



Empowered by **S3 Project**  
Surrounding Sensing Subsystem

## 自動駕駛感知次系統及自駕巴士發展

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# 自動駕駛應用驅動力與產業觀測

預測 2030 年因自駕車、車聯網與分享時代來臨  
MaaS\*有 8,000 億美元商機

- 受NCAP 與各國減少交通零傷亡的重視、自動駕駛車發展有助車輛安全發展的自動駕駛車目標
- 自動駕駛、車隊自動派遣、線上診斷與維修將被大量應用，零組件服務對象與經營方式也面臨改變。
- 2016 年車用電子約為2,486 億美元，預估到2025 年達3,599.5 億美元

\*註：Mobility as a service

## 汽車產業朝共享經濟發展

- 共享自主，如 Google 電動自動駕駛車，目前在英國運行的 Lutz Pathfinder 與 CityMobil2
- 汽車產業即將面臨變革，共享經濟導引流動性服務公司的出現，例如 Uber、Car2Go、DriveNow、Lyft 等
- 然存在私人擁有的汽車，但流動性與比例將降低

## 智慧城市面對的課題： 交通效率、空氣品質、人車安全

- 人口持續增長，結構改變: 預估 2030 年達 86 億，2050 達 98 億，2100 將達 112 億
- 環境負擔積累、:資源耗竭:排放、能源問題與永續發展
- 交通問題待解:移動需求高漲:都市管理，追求效率、安全、個人化服務  
政府、企業、社會推動:帶動技術、產業鏈、商業模式變革

## 全球自駕車運行現況

- 截至2018年9月全球共計40案自駕車上路，其中以Shuttle bus公共接駁佔最多數，占比50%。
- 美國部分，各種運行模式皆有案例；歐洲部分主要以Shuttle Bus公共接駁模式為主；
- 亞洲部分包含中國、韓國、日本及新加坡等國，主要以公共接駁、叫車服務模式為主

資料來源：工研院產科國際所、數位經濟

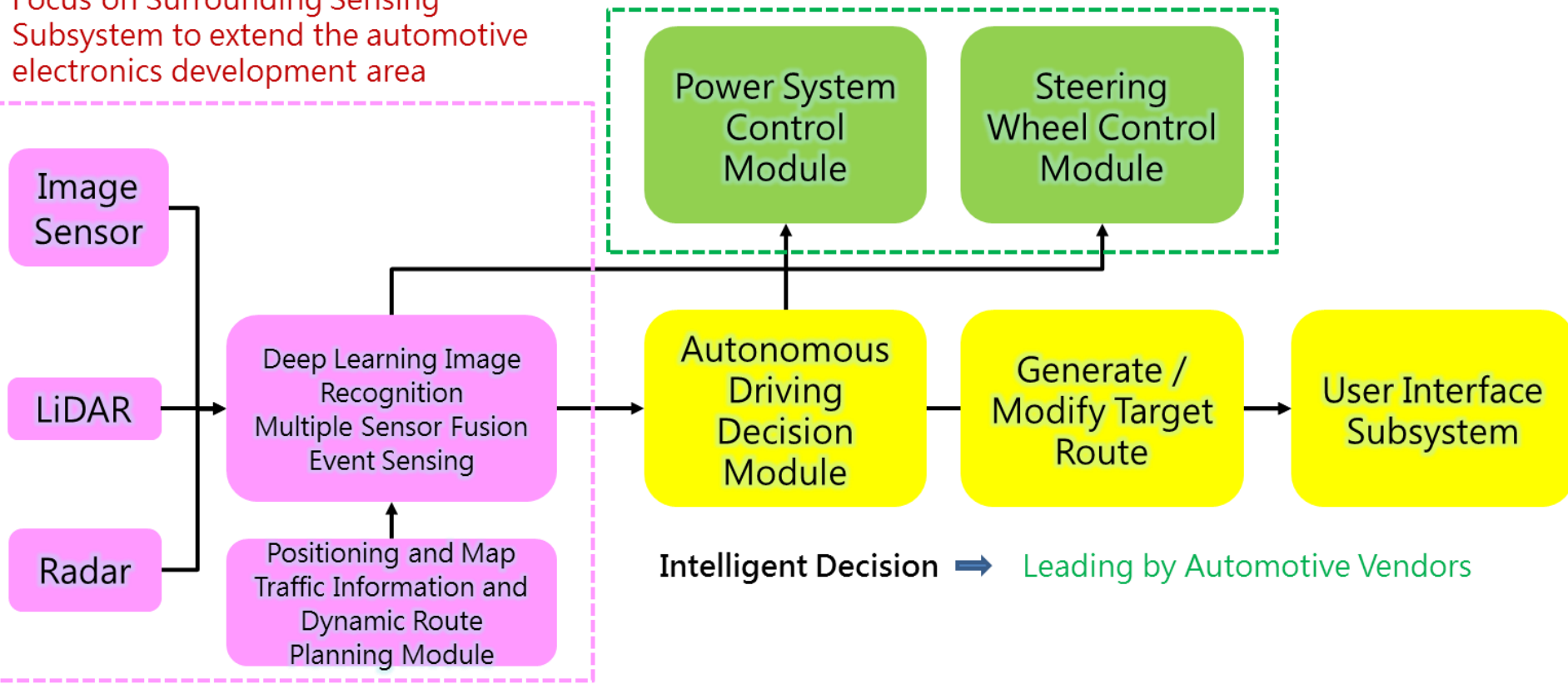


# Opportunity : Sensing Subsystem

## Surrounding Sensing Subsystem

Focus on Surrounding Sensing Subsystem to extend the automotive electronics development area

