ENV-e-CITY: Environmentally Viable Electronic City

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Abstract

The objective of project ENV-e-CITY is to develop an on-line application for environmental information related services. The e-content domain extends over four application areas: air emission, air quality, topography and meteorology. The application framework to be developed includes metadata structures for all application areas, export and import filters, interfaces and various e-content basic services. The user community of the platform envisaged consists of city authorities, consultants involved in environmental impact assessment studies and citizens desiring valid information on the state of the environment. An electronic market place for the e-content itself and the services is also envisaged.

1. Introduction

The public sector information “industry” has been using non-negligible funds to support the “production” of information that serve the citizens while supporting authori-
ties and various decision making bodies in their administrative tasks. This information corpus, produced on the basis of various legislative mandates, is usually disposed to a physical or electronic archive, which is rarely revisited and re-used, although it represents a considerable public investment. Environmental information is among the major players in this field, as it correlates to all the parameters of human life in an organized urban environment. An illustrative example may be sketched on the basis of the so called “Framework Directive 96/62/EC” on ambient air quality assessment and management, that city authorities are obliged to comply with. This obligation is accompanied by the mandate for the provision of reports to the EU via the European Environment Agency (EEA) and includes specific monitoring and reporting actions to be taken from cities of size of more than 250,000 inhabitants. This “new generation” of legislation underlines the need for an efficient environmental assessment, which can be achieved only on the basis of efficient environmental data access, management, dissemination and re-usage at an urban scale. These data are often unavailable for the majority of EU cities, making them ideal nominates for an ENV-e-CITY like application.

2. The ENV-e-CITY project basics

The ENV-e-CITY* project aims at improving access to and use of public sector information, and more specifically environment-related information, by creating an online broker application for environment information related services. The project objective is to create a modular framework for metadata definition and data collection and management, regarding a digital content application on urban environment. This framework consist of a theoretical model, which will be based on existing standards regarding the collection and management of environmental information and related meta-information. This structure will support the creation and operation of added-value services, to be developed as tailored applications “over basic services”, i.e., basic services as well as metadata will be provided by a non or low cost basis, while added-value services and detailed data on top of this core will be granted on a commercial basis. Some added-value services can be implemented during this project, but the main task will be to design and implement interfaces which will allow the linkage of other e-content services to the ENV-e-CITY application.

The project will make use of four pilot application areas as the e-content domain:

Air emissions, air quality, topography data and meteorology. These areas will serve

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as the backbone for e-content basic services, named tools. The latter will consist of Air Quality Models, Environmental Impact Assessment procedures, and other electronic tools aiming at:

1. Serving the application of the EU legal framework regarding environmental monitoring, management and reporting,
2. Serving the local application of policies and strategies at the urban scale,
3. Providing information access towards citizens and
4. Providing environmental e-content for other e-content services and applications.

The ENV-e-CITY project will serve as a shell for hosting and organising all available emission, air quality, topographical and meteorologically related information in a multi-layer way. Data collection and management will be based on a “complete” meta-data structure rather a raw-data access application. The application framework to be developed will combine:

1. A core meta-database of emission, air quality, topographical and meteorological information,
2. Export and import filters (including data/meta-data interchange protocols, like XML and RDF)
3. Search functions and interfaces and
4. Tools/wizards

Since the content description and information regarding data has proven error-prone and close to impossible to implement, a metadata architecture will be developed, that manages metadata about contents and sources and delegates the actual data handling of raw data to the respective data management functions. Dedicated synchronisation strategies will be developed to keep the consistency of the central information server at a sensible level of accuracy.

In addition, ENV-e-CITY aims to target commercial content providers. ENV-e-CITY is not limiting its approach to non-profit organisation in public-private ownership, but also strives to design new information services that can be sold in horizontal or vertical markets. Weather information accompanied by content services for level of comfort, tailored to specific regional requirements in tourism, is a well cited example service. Other services will be employed by news stations, as unique selling points.

On the basis of the above, the ENV-e-CITY project site has been developed, providing the main entry point for project related information and for project work results acting as an “antechamber” for the ENV-e-CITY portal (Figure 1). The project portal is now at the user requirements finalisation status, while some mock-ups have been produced to demonstrated the possible look and feel of the project web-based application (Figure 2).
Fig. 1: The ENV-e-CITY official project site.

Fig. 2: A mock-up of the ENV-e-CITY web-based application.
3. Architecture

The project architecture will be based on the definition of the metadata scheme for organising information about available data and services, many of them with spatial and temporal references. The database ought to support interactive data discovery by the user as well as access by visualisation tools and applications.

The market situation in the environmental domain will require a distributed architecture. Not only the sheer amount of data and capacity needed for the services prevents a centralised solution. Also the requirement of the suppliers to keep their data and services at their site (under their control and maintenance) makes it necessary to find a way to integrate them not physically at one location but in the sense of a broker by linking them via meta information at one central meta-database. Thus, the core of the broker architecture will be a database maintaining information about data and services accessible via the system. This includes all common metadata about data and services like owner, creation date, formats, comments, parameters, access types and the like. Services offered by the broker system will include export from data sources (partly protected access), import to data source (protected access), general administration interface for overall system services, access to basic services (low cost or free access) and access to added value services. Main differences between basic services and added value services are:

