

# Flexible Services

## Envitori

### D2.2 Environmental market place service architecture

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### **3 Executive Summary**

This document was written in Envitori project which is part of Flexible Services program which in turn is part of ICT SHOK called Tivit Oy.

This document presents environmental marketplace architecture. First is described a summary of requirements which were collected during the first project year. The linkage to overall service architecture is presented and finally a pilot architecture with domain models, communication sequences and service interfaces are presented in detail.

The Environmental marketplace architecture described here is not validated as whole as only parts of it were implemented in this project. It will be the work of succeeding projects to validate and develop this architecture further. The Architecture deals mainly with information, functional and communication architecture. Other viewpoints are omitted here.

Chapter Domain model7.1 presents a domain model that introduces central concepts related to the market place domain and gives a view to the roles of marketplace. Chapter 7.2 presents the functional view and 7.3 the informational point of view. Metadata was found to be a crucial concept related to the marketplace and is presented in chapter 7.3.1. The Communication point of view describes communication between actors using sequence charts. Chapter 7.5 describes the actual pilot. Chapter 8 gives light to service interfaces.

Finally there are conclusions and next steps.

## 4 Introduction

The EnviTori project strives for a common way of sharing environmental data, i.e. environmental data and processing services that can be used as the basis for a common environmental data market place, hereinafter referred to as EnviTori market place, or market place. The market place is a crucial part of environmental information market where data providers and users buy and sell environmental information. It provides a technical and commercial solution for information sharing and contains metadata about existing information sources, agreements on using the information, knowledge about data quality, catalogue services to find data sources and users, common interface definitions to access metadata, data and processing services, and common environmental data formats (Figure 1).

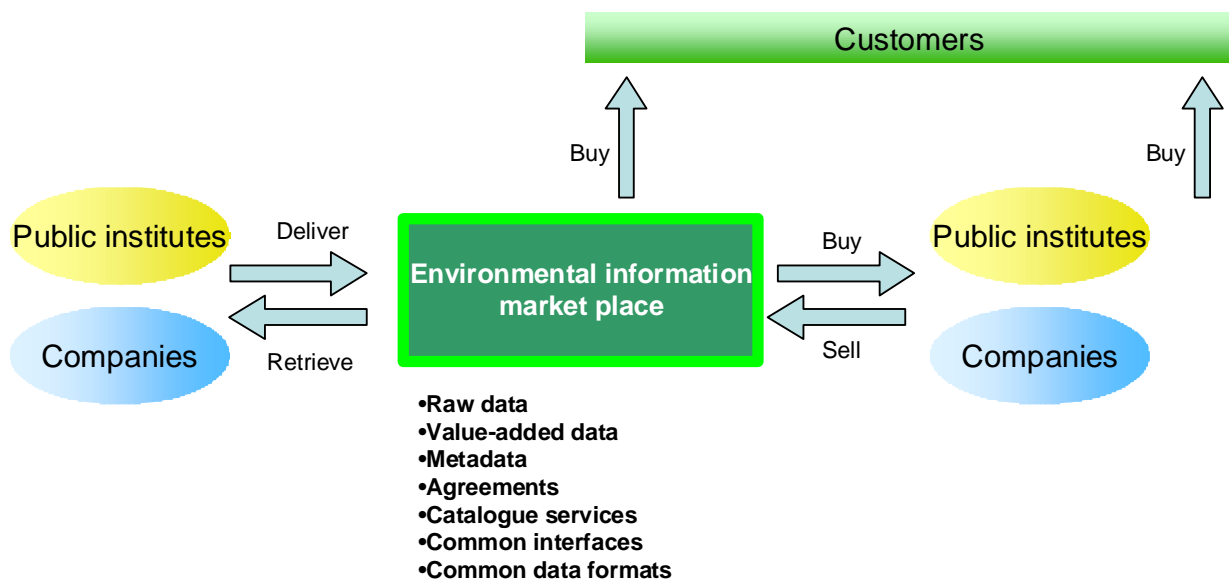


Figure 1. Environmental Information Marketplace - business view.

The market place provides means for consumers, communities and companies to communicate with the public data providers more easily. It enables new ways to discover what kinds of data are available, what kinds of processing services are available, and what kinds of data needs there are. It is foreseen, that by sharing information new innovations and business emerges based on already existing data services. The market place is not a single central system where all the relevant data are collected - instead, the data are distributed to systems managed by different organizations. However, market place provides tools and definitions required for buying and selling data, like catalogue services, and metadata about existing data sources and services.

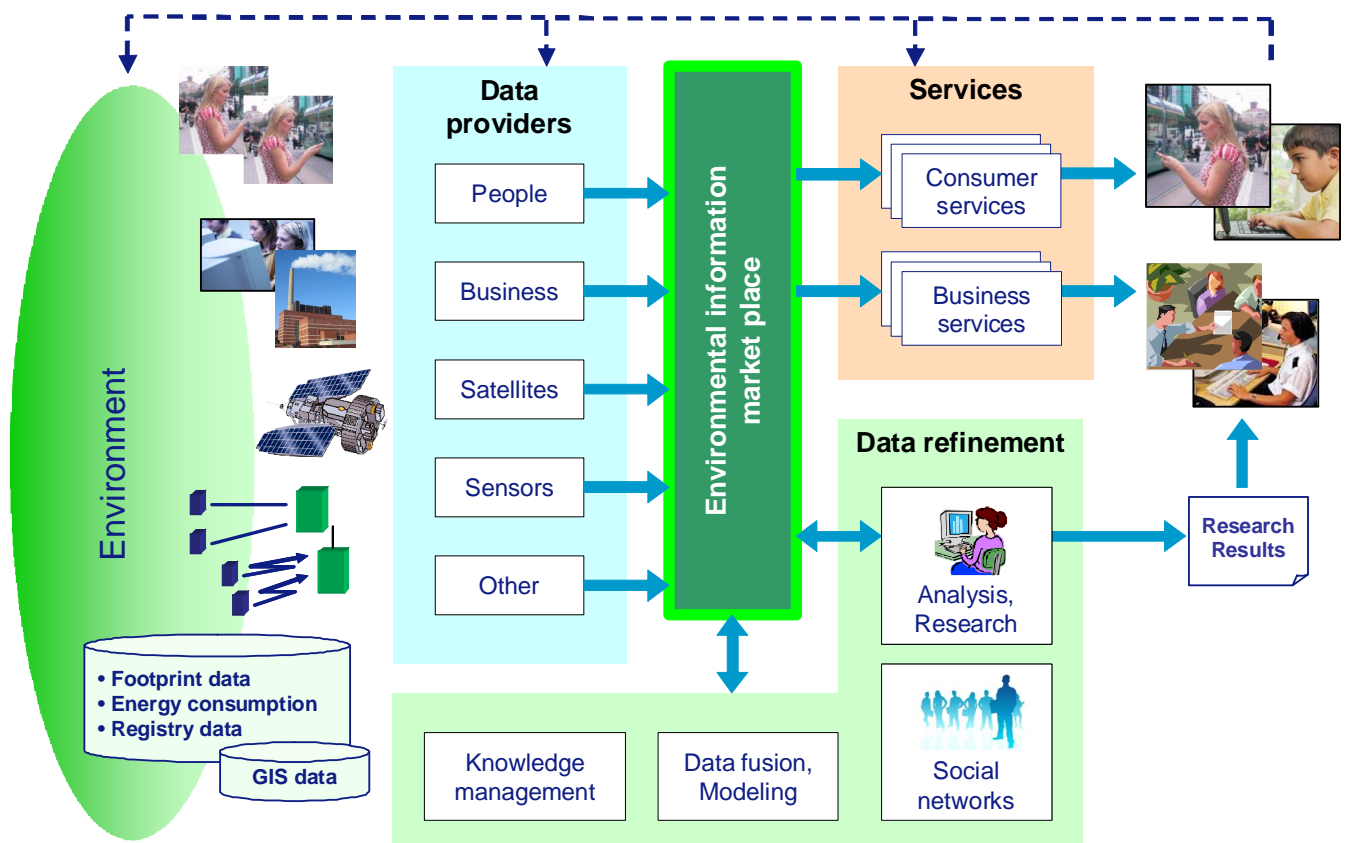


Figure 2. Environmental information market place - technical view.

The market place brings environmental data and processing services into use of end-user services for consumer, authorities and business use.

Figure 2 shows the role of the market place in the distributed environmental monitoring system of systems. Data sources and processing are implemented as services that can be accessed easily and efficiently via the market place to retrieve the relevant data. End-user services utilize the market place to deliver information for sustainable decision making. The business ecosystem consists of information providers, information collection and processing providers, service creators & developers, service creation systems, service consumption based on environmental information, and the market place operator.

This document describes the envisioned technical architecture of the market place.

## 5 Requirements

The earlier deliverables, EnviTori\_D1.1\_market\_place\_Vision and Scope.pdf and EnviTori\_D2.1\_Marketplace Architectural Description.pdf, present the first version of market place requirements. In this chapter we have reanalyzed the requirements and present the most important top level requirements that act as drivers for the architectural design (Table 1). The main function of the market place is to facilitate data and service providers and users to share environmental information effectively and securely.

### 1. Table 1. Marketplace requirements

ID	Requirement
R1	The system has to provide means to find, fetch, buy, offer and/or sell different types of environmental data.
R2	The system has to have the latest information of all environmental services registered in the system.
R3	The system has to provide interfaces both for human users and computer systems to access and use the system.
R4	The system has to provide means to search for and access different environmental services and data.
R5	The system has to provide means for data and service providers to input and update information about available services and data.
R6	The system has to provide means to assess and evaluate the quality, authenticity and reliability of the registered environmental services and data.
R7	The system has to support creation of agreements between data and service providers and users.
R8	The system has to ensure data security and integrity.

## 6 General architecture concept

This chapter deals with architectural viewpoints typical and important in environmental information marketplace. All general viewpoints are not dealt here but concentrated to most important ones. These viewpoints are Information architecture, Functional architecture and Communication architecture. This chapter describes general viewpoint and their connections to environmental marketplace architecture.

This deliverable is based on architecture concept shown in Figure 3. It shows different features and their relationships in a general architecture.

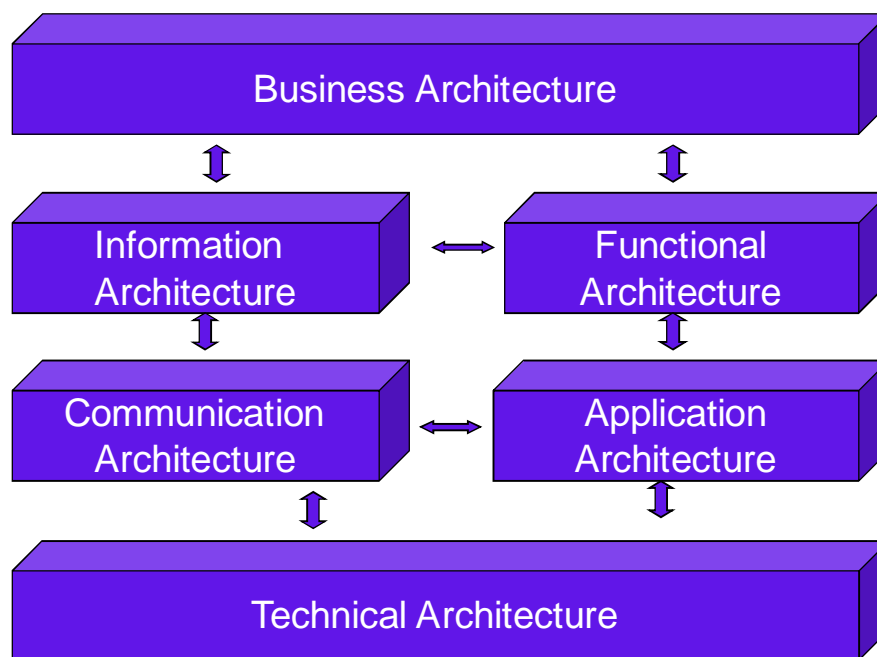


Figure 3. Architecture concept

### 6.1 Architecture design principles for FS type of service

EDEN project has developed architectural principles from the uses cases developed in the beginning of Flexible Services program. These principles are the most important of the ecosystems which are typical for FS type of services. There are also other principles which can be important in some cases but these findings have been regarded the most useful.