Integrated Control → Leading by Automotive Vendors



# ITRI Connected Autonomous Driving Vehicle Solution

## 📍 ITRI Autonomous Driving Vehicle (ITRI ADV)

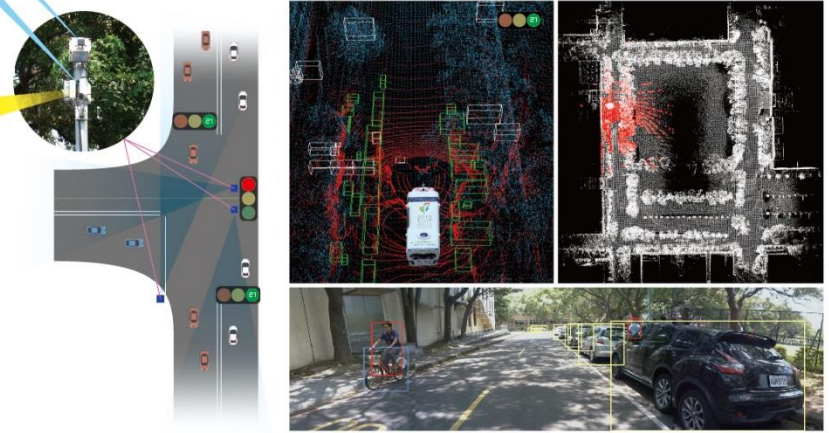
ITRI ADV is the first autonomous driving mid-size bus carrying up to 20 passengers for urban area, with driving abilities in signalized and mixed traffic roads, which is empowered by Surrounding Sensing Subsystem (S3) Project sponsored by Ministry of Economic Affairs (MOEA) in Taiwan.

- Automatic Emergency Braking
- Automatic Fixed-Point Ducking
- Traffic Light Waiting Control
- Lane-Keeping Control
- Cruise Control
- U-Turn Control



## 📍 Surrounding Sensing Subsystem (S3)

ITRI Surrounding Sensing Subsystem (S3) is an integrated perception, cognition and planning development system designed for level 4 self-driving car. It supports multiple sensors including cameras, LiDARs, radars, GPS, IMU, etc. with the state of the art sensor fusion, deep neural network and computer vision technology. The subsystem is also equipped with core technologies such as deep learning image recognition, 3D LiDAR sensing, multi-sensing fusion, real-time path prediction and SLAM. The subsystem is designed for urban area in Asia countries and suitable for all weather condition.



## 📍 ITRI V2X Safety System Solution (iRoadSafe)

iRoadSafe is the first V2X smart system solution, integrating V2V/V2I communications, roadside sensing and roadside display, to provide safety warning to ALL road users. The iRoadSafe can also be integrated with autonomous driving vehicles, providing Signal Phase and Timing (SPaT) and Non-Line-of-Sight (NLOS) detection capabilities, enabling autonomous driving at signalized intersections.



## 📍 Pilot Run in Taiwan

ITRI ADV will hit the road for demonstration during the 2018 Taichung WorldFlora Expo in Taiwan. The iRoadSafe has been deployed in Taiwan for a variety of applications, including bus safety & pedestrian in Taipei, Light-Rail safety in Kaohsiung, and will be integrated with autonomous driving vehicles in Taichung and Tainan.



# ITRI Autonomous Driving Bus (ITRI ADV)

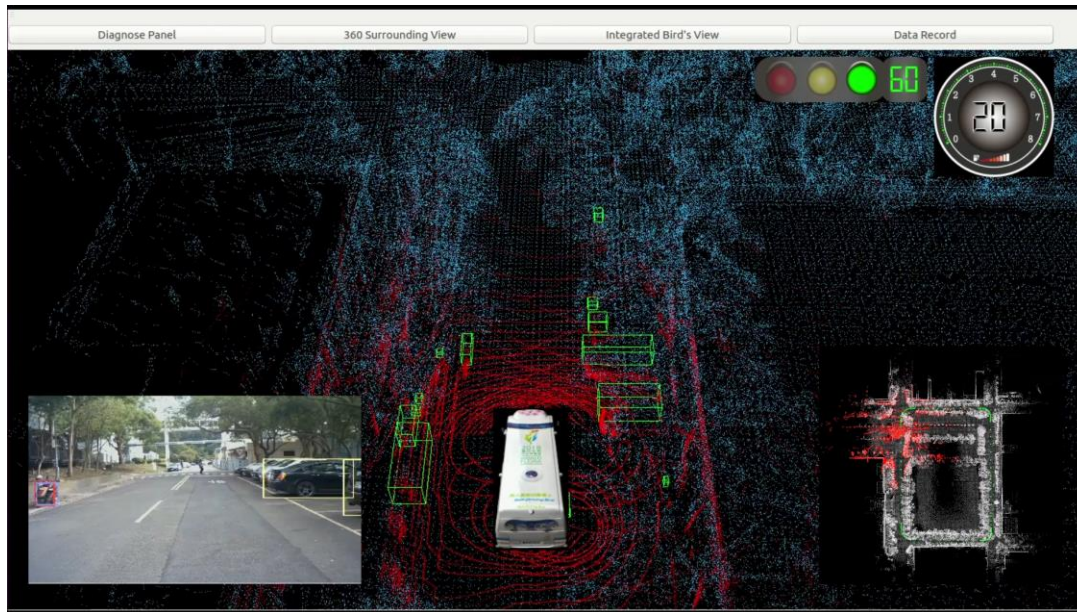
**ITRI ADV** empowered by **Surrounding Sensing Subsystem (S3)** is the first autonomous driving mid-size bus **carrying up 17 passengers** with abilities of driving in **signalized intersections** and **mixed traffic roads** in **urban area**

