



Intelligent Transportation System

Critical role of transportation

Transportation is one of the key factors fueling economy and society to move forward. It is also one of the key factors to measure the civilization of the country.

The subject of transportation covers from cars, planes, ships and railways, which physically connect with each other to move humane and trade goods. Today, transportation is struggling because it becomes complex by the demand from surge of population, expansion of the urban, cost of the construction and operation, threats of emission and pollution, congestion of traffic as well as the risk of the accidents. For example, according to Intel, the demand for urban mobility by personal or public transportation is expected to grow 2.6 times by 2050. To resolve these issues, it should rely on the new technology to offer the efficient and safe service of transportation and more cost-effective solution to satisfy the demands.

What is Intelligent Transportation System?

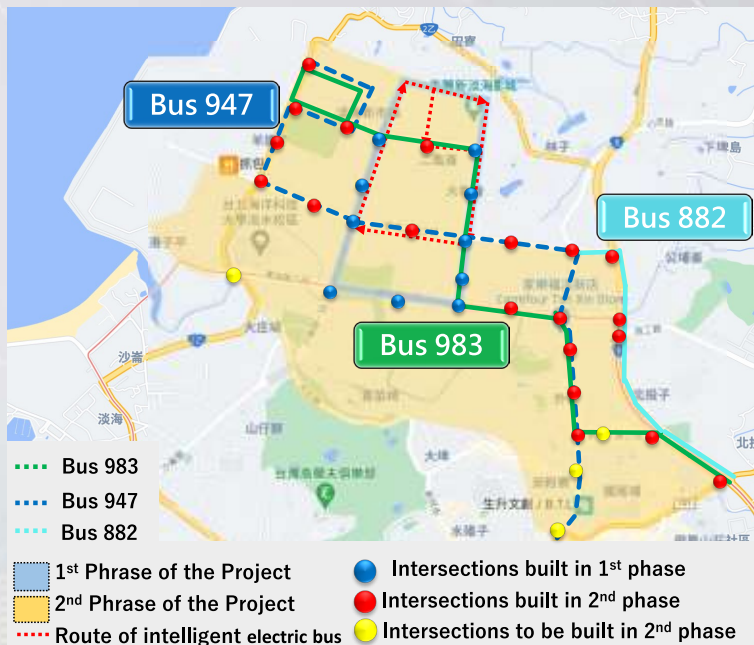
Intelligent Transportation System (ITS) enable new and rich features for road, air, rail and sea by advanced technology of Internet of Thing (IoT) and artificial intelligence (AI). These solutions connect vehicles, traffic signals, toll booths and other infrastructure to help ease congestion, prevent accidents, reduce emissions, support for autonomous driving and make transportation more efficient. Its examples include intelligent traffic management, V2X communication, electric vehicle charging, electronic toll collection, fleet management and a wide range of other mobility solutions. The insight generated by powerful edge computer for transportation could help authority react more quickly, efficiently, safely and accurately to make the use of transportation system committed to the reality of the demand. Intelligent Transportation System is formed by hardware and software with connections to different facilities, including the infrastructure, vehicles, planes and ships. It is a crucial job because it has to detect things accurately and respond in near-real-time. In addition, it has to offer redundant capability to prevent any incident, which obstacles could happen.

Example of Intelligent Transportation System in Taiwan - CV2X application

In order to migrate to the next era of the transportation and comply to the trend of electronic vehicles and autonomous driving, the Ministry of Transportation of Taiwan starts to progress the definition of CV2X in Taiwan, which is also demanded to comply to the international standard in order to build the advance of transportation system and foster the industry of transportation of Taiwan to gain the market in the worldwide. The example of Danhai test site in Taiwan is to meet the following missions:

- **Defining Traffic Controller for Roadside Open Standard (TCROS)**
Based on “Urban Traffic Control Protocol 3.0” to define next generation in accordance of SAEJ2735, an international standard.
- **Establish certified service with TUV for autonomous industry**
Based on defined standard, establish the service for certification to the new products of industry.
- **Demonstrating new applications of intelligent transportation**
Prove new application of intelligent transportation by the integration of hardware and software of edge computing solution.

