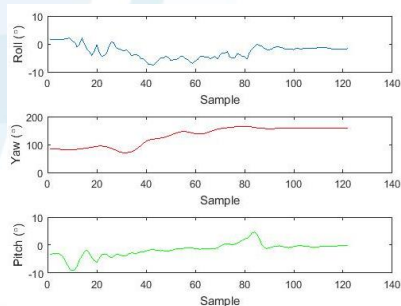
$$\beta = -0.7^\circ$$

$$\gamma = 222.7^\circ$$

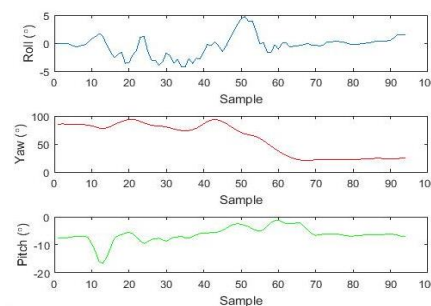
### Proximity

Log

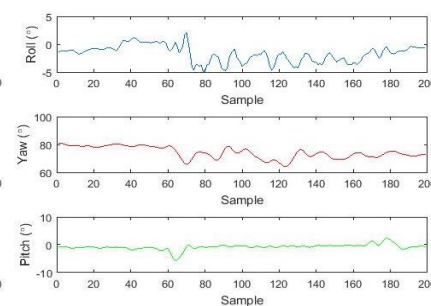
關閉



Right Turn



Left Turn



Base Line

# DSRC Based V2V Solution



## Message Set includes:

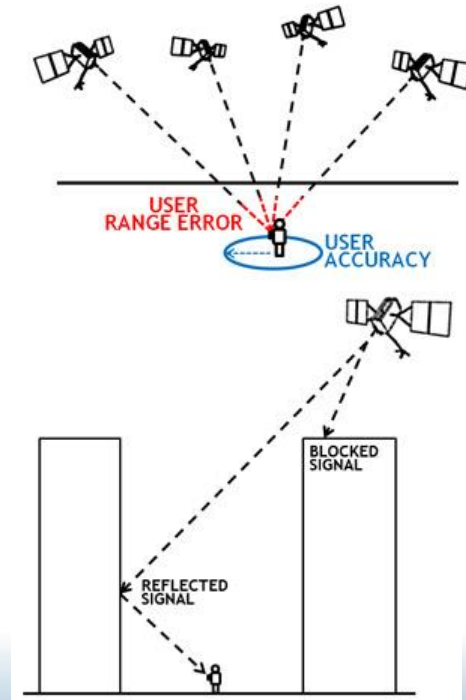
- Position:
  - Latitude
  - Longitude
  - Elevation
- **Transmission**
- Speed
- Heading
- **Steering Wheel Angle**
  - **Lean Angle**
- Acceleration
- Brake System Status
- Vehicle Size

# GPS Accuracy Problem



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- For example, GPS-enabled smartphones are typically accurate to within a 4.9 m (16 ft.) radius under open sky.
- However, their accuracy worsens near buildings, bridges, and trees.
- Too expensive for Real-Time Kinematic (RTK) solutions.



Source: *Official U.S. government information about the Global Positioning System (GPS) and related topics*

