3rd SIP-adus Workshop
On Connected and Automated Driving Systems 2016

Singapore Autonomous Vehicle Initiative (SAVI)

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China
South Korea
Japan
Sea of Japan
East China Sea
North Pacific Ocean
Nepal
Myanmar (Burma)
ASIA
Thailand
South China Sea
Bay of Bengal
Vietnam
Philippines
Gulf of Thailand
Malaysia
Indonesia
Banda Sea
Papua New Guinea
Arafura Sea
Solomon Sea
Singapore
Land area: 719 km²
Population: 5.6 mil
Density: 7,697 /km²
Source: www.singstats.gov.sg

Singapore Road Transport

5km/square km
Road Density

3,500km
Road Network

1car / **10** persons
Car Ownership

960,000
Total Vehicles Population
575,000 private cars

Source: LTA Publications & Research

Our Key Challenges

Increasing Travel Demand

Population increase, intensive development and change in lifestyle

Land Constraints

12% of total land used for road and land transport infrastructure

Shortage of Labour

Truck, lorry and bus drivers

Ageing Population

30% aged 65 and above by 2030

Our key strategies towards a Sustainable Transport Eco-System

Reduce Reliance on Private Transport

Promoting car sharing and mobility on demand

Increase Public Transport Usage

Promoting and making public transport accessible and reliable

Encourage Cycling and Walking

For first-mile and last-mile travel

Sustainable Transport Eco-System

Value Propositions of Autonomous Vehicles

Increase productivity

Autonomous buses to tackle problem of labour shortage

Increase road safety

Enable ageing population to maintain freedom of mobility while ensuring safe driving

Optimise road capacity

Vehicles can move together in a more compact and platoon manner

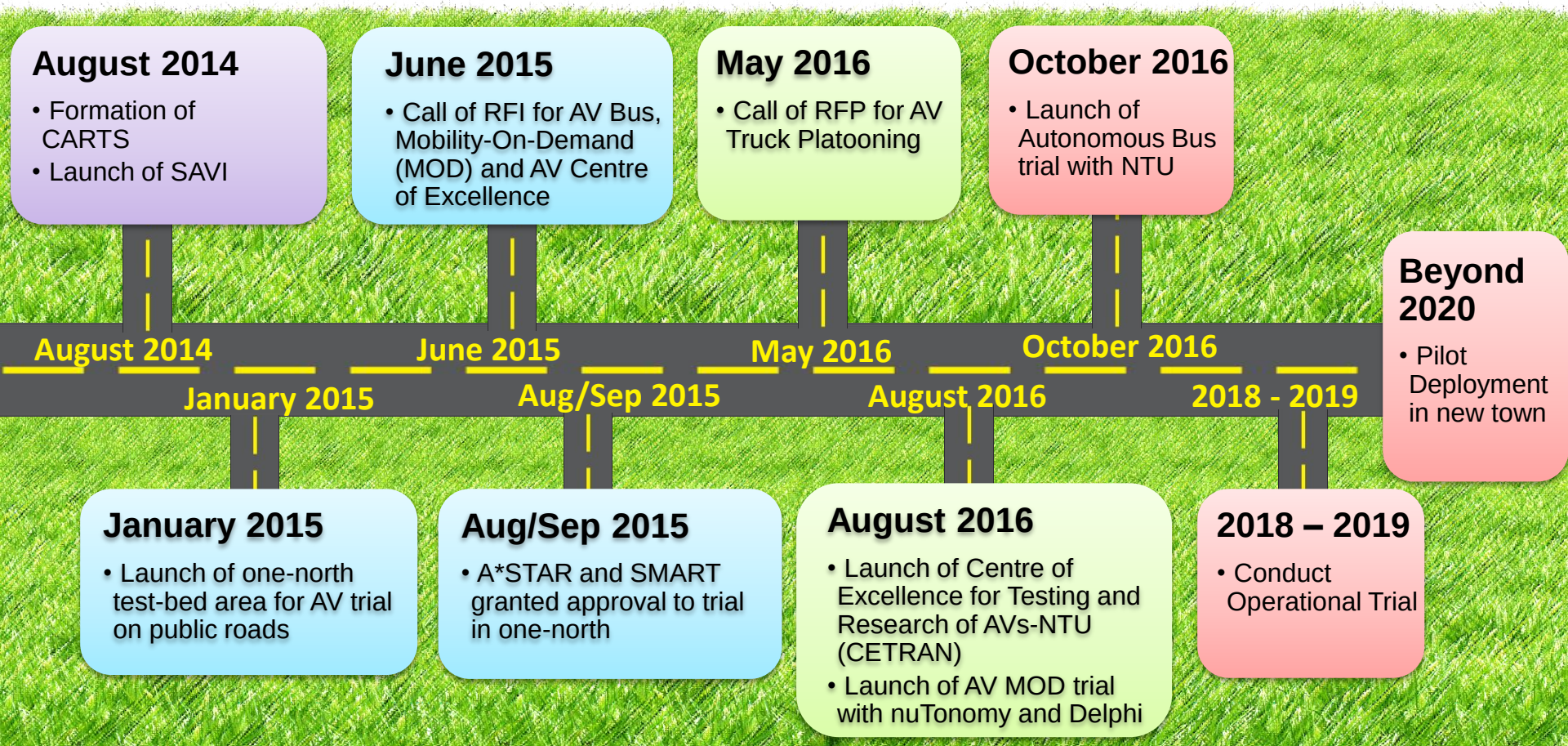
Enabling new mobility concept in new towns

