Data Exchange for Vehicle Pooling in Switzerland - Proposals for Viable and Sustainable Solutions

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1 Abstract

The purpose of this document is to develop a shared understanding of vehicle pooling in Switzerland and to get an overview of the current situation in Switzerland. This could enables SKI+ to provide a central web service and/or data export that allows querying all available offers and demands in Switzerland.

For this purpose, the vehicle pooling providers in Switzerland and their modes of operation are introduced. Based on those, a common data structure is developed to serve as a reference for the providers to share their demands and offers to opentransportdata.swiss[1] and to be exploited by, amongst others, the OpenJourneyPlanner[2]. [1]

2 Glossary with Terms, Abbreviations and References

Abbreviation	Full name, explanation, and hyperlinks
FOT	Federal Office of Transport in Switzerland
GTFS	General Transit Feed Specification
OJP	OpenJourneyPlanner
ODMCH	opentransportdata.swiss
MODI	mobility data infrastructure
NADIM	national data network infrastructure for mobility
NeTEx	Network Timetable Exchange
UC	Use-Case
SKI	Systemaufgaben Kundeninformation

[1] Open-Data-Plattform Mobilität Schweiz | Open Data Plattform Kundeninformation des öffentlichen Verkehrs der Schweiz (opentransportdata.swiss)

[2] OJP Demo (opentdatach.github.io)

3 Introduction

Making public transportation[3] customer information available is one of the goals of the Systemaufgaben Kundeninformation (SKI) working on behalf of the Federal Office of Transportation (FOT) in Switzerland. The SKI+ team, authoring this work, extends on that by integrating all available transportation into travel information data sets and an intermodal trip planner (OJP) to pave the path for a full, discrimination free, multi-modal transportation in Switzerland. The project to provide this federal mobility data infrastructure (MODI) is called national data network infrastructure for mobility (NADIM). One of the mobility modes to consider is vehicle pooling.

This work aims to develop a common understanding of vehicle pooling services in Switzerland. The insights are then used to suggest an architecture that allows to gather, consolidate, and distribute the pooling demands and offers in Switzerland in a standardized manner. This central vehicle pooling service is intended to be like the Shared Mobility services by Federal Office of Energy in Switzerland [1].

This document contains both business and technical aspects. From a business aspect:

- Section 4 gives a definition of vehicle pooling and how it differs from related services.
- Section 5 presents the vehicle pooling providers operating in Switzerland.
- Section 6 identifies use cases derived from the providers' services.

From a technical perspective:

- Chapter 7 introduces the business and technical model, as well as suitable exchange standards that can be exploited for vehicle pooling.
- Chapter 8 defines the architectural framework to collect, distribute, and utilize vehicle pooling services.

Chapter 9 and following contain a short discussion and conclusion, as well as an outlook.

[3] Note, that public transport is defined very broadly in Transmodel to include all MODEs OF Operation. Sharing, taxi, pooling are all public transport as well.

4 Vehicle Pooling

In this section we revisit the existing definitions of vehicle pooling and its many synonyms. We then review the similarities and differences among vehicle pooling and other services, such as on-demand, taxis, and public transport.

There are many synonyms for this form of mobility: Car pooling, ride sharing, car sharing, or to mention a few common (Swiss) German terms, “Mitfahrgelegenheit”, “Fahrgemeinschaft”, or “Fahrdienstvermittlung”.

In the following we only use the term “vehicle pooling”[4]. We specifically do not speak of car pooling, as other vehicle types may be offered, such as (motor)bikes. The NeTEx definitions are as follows [2, p. 10 ff.][5]:

- vehicle pooling: “particular mode of operation of a privately-owned vehicle (car, motorbike, etc.) consisting in sharing the vehicle for a trip between a defined driver who is already engaged in the trip and at least one other traveller”. A differentiation is also drawn with taxis. “[…] type of vehicle pooling […] where […] a driver […] provides […] services to travellers for commercial reasons”.
- car pooling: “vehicle pooling applied to cars, consisting in sharing a privately owned car for a trip between a defined driver who is already engaged in the trip and at least another traveller”.

For our purposes these definitions are extended to include the transport of objects and commercial transport.

4.1 Difference to other services (e.g., On-Demand)

Vehicle pooling is in direct competition with various transportation services, such as on-demand, taxis, and public transport.

The key characteristic of vehicle pooling (as per the definition) that separates it from the others is that it follows a de-centralized, crowd-based approach and consequently primarily involves private drivers. Having primarily private drivers implies:

- Their transportation purpose is to mainly fulfill their own need, rather than that of the passengers.
- They don’t need or want to make profit, but rather share their expenses with one or more passengers.
- They are not licensed.
- They are not part of a (trustworthy) organization.

Requiring private drivers (and passengers) poses the biggest challenge for vehicle pooling providers. They need to convince drivers to share their exclusive and private mode of transportation with strangers, while convincing passengers to make use of these services.

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[4] In Transmodel VEHICLE POOLING is formally defined: An ALTERNATIVE MODE OF OPERATION of a privately-owned vehicle consisting in sharing the vehicle for a trip between the driver who is at the same time performing a trip and at least another traveller.

[5] The NetTEx document also uses the term "ride sharing" (p. 32 ff.) and uses the VehiclePoolingType "commuterCarPooling" to represent it. However, this seems to be an inconsistency throughout the document as the term is not used otherwise.

Although the definition states so, commercial drivers are usually not excluded by the vehicle pooling providers. The need to secure profits does make offers from commercial drivers inherently more expensive in comparison and their involvement in such services less attractive.

This is a more detailed comparison to the previously mentioned examples: on-demand, taxis, and public transportation. Vehicle pooling can be operationally equal to all of them:

- On-demand: The key difference is that on-demand providers own a vehicle fleet and intend to fulfill all passengers' transportation demands. On-demand providers optimize for transporting passengers efficiently (cost) and effectively (exact pick-up at origin and drop-off at destination). On the other hand, vehicle pooling providers focus is on providing IT-infrastructure only and do not have their "own" vehicles to provide services with.
  Nonetheless, operationally, commercial users of vehicle pooling systems can use the demands within a limited area and ultimately build up an on-demand-like service. The overhead to do this is high and the same is possible for on-demand providers. From the vehicle pooling providers' perspective this can be acceptable if those commercial providers operate within their platform. Outside of the vehicle pooling providers' platforms and without any specific collaborations this can lead to a loss of customers.
- Taxis: The key difference is that taxi services do not pool passengers. In fact, taxis run exclusively on behalf of and are fully paid by the passengers requesting their services. Additionally, Taxis benefit from their operational license. The license allows them to pick-up and drop-off passengers ad-hoc within a certain geographical area without prior booking, as well as to make use of specific taxi stands and public transport lanes. Otherwise, a commercial driver can operate similarly to a taxi. As for on-demand this can be an opportunity. Taxis can register as drivers and fulfill demands from the vehicle pooling providers, even more than on-demand providers, i.e., both short- and long-distance.
- Public transport: The key difference is that public transport is usually timetable based. Otherwise, vehicle pooling offers can be in direct competition with public transport. For example, commuter routes, or even long-distance routes may as well be covered with pooling.

We point to our discussion in section 9 for a reflection on these points.

5 Transport providers

This section gives an overview of the vehicle pooling providers that have offers and/or demands in Switzerland. Specifically, we describe their business models using a morphological box, compare them in a larger table, and explain which providers were excluded, and why.

5.1 Morphological box

Generally, the vehicle pooling providers' business concepts can be described with the following properties:

- **setup**, i.e., what their primary operation mode is:
  - between locations and/or stations.
- **demands and offers**, i.e., if and what kind of demands and offers providers have
  - What can be created: demands and/or offers.
  - What can be transported: individuals, freight, loading area.
  - How are they requested: app, website, text-message, phone.
- **monetization**, i.e., how the provider finances itself
  - Who pays for the services: individuals, companies, (local) municipalities, events, state institutions, or sport organizations. If not financed by individuals, services are considered free to use for passengers and drivers. We use the term municipalities as wildcard for all forms of locations, e.g., towns, villages, cities, cantons, etc.
  - How the prices are defined and by whom: driver, passenger, both, and/or provider.
  - Who (if at all) pays the drivers: passenger or provider. If providers pay drivers, passengers travel for free. Payment may be in "points" that can be exchanged to goods with partners.
  - If in-app payments are provided.
- **stakeholders,** i.e., who the providers try to engage
  - who is in their focus, i.e., usually also the financiers of their services (see monetization above): individuals, companies, municipalities, events, etc. We use the term municipalities representative for municipalities, cities, municipalities, etc.
  - who else is involved, e.g., individuals, municipalities, events, partner companies for multi-modality or partner programs, subsidiaries, etc.
  - whether or not commercial drivers are likely to be interested.
- **coverage**, i.e., the main spatial area(s) covered by the provider.
- **specifics**, i.e., any other important note about the provider.

In addition, to ease the understanding of these properties, we provide a morphological box. A morphological box "is a Creative Thinking tool for generating whole solutions to complex problems. The approach is to logically decompose the problem into a number of variables/factors for which solutions or ideas can be identified. From the resulting table of part-solutions (morphological box) the various alternative whole solutions can be explored." [3]

The services of each vehicle pooling provider can be found by traversing the table top to bottom. An exception are the providers' specifics which we cannot clearly categorize. In addition to the list of properties above, we reflect on the demand/offer types that are more relevant for later technical considerations. They do not differ between providers.

Table 1: Morphological box of the vehicle pooling business concepts.

Business Concept	Service Property	Possible values					
setup	Origin	Station			Point		
	Destination	Station			Point		
demands and offers	Demands by	None			Passengers		
	Offers by	Drivers					
	Transport of	Persons			Objects		
	Advertisement via	App	Website		Phone	Text-message	
monetization	Financed by	Individuals	Companies	Municipalities	Events	State institutions	Sport organizations
	Driver expenses defined by	None		Driver	Provider platform		
	Drivers paid by	None		Passenger	Provider		
stakeholders	Focus on clients	Individuals	Companies	Municipalities	Events	State institutions	Sport organizations
	Platform users	Private			Commercial		
	Additional partners	None	Subsidiaries	State	Municipalities	Companies	Research and teaching institutions
	Driver	Private			Commercial		
types	Frequency	Once			Repeated (commuter)		
	Distance	Short distance			Long Distance		

5.2 Comparison of providers

The providers are distributed alphabetically over several tables to support readability. The tables' contents are formulated in similar way to allow comparability.

For each we name the country of their headquarters and give an overview of their business concept as we could extract from their web representation. The date (month and year) of our state of knowledge is given (research date). We also provide a confirmation date, i.e., whether we were able to reach the provider, send them the researched profile, and receive a confirmation.

If we were not able to successfully go through all three steps (contact provider, send profile, confirm profile), **the profiles must be considered assumptions**!

Note that beyond any description made on the business concepts and what is being stated on the platforms, a direct exchange among passengers is always possible. Two key aspects that are usually negotiated are the price and pick-up and/or drop-off location. This is more difficult with providers who serve stations, and with providers who manage and track payments. The flexibility on the exact location is also related to the fact that providers try to preserve users' privacy by abstracting locations to not show a specific address/coordinate.

Another aspect to consider is that with some providers passengers may create a transportation demand, e.g., when not finding an existing offer by a driver. Not all providers have a matching algorithm that combines the demands and offers. Moreover, some users may state that they are indifferent on whether they act as a passenger or driver.