Found principles are:

Modularity refers to a system design where the system is composed of independent components, called modules, such that each module provides a well-defined piece of functionality.

In a distributed architecture with potentially many actors involved, it is not sufficient to simply have modularity. It is also necessary that the interfaces

exposed by the modules are clear and the effects of any operations in the interfaces are well-defined i.e Transparency.

In a loosely-coupled system, the dependence is low, so it is easier to change components independently without the changes propagating throughout the system.

Composability refers to being able to alter the relationships between components dynamically, giving the ability to compose new concepts into being from existing ones.

In late binding, connection formation between components is delayed to as late as possible. This promotes flexibility in that the selection of communication partners can be made with as much information as possible.

Reflection is the ability of a running system to inspect itself and its complete state and to modify its state and composition at run time through generic interfaces.

Interactions between services are bootstrapped through a reasonably well-established service invocation interface (API).

From all possible architectures conforming to the requirements, we should choose one that entices service developers to enter the ecosystem, both from a technical as well as economical perspective i.e. easy ecosystem entry.

More information can be found from EDEN deliverable D1.2.1

In addition EnviTori project has defined Open interfaces as a very important principle of Environmental marketplace architecture. This is not a contradiction to principles presented by EDEN project but EnviTori has slightly different viewpoint. In EnviTori project interfaces are emphasised and therefore this principle is mentioned here. Also support for different interfaces even if they are not necessarily totally open is important. This support can be implemented to some extent but of course all possible interfaces are not supported.

## 6.2 Functionalities

In an environmental marketplace there is needed certain type of functionalities to ensure efficient working of value network. Following functionalities are collected studying definitions of pilot and using requirements to form adequate functional architecture. Main level of functional architecture is shown in Figure 4.

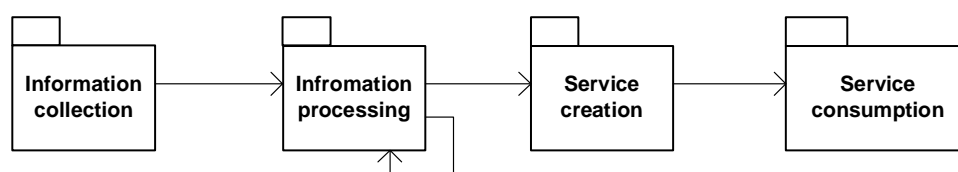


Figure 4. Basic functional chain

In Figure 4 there is shown basic linear dependency of these functional blocks. These dependencies are only as an example and links between functionalities can be much more complex.

Example of this is shown in Figure 5 where information provided by sensor network can be used in service via several different ways.

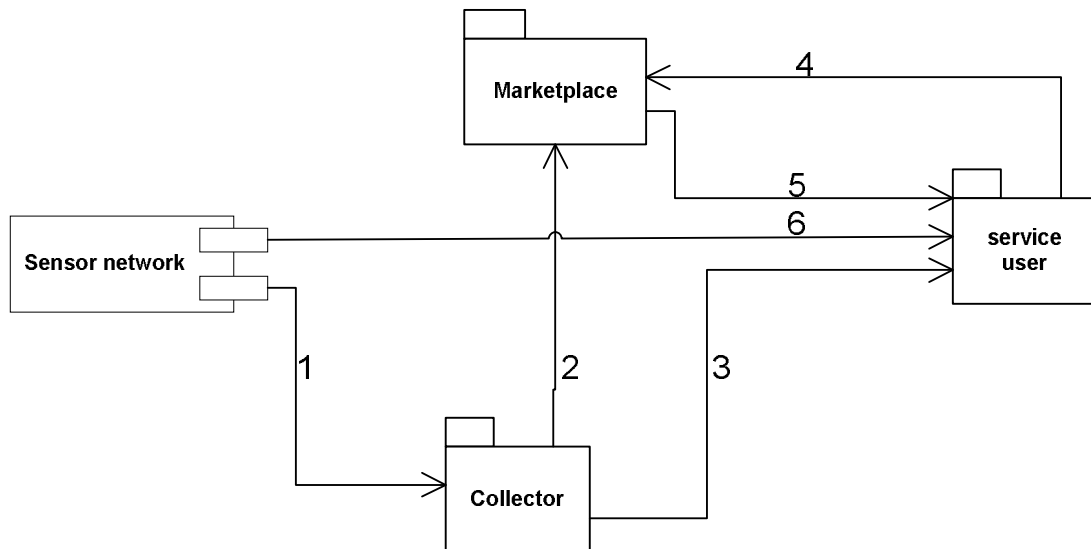


Figure 5. Example of actor network

First possible chain is when sensor network sends information to collector, collector sends this to marketplace and user uses this information in service. This chain uses path 1-2-5 in Figure 5. The information chain can be also 4-5-6 where user asks marketplace where the information is and then acquires that information directly from sensor network. Other combination can exist and it depends of the structure of actor networks how information is transferred in the network.

These main level functionalities comprised of several sub functionalities which are necessary to implement main level functionality.

### 6.2.1 Information collection

Information collection consists of several types of information producers, information collectors and metadata information handling. Producer's level of functional abilities varies from single sensor providing one type of measurement to actor how collects several type of data from simple type of measurements to sophisticated measurements.

Information collection consists also metadata collection. Metadata can be collected from the same source as actual information or it can be gathered from different source.

### 6.2.2 Information processing

Information needs to be processed before it can be provided to user. In certain cases it is simple action but in some cases there is needed excessive information processing of different measurement and meta information.

### **6.2.3 Service creation**

Service creation functionality uses information provided by information processing. Type of service is depended of user of the service. Service creation can be one process creating the whole service or it can be also composed of several other services or service elements.

Example of composed service is forecast of pollen count. This forecast uses forecast of temperature, wind speed and direction and rain/humidity to predict spread of pollen. Same time is needed knowledge how much different plants are predicted to produce pollen under predicted circumstances.

### **6.2.4 Service consumption**

Service consumption is about how provided service is used either consumer or other entity. Most often services are meant to consumer and consumer is usually regarded as end user. There are cases where services are used by companies for their business. In these cases companies can be regarded as end user. It is also possible that other service is the user of another service when the first service is needed to build another service.

## **6.3 Information architecture**

Information has a great importance in environmental information marketplace as term directly suggests. Information includes pure data and meta type of data which is as important as actual information. In many cases information itself is not usable if there is not available sufficient meta information about information itself.

Information architecture deals with information presentation and information transfer between actors.

In here one of the key points is interfaces in changing information between actors.

## **6.4 Communication architecture**

The Communication architecture shows how actors change information between each other. This information can be actual data, metadata or control data to manage environmental marketplace functionalities and services. The pure information can not be expressed exclusively because in the future there is going to be information sources which cannot be seen currently. In this chapter there is presented found generalisations of implemented information marketplace and one example how communication can be done.

First requirement for communication between actors is that they have agreed in a way or another how they communicate. Actors must have knowledge about information itself and also knowledge about control information to be able to communicate.

Simple example of this is sensor measurement which is where single sensor is polled by data collector. When collector sends a request to sensor to send data,

this control signal has to be known by both ends of communication. After signalling sensor sends temperature with agreed protocol to collector.

There are great differences between actors in environmental information marketplace value chain due to different nature of actors. In Figure 4 functionalities have different requirements according to communication. Consumer needs information which human can read and sensors in the other hand have totally different requirements.

## 7 Market place pilot architecture

In this chapter we describe the market place pilot architecture, its domain model, the concepts and their relations. The development of the architecture is iterative process, and this is the first version of the architecture that has not been validated against a working market place pilot system. As the implementation of the pilot proceeds later on, the architectural design is iterated towards the next version.

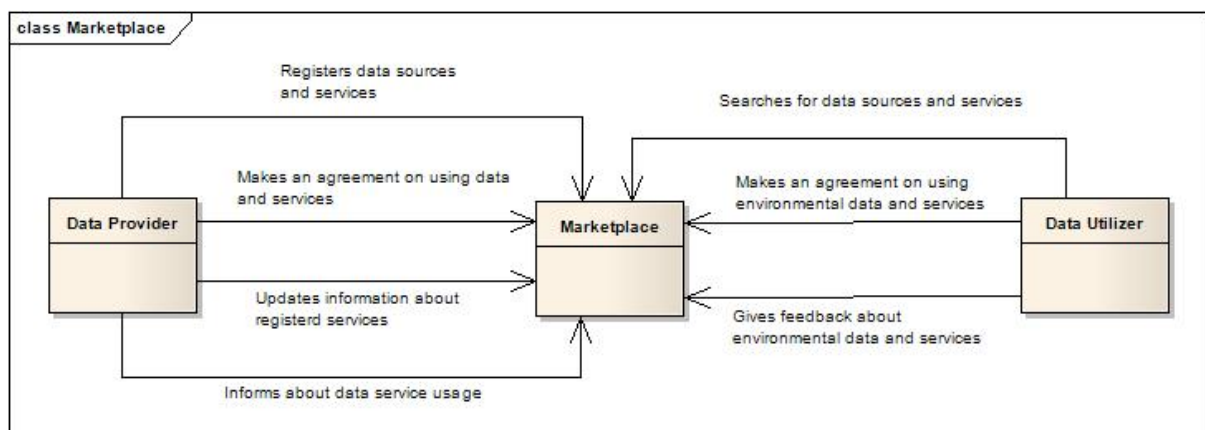
To describe a complex system we need different architectural viewpoints, each of which communicates certain aspects of the system. Here, we describe the market place pilot from functional, information and communication viewpoints.

### 7.1 Domain model

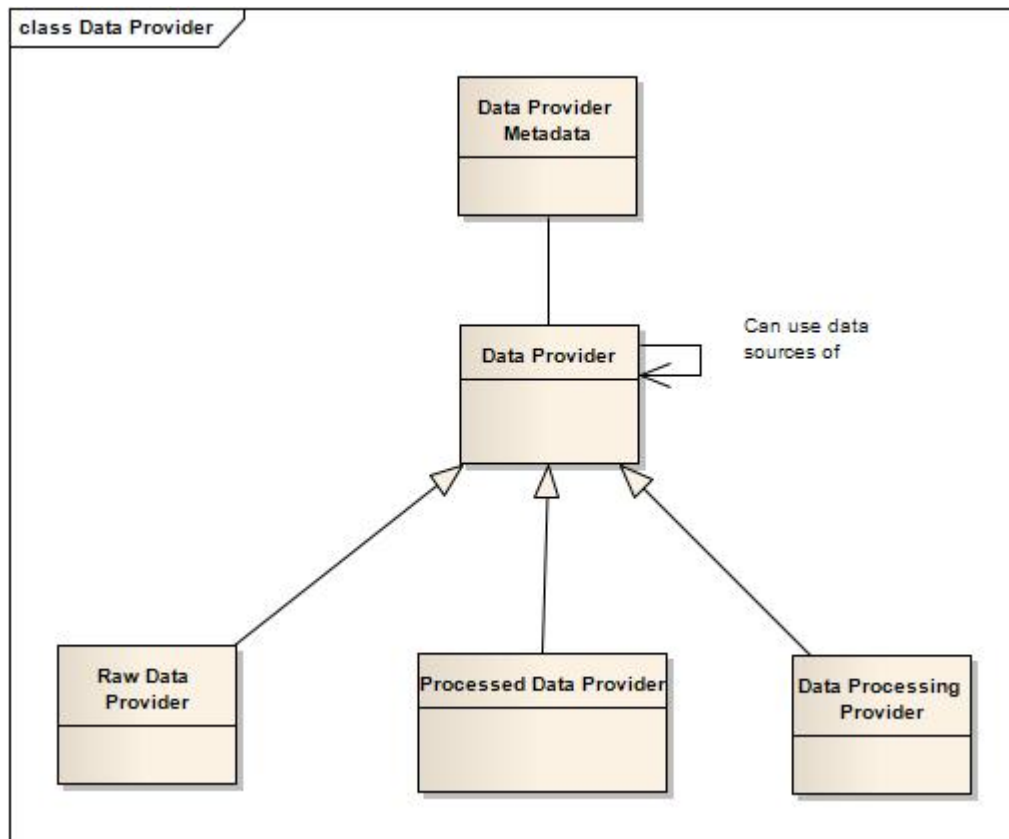
We use UML class models to describe the market place domain. Each sub-chapter describes one package in the class model, its concepts and their relevant relations with each other and with other concepts in other packages. Later on we show how pilot applications implement the market place concepts by describing the pilots using UML object models.

