OpenDataHub Docs Documentation

Release 2023.09

The Open Data Hub Team

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CHAPTER

ONE

QUICKSTART

Over the years, the Open Data Hub Project has grown and there are now many possibilities to find information on the Open Data Hub project or to interact with it.

Information about the Open Data Hub project, its goal, and possibility to interact or collaborate with it can be found in this documentation's sections *Project Overview*, *Getting Involved*, *Open Data Hub Architecture*, and *Accessing the Open Data Hub*.

A complete list of the tools and resources developed and available for everyone (including the Data browser, analytics tools, API and programmatic access, the Web Components Store) can be found on the Open Data Hub portal's Quickstart page.

CHAPTER

TWO

INTRODUCTION

Accessing the Open Data Hub as part of this section.

This is the website of the Open Data Hub documentation, a collection of technical resources about the Open Data Hub project. The website serves as the main resource portal for everyone interested in accessing the data or deploying apps based on *datasets* & *API*s provided by the Open Data Hub team.

The technical stuff is composed of:

- Catalogue of available datasets.
- How-tos, FAQs, and various tips and tricks for users.
- Links to the full API documentation.
- Resources for developers.

For non-technical information about the Open Data Hub project, please point your browser to https://opendatahub.com/.

2.1 Project Overview

The Open Data Hub project envisions the development and set up of a portal whose primary purpose is to offer a single access point to all (Open) Data from the region of South Tyrol, Italy, that are relevant for the economy sector and its actors.

The availability of Open Data from a single source will allow everybody to utilise the Data in several ways:

- Digital communication channels. Data are retrieved from the Open Data Hub and used to provide informative services, like newsletters containing weather forecasting, or used in hotels to promote events taking place in the surroundings, along with additional information like seat availability, description, how to access each event, and so on and so forth.
- Applications for any devices, built on top of the data, that can be either a PoC (Proof of Concept) to explore new means or new fields in which to use Open Data Hub data, or novel and innovative services or software products built on top of the data.
- Internet portals and websites. Data are retrieved from the Open Data Hub and visualised within graphical charts, graphs, or maps.

There are many services and software that rely on Open Data Hub's Data, which are listed in the *Apps Built From Open Data Hub Datasets* section, grouped according to their maturity: production stage, beta and alpha stage.

Figure 2.1 gives a high level overview of the flow of data within the Open Data Hub: at the bottom, *sensors* gather data from various domains, which are fed to the Open Data Hub Big Data infrastructure and made available through endpoints to (third-party) applications, web sites, and vocal assistants. A more technical and in-depth overview can be found in Section *Open Data Hub Architecture*.

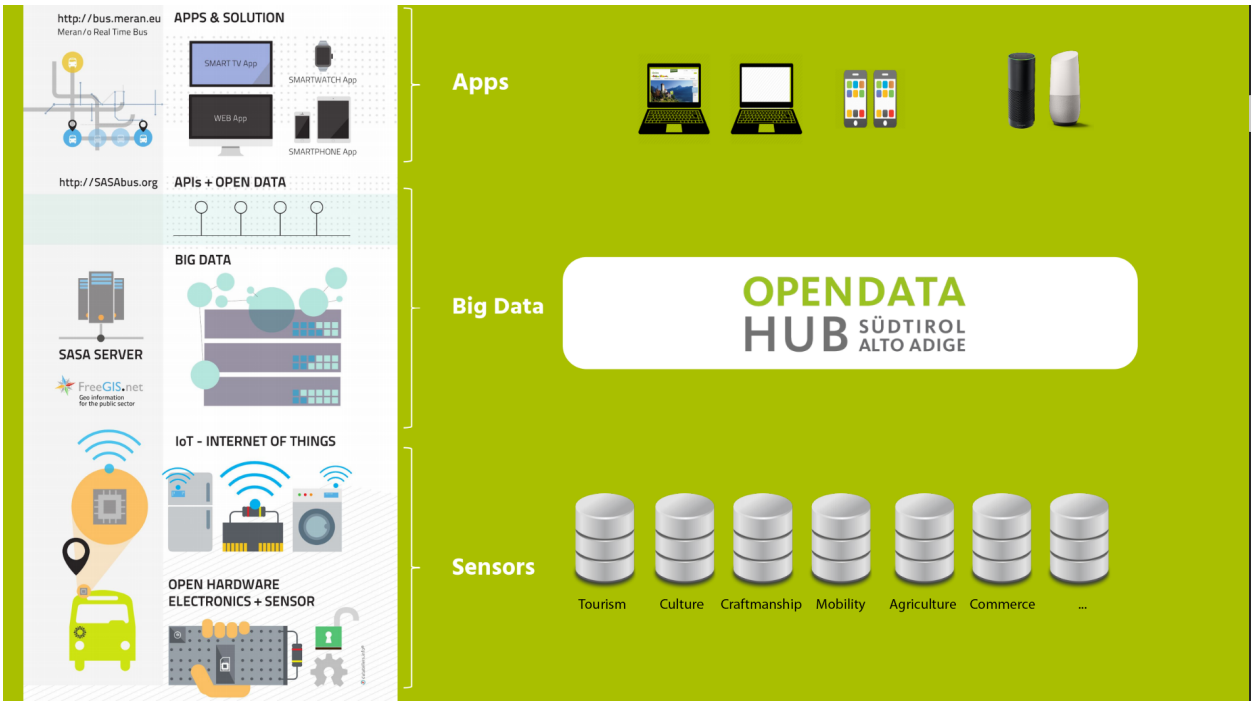


Figure 2.1: An overview of the Open Data Hub Project.

All the data within the Open Data Hub will be easily accessible, preferring open interfaces and APIs which are built on existing standards like The Open Travel Alliance (OTA), The General Transit Feed Specification (GTFS), Alpinebits.

The Open Data Hub team also strives to keep all data regularly updated, and use standard exchange formats for them like Json and the Data Catalog Vocabulary (DCAT) to facilitate their spreading and use. Depending on the development of the project and the interest of users, more standards and data formats might be supported in the future.

2.2 Getting Involved

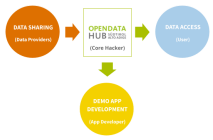


Figure 2.2: Relations between the actors involved in the Open Data Hub.

The Open Data Hub team welcomes new partners and user to join the project. For this reason, a number of services are offered to help you getting in touch with the project and support you in case you want to either collaborate with the project or simply use the data made available.

The Open Data Hub team envisioned different possibilities to join the project, that are detailed in the remainder of this section, including–but not limited to–reporting bugs in the API or errors in the API output, making feature requests or suggestions for improvement, and even to participate in the development or supply new data to be shared through the Open Data Hub.

Figure 2.2 shows at a glance the services offered by the Open Data Hub together with the various roles that potential users can play within the Open Data Hub, according to their interest, expertise, skills, and knowledge.

Data Sharing

The Open Data Hub team helps you in various activities: give **visibility** to your data, identify both **suitable, common formats**, processing algorithms and licenses to share your data, and to use popular technologies known by application developers.

This service is suitable for *Data Providers*.

Data Access

The Open Data Hub team supports software development companies to **access to real-time data**, by making available to everyone a stable **communication channel** which uses a **machine-readable** protocol and an **Open Data license**, to ensure everybody can easily find all the available data.

This service is most suitable for Data Consumers and App developers.

Demo App Development

The Open Data Hub team collaborates with companies to design and develop Proof of Concepts and demo software, released under an *Open Source License* that use data offered by the Open Data Hub. All the software can then either be used as-is–to show and test its potentials, or as a guideline and inspiration to develop new digital products.

This service is suitable for Data Consumers, App developers, and companies interested in development built on top of the Open Data Hub.

Besides the tasks that you find below, you can also help the Open Data Hub project grow and improve by reporting bugs or asking for new features, by following the directions presented in *the dedicated section below*.

2.2.1 How to Collaborate

This section gives an overview of which tasks you can play when collaborating with the Open Data Hub project.

Depending on your interest on the Open Data Hub Project, we welcome your participation to the project in one of the roles that we have envisioned: **User (Data Consumer)**, **App developer**, **Core Hacker**, and **Data Provider**. Below you can find out a list of tasks that belong to each of these roles; we believe that this list can help you understand which type of contribution you can give to the Open Data Hub project!

As a **User** I can…

…install and use an app built on top of the API.
: Browse the list of *available applications developed by third-parties* that use Open Data Hub data, choose one that you are interested in, install it and try it out, then send feedback to their developers if you feel something is wrong or missing.

…explore the data in the datasets.
: Choose a dataset from the list of *Domains and Datasets* and start gathering data from it, by using the documentation provided in this site. You can then provide any kind of feedback on the dataset: reports about any malfunctions, suggestions for improvements or new features, and so on.

  Moreover, if you are interested in datasets that are not yet in our collection, get in touch with the Open Data Hub team to discuss your request.

As a **Data Provider** I can….

…provide Open Data to the Open Data Hub project.
: Share with an Open Data Licence (like e.g., dataset CC0 or dataset CC BY-SA) the data you own, that can prove interesting for the Open Data Hub, for example because they complement existing data in the Open Data Hub or they pertain to an area which is not yet covered. Let your Open Data be freely used by App Developers in their applications.

Note: A *Data Provider* is an entity (be it a private company, a public institution, or a citizen) that gathers data on a regular basis from various sensors or devices and stores them in some kind of machine-readable format.

As an **App Developer** I can…

. . . harvest data exposed by the dataset.
Browse the list of *Domains and Datasets* to see what types of data are contained in the datasets, and think how they can be used.

For this purpose, we maintain an updated list of the *available datasets* with links to the API to access them.

. . . build an application with the data.
Write code for an app that combines the data you can harvest from the available datasets in various, novel way.

To reach this goal, you need to access the APIs, their documentation, and the datasets. It is then your task to discover how you can reuse the data in your code.

. . . integrate Open Data Hub data using Web Components.
The Open Data Hub team and their partner have developed a small library of Web Components that can be integrated in existing web sites or used as guidance to develop new Web Components.

. . . publish my app in Open Data Hub.
As soon as you have developed a stable version of your app, get in touch with us: We plan to maintain an updated list of apps based on our dataset included with this documentation.

No software installation is needed: Go to the list of *available applications developed by third-parties* that use Open Data Hub data, to the API documentation of each *Dataset* and start from there, and develop in a language of your choice an application that uses our data.

As a **Open Data Hub Core Hacker** I can. . .

. . . help shape the future of Open Data Hub.
Participate in the development of Open Data Hub: Build new data collectors, extend the functionality of the broker, integrate new datasets on the existing infrastructure, develop new stable API versions.

To be able to become a core hacker, however, requires a few additional tasks to be carried out:

1. Learn how to successfully integrate your code with the existing code-base and how to interact with the Open Data Hub team. In other words, you need to check the Developer's Flight Rules
2. Understand the *Open Data Hub Architecture*.
3. Install the necessary software on your local workstation (be it a physical workstation, a virtual machine, or a Docker instance), including PostgreSQL with postgis extension, JDK, git.
4. Set up all the services needed (database, application server, and so on).
5. Clone our git repositories. To successfully complete these tasks, please read the *How to set up your local Development Environment?* tutorial, which guides you stepwise through all the required set up and configuration, along with some troubleshooting advice.
6. Coding. That's the funniest part, enjoy!

To support the installation tasks and ease the set up of your workstation, we are developing a script the you will do the job for you. Stay tuned for updates.

2.2.2 Bug Reporting and Feature Requests

This section explains what to do in case you:

1. have found an error or a bug in the APIs;
2. like to suggest or require some enhancement for the APIs;
3. have some requests about the datasets
4. find typos or any error in this documentation repository;
5. have an idea for some specific tutorial.

If your feedback is related to the Open Data Hub Core, including technical bugs or suggestions as well as requests about datasets (i.e. points 1. to 3. above), please insert your issues on the following website:

https://github.com/noi-techpark/bdp-core/issues

If your feedback is related to the Open Data Hub Documentation, please send an email to : our Customer Service will take charge of it.

However, if you feel confident with GitHub, you can insert a new issue using either of the templates

- Report a bug
- Leave your feedback

Note: You need to have a valid github account to report issues and interact with the Open Data Hub team.

We keep track of your reports in our bug trackers, where you can also follow progress and comments of the Open Data Hub team members.

2.3 Accessing the Open Data Hub

There are lots of alternatives to access the Open Data Hub and its data: interactive and non-interactive, using a browser or the command line.

Various dedicated tutorials are available in the *List of HOWTOs* section to help you getting started, while in section *Getting Involved* you can find additional ways to collaborate with the Open Data Hub Team and use the data.

2.3.1 Browser access

Accessing data in the Open Data Hub by using a browser is useful on different levels: for the casual user, who can have a look at the type and quality of data provided; for a developer, that can use the *REST API* implemented by the Open Data Hub or even check if the results of his app are coherent with those retrieved with the API; for everyone in order to get acquainted with the various methods to retrieve data.

Besides the online tools developed by the Open Data Hub and described in section *Quickstart*, these other resources can be access using a browser.

Go to the *Apps Built From Open Data Hub Datasets* section of the documentation, particularly sub-sections *Production Stage Apps* and *Beta Stage Apps*, and choose one of the web sites and portals that are listed there. Each of them uses the data gathered from one or more Open Data Hub's datasets to display a number of useful information. You can then see how data are exposed and browse them.

In the same *Apps Built From Open Data Hub Datasets* section, you can also check the list of the *Alpha Stage Apps* and choose one of them that you think you can expand, then get in touch with the authors to suggest additional features or collaborate with them to discuss its further development to improve it.

Open the Open Data Hub Knowledge Graph Portal where you can explore all the data that are already available as a virtual knowledge graph. Here you can check out some of the precooked query to see and modify them to suit your needs with the help of W3C's SPARQL query language; SPARQL can be used also in the *Playground* to freely query the endpoint.

2.3.2 Programmatic access

Programmatic and non-interactive access to the Open Data Hub's dataset is possible using any of the following methods made available by the Open Data Hub team.

AlpineBits client

The AlpineBits Alliance strives to develop and to spread a standard format to exchange tourism data. Open Data Hub allows access to all data produced by AlpineBits using dedicated endpoints:

The *AlpineBits HotelData* dataset can be access from https://alpinebits.opendatahub.com/AlpineBits/.

See also:

The dedicated howto *How to access Open Data Hub AlpineBits Server as a client*

The *AlpineBits DestinationData* endpoint is available at https://destinationdata.alpinebits.opendatahub.com/.

Statistical Access with R

R is a free software for statistical analysis that creates also graphics from the gathered data.

The Open Data Hub Team has developed and made available bzar, an R package that can be used to access BZ Analytics data (see also *How to Access Analytics Data in the Mobility Domain*) and process them using all the R capabilities. Download and installation instructions, along with example usage can be found on the bzar repository.

See also:

There is a howto that explains how to fetch data from the Open Data Hub datasets using R and SPARQL: *How to Access Open Data Hub Data With R and SPARQL*.

API

The APIs are composed of a few generic methods, that can be combined with many parameters to retrieve only the relevant data and then post-processed in the preferred way.

The following table summarises how the two versions of the API can be used within the Open Data Hub's domains.

API	Tourism	Mobility
v1	recommended	deprecated
v2	–	recommended

There are currently two versions of the API, v1 and v2, with the former now **deprecated** for the Mobility domain and marked as such deprecated throughout the Open Data Hub documentation. New users are recommended to use the new API v2, while users of the API v1 are encouraged to plan a migration to the new API.

The new API v2 has a different approach compared to the previous version, and therefore is not compatible with the API v1, the main difference being that all data stored in the Open Data Hub can now be retrieved *from a single endpoint*, while with API v1 there was an endpoint for each dataset.

This change in approach requires also a breaking change for the users of API v1. The initial step, indeed, will not be to open the URL of the dataset and start exploring, but to retrieve the `stationTypes` and then retrieve additional data about each station. A `stationType` is the main object of a datasets, about which all the information in a dataset relate to; a dataset includes at least one `stationType`. A new, dedicated howto describing in detail the new API v2 and a few basic examples is *already available* in the dedicated section of this documentation.

Note: It is important to remark that the API v2 is **only available** for datasets in the **Mobility** Domain.

CLI access

Unlike browser access, that provides an interactive access to data, with the option to incrementally refine a query, command line access proves useful for non-interactive, one-directional, and quick data retrieval in a number of scenarios, including:

- Scripting, data manipulation and interpolation, to be used in statistical analysis.
- Applications that gather data and present them to the end users.
- Automatic updates to third-parties websites or kiosk-systems like e.g., in the hall of hotels.

Command line access to the data is usually carried out with the **curl** Linux utility, which is used to retrieve information in a non-interactive way from a remote site and can be used with a variety of options and can save the contents it downloads, which can them be send to other applications and manipulated.

The number of options required by **curl** to retrieve data from Open Data Hub's dataset is limited, usually they are not more than 3 or 4, but their syntax and content might become long and not easily readable by a human, due to the number of *filters* available. For example, to retrieve the list of all points of interests in South Tyrol, the following command should be used:

```
~$ curl -X GET "https://tourism.api.opendatahub.com/v1/ODHActivityPoi?pagenumber=1&
↪pagesize=10&type=63&subtype=null&poitype=null&idlist=null&locfilter=null&
↪langfilter=null&areafilter=null&highlight=null&source=null&odhtagfilter=null&
↪odhactive=null&active=null&seed=null&latitude=null&longitude=null&radius=null" -H
↪"accept: application/json"
```

Your best opportunity to learn about the correct syntax and parameters to use is to go to the **swagger interface** of the tourism or mobility domains and execute a query: with the output, also the corresponding **curl** command used to retrieve the data will be shown.

2.3.3 The Open Data Hub Virtual Knowledge Graph

Some datasets in the Open Data Hub, namely Accommodations, Gastronomy, and Events , are organised into a *Virtual Knowledge Graph* that can be accessed using SPARQL from the dedicated SPARQL portal. In order to define more precise queries, this section describes the Knowledge Models (*KM*) underlying these datasets; the description of each KM (Kwowledge Model) is accompanied by an UML diagram which shows the KM at a glance.

Besides standard W3C's OWL and RDF vocabularies, the Open Data Hub VKG uses:

- schema.org for most of the entities used
- geosparql for geo-references and coordinates of objects
- Dublin Core's purl for linking to related resources

Common Notation

Diagrams use UML class diagram formalism widely adopted in Knowledge Representation and in particular in the *W3C's Recommendation* documents for the Semantic Web. The following additional notation applies:

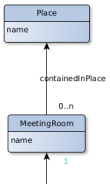
Prefix
: The default prefix used for classes and properties is **https://schema.org/**. This means that, unless differently stated, the definition of classes and properties, including their attributes, rely on a common standard as defined in schema.org's vocabulary. As examples, see the LodgingBusiness class and the containedInPlace property.

Hint: Other prefixes are explicitly pre-pended to the Class or Property name, like e.g., *noi:numberOfUnits*.

Arrows
: Arrows with a white tip denote a *sub-class* relationship, while black tips denote *object properties*.

Cardinality

Cardinality of **1** is usually not shown, but implied; the look across notation is used. For example, the image on the right-hand side–excerpt from the *event dataset* VKG–can be read as *0 to N* **MeetingRoom**s are *ContainedInPlace* **Place**.



Mobility Domain

The entire mobility domain has a unique underlying knowledge model, which encompasses all the datasets and therefore also allows an easier creation of cross-dataset queries. Since the mobility domain gathers data from *sensors*, useful in this domain is also the SOSA (Sensor, Observation, Sample, and Actuator) ontology, which uses **sosa** as prefix. You can check the Classes and Properties of SOSA in the W3C's dedicated wiki page

The central concept is **Station**, of which all `StationTypes` are subclass, while **Observation**, **LatestObservation**, and **ObservableProperty** are used to provide time-related information of the data gathered and relate to **Sensor**. Together with **Platform**, **Sensor** make the relation between a *Station* and its *Sensors*: For example, sensor *EChargingPlug* `isHostedby` an *EChargingstation Platform*, which is also a *Station*.

The knowledge model is completed by the **Feature** superconcept, which contains also **Municipality** and **RoadSegment**, the latter defined by an *hasOriginStation* and an *hasDestinationStation*.

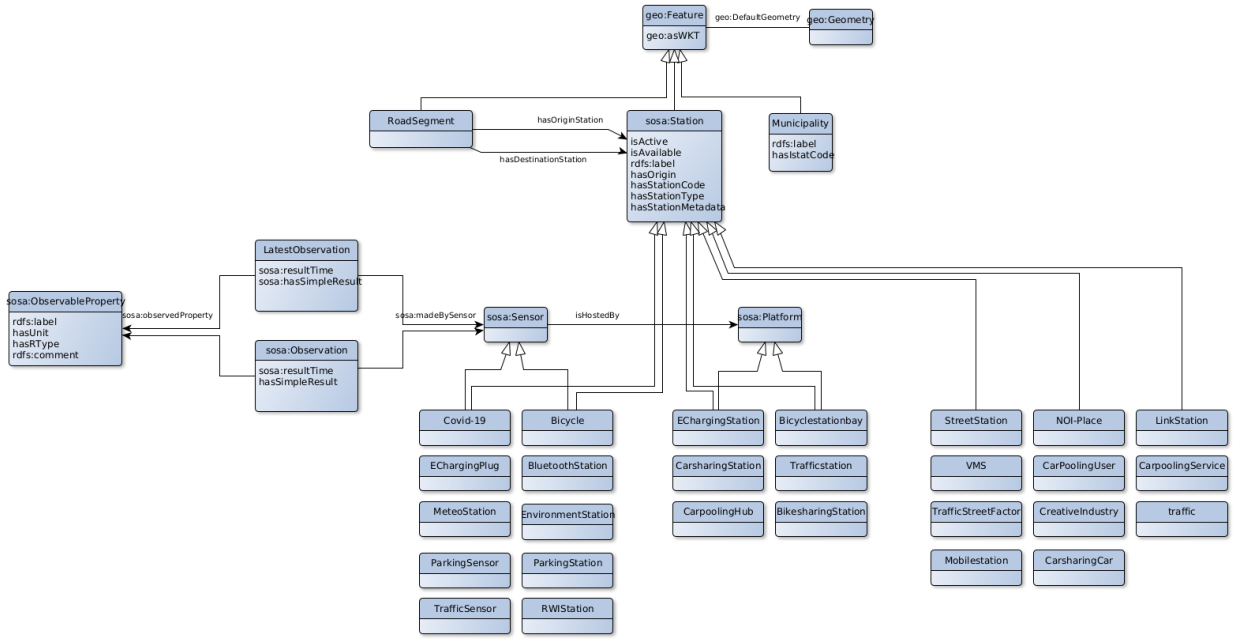


Figure 2.3: The UML diagram of the *Mobility Domain*.

Accommodation Dataset

Central class in this dataset is **LodgingBusiness**, to which belong multiple **Accommodation**s.

A **LodgingBusiness** has as attributes *geo:asWKT*, *email*, *name*, *telephone*, and *faxNumber* and relations

- *address* to class **PostalAddress**, which consists of *streetAddress*, *postalCode*, and *AddressLocality*
- *geo*, i.e., a geographical location, to class **GeoCoordinates**, consisting of *latitude*, *longitude*, and *elevation*

There are (sub-)types of **LodgingBusiness**–called **Campground**, **Hotel**, **Hostel**, and **BedAndBreakfast**–sharing its attributes and relations.

An **Accommodation** is identified by a *name* and a *noi:numberOfUnits* and has relations

- *containedInPlace* to **LodgingBusiness** (multiple **Accommodation**s can belong to it)
- *occupancy* to **QuantitativeValue**, which gives the *maxValue* and *minValues* of available units of accommodation and a *unitCode*.

noi:numberOfUnits is the number of available rooms, suites, apartments, etc. that are available in that **Accommodation**

geo:asWKT is a method used by opengis.net's *geosparql <https://www.geosparql.org/>* to express geographic coordinates in a standard, textual form based on WKT (Well-known text).

