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RE	Restricted to a group specified by the consortium (including the Commission Services)	
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Publishable Abstract

In this public deliverable, D2.4, documentation about the QuaLiFY Server Platform (shortly QSP or Quisper) is provided. QSP, currently in beta version, supports development of new ICT-based solutions for personalized dietary advising by providing easy access to a set of webservices, bringing together data and knowledge about food and nutrition.

Firstly, the general concept of QSP is presented. Its architecture relies on a proxy server and portals for developers of new client applications as well as for webservice providers.

Secondly, the architecture of the platform and configuration of the proxy server are explained.

Then the administrative management system of the platform is briefly described.

The developer portal, which is the entrance point for developers using the QSP webservices, allows developers to apply for one or more webservices. The developer portal is visually integrated with www.quisper.eu.

The provider portal will be used by providers of datasets or knowledge rules. In the portal the providers can see statistics and handle webservice users.

Finally the user manuals for the administrative management system, the developer portal and the provider portal are provided.





Definitions

API	Application Programming Interface	Specifies a software component in terms of its operations, their inputs and outputs and underlying types.
API management system		A process of publishing, promoting and overseeing APIs in a secure, scalable environment. It also includes the creation of end user support resources that define and document the API.
Client application		A web-based or mobile application that integrates with QSP webservices via QSP.
CMS	Content Management System	A software that allows editing and updating content, organizing, deleting as well as maintenance from a central interface.
Data		Facts and figures which relay something specific, but which are not organized in any way.
Developer		A person or a team developing a new service or product.
Dx.y	Deliverable x.y	
Eurogene		Eurogene was an EU-funded eTen project aiming to deliver an integrated high secure cross border platform for preventative healthcare incorporating genetic and lifestyle analysis. More info available at: http://eurogene.biomed.ntua.gr/ .
EURRECA	EURopean micronutrient RECommendations Aligned	EURRECA was a Network of Excellence funded by the European Commission under the Sixth Framework Programme. The Network (2007-2012) addressed the problem of variations in micronutrient recommendations between different European countries. Its main objective was to develop methodologies to standardise the process of setting micronutrient recommendations.
FDTP	Food Data Transport Package	The objective of the EuroFIR FDTP is to ensure recipients can access simple comprehensive, up-to-date food information from food composition databases. Detailed information on data entities and standard thesauri, both used in EuroFIR FDTP, can be found in documents published at http://www.eurofir.org/?page_id=2717 (Accessed on November 2015).
Food4Me	http://www.food4me.org	Food4Me was an EU project aimed to survey the knowledge of personalised nutrition, and to explore the application of individualised nutrition advice. The Food4Me project also investigated consumer attitudes and produced new scientific tools for implementation.
JSON	JavaScript Object Notation	An open, language-independent standard format that uses human-readable text to transmit data objects consisting of attribute–value pairs.
Knowledge		Contextualized information that implies know-how and





		understanding.
Knowledge rule		Algorithm containing the logical rules for the interpretation of a set of data in view of specific scientific evidence.
NRC	https://humanstudies.tno.nl/nrc/#nrc	The Nutrition Researcher Cohort (NRC) is a global cohort of researchers in nutrition and health sciences who gather self-assessment data on lifestyle and health. NRC gives access to reliable information on personal health trajectory, and effects of diet on the personal health.
NuGO	http://www.nugo.org	NuGO is an Association of Universities and Research Institutes focusing on jointly developing the existing research area of nutrigenomics and nutritional systems biology. NuGO evolved from an EU Sixth Framework Network of Excellence (NoE NuGO), and since 2010 the NuGO Association has taken over some of the activities of NoE NuGO that ended in 2010.
Ontology		A specification of a conceptualization: the objects, concepts, and other entities that are assumed to exist in some area of interest and the relationships those hold among them.
Protégé	http://protege.stanford.edu	A free, open-source ontology editor and framework for building intelligent systems.
Provider		A company/person that provides access to a webservice through QSP.
Proxy server or proxy		A dedicated computer or a software system running on a computer that acts as an intermediary between an endpoint device, such as a computer, and another server from which a user or client is requesting a service (definition by WhatIs.com).
QSP or Quisper	QuaLiFY Server Platform	QSP provides easy access to a set of webservices, bringing together data and knowledge about food and nutrition.
REST	Representational State Transfer	An architectural style/approach to communications that is often used in the development of webservices.
SaaS	Software as a Software	A software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted (definition by Wikipedia).
SME	Small and medium enterprise	
SOAP	Simple Object Access Protocol	An architectural style/approach to communications that is often used in the development of webservices.
Taxonomy		A classification of food- and nutrition-related terms like “vitamin B ₁ ”, “thiamin”, “carotene, alpha”, “alpha carotene”, “rs1205”, etc.
WP	Work package	
XML	Extensible Markup Language	A language that defines a set of rules for encoding documents in a format which is both human-readable and machine-readable.





Introduction

In the EU project QuaLiFY, we developed the beta version of the QuaLiFY Server Platform (QSP) to support development of new solutions for personalized dietary advice. QSP provides easy access to a set of webservices, bringing together data and knowledge about food and nutrition. Most of these data and knowledge were gathered by various EU-funded projects (e.g. EuroFIR, NuGO, EURRECA, Eurogene, and Food4Me) and have high scientific value. They are of great interest for commercialisation, but were fragmented and not harmonised. The rest of the data and knowledge provided through QSP were collected by small and medium enterprises (SMEs) and require scientific validation. Through QSP all this data and knowledge - collected from both EU-funded projects and SMEs - were unified to support nutrition research, and businesses in the development of new services and products, according to requirements of specific groups including those at-risk or clinically diagnosed (e.g. diabetic, obese, elderly).

After the end of the QuaLiFY project, the beta version of QSP will be open to developers of existing and new services in personalised dietary advice, as well as to webservice providers of new food- and nutrition-related data and knowledge rules.



Results

1. Quisper Service Platform

The QuaLiFY Server Platform (QSP) is a proxy for several webservices in the field of nutrition and dietary advice. The QSP handles authentication, authorization, statistics, monetization and billing. Moreover, the QSP bundles the separate webservices and provides a single entry point for a lot of information. A high level description is shown in Fig. 1.

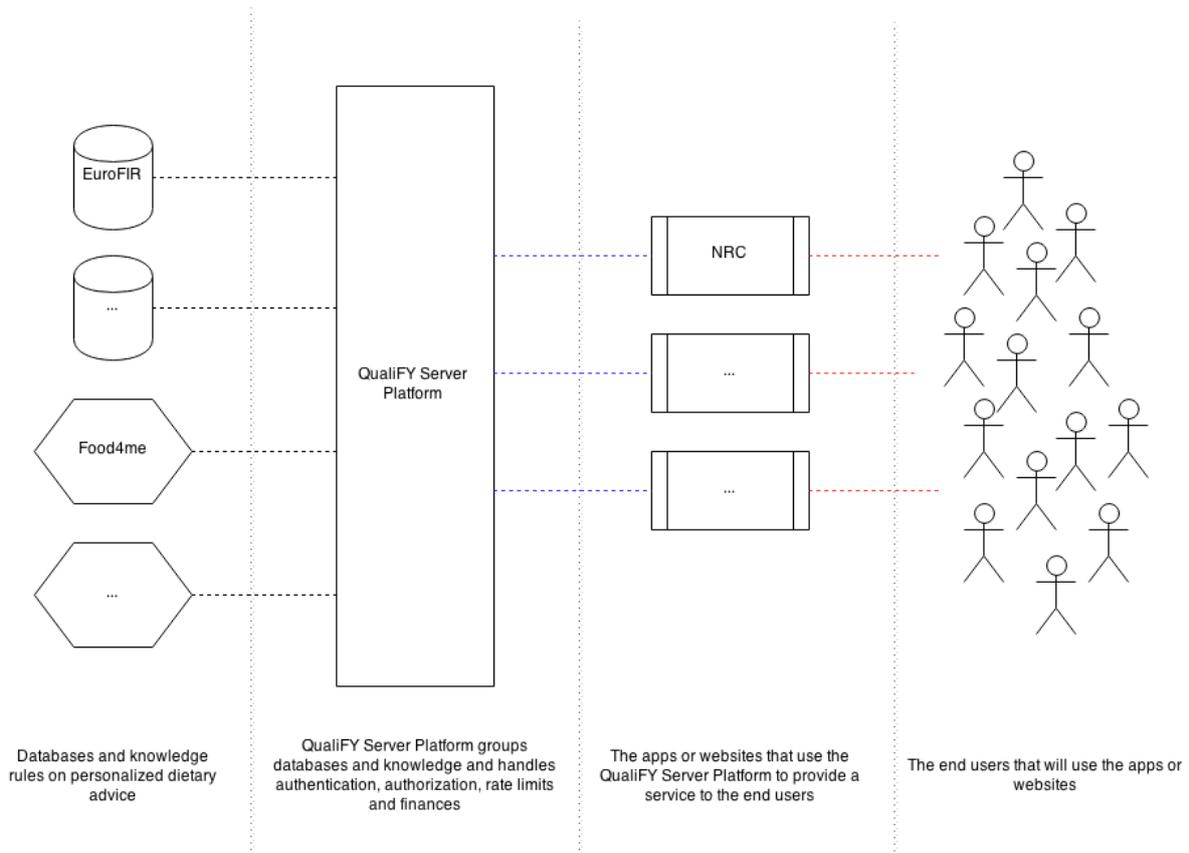


Fig. 1: The QuaLiFY server platform – from databases to end users

The public website related to the QSP can be found at <http://quisper.eu/>.

