

Enhancing Accessibility Information in Google Maps

Adding new pieces of information to GTFS to improve accessibility

Paloma Cáceres, Almudena Sierra-Alonso, Carlos E. Cuesta, José María Cavero, Belén Vela

Escuela Técnica Superior de Ingeniería Informática

Universidad Rey Juan Carlos, URJC

Móstoles (Madrid), Spain

e-mail: {paloma.caceres, almudena.sierra, carlos.cuesta, josemaria.cavero, belen.vela}@urjc.es

Abstract—Google is the most important information provider on Internet. Within the Google ecosystem, Maps is a relevant tool, which is used to calculate routes and to find points of interest. As part of this effort, it has defined Google Transit Feed Specification (GTFS), a format to specify data of public transport. Now public transport agents can provide a “feed” complying with this specification and Google can use them and represent them on Maps. In spite of their relevance for accessibility in mobility, Google Maps does not offer detailed information about accessibility facilities to transit, and GTFS does not specify the necessary structure to provide that information about public transport. In this work, we propose an extension to GTFS to provide relevant data to represent accessibility elements on Google Maps and similar systems to offer different social accessibility services.

Keywords—Public transport; accessibility; Google Maps; GTFS.

I. INTRODUCTION

Google says “Discover the world with Google Maps. Experience Street View, 3D Mapping, turn-by-turn directions, indoor maps and more across your devices”. But, what about accessibility information? On December 2016, the Verge announced that “Google Maps now shows if a location is wheelchair accessible” [1]. The novelty is that Google Maps, an app favored by nearly 70 percent of iPhone users and installed by default in Android, will now list wheelchair accessibility alongside other information, such as traffic and store hours. The new addition makes easier for people with disabilities to use the app; this also applies to other groups, such as parents with strollers and the elderly.

With regard to the accessibility information provided by Maps, even with this addition, it is only including wheelchair accessibility, that is, it just takes into account mobility disabilities or mobility special needs. And what about other disabilities? Is it possible to provide accessibility information to ease the mobility for blind or deaf people? It would be interesting to offer new social accessibility services to help people with different needs. In this way, we feel that it is necessary to express the accessibility information of public transport in a more detailed way, taking into account that this information is even more important to impaired people. In this work, we propose a method to publish such accessibility data for the public transport. This method has been already

validated against real data for the subway in the city of Madrid, Spain (METRO Madrid [2]).

Our proposal to specify the accessibility data of public transport is based on the Identification of Fixed Objects in Public Transport (IFOPT [3]) standard, which is an extension of the European Reference Data Model for Public Transport Information (Transmodel [4]) standard. IFOPT defines a model for the main fixed objects related to access to Public Transport, which also includes constructions to describe accessibility data.

The article is structured as follows: Section 2 describes the GTFS. Section 3 describes our proposal, specifying the context of this work, the modification proposal of GTFS and a case study. In Section 4, the conclusions and future work are presented.

II. ACCESSIBILITY IN GOOGLE TRANSIT FEED SPECIFICATION

GTFS [5] is a format for public transportation schedules and associated geographic information. A feed of GTFS is a collection of a maximum of six CSV files, with a .txt extension. Currently, only two of these files include some information about accessibility and special needs: *stops.txt* and *trips.txt*.

With regard to the *stops.txt* file, GTFS defines that “A stop is a location where vehicles stop to pick up or drop off passengers. Stops can be grouped together, such as when there are multiple stops within a single station. This is done by defining one stop for the station, and defining it as a parent for all the stops it contains. Stops may also have zone identifiers, to group them together into zones”. The *stops.txt* file includes an optional column named *wheelchair_boarding* to indicate accessibility this kind of information about a stop. GTFS states that “It identifies whether wheelchair boardings are possible from the specified stop or station. The field can have the following values:

0 (or empty): Indicates that there is no accessibility information for the stop.

1: Indicates that at least some vehicles at this stop can be boarded by a rider in a wheelchair.

2: Wheelchair boarding is not possible at this stop”.