<http://www.gps.gov/systems/gps/performance/accuracy/>

# Size of Motorcycle and Scooter

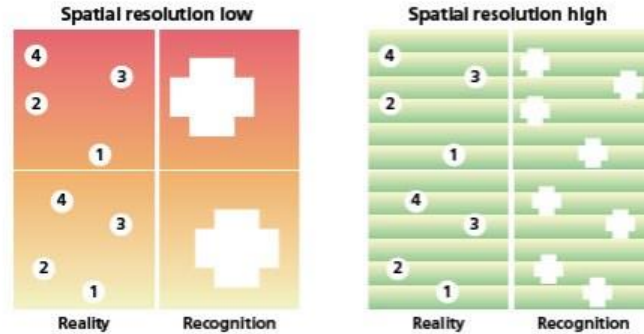


**Powered Motorcycle:** 2210 x 820 x 1060 (Harley-Davidson® Forty-Eight®)



**Scooter:** 1800 x 700 x 1095 (mm) (SYM Z1)

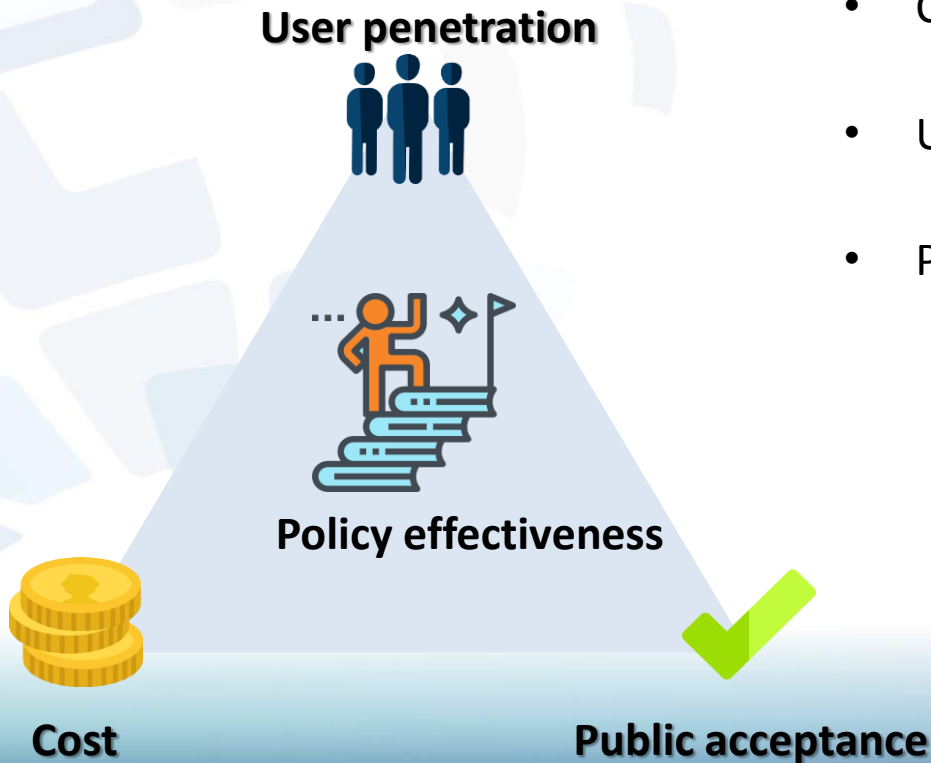
- Hardly to be detected by Radar
- Smaller than GPS accuracy (4.9m)



Source: International Telecommunication Union



# Issues



- Cost
  - Infrastructure Cost
- User penetration
  - OBU Price (target: 5% of scooter price)
- Public acceptance
  - GPS accuracy
  - Coverage of infrastructure
  - Accuracy of alert message
  - Human machine interface

# RFID



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- In 2015, Aarhus, Denmark's second largest city, is currently running a trial where cyclists are given RFID tags that they attach to their wheels.
- The RFID receiver currently operating within Aarhus. It's effect on bike traffic will be evaluated before the technology is expanded to new cities.



Source: GRINDTV

<http://www.grindtv.com/bike/cyclists-denmark-can-now-turn-traffic-lights-red-green/>

# RFID Test in NKFUST



- RFID include:
  - Bi-directional communication
  - GPS
  - GYRO sensor
- Scenario
  - No signal intersection
  - Speeding warning
- Target
  - Cost per unit less than USD 50
  - Cost per intersection lower than USD 200,000 (include 10GHz or 24GHz radar)