Our main source of reference is Trafikguide [4] (with the filter "Ridesharing (Privatauto)"). Trafikguide is a website aggregating various forms of transportation in Switzerland. We contacted all providers that according to their company's website constituted vehicle pooling providers that operate in Switzerland (see section 5.3 for a list of excluded companies). If their coverage was not clear we sent an inquiry. Additional resources were the discussions with providers, as well as Google. The contacts we found beyond Trafikguide were: Mitfahrverband e.V. (see below), mobilu, and fahrpool.com.

As described, one of the leads we found was the Mitfahrverband e.V. [5] a non-profit organization with its headquarters in Germany. It involves a multitude of different vehicle pooling providers in Germany, Austria, and Switzerland, and intends to support the municipalities and tackle holistic goals, such as the creation of a meta-search platform or the establishment of standards.

Table 2: Overview of vehicle pooling providers operating in Switzerland. Not all were available for an exchange.

Provider	Name	BePooler	BlaBlaCar	Carployee	clickAPoint	e-carpooling
	Company	BePooler S.r.l.	Comuto SA	Carployee GmbH	clickAPoint a product from GPSoverIP GmbH	Association e-covoiturage.ch
	URL	BePooler	BlaBlaCar	Carployee New: pavecommute	clickApoint	e-covoiturage
	Research / Confirm date	Sep 23, confirmed Oct 23	Sep 23	Nov 23, confirmed Nov 23	Sep 23, confirmed Oct 23	Sep 23
	Confirmed	Yes	No	No	Yes	No
Business concepts	setup	**setup.** Transport between company (point, which may be places) and any point (may be places).	**setup.** Transport between any two points (may be places).	**setup.** Transport between any two points (may be places).	**setup.** Transport between any two points (may be places).	**setup.** Transport between any two points (may be places).
	demands and offers	**demands and offers.** Transportation demands and offers by passengers and drivers. Demands and offers via App.	**demands and offers.** No transportation demands by passengers. Available offers by drivers via App/Website.	**demands and offers.** Only transportation demands by passengers, who can also be drivers. Search for and matching of demands via App.	**demands and offers.** Transportation demands and offers for/of: persons, seats, freight, and loading area. Demands and offers via App/Website.	**demands and offers.** Transportation demands and offers by passengers and drivers. Demands and offers via Website.
	monetization	**monetization.** Services financed by companies. Drivers' expenses can be voluntarily equally shared among driver and passenger based on a cost proposal of the app. Passenger pays pay driver.	**monetization.** Services financed by individuals for successful trip-arrangement. Driver states desired pricing as part of offer. Passenger pays driver.	**monetization.** Services financed by companies. Drivers' and passengers' efforts (i.e., points) are computed by app. Provider pays driver and passenger in points (specifics).	**monetization.** Financier of services unknown. Driver and passenger negotiate price or desired price is given as part of offer/demand. Passenger pays driver.	**monetization.** Service of non-profit association. Support by Swiss Confederation. Driver and passenger negotiate on pricing or desired pricing is given as part of offer/request. Passenger pays driver.
	stakeholders	**stakeholders.** Focus on companies. Any individual private person. No commercial drivers.	**stakeholders.** Focus on individual persons, private or commercial. Subsidiary exists that is specifically focused on services for municipalities: Klaxit. Another subsidiary for bus transport. No commercial drivers.	**stakeholders.** Focus on companies. Any individual private person, i.e., employee of companies. Cross-company also possible. No commercial drivers.	**stakeholders.** Focus on individual persons, private or commercial. Commercial drivers exist, particularly, for freight and loading areas.	**stakeholders.** Focus on individual persons, private or commercial. Swiss federation, Loterie Romande, erdgas/biogas, and freizeit.ch as partners. No commercial drivers.
	coverage	**coverage.** Focus on Ticino. More locations in Switzerland scheduled.	**coverage.** Europe, including Switzerland.	**coverage.** International, including Switzerland.	**coverage.** Europe, including Switzerland.	**coverage.** Switzerland.
	specifics	**specifics.** In-app payment available, but not mandatory. SBB as partner for free Park&Ride. Municipalities involved for infrastructure (parking).		**specifics.** Different service plans: 1) free trial for smaller companies with self-onboarding 2) full plan for larger companies. Users get points for pooling and can use it for different purposes as defined with the company (vacation days, vouchers, etc.). Per standard, participation in raffles. Successor of Carployee launched in 2021 named "Pave Commute". Overall goal is enablement of sustainable mobility, which is why points can also be gathered by walking by foot/biking, etc.		

Table 1/4

Provider	Name	goFLUX	Greendrive	HéLéman	HitchHike	IDOSH
	Company	goFLUX Mobility GmbH	Greendrive Mobility GmbH	Pôle métropolitain du Genevois français	usus GmbH	Idosharing AG
	URL	goFLUX	Greendrive	Covoiturage Léman	HitchHike	IDOSH
	Research / Confirm date	Dec 23	Sep 23	Sep 23, confirmed Nov 23	Sep 23	Sep 23
	Confirmed	No	No	Yes	No	No
Business concepts	setup	**setup.** Transport between any two points (may be places).	**setup.** Transport between any two points (may be places).	**setup.** Transport between/from pooling stations.	**setup.** Transport between pooling station and any point (can be a place).	**setup.** Transport between any two points (may be places).
	demands and offers	**demands and offers.** Transportation offers by drivers. Available offers by drivers via App.	**demands and offers.** Transportation demands and offers by passengers and drivers. Demands and offers via Website.	**demands and offers.** No transportation offers by drivers. Requests by passengers via App, text-message, or by phone.	**demands and offers.** No transportation demands by passengers. Available offers by drivers via App/Website.	**demands and offers.** Transportation demands and offers by passengers and drivers. Demands and offers via App.
	monetization	**monetization.** Services financed by companies and municipalities. Driver is paid fix per month 150€. Passengers travel for free. Provider pays driver.	**monetization.** Financier of services unknown. Driver and passenger negotiate price or desired price is given as part of offer/demand. Passenger pays driver.	**monetization.** Services financed by municipalities and states. Driver is paid fix price per route and passenger as defined by provider. Provider pays driver.	**monetization.** Services financed by companies and municipalities. Desired pricing is given as part of offer. Passengers pays driver.	**monetization.** Financier of services unknown. Driver and passenger negotiate on pricing. Passengers pays driver. who also gets points.
	stakeholders	**stakeholders.** Focus on companies and municipalities. Private person, who is part of company/municipality. No commercial drivers.	**stakeholders.** Focus on companies. Any individual person, private or commercial. No commercial drivers.	**stakeholders.** Focus on private individuals. Any individual person, private or commercial. Swiss federation, various institutions in Geneva, Vaud, and Vails, as well as various French institutions. No commercial drivers.	**stakeholders.** Focus on companies and municipalities. Any individual person, private or commercial. Also, events, research and teaching institutions, authorities, and small and medium-sized enterprises. No commercial drivers.	**stakeholders.** Any individual person, private or commercial. Any individual person, private or commercial. SBB (for multi-modality). Various companies as partners for points. No commercial drivers.
	coverage	**coverage.** Germany, including Switzerlan.	**coverage.** Austria, including Switzerland.	**coverage.** Parts of French and Swiss regions of Léman.	**coverage.** Switzerland.	**coverage.** Switzerland.
	specifics	**specifics.** If passengers have an existing public transport travelcard it can be included in app and improves inter-modal routing.		**specifics.** A regular public transport is used - or a taxi or uber is booked. An external meta-router was included on the covoiturage-leman website which includes the HéLéman services. This is not affiliated with Ecov who provide the HéLéman services.		

Table 2/4

Provider	Name	Match Rider	mobilu	ride2go	SimplyHop	Taxito
	Company	Match Rider GmbH	mobilu ist eine Marke der telindex GmbH	ride2Go GmbH	Simply Hop	Taxito AG
	URL	Match Rider	mobilu	ride2go	SimplyHop	Taxito
	Research / Confirm date	Dec 23	Sep 23, confirmed Oct 23	Sep 23, confirmed Oct 23	Sep 23, confirmed Oct 23	Sep 23, confirmed Oct 23
	Confirmed	No	Yes	Yes	Yes	Yes
Business concepts	setup	**setup.** Transport between any two stations.	**setup.** Transport between any two points (may be places).	**setup.** Transport between any two points (may be places).	**setup.** Transport between any two points (may be places).	**setup.** Transport between/from pooling stations.
	demands and offers	**demands and offers.** Transportation offers by drivers on pre-defined routes. Requests for offers via App.	**demands and offers.** Transportation demands and offers by passengers and drivers. Demands and offers via Website.	**demands and offers.** Transportation demands and offers by passengers and drivers. Demands and offers via App/Website.	**demands and offers.** Transportation demands and offers by passengers and drivers. Available offers by drivers via Web-App/Website.	**demands and offers.** No transportation offers by drivers. Requests by passengers via text-message and/or mechanically.
	monetization	**monetization.** Services financed by individuals. Driver is paid monthly up to 180€ including specific transportation. Passenger pays 0.15€/km in app. Provider pays driver.	**monetization.** Currently no external financing. Driver and passenger negotiate price or desired price is given as part of offer/demand. Passenger pays driver.	**monetization.** Services financed by companies, municipalities, and events. Driver and passenger negotiate price or desired price is given as part of offer/demand. Passenger pays driver.	**monetization.** Momentarily self-funded but intended to have a monthly fee. Driver and passenger negotiate price or desired price is given as part of offer/demand. Passenger pays driver.	**monetization.** Services financed by municipalities. Drivers is paid based on a flat rate, which is determined together with the municipalities. The provider collects the money. Provider pays driver.
	stakeholders	**stakeholders.** Focus on individual persons, private or commercial. Any individual person, private or commercial. No commercial drivers.	**stakeholders.** Focus on individual persons, private or commercial. Any individual person, private or commercial. Commercial drivers exist.	**stakeholders.** Focus on companies, municipalities, and events. Any individual person, private or commercial. No commercial drivers.	**stakeholders.** Any individual person, private or commercial. Any individual person, private or commercial. Some commercial drivers exist.	**stakeholders.** Focus on municipalities. Any individual person, private or commercial. No commercial drivers.
	coverage	**coverage.** Germany. Switzerland not mentioned.	**coverage.** Switzerland, but not limited,	**coverage.** Europe (mainly Germany), including Switzerland.	**coverage.** Germany, including Switzerland, Austria, and Dubai.	**coverage.** Switzerland.
	specifics	**specifics.** Stations are existing stops and places that are defined by Match Rider. Thus, unlike Taxito there is not necessarily a physical Match Rider infrastructure. Specific routes as defined by Match Rider along pre-defined points along the route, which are also defined by Match Rider. Additional services for municipalities with a “DIY” toolkit, as well as a timetable tool to integrate timetable data into EFA tool by MENTZ.	**specifics.** Content is non-structured text, like newspaper advertisements.	**specifics.** Largest platform for commuter pooling in Germany. As part of the Mitfahrverband eV: a meta-portal for pooling (combining offers of different providers) and an inter-modal routing with public transport are being built. Additionally, a component is being built that allows to find the routes near one’s own starting point with a similar destination (answering “I am here, how can I leave with pooling?”)	**specifics.** Login possible over a regular registration, using a Facebook-account, with the smartphone (Web-App) or website.	**specifics.** Different degrees of digitalization exist. The analog solution involves only a station and a cord that can be pulled raising a hand indicating the wish to be taken along. Like hiking.