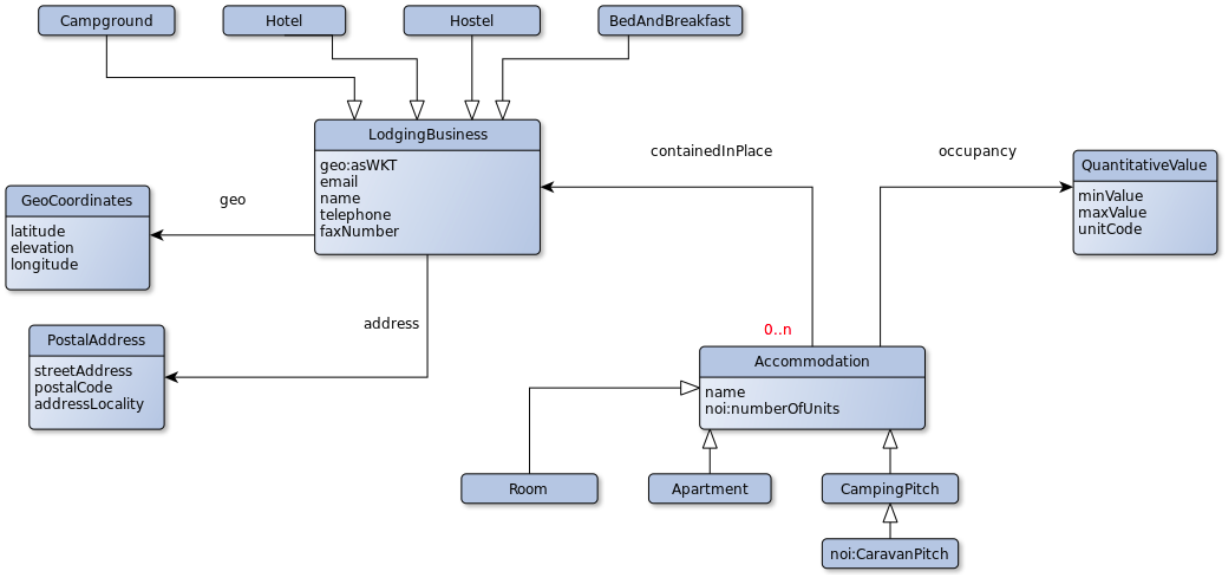


Figure 2.4: The UML diagram of the Accommodations dataset.

Gastronomy Dataset

The main class of this dataset is **FoodEstablishment**, described by *geo:asWKT*, *description*, *name*, *telephone*, and *url*.

A **FoodEstablishment** has

- a **PostalAddress**–consisting of *streetAddress*, *postalCode*, and *AddressLocality*–as *address*
- a **GeoCoordinates**–*latitude*, *longitude*, and *elevation*–as a geographical location *geo*

There are different (sub-)types of **FoodEstablishment**, all sharing the same attributes: **Restaurant**, **FastFoodRestaurant**, **BarOrPub**, **Winery**, and **IceCreamShop**.

geo:asWKT is a method used by opengis.net's *geosparql <https://www.geosparql.org/>* to express geographic coordinates in a standard, textual form based on WKT.

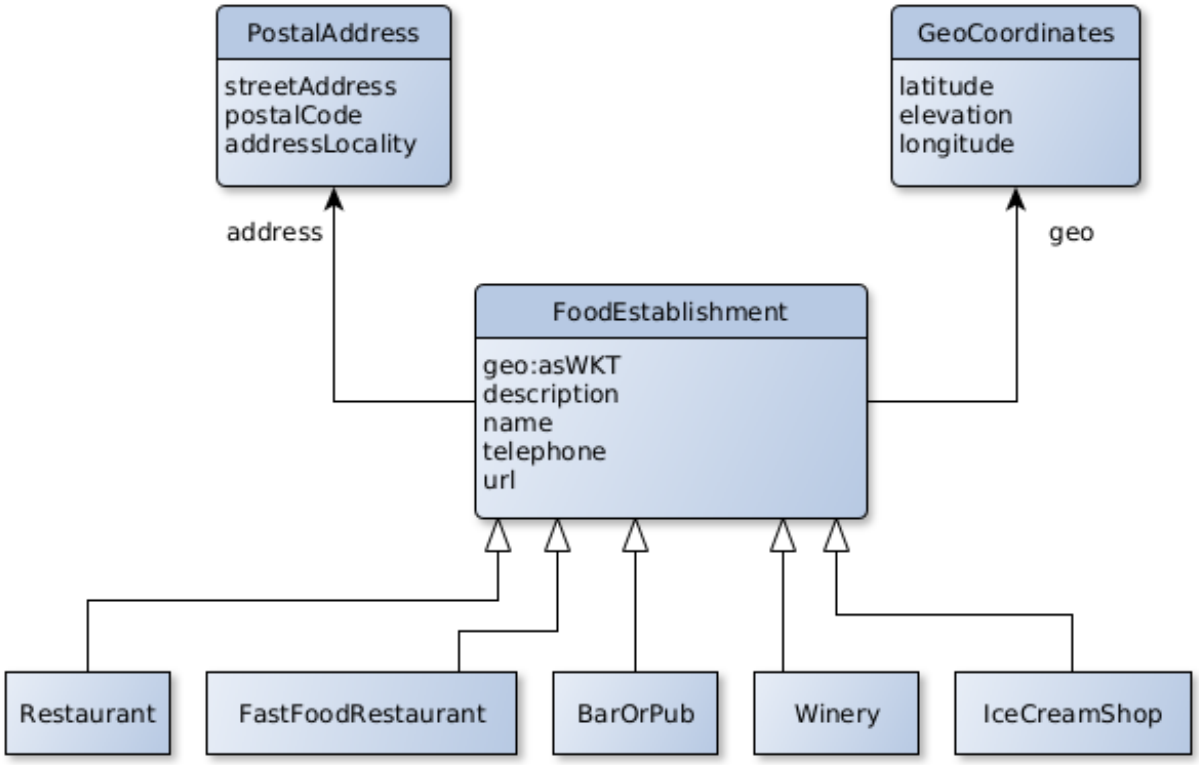


Figure 2.5: The UML diagram of the Gastronomy dataset.

Event Dataset

The main classe in this dataset is **Event**, described by a *startDate*, an *endDate*, and a *description*. Every **Event** has an *organizer*, either a **Person** or an **Organization** and a *location*.

A **Person**–identified by *givenName*, *familyName*, *email*, and *telephone*–*worksFor* an **Organization**, which has a *name* and an *address*, i.e., a **PostalAddress** consisting of *streetAddress*, *postalCode*, *AddressLocality*, and *AddressCountry*.

Finally, an **Event** has as *location* a **MeetingRoom**–identified by a *name*– which is *containedInPlace* a **Place**–which has also a *name*

See also:

The *SPARQL howto*, which guides you in interacting with the SPARQL endpoint.

W3C Recommendation for OWL2 and RDF.

Official Specification of UML Infrastructure are available from Object management group

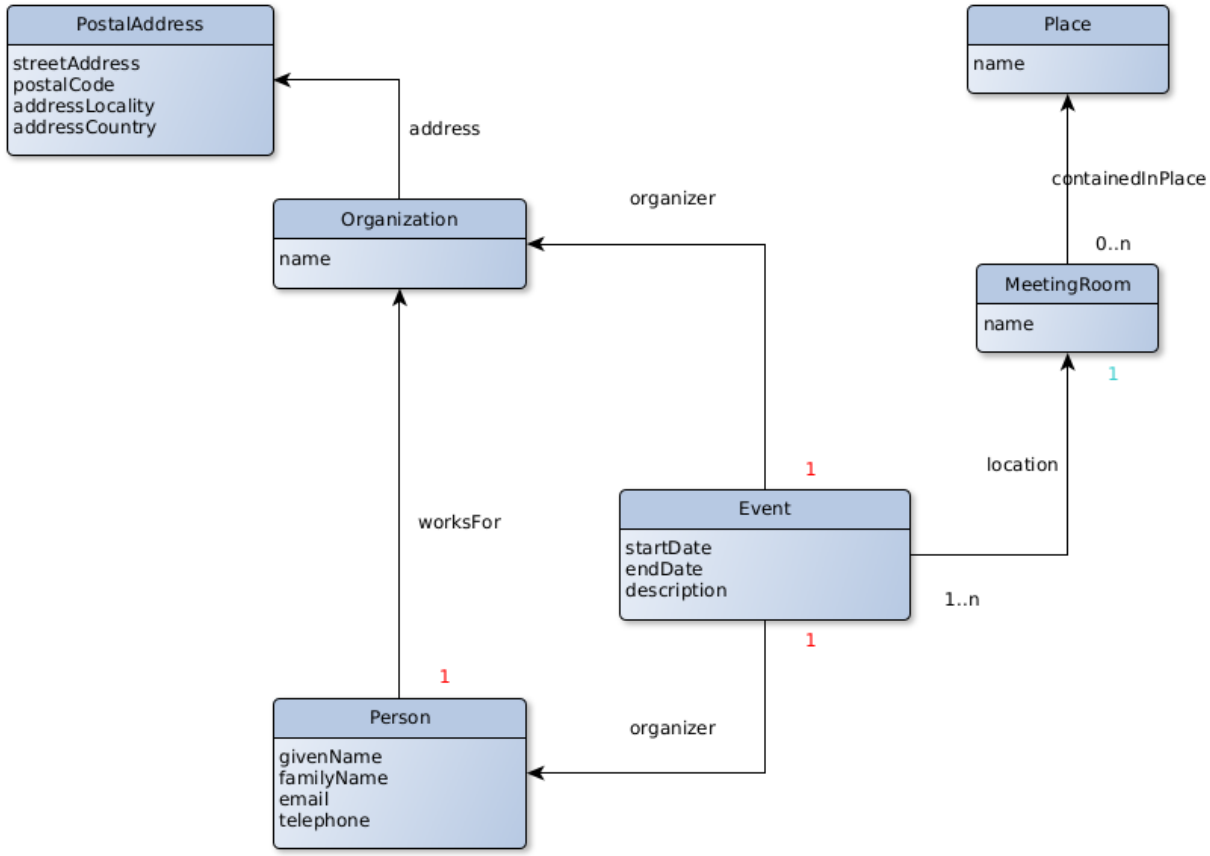


Figure 2.6: The UML diagram of the Events dataset.

2.3.4 The AlpineBits Client

The AlpineBits Alliance strives to develop and to spread a standard format to exchange tourism data. There are two datasets they developed and keep up to date, that are of particular interest for Open Data Hub users: HotelData and DestinationData.

DestinationData

The AlpineBits DestinationData is a standardisation effort to allow the exchange of information related to mountains, events, tourism. Developed by the AlpineBits Alliance, Destination Data relies on a number of standards (Including *json*, REST API, Schema.org, OntoUML) to build the **AlpineBits DestinationData Ontology**, the core result of the effort. The goal of *DestinationData* it to provide a means to describe events, their location, and additional information on them. For this purpose, the DestinationData Ontology specifies a number of **Named Entities** used to describe *Events* and *Event Series*, *Mountain Areas*, *Places*, *Trails*, *Agents*, and so on.

The full specification of the ontology, including architecture of the API and description of the datatypes defines can be found in the latest **2021-04 version** of the official **Destination Data specs** (pdf).

The **reference implementation** of AlpineBits DestinationData is provided by Open Data Hub and publicly available at the dedicated endpoint at https://destinationdata.alpinebits.opendatahub.com/.

See also:

More information and resources about AlpineBits DestinationData can be found on the official page.

HotelData

The AlpineBits HotelData is meant for data strictly related to hotels and booking, like Inventory Basic, Inventory HotelInfo, and FreeRooms. This dataset can be access from the dedicated endpoint at https://alpinebits.opendatahub.com/AlpineBits/

See also:

The dedicated howto *How to access Open Data Hub AlpineBits Server as a client*.

The official page of AlpineBits HotelData.

CHAPTER

THREE

DOMAINS AND DATASETS

What is a Domain?

A *Domain* is a category that contains entities that are closely related. In the Open Data Hub, each domain roughly identifies one social or economical category; the domains intended as sources for data served by the Open Data Hub are depicted at the bottom of Figure 2.1.

Currently, the domains that can be accessed through the Open Data Hub are:

1. *Mobility*, this domain contains data about public transportation, parkings, charging station, and so on.
2. *Tourism*: data about events, accomodations, points of interest, and so on.
3. *Other* domain: a special category that encompasses domains that do not fall in any of the above category.

Each domain is composed by datasets, each of which contains data that provide useful information for the domain.

It is important to note that there is no clear separation between two domains. For example, data about public transportation belong to the Mobility domain, but are also useful for the Tourism domain.

The goal of the Open Data Hub project is to make available datasets containing data about the South Tyrolean ecosystem, to allow third parties to develop novel applications on top of them, consuming the exposed data. These applications may range from a simple processing of datasets to extract statistical data and to display the result in different graphic formats like pie-charts, to far more complex applications that combine data from different datasets and correlate them in some useful way.

As seen in Figure 2.1, data originate from different domains (Mobility, Tourism, and so on); they are gathered from sensors and packed together by *Data Providers*. *Sensors* can be for example GPS devices installed on buses that send their real-time geographic position or a small electronic device on a plug of an e-charging station that checks the if the plug is being used or not, to let people know that the charging outlet is available.

Datasets are accessible through a *REST API*, the URL of each endpoint is given along with other information in the description of each dataset, see the lists of datasets in the remainder of this section.

3.1 Data Providers

A **Data Provider** is any entity that shares their Open Data with the Open Data Hub project, allowing their free reuse (ideally under a free licence like dataset CC0 or dataset CC BY-SA). Data can be picked up by any third-party to build their application. These entities can be private companies or enterprises, public bodies, and even private citizen.

The updated list of Data Providers that contribute to the Open Data Hub is available on the Open Data Hub's home page: https://opendatahub.com/community/

3.2 Datasets, Open Data, and Licenses

The resources that are part of the Open Data Hub Project are subject to different licenses, which are described in section *Licenses for Open Data Hub resources*. Derivative material built using Open Data Hub material is also subjected to different licenses, depending on its purpose, as shown in Figure 3.1.

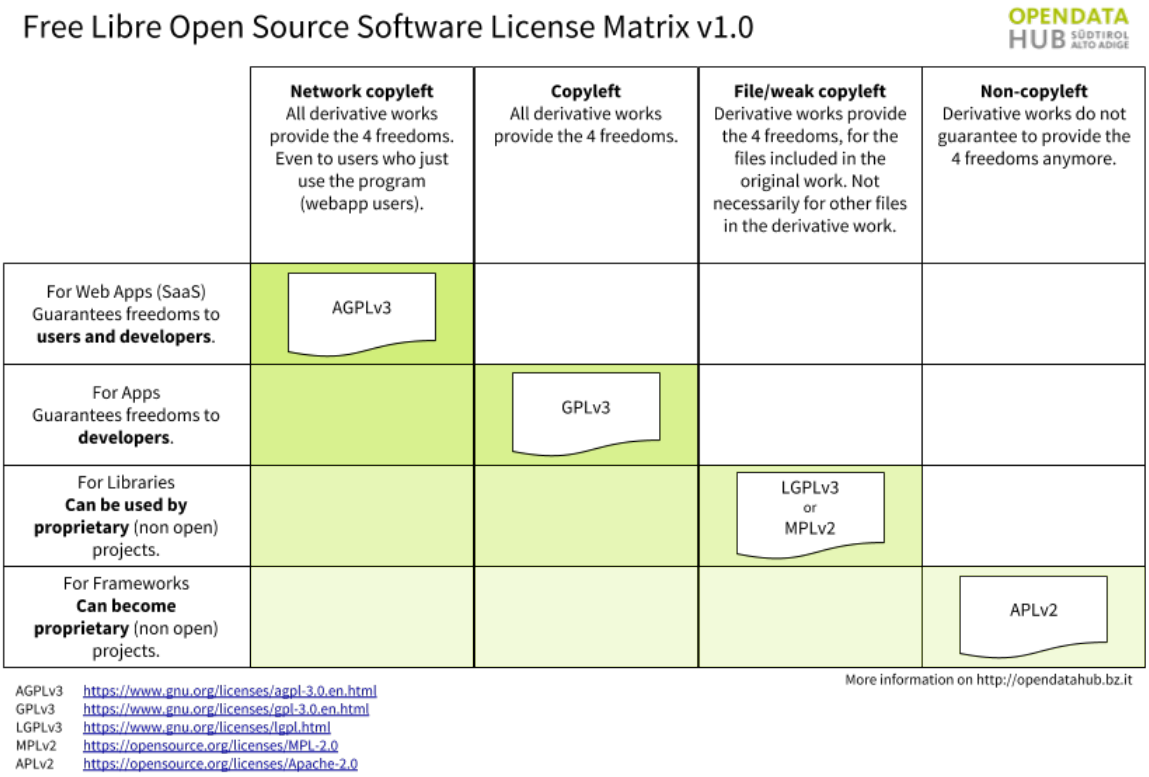


Figure 3.1: Licenses for the Open Data Hub and derivative material.

A large part of the Open Data Hub resources is represented by the datasets. While some of datasets have been provided for testing purposes or for internal use only, most of them are made of open Data only.

The goal of the Open Data Hub project is to expose **only Open Data** and the Open Data Hub team members always suggest to use a dataset CC0 license to Data Providers releasing datasets, it is not yet possible for the Open Data Hub team to guarantee the availability as Open Data of all the data in the datasets, because the data licensing and its distribution rights are decided by the copyright holder of each dataset.

Since some of the datasets may contain data that can not be distributed by the Open Data Hub team under an open

licence like, e.g., dataset CC0 or dataset CC BY-SA, a user will be able to retrieve from each dataset only those data that are distributed as **Open Data**. The response to a query is in JSON format (although *CSV* output can be forced) and is **always** licensed as Open Data. However, the response may include resources like links to web pages, streams, or images that are subject to a different, even proprietary, licence. For more information about this topic, there is a *dedicated section*.

3.2.1 The FLOSS four freedoms

The *four essential freedoms* are the four basic principle to which a software program must comply to be defined free software. As stated on the What is free software? web page (on which you can find a lot more information and details), they are:

Freedom 0 The freedom to run the program as you wish, for any purpose

Freedom 1 The freedom to study how the program works, and change it so it does your computing as you wish. Access to the source code is a precondition for this.

Freedom 2 The freedom to redistribute copies of the program so you can help others.

Freedom 3 The freedom to distribute copies of your modified versions to others. By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

3.2.2 Licenses for Open Data Hub resources

The Open Data Hub Project processes dataset, possibly supplied by third-party sources (i.e., *Data Providers*), which may contain closed data; however, only Open Data are returned to the users' queries.

According to the main goal of the Open Data Hub Project, we have defined licenses for its different components and we use badges across the documentation for a better visibility. As a rule of thumb, we try to do our best to deliver **Open Data**, by developing **Free/Open Source software** that is publicly available on github, and by using an **Open Standard** for the API used to access data.

These licenses are applied to the Open Data Hub components:

- All the **software** released within the Open Data Hub is Free software and complies with the GPLv3 license. code GPLv3 Code repositories can be found at https://github.com/noi-techpark.
- The **Datasets** currently expose only Open Data that are in the public domain, so they are released as CC0. dataset CC0
- The **APIs** have no license yet, since we are in the process to define which among the CC licenses could fit best. See Figure 3.2 for an overview and quick description of CC licenses and derivative material.

3.2.3 CC0 Licensed Data

Open Data Hub provides a live updated table about the number of CC0 licensed data it contains. Please note, this data is calculated on some datasets and does not consider all datasets of the whole Open Data Hub yet.

https://databrowser.opendatahub.com/Home/LicenseStatus

Note: There is an additional clarification about the licence for any content that is retrieved from the datasets in JSON format, which is detailed in Section *License of the JSON Responses*.

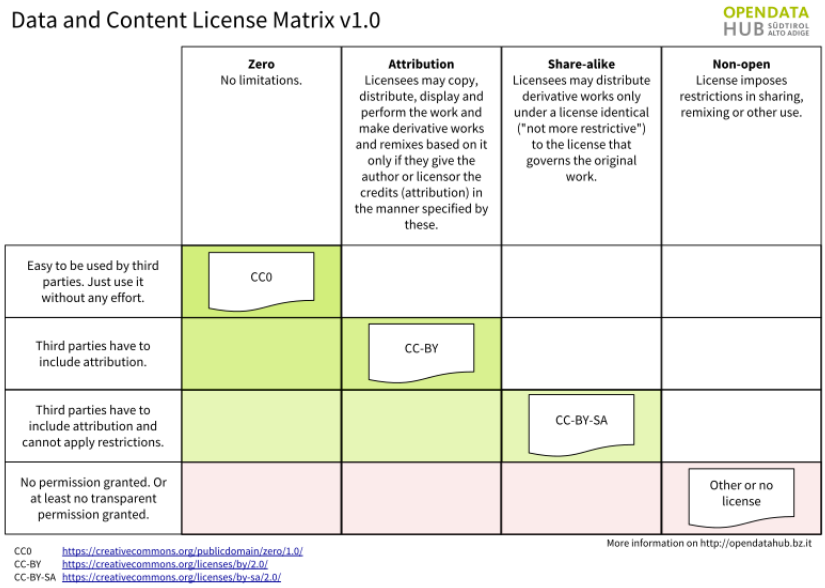


Figure 3.2: Creative Common Licenses and derivative material.

3.2.4 License of the JSON Responses

Whenever you query the data in the Open Data Hub, the snippet that you retrieve always includes a block of information called `LicenseInfo`, similar to the following one:

```
{
   "LicenseInfo": {
     "Author": "",
       "License": "CC0",
       "ClosedData": false,
       "LicenseHolder": "https://www.lts.it"
   }
}
```

The highlighted line shows a licence, which in this case is **CC0**, i.e., public domain and therefore freely reusable.

This block is always included as a child node within a JSON record that starts with an ID and a number of additional information, which may include also hyperlinks to resources that are external to the Open Data Hub, like in the following snippet–shortened for the sake of simplicity, which refers to a webcam and contains a link to an external provider where to find actual resources (e.g., streams and images) from that webcam.

```
{
  "Id": "D3659E1F111C4CDB2EC19F8FC95118B7",
  "Active": true,
  "Streamurl": null,
  "Webcamurl": "https://webtv.feratel.com/webtv/?&pg=5EB12424-7C2D-428A-BEFF-
↪0C9140CD772F&design=v3&cam=6323&c1=0",
  "LicenseInfo": {
    "Author": "",
    "License": "CC0",
    "ClosedData": false,
    "LicenseHolder": "https://www.lts.it"
```

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```
11    }
12  }
```

Whenever hyperlinks like the one shown in line **5** above appear, it must not be implied that the license mentioned in the `LicenseInfo` block (again, CC0) is applied to them: everything contained in that link may be covered by a different licence.

Indeed, the **Licence** mentioned in `LicenseInfo` nodes refer only to content of the parent node–i.e., the one that starts with **"Id"**, not to the content of any of the other children nodes, including `Streamurl` and `Webcamurl`.

3.2.5 APIs Terms of Service

The Open Data Hub project is already used in production for NOI internal projects, and in particular it is the data hub used by the South Tyrolean tourism portal, https://www.suedtirol.info/en/.

The public API are in early development and therefore should be still considered as a **beta** version. If any third party would like to use a stable version of the APIs in its production environment, a special agreement must be signed with NOI techpark. You can contact help@opendatahub.com for any information.

3.2.6 Authentication

The authentication layer is currently intended for **internal use only**. All data in the dataset that you can receive from the Open Data Hub are free to use and do not require any type of authentication.

3.3 Datasets

Changed in version 2022.06: API v1 for Mobility domain are no longer available.

Changed in version 2022.10: Removed information about datasets

The list of datasets and all the information associated with them have been moved to the Open Data Hub main web site with the same categorisation, hence you can find them in the following pages:

- Mobility / Mobility datasets
- Mobility / Traffic datasets
- Tourism datasets
- Other datasets.

To access the dataset, please refer to the *How to Access Mobility Data With API v2* and *How to access Tourism Data?* howtos, which helps you getting started in retrieving data from the Mobility and Tourism datasets, and to the other howtos are available in the *dedicated section*.

Technical Information for Mobility Dataset and *Technical Information for Tourism Dataset* are still available in this documentation portal.

3.3.1 Technical Information for Mobility Dataset

This section contains detailed technical information shared by the datasets in the Mobility domain. The purpose of this section is manifold:

- To understand what output is received as result of a query and its structure–see *The JSON Response Schema*
- To know which methods are available to gather data from the domains via the API calls–see *Structure of the API calls and Payload*
- To learn how to improve responses by tweaking queries using SELECT, and WHERE clauses, logical operators, and parameters.–see *Advanced Data Processing*

The JSON Response Schema

We recall that every query to the mobility datasets will return a JSON-structured file with a number of information about one station (or more) and values it collected over time, both real-time and historical data.

The overall structure of the JSON is the following:

```
"offset": 0,
"data": [],
"limit": 200
```

Here, *offset* and *limit* are used for limiting the displayed results. The three keys have the following meaning:

- *limit* gives the maximum number of results that are included in the response. It defaults to **200**.

  Hint: By setting the value to **-1**, *limit* will be disabled and all results will be shown.

- *offset* allows to skip elements from the result set. The default is **0**, i.e., the results start from the first one.
- *data* is the actual **payload** of the response, that is, the data answering the query; since it changes depending on which API call/method is used, it will be described in the next section.

Hint: It is possible to simulate pagination when there are many results: for example, if there are **1000** values, by adding to successive queries the offsets **0**, **200**, **400**, **600**, and **800**, the response of the query is split on 5 pages of 200 results each.

Structure of the API calls and Payload

In the Mobility domain, there are different general methods that can be used to extract data from the Open Data Hub's datasets and allow to incrementally refine the data retrieved. They are:

1. `/v2/` gives the list of the Open Data Hub's entry points, that is, the possible representations of the data contained in the datasets. to be used in the next methods. See *the details below*.
2. `/v2/{representation}/` shows all the StationTypes available, that is, all the sources that provided data to the Open Data Hub.
3. `/v2/{representation}/{stationTypes}` returns data about the stations themselves, including metadata associated with each, and data about its parent stations, if any.
4. `/v2/{representation}/{edgeTypes}` returns data related to the *edges* and their parts, and is very similar to the previous call.

5. `/v2/{representation}/{stationTypes}/{dataTypes}`. In addition to the data of the previous call, it contains the data types defined in the dataset.
6. `/v2/{representation}/{stationTypes}/{dataTypes}/latest`. In addition to all the data retrieved by the previous call, this call retrieves also the most recent measurement. This method is especially suited for real time retrieval of data.
7. `/v2/{representation}/{stationTypes}/{dataTypes}/{from}/{to}`. All the data retrieved by method #3, but limited to a given historical interval (`from` … `to`).

Note: The interval is *half-open*, i.e., [*from*, *to*), meaning that the *from* date is **included** in the result set, while the *to* date is **excluded**.

Representation types

The first method described in the previous list introduces the available entry points to the API v2: the types of *representation* that can be used to browse or access the data provided by the Open Data Hub Team

The *representation* consists now of a pair of comma-separated keywords composed of:

1. the already existent *flat* or *tree* AND
2. either *node* and *edge*

In both the **flat** and **tree** representations, all the metadata and available data are shown and browsable, the difference being that in *flat*, while *tree* keeps the hierarchical structure of the metadata.

The *node* and *edge* describe a `StationType` and the connection between two `StationTypes`, respectively.

Flat

In the *flat* representation, all metadata and available data can be accessed and browsed. However, no hierarchy appears and data and metadata are shown at the same level.

Tree

In the *tree* representation, all metadata and available data can be accessed and browsed as in *flat*, but in this case, any hierarchy of data or metadata is preserved and shown.

Node

A node is a measurement station and contains all metadata associated to it. The **node** representation corresponds to the *old* (pre-2020.10) output of the API calls, therefore it can safely be omitted for backward compatibility. As an example, valid for all methods listed in the *previous section*, these API calls are equivalent.