AV Mobility-On-Demand and vehicle-sharing schemes to complement walking and cycling in new towns

Increase R&D Value-Add

Singapore is a Living Laboratory and is ideal for conducting test-bed for AV development and deployment

Roadmap and progress of AV program in Singapore



AV and V2X test-bed in one-north

one-north public route AV testing

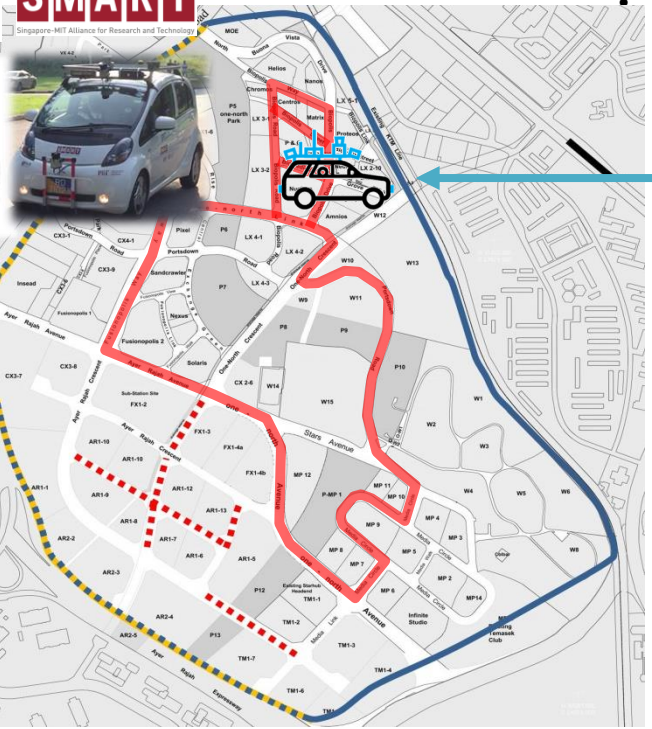
- 4 AV Trial Participants granted approval

Institute for Infocomm Research A*STAR

DELPHI

nuTonomy

SMART Singapore-MIT Alliance for Research and Technology



Surveillance Cameras

- CCTV placed at strategic and critical locations
- Real time streaming of video feeds
- Video recording
- Enable remote monitoring