Table 3/4

Provider	Name	twogo	Ummadum
	Company	Schwarz Mobility Solutions GmbH	ummadum Service GmbH
	URL	twogo	ummadum
	Research / Confirm date	Sep 23, confirmed Oct 23	Sep 23, confirmed Nov 23
	Confirmed	Yes	Yes
Business concepts	setup	**setup.** Transport between any two points (may be places).	**setup.** Transport between any two points (may be places).
	demands and offers	**demands and offers.** Transportation demands and offers by passengers and drivers. Demands and offers via App.	**demands and offers.** No transportation demands by passengers. Available offers by drivers via App.
	monetization	**monetization.** Services financed by companies and municipalities. Drivers' expenses can be voluntarily shared among driver and passenger based on a cost proposal of the app. Passengers pays driver.	**monetization.** Services financed by companies, municipalities, events, and sport organizations. Drivers' expenses (or efforts) are computed by app. Provider pays driver in points (specifics).
	stakeholders	**stakeholders.** Focus on companies and municipalities. Any individual person, private or commercial. Current partner of the largest Automobile Club in Germany (ADAC). Additionally, a multitude of companies for whom services were built. No commercial drivers.	**stakeholders.** Focus on companies, municipalities, events, and sport organizations. Any individual person, private or commercial. Various companies as partners to use points. Also, a multitude of companies and municipalities for whom services were built. No commercial drivers.
	coverage	**coverage.** Germany, including Switzerland.	**coverage.** Austria, including Germany, Switzerland, and Italy.
	specifics	**specifics.** Journey may include intermediate stops. Has a component that allows to find the routes near one's own starting point with a similar destination (answering "I am here, how can I leave with pooling?") Has an automatic matching and algorithm for demands and offers. Manual search is also possible. If offer/demand cannot be found, shows alternative public transport routes.	**specifics.** In addition to pooling various types of sustainable mobility like public transport, biking or walking are supported. Municipality challenges, e.g., to gather a certain number of points within a limited time-window. Sponsors pay (via provider) in points which are worth real money (1 point = 1 Swiss Rappen) or providing other benefits to the users. They may also pay actual money. Within events a focus lies on football clubs. Parking room optimization (booking parking in-app) and several other benefits are supported.

Table 4/4

5.3 Currently not included providers

Note that we left out providers and use cases that deviate significantly from our definition of vehicle pooling or whose services are not suited/intended for distribution over a national platform.

However, for completeness we mention them:

- Fahrpool[6] is an offer that constitutes as vehicle pooling. However, it is specifically designed to be used within a group of persons who know each other. A user can create a link, send it to a group of known persons, who then can organize poolings. Thus, this offer is specifically not intended for an open distribution.
- easycarpooling is a service for which a user loads credit onto the easycarpooling app. Then the user hitchhikes, i.e., stands next to a street, holds up a sign, and waits for someone to hold and pick him or her up and drive him or her to their destination. The user can then give the driver a code that can be redeemed via easycarpooling. Specifically, the driver can choose to cash-out or donate, either to easycarpooling or any other charity. In addition to the service not matching our definition of vehicle pooling, being rather a hitchhiking offer, the service cannot be well represented for distribution via our platforms.
- Similar to easycarpooling Troodle[7] can be considered to be a Hail-and-Ride rather than a pooling approach. Drivers may set destinations. Passengers search for ride-along by naming their destination. As driver is on the way, the potential passengers are shown and driver can pick them up. It may however also be that the driver does not provide a destination but is getting tracked and if a passenger is on the current/estimated path, they are matched and drivers can pick passengers up, i.e., classical hail-and-ride.
- There are many vehicle pooling providers that do not operate in Switzerland. This includes Uber (Pool/Pop)[8], BlaBlaCar Daily[9], Kinto Join[10], and Cabify[11]
- There are services that we exclude, because they are closer to the concept of taxis or on-demand, such as Vertt[12] and UberX Share[13].

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[6] www.fahrpool.com (last accessed 18.10.2023)

[7] https://troodle.me/ (last accessed 15.12.2023)

[8] UberPool vs. UberX - How Does UberPool Work? (last accessed 18.10.2023)

[9] BlaBlaCar Daily - l'application du covoiturage quotidien (last accessed 18.10.2023)

[10] https://www.kinto-mobility.com/ (last accessed 01.11.2023)

[11] https://cabify.com/es/tarifas (last accessed 01.11.2023)

[12] https://www.vertt.ch/ (last accessed 18.10.2023)

[13] https://www.uber.com/de/de/ride/uberx-share/ (last accessed 18.10.2023)

6 Use Cases

This section provides an overview of the use cases supported by the providers. From a customer perspective, there are two main use cases:

- MUC1: Wanting to travel from A to B
- MUC2: Wanting to be transported away from A

To the best of our knowledge, there are no vehicle pooling providers that support the second customer use case. In fact, the main characteristics of vehicle pooling providers can be broken down to whether they start and/or end in a point or station as shown in the following table.

The following ramifications need to be taken into consideration when reading the table:

- The flows in the descriptions are of an abstract nature and do not go into details about the providers' specifics or architecture. For example, for use case #1 (step 2) the destination may be given via a text message for both HéLéman and Taxito, but we won't specify it.
    - We want to highlight however, that some providers in use cases 2-4 do have an automatic assignment of offers and demands. And some of them even allow finding the nearest departing routes ("I am here, take me away").
- We do not differentiate between passengers and drivers where it is not necessary and use the term "user" instead.
- We do not specifically highlight mutable steps, e.g., steps 1 and 2 in use case #1 which may be executed in either order.

Table 3: Use cases of vehicle pooling in Switzerland.

No.	Title	Description	Operator
1	From station to station Usually, MUC2	1. Passenger goes to a starting station (usually signposted). 2. optional: Passenger specifies the start and destination station. 3. Driver is informed about the start and destination station (optional: or sees passenger at station). 4. Passenger and driver agree on travelling together to the destination station (optional: or a deviating location ⇔ UC#3 (station to location)). 5. Passenger and driver reach the destination. 6. optional: Passenger or provider pays driver.	HéLéman Taxito
2	From location to location Usually, MUC1	1. User creates an offer or demand with start and destination location. 2. User searches for suitable routes (optional: including prices) by start and destination location. 3. User selects and books an offer or demand. 4. Passenger and driver meet at start location (optional: or a deviating location agreed upon). 5. Passenger and driver reach the destination. 7. optional: Passenger or provider pays driver.	BePooler BlaBlaCar clickAPoint e-carpooling Greendrive IDOSH Mobilu Ride2go SimplyHop

			twogo ummadum
3	From station to location Usually, MUC1	1. User creates an offer or demand with a start station and destination location. 2. User searches for suitable routes (optional: including prices) by start station and destination location. 3. User selects and books an offer or demand. 4. Passenger and driver meet at start station. 5. Passenger and driver reach the destination location (optional: or a deviating location agreed upon). 6. optional: Passenger pays driver.	HitchHike (HéLéman Taxito, see UC #1)
4	From location to station Usually, MUC1	1. User creates an offer or demand with a start location and destination station. 2. User searches for suitable routes (optional: including prices) by start location and destination station. 3. User selects and books an offer or demand. 4. Passenger and driver meet at start location (optional: or a deviating location agreed upon). 5. Passenger and driver reach the destination station. 6. optional: Passenger pays driver.	HitchHike

7 Data model

This section describes the business data model underlying all vehicle pooling services as it was identified in our analysis.

The model is then mapped to a technical representation which is based on the NeTEx structure and nomenclature [2].

The SKI+ model is mapped onto existing standards that we found as part of our research on possible technical implementations. Specifically, we analyze a mapping to GTFS [6] and RDEX+ [7].

7.1 Business model

This business model is a simplified representation of the essential entities of vehicle pooling services. It forms the minimal common denominator for all offers and demands.

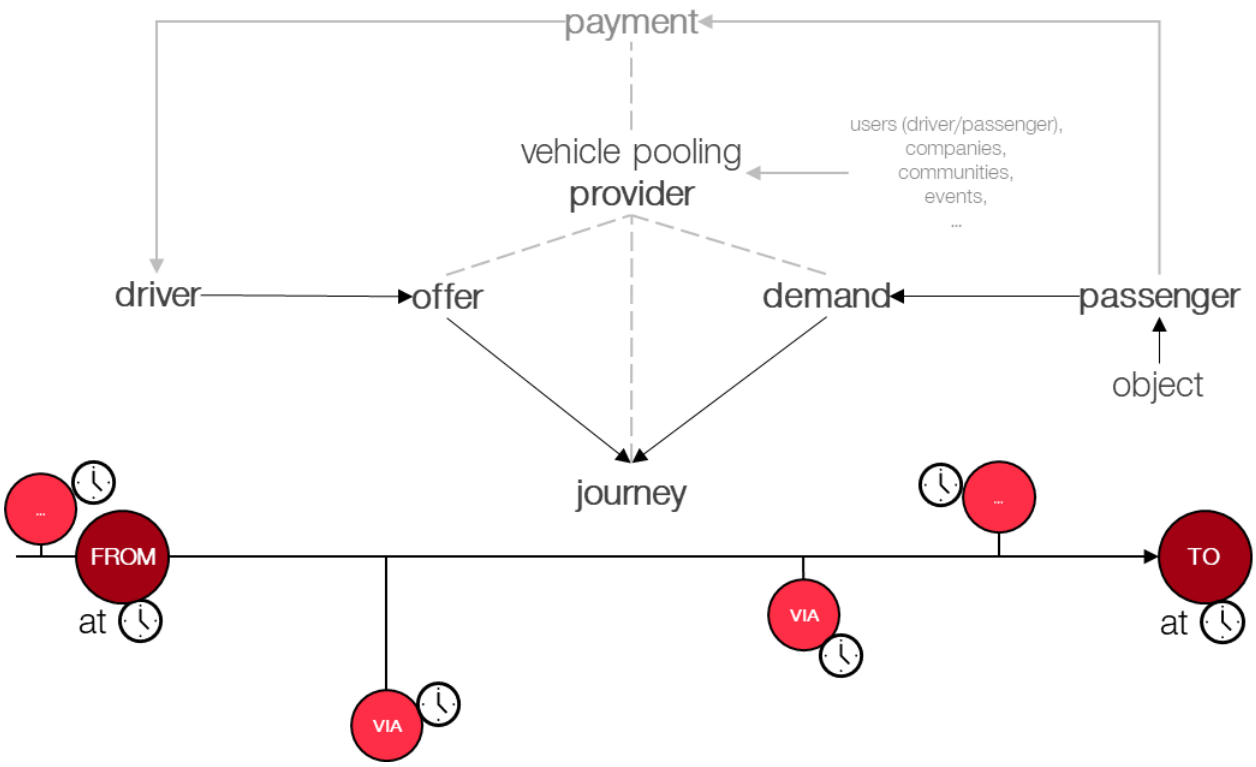

Figure 1: Key aspects of a vehicle pooling business model.

The main entity is the **journey**. It is created either **as** a transport **demand** (need to be transported) or a transport **offer** (ability to transport).

A demand is formulated by a **passenger**, who may want to transport an object or themselves. An offer is formulated by a **driver**[14].

[14] For simplicity, we do not consider passengers to define "offers" (or drivers to define demands). An example would be that a passenger states: "I offer to occupy a seat from A to B". However, that "offer" can as well be considered a demand, which is what we do.

The **journey** always **has** an **origin** (from) and a **destination** (to)[15]. It **can** be extended by **intermediates** (via). Generalizing this, we can consider the journey as a sequence of stops[16].

The **journey** always **has** a **departure time** (from) and **arrival time** (to). It can have **multiple arrival times** at the **intermediaries** (via).

