GRANT CALL FOR SOLUTIONS TO I) REDUCE PUBLIC TRANSPORT JOURNEY DURATION, II) OPTIMISE PUBLIC TRANSPORT SERVICES TO MEET DEMAND AND III) REDUCE LAND USED FOR ROAD CARRIAGeways

1. OVERVIEW

1.1. We would like to position our public transport system to be the choice mode of travel to support continued sustainable growth in travel demand. Some factors that may prevent increased uptake include the availability of public transport, especially during peak hour travel. To encourage more people to shift to public transport, we need to reduce public transport travel times and optimise public transport travel (for example, by reducing incidences where commuters are unable to board).

1.2. At the same time, the above objectives need to be balanced against cost and use of public resources, including land use for road carriageways, to ensure that our public transport system remains affordable and sustainable.

2. SCOPE

2.1. LTA is launching a grant call for proposals that will leverage on research and technology to

(i) Reduce the duration of journeys on public transport,
(ii) Optimise public transport services to meet demand, and
(iii) Reduce land used for road carriageways

Detailed focus areas are elaborated in the table below. The focus areas are meant to be a guide and may not be exhaustive. Proposed projects which do not fall under any of the focus areas but are able to demonstrate how it would contribute towards these aims will be considered. The proposed solutions should be research and technology-driven, rather than infrastructure-driven (e.g. purchase of additional trains and buses).

**Focus Area A: Reduce Duration of Public Transport Journeys**

| Challenge | As part of the 2013 Land Transport Master Plan (LTMP), LTA aims for 85% of public transport journeys within 20km to be completed within 1 hour. Previous travel surveys have shown that First Mile-Last Mile (FMLM) travel takes up a significant proportion of the |
time on public transport journeys, where First Mile refers to the movement of people from their origin onto their first public transport mode, while Last Mile refers to movement of people from the last public transport mode to their destination. Examples of journeys are shown in the table below, while further details are in Appendix 1. Within the public transport segment, travel surveys also show that the duration of public transport journeys involving buses or mixed bus-MRT modes is longer compared to those on rail. This is due to the need for transfers, as well as the greater susceptibility of buses to be impacted by general traffic conditions. In particular, significant sources of delays for buses include time spent waiting at traffic junctions or bus stops when merging back into main traffic.

<table>
<thead>
<tr>
<th>Entire Journey</th>
<th>Start (First mile)</th>
<th>Public Transport (including transfers)</th>
<th>End (Last mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>Rail</td>
<td>Walk</td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td>Bus -&gt; Rail</td>
<td>Walk</td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td>Bus -&gt; Bus</td>
<td>Walk</td>
<td></td>
</tr>
<tr>
<td>Cycle</td>
<td>Bus</td>
<td>Walk</td>
<td></td>
</tr>
<tr>
<td>Shared Transport</td>
<td>Rail</td>
<td>Shared Transport</td>
<td></td>
</tr>
</tbody>
</table>

**Current Situation**

LTA is rapidly expanding Singapore’s rail network to provide commuters with easier access to public transport. By 2030, 8 in 10 households will be within a 10 minutes’ walk from a MRT station. LTA has also introduced policies such as dedicated bus lanes and mandatory give-way to buses. This provides buses with priority when travelling along more congested road stretches. At the same time, LTA implemented the Bus Service Reliability Framework to reduce instances of bus bunching and decrease waiting times for commuters. LTA has also provided predictions of bus arrival times at bus stops through the MyTransport application, to allow commuters to plan their journeys more accurately.

**Possible Solutions (but not limited to)**

This call seeks new ways to reduce the duration of public transport journeys. Research efforts could include, but are not limited to, (a) bottleneck identification and solutioning to FMLM travel; (b) improving travel speeds of buses via technology interventions in
the form of providing a green wave for buses / priority at traffic
junctions; (c) dynamic lane markings to reduce bus-private vehicle
conflicts; or (d) new ticketing technologies to reduce time
required to board and alight from buses.

