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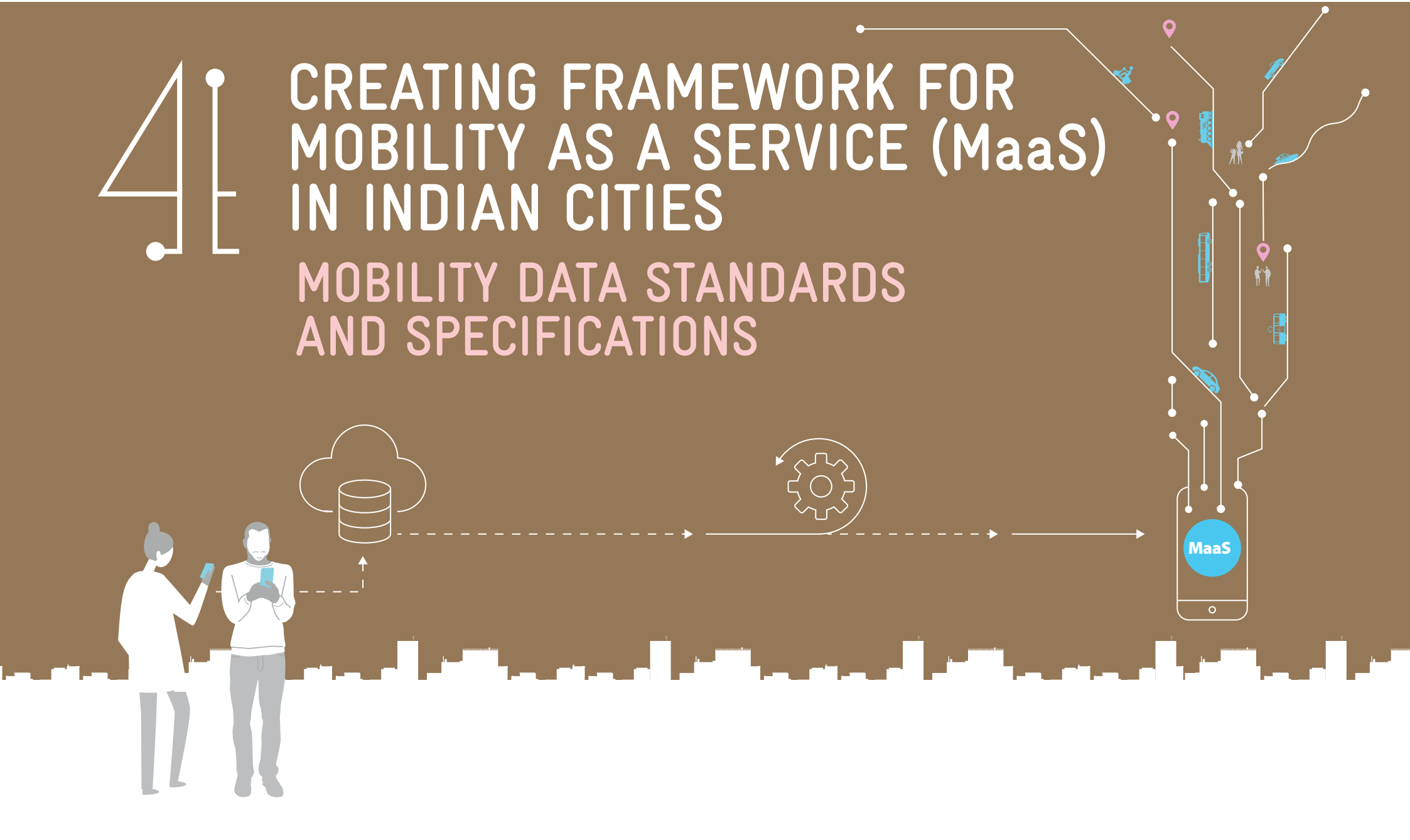
Ministry of Housing and Urban Affairs
Government of India

Green Urban Mobility Partnership

CREATING FRAMEWORK FOR MOBILITY AS A SERVICE (MaaS) IN INDIAN CITIES

MOBILITY DATA STANDARDS AND SPECIFICATIONS



Mobility Data Standards and Specifications

Published by
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

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As at
October 2021, New Delhi

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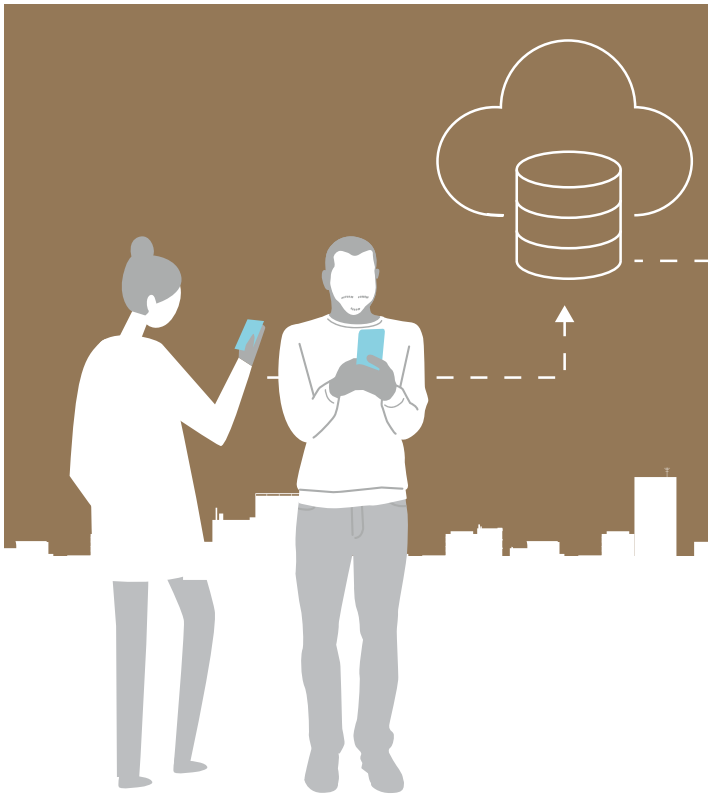
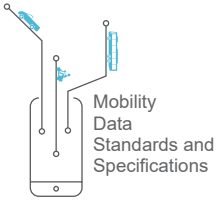


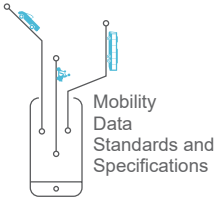


ABOUT THIS REPORT

This report has been prepared as a part of bilateral technical cooperation project “Integrated Sustainable Urban Transport Systems for Smart Cities (SMART-SUT)“ commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) and jointly implemented by Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) GmbH and Ministry of Housing and Urban Affairs (MoHUA), Government of India. The objective of the project is to improve the planning and implementation of sustainable urban transport in selected Indian cities. The project also supports the Green Urban Mobility Partnership (GUMP) between the governments of India and Germany.

Indian cities selected under National Smart Cities Mission are planning, designing, developing, and implementing various urban mobility projects. All these projects, after implementation, produce a huge amount of data. Thus, the management of the mobility data is at centre of increasingly complex urban transport challenges in these cities. The mobility data generated from various sources and in various forms could be used for providing an integrated journey experience to the commuters which is known as ‘Mobility as a Service or MaaS’. Though providing such a service to commuters would require developing standard data collection and management protocols, strong institutional and regulatory framework, interventions related to urban mobility data policies and so on. With this objective in mind, SMART-SUT initiated the study titled “Creating Framework for MaaS in Indian Cities”.

The study aims to explore opportunities for implementing MaaS in Indian cities and identify a structured approach towards developing a smart mobility ecosystem which is required for developing such a solution by leveraging the real value of mobility data. The study outlines a stepwise approach and set of recommendations towards implementing a MaaS solution in the Indian context, a series of reports have been compiled as an output of this study covering various aspects of MaaS. The recommendations from these reports would assist Indian cities embarking on developing various data-driven mobility solutions like MaaS by integrating different transport modes.



ACKNOWLEDGEMENT

The project team would like to thank all the individuals, experts and organisations who have provided continuous guidance and support during the course of this study and preparation of various reports.

The team would like to acknowledge contributions from the various city representatives during stakeholder consultations that took place in various stages throughout the study. We would like to thank Ms V Manjula, Commissioner, Directorate of Urban Land Transport (DULT), Mr Shamanth Kuchangi (DULT), Mr G P Hari, Additional General Manager (Urban Transport), Kochi Metro Rail Ltd (KMRL), Mr Vishal Khanama, General Manager, Ahmedabad Jan Marg Limited (AJL) and other representatives of DULT, KMRL, AJL for their support and knowledge contribution.

Our sincere thanks to Prof Shivanand Swamy, Director Emeritus, Centre of Excellence in Urban Transport, CEPT University, Mr Ravi Gadepalli (Public Transport Expert and Independent Consultant) and Mr Rishi Kothari (World Bank) for providing their valuable feedback and unbiased perspective on challenges and opportunities of MaaS ecosystem in Indian context during the focused group discussions (FGDs) organized by SMART-SUT. Additionally, we would like to appreciate and value the discussions and feedbacks received from all the participants during the consultation.

We would also like to thank Mr Amit Gupta, Mr Harshal Gupta and Mr Jaideep Kapani (Yulu), Mr Arjit Soni, Mr Ajaysinh Solanki and Mr Mufish Saiyed (Mybyk), Ms Anudeepika Jain (Uber), Mr Anish Michael and Mr Roshan Toshniwal (Ola Mobility Institute) for sharing their perspective on operational concerns in MaaS ecosystem from the viewpoint of private sector service providers.

We are also thankful to Mr Shirish Mahendru (Technical Expert, SMART-SUT, GIZ) and Mr Amegh Gopinath (Technical Expert, SMART-SUT, GIZ) for providing their valuable suggestions during internal group consultations.

Special thanks to Mr Yale Wong (ANZ Market Lead, Cities Forum) for peer review of various study outcomes, Mr Dipu Joy (Senior Transport and Regulatory Expert, Cities Forum), Mr Jaime Ruiz and Ms Zeina Nazer (Co-Founders Cities Forum) for providing expert inputs on various aspects of MaaS ecosystem.

We would also like to thank Mr Khelan Modi, Ms Nikita Bhakuni and Ms Sangeetha Ann from Center of Excellence - Urban Transport (CoE-UT), CRDF for assisting the project team with data collection and analysis.

The team would like to acknowledge the contribution of Mr Arpit Kanv and Ms Ronika Postaria (Associate Consultants, Cities Forum), Ms Madhura Kawadkar (CoE-UT, CRDF) for providing extensive support to the project team during report preparation. We would also like to acknowledge the contribution of Mr Deepak Bhardwaj (Cities Forum) in development of web based MaaS toolkit.

During the course of study, the project team had interactions with global industry partners and MaaS experts who provided their advice on technical details of MaaS solution. We are thankful to the contributions of Mr Adrian Ulisse, Mr Satinder Bhalla, Mr Walid Ward, Ms Lina Al Shnaikat and Mr Meshack Ochieng in this regard.

The team is hopeful of the study outcomes being a useful guide for deploying the MaaS ecosystem in Indian context.

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BACKGROUND

India is going through a rapid digital transformation in the transport and mobility sector. It is estimated that with the current pace of access to internet-enabled smartphones, the internet user base in the country will rise to 829 million people by 2022. Approximately, 97 percent of the internet users across India have access to internet through mobile devices. The user base for these smartphones is expected to cover almost 60% of the population [1].

Smartphones with high-speed internet and various sensor technologies can now generate, record and store a high volume of useful data in phones and applications that feed on personal information. While this data can help solve many mobility problems, it builds on a high potential to overlook privacy issues and personal data exploitation, for commercial purposes.

Hence, it is essential to comprehend how this 'smart' transport data is being generated and managed and decide as to which data can be used to develop mobility solutions. Further, mechanisms for data sharing by the government and mobility companies need to be established so that this could be leveraged to provide innovative travel solutions. In this process, it is critical that the privacy of the users must be ensured under the existing legal frameworks.

Mobility as a Service (MaaS) is an emerging smart mobility service that provides access to integrated journey options across different transport modes in a city using a single travel booking and payment platform to its users. With multimodal transport system in the city, MaaS provides commuters with seamless travel options, ascertaining a comfortable journey. The key aspect that enables this solution is the data sharing between different modes and service providers. The study titled "***Creating Framework for Mobility as a Service (MaaS) in Indian Cities***" aims to identify measures that are required for developing a MaaS solution. The objective of the study is :

- To develop a framework for an effective implementation of "Mobility as a Service (MaaS)" in Indian cities.
- To recommend the requisite data and system specifications for implementing MaaS in Indian cities.
- To design an effective policy and a regulatory framework by contextualizing issues related to data sharing in India.
- To develop a capacity-building toolkit for a better understanding of MaaS and facilitating the decision-making process for its successful implementation in Indian cities

Following reports have been compiled and documented* as an output of this study covering various aspects of MaaS :

i. Basics of MaaS and Learnings from Global Case Studies
ii. MaaS Readiness Tool
iii. Urban Mobility Data Policy
iv. Mobility Data Standards and Specifications
v. Legal and Regulatory Framework
vi. System Architecture and Technical Requirements
vii. Reference 'Scope of Work' Document for MaaS Project

This report proposes a four-step framework for management of mobility data which emphasizes on identifying standard data collection, data storage and data sharing protocols. It also details out strategies for cities to leverage mobility data and outlines various existing innovative tools and platforms to promote data-driven analysis, visualization and informed decision making.

[1] https://icea.org.in/wp-content/uploads/2020/07/Contribution-of-Smartphones-to-Digital-Governance-in-India-09072020.pdf

*All the reports can be accessed via https://www.maastoolkit.org/ which has been developed as a web-based capacity building toolkit and an open source knowledge resource for all the stakeholders and government agencies planning to implement MaaS in Indian cities.

MOBILITY DATA: A DEFINITION

"Mobility data" is information about travel that is collected using digitally enabled mobility devices or services.

It may include trip information like - origins, destinations, trip length, trip route, trip start and end time, etc.

It may also provide information related to the vehicles used – i.e., vehicle location, average speed, direction, emissions etc.