```
/v2/tree,node/{stationTypes}
```

```
/v2/flat,node/{stationTypes}
```

```
/v2/tree/{stationTypes}
```

```
/v2/flat/{stationTypes}
```

Note: While only **available** nodes are exposed by the Open Data Hub, the resulting JSON response might still include the *savailable* field, short for station available.

Edge

An Edge is a connection between two stations, improved with additional information, including some descriptive field and geometries that describe the connection on a map. Internally, an edge is composed of three parts (all calles *stations*):

a start station (beginning of the edge), an end station and a station describing the edge. Whenever retrieving an Edge, all metadata referring directly to it begin with *e*, like for example *eactive*, *eavailable*, and so on.

Note: While only **available** edges are exposed by the Open Data Hub, the resulting JSON response might still include the *sbavailable*, *seavailable* and *eavailable* fields, referring to start station, end station, and edge description, respectively.

Moreover, there are neither measurements nor types associated with edges.

Valid combinations are therefore: *flat,node*; *tree,node*; *flat,edge*; *tree,edge*; if neither *node* or *edge* are provided, the default **node** will be used.

An additional representation is *apispec*, which allows to see and reuse the API specification in an OpenAPI v3 YAML format, suitable for swagger-like access to the data.

In the reminder of this section we show examples of some of the above mentioned API methods and describe the outcome, including the various keys and types of data returns by the call.

/v2/{representation}/{stationTypes}

To describe the outcome of this method in details, we will use the following snippet.

Listing 3.1: An excerpt of information about a charging station.


```
 {
"pactive": false,
"pavailable": true,
"pcode": "AER_00000005",
"pcoordinate": {
  "x": 11.349217,
  "y": 46.499702,
  "srid": 4326
},
"pmetadata": {
  "city": "BOLZANO - BOZEN",
  "state": "ACTIVE",
  "address": "Via Cassa di Risparmio  - Sparkassenstraße 14",
  "capacity": 2,
  "provider": "Alperia Smart Mobility",
  "accessType": "PUBLIC",
  "paymentInfo": "https://www.alperiaenergy.eu/smart-mobility/punti-di-ricarica.html",
  "municipality": "Bolzano - Bozen"
},
"pname": "BZ_CASSARISP_01",
"porigin": "ALPERIA",
"ptype": "EChargingStation",
"sactive": false,
"savailable": true,
"scode": "AER_00000005-1",
"scoordinate": {
  "x": 11.349217,
  "y": 46.499702,
  "srid": 4326
```


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```
30    },
31    "smetadata": {
32      "outlets": [
33        {
34          "id": "1",
35          "maxPower": 22,
36          "maxCurrent": 31,
37          "minCurrent": 0,
38          "hasFixedCable": false,
39          "outletTypeCode": "Type2Mennekes"
40        }
41      ],
42      "maxPower": 7015,
43      "maxCurrent": 31,
44      "minCurrent": 6,
45      "municipality": "Bolzano - Bozen",
46      "outletTypeCode": "IEC 62196-2 type 2 outlets (all amperage and phase)"
47    },
48    "sname": "BZ_CASSARISP_01-253",
49    "sorigin": "ALPERIA",
50    "stype": "EChargingPlug"
51  }
```

You immediately notice that all the keys in the first level start either with a **p** (*pactive*, *pcoordinate*, and so on) or an **s** (*sactive*, *scoordinate*, and so on): the former, **p**, refers to data about the *parent* stations, **s** to data of the station itself. Besides the initial *p* or *s*, the meaning of the key is the same. In the snippet above, you see that all the data about a station are grouped together and come after the data of its parent (see lines.

The meaning of the keys are:

- **active**: the station is actively sending data to the Open Data Hub. A station is automatically marked as not active (i.e., `pactive` = false) when it does not send data for a given amount of time (24 hours).
- **available**: data from this station is available in the Open Data Hub.

Note: *active* and *available* might seem duplicates, but a station can be available but not active or vice-versa: In the former case, it means that its historical data have been recorded and can be accessed, although it currently does not send any data (for example, due to a network error or because it is not working or because it has been decommissioned); in the latter case, the station has started to send its data but they are not yet accessible (for example, because the are still being pre-processed by the Open Data Hub).

- **code**: a unique **ID**entifier
- **coordinate**: the station's geographical coordinates
- **metadata**: it may contain any kind of information about the station and mostly depends on the type of the station and the data it sends. In the snippets above, lines 10-16 contain information about the location of a charging station, while lines 28-38 technically describe the type of plugs available to recharge a car.

Hint: The metadata has only one limitation: it must be either a JSON object or `NULL`.

- **name**: a (human readable) name of the station

- **origin**: the *source* of the station, which can be anything, like for example the name of the *Data Providers*, the spreadsheet or database that contained the data, a street address, and so on.
- **type**: the type of the station, which can be a MeteoStation, TrafficStation, EChargingPlug, Bicycle, and so on.

Note: The name of the StationType is **Case Sensitive**! You can retrieve all the station types with the following API call.

```
~$ curl -X GET "https://mobility.api.opendatahub.com/v2/tree" -H "accept:␣
↪application/json"
```

/v2/{representation}/{stationTypes}/{dataTypes}/latest

This API call introduces two new prefixes to the keys, as shown in Listing 3.2.

Listing 3.2: An excerpt of information about a charging station.

```
{
   "tdescription": "",
   "tmetadata": {},
   "tname": "number-available",
   "ttype": "Instantaneous",
   "tunit": "number of available vehicles / charging points",

   "mperiod": 300,
   "mtransactiontime": "2018-10-24 01:05:00.614+0000",
   "mvalidtime": "2020-05-01 07:30:00.335+0000",
   "mvalue": 1,
}
```

The new prefixes are **t** and **m**. The *t* prefix refers to **Data Types**, i.e., how the values collected by the sensors are measured. See below for a more detailed description of data types and some tip about them. The *m* prefix refers to a **measurement**, that is, how often the data are collected, timestamp of the measure, when it is transmitted to be stored, and other information.

Alongside all keys present in Listing 3.1 (see *previous section*), Listing 3.2 contains the additional key:

- **ttype**: the type of the data, which can be expressed as either a custom string, like in the example above, or as a DB function like COUNT, SUM, AVERAGE, or similar
- **tunit** the unit of measure
- **mperiod**: the time in seconds between two consecutive measures
- **mtransactiontime**: timestamp of the transmission of the data to the database
- **mvalidtime**: timestamp of the measurement. It is either the moment in time when the measurement took place or the time in the future in which the next measure will be collected.
- **mvalue**: the absolute value of the measure, represented in either *double precision* or *string* format. It must be paired with the *t* keys to understand its meaning.

Listing 3.2 represents an *EChargingStation* with one available charging point; the last measure was taken on *2020-05-01 07:30:00.335+0000* and will be repeated every 5 minutes (*300* seconds). Moreover, the station appears to not transmit its data anymore, so historical data might not be available.

Data types in the datasets.

Data types are not normalised; that is, there is no standard or common unit across the datasets. Indeed, each data collector defines its own data types and they may vary quite a lot from one dataset to another. There is also neither a common representation format for data types, therefore a same unit can appear quite different in different datasets. For example, to express *microseconds*, one dataset can use

```
"tdescription": "Time interval measured in microseconds",
"tmetadata": {},
"tname": "Time interval",
"ttype": "Instantaneous",
"tunit": "ms",
```

While another:

```
"tdescription": "Microseconds between two consecutive measures",
"tmetadata": {},
"tname": "Time interval",
"ttype": "COUNT",
"tunit": "milliseconds",
```

We can see that, although we might understand that the measures from the two datasets are indeed expressed in milliseconds, this is not true for machine-processed data

`/v2/{representation}/{stationTypes}/{dataTypes}/{from}/{to}`

This method does not add any other keys to the JSON response; all the keys described in the previous two section are valid and can be used.

Advanced Data Processing

Before introducing advanced data processing techniques, we recall that queries against the Open Data Hub's datasets always return a **JSON** output.

Advanced processing allows to build SQL-style queries using the `SELECT` and `WHERE` keywords to operate on the JSON fields returned by the calls described in the previous section. `SELECT` and `WHERE` have the usual meaning, with the former retrieving data from a JSON field, in the form of `SELECT=target[,target,...]`, and the latter retrieving records from the JSON output, using the `WHERE=filter[,filter,...]` form, with an implicit **and** among the filters, therefore evaluation of the filters takes place only if all filters would individually evaluate to **true**.

The `SELECT` Clause

In order to build select clauses, it is necessary to know the structure of the JSON output to a query, therefore we illustrate this with an example with the following excerpt from the Parking dataset that represents all data about one parking station:

```
{
  "sactive": false,
  "savailable": true,
  "scode": "102",
  "scoordinate": {
```

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```
    "x": 11.356305,
    "y": 46.496449,
    "srid": 4326
  },
  "smetadata": {
    "state": 1,
    "capacity": 233,
    "mainaddress": "Via Dr. Julius Perathoner",
    "phonenumber": "0471 970289",
    "municipality": "Bolzano - Bozen",
    "disabledtoiletavailable": true
  },
  "sname": "P02 - City parking",
  "sorigin": "FAMAS",
  "stype": "ParkingStation"
}
```


You see that there are two hierarchies with two levels in the snippet: *scoordinate* and *smetadata*; to retrieve only data from them we will use the *select* clause with the `/v2/{representation}/{stationTypes}` call; you can therefore:

- retrieve only the metadata associated with all the stations; the select clause would be: `select=smetadata`
- retrieve all the cities in which there are ParkingStations with `select=smetadata.municipality`
- retrieve all cities and addresses of all ParkingStations: `select=smetadata.municipality,smetadata.mainaddress`

The latter two examples show that to go down one more step into the hierarchy, you simply add a dot (".") before the attribute in the next level of the hierarchy. Moreover, you can extract multiple values from a JSON output, provided you separate them with a comma (",") and use **no empty spaces** in the clause. In the above examples, each of the element within parentheses–`smetadata`, `smetadata.municipality`, and `smetadata.mainaddress`-- is called **target**.

Within a `SELECT` clause, SQL functions are allowed and can be mixed with targets, allowing to further process the output, with the following limitations:

- Only *numeric* functions are allowed, like e.g., `min`, `max`, `avg`, and `count`
- **No** string selection or manipulation is allowed, but left as a post-processing task
- When a function is used together with other targets, these are used for grouping purposes. For example: `select=sname,max(smetadata.capacity),min(smetadata.capacity)` will return the parking lots with the highest and lowest number of available parking spaces.

The `WHERE` Clause

The `WHERE` clause can be used to define conditions to filter out unwanted results and can be built with the use of the following operators:

- *eq*: equal
- *neq*: not equal
- *lt*: less than
- *gt*: greater than
- *lteq*: less than or equal
- *gteq*: greater than or equal

- *re*: regular expression
- *ire*: case insensitive regular expression
- *nre*: negated regular expression
- *nire*: negated case insensitive regular expression
- *bbi*: bounding box intersecting objects (ex., a street that is only partially covered by the box)
- *bbc*: bounding box containing objects (ex., a station or street, that is completely covered by the box)
- *in*: true if the value of the target can be found within the given list. Example: *name.in.(Patrick,Rudi,Peter)*
- *nin*: False if the value of the target can be found within the given list. Example: *name.nin.(Patrick,Rudi,Peter)*
- *and(filter,filter,...)*: Conjunction of filters (can be nested)
- *or(filter,filter,...)*: Disjunction of filters (can be nested)

As an argument to the *filter*, it is possible to add either a single value or a list of values; in both cases, operators are used to determine a condition and only items matching all of the filters will be included in the answer to the query (implicit *AND*). Like in the case of SELECT clauses, multiple comma-separated conditions may be provided. As an example, the following queries use a value and a list of values, respectively:

- `where=smetadata.capacity.gt.100` returns only parking lots with more than 100 parking spaces
- `where=smetadata.capacity.gt.100,smetadata.municipality.eq."Bolzano - Bozen"` same as previous query, but only parking lots in Bolzano are shown.

In these two examples we use a number in the filter (i.e., gt.**100**), which is by default automatically recognised as a number and the required math is calculated out of the box. In case there is a query in which you use a number, but need to consider it as a string, you need to use double quotes, like gt.**"100"**.

Logical Operators

Besides the operators described in section *The WHERE Clause*, Open Data Hub supports the use of logical operators `and` and `or` in the `WHERE` clause, like these examples show.

```
1 and(x.eq.3,y.eq.5)
2 x.eq.3,y.eq.5
3
4 or(x.eq.3,y.eq.5)
5 or(x.eq.3,and(y.gt.5,y.lt.10))
```

Logical operators are followed by a comma-separated list of *targets*, which can be filters (see previous section for some example), or other logical operators. In complex logical expression, parentheses are employed to assign precedence. Lines 1 and 2 above are equivalent, because the default logical operator is `and`.

The above example will be translated into Postgres as follows:

```
1 (x = 3 AND y = 5)
2 (x = 3 AND y = 5)
3
4 (x = 3 OR y = 5)
5 (x = 3 OR (y > 5 AND y < 10))
```

Additional Parameters

There are a couple of other parameter that can be given to the API calls and are described in this section.

shownull

In order to show **null** values in the output of a query, add `shownull=true` to the end of your query.

distinct

Results in query responses contain unique results, that is, if for some reason one element is retrieved multiple times while the query is executed, it will be nonetheless shown only once, for performance reasons. It is however possible to retrieve each single result and have it appear in the response by adding `distinct=true` to the API call.

> **Warning:** Keeping track of all distinct values might be a resource-intensive process that significantly rises the response time, therefore use it with care.

timezone

By default, the timestamp of the Open Data Hub responses is given in **UTC** time zone. The use of the `timezone` parameter allows to modify the timestamp whenever desirable. To use it, simply append the parameter to your API call.

```
/flat/ParkingStation/occupied/latest?timezone=UTC-2
```

```
/flat/ParkingStation/occupied/latest?timezone=Europe/Rome
```

Note: As argument to the `timezone` parameter, you can use any allowed value in Java's Time zone implementation.

3.3.2 Technical Information for Tourism Dataset

This section contains detailed technical information shared by the datasets in the Tourism domain. The purpose of this section is manifold:

- To know which methods are available to gather data from the domains via the API calls–see *Structure of the API calls*
- To learn how to improve responses by adding filters to the queries.–see *Filters common to all datasets*
- Which kind of data are accepted by the API methods–see *Types of input data*

Structure of the API calls

In the Tourism domain, there are a few API calls that allow to extract the same type of data from the various datasets. Each of these calls can prove useful in different scenarios, depending on the data returned and is described in this section, in which the following conventions are used:

- `{Name}` is the (case sensitive!) name of the dataset you are currently working with, like for example `Accomodation`.
- `{Id}` is the unique identifier of an array within the dataset, i.e., an item of the dataset. It is usually the first key of the resulting JSON output of a query.

The calls defined for every datasets are:

- `/api/{Name}` Return the whole dataset.
- `/api/{Name}/{Id}` Return only item with given `{Id}`.
- `/api/{Name}Reduced` Return only the list of Ids and respective name of the items in the dataset. It is useful to create lists of items or just to have an overview of the dataset's items.
- `/api/{Name}Changed` Return all items that have changed since date `YYYY-MM-DD`
- `/api/{Name}Types` Returns all types of data present in the dataset, that can be later used to ask more precise queries to the dataset.

The following calls have been **removed** and can not be used anymore. They have been replaced by a new filter, called *language*, that operates on the datasets in a similar way to the *The fields Filter* and is described in section *The language Filter*.

- ~~/api/{Name}Localized Return the whole dataset in only the given language (which is a mandatory part of the query)~~
- ~~/api/{Name}Localized/{Id} Return only item with given Id an in given language.~~

Filters common to all datasets

Note: Besides the filters available globally, for each dataset several additional filters are available. They are described in the respective swagger interface.

Filters are used within a dataset and their primary purpose is to limit the result set according to specific parameters, although they might not be available in every API call. Information about default values can be found for each datasets in the swagger interface of the API. Some examples of their use can be found in section *Quick and (not-so) Dirty Tips for Tourism (AKA Mini-howtos)*.

- **Seed** is used to set pagination. See tip *TT3*.
- **Locfilter** is a composed parameters that uniquely identifies a location within South Tyrol. See example *EX2* for a detailed example.
- **Latitude** and **Longitude** are used to identify the (absolute) positioning of a location, point of interest, event, or any other type of object. They must be entered in decimal form
- **Radius** it is the distance in meter prom a geographical point. It can be used together with latitude and longitude to broaden the search for an object. The results are automatically *geosorted*, that is, they are listed from the nearest to the most far away from the selected point. The distance is calculated as the crow flies.
- **IdFilter** allows to extract from the dataset only the items with the given IDs, separated with a `,`.

- **Active** and **OdhActive**. Filters with the same name, with one prefixed by **Odh** refer to the same parameter. The difference is however important: **Active** indicates that the item is present in the original dataset provided, while **OdhActive** shows that the item has been verified by the Open Data Hub team and is present in the Open Data Hub. See discussion in tip *TT2*.
- **ODHTag** allows to filter a result set according to tag defined by the Open Data Hub team. These tags are mostly related with places to see, activities that can be carried out in winter or summer, food and beverage, cultural events and so on

Special common filters

This section describes some useful filters that can be used on all Tourism Datasets. Some of them relies on simpler filters, like *field*, that is described in the *The fields Filter* section below. These filters allow to customise queries and have been introduced for all cases for which there is no existent filter or sorting possibilities.

rawfilter

rawfilter can be appended to any query with the syntax `?rawfilter=<filter(s)>`, in which <filter> has the generic form `<field>, <value>`. These logical operators can be used to combine multiple filters: *eq*, *ne*, *gt*, *ge*, *lt*, *le*, *and*, *or*, *isnull*, *isnotnull*, *in*, *nin*

rawsort

rawsort can be used to sort in ascending order the results of a query; its syntax is `?rawfilter=<filter(s)>`. Here, <*filter*> is the name of a field in the result set. Multiple fields can be specified as comma separated, e.g., `?rawfilter=startDate,Detail.en.Title`. If a <*filter*> is prefixed with a dash, - sorting is reverted, i.e., output is shown in descending order.

removenullvalues

`?removenullvalues=true` removes all **NULL** values from the query's output. While usually it's always desirable to have a full JSON output to be parsed, removing NULL values proves useful to reduce the output size or to verify data quality. By using `removenullvalues`, one can check if all fields of a given entry are populated or not.

The *fields* Filter

A recently added filter is the **fields** filter, which allows to add to a REST request a parameter that can act on multiple keys of a dataset entry, selecting only the entries which have a corresponding value in the dataset. In other words, the purpose of this filter is to retrieve only relevant information from each item in the datasets and strip down information that is not needed or not necessary to the purpose of the query. The *fields* filter can be used on single-valued parameters as well as on dictionary fields.

Lets take as example the *ODHActivityPOI* dataset and its swagger interface https://tourism.api.opendatahub.com/#/ODHActivityPoi; the same approach can be used with other datasets by simply replacing the datasets' name in the URL.

The following query will retrieve from the dataset only those item which have a **Type** and a strong:*Active* keys defined in the dataset:

```
https://tourism.opendatahub.com/api/ODHActivityPoi?fields=Type,Active
```

The following query retrieves information from within a dictionary field:

```
https://tourism.opendatahub.com/api/ODHActivityPoi?fields=Detail.en.Title
```

In particular, all items which have a *Title* in *en*glish within the *Detail* will appear in the result set of this query.

To show how it works, the following excerpt from the dataset shows how to discover the **Detail.en.Title** elements:

```
"Detail": {
  "en": {
    "Title": "01 Cross Country Stadio Track Dobbiaco/Toblach",
    "Header": null,
```

The *language* Filter

The *language* filter can be seen as a special case of the more generic *fields* filter, described in the previous section, and is similar to the second example presented there.

The *language* filter is used to retrieve only the data stored in one of the languages supported by the Open Data Hub. Let's build on the example of previous section and use the *ODHActivityPOI* dataset. The following query will retrieve all the data in the dataset that have some information stored in English:

```
https://tourism.api.opendatahub.com/v1/ODHActivityPoi?language=en
```

Most of the data in the Open Data Hub datasets are available in three languages, English, German, and Italian, for which `en`, `de`, and `it` can be used as value of the *language* filter. Additional language in which data may be available are: Dutch (`nl`), Czech (`cs`), Polish (`pl`), French (`fr`), and Russian (`ru`).

The *search* Filter

Currently available for only a limited number of datasets, namely Accommodations, Gastronomies, Events, Activities, Pois, ODHActivitiesPois, and Article, this filters allows to find whether the given string is contained in one of the field of the JSON response sent as answer to a query.

Exporting and saving data

Queries to the Open Data Hub datasets always return data in JSON format and can be saved in that format either from the browser or from the CLI, in the latter case by simply piping the output to a file. Additionally, it is mow possible to save data also in CSV (Comma Separated value) format.

> **Warning:** This feature is currently available only for the following datasets:
>
> Accommodation, Activity, Article, District, Event, Gastronomy, MetaRegion, Municipality, ODHActivityPoi, Poi, Region, SkiArea, SkiRegion, and TourismAssociation
>
> However, plans are to soon have all Tourism datasets support it.

Depending on how you access the data, there are different modalities to retrieve and save data in CSV format:

- when using a browser, append the keyword `&format=csv` to any query and you will be prompted to provide a name to the file that will contain the required data. Example:

  https://tourism.api.opendatahub.com/v1Activity?fields=Id,Detail.en.Title,ContactInfos.en.CompanyName&pagesize=500

  This query shows its JSON output on the screen. To save it, right click on the page and select *Save as*.

```
:apit:`Activity?fields=Id,Detail.de.Title,ContactInfos.de.CompanyName&pagesize=500&
↪format=csv`
```

Nothing is shown on screen, but a dialog window opens that allows you to select a name for the file and the directory where to save it.

- When using a CLI command to query the Tourism endpoint, replace the header that you send with the **curl** command:

```
~$ curl -X GET "https://tourism.api.opendatahub.com/v1/Activity?fields=Id,Detail.en.
↪Title,ContactInfos.en.CompanyName&pagesize=500" -H "accept: application/json"
```

The output of this query will be in JSON format.