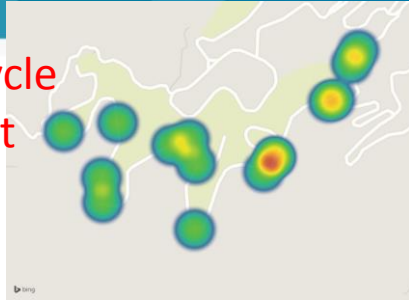
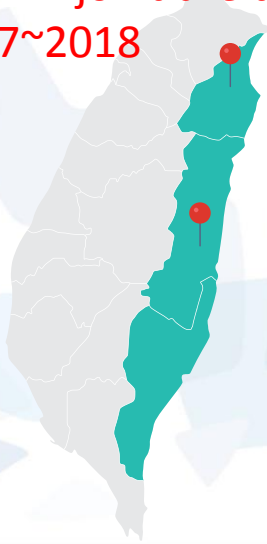
# Open Field Test in East Area of Chinese Taipei



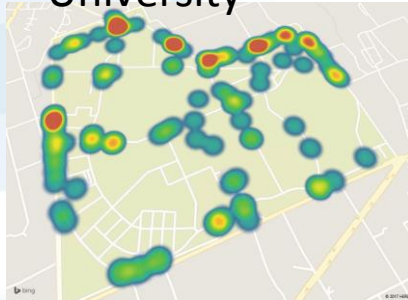
- **Telematics Industry Association**
- **Institute for Information Industry**
- **National Taiwan University**
- **CECI**
- **Alpha Network**
- **Dimension Data**
- **ensoul**
- **Panasonic**
- **Sunsky international**
- **Sponsored by Ministry of Transportation and Communications**

# Diagnosis

About 10,000 motorcycle  
riders will join the test  
In 2017~2018



Fo Guang  
University



National Dong Hwa  
University

- Yilan County
  - Fo Guang University
  - Tamkang University (Lanyang Campus)
- Hualien County
  - National Dong Hwa University
- Work Items:
  - Accident hot spot analysis
  - Intersection improvement

# Solution



on

## Roadside Smart Pillar

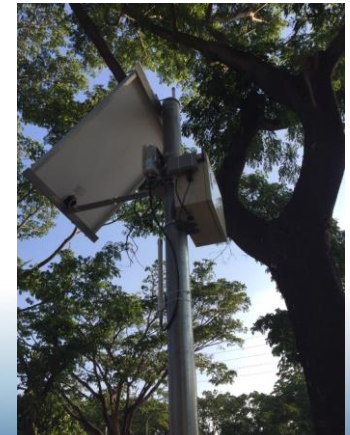
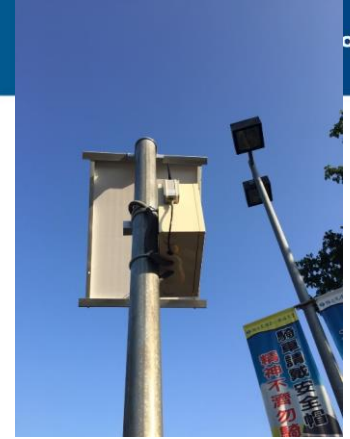
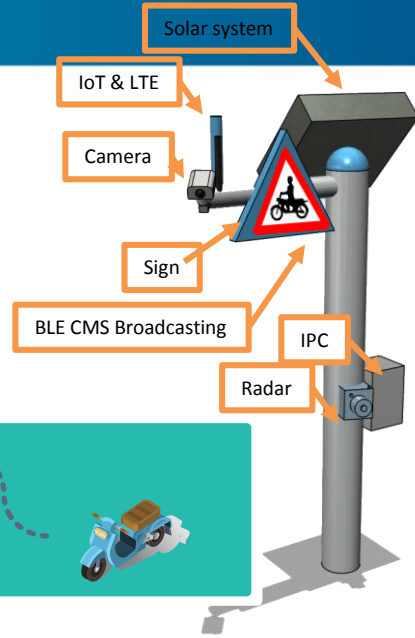
- Sensor fusion technology to detect motorcycle behavior.
- Use Edge computing to estimate the dangerous case.
- Report traffic condition to cloud for traffic management.

## On Motorcycle

- Use sensor and active RFID to broadcast the position.