1.1 Architecture

The architecture of the QSP consists of 4 parts:

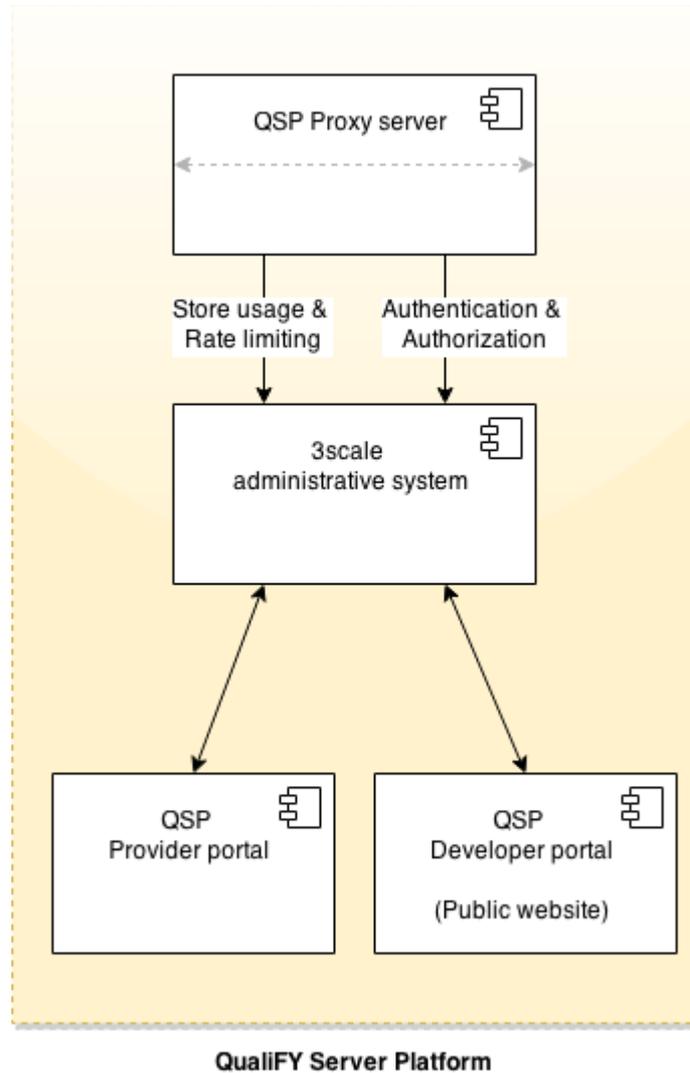


Fig. 2: Architecture of the QuaLiFY server platform

1. The 3scale system is used as the central part of the QSP. This hosted system (<https://qualify-admin.3scale.net>) contains all administrative functionality that is needed to manage the APIs.
2. The Proxy server (<http://qualify.thehyve.net> or <http://api.quisper.eu>) is a separate server (hosted in Germany to avoid issues with the Patriot Act) that actually transfers the data and knowledge from the client to the actual webservices (and the other way around). The 3scale system does not ever see the data passing the proxy server, but only the metadata (who makes which call) and metrics. It consists of an openresty application server (leveraging a.o. nginx and lua) and is configured using puppet.
3. The developer portal (<https://developer.quisper.eu>) is the entrance point for developers using the QSP webservices. It allows developers to create an account and apply for one or more webservices. Developers can also see statistics and read documentation. The developer portal is hosted by 3scale and maintained using the 3scale CMS. The developer portal will be visually integrated with the public frontend website (a wordpress website with public information; not in the graphic).

- The provider portal (<https://provider.quisper.eu/>) is the entrance point for webservice providers. In the portal the providers can see statistics and handle webservice users.

Security

SSL certificates (COMODO Positive SSL with Organization Validation) are installed for the domains <https://quisper.eu>, <https://api.quisper.eu> and <https://provider.quisper.eu>.

Availability of Source Code

Three parts of Quisper (Proxy server, Developer Portal and Provider Portal) are Open Source Software. This means the source code is available with a license which provides the rights to study, change, and distribute the software to anyone. The specific license for Quisper is Affero GPLv3.0 – see below:

GPL

GPL is the most widely used free software license and has a strong copyleft requirement. When distributing derived works, the source code of the work must be made available under the same license.

GNU Affero GPL v3.0	GNU GPL v2.0	GNU GPL v3.0
Required <ul style="list-style-type: none"> ● Disclose Source ● License and copyright notice ● Network Use is Distribution (only Affero) ● State Changes 	Permitted <ul style="list-style-type: none"> ● Commercial Use ● Distribution ● Modification ● Patent Use ● Private Use 	Forbidden <ul style="list-style-type: none"> ● Hold Liable ● Sublicensing <p>only in Affero and v2.0, not 3.0</p>

The 3scale administrative system is a commercial system and therefore not Open Source.

Proxy server (configuration is Open Source)

- hosted in Germany
- official digital certificate
- based on openresty (nginx, lua: All opensource (BSD, MIT))
- license: Affero GPLv3.0
- <https://github.com/thehyve/quisper-configuration-public/>

Provider Portal

- hosted in Germany
- based on
 - Grails: Open source (Apache 2.0)
 - Bootstrap: Open Source (MIT)
- license: Affero GPLv3.0
- <https://github.com/thehyve/qualify-provider-portal>

Developer Portal

- hosted in 3scale CMS
- Generating doc pages with swagger.io: open source (Apache 2.0)
- license: Affero GPLv3.0
- <https://github.com/thehyve/qualify-devportal>



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1.2 3scale administrative system

The most relevant parts of the 3scale system include:

- A list of webservices offered by the QSP. The 3scale system maintains the statistics and authorization for each webservice, and for that reason all webservices are mentioned in the 3scale system.
- A webservice is identified by a number (service identifier), which is automatically generated by 3scale and used for communication from the proxy server to the 3scale system.
- A webservice has application plans ("Application plans define access policies for your API itself, allowing you to differentiate between restricted / limited use (e.g. a testing sandbox) and production or premium usage.") and service plans ("Service plans allow you to define grades of service for each of the services (APIs) available through your developer portal. The plans allow you to define pricing per service and features available"), which can be managed in the 3scale system¹.
- Within an application plan for a webservice, one can specify the metrics to be measured as well as the limits to be posed upon an application using this service. The usage metrics are sent by the proxy server to 3scale. By default, webservices have only a single metric called 'hits', which measures the number of hits on a specific webservice. However, this can be also changed to measure the payload being sent (the bytes sent back and forth).
- A list of developers with an account on QSP. These developers have signed up through the developer portal (or were created by an administrator).
- A list of applications registered by the developers. An application is the result of a developer signing up for a specific webservice. Each application will be given an application key, which is used by the developer to make the webservice calls.
- A list of invoices. Invoices are automatically generated based on the subscriptions and/or usage of the webservices.

1.3 Proxy server

QSP is an open-source nginx web server configured as a proxy, which connects several independent webservices as well as a harmonization webservice for providing a single entry point to QSP webservices.

The QSP proxy also uses 3Scale API to communicate proxy with 3scale platform and provides authentication, authorization, statistics, monetization and billing. However, the traffic between end-users and providers is only visible to the proxy.

The hosting provider for the QSP proxy server is Hetzner (Germany; <https://www.hetzner.de>).

The server configuration and nginx configuration is managed by The Hyve, using puppet. The configuration is based on the example configuration files provided by 3scale and consists of a nginx configuration file and a set of lua scripts.

1.4 Developer Portal

The developer portal (<https://developer.quisper.eu>) is the entrance point for developers using the QSP webservices. It allows developers to create an account and apply for one or more webservices. An overview of the current integrated webservices is available via the Developer Portal. Developers can also see statistics and read documentation.

The developer portal is hosted by 3scale (on a European server) and has been configured and customized by using the 3scale CMS at <https://qualify-admin.3scale.net/p/admin/cms>. The developer portal is visually integrated with the public frontend website (a wordpress website with public information).

The application is based on liquid, a type of templating mark-up language. Documentation can be found at:

- 3scale CMS guide (<https://support.3scale.net/howtos/portal-configuration#cms-guide>)

¹ The pricing model is not fixed yet, but needs to be discussed within Quisper.





- 3scale liquid reference (https://qualify-admin.3scale.net/p/admin/liquid_docs)
- 3scale forum (<https://support.3scale.net/forum>)

1.5 Provider portal

The provider portal is the entrance point for webservice providers. Provider accounts can be created by an administrator. In the portal the providers can see statistics and handle webservice users. The portal is built as a [grails application](#), leveraging [bootstrap](#) for presentation purposes.

The portal uses the 3scale API to retrieve the information and show it to the user. This ensures correct information and only little information to be stored locally. The provider portal only has a list of users and a list of webservices (with a 3scale identifier) and a many-to-many relation between those entities.

The provider portal is currently hosted at the same server as the proxy server. The provider portal can be accessed from <https://provider.quisper.eu/>, while the hosting provider is Hetzner (Germany, <https://www.hetzner.de>).

Currently providers have limited possibilities to manage their API via 3scale, the complete management is handled by an administrator. This has multiple reasons:

- After the addition of a webservice, the settings will probably not change very often
- Letting providers change the settings could easily lead to an instable system, as settings in the admin system do not match the settings on the proxy
- We have not set automatical changes of any proxy settings, as making the system robust enough to do so was out of scope of the project
- If the settings are not changed very often, it is more efficient to have an administrator change the settings than to create an interface for the providers to do so.





