

## USING E-MAPS AND SEMANTIC ANNOTATION FOR IMPROVING CITIZENS' AND ADMINISTRATIONS' INTERACTION

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### Abstract

*The high potential of modern ICT for supporting citizens' and administrations' interaction for the formulation of public policies has been extensively recognized by academics and practitioners, resulting in a rapid development of the e-participation domain in the last decade. Extensive research is required for developing appropriate advanced information and communication technologies (ICT) platforms that exploit and realize this potential to the highest possible extent. In this direction this paper describes an advanced ICT e-participation platform that has been developed having as main objective to improve the quantity and quality of interaction among citizens, and also with public administrations, concerning the formulation of public policies and decisions on environmental and energy issues, as part of the FEED (Federated e-Participation Systems for Cross-Societal Deliberation on Environmental and Energy Issues) project of the European Commission. It enables citizens and administrations to upload geographically referenced multimedia content (e.g. pictures, videos, etc.) on an electronic map of the area which the public policy or decision under discussion concerns, so that other interested citizens or administrations can easily access and download them. The proposed e-participation platform provides: i) federated relevant content from various sources, ii) efficient mechanisms for accessing this content based on maps, semantic annotation and ontologies, iii) additional stakeholders' interaction capabilities through forum and petition functionalities. Finally, a pilot application of this platform for supporting e-participation/e-deliberation concerning important environmental and zoning public policies and decisions in the Flevoland region, Netherlands, which has been designed by the project consortium and is going to be implemented in the near future, is described.*

*Keywords: e-participation, e-deliberation, semantic annotation, semantic web, electronic map (e-map), content federation.*

## 1 INTRODUCTION

Initially, the use of information and communication technologies (ICT) in government focused mainly on supporting its complex internal functions and processes, however subsequently the advent of the Internet gave rise to the development of ‘extrovert’ government information systems (IS) as well; the first generation of them aimed to enable ICT-based remote transactions (e.g. VAT declarations) of citizens with government organizations (‘e-transaction’ systems), while the second generation had a very different orientation: to enable ICT-based interaction between government organizations and citizens for the formulation of public policies and decisions (OECD 2003a, OECD 2003b, OECD 2004, Macintosh 2004, Timmers 2007). The high potential of modern ICT for supporting such interactions has been extensively recognized by academics and practitioners, resulting in a rapid development of the e-participation domain in the last decade. The Organisation for Economic Co-operation and Development (OECD) defines e-participation as the use of ICTs for supporting the provision of information to the citizens concerning government activities and public policies, the consultation with them and also their active participation in public policies and decisions formulation. Saebo et al (2008) gives a more political definition of e-participation, as the extension and transformation of participation in societal democratic and consultative processes mediated by ICT. The OECD emphasizes that ‘all OECD member countries recognise new ICTs to be powerful tools for enhancing citizen engagement in public policy-making’ since ‘the unprecedented degree of interactivity offered by new ICTs has the potential to expand the scope, breadth and depth of government consultation with citizens and other key stakeholders during policy-making’ (OECD 2004). However, further research is required for developing appropriate advanced ICT platforms that exploit and realize this potential to the highest possible extent.

The use of ICT for supporting and enhancing interaction among citizens, and also with public administrations for the formulation and application of various kinds of public policy and decisions is of critical importance, since these problems usually belong to the ones termed as ‘wicked’ by Rittel and Weber (1973), being characterised by high complexity, many heterogeneous views and conflicts among various stakeholders. In particular the problems of public policies and decisions formulation:

- i) have many stakeholders, who are affecting and/or affected by the problem and the solution, each of them having a different view (representation) of the problem, and also different values and concerns,
- ii) do not have mathematically ‘optimal’ solutions, but only ‘better’ and ‘worse’ solutions, the former having more advantages and positive arguments in favour of them than the latter,
- iii) and also there are no clear rules for stopping the search for solution.

Such ‘wicked problems’ cannot be solved by formal ‘first generation’ design methodologies (based on pre-defined algorithms), and require ‘second generation’ ones, which are based on deliberation and argumentation approaches (Rittel and Weber 1973, Buckingham Shum 2003). These approaches include several circles of deliberation, in which the stakeholders interact, each of them raising issues concerning the problem under discussion, proposing solutions and arguing about advantages and disadvantages of them. Such a deliberation and argumentation approach is the best way for addressing the highly complex problems of formulation and application of public policies, and can be greatly supported and enhanced through moderns ICT.

However, in order this approach to be effective and successful, high quantity and quality of interaction among citizens, and also with public administrations is required, which has as a basic precondition that participating citizens are sufficiently informed. Due to the complexity of public policy issues today, this usually necessitates that participating citizens study of large amounts of relevant material, most of them being in textual form, such as:

- a) various reports, plans, laws, committees’ minutes, etc.,
- b) numerous opinions and positions of other citizens (usually expressed in textual form, through letters

sent to public administrations or to the press, and through postings in various e-forums), who might have quite different views, concerns and interests.