Passengers or the vehicle pooling provider may have to pay the driver. This is an aspect that is essential to the vehicle pooling providers, but not necessarily for the exchange[17]. The same is true for the providers' stakeholders, i.e., users, companies, municipalities, entities, etc.

The vehicle pooling provider is the entity responsible for managing the drivers, passengers, offers, demands, and journeys. Among the providers' services are (see also section 4):

- Allow *searching* for available offers and demands (before creating new ones).
- *Match* demands and offers.
- Allow *booking* (possibly automatically) available offers.
- For matching: *compute* a geographical BUFFER around the geographical path between origin and destination and search for *potential sub-paths* to match (intermediaries).

7.2 In-app *payment* facilitation.Technical model

The given minimalistic business model can be extended and mapped to a more comprehensive representation using the NeTEx (part 5) [2] terminology as shown in the Figure below. We refer to this representation as the SKI+ model. Note that:

- Mappings to the business model are represented in purple next to the entities (only the main entity, not considering sub-entities). Attributes with an asterisk (*) are mandatory.
- Like other solutions (presented later), information on the passenger and driver are not mandatory in the technical model. The main reason being the inherent GDPR requirements. Instead, we use a deep link to the provider, which then regulates this aspect.
- We omitted a representation for cost/payment information. This information is not present for some providers, i.e., either they do not have a model for it, it is not mandatory on their platforms, or they do not wish to share the details. The latter is particularly true for their booking capabilities.
- We omitted a more detailed representation of the vehicle pooling infrastructure, such as pooling lanes. Mainly because these do exist in Switzerland. For later versions we consider including a more detailed representation than exists today.
- We added an ExtensionPoint to represent the ability to transport goods, in addition to persons.

[15] Momentarily, we do not know of any vehicle pooling provider that allows drivers or passengers to only define an origin, e.g., "I want to travel somewhere from here, who wants to join?".

[16] Demands typically do not involve intermediates.

[17] Note the discussion on the providers' concerns about externalizing booking in section 9.

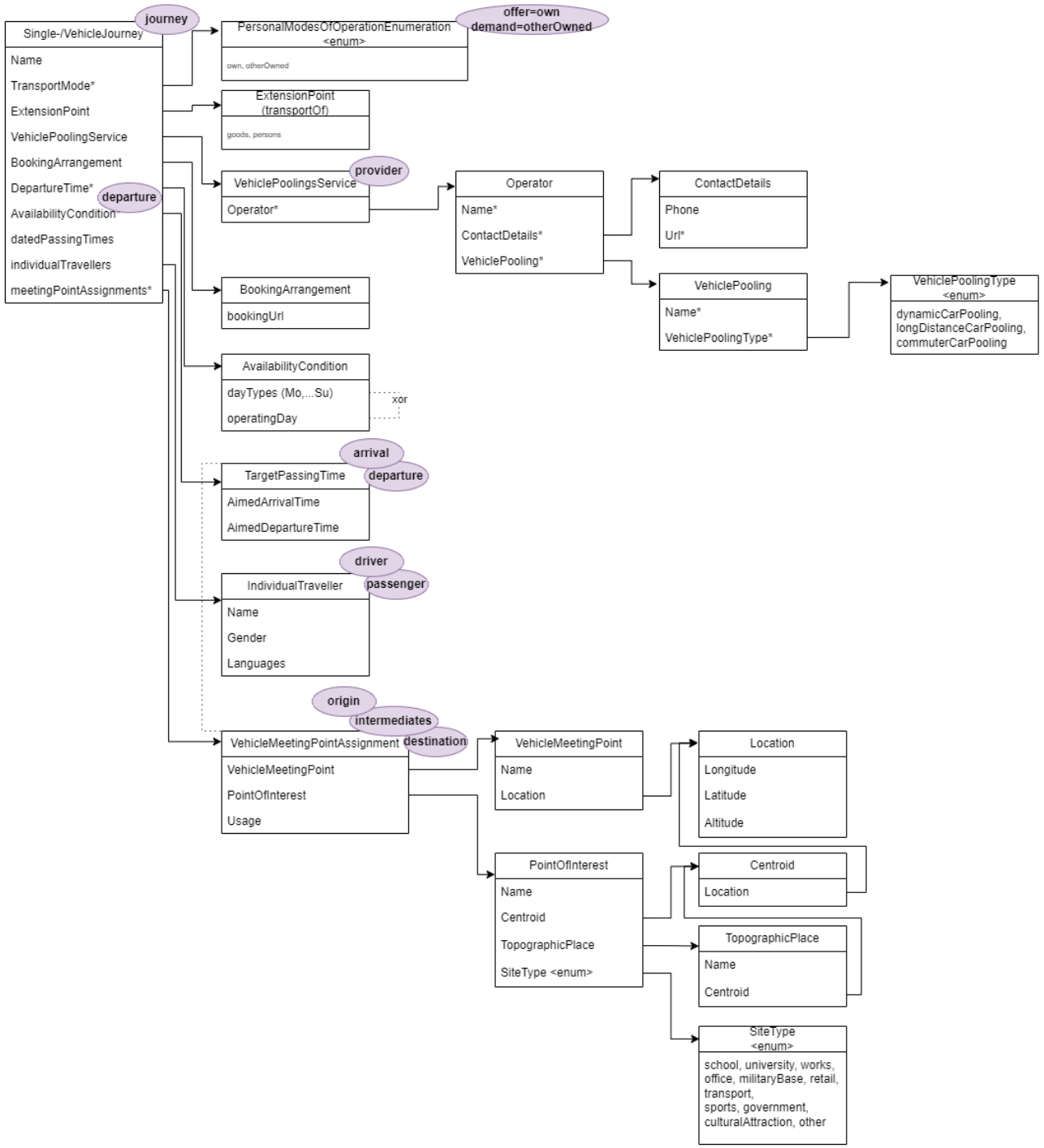

Figure 2: Key aspects of a vehicle pooling technical model. NeTEx-based.

7.3 Data exchange formats

The abstract technical model of the previous section can be represented using different exchange formats. Our research showed that currently used formats range from individual solutions, over the GTFS standard, to vehicle pooling specific standards such as RDEX+ and Amarillo.

First, we present RDEX+ as the only pooling-specific format and how our business model maps onto it. Then, we map both formats onto the highly popular GTFS format (including potential extensions). We do not create a similar mapping to NeTEx for now, because the structure is too verbose (and thus expensive to build) for the purpose and the stakeholders involved in vehicle pooling.

7.3.1 RDEX+ and its successor(s)

7.3.1.1 RDEX+

Description: Citing directly from the RDEX+-Website: "RDEX+ is the new version of the Ridesharing Data Exchange protocol. It revises completely its former syntax (and reuses the ViaNavigo Carpool API syntax[18]) and provides additional features.

RDEX+ was developed by FabMob[19]." [7]

Assessment for our purposes: However, it seems that neither the website nor the standard have been updated since 2021. The documentation on the website was not reachable to verify or to extract more details. As part of our exchange with providers we were told that the initiative has been dismissed. Consequently, we decided not to include a detailed analysis in this document.

Instead, we used the RDEX+ standard to sound our models. However, RDEX+ did not significantly extend on the presented business model. All mandatory attributes of RDEX+ are covered by our technical model. In comparison to our technical model, RDEX+ is different in that it is more detailed. For example, it includes the preferences of the driver (e.g., allowing smokers) and represents the user's picture. None of these optional attributes are necessary to be included in the first iteration of the technical model.

Summary: RDEX+ is not suited, it is deprecated and in our view bloated.

7.3.1.2 Standard covoiturage

Description: We reviewed a new model that followed RDEX+, called the "standard covoiturage" ("carpooling standard"). It was too developed by FabMob [8] and a test server exists for evaluation [9].

For this standard "[…] The publication in final version […]" was "[…] planned for the end of 2022" [8]. Thus, the work on the standard has come to an end as for RDEX+.

Assessment for our purposes: The documentation for the standard [10] shows that it adds to RDEX+ by including comprehensive booking and inter-user-exchange capabilities. Like RDEX+, the maturity, distribution, and further steps for the standard are not clearly documented. Therefore, we decided to not provide a detailed description for this standard either.

As for RDEX+, we did compare the standard to our technical model. The main addition to RDEX+ (and similarly to our technical model) are the more complex pricing and booking capabilities[20], which we do not intend to include for now. Another aspect the standard extended upon is the separation of journeys and trips. The difference or intended interpretation of those two remains unclear from the documentation. An analysis by us showed that schedules are instances of trips because they extend the data model of trips by a specific date and pricing. In any case, this aspect is not of relevance for our definition as recurrence can be represented in a significantly simpler way. Finally, some of the entities introduced with RDEX+ are extended (e.g., a verification attribute for users). These are potential candidates for extending our model going further, but for now we intend to follow an initial minimalistic approach.

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[18] The website linked on the RDEX+-website is not working anymore. Vianavigo is now called Île-de-France Mobilités app.

[19] FabMob France (lafabriquedesmobilites.fr)

[20] NeTEx does have the necessary representation to facilitate booking, too. However, this standard goes further by providing a complete protocol. Unfortunately, the standard is not compared to other existing booking standards.

Summary: Standard covoiturage is not suited, for the same reasons as RDEX+.

The approach following standard covoiturage will, to the best of our knowledge, be driven by the French government. We intend to stay in touch and, if possible, include the outcome of that work in following versions of this document.

7.3.2 GTFS

Description: A description of GTFS standard and its application in Switzerland can be taken from the FOT's document on standardization [6].

In this section we explore its applicability to our model and consider appropriate extensions such as GTFS-Flex. In an initial approach we do not consider GTFS-RT in detail, although, e.g., Amarillo includes such capabilities. Later versions of a potential vehicle pooling service should however include GTFS-RT.

7.3.2.1 GTFS Flex for pooling

Assessment for our purposes: An analysis showed that GTFS Flex is not suited/not needed to represent our technical model:

- We've currently excluded booking capabilities, thus the new `booking_rules.txt` file is not required.
- The `locations.geojson` is primarily intended to be used for areal services, which is not applicable for vehicle pooling as it is not subject to such limitations.
- `stop_areas.txt` and `areas` are not required either.

7.3.2.2 GTFS for pooling (GTFS Pool)

Assessment for our purposes: The standard GTFS format fits well for most parts, but it misses a representation of the users and whether we have an offer or demand. A mapping of the files to our business model is given in the following figure.

Notably, an extension to the `route_type` has been initiated and accepted, reserving the range of 1550-1560 for vehicle pooling within the range of 'private taxis'.