GTFS also specifies that “When a stop is part of a larger station complex, as indicated by a stop with a *parent_station* value, the stop's *wheelchair_boarding* field has the following additional semantics:

0 (or empty): The stop will inherit its wheelchair_boarding value from the parent station, if specified in the parent.

1: There exists some accessible path from outside the station to the specific stop / platform.

2: There exists no accessible path from outside the station to the specific stop/platform”.

With regard to the *trips.txt* file, GTFS defines that “A trip represents a journey taken by a vehicle through stops. So, a single trip represents one journey along a transit line or route”. This file includes two columns, both optional, related to accessibility limitations or special needs: wheelchair_accessible and bikes_allowed. In this work, we only address accessibility aspects and therefore we will not discuss the bikes_allowed field. The wheelchair_accessible field has the following additional semantics:

0 (or empty): Indicates that there is no accessibility information for the trip.

1: Indicates that the vehicle being used on this particular trip can accommodate at least one rider in a wheelchair.

2: Indicates that no riders in wheelchairs can be accommodated on this trip.

In summary, Google Transit Feed Specification only specifies the accessibility information related to mobility needs, not taking into account other disabilities. For instance, we provide a subset of METRO Madrid real data following GTFS in Figure 1 and Figure 2. Figure 1 is a portion of *stops.txt* file, which contains data of Sol stop place. The first line of the file is the header, the second one shows data about the stop place in Sol (stop_id = est_4_12) and its wheelchair accessibility (wheelchair_boarding = 1), that is, “at least some vehicles at this stop can be boarded by a rider in a wheelchair”. Moreover, as Sol stop place is located in a larger station complex, the file also specifies a parent_station value and additional information. For this reason, the following seven lines describe other stops associated to Sol (parent_station = est_4_12), and they inherit its wheelchair_boarding value from the parent station (wheelchair_boarding = 0).

Figure 2 is a portion of *trips.txt* file, which contains the services associated to trips of line 3 (Sol is a stop place in

lines 1, 2 and 3). The first row of the file is the header, next rows represent, for each line, the associated service performing the trip. Each line has an associated value for wheelchair_accessible (in this case value number 1, that is, there exists some accessible path from outside to the specific stop / platform).

These data have been provided by the Regional Consortium for Public Transports of Madrid (CRTM) [6]. As you can see in previous figures, GTFS only makes possible to express that Sol stop place is not fully accessible. It just states that in Sol stop place “at least some vehicles at this stop can be boarded by a rider in a wheelchair” (motor disability). That is, it is impossible to describe the needs for people with audible or visual disabilities, which intend to travel starting or finishing the trip on Sol stop place.

III. OUR PROPOSAL

A. The Context: CoMobility and Access@City Projects

This work is being developed in the context of two related research projects: CoMobility and Access@City.

CoMobility [7] defines a multimodal architecture based on linked open data for a sustainable mobility. Its main goals are improving the citizen mobility, optimizing their trips combining public transport and the sharing of private transport (e.g., car sharing), and also providing a means for accessible trips.

Access@City is a coordinated project, which defines a technological framework to process, manage and use open data about public transport with the goal to promote its accessibility. Multiply@City is a subproject within it, which is focused on processing and armonizing accessibility data of public transport in a semantic way, taking into account that data is provided by different sources and will have different formats. Therefore, it is necessary to integrate accessibility data from open data, together with web scraping, and accessible routes, obtained by crowdsourcing from the users who use mobile technologies. Figure 3 provides a general depiction of this project.

```
stop_id,stop_code,stop_name,stop_desc,stop_lat,stop_lon,zone_id,stop_url,location_type,parent_station,stop_timezone,wheelchair_boarding
est_4_12,12,SOL,Plaza de la Puerta del Sol 6,40.4168864401114,-3.70316633485051,A,http://www.crtm.es,1,,Europe/Madrid,1
acc_4_12_1034,12,Alcalá,Plaza de la Puerta del Sol 13,40.4170832770092,-3.70286697000651,,http://www.crtm.es,2,est_4_12,,0
acc_4_12_1048,12,RENFE,Plaza de la Puerta del Sol 5,40.4168574567112,-3.70286733093632,,http://www.crtm.es,2,est_4_12,,0
acc_4_12_41,12,Carretas,Plaza de la Puerta del Sol 7,40.4166563378432,-3.70344111780431,,http://www.crtm.es,2,est_4_12,,0
acc_4_12_42,12,Carmen,Plaza de la Puerta del Sol 12,40.417145603815,-3.70320130556473,,http://www.crtm.es,2,est_4_12,,0
acc_4_12_43,12,Mayor,Plaza de la Puerta del Sol 9,40.4167162968701,-3.7044923366942,,http://www.crtm.es,2,est_4_12,,0
acc_4_12_776,12,Ascensor,Plaza de la Puerta del Sol 8,40.4166797644568,-3.70432248486764,,http://www.crtm.es,2,est_4_12,,0
acc_4_12_777,12,Preciados,Calle de Preciados 1,40.4172525245465,-3.70405646302912,,http://www.crtm.es,2,est_4_12,,0
```