#### 7.1.1 Marketplace

The marketplace domain model depicts an overall view of how the main actors, Data Provider and Data Utilizer, interact with the marketplace. Data Provider registers data services and sources in the market place and Data Utilizer searches for the services and agrees on using them. Note, that we use the term "Data Utilizer" instead of e.g. "data user" that could be confused with a human user. Data Utilizer is a computer system or a human user.

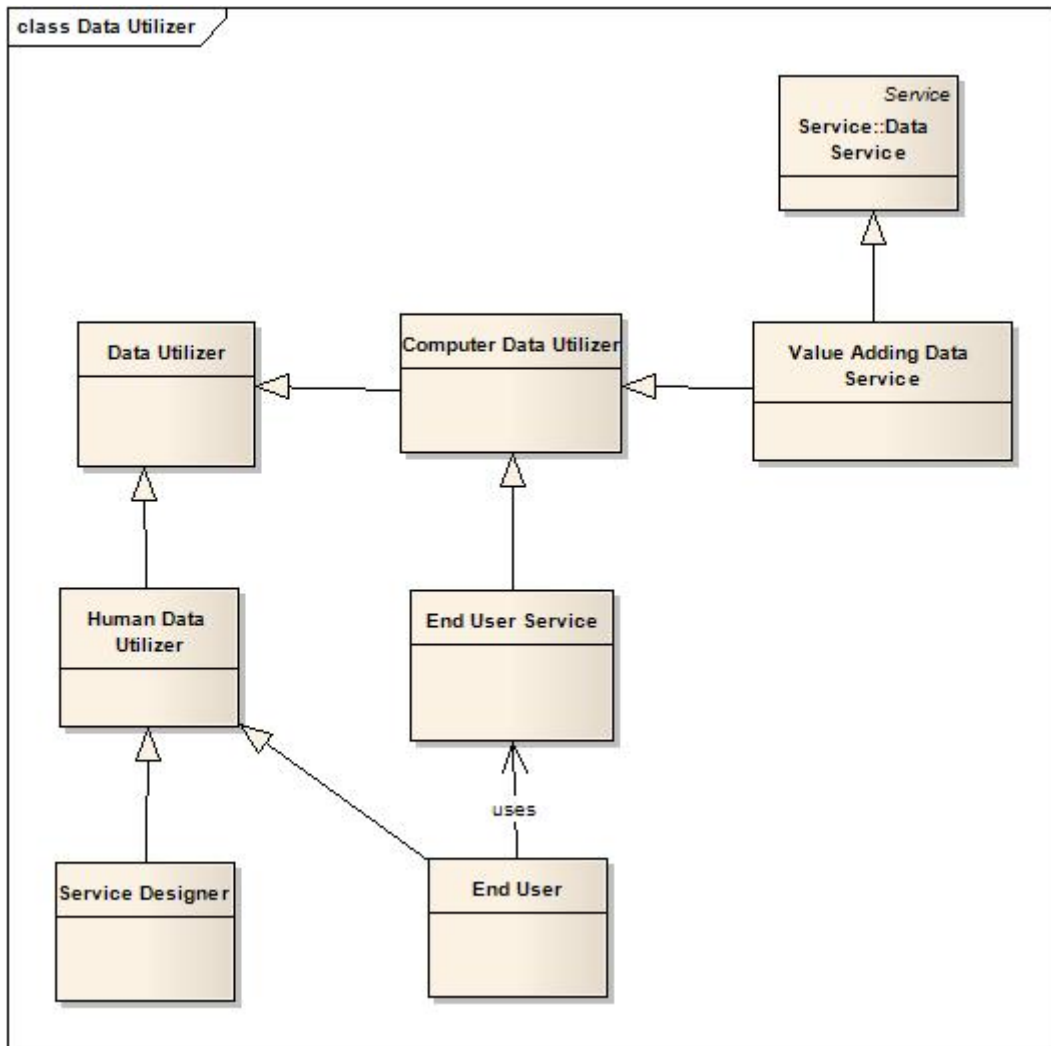


## 7.1.2 Data Provider



Data Provider	An organization possessing data sources and managing data services to access the data.
Data Provider Metadata	Describes the data provider
Processed Data Provider	Organisation refining raw and processed data coming possibly from many Data Providers.
Raw Data Provider	An organisation providing raw data, i.e. measurement data, large databases, large area model results, etc.
Data Processing Provider	An organisation providing certain processing capabilities for certain type of environmental data.

### 7.1.3 Data Utilizer



Computer Data Utilizer

An information system (a computer) utilising environmental data and services.

Data Utilizer

A generic user of data coming from different data sources via data services.

End User

Human end user.

End User Service

A system that utilizes data sources and delivers relevant information to end-users.

Human Data Utilizer

A human user utilizing environmental data and services.

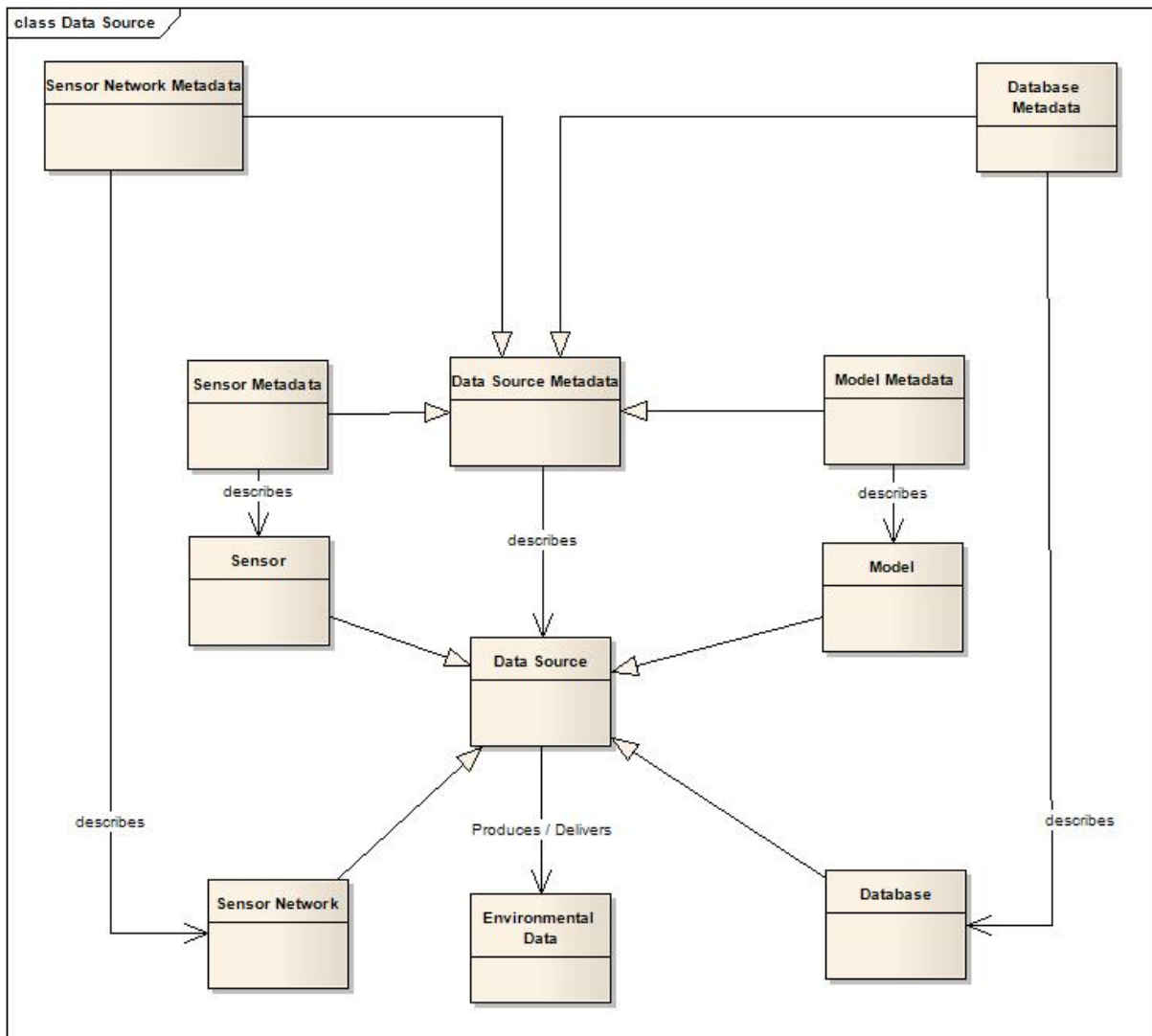
Service Designer

A human or a company that designs a service, value adding service or end user service or some other.

Value Adding Data Service

A computer data utilizer that uses other data services, process and / or fuses the data further, and provides the value-added data as a service to other data utilizers.