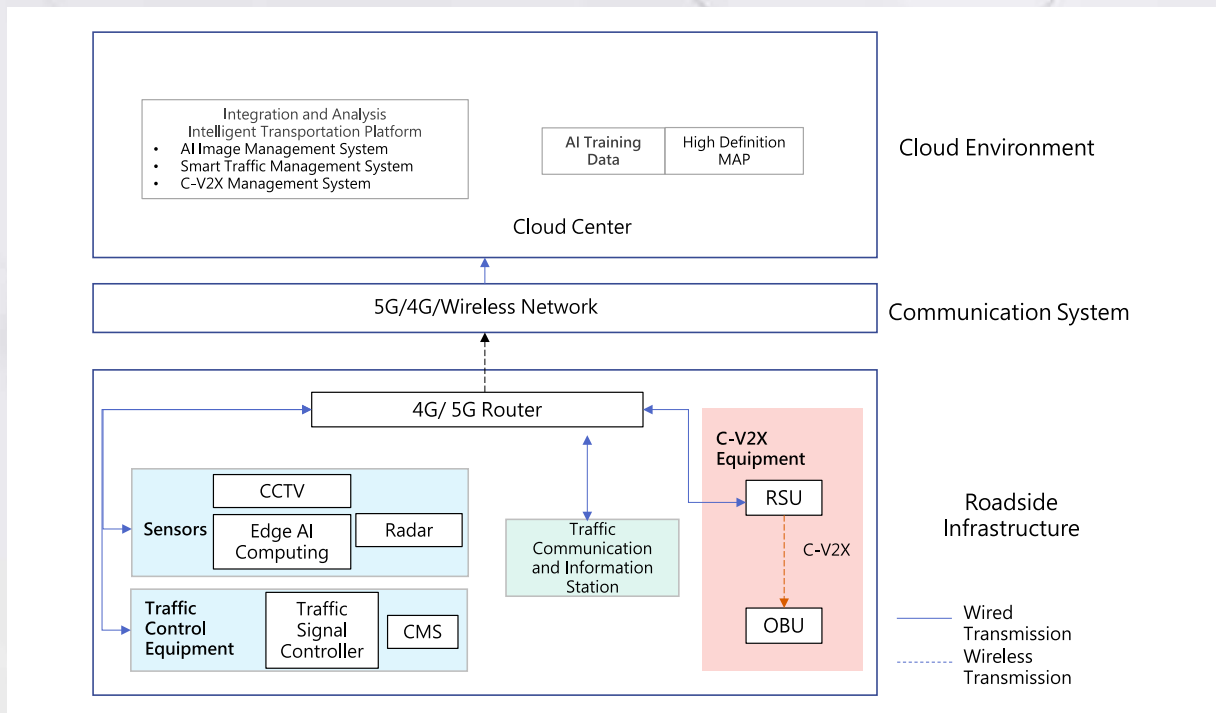
Deployment of test site



The test area is consisting of several blocks of Danhai new city. In each intersection, the AI video camera, radar, RSU is built with the edge computing solution. The mission of this project is to make proof of concept (PoC) of intelligent transportation on application. This is the real venue for the test and the roads in the region provide the service to many different kinds of vehicles, such as buses, trucks, cars, motorbikes and even bicycles. There are schools, residential areas and commercial zone in the regions, which makes the traffic flow different from time to time.

Architecture

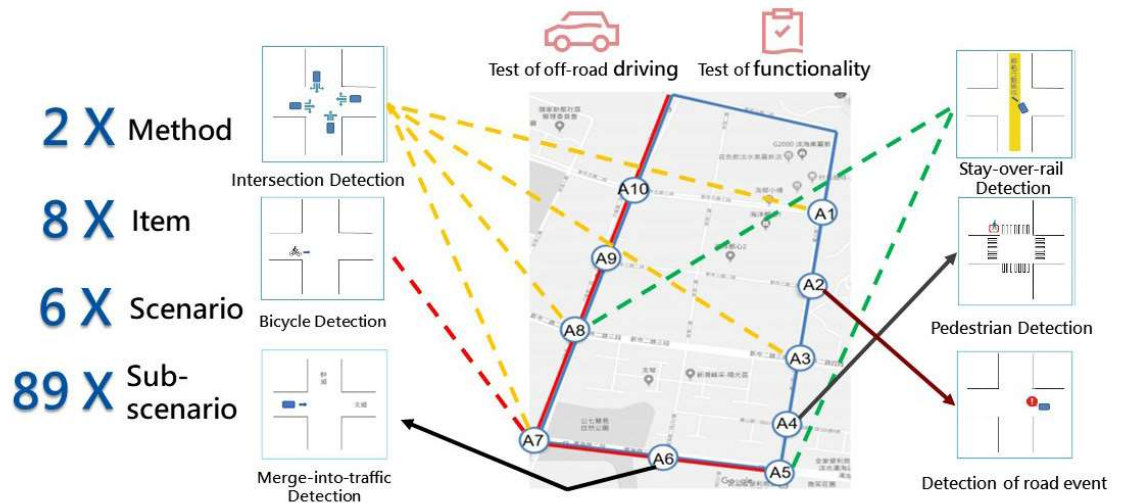
The following chart is the architecture of the intelligent transportation system in Danhai new city, which consists of cloud service, communication of 5G / 4G and those infrastructure of the roadside.