The data is typically recorded as a series of latitude/ longitude coordinates and it is collected at regular intervals by smartphones, on-board computers, or app-based navigation systems

DATA SHARING: COMPETING PRIORITIES

As mobility occurs in the public right of way, Indian city planners and policymakers have the mandate to leverage travel information in order to improve operations and planning, make informed decisions and enable researchers to model the effects of various transportation solutions.

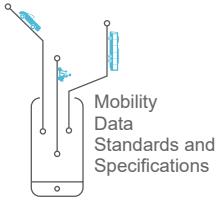
Public funding agencies have an interest in getting access to the mobility data and process it into actionable information to better understand the results of their investment strategies to implement better policies for efficient, equitable and inclusive mobility, and to minimize the externalities related to air pollution, congestion, and road safety.

Users expect that their privacy will be protected “by design”, however many massive consumer apps include abusive data acquisition practices.

Transport Service Providers have financial interests in protecting proprietary information, which leads to the data being kept in silos.

Oversharing or undersharing of mobility data, both are both problematic. A middle ground approach is therefore recommended, where data is shared in specific contexts and managed by a public controlled, trusted third party that implements required anonymization and security features

DATA SHARING: ISSUES



Direct access to the mobility data (lakes) or ensuring competitive access (i.e., through APIs)? Direct access to raw mobility data entails several implications, including protecting privacy and complying with related legal framework (such as EU's GDPR being considered for adaptation in India). On the other hand, APIs are not commonplace, and so, interoperability remains an issue where the legacy systems (such as public transport) have to "compete" with the new mobility providers or services.

Data specification or functional outcome specification? Data standards come with benefits such as increased interoperability between producers and consumers of data, however under some circumstances more bespoke integrations might make sense

Data sharing under different regulatory/operating regimes (i.e., public transport vs others)

THE VALUE OF MOBILITY DATA: FOR WHOM AND FOR WHAT?

Mobility Data Standards and Specifications

PEOPLE

Citizens - from the city / public authority perspective; *Customers* – from the private mobility service providers perspective; *End-Users*, in general

… to access mobility services they value

3RD PARTY AGGREGATORS

Raw or aggregated mobility data platforms; API integrators; MaaS aggregators (at MaaS integration level 1)

…to develop new products and sell data insights (to public and private customers)

MOBILITY OPERATORS

Public Transport Operators (PTO); Privately-held Mobility Service Providers (of shared or pooled mobility, demand-responsive transit, etc.)

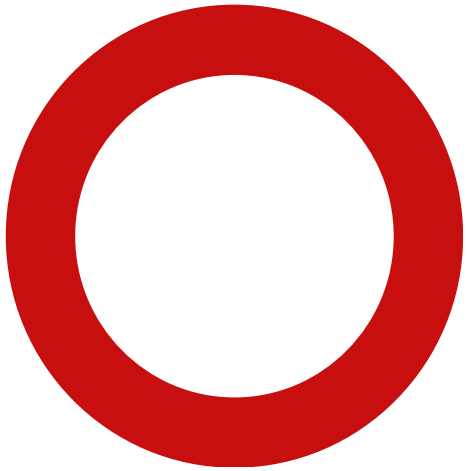
… to improve operations and build their brand

PUBLIC AUTHORITIES

Cities; Public Transport Authorities (PTA); Government Agencies

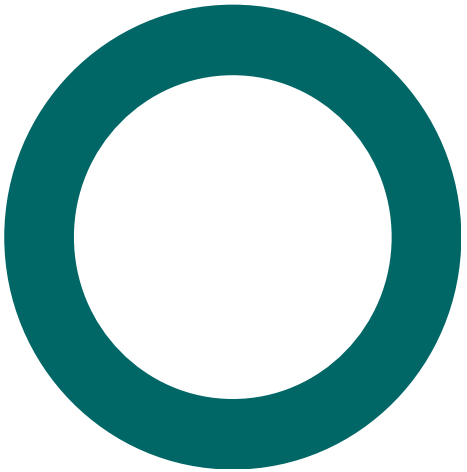
…to improve the efficiency and reliability of service operations and pursue societal goals of sustainability, equity, inclusion

TRUST ARCHITECTURE MODELS



OPERATOR

TRUST LINKED TO TRANSPARENCY ON PURPOSE, USE AND DATA MINIMISATION



PUBLIC AUTHORITY

Source: International Transport Forum

TRUST ARCHITECTURE MODELS: "DON'T TRUST PUBLIC AUTHORITIES"

International Reference Case Study: Uber Movement releases datasets to the public in support of urban and transportation planning. To prevent user privacy issues, Uber aggregates car GPS traces into small areas and releases free data products that indicate the average travel times of Uber cars between them. Although this is certainly useful, some researchers have also pointed out the extent to which such data is actually useful, it is quite evident that Uber does not want to share raw data with Public Authorities (see next)

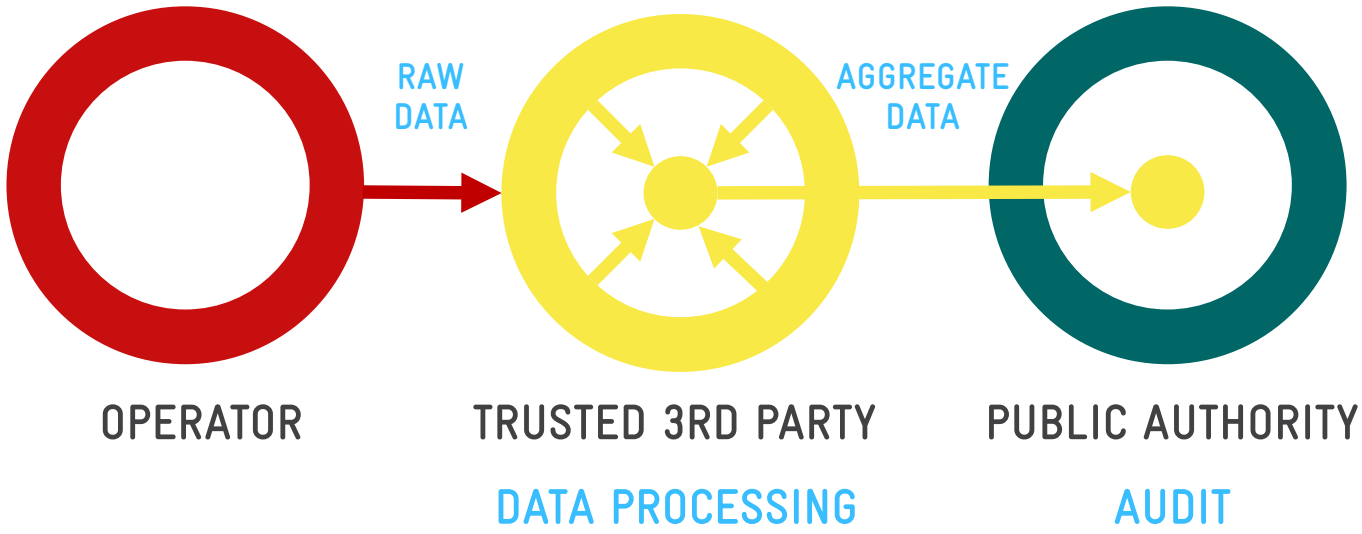
Source: International Transport Forum

TRUST ARCHITECTURE MODELS: "DON'T TRUST OPERATORS / PLATFORMS"

International Reference Case Study: City of Los Angeles (US) data collection strategy to regulate e-scooters through the MDS. Concerns have been raised by major players in the market, such as Uber, which have sued LADOT over what the company considers too stringent data-sharing requirements. The MDS may be expanded in the future to include ride-hailing data, and is being examined by some EU countries to assess compliance with the GDPR

Source: International Transport Forum

TRUST ARCHITECTURE MODELS: "TRUSTED 3RD PARTY"



International Reference Case Study: mobility data standardisation enables data aggregation and the development of commercial solutions for real-time travel and planning in cities. Google is probably the data aggregator which provides most of the information on public transport and traffic conditions at global scale, although several local aggregators also exist in many cities which provide additional layers of information. Moreover, startups like Vianova, Populus, or Remix offer data analytics tools to cities based on aggregated mobility data

Source: International Transport Forum

A FOUR-STEP FRAMEWORK FOR EFFECTIVE MOBILITY DATA SHARING

1) SET MOBILITY DATA STANDARDS

De facto standards and in the making, like: GTFS, GBFS, MDS, etc.

2) COLLECT & SHARE

Data Producers: automotive OEMs, TNCs, micromobility companies, public transport agencies, etc.

3) STORE

Data Stewards: trusted third parties such as National labs and Universities etc.

4) ANALYZE & APPLY

Data Users: urban planners, regulators, policymakers, researchers, etc.

Data-Informed Mobility Policy

FOUR POLICY STRATEGIES TO SUPPORT MOBILITY DATA SHARING

1) ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY PUBLIC AND PRIVATE TRANSPORT SERVICE PROVIDERS (TSPS) IN CITIES.

- General Transit Feed Specification (GTFS)
- General Bike share Feed Specification (GBFS)
- Mobility Data Specification (MDS)
- International Best Practice: National Access Points (NAP) in Europe; emerging standards: General On-demand Feed Specification (GOFS); Transport Operators and MaaS Providers (TOMP); MaaS Alliance API Reference; MaaS Global specs & (proprietary) WhimApp TSP API, etc

2) DEVELOP CLEAR MOBILITY DATA COLLECTION & SHARING LEGAL AGREEMENTS AND TECHNICAL REQUIREMENTS DESIGNED FOR AND AIMED AT TSPS

- For the TSPs operating in India providing ride-sharing (like Uber, Ola, Grab, Meru, Rapido), and micromobility (like Yulu, Vogo, Bounce) – for urban mobility in cities and car-pooling (like BlaBlaCar, SRide, Quick Ride,) – for inter-urban mobility between cities
- Level playing field to protect TSPs legitimate proprietary, financial, and fairness concerns about MD sharing, especially data captured in highly competitive markets

FOUR POLICY STRATEGIES TO SUPPORT MOBILITY DATA SHARING

3) ESTABLISH PUBLICLY OWNED BIG MOBILITY DATA REPOSITORIES

- The data repositories shall be managed by trusted third parties to securely store the mobility data and to provide structured data access to Indian Cities, States, and researchers.
- It shall also leverage other open mobility data resources, such as e.g., Uber Movement, TomTom etc.
- This will help in achieving a good balance between aggregation / anonymization (sufficient to protect privacy) and preserving enough specificity such that the data remains useful (linked with Policy Strategy #4)

4) LEVERAGE EXISTING INNOVATIVE LAND-USE AND TRANSPORTATION PLANNING TOOLS AND PLATFORMS FOR DATA-DRIVEN ANALYSIS, VISUALIZATION AND POLICYMAKING

- Challenges associated with data analysis and visualization can prevent policymakers from extracting useful insights
- Managing large datasets can be expensive, computationally intensive, and time-consuming
- Public agencies may lack in-house data science experts and/or may lack the resources to hire such experts
- Therefore, leveraging existing 3rd party mobility data tools and platforms is a cost-effective approach. Benchmark: Moovit, Vianova, Populus, Remix

FOUR POLICY STRATEGIES TO SUPPORT MOBILITY DATA SHARING

1) STANDARDIZED MOBILITY DATA SPECIFICATIONS

Mobility data to become **more interoperable**, and data sharing **less expensive**.

2) CLEAR MOBILITY DATA SHARING REQUIREMENTS

Mobility data are used in a way that benefits society and supports mobility goals without imposing burdensome requirements on TSPs

3) WELL-DESIGNED STRUCTURES FOR MOBILITY DATA STORAGE

Protect sensitive and personal information, and comply with recommendations for the legal framework for MD sharing and management

4) ANALYSIS & INSIGHT

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

Standardizing data sharing specifications is a critical first step to improving data comparability and reducing administrative burdens associated with data reporting and sharing among TSPs

Standardization implies that there is a consistent, comprehensive, and agreed-upon set of parameters for how data is to be reported

Data standards can emerge via several pathways, i.e. from the “top-down” by an influential actor (e.g., a government agency at country, state, or city level), or from the “bottom-up” by multiple smaller actors who agree to adopt the same specifications

Based on the performed research on the state-of-the-art mobility service providers and the current mobility data standardisation and data sharing practices in India, It is strongly encouraged to adopt a “top-down” approach.

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

The term GTFS originally stood for “Google Transit Feed Specification” and was used to integrate public transport data from TriMet (the public transport agency in Portland, Oregon, USA) into Google Maps to create the first version of Google Transit. This was back in 2005

The developers at Google wanted the format for GTFS feeds to be as simple as possible to give even smaller PT agencies the ability to adopt the standard, leading to their decision to use comma separated values (CSV) files. Even today, **a GTFS feed is a compressed ZIP file containing CSV files**

After its launch in Portland, Google offered their trip planning service to any PT agency for free, as long as they maintained their data in the required GTFS format, and Google Transit quickly spread throughout cities in the US

GTFS has become an integral part of the PT data landscape, and it is no longer solely valuable to Google and PT agencies. Indeed, GTFS feeds can be used by software applications for trip planning, ridesharing, timetable creation, mobile data, visualization, accessibility, analysis tools for planning, real-time information and interactive voice response (IVR) systems. These capabilities sparked the renaming of ‘Google Transit Feed Specification’ to **“General Transit Feed Specification”**

Source - https://developers.google.com/transit/gtfs
https://developers.google.com/transit/gtfs-realtime

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

Despite reservations from some PT agencies to relinquish control of their data, GTFS feeds serve major benefits that help them accomplish their ultimate goals. Being part of the GTFS standard and publishing their route data publicly allows PT agencies' information to be a part of a global set of search products that millions of users already access every day.

Today, GTFS has become ubiquitous, and is employed by more than a thousand PT operators worldwide, being a "de facto" standard for PT.

Even organizations that work with highly detailed data internally using standards like NeTEx find GTFS useful to publish data for wider consumption in consumer applications, where GTFS stands out because it was conceived to meet specific, practical needs in communicating service information to passengers, not as an exhaustive vocabulary for managing operational details.

GTFS is split into a static component that contains schedule, fare, and geographic transit information and a real-time component that contains arrival predictions, vehicle positions and service advisories.

