AUSTRALIAN TRANSPORT SUMMIT 2017

Future Mobility in Singapore – Turning Disruptions into Opportunities

Jeremy Yap, Deputy Chief Executive (Public Transport, Policy & Planning),

Land Transport Authority, Singapore

18 August 2017

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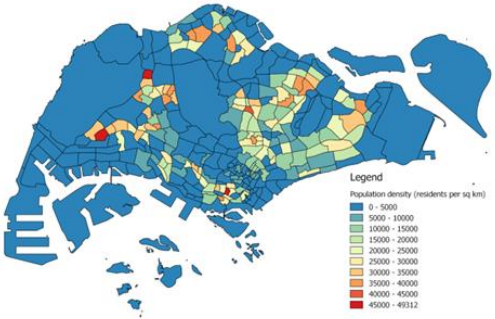
SINGAPORE

A SMALL BUT DENSELY POPULATED COUNTRY



Source: geodata-musing.blogspot.sg

	Singapore	**Sydney** (for comparison)
Total population (mil)	5.61	5.25
Land area (km^2)	719	12,368
Population density (no. of people/km^2)	7,800	424
Data as of 2016	*Source: Singstat*	*Source: population.net.au cityofsydney.nsw.gov.au*

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OUR UNIQUE LANDSCAPE

Growing Population and Economy

5.8 – 6.0 mil by 2020

6.5 – 6.9 mil by 2030

Tighter Land Constraints

12% of land for roads

14% of land for housing

Changing Expectations and Norms

Commuter-centric and inclusive transport system

Aging Population

By 2030: Only 2 persons under 65 for every 1 person above 65

In 2015, it was 5 persons to 1

Imperative to policy innovate and leverage on technology to address these challenges!

Manpower Crunch

Shortage of drivers (PT, logistics, etc.)

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ADDRESSING LAND TRANSPORT GOALS

Singapore

Land Transport Masterplan 2013

Australia

30-minute Cities Plan

More Liveable
More Productive
More Sustainable

Common goal of moving people quickly and efficiently

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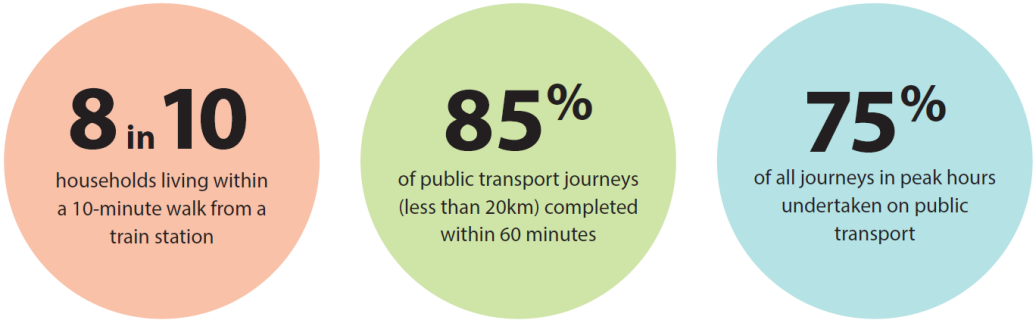
SINGAPORE'S LAND TRANSPORT MASTERPLAN 2013

By 2030,



Promoting Public Transport (PT) as the choice mode:

More reliable PT services

Expanded PT network

Better connectivity to PT nodes

Reducing reliance on private transport

Need to go Car-lite

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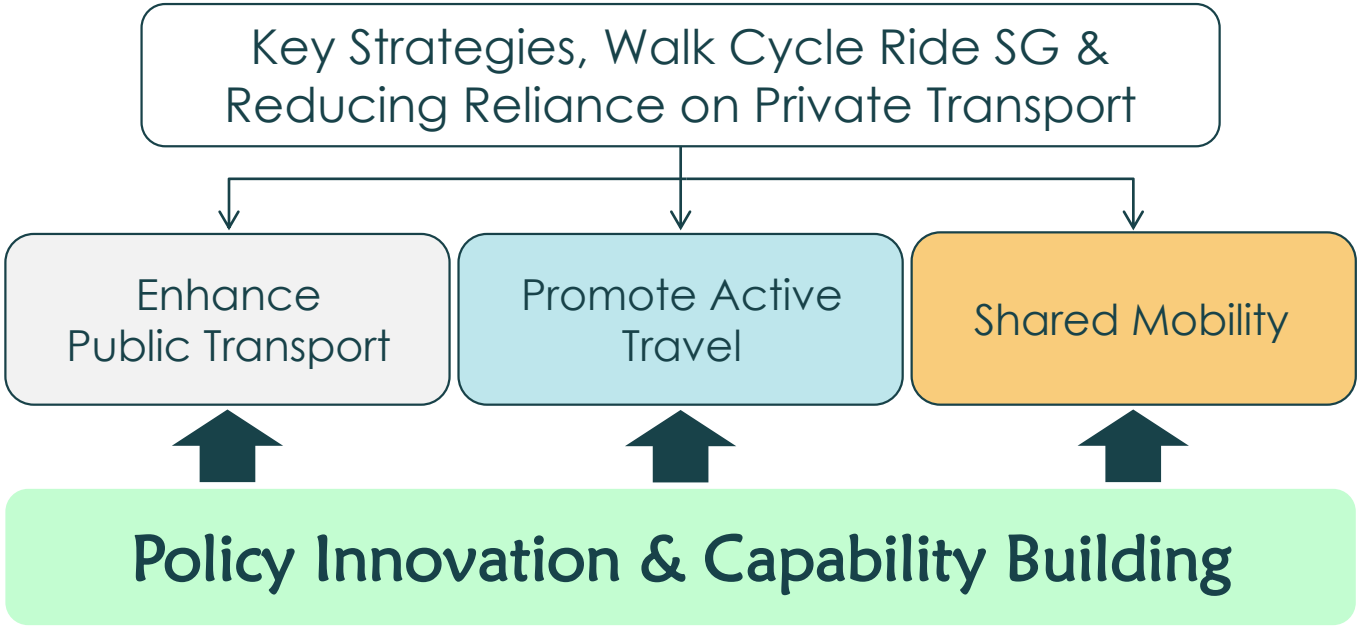
GOING CAR-LITE