```
~$ curl -X GET "https://tourism.api.opendatahub.com/v1/Activity?fields=Id,Detail.en.
↪Title,ContactInfos.en.CompanyName&pagesize=500" -H "accept: text/csv"
```

The output of this query will be in CSV format.

- When using an API Development Environment like Postman, add *accept: text/csv* to the Header of the request. See detailed procedure and screenshot can be found in the *Data Exporting* section of Postman's howto.

Types of input data

Since calls in the tourism domain are quite generic and revolve around a few common calls (see section *Structure of the API calls*), we showed a couple of filters that can be used to reduce the result set and make the query more precise. Depending on the type of filter, a different type of data must be entered to have a successful result, otherwise the filter will not match. In this section we show the most common types of data that should be provided, besides the common strings, dates, and integers.

Bitmask value
: A Bitmasks value is a kind of shorthand that can be entered in a filter to obtain results for different types of that filter's accepted values. Each of the accepted values has a code that is a power of two (1, 2, 4, 8, and so on), hence each sum of different codes produces a unique number. The advantage is that, instead of entering multiple strings that should be matched, you simply need to enter a number as a filter, that is the sum of the values' corresponding codes. See *Example 3*.

Lists
: A list is an (unordered) sequence of items. The available values are usually listed on the right-hand side of the filter, along with the separator, which is a **comma** (**,**). In a few cases, in which more lists are accepted as filter.

Compound values
: Compound values refer to those values that need a prefix before the type of value. See for example *Example2* for a deeper explanation and *Example 1* for a sample query that fails because a wrong compound value was supplied.

Language
: The descriptions of items in the dataset appear in three languages: Italian, German, and English. To retrieve values only in one language, enter **it**, **de**, or **en**, respectively.

CHAPTER

FOUR

LIST OF HOWTOS

This page contains the list of available howtos, divided into areas. The list of howtos, together with a short description is available here:

4.1 Mobility

1. *How to Access Mobility Data With API v2* Getting started with the new API v2.
2. *How to Access Analytics Data in the Mobility Domain* This howto guides you in browse and query data produces from the sensors used in the mobility domain.
3. How to access e-Charging Stations Data? This howto is deprecated and has been removed, please refer to *How to Access Mobility Data With API v2* if you are interested in accessing the mobility dataset.

4.1.1 How to Access Mobility Data With API v2

The new **API v2** (see *the description*) for the Mobility domain has simplified the access to data; among its features, we recall that there is now one single endpoint from which to retrieve data from all datasets.

The starting point for all actions to be carried out on the datasets made available by the Open Data Hub team is the swagger mobility API home page:

https://swagger.opendatahub.com/?url=https://mobility.api.opendatahub.com/v2/apispec

From this site, links provide access to documentation about data licencing and use of the API; it is also possible to contact the Open Data Hub team by sending an email to the issue tracker, to ask questions, provide feedback, or to report issues.

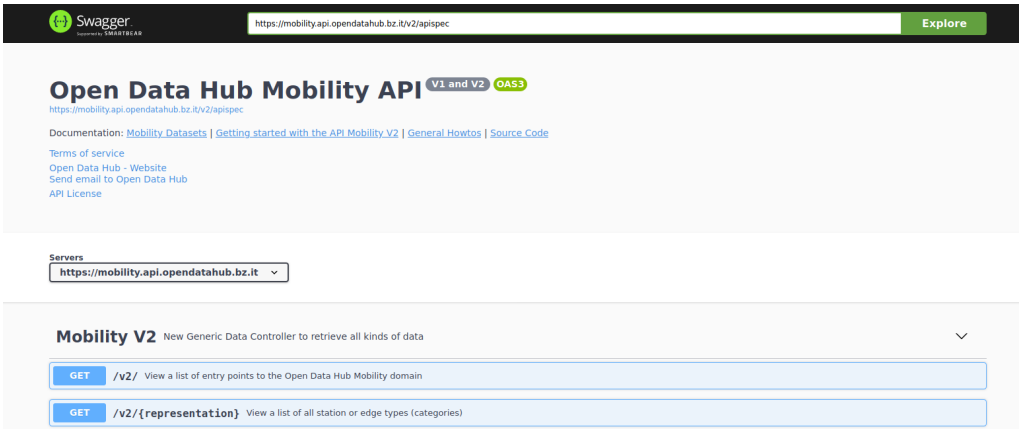

Figure 4.1: The swagger interface of the Mobility API v2.

When executing queries against the datasets, besides

the output data, you will always receive the *curl* command and the corresponding direct URL, to be used for examples, in scripts. See *Example Queries*

Getting Started

In the API v2, the central concept is **Station**: all data come from a given `StationType`, whose complete list can be retrieved by simply opening the second method of the **Mobility V2** controller, **/v2/{representation}**, then click on Try it out and then on *Execute*.

Station types in the resulting list can be used in the other methods to retrieve additional data about each of them. To check which station belongs to which datasets, you can check the list of *Datasets*.

Example Queries

We use some of the techniques presented in section *Advanced Data Processing* and the Parking dataset to show a few simple queries and see the output they provide.

We recall that the two `StationType`s of that datasets are *ParkingStation* and *ParkingSensor*; we start by retrieving all *ParkingStation*s, leaving all other options to their default values, and then building two more refined queries, one using the select clause and one using the where clause:

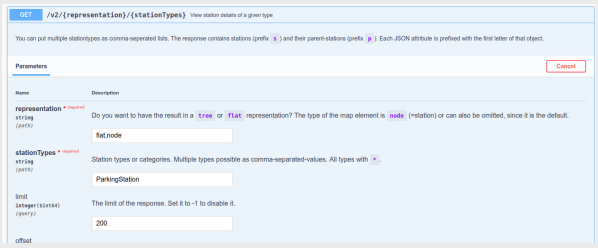

Figure 4.2: Querying all *ParkingStation*s.

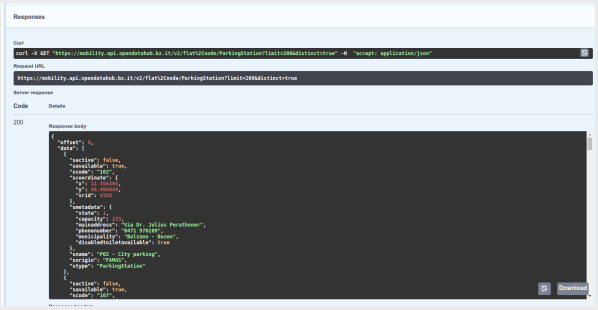

Figure 4.3: The Output of query.

Hint: You can copy to the clipboard or download the result of the query by clicking on the bottom-right corner icons.

If we would like to know the capacity of each of the parking lots, we add *smetadata.municipality, smetadata.mainaddress, smetadata.capacity* to the **select** clause:

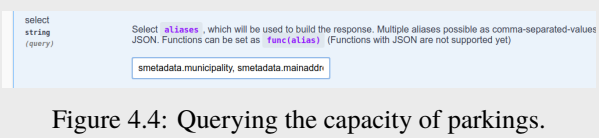

Figure 4.4: Querying the capacity of parkings.

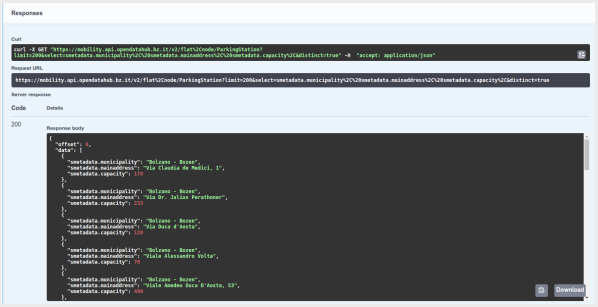

Figure 4.5: The Output of query.

Finally, we are interested only in the *ParkingStation*s whose origin is **not** FAMAS. We need therefore to add the following to the **where** clause (we also remove the entry added for the previous query in the **select** clause):

Figure 4.6: Non-FAMAS *ParkingStation*s.

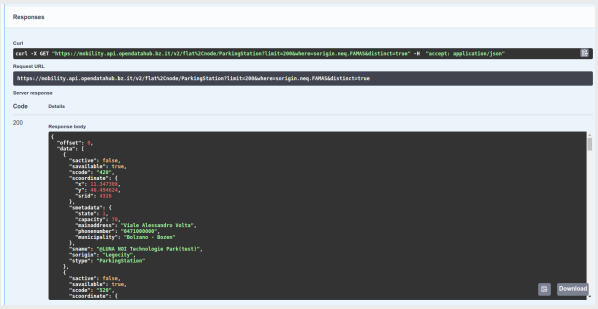

Figure 4.7: The Output of query.

You can build more complex queries by simply adding more entries to the Select and where clauses.

4.1.2 How to Access Analytics Data in the Mobility Domain

This howto guides you in browsing and querying data from the Mobility domain using the https://analytics.opendatahub.com/ web site.

Note: Access to data on this website is now possible by using R. See *the dedicated section* for information and directions.

Introduction

The website https://analytics.opendatahub.com/ gathers data from datasets in the mobility domain and uses them to draw two types of diagram: a *chart* using historical data and an interactive *map* that show where are located the sensors on the territory. The latter is the default landing page.

Charts

The charts page contains a number of options to show data, both historical and current, from the mobility domain. Data are gathered by sensors which are installed on various locations in South Tyrol and are operated and governed by different institutions or public and private companies. While the vast majority of the data comes from South Tyrol, there are datasets (including the E-mobility, weather, and traffic domain), which contain data about some neighbouring Italian provinces and regions.

While there are many controllers in the page, that allow to tweak the search parameter, the basic usage is quite simple and requires two steps:

1. Select a dataset to be added to the chart, from the drop-down menus below the diagram.
2. Restrict the data to be displayed to a date range, either a predefined one or a custom one.

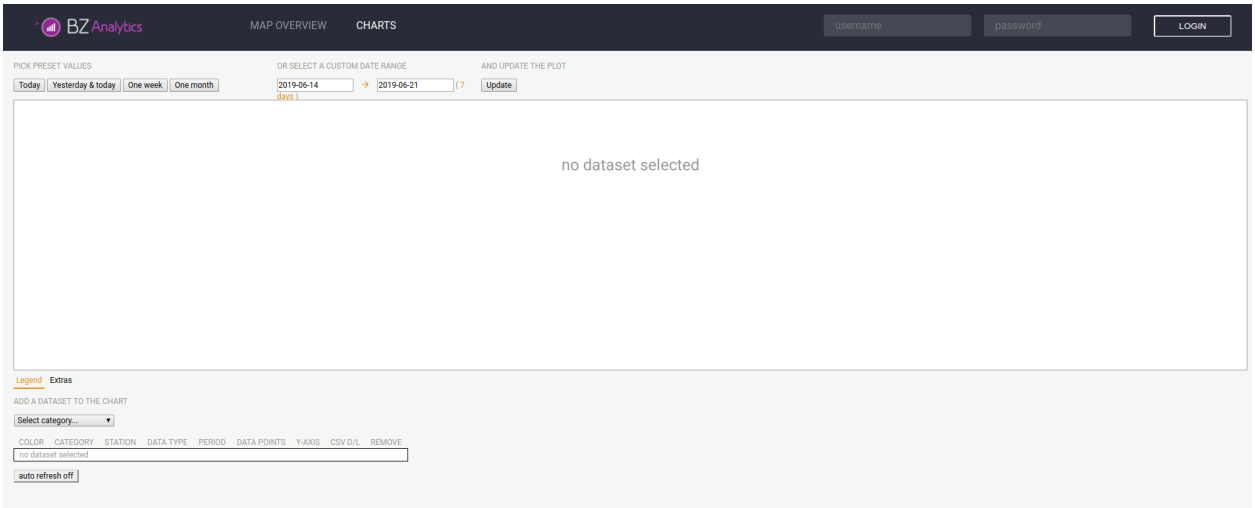

Figure 4.8: The landing page of analytics.mobility.bz.it.

A sample display from the weather datasets is shown in Figure 4.9, in which data from only one temperature sensor are used, and in Figure 4.9, using data from two temperature sensors.

Figure 4.9: Sample temperature diagram on Cima Presena.

Figure 4.10: Sample temperature diagram on Cima Presena and Cima Paganella.

Map Overview

In the map overview, there is a map, initially displaying only the South Tyrol region, with the list of available sensor types on the left-hand side. When clicking on one or more items, the position of all sensors will appear on the map, see Figure 4.11 for the parking lots available in the Trentino-South Tyrol region.

A signpost with a circled **+** indicates that there are more sensors around at that location; this is true especially when the map encompasses a large area, like e.g., the whole South Tyrol region. Therefore, by zooming in on the map, or by (repeatedly) clicking on the **+**, more signposts will appear, until the **+** either disappears or is replaced by a different sign: you have found the (unique) sensor at that location.

In the case of Parking data–and in a few other datasets, the **+** will be replaced by a green, yellow, or red circle, meaning that there are many, a few, or no free parkings in that lot.

For other types of sensors, the **+** simply disappears.

When clicking on a single sensors, a panel will appear on the right-hand side, containing a lot of information about that sensor, including its unique ID within the dataset, geographic coordinates. Additional information displayed depend on the dataset.

4.2 Tourism

1. *How to access Tourism Data?* Description of how to access and manipulate data, the input data used, and the various filters available in the Tourism domain.
2. *How to use the Open Data Hub's Tourism Data Browser?* Access to the open data provided within the Tourism domain.
3. *Quick and (not-so) Dirty Tips for Tourism (AKA Mini-howtos)* Mini howtos, tricks&tips, and use cases for data in the Tourism domain.
4. *How to access Open Data Hub AlpineBits Server as a client* access AlpineBits data

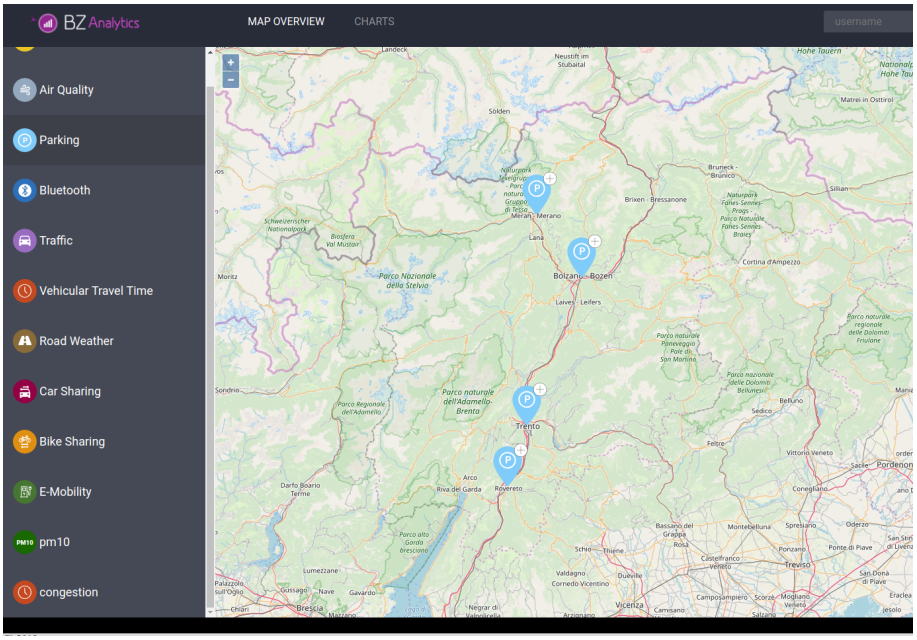

Figure 4.11: Map with parking lot signposts.

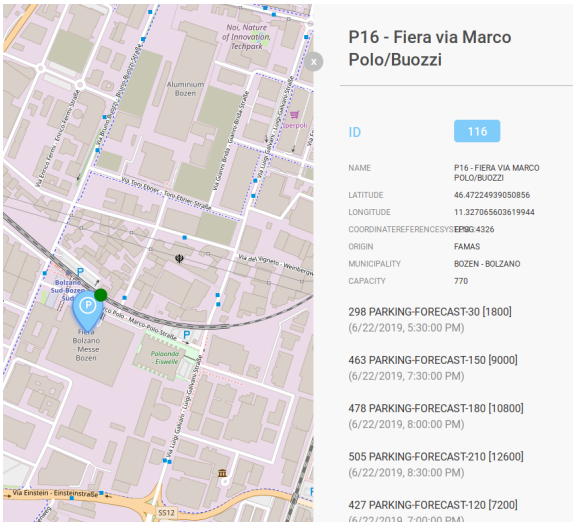

Figure 4.12: Details of a sensor.

4.2.1 How to access Tourism Data?

The purpose of this howto is to quickly introduce the alternatives to access datasets in the Tourism domain. Technical information about the datasets can now be found in section *Technical Information for Tourism Dataset*.

Swagger Interface

All the APIs available for the tourism domain can be accessed from the same URL through their Swagger user interface:

https://tourism.api.opendatahub.com/swagger/index.html

Hint: Check section *Datasets* for direct URLs to the datasets.

With the introduction on the Tourism API graphic interface of a newer swagger version, supplying and storing the token has become easier, making older procedures deprecated or obsolete. Moreover, in the new GUI, for every API method is shown whether it can provide Open Data as a result and if not, it will be necessary to authenticate.

Authentication with Swagger

Authentication is easy and, unlike it happened in the past, it does require only to supply your credentials. From the swagger UI, click on the **Authorize** button on the right-hand side of the page (shown in the bottom-right corner in Figure 4.13).

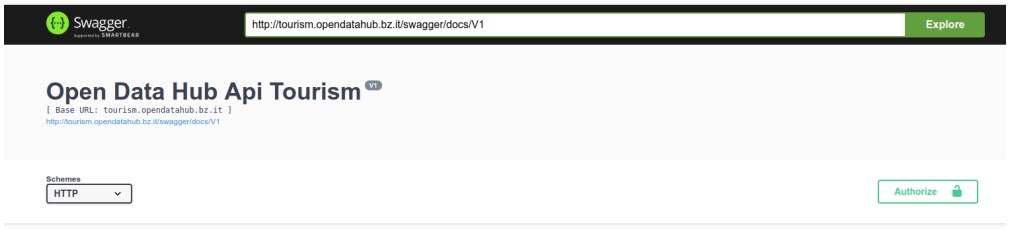

Figure 4.13: The new Swagger UI for Tourism domain.

A dialog window will pop up; here, supply your username and password, and click on **Authorize**. It is not necessary to change any other parameter.

Figure 4.14: Providing credentials for authentication.

After a few seconds a new dialog replaces the one used for authentication, whose most important bit is the **Authorized** word, that means you are now authenticated. No additional step is now necessary: the browser will remember the token. Click on **Close** to close the dialog window start browsing the Tourism data.

To log out, click again on **Authorize** in the Swagger UI (see Figure 4.13), then on **Logout**.

Figure 4.15: Successful authentication.

Browsing API Datasets

The data in the API can be browsed at the following URL:

https://tourism.api.opendatahub.com/v1/

Note: You may need to install a *JSON browser plugin* for your browser to browse the datasets in this way.

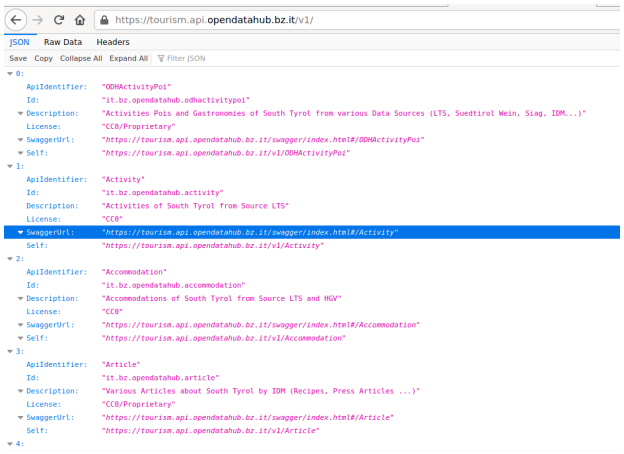

Figure 4.16: Browsing Tourism API

Here, every link can be clicked to navigate through the various datasets and the data they contain. A lot of metadata and information is provided for every object in the dataset, depending on the type of object. For example, The starting point to browse the API, shown in Figure 4.16 includes for each datas licensing information, a description, an ID, the API and swagger URLs, while a dataset shows the total number of items and of pages it contains, the current page, pointers to previous and next page, and the items themselves.

Using Command Line Tools

If you plan to access the API methods with command line tools like **`curl`** or **`wget`**, or only from scripts, you need to add an authentication header to each call. For example, using curl:

```
~# curl -X GET --header 'Accept: application/json' \
--header 'Authorization: Bearer vLwemAqrLKVKXsvgvEQgtkeanbMq7Xcs' \
'https://tourism.api.opendatahub.com/v1/Gastronomy'
```

Note: The string of the token is shortened for the sake of clarity.

It is important to mention that the authorisation header reaquires the following syntax: **Authorization: Bearer**, followed by the whole *string* of the token.

One you have retrieved the data, which come in JSON format, you can process and manipulate them with a tool like jq.

4.2.2 How to use the Open Data Hub's Tourism Data Browser?

This how-to explains the necessary steps to access and retrieve data from the Open Data Hub's tourism domain.

Data Browsing and Exploring

In order to access the data in the tourism domain, launch a browser and point it to https://databrowser.opendatahub.com/.

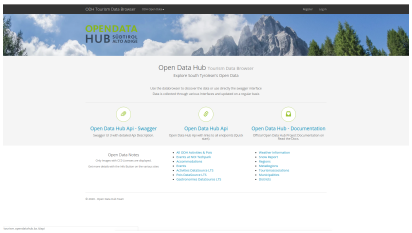

Figure 4.17: The home page of the Tourism Data Browser.

Under the header and an informative message, hyperlinks in the centre of the page allow to open various resources about the Tourism domain.

- The Swagger interface of the datasets, the quickest place from where to access the datasets and learn how to programmatically retrieve the data
- The Open Data Hub API, a browsable, hyperlinked interface over the data in the Tourism domain.

Note: Depending on the browser used to access the APIs, an extension might by needed for the JSON to be properly displayed and browsed. For example, on Chrome you should install https://github.com/callumlocke/json-formatter.

- The Official documentation of the Open Data Hub project

The bar at the top of the page allows to carry out a few actions:

- **ODH Open Data**. This drop-down menu allows to choose the dataset from which to browse the data. These can be reached also using the hyperlinks in the lower part of the home page.
- **Register**. This is currently not active, and redirects to *Log in*.
- **Log in**. Allows to access the data browser as a registered user, for example to add or edit some data. If you have access credentials, write the username (e-mail address) and password that were provided to you and click on Log in. You will be redirected to the home page as a logged in user and from here, you will see the box with the permissions you have to access the various datasets and be able to modify data.

When you access the **ODH Data** item in the top menu, you will be able to select a dataset among those available. As an example, Figure 4.18 shows what is available in the *ODH Open Data* → *Activities & Pois* → *Winter* filter - in this case a list of activities that can be done during the winter on the snow.

The page allows to further filter the results, by using search strings and/or the list of tags underneath, to move between pages of results, and to change language of the interface (although at the moment the page is not fully translated in all languages!)

If you click on the image associated to each item in the list or on the **Detail** button, an overlay will pop up, which contains more detailed information about that activity.

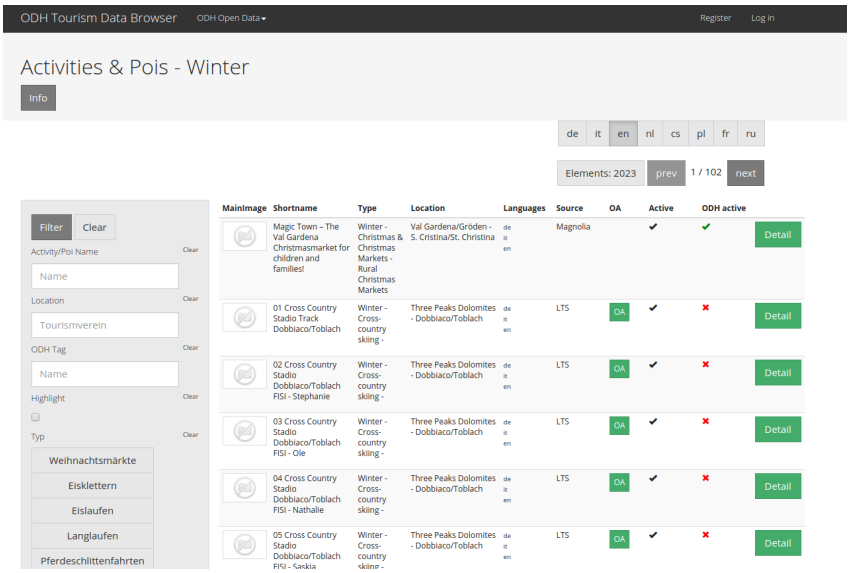

Figure 4.18: Accessing the data through filters or menu item.

Note: Images in the list are displayed only if they are uploaded with a CC0 license.

Logged in Users

When you access the Tourism Data Browser using credentials that have been provided to you by the Open Data Hub team, the appearance of the page slightly changes

In particular, at the bottom of the page a table with the user's role and permissions replaces the list of datasets, and an additional menu item (**external Data Sources**) appears in the top bar, allowing access to some more datasets.

4.2.3 Quick and (not-so) Dirty Tips for Tourism (AKA Mini-howtos)

This section contains various tips and tricks to improve and tweak the queries sent to the Tourism datasets, allowing more precise results to be retrieved. This page is divided into two parts: The first one shows examples with code (usually the API call), the second is organised like a FAQ section.

Example Calls

EX1. Why does this query return no result?

https://tourism.api.opendatahub.com/v1Gastronomy?pagesize=3&categorycodefilter=0&locfilter=reg268

Because there is no value **reg268** for *locfilter*. You can return valid IDs to be used as locfilter using this call:

https://tourism.api.opendatahub.com/v1RegionReduced?language=it

An example result for this call is:

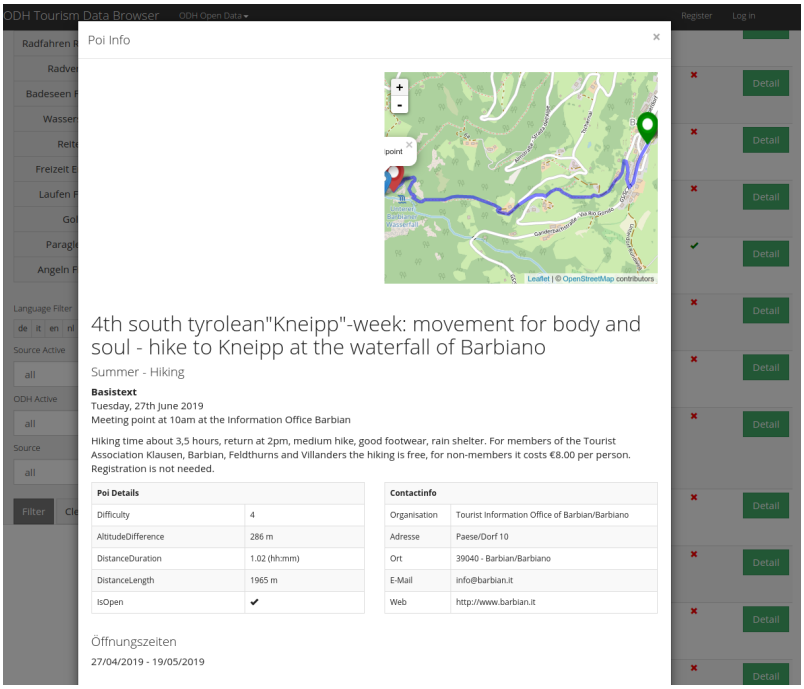

Figure 4.19: Detailed view of a POI (Point Of Interest).

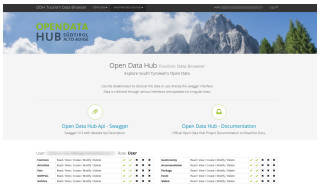

Figure 4.20: The home page after a successful login.