**Requirements**

This focus area is for research that will develop technology
solutions that could help reduce the duration of public transport
journeys. Proposals should identify what challenge they aim to
address, propose innovative solutions to overcome these
challenges, and recommend how the baseline and impact would
be measured. Proposals may wish to also identify suitable
locations to carry out trials, and engage potential collaborators
such as the public transport operators.

**Focus Area B: Optimise Public Transport Services to Meet Demand**

**Challenges**

Peak hour travel is traditionally dominated by work trips from
residential areas to employment zones. This trend remains today
given Singapore’s land use where majority of the residential areas
are located away from key employment zones such as the central
business district. Moreover, businesses prefer traditional working
hours, and location within the central business district or at other
key employment zones. The clustering of employment zones and
working hours poses a challenge to manage the peak hour public
transport travel density.

In order for public transport to be a choice mode for commuters,
it has to be able to meet travel demand effectively. However, this
cannot be at the expense of affordability. There is a need to find
a balance so that our public transport system can remain
affordable for Singaporeans.

Our challenge is therefore to find solutions that are able to meet
public transport demand, particularly at peak hours, while best
utilising our resources to ensure that we have a minimum
utilisation rate and manage demand in the outliers in an efficient
manner.

**Current Situation**

To help improve the availability of public transport, LTA has
introduced more bus services via the Bus Service Enhancement
Programme (BSEP). In particular, new city direct services have been started to augment supply in peak hours. To improve the quality of bus services, LTA has also transited the industry to the Bus Contracting Model with government bearing fare revenue risk while operators focus on bus operations. With the transition, 75% of bus services have become less crowded during peak hours and there have been a 25% reduction in average additional wait time for close to 290 bus services. However, the utilisation at some bus stops remains high, as shown in Appendix 2. In August 2017, LTA has also called a tender for “on-demand, dynamically routed” bus services that would respond to real-time demand through use of a mobile app. This aims to optimise the first and last-mile public transport options in areas with low ridership.

The government has also introduced incentives to encourage off peak travel, with schemes such as Off Peak Travel Pass and Travel Smart Rewards. Beyond the transport front, Singapore has also tried to introduce more residential land use within employment zones to reduce the need for long work trips. There are plans for regional centres to supplement the Central Business District to help to spread out the load on travel corridors. The government has also rolled out initiatives to encourage flexible working arrangements such as telecommuting or flexible working hours.

Possible Solutions (but not limited to) This call seeks new ways to leverage research and technology to optimise public transport services to meet demand. Research areas could potentially include, but are not limited to, (a) developing an adaptive journey planner that incorporates artificial intelligence to provide commuters with real-time information on travel times and crowdedness of various travel options, and which will also facilitate transfers across different public transport modes; (b) reducing travel distances for work trips via setting up satellite smart work centres to allow people to work near their homes; (c) enabling more efficient and demand-responsive management of buses to optimise the use of our bus fleets; (d) designing cost-efficient designs and systems to optimise the use of our rail system during off-peak hours; (e) developing innovative simulation models to assist in planning of bus routes and optimisation of bus and rail operations; (f) better identification and prediction of travel demand. Solutions could aim to either
reduce peak hour travel demand, or optimise the supply of public transport services in order to make the best use of resources.

| Requirements | This focus area is for research that will develop technology solutions to optimise demand for public transport services with spare capacity during peak hours in the areas of planning, infrastructure as well as public transport service design. Solutions should also aim to achieve resource optimisation by either reducing resources needed or keeping it at status quo. Proposals should identify what challenge in improving the public transport peak hour travel density they aim to address, propose innovative solutions to overcome these challenges, identify potential challenges in the development and implementation of such systems and platforms, propose innovative solutions to overcome these challenges, and recommend how the impact would be measured. |