- Automatic Emergency Braking
- Automatic Fixed-Point Ducking
- Traffic Light Waiting Control
- Lane-Keeping Control
- Cruise Control
- U-Turn Control



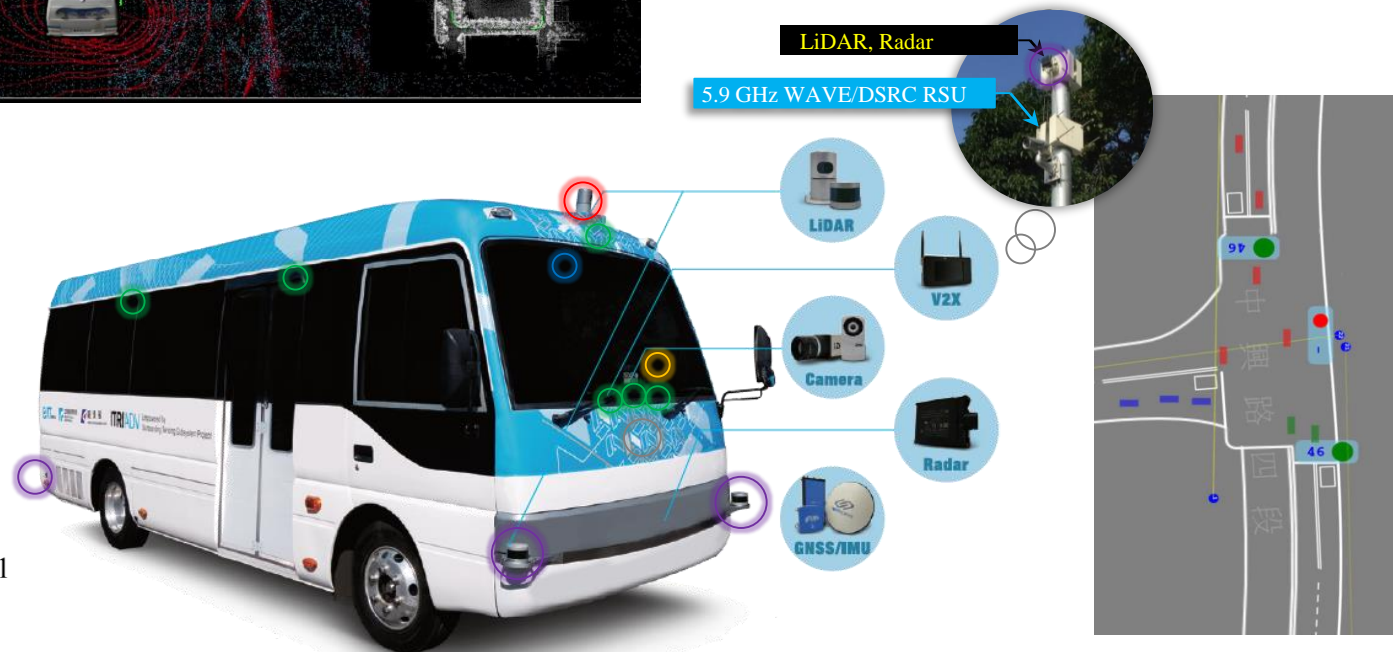
Challenge: Compared to small bus, mid-size bus **needs higher accuracy & lower response time** from the **sensing subsystem** due to the huge vehicle size

# Surrounding Sensing Subsystem (S3)



## Features

- Deep neural network-based video analysis
- Large-scale training data from Taiwan's streets (Formosa database)
- Multi-sensor fusion for most weather conditions (rainy, foggy, darkness etc.)
- Real-time event sensing for accident avoidance
- V2X roadside integration for blind spot detection at intersections
- Distributed computing arch. in the further



- Velodyne HDL-32E x 1
- Velodyne VLP-16 x 4
- GMSL Camera x 9 (IP69K)
- RTK GPS/INS x 1
- 5.9 GHz WAVE/DSRC OBU x 1
- Radar (to be added)

# Demonstration in 2018 Taichung WorldFlora Expo

- ITRI collaborated with Mobiletron, RAC Electric Vehicles and iAuto (NTU startup) to develop the first autonomous mid-size bus, will demonstrate during the 2018 Taichung WorldFlora Expo



