Progress Report and Pilot Platforms Update

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SDI4Apps

DELIVERABLE

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D6.3 PROGRESS REPORT AND PILOT PLATFORMS UPDATE

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

D6.3 Progress Report and Pilot Platforms Update is the third deliverable in the WP6. D6.3 aims to describe current stage of Pilots development and inform about recent progress. In this deliverable wide range of information regarding Pilots can be found such as used data sets, developed applications, user engagement and insight in planned actions for future development.

Overall Pilots have achieved a lot in last six months of projects SDI4Apps second year. Pilots are evolving – Use cases change, basic functionalities are complemented with additional ones and visual appearance of Pilot applications is improving. Pilot's approaches differs – some pilots work to develop extensive data sets and data coverage, some tend to focus more on user engagement. However, a lot has been done already, there is still room for progress.

1 INTRODUCTION

1.1 About the project

The advancements of ICT technologies and shift towards Linked Open Data give opportunity and challenge for innovation based on reuse of geospatial information (GI). Never the less low-cost tools combing a user-friendly and customized data interactions are still in an early stage. Spatial data can benefit in decision making, planning and managing many aspects of socio-economic activities. Pressure is growing on different institutions and local authorities to actively reuse and share GI[1]. This role is demanding in terms of technical knowledge and resources as different software components are required to develop and deploy spatial data infrastructure (SDI).

SDI4Apps creates cloud based framework with open API and aims to promote further reuse of generated solutions, experiences and digital resources for the benefit of different user groups as SMEs, experts, public bodies and citizens. Main target of SDI4Apps is to reduce the gap between SDI experts and micro SMEs and individuals developing applications (apps) based on GI. SDI4Apps is building a cloud based framework that will bridge the gap between the top-down managed world of INSPIRE, Copernicus and GEOSS, built by SDI experts, and the bottom-up mobile world of voluntary initiatives and thousands of micro SMEs and individuals developing applications (apps) based on GI. Provided solutions relieve possibility to collect, store and - what is most important- share different data supporting easy discovery and accessibility of spatial data. SDI4Apps goal is to ensure positive interaction between INSPIRE and various voluntary initiatives as well as to promote building of a successful business on the basis of European SDIs.

1.2 About the deliverable

The WP6 “Internal Pilot Applications” is devoted to SDI4Apps framework and tools evaluation using pilot deployment and demonstrations. To validate solutions created by SDI4Apps and its platform six pilots are developed and used:

1. Easy Data Access– pilot supports easy access to existing services and integrates an API solution, which will support easy collection of information using smart phones and integrate this information into current SDIs.
2. Open Smart Tourist Data - supports related business issues such as easy integration of the SDI4Apps system into proprietary solutions (thanks to the implementation of standards), reusing and sharing existing information resources, channels and tools. Open Smart Tourist Data integrates users’ data, free and open global data, SDI4Apps Team’s data, crowdsourced data and social media.
3. Open Sensors Network - creates an environment where different groups of volunteers (for example farmers) will be able to integrate low cost sensors (meteorological, quality of air, etc.) into local and regional web sensor networks.
4. Open Land Use Map Through VGI - an initiative for voluntary Open Land Use Mapping.
5. Open INSPIRE4Youth - to generate educational environmental and applications for students and youth.
6. Ecosystem Services Evaluation - on the identification of spatial representation of the outcomes of EcoSystem Services (ESS) Evaluation.

Pilot Scenarios and Use Cases are rather diverse and cover various sectors such as tourism, land use management, environment and ecosystems, agriculture, education and research. Involving very different stakeholders, using different data and functionalities pilots represent the diverse possible use of SDI4Apps Cloud platform and created Open API. Pilots are basis for validation of the platform usability and usefulness for the internal and especially external stakeholder, data providers, developers, users and can be used for demonstrations and for testing of SDI4Apps created Cloud Platform. According to Deliverable 8.3 Definition

1 “Development of a Mobile Mapping Solutions for Spatial Data Collection Using Open Source Technologies”, de Abreu Freire, C., E., Painho, M. Procedia Technology, 2014, available at http://www.sciencedirect.com/science/article/pii/S2212017314003429

of Promotion Campaign Pilots can also be seen as tool for dissemination activities to reach and engage different target groups, such as:

1. Private sector,
2. Public sector,
3. Scientists and researchers,
4. Non- governmental sector,
5. Society in general,
6. Specific target groups identified for each of pilots.

The evolution of the project, its cloud platform, pilot applications and increasing engagement of internal and external stakeholders and partners, especially in Y2, has proven that the pilots are core integral part of the project and a platform, and they have been core factors, that foster the engagement of developers and potential users of the platform. Also, taking into account the various nature of the pilot applications, available data, their use cases, and also different external interest towards different topics, covered by the pilots, the current stage of the project, demonstrates that there are differences between the pilots, in terms of their stage of development, user and developer engagement and technological development phases, with some pilots being at more developed stages than others. Lessons learned in currently more developed pilots are being integrated into other, currently less developed pilots, thus achieving both: closer integration and information sharing among pilots, and more aligned pilot development in the Y3.

Based on the Description of the work (DoW), there are the following four deliverables in WP6:

D6.1 Data Models and Platform Specifications for Single Pilots due June 2015. Report describes components and data models of each pilot.

D6.2 Initial Deployment of Single Pilot Platforms due October 2015. Main result of this deliverable is deployed Pilot Platforms.

D6.3 Progress Report and Pilot Platforms Update due March 2016 - **the current deliverable**. Deliverable includes description of pilots and updates regarding all pilots and pilot activities.

D6.4 Progress Report and Final Pilot Platforms Release due March 2017. Deliverable will include pilot descriptions and pilot updates.

The current D6.3 contains wide range of information about six pilots as: description of Use Cases, User engagement, data acquisition, necessary cloud properties and outline of each Application. Deliverable 6.3 also informs about progress and future plans of Pilots. D6.3 is structured in eight chapters: Introduction, separate chapter for each pilot description, which is divided in several subchapters addressing different aspects of pilot deployment, and Conclusion.

D6.3 is useful for understanding the current situation of Pilot development and for evaluating use possibilities of the SDI4Apps Cloud Platform that are demonstrated through Pilots.

2 EASY DATA ACCESS – PILOT 1

The pilot, which is focused on the Burren National Park in Ireland[2], is supporting the wider communities' identification, reporting, and recording of tourist destinations and ground truthing of protected heritage sites datasets in collaboration with the Burren LIFE[3] and SmartOpenData[4] projects. The pilot uses the cloud-based SDI4Apps Platform to enable mobile Apps and services that involve various targeted communities of users through awareness, using social media, crowd-sourcing and open map-based geospatial data.

2.1. Use Cases

2.1.1 Use Case 1: Mobile Apps to support Tourism for Conservation

The Burren Geopark has adopted the ETIS for the Sustainable Management of its Destinations to monitor and measure performance, and is one of 100 destinations in Europe that are currently piloting this system. The Geopark also manages the Burren Tourism for Conservation LIFE Project (LIFE11/IE/922)[5]. The aim of this LIFE project is to strengthen the integration of tourism and natural heritage, reconciling tourism development with conservation of geology, biodiversity and cultural heritage in the Burren area of County Clare. The innovative aspect of the Project is to advance tourism for conservation as a European model of value to local communities. This aims to be a strong demonstration project with pilot actions being stimulated to test the use of tourism for conservation in the Burren.

The SD4Apps Platform enabled apps aim to directly contribute to the project's objective "To show measurable environmental, social and economic benefits of the model", and be part of the model that can be transferred to all European GeoParks, and thus enable its long-term sustainability and exploitation by MAC.

Use case ID:	UC1.1
Use case Title:	ETIS Webservice for the Burren & European GeoParks Network
Abstract:	The SDI4Apps Platform enabled European Tourism Indicators System (ETIS) webservice for sustainable management at destination level, streamlines and enhances the current manual system by transforming the ETIS Excel dataset into Linked Data.
User groups/ stakeholders:	1. Public bodies – National Parks Wildlife Service (NPWS) 2. Experts – Management and Researchers in the Burren GeoPark, GeoParks Network 3. Enterprises, Companies and SMEs – Burren GeoPark 4. Citizens – visitors to the Burren National Park.

[2] As described in D6.1
[3] See www.burren.ie
[4] www.smartopendata.eu
[5] See www.burren.ie

Description (all the steps that will be done by the user):	The Burren Geopark's solidity as a destination is exemplified by its benchmarking and monitoring procedures. It has adopted the recently launched European Tourism Indicator System for the Sustainable Management of Destinations (ETIS) [6] to monitor and measure performance and is one of 100 destinations in Europe that are currently piloting this system. Further to this, Failte Ireland, the national tourism development authority, has expressed interest in using the Geopark's work on the ETIS as a pilot for assessing for larger-scale, national projects. The SDI4Apps Platform enabled European Tourism Indicators System (ETIS) webservice for sustainable management at destination level, streamlines and enhances the current manual system by transforming the ETIS Excel dataset into an easy access online service, and enables the Burren GeoPark initially (and all other GeoParks subsequently) to: 1. Set up their destination with suitable indicators and targets (by its Local Destination Co-ordinator and Stakeholder Working Group) 2. Provide online data collection by each stakeholder group (including Destination management, Enterprise , Resident and Visitor Surveys) – this will include automatic updating from appropriate online source databases 3. Review progress and results achieved to date at their destination by Monitoring Results and Charting Destination, Enterprises, Residents, Visitors Impressions, Spending and Time – this will include automatic geographic visualisation by linking to appropriate Geospatial data sources. This enables the Stakeholder Working Group and visualisation by the various stakeholders to provide an ongoing community "crowsdsourcing verification" that the results and data being entered matches the perceptions of the various stakeholders 4. Provide benchmarking with other destinations (e.g. other GeoParks) through each of these views and access to their linked open datasets[7].
How users are involved in the design and development process?	Using the Social Validation approach and plans defined in D2.2 users have been engaged since very early in the project. To date there have been 5 meetings with the Burren Management Team and 2 with other stakeholders including the County Council.
Criteria of success:	• Usage level & Social Validation of Services that use SDI4Apps

[6] http://ec.europa.eu/growth/sectors/tourism/offer/sustainable/indicators/index_en.htm

[7] The pilot may find that the ongoing community stakeholders' crowdsourcing verification at point 3, may not be adequate for the Geoparks Network, who may prefer to include independent 3rd party verification of the data to ensure the integrity of the ETIS benchmarking across the Geoparks. This may require another visualisation option across the destinations to verify that the data being entered is good as basically the GeoParks will be competing with each other in the GeoParks Network benchmarking exercise.

	• Easy collection of information using smart phones • Integration of VGI into existing SDIs • Increased access to harmonised & interoperable GI, L/OD & VGI data • Integrate data from users', OD, crowd-sourced & social media. • Reuse & share tourist information resources, channels & tools • SMEs, Students & Researchers developing new Apps • New tourism activities, visitors & jobs, and SME developed services.
Interoperation with other SDI4Apps pilots:	• Open Smart Tourist Data • Open INSPIRE4Youth • Ecosystem Services Evaluation.
Performance:	Standard user acceptable response and latency times for information retrieval of 2 seconds[8], measured as defined in D3.5 (Technical Test Methodology).
App ID:	A1.1.
Notes and issues:	Once proven by the Burren Team, further GeoParks will be able to implement similar activities, and provide benchmarking with other destinations (e.g. other GeoParks) through each of these views and access to their linked open datasets.

Table 1 USE Case 1.1

2.1.2 Easy Use Case 2: Mobile App for Protected Heritage Sites

The SDI4Apps Platform is enabling the provision of an easy access App service for use by Field Officers and to mobilise a very motivated community, by enabling visitors and people interested in their local heritage, to seek out and ground truth[9] potential–monument sites in the Burren National Park and beyond. Verified sightings will be added to the Irish National Monuments Database[10].
In Ireland, the Irish Heritage Council[11] is a statutory body that takes an integrated approach to heritage, with responsibilities that include both its cultural and natural aspects. The Heritage Council's vision is that the value of heritage is enjoyed, managed and protected for the vital contribution that it makes to the community's identity, well-being and future. In practical programmes across Ireland the Heritage Council is putting in place infrastructure and networks to enable communities to take responsibility for and participate in the development and conservation of their heritage assets. This Ground Truthing App aims to contribute directly to that, and in turn provide a means for its long-term sustainability and exploitation by MAC.

[8] "A study on tolerable waiting time: how long are Web users willing to wait?", Nah, F. Behaviour & Information Technology, 2004, available at http://sighci.org/uploads/published_papers/bit04/BIT_Nah.pdf
[9] Ground truthing is the process of gathering data in the field that either complements or disputes airborne remote sensing data collected by aerial photography, satellite sidescan radar, or infrared images (http://www.missiongroundtruth.com/groundtruth.html), see also http://en.wikipedia.org/wiki/Ground_truth
[10] Mapped at http://webgis.archaeology.ie/NationalMonuments/FlexViewer/, and which is compliant to INSPIRE Protected Site Theme – PS v3.2 - http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.0.pdf
[11] www.heritagecouncil.ie

Use case ID:	UC1.2
Use case Title:	App to Ground-Truth potential–Protected Monument sites
Abstract:	SDI4Apps Platform enabled App to Ground-Truth potential–Protected Monument sites.
User groups/ stakeholders:	1. Public bodies – Heritage Council, National Monuments Service, Irish Government Department of Arts, Heritage and the Gaeltacht. 2. Experts – Field Monuments Advisors & Researchers 3. Enterprises, Companies and SMEs – Farmers. 4. Citizens – visitors and people interested in their local heritage
Description (all the steps that will be done by the user):	The Monuments Ground Truthing App steps are: 1. Introducing the National Monuments Service, and direct users to browse open satellite map sources such as OpenStreetMap[12], to find potential archaeological sites in their chosen area (or their current locations if they are already on site). Later on, further Geographic Information sources from the Heritage Council Map Viewer, may also be included. 2. Allowing the user to access a database of previous ground truthing observations, and the Heritage Council's Map Viewer to determine if a chosen site is already recorded by the National Monuments Service as a national monument or has been previously crowd-source reported. If so the user can continue to investigate their chosen area for other potential sites. 3. Supporting the user on-site to ground truth a potential heritage site. This involves using their phone or tablet to take a number of photographs, record notes, note the geo-location using their phone's GPS, as well as their own identity. 4. The recorded information is uploaded to an easy access database, that is be mainly CSV with the images and associated maps & GeoSpatial Information. 5. Field Monument Advisers, National Monuments Service staff, and other experts (as well as people who may be interested in the app, such as members of the BurrenBeo Volunteers, Institute of Archaeology of Ireland, GeoPark/BFCP Team, etc) have access to a webservice to authenticate each crowd-sourced ground truthing observation uploaded to the database. They are able to inform and/or post further queries to the person who uploaded the observations. They are also able to delete any defamatory, malicious or frivolous observations. All other observations, are then visible to the general public on a map, showing the protected monuments (via the Heritage Council's Map Viewer), the crowd-sourced ground truthing observations that are potential national monuments, as well as those that are not (to avoid people wasting their time investigating them again).
How users are involved in the design and development process?	Using the Social Validation methodology and plans defined in D2.2 users have been engaged since very early in the project. To date there have been 2 meetings with the Heritage Council and Irish Government Department of Arts, Heritage and the Gaeltacht, and 3 with Field Monuments Advisors from the National Monuments Service. This app was also discussed at the 5 meetings with the Burren Management Team.
Criteria of success:	• Usage level & Social Validation of Services that use SDI4Apps • Easy collection of information using smart phones

[12] www.openstreetmap.org

	• Integration of VGI into existing SDIs • Increased access to harmonised & interoperable GI, L/OD& VGI data • Integrate data from users', OD, crowd-sourced & social media.
Interoperation with other SDI4Apps pilots:	• Open Smart Tourist Data • Open INSPIRE4Youth • Ecosystem Services Evaluation
Performance:	Standard user acceptable response and latency times for information retrieval of 2 seconds[13], measured as defined in D3.5 (Technical Test Methodology). The uploading of multiple large high-definition photographs may take longer.
App ID:	A1.2.
Notes and issues:	At the end of the project, the Heritage Council and National Monuments Service will decide if the ground trothing observations should be included as a permanent Voluntary Geographical Information (VGI).

Table 2 Use Case 1.2

2.2 USER ENGAGEMENT

The Easy Data Access pilot is focused on the following services:

1. SDI4Apps enabled European Tourism Indicator System (ETIS) Webservice for the Burren and European GeoParks Network.
2. SDI4Apps enabled App to Ground-Truth potential Protected Monument sites

2.2.1 Stakeholders and their roles

The pilot addresses four target groups: Public bodies, Experts, SMEs and Citizens. Their roles in the 2 services are as follows:

Stakeholders	Use Case UC1.1 - ETIS	Use Case UC1.2 - Ground Truthing	Roles
Public bodies	• National Parks Wildlife Service (NPWS)	• Heritage Council, • National Monuments Service, • Irish Government Department of Arts, Heritage and the Gaeltacht.	• Users. • Policy Decision Makers. • Funders to continue the service.
Experts	• Management of the Burren GeoPark • Members of GeoParks Network.	• Monuments Field Officers • Researchers	• Users • Data providers. • Operational Decision Makers.

[13] "A study on tolerable waiting time: how long are Web users willing to wait?", Nah, F. Behaviour & Information Technology, 2004, available at http://sighci.org/uploads/published_papers/bit04/BIT_Nah.pdf

	• Researchers		
SMEs, Enterprises and Companies	• Burren GeoPark • Local Enterprises	• Burren Farmers. • Local Enterprises	• Users • Data providers • New Apps and services
Citizens	• Tourists and Visitors to the Burren National Park • All local people.	• Tourists and visitors • All People interested in their local heritage	• Users • Data providers.

Table 3 Stakeholders and their roles

Engagement method

Based on the Social Validation approach and plans defined in D2.2 (Social Validation Methodology) users have been engaged from early in the project using Social Validation/Co-design meetings and discussions with the GeoPark stakeholder groups, who have identified the Use Cases and services providing the most immediate benefit/added value for them.

Incentives for engagement

The GeoPark users and stakeholder groups themselves, identified the Use Cases and services providing them with the most immediate benefit/added value for the Burren Park. So they are much incentivised to ensure that the Apps and services are provided to meet their needs, so that they can be continued after the project ends.

Timing, planning, indicators

The applications have been implemented on the SDI4Apps Platform infrastructure and are being trialled with the stakeholders, and as the SDI4Apps Platform back-end services are available these will be further evolved and rolled-out as defined in task T6.1 to the end of the project in March 2017. The two services are being operated and evaluated (in WP6) with both internal and external stakeholders and users.

From the Social Validation in D2.2, the criteria of success for this pilot's services are as follows:

1. Easy collection of information using smart phones
2. Integrate data from users', OD, crowd-sourced and social media.
3. Reuse and share tourist information resources, channels and tools
4. Integration of VGI into existing SDIs
5. Increased access to harmonised and interoperable GI, L/ODand VGI data
6. Usage level and Social Validation of Services that use SDI4Apps
7. New tourism activities, visitors and jobs, and SME developed services.
8. SMEs, Students and Researchers developing new Apps and Services

Quantified in the following indicators:

Easy Data Access pilot Scenarios Success Criteria	Apps/ Svcs in Operation	No of App/ Svc Users	No GI/LOD datasets in use	No VGI datasets created	Monthly accesses	New Apps/ Svcs
1. SDI4Apps enabled ETIS Webservice for the Burren & European GeoParks Network.	2	15	10	2	100	2
2. SDI4Apps enabled App to Ground-Truth potential	1	10	5	1	50	2

Protected Monument sites						
Total for Irish Pilot	**3**	**25**	**15**	**3**	**150**	**4**

Table 4 Easy Data Access pilot Success Indicators

The Easy Data Access pilot will demonstrate achievement of its intended outcomes mainly through Social Validation, which has identified the above criteria and indicators of success according to the different standpoints of the actors represented in each usage scenario, as a framework for evaluating the added value of the services that conform to the standards proposed by SDI4Apps. This activity takes into account the taxonomy of social validation approaches elaborated in D2.2, i.e.:

1. Validation driven by the prospect of user engagement - In this case end-users are not yet directly involved in social validation, but the prospect of user engagement is already influencing institutional behaviour.
2. Validation through direct user interaction with the easy data access process - With the direct participation of (expert/non expert) users in data access.
3. Validation driven by the co-design of innovative "demand pull" services - This is the most user-driven approach, as it actually involves final end-users in the co-design of services (such as ETIS and Ground-Truthing) that use the SDI4Apps platform.

These indicators are being matched with evaluative questions that will be used throughout task T6.1 for the pragmatic assessment of impact generated by the Apps and services enabled by the SDI4Apps platform – and more broadly, on the environmental related activities in which users are involved.

2.2.2 Business plan - market potential

The sustainable operation of the 2 pilot services will be funded and extended by the public agencies involved, with MAC (the SME partner involved) exploiting the specific ETIS and Ground Truthing Use Case opportunities. This will mainly involve the "White Label Development" with "Dual Licencing" business models[14].

The context and long term business of the 2 Use case services will be as follows:

1.ETIS Service

The Burren, and all GeoParks, need an open common standard to track their progress towards their sustainability objectives in particular, and to benchmark their progress with other sustainable destinations. Currently the ETIS is the only such standard but being an offline Excel file it does not allow for real-time inputs or benchmarking across destinations. The SDI4Apps Platform enabled service addresses these as described above.

The tangible benefits in the short term for the Burren and other GeoParks is the ability to define their destination's indicators and targets by its Local Destination Co-ordinator and Stakeholder Working Group, then track their progress in real-time through crowd-sourcing by the various stakeholders, and provide benchmarking with other destinations (e.g. other GeoParks) through each of the provided views and access to their linked open datasets. As well as the control, extra visitors and profile that this provides to each GeoPark, this will also demonstrate and validate the ETIS approach for all of Europe.

It is anticipated that as each destination's use of the ETIS matures and the indicator data collected becomes more extensive, the webservice will enable comparisons of the destination's progress against international benchmarks. This will give greater context to the achievements and give destination stakeholders motivation to take further actions to improve results. It will also encourage knowledge sharing between destinations. The intention is not to create competition between

[14] As defined in "Eight Business Model Archetypes for PSI Re-Use" Ferro and Osella, "Open Data on the Web" Workshop, 24-24 April 2013, Google Campus, Shoreditch, London, http://www.google.ie/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=2&cad=rja&ved=0CDoQFjAB&url=http%3A%2F%2Fwww.w3.org%2F2013%2F04%2Fodw%2Fodw13_submission_27.pdf&ei=Fxt5UsqPIuXe7AbQ94DwAw&usg=AFQjCNFkTHAJMbe5x_Dg4YyWpTeMYDlzpg&bvm=bv.55980276,d.ZGU.

destinations, but to recognise that the results generated through the process are core to the decision making plans for each destination.
The monetisation of these benefits will be expressed in the plans of the Burren and other GeoParks. At present, the European GepParks Network comprises 69 parks from 23 European Countries[15], while the Global GeoParks Network has 111 members[16]. MAC plans to use the Burren GeoPark as a reference site to encourage further European Geoparks to take up and fund the ETIS service for their parks, and eventually extend it to the Global GeoParks. Assuming average annual service revenues per GeoPark per year to be €5k, the European Network represents a potential market of about €0.3m and the Global Network about €0.5m per year. In addition MAC would aim to earn additional revenues from dual-licensed features for proprietary added-value features, and target the ETIS standardized service to all sustainable tourism destinations.

2. Heritage Ground-Truthing Service

The SDI4Apps Platform enables the provision of an easy access App service to mobilise a very motivated community, by enabling field officers, visitors and people interested in their local heritage, to seek out and ground truth potential–Monument sites in the Burren and beyond.
In the short-term the benefits are increased special interest tourists visiting the Burren, and other supported sites, and greater awareness of the Irish Protected Monuments sites. For instance, the App may help Burren farmers (as well as Irish farmers generally) to determine if their farm might contain a potential National Monument Site (especially field systems) on their land. In addition, the app and process is very educational and will probably be used by teachers and students to discover and contribute to their local heritage. For instance, it could complement the courses and practical local environmental work carried out by BurrenBeo Trust[17].
The crowd-sourced ground truthing observations (both positive and negative) may be included as a permanent Voluntary Geographic Information (VGI) layer on the National Monuments map on the Irish Heritage Council's Mapping Viewer. This process will also initiate a process for the digital preservation of the VGI data concerning the features that were investigated, both those that are validated to be national monument sites, and those that are not, to avoid people wasting their time and resources in investigating them again.
The Burren is very well observed and recorded over many years, so few new National Monument sites are likely to be found during the second iteration of the Irish pilot. However other sites, such as Lough Derg and the Slieve Aughtry, which is also in the Mid-West Region of Ireland, are likely to yield many new national monuments. So further sites, beyond the Burren, are likely to be supported by this Application quite early after this current project ends.
MAC plans to monetise these benefits, by again using the Burren GeoPark as a reference site to encourage further sites to adopt usage of the Ground-Truthing app and service. These could be funded by local, regional or national public agencies, either on a flat annual fee basis or on a cost per transaction. The potential is huge, as the Irish National Monuments Dataset contains records of 138,800 sites[18]. Ireland represents about 1% of the land area of Europe, so there could well be over 10M such sites across Europe. At the top end, there are over 1,000 UNESCO protected cultural and natural sites in 169 countries across the world[19]. The Ground-Truthing App and service could be directly used for heritage and protected sites across Europe, or to crowd-source ground-truthing of environmentally sensitive sites. There are over 26,000 Natura 2000 protected sites in Europa[20]. So it would be reasonable that there could 10 agencies per Member State willing to fund the service for their sites across Europe, and again assuming €5k per service per year, gives a very conservative potential market of about €1.4m per year. In addition MAC would aim to earn additional revenues from dual-licensed features for proprietary added –value features. These and other ground truthing requirements will provide further exploitation opportunities for MAC (the SME involved) and others.

[15] http://www.europeangeoparks.org/?page_id=168
[16] http://www.globalgeopark.org/aboutGGN/list/index.htm
[17] www.burrenbeo.com
[18] http://www.archaeology.ie/archaeological-survey-ireland
[19] https://en.wikipedia.org/wiki/Table_of_World_Heritage_Sites_by_country
[20] http://ec.europa.eu/environment/nature/natura2000/barometer/docs/Natura%202000%20barometer%202013.xls

2.3 DATA ACQUISITION

2.3.1 Datasets

The datasets being used in the two Apps and Services are as follows:

1. **Mobile Apps to support Tourism for Conservation**
   - ETIS (European Tourism Indicator System) Dataset
     - Defined as an Excel Spreadsheet & PDF Guide http://bookshop.europa.eu/en/the-european-tourism-indicator-system-pbNB3213182/
   - External Open Datasets include
     - Logainm Placenames Database of Ireland – LOD - www.logainm.ie/en
     - Irish Open Government Data Portal - http://data.gov.ie/
     - National Biodiversity Data Centre Ireland - www.biodiversityireland.ie
     - EU Open Data Portal - http://open-data.europa.eu/en/data/dataset
     - Eurostat Linked Data - http://eurostat.linked-statistics.org/
     - Open Street Map - www.openstreetmap.org
     - GeoNames - www.geoames.org

Dataset ID:	DS1.1
Resource title:	ETIS Dataset
Resource abstract:	The European Tourism Indicator System for the Sustainable Management of Destinations (ETIS) [21] to monitor and measure performance of destinations in Europe
Geographical coverage:	Burren GeoPark initially, but eventually can be scaled to all GeoParks across Europe
Level of detail:	ETIS dataset and manual process

Resource locator:	The dataset is accessed through the following JSON files URLs:
	//GET PUT to retrieve or update indicators
	http://www.ETISapp.eu/api/ETISIndicators
	//GET POST to retrieve or add a new survey
	http://www.ETISapp.eu/api/Survey?Id=4

Restrictions/ Licences:	ETIS Dataset license: Likely to be Creative Commons Attribution (CC BY)[22] But will be finally determined later in collaboration with the Burren GeoPark, GeoPark Network and other stakeholders
Format:	Currently Excel offline.
Transformation:	Transformed from Excel/CSV to LOD RDF by MAC using the Enablers of the SDI4Apps Platform.
Ready to use:	In the process of being published online.
Size:	<100kB at present.
Data acquisition:	Continuous by crowdsourcing.
Notes and issues	• Transformation (Excel/CSV to RDF) • Storage (on SDi4Apps Platform) • Search (on SDi4Apps Platform, to include further GeoParks (including possibly other pilots) later.

[21] http://ec.europa.eu/growth/sectors/tourism/offer/sustainable/indicators/index_en.htm

[22] Creative Commons licenses consist of 4 major condition modules (see http://en.wikipedia.org/wiki/Creative_Commons_licenses)

1. Attribution (BY), requiring attribution to the original author;
2. Share Alike (SA), allowing derivative works under the same or a similar license (later or jurisdiction version);
3. Non-Commercial (NC), requiring the work is not used for commercial purposes; and
4. No Derivative Works (ND), allowing only the original work, without derivatives.

	• Visualization (for all GeoPark Stakeholders)

Table 5 Data Set 1.1

2. Mobile App for Protected Heritage Sites

- Irish National Monuments Dataset
  - Compliant to INSPIRE Protected Site Theme - PS v3.2 - http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.0.pdf
- External Open Datasets include
  - Irish Heritage Council heritage maps - www.heritagecouncil.ie/heritage-maps/heritage-maps?
  - Logainm Placenames Database of Ireland – LOD - www.logainm.ie/enn
  - Irish Open Government Data Portal - http://data.gov.ie//
  - Irish Spatial Data Exchange (ISDE) - www.isde.ie
  - Eurostat Linked Data - http://eurostat.linked-statistics.org/
  - Open Street Map - www.openstreetmap.org
  - GeoNames - www.geonames.org

Dataset ID:	DS1.2
Resource title:	Potential Monuments Voluntary Geographic Information Dataset.
Resource abstract:	Dataset to record Voluntary Geographic Information (VGI) reports from professionals, visitors and people interested in their local heritage, to seek out and ground truth[23] potential-Monument sites in the Burren and beyond.
Geographical coverage:	Burren GeoPark now, but eventually will be scaled to all of Ireland, and subsequently in other European locations.
Level of detail:	As defined in the National Monuments Protected Sites Dataset[24].

Resource locator:	The dataset is accessed through the following JSON files URLs:
	//GET POST site data
	http://www.GroundTruthing.eu:8080/api/Sites
	//GET POST photo data
	http://www.GroundTruthing.eu:8080/api/photo

Restrictions/Licences:	Dataset license: Likely to be Creative Commons Attribution Non-Commercial No Derivatives (CC BY-NC-ND)[25] To be determined later in discussions with the Heritage Council, and National Monuments Service, once they have feedback from the current trials.

[23] Ground truthing is the process of gather data in the field that either complements or disputes airborne remote sensing data collected by aerial photography, satellite sidescan radar, or infrared images (http://www.missiongroundtruth.com/groundtruth.html), see also http://en.wikipedia.org/wiki/Ground_truth

[24] INSPIRE View Service (need to register to use) https://www.geoportal.ie/geoportal/catalog/search/resource/details.page?uuid={F6DE3EBB-FC5C-4D79-A00A-BC45AB9F55F6}
INSPIRE "Predefined" download service https://www.geoportal.ie/geoportal/catalog/search/resource/details.page?uuid={F6DE3EBB-FC5C-4D79-A00A-BC45AB9F55F6}

[25] Creative Commons licenses consist of 4 major condition modules (see http://en.wikipedia.org/wiki/Creative_Commons_licenses)

Format:	CSV with GI elements in ESRI Shapefile format. The National Monuments Parent dataset is compliant to INSPIRE Protected Site Theme – PS v3.2[26]
Transformation:	Various to RDF.
Ready to use:	In process of being published online.
Size:	<100kB at present.
Data acquisition:	Continuous by VGI/Crowdsourcing.
Notes and issues	Datasets link the datasets provided by the Heritage Council Heritage Maps that allow users to look at a wide range of heritage data sets on a map[27]. Many of these data sets were collected by government departments but many others have been collected by local authorities through the County Heritage Plans. Coverage of some data sets is on an individual county basis, rather than as a national coverage[28], and some of the content, such as the content of points of interest on maps, is not always consistent. An INSPIRE compliant schema, "Protected Sites Data Specification"[29], has been developed and implemented for the Irish National dataset of protected sites using the Geographic Markup Language (GML – Simple Features Profile) by the Irish Government Department of Arts, Heritage and Gaeltacht.