**Focus Area C: Reduce Land Used for Road Carriageways**

| Challenge | In land scarce Singapore, roads take up a significant amount of land space. While Singapore has made significant and sustained investments to expand and develop our road infrastructure to ensure good connectivity for people and goods, these efforts cannot be unabated. Land used for roads to support the needs of private cars is less efficient as compared to other transport modes. Land is also needed in the form of car parks and access roads, should our strategy continue to be centred on private cars. To continue to cater for the growth in Singapore’s population and economy – and correspondingly travel demand – a more efficient strategy towards road planning is therefore needed. There is a need to ensure prudence in road building, as space used by road carriageways can be potentially used for other purposes, such as walkways, parks and open space. There are also specific challenges based on the characteristics of each residential town. For example:

a) **Town with mature public transport system** – Residents living in a town with a mature public transport system have accustomed themselves to a certain habit of commuting. Hence, removal of road carriageways should not disrupt |
| Possible Solutions (but not limited to) | The government is investing heavily in public transport infrastructure to create a car-lite society where people prefer to walk, cycle and take public transport. These efforts include expanding the rail network to 360km by 2030 and ensuring that 80 per cent of households will be within a ten-minute walk to an MRT station. We are also growing our cycling network, with Singapore’s first walking and cycling town Ang Mo Kio to be completed in 2020. Buses are given the priority on roads where bus lanes are implemented and full-day bus lane hours have been extended. The new Electronic Road Pricing system will offer a host of additional information for motorists and enable distance-based charging based on a pay-as-you-use principle. All these measures are to encourage people to choose more efficient transport modes such as MRT, public buses and activemobility over private cars, so that less road space is needed to support people’s travel demand. |
| Current Situation | these habits significantly and recovered land should be channeled into something beneficial to the residents.  

b) **Town with a new transportation node** – A town with a new transportation node such as a MRT station provides flexibility in the planning for the features (e.g. roads, walkways) around the station. Research should help generate a solution that could either reduce size of road carriageway, eliminate the need to introduce new road carriageway, or opportunities to permanently remove existing road carriageway due to the introduction of a new transportation node, while at the same time maintaining level of accessibility.  
c) **Central Business District (CBD)** – The CBD is the commercial and business centre of Singapore with numerous transport facilities supporting economic and social activities. Research should help to generate solutions to introduce new urban designs with less road space, while maintaining the level connectivity and accessibility in CBD. |

This call seeks new ways of town planning or technologies that will help to reduce land use required for road carriageway. To ensure that solutions proposed are practicable, proposals should illustrate how the solutions will be implemented in the following areas (further details are in Appendix 3):  
a) **Town with mature public transport system – Ang Mo Kio**
| b) Town with a new transportation node – Marine Parade |
| c) Central Business District (CBD) |

Research efforts could include, but are not limited to,

a) Developing a database on space devoted to all road components (carriageways, side tables, and etc.)

b) Developing a typical concept design for road removal

c) Developing possible collaborative design with other pre-existing car-lite initiatives and at the same time ensuring no adverse impact on the overall transportation system.

d) Examining the transformation of residents’ commuting habits due to the implementation of solution.

**Requirements**

This focus area is for research that will develop solutions to reduce or remove road carriageway in the three areas listed above and use the land saved for something beneficial to the residents based on town planning typology. Proposals should identify what are the challenges or considerations they aim to address, suggest possibilities for what the land saved could be used for, and highlight how the solution can be implemented in other areas.

### 3. ELIGIBILITY CRITERIA

3.1. This call is open to all R&D organisations in Singapore including publicly funded institutes of higher learning (IHLs), not-for-profit research institutions, public sector agencies, companies and company-affiliated research entities.

3.2. The Lead Principal Investigator will be required to have a minimum time commitment of 9 months per year in Singapore. International parties can participate in the project as Collaborators. All work should be done in Singapore, unless expressly approved by LTA.

### 4. APPLICATION PROCESS AND EVALUATION CRITERIA

4.1. Proposals will be selected through a two-stage process and evaluated based on i) potential for impact, ii) strength of project execution, and iii) technical competency of the team. In the first stage, interested applicants will submit white papers. Shortlisted white papers will then subsequently be invited to revise and develop their white papers into a full proposal in the second stage.
4.2. The first stage of the grant call will be launched on **3 Jan 2018 (Wednesday)**, **1200hrs**. Interested applicants should submit white papers to NRF’s Integrated Grant Management System ([https://researchgrant.gov.sg/Pages/index.aspx](https://researchgrant.gov.sg/Pages/index.aspx)) by **21 Feb 2018 (Wednesday)**, **1200hrs**. All Investigators and Offices of Research should be copied in the email. Only white papers in **Word**, **Excel** and **PDF** formats should be submitted.