2. User Documentation

The documentation is published on the documentation page (<https://developer.quisper.eu/docs>) and attached as annex to this report.

2.1 Developer documentation

Annex 1 - Manual for Developers: How to use the developer portal (<https://developer.quisper.eu/>).

Annex 2 - Manual for Developers: How to connect to a webservice (<https://developer.quisper.eu/>).

2.2 Provider documentation

Annex 3 - Manual for Providers: How to use the provider portal (<https://provider.quisper.eu/>).





3. Current available webservices

Currently the following webservices are available for accessing food- and nutrition-related 1) data and 2) knowledge rules.

A more detailed description of food- and nutrition-related data and knowledge rules provided through QSP can be found on the QualiFY frontend website (<http://quisper.eu>) as well as in the QSP developer portal (<https://developer.quisper.eu/>), in the Swagger documentation.

3.1 Webservices for accessing data

EuroFIR-FoodTransport

Provider: EuroFIR AISBL / EU project & NoE EuroFIR

Webservice type: SOAP/XML

Brief description: Provides access to food composition data collected by EU project EuroFIR for the following countries:

- Poland, Norway, Italy, Lithuania, Portugal, UK, France, Iceland, Italy, Austria, Bulgaria, Czech Republic, Ireland, Slovakia, Belgium, Denmark, Latvia, Canada, Turkey, Spain, Switzerland, Finland, Serbia, The Netherlands, Greece, Sweden, Slovenia, USA

Requests/responses: Requests use purpose-designed Food Data Query Language (FDQL), which is part of the EuroFIR webservice specification. Responses use Food Data Transport Package (FDTP) to deliver food composition information and Meta Data Transport Package (MDTP) to deliver related meta-data.

Remark: EuroFIR, in cooperation with national compilers from its member states, maintains food composition databases and upgrades them with new data.

ref values de

Provider: VivSan

Webservice type: RESTful HTTP-based API (webservice) using JSON as data exchange format for dietary intake reference values² (Fig. 3).

Scope of dietary reference intake values: The webservice considers D-A-CH dietary reference intake values. The abbreviation D-A-CH arises from the initial letters of the common country identification for the countries Germany (D), Austria (A) and Switzerland (CH), which are also used in other countries. The Reference Values for Nutrient Intake are the basis on which diets are planned to match nutritional requirements for food intake. In addition, they form the basis for food rules and regulations for the food industry and food monitoring. The majority of the revised reference values (e.g. energy) are published open access³.

Requests/responses: The parameters which can be used to request dietary intake values are the following:

- Gender: male or female;
- Age: see the list of nutrients available in D2.1.

The request can have either one, two or all parameters which will then return the appropriate data to the client.

Brief description: In the case of the developed webservice for German reference values the service receives its input values (e.g. age, sex and nutrient) and returns the value for a specific age and sex for the specified nutrient. As a basis for this webservice the German reference values were considered.

Remark: The webservice developed by VivSan for D-A-CH dietary/nutrient intake values was the first fully operational webservice using latest web technologies according to latest standards on the QSP. It was also the

² According to standards laid out by the Internet Engineering Task Force (IETA).

³ Source: <https://www.dge.de/en/>





first one to implement the correct type of documentation. By changing the underlying data in the tables, the webservice can easily be used for a wide variety of dietary reference intake values of other countries or institutions (e.g. WHO, FAO, etc.).

Basic outline of webservice for Dietary Intake Reference Values (D-A-CH)

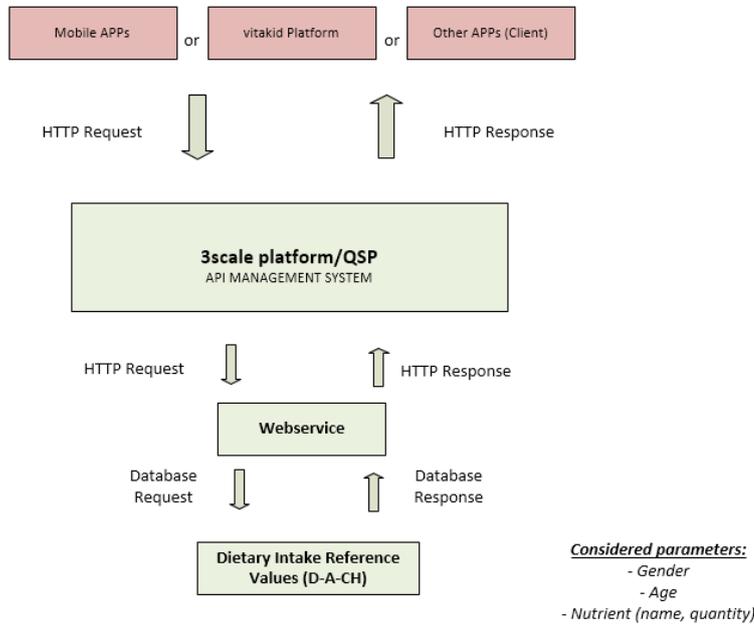


Fig. 3: Basic outline of webservice for Dietary Intake Reference Values

EuroFIR-DietaryReferenceValues

Provider: EuroFIR AISBL

Webservice type: REST/JSON

Brief description: Provides access to dietary reference values for the following countries:

- Austria, Switzerland, Germany, Slovenia, Czech Republic (Reference values for nutrient intake D-A-CH⁴), 2000
- United Kingdom (Scientific Advisory Committee on Nutrition (SACN)), 2012
- Italy (LARN, SINU – Italian Society for Human Nutrition), 2014
- Nordic countries (Nordic Nutrition Recommendations, Nordic Council of Ministers, 2012)
- Europe (EFSA Scientific Opinions):
 - EFSA Panel on Panel on Dietetic Products Nutrition and Allergies, Scientific Opinion on Dietary Reference Values for Iodine, 2014
 - EFSA Panel on Panel on Dietetic Products Nutrition and Allergies, Scientific Opinion on Dietary Reference Values for pantothenic acid, 2014
 - EFSA Panel on Panel on Dietetic Products Nutrition and Allergies, Scientific Opinion on Dietary Reference Values for biotin, 2014
 - EFSA Panel on Panel on Dietetic Products Nutrition and Allergies, Scientific Opinion on Dietary Reference Values for Vitamin C, 2014
 - EFSA Panel on Panel on Dietetic Products Nutrition and Allergies, Scientific Opinion on Dietary Reference Values for manganese, 2013

⁴ D-A-CH stands for the German-speaking countries: Germany, Austria and Switzerland.





- EFSA Panel on Panel on Dietetic Products Nutrition and Allergies, Scientific Opinion on Dietary Reference Values for molybdenum, 2013
- EFSA Panel on Panel on Dietetic Products Nutrition and Allergies, Scientific Opinion on Dietary Reference Values for fluoride, 2013
- EFSA Panel on Panel on Dietetic Products Nutrition and Allergies, Scientific Opinion on Dietary Reference Values for niacin, 2014
- Protein and Amino Acids Requirements in Human Nutrition, WHO/FAO/UNU Expert Consultation, 2007

Requests/responses: A request is based on REST html query with JSON response, which returns dietary reference values with regards to query parameters (“component_code” and “eng_name”).

Remarks: In the project proposal, as well as in the QuaLiFY DoW, we stated that dietary reference values gathered in the EU project EURRECA would be applied. As the EURRECA values consider only micronutrients and are not updated, EuroFIR collected up-to-date dietary reference values from evidence-based sources (listed above) considering the EURRECA framework [14]. EuroFIR has asked the authors of the above listed dietary reference values for the permission for using the values for the aims of Quisper.

vitalinq

Provider: VitalinQ

Webservice type: REST/JSON

Brief description: Provides access to compositional data of food products, daily recipes, measure objects, measurements, etc.

Requests/responses: A request is based on a query with JSON response, which returns a recipe of the day, a dietary advice of the day, a measure object, measurements, or a food or a group of foods with either compositional data or meta data for a given food name or EAN barcode.

Remark: Detailed information can be found at <https://api.vitalinq.nl>.

SwissAnalysis-BiomarkerAnalysis

Provider: SwissAnalysis / Sonce.net

Webservice type: REST/JSON

Brief description: A detailed list of a large amount (127) of different biomarkers can be requested via the webservice. The biomarkers database can be managed via WordPress CMS by the provider (SwissAnalysis) where normal values for biomarkers analysis can be added, alongside subtype (e.g. vitamins), unit, methods used, synonyms and SA code. Blood drawing material will be sent out. Furthermore, it provides access to the individual results, as soon as lab work is finished by creating a user account for each individual client.

Requests/responses: Response is based on a HTTP GET request and retrieves the biomarkers list in the following format:

id => Quisper internal ID
name => Short name
type => Type of biomarker (e.g. Vitamins)
abbreviation => Abbreviation or SA code
synonyms => Full name and/or synonyms
unit => Default unit(s)
method => Default method(s)
normal_range => Common range (depends on other factors, such as age, nationality, etc.)
modified_gmt => GMT timestamp when the biomarker was last modified (for caching purposes, etc.)

Remarks: The service can be extended to provide different functionalities as needed by the labs which will be performing the analysis.





Vitas

Provider: Vitas

Webservice type: REST/JSON

Brief description: Provides access to results of biomarker analysis performed on regular blood samples or dried blood spots.