```
{
  "Id": "D2633A26C24E11D18F1B006097B8970B",
  "Name": "Alta Badia"
}
```

Therefore, use the ID **regD2633A26C24E11D18F1B006097B8970B** in *locfilter* to search for Gastronomy in the Alta Badia region.

EX2. The locfilter parameter.

Q: How do I correctly use the *locfilter* parameter?

```
locfilter =>
Locfilter (Separator ',' possible values: reg + REGIONID = (Filter by
Region), reg + REGIONID = (Filter by Region), tvs + TOURISMVEREINID =
(Filter by Tourismverein), mun + MUNICIPALITYID = (Filter by
Municipality), fra + FRACTIONID = (Filter by Fraction)),
(default:'null')
```

It seems to accept a string, but how is this string built?

A: *locfilter* accepts a string composed as follows: a region identifier, followed immediately by a location Identifier.

Location identifier are the following four:

- **reg**: Region (Italian Regione)
- **tvs**: Turistic association (German Tourismusverein)
- **mun**: Municipality, i.e., town or city (Italian Municipalità)
- **fra**: Suburb or district (Italian frazione)

IDs for each location can be gathered either from the swagger interface or using an API calls:

- **reg**:

  http://tourism.opendatahub.com/swagger/ui/index#!/Common/Common_GetRegionsReduced https://tourism.api.opendatahub.com/v1RegionReduced?language=it

- **tvs**:

  http://tourism.opendatahub.com/swagger/ui/index#!/Common/Common_GetTourismvereinReduced https://tourism.api.opendatahub.com/v1TourismAssociationReduced?language=iturismusverein)

- **mun**:

  http://tourism.opendatahub.com/swagger/ui/index#!/Common/Common_GetMunicipalityReduced https://tourism.api.opendatahub.com/v1MunicipalityReduced?language=it

- **fra**:

  http://tourism.opendatahub.com/swagger/ui/index#!/Common/Common_GetDistrictReduced https://tourism.api.opendatahub.com/v1DistrictReduced?language=it

For example, to retrieve all Gastronomy in the suburb of Lana, first retrieve its ID, which is:

```
{
  "Id": "79CBD79551C911D18F1400A02427D15E",
  "Name": "Lana"
}
```

Then pass the string **fra79CBD79551C911D18F1400A02427D15E** as *locfilter*:

https://tourism.api.opendatahub.com/v1Gastronomy?locfilter=fra79CBD79551C911D18F1400A02427D15E

EX3. The *categorycodefilter* parameter.

Q: *categorycodefilter* seems similar to the *locfilter* parameter found in *this trick*, but this does not accept string?

```
Category Code Filter (BITMASK values: 1 = (Restaurant), 2 = (Bar /
Café / Bistro), 4 = (Pub / Disco), 8 = (Apres Ski), 16 =
(Jausenstation), 32 = (Pizzeria), 64 = (Bäuerlicher Schankbetrieb),
128 = (Buschenschank), 256 = (Hofschank), 512 = (Törggele Lokale),
1024 = (Schnellimbiss), 2048 = (Mensa), 4096 = (Vinothek /Weinhaus /
Taverne), 8192 = (Eisdiele), 16348 = (Gasthaus), 32768 = (Gasthof),
65536 = (Braugarten), 131072 = (Schutzhütte), 262144 = (Alm), 524288 =
(Skihütte)
```

The *categorycodefilter* parameter accepts integers instead of strings, in *bitmask-value*. The code of each category is a power of 2, so to search in multiple categories, simply **add** the respective codes and pass them as value of the parameter. For example, to search for Restaurants (1) and Pizzerias (32), pass **33** to *categorycodefilter*:

https://tourism.api.opendatahub.com/v1Gastronomy?categorycodefilter=33

Tips and Tricks

TT1. Categorycodefilter in the Accomodation dataset.

Q: In the Accommodation dataset there's no *categorycodefilter* filter, like in the Gastronomy dataset. Is there some equivalent filter?

A: In the Accommodations dataset use **categoryfilter** instead.

TT2. *odhactive* and filters starting with *odh*.

Q: What is the purpose of the *odhactive* filter? And what do all the filters prefixed with **odh** stand for?

A: In the datasets, there are filters like *active* and *odhactive*, where *odh* simply stands for Open Data Hub. Filters starting with **odh** are collectively called *ODHtags*.

Datasets filtered with the former return all data sent by the dataset provider, while the latter returns those validated by the Open Data Hub team as well. This parameter is useful in a number of use cases. Suppose that the Open Data Hub team receives a dataset contains name and location of ski lifts within South Tyrol's ski areas. If the dataset has not been updated in a few years, some entry in that dataset might be non valid anymore, for example a ski lift has been replaced by a cable car or has been dismantled. If this case has been verified by the Open Data Hub team, the entry referring to that ski lift will not appear in the Open Data Hub.

TT3. The *seed* filter

Q: What is the *seed* filter used for?

A: *seed* is used in pagination, i.e., when there are two or more pages of results, to keep the sorting across all pages. When retrieving a high number of items in a dataset it is desirable to have only a limited amount of results in each page.

It is possible to activate seed in two ways: in the dataset, choose a pagenumber (the number of the result page that will be shown first) or a pagesize (number of items in each page, we'll use **15** in this example) and set seed to **0**. At the beginning of query's **Response Body** you will see something like:

```
 {
"TotalResults": 10564,
"TotalPages": 705,
"CurrentPage": 1,
"OnlineResults": -1,
"Seed": "43",
"Items": [
  {
```

The remainder of the **Response Body** contains the first 15 sorted items. If you now want to retrieve page 2, page 56, or any other, use **43** as seed and write **2**, **56**, or the desired value as pagenumber.

If you do not enter the **seed**, you could find an item that was already shown before, because the API can not guarantee that the same sorting is used in different queries.

4.2.4 How to access Open Data Hub AlpineBits Server as a client

In this howto, we show how to retrieve data from the AlpineBits Server endpoint for the Open Data Hub located at https://alpinebits.opendatahub.com/AlpineBits, by using the (Linux) command line–in particular the **`curl`** application, and the popular *Postman* API development environment. An example call can be seen *at the bottom* of this section.

Note: Alternative command line programs like **`wget`** can be used as well: simply adapt the parameters described in the remainder of this section.

The first important thing to mention is that requests to this endpoint need a **POST** method and an authentication token, therefore you should specify options `--request POST` and a header requiring *Basic* authorization and containing your token: `--header 'Authorization: Basic <your-email-address>'`

Note: While there is no authorization required to access the Open Data Hub AlpineBits Server, we strongly suggest you to insert as token your email address for debugging reasons. It will help trace your calls in the case you require support from the Open Data Hub Team.

Next, it is necessary to provide the correct *client protocol version* and a *client ID*, which are two additional headers, namely `--header 'X-AlpineBits-ClientProtocolVersion: 2017-10'` and `--header 'X-AlpineBits-ClientID: 'My test request'`.

Concerning the client protocol version, it must be one of the supported version mentioned in Table 4.1, which also shows the actions that can be used together with the protocol.

Table 4.1: Matrix of the protocol versions and supported actions in the AlpineBits implementation of the Open Data Hub.

Open Data Hub AlpineBits Server Actions	**2017-10** PUSH	**2017-10** PULL	**2018-10** PULL	**2018-10** PUSH
FreeRooms	Yes	No	Yes	No
GuestRequests	–	–	–	–
Inventory Basic	Yes	Yes	Yes	Yes
Inventory HotelInfo	Yes	Yes	Yes	Yes
RatePlans	–	–	–	–
BaseRates	–	–	–	–

Note that PUSH and PULL refer to the action of uploading to and downloading from AlpineBits Server, respectively.

Finally, to retrieve data from the AlpineBits Server, you need to set the correct content type (i.e., *multipart/form-data*) and provide an *action*. The content type is specified in another header by `--header 'Content-Type: multipart/form-data'`, while the action is given as a form: `--form 'action=getVersion'`.

Summing up what was described above, a call to the AlpineBits Server endpoint looks like the following one:

```
~# curl --location --request POST \
'https://alpinebits.opendatahub.com/AlpineBits' \
--header 'Authorization: Basic <your-token-here>' \
--header 'X-AlpineBits-ClientProtocolVersion: 2017-10' \
--header 'X-AlpineBits-ClientID: 'My test request' \
--header 'Content-Type: multipart/form-data' \
--form 'action=getVersion'
```

Here, you can see that the additional option `--location` is used, that will make sure to resend the request in case a **3xx** HTTP error code is received, i.e., if the requested resource has been moved.

Postman Setup

In Postman, you need to enter the same data as in the call shown in previous section. The Postman setup equivalent to that call is shown in the two screenshots.

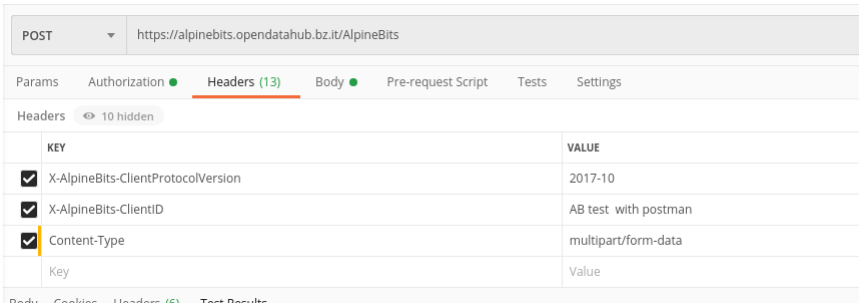

Figure 4.21: Definition of the call's headers.

In the headers you need to add all the parameters as in the curl version, except for the authentication: this option need to be specified in the *Authorization* tab of postman. Here, choose **Basic Auth** as type and use **someuser** and **secret** as username and password, respectively.

Note: It is suggested to use, instead of *someuser* and *secret*, your contact information, in order to be able to contact you for some technical reasons.

Next, you need to add, in Postman's *Body* tab, the `action`. Choose **form-data**, enter **action** as key and the name of the method to retrieve data, in our example **getVersion**.

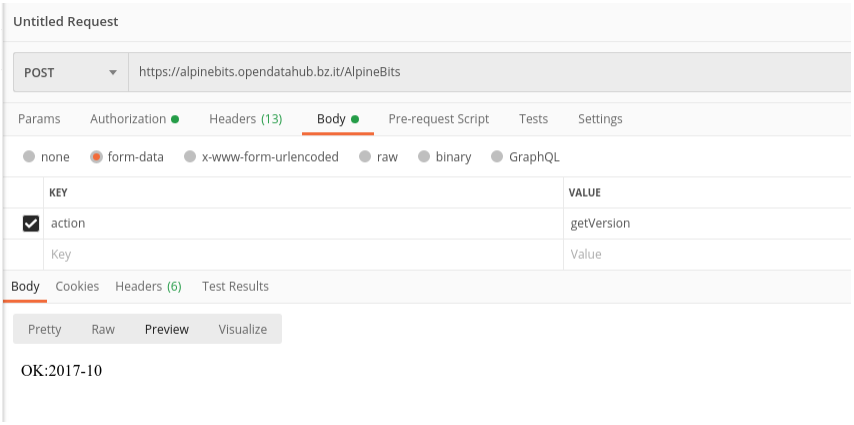

Figure 4.22: Definition of the *action* and the outcome of the call.

Once done, make sure to select **POST**, then click on Send and you will receive the result in the bottom part of Postman's window, like in Figure 4.22.

See also:

More information about the interaction with AlpineBits can be found in the official documentation, available at https://www.alpinebits.org/hoteldata/.

4.3 Generic HOWTOs

1. *How to use authentication?* Access to data that are not yet open (mostly for internal use).
2. *How to set up your local Development Environment?* Set up your workstation to develop for Open Data Hub–This tutorial is still in development and not so useful at the moment!
3. *GITHUB Quick Howto* get started with GitHub workflow
4. *How to set up Postman (API Development Environment)?* Setup of Postman, a popular API development environment, to access data from the Open Data Hub.
5. *How to insert and modify NOI Events?* Create and modify NOI events directly from the Open Data Hub portal.
6. *How to Publish your Web Component on the Open Data Hub Store* share your Web Components with Open Data Hub team
7. *How to Access Open Data Hub Data Using SPARQL* query Open Data Hub datasets using W3C's Query Language.
8. *How to Access Open Data Hub Data With R and SPARQL* query Open Data Hub datasets using R and its SPARQL library.

4.3.1 How to use authentication?

There are two methods to access protected data in the dataset: **Bearer Token Login** and **OAuth2 authentication**. Both authentication methods can be used within a browser or from the command line, with only slight differences.

Hint: The Open Data provided by the Open Data Hub can be freely accessed, authentication is meant only for internal use.

In this section we show how to use authentication within the Open Data Hub, provided that you own an username and a password to access the closed data in the datasets.

To obtain the credentials, please send an email to help@opendatahub.com. This action will open a support ticket that will be taken in charge by the Customer Support Team.

Bearer Token Login

Bearer token login is used to access the *Datasets*; description of the procedure is available at *Authentication with Swagger*.

OAuth2 authentication

OAuth2 authentication can be used in all the *Datasets* that are marked with the 

badge, so pick one dataset and go to its swagger interface, whose URL is provided together with the information of the dataset.

Note: As of Sep 29, 2023, authentication is not yet publicly available, so the following guidelines can not yet be put in practice.

If you use a browser

Make sure you have obtained a valid username and password, then open the **`/rest/refresh-token`** method and write you username and password in the two **user** and **pw** fields, respectively, as shown in Figure 4.23.

If your credentials are valid, you will receive a new token, otherwise the response will be a **401 Unauthorized** error message.

The token you received can be used in any of the API's methods that require authorisation. A sample call is shown in figure Figure 4.24. Note the syntax of the `Autorization` parameter: You must use prefix the authentication token with the **Bearer** string, followed by an empty space, then by the token.

In case you do not respect the Authorization+space+token sequence, use additional separators in the sequence (like Figure 4.25 shows), or use an invalid token, you will receive an **401 - Unauthorized** HTTP response.

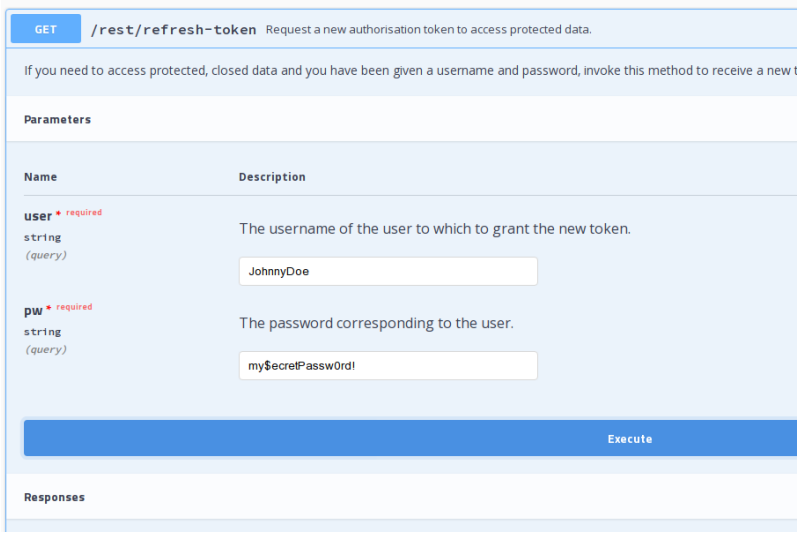

Figure 4.23: Request a new OAuth2 token.

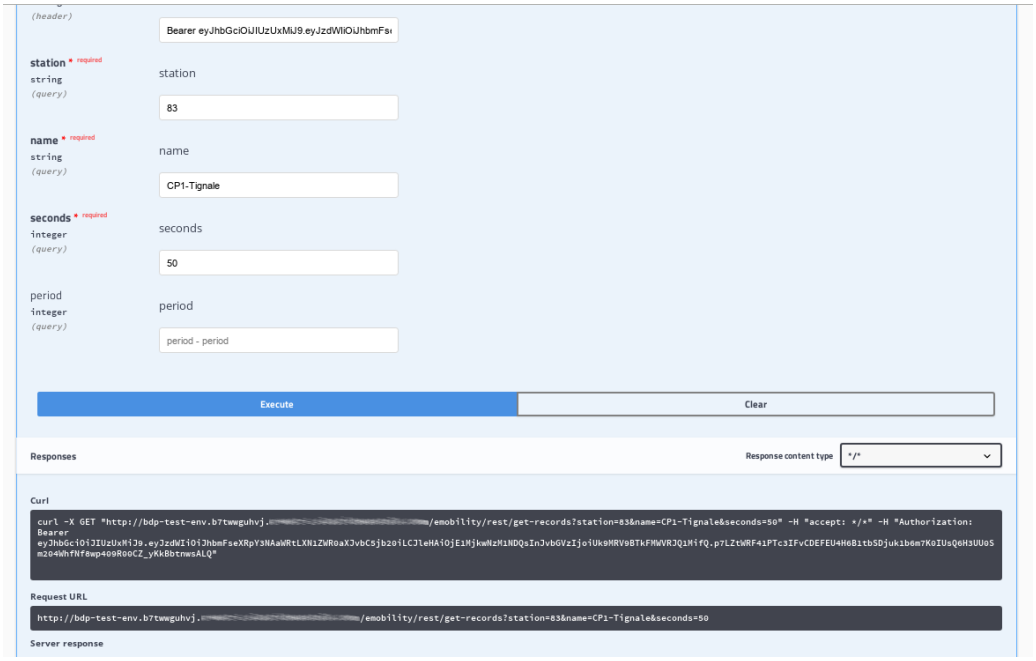

Figure 4.24: A successful call to a method requiring authentication.

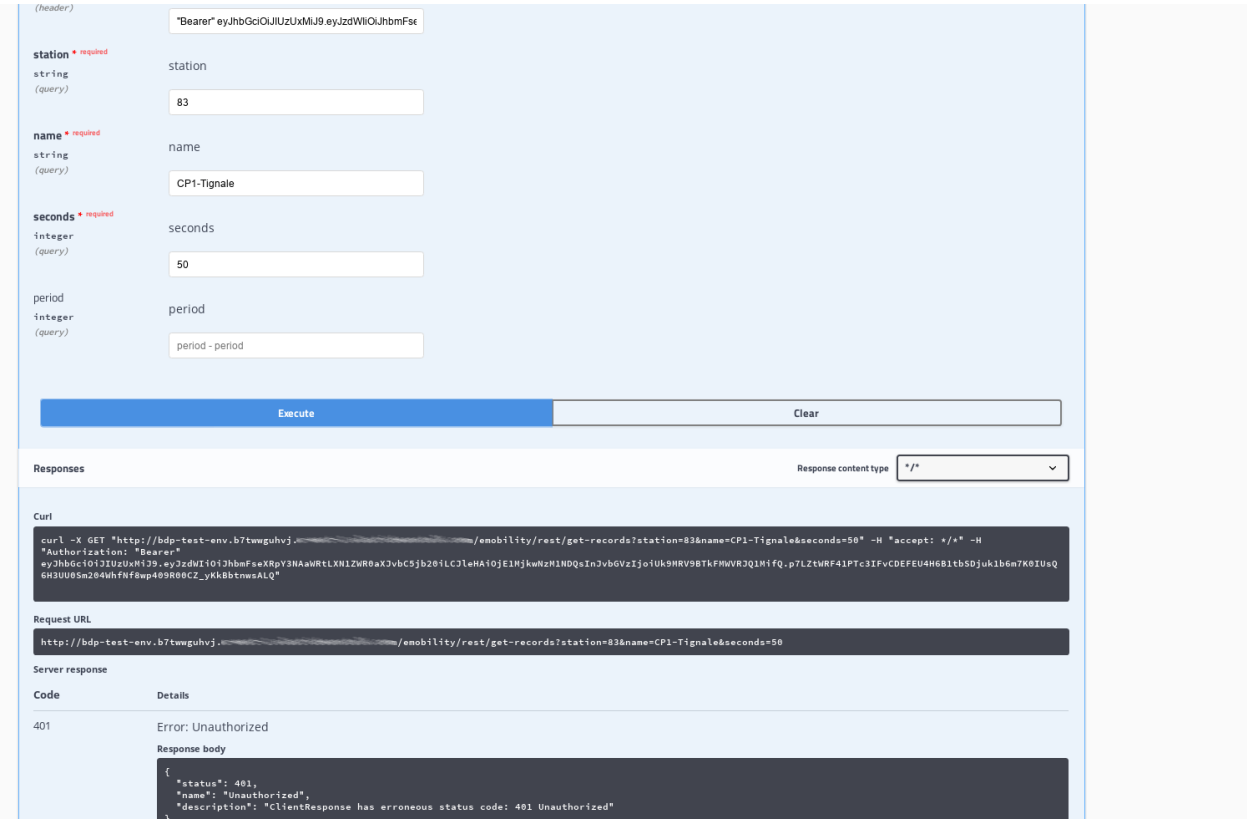

Figure 4.25: A failed call to a method requiring authentication.

If you use the Command Line Interface.

Open a shell on your workstation and use a tool like **curl** or **wget**, with the appropriate options:

-X

Specify the request method (GET)

--header, -H

Add extra header information to be included in the request.

Note that the *--header* option is used twice: The first to receive the answer in **text/html** format, the second to provide the credentials required to access protected content.

API calls can be done using a tool like **curl** or **wget**, with the same *-X* and *--header* option used twice: The first to require the format of the response, the second to provide the credentials, like for example:

```
~$ curl -X GET "https://bdp-test-env.b7twwguhyj.example.com/emobility/rest/get-records?
↪station=83&name=CP1-Tignale&seconds=50" --header "Accept: */*" --header
↪'Authorization: Bearer <token>'
```

Make sure to replace the <token> with the actual token you received.

4.3.2 How to set up your local Development Environment?

This tutorial will guide you in the setup of the local infrastructure to be able to deploy, on top of the Open Data Hub, a new Data Collector Object starting from a simple **HelloWorld** template we provide.

This tutorial is divided into three parts:

1. Software installation
2. Services configuration
3. Troubleshooting

Software Installation

The following installation directions have been verified on a VM with installed either **Debian 9** or **Ubuntu 18.04.01 LTS**. The applications installed on it are the **Suggested** version.

Note: All the commands and configuration items (including their location in the filesystem) refer to this distribution and should be identical or quite similar on all other debian-based distributions as well.

On other Linux distribution some the name of the single packages might vary.

You need to install the following software:

Software	Minimum	Suggested	Notes
PostgreSQL	9.6	10.5	
postgis ext.	2.2	2.4	
Java	JRE7	JRE8	Most of the packages require Java 8 to be built.
git	2.17	2.17	
xmlstarlet	1.6.1	1.6.1	
Apache Maven	3.3.9	3.5.2	Optional. If you don't use it, do not install it.
tomcat8	8.0	8.5	Optional. You can either use the tomcat server provided by Open Data Hub or install another application server.

Note: In case you opt to not use Maven or Tomcat, remember to edit the script in order to not attempt to configure them!

On a typical debian-based Linux distribution, installing the software is achieved by opening a shell/terminal, then issuing the following command, provided you have the rights to install software:

```
~$ sudo apt-get install git openjdk-8-jdk postgresql postgis maven tomcat8 xmlstarlet
```

This command ensures that all dependencies are installed as well. If you have none of these package already installed, you might need to download up to ~125Mb of packages.

Services configuration

The services will be configured automatically, since we developed a script that does most of the job for you. However, a few preliminary steps are required:

1. Make sure tomcat8 and postgres are running. If the do not or if you are unsure, refer to *entry 1* in section *Troubleshooting*.
2. Verify that tomcat and postgres are listening on the right port (**8080** and **5432** respectively). See *entry 2* in section *Troubleshooting* for more information.
3. Make sure there is a database role configured with a password and a few access permission.
4. Set two environment variables.
5. Edit the script to suit your workstation.
6. Launch the script.

Warning: The script **might silently fail** on some machine, for example on Ubuntu 18.04, because it ships with Java 11. In this case, please install also java 8 and make it the default java version.

Troubleshooting

1. **How do I check if a service is running?**

You can check that a service like tomcat or postgres is running from the CLI, by issuing the following command and see an output similar to the one show here, where the active (running) string can be read.