4.3. White papers should cover the objectives, proposed approach and project execution plan. This would include explaining and quantifying the outcomes that could be achieved to (a) reduce the duration of journeys on public transport, (b) optimise public transport services to meet demand and (c) reduce land used for road carriageways. The guidelines for drafting the white paper is in **Attachment 1**.

4.4. LTA will support 100% of the approved qualifying direct costs of a project for IHLs, not-for-profit research institutions and public sector agencies. Companies and company-affiliated research entities will qualify for up to 70% of the approved qualifying direct costs of a project. 20% of indirect costs (costs that that are incurred for common or joint objectives and therefore cannot be identified readily and specifically with a particular project) will only be allowed for IHLs and not-for-profit entities. A list of non-fundable direct cost items is in **Attachment 2**.

4.5. **Funding support will be up to three years.** Deliverables are expected to be commensurate with the level of funding requested. LTA may require that funding support will be based on achievement of milestones in a payment schedule.

4.6. White papers that provide cash or in-kind contributions will be viewed favourably. Multi-disciplinary/organisation teams or teams with industry collaborators are also encouraged to perform holistic analysis and facilitate downstream commercialisation and deployment of R&D technologies developed. White papers which involve a trial or pilot and include plans for scale-up are preferred. Where applicable, technology readiness level (TRL) of the proposed technology should be at least TRL 5 (prototype demonstration in a relevant environment) and above at the end of the project. **Appendix 4** shows the definitions of the TRLs.

4.7. The following may be rejected without review:

- Late or incomplete white papers (including white papers that do not follow the guidelines)
- White papers that do not fall within the scope of the grant call
- Duplicates of white papers submitted to any other funding agencies for simultaneous consideration
- Ineligibility of the Investigators or R&D organisation
4.8. Submission of white papers to LTA shall be construed as consent by the applicants to participate in the evaluation process. Selection of reviewers is at the sole and exclusive discretion of LTA. LTA shall not be liable for the release of information concerning white papers and proposals to third parties by individuals involved in the evaluation process.

4.9. LTA may require white papers and proposals to be revised or combined as it sees fit to enhance outcomes, facilitate integration of approaches, and optimise funding resources. LTA’s funding decision will be final.

5. CONTACT INFORMATION

5.1. For further enquiries on this Open Call, please email LTA at LTA_Innovate@lta.gov.sg.

5.2. For any enquiries related to NRF’s Integrated Grant Management System, please email the helpdesk at helpdesk@researchgrant.gov.sg.
Appendix 1: Summary of Durations for Current Public Transport Journeys
Appendix 2: Sample Bus Routes with High Average Utilisation

AM Peak

<table>
<thead>
<tr>
<th>Svc No.</th>
<th>Operator</th>
<th>Peak / Non-Peak Indicator</th>
<th>Direction</th>
<th>Bus Stop Code</th>
<th>Average Utilisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>654</td>
<td>LTAB</td>
<td>Peak Direction</td>
<td>1</td>
<td>67151</td>
<td>102.50%</td>
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<tr>
<td>671</td>
<td>LTAB</td>
<td>Peak Direction</td>
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<td>67489</td>
<td>101.21%</td>
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<tr>
<td>670</td>
<td>LTAB</td>
<td>Peak Direction</td>
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<td>59321</td>
<td>96.37%</td>
</tr>
<tr>
<td>668</td>
<td>LTAB</td>
<td>Peak Direction</td>
<td>1</td>
<td>54291</td>
<td>94.92%</td>
</tr>
<tr>
<td>652</td>
<td>LTAB</td>
<td>Peak Direction</td>
<td>1</td>
<td>54379</td>
<td>93.41%</td>
</tr>
<tr>
<td>672</td>
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<td>Peak Direction</td>
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<td>64249</td>
<td>91.82%</td>
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<tr>
<td>660</td>
<td>LTAB</td>
<td>Peak Direction</td>
<td>1</td>
<td>63399</td>
<td>86.84%</td>
</tr>
<tr>
<td>669</td>
<td>LTAB</td>
<td>Peak Direction</td>
<td>1</td>
<td>84199</td>
<td>85.64%</td>
</tr>
<tr>
<td>89E</td>
<td>SBST</td>
<td>Peak Direction</td>
<td>1</td>
<td>65199</td>
<td>84.99%</td>
</tr>
<tr>
<td>664</td>
<td>LTAB</td>
<td>Peak Direction</td>
<td>1</td>
<td>96261</td>
<td>84.19%</td>
</tr>
</tbody>
</table>