Requests/responses: Both requests and responses are JSON strings. For now, three markers can be specified in the request, Omega-3 index, total Carotenoids and 25-OH-D3.

Remark: This webservice can be extended to include a wide range of biomarkers and would support the offering of biomarker analysis from QSP as well as an automated way of collecting data and possibly combine these with reference ranges and knowledge rules for visualisation on apps and webpages.

FWiz-BrandedFoodData

Provider: FoodWiz / IFR

Webservice type: REST/JSON

Brief description: Provides access to compositional data of UK branded foods (food products) as well as to their metadata (e.g. EAN barcodes).

Requests/responses: A request is based on a query with JSON response, which returns either one product with its nutrition data for given EAN barcode or a list of products that match given product name. Additional parameters 'pageSize' and 'pageIndex' are optional and provided in order to limit the data sent by one particular API call.

Remark: Currently, this webservice returns energy value and the compositional data with respect to the mandatory nutrition regulation (REGULATION (EU) No 1169/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL).



3.2 Webservices for accessing knowledge rules

SafeCape

Provider: SafeCape

Webservice type: REST/JSON

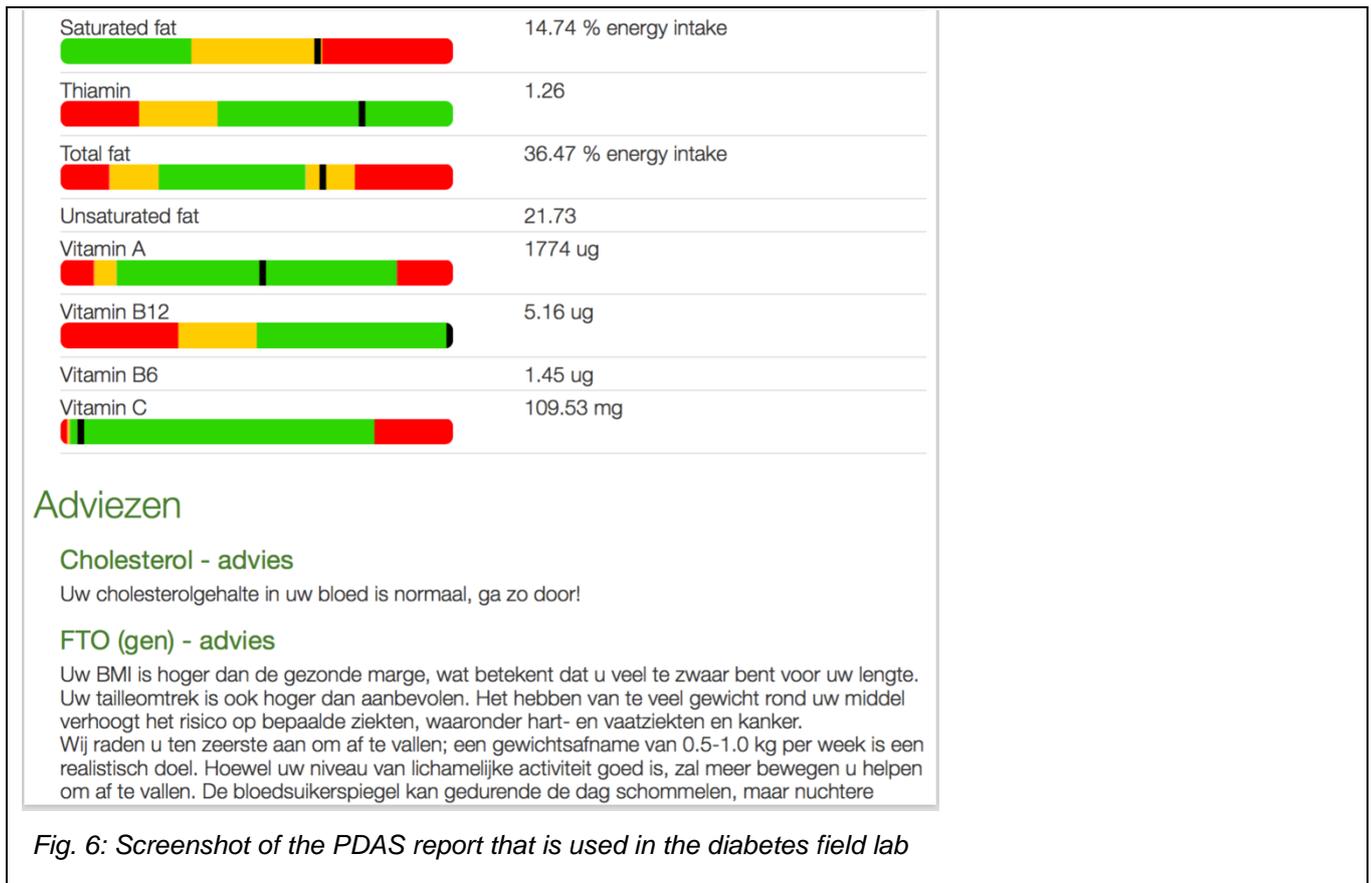
Requests/responses: The service receives as input machine-readable data about an individual (genotyping information, phenotype information, physical activity) and transforms these data into meaningful personalized recommendations and goals based on demonstrated associations among genes and other factors like diet and lifestyle (genotype-phenotype-nutrition interactions). The service is inherently multilingual and both input and output can be provided in any language.

Brief description: Generates personalized dietary advices (in a form of personalized reports) based on personal data (gender, body height, body weight), physical activity level and genetic profile (45 SNPs). The recommendations indicate e.g. whether one should increase or decrease nutrient or specific food intake, define possible predisposition to celiac disease, lactose intolerance risk, saturated fat and refined carbohydrate sensitivity etc. and can be delivered either as final reports in various formats (e.g. MS Word, PDF, HTML etc.) or as machine-readable output that can be integrated with other information into a final report, further processed or displayed on any device.

Remark: SafeCape API is powered by Rules Toolset © technology.



Fig. 4: Basic outline of SafeCape webservice



vitalinq

Provider: VitalinQ

Webservice type: REST/JSON

Requests/responses: A request is based on a query with JSON response, which returns a dietary advice for the specified day or nutrient.

Brief description: Provides access to personalized dietary advices considering food intake, measurements, etc.

Remark: Detailed information can be found at <https://api.vitalinq.nl>.



3.3 Webservice for harmonisation

HarmonizationQuisper

Provider: JSI

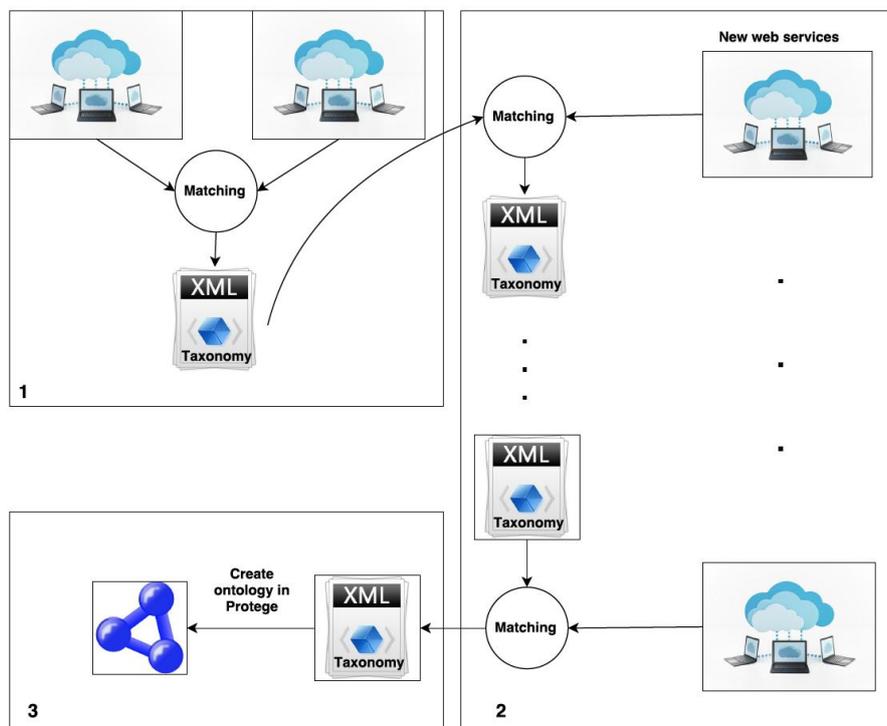
Webservice type: REST/XML

Requests/responses: Requests use purpose-designed Quisper Data Query Language [1], which is based on the Quisper ontology. Responses are provided in an XML document, which contains the response from the requested webservice(s).

Brief description: Provides a single-point access to QSP webservices. It relies on the Quisper Ontology that is created in a semi-automatic way. Firstly, QSP webservices are matched by using POS tagging (i.e. a probability weighed method), in order to catch similar terms and to organize them as taxonomy. This step is performed whenever a new webservice appears and needs to be matched with the taxonomy. Using the taxonomy of extracted concepts and relations between the variables in matched webservices, we have also created the Quisper Ontology that can be verified and edited by a human expert using Protégé that is a free, open-source ontology editor (<http://protege.stanford.edu>).

Remark: The Quisper Ontology can be accessed in Protégé via the temporal JSI account ([http://webprotege.stanford.edu/#List:coll=Home](http://webprotege.stanford.edu/#List:coll=Home;));).