MAKING TRANSPORT PUBLIC, SHARED AND ACTIVE



Enhance Public Transport

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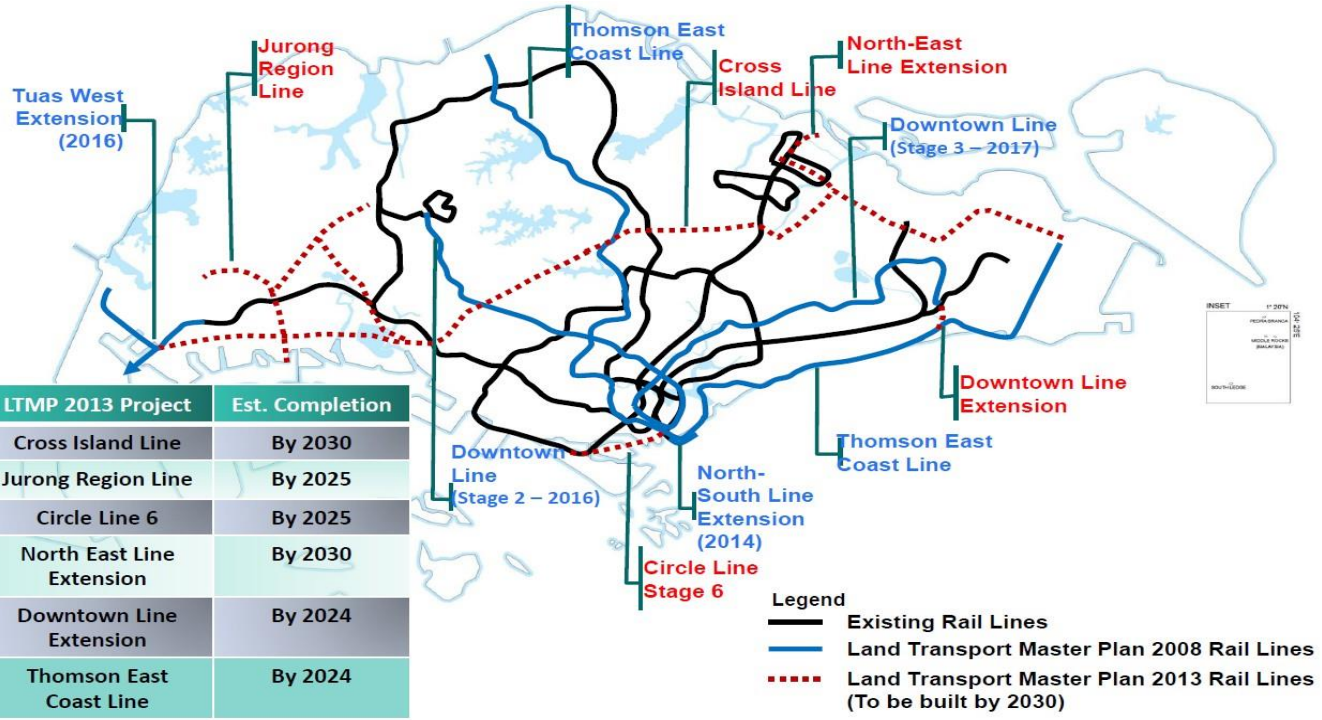
DOUBLING RAIL NETWORK TO 360KM



LTMP 2013 Project	Est. Completion
Cross Island Line	By 2030
Jurong Region Line	By 2025
Circle Line 6	By 2025
North East Line Extension	By 2030
Downtown Line Extension	By 2024
Thomson East Coast Line	By 2024

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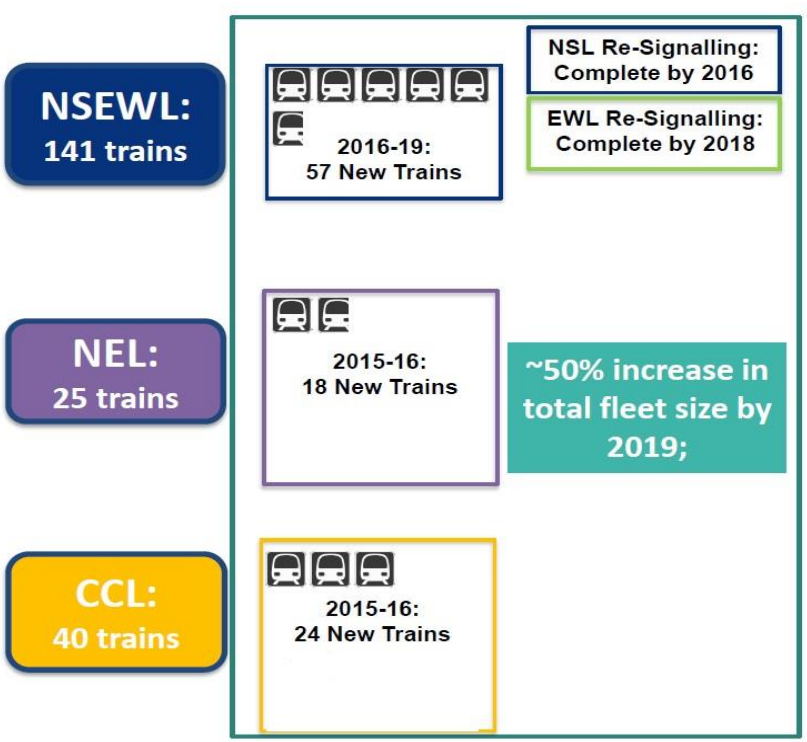
INCREASING RAIL CAPACITY



As short as 100-110 sec peak period wait time, from current 2.3 min

~25% improvement in peak period wait time with improvements

Peak period wait time no more than 2 min, from current 2.7 min

Wait time no more than 5 min at all times*; achieved for NSEWL and NEL in 2014, CCL in 2016

*except when trains have to be withdrawn to or launched from depots in the early morning/ late nights or for maintenance activities to sustain reliability.

