Public Transport Management – where do we stand?

Public transport, PTM, Mobility data, Data standards

The key function of Public Transport Management (PTM) is to merge behavioural science and systems engineering to determine how to improve the flow of passengers on mass public transport. The efficiency of a transport system depends on several elements, such as available technology, governmental policies, the planning process, and control strategies. The key element lies in the digitalisation approach of all public transport services as well as real-time information, thus standardization is necessary for a consistent and comprehensive definition of how data is to be reported.

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Public Transport Management (PTM) represents a set of various solutions and tools that aim at making public transport services more efficient and sustainable for operators and drivers while putting the end-users at the centre of the approach. Its key elements comprise fleet and terminal management as well as real-time passenger and driver information. Nowadays PTM encompasses various electronic systems such as automatic fare collection system (AFCS), security and surveillance systems (passenger, driver, transport, payment, etc.) and collection of solutions to increase cost-efficiency and minimise the environmental impact. Public transport as well as its management systems become more and more cooperative, integrated and automated which can provide various intelligent transport solutions. Furthermore, digitalisation policy creates a level playing field for various companies to offer their services and creates favourable conditions for new companies to enter the market with new services.

There are more than 50 PTM-systems installed across the globe, 15,000 connected vehicles, 5.5 million passengers per day and 500 million monitored kilometres per year [1]. Each PTM system includes a number of smaller sub-systems that allows the management authority at any time to analyse the required data to make certain decisions. These systems include everything from fleet management tools, traffic management and planning, parking and road safety, real-time vehicle tracking to journey planning applications for end users [2].

In *Figure 1*, important stakeholders, their activities and added value to the business model can be found, in which the focal point of a PTM system is the end-user of the public transport. In this business model, the information on growing public transport users' demand is detected by the system, which is based on the travelling patterns of users, infrastructure, availability of public transport, low emission zone, park & ride, etc. The solution is offered by the system for more reliable arrival times based on trip time advice and floating traffic data. Therefore, less waiting for the arrival of the transport, short travel time, comfort, safety, as well as efficiency of public transport use, which implies lower costs, fewer accidents, congestions, and efficient use of Mobility as a Service (MaaS) services. A value-in-use of this business model is the optimal public transport system for a traveller. For more information on this, see [3].

As PTM is based on congregating and analysing all received data that streams from various sub-systems that are working together and in a harmonious way, standardization (related to representation and exchange of data about public transportation systems) can aid to the interoperability of different systems, as many interoperability problems arise from the use of old information systems to manage operational data such as schedules and tariffs.

Each PTM system operates with mobility data. Mobility data is information about travel that is collected using digitally ena-

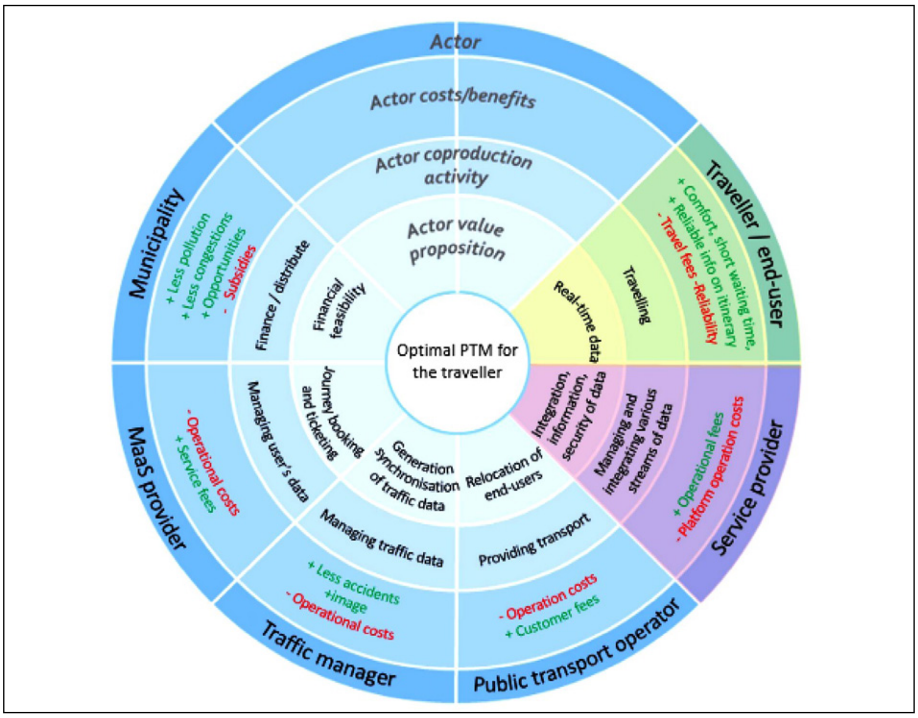

Figure 1: Business model radar for Public Transport Management [3]

bled mobility devices or services. The mobility data is typically recorded as series of latitude/longitude coordinates and collected at regular intervals by smartphones, on-board computers, or app-based navigation systems. The mobility data may include information about trips, for instance:

- origins,
- destinations,
- trip length,
- trip route,
- start and end times
- and information about the vehicles used, such as:
- vehicle location,
- average speed,
- direction,
- sudden breaking,
- emissions.

All mobility data can contain static and dynamic/real-time information. Static information includes:

- routes and schedules;
  while dynamic information includes:
- traffic conditions,
- real-time public transport schedules (expected time of arrival),
- information pertaining to bus stops,
- incidents.

The data is physically stored on a server that provides access to the client applications of different types and roles, based on access permissions [2]. Wireless broadband provides the high-speed connectivity needed and a proven solution that can be deployed at a fraction of the cost and time of fibre or wired connectivity. Therefore, it is of paramount importance to have a comprehensive, consistent, and agreed set of parameters for data to be easily communicated and used.

GTFS stands for “General Transit Feed Specification” which defines a common format for public transportation schedules and associated geographic information. GTFS feeds can be used for trip planning, ride-sharing, timetable creation, mobile data, visualisation, accessibility, analysis tools for planning, real-time information, and interactive voice response (IVR) systems [5]. Additionally, other extensions were proposed, as follows:

- GTFS-Flex [6] is an extension to enable trip planning for various types of demand-responsive or special transport services for people with disabilities. As an example, the trip planning software OpenTripPlanner [7] generate trips combining demand-responsive and fixed route service. Figure2 presents a comparison between the original GTFS and the proposed extension GTFS-Flex model.
- GTFS-Realtime [8] allows maps to convey dynamic information about when public transport is actually arriving and departing, rather than relying on static, preset schedules. It also allows PT agencies to provide real-time updates about their fleet to application developers.

Alternatives to GTFS and its extensions include the standards GOFS (General On-demand Feed Specification) developed by MobilityData and the REST API/XML. GOFS aims to integrate on-demand services with other mobility options in common platforms for travellers. REST API/XML acts as an alternative to GTFS-Realtime. Moreover, the following standards will be mandatory for all MaaS actors in Europe in 2023:

- NeTEx (Network Timetable Exchange) [9] is a public transport data standard developed under the aegis of CEN (Comité Européen de Normalisation). It provides a means to exchange data for passenger information such as stops, routes timetables and fares, among different computer systems, together with related operational data.
- SIRI (Service Interface for Real-Time Information) [10] is a protocol that allows exchange of dynamic information about public transport services and vehicles. Just as NeTEx, SIRI is based on Transmodel for public transport information. SIRI has mainly seen uptake in Europe, but some US agencies, 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-RealTime.

There are several examples of solved challenges that are related to standardizing shared data:

- Trip planning: enables trip planning for various types of demand-responsive or paratransit service.
- Dynamic information about on PT: conveys information on real-time arrival and departing prediction of public transport.
- Fleet information: allows PT agencies to provide real-time updates about their fleet to application developers.
- Information on a specific segment of a trip: allows user to request information on a single stop without having to download data on the whole public transport system.
- Vehicle information: Information report the real-time information about available vehicles location of a vehicle, vehicle type, and current battery charge.
- Exchange/integration of information between various systems: exchanges data for passenger information such as stops,