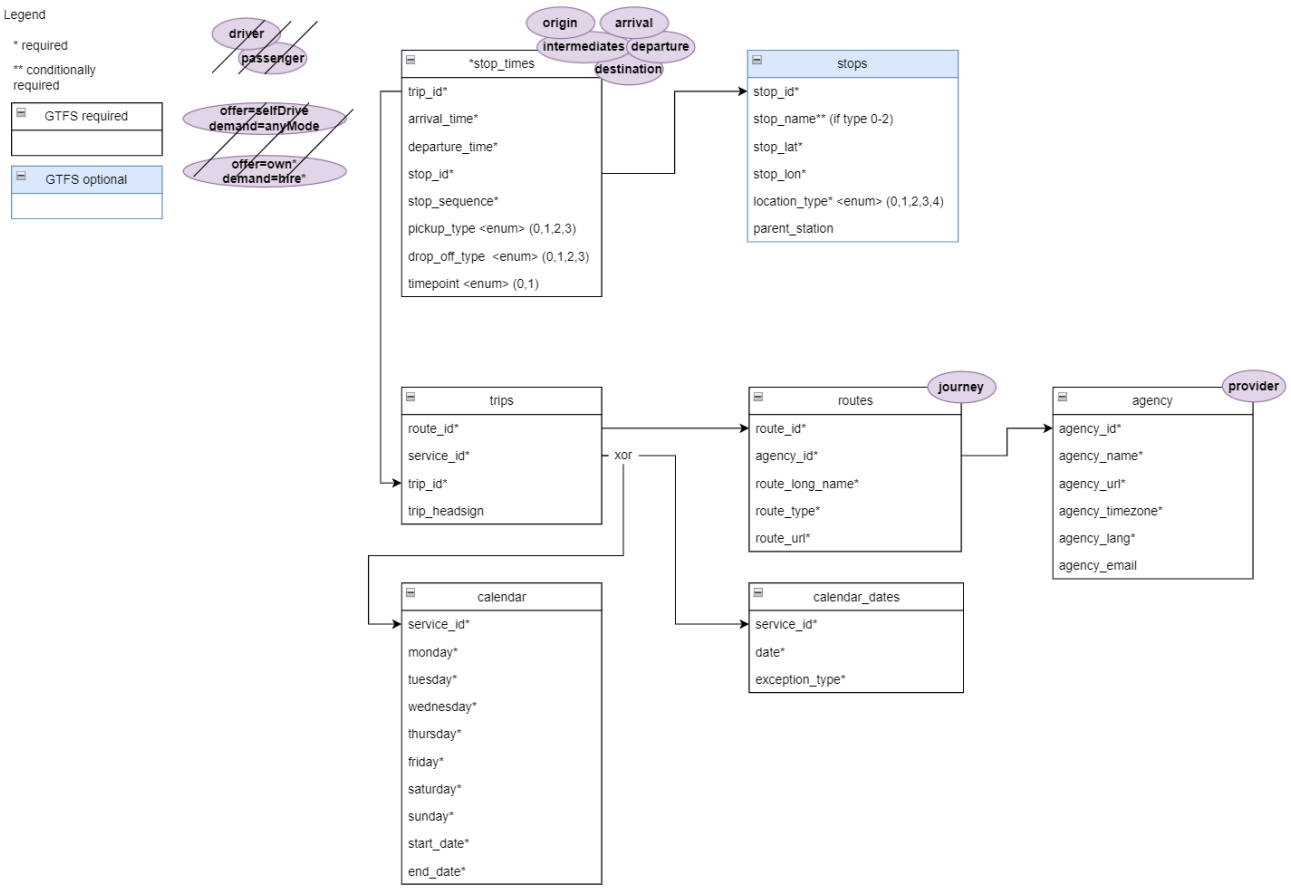


Figure 3: GTFS-based representation of vehicle pooling. Some business aspects not representable.

7.3.2.3 A GTFS extension for pooling

We suggest a set of adaptations to the GTFS standard model to make it suitable for vehicle pooling! However, due to the large extend of this technical description we've moved it to the Appendix 12.

7.3.3 Amarillo

Description: The Amarillo framework is described in section 8. The framework is built around Open-API, thus also inherently includes a data model. The data model can be considered part of the data exchange, although the output of the framework is ultimately GTFS and GTFS-RT.

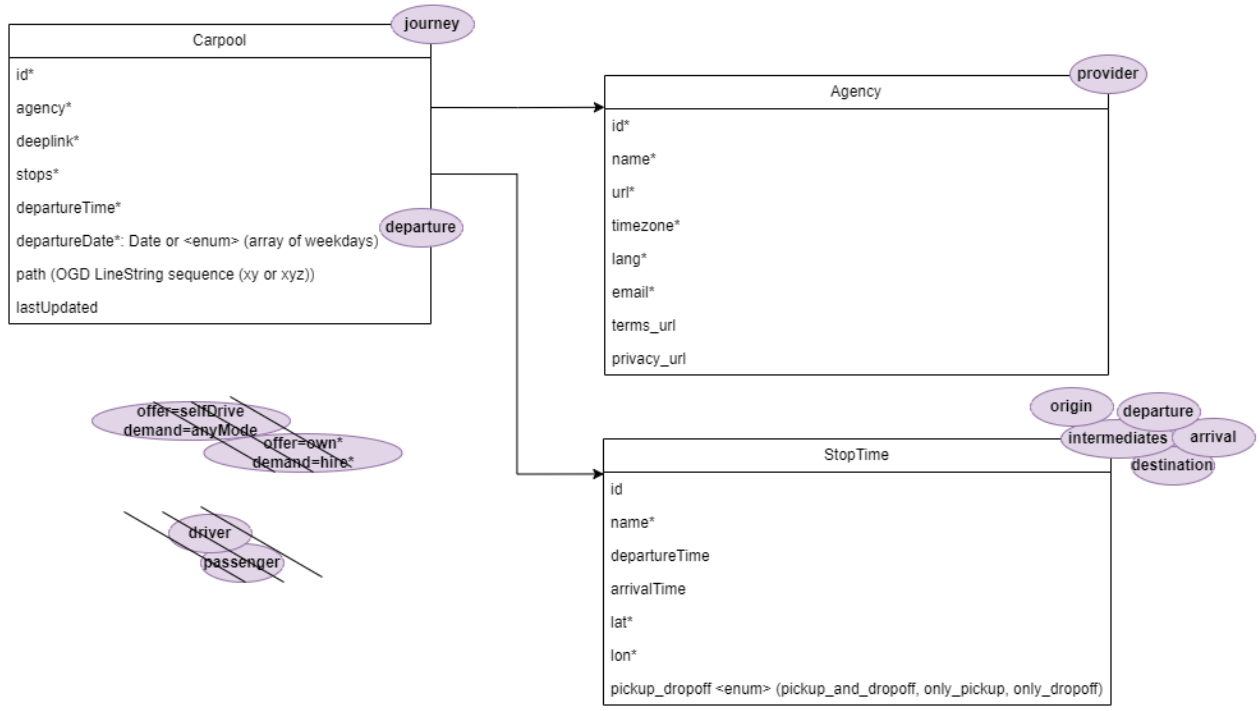


Figure 4: Amarillo (OpenAPI) model for vehicle pooling. Some business aspects not representable.

Assessment for our purposes: Opposed to our model Amarillo does not separate between demands and offers. Instead, it abstracts demands and offers to being Carpools, i.e., journeys. This needs to be included, possibly as simplistic as it exists for RDEX+ with a specific attribute. Otherwise, consuming systems are not able to appropriately process the data. For example, System 1, missing an offer from A to B, cannot know if System 2 is providing an alternative offer to display or whether it's a demand, thus, missing a vehicle for transportation.

Amarillo does not consider representing demands and offers for transporting goods. An aspect that needs to be included going further.

Drivers and passenger are not modelled either. While not essential to the operations, this piece of information is essential for the end-users. Users want to decide if they wish to travel with the respective other person. In other words, a crowd-sourced approach needs the crowd.

The vehicle pooling provider is named "agency" but is otherwise modelled similarly.

All remaining information is modelled as a sequence of stops into an array of StopTime entities. Thus, from origin to destination, including all intermediaries, with their respective departure and arrival times, and coordinates, as well as whether they are used as pick-up, drop-off, or both is represented within that one entity. This is a more on-point representation compared to our verbose NeTEx-based approach. It is better in the sense that it is easier to comprehend and employ.

A specificity to Amarillo is that it encodes weekday operations and operations on a specific date within the same attribute, e.g., the DepartureDate. These two should be separated to avoid building interpretation logic for single objects.

- An object that we did not include in the Figure but is part of Amarillo is the region. It is simply a BoundingBox with an id and does not have any referencing attributes to the other entities. It is only used computationally, i.e., to provide the offers and demands within a region.

8 Architecture

This section shows the key components that can be included to gather, consolidate, aggregate, and distribute the vehicle pooling offers and demands available in Switzerland: vehicle pooling providers, data collection, data mapping, data distribution, and vehicle pooling consumers.

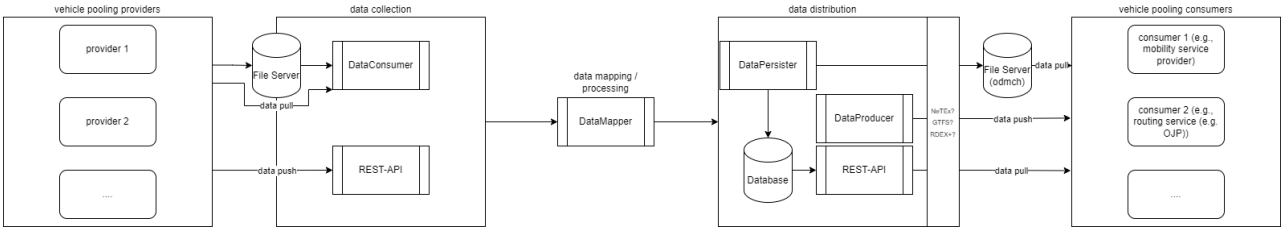


Figure 5: Suggested architecture for vehicle pooling.

The **data collection** gathers information on the providers, their offers, demands, and infrastructure (e.g., stations). It has two possible sub-components. The *DataConsumer* can periodically read from a file server or an endpoint of the vehicle pooling provider. The *REST-API* allows providers to manage their offers/demands, organization, and infrastructure.

The **data mapping/processing** maps/transforms any specificities of the data given by the vehicle pooling providers onto the standard model as described in section 7. For example, it would require the data consumer and mapper to read and map the content of a vehicle pooling provider's CSV. Note that neither component would ensure a data completeness. That can only be ensured by the providers.

The **data distribution** (stores and) shares the gathered and standardized data. It has three possible sub-components. The *DataPersister* stores the data on a file server. To provide the *REST-API* it must additionally store the data in a (No-SQL) database. This process can involve a consolidation, e.g., one file for all offers, to simplify consumption. The *DataProducer* can write the data directly onto an external (file) server or endpoint residing with the vehicle pooling consumers, such as a MaaS-provider. Note that no vendor/provider specific formats are provided to ensure discrimination free data distribution. Instead the previously mentioned standards will be used for all.

Not all (sub-)components are mandatory. We suggest and will in the following assume a minimalistic architecture that involves only a REST-API for *data collection*, no *data mapping*, and a DataPersister, database, and REST-API for *data distribution*. Existing solutions

Our research revealed two frameworks. The "standard covoiturage" introduced in section 7.3.1.2 and Amarillo [11]. As mentioned in the previous section the former solution has been discontinued end of 2022. Thus, currently the only framework to shed further light on is Amarillo.

Amarillo is an open-source framework for vehicle pooling services. The term amarillo originates from a profession in Cuba, which helps hitchhikers find a suitable ride [11].

The framework follows the minimalistic framework approach mentioned above as shown in the documentation [12]. In the following we more light on its components.

8.1 Data collection in Amarillo

The data collection is done using a very simple REST-API (see Screenshot below):

Currently no API exists for gathering the “agency”, i.e., the vehicle pooling providers. However, the following shows their representation:

8.2 Data mapping/processing in Amarillo

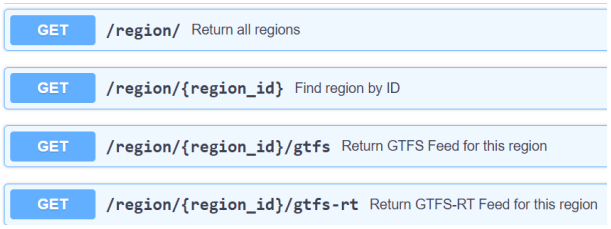
According to its documentation [11] amarillo enriches the vehicle pooling offers with potential pick-up and drop-off points (i.e., VEHICLE_MEETING_POINTS) along the presumable route of the driver with little deviation. The locations include places such as park-and-ride areas or bus stops.