Table 6 Data Set 1.2

2.3.2 Data Models

In line with the SDI4Apps iterative approach to user validation (as defined in D2.2), implementations of the Easy Data Access pilot has further determined the requirements with users and an evolutionary implementation of the following services in the Easy Data Access pilot to involve Burren citizens and stakeholders:

1. SDI4Apps enabled European Tourism Indicator System (ETIS) Phone Apps for the Burren and European GeoParks Network.
2. SDI4Apps enabled App to Ground-Truth potential Protected Monument sites

1. Mobile Apps to support Tourism for Conservation – Data Model for ETIS

The Tourism for Conservation data model was developed based on the ETIS dataset[30] to be as follows:

[26] Defined in http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.0.pdf
[27] See www.heritagecouncil.ie
[28] http://heritagemaps.biodiversityireland.ie/#/Map
[29] Defined in http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.0.pdf
[30] Defined as an Excel Spreadsheet dataset and PDF Guide at http://bookshop.europa.eu/en/the-european-tourism-indicator-system-pbNB3213182/

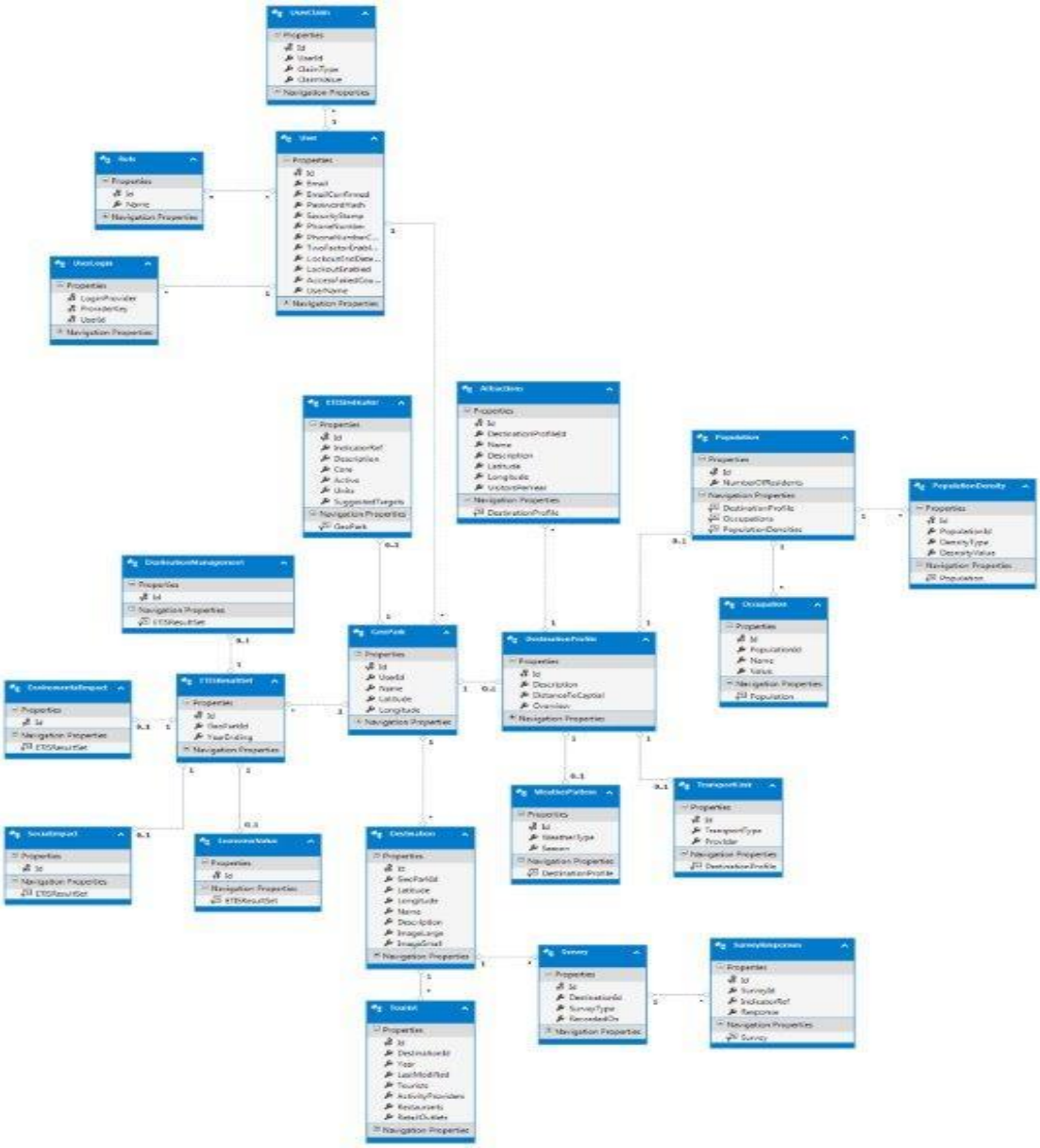


Figure 1 Tourism for Conservation data model

2. Mobile App for Protected Heritage Sites - Data Model for National Monuments

The Ground Truthing App uses the following generic SPOI data model[31] to ensure its completeness to support further tourism services in the future and compatibility with the SPOI dataset and Pilot 2 "Smart Tourist Data" services:

[31] http://portal.sdi4apps.eu/SPOI

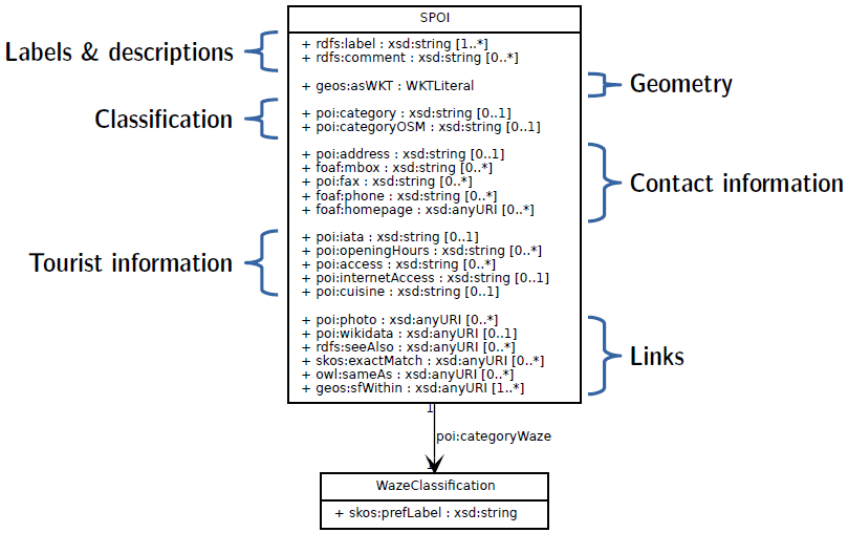


Figure 2 Ground-Truthing SPOI data model

The Ground-Truthing Heritage service seamlessly interacts with the data model of the Irish National Monuments dataset. This is compliant to the INSPIRE Protected Sites Data Model[32] and Simple Applications Schema[33], as follows:

[32] http://inspire.ec.europa.eu/data-model/approved/r4618-ir/html/
[33] http://inspire.ec.europa.eu/applicationschema/ps

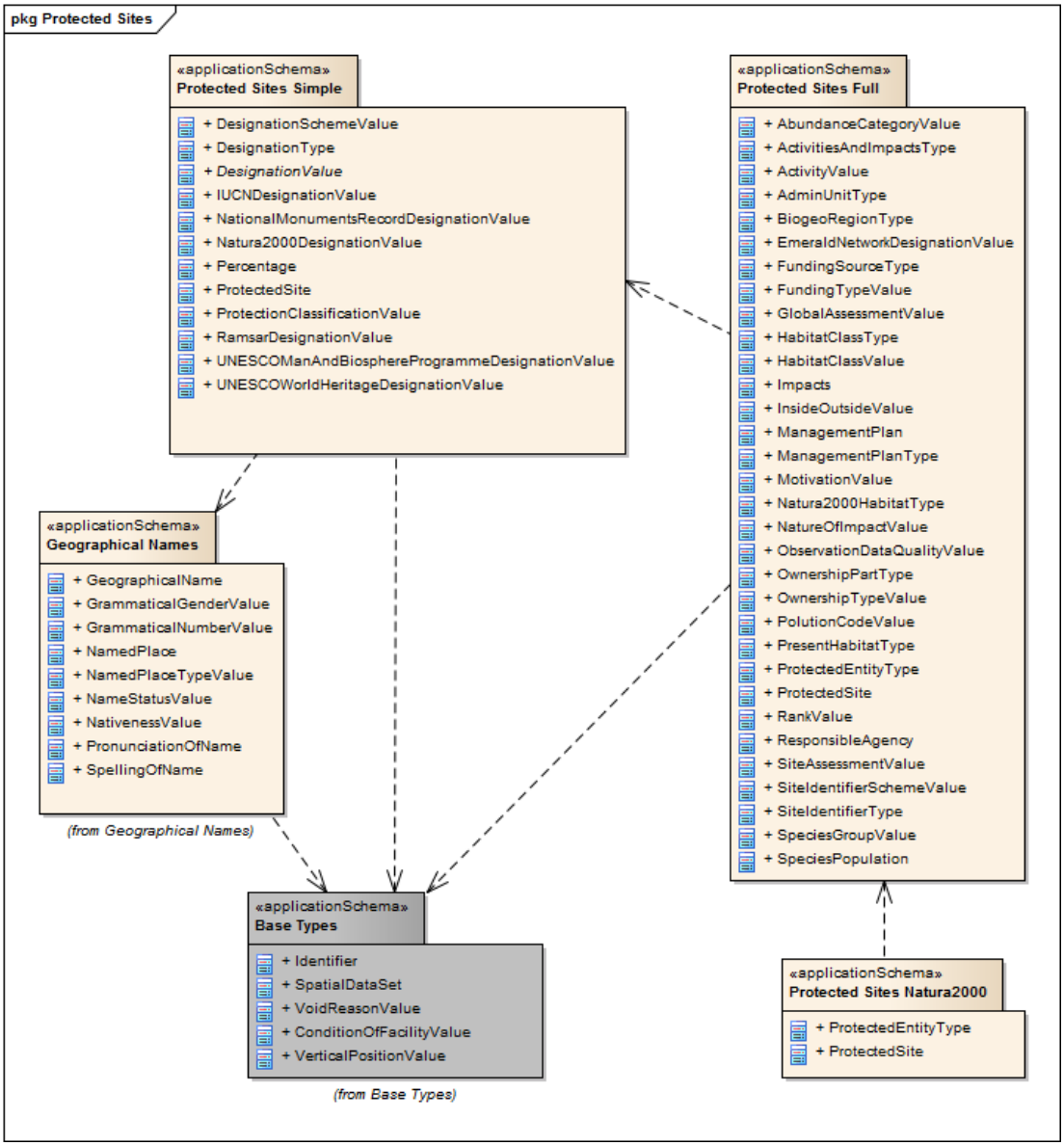


Figure 3 Protected Heritage Sites - Data Model for Irish National Monuments

2.4 APPS AND SERVICES

From initial Social Validation meetings and discussions with the various stakeholder groups in the Burren, as described in D2.2 (Social Validation Methodology), the following applications were identified as being potentially most beneficial to them;

1. SDI4Apps enabled European Tourism Indicator System (ETIS) Webservice and various stakeholder crowdsourcing apps for the Burren and European GeoParks Network, to support Tourism for Conservation
   - SDI4Apps is enabling an ETIS Webservice and Apps for the Burren and European GeoParks Network. ETIS is a new EU standard[34], that is a local community led process for monitoring, managing, and

[34] Defined as an Excel Spreadsheet dataset and PDF Guide at http://bookshop.europa.eu/en/the-european-tourism-indicator-system-pbNB3213182/

enhancing the sustainability of a tourism destination. The SDI4Apps Platform enables streamlining and enhancing the current manual system by transforming the current manual system to an easy access online service. The Burren Geopark has adopted the ETIS for the Sustainable Management of Destinations to monitor and measure performance, and is one of 100 destinations in Europe that are currently piloting this system. In addition, Failte Ireland, the national tourism development authority, has expressed interest in using the Geopark's work on the ETIS as a pilot for assessing for larger-scale, national projects.
The SD4Apps Platform enabled apps aims to directly contribute to the project's objective "To show measurable environmental, social and economic benefits of the model", and be part of the model that can be transferred to all European GeoParks, and thus enable its long-term sustainability and exploitation by MAC.

2. SDI4Apps enabled Application to Ground-Truth potential Protected Monument sites.
   - The SDI4Apps platform is enabling the provision of an application to mobilise a very motivated community, by enabling field officers, visitors and people interested in their local heritage, to seek out and ground truth[35] potential–monument sites in the Burren National Park and beyond. Verified sightings will be added to the Irish National Monuments Database[36].

Both pilot applications were identified and requested through User Validation/Co-design meetings and discussions with the GeoPark stakeholder groups, as providing the most immediate benefit/added value to them[37]. So the applications will be tested and ultimately validated by those groups using the services operating on the SDI4Apps Platform[38].

The initial iterations of the Easy Data Access Pilot Apps focused on developing the services' user interfaces and front-ends, by developing the two use cases as hybrid asynchronous apps written in open source AngularJS[39], using the open source IONIC HTML5 native app development framework[40] compiled to native code for the various mobile platforms (Android, IOS, Windows) using the open source Apache CORDOVA plugins[41]. This framework approach decouples the client application from the backend SDI4Apps architecture. By using angular JS it allows a common framework for both mobile development and web portal clients.

2.4.1 User App

Application ID:	A1.1
Name of the app:	European Tourism Indicator System (ETIS) service stakeholder crowdsourcing apps (Visitors, Residents and Enterprises).
Application description:	The SDI4Apps Platform enabled European Tourism Indicators System (ETIS) webservice for sustainable management at destination level, streamlines and enhances the current manual toolkit standard, as specified by DG

[35] Ground truthing is the process of gathering data in the field that either complements or disputes airborne remote sensing data collected by aerial photography, satellite sidescan radar, or infrared images (http://www.missiongroundtruth.com/groundtruth.html), see also http://en.wikipedia.org/wiki/Ground_truth
[36] Mapped at http://webgis.archaeology.ie/NationalMonuments/FlexViewer/, and which is compliant to INSPIRE Protected Site Theme – PS v3.2 - http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.0.pd
[37] As described in D2.2
[38] As discussed in D2.2.
[39] https://angularjs.org/
[40] http://ionicframework.com/
[41] http://cordova.apache.org/

	Growth, Internal Market, Industry, Entrepreneurship & SMEs, Sustainable Tourism[42]
Application URL:	http://portal.sdi4apps.eu/ETIS for the main ETIS dashboard. The stakeholder survey apps are at the following URLs: • Visitor http://www.ETISapp.eu/visitorsurvey.html • Resident http://www.ETISapp.eu/residentsurvey.html • Enterprise http://www.ETISapp.eu/enterprizesurvey.html
Supported functionality / capabilities:	The SDI4Apps enabled European Tourism Indicators System (ETIS) webservice enables the Burren GeoPark initially (and all other GeoParks subsequently) to: 1. Set up their destination with suitable indicators and targets. 2. Provide online data collection by each stakeholder group. 3. Visualisation to review progress and results achieved to date at their destination, by the various stakeholders to provide an ongoing community "crowdsourcing verification". 4. Provide benchmarking with other destinations.
Related services:	• S1.1 - Advanced Visualisations • S1.2 - Data Harmonisation • S1.3 - Integration of Mobile Apps. • S1.4 - Interoperability between local & global geospatial models. • S1.5 - Linked Open Data
Datasets required	DS1.1 – ETIS Dataset
Timeplan for the development:	Operational now and will be continuously improved throughout the remainder of task T6.1 to the end of the project in March 2017
Responsibility for the development:	Ed Keane, MAC. E.keane@mac.ie
Detailed description of planned or already carried out testing:	Early demonstration has established the basic required functionality and utility with users. The functionality is being evolved and improved in line with user feedback, and use of further services on the SDI4Apps Platform. Testing is being undertaken as per the internal/external Validation in tasks T2.3/T2.4.
Role of the user:	Users (visitors, enterprises and residents) on the Burren will input and use the Apps.
Role of the administrator:	The Burren GeoPark Manager and her team define their targets and elements of the ETIS standard they wish to use to manage their GeoPark on the service dashboard, and then monitor and manage the crowdsourced data coming into the service.
Offline use:	Yes Apps use the SDI4Apps Enablers for offline data input, but data access requires real-time online access to the service.
Who will be responsible for the application management?	MAC
Notes and issues	• Graphical user interface – Standard HTML5 browser.

[42] http://ec.europa.eu/growth/sectors/tourism/offer/sustainable/indicators/index_en.htm

	• Viewing the Burren ETIS dataset as progress charts, and associated GI images.

Table 7 Application 1.1

The Easy Access Pilot to support Tourism for Conservation Service implements the ETIS Process, as follows:

- GeoPark Manager selects ETIS options relevant to their Park and the content is automatically published in Survey Apps for
  - Visitors
  - Residents
  - Enterprises
- The Webservice Dashboard shows how the destination is performing as per the ETIS framework.

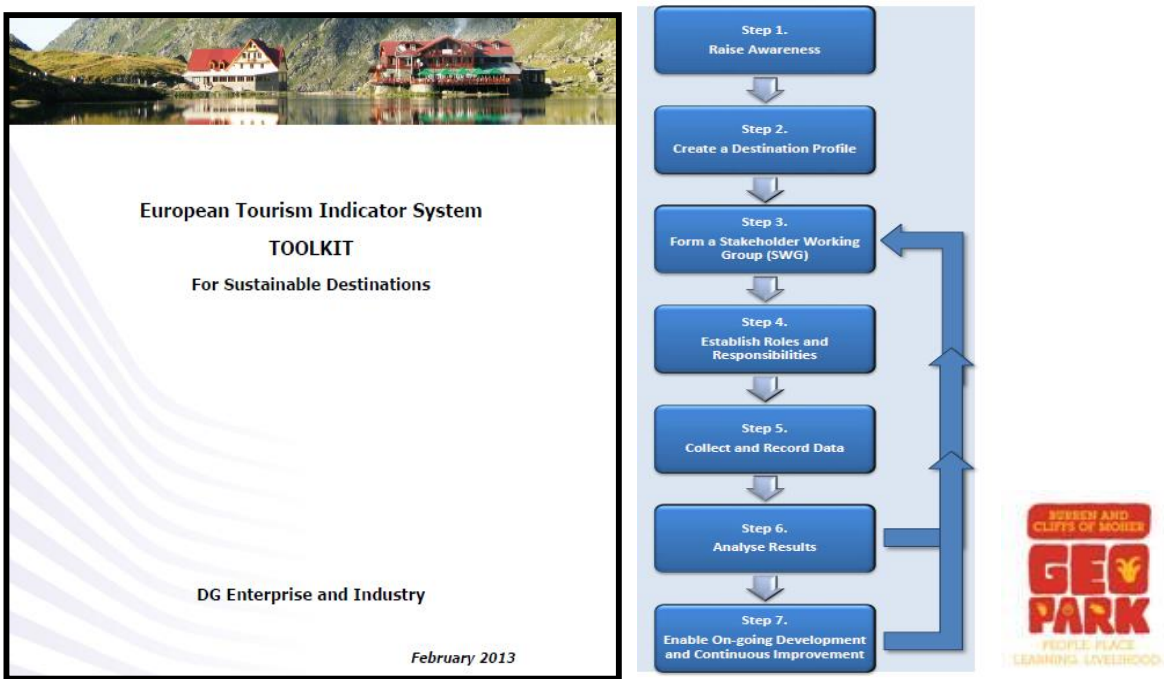


Figure 4 ETIS Toolkit and Process

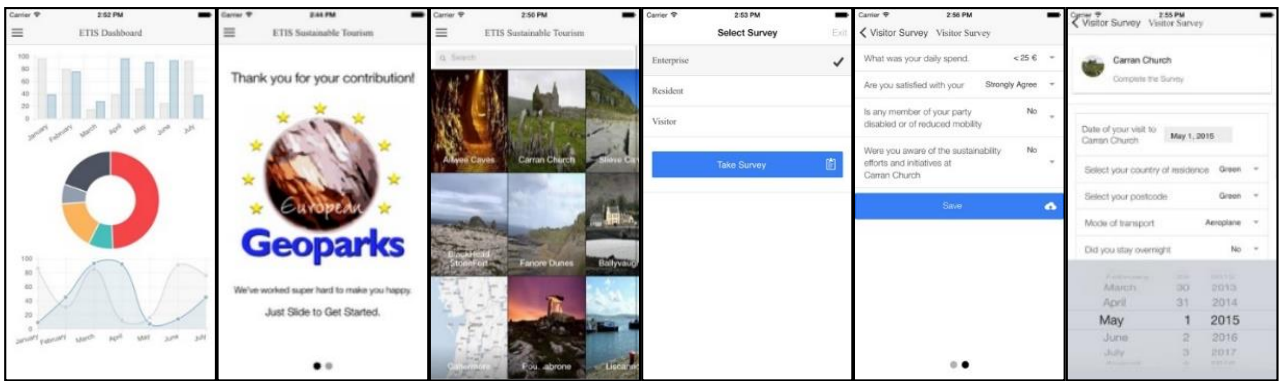


Figure 5 ETIS Apps

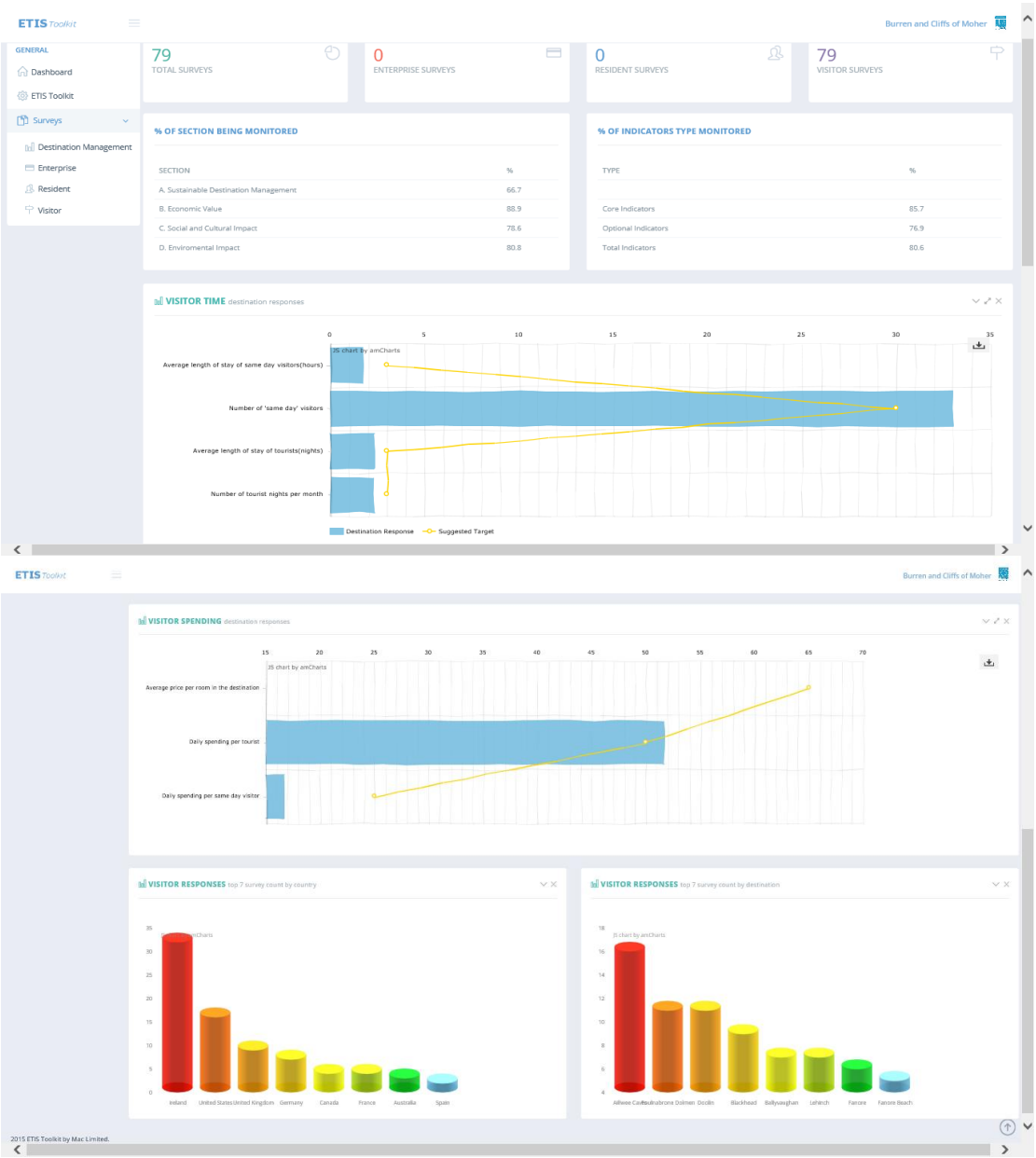


Figure 6 ETIS Management Dashboard showing how the destination is performing

2.4.2 User App Ground-Truth potential Protected Heritage sites

Application ID:	A1.2
Name of the app:	Potential Monuments Ground Truthing Application
Application description:	This App enables monuments field officers, visitors and people interested in their local heritage, to seek out and ground truth[43] potential Monument sites in the Burren and beyond.

[43] Ground Truthing is a Crowdsourcing/VGI process of gathering data in the field, to either complement or dispute remotely collected data.d

Application URL:	http://www.GroundTruthing.eu
Supported functionality / capabilities:	The Monuments Ground Truthing App: 1. Directs users to browse OpenStreetMap satellite map sources to find potential heritage sites in their chosen area. 2. Allows the user to access a database of previous ground truthing observations to determine if a chosen site is already recorded by the National Monuments Service as a national monument or has been previously crowd-source reported. If so the user can continue to investigate their chosen area for other potential sites. 3. Supports the user on-site to ground truth a potential archaeological site. This involves using their phone or tablet to take a number of photographs, record notes, note the geo-location using their phone's GPS, as well as their own identity. 4. The recorded information is uploaded to a Heritage Vault database. 5. Field Monument Advisers, National Monuments Service staff, and other experts who have access, use a webservice to authenticate each crowd-sourced ground truthing observation uploaded to the easy access database.
Related services:	The services (with IDs) which are needed by the apps are (as defined below) • S1.1 - Advanced Visualisations • S1.2 - Data Harmonisation • S1.3 - Integration of Mobile Apps. • S1.4 - Interoperability between local & global geospatial models. • S1.5 - Linked Open Data.
Datasets required	DS1.2 Potential Monuments Voluntary Geographic Information Dataset
Timeplan for the development:	Operational now and is being continuously improved throughout the remainder of task T6.1 to the end of the project in March 2017
Responsibility for the development:	Ed Keane, MAC. E.keane@mac.ie
Detailed description of planned or already carried out testing:	Early demonstrations have established the basic required functionality and utility with users. The functionality is being evolved and improved in line with user feedback, and use of further services on the SDI4Apps Platform. Testing will be undertaken as per the internal/external Validation in tasks T2.3/T2.4.
Role of the user:	Uses the App as described above.
Role of the administrator:	Uses the Heritage Vault webservice as described above
Offline use:	Yes, App can be used offline for data input, but not for data access.
Who will be responsible for the application management?	MAC
Notes and issues	• Graphical user interface – Standard HTML5 browser. • Implementing the National Monuments VGI Ground-Truthing process as indicated above for individual users. • Viewing, searching, editing for the Heritage Council and National Monuments Service staff.

Table 8 Application 1.2

The Heritage Ground Truthing App

- Enables Field Officers, visitors and people interested in their local heritage, to seek out and ground truth Heritage sites by using their phones to record the site.
- Once reported the inputs are verified by Heritage Council professional staff to confirm their status, at the pilot portal at http://www.GroundTruthing.eu
- The service will eventually interface into the Irish National Monuments dataset

An Chomhairle Oidhreachta
The Heritage Council

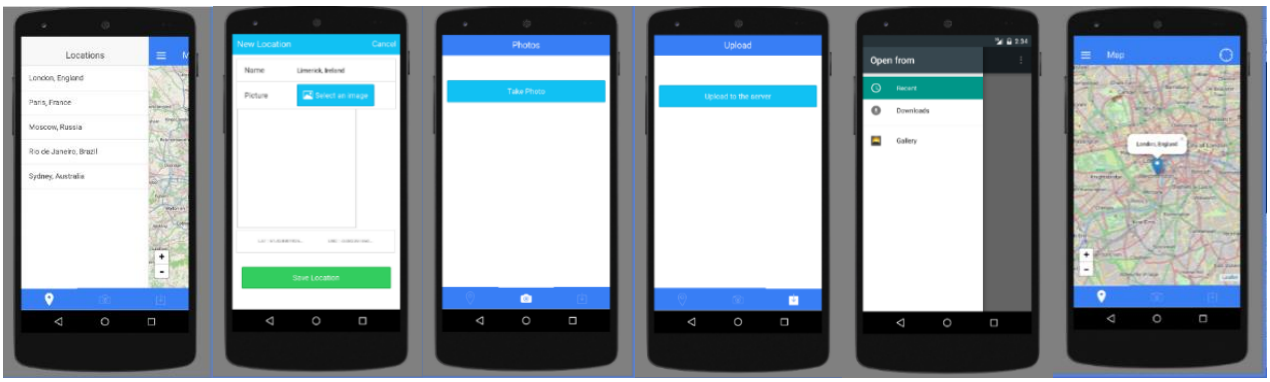
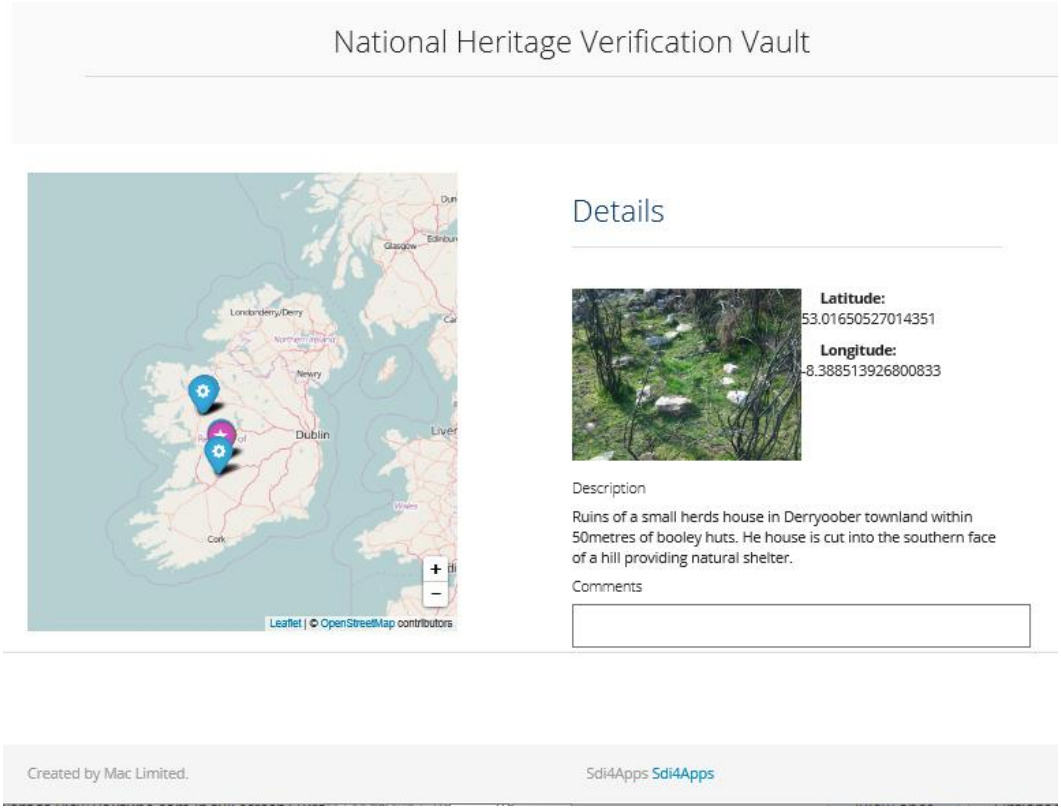


Figure 7 Heritage Ground Truthing App



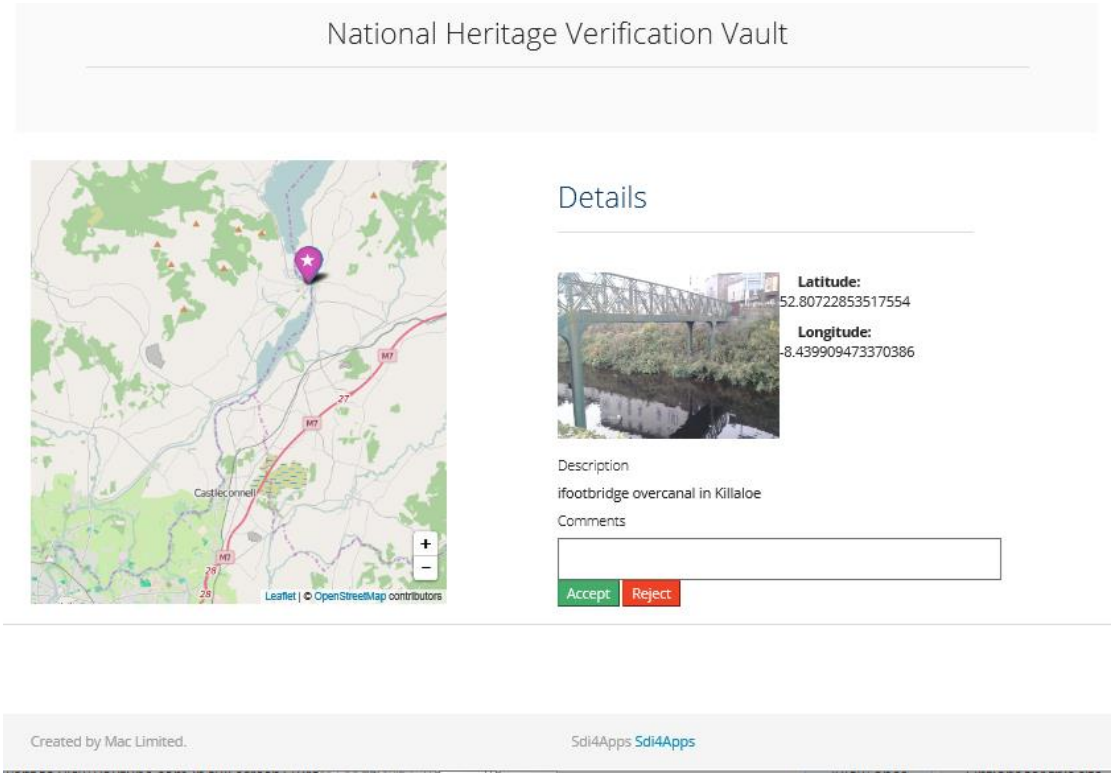


Figure 8 Heritage App Verification Webservice

Figure 9 Irish National Monuments dataset[44]

2.4.3 Services

As reported in D2.2 the services from the SDI4Apps infrastructure point of view that will be necessary for the above mentioned apps, are as follows (with service codes in brackets):

- SDI4Apps Platform and Advanced visualisations (S1.1)
  - Validation & integration tools
  - Advanced Visualisation framework & API (of GI & non-GI components)
- Data harmonisation (S1.2)
  - Scalable GI to LOD transformation & harmonisation service, from many heterogeneous database sources, including HALE support.

[44] At http://webgis.archaeology.ie/nationalmonuments/flexviewer/

- Integration of mobile apps (S1.3)
  - Scalable crowdsourced/VGI real-time data collection with Open API.
- Interoperability between local & global geospatial models (S1.4)
  - Scalable Geo-focused Crawler for automatic collection of OGC services endpoints representing spatial content available via the deep web.
- Linked Open Data (S1.5)
  - Scalable INSPIRE GI schema to LOD transformation & harmonisation service, with persistent URIs.
  - Scalable RDF Triple Storage service for LD (such as Virtuoso)
  - Semantic indexing infrastructure to transform GI to LOD
  - Scalable MapServer (or GeoServer) implementation

As discussed in D6.1 and D6.2, these map to the SDI4Apps Enablers, defined in D3.1, D3.2.1 and D3.5, as follows:

Services required from the SDI4Apps Infrastructure	**SDI4Apps Enablers that will be provided** (defined in D3.1, D3.2.1, D3.5)
1. SDI4Apps Platform and advanced visualisations (S1.1)	Cloud Platform with preinstalled Linux operating system, Perun account management system, & powerful hardware machines. HSLayers and HSLayers NG visualisation tools
2. Data harmonisation (S1.2)	Sesame/D2RQ/Postgres-XL-PostGIS.
3. Integration of mobile apps (S1.3).	Postgres-XL clustered database with PostGIS extension, nginx web server with MapProxy caching, HAProxy load-balancer, & Apache.
4. Interoperability between local & global geospatial models (S1.4)	Micka metadata catalogue management system, supporting discovery of existing geospatial data & services
5. Linked Open Data (S1.5)	Virtuoso/Sesame triple store framework & D2RQ Platform. MapServer/Geoserver Web Map Service

Table 9 SDI4Apps Enablers

The tables for each of these services are as follows:

Service ID:	S1.1
Name of the service:	SDI4Apps Platform and Advanced Visualisations
Service description:	As defined in the WP3 and WP4.
Supported functionality / capabilities:	Advanced Visualisation framework & API (of GI & non-GI components)
Related apps:	A1.1, A1.2
Timeplan for the development:	As defined in the WP3 and WP4.
Responsibility for the development:	As defined in the WP3 and WP4.
Detailed description of planned or already carried out testing:	As defined in the WP3 and WP4.
Service run by SDI4Apps Platform?	Yes

Use of OpenAPI functionality: basic and advanced	As defined in the WP3 and WP4.
Notes and issues	Will use the IaaS cloud operated by CERIT-SC, based on the OpenNebula cloud management system, KVM and Xen hypervisors, disk images with preinstalled Linux operating system, Perun account management system, and powerful hardware machines, running the HSLayers and HSLayers NG SDi4Apps Enablers.