Source - https://developers.google.com/transit/gtfs
https://developers.google.com/transit/gtfs-realtime

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

GTFS-Realtime allows maps to convey dynamic information about when PT is actually arriving and departing, rather than relying on static, preset schedules. The tradeoff of this improved accuracy is that **GTFS Realtime requires inputs called "protocol buffers," which are more complex than CSV files.** The system uses one of the two methods i.e. fetch, which allows Google, or other developers, to retrieve data from a web location; or push, which allows users to upload data programmatically.

Accommodating the advanced inputs required by GTFS Realtime involves hiring additional technical expertise, which may be hard to do under a limited operating budget. Smaller transit agencies may face other hurdles as well, such as difficulty in procuring adequate in-vehicle tracking technology necessary to implement GTFS Realtime.

An alternative to GTFS Realtime is a **REST API/XML. Re**presentational **S**tate **T**ransfer (REST) which is an architectural style for **A**pplication **P**rogramming **I**nterfaces (APIs). There are many alternative data-exchange formats that are compatible with RESTful APIs, including JSON and HTML, but the most used in transportation spaces is e**Xtensible M**arkup **L**anguage (XML).

Source - https://developers.google.com/transit/gtfs
https://developers.google.com/transit/gtfs-realtime

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

RESTful API/XML is a generalized format and is not necessarily transit-specific, though it can be adapted to fit transit-specific needs. While GTFS Realtime reflects the actual, GPS-identified location of every vehicle or device in operation in a given system (i.e., *"where are all the buses in the system?"*), a RESTful API makes real-time arrival and departure predictions based on when a transit unit arrives or departs from a specific stop (i.e., *"what's the next bus at this stop?"*)

A RESTful API essentially trades network completeness for reduced data-management requirements and greater object specificity (i.e., a user can request information on a single stop without having to download data on the whole transit system). In practice, a RESTful API/XML may be more feasible for smaller municipalities (which generally have fewer technical resources), while **GTFS-Realtime is better suited for larger municipalities.**

To view an entire PT map, RESTful APIs require individual requests to fetch stop data one at a time and thus may require more data storage space than GTFS Realtime. The REST/XML approach also tends to be less open. For the third parties to access some REST/XML APIs, registration for an API key is required.

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

GTFS-Flex is an extension of the GTFS designed to enable trip planning for various types of demand-responsive services – such as e.g., Nemi - or paratransit service

While GTFS-powered feeds offer convenient information on fixed route, scheduled service, they are not designed to show demand-responsive service, leaving users in certain areas with an incomplete picture of their options

GTFS-Flex remedies this, enabling trip planning software such as OpenTripPlanner to generate trips combining demand-responsive and fixed route service.

Source - https://github.com/MobilityData/gtfs-flex

Mobility Data Standards and Specifications

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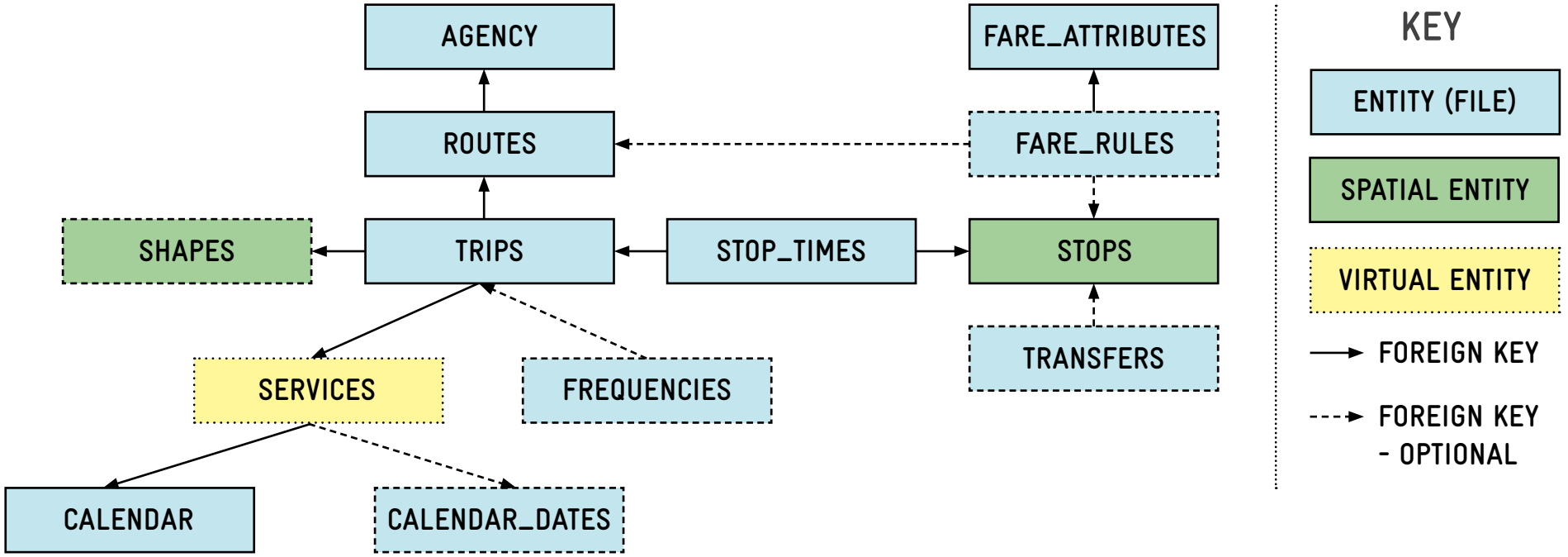


GTFS DATA MODEL DIAGRAM

Source - https://www.transitwiki.org/TransitWiki/index.php/General_Transit_Feed_Specification

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

Modeled after the GTFS, the **General Bike Share Feed Specification (GBFS)** was officially adopted in November 2015 by the North American Bike Share Association.

The first version of GBFS did not support “deep linking” to 3rd party apps (a preliminary feature much needed by MaaS aggregators). This has been addressed in 2020 by updating the feed specification to enable a seamless traveler experience by tapping on a bike or scooter in the 3rd party app, and the provider’s rental app is immediately opened to that particular vehicle or station.

GBFS APIs report the real-time information about *available* vehicles, as it was not designed to share continuous information about vehicles during trips, being redistributed within the city by the operator, or having their batteries charged (if electric).

GBFS is limited in its ability to reconstruct or retroactively view data and, as such, cannot be used for compliance and auditing.

Source - https://github.com/NABSA/gbfs/blob/master/gbfs.md

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

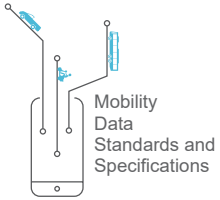
GBFS data feeds typically report the location of a vehicle, vehicle type (bike/scooter), and current battery charge (if electric)

GBFS is increasingly required by cities around the world as part of the micromobility regulations to obtain data related to available shared bikes and scooters for increased transparency and oversight.

230+ shared bike and scooter operators have adopted GBFS to share real-time information with mobile apps, such as public transport and map apps used by millions of travelers around the world, to display vehicles from different operators to individual customers

GBFS is required as part of the Mobility Data Specification (MDS)

Source - https://github.com/NABSA/gbfs/blob/master/gbfs.md



ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

Introduced by LA Department of Transport (USA) in September 2018, the **Mobility Data Specification (MDS)** built on GBFS by expanding on what data cities could require from mobility operators (through a "Provider API")

MDS also introduced the concept that cities could communicate back to operators (through an "Agency API"). In practice, however, the vast majority of cities only require and use the MDS "Provider API"

Unlike the GBFS, in addition to the status of available vehicles MDS also specifies how information should be shared about vehicles that are unavailable due to redistribution, maintenance, or low battery through vehicle event status changes

MDS introduced the concept of sharing data for trips, including starts, ends, and entire series of trip trajectories/ routes

While MDS was initially designed for dockless bikes and scooters, and currently only specifies how data from these services should be shared, many cities hope to expand these data sharing standards to other services (e.g., ridesharing)

MDS is now managed by the Open Mobility Foundation (OMF)

Source - https://github.com/openmobilityfoundation/mobility-data-specification

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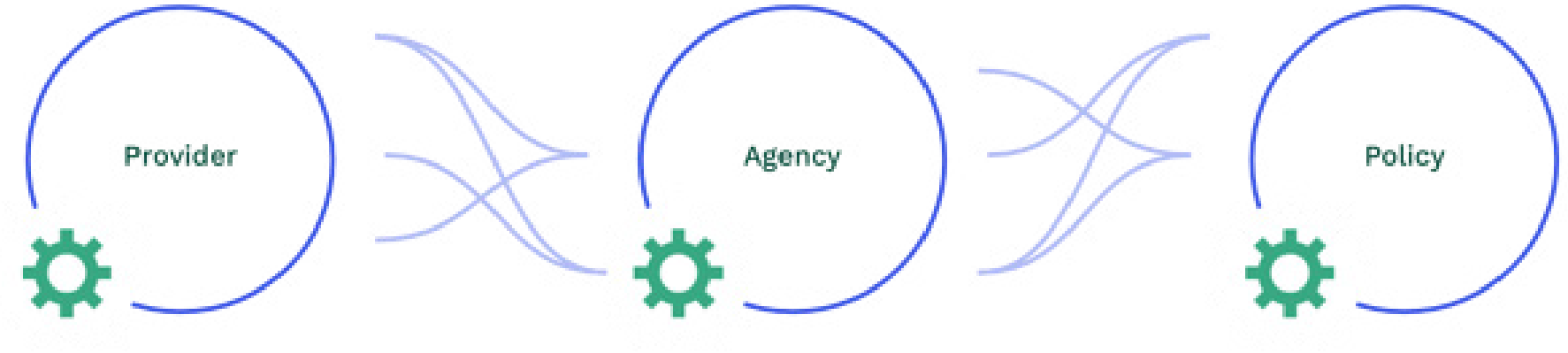
MDS consists of a number of Application Programming Interfaces (APIs), including **Provider**, **Agency**, and **Policy**



Source - https://github.com/openmobilityfoundation/mobility-data-specification

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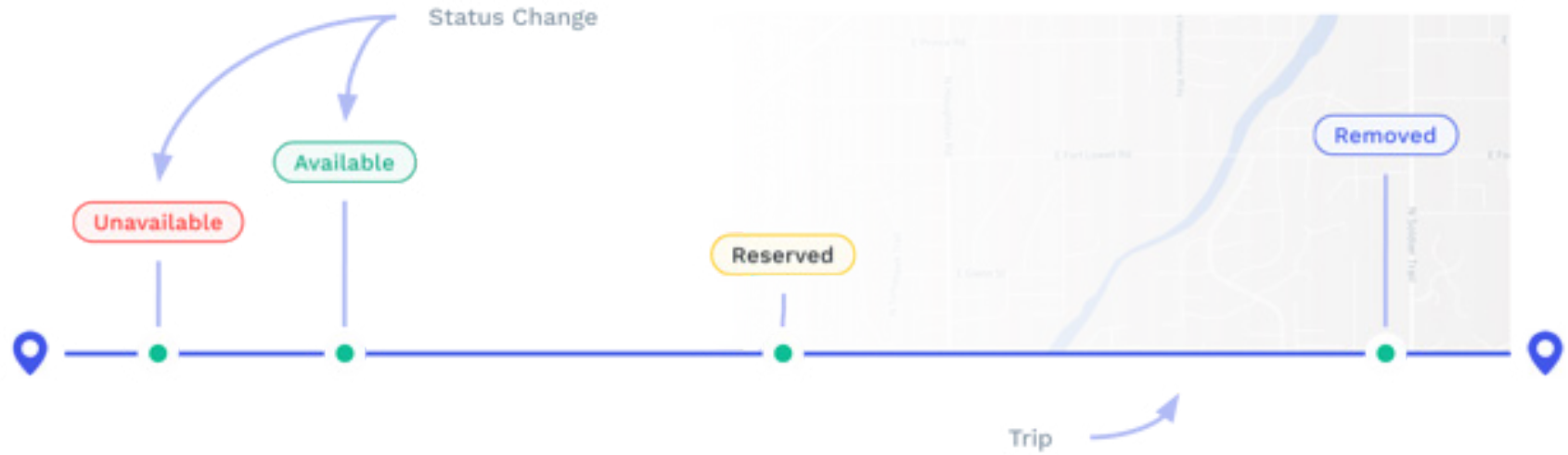
"PROVIDER API"

The most broadly used of the three sub-specifications, is designed for implementation by mobility operators and enables regulators to query historical information on trips and vehicle status. Provider API has two main concepts: "status changes" and "trips"



Source - https://github.com/openmobilityfoundation/mobility-data-specification

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"PROVIDER API"

What is a *status change?*

A status change describes a single micromobility-device-related action that happened at a specific place and time. Examples are: a device being reserved for use, therefore it is shown as unavailable; or after a trip is completed and a device become available again.

What is a *trip?*

A trip is a single journey that was made with a micromobility vehicle. Potential fields for trips include duration, distance, start and end times, route, cost and parking URL.