<table>
<thead>
<tr>
<th>Basic services</th>
<th>Added value services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide navigational and non marketable functions for customers</td>
<td>Provide services of high commercial value to customers</td>
</tr>
<tr>
<td>Probably non-customisable</td>
<td>Customisable</td>
</tr>
<tr>
<td>Operated by the broker operator</td>
<td>Operated by external partners or by the broker operator based on fees</td>
</tr>
<tr>
<td>Are directly related to the ENV-e-CITY content</td>
<td>May be accomplishing ENV-e-CITY services in different ways (e.g., computing, layout, printing, postal, law, or other consulting services)</td>
</tr>
<tr>
<td>Attract customers</td>
<td>Bind customers</td>
</tr>
</tbody>
</table>

The broker system will therefore represent a docking station where additional services can be linked by clearly defined interfaces (Figure 3).
4. Platform implications

In regard to the services that ENV-e-CITY needs to implement, possible ways to separate the request mechanism and the backend via the use of a middle tier (e.g. a servlet interface) have been investigated. The basic development philosophy to be used underlines the need to focus primarily on this interface, where all backends would “plug-in”, while additional applications should be developed as backend wrappers by using the API provided by the middle tier. That benefits the application as it provides the advantage of being able to base components in different geographical locations with the technical coordinators remaining in charge (hosting and administering) of the middle tier.

Therefore, there are several design options to implement such a broker platform. One solution for Internet applications is a distributed client-server architecture for transparent integration (and thus added value by integration) of diverse and distributed information resources, complex and powerful assessment tools such as models, and expert systems for assessment (spatial interpolation, multi-criteria comparison, ranking and benchmarking).

Several strategies, architectures and platforms for web services are available (most notably Microsoft .NET, Sun ONE, IBM Web Services), all basically consisting of a set of three XML applications (King, 2001):

- UDDI (Universal Description, Discovery, and Integration)
- SOAP (Simple Object Access Protocol)
- WSDL (Web Service Description Language)

In addition to these three basic standards, a proliferation of side protocols and XML applications raised. This led to an effort to combine all these into one major framework to specify an XML based data and business process exchange over the Internet, called ebXML (e-business XML). ebXML defines core components, business processes, registry and repository, messaging services, trading partner agreements, and security.

To enable services on the ENV-e-CITY platform the service providers have to adapt their applications concerning design, scale, interface technology as well as architecture for remote invocation. The link-up of these applications to ENV-e-CITY has major advantages: first of all, web service based implementations are not only limited to the project platform, but can also be reused in other environments. In addition, the protocol is independent from the transport media, programming language and operating system making them an ideal nominee for distributed development in heterogeneous, networking environments. Finally, it also allows service and data providers to keep control over their services, because all services can be hosted on the respective provider machines.

An example of various technologies currently being investigated to be used in the project follows:

<table>
<thead>
<tr>
<th>System components</th>
<th>Technologies-tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating system</td>
<td>Debian GNU/Linux</td>
</tr>
<tr>
<td>Database</td>
<td>PostgreSQL</td>
</tr>
<tr>
<td>Web server</td>
<td>Apache</td>
</tr>
<tr>
<td>Access statistics</td>
<td>Webalizer</td>
</tr>
<tr>
<td>Web scripting language</td>
<td>PHP/Perl</td>
</tr>
<tr>
<td>Programming language</td>
<td>Java 1.4</td>
</tr>
<tr>
<td>Make tool</td>
<td>Jakarta Ant</td>
</tr>
<tr>
<td>Unit testing framework</td>
<td>JUnit</td>
</tr>
<tr>
<td>Performance testing</td>
<td>Jmeter</td>
</tr>
<tr>
<td>Servlet container</td>
<td>Jakarta Tomcat</td>
</tr>
<tr>
<td>Web services toolkit</td>
<td>Apache SOAP</td>
</tr>
</tbody>
</table>

5. Conclusions

ENV-e-CITY is designed to be an Internet-based broker for services related to the urban environment, linked (but not limited) to air quality, air emissions, meteorology and topography data. Therefore, ENV-e-CITY is a “market place”, where potential “clients” are attracted to seek for services that are either not available, incomplete or only available with long delivery times and very expensive. This “marketplace” has
already started to be shaped by needs related to information providence, advanced competitiveness and sustainable development, resulting by increased social awareness and need for well being, as reflected in the contemporary legislative framework of the EU. In addition to the above, public sector information (where ENV-e-CITY builds upon) has reached in EU a “critical mass”, which on the one hand provides content sufficient for exploitation, and on the other is formalized into a slow moving, expensive in its maintenance, bureaucratic “giant”. Another important point that ENV-e-CITY invests upon is related to the concept of Immaterialisation. Immaterialisation refers to the replacement of products by services, e.g., the use of products to be utilised for specific purposes is replaced by information and telecommunication services. ENV-e-CITY strives to replace “traditional” environmental reporting and management schemes with schemes solely based on information services and provide benefits for

- the citizen, ENV-e-CITY vs. current situation: the ability to have access to both data and tools that will allow the formulation of personalised queries and views regarding the state of the urban environment.
- city authorities: a platform for collecting and reporting of environmental data, in line with the EU legislation. More specifically, and concerning emission data, a data exchange module will be developed for the collection and management of emission information at a city level. In addition, cities will be provided with a toolbox that will allow them to calculate statistics and indicators available for sectoral analysis of environmental impact and other statistics linked with reporting obligations towards the Commission.
- commercial exploitation: provide raw data to EIA companies and every other interested party, plus online, tool related services, plus expert support (e.g., suggestions for the use of air quality models in an EIA study, evaluation and validation of assessments performed by the user.
- service engineering: exploitation of environmental data for the provision of new information services to citizens that are marketed in bundles with other information services. Based on the available data, new service portfolios can be designed.

**Bibliography**


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