This requirement puts significant have a negative impact on the quantity and quality of both 'traditional' and ICT-based citizens' participation, since most citizens today do not have enough time for such extensive study, and also some of them lack the required familiarity and education. One approach that has been proposed for overcoming this problem is the use of Computer Supported Argument Visualisation' (CSAV) methods (Kirschner et al 2003) for the visual representation of the main points of large relevant textual documents (e.g. reports, plans, laws, committees' minutes, etc.) and lengthy 'traditional' or electronic discussions, so that interested citizens can understand these main points with minimal effort and time; however, this approach has been only to a limited extent explored (e.g. Renton & Macintosh 2007, Loukis et al 2009). Another approach for overcoming the above problem would be the provision to the participating citizens of relevant information in multimedia (e.g. images, video, etc.) and e-maps form, instead of textual, since the former is much easier to understand than the latter, and requires less time and effort. The present paper contributes to the exploration of this approach.

In particular, this paper describes an advanced ICT e-participation platform that has as main objective to improve the quantity and quality of interaction among citizens, and also with public administrations, concerning the formulation of public policies and decisions on environmental and energy issues. It has been developed as part of the FEED project (Federated e-Participation Systems for Cross-Societal Deliberation on Environmental and Energy Issues) ([www.feed-project.eu](http://www.feed-project.eu)), which is co-funded by the European Commission under the FP7 e-Participation. This platform enables citizens and administrations to upload geographically referenced multimedia content (e.g. pictures, videos, etc.) on an electronic map of the area which the public policy or decision under discussion concerns, so that other interested citizens or administrations can easily access and download them. The proposed e-participation platform provides:

- i) federated content, both 'internal' to it and 'external' residing in other web-sites, from various sources (managed, validated and non-validated),
- ii) efficient mechanisms for accessing all this content based on maps, semantic annotation (Fensel et al 2003) and ontologies (Fensel 2004, Loukis 2007),
- iii) additional stakeholders' interaction capabilities through forum and petition functionalities.

These capabilities the platform provides allow citizens to share quickly and easily content they have generated themselves on the issue under discussion (e.g. a picture or video produced even through a simple mobile phone, which shows a problem or documents an opinion/position) with other citizens, and also to search (using the e-map or/and the semantic annotation of all documents) for relevant content provided by other citizens or public administrations. Beyond this powerful interaction mechanism, the platform offers additional interaction capabilities through the forum and petition functionalities. The capabilities can result in a significant improvement of the quantity and quality of interaction among citizens, and also with public administrations, concerning the formulation of public policies and decisions, therefore it can enhance considerably both 'traditional' and ICT-based citizens' participation.

The paper is structured in seven sections. In section 2 the architecture of the platform is presented, while in section 3 the functionality it provides is described. Then in section 4 its annotation engine is presented. It is followed by section 5 describing a pilot application of this platform for supporting e-participation/e-deliberation concerning important environmental and zoning public policies and decisions in the Flevoland region, Netherlands, which has been designed by the project consortium and is going to be implemented in the near future. Finally section 6 summarizes conclusions and future research activities.

## 2 PLATFORM ARCHITECTURE

The following Figure 1 shows the overall architecture of the platform. The main objective of this architecture is to bring together a number of pre-existing software components and underlying infrastructures along with semantic components (based on ontologies), which are being developed during the project Baseline Definition phase.