車王電子  
MOBILETRON™

RAC

iAuto



# Demonstration in 2018 Taichung WorldFlora Expo

- 路線長度來回共2.9公里
- 行駛時間來回約20分鐘
- 營運時間9:00 – 17:30
- 30分鐘一班 每日16班
- 兩台自駕車交替於A6發車

中科路車輛動線示意圖



於試營運期間僅  
供自駕車通行





# V2X Smart Roadside Integration

## 自駕感知連動智慧路側系統

### 智慧路側系統iRoadSafe :

- 國際首套車聯網路口防撞警示系統
- 首創結合車用短距無線通訊、路側雷達/光達感測、電子看版
- 提供用路人車事故預警

### 自動駕駛感知次系統(Surrounding Sensing Subsystem, S3) :

- 國內首套針對自動駕駛需求研發之環週感知次系統
- 涵蓋深度學習影像辨識、三維光達感測、多重感知融合、即時事件推理、系統驗證等關鍵核心技術

#### 深度學習影像辨識 :

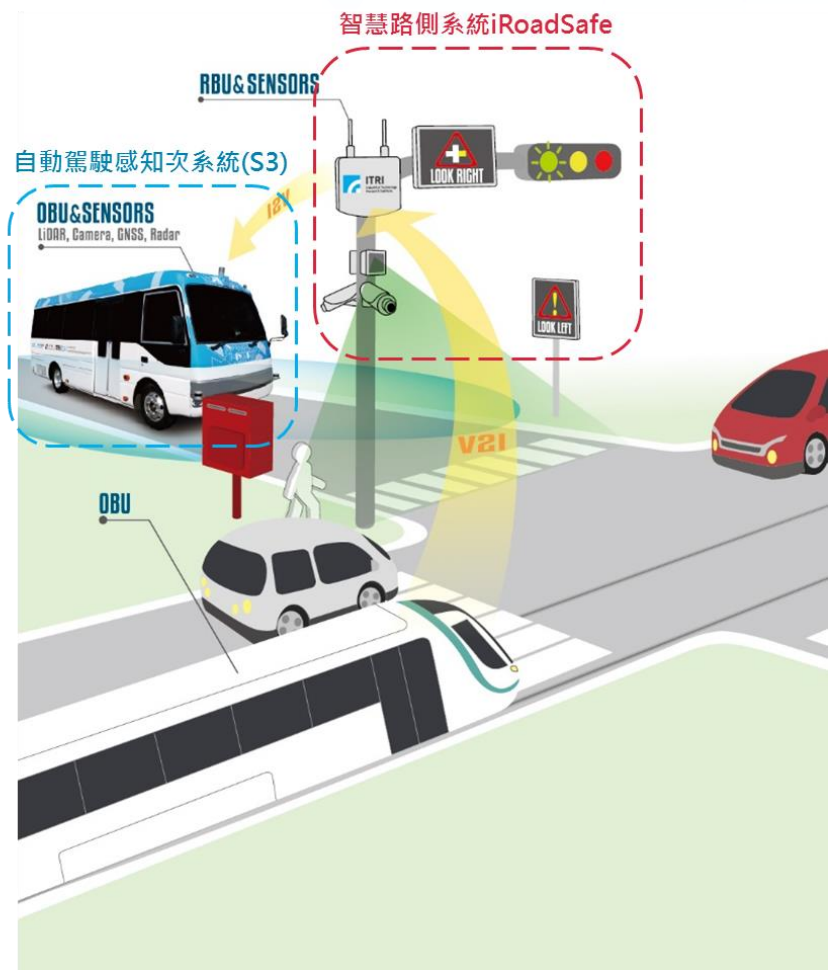
- 自駕車視覺能夠辨認的更多、更準，帶動圖資與工業電腦產業切入自駕

#### 多重感測融合技術 :

- 即時融合視、聽覺的多重資訊，更精確，提升車用電子與網通產業競爭力

#### 自動駕駛研發驗證平台 :

- 國內首座虛擬驗證與實車驗證平台

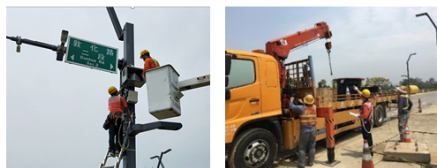


# Demonstration in 2018 Taichung WorldFlora Expo

## 路側設施

### 01 無線通訊系統

✂ 光纖佈覽及路側設備建置



### 02 廣域光纖內網

⚡ 低延遲+大量影像穩定傳輸

### 03 TOP 影像檢索系統

🚗 自駕車辨識/路側影像記錄

📱 多元終端平台播放

📺 即時/歷史影像多分割視窗  
播放查詢

🔍 事件查詢

### 04 智慧安全路口

📶 車輛及行人偵測

📺 號誌資訊廣播



台中水湳智慧城自駕車發展計畫

iRoadSafe

(此資料由鼎漢工程顧問提供，工研院協助，尚在規劃中)