Peak period wait time no more than 2.7 min, from current 3.5 min

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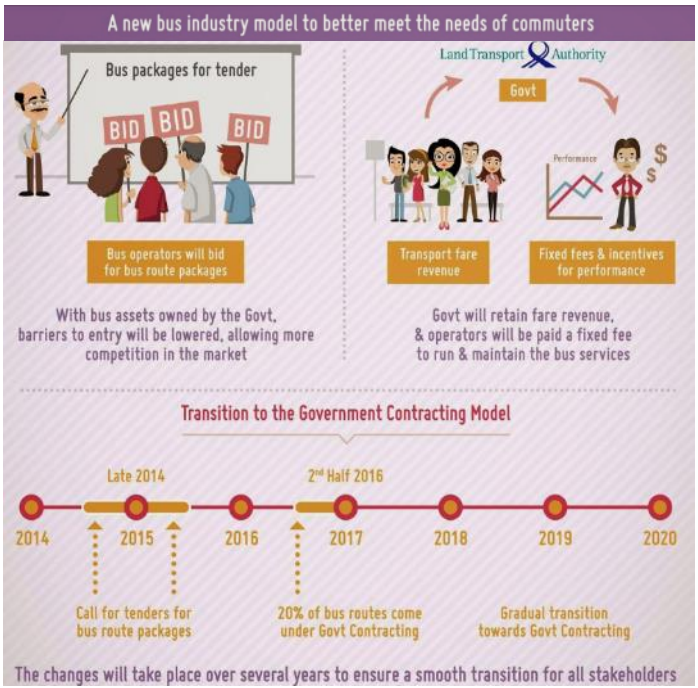
EXPAND BUS FLEET & NETWORK CONNECTIVITY

Bus Service Enhancement Program (BSEP)

As of October 2016

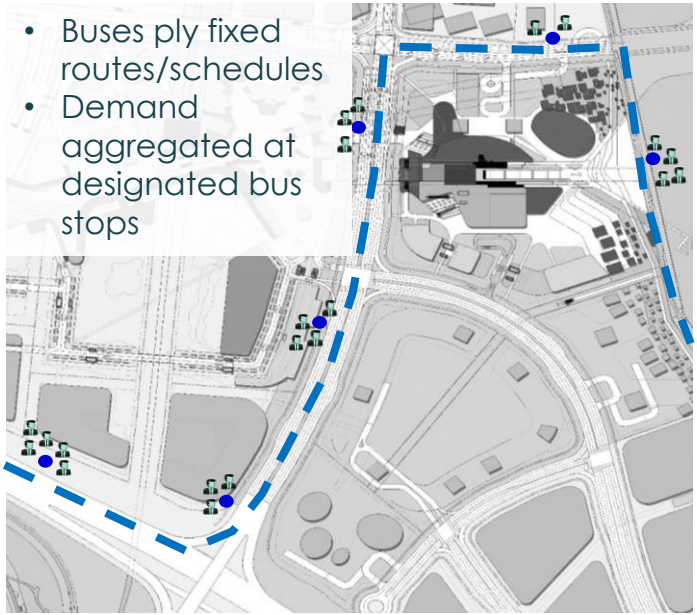
Bus Contracting Model (BCM)



DEMAND RESPONSIVE BUS SERVICES

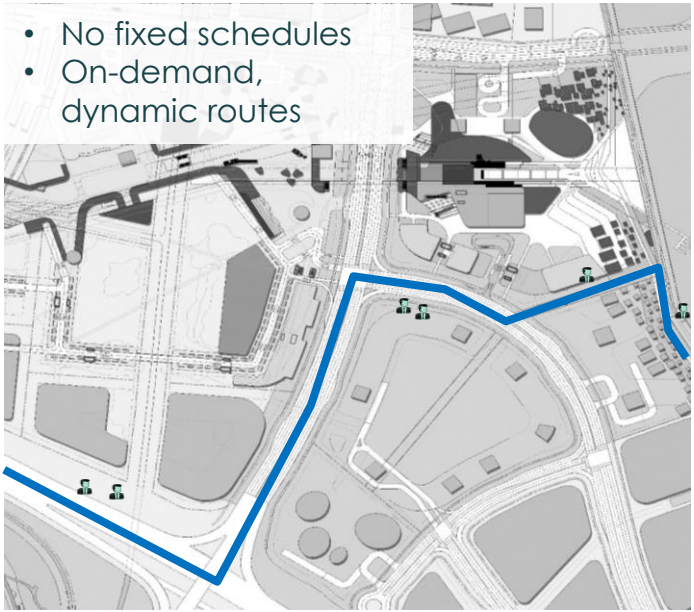
Normal Bus Services

- Buses ply fixed routes/schedules
- Demand aggregated at designated bus stops



Demand Responsive Bus Services

- No fixed schedules
- On-demand, dynamic routes



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DRBS – BENEFITS TO COMMUTERS

Efficiency

Dynamic routing could enable the DRBS to travel on a shorter route based on commuter demand, hence optimizing their waiting & total journey time

Convenience

DRBS can obviate the need for commuters to seek transfer onto connecting bus services as it is not restricted by fixed routes

Affordability

Efficient deployment of resources can bring about cost savings to sustain the improved PT service quality for our commuters (without incurring additional costs)

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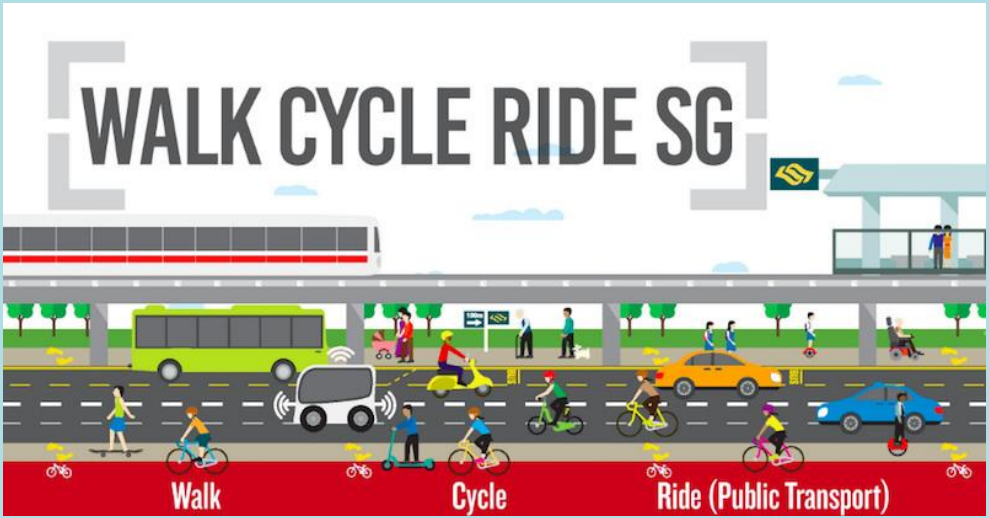
Promote Active Travel



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WALK CYCLE RIDE

Beyond LTMP 2013, Singapore has embarked on the **Walk Cycle Ride SG** strategy to build a car-lite Singapore that is so well connected that people actively choose to **walk**, **cycle**, and **ride** to get around.