### 7.1.4 Data Source

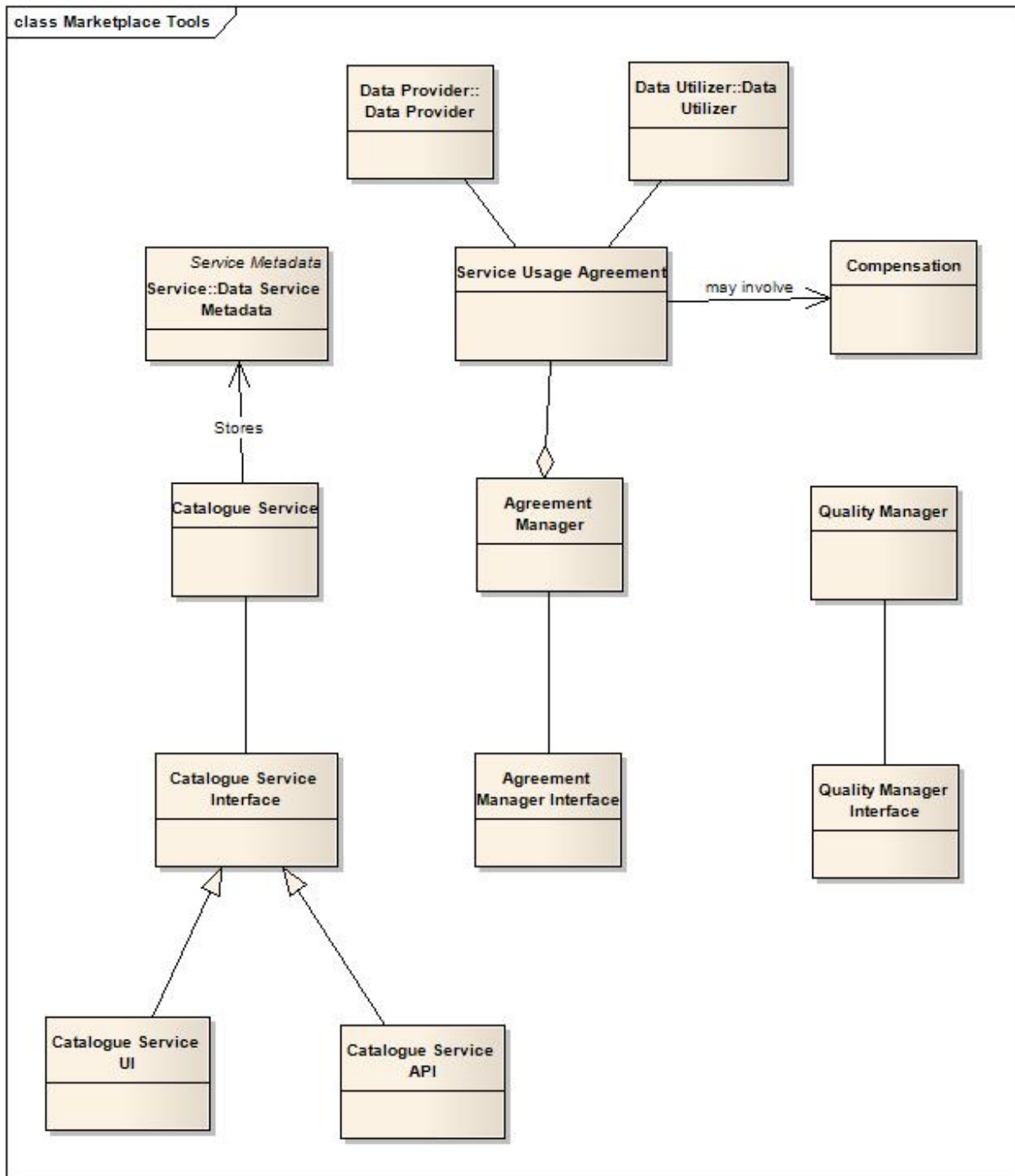


Data Source

A system producing environmental information. The information can be measured, modelled, analysed and can be related to a location in space and time or not.

Data Source Metadata	Describes a data source.
Database	An information system storing environmental data.
Database Metadata	Metadata describing the stored data in the database
Environmental Data	Data related to natural or built environment or environmental analysis. E.g. measurement data, model data, life-cycle analysis data, etc.
Model	An information system modelling a phenomenon. E.g. a weather forecast model.
Model Metadata	Metadata describing a model.
Sensor	A device measuring certain parameters in an environment.
Sensor Metadata	Metadata describing the sensor.
Sensor Network	A collection of sensors.
Sensor Network Metadata	Metadata describing the sensor network.

## 7.1.5 Marketplace Tools



Agreement Manager

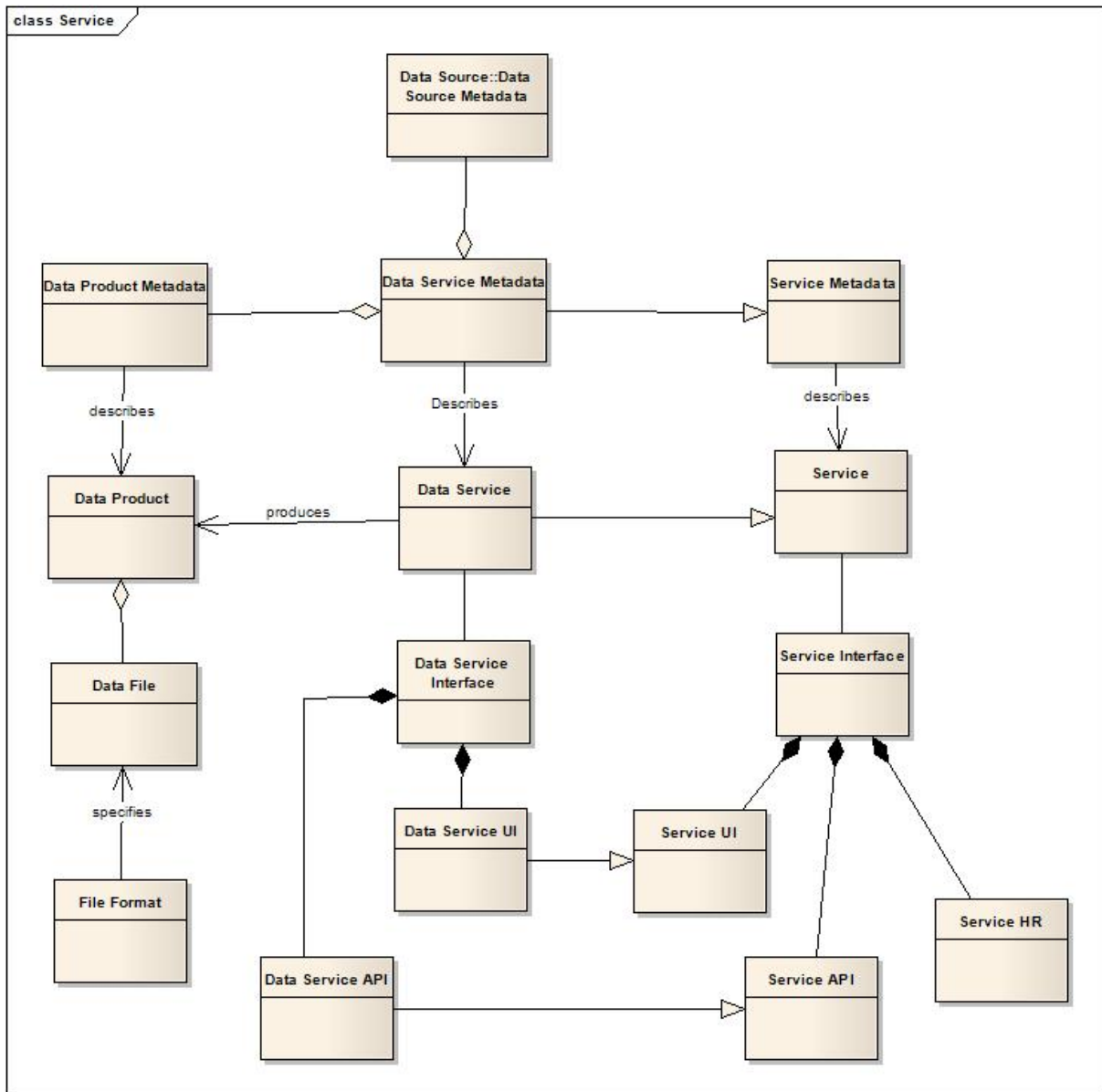
A service that creates and manages agreements between Data Providers and Data Utilizers.

Agreement Manager Interface

Interface to access and update agreement information. Both UI and API.

Catalogue Service	Stores and manages information about data and services, and provides interface to query and update the information.
Catalogue Service API	Application programming interface to query and update data source metadata information.
Catalogue Service Interface	Interface to access a catalogue service that stores metadata about data sources and services. Can be either user interface (UI) or application programming interface (API).
Catalogue Service UI	User interface to query and update data source metadata information.
Compensation	Some form of a compensation for the usage of data or a service.
Quality Manager	A service that collects and manages quality information about data, data services, processing services and data providers.
Quality Manager Interface	Interface to access quality information. Both UI and API.
Service Usage Agreement	An agreement made between a data utilizer and a data provider on the conditions and terms on how a data service is used

## 7.1.6 Service



Data File

File containing environmental data

Data Product

A package of data files containing data produced by a data service.

Data Product Metadata

Describes a data product.

Data Service

A data service (an information system) that provides access to environmental data sources.

Data Service API

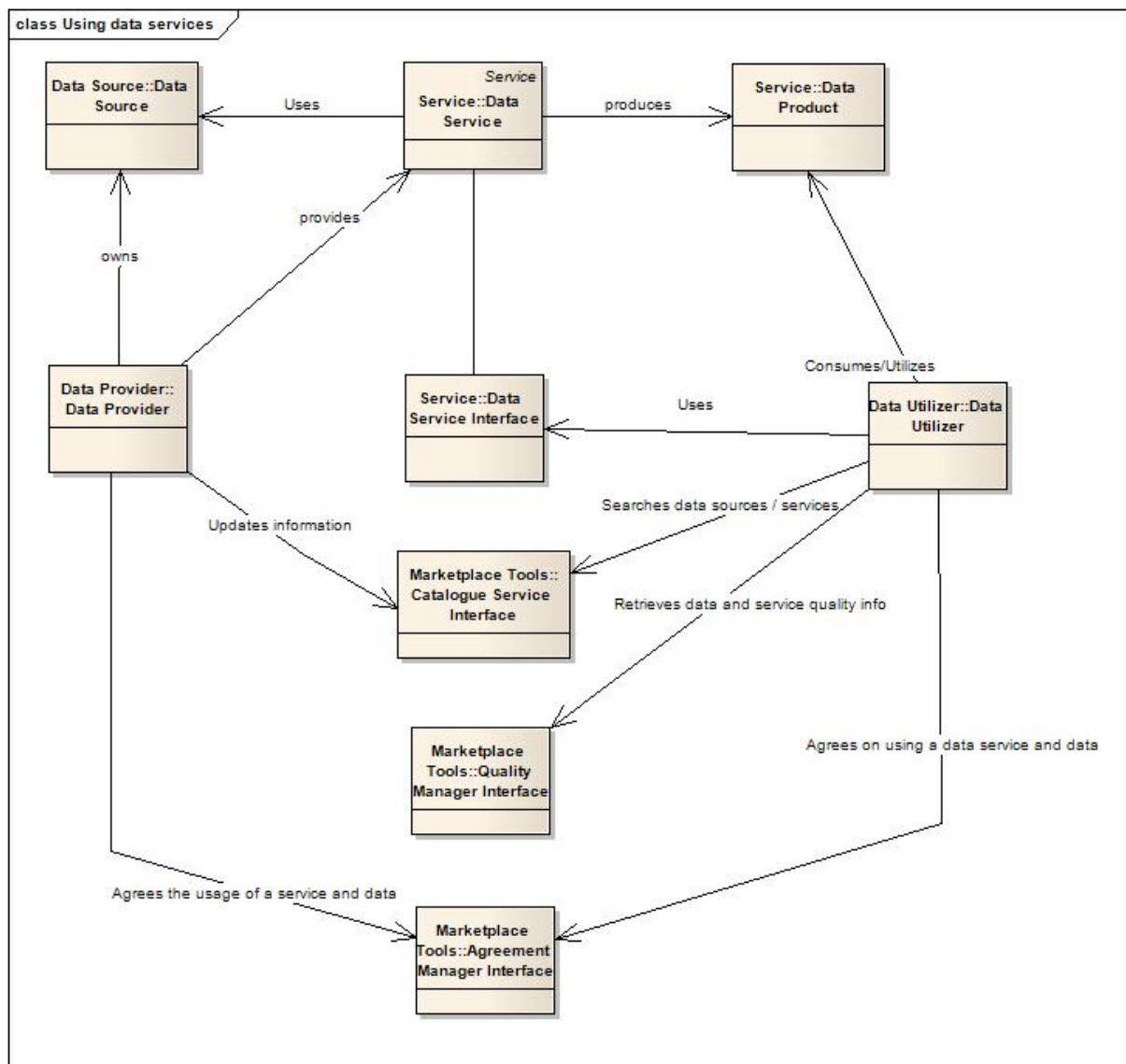
Application programming interface (API) to access and use a data service.

Data Service Interface	An interface to access a data service.
Data Service Metadata	Describes a data service.
Data Service UI	UI to access a data service.
File Format	Environmental data file format accepted in the market place.
Service	<p>A service by itself is an abstract concept.</p> <p>There can be different types of services, provided by information systems or humans or both in combination. All services must have at least one of the following interfaces:</p> <ul style="list-style-type: none"> <li>-Service UI: Software interface for a human user</li> <li>-Service API: Software interface for computer usage</li> <li>-Service HR: Human interface for a human user</li> </ul>
Service API	Application programming interface (API) to access a service.
Service HR	A human interface through which human users can interact with the service. For example a helpdesk service on a phone.
Service Interface	An interface via the service is operated.
Service Metadata	Describes the service (capabilities, how to use, etc)
Service UI	UI to access a service.