# Demonstration in 2018 Taichung WorldFlora Expo

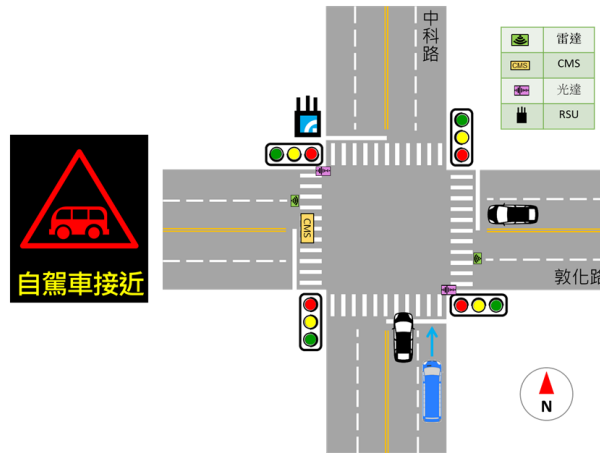
- Integrated with iRoadSafe to support smart road intersection

## 優先號誌



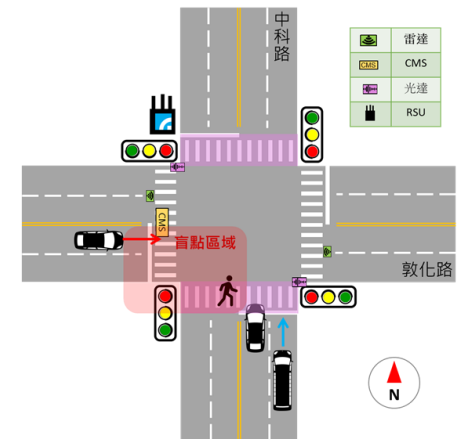
當自駕巴士即將進入路口，延長綠燈秒數使自駕巴士能夠順利通過路口

## iRoadSafe 智慧路口 - 自駕車接近



路口LED電子看板在自駕車要通過路口前，會提供自駕車接近訊息，提醒敦化路方向來車注意

## iRoadSafe 智慧路口-路口盲點/行人偵測

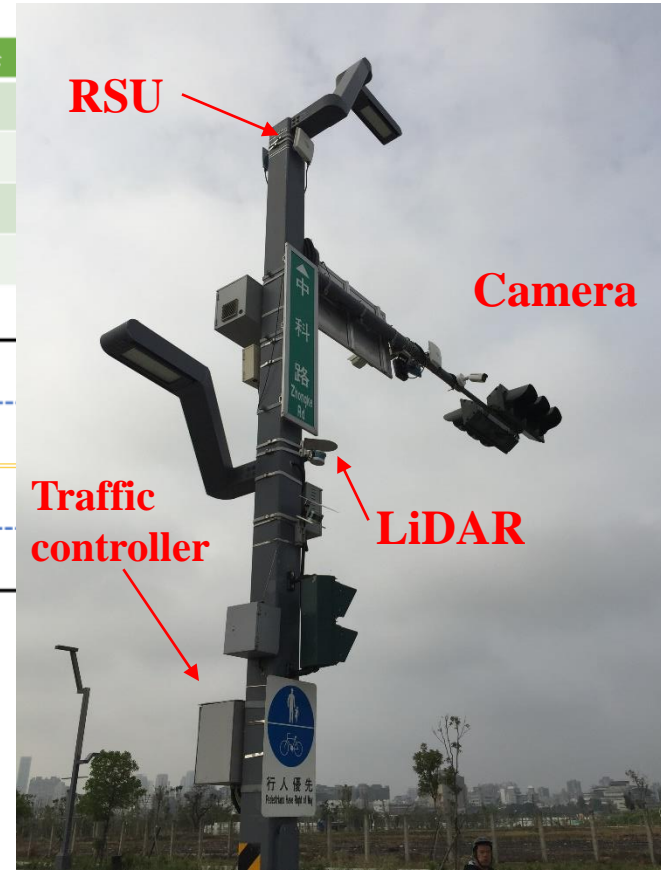
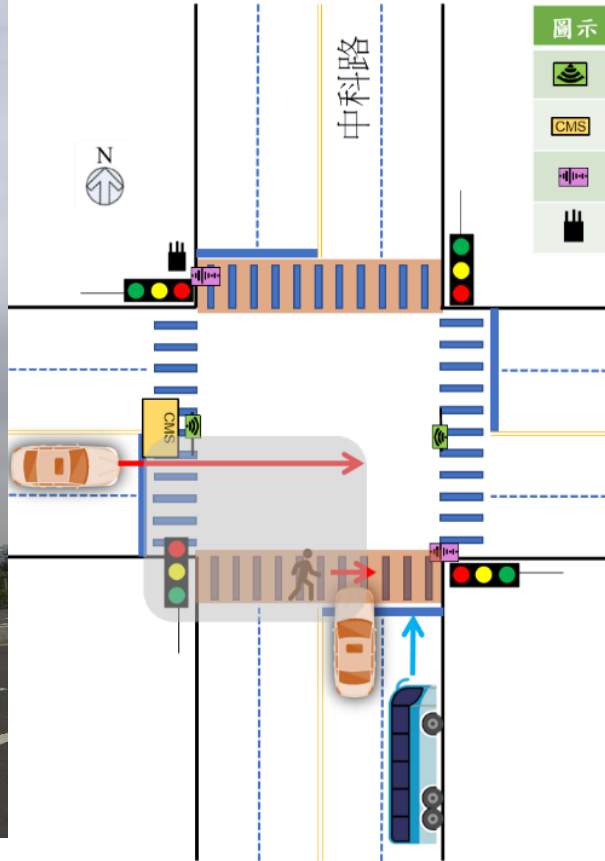
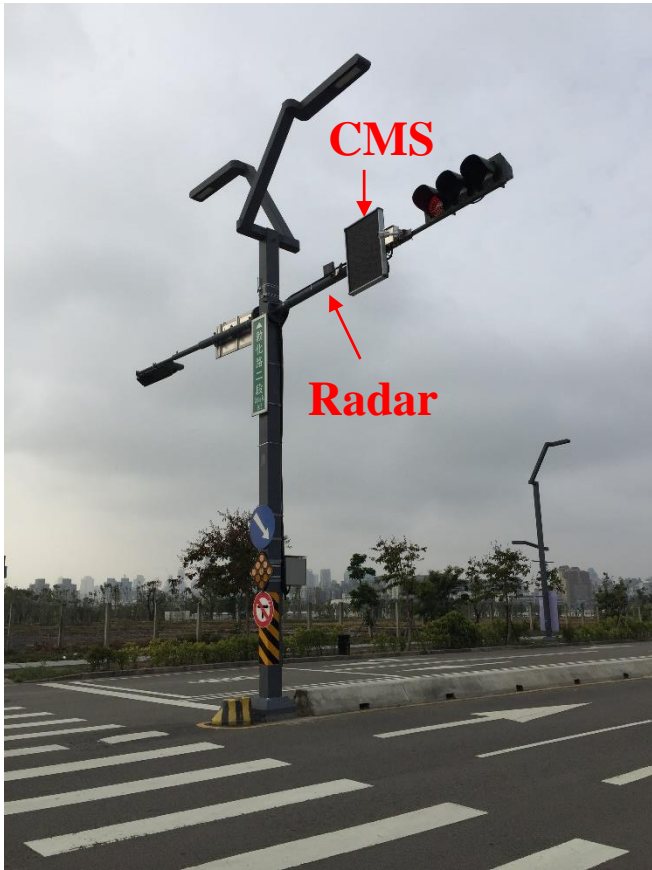