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WALK2RIDE PROGRAMME

- 200km of new sheltered walkways by 2018
- Sheltered connectivity between transport nodes and:
  - ✓ Schools
  - ✓ Health care facilities
  - ✓ Residential developments
  - ✓ Public amenities

  within 400m radius of all MRT stations and within a 200m radius of all LRT stations and bus interchange
- Barrier-free connectivity
  - ✓ Signage
  - ✓ Network maps

Covered walkways for 59 MRT stations by 2018

Commuters need not fear rain or shine with extra 200km planned

By LEE JIAN XUAN

HEARTLAND commuters will have sheltered walkways within a 400m radius of their nearest MRT station by 2018.

The Land Transport Authority (LTA) announced in a statement yesterday that work on these walkways will begin in the final quarter of this year and be completed progressively over the next four years.

The move will add more than

A sheltered walkway linking the Lakeside MRT Station with the bus interchange. The Walk2Ride scheme will connect all MRT stations via such walkways to schools, homes and public amenities within a 400m radius. PHOTO: BERITA HARIAN

The Straits Times
30 May 2014

Sheltered Walkways

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BOOSTING CYCLING INFRASTRUCTURE

- 700km of cycling paths by 2030
- Increasing bicycle-friendly infrastructures:
  - ✓ Bicycle crossings
  - ✓ Bicycle parking facilities
  - ✓ Bicycle wheeling ramps
- Improving intra-town connectivity
  - ✓ Every HDB town to have cycling network by 2030
  - ✓ Connect transport nodes to homes and key amenities
  - ✓ Develop model "walking and cycling towns"


Ang Mo Kio to be model walking, cycling town

Work starts on 20km cycling path network to enable seamless travel for pedestrians and cyclists

The Straits Times
19 March 2016


Bicycle crossing


Bicycle wheeling ramp


Cycling path at Ang Mo Kio (model town)

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ACTIVE MOBILITY INITIATIVES

Foldable bikes, PMDs on buses, trains all day

After successful six-month trial, move will be made permanent

Melissa Lin

Commuters will be able to continue taking their foldable bicycles and personal mobility devices (PMDs) development Authority announced yesterday plans for cycling routes in the central area that will be en, the LTA had said. They were more often seen at interchange stations such as Jurong

The Straits Times
29 May 2017

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SHARED MOBILITY

THE RISE OF SHARING ECONOMY

- As people warm up to the concept of a sharing economy, more are "paying-to-use" as opposed to "paying-to-own" – we are seeing the same trends in transport
- The sharing economy has resulted in disruption to the taxi industry in the form ride-sharing services such as Uber and Grab

Source: Mon IPAG

Source: Mon IPAG

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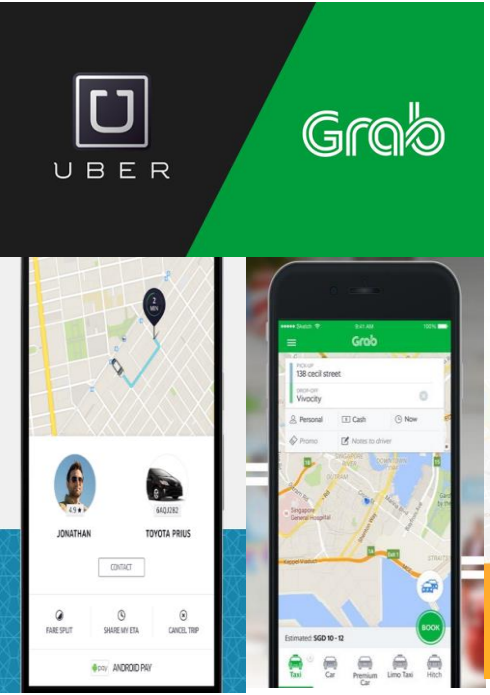
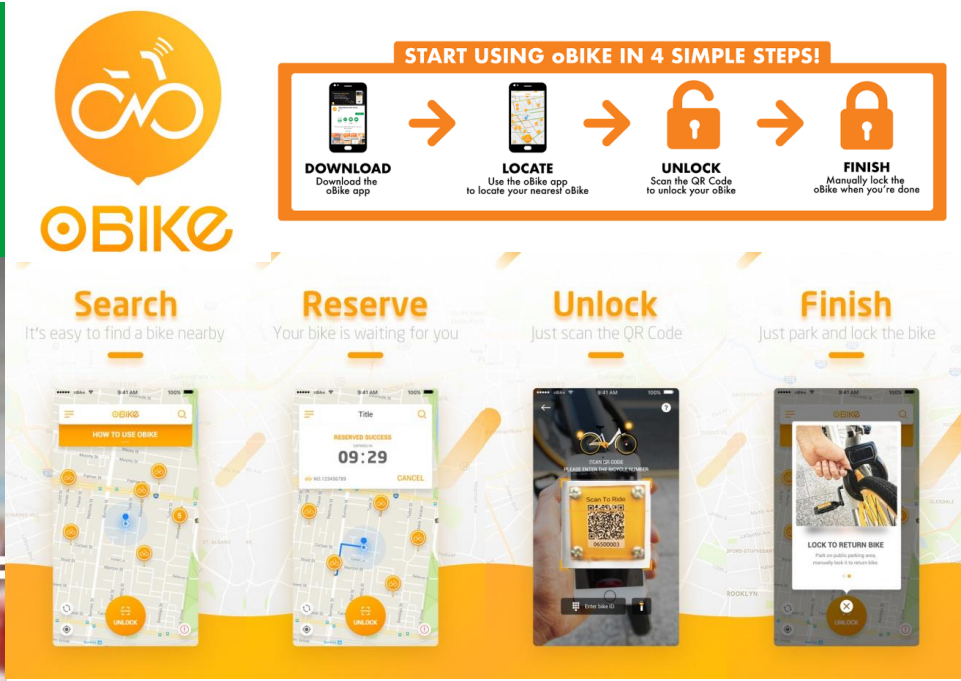
DISRUPTIONS ARE ALREADY HAPPENING





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EMBRACING DISRUPTIONS – PRIVATE HIRE CARS

- Innovation should facilitate benefits to commuters
- Vocational Licensing of private-hire car drivers
- "Light touch" regulation of third-party taxi applications
- New regulations will level-up driver requirements, protect commuter interests, while allowing the disruptors to grow and offer commuters more options

Law to regulate taxi booking services

By LIM YAN LIANG

WHILE some regulation of third-party taxi booking services is necessary to protect commuter interest and safety, Transport Minister Lui Tuck Yew said a light-touch approach will be adopted in how the Government regulates such service providers operating here.