```
~$ service tomcat8 status
  tomcat8.service - LSB: Start Tomcat.
   Loaded: loaded (/etc/init.d/tomcat8; bad; vendor preset: enabled)
   Active: active (running) since Wed 2018-06-13 16:36:28 CEST; 14min ago
     Docs: man:systemd-sysv-generator(8)
   CGroup: /system.slice/tomcat8.service
           └─13828 /usr/lib/jvm/java-8-openjdk-amd64/bin/java -Djava.util.logging.config.
↪file=/var/lib/tomcat8/conf/lo

Jun 13 16:36:23 odh systemd[1]: Starting LSB: Start Tomcat....
Jun 13 16:36:23 odh tomcat8[13802]:  * Starting Tomcat servlet engine tomcat8
Jun 13 16:36:28 odh tomcat8[13802]:    ...done.
Jun 13 16:36:28 odh systemd[1]: Started LSB: Start Tomcat..
```

If you do not use systemd, the command will have a different output:

```
~$ service tomcat8 status
[ ok ] Tomcat servlet engine is running with pid 11357.
```

From a browser you should connect to https://localhost:8080/ (replace `localhost` this the URL or IP where your application server is located) and see the following page:

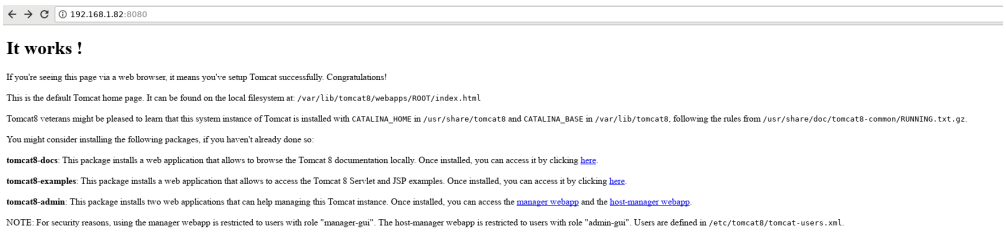

Figure 4.26: The tomcat8 default landing page.

If tomcat is not running, start it using the following command, then entering your password.

```
~$ sudo service tomcat8 start
[sudo] password for odh:
```

You can check again if tomcat is running with the command **`service tomcat8 status`**.

2. **How do I check the port on which a service is listening?**

You can use the **`netstat`** command line utility, like this:

```
~# netstat -plnt4
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/
↪Program name
```

(continues on next page)

(continued from previous page)

```
tcp        0      0 0.0.0.0:5432            0.0.0.0:*               LISTEN      2427/
↪postgresql
tcp        0      0 0.0.0.0:22              0.0.0.0:*               LISTEN      2719/sshd
tcp        0      0 127.0.0.1:8080          0.0.0.0:*               LISTEN      2863/
↪tomcat8
```

Make sure that at least ports 8080 and 5432 are present (tomcat and postgres respectively) in the **Local Address**.

It is suggested to run this command as superuser, because otherwise not all information is present.

4.3.3 GITHUB Quick Howto

This howto guides you in setting up on your local workstation the (forked) `git` repositories needed to contribute to the Open Data Hub project, along with some troubleshooting concerning pull requests and merge conflicts. For more detailed help, please refer to the online Github help, at https://docs.github.com/en/.

Prerequisites

There are no particular requirements to be satisfied to set up a workstation to work on Open Data Hub code, besides the standard software `git` and an IDE of your choice.

However, depending on the contribution you want to give, you may need to install some of the software used by the Open Data Hub, so make sure that you read the Developer's Flight Rules to understand if you need to install some more software.

You also need an account on Github to be able to fork projects and contribute to the Open Data Hub project.

Conventions

In the following documentation some example names are used. Please replace them with suitable values:

- Replace `$USERNAME` with your username on GitHub.
- Replace `$BRANCH` with the branch name you will develop in your forked version.

Project Checkout

Before starting the development, you need to fork the original (upstream) repository.

1. Navigate to the repository on GitHub, e.g., https://github.com/noi-techpark/bdp-core.
2. Create a fork of the repository by clicking on the **Fork** button. If you are not logged in, you will be asked for a github username and password.
3. Navigate to your forked repository on GitHub, e.g., https://github.com/\protect\T1\textdollarUSERNAME/bdp-core.
4. Check out the forked repository on your local machine, using the link that appears in your repository (see Figure 4.28):

```
~$ git clone git@github.com:$USERNAME/bdp-core.git
```

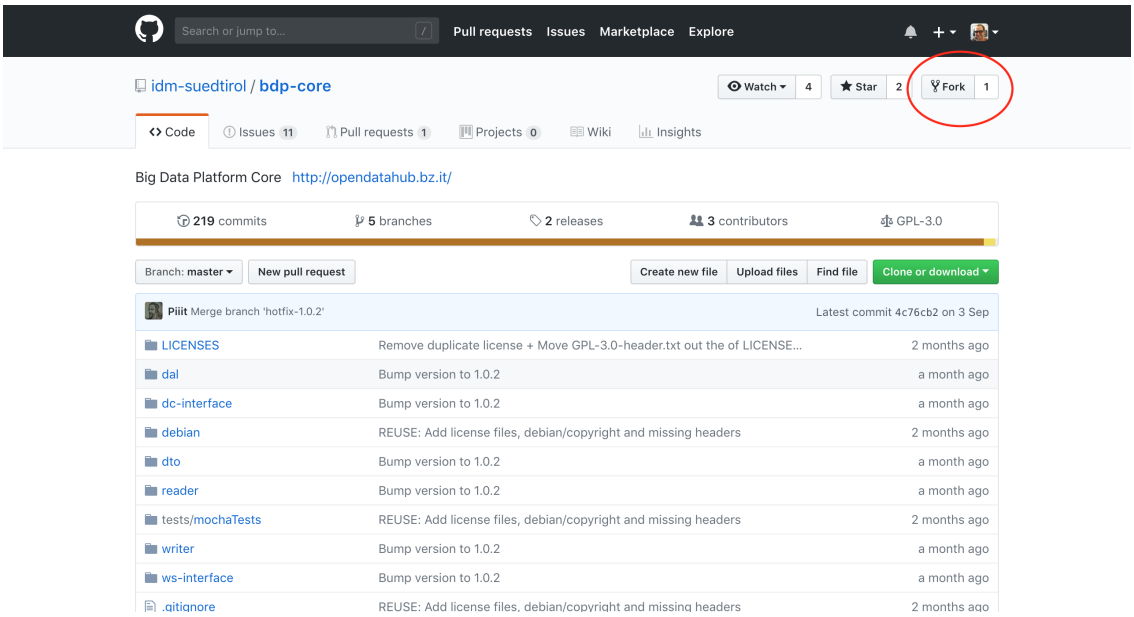

Figure 4.27: Fork the repository.

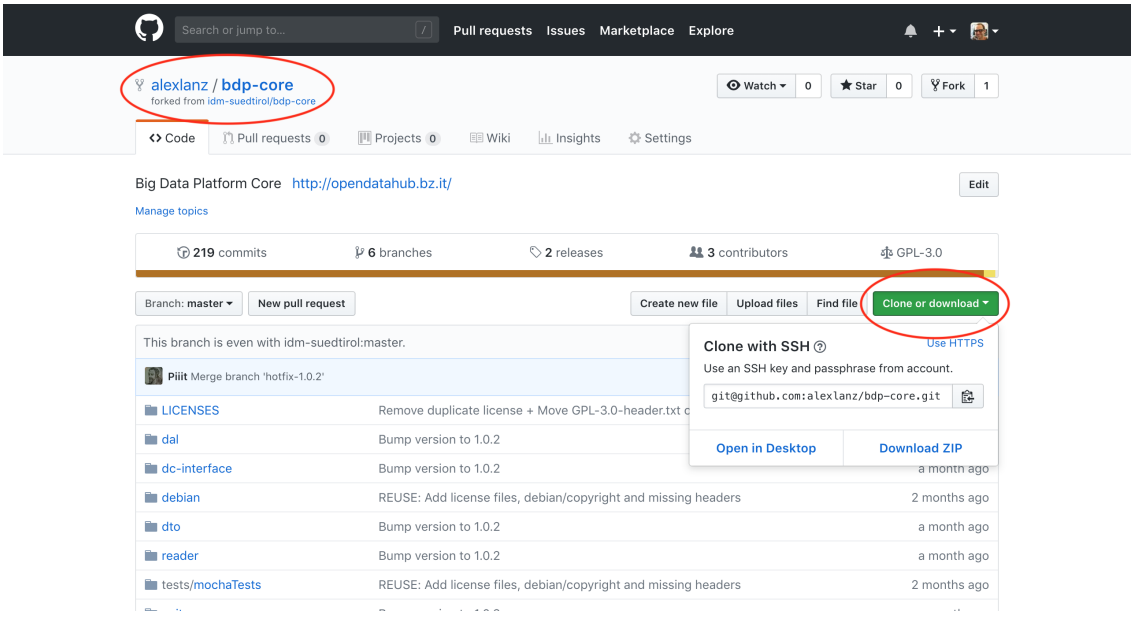

Figure 4.28: Clone the repository.

Create a pull request

In order to let your contribution be accepted in the Open Data Hub code base, you need to follow the following steps.

1. Checkout the **development** branch:

```
~$ git checkout development
```

2. Create a new branch from the **development** branch locally on your machine:

```
~$ git checkout -b test-branch
```

3. Make some changes to the code and commit them:

```
~$ git add -A
~$ git commit -m "Some commit message"
```

4. Push the new branch to GitHub:

```
~$ git push --set-upstream origin test-branch
```

5. Navigate to your feature branch on Github (https://github.com/\protect\T1\textdollarUSERNAME/bdp-core/pull/new/\protect\T1\textdollarBRANCH) to create a new pull request (see Figure 4.29).

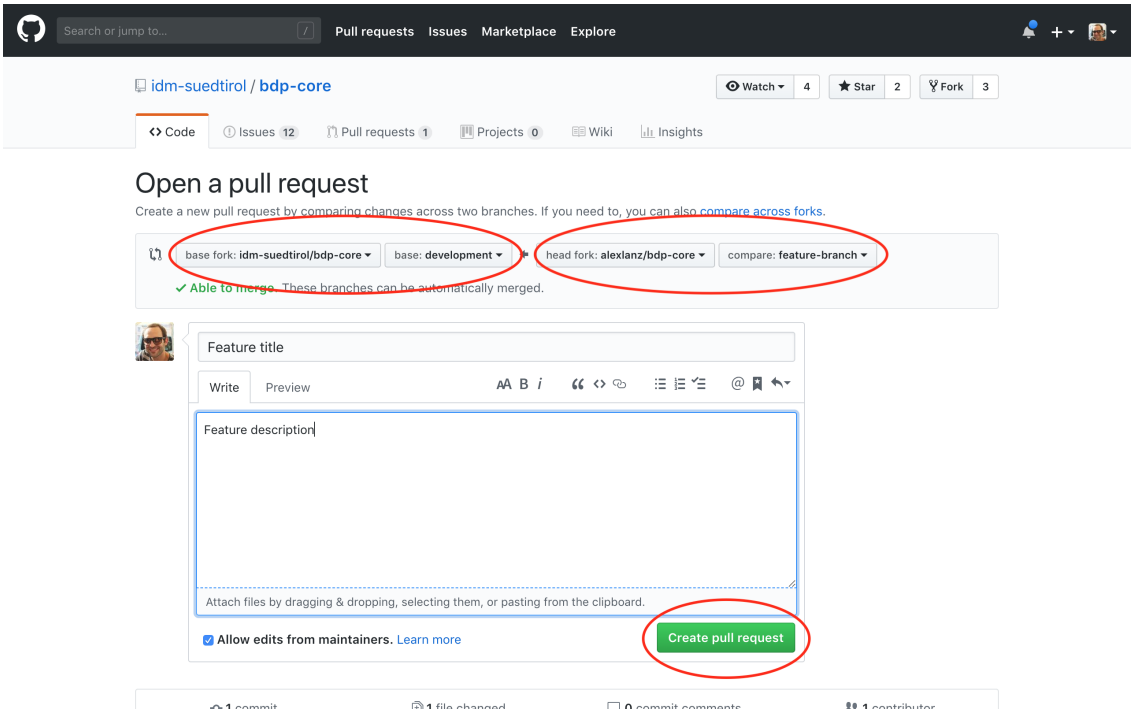

Figure 4.29: Create a pull request.

You can write some description as well, to describe your changes.

6. Commit and push any changes of the pull request to this new branch.
7. For every commit the continuous integration pipeline will execute the tests and display the results in the pull request, like shown in Figure 4.30
8. In addition, the detailed logs can be viewed under https://ci.opendatahub.com.

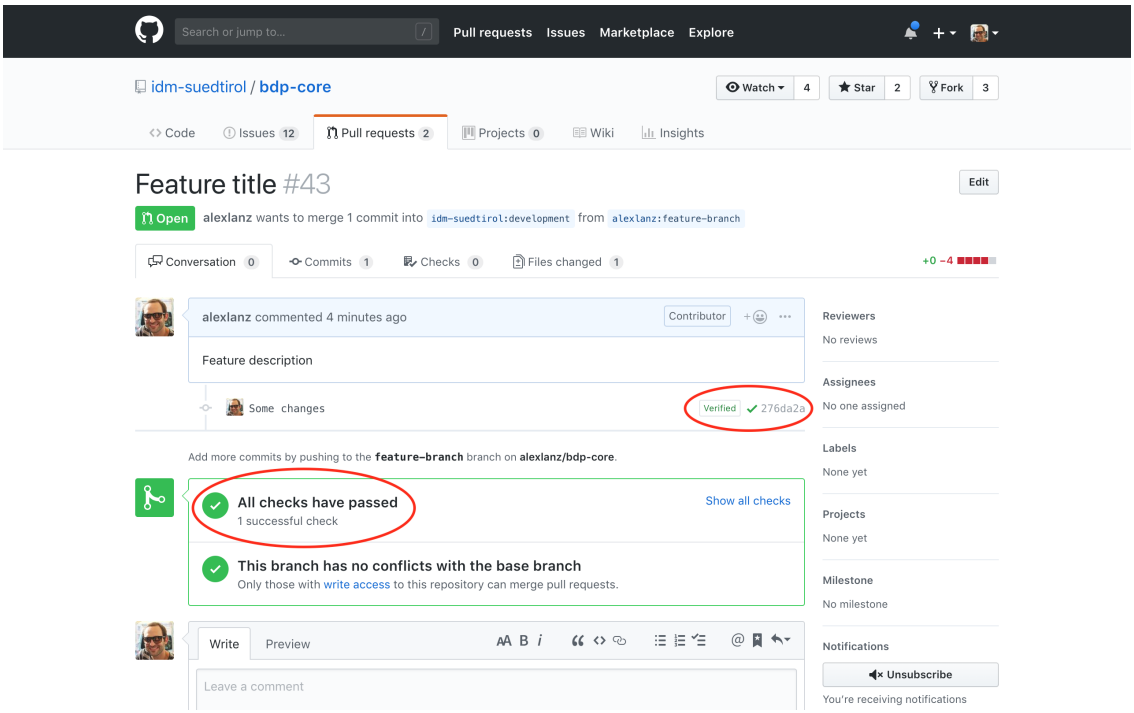

Figure 4.30: Show outcome of a pull request.

Syncing a Fork

Your forked repository does not receive the updates of the original repository automatically. To sync for example the **development** branch of the two repositories and to keep the forked repository up-to-date with all the latest changes of the **development** branch from the original repository, the following steps have to be performed.

Before you can sync your fork with the original repository (an upstream repository), you must configure a remote that points to the upstream repository in Git. A more detailed description for the following steps can be found in the online Github help.

1. List the current configured remote repository for your fork.

```
~$ git remote -v
```

2. Specify a new remote upstream repository that will be synced with the fork.

```
~$ git remote add upstream https://github.com/noi-techpark/bdp-core.git
```

3. Verify the new upstream repository you've specified for your fork.

```
~$ git remote -v
```

You need sync a fork of a repository to keep it up-to-date with the original repository (upstream repository). A more detailed description for the following steps can be found in the online Github help https://docs.github.com/en/pull-requests/collaborating-with-pull-requests/working-with-forks/syncing-a-fork.

1. Fetch the branches and their respective commits from the upstream repository. Commits to **development** will be stored in a local branch, **upstream/development**

```
~$ git fetch upstream
```

2. Check out your fork's local **development** branch.

```
~$ git checkout development
```

3. Merge the changes from **upstream/development** into your local **development** branch. This brings your fork's development branch into sync with the upstream repository, without losing your local changes.

```
~$ git merge upstream/development
```

Resolving Merge Conflicts

When creating and working on a pull request, it could happen that the destination branch of the original repository will change. These changes could result in merge conflicts when pulling your code, like shown in Figure 4.31.

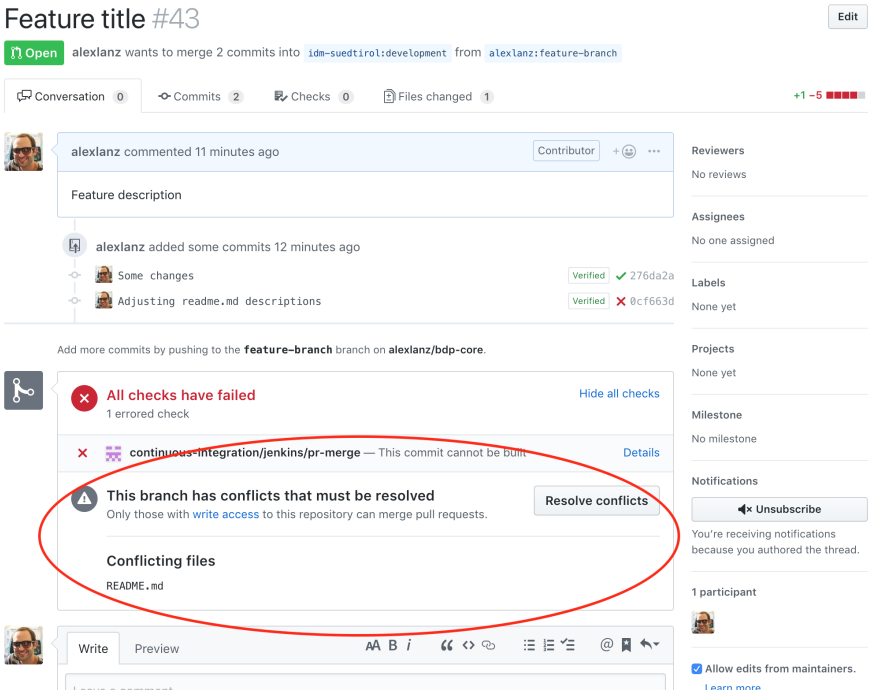

Figure 4.31: A Merge Conflict.

To resolve merge conflicts, the following steps must be performed.

1. *Sync your forked repository* and make sure your local destination (development) branch is up to date with the original (upstream) repository branch.
2. Check out your feature branch (replace *$BRANCH* with the actual branch name).

```
~$ git checkout $BRANCH
```

3. Merge the changes of the development branch to the feature branch.

```
~$ git merge development
```

The command will output the files with merge conflicts. See sample output in Figure 4.32.

```
Auto-merging README.md
CONFLICT (content): Merge conflict in README.md
Automatic merge failed; fix conflicts and then commit the result.
```

Figure 4.32: Merge conflicts output.

4. Go the the listed files of the previous output and resolve all merge conflicts. The conflicts in the files begin with <<<<<<< and end with >>>>>>>. The ======= separates the two versions.

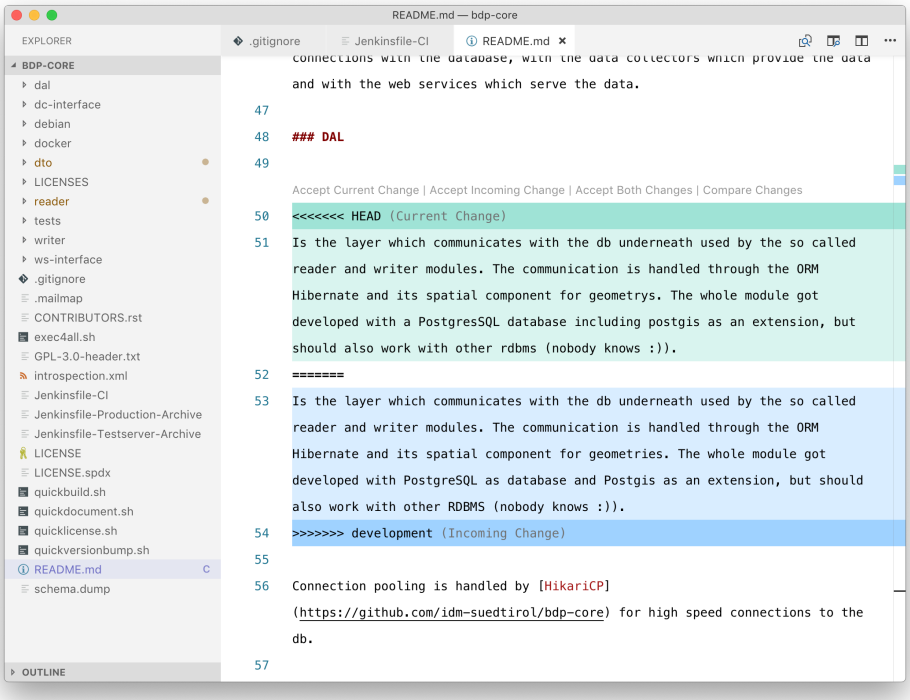

Figure 4.33: Solving a merge conflicts.

You can resolve a conflict by simply deleting one of the two versions of the code **and** the inserted helper lines beginning with <<<<<<<, =======, and >>>>>>>.

If none of the two versions is completely correct, then you can delete the conflict entirely and write your own code to solve the conflict.

5. Add all resolved files to the index, commit the changes and push the changes to the server.