當自駕巴士即將進入路口，透過車載設備及車聯網技術提前掌握路口其他方向之來車及行人，能有效使自駕巴士於路口減速、煞停，以避免事故發生

台中水湳智慧城自駕車發展計畫

# Demonstration in 2018 Taichung WorldFlora Expo Integration with V2X Roadside

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# Taipei's iRoadSafe Deployment

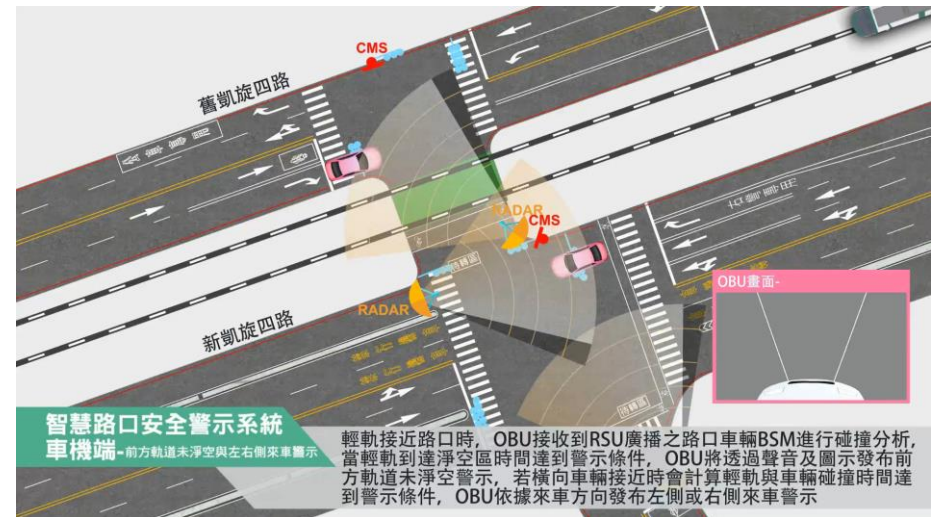
- **Bus & Pedestrian Safety Warning in Signalized Crosswalk**
  - Deployed at 3 intersections with 4 crosswalks and installed OBU on 18 buses
  - Detect crossing pedestrians using LiDAR (Velodyne VPL-16)
  - Provide safety warning to the bus driver using OBU from through V2I
  - Provide safety warning to pedestrians using CMS (Changeable Message Sign)