Under this architecture, AI video camera and radar are the mediums to collect the data for the process of edge computing solution. The information after process is sent to the cloud server via communication of 5G at the same time. In order to support near-real-time reaction and service, the information by edge computing solution could at-once conduct the traffic signal controller in the same cabinet to response for the immediate demand on the road. The information, sent to the Intelligent Transportation Platform via 5G could be used for the further management of the traffic control. For the prospect of the autonomous purpose, the information is delegated to the autonomous platform to deliver the message to the vehicles, which its autonomous system may need for direction and safety.

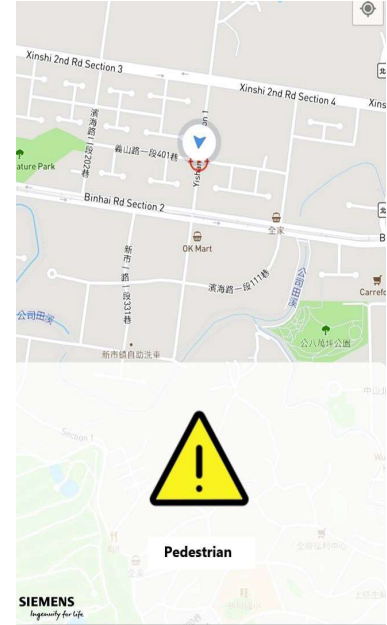
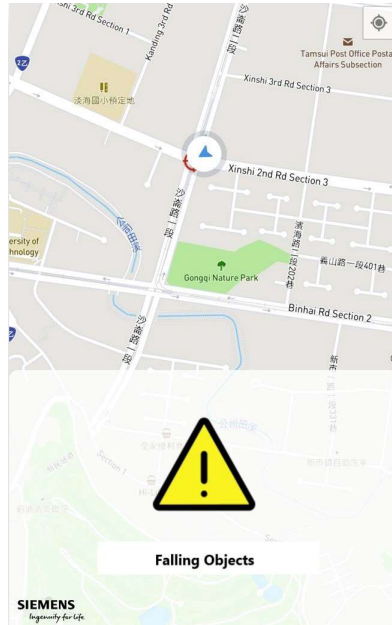
Test items

Establish certified service with TÜV as the third party · for the test of off-road driving and test of functionality in order to improve the quality of service.



The testified programs includes 8 items, 7 scenarios and 89 sub-scenarios by two methods, which is considered as the necessary information for the further management. For examples, it detects the cars approaching to the intersection. It detects different kinds of vehicles. It also detect the appearance and behavior of pedestrians.

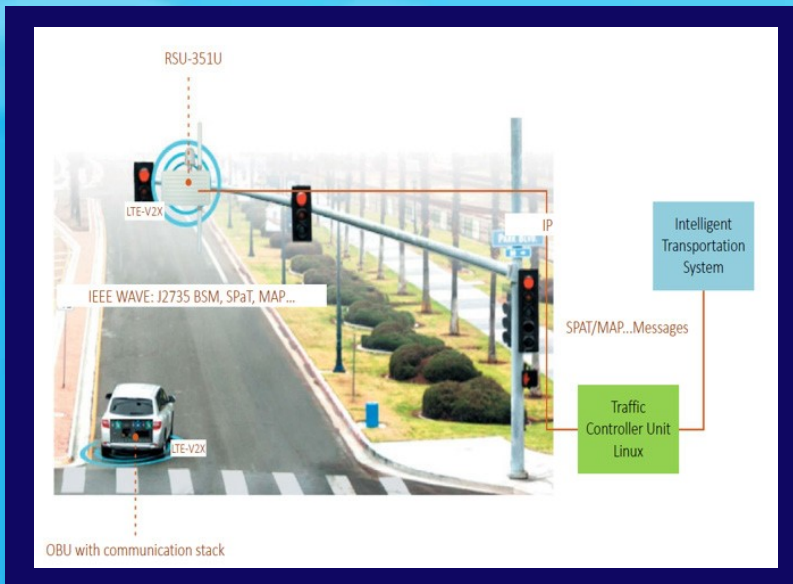
The Message to vehicles by detection on the roadside