## 7.2 Functional viewpoint

The functional architecture defines individual logical components, their functions, and interfaces between them. The market place provides functions for data providers to register and update information about data and processing services, and making agreements with the data utilizers.

Data utilizers use market place functionality to search for relevant data services, retrieve information about data and service quality, agree on using the services with the data provides, and use the services to access the data.



### 7.3 Information viewpoint

The information architecture models the information that the system holds, the information processing that the system carries out, information sources and sinks, and the information flows between them. The market place contains

- profile information about data providers
- profile information about data utilizers
- metadata about the data sources and services that data providers provide
- metadata about data quality
- metadata about service quality
- statistical feedback information about data and services

The market place relies on commonly used data formats for representing various types of environmental data, and doesn't require a specific data format to be

used. However, in order to describe the available data and services, the market place defines a metadata format that should be used when data sources and services are registered in the market place.

### 7.3.1 Metadata

*“Metadata is loosely defined as data about data. Metadata is a concept that applies mainly to electronically archived or presented data and is used to describe the a) definition, b) structure and c) administration of data files with all contents in context to ease the use of the captured and archived data for further use.”<sup>1</sup>*

For example metadata could be purpose of data, time and date of creation, authors, what standard used, etc. With these information users can find and compare data without look at data and understand meaning of data.

It's important to define good metadata for the market place. Without metadata the market place has many limitations. Users can't find meaningful data, can't easily take advantage of data, chooses improper or useless data for user requirements, etc. The market place has many data providers and data is in many formats and locations, with defined metadata information about data from data providers could be harmonize, i.e. users could easily find and compare data from different sources.

Well defined metadata should answer to these questions:

Services:

- Where can I (as a user) find the service?
- Do I have rights to use the service?
- How do I use the service?
- What is prize?

Data sources:

- How do I receive the data, from webservice or other media?
- What is the format of data?
- Can I get history of data?
- Can I get historical data?
- What is prize?

Data:

- How and where can I use the data?
- What is structure of the data?
- What is quality of the data?

The first version of the market place concentrates in the interfaces between the data provider and the market place, and between the data utilizer and the market place. The data provider describes what kind of data sources and services it is providing, and the data utilizer queries for data and services.

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<sup>1</sup> <http://en.wikipedia.org/wiki/Metadata>

An important part of the interface is the metadata that describes the data and services. The first version of EnviTori metadata is based on the Finnish JHS158 standard which is based on the ISO 19115 standard. Elements of ISO 19115 are also the basis the INSPIRE directive that defines how GIS data is shared between organisations in different European countries. Figure shows how EnviTori metadata relates to existing standards. Finnish data providers have to conform to INSPIRE and to ISO 19115, and therefore it is beneficial that EnviTori metadata is based on the standards. This makes conversions from existing metadata descriptions to EnviTori format easier.

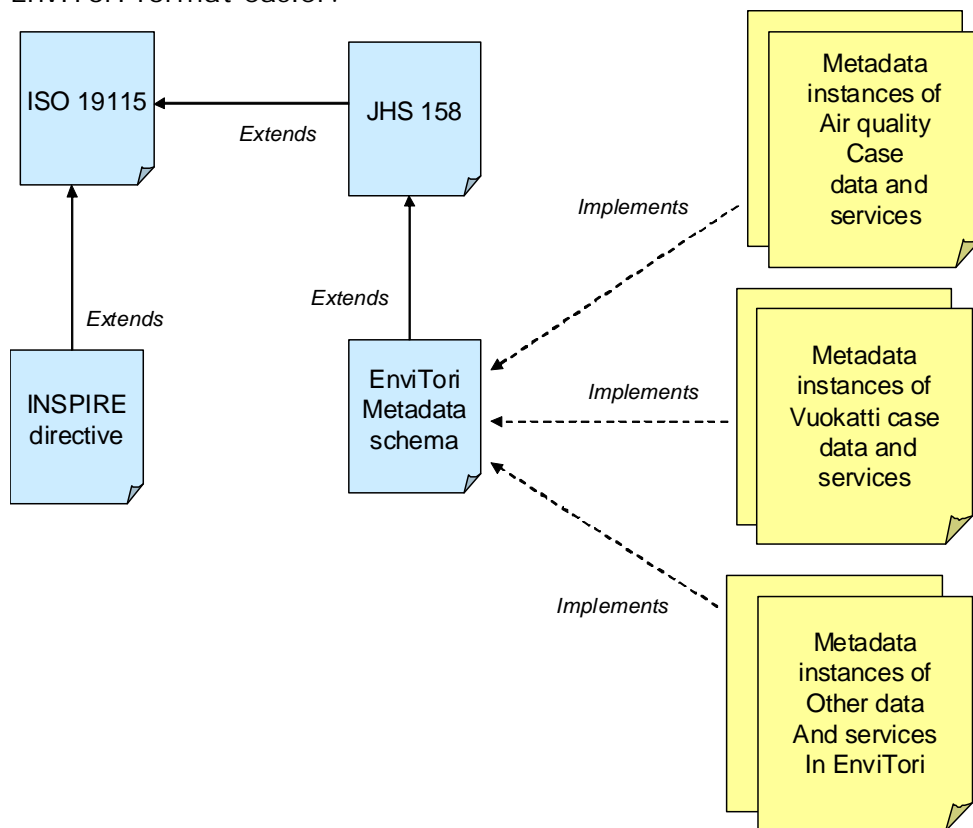


Figure 6. EnviTori Metadata schema and its relations.

EnviTori metadata format is developed iteratively by first selecting relevant elements from the JHS158 standard, and then adding elements that are required to describe the data and services in EnviTori context. Figure shows what elements are selected from JHS158 and what are EnviTori-specific.

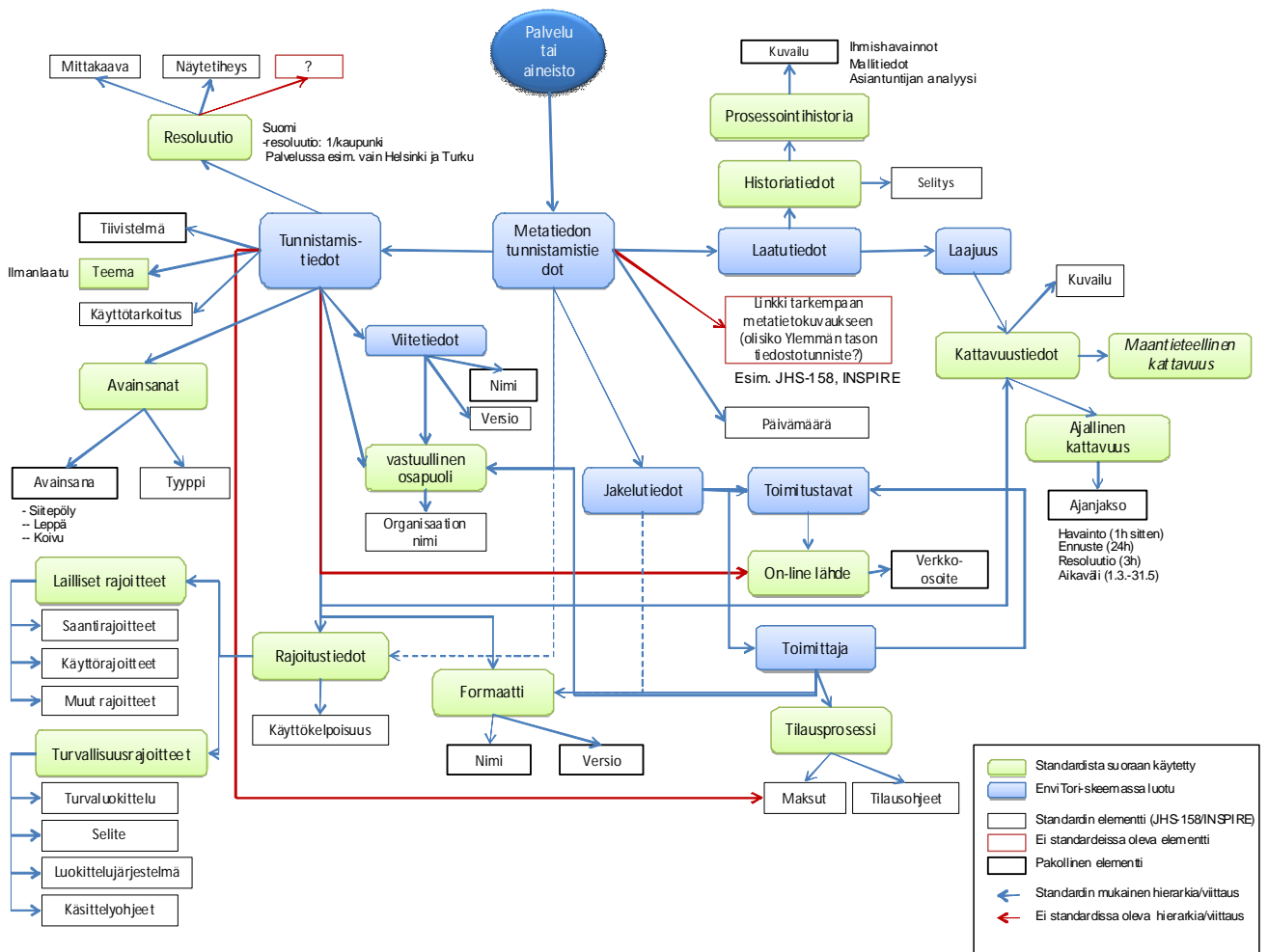


Figure 7. EnviTori metadata schema illustrated. (The elements in Finnish)

EnviTori metadata is created to UML-model. EnviTori XML-schemas are generated from the model. Figure shows EnviTori elements, which are modified from JHS158. These elements have \_ET postfix in their name.

#### 7.4 Communication viewpoint

The Communication architecture shows how actors change information between each other. This information can be metadata about data and services, control data to manage environmental marketplace functionalities and services, and the environmental data itself.

We use UML sequence diagrams to describe how actors in the market place communicate to exchange metadata and environmental data. Four communication scenarios are presented:

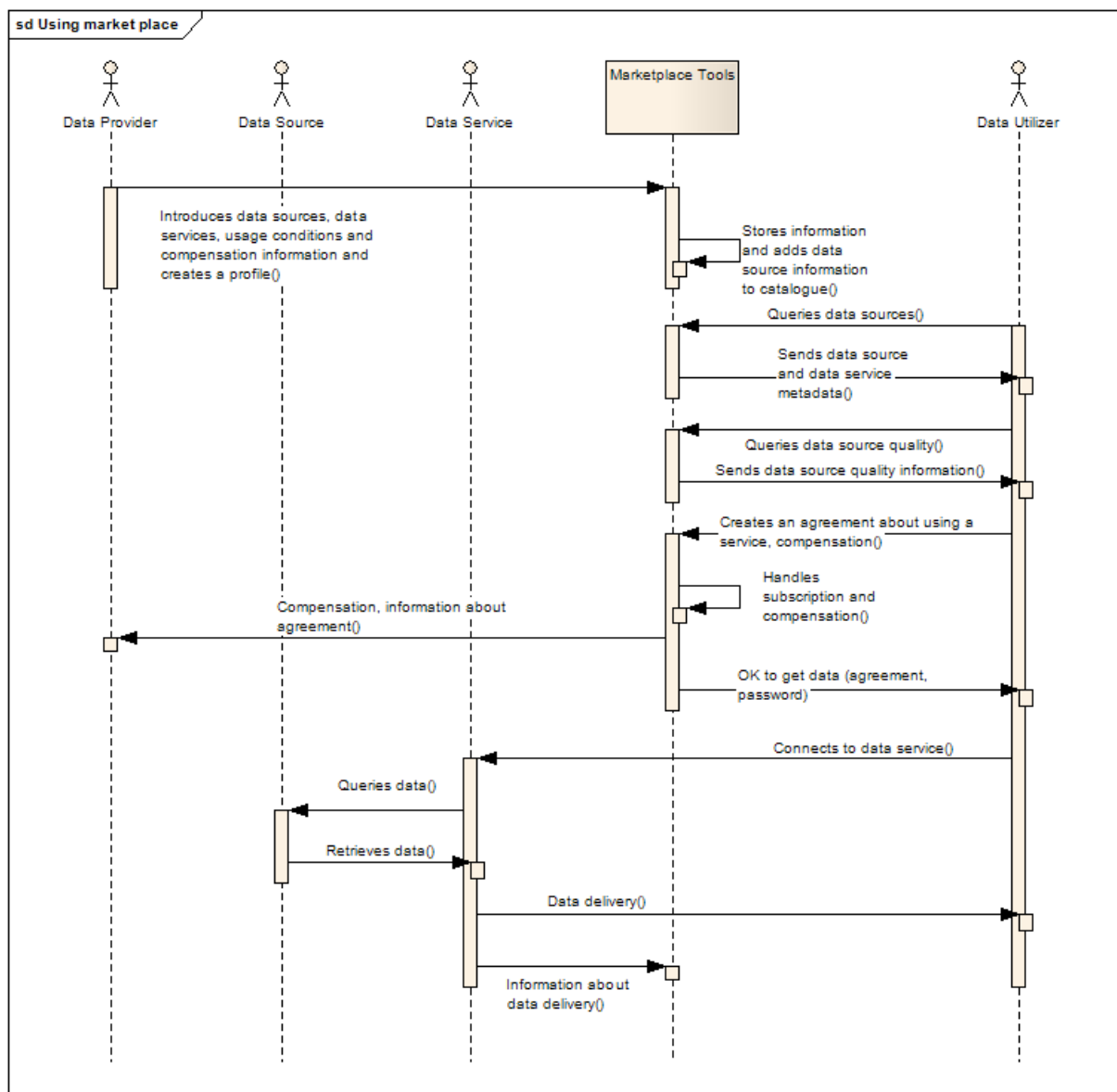
Data Provider introduces data services in the market place and Data Utilizer searches for relevant services in order to access relevant data

System Developer searches for relevant data services that he can integrate in to the system he is developing

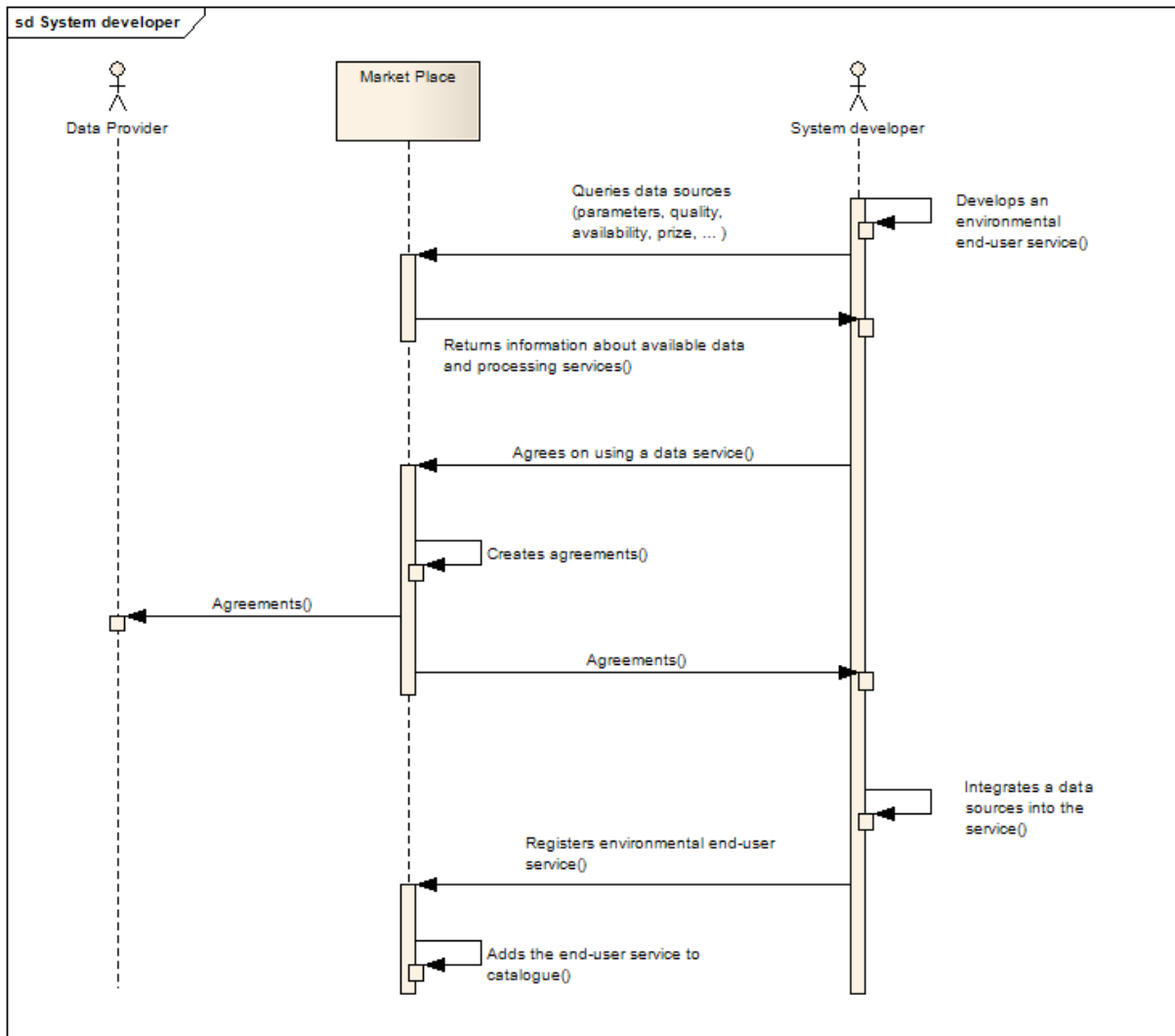
End User uses market place to find end-user services that provide relevant environmental information.

End User Service discovers a relevant new data service (that Data Provider introduces to the market place) and agrees to use the new service in order to deliver additional value to End User.

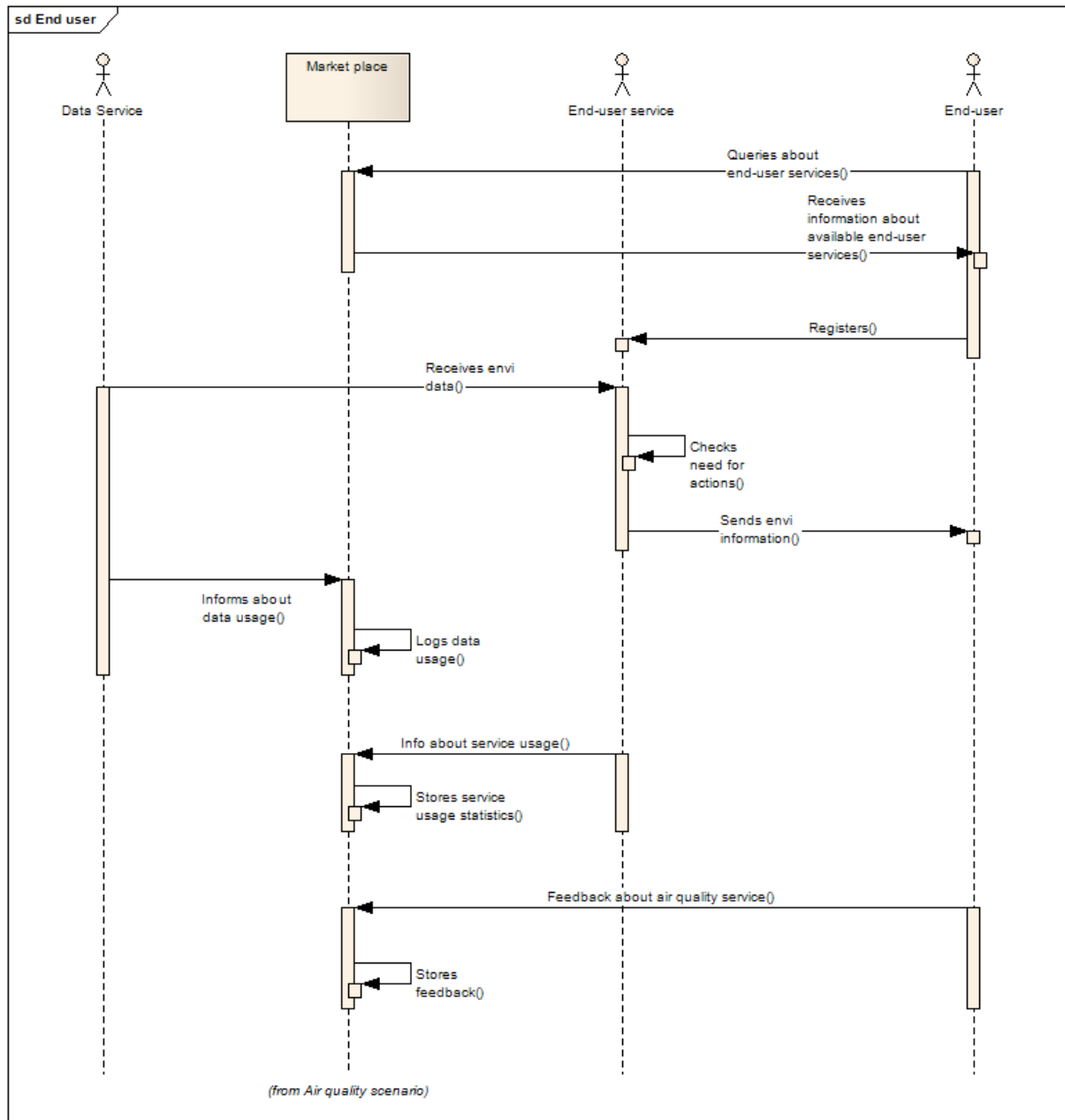
### 7.4.1 Data Provider and Data Utilizer communication