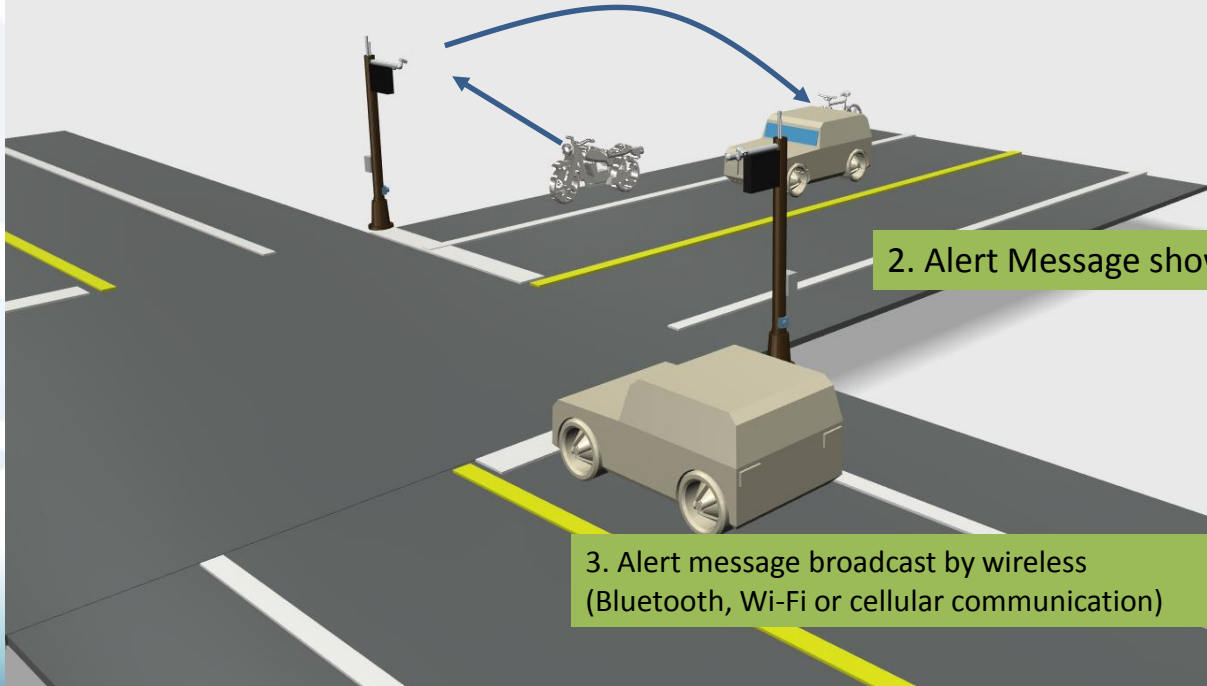
## On Car

- Receive the advise from roadside smart pillar and V2X information by WiFi.