Figure 1. GTFS stops.txt file about Sol stop place of METRO Madrid.

```
route_id,service_id,trip_id,trip_headsign,trip_short_name,direction_id,block_id,shape_id,wheelchair_accessible
4_3___,4_I12,4_I12-003_2015I12_1_1_4_3___,MONCLOA,VILLVERDE ALTO-MONCLOA,0,,4_3___1_IT_1,1
4_3___,4_I12,4_I12-003_2015I12_2_1_4_3___,VILLVERDE ALTO,MONCLOA-VILLVERDE ALTO,1,,4_3___2_IT_1,1
4_3___,4_I13,4_I13-003_2015I13_1_1_4_3___,MONCLOA,VILLVERDE ALTO-MONCLOA,0,,4_3___1_IT_1,1
4_3___,4_I13,4_I13-003_2015I13_2_1_4_3___,VILLVERDE ALTO,MONCLOA-VILLVERDE ALTO,1,,4_3___2_IT_1,1
4_3___,4_I14,4_I14-003_2015I14_1_1_4_3___,MONCLOA,VILLVERDE ALTO-MONCLOA,0,,4_3___1_IT_1,1
4_3___,4_I14,4_I14-003_2015I14_2_1_4_3___,VILLVERDE ALTO,MONCLOA-VILLVERDE ALTO,1,,4_3___2_IT_1,1
4_3___,4_I15,4_I15-003_2015I15_1_1_4_3___,MONCLOA,VILLVERDE ALTO-MONCLOA,0,,4_3___1_IT_1,1
4_3___,4_I15,4_I15-003_2015I15_2_1_4_3___,VILLVERDE ALTO,MONCLOA-VILLVERDE ALTO,1,,4_3___2_IT_1,1
```

Figure 2. GTFS trips.txt file: only line 3 (Sol stop place of METRO Madrid included).

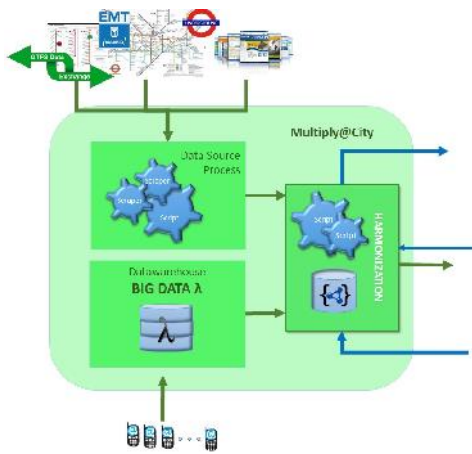


Figure 3. Multiply@City Project architecture.

The Regional Consortium for Public Transports of Madrid (CRTM) [6], the Madrid public bus company (EMT Madrid) [8], the Spanish National Society of Blind People (ONCE) [9], and the Chair of EcoTransport, Technology and Mobility of Rey Juan Carlos University [10] have expressed an interest in our CoMobility and Access@City projects' results.