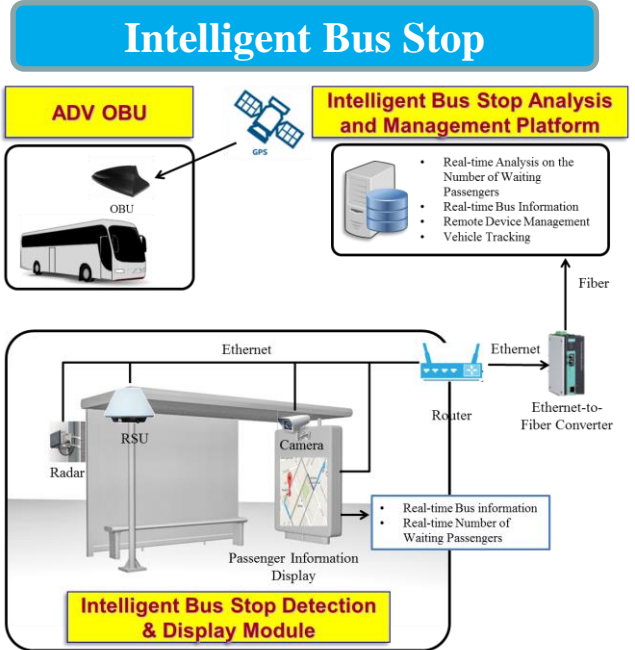
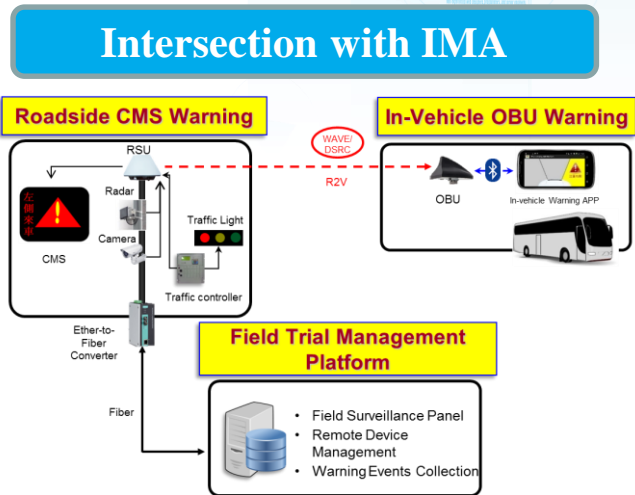
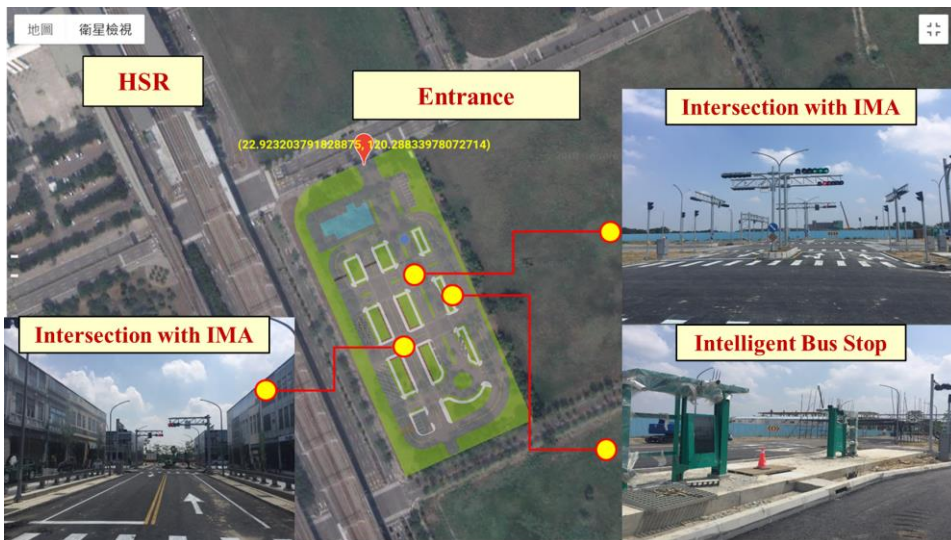
# Kaohsiung's iRoadSafe Deployment

- **Tram collision avoidance system**

- 2 intersections deployed with Radar, RSU and CMS
- Intersection between Kaixuan 4th Rd./ Zhongshan 3rd Rd.
- Intersection between Kaixuan 4th Rd./ Zhenxing Rd
- 8 Trams equipped with OBUs



# iRoadSafe Deployed in Taiwan's First Autonomous Driving Test Field



# Real-World Deployment of iRoadSafe

With support from MOTC, iRoadSafe has been deployed at 21 sites of 9 cities across Taiwan (基隆、新北、台北、桃園、新竹、台中、南投、台南、高雄) for field trial since 2016.

## Field Trial Deployment in Taiwan

iRoadSafe has already been deployed and tested in 4 cities (Keelung, Hsinchu, Nantou, and Kaohsiung) in Taiwan, including 8 intersections with different geometry and 2 highway ramps.