Quisper ontology learning process [2]:





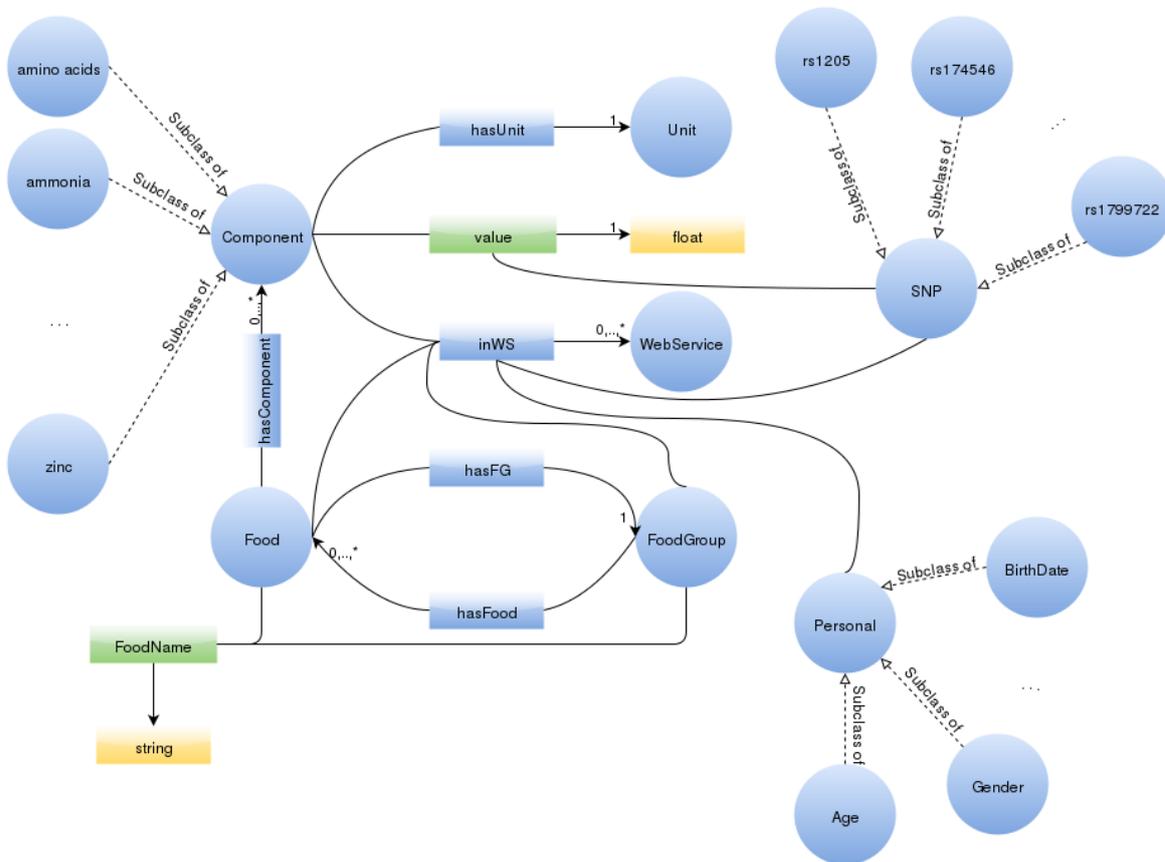
The Quisper taxonomy:

```

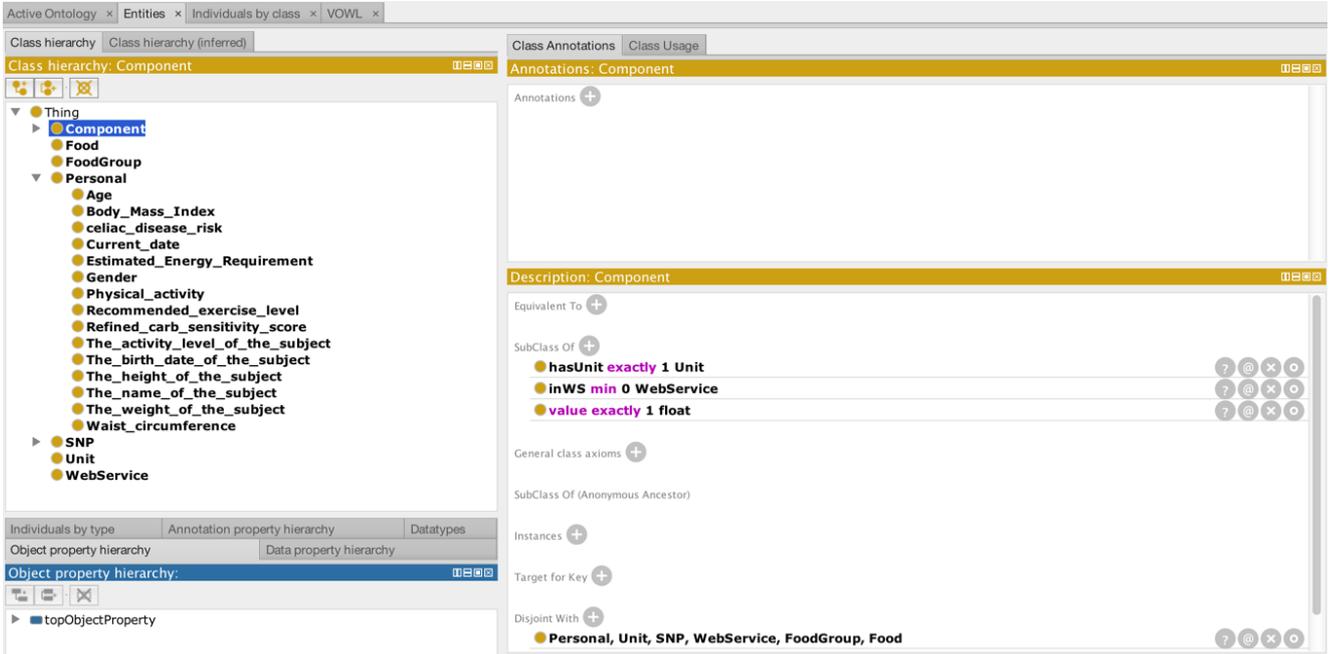
<Taxonomy>
...
  <WSproviders>
    <WSprovider name="EuroFIR " version="..." />
    <WSprovider name="Food4me" version="..." />
  </WSproviders>
  <Matching class="Component">
    <Descriptions>
      <Description source="EuroFIR" description="beta-carotene.beta-carotene.carotene, beta-
      .carotene, beta-, cis" code="CARTB.CARTB.." />
      <Description source="Food4me" description="Beta-carotene" code="103068006" />
    </Descriptions>
    <MatchScore>
      <MatchPair>
        <WSprovider name="EuroFIR" />
        <WSprovider name="Food4me" />
        <matchScore>0.1875</matchScore>
      </MatchPair>
    </MatchScore>
  </Matching>
...
</Taxonomy>

```

The Quisper ontology:



The Quisper ontology in Protégé:



The screenshot shows the Protégé ontology editor interface. The main window displays the 'Class hierarchy' for the 'Component' class. The hierarchy is as follows:

- Thing
 - Component
 - Food
 - FoodGroup
 - Personal
 - Age
 - Body_Mass_Index
 - celiac_disease_risk
 - Current_date
 - Estimated_Energy_Requirement
 - Gender
 - Physical_activity
 - Recommended_exercise_level
 - Refined_carb_sensitivity_score
 - The_activity_level_of_the_subject
 - The_birth_date_of_the_subject
 - The_height_of_the_subject
 - The_name_of_the_subject
 - The_weight_of_the_subject
 - Waist_circumference
 - SNP
 - Unit
 - WebService

The right-hand pane shows the 'Annotations: Component' section, which is currently empty. Below it, the 'Description: Component' section shows the following properties:

- Equivalent To: (empty)
- SubClass Of:
 - hasUnit exactly 1 Unit
 - inWS min 0 WebService
 - value exactly 1 float
- General class axioms: (empty)
- SubClass Of (Anonymous Ancestor): (empty)
- Instances: (empty)
- Target for Key: (empty)
- Disjoint With:
 - Personal, Unit, SNP, WebService, FoodGroup, Food