B. Proposal of the GTFS Modification

The intent of our proposal is to improve accessibility information to support new social accessibility services. We have then integrated information relevant to blindness, hearing and mobility impairments and we have included the following pieces of information:

1) *Stops.txt* file: We have added two new columns, which are *blindness_accessing* and *deaf_accessing*. The values of these columns follow the same pattern as the GTFS specification for the mobility disability:

0 (or empty): There is no accessibility information for the stop.

1: Indicates that at least some vehicles at this stop can be boarded by blind (resp. deaf) people.

2: The access for blind or deaf people is not possible at this stop.

Moreover, GTFS specifies: “When a stop is part of a larger station complex, as indicated by a stop with a *parent_station* value, the values of the *blind_accessing* and *deaf_accessing* have the following additional semantics:

0 (or empty): The stop will inherit its value from the parent station *blind_accessing* and *deaf_accessing* fields, if specified in the parent.

1: There exists some accessible path for blind or deaf people from outside the station to the specific stop or platform.

2: There exists no accessible path for blind or deaf people from outside the station to the specific stop/platform.

2) *Trips.txt* file: We have also added two new columns, which are *blind_accessible* and *deaf_accessible*. The values

of these columns follow the same pattern as the GTFS specification. The meanings of these values are:

0 (or empty): Indicates that there is no accessibility information for the trip

1: Indicates that the vehicle being used on this particular trip has elements to assist blind or deaf people.

2: Indicates that there are no elements to help blind or deaf people on this trip.

C. Case Study: Proposed GTFS extension with data of METRO Madrid

In this subsection we describe the process to represent the accessibility data of METRO Madrid on Google Maps, using our proposed extension.

To realize the case study, it was necessary to use real data of METRO Madrid, namely lines, stations in each line and their accessibility. METRO Madrid specifies the accessibility in two different ways. The first one is on the *stations* web page. There, the user can determine if a station is accessible or not by means of icons (e.g., a wheelchair icon is shown to identify if a station is absolutely accessible, i.e., it has universal accessibility). The second way is on the specific *accessible stations* web page. In that case, METRO Madrid only indicates the accessible stations for each line. There are three different types of accessibility:

- *Universal accessibility* (UA): A stop place with UA indicates that any person should be able to access to the stop place, regardless of potential disabilities.
- *Complementary accessibility measures* without lifts and/or ramps (CAM): A stop place with CAM indicates that there are facilities to simplify the access of blind or deaf people, but the access of mobility impaired people could present issues.
- *Lifts and/or ramps* without complementary accessibility measures (LAR): A stop place with LAR indicates that there are facilities to simplify the access of mobility impaired people, but there are not special resources for blind or deaf people.

As METRO Madrid does not provide the means for downloading these data, we used a scraper to determine which stations are accessible, and their kind of accessibility in every case. This information was stored as a CSV file.

To integrate this information with previous GTFS data in the new structure proposed for GTFS, we have defined the following correspondences (see 0):

TABLE I. CORRESPONDENCES BETWEEN NEW GTFS AND METRO MADRID

GTFS Extension		METRO Madrid Accessibility		
Files	Added fields	UA	CAM	LAR
<i>Stops.txt</i>	<i>wheelchair_boarding</i>	1	2	1
	<i>blind_accessing</i>	1	1	2
	<i>deaf_accessing</i>	1	1	2
<i>Trips.txt</i>	<i>wheelchair_accessible</i>	1	2	1
	<i>blind_accessible</i>	1	1	2
	<i>deaf_accessible</i>	1	1	2

```

stop_code,stop_name,stop_desc,...,parent_station,stop_timezone,wheelchair_boarding, blindness_accessing, deaf_accessing
est_4_12_12,SOL,Plaza de la Puerta del Sol 6,...,Europe/Madrid,1,1,1
acc_4_12_1034,12,Alcalá,Plaza de la Puerta del Sol 13,...,est_4_12,,0,0,0
acc_4_12_1048,12,RENFE,Plaza de la Puerta del Sol 5,...,est_4_12,,0,0,0
acc_4_12_41,12,Carretas,Plaza de la Puerta del Sol 7,...,est_4_12,,0,0,0
acc_4_12_42,12,Carmen,Plaza de la Puerta del Sol 12,...,est_4_12,,0,0,0
acc_4_12_43,12,Mayor,Plaza de la Puerta del Sol 9,...,est_4_12,,0,0,0
acc_4_12_776,12,Ascensor,Plaza de la Puerta del Sol 8,...,est_4_12,,0,0,0
acc_4_12_777,12,Preciados,Calle de Preciados 1,...,est_4_12,,0,0,0