Table 10 Easy Data Access pilot service: Platform and Advanced Visualisations

Service ID:	S1.2
Name of the service:	Data Harmonisation
Service description:	As defined in the WP3 and WP4.
Supported functionality / capabilities:	Scalable GI to LOD transformation and harmonisation service, from many heterogeneous database sources, including HALE support.
Related apps:	A1.1, A1.2
Timeplan for the development:	As defined in the WP3 and WP4.
Responsibility for the development:	As defined in the WP3 and WP4.
Detailed description of planned or already carried out testing:	As defined in the WP3 and WP4.
Service run by SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	As defined in the WP3 and WP4.
Notes and issues	Will use the Sesame/D2RQ/Postgres-XL-PostGIS SDi4Apps Enablers as tabulated above.

Table 11 Easy Data Access pilot service: Data Harmonisation

Service ID:	S1.3
Name of the service:	Integration of Mobile Apps.
Service description:	As defined in the WP3 and WP4.
Supported functionality / capabilities:	Scalable crowdsourced/VGI real-time data collection with Open API
Related apps:	A1.1, A1.2

Timeplan for the development:	As defined in the WP3 and WP4.
Responsibility for the development:	As defined in the WP3 and WP4.
Detailed description of planned or already carried out testing:	As defined in the WP3 and WP4.
Service run by SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	As defined in the WP3 and WP4.
Notes and issues	Will use the SDi4Apps Enabler providing Postgres-XL clustered database with PostGIS extension, nginx web server with MapProxy caching, HAProxy load-balancer, & Apache.

Table 12 Easy Data Access pilot service: Integration of mobile Apps

Service ID:	S1.4
Name of the service:	Interoperability between local & global geospatial models.
Service description:	As defined in the WP3 and WP4.
Supported functionality / capabilities:	Scalable Geo-focused Crawler for automatic collection of OGC services endpoints representing spatial content available via the deep web.
Related apps:	A1.1, A1.2
Timeplan for the development:	As defined in the WP3 and WP4.
Responsibility for the development:	Who is responsible for the development?
Detailed description of planned or already carried out testing:	As defined in the WP3 and WP4.
Service run by SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	As defined in the WP3 and WP4.
Notes and issues	Will use the SDi4Apps Enabler providing Micka metadata catalogue management system, supporting discovery of existing geospatial data and services.

Table 13 Easy Data Access pilot service: Interoperability between local & global geospatial models

Service ID:	S1.5
Name of the service:	Linked Open Data
Service description:	As defined in the WP3 and WP4.
Supported functionality / capabilities:	• Scalable INSPIRE GI schema to LOD transformation & harmonisation service, with persistent URIs. • Scalable RDF Triple Storage service for LD (such as Virtuoso) • Semantic indexing infrastructure to transform GI to LOD • Scalable MapServer and GeoServer implementation
Related apps:	A1.1, A1.2
Timeplan for the development:	As defined in the WP3 and WP4.
Responsibility for the development:	As defined in the WP3 and WP4.
Detailed description of planned or already carried out testing:	As defined in the WP3 and WP4.
Service run by SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	As defined in the WP3 and WP4.
Notes and issues	Will use the following SDi4Apps Enablers: • Geoserver or MapServer Web Map Service • Virtuoso/Sesame triple store framework & D2RQ Platform. • Sesame/D2RQ/Postgres-XL-PostGIS

Table 14 Easy Data Access pilot service: Linked Open Data

2.5 Cloud Properties

Current deployment of the Easy Access pilot in the cloud environment uses one virtual machines (VM) for each of the two services. As usage grows the services will require the inherent static and dynamic scalability of the Cloud platform, as their VGI/crowdsourcing will lead to increasing content and is likely to be bursty as each targeted user group will tend to input content at similar times.

Standard VMs are used (as discussed in D6.1)

- Running the SDI4Apps Platform and Enablers (as above), running on Ubuntu Linux.
- Fairly limited storage (<20GB) as the Easy Data Access pilot is not data intensive, but it will include images, maps and other objects such as videos and audio files.

- No other special requirements are envisaged at this time.

2.6 Use of the SDI4Apps Platform and other re-usable software

Both of the Easy Access Pilot services are running on the cloud-based SDI4Apps Platform on 2 VM instances at the following addresses:

1. http://www.ETISapp.eu for the ETIS
2. http://www.GroundTruthing.eu for the Ground Truthing (GT).

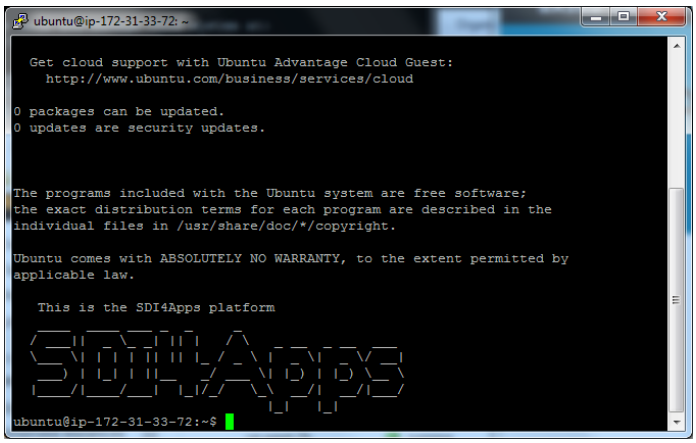


Figure 10 SDI4Apps Platform

2.6.1 SDI4Apps Enablers and functionalities currently being used.

The SDI4Apps Platform Enablers that are currently being used by the Easy Access Apps are:

- SDI4Apps Cloud Platform providing an Ubuntu VM for each service.
- PostGres XL clustered database for integration of mobile apps.

The Apps use the following Enhanced Enablers by means of the s4a.js client-side Javascript library for rapid HTML5 spatial application development based on the SDI4Apps OpenAPI GIS server platform – from https://github.com/SDI4Apps .

- Feature Synchronising Service
  - Check-in & Check-out data from Postgres in GeoJSON.
- Background Map Service
  - Light smart MVtiled maps from Open Street Maps in user's device.

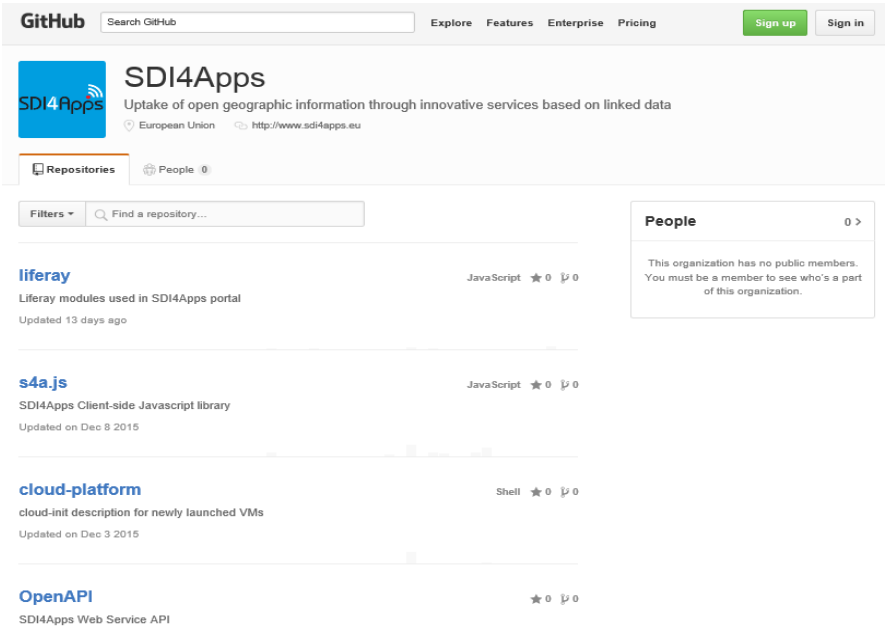


Figure 11 SDI4Apps Repositories

2.6.2 SDI4Apps functionality requirements in the future

As illustrated in the table above the SDI4Apps Platform Enablers that will be used by the Easy Access in the future (as they become available) are:

- HSLayers and HSLayers NG advanced visualisation tools
- Sesame/D2RQ/Postgres-XL-PostGIS for data harmonisation.
- Micka metadata catalogue management system, supporting discovery of existing geospatial data & services
- Virtuoso or Sesame triple store framework & D2RQ Platform for Linked Open Data support.
- MapServer or Geoserver Web Map Service

2.7 Pilot Progress

The two Easy Access Apps were developed as hybrid asynchronous apps using the open device-independent IONIC Framework, as shown in section 2.5. This allowed early demonstrations of the service to users for their feedback and social validation.

The back-ends were then developed on the SDI4Apps cloud Platform using a VM instance for each of the two services.

The Pilot's services are now being operated:

1. with continuous checking that their Communities are satisfied, by:
    - Internal validation of the pilots and their users (as per D2.3.2)
    - External validation of user and developer communities using the SDI4Apps Platform to enable services beyond the pilots (as per D2.4.1)
2. The functionality of both services is being continuously updated throughout T6.1
    - based on feedback from users and upgrades to the SDI4Apps Platform.

2.7.1 SDI4Apps functionality requirements in the future

In the future it is foreseen that the functionality of both services will be updated based on feedback from users during the pilot. As the ETIS service is based on a standard, it is likely to just incrementally improve. However it is expected that user feedback and requests are likely to broaden and improve the Ground-Truthing App. In both cases, their data/content models are expected to remain fairly constant.

Beyond that, MAC aims to sustain and exploit the ETIS service by targeting further GeoParks in Europe, once this project ends. So once proven by the Burren Team, with the Burren as a reference site, further GeoParks will be encouraged to implement similar activities, and provide benchmarking with other destinations (e.g. other GeoParks) through each of these views and access to their linked open datasets. The pilot may find that the ongoing community stakeholders' crowdsourcing verification, may not be adequate for the Geoparks Network, who may prefer to include independent 3rd party verification of the data to ensure the integrity of the ETIS benchmarking across the Geoparks. This may require another visualisation option across destinations to verify that the data being entered is good as basically the GeoParks will be competing with each other in the GeoParks Network benchmarking exercise.

In the short-term the benefits of the Ground-Truthing App will be increased special interest tourists visiting the Burren, and other supported sites, and greater awareness of the Irish Protected Monuments sites. For instance, the App may help Burren farmers (as well as Irish farmers generally) to determine if their farm might contain a potential National Monument Site (especially field systems) on their land. In addition, the app and process will be very educational and will probably be used by teachers and students to discover and contribute to their local heritage. For instance, it could complement the courses and practical local environmental work carried out by BurrenBeo Trust[45]. However beyond that MAC, aims to apply the Ground-Truthing App to further locations (both within and outside of Ireland) and other applications (such as crowdsource reporting instances in the control of Invasive Alien Species[46], pollution events etc).

2.8 Innovative aspects and benefits

The innovative aspects of the Easy Access Pilot Apps, with respect to state-of-the-art are as follows:

- Both Apps (ETIS and Ground Truthing)
  - Use SDI4Apps Enablers and Cloud-based scalable platform
  - Came out of a social validation process with the relevant external stakeholders, who co-designed the services involved.
  - Are based on Linked Data principles and Linked Open Data sources.
  - Apps use an open framework that enables them to be adapted to various mobile devices, & evolving SDI4Apps Enablers & platform
- ETIS is the first implementation of the standard that the EU hopes will be used Europe-wide for all Sustainable Destinations.
- The Monuments Ground-Truthing Service is expected to totally change how the Monument Field Officers operate in Ireland:
  - They can now use crowdsourcing by verifying each report on the Heritage Vault portal, and do not need to visit every site,
  - When they do visit a heritage site, they only need their phone and not the large rucksack of equipment that they need now.
- If the experience with Crowdsourced Ground Truthing proves positive – the Irish Heritage Council plan to integrate it into their National Monuments Service and dataset

45 www.burrenbeo.com
46 See for instance http://ec.europa.eu/environment/nature/invasivealien/index_en.htm and http://invasivespeciesireland.com/

2.9 Future outlook

In the future it is foreseen that the functionality of both services will be updated based on feedback from users during the pilot. As the ETIS service is based on a standard, it is likely to be just incrementally improve. However it is expected that user feedback and requests are likely to broaden and improve the Ground-Truthing App. In both cases, their data/content models are expected to remain fairly constant.

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[47] www.burrenbeo.com
[48] See for instance http://ec.europa.eu/environment/nature/invasivealien/index_en.htm and http://invasivespeciesireland.com/ and
[49] http://portal.sdi4apps.eu/spoi
[50] http://webgis.archaeology.ie/nationalmonuments/flexviewer/

3 PILOT 2 OPEN SMART TOURIST DATA

The Open Smart Tourist Data pilot will support related business subjects such as easy integration of the SDi4Apps platform into proprietary solutions (thanks to the implementation of standards), reusing and sharing of existing information resources, channels and tools. Open Smart Tourist Data will integrate users' data, free and open global data, SDI4Apps Team's data, crowdsourced data and social media. This pilot application will represent a practical and useful subset from the wide range of outputs of tourist data related projects. It will cover and integrate:

- a wide range of input data sets;
- design and modify processing and exploitation methods and implement standards;
- improve the presentation of results and communication between participants in the tourist industry;
- evaluate the effectiveness of the SDI4Apps solution, and limits and benefits of the solution in comparison with existing technologies;
- reuse of results from existing projects such as Citadel on the Move or Open Transport Network.

Data and information represents keywords of current society as well as contemporary tourism and tourist industry. Both are major subjects of the tourist industry (participants and providers) that deal with data and information and need them mainly for communication within each group and also between both groups of tourism subjects. Data and information involve a huge number of varied items related to selection of destination or offer of services of the tourist industry. Data and information do not mean just spatial data sets, maps, web cameras, hand-outs or catalogues, but also personal information such as recommendations, comments on social media channels, published private photos or stories.

Existing solutions for the tourist industry based on information technologies (IT) are focused mainly on one component of information such as global information, local or regional data or social media and crowd-sourcing. The main problem of this approach is that various types of information are collected and managed at different levels. For example, it is possible to have a central database of roads on the European level, but it is not possible to maintain up-to-date uniform information about accommodation, services, events, etc.

On the other hand, there are local systems, which are collecting this information. These systems usually cover small regions or groups of service providers with up-to-date data, but the problem of such local information systems is their heterogeneity and usability. All users (including SMEs participating on the tourist industry and being not focused on information technologies) or such data and information are limited by their heterogeneities that cover various data models, data formats, types of information, level of detail, semantics (terminology), portrayal rules, geometry, coordinates and coordinate systems and above all the updating frequency. Travellers have their own requirements. They want to find interesting, attractive and credible information simply and fast without any difficulties.

The heterogeneities limit sharing and reuse of existing data sets as well as their integration to external applications and data sets. The heterogeneity means also very important questions related to reliability and quality of the provided information.

The new data component of the tourist industry constitutes Volunteered Geographic Information (VGI) related to crowd-sourcing, e.g. Wikitravel (free, complete, up-to-date and reliable world-wide travel guide; shared repository for images and other media), OpenStreetMap, Open Weather Map or Open Event Map.

Open Smart Tourist Data will interconnect user requirements and characteristics of existing data sources. This approach will add other components such as global and local open data sources and crowd-sourcing initiatives (e.g. OpenStreetMap), own data of the partners, social media (to provide another type of information and feedback from real users) and the latest technologies and technological standards that enable to use various hardware platforms and devices to manage, collect and present data.

Pilot 2 includes three main applications (described in the following table):

- Smart Points of Interest (SPOI) dataset, including an access to SPOI via HS Layers map client and SPARQL endpoint
- Open Smart Tourist Crowdsourcing
- Open Smart Advertisement

Property	Description
Data amount	almost 24 000 000 POIs (as RDF triples)

Files size	394 GB
Coverage	global
Data resources	• OpenStreetMap • GeoNames.org • Natural Earth • Citadel on the Move data (more than 30 datasets) • Local data from SDI4Apps partners (Pošumaví region, Czechia, Zemgale, Vidzeme, Latvia, Sicily, Italy) • Data from pilots of the OTN project • Experimental ontologies (UWB)
Classification	SPOI contains ten fundamental classes adopted from the data model used for data of the Waze navigation tool. As a secondary classification the OSM keys and values and used.
Links	• Developed Waze classification vocabulary • DBpedia, GeoNames.org, LinkedGeoData • Wikipedia, Wolfram|Alpha • web pages, photos, pictures, maps...

Table 15 Pilot 2 Applications general description

Pilot 2 uses mainly respected and open web standards such as RDF format, SPARQL query language or several vocabularies (for example FOAF or RDFS). The data storage and SPARQL endpoint is implemented in Virtuso tool. For visualization the HS Layers NG is used.
Both application are accessible on the Internet – SPOI as SPARQL endpoint (http://data.plan4all.eu/sparql) or web page (http://gis.zcu.cz/spoi/), map client (http://ng.hslayers.org/examples/geosparql). User can test both application and provide feedback to the authors and developers. There is also intensive communication among developers group. For example during last two months there were several important changes in SPOI data model caused by feedback from project team.
SPOI (as the main output of the Pilot 2) is the seamless and open resource of POIs that will be available for other users to download, search or use in applications and services. The data model (see Figure) of SPOI comes from review of literature, existing data (for example OpenPOIs) and recommendations of W3C and OGC and user requirements. The current version of the data set has been created as a harmonized combination of selected OpenStreetMap data, experimental ontologies developed in the Section of Geomatics of the University of West Bohemia, local data provided by the Uhlava region (Czech Republic) and other data mentioned above. The transformation was realized primarily by XSLT templates and Saxon processor. Data are stored in the Virtuoso tool as RDF triples. SPOI is published via map client and SPARQL endpoint which enables comfortable, efficient and standardized querying of data.

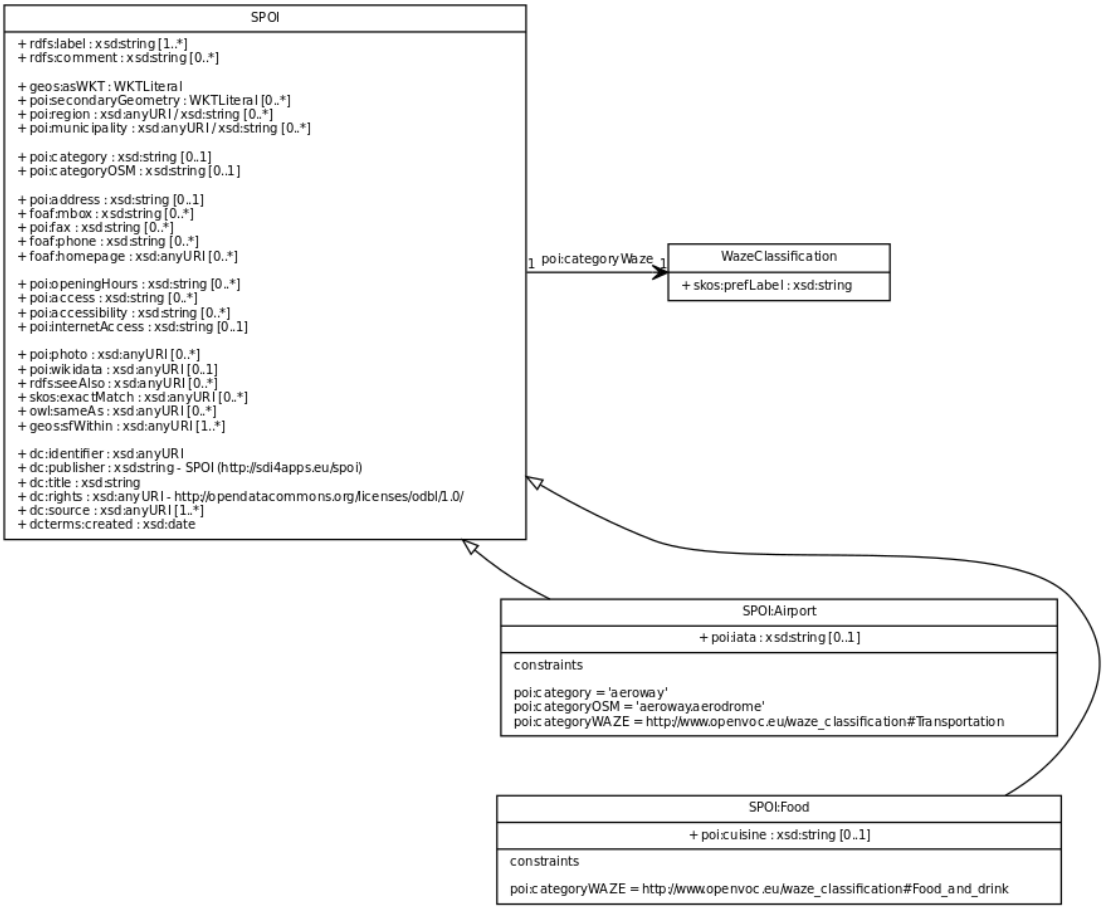


Figure 12 Pilot 2 Data Model

3.1 USE CASES

Use case ID:	UC2.1
Use case Title:	Smart Tourism
Abstract:	Use case UC2.1 is focused on real using of SPOI dataset via services such as map portal and SPARQL endpoint. The term “real using” does not mean only downloading and implementing data to an application or service, but also providing a feedback (for example requirements on data model extension or new vocabulary implementation) and updating or adding new data.
User groups/stakeholders:	• Subjects dealing with tourism and related domains • Authorities supporting tourism • Visitors
Description (all the steps that will be done by the user):	1. Open the SPOI web page 2. Find relevant data on the map client 3. Download data via SPARQL endpoint or ask for data dump 4. Use data in own application or service / provide a feedback (including data updating or adding)

How users are involved in the design and development process?	Through providing relevant feedback and requirements. During last month we co-organized two meetings with users in the Czech Republic. We participated in the meeting with experts from INSPIRE and Danube strategy in Ispra, Italy and in the meeting of OpenTransportNet project.
Criteria of success:	Number of real users
Interoperation with other SDI4Apps pilots:	Open INSPIRE4Youth - sharing data
Performance:	During the last year the speed of information retrieval was improved by optimization of technological processes and tools.
App ID:	A2.1, A2.2., A2.3
Notes and issues:	-

Table 16 Use Case 2.1

3.2 USER ENGAGEMENT

Identified and involved stakeholders:

- Data providers
  - Subjects involved in tourism business (lodging providers, tourist agencies, local tourism authorities)
  - Organizations and institution (local action groups, municipalities) supported and promoted tourism
  - Open data providers
  - VGI activities and crowdsourcing
- Data users
  - Subjects involved in tourism business (lodging providers, tourist agencies, local tourism authorities)
  - Organizations and institution (local action groups, municipalities) who supports and promotes tourism
  - Visitors

- Stakeholders' roles - data providers (including updating existing data) and/or data users
- Stakeholder engagement methods - SPOI data using via provided services and tools (SPARQL endpoint, map client, tool / service for editing); the events organized for stakeholders are described in the UC2.1 table.
- Stakeholder engagement success - real users dealing with SPOI data and understanding benefits coming from SPOI using, monitoring of stakeholder engagement will be more active during third year of project
- User requirements will be integrated on demand
- Users who validate the final apps - all users
- Business plan- market potential - the market potential is based on development of application (including mobile applications) or services based on SPOI. Also data dumps or prepared SPARQL queries to data download could represent a market potential. There is also an opportunity of commercialization that is related to advertising and push marketing.

3.3 DATA ACQUISITION

3.3.1 Datasets

Dataset ID:	DS2.1
Resource title:	OpenStreetMap (OSM)
Resource abstract:	Selected POIs (for example restaurants, bus stops, hotels) provided in OSM for particular countries.
Geographical coverage:	global
Level of detail:	depend on approach of data providers
Resource locator:	http://download.gisgraphy.com/openstreetmap/
Restrictions/Licences:	Open Database Licence
Format:	OSM
Transformation:	Format conversion (from original format to an XML file, which is processable by XSLT script), filtering (this harmonization function was applied because of big size of data containing many useless data and attributes), transformation to data model (the transformation was realized by XSLT templates and processor).
Ready to use:	yes
Size:	-
Data acquisition:	via script (OSM data are fully automatically downloaded on demand, we suppose that the update will be realized in regular intervals (such two times per year).
Notes and issues	-

Table 17 Data Set 2.1

Dataset ID:	DS2.2
Resource title:	GeoNames.org
Resource abstract:	POIs (for example natural features or settlement) provided in GeoNames.org for particular countries.
Geographical coverage:	global
Level of detail:	point data
Resource locator:	http://www.geonames.org

Restrictions/Licences:	Creative Commons
Format:	TXT
Transformation:	Format conversion (from original format to an XML file, which is processable by XSLT script), filtering (this harmonization function was applied because of big size of data containing many useless data and attributes), transformation to data model (the transformation was realized by XSLT templates and processor).
Ready to use:	yes
Size:	-
Data acquisition:	via script (GeoNames.org data are fully automatically downloaded on demand, we suppose that the update will be realized in regular intervals (such two times per year).
Notes and issues	-

Table 18 Data Set 2.2

Dataset ID:	DS2.3
Resource title:	Natural Earth
Resource abstract:	From this resource the data on national parks in the USA and airport were adopted.
Geographical coverage:	global
Level of detail:	point data
Resource locator:	http://www.naturalearthdata.com/
Restrictions/Licences:	Public domain
Format:	KML
Transformation:	Format conversion (from original format to an XML file, which is processable by XSLT script), filtering (this harmonization function was applied because of big size of data containing many useless data and attributes), transformation to data model (the transformation was realized by XSLT templates and processor).
Ready to use:	yes
Size:	-

Data acquisition:	one-time download; in case of an update original data the dataset will be downloaded and processed again. There will be a control process to find an update.
Notes and issues	-

Table 19 Data Set 2.3

Dataset ID:	DS2.4
Resource title:	Data provided by Citadel on the Move project
Resource abstract:	From this open resource the data sets related to more than 30 cities and regions over the worlds. The data set contain more detail informationthan global data resources on particular cultural objects (e.g. libraries, theatres), institutions or transportations issues (e.g. bus stops).
Geographical coverage:	global (but not continuous)
Level of detail:	point data
Resource locator:	http://www.citadelonthemove.eu/
Restrictions/Licences:	CC BY 4.0 or similar licence being in harmony with ODbL
Format:	JSON
Transformation:	Format conversion (from original format to an XML file, which is processable by XSLT script), filtering (this harmonization function was applied because of big size of data containing many useless data and attributes), transformation to data model (the transformation was realized by XSLT templates and processor).
Ready to use:	yes
Size:	-
Data acquisition:	one-time download; the Citadel on the Move data catalogue (http://www.citadelonthemove.eu/en-us/opendata/opendataindex.aspx) contains all necessary metadata.
Notes and issues	-

Table 20 Data Set 2.4

Dataset ID:	DS2.5
Resource title:	Open Transport Network data

Resource abstract:	Data provided by pilot partners (Antwerpen and Issy) of the Open Transport Network project. Data contains several POIs in both above mentioned cities focused mainly on historical monuments, culture and art.
Geographical coverage:	Antwerpen, Issy
Level of detail:	point data
Resource locator:	Web pages of both cities
Restrictions/Licences:	Licences compatible with ODbL
Format:	XML, CSV
Transformation:	Format conversion (from original format to an XML file, which is processable by XSLT script), filtering (this harmonization function was applied because of big size of data containing many useless data and attributes), transformation to data model (the transformation was realized by XSLT templates and processor).
Ready to use:	yes
Size:	-
Data acquisition:	one-time downloads; all information on data are provided by original data resources (institution in Antwerpen and Issy).
Notes and issues	-

Table 21 Data Set 2.5

Dataset ID:	DS2.6
Resource title:	Data from local providers
Resource abstract:	Data provided by pilot partners of the SDI4Apps project.
Geographical coverage:	experimental ontologies developed in the University of West Bohemia to illustrate potential of goe-ontologies (sights in Rome, European ski resorts); sample information from the catalogue of travel agency (Ghana, Senegal); POI focused on tourism provided by Pošumaví region (Czechia), Sicily (Italy) and Zemgale (Latvia).
Level of detail:	point data
Resource locator:	-
Restrictions/Licences:	Licences compatible with ODbL
Format:	OWL, DOC, XML, XLS

Transformation:	Format conversion (from original format to an XML file, which is processable by XSLT script), filtering (this harmonization function was applied because of big size of data containing many useless data and attributes), transformation to data model (the transformation was realized by XSLT templates and processor).
Ready to use:	yes
Size:	-
Data acquisition:	one-time downloads
Notes and issues	-

Table 22 Data Set 2.6

3.3.2 Data Models

The schema of the data model is published on the figure at the section 2.1. The data model is divided into seven parts:

- Labels & description
- Geometry & localization
- Classification
- Contact information
- Tourist information
- Links
- Metadata

Authors have tried to use existing vocabularies as much as possible. The data model is designed for RDF data and following external vocabularies and formats are incorporated:

- RDFS (RDF Schema)
- XSD (XML Schema)
- OWL (Web Ontology Language)
- SKOS (Simple Knowledge Organization System)
- FOAF (Friend of a friend)
- GeoSPARQL
- Dublin Core

Also namespace for non-shared properties was declared - http://www.openvoc.eu/poi.

3.4 APPS AND SERVICES

3.4.1 User App

Application ID:	A2.1 (sdi4apps.eu/spoi)
Name of the app:	Smart Points of Interest publication
Application description:	Application is able to provide data from SPOI dataset. There are two possibilities - map client (viewing) and SPARQL endpoint (downloading).
Supported functionality / capabilities:	• common functionality of the map portal (zooming, panning, layer switching…)

	• searching • querying
Related services:	S2.1, S2.2, S2.3, S2.4
Datasets required	DS2.1 - D2.6
Time plan for the development:	Plan for 2016: • Optimization of technological aspects • Better cartography to map client • Development more user-friendly solution based on input and feedback from external and internal stakeholders • Pre-defined queries
Responsibility for the development:	Otakar Cerba (UWB), Jachym Kellar (UWB), Raitis Berzins (BOSC), Dmitrij Kozuch (HSRS), Karel Charvat (CCSS)
Main updates:	• New environment of map client (February 2016) • New icons (December 2015)
Detailed description of planned or already carried out testing:	There will be applied continual testing, including continuous provision of feedback from the users.
Role of the user:	Using application and data Providing feedback and proposals
Role of the administrator:	To manage the application development and maintenance, integration of the received feedback and proposals into the application
Offline use:	No
Who will be responsible for the application management?	Administrator
Notes and issues	-

Table 23 Application 2.1

Application ID:	A2.2
Name of the app:	Open Smart Tourist Crowdsourcing
Application description:	Mobile application will support automatic tracking of roads and collection of POI.
Supported functionality / capabilities:	• Automatic tracking • Mobile displaying maps • Collection of POI including photos
Related services:	S2.1 (Relational database), S2.2 (No-SQL database), S2.3 (Map portal), S2.4

Datasets required	DS2.1 - D2.6
Time plan for the development:	The application will be developed according to spontaneous and incremental Living Lab approach which require flexibility and continual communication with users. This part is partially developed. The current version of the map client enables a simple editing of POIs. The other functions (adding new POIs etc.) will be realized during summer 2016.
Responsibility for the development:	Premysl Vohnout (BOSC)
Main updates:	Planed to make publicly available till end of 2016 year.
Detailed description of planned or already carried out testing:	There will be applied continual testing, including feedback providing.
Role of the user:	Using application and data Providing feedback and proposals
Role of the administrator:	Administrator, Manager - Data and services maintenance, Other development, integration of the received feedback and proposals into the application
Offline use:	Yes
Who will be responsible for the application management?	Administrator
Notes and issues	-

Table 24 Application 2.2

Application ID:	A2.3
Name of the app:	Open Smart Advertisement
Application description:	Application will allow to be embedded into Web pages of Travel Agencies, regional Agencies etc.
Supported functionality / capabilities:	• Embed • Open API • Routing • Functions of traditional map portal (zooming, panning, layer switching)
Related services:	S2.1 (Relational database), S2.2 (No-SQL database), S2.3 (Map portal), S2.4
Datasets required	DS2.1 - D2.6

Timeplan for the development:	The application will be developed according to spontaneous and incremental Living Lab approach which require flexibility and continual communication with users. The main development will be realized in the year 2016.
Responsibility for the development:	Karel Charvat (CCSS)
Main updates:	Planed to be publicly available till end of year 2016.
Detailed description of planned or already carried out testing:	There will be applied continual testing, including provision of the feedback.
Role of the user:	Using application and data Providing feedback and proposals
Role of the administrator:	Administrator, Manager - Data and services maintenance, Other development
Offline use:	Yes
Who will be responsible for the application management?	Administrator
Notes and issues	-

Table 25 Application 2.3

3.4.2 Services

Service ID:	S2.1
Name of the service:	Relational database
Service description:	A relational database storing and providing spatial data (route segments) and enabling SQL queries.
Supported functionality / capabilities:	SQL queries Interconnection to map client
Related apps:	A2.1, A2.2., A2.3
Timeplan for the development:	The service is developed only an implementation is necessary. It will be realized till the end of 2016.
Responsibility for the development:	HSRS

Detailed description of planned or already carried out testing:	There is implemented and tested MySQL database with selected datasets.
Service run by the SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	-
Notes and issues	-

Table 26 Service 2.1

Service ID:	S2.2
Name of the service:	No-SQL database (Virtuoso)
Service description:	A no-SQL database storing and providing RDF triples and enabling SPARQL queries.
Supported functionality / capabilities:	SPARQL queries Interconnection to map client
Related apps:	A2.1, A2.2., A2.3
Timeplan for the development:	The service is developed only an implementation is necessary. It will be realized till the end of 2016.
Responsibility for the development:	HSRS
Detailed description of planned or already carried out testing:	There is implemented and tested Virtuoso database with selected datasets (SPOI knowledge base).
Service run by the SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	-
Notes and issues	-

Table 27 Service 2.2

Service ID:	S2.3

Name of the service:	Map portal
Service description:	A service providing function of traditional map portal (zooming, panning, layer switching).
Supported functionality / capabilities:	Combination of RDF data, traditional spatial data, APIs and Linked data.
Related apps:	A2.1, A2.2., A2.3
Timeplan for the development:	The service is published, there are expected a few changes (re-design).
Responsibility for the development:	HSRS
Detailed description of planned or already carried out testing:	The second version of map services is available and tested.
Service run by the SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	-
Notes and issues	-

Table 28 Service 2.3

Service ID:	S2.4
Name of the service:	SPARQL endpoint
Service description:	Possibility of querying via SPARQL language. The results could be published in many formats such as JSON, HTML, XML or RDF.
Supported functionality / capabilities:	Querying RDF data
Related apps:	A2.1, A2.2., A2.3
Timeplan for the development:	The service is tested.
Responsibility for the development:	HSRS, BOSC

Detailed description of planned or already carried out testing:	The current version of the SPARQL endpoint is available and tested.
Service run by the SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	-
Notes and issues	-

Table 29 Service 2.4

3.5 Cloud Properties

The implementation of cloud environment is still being discussed. There are several possibilities how to exploit benefits of cloud solution and transfer several functionalities such as data harmonization (which is time and memory consuming) or data storage (at this point server engine Virtuoso is used).