He said this yesterday before Parliament approved a Bill making it necessary for third-party taxi booking services that have more than 20 participating taxis, to register with the Land Transport Authority (LTA) in order to operate in Singapore.

The Straits Times
12 May 2015

GrabCar, Uber drivers to be licensed

Transport app drivers will also have to go for medical checks, background screenings

Adrian Lim

two years. Both permanent residents and work permit holders are

The Straits Times
13 April 2016

THE STRAITS TIMES

LTA has received 39,000 applications for the Private Hire Car Driver's Vocational Licence

The decals used by Grab to indicate the private-hire car driver has applied for their Vocational Licence ST PHOTO: KUA CHEE SIONG
PUBLISHED JUN 23, 2017, 2:00 PM SGT
UPDATED 1 HOUR AGO

SINGAPORE - The Land Transport Authority (LTA) has received about 39,000 applications for the Private Hire Car Driver's Vocational Licence (PDVL) as of June 21.

The Straits Times
23 June 2017

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EMBRACING DISRUPTIONS – PERSONAL MOBILITY SOLUTIONS

- LTA called a tender in July 2016 for a bicycle-sharing scheme comprising 2,300 bicycles and 230 docking stations across Singapore
- Received 13 bids and scheduled to launch scheme by end 2017
- However, with the emergence of market disruptors since early 2017, **LTA boldly aborted the bicycle-sharing tender**

LTA shelves govt-run bicycle-sharing plans

Three private firms already looking to offer thousands of bikes over next two years: LTA

Zhaki Abdullah

to launch this year-end with more than 2,300 bicycles in the Jurong

tors have obviated the need for a government-run system backed by government grants," LTA said. It will "continue to monitor developments in the bike-sharing landscape, and introduce new plans if necessary".

First proposed three years ago,

turned at specialised docking stations. Around 210 such stations were planned for Singapore.

Since then, a new kiosk-free bike-sharing model has emerged. This "dockless" system uses an app by which users can locate the bikes for

The Straits Times
25 March 2017

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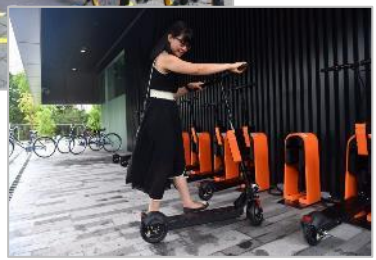
EMBRACING DISRUPTIONS – PERSONAL MOBILITY SOLUTIONS

- Latest solutions offered by the industry
  - Dockless bicycles
  - E-scooter sharing
- Embracing disruptions mean being prepared to abort conventional models to seize opportunities
- Open and ready to welcome new forms of personal mobility solutions as and when the industry is ready
- Allowing space for disruptors:
  - Designating bicycle parking zones
  - Requiring operators to provide direct feedback channels, ensuring prompt bicycle removal

Demarcated area for dockless bicycle parking outside Promenade MRT



Source: Straits Times

Pick up e-scooter or bike at Science Park 1

50 e-scooters, 20 bikes will be available for rent across six parking zones in park area

Zhaki Abdullah

An e-scooter and bicycle rental

Neuron joins another start-up, Telepod, which recently launched a

The Straits Times
15 June 2017

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AVs FOR PUBLIC TRANSPORT

- We envisage AV technology complementing existing public transport system by enhancing connectivity to major transportation nodes (MRT stations and bus interchanges), through:
  - Autonomous buses providing fixed and scheduled services
- Not encouraging private AV ownership but AVs for public transport
  - Point-to-point mobility-on-demand services providing first-mile/last-mile connectivity
  - Backbone of our sustainable urban mobility strategy will still be Public Transport and its mass transit movement
    - Almost all of our metro lines are already driverless!

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REGULATORY SANDBOX TO SHAPE OUR REGULATIONS

Passed the Road Traffic (Amendment) Bill in early 2017:

- To provide the Minister with the power to make rules to regulate the use of AVs
- Powers include the ability to exempt or modify existing provisions
  - Changes, if required, can be made quickly to adapt regulations in response to rapid developments in AV technology

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BUILDING CAPABILITIES IN SINGAPORE

On 1 August 2016, CETRAN was launched to:

- Build up technical capabilities and knowledge in the testing and certification of AV capabilities
- Facilitate the drafting of regulations to allow eventual deployment of AVs on public roads

CETRAN will also operate an AV test circuit that will support AV testing and certification activities.

CETRAN Partners:

TÜV SÜD, TUM CREATE, BMW, TNO

Land Transport Authority – We Keep Your World Moving

jtc – Breaking New Ground

NANYANG TECHNOLOGICAL UNIVERSITY

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

FACILITATING TRIALS

THE STRAITS TIMES

Driverless vehicle trial routes expand by 55km to NUS, Buona Vista and Dover

The Straits Times
23 June 2017

LTA extends driverless car test circuit by 55 km

By Soon Weilun
soonwl@sph.com.sg
@SoonWeilunBT

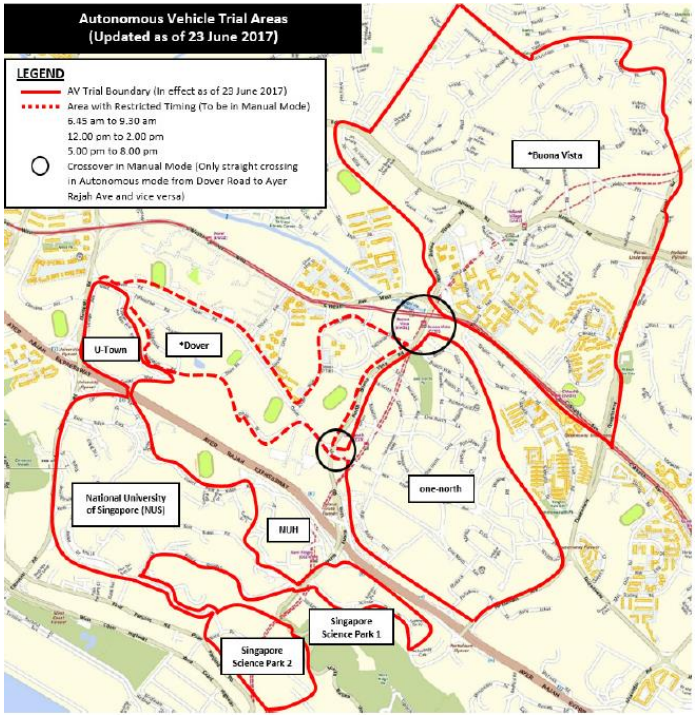
Singapore

SINGAPORE is extending the length of

ments in autonomous mode.