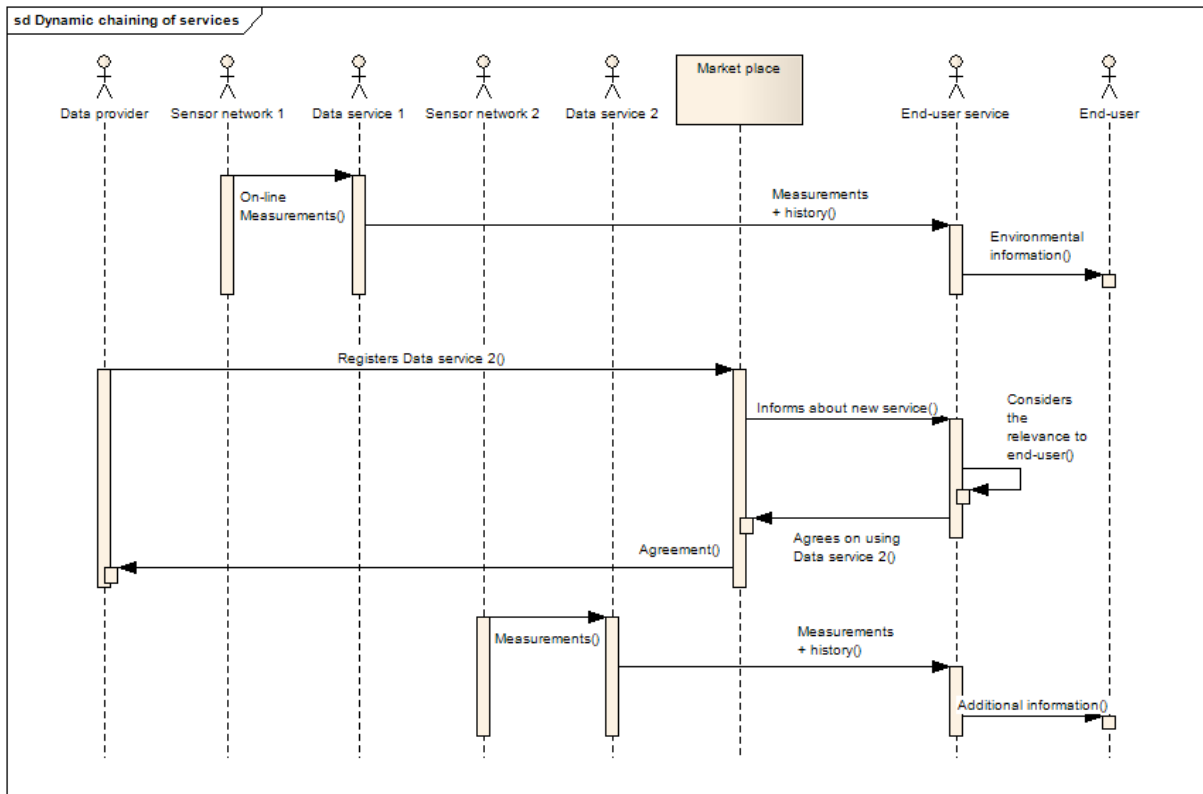
## 7.4.2 System Developer communication



### 7.4.3 End-User communication



### 7.4.4 End-User Service communication



### 7.5 Market place metadata search prototype

A market place metadata search prototype was implemented to illustrate how system developers and end-users would use the market place. The prototype contains metadata about existing data sources and services, and provides a simple user interface to search for relevant data (Figure 8). The metadata contains data sources of the pilot applications, but also some other sources were included as examples.

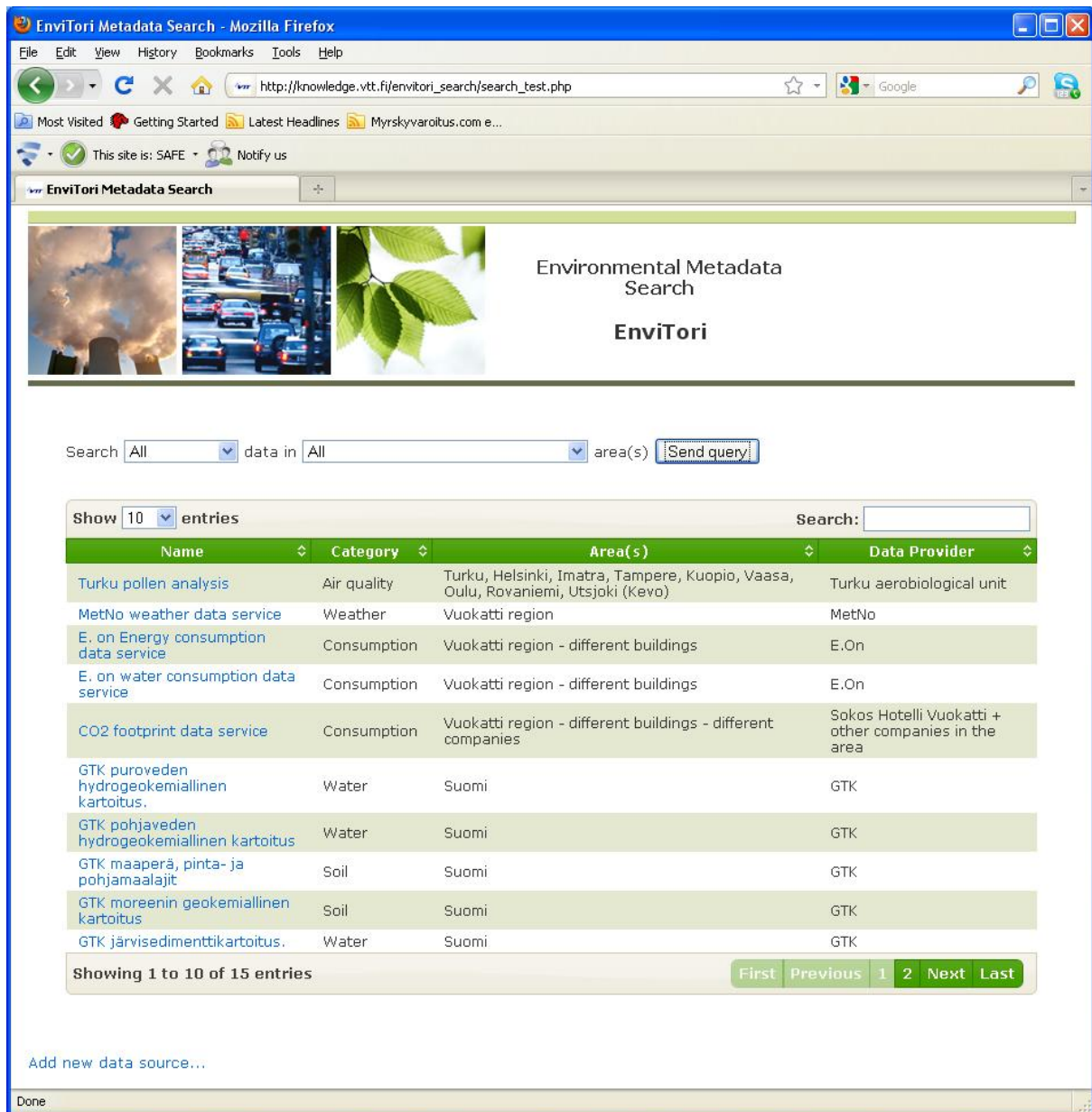


Figure 8. A screenshot of the EnviTori prototype for metadata search.

## 7.6 Application pilots in the market place

The market place development has been conducted parallel with two environmental service pilot cases: 1) air quality pilot and 2) Vuokatti pilot. The air quality pilot service provides consumers SMS alerts about changes in the air quality and air quality observations and forecasts on a map-based user interface (Figure). The alerts are based on user health profiles.

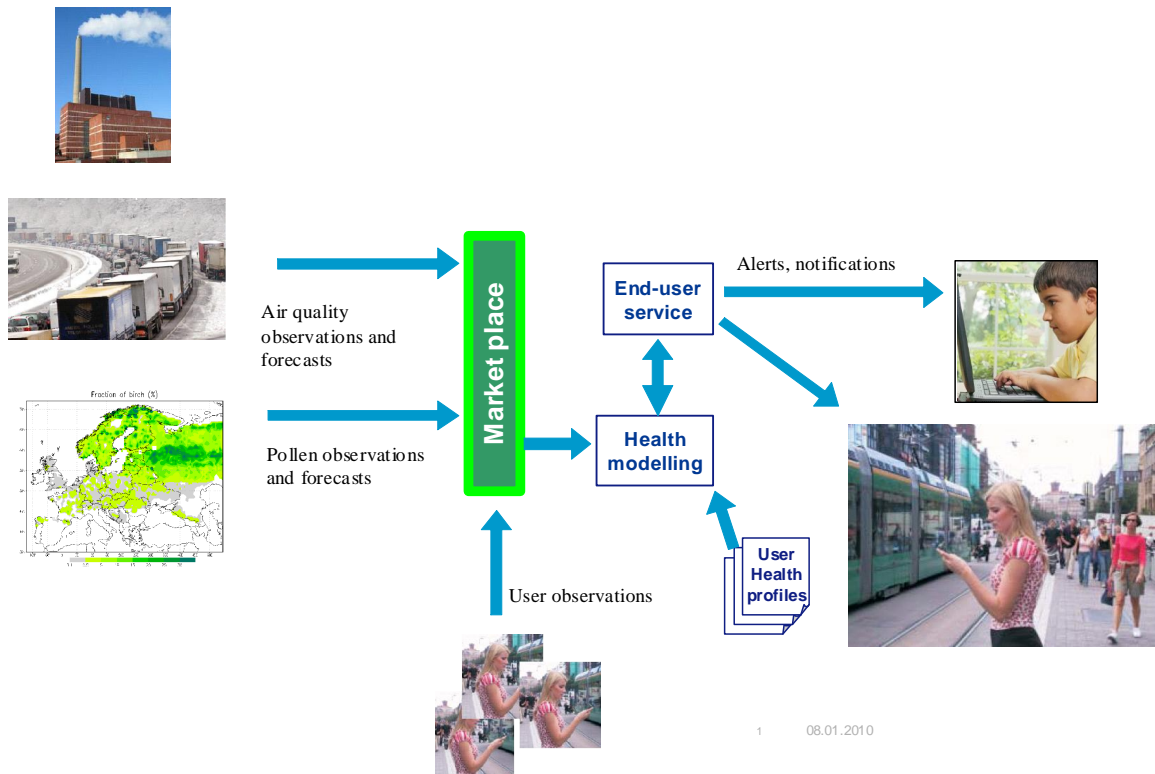


Figure 9. Air quality service

The Vuokatti pilot concentrates in Vuokatti area and develops a service to deliver environmental information to people visiting the area and to the businesses operating in the area. The data sources include weather data, air quality data, CO2 data and energy consumption data.

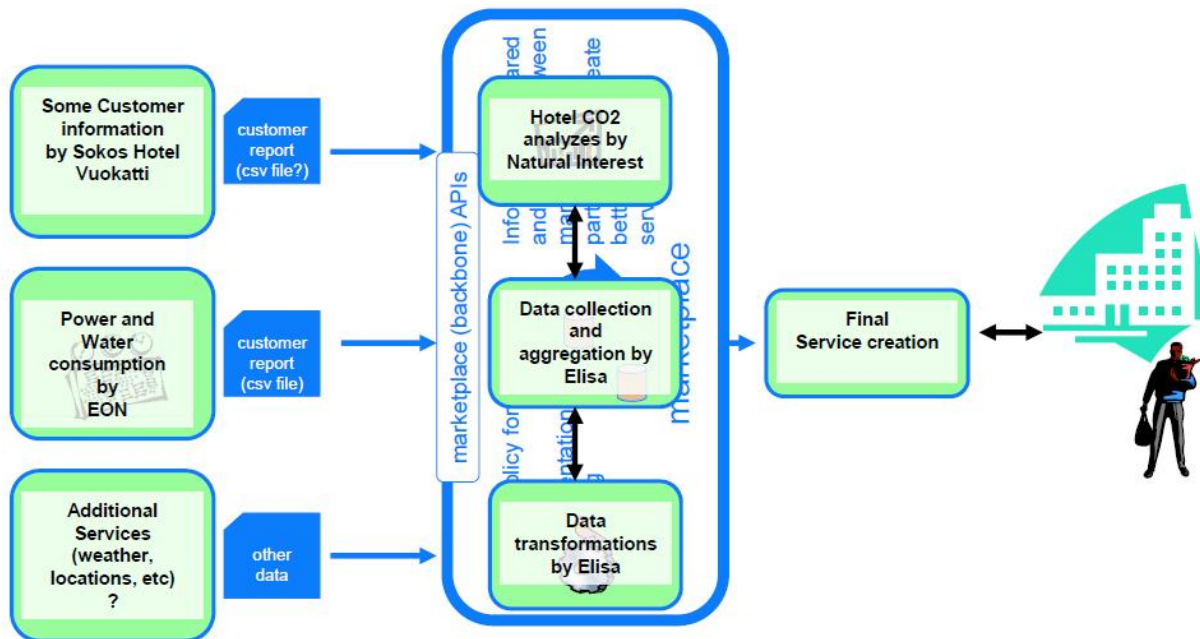


Figure 10. Vuokatti pilot data flow diagram.