3.6 Use of the SDI4Apps Platform and other re-usable software

Except vocabularies and standards like RDFS, FOAF, SKOS, OWL described above there are used solutions based on open-source (or free), respected and well-documented software such as Virtuoso or HS Layers. This fact supports transfer of proposed solution, because there are not any financial or technological barriers present.

3.7 Pilot Progress

The following list contains main changes realized during last six month:

- Increase of data amount (from 4,5 million to 23,9 million triples)
- Adding of new data resources (e.g. Natural Earth, Citadel on the Move)
- Extension of the data model
- Development of new harmonization procedures
- Re-design of map portal
- Optimization of Virtuoso storage
- Promotion of SPOI solution.

3.8 Innovative aspects and benefits

The main innovations of the pilot consist in:

- Development new data model for POIs re-using external solutions as much as possible
- Development of the global, seamless and open dataset based on graph structures and Linked data approach
- Enabling a universal opportunity of querying and downloading data
- Integration of RDF data together with raster data layers (services) to the map portal.

3.9 Future outlook

Based on the received input from external and internal stakeholders, currently there are many possibilities how to improve and upgrade results of Pilot II, especially the SPOI. The future steps could be divided into following parts:

1. Data resources – searching for new resources such as Wikidata, other data from Citadel of the Move. Open data published by cities, regional authorities or national organizations; better exploitation of processed data resources (especially OpenStreetMap);

2. Linked data – massive linking with Linked data resources (e.g. GeoNames.org, DBpedia, LinkedGeoData and various vocabularies; development of new vocabularies (e.g. RDF vocabulary of OpenStreetMap Map Features as the second classification system of SPOI);

3. Metadata – extension of existing metadata (e.g. properties dct:type or dct:description), adopting metadata from processed resources, testing of other metadata systems (e.g. PROV-O ontology), integration of attribute metadata;

4. Data model – integration of new object properties based on methodology and topology, extension of new datatype properties based on user requirements, testing and possible integration of existing properties;

5. Data management – development of update procedure taking into consideration of specifics of particular input data (for example frequency of updates of original data or existence of persistent ID), creating of POIs as a combination of more input data;

6. Data publishing – preparation of samples of data dumps, SPARQL queries samples, improving of map client (for example possibilities of filtering, editing data or adding new POIs), maintenance of SPOI web page, development of new applications and services using POIs.

4 PILOT 3 OPEN SENSOR NETWORK

Sensors are important part of common data producers at these days. We are searching for effortless and straightforward utilization of existing sensors that are available via the web during the pilot Open Sensor Network. But reusing of existing sensors run by third-party providers comes with lot of questions. These questions reaching from initial searching of these services via satisfactory description by metadata and coming to filtering of found sensor candidates. Very good comparison is that as same as we are searching suitable repairman company in yellow pages, it can be useful to find some universal "yellow pages" for searching appropriate sensors and sensor data producers.

Currently we are supporting in pilot two types sensors:

- Ground water sensors
- Agrometeorological sensors

The water quality depends on the crop type and the irrigation method, as well the soil types, groundwater levels, soil and water chemistry, nutrient loads, limits on chemicals, the salt tolerance of crops, the leaching of salts, and management of drainage water. There are several barriers to the reuse of wastewater in agriculture. The key barrier is that many stakeholders do not view wastewater, even if adequately treated, as a resource or they see the energy costs of treating wastewater to an adequate standard as being prohibitively expensive. One of the aims of the project pilot is to utilise recent innovations to turn wastewater reuse into a profitable, socially beneficiary and environmentally safe business.

Agriculture requires the collection, storage, sharing and analysis of large quantities of spatially referenced data. For this data to be effectively used, it must be transferred between different hardware, software and organisations. These data flows currently present a hurdle to uptake of precision agriculture as the multitude of data models, formats, interfaces and reference systems in use result in incompatibilities. Management of huge amounts of data is a challenge. Spatio-temporal data is increasingly collected by remote or in-situ sensors rather than by field campaigns. The wireless communications have several benefits, but also pose challenges to the data exchange reliability and power supply. Sensor calibration and deployment as well as maintenance of sensors need resources and technical skills and increase the costs of data acquisition. Both increasing the amount of data and awareness of data quality issues highlight importance that metadata are attached to sensor data.

The current implementation was focused on implementation of catalogue for sensor data. Internet of Things (IoT) Discovery from FI WARE was selected as a candidate. It is now integrated with rest of SDI4Apps services.

4.1 USE CASES

Use case ID:	UC3.1
Use case name:	OpenSensorNetwork data management
Abstract:	The Open Sensor Network scenario will collect and monitor data from in-field sensors. The basic approach will be for web services to send various sensors' proprietary protocols to a common database that is accessible with open protocols. The scenario will be then extended to use the SDI4Apps cloud based tools to process/aggregate the data directly from the sensors on the fly in real-time. In all cases the end users will be able to monitor the ongoing situation using their PCs, tablets or Smartphones.

Description (all the steps that will be done by the user):	There will be next steps supported by system: • Registration of sensors URI (every single sensor or WSN has to be registered) in catalogue describing sensors, measurement parameters, time period, URI and protocol for accessing data Discovery sensors in geographical context, time period and also in parameters for measurement • Accessing data from different sensor through one interoperable protocol
User groups/stakeholders:	Public bodies – National and Regional Authorities providing meteorological information. Farmers – owners of sensors on fields Experts – Agricultural and environmental. Enterprises, Companies and SMEs – particularly farmers, growers, and agro-supply companies.
How and when will the users be involved in the design and development process?	The users are involved on level of user requirements and on level of testing.
Criteria of success:	User satisfaction, easy access to data from different providers
Interoperation with other SDI4Apps pilots:	
Performance:	The solution will require large parallel access to big data. Data stored on server will be generated from different places. For some data, solution will provide only brokerage, transforming data into one format.
App ID	A 3.1
Notes and Issues	

Table 30 Open Sensor network pilot Use case 1

Use case ID:	UC3.2
Use case name:	OpenSensorNetwork Early Warning
Abstract:	The use case will be focused on prediction of critical situation like radiation frost or similar events and sends early warning to farmers
Description (all the steps that will be done by the user):	There will be next steps supported by system: • Receiving early warning from WSN • Promptly delivering warning to farmer • Visualising data from sensors measurement.

User groups/stakeholders:	Public bodies – National and Regional Authorities providing meteorological information. Farmers – owners of sensors on fields Experts – Agricultural and environmental. Enterprises, Companies and SMEs – particularly farmers, growers, and agro-supply companies.
How and when will the users be involved in the design and development process?	The users are involved on level of user requirements and on level of testing. There also will be reused experiences from already running systems.
Criteria of success:	User satisfaction, easy access to data from different providers
Interoperation with other SDI4Apps pilots:	
Performance:	The solution will require large parallel access to big data. Data stored on server will be generated from different places. For some data, solution will provide only brokerage, transforming data into one format.
App ID	A 3.2
Notes and Issues	

Table 31 Open Sensor network pilot Use case 2

Use case ID:	UC3.3
Use case name:	OpenSensorNetwork Ground Water Monitoring
Abstract:	The Ground water Scenario will allow to provide monitoring of groundwater level and display measurement and interactive maps demonstrating development.
Description (all the steps that will be done by the user):	There will be next steps supported by system: • See measurements from sensors • See spatio-temporal maps derived from groundwater measurement.
User groups/stakeholders:	Public bodies – National and Regional Authorities providing meteorological information. Farmers – owners of sensors Experts – Agricultural and environmental. Enterprises, Companies and SMEs – particularly farmers, growers, and agro-supply companies.
How and when will the users be involved in the design and development process?	The users are involved on level of user requirements and on level of testing.

Criteria of success:	User satisfaction, easy access to data from different providers
Interoperation with other SDI4Apps pilots:	
Performance:	The solution will require large parallel access to big data. Data stored on server will be generated from different places. For some data, solution will provide only brokerage, transforming data into one format.
App ID	A 3.3
Notes and Issues	

Table 32 Open Sensor network pilot Use case 3

4.2 USER ENGAGEMENT

The Pilot will connect two basic groups of users:

- Sensor data producers that means sensors owners or producers, who will register their sensors in sensors catalogue together with all necessary parameters and protocols for accessing of sensors.
- Sensor data consumers, who will have two possibilities to access sensors measurement on the base of their selection through interoperable protocols or use SDI4Apps Apps. This second group will consists of farmers, scientist, service organisations, advisors and public servant.

Till now the main problem is interoperability. An important task for this is to define two issues:

- Catalogue for describing and cataloguing of sensors, till now none of commonly used catalogue is suitable for this purposes
- Protocols for accessing sensors from different repositories of different providers, the problem is that most of data is offered through proprietary protocols and standardized service SOS is not used widely

4.2.1 Business plan - market potential

The business will be mainly generated through Apps for final users and also for additional services and consultancy for other stakeholders, APPs development, sensors providers and service providers. Part of services will be also related to development of new customer oriented Apps

4.3 DATA ACQUISITION

4.3.1 Datasets

Dataset ID:	DS3.1
Resource title:	Senslog Catalogue
Resource abstract:	The catalogue will manage information about different sensors coming from different sensor providers
Geographical coverage:	World Wide
Level of detail:	
Resource locator:	Till now not fixed.
Restrictions/ Licences:	Common Creative
Format:	RDF conform with the IoT-A ontologies
Transformation:	
Ready to use:	From October 2015
Size:	500 GB

Data update:	Daily
Notes and issues	

Table 33 Open Sensor Network pilot data set: Senslog Catalogue

Dataset ID:	DS3.2
Resource title:	Senslog Database
Resource abstract:	Will store data from sensor measurement and also to this database will be provided harvesting of sensor measurements, which will be not accessible through Interoperable protocols.
Geographical coverage:	World Wide
Level of detail:	
Resource locator:	Till now not fixed.
Restrictions/ Licences:	Common Creative
Format:	JSON, OGC SOS, NGSI-9/10 JSON
Transformation:	Between different protocols
Ready to use:	From January 2016
Size:	>2 Terabytes
Data update:	Continuously
Notes and issues	

Table 34 Open Sensor Network pilot data set: Senslog Database

4.3.2 Data Models

The data model for data storage and access was prepared and agreed with other projects (FOODIE, OTN). The data model was improved especially in the field of large tables. The largest table *observations* and *units_positions* are growing in coherence with continuous data collections, they were supplemented with table partitioning mechanism. Partitioned child tables are stored in separate database schema and allow better querying, backuping and maintenance.

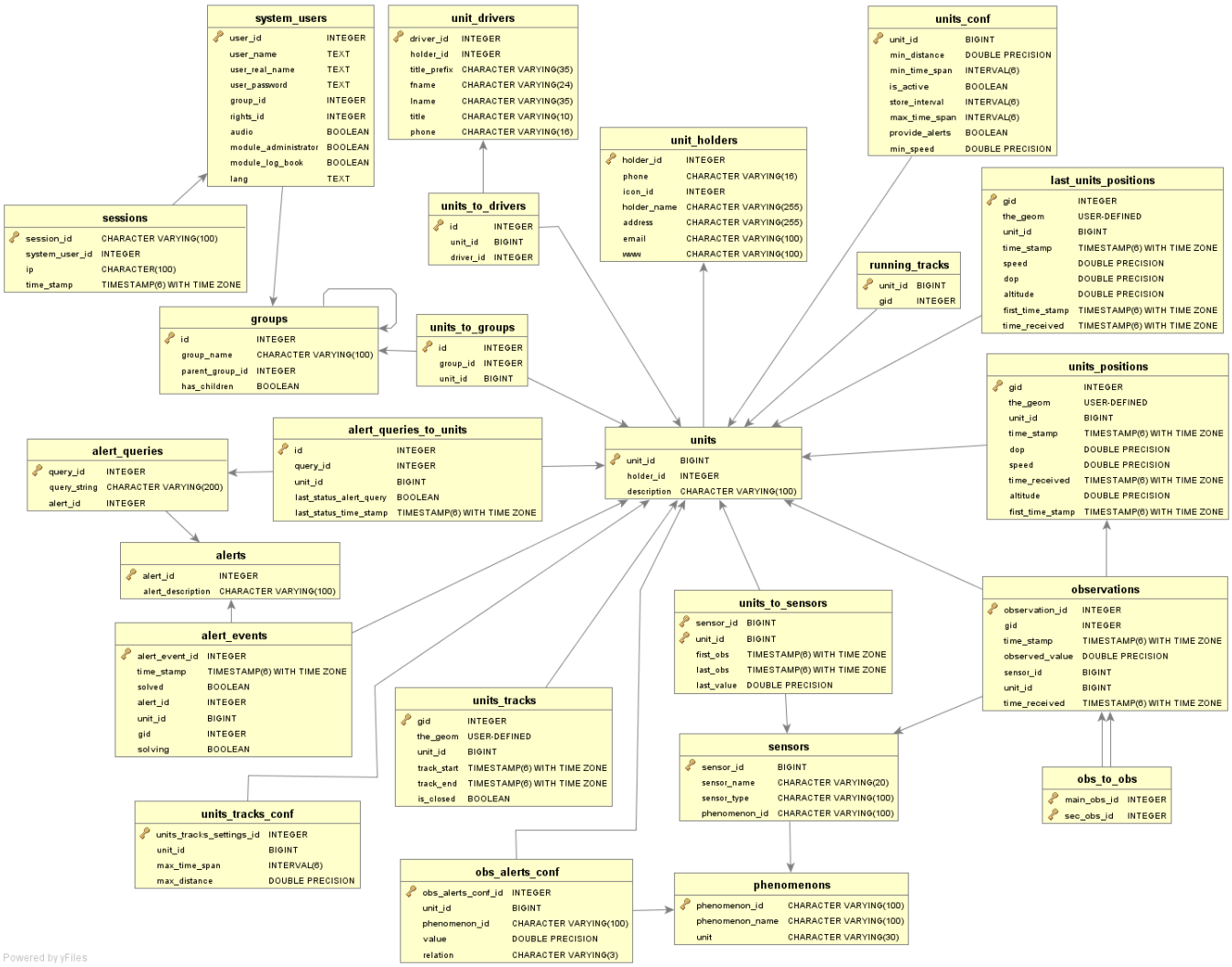


Figure 13 Open Sensor Network pilot data model

4.4 APPS AND SERVICES

4.4.1 User App

Application ID:	A3.1
Name of the app:	IoT Discovery
Application description:	We select IoT Discovery GE from the FIWARE world as solution. IoT Discovery can be considered as a point for data producers to register the availability of sensors, and for data consumers to discover available sensors. IoT Discovery is using either the OMA NGSI-9 messaging protocol, or the Sense2Web API that supports Linked Open Data. Both interfaces serve as a service discovery mechanism (SDM) for IoT Descriptions. An SDM is analogous to a registry or directory for IoT entities, where information

	about the IoT entity can be discovered (e.g. what attributes can be queried, or to get metadata about those attributes providing more detailed information.) It also provides information on how to reach the entity. SDM allows users to discover or check what is available and know where actual context sources are, and avoid unnecessary network overload of IoT context providers. Significant issue comes into consideration together with the idea of Sensor Catalogue. If a lot of sensors from different providers are registered in the catalogue and therefore theirs metadata are accessible from one point. How to make sensor data accessible at the same point? And more complexly, how to access sensor data from different providers that are published using different protocols? It means from the user point of view the problem with different publishing protocols is delegated on the catalogue side. No necessity to have several applications for many of used protocols as the sensor data consumer. A user having an application communicating over one protocol can access wider range of sensors by the catalogue access point. It can be radical benefit on the client side.
Application URL:	http://portal.sdi4apps.eu/senslog
Supported functionality / capabilities:	Discovery of sensors in distributed environment and their semantic description and access
Related services:	S3.1 Iot Discovery S3.2 Senslog
Datasets required	PosgreSQL
Timeplan for the development:	The solution is continuously tested. New GUI development is planned to be more similar with other GE of SDI4Apps
Responsibility for the development:	Michal Kepka, Marek Splichal
Detailed description of planned or already carried out testing:	The testing is running, currently is under development harvesting from SWE SOS services.
Role of the user:	Registering sensors, searching for sensors, accessing sensors in distributed environment
Role of the administrator:	System administration

Offline use:	No
Who is responsible for the application management?	Michal Kepka
Notes and issues	

Table 35 IoT Discovery Application

Application ID:	A3.2
Name of the app:	IoT view
Application description:	Visualisation of sensors measurement on the maps and in the form of graphs is GUI for end user access sensors measurement
Application URL:	http://portal.sdi4apps.eu/senslog/view
Supported functionality / capabilities:	Display sensors in map and measurement in graphs
Related services:	S3.1 Iot Discovery S3.2 Senslog S3.3 NG HSlayers Sensor client
Datasets required	PosgreSQL
Timeplan for the development:	The solution is continuously tested. GUI is updated according to needs
Responsibility for the development:	Michal Kepka, Marek Splichal, Raitis Berzins, Premysl Vohnout
Detailed description of planned or already carried out testing:	We are starting connecting different types of sensors
Role of the user:	Displaying sensors and measurements
Role of the administrator:	System administration

Offline use:	No
Who is responsible for the application management?	Michal Kepka
Notes and issues	

Table 36 IoT view Application

4.4.2 Services

Service ID:	S3.1
Name of the service:	IoT Discovery
Service description:	IoT Discovery consists of two modules: NGSI-9 Server: • Server provides a repository for the storage of NGSI entities only • Allows NGSI-9 clients to: - Register context information about Sensors and Things - Discover context information using ID, attribute, attribute domain, and entity type • NGSI-9 clients include other FIWARE GEs, such as the Data Handling GE and the Device Management GE for registration, and the IoT Broker for discovery. Sense2Web Linked-data platform: • Provides a semantic repository for IoT providers to register and manage semantic descriptions (in RDF/OWL) about their "Things"; Thing can be Sensor/Actuator Devices, virtual computational elements (e.g. data aggregators), virtual representations of any Physical Entity • Provides to discover registered IoT elements using: - Retrieve descriptions in RDF - A probabilistic search mechanism that provides recommended and ranked search results for queries that don't provide exact matching property values - Semantic querying via SPARQL - An association mechanism that associates Things and sensors based on their shared attribute (e.g. temperature) and spatial proximity, which can then be queried via SPARQL
Supported functionality / capabilities:	Both modules serve as a service discovery mechanism (SDM) for IoT Descriptions. An SDM is analogous to a registry or directory, and can be seen as a "yellow pages" for IoT entities, whereby can be discovered information about the IoT entity, such as what attributes can be queried about, and metadata about those attributes which provide more detailed information about it. It also provide information on how to reach it. It allows users to discover or check what is available and know where actual context sources are, and avoid unnecessary network overload of IoT context providers, especially if the context provider have constrained resources, such as gateways, or any wireless device.

	The platform currently supports IoT Descriptions based on the IoT-A Project[51], but can be extended to support other types. A Web User interface is provided for users to create, read, update and delete (CRUD) semantically-annotated IoT Descriptions, and also link them to other Linked Open Data (LOD) resources on the Web. According to testing results, storages of NGSI-9 Server and of Sense2Web linked-data platform are not connected together. Elements stored in storage of Sense2Web module can't be queried from API of NGSI-9 Server module and vice versa.
Related apps:	A3.1
Timeplan for the development:	Solution is installed and tested
Responsibility for the development:	Michal Kepka
Detailed description of planned or already carried out testing:	Testing started
Service run by the SDI4Apps platform?	Yes
Notes and issues	

Table 37 Open sensor network pilot service: IoT discovery service

Service ID:	S3.2
Name of the service:	SensLog
Service description:	SensLog is a software component for receiving, storing, analysing and publishing sensor data in various interfaces. SensLog receives sensor data in form of HTTP GET requests and stores them to PostgreSQL database with PostGIS extension. SensLog publishes data using proprietary RESTful API version 1.0 and using standardized OGC Sensor Observation Service version 1.0.0. SensLog contains also simple GUI with several functions to show data, it is supposed to be used in combination with other clients.
Supported functionality / capabilities:	Accessing data from sensor measurement using three different protocols: • OGC SOS • REST JSON protocol • NGSI-9 JSON
Related apps:	A3.1 A3.2

[51] http://iot-a.eu/

Timeplan for the development:	Solution is installed and tested
Responsibility for the development:	Michal Kepka
Detailed description of planned or already carried out testing:	Testing started
Service run by the SDI4Apps platform?	Yes
Notes and issues	

Table 38 Open sensor network pilot service: Senslog

Service ID:	S3.3
Name of the service:	HSlayers NG
Service description:	HSlayers NG is a web mapping library written in Javascript. It extends OpenLayers 3 functionality and takes basic ideas from the previous HSlayers library, but uses modern JS frameworks instead of ExtJS 3 at the frontend and provides better adaptability. That's why the NG ("Next Generation") is added to its name. It is still under development and provided as open source. HSLayers is built in a modular way which enables the modules to be freely attached and removed as far as the dependencies for each of them are satisfied. The dependency checking is done automatically. Core of framework is developed using AngularJS, requireJS and Bootstrap. This combination of frameworks was chosen mainly for providing fast and scalable development and for providing modern responsive layout of application.
Supported functionality / capabilities:	Visualisation of sensors position in map Visualisation of measurement in Graphs Switching parameters for visualisation
Related apps:	A3.2
Timeplan for the development:	Solution is installed and tested
Responsibility for the development:	Marek Splichal, Raitis Berzins

Detailed description of planned or already carried out testing:	Testing started
Service run by the SDI4Apps platform?	Yes
Notes and issues	

Table 39 Open sensor network pilot service: HSlayers NG

4.4.3 IoT Discovery detailed description

NGSI-9 Server description

The NGSI-9 server allows NGSI-9 clients to register and discover descriptions about the availability their IoT entities, which are based on the NGSI context entity model.

The main components of the NGSI-9 server is the NGSI-9 handler and the NGSI-9 store. The NGSI-9 handler acts as the configuration manager. The NGSI-9 handler is responsible for handling requests based the corresponding function, and also handling the representation of the request/response based on what the client sends and expects (currently XML or JSON). The NGSI-9 store is responsible for the storage of registrations and subscriptions, and querying the store based on a client's discovery request.

According to testing results, NGSI-9 Server is not yet working properly.

Sense2Web Platform

This component addresses the discovery of IoT objects, by providing a repository for IoT Context Producers to register their IoT Things, Resources, and Devices, using semantically-annotated Descriptions based on the Internet of Things Architecture[52]ontology models. One of the main goals of this component is to make use of semantic annotation in order to apply formal naming and relational conventions to the description of an IoT Object, which is explicitly absent in NGSI-9/10. The component makes use of the Sense2Web IoT Linked Data Platform baseline asset, which provides a repository for the CRUD (Create, Read, Update and Delete) management of semantic IoT descriptions, that complies with the IoT-A ontology[53] models. Sense2Web can also associate different IoT object ontologies to domain data and other resources on the Web using Linked Open Data.

This component provides a set of interfaces a user can interact with. The first is a Web User Interface whereby a user can perform CRUD operations on the IoT Descriptions, and also query the IoT Descriptions as well. When registering or updating, a user can either upload an IoT Description or complete a form which is then sent to the server to be converted to RDF, and storing it in the RDF database.

The second interface is a RESTful CRUD and SPARQL interface. This interface mainly supports M2M interactions. An application can also perform CRUD operations on the IoT descriptions in the repository, and query for a particular piece of information from the descriptions using SPARQL.

The third interface allows users to query about an IoT description using keywords or templates that share the same structure as the IoT description. This type of query input is handled by the IoT Search Engine, which will search for the relevant query.

[52]http://www.iot-a.eu/public
[53]http://iot.ee.surrey.ac.uk/s2w/share/ontologies/iot-a/original/

Figure 14 Sense2Web platform

Description of Web User Interface

Register

The current ontologies that are supported are the IoT-A ontologies that define a Resource, Virtual Entity and Service. Registering can be done either by uploading a description file or by completing a form. The form will not be accepted unless an ID, Name and Latitude/Longitude coordinates are at least entered. Once the form is submitted the page will return links for viewing the RDF result of the submission in various formats i.e. RDF/XML, RDF/XML-ABBREV,RDF/JSON, N3, N-TRIPLE and TURTLE.

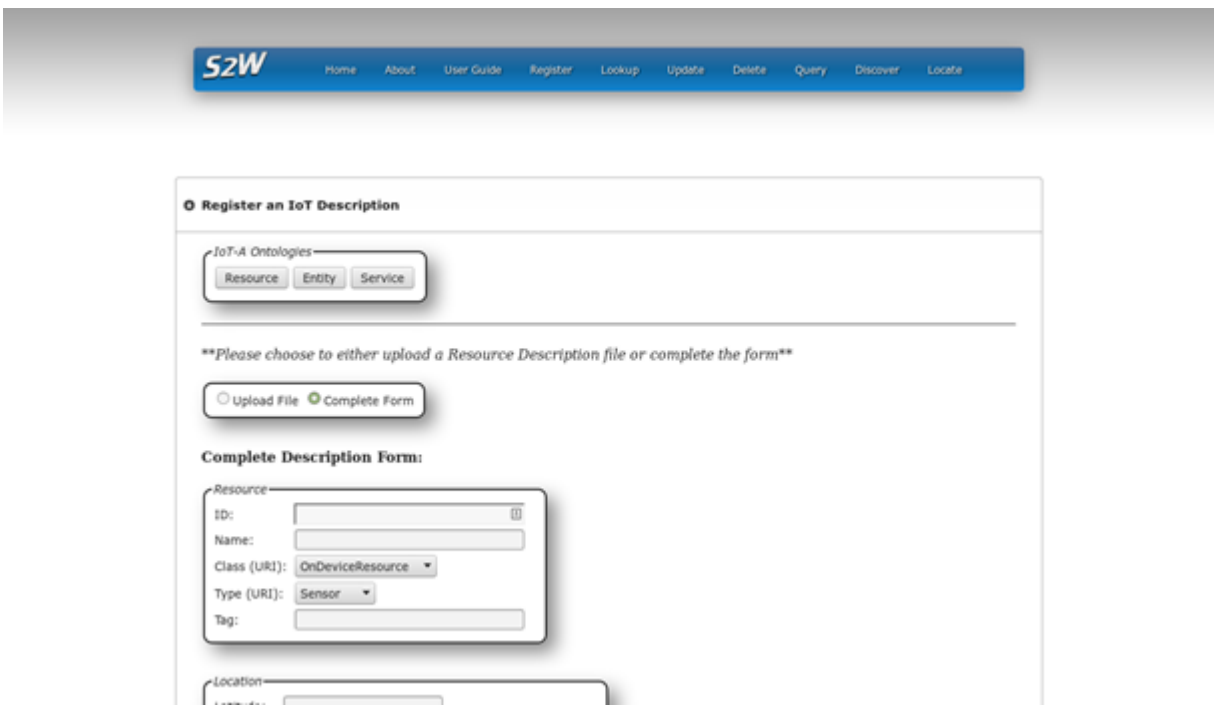


Figure 15 Registering form example

Lookup

To lookup a description, the relevant repository needs to be selected i.e. Resource, Entity, Service. The ID of the description in question must then be entered.

Figure 16 Description Lookup

Update

The Update page is similar to the Register page with the exception that the current values for a description can be retrieved and populated into the fields by entering the ID of the description in question, and clicking on the "retrieve" button.

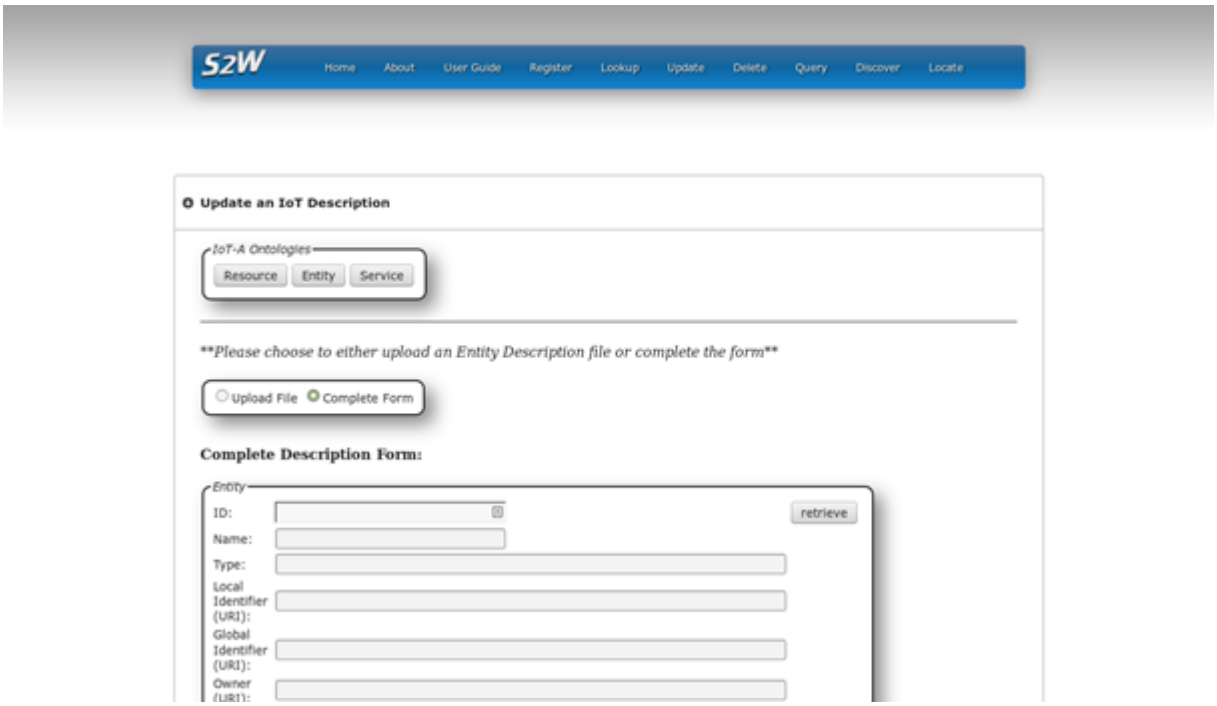


Figure 17 Update

Delete

To delete a description, the relevant repository needs to be selected i.e. Resource, Entity, Service. The ID of the description in question must then be entered.

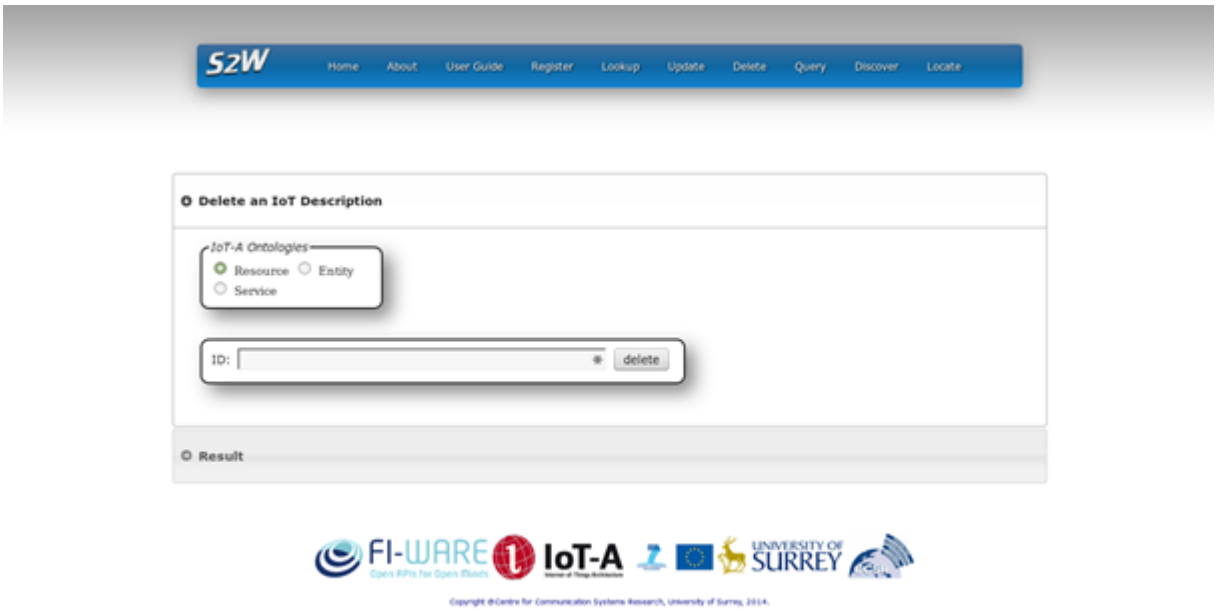


Figure 18 Delete

Query

The platform supports SPARQL for querying IoT descriptions. When choosing a particular type of description, the respective SPARQL template is provided for a user to use and edit.

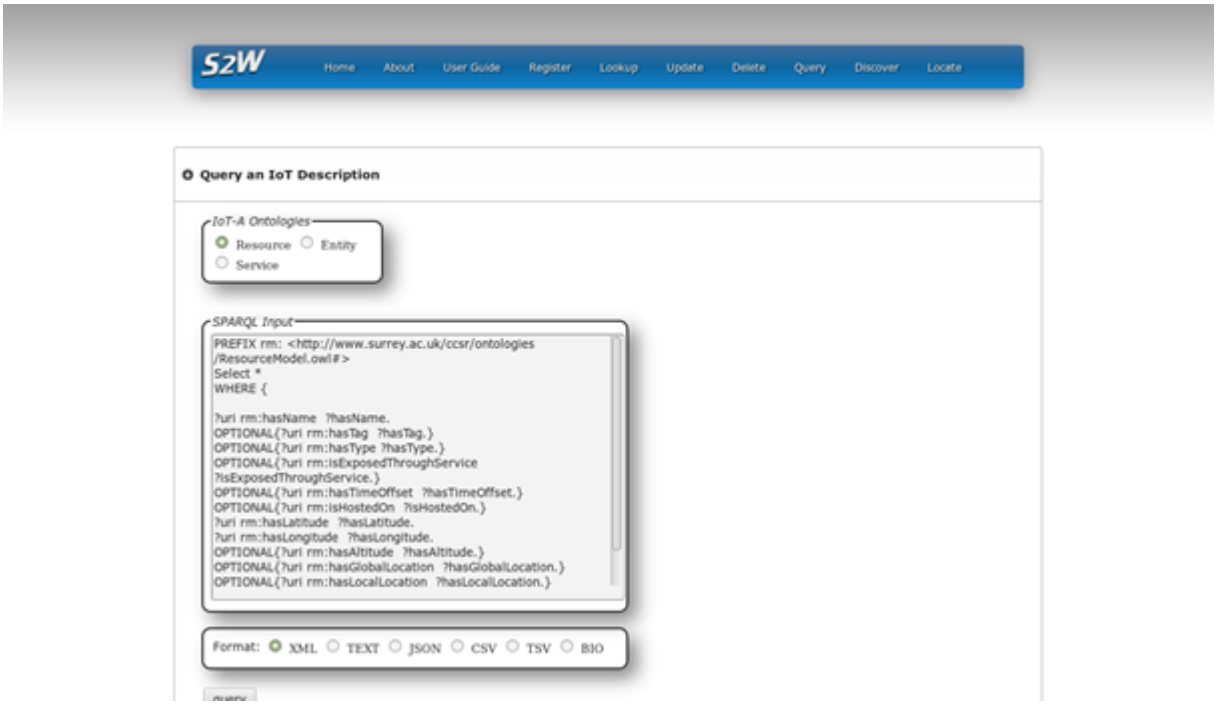


Figure 19 SPARQL template

Discover

In the case where a user does not know the description or the exact naming for its attributes that the user is looking for, the probabilistic search engine can be used to provide recommended and ranked suggestion for a description relevant to the search input. Here the user should enter a keyword for as many fields as required.