Source - https://github.com/openmobilityfoundation/mobility-data-specification

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"AGENCY API"

It was designed for regulatory agencies to capture specific events, such as trip starts and allows for the monitoring of mobility services in real-time. Due to significant privacy concerns, such as its requirement of real-time telemetry provided at the start and end of every trip, the Agency API has not yet been widely implemented

"POLICY API"

It was designed for regulatory agencies, and it allows them to publish clearly defined rules for mobility service operators to follow. It enables regulators to set and amend policy guidance by specific geographies, such as speed limits, off-limit areas, differential caps by geographic zone, or equity zones. To protect user privacy as well as limit the information cities collect, the Policy API does not require real-time service. MDS Policy API can also be used to define programme rules that can be measured and managed through the Provider or Agency API

Source - https://github.com/openmobilityfoundation/mobility-data-specification

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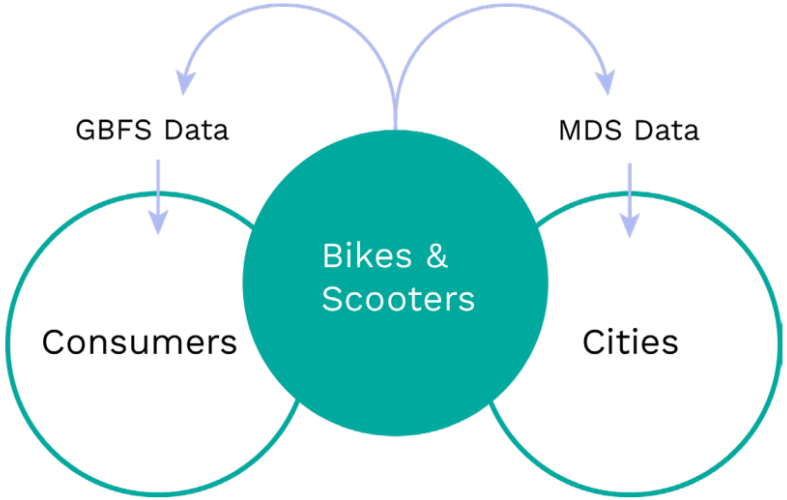


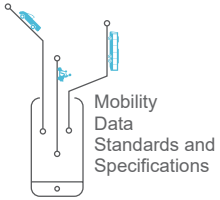
MDS

- Newer standard designed for regulatory agencies in cities
- Ability to fetch real-time and historical data
- GBFS is required as part of MDS, **therefore before MDS, GBFS should be implemented**

GBFS

- Originally designed for bike share systems
- Shows the currently available vehicles and not real-time
- Intended to make information publicly available online, mainly to consumers

MDS SHADES OF GREY



The end users generate abundance of data while moving which gives rise to privacy concerns. However, it is important to note that **no personal rider** or user information is ever shared by operators with cities under MDS guidelines, as no personal data is needed to make policy decisions.

In Europe, healthy skepticism of MDS goes a bit further due to the fact that some elements of it seem at odds with guidelines put forth by the GDPR (General Data Protection Regulation). When it comes to data security, limitation and accuracy, all very important topics covered by the GDPR, MDS does not go into explicit detail. But It is also important to note that MDS is at its heart a set of guidelines designed to help cities gain an overview, and not an enforceable set of laws that restricts the rights of cities and operators. That means that it is in cities' best interest to **utilize the parts of MDS that work for them.**

One part of MDS that often garners negative attention is **real-time data collection**. MDS suggests that the start and end location of every trip should be recorded in real-time, and the actual, detailed route taken between those locations should be recorded within 24 hours. Do cities need that data to make informed policy decisions? The short answer is 'yes': without that data, cities are not capable of staying competitive with private operators. But that does not mean that it has to be *real-time data* - data collection can be delayed and aggregated without losing its effectiveness

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

National Access Points (NAPs) are the EU strategy to get closer to EU-wide MaaS

The regulation EU 2017/1926 of 31 May 2017 on the provision of EU-wide multimodal travel information services calls for standardization of formats for all traffic and travel data from all public and private transportation modes, and the creation of a NAP in all EU member states to be the point where (professional) users of mobility data can get to know where to find data from all mobility actors in each country. It does not address open booking and payment

The purpose of NAPs is to create a catalogue for open mobility data and provide access either directly or through reference to the data sources

All transport actors in the EU are required to, as a minimum, make static travel and traffic data available as open data and provide such data at the same quality as used internally on their own digital platforms

Standards include NeTEx, SIRI, DATEX-II, TAP-TSI, and INSPIRE

/ Although NAPs and the herewith referenced mobility data standards compete to the European market mostly, we include them in this report as international best practice to consider for reference and inspiration for MaaS development in India, where e.g., Indian states could foster the establishment of their own NAPs /

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

NeTEx – short for Network Timetable Exchange – is a public transport data standard developed under the aegis of CEN (Comité Européen de Normalisation) and is the most recent development stage in over fifteen years work to systemise and harmonize European passenger information data

NeTEx provides a means to exchange data for passenger information such as stops, routes timetables and fares, among different computer systems, together with operational data. It can be used to collect and integrate data from many different stakeholders, and to reintegrate it as it evolves through successive versions

NeTEx is intended to be a general-purpose XML format designed for the efficient, updateable exchange of complex transport data among distributed systems. This allows the data to be used in modern web services architectures and to support a wide range of passenger information and operational applications

The NeTEx and SIRI standards will be mandatory for all MaaS actors in Europe in 2023, whether public or private, to enable open mobility data to support multimodal travel information services and will cover all modes of mobility including micromobility

Source - http://netex-cen.eu/

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

SIRI – short for Service Interface for Real Time Information - is a protocol that allows exchange of real-time information about public transport services and vehicles

Just like NeTEx, SIRI is based on Transmodel for public transport information and comprises a general-purpose model and an XML schema for public transport information

Given its history, SIRI has mainly seen uptake in Europe, but some US agencies, such as MTA, offer real-time information about their services through SIRI.

The main benefit of SIRI is that it may convey more details about public transport than GTFS-real-time

Source - http://www.transmodel-cen.eu/standards/siri/

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

DATEX-II is the electronic language used in Europe for the exchange of traffic information and traffic data; it is is a multi-part standard, maintained by CEN Technical Committee 278, Road Transport and Traffic Telematics; in its latest update DATEX-II has broadened its focus to the domains of urban mobility, electromobility charging infrastructure, logistics, electronic traffic regulations and cooperative, connected and automated mobility

TAP-TSI - Technical Specification for Interoperability (TSI) for Telematics Applications for Passenger services (TAP): it allows the harmonization / standardisation of procedures, data and messages to be exchanged between the computer systems of railway companies, of the infrastructure managers and of the tickets vendors in order to provide reliable information to passengers and to issue tickets for a journey on the EU railway network

INSPIRE (INfrastructure for SPatial InfoRmation in Europe): the EU has stimulated the process of standardization and interoperability of common data models, code lists, map layers and additional metadata to be used when exchanging spatial datasets, particularly for describing Transport Networks (among other applications) through the INSPIRE Directive (2007/2/EC). When implementing INSPIRE compatibility should be sought with the standard format DATEX II

Source - https://www.datex2.eu/datex2/specifications
https://www.era.europa.eu/sites/default/files/filesystem/tap/baseline_1.1.0_archive/tap-tsi-technical_document_tap_b_30.pdf

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

TPEG (Transport Protocol Experts Group) is a global data protocol suite for traffic and travel related information. TPEG can be carried over different transmission media (bearers), such as digital broadcast or cellular networks (wireless Internet). TPEG applications include, among others, information on road conditions, weather, fuel prices, parking or delays of public transport

IATA (International Air Transport Association) is the trade association for the world's airlines, representing some 290 airlines or 82% of total air traffic. The IATA has developed several standards, such as **AIDX** (Aviation Info Data Exchange), the global XML messaging standard for exchanging flight data between airlines, airports, and any third party consuming operational data. Because intercity, air travel is in the scope of MaaS, particularly in large countries like India, we include it in our report

Source - https://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_TN_v3.2.pdf
https://www.iata.org/en/publications/standards-manuals/

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

GOFS (General On-demand Feed Specification). **MobilityData**, a nonprofit organization based in Montreal (Canada) has assembled an industry working group looking to develop an open data standard (GOFS) so riders can integrate on-demand services with other mobility options in common platforms

Mobility operators are being encouraged to contribute to the development of open standards and use them to provide public APIs with high-quality data for riders. MaaS platforms are envisioned to play a role in integrating APIs that use open standards to clear the way for riders looking to get from A to B

Even nonprofits and governments are being recruited into supporting the future GOFS data specification through the creation and adoption of open standards and encouraging governments to make open APIs and data standards part of their mobility programs and first/last-mile options

ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

TOMP (Transport Operators and MaaS Providers) is being developed by the Transport Operators and MaaS Providers (TOMP) Working Group including public and private stakeholders and is aimed at facilitating the implementation of MaaS and the corresponding exchange of data in Europe

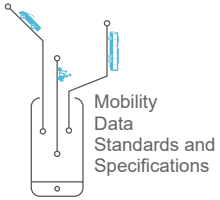
The TOMP-API describes a full MaaS journey, including operator information, planning, booking, support, payments and trip execution

The goal of this API (and the working group developing it) is to provide a generic and open interface between Transport Operators and MaaS Providers, enabling an open ecosystem

The API facilitates an open ecosystem by lowering entry barriers of new actors on the market as they can connect easily to a wide range of stakeholders. Since the focus lies on sharing asset information, both the asset information from free-floating systems and the information from station or fixed-route systems mobility hubs or station-dependent transportation can be shared through the functional descriptions

The TOMP-API specification holds much promise for creating a common standard for MaaS applications, but similar to GOFS cannot be seen as the sole interface in which to develop and build a shared mobility ecosystem

Source - https://tomp-wg.org/#:~:text=The%20TOMP%2DWG%20(Transport%20Operator,API%20(Applicable%20Programming%20Interface).



ENCOURAGE VOLUNTARY ADHERENCE TO STANDARDIZED MOBILITY DATA SPECIFICATIONS BY TSPs (PUBLIC AND PRIVATE) AND CITIES

In order to enable MaaS and mobility management cities must undertake an effective digitization of their public right-of-way, the kerbs, streets, and sidewalks that typically fall under the authority of city departments of transportation

Cities' underlying operating code is defined by the signs, lanes, sidewalks, and crossings that program the basic functions of a street

A core challenge is that much of this information is not digitized at all, let alone in a consistent format

Data standards that enable mobile applications, web applications, and connected vehicles are important building blocks, but to achieve Level 4 MaaS and mobility management, cities will need to digitise certain critical elements of their public right-of-way and existing physical systems

New standards, like CurbLR and ISO 4448, and new data collection methods, such as the SharedStreets' CurbWheel, are two examples of how cities can begin to digitise (and standardise) how they share information about their physical infrastructure

Expanding the digitisation and standardisation of this information is a critical building block that will enable public agencies to effectively optimize how mobility vehicles utilize this physical space, space that typically only cities ultimately control

Source - https://www.curblr.org/
https://github.com/sharedstreets/curb-wheel
https://harmonizemobility.com/sidewalkandcurb/

DEVELOP CLEAR MOBILITY DATA COLLECTION & SHARING LEGAL AGREEMENTS AND TECHNICAL REQUIREMENTS DESIGNED FOR AND AIMED AT TSPs

Establishing uniform standards for mobility data (Policy Strategy #1) will facilitate data sharing across the public and private sectors. There is a particular need for clear data-sharing requirements with respect to TSPs. To date, many TSPs companies have been largely reluctant to share data with public agencies and other end-users for reasons discussed before

An important question is whether it is the role of Indian states or cities to set data-sharing protocols for TSPs. A state-led approach will generally yield reduced costs due to economies of scale, improved consistency and comparability across a greater area, more resources available for oversight, and greater public-sector leverage for negotiating with TSPs. Some cities might be empowered to lead if their states are reluctant to get involved, or where data from state collection efforts are not shared with cities. State leadership may also make sense given that challenges associated with data collection can be more acute for many smaller or lower-resourced cities, which may lack the legal and institutional capacities to negotiate with TSPs directly over data policy

DEVELOP CLEAR MOBILITY DATA COLLECTION & SHARING LEGAL AGREEMENTS AND TECHNICAL REQUIREMENTS DESIGNED FOR AND AIMED AT TSPs

Some cities will likely continue to push for data sharing beyond what their states require because city-led efforts can be better tailored to local needs and capacities. This could result in a “patchwork” of data-sharing requirements, which could generate additional costs and challenges for stakeholders operating in multiple jurisdictions.

Significant city-led efforts, however, could also lead to pressure from state level interests that may prefer uniformity over local control. Theoretically this pressure could result in policy at the state level that pre-empts local data collection in favor of larger scale uniformity, but this is not a guaranteed outcome. A state level policy debate could also lead to policy that supports cities in differentiating their mobility data collection strategies

The specifics of state-region and city-led data-sharing approaches will vary depending on the unique preferences and capacities of the different jurisdictions. This makes generalizing best practices for TSP data collection approaches difficult, particularly when there is no National policy and framework towards MaaS deployment in India.

ESTABLISH PUBLICLY HELD BIG MOBILITY DATA REPOSITORIES

The development and adoption of data specifications enables cities to access the data from private mobility operators, including (in the case of MDS) detailed data about trips that can potentially be used to re-identify the whereabouts of specific individuals. This has raised **privacy concerns** by a variety of players in both the private and nonprofit sectors

There are several potential solutions that enable cities to access and store the data they need to manage the public right of way, while protecting against unnecessary risks associated with free-flowing, unprotected personal trip data. Namely:

- Secure access to data: rather than require open access to potentially sensitive data feeds (e.g., APIs such as MDS), cities require this type of information to be delivered only through secure data feeds that are associated with limited access and specific provisions about their use. However, this will typically come at the cost of reduced interoperability, as proprietary data formats are likely to be used under this scenario

ESTABLISH PUBLICLY HELD BIG MOBILITY DATA REPOSITORIES

Data license agreements: cities and operators are now beginning to establish data license and security provisions that define how potentially sensitive data should be stored, processed, and delivered. Several public agencies and private companies are now part of the SAE mobility data consortium, a multistakeholder collaborative developing best practices with guidance on responsible data licensing practices in this rapidly changing space

Robust, third party solutions: some public agencies may not have the desire or resources to manage the complex flow of an ever-changing landscape of mobility operators, or the security requirements associated with protecting personal data. Secure third party data platform SaaS solutions, such as Moovit, Vianova, Populus, or Remix(to name a few), allow for cities to efficiently harness mobility data for important policy and planning decisions. Many cities, large and small, are finding that this is a very cost-efficient path forward, as these third party solutions are processing data feeds from multiple operators with economies of scale

Focusing on information (not necessarily raw data) to guide decision making: many of the key policy and planning decisions that cities hope to make with access to information from mobility operators can often be achieved by access to historical, anonymized, and aggregated data, which minimizes privacy risks and concerns about surveillance. Again, these are insights that can be provided by outsourced third party solutions

MOBILITY-RELATED BIG DATA IN THE PRIVATE SECTOR

A bunch of well-recognized big mobility-data vendors offer applications for mobility planning, carefully secure their datasets and/or package data into aggregated formats for use by urban planners and practitioners. Purchasing such data (and more often, the insights deriving from these data) from these purveyors can be expensive. For smaller Indian state agencies and cities, data costs might represent a significant obstacle to data accessibility. However, we compile them for reference, where some datasets are actually free to use, under some specific requirements:

- **Uber Movement:** Uber gathers trip data in more than 10,000 cities across the world, including Bangalore, Hyderabad, Kolkata, Mumbai and New Delhi, in India. Uber Movement gives urban planners and researchers free access to Uber's aggregated data to help make informed decisions about cities, so that they can: identify and measure congestion in their jurisdictions; calibrate and validate travel demand models; measure the efficacy of policies and infrastructure investments; build a 'transportation scorecard' for a city or across a region. An illustrative example how Uber Movement has been applied in India is the use case for "Examining the Impact of Traffic as Delhi Shops on Dhanteras"

- **TomTom Traffic Index** ranks urban congestion worldwide and provides free access to city-by-city information, including Mumbai, Bengaluru, New Delhi and Pune, in India. City planners and policy makers can use the index to help tackle traffic-related challenges

LEVERAGE EXISTING INNOVATIVE LAND-USE AND TRANSPORTATION PLANNING TOOLS AND PLATFORMS FOR DATA-DRIVEN ANALYSIS, VISUALIZATION AND POLICYMAKING

In addition to streamlining mobility data sharing, there are opportunities to improve mobility data evaluation. The easier it is for planners and other practitioners to incorporate transportation data into decision making, the more informed and responsive those decisions will be

There are both proprietary and open-source platforms for mapping and visualizing mobility data. Proprietary platforms typically have greater technical and analytical capabilities, but cost money to use. Relying on private platforms to store and/or visualize public data may also set a troubling precedent. Open-source platforms provide more transparency and accessibility, but they can be difficult and expensive for public agencies and other not for profit entities to maintain

There are several private companies developing such platforms. Although in most cases (with the exception of Moovit) the extent to which such platforms are already deployed and processing data from mobility data providers in India has to be further researched (e.g., by contacting the sales teams of these providers)

LEVERAGE EXISTING INNOVATIVE LAND-USE AND TRANSPORTATION PLANNING TOOLS AND PLATFORMS FOR DATA-DRIVEN ANALYSIS, VISUALIZATION AND POLICYMAKING

Moovit provides insights about where, when, and how people move around cities worldwide. In India, Moovit is in Ahmedabad, Bengaluru, Chennai, Hyderabad, Mumbai, Mysore, New Delhi, and Pune.

It is arguably the world's largest repository of public transport data, and through their "Urban Mobility Analytics" tool they combine multiple data sources, including anonymized, aggregated data from hundreds of millions of Moovit users, with advanced algorithms to provide detailed insights into how people move around previously mentioned Indian cities, therefore supporting them make more informed, data-driven mobility decisions

LEVERAGE EXISTING INNOVATIVE LAND-USE AND TRANSPORTATION PLANNING TOOLS AND PLATFORMS FOR DATA-DRIVEN ANALYSIS, VISUALIZATION AND POLICYMAKING

Vianova uses connected vehicles data to help cities and mobility operators build safer and more efficient streets

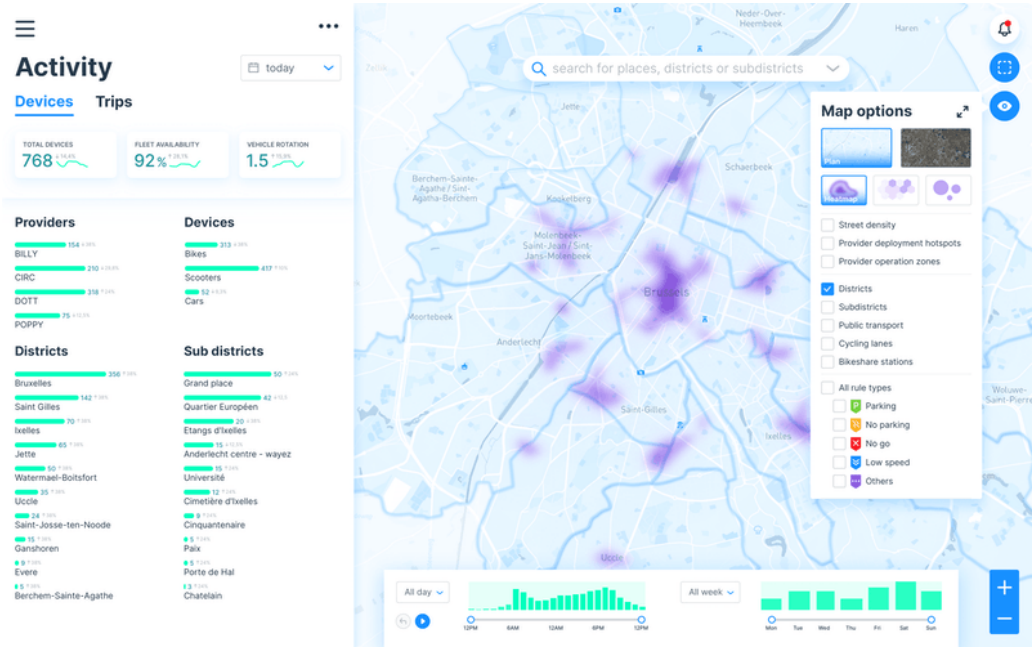
Visualize in real-time anonymized locations of vehicles in the city, as well as mobility operators' deployments

Monitor the evolution of fleets sizes, services utilisation and number of trips, by providers

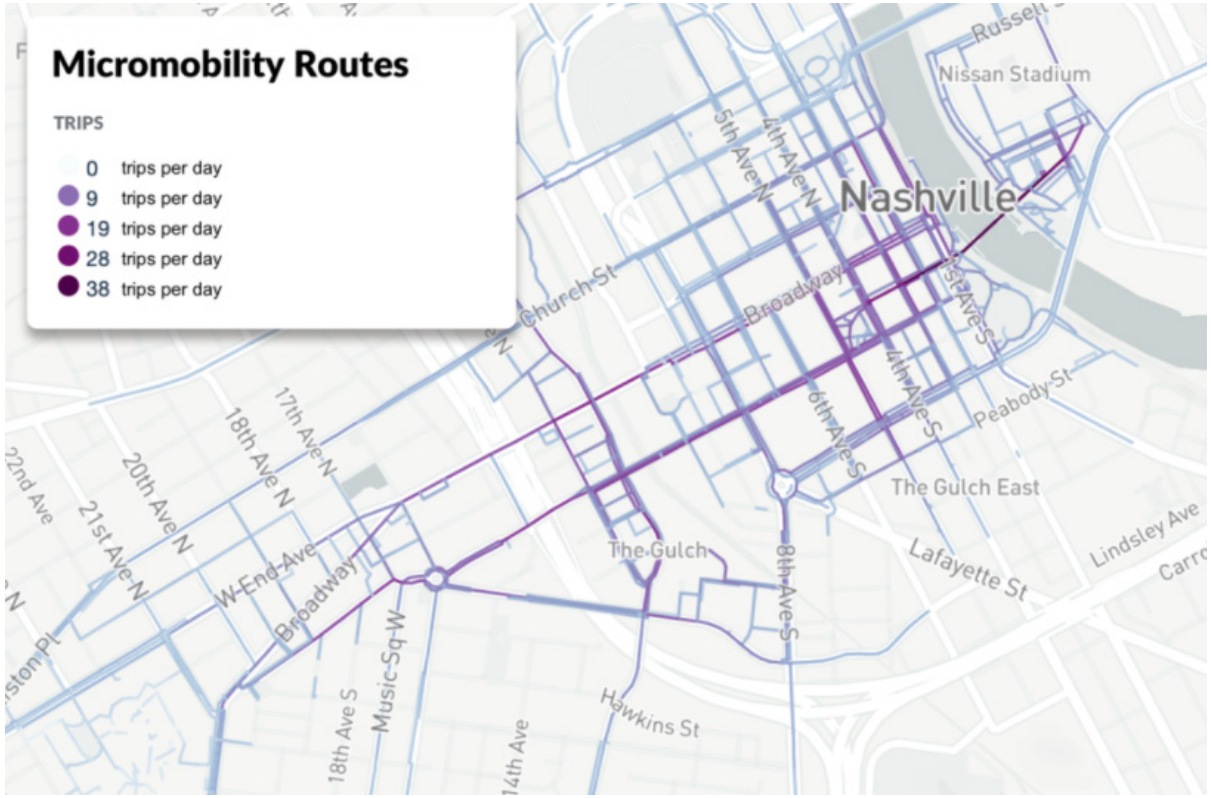
Receive alerts for safety hazards and send service request

Access, integrate and share reliable mobility data streams from +50 Mobility Data Connectors

Easily retrieve historical data and insights within city own tools to perform travel behaviour analysis and mobility planning



LEVERAGE EXISTING INNOVATIVE LAND-USE AND TRANSPORTATION PLANNING TOOLS AND PLATFORMS FOR DATA-DRIVEN ANALYSIS, VISUALIZATION AND POLICYMAKING



Populus operates a multi-city mapping platform designed to assist cities in tracking shared mobility services such as bikes, scooters, and vehicles

Platform data is location-based and time-sensitive

Populus data is compiled using the Populus Mobility Manager and is available in real-time, which allows cities to adjust planning decisions in response to the trends observed

LEVERAGE EXISTING INNOVATIVE LAND-USE AND TRANSPORTATION PLANNING TOOLS AND PLATFORMS FOR DATA-DRIVEN ANALYSIS, VISUALIZATION AND POLICYMAKING

Remix offers an integrated suite of products that contain public transport, street-specific, and new mobility data, often in real time

Remix digitises policies like caps and equity into easy-to-use dashboards, so new mobility operators can measure how their micromobility programmes perform day-to-day. When cities and mobility providers can see and understand the same metrics, they can collaborate more effectively to reach shared goals together

Micromobility is new for many cities, and technology has enabled public-private collaboration in a way never seen before. Improve street safety and comfortable riding by creating geospatial policies, such as no-parking zones, and easily communicating them to all providers

How are micromobility riders affecting streets? Visualize well-utilized corridors, compare with existing bike networks, and identify risks so you can plan new, safer infrastructure for riders

WAYS CITIES CAN LEVERAGE MOBILITY DATA

With the emergence of shared mobility services and Mobility as a Service disrupting the way end users interact with and consume mobility services (including public transport as the backbone of urban mobility), Indian cities are faced with the challenge to establish strategies to make more informed decisions with regards to the urban planning and mobility management

Through effective mobility data sharing and management, and well-thought and deployed MaaS schemes, Indian cities will be equipped to answer questions such as:

- Were scooters equitably distributed in low-income neighborhoods according to city policy over a given period of time (such as e.g., the past month)?
- Where are the majority of scooter trips taking place on the city streets?
- How can we make sure micromobility is a safe and effective form of transportation?
- Will shared mobility be a way to generate revenue for the city or will it cost public money (e.g., invest to adapt / upgrade infrastructure for safer travel)?
- How will cities manage the expectations of their citizens and operators?

WAYS CITIES CAN LEVERAGE MOBILITY DATA

POLICY OBJECTIVE	REGULATORY TASK	DATA NEEDS
EQUITY	ENSURE SERVICES ARE PRESENT IN ALL AREAS	MONTHLY ZONAL AGGREGATE "START_TRIP" AND "END_TRIP" DATA
OBSTRUCTION OF PUBLIC SPACE	ENFORCE PARKING RESTRICTION	DEVICE-SPECIFIC "END-TRIP" LOCATION STAMP (DATA ONLY RETAINED FOR NON-CONFORMING INCIDENTS
FUTURE PLANNING	GATHER INFORMATION ON TRAVEL DEMAND AND LOCATION	AGGREGATE ROUTE TRACES FOR ORIGIN-DESTINATION AND TRAVEL PATH INSIGHT

Source: International Transport Forum

A Policy Objective > Regulatory Task > Data Needs approach to "mapping" mobility strategies by cities can be helpful to engage local stakeholders, identify relevant existing legal frameworks or instruments, and required upgrades, and ultimately which mobility datasets are needed (and which players can provide them)

Additionally, a descriptive use case formulation can complement this approach, where a question-answer format will be instrumental in identifying what is required for a successful deployment of shared mobility programmes and, ultimately MaaS (see next slides)

USE CASE 1 - HOW MOBILITY DATA CAN SUPPORT CITIES' SHARED MOBILITY GOALS AND MaaS: DAY-TO-DAY PROGRAMME MANAGEMENT

The success of a shared mobility city programme does not hinge on a few key moments; it is dependent upon things that happen each day, over periods of time. The accumulation of these activities, and the data they provide will help cities understand if they are meeting their greater community and transportation goals. Understanding and adapting programmes to meet city's needs is critical, and dependent on accurate and actionable data

Seeing the current state of the streets: a clear picture of how many vehicles are on the street, where they are located, and where trips start and finish will help cities understand user behaviors and how operators are supporting service area's needs

Cities will want to consider the following questions:

- *How established vehicle caps perform against demand?* With data showing the number of vehicles on the streets at any given time, as well as usage data, cities will be able to see if vehicles are sitting idle or scarcely available. In order to get accurate data, it is important to be in agreement with operators about when and how vehicles will be accounted for
- *Where are vehicles located?* Knowing vehicle location helps cities understand if zone restrictions are working and service goals are achieved. Most programmes have designated no parking and no riding zones, as an example, where shared mobility vehicles are prohibited. Vehicle location data also help cities understand if they are serving service areas as intended

USE CASE 1 - HOW MOBILITY DATA CAN SUPPORT CITIES' SHARED MOBILITY GOALS AND MaaS: DAY-TO-DAY PROGRAMME MANAGEMENT

Understanding usage and revenue: an important piece of data for operators and cities alike is understanding, if the programs are meeting city needs from both a service and revenue perspective. One way cities can generate revenue is through a per-ride fee collected by the operator. In this approach, revenue raised is directly related to the number of trips taken. However, the cost to introduce a programme must be taken into consideration. Understanding the number of rides and possible fee structure options will enable cities to evaluate if their programmes are feasible.