EnviObserver	A system to collect user observations using mobile phones and providing user observations via web user interface and a web service interface.
FMI Air Quality Forecast Data Service	A data service providing numerical air quality forecasts in grid format.
FMI Air Quality Observation Data Service	Data service that provides air quality observations for Helsinki region in XML format. Data is owned by HSY.
FMI Pollen Forecast Data Service	A data service that provides numerical pollen forecasts in grid format.
FMI	Finnish Meteorological Institute. Provides air quality data as well as weather data.
HSY Air Quality Sensor Network	Air quality sensors operated by HSY within the Helsinki region.
HSY Air Quality HSY	Helsingin Seudun Ympäristöpalvelut. Measures air quality around Helsinki region.
Medixine Air Quality Alert Service Pollen Alert Message	Environmental Data. Alert messages tailored based on users' health profiles.
Pollen Analysis	Analysis of the pollen situation in Finland. Done by experts of university of Turku.
Pollen Forecast	Model based numerical pollen forecast in a grid.
Pollen Model	Model predicting pollen dispersion.
Turku Pollen Analysis Data Service	Pollen data source provided by Turun aerobiologinen yksikkö. Analysis that covers whole Finland is based on observations and model predictions.
Turun Aerobiologinen Yksikkö	Provides Finland wide pollen analysis a couple of times a week.
User Observation Data Service	Provides user observations.

User Observations

User observations about environmental parameters, like air quality, water quality, snow properties.

VTT Pollen Analysis Web Service

Web service that provides pollen data in XML format. Pollen data comes from Turku Pollen Analysis Data Service.

VTT

Provides user observation data.

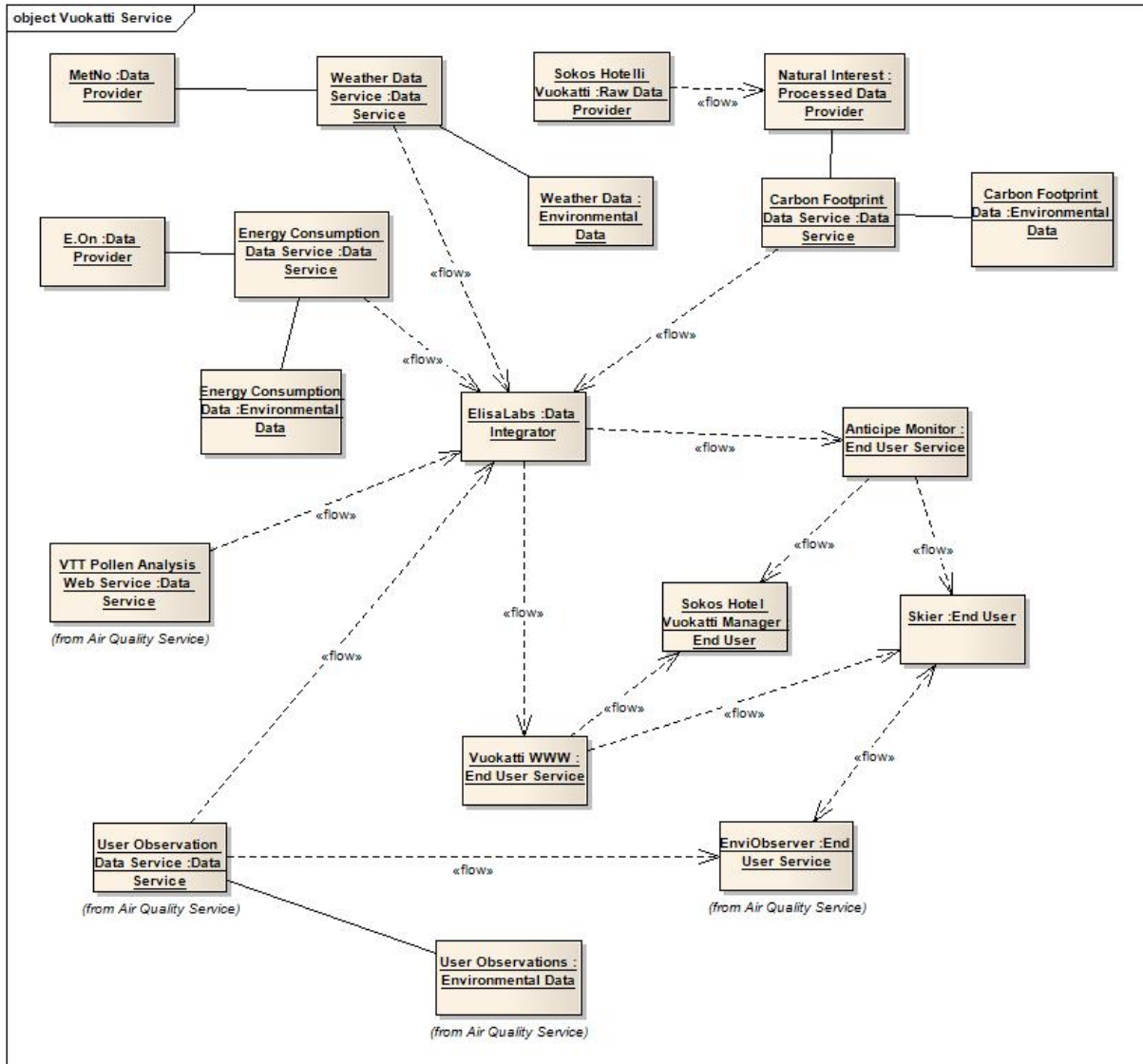


Figure 12. Vuokatti pilot service object model: architecture domain model classes.

Anticipe Monitor

Situation awareness system by Anticipe

Carbon Footprint Data

Carbon footprint data about products, processes and services.

Carbon Footprint Data Service

E.On ElisaLabs	Energy consumption data provider Integrates data from other sources and delivers them to end-user systems.
Energy Consumption Data Service Energy Consumption Data	Environmental Data
MetNo	Norwegian Meteorological Institute
Natural Interest	Calculates carbon footprint values.
Skier	A visitor in Vuokatti area.
Sokos Hotel Vuokatti Manager	A human end user that is interested in developing hotel processes to reduce carbon footprint, and in getting more customers to the hotel.
Sokos Hotelli Vuokatti	A hotel in Vuokatti area that provides raw data for carbon footprint calculations.
Vuokatti WWW	WWW pages of Vuokatti Ski resort that provide environmental data (among other things).
Weather Data Service Weather Data	Is Environmental Data

## 8 Service Interfaces

Service interfaces act as technical contracts between different actors (like the services of Market Place, Data Service) within the system. For example, through the dedicated interface Data Utilizer fetches information from the Data Services.

Primarily, the protocol used while accessing the service via the interface is Web Service/SOAP (defined using Web Service Definition Language (WSDL)) , but other protocols like Web Service/REST or FTP are possible in those cases where it is seen feasible.

### 8.1 Services of the Market Place

The Market Place provides the following services.

#### 8.1.1 Catalogue Service

Catalogue Service is dedicated for the searching of Data Services by Data Utilizers. Thus, all the Data Services should be published (registered) into the catalogue of Catalogue Service.

Information of the Data Service, which is stored into the catalogue include

1. metadata about the service including access point, interface reference
2. metadata about the provided data sources

[For more detailed description of the metadata of Data Service and Data Sources, see the '7.3.1 Metadata'-chapter of this document]

The published profile of the Data Service containing the mentioned metadata entries is published by the related Data Provider.

Data Utilizers can find the desired Data Service and its desired Data Sources by using the metadata elements of the service and the data sources as the conditions of the searches.

Typical action procedure of the Data Utilizer using Catalogue Service is diagrammed in ' 7.4.1 Data Provider and Data Utilizer communication ' -chapter of this document.

Implementation note: It is considered whether it is feasible to utilize the existing service registry implementation like UDDI and OGC Catalogue Service or to implement the specialized one for Market Place.

##### 8.1.1.1 Operations

The following operations are provided.

'Find services' operation provides the ways to search Data Services based on the dedicated search conditions.

The search conditions utilize among other properties the published metadata of the Data Service and Data Sources.

The search operation provides ways to compose the operation parameters using typical combination elements like logical operatives AND, OR, NOT.

[For more detailed description of the metadata of Data Service, see the ' 7.3.1 Metadata' -chapter of this document]

'Publish data service information' operation provides the ways to publish the information profile about data service and its data sources into the catalogue.

'Modify data service information' operation provides the ways to modify the information profile about data service in the catalogue.

'Remove data service information' operation provides the ways to remove the information profile about data service from the catalogue.

### **8.1.2 Agreement Manager**

Agreement manager is involved in contract creation and administration process. Data Provider and Data Utilizer make the contract with each other about usage of Data Service. The contract creation is supported in the Market Place system and operations like "announce contract" and "accept contract" are for contract creation process. There are also operations for compensation and management purposes.

#### **8.1.2.1 Operations**

##### **'Announce Contract'**

For Data Provider: To announce conditions that forms contract.

##### **'Accept Contract'**

For Data Utilizer: To accept contract for using a Service.

### **8.1.3 Quality Manager**

Quality of service is important when data the Data Service from Data Provider is used in scientific purposes or some other major application. For knowing how good the specific Data Service is, user can get information about quality of Data Service from Quality Manager (QM). Purpose of QM is to log and report about Data Services quality. Other relevant information about Data Service is how measures are collected. QM also offers information about Data Services measurement procedures.

#### **8.1.3.1 Operations**

Operations that support Quality-collecting and -reporting functions.

## **8.2 Recommended interfaces**

### **8.2.1 Generic Data Service**

Each Data Service, which is published by the relevant Data Provider, should implement an interface, which is used by related Data Utilizers. To limit the amount of the different Data Service interfaces, the interface of Generic Data

Service is described here and it is recommended to be used, if feasible, while the Data Services in typical cases are implemented.

The nature of interface is the Web Service interface based on the WSDL characteristics.

The detailed and proper WSDL-definition of the interface will be produced at the later phase of the future projects.

### **8.2.1.1 Operations**

The following operations are provided.

'Get Service Information' operation provides the ways to request

1. information about the service including the relevant metadata
2. information about the selected subset of Data Sources including the relevant metadata provided by the service

'Fetch Data' operation provides the ways to request

1. Selected subset of Data Products, which are produced by the selected subset of Data Sources of the service.

'Control Functions' operation provides the ways to

1. control the overall functions of the service in the sense which is applicable for the needs of the client [ This needs more analysis of the relevant use cases ]

### **8.3 Common functionalities**

EDEN project has defined and described common functionalities for all the related projects. More information can be found from EDEN deliverable D1.2.1

Thus, the definitions of common functionalities of EnviTori like.

- Security functionality and Trust and Privacy
- Authentication
- Authorization and Access Rights Management

follow the principles, conventions and practices of the EDEN project.

## **9 Conclusions and next steps**

In the EnviTori project we have taken the first steps towards building an environmental information market place. In this document we have described the first version of the market place architecture. It should be emphasized that we are in the early phases of the work, and the architecture has not been fully validated yet, but only parts have been implemented. We have developed a domain model that describes the concepts related to environmental monitoring and the market place.

The architecture relies on service-oriented architecture model, in which data sources and processing systems are implemented as services that can be accessed via the internet. The role of the market place is act as an access point to multitude of data sources, processing services, models, databases and end-user services. This implies that the market place contains up-to-date metadata about the data providers and utilizers, and about existing environmental services. First version of metadata schema has been implemented to describe available information.

The development work continues in on-going and coming research activities. The Measurement, Monitoring, and Environmental Assessment (MMEA) research programme in the Cleen SHOK has already taken the domain model into use and will continue to elaborate it further. The market place is seen as a crucial component in the MMEA architecture, and the development of the market place pilot system continues in the MMEA. New data sources related to water lquality and weather monitoring will be implemented into the market place.

The air quality pilot, as one of the market place end-user services, will be developed further in coming projects. This brings new data sources related to air quality monitoring into the market place. Participatory sensing theme will continue with MMEA and JVP (Lake water quality related TEKES project) projects, and data coming from people as environmental sensors will become available in the market place.