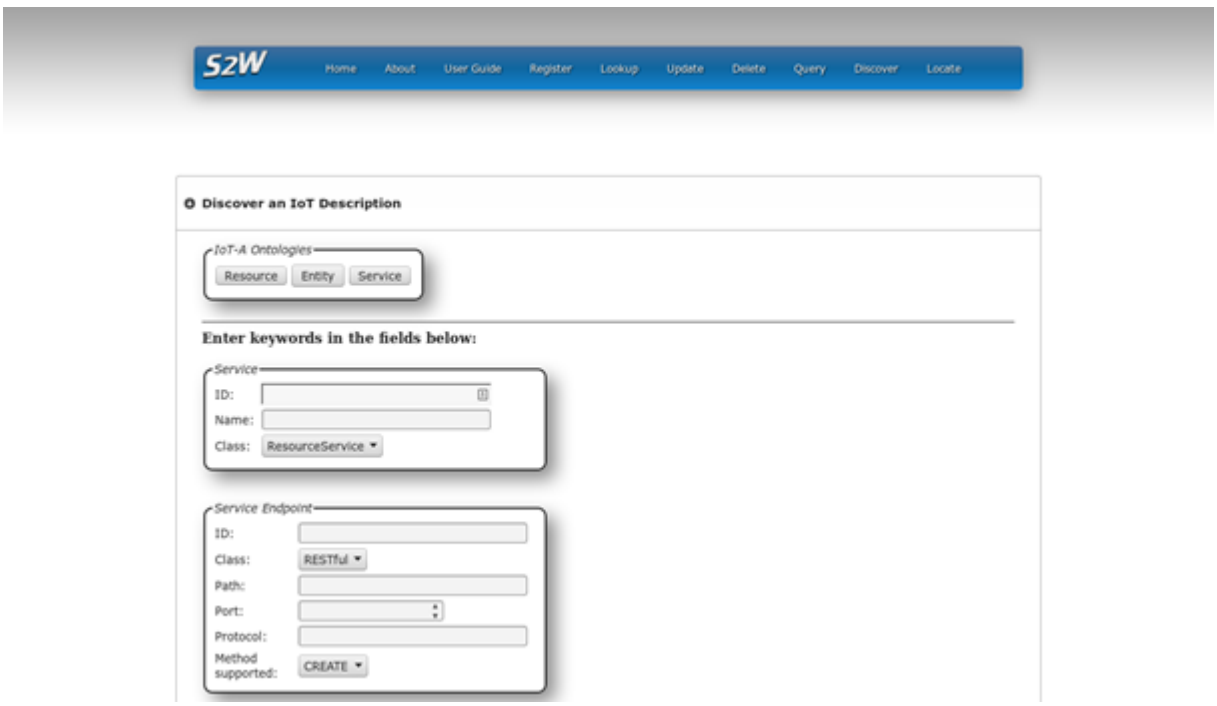


Figure 20 Search by keyword

Locate

A simple map application is provided to show the location of a Resource or Entity. Clicking on a particular Object will display its main properties and a link to its description. But testing shows that publishing of Objects locations is not working properly.

Figure 21 Objects location

4.4.4 SensLog detailed description

SensLog consists of database model and server-side application. The core of the database part is a relational data model that was inspired by standardized data model for observations from specification OGC Observations&Measurements version 1.0. SensLog model implements more functionality contrary to O&M model that has been necessary in created sensor networks. Data model is shown in chapter 4.3.2.

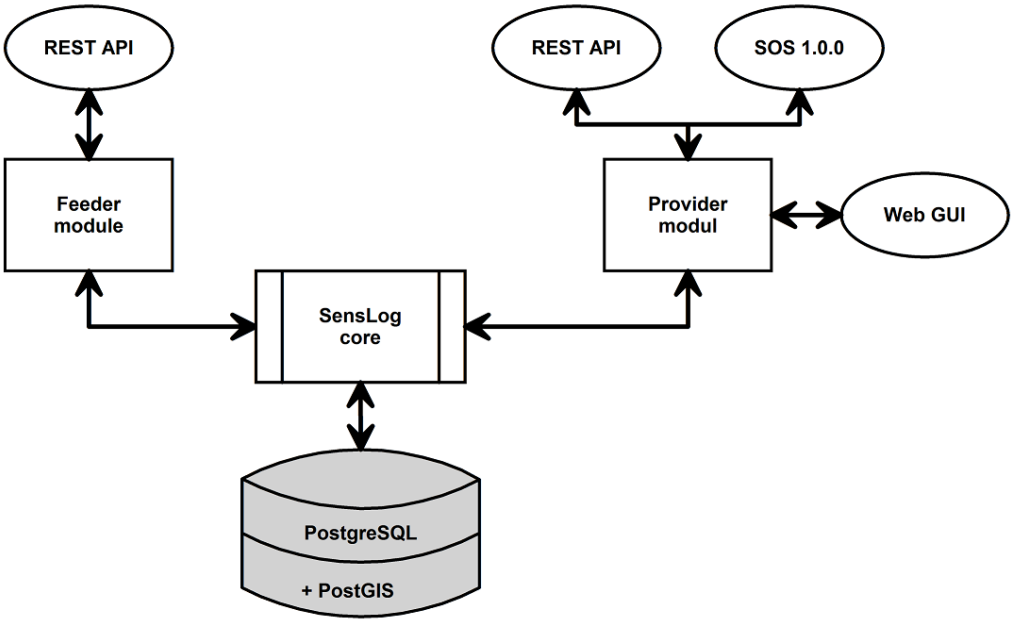


Figure 22 Overview of SensLog structure

There are several core tables that hold structure of the sensor network and user hierarchy. Units are main element of the sensor network and are stored in units table. Unit is physical node with one or more connected sensors. Positions of observations are connected to whole unit. Sensors are physical devices that are measuring phenomena. In the used data model one sensor is measuring one phenomenon. In case of measuring more phenomenon with one sensor device, it is necessary to decompose the device to several virtual sensors. Observations represent values measured by each unit and sensor pair in specified time stamp and at specified position. The unique observation is determined by time stamp, ID of unit and ID of sensor that have produced the observed value. Unit's positions table holds location of units in defined coordinate reference system. A hierarchy of users and units can be created through Groups table. It allows users to access only units that are in same group or subordinate groups.

Database model contains procedures and functions to process and manipulate with data in transactional form. Especially several triggers prevents data integrity.

Server-side part of the application contains most of the application logic. Diagram on figure 23 shows simple schema of the server-side part of SensLog. Sensor data are pushed to SensLog from sensor networks through RESTful API from Gateways. Receiver module contains check mechanism to prevent insertion of data in incorrect form. Service for inserting data is described in chapter SensLog interface.

Data consumers can receive data by one of the interfaces after authentication. There are several services to provide not only measured data or status data of the network but also structure of sensor network itself.

Users can use Web GUI that allows visualization of measured data in form of simple charts and maps. Main access to sensor data is provided by RESTful or SOS interface and it is expected further processing in other clients or applications.

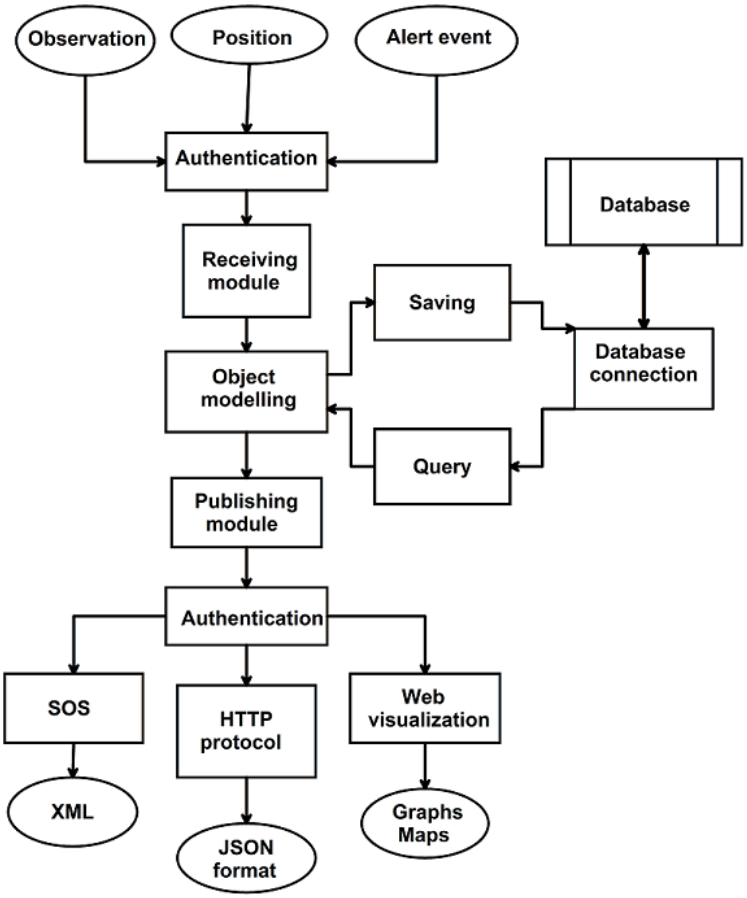


Figure 23 Schema of server-side part

SOS provides access to observations from sensors and sensor systems in a standard way. The same way is suitable for any type of sensor systems. It could be remote sensing, in-situ, fixed and mobile sensors. SOS leverages the O&M specification for modelling observations and the TML and SensorML specifications for modelling sensors and sensor systems. SOS is primarily designed to provide access to observations. The SensLog is mainly focused on publication of observations in standard form for consumers of observations.

Implemented SOS contains mandatory operations:

- GetCapabilities – provides the main access to SOS service metadata. It contains description of service identification, service provider, list of operations, filter capabilities and list of observations offerings. Example of the Capabilities document is shown of figure 5 below.
- GetObservation – provides access to sensor observations and measurement data, a spatio-temporal query filtered by phenomena can be used. It contains identification of time period and text block with sensor data. Example of ObservationCollection is shown on figure 6 below.
- DescribeSensor – retrieves detailed information about the sensors and processes generating those measurements. In context of SensLog operation DescribeSensor provides metadata about the whole unit with individual sensors as Outputs. Example of SensorML document is shown on figure 7 below.

All request and response messages are XML documents with structure and elements defined by OGC standard document. Schemas of the XML documents are part of OGC Schemas Repository.

```xml
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<ns4:Capabilities xmlns="http://www.opengis.net/ogc" xmlns:ns2="http://www.opengis.net/gm
  <ns10:ServiceIdentification>
  <ns10:ServiceProvider>
  <ns10:OperationsMetadata>
  <ns4:Filter_Capabilities>
  <ns4:Contents>
    <ns4:ObservationOfferingList>
      <ns4:ObservationOffering ns2:id="admin">
        <ns2:name>admin</ns2:name>
        <ns2:boundedBy>
          <ns2:Envelope srsName="urn:ogc:def:crs:EPSG:4326">
            <ns2:lowerCorner>16.6147785186768 49.0214881896973</ns2:lowerCorner>
            <ns2:upperCorner>16.615421295166 49.0239219665527</ns2:upperCorner>
          </ns2:Envelope>
        </ns2:boundedBy>
        <ns4:time ns3:type="simple">
          <ns2:_TimeGeometricPrimitive xsi:type="ns2:TimePeriodType" frame="ISO-8601">
            <ns2:beginPosition>2010-04-27T06:47:06+02:00</ns2:beginPosition>
            <ns2:endPosition>2011-05-05T18:27:32+02:00</ns2:endPosition>
          </ns2:_TimeGeometricPrimitive>
        </ns4:time>
        <ns4:procedure ns3:href="0"/>
        <ns4:procedure ns3:href="2"/>
        <ns4:procedure ns3:href="3"/>
        <ns4:procedure ns3:href="4"/>
        <ns4:procedure ns3:href="32768"/>
        <ns4:procedure ns3:href="32769"/>
        <ns4:procedure ns3:href="32770"/>
        <ns4:procedure ns3:href="32771"/>
        <ns4:procedure ns3:href="32772"/>
        <ns4:procedure ns3:href="32773"/>
        <ns4:procedure ns3:href="10132866067"/>
        <ns4:procedure ns3:href="10414158052"/>
        <ns4:procedure ns3:href="101020551187"/>
        <ns4:procedure ns3:href="101471635475"/>
        <ns4:procedure ns3:href="101502765075"/>
        <ns4:procedure ns3:href="103653328915"/>
        <ns4:procedure ns3:href="103852820499"/>
        <ns4:procedure ns3:href="103975897107"/>
        <ns4:observedProperty ns3:href="Count" ns3:type="simple"/>
        <ns4:observedProperty ns3:href="Dew point" ns3:type="simple"/>
        <ns4:observedProperty ns3:href="Generated - TODO" ns3:type="simple"/>
        <ns4:observedProperty ns3:href="Humidity" ns3:type="simple"/>
        <ns4:observedProperty ns3:href="Moisture" ns3:type="simple"/>
        <ns4:observedProperty ns3:href="retransmission count" ns3:type="simple"/>
        <ns4:observedProperty ns3:href="Rssi" ns3:type="simple"/>
        <ns4:observedProperty ns3:href="Temperature" ns3:type="simple"/>
        <ns4:observedProperty ns3:href="Voltage" ns3:type="simple"/>
        <ns4:featureOfInterest ns3:href="fOi"/>
        <ns4:responseFormat>text/xml;subtype="om/1.0.0"</ns4:responseFormat>
        <ns4:resultModel>ns5:Observation</ns4:resultModel>
        <ns4:responseMode>inline</ns4:responseMode>
      </ns4:ObservationOffering>
    </ns4:ObservationOfferingList>
  </ns4:Contents>
</ns4:Capabilities>
```


Figure 24 Example of Capabilities document

```
3   xmlns:ns10="http://www.opengis.net/ows/1.1" xmlns:ns11="http://www.w3.org/2001/SMIL20/Language"
4   xmlns:ns2="http://www.opengis.net/sos/1.0" xmlns:ns3="http://www.opengis.net/gml"
5   xmlns:ns4="http://www.w3.org/1999/xlink" xmlns:ns6="http://www.opengis.net/swe/1.0.1"
6   xmlns:ns7="http://www.opengis.net/sensorML/1.0.1" xmlns:ns8="urn:us:gov:ic:ism:v2"
7   xmlns:ns9="http://www.w3.org/2001/SMIL20/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
8 - xsi:schemaLocation="http://www.opengis.net/om/1.0 http://schemas.opengis.net/om/1.0.0/om.xsd">
9 -   <ns5:member ns4:type="simple">
10 -    <ns5:Observation>
11 -      <ns5:samplingTime ns4:type="simple">
12 -        <ns3:TimePeriod>
13            <ns3:beginPosition>2011-06-20T08:09:53+02:00</ns3:beginPosition>
14            <ns3:endPosition>2011-06-20T11:48:36+02:00</ns3:endPosition>
15          </ns3:TimePeriod>
16        </ns5:samplingTime>
17        <ns5:procedure ns4:href="32768" ns4:type="simple" />
18        <ns5:observedProperty ns4:type="simple" />
19        <ns5:featureOfInterest ns4:href="urn:ogc:def:feature:OGC-SWE:3:transient" />
20 -      <ns5:result>
21 -        <swe:elementCount xmlns:swe="http://www.opengis.net/swe/1.0.1">
22 -          <swe:Count>
23              <swe:value>19</swe:value>
24            </swe:Count>
25          </swe:elementCount>
26 -        <swe:elementType xmlns:swe="http://www.opengis.net/swe/1.0.1" name="Components">
27 -          <swe:SimpleDataRecord>
28 -            <swe:field name="Time">
29                <swe:Time definition="urn:ogc:data:time:iso8601" />
30              </swe:field>
31 -            <swe:field name="Accum growing degree">
32 -              <swe:Quantity definition="Temperature">
33                  <swe:uom code="C" />
34                </swe:Quantity>
35              </swe:field>
36 -            <swe:field name="Eko air temp">
37 -              <swe:Quantity definition="Temperature">
38                  <swe:uom code="C" />
39                </swe:Quantity>
40              </swe:field>
41            </swe:SimpleDataRecord>
42          </swe:elementType>
43 -        <swe:encoding xmlns:swe="http://www.opengis.net/swe/1.0.1">
44            <swe:TextBlock blockSeparator="@" decimalSeparator="." tokenSeparator=";" />
45          </swe:encoding>
46 -        <swe:values xmlns:swe="http://www.opengis.net/swe/1.0.1">
47           2011-06-20T08:09:53+02:00;14.05@2011-06-20T08:10:53+02:00;2184.44166974999@2011-06-20T08:25:30+02:00;14.64@
48           2011-06-20T08:41:08+02:00;15.01@2011-06-20T08:56:53+02:00;15.01@2011-06-20T09:10:53+02:00;2192.32833641666@
49           2011-06-20T09:12:23+02:00;15.01@2011-06-20T09:28:00+02:00;15.94@2011-06-20T09:43:37+02:00;15.77@
50           2011-06-20T09:59:16+02:00;16.219999@2011-06-20T10:10:53+02:00;2201.06333616666@2011-06-20T10:14:51+02:00;16.5@
51           2011-06-20T10:30:31+02:00;17.9@2011-06-20T10:46:06+02:00;21.870001@2011-06-20T11:01:45+02:00;21.58@
52           2011-06-20T11:10:53+02:00;2213.52583641666@2011-06-20T11:17:22+02:00;19.84@2011-06-20T11:33:00+02:00;20.959999@
53           2011-06-20T11:48:36+02:00;20.9
54          </swe:values>
55        </ns5:result>
56      </ns5:Observation>
57    </ns5:member>
58  </ns5:ObservationCollection>
```


Figure 25 Example of ObservationCollection document

```
5    xmlns:ns3="http://www.opengis.net/gml" xmlns:ns4="http://www.w3.org/1999/xlink"
6    xmlns:ns5="http://www.opengis.net/om/1.0" xmlns:ns6="http://www.opengis.net/swe/1.0.1"
7    xmlns:ns8="urn:us:gov:ic:ism:v2" xmlns:ns9="http://www.w3.org/2001/SMIL20/"
8    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.0.1"
9  - xsi:schemaLocation="http://www.opengis.net/sensorML/1.0.1 http://schemas.opengis.net/sensorML/1.0.1/sensorML.xsd">
10 -   <ns7:member ns4:type="simple">
11 -     <ns7:System>
12 -       <ns7:identification ns4:type="simple">
13 -         <ns7:IdentifierList>
14 -           <ns7:identifier>
15 -             <ns7:Term definition="unit_id">
16               <ns7:value>101502765075</ns7:value>
17               </ns7:Term>
18             </ns7:identifier>
19 +           <ns7:identifier>
24           </ns7:IdentifierList>
25         </ns7:identification>
26 +       <ns7:capabilities ns4:type="simple">
40 -       <ns7:outputs ns4:type="simple">
41 -         <ns7:OutputList>
42 -           <ns7:output ns4:type="simple">
43 -             <ns6:Quantity definition="Temperature">
44 -               <ns3:metaDataProperty>
45 -                 <ns6:TimeRange>
46                   <ns6:value>2010-06-23T18:50:04+02:00 2011-06-09T06:12:11+02:00</ns6:value>
47                 </ns6:TimeRange>
48               </ns3:metaDataProperty>
49               <ns3:description>air temperature Papouch TH2E</ns3:description>
50               <ns6:uom ns4:type="simple" code="C" />
51             </ns6:Quantity>
52           </ns7:output>
53 +         <ns7:output ns4:type="simple">
64 +         <ns7:output ns4:type="simple" name="Vlit volt 200">
75 +         <ns7:output ns4:type="simple">
86 +         <ns7:output ns4:type="simple" name="Rssi 200">
97 +         <ns7:output ns4:type="simple">
108 +        <ns7:output ns4:type="simple">
119          </ns7:OutputList>
120        </ns7:outputs>
121 -      <ns7:positions ns4:type="simple">
122 -        <ns7:PositionList>
123 -          <ns7:position ns4:type="simple" name="Last unit position">
124 -            <ns6:Position>
125 -              <ns6:location ns4:type="simple">
126 -                <ns6:Vector referenceFrame="EPSG:4326">
127 +                  <ns6:coordinate name="longitude">
132 +                  <ns6:coordinate name="latitude">
137                  </ns6:Vector>
138                </ns6:location>
139              </ns6:Position>
140            </ns7:position>
141          </ns7:PositionList>
142        </ns7:positions>
143      </ns7:System>
144    </ns7:member>
145  </ns7:SensorML>
```


Figure 26 Example of SensorML document

SensLog Web GUI

SensLog contains simple GUI for visualization of measured data on the Web. Web GUI contains visualization of unit positions and visualization of current values in sensor network and history of values for selected time span for specified sensor. Visualization of current values of specified unit is shown on figure 9 and 7-day history of air pressure sensor is shown on figure 10.

Teplota vzduchu	Vlhkost vzduchu	Rosný bod	Tlak vzduchu	Rychlost větru (min)	Rychlost větru (ø)	Rychlost větru (max)	Směr větru (min)	Směr větru (ø)	Směr větru (max)	Déšť akumulace	Déšť intenzita	Déšť trvání	Kroupy akumulace	Kroupy intenzita	Kroupy trvání
2.5 °C	65.400002 %	-3.132891 °C	971.900024 Pa	0.4 km/h	1.5 km/h	1.8 km/h	248 °	303 °	277 °	0 mm	0 mm/h	0 s	0 zás/cm²	0 zás/cm²/h	0 s
11.02.2016 21:30:02	11.02.2016 18:50:02	11.02.2016 20:45:02	11.02.2016 20:00:02	11.02.2016 19:50:02	11.02.2016 21:45:02	11.02.2016 18:20:02	11.02.2016 21:25:02	11.02.2016 19:15:01	11.02.2016 19:30:02	11.02.2016 21:25:02	11.02.2016 20:45:02	11.02.2016 21:40:03	11.02.2016 21:00:04	11.02.2016 21:40:03	11.02.2016 19:25:02

Počet dnů historie: 7 30 90 365

Figure 27 Example of current observed value of selected sensor unit

Teplota vzduchu	Vlhkost vzduchu	Rosný bod	Tlak vzduchu	Rychlost větru (min)	Rychlost větru (ø)	Rychlost větru (max)	Směr větru (min)	Směr větru (ø)	Směr větru (max)	Déšť akumulace	Déšť intenzita	Déšť trvání	Kroupy akumulace	Kroupy intenzita	Kroupy trvání
2.3 °C	65.400002 %	-3.132891 °C	971.900024 Pa	0.4 km/h	1.6 km/h	1.8 km/h	289 °	303 °	277 °	0 mm	0 mm/h	0 s	0 zás/cm²	0 zás/cm²/h	0 s
11.02.2016 20:25:02	11.02.2016 18:50:02	11.02.2016 20:45:02	11.02.2016 20:00:02	11.02.2016 19:50:02	11.02.2016 18:20:01	11.02.2016 18:20:02	11.02.2016 20:10:02	11.02.2016 19:15:01	11.02.2016 19:30:02	11.02.2016 20:10:02	11.02.2016 20:45:02	11.02.2016 18:50:02	11.02.2016 21:00:04	11.02.2016 20:40:03	11.02.2016 19:25:02

Počet dnů historie: 7 30 90 365

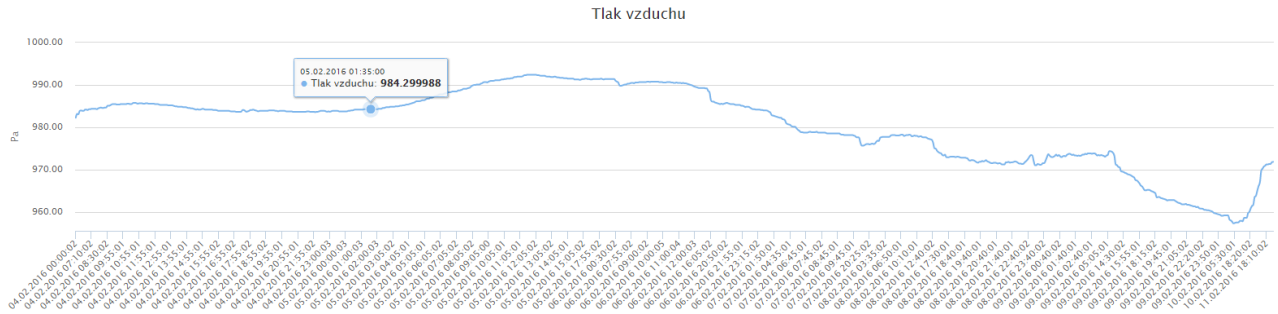


Figure 28 Example of 7-day history of air pressure sensor on selected unit

4.5 Cloud Properties

Regarding Open Sensor network pilot one virtual machine with Debian 8 Jessie is used for deployment, but is possible to install on any system (Linux, Windows, BSD, etc.) capable to run Java containers and MySQL (MariaDB).

SensLog runs as web application in Apache Tomcat and needs running PostgreSQL database.

Installation can be summarized in several points:

1. Installation of PostgreSQL with PostGIS extension

It is necessary to install last version of PostgreSQL DBMS and install PostGIS spatial extension. There is necessary to add enough empty disc capacity for storing sensor data and open port for accessing the DBMS from application. Last version of SensLog was tested with PostgreSQL 9.4 and PostGIS 2.1.

2. Building of complete database model

There is necessary to create empty database at installed PostgreSQL and create user account that will be associated with SensLog application. The database model will be constructed by SQL scripts provided with application installation. SQL scripts create all tables with relations and PL/SQL procedures and functions. After model construction there is necessary to initialize database model, that means create at least one system user and one corresponding group.

3. Installation of Apache Tomcat server

There is necessary to install Apache Tomcat on server and create one user that will be able to deploy web applications. Last version of SensLog was tested to be running with Tomcat version 7.0.x.

4. Configuration of SensLog instance

Configuration of SensLog consists of modifying configurations files according to templates. It means insert credentials for database connection and specify details of database model if it is necessary.

5. Deployment of SensLog instance to Tomcat

Deployment can be done by uploading war file to Tomcat instance or by deploying by Maven from source code. There is necessary to have rights to upload new applications to Tomcat.

Before starting of data collecting from sensor network it is necessary to insert into database model structure of sensor network and users' hierarchy. This can be done by direct inserting into database model or by services via API.

4.6 Use of the SDI4Apps Platform and other re-usable software

There are used solutions based on open-source software in this Open Sensor Network pilot. Sensor catalogue is using IoT Discovery Generic Enabler from FI WARE world that has documented structure and is using standardized protocol NGSI and RESTful API with RDF format. SensLog application is written in Java and is available in form of source code in SDI4Apps Github repository. SensLog uses very popular JSON format in RESTful API and standardized OGC SOS service. Both pilot applications are using SDI4Apps platform and infrastructure and partly are using libraries used in other pilot application (HSLayers NG, Virtuoso, etc.).

4.7 Pilot Progress

During last 6 months following progress was done:

- IoT Discovery GE was selected as candidate for sensor catalogue
- IoT Discovery was tested and features were described from sensor data producer point of view
- Sensor metadata structure in IoT Discovery was compared and mapped to sensor metadata structure provided by OGC SOS services
- IoT Discovery was deployed in SDI4Apps platform and sensor metadata insertion was designed
- SensLog data model was improved for long series of data collecting by large table partitioning mechanism
- SensLog data model was designed for database partitioning in the environment of the SDI4Apps cloud
- SensLog REST API was improved by services for easy overview data access and for structured data publishing for charts visualization

4.8 Innovative aspects and benefits

Main innovative aspects of the pilot consists of:

- Selecting software candidate for sensor catalogue as unique solution
- Designing mechanism for harvesting OGC SOS services to sensor catalogue
- Providing integrated solution for sensor networks for storing sensor data in universal data model
- Providing solution for publishing sensor data in several ways and protocols

4.9 Future outlook

The next step will be focused on adding sensor into network and improve visualization. Also interoperability of IoT Discovery and SWE SOS will be tested. Improvements and updates according to validation results will be implemented to ensure that created solution meets the needs of user. Where possible, relevant INSPIRE activities will be taken into the consideration (MIG, ARE3NA).

5 PILOT 4 OPEN LAND USE MAP THROUGH VGI

The pilot Open Land Use Map through VGI is intending to create open available pan-European map of land use , that will be available to the users in some popular formats used to share geodata (OGC services: WMS/WFS but also as shapefile/kml).

Building a uniform EU-wide standard and data source that is a qualitative source for land use planning is a big challenge. Such a source is only achievable by combining several regional and/or national data sources to derive specific land use information. An EU-Wide source is only possible by implementing a common data standard and by integrating various national data sources.

The two most used data sources on the European level are the CORINE Land Cover and the Urban Atlas datasets. The CORINE dataset covers the whole EU whereas the Urban Atlas is only available for large urban zones (over 100 000 inhabitants). Both datasets are straightforward to use. The features are represented by individual polygons that seamlessly cover the whole area of the datasets. Each feature has an attribute indicating the land use / land cover category.

A key issue is that it is often not possible to derive land use information from out of the land cover categorization. So there afterwards may be features with unknown land use.

Regarding the input data - the ideal situation is to have the land use information on a parcel level. However this is not available in the most of European countries. The usual situation is that we have two pan-European datasets: CORINE and Urban Atlas. The spatial resolution of those is not so great (CORINE is prepared for map scale 1:100 000 and Urban Atlas – to the scale 1:10 000). On top of those two pan-European datasets there is one more – LUCAS that is just point layer – that can be somehow used for the results calibration. Except those pan-European datasets there is sometimes national/local datasets that are available. In different countries those can be different – it can be cadastral map, spatial plan, farmers' land blocks, land use maps etc. Also the coverage of these national/local datasets can be different- they can cover the whole territory or just be partial.

Therefore, the most achievable solution is to make use of the CORINE and Urban Atlas datasets in combination with more detailed local land-use datasets that are available.

In principle, land use information can be also derived from non-authoritative data sources like OpenStreetMap. Such a solution could be a viable alternative, a second best option when no accurate official data is available on member state level.

In the process of the map creation we are doing two main tasks. First one is partitioning the area into the smallest possible units (in the ideal case those need to be logical units such as parcels, buildings, farmer's blocks, zoning features etc. , if this is not possible then features from Urban Atlas and CORINE Land Cover or their parts). This partitioning is the stepwise combination of available data source in the order of their precision. At first we add the features from the most precise data source to this partition and subsequently add features from the rest data sources (those are ordered by the geometric precision) to the unfilled areas. This is done until we have partitioned the whole area. An example of such stepwise partition is shown on the image below. It depicts the process of Czech Republic open land use map creation:

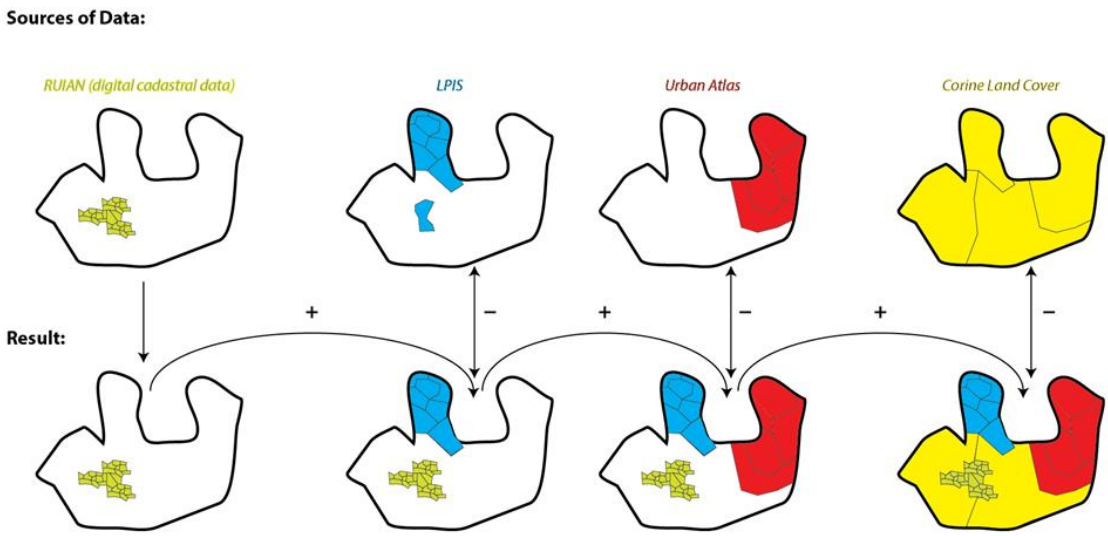


Figure 29 Example data sources compilation

Luckily in the case of the Czech Republic all the features in the resultant area partition have attribute from which the land use can be derived (digital cadastre, farmers blocks, Urban Atlas and CORINE Land Cover).

In some cases however, for instance Flanders province of Belgium, the large scale topographic database (GRBgis) is used as one of the inputs. Many layers from that database don't include information about the land use and it can't be derived just from that layer. Take for instance land parcels from the mentioned GRBgis large scale topographic database. Those are just parcel borders with the identification number. No information about the land use on the parcel is present. The same can be said about the buildings layer. The information about land use is lacking. So this information about land use need to be somehow copied from the may be less precise geometrically-wise layers but where it is present. In case of Flanders the information can be taken from Urban Atlas features inside which buildings/parcels lie. In the result we will have very precise geometries - not so precise land use but it is better than nothing.

Together with the partition of the area the transformation of original data structure into the resulting data model can be performed (the most of attributes are straight-forward to transform, just transformation of original land use into HILUCS land use requires design of a mapping between original land use categories of given data set onto HILUCS land use categories). The resulting data model can be seen on the following image. It is quite self-explanatory. First attribute is unique id of the feature, second - geometry of the feature, third - the numeric code of the HILUCS land use category to which the feature's land use belongs, fourth - the URI of this HILUCS category (for instance: http://inspire.ec.europa.eu/codelist/HILUCSValue/4_1_1_RoadTransport), fifth - land use category from the original dataset, sixth - URI of this land use category if exists, seventh - reference to the object from which the geometry of the feature was derived, eighth - reference to the object from which the attribute of the land use was derived, ninth - the municipal code, in which the feature lies, tenth - the date of the feature creation, eleventh - the date of the feature extinction.