To inform the public, signboards will be put up in the test areas to indicate that trials are being carried out. All AV test vehicles will continue to sport decals and

The Business Times
24 June 2017



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AN ECOSYSTEM OF TRIALS

Fixed Routes & Scheduled Services

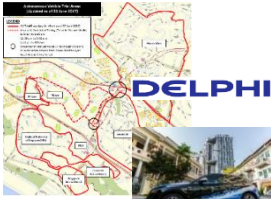
Autonomous Vehicle Trials @ NTU-CleanTech Park

Autonomous Bus Trials @ potential JTC sites, e.g. NTU-CleanTech Park, Jurong Island, etc

Autonomous Shuttle @ Gardens by the Bay

Point-to-Point Mobility on-Demand

Autonomous Vehicle Mobility-on-Demand Trials @ one-north



Autonomous Shuttle @ Sentosa

Development efforts on-going on 2 Navya Armas and 2 ST-built shuttles

SHAPING THE MARKET – LEADING DEVELOPMENTS IN AUTONOMOUS BUSES

LTA in partnership with:

Energy Research Institute at Nanyang Technological University (ERI@N)	Singapore Technologies Kinetics (STK)
• Signed agreement in Oct 2016 • 2 electric autonomous buses • Trialled on roads between NTU and Cleantech Park • Opportunistic charging technology (recharged when they stop at a bus depot or bus stops)	• Signed agreement in April 2017 • 2 full-sized 40-seater electric autonomous buses • To serve fixed and scheduled services for intra- and inter-town travel • Trialled in various environments of increasing complexity • Subject buses to as many scenarios as possible

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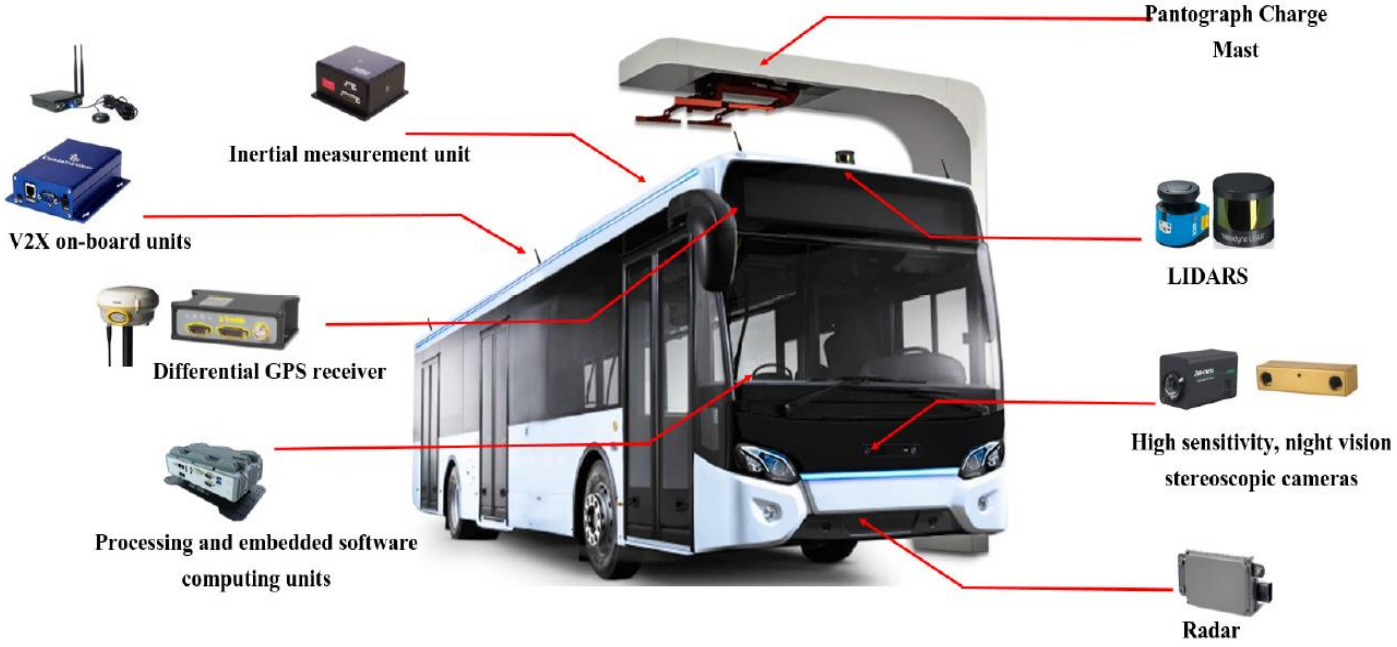
ERI@N'S ELECTRIC AUTONOMOUS BUS



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STK'S ELECTRIC AUTONOMOUS BUS

Commuters can catch a driverless public bus by 2020

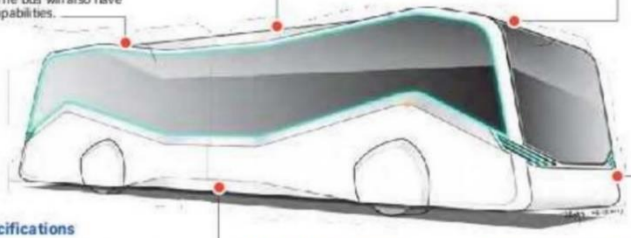
Consortium led by ST Kinetics expects to unveil battery-powered prototype by early next year

ST Kinetics' autonomous bus prototype

Connectivity
The autonomous bus will be equipped with vehicle-to-vehicle and vehicle-to-infrastructure connectivity to communicate seamlessly with other autonomous vehicles and infrastructure. The bus will also have Wi-Fi and 4G capabilities.