No mapping is needed as the data is already provided using the predefined interface, thus implicitly enforcing a “standard”.

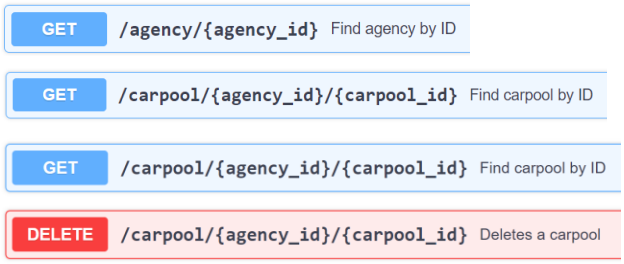
8.3 Data distribution in Amarillo

Amarillo provides different options to request offers within regions (a description of regions is given in the next section as part of the data model). Either all regions or a specific region by ID (formatted as JSON, GTFS, or GTFS-RT).

region



Amarillo further allows querying agencies and specific offers of an agency, by ID. It is also possible to get or delete a specific “Carpool” by ID.



In addition to the changes to the model described in section 7.3.3, the following extensions to the interface are needed:

- Getting all agencies
- Modifying an agency (add, update, delete), if eligible
- Getting all offers
- Getting all demands
- Modifying a region (add, update, delete), if eligible

Not directly linked to the REST-API, but rather to the framework or the implementing system is the need for an authentication procedure that allows identifying eligibility to, e.g., modify agencies.

The existing export functionality via the REST-API is not ideal and the framework should be modified to allow storing to an internal file server as shown in our suggested architecture.

9 Discussion

The introduction of vehicle pooling services as part of the MODI will have implications for existing offers by, amongst others, on-demand and taxi providers, and public transport.

Vehicle pooling demands can be exploited by non-pooling providers to serve them or by commercial pooling drivers to create a competition to the non-pooling providers. The former requires a registration on the vehicle pooling platform to get the user's contact details, while the latter requires an easy access to the booking/sales API of the vehicle pooling providers.

Vehicle pooling offers can be considered a direct competition (short-distance and long-distance) to non-pooling providers. That is also the case without providing a central offer/demands API. In particular, the obstacles that exist today for such offers, i.e., the involvement of private users or the need for competitive pricing do not change.

One important feedback we received from the vehicle pooling providers points to the same issue. Providers uttered their concerns towards opening the booking and sales interfaces for a Mobility-as-a-service provider. The vehicle pooling business relies strongly on software, which is why it can be easily replicated and emulated. Providers fear that a central point can emulate their services and cause users to divert towards central platform and away from the existing vehicle pooling providers.

10 Conclusion

Centrally gathering, consolidating, and distributing all available vehicle pooling offers and demands can benefit the vehicle pooling providers and the multi-modal transportation network in Switzerland.

An initial solution should not encompass a booking/sales component. This prevents a central point-of-contact to divert customers from the providers and an unintended exploitation of demands by non-pooling providers.

With such a framework vehicle pooling providers can utilize their knowledge of each-others' offers and demands to complement their respective network. All other non-pooling providers can do the same and initiate collaborations with the vehicle pooling providers.

11 Outlook

In a next step the FOT will have to decide how and when to proceed with the integration of vehicle pooling into NADIM.

We might do another appendix to show how pooling can be modelled in NeTEx in a future version.

A decision in favor of vehicle pooling implies that all vehicle pooling providers will be contacted to actively integrate their offers and demands in the way and extend as per the request of the FOT.

Note for future references, that a booking/sales component would require a strong governance framework to address the concerns of the vehicle pooling providers.

Another aspect that was not yet assessed in detail was GTFS-RT. This allowed us to keep the scope small. Later versions of a potential vehicle pooling service should however include GTFS-RT.

Finally, we strongly recommend intensifying the exchange within Europe, amongst others with France and Germany, who both currently have a variety of initiatives to push vehicle pooling and its standardization and exchange.

12 APPENDIX A: GTFS for pooling – a standard extension proposition

We indicate the changes with X categories:

- **required:** This field used to be optional or only conditionally required but is now required.
- **guidelines:** The description was adapted to include an explicit reference to vehicle pooling.
- **modified**: This field's value range or type was modified for vehicle pooling.
- **field:** This is a new field.
- **moved to …:** This field's position in the file was moved.

If not stated otherwise the following texts are full citations from the original GTFS Schedule reference documentation [13]. We've also highlighted the original sentences by making them *italic*.

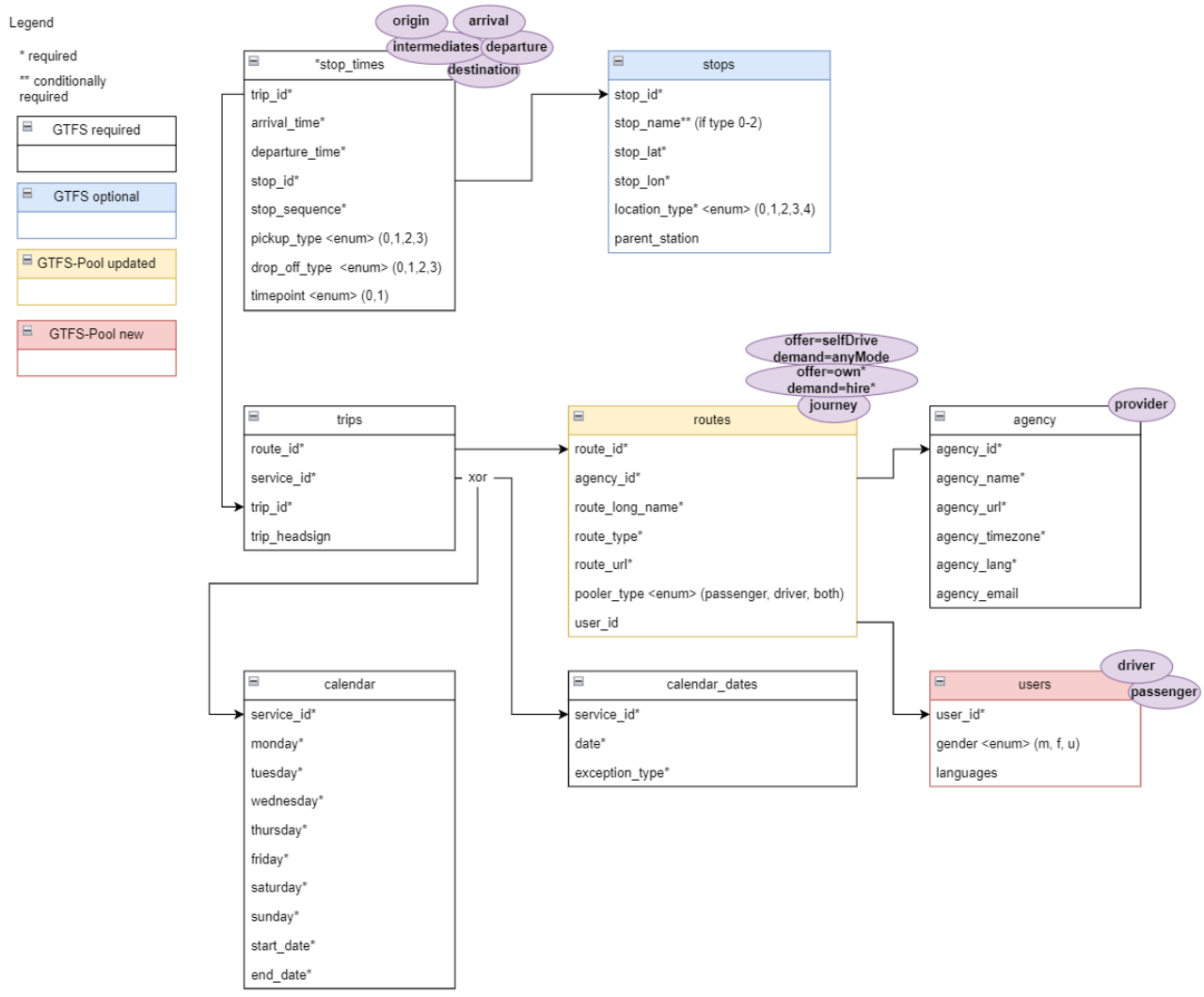
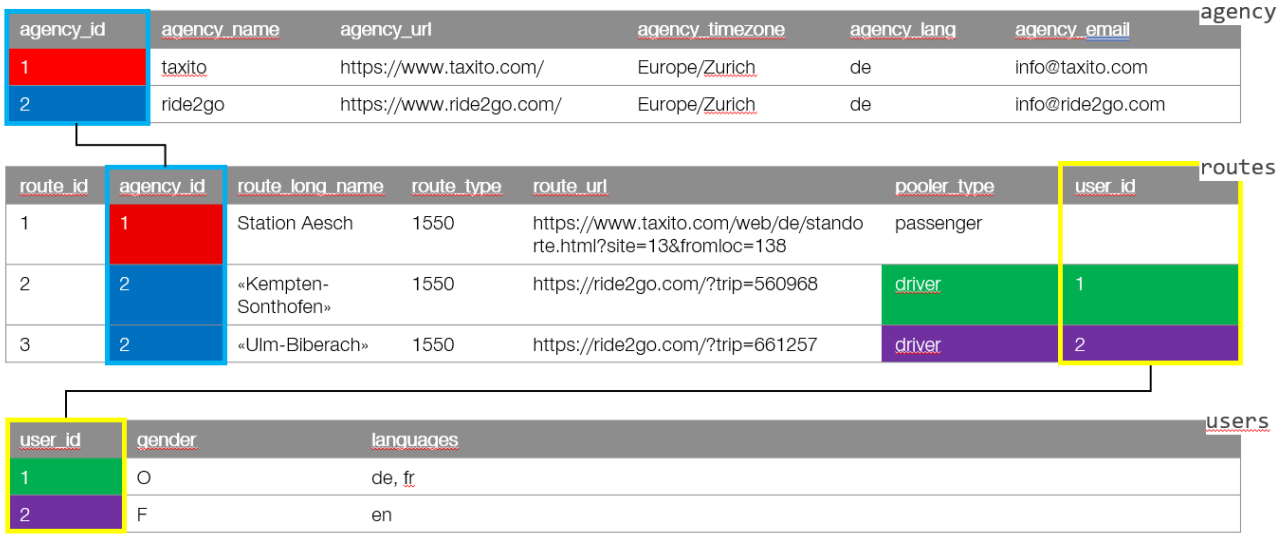


Figure 6: Suggested adaptation to the standard GTFS model to represent vehicle pooling.

12.1.1.1.1 routes.txt & agency.txt & users.txt

First, we reflect on how the agency's journeys, i.e., offers and demands, can be represented.