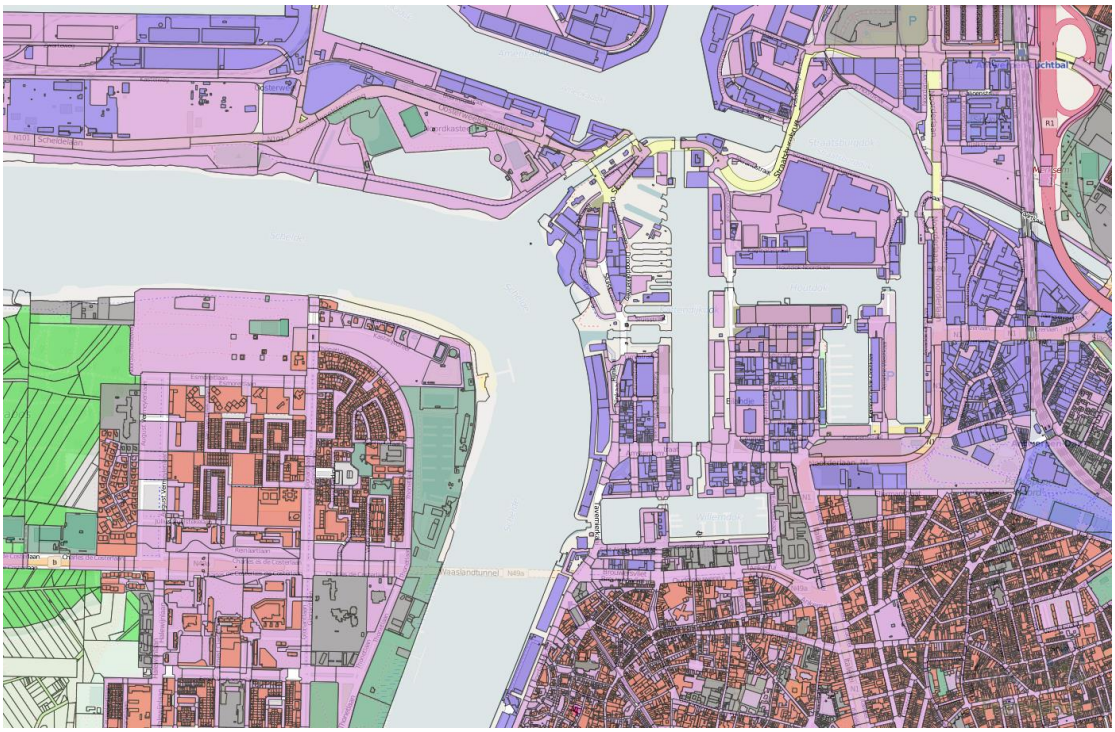


Figure 30 Open Land Use Map through VGI

The model is more complete than the INSPIRE existing land use feature data model as it also include the reference to the objects from which land use/geometry were derived otherwise the attributes is almost identical. This you can see below. In future when data from digital spatial plans and also VGI (data collected from users through web-application) will start to get integrated into the dataset - some changes to data model are possible. Such attributes as whether it is existing or planned land use and in case of planned land use what are the regulations etc. could be added to the data model. So far from 4 areas that are included into Open Land Use Map none of them was having spatial plan as a data source.

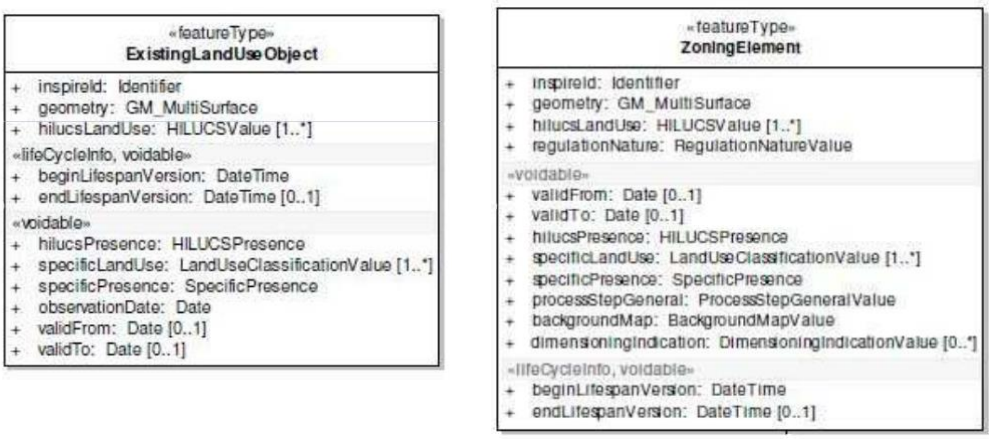


Figure 31 Objects attributes

The areas that were integrated into Open Land Use Map so far are: Czech Republic, Latvia, Flanders region, Slovakia.

5.1 USE CASES

Use case ID:	UC4.1.
Use case name:	Preparation of basic regional Land Use Maps
Abstract:	To be possible to provide VGI updating of Land Use maps, it is necessary to have initial map layers, which will be used for later VGI editing. This will include sets of initial Land Use maps in different scales and in different levels of information and basic geometry, which will be used for future classification, This basic geometry will be initially classified on the base of available data. All this layers will be available for visualization and for download. So far land use maps of four areas were prepared: Czech Republic, Latvia, Flanders region of Belgium, Slovakia. The data is published as wms/wfs ogc services but also available for download in shapefile format. The data can be visualized in any desktop GIS but also in Map Composer component. The visualization can be stored into Map Compositions component.
Description (all the steps that will be done by the user):	There are four steps, which will be necessary to provide for every area. Often these activities will be outsourced to SDI4Apps team or external experts • Get available land use data on pan-European, regional and local levels • Convert it to our data model • Integrate data geometrically (see description in the beginning of the chapter) • If necessary derive land use of areas that don't have land use category from less precise geometrically-wise layers that have this information about land use • Publish data in popular formats • Think about the applications (usage) for the resultant data
User groups/stakeholders:	Public bodies Service Company
How and when will the users be involved in the design and development process?	The end users will be involved in design of applications and mainly in process of data preparation.
Criteria of success:	• Usage level & Social Validation of Services that use SDI4Apps • Easy collection of information using smart phones & LOD • Integration of VGI into existing SDIs & LOD • Increased access to harmonised & interoperable GI, L/OD & VGI data

	• Integrate data from users', OD, crowd-sourced & social media • Coverage of region with basic maps • Attracted investors
Interoperation with other SDI4Apps pilots:	Easy Data Access INSPIRE4Youth
Performance:	This Use case will require scalable computing, initial building of Open Land Use maps is time consuming process, which will require large computing capacity
App ID	The data are prepared outside of SDI4Apps system.
Notes and Issues	The next planned step for this use case is to revise already created land use maps (we have new data for Czech Republic and Latvia – so the maps need to be updated) and expand to other countries (good example for this is Ireland where all spatial plans there are publicly available, Provincia di Belluno from Italy – SDI4Apps partners from Foodie project – that are willing to provide the data, in April Paris plans to open its spatial plan in digital format – so if it happens – it can also be converted to OLU.

Table 40 Open Land Use Map through VGI pilot Use case 1

Use case ID:	UC4.2.
Use case name:	VGI for Land Use
Abstract:	The use case will support updating of available Open Land Use map by volunteers from their computers or from terrain. It will require interaction of volunteers and system administrators, who will take responsibility for open Land Use map validation.
Description (all the steps that will be done by the user):	There will be next possible tasks provided by volunteers • Reclassified object in Open Land Use • Draw new objects into Open Land Use maps • Make evidence from terrain (taking photo) of error in Open Land Use map From the side of system administrator update of data will be provided on the base of acceptance volunteers suggestions.
User groups/stakeholders:	Volunteers Students Public bodies Service organisations

How and when will the users be involved in the design and development process?	End users, mainly regions are involved into design of application. They will have also chance to report bugs or make suggestion for improvement use developers blog and Redmine
Criteria of success:	• User validation • Community of people updating maps • New Open Land Use and LOD
Interoperation with other SDI4Apps pilots:	Easy Data Access INSPIRE4Youth Ecosystem Services Evaluation Pilot
Performance:	For visualisation standard user acceptable response and latency times for information retrieval of 2 seconds, to be measured as defined in D3.5 (Technical Test Methodology).
App ID	A4.1
Notes and Issues	This use case is still in the initial stage. It is good in the beginning to learn how to integrate into the map simple data layers from which land use can be derived, then spatial plans and then VGI data.

Table 41 Open Land Use Map through VGI pilot Use case 2

Use case ID:	UC4.3.
Use case name:	Brownfields, Greenfields
Abstract:	Municipalities, region or owners will publish information about their brownfields and greenfield as part of Open Land Use map. Municipalities and regions will have possibility to display this maps as embedded on their Web pages.
Description (all the steps that will be done by the user):	The brownfield owners will publish information about their brownfields, Greenfields as part of Open Land Use. This information will include: • Description of brownfields, Greenfields • Offer for potential usage • Location • Description • Owners including contacts • Eventual Urban/Spatial plan Owners of brownfield will be able to use Embedded services and run application from their Web pages.
User groups/stakeholders:	Brownfield owners Public bodies Service organisations

How and when will the users be involved in the design and development process?	End users, mainly regions are involved into design of application. They will have also chance to report bugs or make suggestion for improvement use developers blog and Redmine
Criteria of success:	• User validation • Community of people updating maps • New Open Land Use and LOD
Interoperation with other SDI4Apps pilots:	Easy Data Access INSPIRE4Youth Ecosystem Services Evaluation Pilot
Performance:	For visualisation standard user acceptable response and latency times for information retrieval of 2 seconds, to be measured as defined in D3.5 (Technical Test Methodology).
App ID	A4.2
Notes and Issues	Currently we are conducting the survey from Latvian municipalities to identify precise user requirements for this use case. Collecting brownfield and greenfield information and requirements from other partner countries is also being planned.

Table 42 Open Land Use Map in evaluating

Use case ID:	UC4.4.
Use case name:	Use of Open Land Use map for public transport analysis
Abstract:	Based on information coming from public transport companies it is possible to derive useful correlations between the frequency of the public transport connections and land use in the close vicinity of public transport stop. Also if the additional data about the building density and population density in the area are available it is possible to evaluate public transport system – if number of bus connection here and there is adequate, also if public transport connections are distributed in a smart way throughout the day.
Description (all the steps that will be done by the user):	In order to conduct such analysis users need to have data about public transport schedule (typically all city-halls possess such information). Also the Open Land Use map needs to be prepared for the city. Some additional data such as number of passengers travelling (from electronic tickets validation) can be also very valuable – to have.
User groups/stakeholders:	City officials Public transport companies

How and when will the users be involved in the design and development process?	The users will provide data input. Also the measures to take to improve the situation (if there will be some problems/inefficiency found during the analysis) will be discussed after the analysis is conducted with the users.
Criteria of success:	• User providing the data for the analysis • User taking real measures to improve the situation based on the discussion with us
Interoperation with other SDI4Apps pilots:	
Performance:	The analysis will be tailored to each user situation (motivation, data availability etc.) so it is very difficult to estimate the overall performance.
App ID	
Notes and Issues	This use case tries to explore the relation between land use and public transport connections. Currently it is in the initial stage. And methodology for it is getting researched and tested. We have two cities where we are working on this use case : Riga (this was an outcome from the hackathon in Riga) and also in Antwerpen (where it is conducted more in frame of OpenTransportNet project). For the visualization of the outcomes WebGLayer js library can be used that is included into s4a.js library.

Table 43 Open Land Use Map for public transport analysis

5.2 User engagement

For this pilot, we expected next groups of users

- Public bodies – National and Regional Authorities responsible for spatial planning and land use.
- Experts – Planning and Land Use experts and decision makers.
- Enterprises, Companies and SMEs – related to Land Use. and brownfields
- Citizens – visitors and people interested in planning and land use in their local environment.
- Students – interested about thematic data
- Farmers and forest owners – putting their information into the system
- NGOs – interested in better information about land use mainly in sensitive areas
- Researchers interested in Land use data analysis
- Real estate business and investors interesting about land use analysis
- System administrators – people responsible for managing data sets for certain regions.
- Public transport companies

For each of them different use case will be relevant.

However in general it can be said that the roles of most stakeholders in the use-cases are similar. They provide the data and then they benefit from the solutions we have built upon their needs and data. Situation may be a bit different with brownfields/greenfields use-case where we are in the middle (broker) between the public bodies and brownfields/greenfield owners and the potential investors. In this case role of the public bodies is to provide the data, our role to publish it in a well-arranged, clear way and to underline the connection of this data to the surrounding context (land use, transport infrastructure, limits etc.), and finally the role of investors is to select what is good to them and invest money.

Engagement methods could be through the various promotional actions that are taken within this and other projects (see memorandum of understanding between Sdi4Apps, Open Transport Net, Foodie, ECIM: http://sdi4apps.eu/2016/02/memorandum-of-understanding-between-sdi4apps-otn-foodie-and-ecim/). Hackathons, expos, social medias, direct contact with the potentially interested customers are one of the undertaken strategies how to get the stakeholders into the use cases.

Success is the measure to what the technical development corresponds to the quality of our products. If we have good developed, reliable products for each use-case and growing usage from the side of stakeholders – it can be treated as the success. If we do have good developed, reliable solutions but no one is using them then it isn't success. So if the development is proportional to the number of users then it is success. If not then we need to put more effort on propagation of the products.

As it can be seen from the stakeholders list – it is very wide. Many groups of people have the interest in the land use. For now there are not any exclusive requirements for the users groups – just the will of them to provide the data and use the benefits of our proposed products.

The validation of the final products will be done by various groups of the stakeholders and as it was mentioned the successful validation is directly dependant on the number of the engaged users. If there will be good technological state of the products – they so to say be validated – the number of users will grow. As there are many potential users – that are met during the events being organized by Plan4All association but also by the projects between which the mentioned memorandum of understanding was signed.

The market potential is good. Our position on the market is quite unique. This information could be used in many cases – as an example of one use case we see practical usage of such map in analysing public transport system. Also there is no any good interactive brownfield/greenfield finder for the investors that takes spatial context of the brownfield/greenfield into the account. This services difference is that it can derive data from many sources, provide larger and more comprehensive data combination options and for several countries simultaneously. It is desirable to explore and use all this potential.

Regarding the business model as it was mentioned in D6.1. It will be based on four pillars:

- Services for municipalities, regions and brownfield users to harmonise their data.
- To use embedded functionality for publishing data on web pages of cities, regions, brownfields owners.
- On demand analysis for certain users like banks, real estate etc. (this now also gets extended to public transport companies)
- Consultancy for developers of applications.

5.3 Data acquisition

5.3.1 Datasets

Dataset ID:	DS4.1
Resource title:	Open Land Use dataset

Resource abstract:	The dataset that is the main input for the proposed use-cases, services and applications. It is created in a process of data integration and harmonization that was described in the beginning of the chapter. The detailed specification of each datasets is available at the following pages: http://app.hslayers.org/open_land_use/ also http://sdi4apps.eu/open_land_use/ for Czech Open Land Use map, http://app.hslayers.org/open_land_use_lv/ or http://sdi4apps.eu/open_land_use_lv/ for Latvian Open Land Use map, http://app.hslayers.org/open_land_use_sk/ for Slovakian Open Land Use map. The Open Land Use map of Flanders doesn't have its web-pages yet. However the dataset can be found published at the following web-page http://opentnet.eu/web/guest/create-maps . In future it is planned to have one centralized page where there will be general information and pan-European dataset: http://sdi4apps.eu/open_land_use/ then there will be available detailed information about each region at sub-pages such as : http://sdi4apps.eu/open_land_use/cz for Czech Republic, http://sdi4apps.eu/open_land_use/sk for Slovakia, http://sdi4apps.eu/open_land_use/fl for Flanders province etc.
Geographical coverage:	Planned pan-European. Currently – Czech Republic, Slovakia, Latvia and Flanders regions
Level of detail:	Depending on the sources between 1:250 (Flanders cadastre) to 1:100 000 (CORINE Land Cover dataset)
Resource locator:	The data is stored in PostgreSQL database but also available through the WMS/WFS services: http://gis.lesprojekt.cz/wms/open_land_use/cz? http://gis.lesprojekt.cz/wms/open_land_use/sk? http://gis.lesprojekt.cz/wms/open_land_use/lt? http://gis.lesprojekt.cz/wms/open_land_use/fl? Also for download as shapefiles at the level of individual municipalities (for now just Czech and Latvian) at: http://sdi4apps.eu/open_land_use/download/
Restrictions/Licences:	The licenses apply depending on the underlying datasets. The most restrictive from all – is Creative Commons Attribution-ShareAlike 2.0 under which OpenStreetMap is published. The different licenses partially were a motivation to publish the data by individual municipalities (see shapefile download). Because otherwise if we publish the whole dataset – it needs to be under mentioned

	Creative Commons Attribution-ShareAlike 2.0 license- as it is the most strict among all used data to create Open Land Use map.
Format:	The data is stored in PostgreSQL database with PostGis extension.
Transformation:	The dataset is published in EPSG:3857 reference system.
Ready to use:	Yes.
Size:	Up to 40GB if you take all data we have stored in database.
Data acquisition:	The data is shared through OGC WMS/WFS services but also through shapefile download.
Notes and issues	

Table 44 Data set 4.1

5.3.2 Data Models

Dataset DS4.1. See the following image:

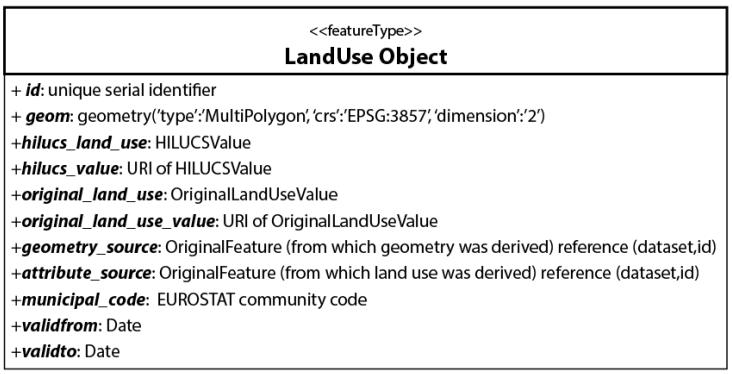


Figure 32 Example of Land Use map

5.4 Apps and Services

5.4.1 User App

Application ID:	A4.1
Name of the app:	OLU Crowdsourcing Apps
Application description:	• The crowdsourcing Apps will support next functionality:

	• Edit attribute of objects • Edit objects • Collect information demonstrating objects in terrain
Supported functionality / capabilities:	• Data collection • Data editing
Related services:	S4.1
Datasets required	DS4.1
Time plan for the development:	Planned to finalise till September 2016
Responsibility for the development:	HSRS
Detailed description of planned or already carried out testing:	The testing will start from June 2016
Role of the user:	Crowdsourcing of data
Role of the administrator:	Validation of data
Offline use:	Not initially
Who will be responsible for the application management?	HSRS
Notes and issues	

Table 45 Open Land Use Map through VGI user App 1

Application ID:	A4.2
Name of the app:	Brownfield publishing and searching
Application description:	• The Brownfield publishing and searching Apps will support next functionality: • Publish information about brownfield • Search and visualise brownfield
Supported functionality / capabilities:	• Registered on portal • Registered Brownfields • Search for brownfield • Visualise brownfield
Related services:	S4.1

Datasets required	DS4.1
Timeplan for the development:	Planned to finalise till September 2016
Responsibility for the development:	HSRS
Detailed description of planned or already carried out testing:	The testing will start from June 2016
Role of the user:	Crowdsourcing of data
Role of the administrator:	Validation of data
Offline use:	
Who will be responsible for the application management?	HSRS
Notes and issues	

Table 46Open Land Use Map through VGI user App 2

Application ID:	A4.3
Name of the app:	Public transport availability app
Application description:	• The app will show the availability of public transport at different public transport stops. It will be able to identify too weak/too strong spots in public transport system. The correlation between public transport connections and underlying land use in the vicinity of the public transport stop will be taken into account in stops categorization. It is mostly app - designed for data visualization. It will be at first done individually for the places where public transport data is available as well as Open Land Use Map. The application is done in strong collaboration with Open Transport Net project.
Supported functionality / capabilities:	• Visualizing land use • Visualizing public transport stops • Visualizing public transport connections • Visualizing frequency of public transport connections • Identifying weak/strong spots • Categorizing the public stops based on the underlying land use in the vicinity of the stop
Related services:	
Datasets required	DS4.1 plus related datasets of transport network

	(http://opentransportmap.info/) and public transport connections (schedules)
Timeplan for the development:	June 2016
Responsibility for the development:	HSRS, UWB
Detailed description of planned or already carried out testing:	Some initial work specifying user requirements and doing initial steps was done in Riga during the hackathon but also within Open Transport Net project
Role of the user:	visualizing the data, exploring the data and its patterns
Role of the administrator:	
Offline use:	
Who will be responsible for the application management?	HSRS, UWB
Notes and issues	

Table 47Open Land Use Map in analysis of public transport availability

5.4.2 Services

Service ID:	S4.1
Name of the service:	Data editor
Service description:	The editor will allow edit data using Web and mobile interface.
Supported functionality / capabilities:	• Edit attributes • Edit objects • Add objects
Related apps:	A4.1, A4.2
Timeplan for the development:	Planned to finalise till September 2016
Responsibility for the development:	HSRS
Detailed description of	Testing will start from June 2016

planned or already carried out testing:	
Service run by the SDI4Apps platform?	Yes
Notes and issues	

Table 48Open Land Use Map through VGI pilot service: Data editor

5.5 Cloud properties

Cloud Property	Open Land Use Map through VGI Pilots Requirements
Operating system preferred for deployment of server-side services, and why?	Deployed, configured and tested on Debian Linux operating system, but can run on any Linux Distro, or Windows machine, platform independent
Can Ubuntu Linux 14.04 LTS be used as the operating system? Any objections against using it as the default operating system for deployment?	Yes
Requirements for data storage space in gigabytes.	>1 TB
Need for scalability of the application regarding the amount of stored data, the amount of data processing, the number of concurrent users, or anything else? (Scalability requirements make application design and development more complex and thus costly, but prepare the application for future success.)	Geoserver HSlayers NG Senslog

Table 49 Open Land Use Map through VGI pilot Cloud Property requirements

5.6 Use of the SDI4Apps Platform and other re-usable software

The applications are based on the components described in infrastructure of Sdi4Apps Open API. So it shouldn't be problem in future to deploy them on the platform. Nowadays however there is not such big advantage taken of SDI4Apps cloud platform. Mainly because the applications still are under development and not mostly ready for the production deployment.

5.7 Pilot Progress

As for the pilot progress it can be said that the most effort was put into the first and arguably the most import use case – creating of the Open Land Use map itself. Czech Open Land Use map was finalized- and now its second version is coming out. Latvian Open Land Use map was published. Slovak Open Land Use map was published during the recent hackathon in Riga. The Flemish Open Land Use map is being finalized. There was big advantage taken from the collaboration with Open Transport Net project. New use case about analyzing the public transport availability that takes into account land use has started. Also Flemish government that is taken part in Open Transport Net project has provided their large scale topographic database (GRBgis) that was partially used to create Open Land Use map of Flanders. Regarding the rest of use cases we are now at the stage of collecting the real data about brownfields/greenfields that needs to be published outside by the Latvian municipalities. After this and user requirements will be collected we will be in the active stage of that use case development.

5.8 Innovative aspects and benefits

Before that the land cover/ land use of the area was mostly derived from raster data - satellite/aerial images by the classification (of pixels) process. The spatial resolution of such resulting datasets weren't always so great (take for instance CORINE Land Cover dataset). Also the classification of pixels isn't always 100% reliable. Nowadays as many vector data sources are becoming publicly available (cadastral data, vector topographic databases, spatial plans, thematic vector layers publications such as brownfields/greenfields) it becomes possible to use these data sources to create very detailed land use maps that are partitioned in the logical geometries (for instance individual buildings, parcels, block of houses etc.). And in this pilot we are trying to take the advantage of this idea. This is probably the biggest conceptual innovation. Otherwise other innovations can include providing data about brownfieds/greenfields with the spatial context (land use in surrounding areas, limits and transport infrastructure). Usually going to web pages of real estate agency the spatial context of the place is not given (maximum topographic map with the point of the property on it is provided). And the other innovative aspect we are exploring right now as part of use case 4 which attempts to categorize the public transport stops by the underlying land-use and explore the adequateness of public transport connections to those different types of the public transport stops.

6 PILOT 5 OPEN INSPIRE4YOUTH

The pilot is focused on building of Environmental and Geographical Web based atlas based on utilization of Geospatial data, Linked Open data and other environmental data (maps) for educational and gaming purposes. The main components of the environment will be introduced - water, air, soil, forests, nature protection, climate information, landscape, waste management, forest management etc. Each component has its actual condition measured for the region. Depending on data availability this measured condition can be compared with a European standard. All this will be made available in an entertaining manner - no school textbooks. Pilot will also re use database of Smart Point of Interest from Smart Tourist Data pilot. The main user group for this Atlas are students - higher grades of elementary schools, high schools and universities. However it should be appealing also for any adult person interested in topic.

6.1 USE CASES

One of the interesting tasks of the pilot is creating ontologies for those mentioned geographic objects. Here for example is one possible ontology for river class: http://dbpedia.org/ontology/River , for countries: http://dbpedia.org/ontology/Country . Those are from dbpedia. Here some examples of ontology of features of geonames database: http://www.geonames.org/ontology/ontology_v3.1.rdf . After creating those ontologies and then storing the data in RDF format and uploading it to Virtuoso, it is possible to query the data based on created ontologies, taking into account different interesting relationships between the classes. This can be very useful as in some cases it is impossible precisely to define some of the relationships by geometrical/topological means or even by visual means. Especially if we take into account that vast majority of datasets don't come with fixed topology this becomes very hard. Take for example following case:

Does city Turnov lie on Jizera river?

From visual perspective if the city is represented by point this is not so obvious.

Figure 33 Example of Questioners

The city is represented by a center point on this map and the river obviously flows partially through the cartographic representation of this point, but not through its centre. So what can we say does it flow through the city or not? Possibly if we would have correct topology: points snapped on the lines (i.e. if road goes through the point representation of the city – the point needs to be snapped onto the road, or if the river flows through the city that is represented by the point – again the point needs to be snapped to it), but here it isn't the case – we don't have correct topology. Or even if the topology wasn't fixed but the city was represented by the polygon feature – we could somehow decide if it intersects with the line of the river. But

again this is not the case. So we can't be normally sure (until we know the correct answer) from this map if the city Turnov lies on Jizera river. What can help us is to define precisely the relationship between these two instances:

```
<owl:NamedIndividual rdf:about="http://www.sdi4apps.eu/GFO#Jizera">
        ...
        <flows_through rdf:resource="http://www.sdi4apps.eu/GFO#Turnov"/>
        ...
</owl:NamedIndividual>
```

After that we will be sure what the correct answer yes. And even the computation of correct answer will be much faster than to look on the fly whether the line of the river intersects the polygon of the city , especially when there are topological errors in the data.

Of course what we have in RDF data also needs to be precomputed in advance. But if then we can allow the process to take longer time and find suitable geometrical representations of objects with correct topologies.

So for what it can be useful in our pilot?

For educational geo-games.

Probably most of you had to do geographical quiz (A-B-C-D) or even blind map tasks. This concept of LOD in geography can be used for this. Storing everything that is explicitly defined and known is good for quizzes. Some examples of the tasks can include typical quiz questions:

Through which countries flows Danube river?

a)Bulgaria,Ukraine,Slovakia,Serbia,Romania,Germany,Hungary,Croatia,Netherlands

b)Austria,Bulgaria,Ukraine,Slovakia,Serbia,Romania,Bosnia,Germany,Hungary,France

c)Austria,Bulgaria,Ukraine,Slovakia,Serbia,Romania,Moldova,Italy,Hungary,Netherlands

d)Austria,Bulgaria,Ukraine,Slovakia,Serbia,Romania,Moldova,Germany,Hungary,Croatia

Through which countries flows Oder river?

a) Czechia, Germany, Poland

b) Austria, Germany, Italy

c) Croatia, Hungary, Moldova

d) Czechia, Poland, Lithuania

To which river Morava is tributary?

a) Labe

b) Oder

C) Danube

d) Thaya

In which country starts the river Thaya?

a) Austria

b) Germany

C) Poland

d) Italy

Or blind map tasks:

Click on the spring of Jizera river?

Select all settlements on Jizera river that have more then 10 000 inhabitants?

Figure 34 Example of Questioners 2

This is already next level games in comparison to the games that were shown on Liberec GISdays before. See: http://env.kraj-lbc.cz/mapserv/geohra/ . Typical task was to click the most close to the given point. There were different point object given and some description of them + pictures. User needed to click on the spot where he thinks the guessed place lies. Then the distance between user's answer and correct answer was calculated. In the end of the game the distance for all answers was aggregated and the person with the smallest distance was the highest in the user's rank.

The semantic to such games brings a lot. It allows to add pictures and description of the places automatically if needed – for example from DB:Pedia. Also as was mentioned below it allows explore various interesting relationships between the objects: rivers and towns, mountains and provinces, lakes and habitats of water bird species, countries and forests, and in questions all these relationships can be combined for example we have following classes: cities, provinces, countries and rivers then we can ask such question 'find the city with more then 100 000 inhabitants, that lies in x province, on the bank of x river, that flows through x,y,z countries?'. It can well be filled with the picture of the most famous monument from that city from DB:Pedia.

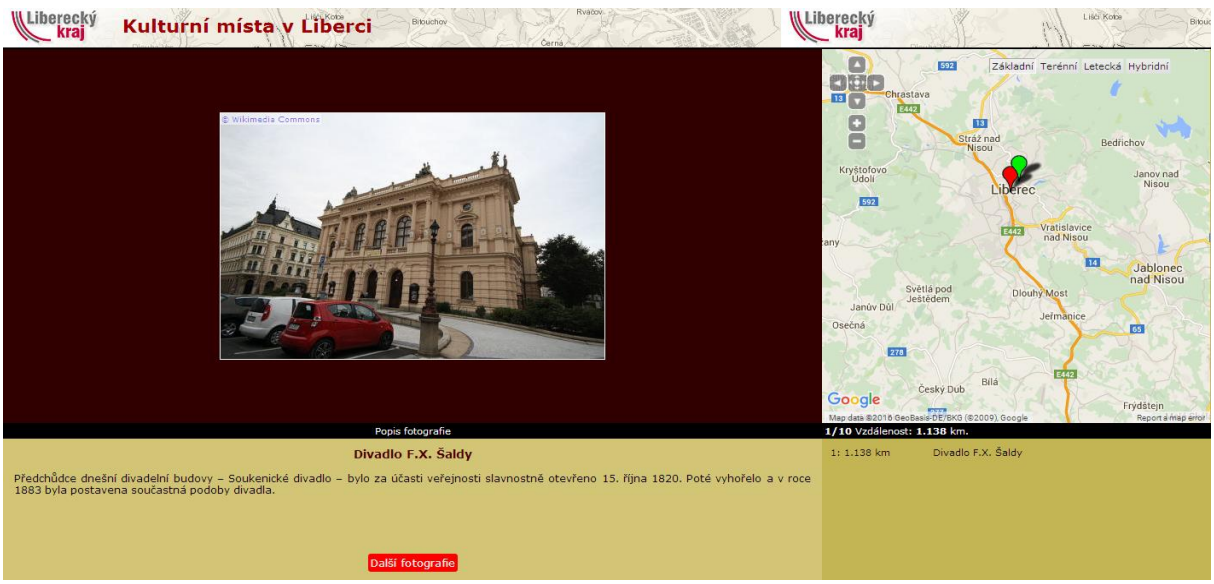


Figure 35 Use of DBpedia pictures

From what has been said it is obvious that the main stakeholders are people from educational establishments – mainly teachers and students. However such games could be used by anyone on social networks – not just students, to test geographical skills of the friends on the network. The engagement strategies to bring the users could be social networks/contact with high schools. The measure of success number of created quizzes and measuring the number of people who have filled in the quiz.

Use case ID:	UC5.1
Use case name:	Regional Atlas of Environment
Abstract:	Electronic version of Regional Atlas of Environment. It is expected that the Atlas will have four faces: Classical Atlas, which will focus on "regular" description of the components of the environment and will be targeted at a comprehensive view of the basic components of the environment. Main components of environment will be introduced: water, air, soil and forests, nature and landscape, waste management, forest management, flood protection etc. For this functionality will be used mainly web application. Alive Atlas, which will be continuously added to the contents of the current data, data from sensors, data obtained from crowdsourcing. Using form of web application. Custom Atlas, which focuses on creating custom mapping composition of acquiring personal data and sharing. For this functionality will be used web application and also mobile application of atlas. Mobile app will use geolocations to visualize actual data related to the environment in user´s current area. **Game Atlas**, which will be focused on presenting entertaining and appealing way of submission facts. It will try to arrange an interesting interaction between users and will encourage to work with Atlas. We are tipped sample tasks that could be solved by means of Atlas: **Nature trails** Students would to map an existing nature trail. Along the way, take pictures of nature stops and give their content into context with the appropriate thematic map (conservation, water management ...). Advanced students will try to propose a new nature trail in their neighbourhood. They´ll pass route and enter it into map. They´ll find some interested places and try to propose educational boards using maps from the app. They can attempt to find a similar pathway in other parts of Europe and to compare natural conditions. **Safely to School** Crowsourcing collecting data from students who might have a real use. Students (or public) track down its surroundings, where they feel completely safe and conversely where they do not feel safe. Subjective evaluation will only have simple rules make it easy for the operator. The result could be continuously emerging heatmap that reveals the unpopular or danger part of the city. Another tasks for data collection:

	outdoor signs on walking trails and signs with a labels and information on protected areas, mapping health condition and collecting photographs of alleys, illegal landfills...
Description (all the steps that will be done by the user):	1. Logging into Atlas 2. Study a chapter of one of the components of the environment 3. Choose some task 4. Solving task 5. Collect points for solving
User groups/stakeholders:	• Students (mainly in the age 12 – 15 or 15 to 18) • Public with the interest in environment
How and when will the users be involved in the design and development process?	• In the preparation process • Giving some feedback • Data acquisition through mobile application
Criteria of success:	• Usage level & Social Validation of Services that use SDI4Apps • Collection of relevant dataset resources • Integrate data from users', OD, crowd-sourced & social media. • Reuse & share environmental information resources, channels & tools
Interoperation with other SDI4Apps pilots:	Easy Data Access Open Smart Tourist Data Open Land Use map
Performance:	
App ID:	A5.1
Notes and Issues	

Table 50 Open INSPIRE4Youth Pilot: Use case 1

Use case ID:	UC5.2
Use case name:	From European Protected areas, landscape and habitats towards region
Abstract:	The Use cases will prepare basic Pan European Layers about Natura 2000, bio zones, climatic zones, landscape and other relevant data. Information will be interlinked with DBPedia and other LOD sources. This pan European data sets will be base for activities of students collecting their relevant regional data and local data, demonstrating different approaches to environmental protection. Students will

	have information search for relevant information cross Europe, but also will actively collected data related to their regions.
Description (all the steps that will be done by the user):	The students will have next possibilities: • to search for relevant map context related to certain regions and certain themes from computers and smartphones • Students will have possibilities to use advanced visualisation methods explaining them different environmental problems. Map data will have possibility to be connected with textual data, videos, images excel tables, etc. • Students will have possibilities to collect information directly in the terrain and connected this information with positions (photos, videos etc.) • Students will have possibilities to publish other data like texts, tables etc. and eventually connected this information with position • Students will have possibilities to prepare their own thematic maps
User groups/stakeholders:	Students from secondary schools Teachers University students
How and when will the users be involved in the design and development process?	• To provide a feedback. • To provide new content or modified existing content (in a later advanced version). • To share information in social media.
Criteria of success:	• Usage level & Social Validation of Services that use SDI4Apps • Easy collection of information using smart phones & LOD • Integration of VGI into existing SDIs & LOD • Increased access to harmonised & interoperable GI, L/OD & VGI data • Integrate data from users', OD, crowd-sourced & social media. • Reuse & share tourist information resources, channels & tools • New tourism activities, visitors & jobs, and SME developed services.
Interoperation with other SDI4Apps pilots:	Easy Data Access Open Land Use map
Performance:	For visualisation standard user acceptable response and latency times for information retrieval of 2 seconds, to be measured as defined in D3.5 (Technical Test Methodology).
App ID:	A5.1, A5.2

Notes and Issues	

Table 51 Open INSPIRE4Youth Pilot: Use case 2

6.2 USER ENGAGEMENT

The identified stakeholder group:

- Schools and students
- Public bodies – European, National and Regional Education and Environmental Authorities.
- Experts – Education and Environmental experts, Researchers & decision makers.
- Enterprises, Companies, NGOs and SMEs – targeting and working with young people.
- Citizens – young people.