# Work Flow

1. Roadside Smart Pillar detect incoming vehicle (car or two-wheelers) by 10GHz or 24GHz radar or active RFID

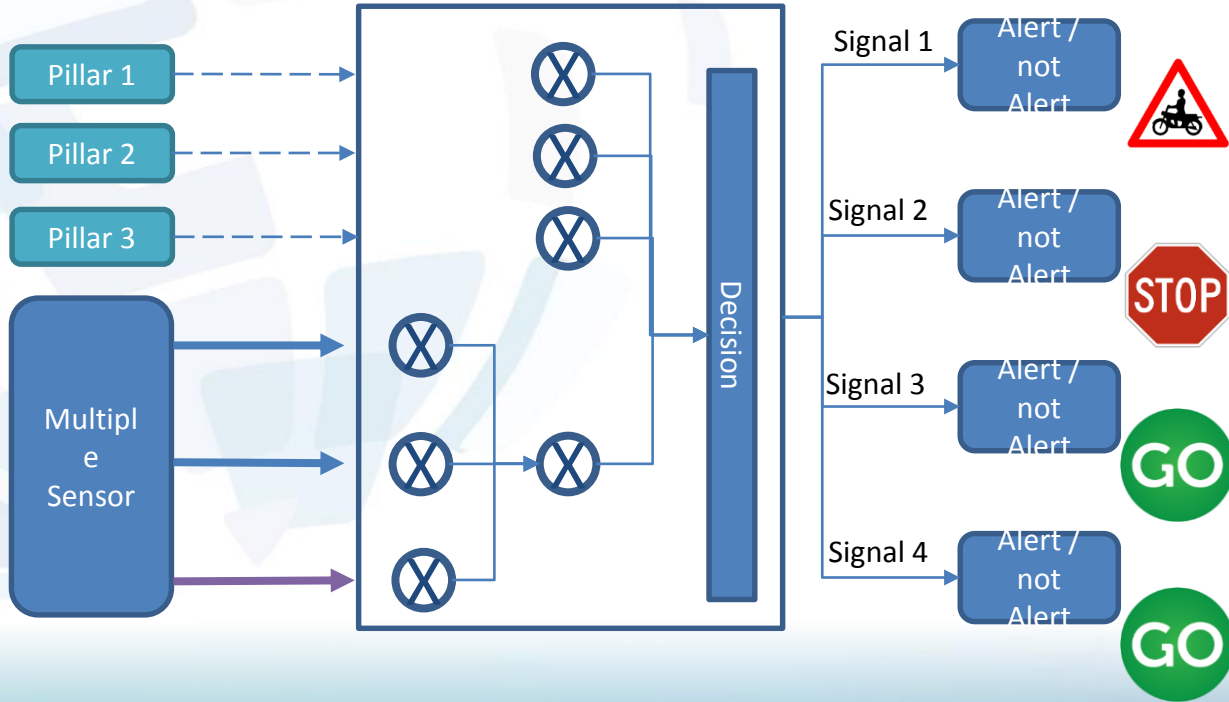


2. Alert Message shown by LED sign



3. Alert message broadcast by wireless  
(Bluetooth, Wi-Fi or cellular communication)

# Smart Pillar Controller



# Alert



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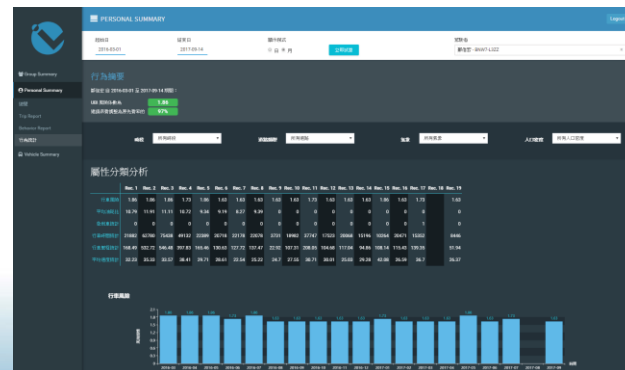
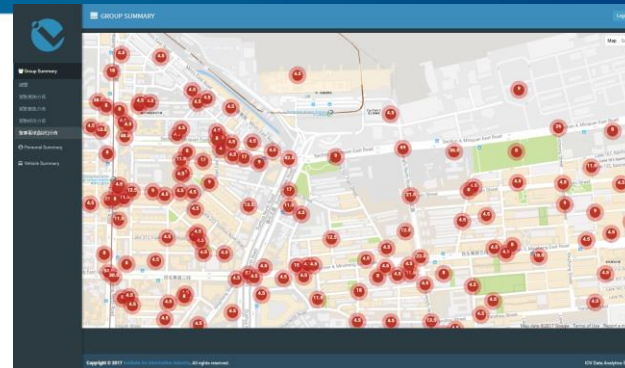