```
~$ git add -A
~$ git commit
~$ git push
```

6. After resolving the merge conflicts, the pull request can be accepted.

A more detailed description can be found in the online Github help: ttps://docs.github.com/en/github/collaborating-with-pull-requests/addressing-merge-conflicts/resolving-a-merge-conflict-using-the-command-line

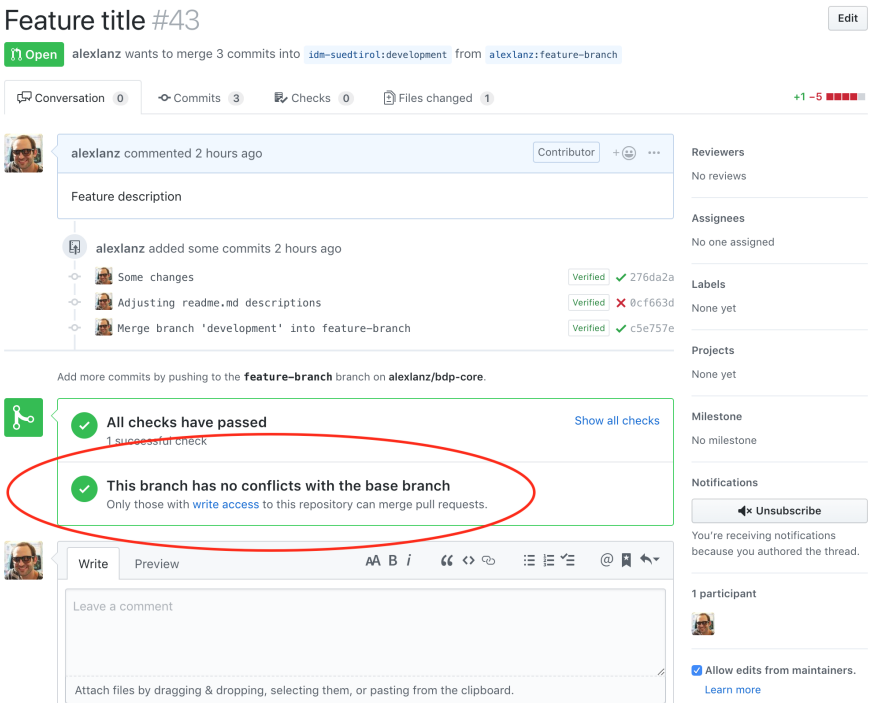

Figure 4.34: A solved merge conflict.

4.3.4 How to set up Postman (API Development Environment)?

Postman is a popular API development environment, that is, a tool that is used (among other useful features) to ease the interaction with API calls to remote sites. In this tutorial, we show the few steps necessary to set Postman to connect to the Open Data Hub datasets in both the mobility and tourism domains.

In the remainder of this tutorial, we will use as example the E-charging station dataset, located at https://swagger.opendatahub.com/?url=https://mobility.api.opendatahub.com/v2/apispec#/Mobility%20V1%20-%20Emobility/ for the mobility domain and the Accommodations dataset, located at https://tourism.api.opendatahub.com/#Accommodation.

Initial Setup

After Postman has been launched, click on the New button, then on Request to start the configuration of the Open Data Hub endpoints, like shown in Figure 4.35.

In the dialog window that opens, write the URL of the endpoint in the *Request name* textfield and assign it in the ODH collection, see Figure Figure 4.36.

Hint: If no collection has already been created, create one by clicking on + Create collection, then write **ODH** and confirm.

Click on Save to ODH to start querying the endpoint.

Repeat the procedure for the Accommodation dataset and for any other dataset you want to query.

It is now possible to start querying the endpoints, by providing next to the **GET** button the corresponding call, like shown in Figure 4.37 for the E-charging station dataset and in Figure 4.37 for the Accommodation dataset. However,

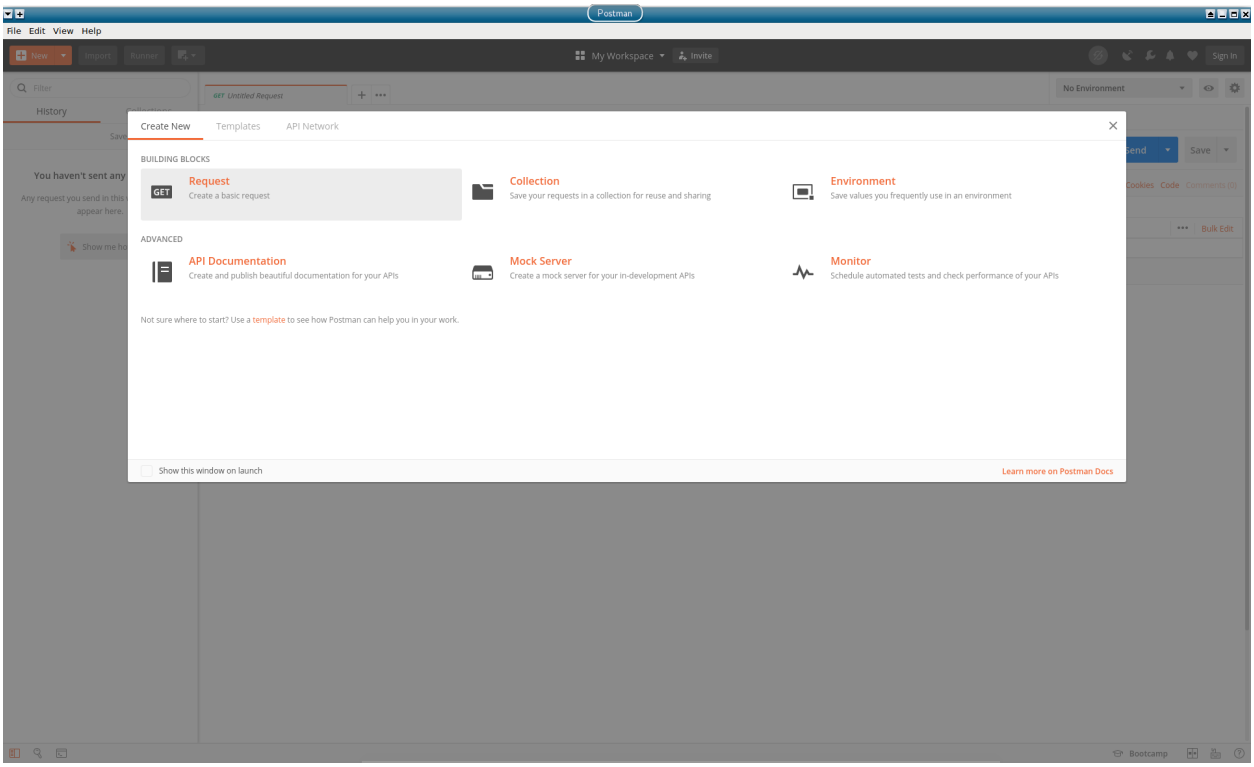

Figure 4.35: Start of a new request creation.

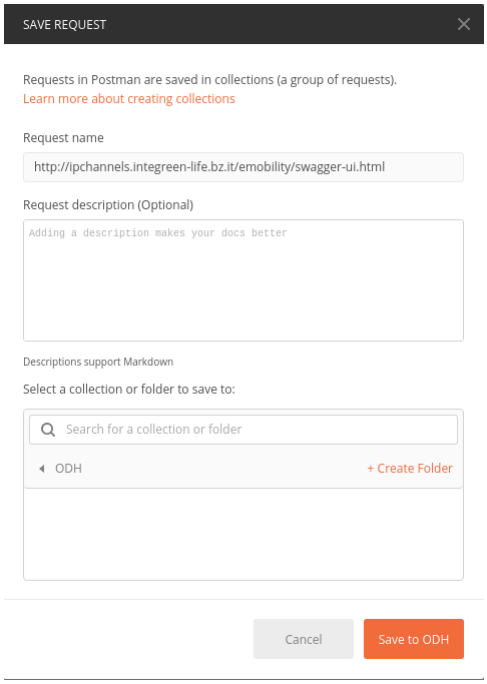

Figure 4.36: Defining a new endpoint in the mobility domain.

while the former images shows a set of results, on the latter appears the message *Authorization has been denied for this request.* and the status 401 Unauthorized.

Figure 4.37: Querying the *E-charging station* endpoint.

Figure 4.38: Querying the *Accommodation* endpoint.

The reason is that the data contained in that dataset have not (yet) been published as open data, therefore authentication is necessary. This is where Postman proves useful, since it can request authentication tokens (OAuth2 in the case of Open Data Hub), store them, and use them whenever the are needed.

Getting a new Authorisation Token

To request a new authorisation token, click on *Authorization* right below the GET request, then select OAuth 2.0 as the *Type*.

Now, in the right-hand side of the window, write the URL that manages the tokens (for the tourism domain, this is https://tourism.opendatahub.com/token and click on the Get New Access Token button (Figure 4.39).

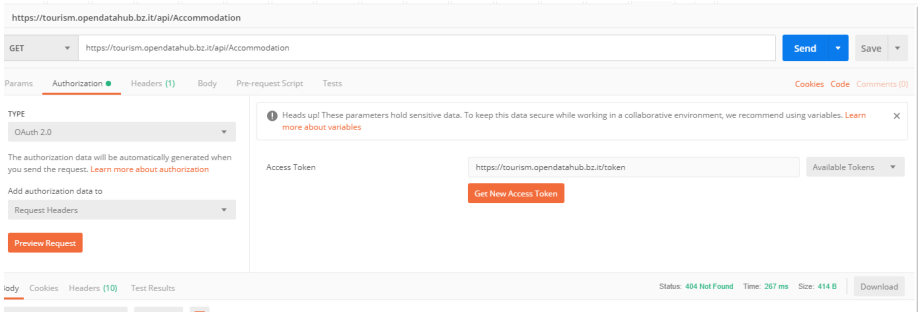

Figure 4.39: Requesting an access token.

In the dialog window that opens fill in all the necessary fields, like shown in Figure 4.40, selecting **Password Credentials** as the *Grant Type*, then click on Request Token. Make sure you have received the username and password to obtain the token, and give it a name easy to remember.

If your credentials are correct and the request is successful, the dialog window will be replaced by another one containing the access token and a few details about it, including its validity and expire date, see Figure 4.41 and Figure 4.42.

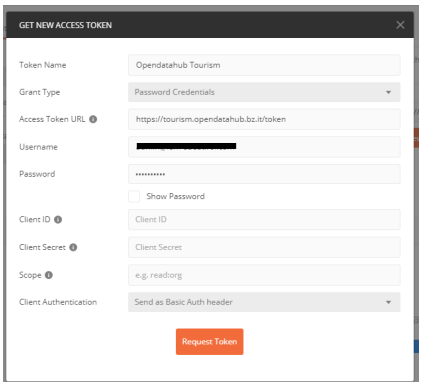

Figure 4.40: A filled-in token request.

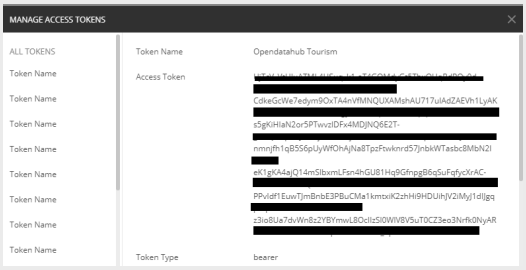

Figure 4.41: An access token.

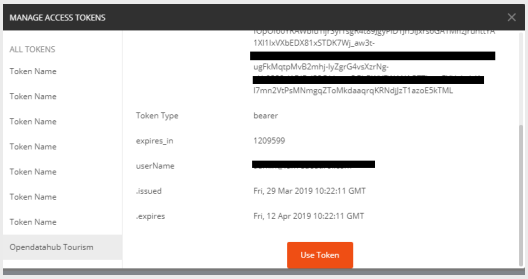

Figure 4.42: Information about an access token

It is now possible to select the token: Select **Opendatahub Tourism** from the *Available Tokens* drop-down menu (see Figure 4.39), click on *Body* and repeat the GET request. You should be able to see now the data in the dataset, like shown in Figure 4.43.

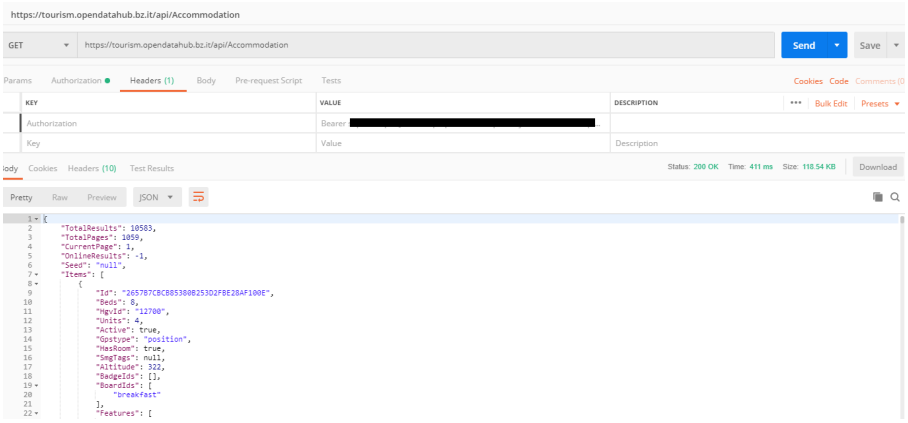

Figure 4.43: Access to data requiring authorisation.

Data Exporting

By default, queries to the Open Data Hub return data in JSON format and postman does not need any setup for that. It is however possible, for some datasets in the Tourism domain–check *Exporting and saving data* section for the list, to have postman receive data in CSV. The required set up is shown in Figure 4.44: in the *Header* tab under the query, add a key **Accept** with value **text/csv**.

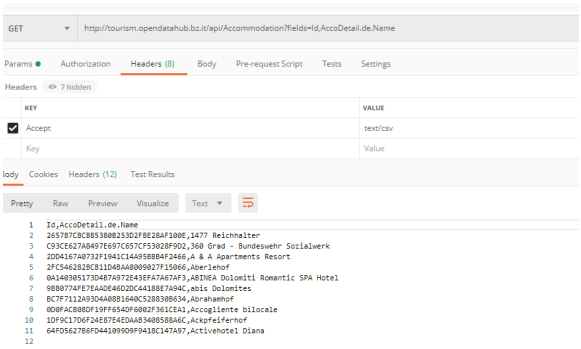

Figure 4.44: Exporting data from the Tourism domain in CSV format.

4.3.5 How to insert and modify NOI Events?

After reading this article, you will be able to use the Open Data Hub tourism portal to insert, modify, and delete events that take place at NOI Techpark in Bolzano (in the remainder, **NOI events**).

Preliminaries

Since you must login to create events, you need valid credentials to be able to add NOI events, that you should have received from the Open Data Hub team.

Go to https://databrowser.opendatahub.com and click on Log in (top right corner)

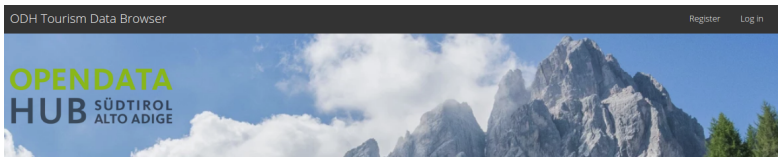

Figure 4.45: Upper section of the tourism portal.

Provide your credentials, then you will be redirected to your homepage, that shows among other information, the roles you have within the Open Data Hub.

Creation of a new NOI Event

Once logged in, click on *ODH Data* → *Events NOI* → *Events EURAC NOI* (see Figure 4.46).

Note: The drop-down menu that you will see might differ from those shown in the screenshot, depending on your permissions.

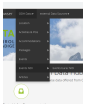

Figure 4.46: Menu item to create a new event

You will now see a list of events that will take place at Bolzano's NOI Techpark today or in the next days. For each event, the description, start and end date, and the location where it takes place are shown. If the event is marked as **Active**, it is displayed on the official NOI web page at https://today.noi.bz.it/.

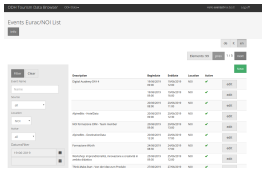

Figure 4.47: List of events.

In order to add a new event, click on the New button to create a new event.

In the dialog that opens, fill in all the fields you deem necessary, but at least the title, organiser, location, and time.

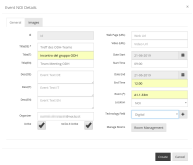

Figure 4.48: An example event with a few details provided.

Remember to tick the *Active* and *noi.bz.it Active* checkboxes: The latter allows the event to show up on https://today.noi.bz.it/.

If the event is set to take place in more rooms, click on the Room Management button to add more rooms and time slots to the event.

If the event has a web page and/or a video trailer, you can add a link to them in the *Web Page (URL)* and *Video (URL)* text-fields.

It is even possible to add images to the event, by clicking on the *Images* tab on top of the dialog and then on Choose File to upload a file. For each image, a few information can be added:

- The author's name.
- The licence used for the image, either **Proprietary** or **CC0**. 

Hint: We prefer that a **CC0** licence be used; it is neccessary to have the rights to upload the photo with **CC0**.

- The position of the image within the gallery, if you upload more than one image. Image in position **0** will be the cover page of the gallery

When you have provided all the necessary information, click on Create to create the event, which will now show up in the list.

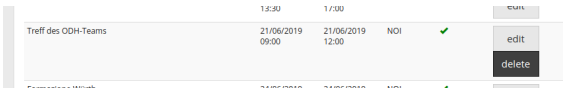

Figure 4.49: List with the new event.

Note that the title of the event is shown in the list in the language selected in the GUI (German in Figure 4.49).

If you later need to modify the event, click on the Edit button next to the event in the event list. For example, suppose the event used throughout this howto needs to be modified, because the meeting had to be postponed by one hour (10:00 to 13:00, instead of 9:00 to 12:00). Also the room is not available anymore, therefore it must be changed as well. These changes are shown in picture Figure 4.50.

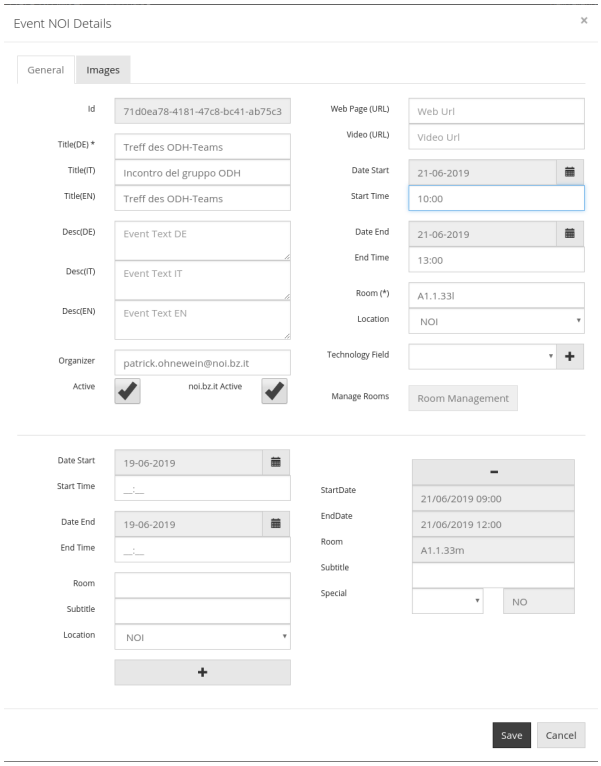

Figure 4.50: Changing event's details.

Click on Save to save the modified event.

To delete an event, click on the Delete button next to the event, then confirm your choice in the confirmation dialog that will appear.

4.3.6 How to Publish your Web Component on the Open Data Hub Store

This how to guides you in the process of making available a Web Component that you created with the Open Data Hub Community, by publishing it on Open Data Hub Store.

The only requirement is that the Web Component **must** be released as an *Open Source Licence*.

One of three alternatives can be chosen to publish a Web Component on the Store: as a **full open source** project, as a **forked** project, or using what we call the **external workflow**; the preferred being the first one.

1. When using the **full open source** path, you simply hand in the source code of your Web Component to the Open Data Hub team, no additional effort is required from your side. The code will be placed in a GIT repository, and immediately made available through the Store. Future versions of the Web component are developed under the control of the Open Data Hub team directly within this repository.
2. The **forked** project way will still see the Web Component's source code saved in a GIT repository, but you own full control of it, and decide about its future versions. The difference with the previous method is that the updates are done by you in your repository and the Open Data Hub team will need to keep its copy synchronised with yours.
3. Finally, the **the external workflow** is the one is which nothing is saved in a GIT repository. You will maintain full control of the source code and of the Web Component's development, including the right to pull it out of the store. Should you decide to follow this path, you will have to satisfy a few more requirements, to ensure proper integration with the Store:

    1. You need to install in the root directory of your Web Component's source code a suitable `wcs-manifest.json` file, that you will receive via pull request.
    2. Your Web component must be saved (better if in *minified* form) under a `dist` directory, e.g., as `$ROOT/dist/widget.min.js`, where `$ROOT` is the root directory of your repository.
    3. You need to tag a commit on your master branch with a *semantic versioning* tag, to communicate to the Store that the corresponding version should be published (example, `git tag -a "v1.2.3" -m "v1.2.3"`).

    An example of these files and setup can be found in the published example of a generic map, that you can find at https://github.com/noi-techpark/webcomp-generic-map.

    Finally, to ensure that your Web Component is kept updated in the Store, suitable pull requests will be sent to your repository.

In all three cases, a repository called **origins** (hosted on github will hold a reference to each Web Component's repository, from where all files that are necessary for its deployment including the *manifest* file, the javascript, and logo if present-to each Web Component's version. It is therefore important, in case the **external workflow** has been chosen, that the URL to the Web Component be stable, otherwise the Web Component will *not* be available.

4.3.7 How to Access Open Data Hub Data Using SPARQL

Changed in version 2023.1: notify users of SPARQL endpoint reachable upon request only.

> **Warning:** The SPARQL endpoint is currently not active, but can be activated upon request to help@opendatahub.com. However, the ODH SPARQL portal, which contains sample data and queries, can be accessed at https://sparql.opendatahub.com/.

The Open Data Hub's dataset can be queried using the SPARQL query language, using the Open Data Hub Knowledge Graph Portal. This howto helps you in getting acquainted with the functionalities offered by the endpoint. However, this howto does not cover SPARQL: if you are not familiar with it, here is some reference:

- The SPARQL Query Language Recommendation is the official and normative W3C definition of SPARQL and also contains a lot of examples and querie to learn from
- A tutorial about SPARQL written by Apache Jena's team. Oriented toward Jena, it nonetheless includes and explains a lot of basic notions

Data Available in the Portal

The landing page of Open Data Hub's SPARQL endpoint contains the following elements:

1. The buttons in the banner at the top of the page.

   Playground

   The *Playground* is a space in which to freely write SPARQL queries against the Open Data Hub datasets. It is most suited for users that already know SPARQL and how to use it to interact with Open Data Hub.

   See section *Working in The Playground*.

   Regular Queries

   Regular Queries are a sample queries that can be used either standalone, to gather example data, or can be edited and modified to tweak the results.

   See section *Working with Regular Queries*.

   Data Quality Queries

   Similar to Regular Queries, *Data Quality Queries* are precooked queries that will gather data, but with an emphasis on their quality. They can be used to check whether some of the data are incomplete.

   See section *Working with Data Quality Queries*.

   Mobility

   Mobility queries are sample queries against all the datasets in the entire mobility domain. They can be used as they are or modified and tweaked to extract more precise data.

   You can refer to section *Working in The Playground*.

   Tourism and Mobility

   Tourism and Mobility queries combine datasets from the tourism domain with observations gathered by sensors in the mobility domain.

   You can refer to section *Working in The Playground*.

2. The main area, consisting of a large textarea, in which to write SQARQL queries, and of a number of precooked queries when the *Regular Queries* or *Data Quality Queries* buttons are clicked. The three buttons on the textarea's top right corner can be used to
   - Copy the URL of the query and share it, store it for future use, or use it in scripts.
   - maximise the textarea
   - execute the query. If the query contains some syntactic error, it is accompanied by a yellow question mark and it is not executed, but an error message is displayed
3. A number of visualisation and download options in the bottom area. Also this part of the area can be maximised
   - *Table*. A simple table with a result on each row
   - *Response*. The actual JSON received as result
   - *Pivot Table*. Analyse statistically the query result

- *Google chart*. Use the data retrieved within a Google Chart. The default representation is a simple table, more can be employed, by clicking on the Chart Config button on the right-hand side.
- *Geo*. See on a map the location of the results
- download the result set as a CSV file

Working in The Playground

The playground is the place in which you can build you queries against the Open Data Hub endpoint. Queries can be built using built-in or custom prefixes as well as all SPARQL operators. There is a validation of the queries, therefore in case of mistakes a red warning icon will appear on the left-hand side of the offending line.

Note: Generic queries might return hundreds or thousands of results, so the use of the `LIMIT` clause helps to receive quicker answers.

Working with Regular Queries

Regular queries are predefined queries that give a glimpse of the data contained in the Open Data Hub. Regular queries are rather generic and can be used as starting point for more precise and refined queries. They can be edited directly in the textarea or copy and pasted in the Playground.

Working with Data Quality Queries

Data quality queries are built with purpose to verify if there are incomplete or wrong data in a dataset.

4.3.8 How to Access Open Data Hub Data With R and SPARQL

Changed in version 2023.1: notify users of SPARQL endpoint reachable upon request only.

Datasets and their data in the Open Data Hub can be accessed using R, a software for statistical analysis and Open Data Hub's SPARQL endpoint.

Warning: The SPARQL endpoint is currently not active, but can be activated upon request to help@opendatahub.com. However, the ODH SPARQL portal, which contains sample data and queries, can be accessed at https://sparql.opendatahub.com/.

This howto shows you a method to retrieve data from the Open Data Hub, but does not address other features like, for example, plotting fetched data on a map.

It is also assumed you have already installed R on your workstation as well as the required R's SPARQL library from CRAN (Comprehensive R Archive Network).

Note: The SPARQL package is currently archived as apparently not maintained anymore. In this howto, we use the latest version available, which is available at the above mentioned link.

Install SPARQL library

To install the SPARQL library, simply execute on Debian-like systems:

```
~# Rscript -e "install.packages('SPARQL')"
Installing package into '/usr/local/lib/R/site-library'
(as 'lib' is unspecified)
trying URL 'https://cloud.r-project.org/src/contrib/SPARQL_1.16.tar.gz'
Content type 'application/x-gzip' length 6548 bytes
==================================================
downloaded 6548 bytes

* installing *source* package 'SPARQL' ...
** package 'SPARQL' successfully unpacked and MD5 sums checked
** R
** byte-compile and prepare package for lazy loading
** help
*** installing help indices
** building package indices
** testing if installed package can be loaded
* DONE (SPARQL)

The downloaded source packages are in
   '/tmp/RtmpISkL9Z/downloaded_packages'
```

If you see the message *** DONE (SPARQL)**, the installation was successful.

If you see instead any **ERROR**, like those reported below, please refer to section *Troubleshooting*:

```
Warning messages:
1: In install.packages("SPARQL") :
  installation of package 'RCurl' had non-zero exit status
2: In install.packages("SPARQL") :
  installation of package 'SPARQL' had non-zero exit status
```

In order to fetch data, you need:

1. An endpoint, which for Open Data Hub is https://sparql.opendatahub.com/sparql
2. a SPARQL query, that you can simply copy from one of the precooked queries at https://sparql.opendatahub.com/
   We'll be using this one:

```
PREFIX schema: <https://schema.org/>
PREFIX geo: <http://schemas.opengis.net/geosparql/1.0/geosparql_vocab_all.rdf#>
PREFIX noi: <https://noi.example.org/ontology/odh#>

SELECT ?pos ?posLabel
WHERE {
  ?p a noi:Pizzeria ;
     geo:asWKT ?pos ;
     schema:name ?posLabel ;
     schema:geo ?geo .
  FILTER (lang(?posLabel) = "it")
}
LIMIT 10
```

3. An R script to put all together

```
library(SPARQL)

endpoint <- "https://sparql.opendatahub.com/sparql"

query <-
'PREFIX schema: <https://schema.org/>
PREFIX geo: <http://schemas.opengis.net/geosparql/1.0/geosparql_vocab_all.rdf#>
PREFIX noi: <https://noi.example.org/ontology/odh#>

SELECT ?pos ?posLabel
WHERE {
  ?p a noi:Pizzeria ;
     geo:asWKT ?pos ;
     schema:name ?posLabel ;
     schema:geo ?geo .
  FILTER (lang(?posLabel) = "it")
}
LIMIT 10'

result_set <- SPARQL(endpoint,query)
print(result_set)
```

The script above can be saved in a file called `R-demo.r` and executed using the **`Rscript R-demo.r`** command. The output will be similar to:

```
~# Rscript R-demo.r
 Loading required package: XML
 Loading required package: RCurl
 $results
                                                                                pos
 1  "POINT (11.440394 46.511651)"^^<http://schemas.opengis.net/geosparql/1.0/geosparql_
↪vocab_all.rdf#wktLiteral>
 2  "POINT (11.200728 46.729921)"^^<http://schemas.opengis.net/geosparql/1.0/geosparql_
↪vocab_all.rdf#wktLiteral>
 3      "POINT (11.9412 46.9803)"^^<http://schemas.opengis.net/geosparql/1.0/geosparql_
↪vocab_all.rdf#wktLiteral>
 4      "POINT (11.4278 46.4135)"^^<http://schemas.opengis.net/geosparql/1.0/geosparql_
↪vocab_all.rdf#wktLiteral>
 5  "POINT (11.326362 46.310963)"^^<http://schemas.opengis.net/geosparql/1.0/geosparql_
↪vocab_all.rdf#wktLiteral>
 6  "POINT (12.279453 46.733497)"^^<http://schemas.opengis.net/geosparql/1.0/geosparql_
↪vocab_all.rdf#wktLiteral>
 7  "POINT (10.867335 46.622179)"^^<http://schemas.opengis.net/geosparql/1.0/geosparql_
↪vocab_all.rdf#wktLiteral>
 8  "POINT (11.241217 46.246141)"^^<http://schemas.opengis.net/geosparql/1.0/geosparql_
↪vocab_all.rdf#wktLiteral>
 9   "POINT (11.598339 46.40688)"^^<http://schemas.opengis.net/geosparql/1.0/geosparql_
↪vocab_all.rdf#wktLiteral>
 10     "POINT (12.0114 46.7474)"^^<http://schemas.opengis.net/geosparql/1.0/geosparql_
↪vocab_all.rdf#wktLiteral>
                                          posLabel
 1           "Ristorante Pizzeria Bar Pirpamer"@it
```

(continues on next page)

(continued from previous page)

```
2                      "Bar Pizzeria Alpenhof"@it
3            "Ahrner Wirt Ristorante Pizzeria"@it
4                 "Ristorante Pizzeria Adler"@it
5                           "Hotel Al Mulino"@it
6               "Ristorante Pizzeria Zentral"@it
7       "Hotel Ristorante Bar Rasthof Vermoi"@it
8                            "Hotel Grünwald"@it
9                               "Hennenstall"@it
10 "Après Ski Bar Pizzeria Ristorante "Gassl""@it
```

In the script, all data fetched are kept into the **result_set** variable and can be manipulated at will using R libaries.

Troubleshooting

SPARQL installation fails!

When installing a package, R tries to satisfy all the package's dependencies and installs any missing library required by the package. If you still stumble upon errors, like for example:

```
Warning messages:
1: In install.packages("SPARQL") :
  installation of package 'RCurl' had non-zero exit status
2: In install.packages("SPARQL") :
  installation of package 'SPARQL' had non-zero exit status
```

It means that SPARQL's dependency **RCurl** also failed. In this case it is not easy to spot the root cause, which is a missing package in the OS installation, called **libcurl4-gnutls-dev**. To install it on a Debian-like system, use as *root* the following command:

```
~# apt-get install libcurl4-gnutls-dev
```

I have some strange warning when executing the script!

If you execute a query and the outcome is not a result set but some error message similar to the following ones, please verify that the URL of the SPARQL endpoint is correct: **https://sparql.opendatahub.com/sparql**

```
Opening and ending tag mismatch: meta line 5 and head
Opening and ending tag mismatch: meta line 4 and html
Premature end of data in tag meta line 3
Premature end of data in tag head line 2
Premature end of data in tag html line 1
```

CHAPTER

FIVE

DOCUMENTATION FOR DEVELOPERS

This section contained a lot of documentation that developers had to adhere to when collaborating with the Open Data Hub:

- Coding conventions including programming languages and technologies used, development and deployment workflows, and more
- Design of databases, their use, access to tables and data, and more
- Relation between Open Data Hub's core development team and external collaborators
- Authentication

As the development team grew, most of these guideline changed, some technologies have been obsoleted and new ones were introduced. Additionally, the number of repositories managed for the Open Data Hub Project has increased considerably, and many of them have specific guidelines for developers.

Therefore, to simplify access to information relevant to developers, all the content that was featured in this section has been moved and rearranged. The repository https://github.com/noi-techpark/documentation contains a README.md file organised as a set of *Flight Rules* that allows a new collaborator to be productive in a short time.

Then, depending on which part of the Open Data Hub Project you are going to collaborate, have a look at the `README.md` files in the various repositories.

CHAPTER

SIX

APPS BUILT FROM OPEN DATA HUB DATASETS

This section features a list of applications–and their descriptions–built using the *Domains and Datasets* that the Open Data Hub team makes available.

Applications are grouped according to their status in three categories:

- Production status. These applications are already used in production environment.
- Development status, aka *beta stage*, shown by the 

badge. Application in beta stage are developed actively and might already be suitable for a production environment.
- Experimental status, aka *alpha stage*, shown by the 

badge. Applications falling in this category are in the early stage of development, and might be for example, a proof of concept or the outcome of a hackathon. They might not be maintained or developed further and should not be considered mature enough to be deployed in a production environment.

If you are developing one application with the data provided by datasets of the Open Data Hub project, send an email with a short description, an email contact and its status and we'll add it to the list.

6.1 Production Stage Apps

- https://www.suedtirol.info/en This portal is the official touristic site of the South Tyrol region. It uses the data extracted from the *Datasets* to display events in the region of South Tyrol and other useful information to help tourists organise their holiday in South Tyrol. All information are available also for every region that composes South Tyrol, including historical remark and proposed taste itinerary.

  Additionally, it is also possible to subscribe to the newsletter, to browse or search for events and points of interest. For most of the points of interest there are suggestions for hiking tracks or walks to reach them.

  Hotel description and availability with options for booking are additional services offered by the site.
- South Tyrol Guide, the official smartphone app for exploring and experiencing South Tyrol, available for both Android and iPhone mobile devices. This app offers all the functionalities of the above-mentioned web site, plus the ability to locate events, points of interest and the like near your current position.

6.2 Beta Stage Apps

- https://mobility.meran.eu/ This web site is the first example of a Mobility-as-a-Service application; it includes real-time information of multiple mobility services, like public transportation, places of interests, car sharing services, parking lots, and more in the city of Merano/Meran.
- https://mobility.bz.it/ This web site is the counterpart of the previous one for the city of Bolzano/Bozen.
- https://parking.bz.it/ A web site that displays the real-time parking availability of off-street parking lots in South Tyrol. On mobile devices, it can also show directions from your current position to the chosen parking lot.
- https://traffic.bz.it/ Some streets in South Tyrol are monitored for real-time vehicular travel times; the data collected are used by this web site to show traffic slowdowns or jams.
- https://bus.bz.it/ This web site shows the real-time positions of the buses managed by the public transport operator SASA. Urban or suburban bus lines can be shown, and for each bus can be shown the next few stops and an estimate of the arrival time.
- https://map.clean-roads.eu/ This web page was one of the CLEAN-ROADS project outcomes, which presented real-time data of the meteorological stations that situated along public streets.

6.3 Alpha Stage Apps

All the projects listed in this section have been built during various hackathons and must be considered as *Experimental*.


Year 2018

Summer Lido Hackathon

Projects developed during the Summer Lido Hackathon 2018

- https://hackathon.bz.it/project/south-tyrol-crime-scene-stcs- is an interactive thriller combining traditional storytelling and augmented reality.
- https://hackathon.bz.it/project/sama—smart-application-medical-appointment is a prototype for the booking of appointments in the South Tyrolean hospitals.
- https://hackathon.bz.it/project/ifc-converter-and-aivrtour is on the one side a converter of 3D reality data formats (form ifc to dae/obj), while on the other side it applies AI to virtual reality for museums, real estates, and on tourism.
- https://hackathon.bz.it/project/travel-win is an app for South Tyrol tourists that can collect points to receive gifts.
- https://hackathon.bz.it/project/ugo Get your pictures printed on paper and delivered to your hotel.
- https://hackathon.bz.it/project/sportmap.net Creation of a OpenData map with trendy sport locations, courses, & events.
- https://hackathon.bz.it/project/game-of-alps Get unique experiences by completing challenges around South Tyrol. Gather crystals and collect rewards from local tourist offices. Additionally get discounts for restaurants and entrance tickets.

HackTheAlps

Projects developed during HackTheAlps 2018.

- Activity Crystal goal of the project was to build something simple & fun that gets people off their couches.
- Explore South Tyrol aims at providing the user with a new experience when visiting South Tyrol. The user can discover and share cool new places in South Tyrol in a truly immersive way.
- Offtrack is an app that bridges ski rentals, skipass sellers, and insurances, to create a new kind of business, centred on the safety of ski enthusiasts.

Vertical Innovation Hackathon

Projects developed during Vertical Innovation 2018.

- Smart Bivouac is the project that won the **Cassa di Risparmio / Sparkasse award** at the Hackathon. The idea on which the project is based is to avoid crowded bivouacs in the South Tyrolean area with the use of LoRa technology, that helps in booking a place in a bivouac.
- RESK is the project that won the **Wuerth Phoenix award** at the Hackathon, which had the use of Open Data Hub data in its criteria. The goal of the project is to reduce the first intervention times, for EMT and first-aider to react more promptly to help requests and save more lives.
- Back forth has the goal to solve the commuting problems in South Tyrol with an eye on eco-friendliness and Open Source .
- Pool me aims at promoting carpooling in South Tyrol by logging and storing all rtavels done.
- WideOpen is a change management platform that helps companies in adopting flexible working hours policies in order to make the rush hour a relic of the past.

Moreover, the following applications use the Open Data Hub as a feature, but not as their core.

- https://hackathon.bz.it/project/the-smart-team
- https://hackathon.bz.it/project/green-revolution
- https://hackathon.bz.it/project/my-south-tyrol
- https://hackathon.bz.it/project/think
- https://hackathon.bz.it/project/webike

Year 2019

NOI Hackathon Summer edition

Projects developed during the Summer Lido Hackathon 2019

- WeMap Lit element component for display opendata on google maps.
- Tito is an app and web component that analyses historical data about trips made in South Tyrol and suggests the best one to allow people to share them and plan to travel together along them.

NOI Hackathon SFScon Edition

Projects developed during NOI Hackathon SFScon Edition 2019.

- Greenify is a Web Component and user interface intended for tourists and hotels interested in sustainable environment. The authors strive for South Tyrol to become an environmental friendly region, therefore this Web Component classify hotels and assign them scores and certifications of their environmental friendliness.
- The Vecia follows Jane's journey in South Tyrol and shows a web component to enhance sustainable tourism.
- Sharing is Caring consists of a web component that allows tourist to access easily information about public transportation in South Tyrol and allow them to move around without using their own car.
- Green Speed gather information from different sources to help travelers in South Tyrol to get directions using public transportation and provide them with the actual carbon footprint.

CHAPTER

SEVEN

APPENDICES

The following is the list of appendices.

7.1 Open Data Hub Architecture

Changed in version 2023-09: replace obsolete architecture description

The architecture of the Open Data Hub has grown over time from a software that could be run on (almost) anyone's box with little requirements to a fully fledged infrastructure built on Kubernetes, its package manager, Helm, and Terraform. Dozen of software have been packed together to create a platform that is able to scale up quickly and easily, and it is continuously evolving.

It has therefore become difficult to keep the description of the architecture updated, because it has become rather technical. For these reasons, and to allow developers to remain updated on the evolution of the Open Data Hub ecosystem, a dedicated repository has been created, that contains the full information and is updated constantly.

The repository is available at https://github.com/noi-techpark/odh-infrastructure-v2

7.2 Glossary

API
: The Application Programming Interface is a collection of methods that a software program makes available to allow interaction with other programs.

Claim
: In JSON Web Token, a claim is a piece of information about a subject, structured as a key/value pair.

CSV
: CSV stands for Comma Separated Value, and is a file in which the content is organised in a fixed number of fields per line, separated by a comma (,) or some other symbol, like a semi-colon, a slash, or a vertical bar.

Data Format
: Data format is the way information is encoded and exchanged between applications.

Data Provider
: A Data Provider is an entity that supplies data or datasets to the Open Data Hub. See *detailed description*.

Dataset
: A dataset is a collection of records from a Data source.

Domain
: A domain is a category of interest to which one or more datasets belong to.

Endpoint
An Endpoint is an online resource that make data available, usually through REST APIs.

JSON
The JavaScript Object Notation is a lightweight data format to ease the exchange of data between computer and its understanding for humans. Essentially a JSON file is a sequence of key-value pairs, organised into lists (arrays, sequences, vectors). Nesting of key-values and of lists is supported.

JSON Web Token
It is a mechanism to exchange a claim between two parties, used for authentication purposes when the claim is digitally signed and/or encrypted.

Key-value
Also called name-value pair or attribute-name pair, a key-value pair is a simple data structure in which information are stored as tuples {attribute, value}, with no constraint of uniqueness on both attribute and value.

ODHtags
In the tourism domain, this name refers to all the tags/filter that refer to data that have been validated by the Open Data Hub team.

REST API
RESTful API
A REST(ful) API is a Web Service that adheres the architectural constraint of a RESTful system. It is composed of a URI, a collection of methods to interact with the resources offered by the Web Service, and a media type defining the accepted data formats.

Sensor
Within the Open Data Hub, a sensor is intended as a kind of *device* that gathers data and sends them to another device which stores them in a machine-readable format, used to exchange or publish them. Depending on the domain a sensor may collect environmental data in the mobility domain (like, e.g., temperature, humidity, pressure), but in the tourism domain a *sensor* can collect the guests in a hotel or the people attending at an event. In these cases, the *device* is usually a human (e.g., the hotel's receptionist and the organiser of the event), and the data are digitalised manually.

Statistical Graphics
Statistical graphics are means to display statistical data with the purpose to ease their interpretations. Common statistical graphics include pie charts, histograms, and scatter plot.

Web Component
A Web Component is a set of API that allows the creation of interoperable HTML widgets that can be shared and reused.

7.3 Changelogs

Changed in version 2022.10: this section has been split, now there is a dedicated Changelog page for each year.

This section contains the Changelog of the Open Data Hub project's documentation.

- Previous to June 2020, we maintained no changelog.
- The list of changes made from June, 2020 to February, 2021 can be `downloaded` as a text file.
- Since March 2021 we adopted a more structured approach: This section indeed will contain an entry for each change made to the documentation.

Note: We do not schedule regular releases of the documentation, we rather publish new versions *"When they are ready"*, therefore each *version* is identified by a string **YYYY.MM**, in which *YYYY* is the year and *MM* the month of

the release.

7.3.1 Changelog 2021

2021.03

Released: 31 March 2021

- **[Improvement]** ¶ Add **changelog** extension.

  References: #194
- **[Improvement]** ¶ Add AlpineBits to the *Accessing the Open Data Hub* section.

  References: #203
- **[Bugfix]** ¶ Fix layout of datasets in *Other Domains*.

  References: #199

2021.04

Released: 30 April 2021

- **[Improvement]** ¶ Add to each dataset a direct permalink that can be copied and sent to third party.

  References: #206
- **[Improvement]** ¶
  - Replace tabs in the howto list with subsections.
  - Remove the mobility howto for deprecated API v1.
  - Reduce size of images in howtos and align them if layout allows.

  References: #208
- **[Bugfix]** ¶ Add correct images to *How to Access Analytics Data in the Mobility Domain* howto.

  References: #208
- **[Bugfix]** ¶
  - Remove drop downs from all the lists of *datasets* (Mobility, Tourism, Other)
  - fix the panel's width to avoid scrollbars whenever possible.

  References: #212
- **[Bugfix]** ¶ Add troubleshooting section to *R howto*.

  References: #213
- **[New Feature]** ¶ New Howto: *How to Access Open Data Hub Data With R and SPARQL*

  References: #204

2021.05

Released: 31 May 2021

- **[Improvement]** ¶ A lot of improvements have been added to the general structure of the documentation, the most important being:
  - reorder ToC and make some section more prominent
  - made bash code snippets more usable
  - made accessing methods more immediate to see

  For more details, please check the reference.

  References: #209
- **[Improvement]** ¶ The technical content of the *getting started* howtos has been moved to the *Datasets* section, making them shorter. Also a few examples have been added to *How to Access Mobility Data With API v2*.

  References: #214

2021.06

Released: 30 June 2021

- **[Change] [Improvement]** ¶ The Tourism domain was modified and improved in several points, which are reflected in the documentation:
  - New Swagger and API URLs
  - Localised methods have been definitely removed
  - A new *extlink* to shorten URLs of tourism API in the documentation source code has been introduced
  - The *How to access Tourism Data?* article has been modified to include the API browsable interface
  - Tourism datasets have been ordered lexicographically

  References: #220
- **[Change] [Improvement]** ¶ The description of the new Knowledge Graph underlying the Mobility domain has been added. Also the *SPARQL Howto* has been updated to reflect the new precooked queries and layout.

  References: #219

2021.08

Released: 31 August 2021

- **[Improvement]** ¶ Add statistics about Tourism's Open Data and CC0-licensed images

  References: #232
- **[Improvement]** ¶ Rearrange subsections in sections *Accessing the Open Data Hub* and *Domains and Datasets*, add a new FAQ entry and reformat FAQ section.

  References: #221
- **[Improvement]** ¶ The sphinx-panels extension has been replaced by its successor, sphinx-design.

  References: #233

- **[Change] [Improvement]** ¶ Keycloak has been introduced as default authentication method for the Open Data Hub.

  References: #223

- **[Change]** ¶ The URL of the Tourism API has been updated

  References: #231

- **[Bugfix] [Improvement]** ¶ Update old URLS, fix broken links.

  References: #227

- **[New Feature]** ¶ New filters for the tourism domain: rawfilter, rawsort, and removenullvalues.

  References: #224

2021.09

Released: 30 September 2021

- **[Bugfix]** ¶ Fix requirements.txt file.

  References: #244

- **[New Feature] [Improvement]** ¶ AlpineBits DestinationData and HotelData have now a dedicated page.

  References: #225

2021.12

Released: 31 December 2021

- **[New Feature]** ¶ Add WeatherHistory dataset.

  References: #247

7.3.2 Changelog 2022

2022.03

Released: 31 March 2022

- **[Improvement]** ¶ Major changes to sectioning: unify sections *Project Overview*, *Getting Involved*, and *Accessing the Open Data Hub*; move description of domains to *Domains and Datasets* section, move *Open Data Hub Architecture* to *Appendices*.

  References: #251

- **[New Feature]** ¶ Add section *Quickstart*.

  References: #250

2022.05

Released: 31 May 2022

- **[Improvement]** ¶ Slight improvements to the section names, documentation for GitHub workflow moved to howto.

  References: #255

- **[Improvement]** ¶ The custom theme was modified to keep it updated with the upstream one. Also, contact information were changed.

  References: #253

2022.06

Released: 30 June 2022

- **[Improvement]** ¶ Support for Mobility API v1 has been dropped and is no longer available.

  References: #259

2022.10

Released: 31 October 2022

- **[Change]** ¶ FAQ were moved to the wiki.

  References: #255

- **[Change]** ¶ The list of datasets and information about them was moved to the main Open Data Hub web page.

  References: #263

- **[Change]** ¶ For improved terminology consistency, we made sure that all occurrences of the *ODH* acronym were replaced with its expanded form, Open Data Hub.

  References: #264

- **[Bugfix] [Improvement]** ¶ The *Changelogs* section was reorganised: entries of each year were moved to a separate page and issues were grouped according to their released version. Also, missing changelog entries for tickets #263 and #264 have been added.

  References: #268

7.3.3 Changelog 2023

2023.01

Released: 31 January 2023

- **[Changes]** ¶ Replace Open Data Hub domains from `.bz.it` to `.com`.

  References: #262

- **[Changes]** ¶ Update outdated links, remove broken links, and fix `linkcheck` builder's configuration.

  References: #269

- **[Changes]** ¶ Added a warning to inform that the SPARQL endpoint is available on demand only.

  References: #273

2023.07

Released: 31 July 2023

- **[Bugfix]** ¶ As required by the readthedocs.org rules, configuration file `.readthedocs.yaml` is included in the docs for a correct build.

  References: #289

- **[Changes]** ¶ The list of *Data Providers* is now available on https://opendatahub.com/community/.

  References: #277

- **[Changes]** ¶ All the information about the licenses used for Open Data Hub resources are grouped together in the same section, *Datasets, Open Data, and Licenses*, .

  References: #278

- **[Changes]** ¶ The material in section *Documentation for Developers* was mostly outdated or obsolete, and has been replaced with a summary and a link to developer's Flight Rules, which are constantly updated by the developers themselves.

  References: #279

- **[Changes]** ¶ All the content of the *Quickstart* has been moved to the Open Data Hub Portal and is now replaced with a link to the Portal's *Quickstart*.

  References: #280

- **[improvements]** ¶ The `hidemail.py` python script used to obfuscate e-mail addresses with a proper Sphinx extension.

  References: #281

- **[Improvements]** ¶ A few changes to make this technical documentation site more similar to the Open Data Hub portal. In particular,

  - The logo is updated
  - There are some new CSS rules
  - The *Open Sans* fonts are now used throughout the Documentation
  - External links open in a new tab
  - A favicon was added

  References: #288

2023.09

Released: 30 September 2023

- **[Improvements]** ¶ Replace the outdated descriptio of the architecture with link to dedicated repository.

  References: #293

- **[Improvements]** ¶ Update documentation footer with NOI's copyright.

  References: #295

CHAPTER

EIGHT

FREQUENTLY ASKED QUESTIONS

Changed in version 2022.10: removed FAQ

The list of FAQ has been moved to the Open Data Hub wiki, where you can find also Specific FAQ for the Mobility domain and the Tourism domain.

More information on the Open Data Hub can be found on the project's home page.

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