The information would be used for not only the response for the immediate control of traffic signal, but also the decision of the traffic management, for example “green light wave”, which could provide the priority of the traffic direction or improvement of the congestion. Certainly, via 5G transmission, the vehicles would receive the message regarding the status of traffic signal and condition of the road ahead. For the autonomous driving, vehicles can only rely on the message sent by the communication regarding the traffic signal, risk or appearance of other users like pedestrian ahead when the vehicles don’t have “eyes” to watch but “receiver” to get the message to instruct the vehicles.

Architecture of CV-I

The connection between the roadside infrastructure and vehicles is based on international CV2I. The application of SAE J2735 here is based on CV2I standard and provides the notice of pedestrian safety message (PSM) and roadside alert (RSA). CV2X is the international guideline for connected vehicles and roadside infrastructure to develop many of application and promote them internationally without conflicts.



Application 1 - VIPS

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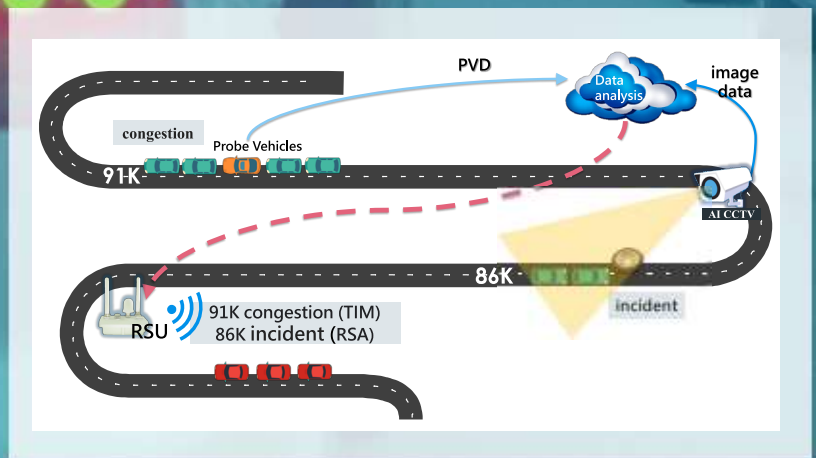
Application 2 – Crowdedness Detection



This service provide the detection of crowd density in the station or area by AI video detection and analysis. The information can be provided for the security of the station or area to prevent from falling down or intrusion. It can also help improve the service quality by providing the alert of overcrowded or the statistic of the distribution of crowd and flow in the station or area.

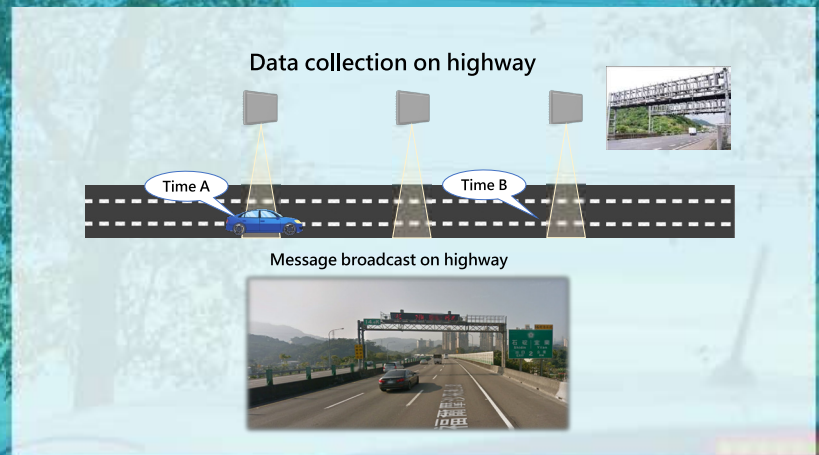
Application 3 – Traffic Detection

The detectors on the highway detect the traffic to provide the notice to the following vehicles in case of congestion or accident to allow them to prepare or divert. The detectors could collect the behavior of the vehicles on highway including its speed or if any vehicles needs SOS.



Application 4 – Message Broadcasting

The information, detecting from the road could be processed and analyzed by the platform of traffic management then become meaningful reference and be broadcasted through the signboard.