Dedicated Short Range Communications (DSRC) beacons

- Position augmentation
- V2I information dissemination

AV Performance Evaluation System

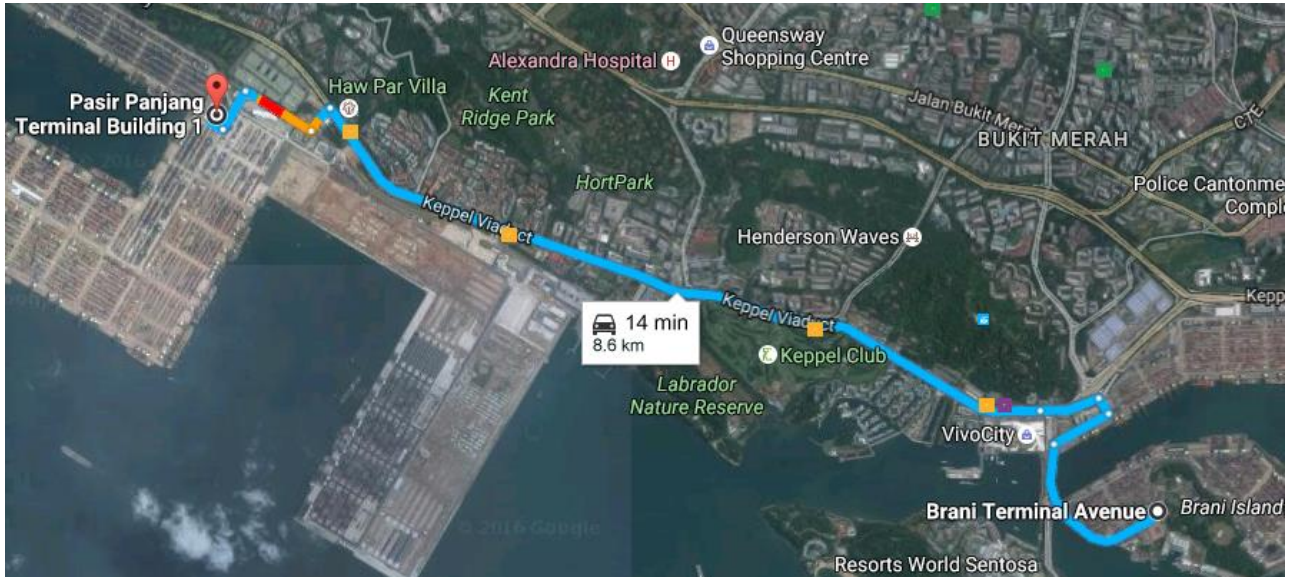
- AV Monitoring and Evaluation
- Manage V2I information dissemination

Land Transport Authority

Launch of Request for Proposal (RFP) for Autonomous Truck Platooning

Launched in **May 2016** and closed in August 2016

- explore AV technology for freight transport in Singapore
- manually driven lead truck is followed by a convoy of driverless trucks
- Currently under evaluation



Land Transport Authority

Launch of Centre of Excellence for Testing & Research of AVs-NTU (CETRAN)

Launched on 1 August 2016

Vision:

To position Singapore as a renowned AV Knowledge and Research Centre to catalyse the testing and certification of AV Technology for urban cities

- build up technical capabilities and knowledge in testing and certification of AV capabilities,
- to facilitate drafting of regulations to allow eventual deployment of AVs on public roads

CETRAN launched event

CETRAN Partners:

jtc Breaking New Ground

Land Transport Authority We Keep Your World Moving

NANYANG TECHNOLOGICAL UNIVERSITY

Launch of Centre of Excellence for Testing & Research of AVs-NTU (CETRAN)

An enclosed test circuit located at **CleanTech Park** will be developed to support all the AV dedicated testing and certification activities.