The Quisper ontology (part from the xml schema):

```
<owl:ObjectProperty rdf:about="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#hasComponent">
  <rdfs:range rdf:resource="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#Component"/>
  <rdfs:domain rdf:resource="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#Food"/>
</owl:ObjectProperty>

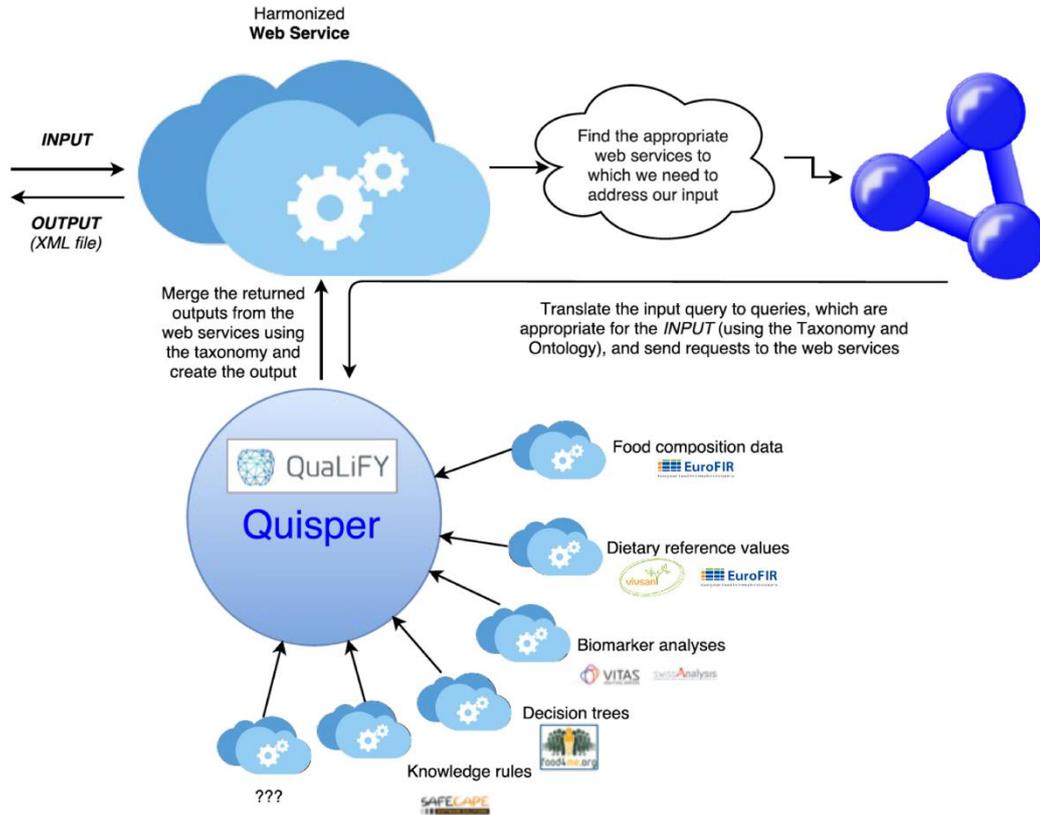
<!-- http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#hasFG -->
<owl:ObjectProperty rdf:about="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#hasFG">
  <rdfs:domain rdf:resource="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#Food"/>
  <rdfs:range rdf:resource="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#FoodGroup"/>
  <owl:inverseOf rdf:resource="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#hasFood"/>
</owl:ObjectProperty>

<!-- http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#hasFood -->
<owl:ObjectProperty rdf:about="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#hasFood">
  <rdfs:range rdf:resource="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#Food"/>
  <rdfs:domain rdf:resource="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#FoodGroup"/>
</owl:ObjectProperty>

<!-- http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#hasUnit -->
<owl:ObjectProperty rdf:about="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#hasUnit">
  <rdfs:domain rdf:resource="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#Component"/>
  <rdfs:range rdf:resource="http://www.semanticweb.org/tome/ontologies/2015/7/untitled-ontology-11#Unit"/>
</owl:ObjectProperty>
```



Quisper Harmonization Webservice:



4. Current available client applications

4.1 NRC portal

Provider: TNO / NuGO

Application type: portal for do-it-yourself (D.I.Y.) measurements

Brief description: The NRC portal is a client for gathering information to conduct studies that support D.I.Y. measurements. The portal is used as a client in the Nutritional Research Cohort (NRC) but an adaptation of the NRC portal was used as the central portal for reporting all measurements for the type 2 diabetes field-lab. On the NRC portal, various measurements can be reported and visualized. The NRC portal is generic; if necessary, new measurements can be added to the portal, which are defined by the administrator. Besides manual input, the NRC portal supports various APIs that, if once connected, extract data to the portal from various devices and measurements. The NRC portal supports the QSP webservice PDAS as well as APIs from Whittings, Fitbit, Medisana and Fatsecret.

Screenshot of the study portal, an adaptation of the NRC portal.



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 613783.



PDAS configuration – biomarker field mapping:

PDAS configuration

[Refresh properties](#)

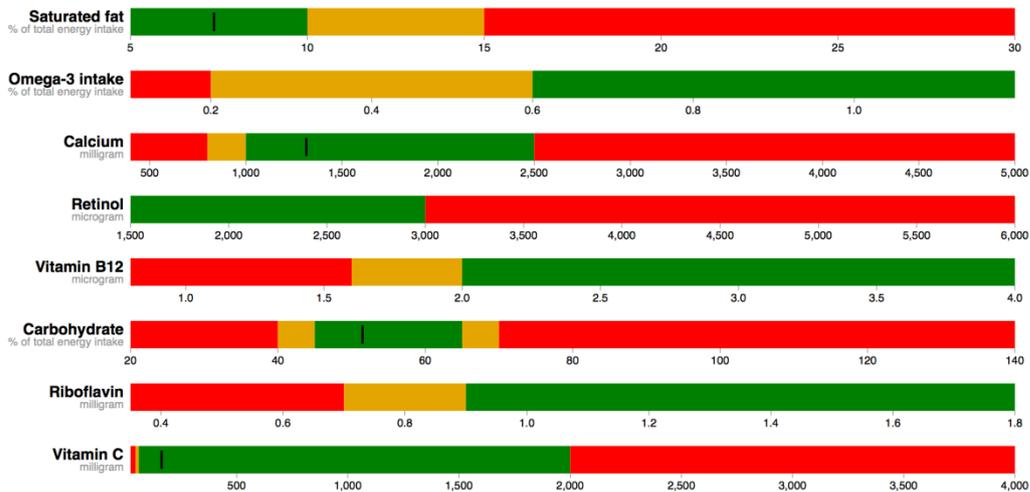
Field mapping for Biomarker

- Alpha-carotene** - none -
- Beta-carotene** - none -
- Beta-cryptoxanthin** - none -
- Carotenoids** - none -
- Cholesterol** - none -
- Docosahexaenoic acid** - none -
- Docosapentaenoic acid** - none -

An example of the advice presented in the NRC portal together with a graphical representation of some of the measurements:

Omega-3 index

Based on your blood results your omega-3 is just below sufficient levels. This appears to be coming mainly from your supplement intake. You should always try to include 2 portions of fish in your diet per week, 1 to be oily.





4.2 Food intake and physical activity smartphone application in adolescents

Provider: FoodWiz / IFR

Application type: Android mobile application

Brief description: This smartphone application was developed to support the field lab on obese adolescents. It is aimed for food intake and physical activity assessment (described in details in deliverables D3.1-4). The data used in the App is taken from a commercial source “BrandBank” combined with the most recent on-line version of the UK National Nutrient Data known as McCance and Widdowson’s The Composition of Foods, which is compiled by scientists at the IFR Food Databanks National Capability involved in the current project. These data have been provided to QSP through the FWiz-BrandedFoodData webservice (presented above). To support portion size estimation, the application was connected to the scale ‘Libra’ described below in the subsection Open Platform for Clinical Nutrition (OPEN).

4.3 vitakid Food and Health Platform (vitakid)

Provider: VivSan

Application type: Web-based or mobile (Android, IOS, Windows) application

Brief description: The vitakid-platform is a food and health platform for different settings and regions and in different languages. It has all necessary tools for dieticians, caterers, care takers, institutions, parents and children implemented and connects these different stakeholder in different settings according to the WHO developed settings approach with each other⁵. Furthermore it has an extensive recipe database, enriched food database, health promotion articles, etc.

The vitakid-platform was used in Spain and is currently used in Germany and France in nurseries and elementary schools. English and Arabic versions of the platform also exist. Some functionality of the vitakid Food and Health Platform is used in the clinical setting of the field lab for children with eating disorders. Unfortunately, the developed webservice for dietary intake reference values (see above) could not be connected to the vitakid-platform within the field lab due to security issues of the QSP, which does not comply to BSI-Standard 104 (security and data privacy standards) for passing these types of data on. It was inter alia aimed for personalized dietary menu planning (described in details in deliverables D3.1-4). The webservice uses D-A-CH Dietary Intake Reference Values, which are mainly used in Germany, Austria, Switzerland and other countries.

4.4 Open Platform for Clinical Nutrition (OPEN)

Provider: JSI

Application type: web-based application upgraded with a device (kitchen scale)

Brief description: OPEN is a web-based application (<http://opkp.si>) that supports food and physical activity recording and diet planning as well as 24-hour recall and food frequency questionnaires including photographs. It enables online interaction between a dietitian/researcher and a patient/study participant. To support its use in different countries and languages, OPEN allows translation of the user interface into any language as well as the use of any food composition dataset that complies with Food data structure and format standard (BS EN 16104:2012). By default, OPEN refers to national dietary recommendations, which can be modified by the dietitian/researcher to suit the needs of the individual patient/study participant.

⁵ See: http://www.who.int/healthy_settings/about/en/





In order to test the QSP concept as well as:

- To support the QuaLiFY field lab on diabetic patients, we connected OPEN with QSP and adjusted OPEN to Dutch (<http://openl.eu>);
- To support another QuaLiFY field lab on obese adolescents, we manufactured 20 pocket-size scales 'Libra' which were initially developed to be wirelessly connected to OPEN [3]. The scales Libra were connected with the FWiz client application (described above) by FoodWiz;
- We sent a scale's sample to VivSan because they expressed an interest in its usage in their QSP client application. Unfortunately, VivSan was not able to use the scale within the field lab.





Conclusion

This document provides documentation of the QuaLiFY Server Platform (QSP). The beta version of this platform has been developed by a group of SMEs and researchers, as part of the EU project QuaLiFY. This has been done in order to provide various ICT solutions for professionalism of SME activities in Personalised dietary advice services:

1. We have established a distributed knowledge repository of food- and nutrition-related data and information that is upgraded with knowledge rules for generating personalized advices based on genotype-phenotype-nutrition relationships.
2. In this way, data and knowledge gathered by various EU funded projects (EuroFIR, NuGO, Eurogene, Food4me etc.) and SMEs have been unified to support food- and nutrition research, and businesses in the development of new products, according to requirements of specific groups including those at-risk or clinically diagnosed (e.g. diabetic, obese, elderly).
3. Both providers (of data and knowledge) and users (application developers) have access to the QSP via the Provider Portal and Developer Portal.