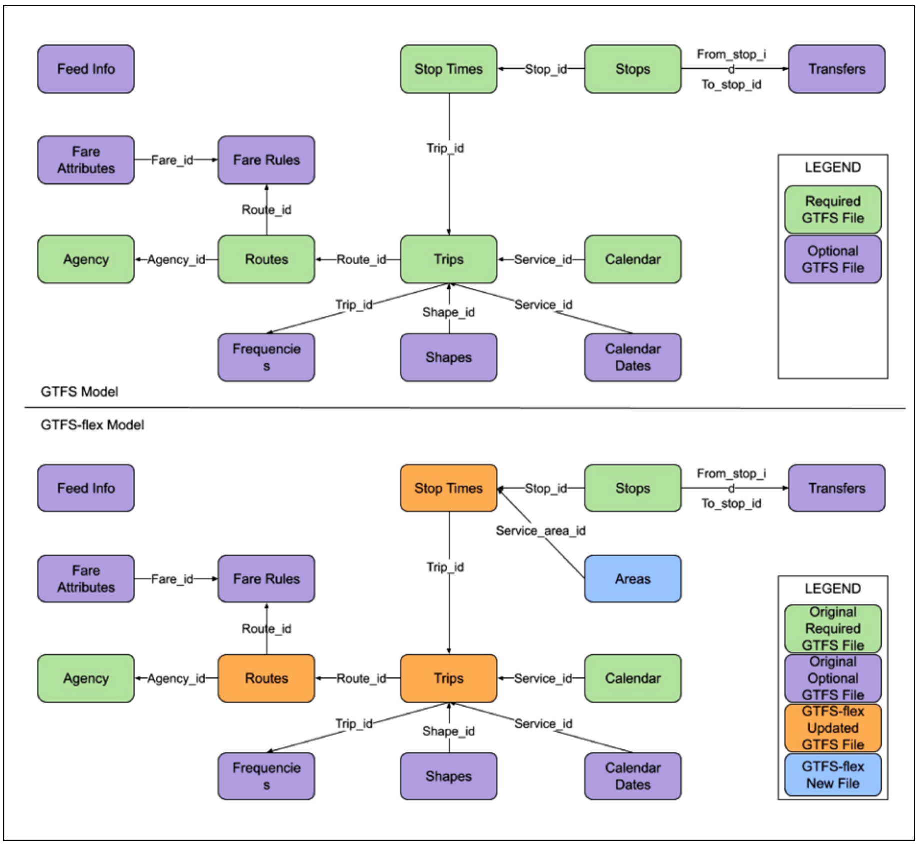

Figure 2: GFTS and GFTS Flex Diagram [4]

routes timetables and fares, among different computer systems, which can be collected from various stakeholders.

- Cost reduction: reduces administrative burdens related to data sharing.
- Data analysis: timetable creation, visualisation, analysis tools for planning, real-time information, and interactive voice response (IVR) systems.

Depending on the collected data and the PT services that need to be supported by the PTM system, different outputs are obtained and they can be used as the main KPIs. Here we focus on selected outputs since different PTM systems have different purposes to achieve:

- location of origin and destination information for riders,
- waiting times at the location,
- information on average boarding per PT line,
- information on boarding time at each stop, including specific times throughout the day,
- data on load-factor and estimation of vehicle crowding,
- identification of first/last-mile barriers to ridership,
- information on fleet availability,
- information on transportation means availability (vehicle, bikes, scooter, etc.),
- breakdown of common line transfers.

As an equivalent to the levels of MaaS integration topology, an evolution of the levels of Mobility Management is briefly shown in *Figure 3*. This presentation focuses on penetration and contribution of mobility data in each level that corresponds to Maas Integration levels. In total, there are 5 levels, yet since the Level 0 represents no integration or no information, it is not discussed here.

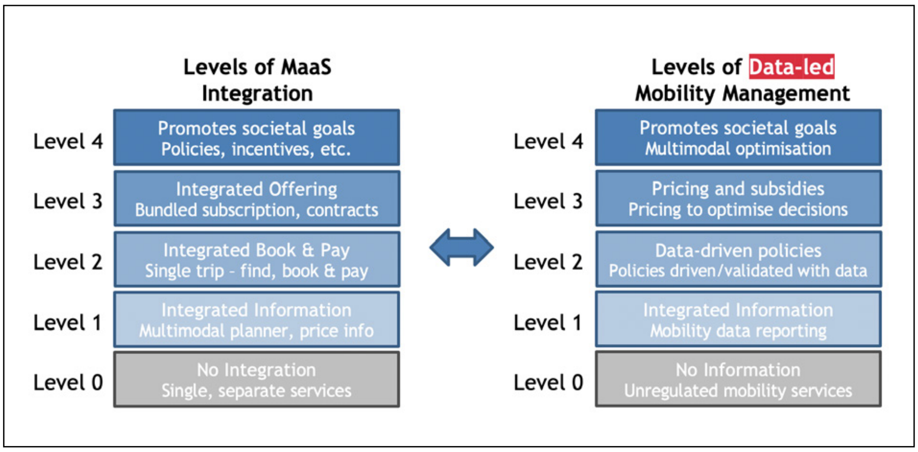

Figure 3: Levels of MaaS integration and data-led mobility management [11]

In the past years, many cities have achieved Level 1 of Mobility Management, securing access to mobility data from private fleet operators. With this 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. 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. 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. 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.

In order to reach Level 4 mobility management, cities will need an 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 together with 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. ■

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