Targeted to complete in **2nd half 2017**.

jtc Breaking New Ground

Land Transport Authority We Keep Your World Moving

NANYANG TECHNOLOGICAL UNIVERSITY

Launch of Mobility-on-Demand trials in one-north

On **1 August 2016**, LTA signed partnership agreements with **Delphi** and **nuTonomy** to :

- Test on shared, first-and-last-mile, and intra-town self-driving transportation concepts in the one-north test-bed.
- Develop and test autonomous mobility-on-demand (MOD) services for point-to-point mobility.

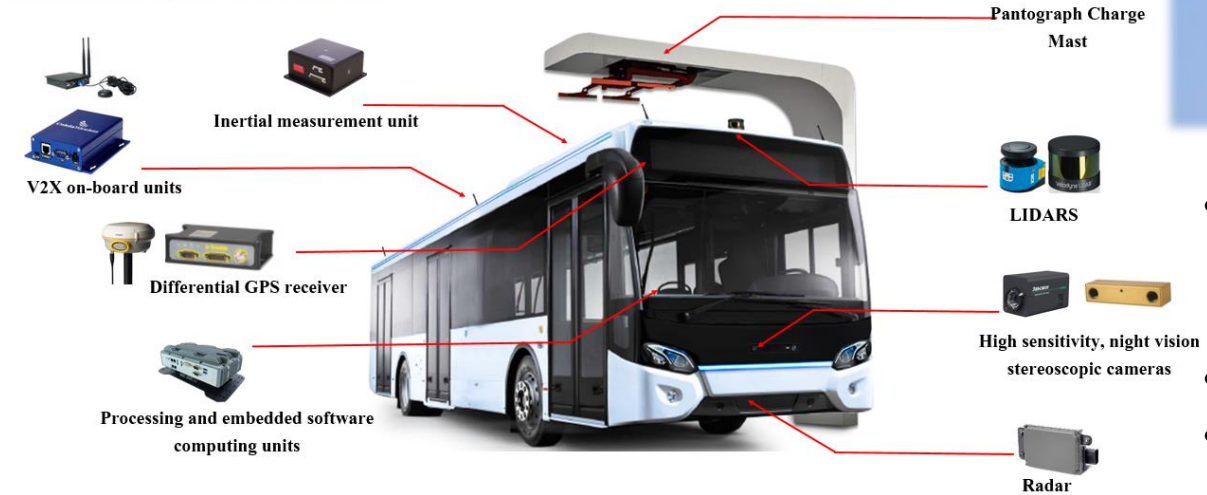
DELPHI

nuTonomy

Launch of Autonomous Bus Trial

- On 19 October 2016, LTA signed a partnership agreement with **Energy Research Institute@NTU (ERI@N)** to conduct autonomous bus trials for **fixed and scheduled services** for intra- and inter-town travel

Components of AV Robotics Kit



- Use of electric hybrid buses (with fast charging capabilities)
- Suite of intelligent sensors
- Study on adaptability to local bus operations and climate conditions

Other On-going AV initiatives in Singapore

NAVYA trial at Nanyang Technological University (NTU)