The QSP has been designed and implemented in such a way that any new data and additional knowledge rules can be provided through the QSP via independent webservices.

We have developed a webservice that enables semi-automated harmonization of terms and concepts used in different QSP webservices, and relies on the Quisper taxonomy and ontology. This harmonization webservice is connected to QSP in the same way as other webservices, meaning that QSP will be able to be upgraded not only by new data and knowledge rule webservices but also by new harmonization webservices.



References

- [1] Eftimov, T. & Koroušič Seljak, B. (2015) "The Quisper Data Query language". The JSI Technical Report No. 11987, Jožef Stefan Institute, Ljubljana, Nov. 2015.
- [2] Eftimov, T. & Koroušič Seljak, B. (2015) "QOL - Quisper Ontology Learning using personalized dietary services". The JSI Technical Report No. 11985, Jožef Stefan Institute, Ljubljana, Nov. 2015.
- [3] BIASIZZO, A., KOJEK, G., KOROŠEC, P., KOROUŠIČ-SELJAK, B., PAPA, G. (2015) "Bluetooth kitchen scale V3.0". The JSI Technical Report No. 11950, Jožef Stefan Institute, Ljubljana, 2015.

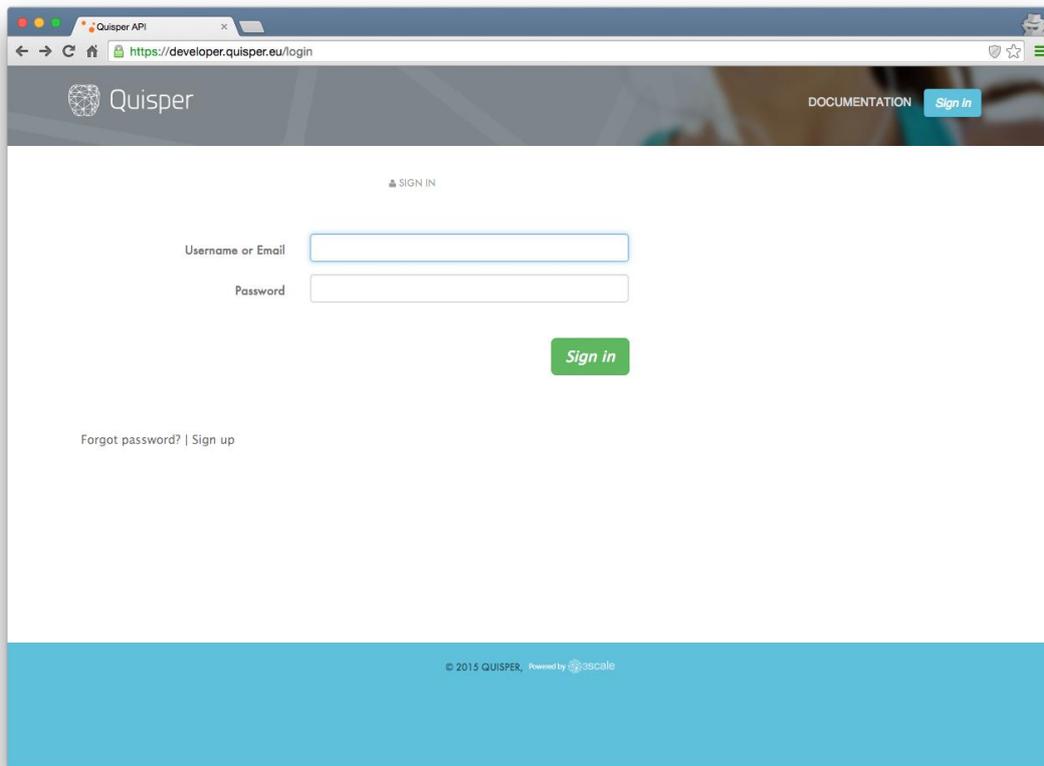


Annexes

Annex 1 - Manual for Developers: How to use the developer portal

4.1 Login or sign up

First, you will have to sign up for and login to the developer portal. You will receive your login confirmation by email.



4.2 Subscribe to a service

Before you can create an application, you must subscribe to one or more of the services. When you do not have any application yet, these services are listed on the main page. They can also be found under the section Services. You might already be subscribed to some services by default.





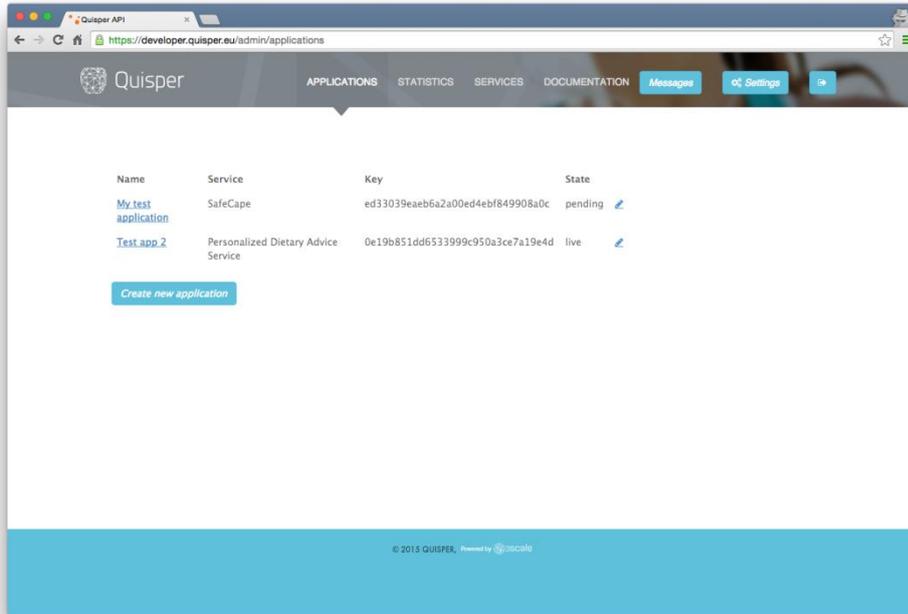
Name	Description	Current subscription	Service plans	Application plans
SafeCape	SafeCape is a REST API which contains scientifically validated genotype-phenotype-nutrition associations and can be used to generate personalized nutrition and lifestyle recommendations for an individual. Input variables include 45 SNPs related to metabolism, detoxification ability etc. and output variables contain personalized recommendations that indicate e.g. whether one should increase or decrease nutrient or specific food intake, define possible predisposition to celiac disease, lactose intolerance risk, saturated fat and refined carbohydrate sensitivity etc.	Default Review/Change	Default Free	SafeCape Application Plan
ref_values_de	Parameters: age: age in years (e.g. 5) gender: sex (male/female) nutrient: name of nutrient in German (e.g. Vitamin E-Tocopheroläquivalent, Energie, etc.) to see an example of all reference values for 5 yr. old girls -> http://185.21.103.97:8080/api/ref-values?age=5&gender=female	Subscribe	refs Setup fee USD 0.00 Flat cost USD 100.00	Starter
EuroFIR- FoodTransport	FoodTransport service by EuroFIR	Subscribe	Default Setup fee USD 50.00 Flat cost USD 20.00	EuroFIR- FoodTransport
Personalized Dietary Advice Service	The PDAS is a web-service based on the Food4Me level 3 advices. The service uses Food intake, biomarkers from bloodanalysis, SNP data and other body metrics (weight, BMI etc) as input. The service consists of two databases, one that contains guidelines and information like Daily, Recommended Intake values etc, etc. These values are used as cut-off values for the actual decision trees, the	Default Review/Change	Default Free	Default

You are subscribed to a service with a plan. Each service can offer more than one plan. Plans may vary by price and the amount of resources you may use (number of calls, etc.). Plans can be reviewed and changed by clicking the *review/change* button.

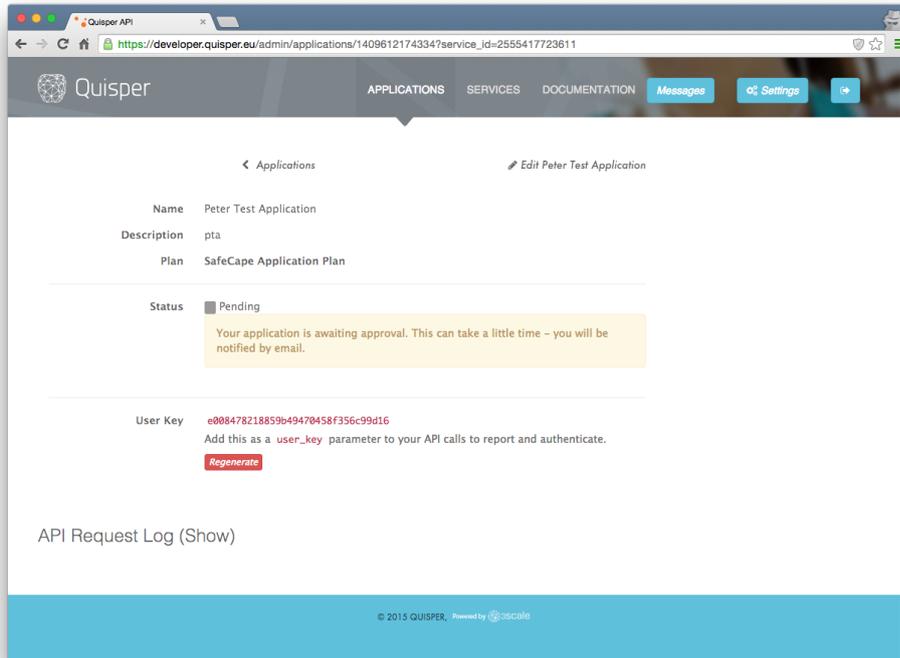
4.3 Creating an application

In the section Applications, your current applications are listed. Click the button to create a new application. You are then prompted to select one of the services that you want to use for this application (only services to which you are subscribed are shown).