PM Peak

<table>
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<tr>
<th>Svc No.</th>
<th>Operator</th>
<th>Peak / Non-Peak Indicator</th>
<th>Direction</th>
<th>Bus Stop Code</th>
<th>Average Utilisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>825</td>
<td>SMRB</td>
<td>Peak Direction</td>
<td>1</td>
<td>55509</td>
<td>97.22%</td>
</tr>
<tr>
<td>652</td>
<td>LTAB</td>
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<td>2</td>
<td>8031</td>
<td>92.73%</td>
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<tr>
<td>654</td>
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<td>2</td>
<td>3381</td>
<td>90.46%</td>
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<tr>
<td>160</td>
<td>SBST</td>
<td>Peak Direction</td>
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<td>46059</td>
<td>85.00%</td>
</tr>
<tr>
<td>170</td>
<td>SBST</td>
<td>Non-Peak Direction</td>
<td>2</td>
<td>46069</td>
<td>82.13%</td>
</tr>
<tr>
<td>89E</td>
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<td>671</td>
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<td>Peak Direction</td>
<td>2</td>
<td>3129</td>
<td>72.12%</td>
</tr>
</tbody>
</table>
Appendix 3: Information on specific town

**Town with mature public transport system – Ang Mo Kio**

Currently, Ang Mo Kio is served by North South Line with a bus interchange at Ang Mo Kio MRT station. Dedicated cycling lanes have been newly introduced to encourage active modes. The first phase of the Ang Mo Kio Cycling network was officially opened in July 2016. The full network will be completed in 2020 with walking and cycling corridor that runs along the MRT viaduct between Yio Chu Kang MRT station and Bishan-Ang Mo Kio Park.

**Town with a new transportation node – Marine Parade**

The existing traffic layout at Marine Parade are currently going through temporary reconfiguration for the construction of the new Marine Parade MRT Station. Thus, the commuting habits of the residents are undergoing changes to adapt to the implemented road diversion schemes at Marine Parade Road and the temporary closure of Joo Chiat Road.

**Central Business District (CBD)**

As part of the Car-lite strategy, there are various initiatives to encourage walking, cycling and public transport in CBD. These initiatives include Car-free Zones, Car-free Sunday, opening of Bencoolen streets with dedicated cycling lanes and opening of DTL2 and DTL3.
Appendix 4: Technology Readiness Level Chart

A progressive approach, depending on the Technology Readiness Level (TRL) at the point of decision, is used to evaluate test-bedding of new mobility concepts.

Prototype demonstration in a relevant environment (for TRL 5 & 6)
A technology of interest has demonstrated potential to meet certain transport objectives. It will then be pursued for further development at the component level and subsequently tested for operational viability within confined test areas that mimic part of an envisaged operational environment.

Proof-of-Concept (POC) demonstration in an operational environment (for TRL 7)
If a technology of interest has been proven its potential at the component level, its development will be further pursued. In this case, the test-bedding environment will be escalated into the actual operational environment with actual interaction with other road users and commuters. At this stage, we will focus on evaluating the proposed mobility concept, which deploys the technology of interest, for its envisaged benefits and values in meeting the transport objectives.
Full Scale Deployment (FSD) (for TRL 8 & 9)
This level will be considered after a successful Proof-of-Concept (POC) demonstration. However, it may not be a straight-forward process as other considerations like commercial viability, operational sustainability, and other policy considerations (especially when the new mobility concept could be disruptive to existing modes of travel).