Auto-Rider at Gardens by the Bay

Upcoming AV Mobility-on-Demand trial on Sentosa island

V2X Initiatives in Singapore

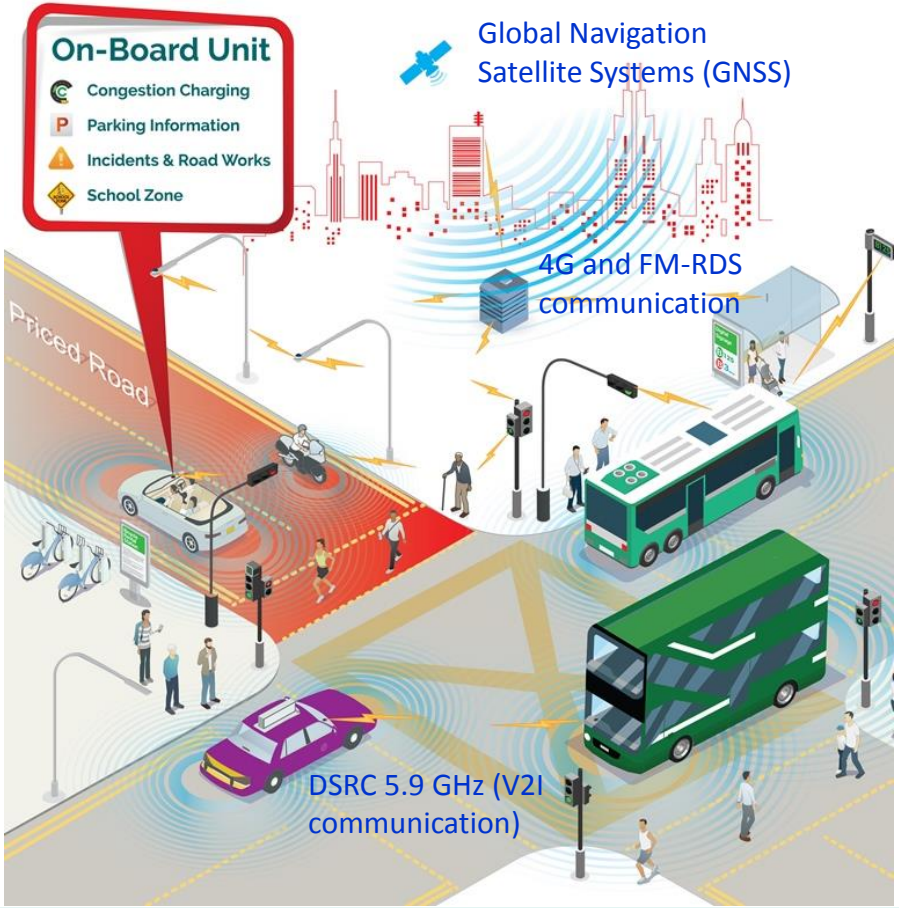
Intelligent Fleet Management Systems

Integrated Transport Management Systems

Vehicle-to-Vehicle Communications

Vehicle-to-Infrastructure Communications

Next-Gen Electronic Road Pricing System



Global Navigation Satellite Systems (GNSS) based system in urban environment

Target Deployment in 2020!

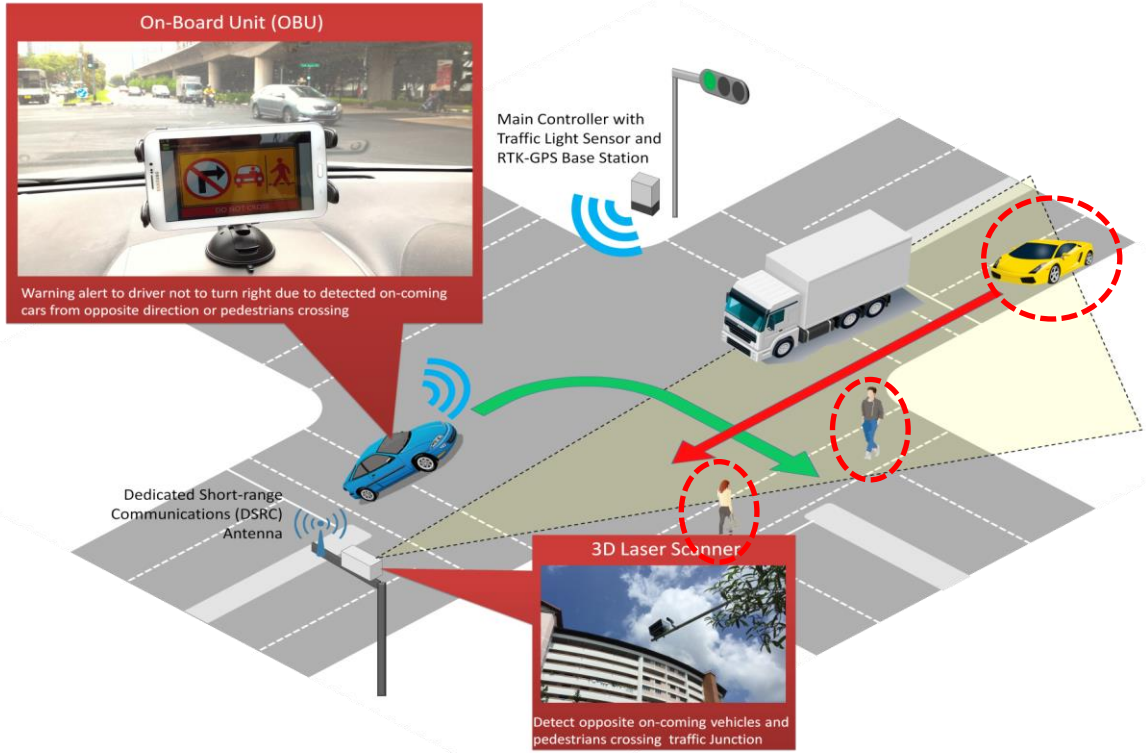
~1 million vehicles serving as probe sensors on the ground