Cities will want to consider the following questions:

- *How many trips are being taken?* The number of trips for a given programme can be measured in overall journeys, but there is also a way to use trips as a measure of efficiency for operators: trips per vehicle per day. For cities, it can help them understand utilisation of the services being provided and where it can help underserved areas. Operators can use this measure to evaluate profitability and determine if they are covering costs
- *Is this costing money or making money?* Fee structures can vary from city to city — what works well in one area may not meet the needs of another. With usage data, cities can evaluate fee structures, model potential fee changes, and see how it would impact city revenue. Different cities and operators take different approaches to pricing: some look at the number of vehicles, others the number of trips. Usage data can offer insight into what structure makes the most sense for a given city

USE CASE 1 - HOW MOBILITY DATA CAN SUPPORT CITIES' SHARED MOBILITY GOALS AND MaaS: DAY-TO-DAY PROGRAMME MANAGEMENT

Safety and adapting policies: the ability to set policies and adapt them over time is another important aspect of shared mobility programme management that can be informed by data collection

Cities will want to consider the following questions:

- *Are speed limits and no ride zones working?* Shared mobility data can tell cities if existing policies are being observed, need to be reconsidered, or if new policies should be introduced. Speed limits for vehicles can vary based on different geographies within cities and data can help them understand if the rules in place are being followed
- *Is there a need to update city policies over time?* The policies of a given city programme will need to adjust over time for a number of reasons. A city may find that some of their assumptions when the policies were set up were incorrect, broader city regulations may change, or infrastructure changes may prompt needed changes. In some cases, a temporary event such as a storm (frequent in India, especially during the monsoon seasons) will prompt cities to need to remove vehicles from streets. Knowing the current state of a city programme and its vehicles will enable cities to develop and adjust policies to make them more effective

USE CASE 2 - HOW MOBILITY DATA CAN SUPPORT CITIES' SHARED MOBILITY GOALS AND MaaS: EVALUATE AND IMPROVE A CITY PROGRAMME WITH DATA

The introduction of shared mobility to a city will not be a "set it and forget it" event. It is likely that the data cities begin to collect after launch will help them understand the needs of citizens and adapt their programme to suit them. Evaluating city programmes with data and being able to communicate the results to stakeholders are necessary in order to build and maintain support for the programme

Cities will want to consider the following questions:

- *What types of trips are made?* For many cities, shared mobility can support the utilisation and extend the service area of existing public transport options. The types of trips being made can offer insight into the programme objective results. If trips are beginning and ending at public transport hubs, for instance, we can assume that riders are using the vehicles as a component of their public transport journey. For instance, data from existing shared mobility programmes during the COVID-19 shutdown showed that the average scooter ride increased in distance in a number of markets, indicating that riders likely used the vehicles in lieu of using an enclosed public transportation option
- *Are equity areas well served?* Many cities require the deployment of a specific number or proportion of vehicles to underserved areas in order to improve transportation offerings. Captured data allows cities to see if operators are meeting the required number of vehicles, and how they are being utilised

USE CASE 2 - HOW MOBILITY DATA CAN SUPPORT CITIES' SHARED MOBILITY GOALS AND MaaS: EVALUATE AND IMPROVE A CITY PROGRAMME WITH DATA

Cities will want to consider the following questions:

- *What streets are used?* A city's overall planning and public transportation goals may include encouraging the use of existing greenways and bike lanes. The data cities collect on usage and routes will tell them if the intended routes are being utilised or not.
- *Is the city programme successful?* The success of a city programme will be dependent on a number of factors, including achievement of goals to service areas, usage of identified preferred streets and routes for travel, and service levels meeting city demand. It will not be a single moment in time that determines this success

Throughout the life of a city programme, cities will need to communicate to various stakeholder audiences about the service levels, successes and challenges they have experienced. The data they collect about their programmes will foster trust with local stakeholders, ensuring that everyone is speaking the same language and able to interpret progress toward the agreed-upon goals. Possible groups may include larger local government, transportation departments, and the general public

USE CASE 3 - HOW MOBILITY DATA CAN SUPPORT CITIES' SHARED MOBILITY GOALS AND MaaS: PROGRAMME RENEWAL PLANNING

As cities look to extend their programmes year after year, they will have opportunities to make adjustments to better reach their larger, long-term transportation goals

Cities will want to consider the following questions:

- *How much fee revenue would you bring in with a change to your fee structure?* Revenue is often a central concern for cities launching shared mobility programmes. How much a programme will cost and how much revenue it will generate will be determined by their fee structure and programme utilisation. Permitting and licensing fees are assessed initially, and typically recur annually at a fixed rate, providing some fee revenue to cities that is highly predictable. Variable revenue options include per-vehicle fees from operators and per-ride fees paid by users. The data cities capture and analyse can help them model potential changes in their fee structure and determine the level of fee to charge, and the way to administer it
- *How would a subsidy impact operations and/or service?* Subsidies can be used to encourage mobility providers to focus on service provisions that are prioritised by a city. For example, a city might choose to give operators exclusive rights to offer their service within a given area in exchange for that operator providing free, or discounted rides for low-income citizens. Under this scenario, the city would not collect a fee from the operator, effectively subsidising the provision of benefit to the public through the operator. Such city strategies to nudge given mobility behaviours can be efficiently managed through tools such as Rideal (refer to this article on the topic of "microsubsidies")

USE CASE 3 - HOW MOBILITY DATA CAN SUPPORT CITIES' SHARED MOBILITY GOALS AND MaaS: PROGRAMME RENEWAL PLANNING

Cities will want to consider the following questions:

- *Where should parking corrals go?* One of the biggest debates about shared mobility vehicles is whether vehicles should be docked at specific locations, as many bike shares require, or if vehicles do not need to be docked, just safely parked in a designated service area. Many objections to e-scooter programs were founded in the concern that scooters may be left in the middle of a sidewalk and obstruct the pedestrian right of way
- *Should cities introduce a dynamic cap to better serve designated areas?* Dynamic caps allow cities to raise or lower the limit to the number of deployed vehicles throughout the year in order to match demand and performance. These can be especially useful during seasonally busier times, or times when cities want to limit the number of vehicles deployed for any reason. It can be difficult to know the number of vehicles that are considered optimal for a given city programme before a pilot launch.

USE CASE 4 - HOW MOBILITY DATA CAN SUPPORT CITIES' SHARED MOBILITY GOALS AND MaaS: BROADER INFRASTRUCTURE AND PLANNING

The MDS a city receives from the "Provider API" can potentially inform broader infrastructure planning in the city by offering insight into travel patterns of residents

Cities will want to consider the following questions:

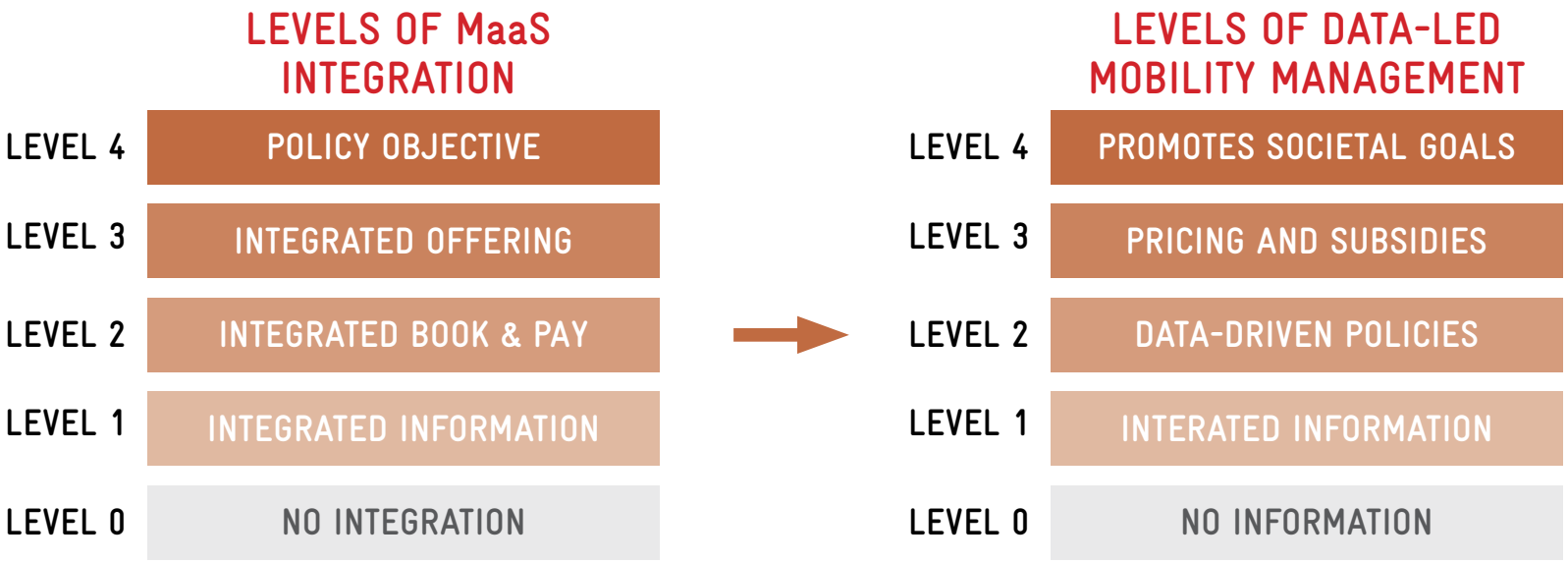
- Where should the city prioritise new protected lanes? Where trips begin and end, and the frequency of trips in an area can help cities understand the streets that would benefit from protected lanes, such as bike lanes or designated greenways. Shared mobility data can be a powerful indicator in city prioritisation processes
- What is the anticipated use of new infrastructure? The insights provided by trip data in shared mobility programmes can help communities understand the changing infrastructure needs of their city and begin to plan for them. Shared mobility has long been considered a complement to public transport, but since the COVID pandemic began, it has received broader consideration as an alternative to it. Travel patterns and usage can also help cities prioritise specific projects over others in order to serve the most significant public needs

USE CASE 4 - HOW MOBILITY DATA CAN SUPPORT CITIES' SHARED MOBILITY GOALS AND MaaS: BROADER INFRASTRUCTURE AND PLANNING

Cities will want to consider the following questions:

- *Based on competing interests for kerb/sidewalk space, what is the best allocation?* With new modes and uses, there are now more demands on the streets and sidewalks than ever. This includes increased pickups and drop-offs from ride-hailing companies, like Uber and Ola, delivery vehicles, sidewalk cafes, and parklets. MDS allows those who manage the kerb a chance to understand the specific demand for shared mobility vehicle parking and where it fits within the hierarchy of needs for a given area. As MDS expands, similar data on other modes described above will provide a more complete picture of those demands. New policies can reflect these needs, including appropriate pricing for use of the space, based on days of the week and time
- *How can sharing data with partner agencies help with long-term planning?* Publicly shareable aggregations of MDS allow public authorities to prioritise a list of active transportation projects based on usage data. Similarly, those agencies wishing to calibrate their travel demand models can get a better understanding of the types of trips being taken by shared mobility and the routes they take. This can help with forecasting shared mobility's role in long-range transportation planning. An economic development agency can use MDS to tell retailers how many scooter trips ended within redevelopment or other priority zones. Finally, cities that are thinking of starting their own shared mobility programmes can use the data to anticipate usage based on characteristics of other cities in the region

MaaS AND MOBILITY MANAGEMENT



Data is of utmost importance to sustain effective MaaS that maximises public benefit, increases public transport ridership, while establishing a level playing field for privately-held mobility services to thrive

Analogous to the widely-referenced levels of MaaS integration topology1, an evolution of the levels of mobility management is presented, highlighting the key contribution of mobility data in each level

Source - Sochor, J., Arby, H., Karlsson, I. M. & Sarasini, S. (2018). A topological approach to Mobility as a Service: A proposed tool for understanding requirements and effects, and for aiding the integration of societal goals. Research in Transportation Business & Management

MaaS AND MOBILITY MANAGEMENT

LEVELS OF MaaS INTEGRATION

LEVEL 4	PROMOTES SOCIETAL GOALS POLICIES, INCENTIVES, ETC.
LEVEL 3	INTEGRATED OFFERING BUNDLED SUBSCRIPTION, CONTRACTS
LEVEL 2	INTEGRATED BOOK & PAY SINGLE TRIP-FIND, BOOK & PAY
LEVEL 1	INTEGRATED INFORMATION MULTIMODAL PLANNER, PRICE INFO
LEVEL 0	NO INTEGRATION SINGLE, SEPARATE SERVICES

LEVELS OF DATA-LED MOBILITY MANAGEMENT

LEVEL 4	PROMOTES SOCIETAL GOALS MULTIMODAL OPTIMISATION
LEVEL 3	PRICING AND SUBSIDIES PRICING TO OPTIMISE DECISIONS
LEVEL 2	DATA-DRIVEN POLICIES POLICIES DRIVEN/VALIDATED WITH DATA
LEVEL 1	INTEGRATED INFORMATION MOBILITY DATA REPORTING
LEVEL 0	NO INTEGRATION UNREGULATED MOBILITY SERVICE