Application 5 – CV2I

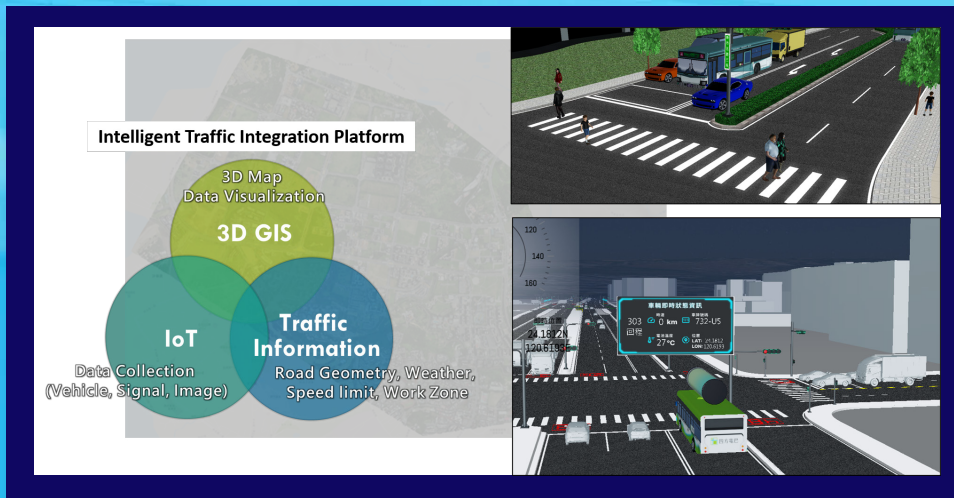
The digitalized traffic signal could deliver the message via RSU to vehicles regarding the in-coming change of the traffic light, road condition, pedestrian and any special activities or incidents on the road for safety and environment.



The benefit of CV2I is mutual instead of one way from the signal to vehicle. The special vehicles, such as ambulance or fire fighter could

communicate with the traffic signal to get the priority of the road for their emergence.

Application 6 – Digital Twin

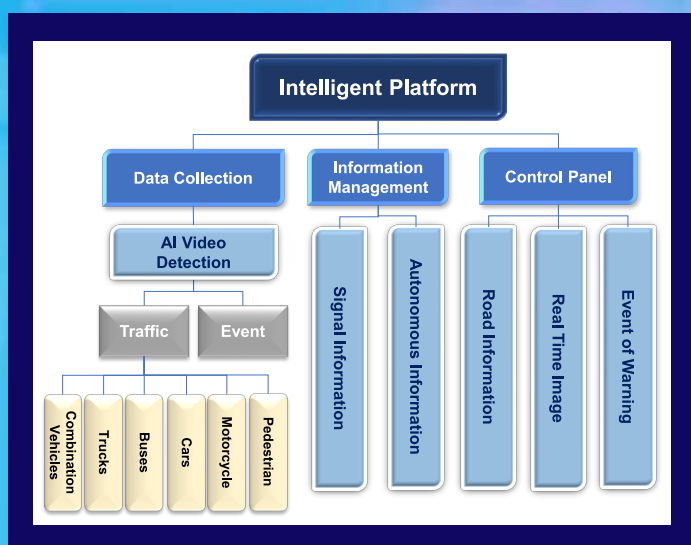


The platform of management adapts the technology of digital twin by creating 3D map to demonstrate the traffic condition in the area. It is more alive and easier to understand.

The digital platform is based on multiple format and big quantity of sensors in a defined space and simulate all of the events in the area by the collected data. The useful reference could become further suggestion in consideration of the new infrastructure in the future.

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Application 7 – Intelligent Platform



Based on digital twin technology, the intelligent platform is created to manage the traffic in a defined area.

All of the collected data is not just used for near-real-time response on the road but also emerged to the intelligent platform to use for analysis and reference for the traffic decision, such as diversion of the traffic or setup of the green light wave.

Conclusion

Intelligent transportation would become a professional domain to develop a series of the hardware and software to fit to the different and exclusive condition and demand of the traffic in every region and every country. However, the software could resolve the issue of exclusive condition and demand while the hardware would sustain the software to perform and communicate efficiently without latency.

The policy of the transformation to electric vehicles would create more feature and functions of the vehicles to make the vehicle more powerful. This wave would encourage in-car entertainment, navigation, autonomous driving, charging and safety. Some of those, such as autonomous driving, accurate navigation or even charging could drive the revolution of the roadside infrastructure to become smart. Government should soonest be expected to provide the standard and policy for the introduction of the new era of electric vehicles and traffic management.



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