6.3 DATA ACQUISITION

6.3.1 Datasets

Dataset ID:	DS1.1
Resource title:	Administrative (settlements, provinces, countries etc.) and physical (rivers, lakes, mountains etc.) features from OpenStreetMap
Resource abstract:	The features that will be included in the visualizations and games (in first step countries and rivers) will be downloaded from OSM, converted to correspondings RDF triples and uploaded to Virtuoso.
Geographical coverage:	The dataset aims to cover the whole world.
Level of detail:	Depending on the underlying OpenStreetMap features.
Resource locator:	The data will be stored in Virtuoso and available to be queried from SPARQL endpoint.
Restrictions/Licences:	Creative Commons Attribution-ShareAlike 2.0
Format:	The data is stored in RDF triples in Virtuoso
Transformation:	The dataset will be published in EPSG:4326 reference system.
Ready to use:	No.
Size:	It will be tens of gigabytes of data.

Data acquisition:	Through SPARQL endpoint.
Notes and issues	

6.3.2 Data Models

In the pilot activities there will be used following data models adopted from external resources (therefore there will be only references as sources of relevant information):

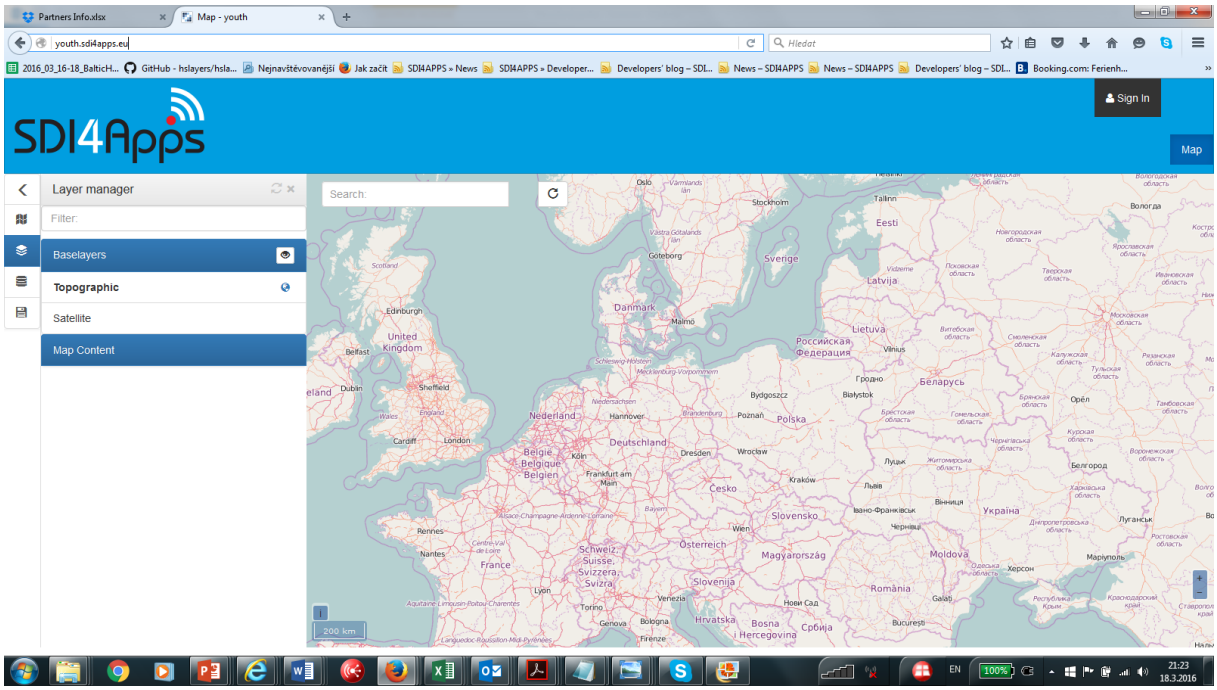
- Data models from POIs and roads as they are published in the Pilot 2
- INSPIRE data models (above all protected areas) as they are published in relevant specifications. Potential modifications will be realized on the basis of user requirements during solution of pilot activities.
- Local data models of the Liberec region data (data model are available now).

6.4 APPS AND SERVICES

6.4.1 Applications

Map Composer

- The application is providing the necessary functionality for displaying geographic data on a map and then creating a map composition (a thematic map) that can contain several data layers. After the map composition is created, i.e. detailed definition and metadata of each layer of the composition along with the composition itself, it can be saved as a JSON-styled text document. Then, this document can be read and visualized by an HSLayers NG-based web application. So, the main purpose of the application is to share visualized geographic data between users.
- Map Composer is currently it is able to display map layers that come from the following services/sources: WMS, WFS, WCS, KML, GeoRSS, GML, GeoJSON and SOS. A user can then combine the layers he wishes into a composition that will be saved as an .hsl file (JSON styled text document that contains all necessary definitions and metadata of each layer and composition itself). It is further intended that the user will publish the composition he has created and share it with other users. It can be done in several ways: if user sets composition to “public” it can be viewed by other users of the platform in the Thematic Atlas web-application or the user can use Embed Map utility (feature of Thematic Atlas) to generate link to insert the map window with composition into any web-page (as data object, iframe etc.).
- In the context of the project the Map Composer is playing very important role as it is allowing thematic map creation. With the help of this application users can overlay data from different sources and visually explore patterns in data and relationships between different data layers. The application is intuitive enough even for users that don’t have strong background in GIS.



Application ID:	A5.1
Name of the apps	Map Composer
Application description	Map composer is supporting preparation of Map composition from available services
Application URL:	http://youth.sdi4apps.eu/
Supported functionality / capabilities:	Discovery services, Compose services
Related services:	S5.1 (Catalogue service) S5.2 (Visualisation service)
Datasets required	Metadata catalogue
Timeplan for the development:	Application is deployed
Responsibility for the development:	Premysl Vohnout, Raitis Berzins
Detailed description of planned or already carried out testing:	The Apps is operational
Role of the user:	Discovery data, Prepare composition, Add SPOI data
Role of the administrator:	Manage application
Offline use:	No

Who is responsible for the application management?	Premysl Vohnout
Notes and issues	

Table 52 Map Composer Application

Thematic Map Viewer

Thematic Map Viewer is serving this purpose as well as it provides tools to search compositions in the project catalogue using different search criteria as search by text string in title/abstract, filter by keywords, search by current map extent. It is map-centred application. The map clearly dominates the screen. The second most dominant element is Composition panel. This panel contains detailed information about the current composition (composition abstract as well as detailed info (name, legend, and source) about layers that comprise the composition) as well as it allows user to search compositions saved in the project's catalogue.

Application ID:	A5.2
Name of the apps	Thematic Map Viewer
Application description	Thematic Map Viewer allows display prepared map composition
Application URL:	http://youth.sdi4apps.eu/
Supported functionality / capabilities:	Discovery services, View services
Related services:	S5.1 (Catalogue service) S5.2 (Visualisation service)
Datasets required	Metadata catalogue
Timeplan for the development:	Application is deployed
Responsibility for the development:	Premysl Vohnout, Raitis Berzins
Detailed description of planned or already carried out testing:	App is ready for testing
Role of the user:	Visualise and access Map information, Embedded data into other Web Pages
Role of the administrator:	Administration of compositions
Offline use:	No
Who is responsible for the application management?	Premysl Vohnout
Notes and issues	N/A

Table 53 Thematic Map Viewer

Mobile Thematic Viewer

It is mobile version of Thematic Viewer. The mobile application being developed as a part of the SDI4Apps project is a result of the HS-Layers framework and mobile specific code integration. It utilises PhoneGap framework, which packs HTML, CSS3 and JavaScript code into an installation package. Apache Cordova is the software developer uses to compile the application with PhoneGap. Because PhoneGap is based on rendering the application via web view, not the platforms UI framework, the source code does not have to be platform specific and can still benefit from the native device APIs. As the consequence of employing web views, performance and other issues may arise.

One such issue is the fact that Android devices prior to V4.4.3 KitKat uses the default Android browser to render the web view, which does not provide GPU acceleration and restricts CPU support if the application calls for GPU acceleration. This results in severe performance decrease and has to be dealt with. Subsequent Android versions use Chromium for web view rendering, which does support GPU acceleration. The Crosswalk webview plug-in for Cordova solves this issue by incorporating Chromium directly in the application package. That increases the package size by approximately 20 MB, which could be undesirable.

Another matter addressed was usage of proxy service by HS-Layers. The service could not be utilised in the application, because it is written in Python, which is unsupported by Cordova by default. Cordova instead uses domain whitelisting for various types of HTTP requests (images, stylesheets, scripts, etc.), so a simple URL may be used for search queries and JSON or image requests if whitelisted properly. HS-Layers components that make HTTP requests needed to be modified so they make a request with simple URL in the mobile version, but still serve the URL to the proxy service on desktop. A JavaScript mobile variable was defined in the index.html file of the Cordova application and a conditional statement in each component verifies if this variable is defined.

Geolocation component also needed to be rewritten to use native geolocation API via the Cordova Geolocation plug-in. This allows for usage of high precision GPS service. A GPS logging functionality was also introduced as a part of the mobile geolocation component. It employs a WebSQL database to store location information (available values are longitude, latitude, altitude, horizontal accuracy, current velocity and heading). Another storage options are also available, including local file storage or other database types. This logging functionality can be extended to display various statistics about created GPS tracks or the tracks themselves as features on the map. Displaying velocity and altitude as well as centring on the user's current position functions as intended.

Mobile specific layout was dealt with mainly at the Dresden 2015 hackathon. A CSS stylesheet is used to redefine properties of relevant classes. The mobile toolbar is proposed to be located on the bottom of the screen and to contain only four buttons, namely Layer manager, Search, Geolocation and one specific to each example. This results in a simpler layout that is easier to use on a mobile device than the desktop layout.

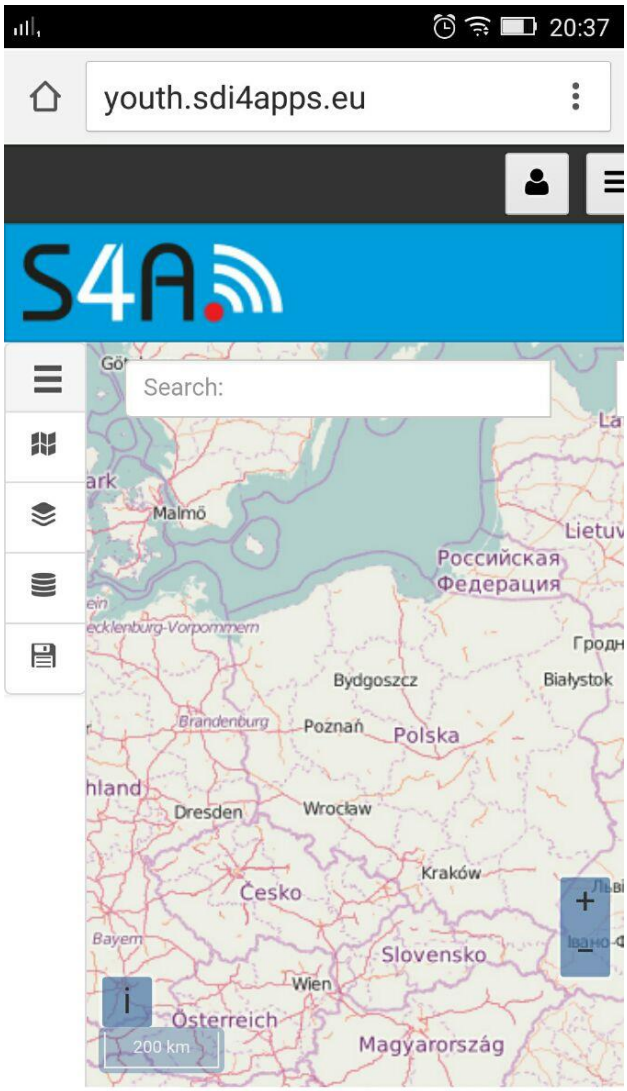


Figure 36 Mobile Thematic Viewer layout 2

There are tasks that are yet to be addressed. A priority is to improve the application's performance, which is unsatisfactory at the moment and is partly linked to WMS service rendering. Another task is to design new zoom buttons located on the right side of the screen, as the whole mobile layout will

Application ID:	A3.1
Name of the apps	Mobile Thematic Map Viewer
Application description	Map Thematic Viewer is mobile version of Thematic Viewer
Application URL:	Till now not publicly available, it is in testing mode, it is Smartphone Apps
Supported functionality / capabilities:	Discovery services, View services
Related services:	S5.1 (Catalogue service) S5.2 (Visualisation service)

Datasets required	Metadata catalogue
Timeplan for the development:	Application is tested
Responsibility for the development:	Šimon Leitgeb, Premysl Vohnout
Detailed description of planned or already carried out testing:	The Apps is ready for testing
Role of the user:	Visualize data in concrete location
Role of the administrator:	Manage system
Offline use:	No
Who is responsible for the application management?	Šimon Leitgeb, Premysl Vohnout
Notes and issues	

Figure 37 Semantic explorer

be designed for right-handed person, but a user setting to switch to left-handed layout is also a possibility. Further improving the mobile layout and testing the application on a physical device will also follow.

Figure 38 Mobile Thematic Viewer layout 2

Semantic explorer

The Apps provides spatial analysis and build semantic linkage among different types of data. Like for example: river A is crossing countries A, B, C. Protected area X is in countries Y. Z. The results of analysis are stored as RDF files, so it allows different types of queries and educational scenarios. The next images show examples of derived ontologies

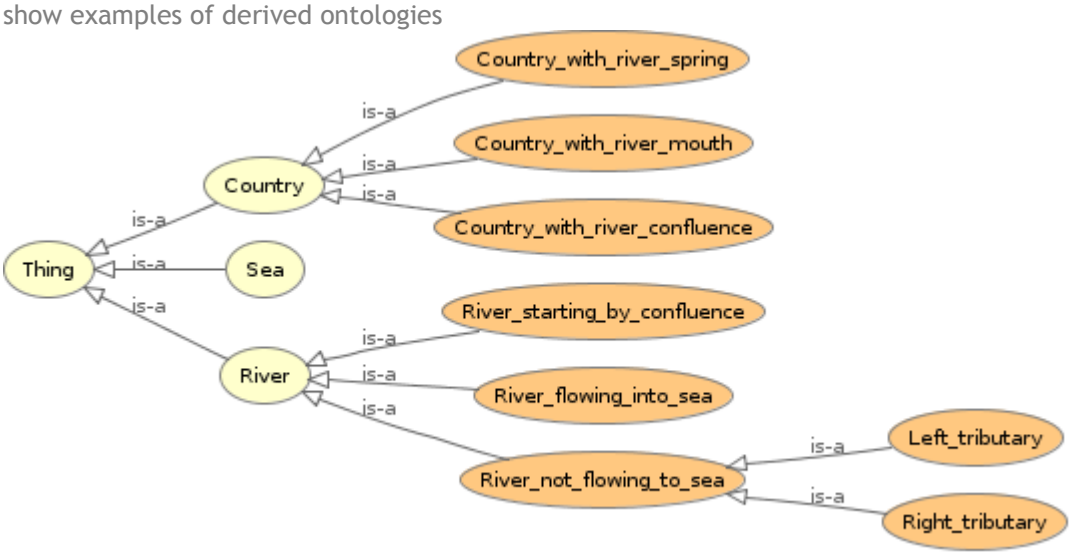


Figure 39 Classes

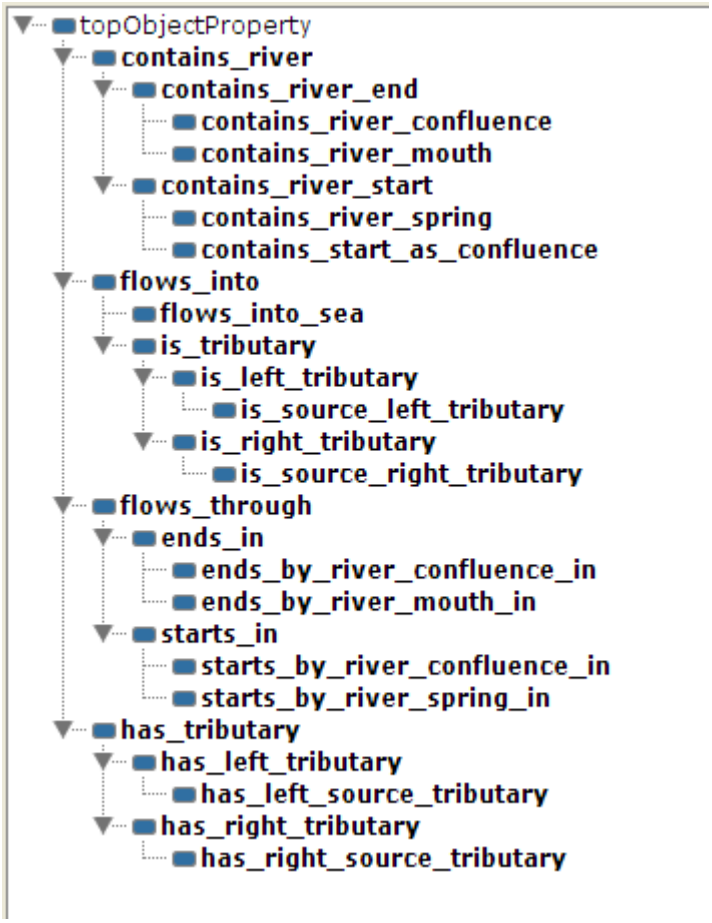


Figure 40 Object properties

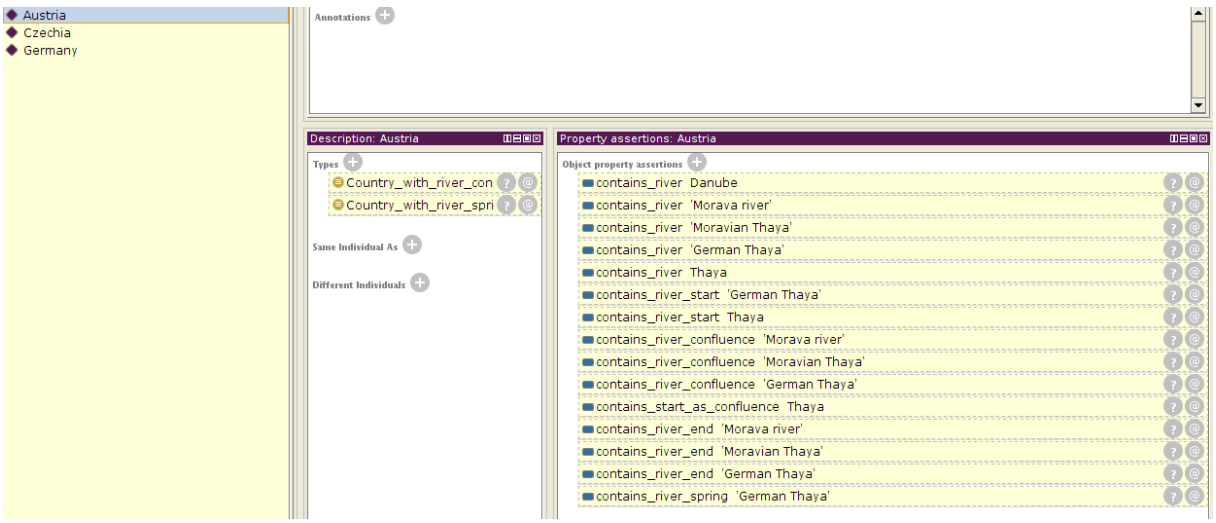


Figure 41 Austria example

Figure 42 Classes II

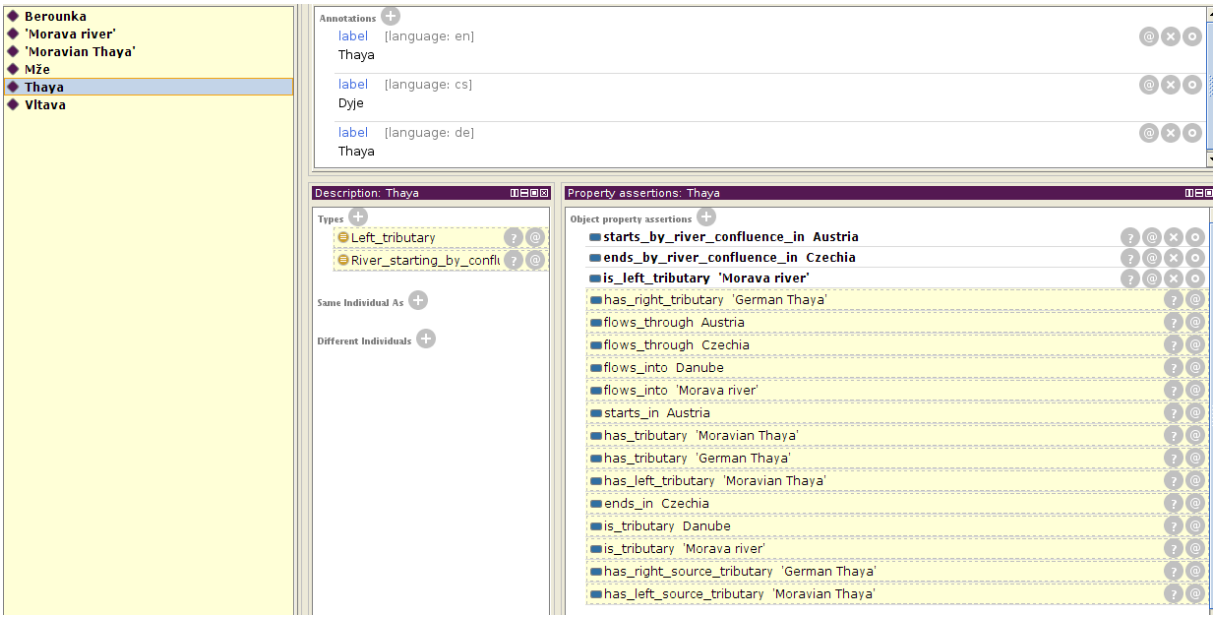


Figure 43 Dyje

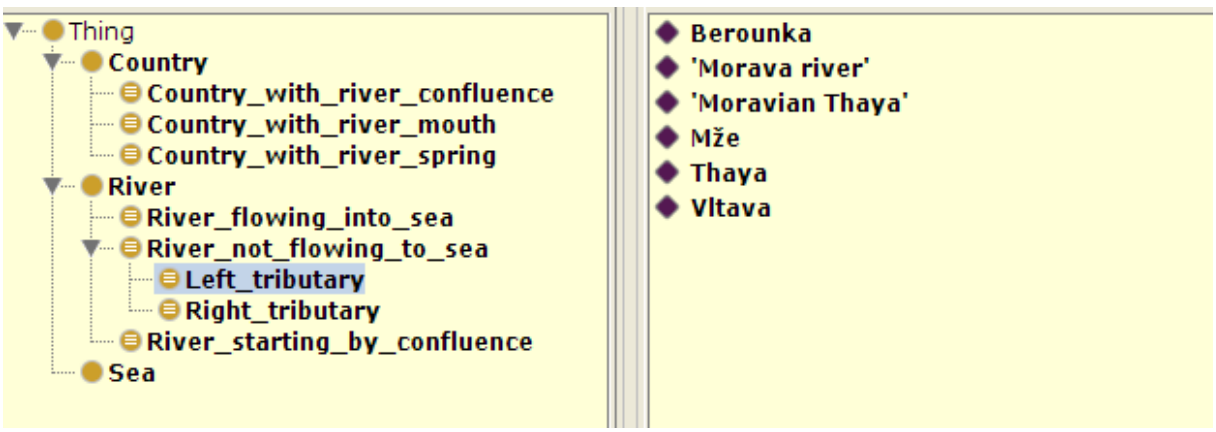


Figure 44 Left Tributaries

Application ID:	A5.4

Name of the apps	RDF explorer
Application description	RDF explorer allows building relation among objects and provide sprawl queries
Application URL:	
Supported functionality / capabilities:	SparqEnd Point, Java Script client, Map client
Related services:	Virtuoso
Datasets required	Maps of geographical objects RDF data
Timeplan for the development:	Application is tested
Responsibility for the development:	Ota Cerba, Dmitrij Kozuch, Raitis Beryins
Detailed description of planned or already carried out testing:	The Apps is under final developments
Role of the user:	Visualize data in concrete location
Role of the administrator:	Manage system
Offline use:	No
Who is responsible for the application management?	Premysl Kozuch
Notes and issues	

Table 54 RDF explorer

6.4.2 Services

For management of Geographic Metadata Micka will be used. Micka, developed by HSRS, is used as a metadata catalogue for SDI4Apps. MICKA is a complex system for metadata management (metadata creation, editing, storing, etc.) used for building SDI or geoportal solutions. It contains tools for editing and management of metadata for spatial information, web services and other sources (documents, web sites, etc.). It includes online metadata search engine, portrayal of spatial information and download of spatial data to local computer.

MICKA fully complies with the ISO 19115 standard. It can be integrated with map applications and it is multilingual. The web catalogue service uses OGC specifications (standards).

MICKA is compatible with obligatory standards for European SDI building (INSPIRE). Therefore it is ready to be connected with other nodes of prepared networked metadata catalogues (its compatibility with pilot European geoportal is continuously being tested).

Virtuoso is an innovative industry standards compliant platform for native data, information, and knowledge management. It implements and supports a broad spectrum of query languages, data access interfaces, protocols, and data representation formats that includes: SQL, SPARQL, ODBC, JDBC, HTTP, WebDAV, XML, RDF, RDFa, and many more.

Service ID:	S5.1
Name of the service:	Catalogue service
Service description:	Catalogue service allows search for OGC services (WMS, WFS, KML, WCS) GeJson services and map compositions
Supported functionality / capabilities:	CSW
Related apps:	A5.1, A5.2 A5.3
Timeplan for the development:	Implemented
Responsibility for the development:	Premysl Vohnout, Stepan Kafka
Detailed description of planned or already carried out testing:	The solution was tested
Service run by the SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	Basic CSW
Notes and issues	

Table 55 Open INSPIRE4YOUTH pilot service – Catalogue service

Visualisation services

Visualisation services are based on HSlayers NG engine. HSlayers NG is an online mapping library which operates in a web browser. It extends OpenLayers 3 functionality and takes some ideas from the original HSlayers library, but doesn't use Ext3 as the frontend javascript framework and is more lightweight in general. That's why the NG or "Next Generation" is added to its name. It is still under development and published under GNU/GPL licence version 3. HSLayers is built in a modular way which enables the modules to be freely attached and removed as far as the dependencies for each of them are satisfied. The dependency checking is done automatically.

- Map: The map functionality is provided by OpenLayers3 and extended by some controls like navigation bar, scale line, attribution dialog, GPS and compass tracking etc. It supports multi-touch gestures, but the performance is highly dependent on the browser and mobile device hardware so can be a bit slower than in native applications.
- Layer manager and legend: Layer manager (Figure 8) is used for listing all the map layers, displaying or hiding them and setting the transparency. The user can view layers metadata and attribution by clicking on it. A legend is fetched from the server and displayed in a

separate panel for all the wms layers on the map. Grouping of layers in containers is also provided which enables a more user friendly and organized representation of layers for

- OGC Web Services context parser: This is used for GetCapabilities requests to different map servers and parsing the response. It can then be used for automatic or user initiated generation of map layers only by knowing the URL to the specific OGC standardized map service.
- Query tool: This generates a GetFeatureInfo request for every WMS layer on the map and displays the list of features and their attributes at the specified coordinate. For vector layers the attribute list is generated directly on client side without server interaction.
- Search field: This provides a field for entering a name of a place and displaying a list of possible geographical names which begin with the phrase entered. Zooms the map to the place selected. It uses api.geonames.org service as the database, but in the future will be extended to different data sources.
- Print dialog: This is used for printing the map with the users' browser print dialogue. The printing is done completely on client side by using HTML5 canvas graphics enabling a good performance. For it to work WMS server has to be configured to have Access-Control-Allow-Origin header (CORS support).
- Permalink: This provides the user with a URL which describes the current map state and view enabling the sharing and bookmarking of different map compositions. It also serves as a URL API when using HSLayers NG applications in an iframe or similar embedded environment.
- Linked Open Data explorer: Eurostat explorer (Figure 9) is a demo application (module) which queries Semantic Web data sources via SPARQL endpoints. It demonstrates the feasibility of automatic query building for Eurostat report data and displaying it on a map of NUTS2 regions (specified in GeoJSON file) according to the calculated transparency ratios. On the server side it uses a Virtuoso Universal Server which is a middleware and database engine hybrid that combines the functionality of a traditional RDBMS, ORDBMS, virtual database, RDF, XML, free-text, web application server and file server functionality in a single system.
- Measurement tool: This provides the measurement of distances of polylines and areas of polygons in metric units.
- Panoramio layer and info panel: This is used mainly for touristic purposes (Figure 10). It creates a special layer which contains the thumbnails of scenic landscape photos from user generated and open database called "Panoramio". The photos are displayed in the place where they were taken. It uses Panoramios API, to get the most popular images in the current map extent. The number of images returned is dependent on the screen size of the users' device.

Service ID:	S5.2
Name of the service:	Visualisation services
Service description:	Visualisation services are basic tools for all three Apps
Supported functionality / capabilities:	Discovery and visualisation
Related apps:	A5.1, A5.2 A5.3
Timeplan for the development:	Implemented

Responsibility for the development:	Premysl Vohnout, Raitis Berzins
Detailed description of planned or already carried out testing:	The solution was tested
Service run by the SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	HS LAyers advanced API
Notes and issues	N/A

Table 56 Open INSPIRE4YOUTH pilot service - Visualisation services

Virtuoso

Virtuoso Universal Server is a middleware and database engine hybrid that combines the functionality of a traditional RDBMS, ORDBMS, virtual database, RDF, XML, free-text, web application server and file server functionality in a single system. Rather than have dedicated servers for each of the aforementioned functionality realms, Virtuoso is a "universal server"; it enables a single multithreaded server process that implements multiple protocols. The open source edition of Virtuoso Universal Server is also known as OpenLink Virtuoso. The software has been developed by OpenLink Software with Kingsley Uyi Idehen and Orri Erling as the chief software architects.

Core database engine

Virtuoso provides an extended object-relational model, which combines the flexibility of relational access with inheritance, run time data typing, late binding, and identity-based access. Virtuoso Universal Server database includes physical file and in memory storage and operating system processes that interact with the storage. There is one main process, which has listeners on a specified port for HTTP, SOAP, and other protocols.

Architecture

Virtuoso is designed to take advantage of operating system threading support and multiple CPUs. It consists of a single process with an adjustable pool of threads shared between clients. Multiple threads may work on a single index tree with minimal interference with each other. One cache of database pages is shared among all threads and old dirty pages are written back to disk as a background process. The database has at all times a clean checkpoint state and a delta of committed or uncommitted changes to this check pointed state. This makes it possible to do a clean backup of the checkpoint state while transactions proceed on the commit state.

Service ID:	S5.3
Name of the service:	Virtuoso
Service description:	Universal Server
Supported functionality / capabilities:	Management of RDF data
Related apps:	A5.1, A5.2 A5.3,A 5.4
Timeplan for the development:	Instaled

Responsibility for the development:	Premysl Vohnout, Raitis Berzins
Detailed description of planned or already carried out testing:	The solution was tested
Service run by the SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	Sparkl Queries
Notes and issues	N/A

Table 57 Open INSPIRE4YOUTH pilot service -Virtuoso

6.5 Cloud Properties

Pilot Open INSPIRE4YOUTH is using one virtual machine. It is deployed, configured and tested on Debian Linux operating system, but can run on any Linux Distro, or Windows machine. It is platform independent.

Cloud Property	Open INSPIRE4Youth Pilots Requirements
Operating system preferred for deployment of server-side services, and why?	Deployed, configured and tested on Debian Linux operating system, but can run on any Linux Distro, or Windows machine, platform independent
Can Ubuntu Linux 14.04 LTS be used as the operating system? Any objections against using it as the default operating system for deployment?	Yes
Requirements for data storage space in gigabytes.	>500 GB
Need for scalability of the application regarding the amount of stored data, the amount of data processing, the number of concurrent users, or anything else? (Scalability requirements make application design and development more complex and thus costly, but prepare the application for future success.)	Geoserver HSlayers NG Senslog

Table 58 Open INSPIRE4Youth pilot Cloud Property requirements

6.6 Use of the SDI4Apps Platform and other re-usable software

The pilot will use the infrastructure of the platform described in Open API.

6.7 Pilot Progress

The data collection process has started. The administrative borders and rivers have been downloaded from Open Street Map. Now the ontology for rivers and countries is being prepared. The scripts to transform the data into the proposed ontology now have to be prepared. After that we have initial data pool – we can start with the others activities that were outlined here. As iteration of development the applications need to be tested with the stakeholders to get their feedback.

6.8 Innovative aspects and benefits

The innovative is idea to provide the gaming tool based on LOD for the school audience.

6.9 Future outlook

The main focus will be on publishing data and preparation of Map Composition with different educational content. It is planned for Danube Hackathon. In next stage VGI tools will be implemented.

7 PILOT 6 ECOSYSTEM SERVICES EVALUATION

Demonstration of the potential of the Ecosystem Services Evaluation on top of available spatial data infrastructures.

7.1 PILOT DESCRIPTION

EcoSystem Services (ESS) represents the direct and indirect contributions of ecosystems to the human well-being. Action 5 of the EU Biodiversity Strategy to 2020 calls Member States to map and assess the state of ecosystems and their services in their national territory. Main ambition is to create the single web/mobile website/portal tool (human readable interface) allowing to raise awareness of the relevance of biodiversity and the ecosystem services and explain the complex concepts and benefits related to the Ecosystem services evaluation in simple way to the wider public. At the same time tool shall provide the domain experts with the possibility to create the zonal statistics from the outcomes of the ecosystem services evaluation and share related spatial data/services, documents (eg. Methodologies, or models) in connection to the work done via ESP visualisation tool, including the projects (e.g. MAES catalogue of case-studies) describing the particular implementations of ecosystem services. For machine readable interface, where possible appropriate API will be made available to strengthen the further reuse of the resources. Pilot aims to provide the common interface facilitating the access and exchange of the knowledge and resources related to the topic of ESS with the possibility to visualise the ecosystem services values for particular location of the interest.