The agencies are described in the "agency.txt" file, the journeys in the "routes.txt" file, which is extended with the pooler_type to indicate offers/demands and an optional user (in users.txt).



routes.txt

Field Name	Type	Presence	Description
route_id	Unique ID	Required	*Identifies a route.*
agency_id	Foreign ID	Required	New: required *Agency, i.e., the vehicle pooling provider for the specified route.*
route_long_name	Text	Required	New: required + guidelines *Full name of a route.* For *pooling from stations:* the originating station name. For *pooling between places*: the originating and destined place. For privacy purposes and to simplify the definition of `stops/stop_times.stop_id` we strongly recommend using a georeferenced place near the requested origin instead of what was requested. Required, because no "`route_short_name`".
route_type	Enum	Required	New: modified *Indicates the type of transportation used on a route.* Valid options for vehicle pooling are [14] [15]: • 1550 – car as vehicle • 1551 – scooter as vehicle • 1552 – cycle as vehicle • 1553 – motorbike as vehicle • 1554 – all other vehicles

Field Name	Type	Presence	Description
route_url	URL	Required	*URL of a web page about the particular route. Should be different from the* `agency.agency_url` *value.*
pooler_type	Enum	Optional	New field Inspired from RDEX+ [7]: Type of the vehicle pooler's journey. • driver – if it is an offer created by a driver • passenger – if it is a demand of a passenger • both – if it is either an offer or demand
user_id	Foreign ID	Optional	New field User, i.e., the individual who is demanding or offering a journey. This is usually not possible for station-based services.

`agency.txt`

Unique ID: (agency_id, agency_user_id)

Field Name	Type	Presence	Description
agency_id	Unique ID	Required	New: required *Identifies a vehicle pooling provider. Note that in some cases, such as when a single agency operates multiple separate services, agencies and brands are distinct. This document uses the term "agency" in place of "brand". A dataset may contain data from multiple agencies.*
agency_name	Text	Required	*Full name of vehicle pooling provider.*
agency_url	Enum	Required	*URL of the transit agency.*
agency_timezone	Enum	Required	*Timezone where the transit agency is located. If multiple agencies are specified in the dataset, each must have the same* `agency_timezone`*.*
agency_lang	Language code	Required	New: required *Primary language used by this transit agency. Should be provided to help GTFS consumers choose capitalization rules and other language-specific settings for the dataset.*
agency_email	Email	Optional	*Email address actively monitored by the agency's customer service department. This email address should be a direct contact point where transit riders can reach a customer service representative at the agency.*

users.txt

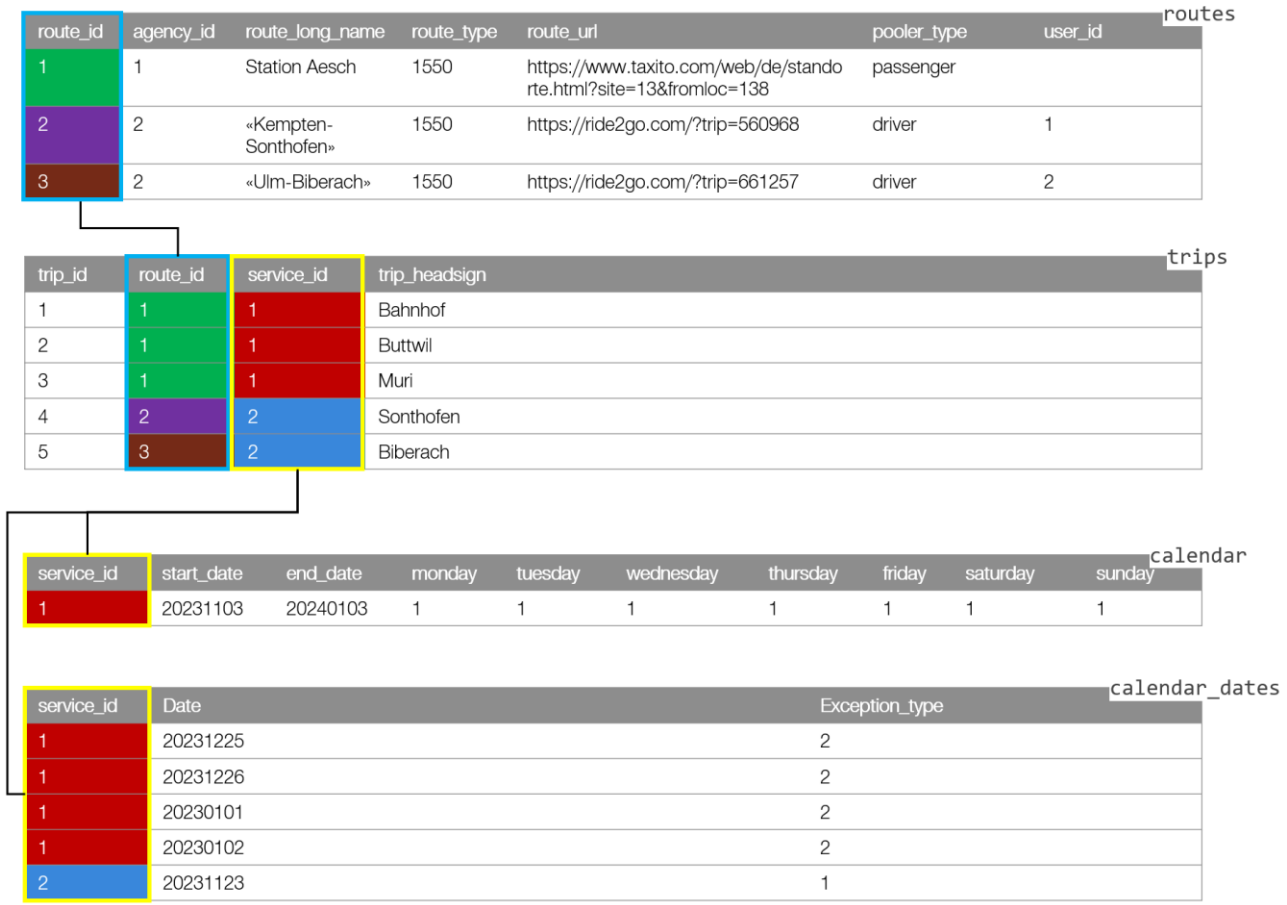
Unique ID: (user_id, agency_user_id)

Field Name	Type	Presence	Description
user_id	Unique ID	Required	Identifies a user.
gender	Enum	Optional	Gender of the user. Inspired by [7]: • F – female • M – male • O – others
languages	Enum	Optional	List of two-character ISO-Codes [16] of the languages the user speaks.

12.1.1.1.2 trips.txt & calendar.txt & calendar_dates.txt

Second, the previous journeys are connected to trips and operation dates.

The trips (trips.txt) reference either the possible destination stations of a departing stations (green journey/route) or the actual destination for between-place-journeys (purple/brown journey/route). The service times are then connected to date ranges in the calendar.txt, for which exceptions (e.g., holidays) are defined in the calendar_dates.txt.



routes

route_id	agency_id	route_long_name	route_type	route_url	pooler_type	user_id
1	1	Station Aesch	1550	https://www.taxito.com/web/de/standorte.html?site=13&fromloc=138	passenger	
2	2	«Kempten-Sonthofen»	1550	https://ride2go.com/?trip=560968	driver	1
3	2	«Ulm-Biberach»	1550	https://ride2go.com/?trip=661257	driver	2

trips

trip_id	route_id	service_id	trip_headsign
1	1	1	Bahnhof
2	1	1	Buttwil
3	1	1	Muri
4	2	2	Sonthofen
5	3	2	Biberach

calendar

service_id	start_date	end_date	monday	tuesday	wednesday	thursday	friday	saturday	sunday
1	20231103	20240103	1	1	1	1	1	1	1

calendar_dates

service_id	Date	Exception_type
1	20231225	2
1	20231226	2
1	20230101	2
1	20230102	2
2	20231123	1

`trips.txt`

Field Name	Type	Presence	Description
trip_id	Unique ID	Required	New: moved to first place *Identifies a trip.*
route_id	Foreign ID	Required	*Identifies a route.*
service_id	Foreign ID	Required	*Identifies a set of dates when service is available for one or more routes.*
trip_headsign	Text	Optional	New: guidelines *Text that appears on signage identifying the trip's destination to riders. Should be used to distinguish between different patterns of service on the same route.* For *pooling to stations:* the destination station. For *pooling to places*: the destination place.

`calendar.txt`

NEW: used *for recurring offers/demands*, otherwise `calendar_dates.txt` is used. Additionally, `calendar_dates` is used for exceptions (add/delete) to the recurrence.

Field Name	Type	Presence	Description
service_id	Unique ID	Required	*Identifies a set of dates when service is available for one or more routes. Each service_id value must be unique in a calendar.txt file.*
start_date	Date	Required	New: moved to second place *Start service day for the service interval.*
end_date	Date	Required	New: moved to third place *End service day for the service interval. This service day is included in the interval.*
monday	Enum	Required	*Indicates whether the service operates on all Mondays in the date range specified by the* **`start_date`** *and* **`end_date`** *fields.* *Note that exceptions for particular dates may be listed in calendar_dates.txt. Valid options are:* *1 - Service is available for all Mondays in the date range.* *0 - Service is not available for Mondays in the date range.*
tuesday	Enum	Required	*Functions in the same way as* **`monday`** *except applies to Tuesdays*
wednesday	Enum	Required	*Functions in the same way as* **`monday`** *except applies to Wednesdays*
thursday	Enum	Required	*Functions in the same way as* **`monday`** *except applies to Thursday*
friday	Enum	Required	*Functions in the same way as* **`monday`** *except applies to Fridays*
saturday	Enum	Required	*Functions in the same way as* **`monday`** *except applies to Saturday*
sunday	Enum	Required	*Functions in the same way as* **`monday`** *except applies to Sunday*