# Cloud and Big Data

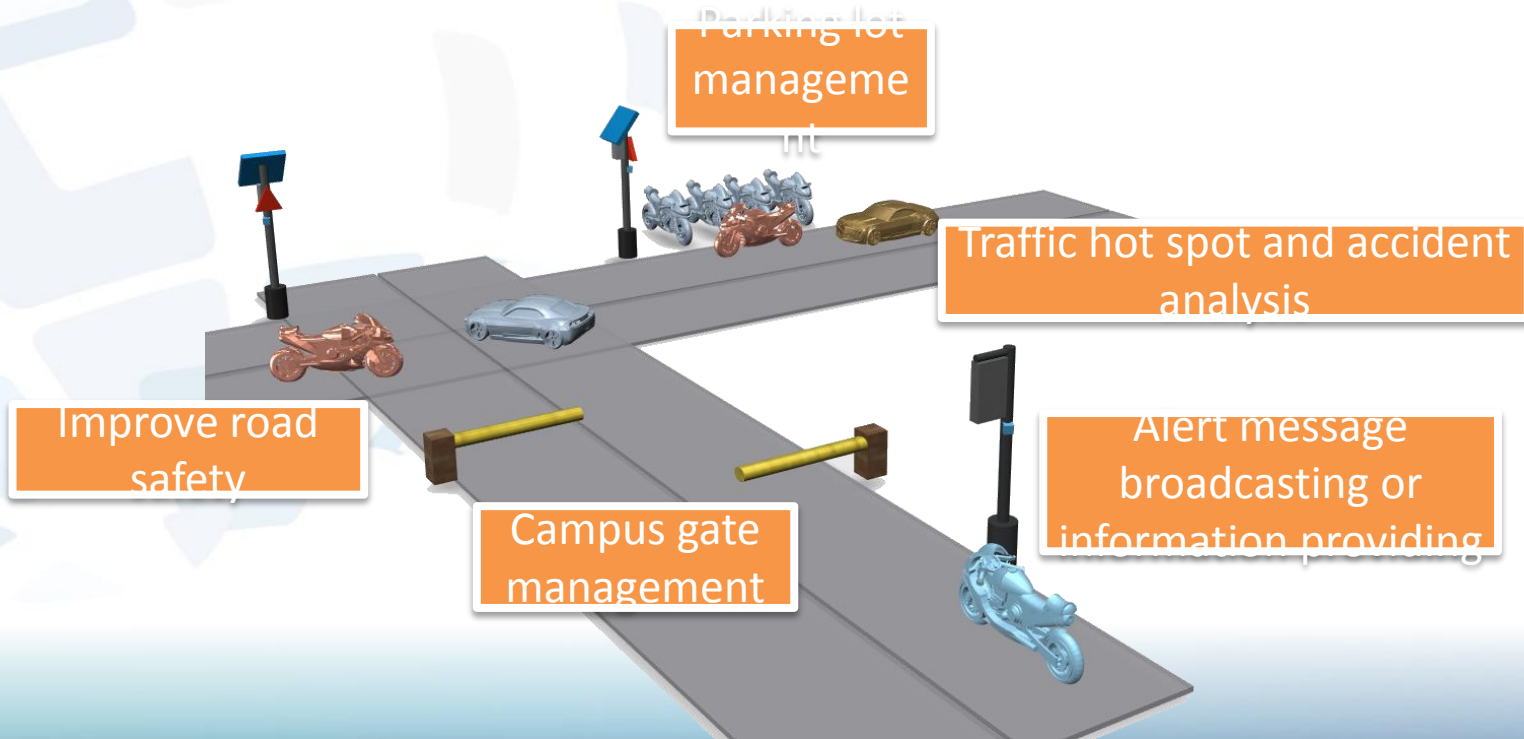


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- Reliability rate
- Availability rate
- Maintainability rate
- Safety rate
- Surveillance video
- Flow statistics



# Campus Management



# The Impact of the Future

## Safety and Intelligent

- IoT supported ITS
- Motorcycle ADAS
- Accident analysis based ITS service

Leverage the netcomm energy in Taiwan



## Innovation and Sharing

- Motorcycle sharing (U-Moto)
- New business model to seamless ITS service

Build up traffic cloud and losing legal limitation



## Green and ECO Friendly

- Low energy consumption
- New energy development

Lower petroleum needs and toxic emissions

Safety ITS



## Economic Promotion

- Service driven by social needs
- Intelligent motorcycle
- Safe and rapid transport solution
- Emerging markets development

Solve south Asia mutual social problem on traffic



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