Source: Populus

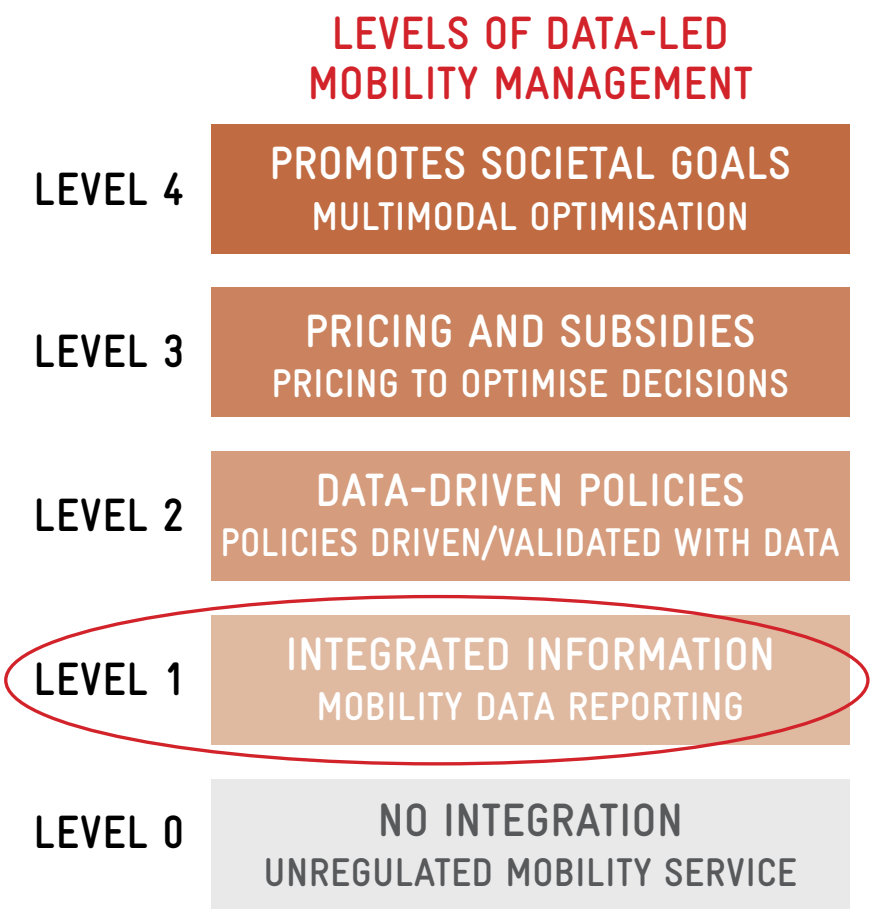
MOBILITY DATA REPORTING

In recent years, many cities have achieved Level 1 of Mobility Management, securing access to mobility data from private fleet operators. Public agencies, including city departments of transportation and public transport agencies need access to mobility data in order to serve as effective mobility managers

With data, public agencies can make more informed decisions about where to place new infrastructure (e.g., kerb loading, scooter parking), ensure that services are equitable (i.e., that they are accessible in historically underserved communities), and determine how new mobility services can be leveraged to reduce congestion and climate impacts

Largely influenced by their prior experiences with ride hailing services, cities around the world are more prepared with regulatory frameworks that are being applied to new mobility services (e.g., shared electric scooters)

As additional mobility services are introduced in cities, including shared moped, autonomous delivery, and autonomous ride hailing services, city departments of transportation must have some level of access to data from these services in order to adapt transportation infrastructure and policy to keep up with changing needs of the public right-of-way. Many cities have already reached Level 1 of Mobility Management for shared micromobility, with many having advanced to Level 2



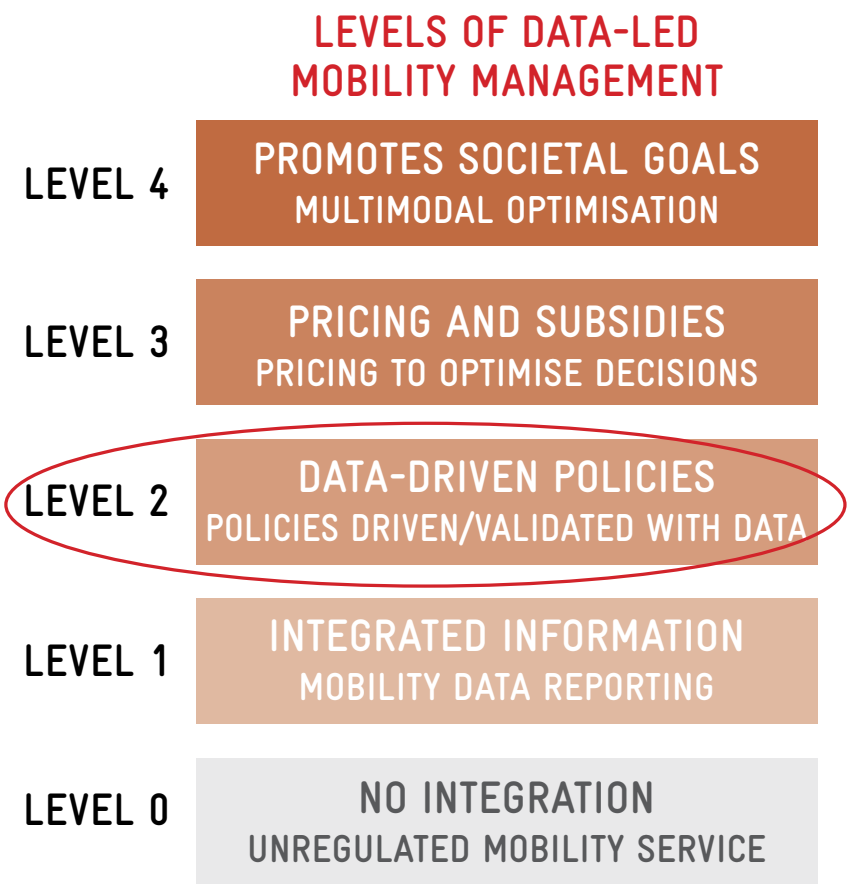
Source: Populus

POLICIES DRIVEN/ VALIDATED WITH DATA

Level 2 of mobility management is achieved when cities are able to leverage the data that they receive from mobility operators to set more effective policies

Examples of data-driven policies that might be implemented by cities to manage mobility fleets (that are already implemented for micromobility services) include:

- **Parking:** geospatial areas for preferred and restricted parking areas might be communicated to mobility fleets for pedestrian safety or other needs
- **Trips:** routes and specifically no ride/no-trip paths might be shared to communicate where pedestrians, and micromobility or other types of vehicles will ply
- **Equity:** cities might require or subsidise (see Level 3) fleet service in an area that is historically underserved
- **Fleet size:** cities might set a minimum level of service or maximum fleet size



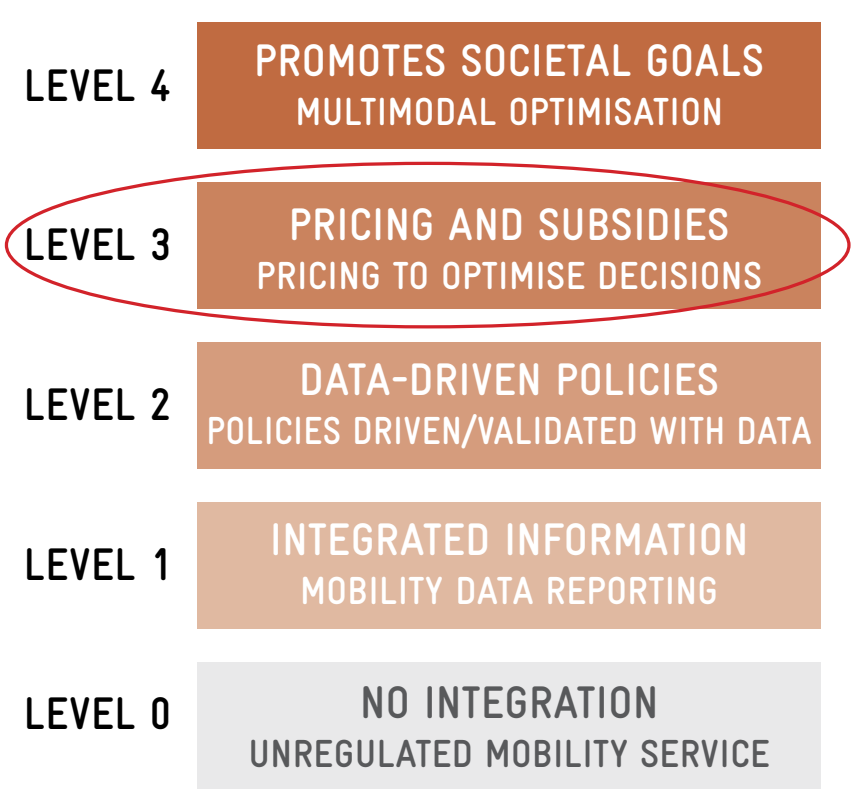
Source: Populus

PRICING TO OPTIMISE DECISIONS

Given that most traveller decisions are largely influenced by time and cost, pricing is an incredibly important tool for public agencies to leverage for shaping desired transportation outcomes. Level 3 mobility management is achieved when cities effectively leverage pricing strategies, including subsidies, to influence how travellers decide whether to walk, drive, use micromobility, or use public transport

In 2020, many cities overseeing shared micromobility programs began to implement more complex policies for pricing the public right-of-way, including parking fees (applied to restricted parking areas), fines for non-compliance with equity policies, and fees for riding in no-ride zones

While setting a fair price for access to roads, kerbs, and on/off-street parking is an important mechanism for cities to influence traveller behaviour, providing subsidies is equally important. Public transportation services are typically heavily subsidised because they are viewed as a significant public utility



Source: Populus

PRICING TO OPTIMISE DECISIONS

Similarly, as new private mobility services continue to expand, it is important for cities to determine when and where private mobility services can provide social benefit (or can be influenced to provide social benefit) to warrant a subsidy.

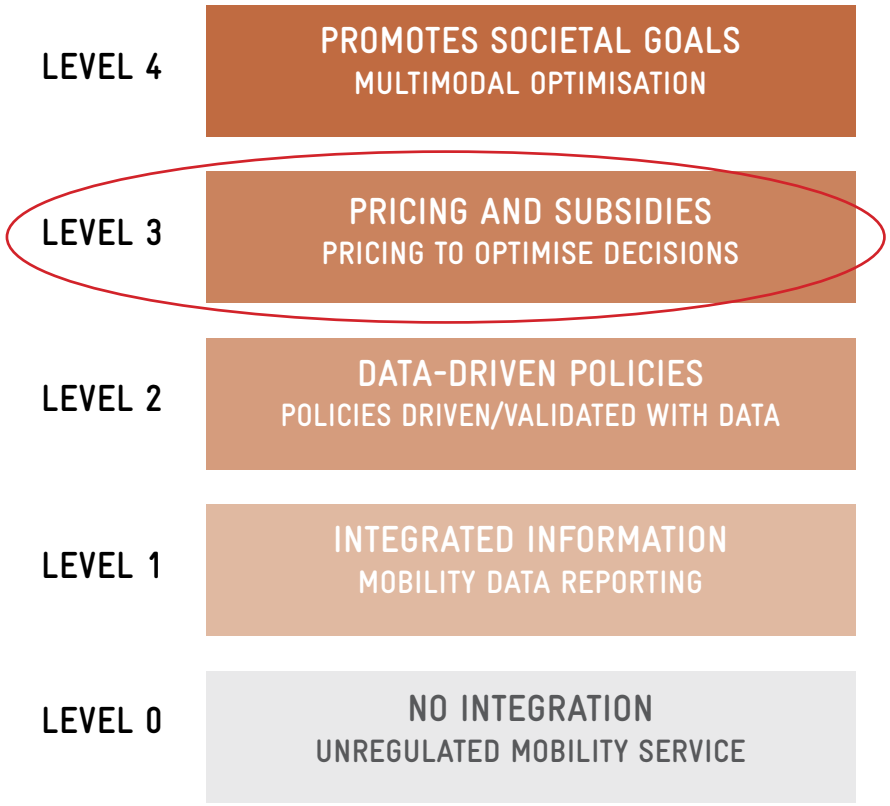
Public subsidies must be implemented in the most transparent, cost-efficient, targeted way, and be designed to address Key Performance Indicators included in cities' mobility plans

Rideal is a powerful SaaS platform that can be plugged into any existing MaaS or Mobility Service Provider platform, to design, manage and monitor subsidy programmes, and also monitor its effectiveness in real-time

Subsidising shared mobility with public money is not new. For example, prior to the emergence of venture-backed electric scooter companies, the majority of bike share systems received public subsidies

Moreover, important industry stakeholders, such as the UITP, or Polis, to name some, are embracing the idea of micro-subsidies to any mobility service available in a city as a way to implement more efficient mobility strategies, where availability of data provided by / shared through MaaS platforms is critical

LEVELS OF DATA-LED MOBILITY MANAGEMENT

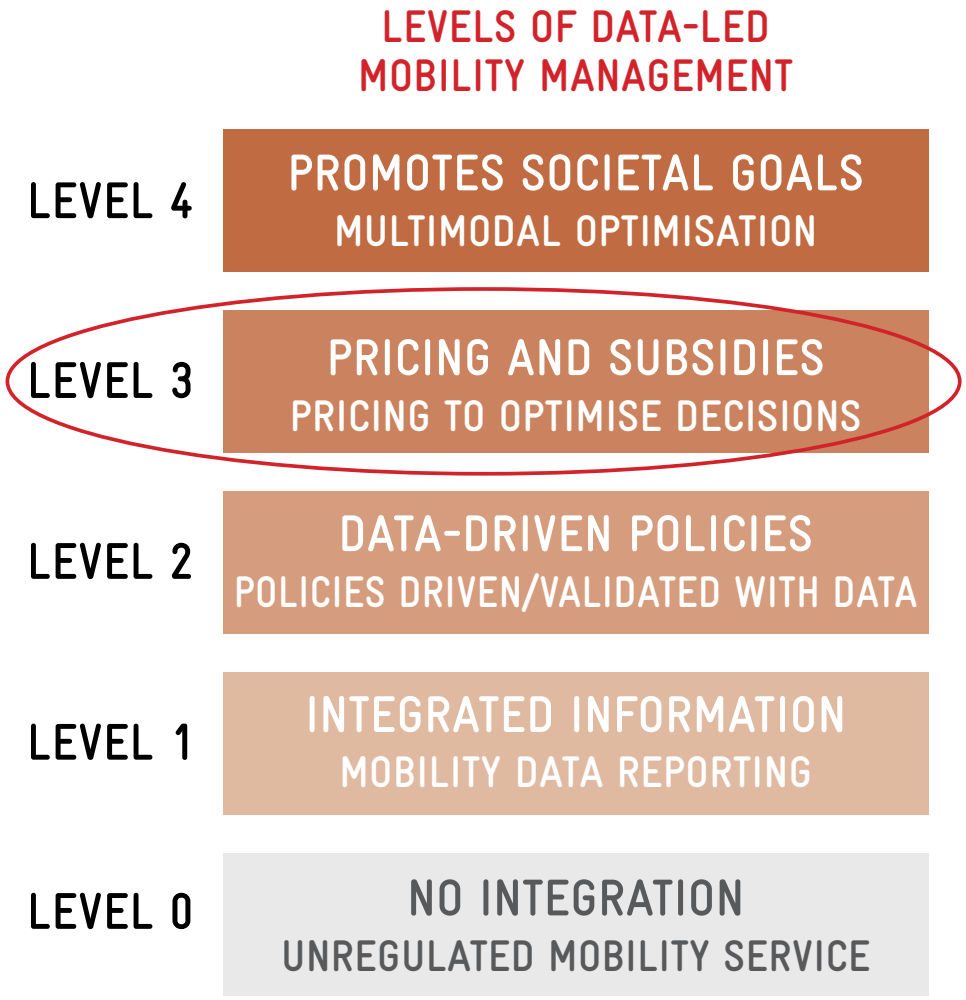


Source: Populus

PRICING TO OPTIMISE DECISIONS

Key examples of when cities may provide subsidies to private fleet operators include:

- Supporting first/last-mile access to mass transit
- Expanding transportation access in underserved areas
- Shifting travellers to certain modes to reduce congestion during peak transit times
- Supporting services that have a lower carbon footprint than personal vehicles



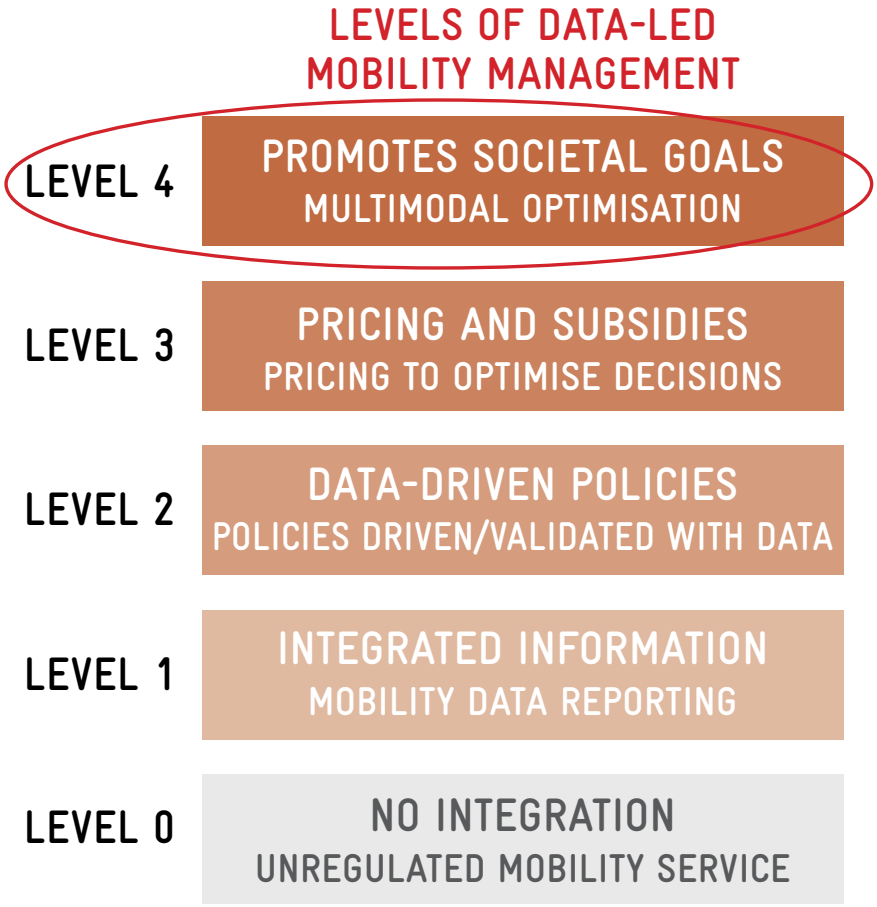
Source: Populus

MULTIMODAL OPTIMIZATION TO PROMOTE SOCIETAL GOALS

Today, many cities have realized Level 1, 2, and perhaps 3 of mobility management: mobility data sharing, data-driven policies, and pricing (though few have implemented subsidies). However, the most sophisticated mobility management solutions that exist today are applied only to micromobility services (e.g., shared bikes and scooters), and generally lacking other transportation modes (e.g., Uber/Ola, carsharing)

Platforms like **Vianova**, **Populus**, or **Remix** deliver Levels 1 to level 3 mobility management solutions for cities to manage multiple shared modes, including shared bikes, scooters, mopeds, and cars

Few cities have implemented mobility management beyond shared electric scooters, and no cities have effectively implemented mobility management to optimise across the multiple transportation modes that exist in these cities (i.e., shared micromobility, Uber/Ola, carsharing, mass transit, etc.)



Source: Populus

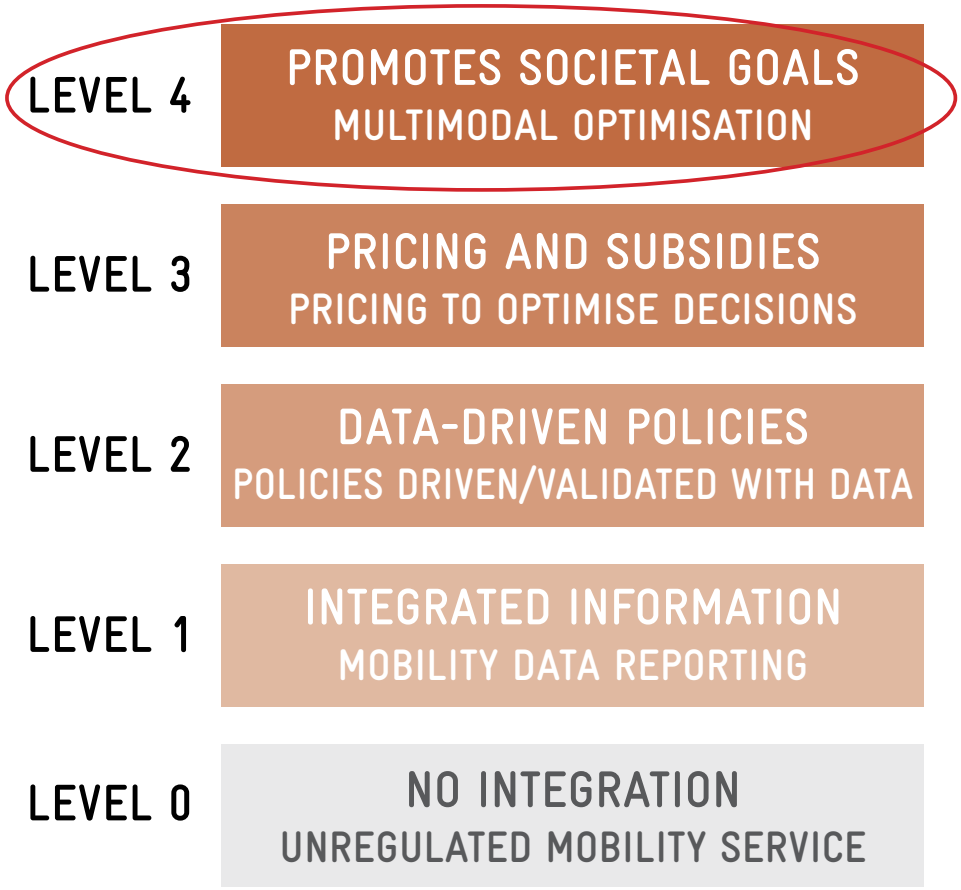
MULTIMODAL OPTIMIZATION TO PROMOTE SOCIETAL GOALS

With Level 4 mobility management, public agencies will be able to influence how travellers make transportation decisions across modes to promote societal goals: reducing transportation climate impacts, limiting congestion, and expanding equitable access to mobility.

To reach Level 4 mobility management, cities will need access to data from the various transportation services delivered on their public right-of-way in order to make data-driven decisions, including the implementation of pricing and subsidies

Level 4 mobility management can more easily be achieved alongside Level 4 MaaS solutions. That is, the mechanism through which real-time information about transportation options, and specifically new pricing and subsidies could be more easily delivered to a large population of travellers through one, or more likely, multiple, MaaS consumer-facing applications

LEVELS OF DATA-LED MOBILITY MANAGEMENT



Source: Populus

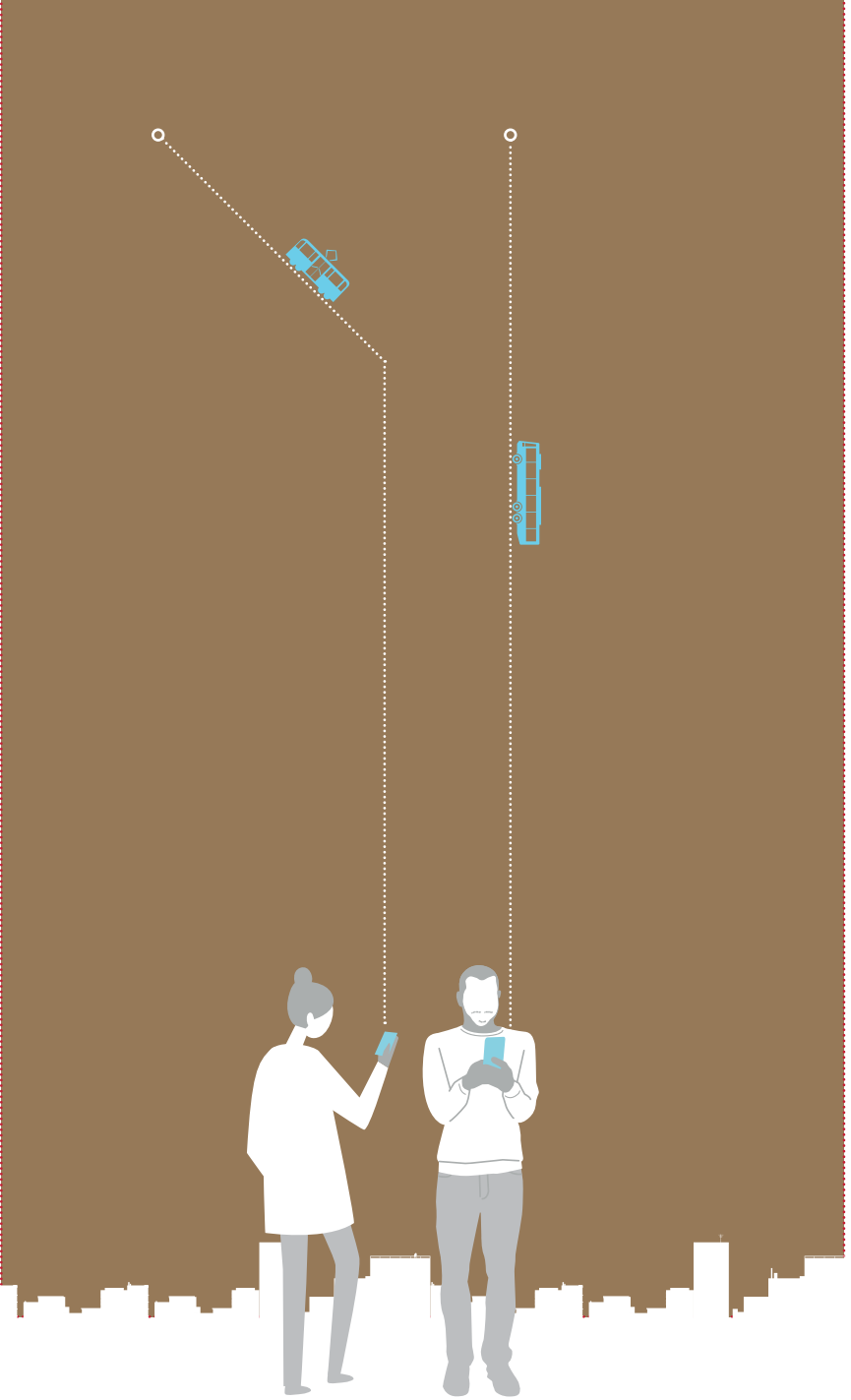
MULTIMODAL OPTIMIZATION TO PROMOTE SOCIETAL GOALS

To utilise customized Terms of Use (ToU) of mobility data, encompassing clauses to specify intermediate developer server architecture, tiered rate limits, no liability, no use of trademarks, no endorsements, and to allow termination of access if the City or Public Transport Authority (PTA) finds that the ToU has not been fulfilled by a third-party developer. While standard international open licenses, such as Creative Commons Attribution (CC-BY), are generally preferable, we propose customized ToU for Indian Cities / PTAs in order to enable their preferred approach for a gradual, closely managed the opening of their data. Since the current policy framework in India lacks a state-wide policy, it is recommended to launch the mobility data non exclusively to third-party developers

To openly publish static public transport data as General Transit Feed Specifications (GTFS)(many Indian cities still do not provide such data). To publish real-time public transport data as GTFS-RealTime, it is recommended to perform load testing of the existing city or PTA data servers and to compare results with the benchmarks. Furthermore, developing authorization/authentication mechanisms and caching technologies is crucial. In any case, the ToU should state that if the data is used, then the user is deemed to have accepted the license conditions. Examples of best practice GTFS in India (non-exhaustive list): Delhi Transport Corporation; Kochi Metro Rail Ltd; Hyderabad Metro Rail Limited

NOTE

NOTE



Ministry of Housing and Urban Affairs (MoHUA) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH are jointly implementing the technical cooperation project "Integrated Sustainable Urban Transport Systems for Smart Cities (SMART-SUT)", commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ). The project works with the three Smart Cities of Bhubaneshwar, Coimbatore, and Kochi and respective state governments of Odisha, Tamil Nadu, and Kerala to promote low carbon mobility planning, and to plan and implement sustainable urban transport projects.

As part of the Indo-German bilateral cooperation, both countries have also agreed upon a strategic partnership - Green Urban Mobility Partnership (GUMP) between Ministry of Housing and Urban Affairs (MoHUA) and Federal Ministry for Economic Cooperation and Development (BMZ). Within the framework of partnership's technical and financial cooperation, the German government will support improvements in green urban mobility infrastructure and services, strengthen capacities of national, state, and local institutions to design and implement sustainable, inclusive, and smart mobility solutions in Indian cities. As part of the GUMP partnership, Germany will also be supporting expansion of public transport infrastructure, multimodal integration, low-emission or zero-emission technologies, and promotion of non-motorised transport in India. Through this strategic partnership, India and Germany intend to jointly achieve effective international contributions to fight climate change.