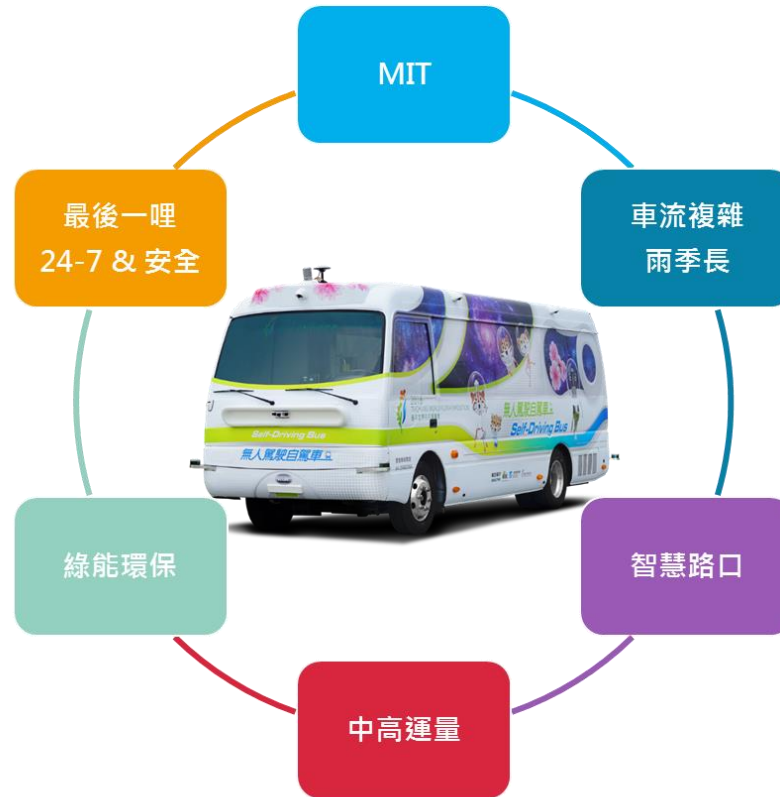






# 工研院自動駕駛接駁車特色

搭載國人自主研發之  
自動駕駛感知次系統



為台灣及亞洲地區獨特的交通  
狀況量身打造，加強特殊道路  
環境設計

透過智慧路側系統 - iRoadSafe，  
提供路口號誌時相與非視線危  
險人車訊息，使自駕車具備開  
放路口通行能力

工研院自駕車為中型巴士，  
更適合都會區中高運量需求

自動駕駛車輛即使半夜三更提  
供服務也不會有疲勞駕駛的問  
題，讓離峰時間的用車需求交  
給自駕車，讓職業駕駛們回家  
休息吧!

環保電動綠能中巴，減少二氧  
化碳排放，節能減碳救地球

# S3 Partnership Program

## 自動駕駛感知次系統產業合作夥伴計畫

於2018年正式成立「自動駕駛感知次系統產業合作夥伴計畫」，會員招募針對車聯網業者，ADAS相關業者車用感測器業者，以及汽車電子業者等，**目前已有10家國內業者付費加入夥伴計畫之行列**

### 目標/目的

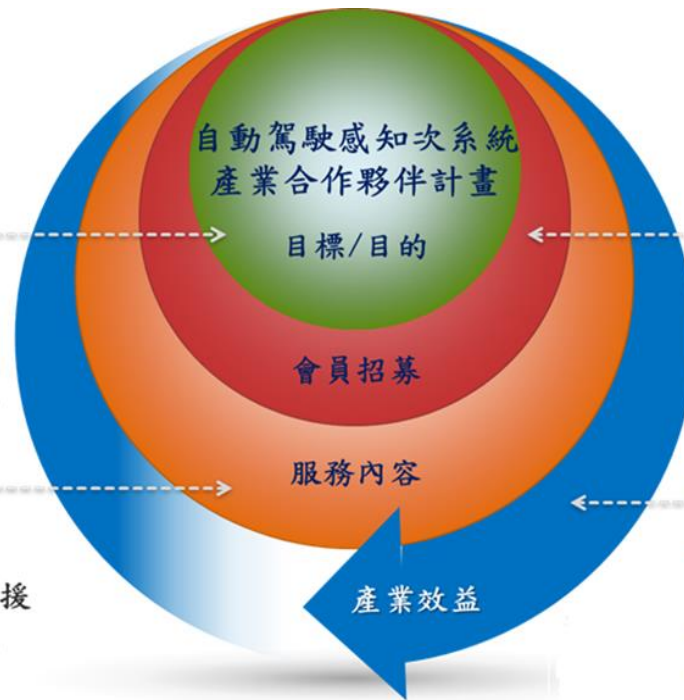


- 宣告攻堅自動駕駛感知次系統
- 有效尋找可共同合作開發之夥伴

### 服務研擬



- 國際自駕感知技術最新趨勢分享
- 訓練資料庫存取
- 整車測試服務諮詢
- 關鍵技術授權
- 次系統驗測平台支援
- 場域驗證環境支援



### 會員招募規劃



- 與公協會合作
- 導入V2X產業合作夥伴計畫既有會員
- 新會員招募

### 產業效益



- 快速形成產業聚落



### 自動駕駛感知次系統 產業合作夥伴

*Accelerating Your Products Roadmap  
on Autonomous Driving*

車王電子  
MOBILETRON

Unex

FAR EASTONE  
遠傳

LITEON

RoyalTek

INVENTEC

ST Electronics  
A company of STMicroelectronics

Hwa-om  
SYSTEMS INC.

ALPHA  
明泰科技  
Alpha Networks Inc.

程程科技

S3 Partnership Program Website: <https://s3pp.itri.org.tw/>

# THANK YOU FOR LISTENING!

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