Precise positioning
The bus will use a Global Positioning System. It will also be fitted with sensors to scan the surroundings and determine the vehicle's position in any environment.

Perception sensors
Perception sensors will provide 2D and 3D maps of the environment to allow the bus to avoid obstacles.



Vehicle Specifications

Size	12m (length) x 2.55m (width) x 3m (height)
Carrying capacity	36 seated, 33 standing, 1 wheelchair (configurable)
Doors	Three
Maximum operating speed	Up to 60km/h
Typical range	30-50km

Body and powertrain
The bus will have an all-aluminium body and chassis. It has electric motors powered by two choices of batteries.

Pedestrian and vehicle detection
Radars and sonars will cover the area within 10m in front of the vehicle and scan the surroundings before the bus moves off. Long-range radars will detect vehicles that are up to 200m ahead. Cameras will detect obstacles and supplement perception maps with environmental analysis and classification (such as road signs and traffic lights).

Source: LTA STRAITS TIMES GRAPHICS

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TRIALS ON POINT-TO-POINT MOBILITY-ON-DEMAND SERVICES

- Ministry of Transport, Sentosa Development Corporation and ST Kinetics signed an agreement in April 2017 to develop and trial 4 mobility-on-demand vehicles (MODVs)
- Visitors will be able to call for the MODVs via their smartphones or information kiosks located across the island
- When deployed in 2019, the MODVs will provide self-driving shuttle service to island visitors on-demand to serve their intra-island travel needs in Sentosa

Artist's impression of the ST Kinetics-built MODV

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AVs FOR FREIGHT AND UTILITY

Freight

Truck Platooning for Port Operations

PSA The World's Port of Call

- MOT and PSA signed agreements with Scania and Toyota for trials
- Comprises 1 human-driven truck with 3 driverless follower trucks
- Trial in enclosed port area and open roads on West Coast Highway

Utility

National Environment Agency
Safeguard · Nurture · Cherish

Road Sweeping

- MOT and NEA launched Request for Information on self-driving utility vehicles
- Common mobility platform, multiple use cases
- Functional autonomy, road sweeping etc.
- Specialised self-driving capabilities, e.g. kerb following and obstacle avoidance

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BUILDING CAPABILITY

CAPACITY & COMPETENCY

For Conventional Projects

&

For Emerging Areas

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BUILDING CAPACITY AND COMPETENCY FOR EMERGING AREAS

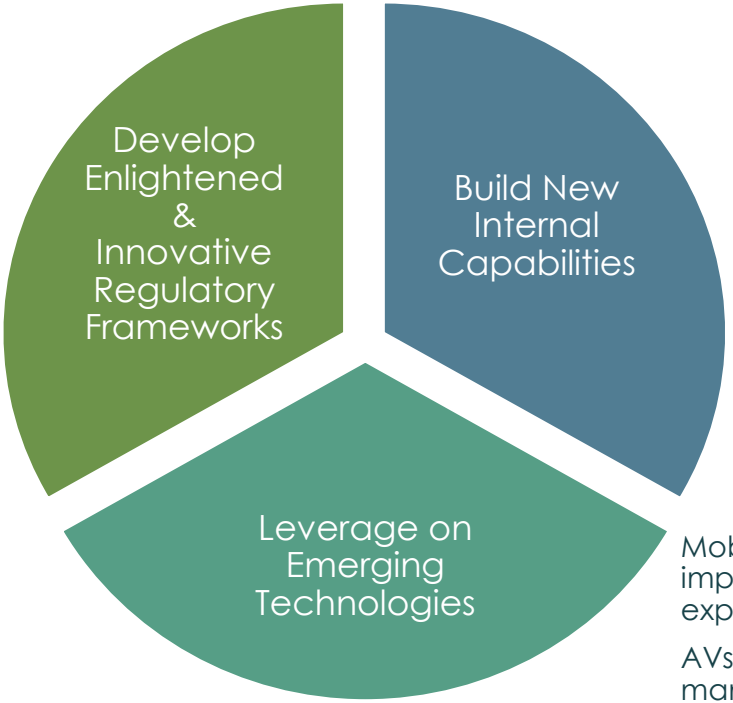
Rules that allow for co-existence of new and conventional mobility markets

Policy innovation needs to be responsive

Calibrated licensing for light regulatory touch

Self-regulation and internal discipline

Industry activation of market players



Data Science & Fusion Analytics

Planning Analytics

Economics (Social Sciences) Unit

AV & Automotive Engineering

Mobility Sensors to improve commuters' experience

AVs to relieve manpower crunch

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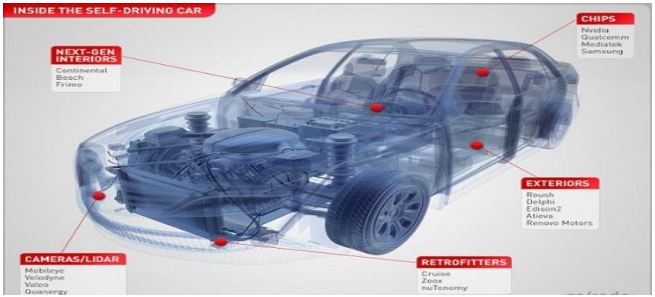
BUILDING NEW INTERNAL CAPABILITIES

Data Science and Analytics Division

Economics Unit

Planning Analytics Unit



Ops Research, Automotive and Software Engineers

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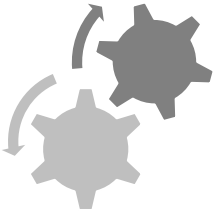
RESTRUCTURING: NEW "LTA TECHNOLOGY & INDUSTRY DEVELOPMENT GROUP"

Future Mobility

Industry Development



SG Rail Academy

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UPSKILLING THE TRANSPORT WORKFORCE