```

Figure 4. New GTFS stops.txt file, including improved accessibility information in the Sol stop place

Following these specifications, we added these new attribute values to GTFS *stops.txt* file and *trips.txt* files. Figure 4 shows the *stops.txt* file with the values concerning the accessibility in the Sol stop place. We have omitted some fields in the central part of every row with the purpose of highlighting the additional accessibility fields added, which are also emphasized. This new accessibility information could be represented in Google Maps. In Figure 5 we mark the accessibility by means of colours in the Sol area:



Figure 5. Adding detailed accessibility in Google Maps.

The key box points to the Sol stop place. It is annotated with three colours: this is done to highlight that universal accessibility also includes lifts or/and ramps (LAR) and complementary measures of accessibility (CAM). However, when a stop place is only marked with dark blue colour, it has only ramps or/and lifts to access. When a stop place is only marked with green colour, it has only complementary measures of accessibility.

IV. CONCLUSION AND FUTURE WORK

Google Maps is probably the most widely used service for mobility. But currently it does not show the accessibility elements available in public transport. To represent the public transport information on the map and to calculate routes, Google uses the “feeds” (specified in GTFS) provided by transport companies. Due to the relevance of accessibility in mobility, we think it is necessary to calculate accessible routes, and to represent accessibility on Maps. In this work, we have extended the GTFS specification to support new social accessibility services.

This extension consists of adding relevant fields in the *stops.txt* and *trips.txt* files. To prove the validity of this extension, we have used real data of METRO Madrid. After obtaining them, we have identified the accessibility correspondences between GTFS and METRO Madrid data, and we added these new values to the *stops.txt* and *trips.txt* files. Next, we have represented them on the map: if a station has universal accessibility, complementary measures (for blind and deaf people) or only lifts or/and ramps (for mobility impairments).

For future work, we intend to provide fully accessible routes (from a stop to other) using these accessibility data.

ACKNOWLEDGMENTS

This work is supported by the Multiply@City project (TIN2016-78103-C2-1-R), funded by the Spanish Ministry of Economy and Competitiveness. We would like to thank Eva María Jiménez Criado for her support.

REFERENCES

- [1] The Verge, <http://www.theverge.com/2016/12/15/13968054/google-maps-twenty-percent-wheelchair-accessible> [retrieved: february, 2017].
- [2] METRO Madrid, <https://www.metromadrid.es/en/index.html> [retrieved: february, 2017].
- [3] CEN/TC 278. Intelligent transport systems - Public transport - Identification of Fixed Objects In Public Transport (IFOPT), EN 28701:2012.
- [4] Transmodel, standardization, E. C. (2016). Transmodel, Road Transport and Traffic Telematics. Public Transport. Ref. Data Model, EN 12896, <http://www.transmodel.org/index.html>
- [5] Google Transit Feed Specification, <https://developers.google.com/transit/gtfs/> [retrieved: february, 2017].
- [6] Regional Consortium for Public Transports of Madrid (CRTM), <http://datos.crtm.es/> [retrieved: february, 2017].
- [7] C.E. Cuesta, P. Cáceres, B. Vela, J.M. Cavero, CoMobility: A Mobile Platform for Transport Sharing, ERCIM News 2013(93), pp. 22-23.
- [8] EMT Madrid home page, <http://www.emtmadrid.es> [retrieved: february, 2017].
- [9] Spanish National Society of Blind People (ONCE, Organización Nacional de Ciegos de España) <http://www.once.es/new> [retrieved: february, 2017].
- [10] Chair of EcoTransport, Technology and Mobility (ChETM) of the Rey Juan Carlos University, <http://www.catedraetm.es/> [retrieved: february, 2017].