Third-party payment specification for Mobility as a Service

Brecht Van de Vyvere[1], Tim Asperges[2], Pieter Colpaert[1], Ruben Verborgh[1]

[1]IDLab, Department of Electronics and Information Systems, Ghent University – imec
[2]City of Leuven

Abstract. MaaS is able to calculate the least expensive route over multiple mobility providers as billing information has already been standardized . However, this does not include third-party payment schemes where a third party, such as a local government, compensates a part of a travellers' trip cost when certain criteria are met. To automatize third-party agreements for MaaS, we propose (i) a specification to set up a third-party payment system specifying, among others, how multimodal criteria and trips can be semantically described, and (ii) an open source validator tool returning the compensation for a trip. In future work, we are investigating how personal data can be integrated using Solid data pods.

1. Introduction

Standardized data models (GTFS [2], MDS [3]) or Web APIs (GBFS [4], TOMP API [5]) allow MaaS providers to calculate the financial cost of a trip, however, this does not exist for third-party payment schemes. The term 'third-party payment' (TPP) refers to the compensation a traveller receives from a third party, such as a local government, when a trip is performed compliant with the third parties' criteria. Such a

system can be achieved in a pre- or postpaid fashion. From the view point of a traveller, with prepaid, only a smaller part of the trip must be paid by the traveller; the other part is arranged between the third party and mobility provider. With postpaid, the traveller only gets compensated afterwards. In this article, we will focus on prepaid, being the most convenient for travellers. Prepaid can be implemented with vouchers or mobility budget containing, for example, free rides or credit. Another approach is an agreement describing the criteria and how a mobility provider invoices the third party. Cities already set up agreements with transport providers (Table 1) where local decisions define the criteria in the form of subsidy measurements. The overview on Table 1 shows that criteria are based on location, time, transport modality and profile information. Currently, these TPPs are made ad hoc lowering the discoverability and reusability for route planning advice in MaaS. Therefore, we propose a specification for a prepaid TPP system defining the semantic description of subsidy measurements and trips, and an open-source validator to verify whether a trip is compliant with a subsidy measurement.

City	Description	Provider	Criteria
Deinze	Free rides with shared bikes	Blue Bike	Location of the trip must be in Deinze
Leuven	Free rides with bus	De Lijn	Citizens younger than 12 years of district Leuven
Leuven	Discount on public transport	NMBS and De Lijn	During certain events
Schoten	Vouchers for 20 minutes free rides with shared bike	Mobit	During certain events

Table 1: State of play of third-party payment schemes in Flanders

2. Third-party payment specification for MaaS

The TPP specification[6] first describes the steps local governments and mobility operators can perform to compensate a travellers' trip. Inspired by projects like the Mobility Data Specifications (MDS [3]) and LBLOD [7], we specify which standards to use to describe subsidy measurements and trips, and how trips can be validated in an automated fashion. On the overview (Fig. 1), the system starts with the local government (agency), that defines which trips can be compensated. When a MaaS provider can implement the subsidy and conforms with the cities' quality framework (QF), a TPP agreement can be arranged, which is annotated according to the Local Decisions as Linked Open Data (LBLOD)[8] Application Profile (AP) for subsidies [7]. The trip of a user is described with the Open Standards for Linked Organizations (OSLO) [9] AP 'trips and offer'[10] and can be validated with the semantically annotated agree-

ment. When a trip meets the criteria, the validator returns how much can be compensated. For reimbursement, the mobility provider sends an invoice with the number of trip compensations.

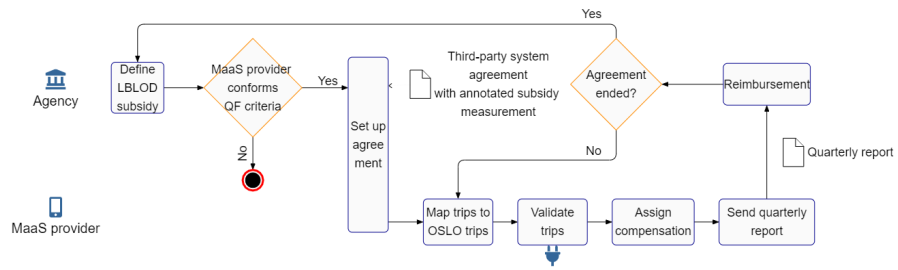

Fig. 1: Overview of setting up a TPP scheme between an agency (top row) and MaaS provider (bottom row).

Similarly to MDS, we provide a JSON(-LD) template with corresponding table for each type of object. This way, developers do not need to understand semantic technologies to start mapping their data. A JSON-LD context is added to make the template semantically interoperable. In Fig. 2, we give an example of a requirement for shared bikes in Leuven. Next to RouteSegmentRequirements, an agency also needs to describe the SubsidyMeasurement, which combines multiple requirements, and Payment indicating how much will be compensated. More details can be found on the Github repo of the specification[6]. Similarly, providers need to map every trip to "trips and offer"[10]. A trip executes a certain route composing multiple route segments. These segments specify the departure and arrival time, GPS telemetry, price and transport

modality. For example, Fig. 3 demonstrates a shared bike system during rush hours and costing 8.2 Euros. With the standardized description of a trip and subsidy measurement as input, an Open Source validator is being developed[6] returning whether a trip is conform with the subsidy measurement and how much compensation can be given. MaaS providers can incorporate this tool into their route planning engine. Also, agencies could use this tool as validation step before payment.


```
{
  "@type": "RouteSegmentRequirement",
  "description": "Only shared bikes, on monday between 4pm and 6pm and u
  "meansOfTransport": "http://www.wikidata.org/entity/Q1358919", // Bike
  "location": {
  "@type": "Place",
    "geometry": {
      "wkt": "POLYGON((4.676055908203124 50.88993205766312,4.72343444824
    }
  },
  "time": [{
    "@type": "OpeningHoursSpecification",
    "dayOfWeek": "http://schema.org/Monday",
    "startTime": "15:00:00"
    "endTime": "18:00:00"
  }]
}
```


Fig. 2: A traveller is eligible for a subsidy measurement when he uses a shared bicycle within the centre of Leuven and on a monday during rush hours.

```
{
  "@type": "RouteSegment",
  "departureTime": "2020-06-09T16:01:00",
  "arrivalTime": "2020-06-09T17:05:00",
  "telemetry": [ … ],
  "price": {
     "@type": "MonetaryAmount",
     "value": "8.2",
     "currency": "EUR"
 },
  "meansOfTransport": "http://www.wikidata.org/entity/Q1358919" // Share
}
```

Fig. 3: This route segment is performed during rush hours in the centre of Leuven with a shared bike system.

3. Conclusion

The specification and validator proposed in this demo sets the first steps towards third-party payments for MaaS. In future work, we want to make TPPs on the one hand more inclusive and on the other hand use the validator in a generic, cross-domain incentives (subsidy measurements) platform. Both aspects require the use or creation of personal data: the validator will need to be extended to handle profile information, and incentives should be assignable to a person. As cities nor MaaS operators should be responsible for managing personal data, we are looking into using Solid

data pods, an innovative data storage solution for private data. With this last element added, we hope to have an interesting discussion during the workshop about the future ecosystem of TPPs for MaaS.

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