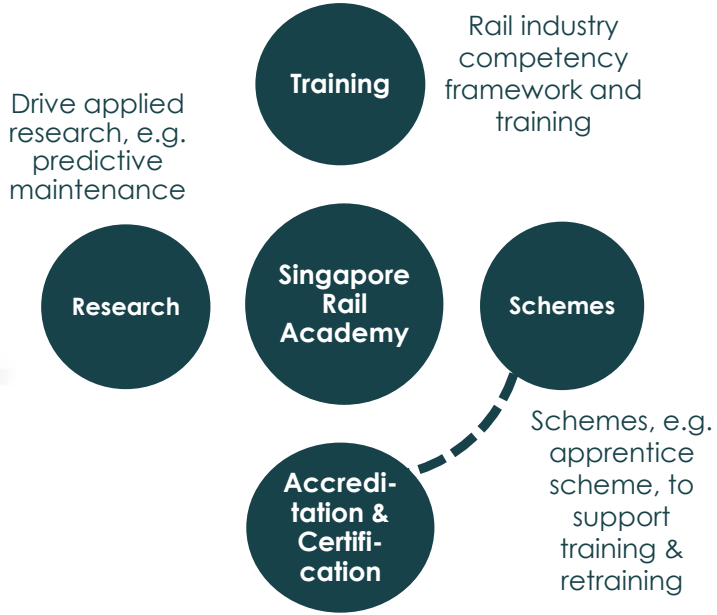
Singapore Bus Academy

One-stop training, test and accreditation centre for bus professionals

Continual Training & Skills Deepening

Enhanced Vocational License (VL) Training Programme

Singapore Rail Academy



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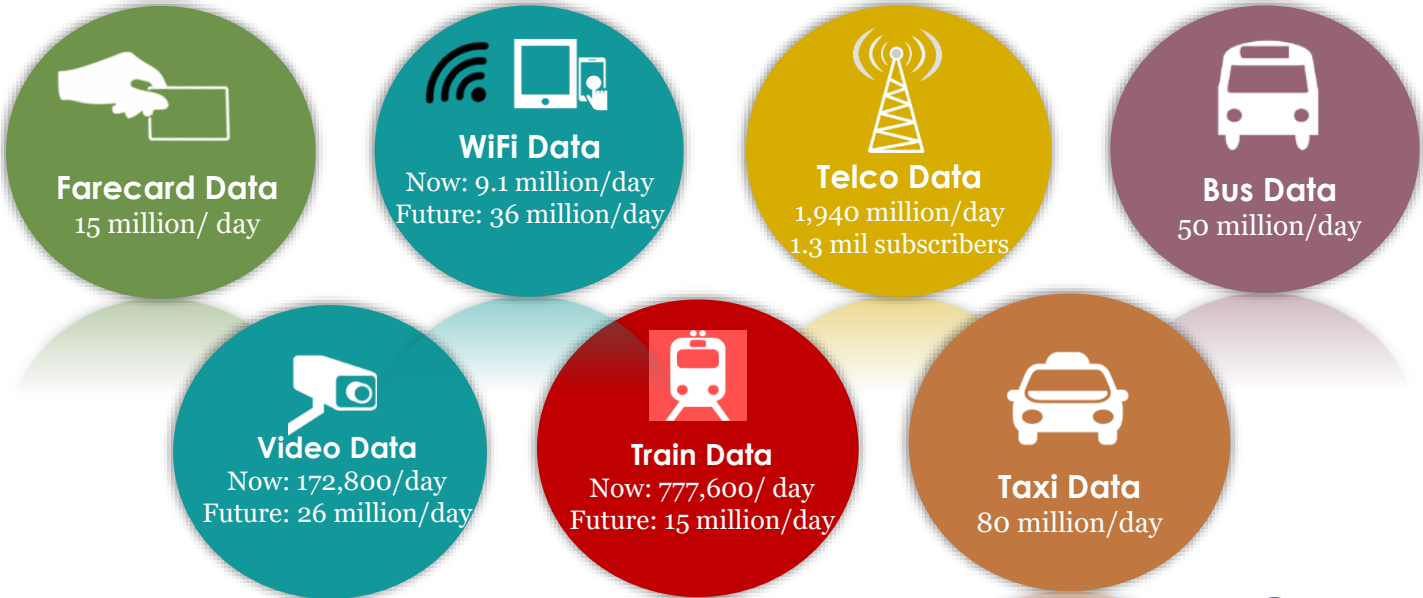
LEVERAGING EMERGING TECHNOLOGIES

Improving Commuting Experience Using Mobility Sensors



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PT INDUSTRY TRANSFORMATION MAP

PT ITM Vision

A technology-enabled PT industry supported by a highly competent workforce

Technology, Innovation & Productivity (Rail)

- Leverage on industry partnership to enhance data availability
- Enhance rail asset management
- Enhance rail reliability through technology adoption/deployment

Technology, Innovation & Productivity (Bus)

- Enhance bus design, operations and maintenance regime through technology adoption and innovation (e.g. data analytics, EV, AV)
- Enhance bus interchange management system and network optimisation

Jobs & Skills

- Identify the current, intermediate and long term manpower & skills requirements
- Capability development through rail/bus academies
- Centralised talent pool management
- Enhance job mobility and transition within the industry

Regulations & Internationalisation

- Enhance regulatory frameworks to support industry collaboration, facilitate data sharing and encourage technology adoption & innovation
- Establish and enhance G-G ties to support internationalisation

Key Enablers

- Government leads and sponsors industry integration and good industry practices (e.g. funding to incentivise technology adoption and innovation)
- Strengthen partnership with the Union to prepare the workforce for industry transformation

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WHAT'S NEXT

The Hoversurf Scorpion, a human-carrying drone developed by a Russian startup, has already been prototyped and could be an urban-mobility option for Singapore.

Singapore in talks with firms to try out 'flying taxis'

Transport Ministry looks at aerial taxis and on-demand dynamic-routing bus services for the future

to pay for different mobility services tailored for different kinds of journeys. Mr Pang said that it may thus be possible to ride in a driverless pod to work, cycle to the gym after work,

The Business Times
24 March 2017

Source: Volocopter VC200

Source: Ehang 184

LEARNING POINTS FROM LTA'S TRANSFORMATION JOURNEY

- We are forging ahead with developing an exciting future for mobility and are determined to LEAD the TRANSITION
- While there are technological/digital/business model disruptions, we can turn them into opportunities to improve transportation
- Policy and regulatory innovation are key
- When building capabilities, it is not just the organisational perspective. Industry transformation is also crucial for success
    - Need to develop and transform our industries to take advantage of economic opportunities, elevate the skills and capabilities of our workforce, and create new and better jobs.
- We look forward to developing this exciting future for mobility in Singapore and improving the quality of life and the living environment for Singaporeans

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THANK YOU

Land Transport Authority