Wider context

EcoSystem Services (ESS) represents the direct and indirect contributions of ecosystems to the human well-being. Action 5 of the EU Biodiversity Strategy to 2020 calls Member States to map and assess the state of ecosystems and their services in their national territory. Pilot aims to provide in connection to the Mapping and Assessment of Ecosystems and their Service (MAES) activities the common interface facilitating the access and exchange of the knowledge and resources related to the topic of ESS with the possibility to visualise the ecosystem services values for particular location of the interest on national level with the potential for re-use in other countries or for links to EU level. Pilot aims to address the challenges identified during the MAES Delivery Workshop organized in Brussels on 15-16 December 2015 particularly in area of:

- Strengthening and using the knowledge base on biodiversity and ecosystem services in order to contribute to halting biodiversity loss and reach the EU 2020 biodiversity target
- Where possible re-use the activities and their outcomes already done via ESP-VT and DRDSI and Openness projects.

There are various types and classifications of ES (e.g. The Economics of Ecosystems and Biodiversity (TEEB)). ESS evaluation represents one of the six pilots utilising the SDI4Apps framework, addressing identification of spatial representation of the outcomes of ESS evaluation with a focus on sustainable support of tourism and regional development.

7.2 USE CASES

There has been identified 3 possible use cases for ESS pilot:

1. Ecosystem services (ESS) portal
2. ESS utilisation for the evaluation of landscape potential to provide the recreational services
3. ESS in city environment

Use case ID:	UC6.1
Use case Title:	Ecosystem services portal (ESS portal)
Abstract:	Simple and unified responsive web application providing the possibilities to communicate, collect, search, display and access the ESS related data and information (documents, projects). In addition portal will allow users to create the zonal statistics from the outcomes of the ecosystem services evaluation.
User groups/stakeholders:	**Citizens:** Main objective of the portal will be to provide simple user interface for general public presenting the ESS in simple way using textual, map, graph and tabular presentation. **SMEs:** Their main motivation will be the possibility to access, extend and use additional and detailed ESS related items (datasets, methodologies, computation webprocessing functionality, projects, etc.) with the main objective to generate new data, services and other related added value with the market potential. **Public sector users:** Will use the portal mainly for the needs of spatial planning and area management related activities , including the support activities focused on awareness raising. **Research & Development (R&D) stakeholders:** Aiming to access interesting data to be used for development and implementation of the appropriate methodologies for ESS evaluation and stimulate the discussion towards the developing commonly agreed data standards.
Description (all the steps that will be done by the user):	Users will be splitted to the selected groups based on the particular projects and roles and their related rights. **Non registered user:** Will be able to search across the content provided by the portal including the API for resources with non restrictive licence conditions. **Registered user:** Can access for additional and detailed information items (datasets, methodologies, computation webprocessing functionality (possibility to create the zonal statistics from the outcomes of the ecosystem services evaluation), projects, usage / queries stats, etc.). At the same time this role will also allow to upload items into the portal and assign appropriate publishing options based on licence conditions. **Administrator:** Provides the full user's, content and functionality management.
How users are involved in the design and development process?	Users will be invited to cooperate on the design and development (initial possibility will be provided during the Baltic Open (Geo) Data Hackathon 2016) as well as during the testing of the pilot.
Criteria of success:	Launched portal, amount of available resource items and user stats.

Interoperation with other SDI4Apps pilots:	• Easy Data Access • Open Smart Tourist Data • Open Sensor Network • Open Land Use Map Through VGI • Open INSPIRE4Youth
Performance:	Standard user acceptable response and latency times for information retrieval of 2 seconds[12], measured as defined in D3.5 (Technical Test Methodology).
App ID:	A6.1
Notes and issues:	Portal shall also act as envelope for the ESS projects describing the particular implementations. Next two use cases depict such projects foreseen to be implemented within this pilot.

Table 59 Use Case 6.1

Use case ID:	UC6.2
Use case Title:	Ecosystem services utilisation for the evaluation of landscape potential to provide the recreational services (ESS Tourism)
Abstract:	Evaluation of the landscape potential for the provision of the recreational services based on location of interesting recreational features, analysis of the demand and offer for such recreational activities. This use case can act as one of the projects to be created, executed and maintained under the ESS portal. Use case could also facilitate the calculation on the fly the value of a ESS relevant for recreation, tourism within a selected feature (e.g. NUTS districts, protected sites, recreational areas etc.) and/or try to identify potential unused areas (brownfield) where the combination of landscape potential and ESS value can provide values applicable for recreational purposes.
User groups/stakeholders:	**SMEs:** Willing/planning to publish information about their interesting recreational services, features and interesting to see, what is the demand for such services in the particular area, including the access to the calculations execution. **Public sector:** Mainly for the needs of spatial planning and area management related activities. **R&D:** Aiming to access interesting data to be used for development and implementation of the appropriate methodologies for ESS evaluation as well as execute the calculations of ESS evaluation values.

	Citizens: Interesting to know, what can be be the particular recreational services for the particular area including their impact on the local ecosystem.
Description (all the steps that will be done by the user):	**SMEs:** Can register and provide the information about their interesting recreational services in addition to the information already provided by the website. In addition SME user can access the section of the website, where results and analytics of the queries from the users showing their preferences for particular area are accessible. Access to the calculation of th e Unregistered user can access certain type of information about the available recreational services, identified ESS and statistics for their demand. **Public sector:** User can register and save results of the use, plus where needed provide additional information needed to calculate the recreational ESS evaluations. Outcomes of this evaluation, can be consequently used in the development of the Plans as well as in the evaluation of the provision of the subsidies for particular activities of local, regional or national importance. Unregistered user can access certain type of information about the available recreational services, statistics for their demand and identified ESS. **R&D:** User can register and use, plus where needed provide additional information needed to calculate the recreational ESS evaluations. At the same time user can download, submit, test new data and methodology for the calculation of the recreational ESS evaluations. Outcomes can be used in the development of the new data and services, preparation of the new research publications as well as in improvement of the methodologies. Unregistered user can access certain type of information about the available recreational services, statistics for their demand and identified ESS including basic info about the available methodologies. **Citizens:** Registered users can access the detailed information about the interesting recreational services and identified ESS including their impact on the local ecosystem. They can evaluate and store their favourite services as well as their impact on the local ecosystem. Unregistered users can access basic information about the interesting recreational services including the simplified option to evaluate them. Public access will also provide filtered information about the identified ESS including their impact on the local ecosystem.

How users are involved in the design and development process?	Users will be invited to consult the description of the use cases, apps and selection of the data resources and related methodologies. Based on that next iteration of the pilot will be developed and provided for the consultation.
Criteria of success:	Amount of published evaluated ESS, and related methodologies, user stats.
Interoperation with other SDI4Apps pilots:	• Easy Data Access • Open Land Use Map Through VGI • Open Smart Tourist Data • Open INSPIRE4Youth
Performance:	Sufficient performance to support the data processing during the calculation of the ESS evaluation.
App ID:	A6.1
Notes and issues:	Foreseen input datasets: Copernicus, INSPIRE, ZB-GIS, Open Street Map. DTM SR, SlovStat (statistical database for demography, recreation), Open Data portal. Data from relevant projects (e.g. OpenTransportNet, Foodie, DRDSI, etc.)

Table 60 Use Case 6.2

Use case ID:	UC6.3
Use case Title:	Ecosystem services in city environment (ESS Urban)
Abstract:	Utilisation of the ESS for the evaluation of the quality of life in urban city. This use case can act as one of the projects to be created, executed and maintained under the ESS portal.
User groups/stakeholders:	As in UC 6.2 with focus on urban ESS
Description (all the steps that will be done by the user):	Users will be splitted to the selected groups based on the particular projects and roles and their related rights. **Non registered user:**

	Will be able to search across the outcomes of the ESS evaluation of the city environment and underlying information, including the statistics. **Registered user:** Can access and download the outcomes of the ESS evaluation including the possibility to provide additional and detailed information.
How users are involved in the design and development process?	Users will be invited to consult the description of the use cases, apps and selection of the data resources and related methodologies. Based on that first iteration of the pilot will be developed and provided for the consultation.
Criteria of success:	Amount of published evaluated ESS, and related methodologies, user stats.
Interoperation with other SDI4Apps pilots:	• Easy Data Access • Open Sensor Network • Open Land Use Map Through VGI
Performance:	Sufficient performance to support the data processing during the calculation of the ESS evaluation.
App ID:	A6.1
Notes and issues:	Foreseen input datasets: Copernicus, INSPIRE, ZB-GIS, Open Street Map. DTM SR, SlovStat (statistical database for demography, recreation), Open Data portal. Data from relevant projects (e.g. OpenTransportNet, Foodie, DRDSI, etc.)

Table 61 Use Case 6.3

7.3 USER ENGAGEMENT

At this moment, the main user demand comes from research and public sector domain, mainly from authorities involved into the activities related to the implementation of the Action 5 of the EU Biodiversity Strategy to 2020.

When completed by the 2020 target, the mapping and assessment of ecosystems and their services , and the valuation and accounting work will allow public decision - makers and private - sector stakeholders to better understand how our economy and society depend on healthy, resilien t and productive ecosystems and to ensure that interdependencies between human activities and ecosystem condition are adequately taken into account in planning and decision making at all levels.

At the same time methodologies and input and output data can be of wide use also for the national and local activities driven by the non-governmental sector aiming to improve the quality of the life as well as strengthen the governance transparency via participative approach (Open government participation OGP).

7.3.1 Identified and involved stakeholders

Based on preliminary investigations and initial interaction with the actors involved in the Slovakian MAES activities, following stakeholders have been identified:

- CETIP network (Centrum transdisciplinárnych štúdií inštitúcií, evolúcie a politík - CETIP)
- Constantine the Philosopher University in Nitra (Univerzita Konštantína Filozofa v Nitre - UKF)
- Comenius University in Bratislava (Univerzita Komenského v Bratislave UK)
- Ministry of Environment of the Slovak Republic (Ministerstvo životného prostredia Slovenskej republiky - MZP SR)
- Ministry of Transport, Construction and Regional Development of the Slovak Republic (Ministerstvo dopravy, výstavby a regionálneho rozvoj
- a Slovenskej republiky - MDVRR SR)
- National forest centre (Národné lesnícke centrum - NLC)
- Pronatur (Civil Association - Pronatur)
- Slovak academy of science (Slovenská akadémia vied - SAV)
- Slovak environment agency (Slovenská agentúra životného prostredia - SAZP)
- Slovak water management enterprise (Slovenský vodohospodársky podnik - SVP)
- Slovak hydrometeorological institute (Slovenský hydrometeorologický - (SHMÚ)
- Soil Science and Conservation Research Institute (Výskumný ústav pôdoznalectva a ochrany pôdy - VÚPOP)
- State Nature Conservancy of the Slovak Republic (Štátna ochrana prírody Slovenskej republiky - ŠOP SR)
- Technical University in Zvolen (Technická univerzita vo Zvolene - TUZVO)

Stakeholders	UC7.1 - ESS portal	Use Case UC7.2 – ESS Tourism	Use Case UC7.3 – ESS in city/urban environment	Roles
Public bodies	UKF, UK, MZP SR, MDVRR SR, NLC, SAV, SAZP, SVP, SHMÚ, VÚPOP, SOP SR, TUZVO	SAZP, MZP SR, MDVRR SR, VUPOP, UKF, SAV, NLC, UK	UKF, SAZP, MDVRR SR	Users, Policy Decision Makers, Possible funders to continue the service.
NGOs	ProNatur	ProNatur		Users, Data providers, New Apps and services

SMEs, Enterprises and Companies	CETIP e-PRO	CETIP e-PRO		Users, Data providers
Citizens	Anyone	Tourists and visitors	All People interested in their local urban communities and activities	Users, Data Providers

Table 62 Stakeholder engagement methods and conditions for the successful sustainability

Stakeholders have been engaged in the project using Social Validation/Co-design meetings and discussions with the SK MAES representatives and some additional experts in the field. They have been provided with initial set of possible use cases, which were ranked and those selected to be supported further on. They will be also invited to contribute the shaping the tool directly via stakeholders events (Baltic Open Geo Hackathon) as well as regularly during the development iterations. Important precondition for the sustainable and successful interaction with the stakeholders is the clear and regular interaction ensuring the users' requirements are confronted with their understanding by the development and implementation team.

7.3.2 User requirements

Process of user requirements collection for the second version of the ESS pilot was initiated during the dedicated Workshop taking place in Bratislava on the 10th of December 2015, where the representatives of the stakeholders identified in chapter 7.3.1. took place. Results of this workshop were collected via workshop report. At the same time, taking into the consideration the need to cope with the complex domain, user requirements will be checked and revised also during the next phases, ensuring the common understanding between users as well as developers took proper space.

7.3.3 Users who validate the final apps

Except of the stakeholders identified in 7.3.1. testing and validation is foreseen to be promoted during the suitable events (hackathons, workshops, conferences) organised in the within the lifespan of the project.

7.3.4 Business plan- market potential

Although pilot is mainly addressing public and R&D sector, there still remains the room for commercial and market potential. This lays particularly in the area of the geo-information support for the data collection, processing and publication. Detailed options for further stimulation to increase the possible business potential will be investigated in line with the business modeling activities.

7.4 DATA ACQUISITION

7.4.1 Datasets

Following datasets and repositories are going to be taken into the consideration for the further development:

Dataset ID:	DS6.1
Resource title:	Corine land cover
Resource abstract:	Dataset containing the land cover of Slovakia from 2006
Geographical coverage:	Slovakia
Level of detail:	1:50 000
Resource locator:	http://geoportal.gov.sk/sk/cat-client/detail.xml?uuid=877f18bc-31e8-4d42-83aa-159e33a598e3&serviceId=1 https://data.sazp.sk/dataset/sk-ld-inspire-corine-land-cover
Restrictions/Licences:	CC-BY
Format:	ESRi shapefile, RDF
Transformation:	In case of RDF transformation based on SmOD INSPIRE Vocabularies https://www.w3.org/2015/03/inspire/
Ready to use:	yes
Size:	50MB
Data acquisition:	Transformation via OpenDataNode
Notes and issues	

Table 63 Data Set 6.1

Dataset ID:	DS6.2
Resource title:	Protected sites
Resource abstract:	Dataset containing INSPIRE protected sites of Slovakia
Geographical coverage:	Slovakia

Level of detail:	1:10 000
Resource locator:	http://geoportal.gov.sk/sk/cat-client/detail.xml?uuid=5eb1af82-3b9d-409e-b4f5-cb7a026977b9&serviceId=1 https://data.sazp.sk/dataset/sk-ld-inspire-protected-sites
Restrictions/Licences:	CC-BY
Format:	GML, RDF
Transformation:	In case of RDF transformation based on SmOD INSPIRE Vocabularies https://www.w3.org/2015/03/inspire/
Ready to use:	Yes
Size:	40 MB
Data acquisition:	Transformation via OpenDataNode
Notes and issues	

Table 64 Data Set 6.2

Dataset ID:	DS6.3
Resource title:	Urban Atlas
Resource abstract:	The Urban Atlas is providing pan-European comparable land use and land cover data for Large Urban Zones with more than 100.000 inhabitants as defined by the Urban Audit.
Geographical coverage:	Europe
Level of detail:	1:10 000
Resource locator:	http://www.eea.europa.eu/data-and-maps/data/urban-atlas
Restrictions/Licences:	EEA standard re-use policy: unless otherwise indicated, re-use of content on the EEA website for commercial or non-commercial purposes is permitted free of charge, provided that the source is acknowledged

	(http://www.eea.europa.eu/legal/copyright). Copyright holder: Directorate-General Enterprise and Industry (DG-ENTR), Directorate-General for Regional Policy.
Format:	SHP
Transformation:	Compiled from thousands of pictures from European satellites, Urban Atlas provides sufficient coverage for detailed and cost-effective mapping of larger urban zones, yielding accurate land cover and usage data. Urban Atlas' mission is to provide high-resolution hotspot mapping of changes in urban spaces and indicators for users such as city governments, the European Environment Agency (EEA) and European Commission departments. More than 300 major cities in the EU will be covered by early 2011. More details can be found in the Mapping Guide (see section: Methodology) CRS transformation EPSG:3035 to EPSG:4326
Ready to use:	yes
Size:	160 MB
Data acquisition:	2005-2007
Notes and issues	

Table 65 Data Set 6.3

Dataset ID:	DS6.4
Resource title:	Open Street Map
Resource abstract:	OpenStreetMap is a map of the world, created by people like you and free to use under an open license.
Geographical coverage:	Global
Level of detail:	GPS accuracy
Resource locator:	http://www.openstreetmap.org/#map=7/49.099/16.227
Restrictions/Licences:	OpenStreetMap is *open data*: you are free to use it for any purpose as long as you credit OpenStreetMap and its contributors. If you alter or build upon

	the data in certain ways, you may distribute the result only under the same licence.
Format:	SHP
Transformation:	No CRS transformation needed
Ready to use:	Yes
Size:	27 MB
Data acquisition:	
Notes and issues	

Table 66 Data Set 6.4

Dataset ID:	DS6.5
Resource title:	LUCAS (2012)
Resource abstract:	LUCAS stands for the Land Use and Coverage Area frame Survey. EUROSTAT has carried out this survey every 3 years since 2006 to identify changes in land use and cover in the European Union. LUCAS surveys are carried out in situ; this means that observations are made and registered in the field all over the EU. The latest published LUCAS survey dates from 2012 and covers all the then 27 EU countries and observations at more than 270 000 points.
Geographical coverage:	EU
Level of detail:	Point measurements
Resource locator:	http://ec.europa.eu/eurostat/web/lucas/data/primary-data/2012
Restrictions/Licences:	No restrictions
Format:	XLS
Transformation:	No CRS transformation needed

Ready to use:	Yes
Size:	55 MB
Data acquisition:	2012
Notes and issues	

Table 67 Data Set 6.5

Dataset ID:	DS6.6
Resource title:	SK Open Land Use
Resource abstract:	Open Land Use Map is a composite map that is intended to create detailed land-use maps of various regions based on certain pan-Europen datasets such as CORINE Landcover, UrbanAtlas enriched by available regional data.
Geographical coverage:	Slovakia
Level of detail:	1:10 000 - 1:100 000
Resource locator:	http://app.hslayers.org/open_land_use_sk/
Restrictions/Licences:	CC-BY
Format:	GML
Transformation:	Transformation based on Open Land Use transformation methodology from D7.4 GI INNOVATION WHITE PAPER II: DATA HARMONIZATION, INTEROPERABILITY & LICENSING IN OPEN TRANSPORT NET
Ready to use:	Yes
Size:	
Data acquisition:	Based on the transformation build on top of DS6.1, DS 6.3, DS6.4 and DS 6.5
Notes and issues	
Dataset ID:	DS6.6
Resource title:	SK Open Land Use

Resource abstract:	Open Land Use Map is a composite map that is intended to create detailed land-use maps of various regions based on certain pan-Europen datasets such as CORINE Landcover, UrbanAtlas enriched by available regional data.
Geographical coverage:	Slovakia
Level of detail:	
Resource locator:	http://app.hslayers.org/open_land_use_sk/
Restrictions/Licences:	CC-BY
Format:	WMS, WFS
Transformation:	Transformation based on Open Land Use transformation methodology from D7.4 GI INNOVATION WHITE PAPER II: DATA HARMONIZATION, INTEROPERABILITY & LICENSING IN OPEN TRANSPORT NET
Ready to use:	Yes
Size:	
Data acquisition:	Based on the transformation build on top of DS6.1, DS 6.3, DS6.4 and DS 6.5
Notes and issues	

Table 68 Data Set 6.6

Dataset ID:	DS6.7
Resource title:	Ecosystem services: Wood (Paper pulp) production
Resource abstract:	Layer providing information about the average value of forest growth in particular type of forest per year.
Geographical coverage:	Slovakia
Level of detail:	1:100000
Resource locator:	http://147.251.252.167:8080/geoserver/web/?wicket:bookmarkablePage=:org.geoserver.web.demo.MapPreviewPage
Restrictions/Licences:	CC-BY

Format:	geoTiff
Transformation:	Based on ESS transformation (http://sdi4apps.eu/project-information/pilot-applications/pilot-6-ecosystem-services-evaluation/)
Ready to use:	Yes
Size:	40 MB
Data acquisition:	Layer was created on the top of the Corine Landcover 2006, where forest categories were evaluated based on Corine classification. (Coniferous forest, deciduous forest, mixed forest). Individual cells of the layers were assigned with average value of forest growth in this type of forest per year.
Notes and issues	

Table 69 Data Set 6.7

Dataset ID:	DS6.8
Resource title:	Ecosystem services: Number of livestock per hectare of pasture
Resource abstract:	Layer represents the number of livestock grazing on one hectare in a given district.
Geographical coverage:	Slovakia
Level of detail:	1:100000
Resource locator:	http://147.251.252.167:8080/geoserver/web/?wicket:bookmarkablePage=:org.geoserver.web.demo.MapPreviewPage
Restrictions/Licences:	CC-BY
Format:	geoTiff
Transformation:	Based on ESS transformation (http://sdi4apps.eu/project-information/pilot-applications/pilot-6-ecosystem-services-evaluation/)
Ready to use:	Yes
Size:	35 MB

Data acquisition:	Layer was formed as a combination of statistical data number of animals in the various districts of the Slovakia and suitable pastures for grazing livestock.
Notes and issues	

Table 70 Data Set 6.8

Dataset ID:	DS6.9
Resource title:	Ecosystem services: Carbon sequestration
Resource abstract:	Layer defines the volume of CO2 sequestration in the country by tons per year.
Geographical coverage:	Slovakia
Level of detail:	1:100000
Resource locator:	http://147.251.252.167:8080/geoserver/web/?wicket:bookmarkablePage=:org.geoserver.web.demo.MapPreviewPage
Restrictions/Licences:	CC-BY
Format:	geoTiff
Transformation:	Based on ESS transformation (http://sdi4apps.eu/project-information/pilot-applications/pilot-6-ecosystem-services-evaluation/)
Ready to use:	Yes
Size:	75 MB
Data acquisition:	Layer was created by assessing landscapes types according the Corine Landcover and assignment of values of CO2 sequestration for particular land type.
Notes and issues	

Table 71 Data Set 6.9

Dataset ID:	DS6.10
Resource title:	Ecosystem services: Landscape quality from tourism perspective

Resource abstract:	Layer expresses potential of the area for tourism.
Geographical coverage:	Slovakia
Level of detail:	1:100000
Resource locator:	http://147.251.252.167:8080/geoserver/web/?wicket:bookmarkablePage=:org.geoserver.web.demo.MapPreviewPage
Restrictions/Licences:	CC-BY
Format:	geoTiff
Transformation:	Based on ESS transformation (http://sdi4apps.eu/project-information/pilot-applications/pilot-6-ecosystem-services-evaluation/)
Ready to use:	Yes
Size:	38 MB
Data acquisition:	Layer was evaluated as summary of areas and points potentially interesting for tourism. As inputs connected layers of protected areas evaluated according to their relevance were used. Taking into the consideration legal access restrictions (eg. Restricted access to some small scale protected areas with the highest level of protection). In addition areas suitable for tourism (eg. large water dams and local objects significant for tourism as castles, caves and another important cultural, landscape and natural sites) have been also added as imput to the layer. The areas with the highest ratings (values) are the best from the tourism perspective.
Notes and issues	

Table 72 Data Set 6.10

Dataset ID:	DS6.11
Resource title:	Ecosystem services: Biodiversity
Resource abstract:	Layer reflects the quality of the territory in terms of biological diversity.
Geographical coverage:	Slovakia
Level of detail:	1:100000

Resource locator:	http://147.251.252.167:8080/geoserver/web/?wicket:bookmarkablePage=:org.geoserver.web.demo.MapPreviewPage
Restrictions/Licences:	CC-BY
Format:	geoTiff
Transformation:	Based on ESS transformation (http://sdi4apps.eu/project-information/pilot-applications/pilot-6-ecosystem-services-evaluation/)
Ready to use:	Yes
Size:	30MB
Data acquisition:	The layer was created from layers of qualitative assessment of occurrence approx. 250 selected protected species and their mutual overlay. The areas with the highest ratings (values) are the best in the biodiversity.
Notes and issues	

Table 73 Data Set 6.11

Dataset ID:	DS6.12
Resource title:	Ecosystem services: Overall assessment
Resource abstract:	Layer defining the landscape quality from the perspective of the provision of selected ecosystem services.
Geographical coverage:	Slovakia
Level of detail:	1:100000
Resource locator:	http://147.251.252.167:8080/geoserver/web/?wicket:bookmarkablePage=:org.geoserver.web.demo.MapPreviewPage
Restrictions/Licences:	CC-BY
Format:	geoTiff
Transformation:	Based on ESS transformation (http://sdi4apps.eu/project-information/pilot-applications/pilot-6-ecosystem-services-evaluation/)

Ready to use:	Yes
Size:	40MB
Data acquisition:	Layer is the result of the overlay of the normalized ecosystem services related layers (DS 6.7 - DS 6.10).
Notes and issues	
Dataset ID:	DS6.12 ESS Overall assessment
Resource title:	
Resource abstract:	
Geographical coverage:	Slovakia
Level of detail:	Various
Resource locator:	http://147.251.252.167:8080/geoserver/web/?wicket:bookmarkablePage=:org.geoserver.web.demo.MapPreviewPage
Restrictions/Licences:	CC-BY
Format:	geoTiff
Transformation:	
Ready to use:	
Size:	Based on particular resource
Data acquisition:	
Notes and issues	

Table 74 Data Set 6.12

7.4.2 Data Models

Based on the input dataset and desired target output data, relevant models will be identified and used. For INSPIRE compliance relevant data models and appropriate data specifications will be

used. For linked data transformations SmOD INSPIRE Vocabularies as well as other relevant models will be used.

7.5 APPS AND SERVICES

For time being only one application is going to be developed. For the services there will be available published services from Geoserver.

7.5.1 User App

Application ID:	A6.1
Name of the app:	Ecosystem services portal
Application description:	Simple and unified responsive web application providing the possibilities to communicate, collect, search, display and access the ESS related data and information (documents, projects). In addition portal will allow users to create the zonal statistics from the outcomes of the ecosystem services evaluation.
Supported functionality / capabilities:	• User registration and maintenance • Possibility to upload, store and maintain resources • Transformation of the spatial data resources • Data processing and calculations (e.g. Zonal statistics) • Publication of the resources (via webinterface of CMS, via web services, API)
Related services:	S6.1
Datasets required	DS6.1 – DS6.6
Timeplan for the development:	First mock up of second version by April 2016
Responsibility for the development:	Martin Tuchyna (SAZP) Jakub Kočica, Marek Hubáček (Pronatur) Tomáš Kliment, Ivan Mojsej (E-PRO)
Main updates:	• Content management system CMS • User management system • Storage for resources for spatial (vector, gridded data) and non spatial (documents, media) resources. Storage shall support relational and semantic store options • Transformation component

	• Processing/Calculation component • Publication component

Detailed description of planned or already carried out testing:	• Re-use or development of the web interface of the ESS Portal
	• Design and implementation of processing functionality supporting the mapping ESS and calculating the zonal statistics as an outcomes of the ESS evaluation
	• Possible use cases for the ESS projects to be provided as initial case-studies:
	  ○ ESS utilisation for the evaluation of landscape potential to provide the recreational services
	  ○ ESS in city/urban environment

Role of the user:	• Using application and data • Providing data, feedback and proposals
Role of the administrator:	To manage the application development and maintenance
Offline use:	No
Who will be responsible for the application management?	Martin Tuchyna (SAZP)
Notes and issues	

Table 75 Application 6.1

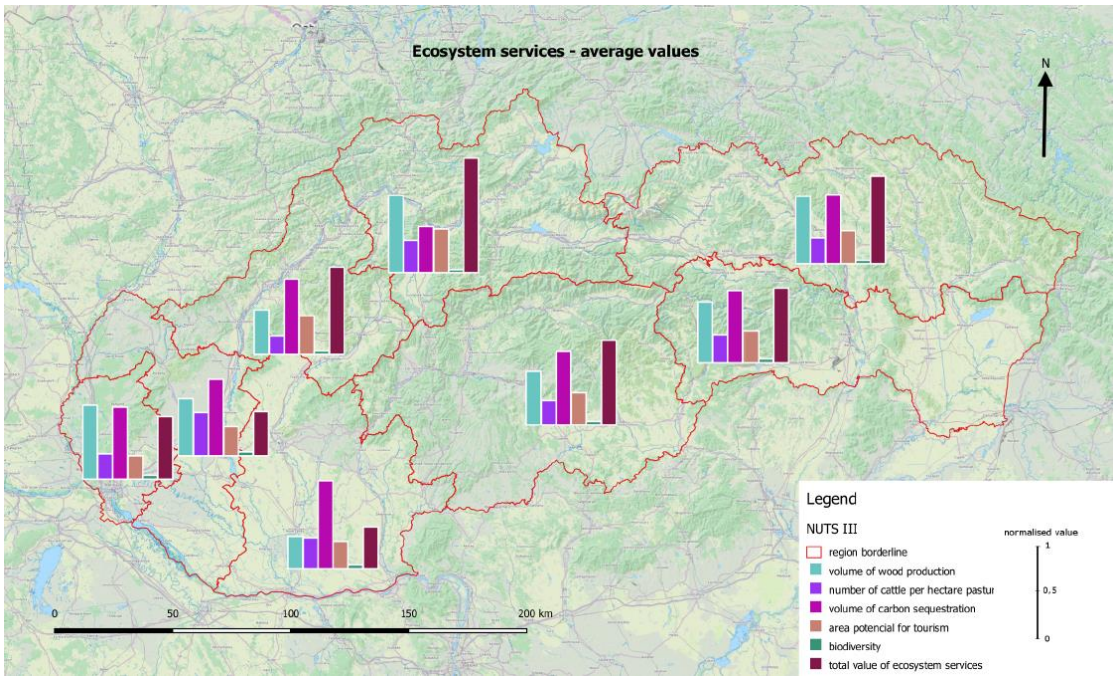


Figure 45 Example of zonal statistics from the outcomes of the ecosystem services evaluation

7.5.2 Services

Service ID:	S7.1
Name of the service:	WMS/WCS service for Ecosystem service pilot
Service description:	An OGC Web map services providing the machine readable access to the particular ecosystem services layers, including overall assessment of ecosystem services value layer.
Supported functionality / capabilities:	Visualisation, overlay
Related apps:	A7.1
Timeplan for the development:	First mock up of second version by April 2016
Responsibility for the development:	Martin Tuchyna (SAZP) Jakub Kočica, Marek Hubáček (Pronatur) Tomáš Kliment, Ivan Mojsej (E-PRO)
Detailed description of planned or already carried out testing:	As with A7.1
Service run by the SDI4Apps platform?	Yes
Use of OpenAPI functionality: basic and advanced	Yes
Notes and issues	

Table 76 Service 6.1

7.6 Cloud Properties

ESS pilot is deployed using 4(+1) virtual machines with the same technical parameters (2x CPU, 8GB memory, 100GB HDD) as follows:

- Web GIS server: GeoServer open source (machine name: sdi4apps_sazp_geoserver) + planned for testing Mapserver (name:)
- Web Server: Running the front end OL3 application (name: sdi4apps_sazp_ol3)
- DB server: Running DBMS Postgres XL (name:sdi4apps-postgresxl)
- Metadata catalogue: Runnning Geonetwork opensource catalogue application (name: smopda_sazp_geonetwork3).

7.7 Use of the SDI4Apps Platform and other re-usable software

The SDI4Apps Platform Enablers that are currently being used by the Easy Access Apps are:

- SDI4Apps Cloud Platform providing an Ubuntu VM for each service.
- PostGres XL clustered database for integration of mobile apps.
- Open Layers

From the ISA activities:

- GeoDCAT-AP via
  - GeoDCAT-AP XSLT
  - GeoDCAT-AP API source code
  - GeoDCAT-AP API demo
  - GeoDCAT-AP implementations
- LD proxy: WFS2LD

7.8 Pilot Progress

Main activities from the November 2015 were focused on the interaction with the stakeholders with the intention to narrow down the user requirements. At the same time further data processing work have been done, as well as identification of the most suitable enablers and other software components.

7.9 Innovative aspects and benefits

Pilot will have an ambition to present the resources and their derivations related to the ESS activities via new innovative approach. At the same time, effort will be done to implement certain outcomes of the Interoperability solutions for European public administration initiative ISA[2] and Danube reference data and service infrastructure DRDSI. Where possible pilot will reflect the latest outcomes of the INSPIRE Maintenance and implementation framework.

7.10 Future outlook

Future development of the pilot will focus on closer coverage of the stakeholder's requirements as well as tighter re-use of the SDI4Apps enablers. These will include mainly support for the user and data management, better visualisation, stronger support for the web processing services and enrichment of the pilot with the linked data dimension. Portal solution including the possibility to create the zonal statistics fully based on cloud environment is also foreseen to be developed within the next period.

Further progress will be regularly updated also via dedicated pilot website: http://sdi4apps.eu/project-information/pilot-applications/pilot-6-ecosystem-services-evaluation/

8 CONCLUSION

During two years of SDI4Apps project, Pilots have been developed from set of ideas to actual solutions. Open minded approach of pilot development does not limit Pilots in the initial plan, but allows progress of use cases. Thanks to the ongoing development and adjustments Pilots are becoming more and more representative of needs and interests of stakeholders as well as demonstrate wider range of SDI4Apps Platform's possibilities and SDI4Apps platform possibilities.

At this stage of project in six pilots' altogether ten SDI4Apps framework demonstration applications have been deployed:

- European Tourism Indicator System (ETIS) service stakeholder crowdsourcing
- Potential Monuments Ground Truthing
- Smart Points of Interest publication
- Open Smart Tourist Crowdsourcing
- Open Smart Advertisement
- *IoT discovery*
- IoT view
- *Open Land Use*
- *Map Composer*
- *Thematic Map Viewer*
- Ecosystem Services Portal.

Applications that are launched for external use allow to actively execute social validation that can be used for checking that users are satisfied with what has been done and to plan further improvements. Already organised Hackathons were good basis for pilot demonstrations, attraction of external users, feedback collection and promotion of created solutions.

Last year for SDI4Apps project Pilots has been very productive in terms of specifying user requirements, updating functionality and data collecting and integrating. Pilot 1 and Pilot 6 have focused on services demonstrations and updates according to user requirements. Both Pilot 1 and Pilot 6 have actively engaged stakeholders in Social Validation/ Co- design meetings and discussions. Pilot 2 has focused on data amount and data sources extensions as well as on Pilot promotion. Pilot 2 has increased number of data sets from two to six comparing with initial stage of pilot development (described in D6.1) and accordingly has faced and solved many issues regarding data acquisition, conversations, filtering and different licencing. During last six months Pilot 3 has improved SensLog data model and worked on more active use of SDI4Apps cloud. Pilot 4 focused on the development of Use case 4.1- Preparation of basic regional Land Use Maps- finalizing work on Czech Open Land Use map and publishing Latvian Open Land Use map and Slovak Open Land use map. Regarding pilot 5 now the data collection has started and main pilot functionalities are updated.

In second year of the project created Pilot Applications have been tested by internal and external users as discussed in D.2.2.