After providing a name and description for your application, the application is created and you are directed to a screen showing your application's properties, plan, status and user key. You may have to wait until your application is approved. You need the user key / credentials when you make calls from your application.



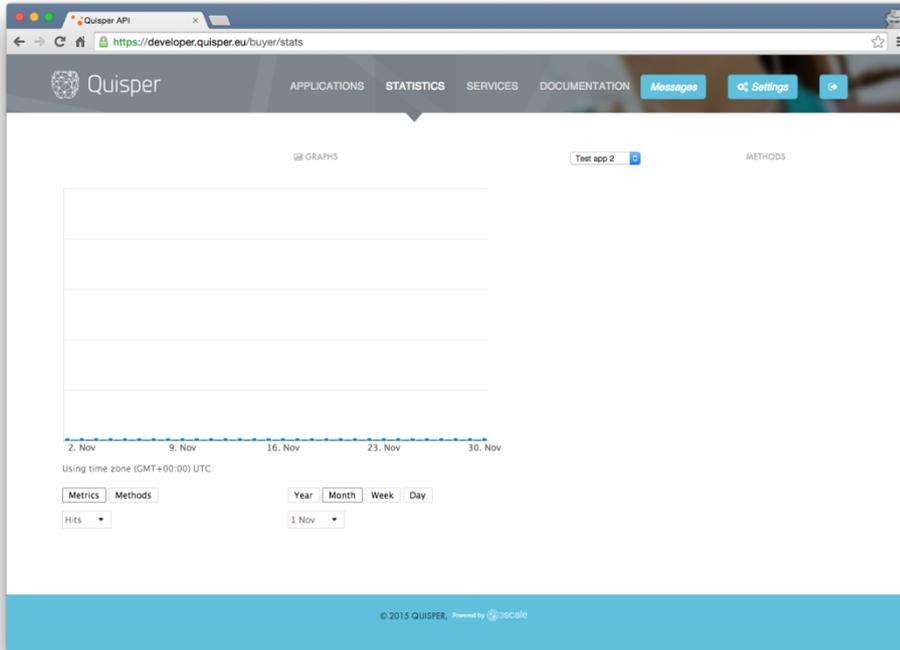
4.4 Multiple services in one application

If you want to make use of multiple services in your application, you must first subscribe to these services. Then, in the developer portal, create one application for each service. You will be prompted to select the service to use for each application. Use the different user keys for the corresponding calls in your actual application.



4.5 Viewing statistics

Once you have one or more applications that are live (they have been approved), the *statistics* menu option becomes visible. This allows you to view statistics of your applications.

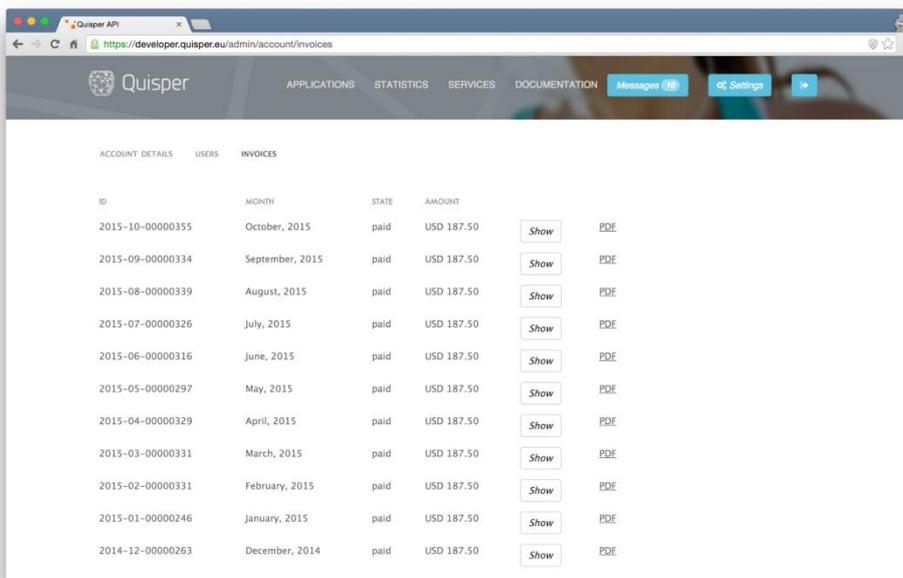


4.6 Account details and password

Click the *settings* button to see the account details. You can click the *edit* link to edit. The password can be changed in the section Users by clicking the *edit* icon in the list.

4.7 Viewing invoices

A list with invoices is available in the section Invoices, after clicking the *settings* button.



ID	MONTH	STATE	AMOUNT	Show	PDF
2015-10-00000355	October, 2015	paid	USD 187.50	Show	PDF
2015-09-00000334	September, 2015	paid	USD 187.50	Show	PDF
2015-08-00000339	August, 2015	paid	USD 187.50	Show	PDF
2015-07-00000326	July, 2015	paid	USD 187.50	Show	PDF
2015-06-00000316	June, 2015	paid	USD 187.50	Show	PDF
2015-05-00000297	May, 2015	paid	USD 187.50	Show	PDF
2015-04-00000329	April, 2015	paid	USD 187.50	Show	PDF
2015-03-00000331	March, 2015	paid	USD 187.50	Show	PDF
2015-02-00000331	February, 2015	paid	USD 187.50	Show	PDF
2015-01-00000246	January, 2015	paid	USD 187.50	Show	PDF
2014-12-00000263	December, 2014	paid	USD 187.50	Show	PDF





Annex 2 - Manual for Developers: How to connect to a webservice

Step-by-step guide to connect to a Quisper webservice.

Connecting to a webservice requires a Quisper developer account with credentials for the chosen webservice.

1. Create an account

Create a Quisper developer account at the [Quisper Developer Portal](#).

2. Subscribe to the webservice you need

- a. Go to *Services* (from the top menu)
- b. Choose the webservice you need and click *Subscribe*. Please note that if you are already subscribed to this webservice, you will only have the button *Review*.
- c. Choose a service plan for the service you want to subscribe to and click *Subscribe*.

→ The service plan determines the service level that is provided by the service provider. Each service level may have a different price.

3. Create an application for the webservice you need

- a. Go to *Applications* (from the top menu)
- b. Click *Create new application* and choose the webservice you want to create an application for (by clicking its title)
- c. Fill in a name and description for your application, and (if appropriate) choose an application plan.
- d. Click the *Create application* button

→ Application status

Depending on the webservice settings, the webservice provider must approve the application. This could take some time. Meanwhile, your application status will be *Pending*, and the credentials cannot yet be used. For some webservices, the application is automatically approved, and its status will be *Live*.

4. Lookup the credentials

Please note that every application has its own credentials.

→ These credentials are used to identify your application to the Quisper platform. Without it, you will not be able to use the Quisper webservices.

- a. Go to *Applications* (from the top menu)
- b. The list shows all your applications. Look up the one that is associated with the chosen webservice.
- c. Write down the credentials in the *application_key* column.'

5. Test your application key

Make a manual call to a webservice.

For example: `curl -v http://api.quisper.eu/pdas/properties.json -H "user_key: [application key]"`

6. Implement the calls

Implement the calls to the Quisper webservice in your own application or webservice.

The exact calls can be found on [quisper.eu](#). Make sure to include the `user_key` header in each call.





Annex 3 - Manual for Providers: How to use the provider portal

Authentication

To use the provider portal, a user account is needed. A provider can obtain a user account by contacting the QSP administrator, who can create an account. The account will only provide access to a subset of all webservices, relevant to the provider.

Statistics

The statistics page provides insights in the usage of the webservices. A chart is shown depicting the usage of the webservice in the chosen period.

- By default, the last month of 2014 is selected. However, the user can select any day, week, month or year to get more details or a more general overview
- All metrics that are being measured for a webservice are shown. By default, for each webservice the number of hits is measured. However, a provider can contact the QSP administrator to discuss other metrics
- If a provider has access to a single webservice, the chart is shown on load. If a provider has access to multiple webservices, the user has to click the name of the webservice to show a chart for that webservice.

Applications

The applications page shows a list of applications that developers have created for a given webservice. Each application has a status (*pending acceptance*, *live* or *suspended*), which can be changed by the provider. The user can click on the name of the application to open a popup with more details about the application and its developer.

- If a provider has access to a single webservice, the list of applications is shown on load. If a provider has access to multiple webservices, the user has to click the name of the webservice to show the list of applications for that webservice.

→ By default, an application that is being created by a developer has the status *live*. However, a provider could change the settings for a webservice in such a way, that each application for that webservice needs acceptance from the provider. To do so, contact the QSP administrator.