Enabling technologies for ITS apps & services (E.g. V2X, Prediction, analytics)

Land Transport Authority

V2I Cooperative ITS Applications

Enhance Junction Safety Through V2I



- Detect crossing pedestrians
- Detect on-coming vehicles from opposite direction
- Obtain traffic signal status
- Provide and display alert warning messages on OBUs in cars/buses who are doing right turning at intersections

V2I Cooperative ITS Applications

Providing Vehicle Priority at Traffic Intersections

Public Buses

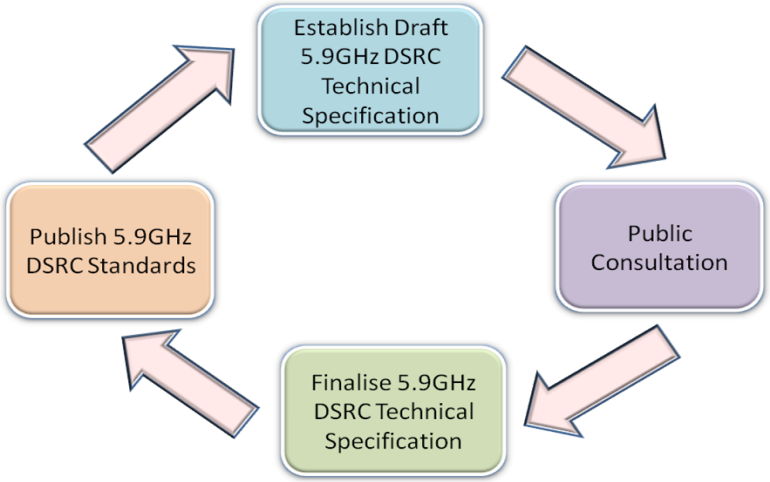
- Reduce variability in bus movement
- Enhance commuters' travelling experience by reducing waiting time.

Emergency Vehicles

- Facilitate emergency vehicles' response time to scene and hospital
- Save lives in life-threatening cases

Standardisation Efforts

- A taskforce comprising government agencies, Industry players and academic institutions was formed in 2014 to establish and adopt the 5.9GHz DSRC standards for ITS in Singapore.
- Public consultation on the proposed regulatory framework and standards was launched in Dec 2015.
- The standards was published in October 2016 downloadable @:
- http://www.imda.gov.sg



Looking Ahead

- AVs provide opportunities to support a sustainable transportation eco-system within Singapore
- The convergence of Autonomous Vehicles (AVs) and Connected Vehicles (CVs) is likely to influence and change the way V2X technologies are deployed.
- Appropriate standards is key to catalyze and support the implementation of V2X technologies in future ITS applications


Our Vision for Future New Town in Singapore


Singapore – Host City for 26th ITS World Congress 2019
21-25 Oct 2019
Thank You!!
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