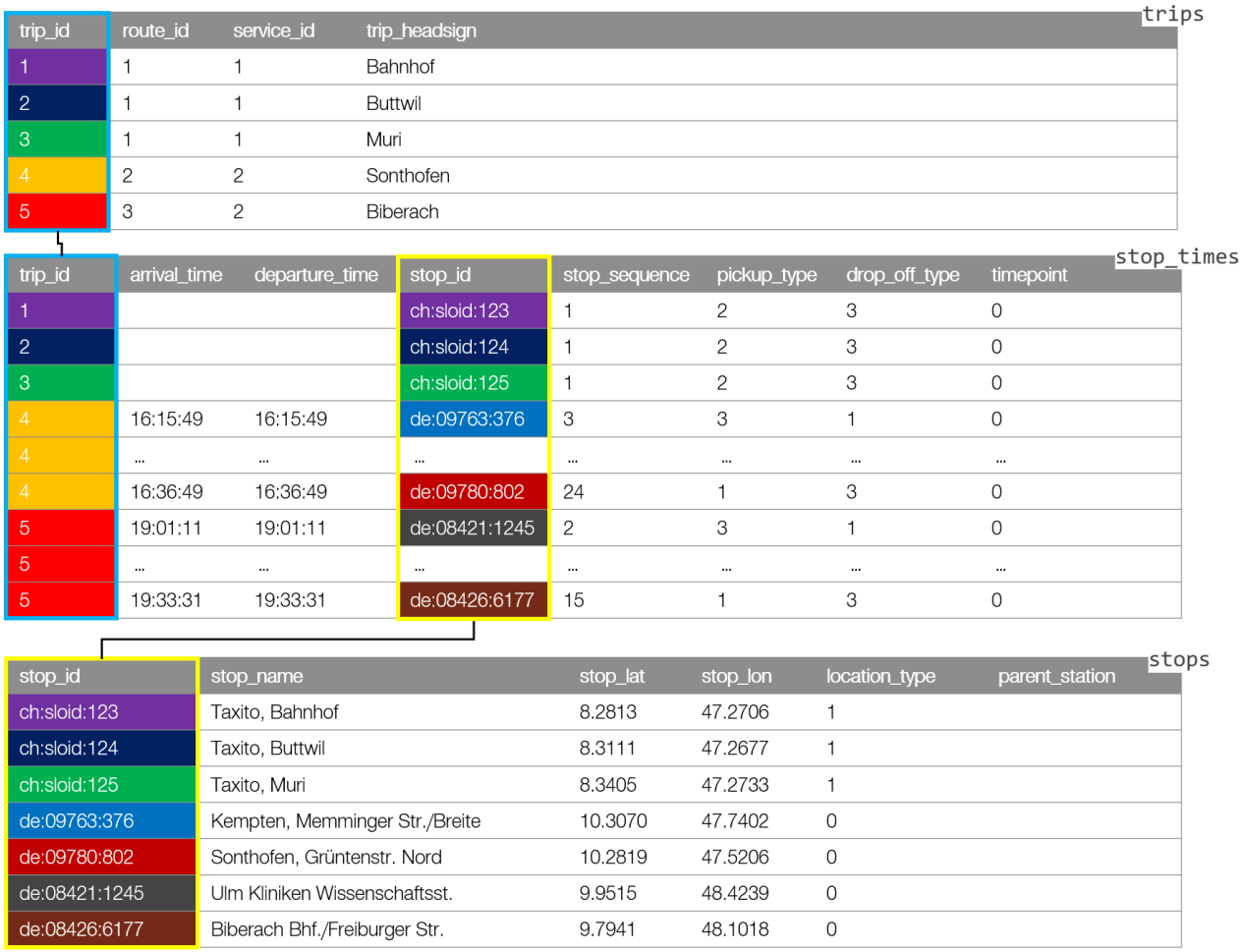
`calendar_dates.txt`

Field Name	Type	Presence	Description
service_id	Unique ID	**Required**	*Identifies a set of dates when a service exception occurs for one or more routes. Each (`service_id`, date) pair may only appear once in `calendar_dates.txt` if using `calendar.txt` and `calendar_dates.txt` in conjunction. If a `service_id` value appears in both `calendar.txt` and `calendar_dates.txt`, the information in `calendar_dates.txt` modifies the service information specified in `calendar.txt`.*
date	Date	**Required**	*Date when service exception occurs.*
exception_type	Enum	**Required**	*Indicates whether service is available on the date specified in the date field. Valid options are:* *1 - Service has been added for the specified date.* *2 - Service has been removed for the specified date.*

12.1.1.1.3 stop_times.txt & stops.txt

Third, the previous trips are connected to specific stop times and stops.

The stop times (stop_times.txt) are optional for station-based trips that only exist when there is an effective demand at the station. The planned place-based-trips do however have departure and (possibly computed) arrival times. The intermediate stops of the trips may be computed as well, i.e., unknown/undefined originally by the driver. The stops (stops.txt) along which the drivers will halt are then specified with their coordinates and IDs in the stops.txt. We suggest the application of SLOIDs, if possible.



trips

trip_id	route_id	service_id	trip_headsign
1	1	1	Bahnhof
2	1	1	Buttwil
3	1	1	Muri
4	2	2	Sonthofen
5	3	2	Biberach

stop_times

trip_id	arrival_time	departure_time	stop_id	stop_sequence	pickup_type	drop_off_type	timepoint
1			ch:sloid:123	1	2	3	0
2			ch:sloid:124	1	2	3	0
3			ch:sloid:125	1	2	3	0
4	16:15:49	16:15:49	de:09763:376	3	3	1	0
4	...	...	...	...	...	...	...
4	16:36:49	16:36:49	de:09780:802	24	1	3	0
5	19:01:11	19:01:11	de:08421:1245	2	3	1	0
5	...	...	...	...	...	...	...
5	19:33:31	19:33:31	de:08426:6177	15	1	3	0

stops

stop_id	stop_name	stop_lat	stop_lon	location_type	parent_station
ch:sloid:123	Taxito, Bahnhof	8.2813	47.2706	1	
ch:sloid:124	Taxito, Buttwil	8.3111	47.2677	1	
ch:sloid:125	Taxito, Muri	8.3405	47.2733	1	
de:09763:376	Kempten, Memminger Str./Breite	10.3070	47.7402	0	
de:09780:802	Sonthofen, Grüntenstr. Nord	10.2819	47.5206	0	
de:08421:1245	Ulm Kliniken Wissenschaftsst.	9.9515	48.4239	0	
de:08426:6177	Biberach Bhf./Freiburger Str.	9.7941	48.1018	0	

`stop_times.txt`

Primary key: (trip_id, stop_sequence)

Field Name	Type	Presence	Description
trip_id	Foreign ID	**Required**	*Identifies a trip.*
arrival_time	Time	**Conditionally Required**	**NEW: guidelines** *Arrival time at the stop (defined by `stop_times.stop_id`) for a specific trip (defined by `stop_times.trip_id`) in the time zone specified by `agency.agency_timezone`, not `stops.stop_timezone`.*

Field Name	Type	Presence	Description
			If there are not separate times for arrival and departure at a stop, `arrival_time` *and* `departure_time` *should be the same.* *For times occurring after midnight on the service day, enter the time as a value greater than 24:00:00 in HH:MM:SS.* *If exact arrival and departure times (*`timepoint=1` *or empty) are not available, estimated or interpolated arrival and departure times (*`timepoint=0`*) should be provided.* *Conditionally Required:* *- Required for the first and last stop in a trip (defined by* `stop_times.stop_sequence`*).* *- Required for* `timepoint=1`*.* *- Optional otherwise.* NEW: • For station-based vehicle pooling this field is OPTIONAL. • For location-based vehicle pooling we recommend computing a set of possible stops along the path to facilitate inter-modal computations. Example: user creates offer from A to B. Routing engine computes A, a', a'', a''', B. Then lock a', a'', and a''' to specific places (e.g., a bus station). Publish the complete route with estimated stop-times.
departure_time	Time	Conditionally Required	*Departure time from the stop (defined by* `stop_times.stop_id`*) for a specific trip (defined by* `stop_times.trip_id`*) in the time zone specified by* `agency.agency_timezone`*, not* `stops.stop_timezone`*.* *If there are not separate times for arrival and departure at a stop,* `arrival_time` *and* `departure_time` *should be the same.* *For times occurring after midnight on the service day, enter the time as a value greater than 24:00:00 in HH:MM:SS.* *If exact arrival and departure times (*`timepoint=1` *or empty) are not available, estimated or interpolated arrival and departure times (*`timepoint=0`*) should be provided.* *Conditionally Required:* *- Required for* `timepoint=1`*.*

Field Name	Type	Presence	Description
			- Optional otherwise.
stop_id	Foreign ID	**Required**	*Identifies the serviced stop. All stops serviced during a trip must have a record in* `stop_times.txt`*. Referenced locations must be stops/platforms, i.e. their* `stops.location_type` *value must be* `0` *or empty. A stop may be serviced multiple times in the same trip, and multiple trips and routes may service the same stop.*
stop_sequence	Non-negative Integer	**Required**	*Order of stops for a particular trip. The values must increase along the trip but do not need to be consecutive.*
pickup_type	Enum	Optional	*Indicates pickup method. Valid options are:* *0 or empty - Regularly scheduled pickup.* *1 - No pickup available.* *2 - Must phone agency to arrange pickup.* *3 - Must coordinate with driver to arrange pickup.*
dropoff_type	Enum	Optional	*Indicates drop off method. Valid options are:* *0 or empty - Regularly scheduled drop off.* *1 - No drop off available.* *2 - Must phone agency to arrange drop off.* *3 - Must coordinate with driver to arrange drop off.*
timepoint	Enum	Optional	*Indicates if arrival and departure times for a stop are strictly adhered to by the vehicle or if they are instead approximate and/or interpolated times. This field allows a GTFS producer to provide interpolated stop-times, while indicating that the times are approximate. Valid options are:* *0 - Times are considered approximate.* *1 or empty - Times are considered exact.*

`stops.txt`

Field Name	Type	Presence	Description
stop_id	Unique ID	**Required**	*Identifies a location: stop/platform, station, entrance/exit, generic node or boarding area (see* `location_type`*).* *Multiple routes may use the same* `stop_id`*.*

Field Name	Type	Presence	Description
stop_name	Text	Conditionally Required	*Name of the location. The* `stop_name` *should match the agency's rider-facing name for the location as printed on a timetable, published online, or represented on signage. For translations into other languages, use* `translations.txt`*.* *When the location is a boarding area (*`location_type=4`*), the* `stop_name` *should contains the name of the boarding area as displayed by the agency. It could be just one letter (like on some European intercity railway stations), or text like "Wheelchair boarding area" (NYC's Subway) or "Head of short trains" (Paris' RER).* *Conditionally Required:* *- Required for locations which are stops (*`location_type=0`*), stations (*`location_type=1`*) or entrances/exits (*`location_type=2`*).* *- Optional for locations which are generic nodes (*`location_type=3`*) or boarding areas (*`location_type=4`*).*
stop_lat	Latitude	Conditionally Required	*Latitude of the location.* *For stops/platforms (*`location_type=0`*) and boarding area (*`location_type=4`*), the coordinates must be the ones of the bus pole — if exists — and otherwise of where the travelers are boarding the vehicle (on the sidewalk or the platform, and not on the roadway or the track where the vehicle stops).* *Conditionally Required:* *- Required for locations which are stops (*`location_type=0`*), stations (*`location_type=1`*) or entrances/exits (*`location_type=2`*).* *- Optional for locations which are generic nodes (*`location_type=3`*) or boarding areas (*`location_type=4`*).*
stop_lon	Longitude		*Longitude of the location.* *For stops/platforms (*`location_type=0`*) and boarding area (*`location_type=4`*), the coordinates must be the ones of the bus pole — if exists — and otherwise of where the travelers are boarding the vehicle (on the sidewalk or the platform, and not on the roadway or the track where the vehicle stops).* *Conditionally Required:*

Field Name	Type	Presence	Description
			- Required for locations which are stops (`location_type=0`), stations (`location_type=1`) or entrances/exits (`location_type=2`). *- Optional for locations which are generic nodes (`location_type=3`) or boarding areas (`location_type=4`).*
location_type	Enum		*Location type. Valid options are:* *`0` (or blank) - Stop (or Platform). A location where passengers board or disembark from a transit vehicle. Is called a platform when defined within a `parent_station`.* *`1` - Station. A physical structure or area that contains one or more platform.* *`2` - Entrance/Exit. A location where passengers can enter or exit a station from the street. If an entrance/exit belongs to multiple stations, it may be linked by pathways to both, but the data provider must pick one of them as parent.* *`3` - Generic Node. A location within a station, not matching any other location_type, that may be used to link together pathways define in pathways.txt.* *`4` - Boarding Area. A specific location on a platform, where passengers can board and/or alight vehicles.*
parent_station	Foreign ID		*Defines hierarchy between the different locations defined in `stops.txt`. It contains the ID of the parent location, as followed:* *- Stop/platform (`location_type=0`): the `parent_station` field contains the ID of a station.* *- Station (`location_type=1`): this field must be empty.* *- Entrance/exit (`location_type=2`) or generic node (`location_type=3`): the `parent_station` field contains the ID of a station (`location_type=1`)* *- Boarding Area (`location_type=4`): the `parent_station` field contains ID of a platform.* *Conditionally Required:* *- Required for locations which are entrances (`location_type=2`), generic nodes (`location_type=3`) or boarding areas (`location_type=4`).* *- Optional for stops/platforms (`location_type=0`).* *- Forbidden for stations (`location_type=1`).*

13 Annex: Bibliography

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