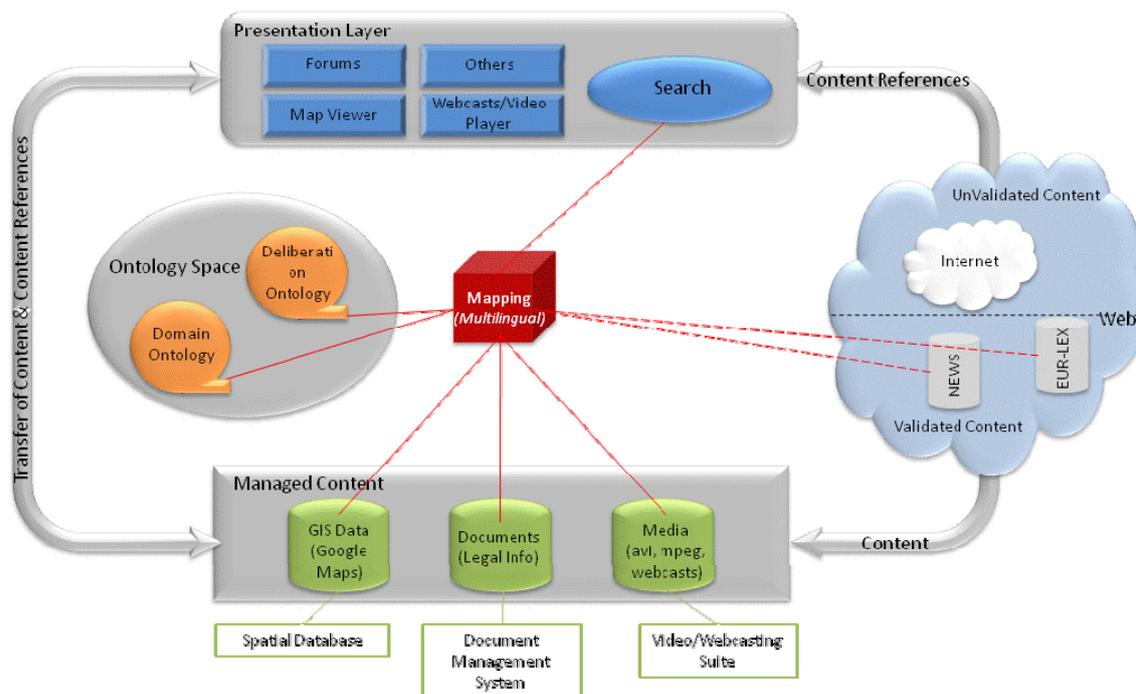


Figure 1: Platform Overall Architecture

We can see that the platform includes the following elements:

- Federated content, which comprises the ‘managed content’ (GIS data, documents and multimedia content) and the web content, which includes ‘validated content’ that is found in web databases (e.g. Eur-Lex and Google News) and ‘invalidated content’ that is found dispersed over the Internet. Regarding the ‘managed content’, the main subsystems that store and retrieve this content are a document management system, a web-casting platform and spatial data infrastructures.
- Presentation Layer, which is the platform web front end for its human end users. It incorporates a number of e-participation tools, such as forums, petitions, meetings calendar, webcast/media player and map viewers that help end users both to access the content and also express their opinion during a deliberation process. Furthermore the Presentation Layer incorporates also a search facility that allows end users to access all categories of federated content. The provided search capabilities will either be free-text search and/or search by deliberation type or ontology term.
- Ontology Space, which incorporates the necessary ontologies that determine the semantic capabilities of the system. In particular, the ‘deliberation ontology’ provides a “grammar” for defining different types of deliberation; based on the deliberation ontology, different deliberation models are specified according to the needs of every pilot site that will be implemented during the trial operation. On the contrary, the ‘domain ontology’ specifies the “things” the deliberation process will be about. Practically the domain ontology provides an advanced keyword index to every data source (mainly managed content) that the system is referencing.

### 3 PLATFORM FUNCTIONALITY

As mentioned in the previous section the content provided by this platform to the user can be grouped into the following three categories according to its source:

I) Managed Content: It includes material that has been selected by the authorized system managers, assessed as suitable for the purposes of the particular e-deliberation project, and stored, maintained and updated within the FEED platform (internal content). It consists of a) textual content, such as laws relevant to environmental and energy issues, legislative process documents, relevant articles, etc., b) multimedia content, such as images, or audio and video material from discussions in parliaments or local councils, enriched with vital contextual information (e.g. textual information concerning speaker's profile or the particular agenda item that the particular audio/video concerns) making these webcasts more meaningful and useful, and c) spatial data, such as maps of the area that the particular environmental and energy deliberation concerns, providing also the capability to connect the above textual and multimedia content to particular geographic locations of these maps (geographic referencing).

II) Validated Content: It includes material from similar sources as the managed content (e.g. relevant laws, legal documents, etc), but also news items/newsfeeds, which have been selected as appropriate and have been validated by the system managers, but reside in external organized storage facilities (e.g. in various web databases, such as EUR-LEX); they are accessible to the FEED users through a searching capability, that either accesses directly the content's storage facility, or uses its search API (if it exists). Integration of this category of content is made in the case that the necessary APIs/Web Services are available on behalf of the corresponding content providers (e.g. the EUR-LEX database).

III) Non-validated Content: It includes material stored outside the FEED platform that has not been validated by the system managers, so no guarantee can be given about its reliability, but might be of interest for the participants in the particular e-deliberation project. Main sources of such information are links to other web sites and/or content stored in external systems, as well as all the widely used search engines that exist on the Internet; this type of content will be accessible by the users through their references stored in the platform. Also we can have non-validated content provided by the platform end users, either as posted references in the forums, or as attached textual or multimedia documents (possibly connected to a particular location (point or area)), which will be stored within the FEED platform.

From the user functionality perspective the proposed e-participation platform includes eight interconnected functionality modules. Its most innovative feature is the wide use of map technologies in order to present information and initiate public deliberation. The map environment is completely interactive, so it can be used not only to enable the users find and access already stored data (e.g. request all documents associated with a particular area), but also to enable them upload on the platform their own content on the topic under discussion (e.g. textual or multimedia files), opinions and plans, and associate them instantly with a specific location (point or area) on the map.

the platform includes three map-oriented modules: Map, History and Vision. The Map module allows the user to focus on a particular geographical area of interest and interrogate the system to provide all information available in the platform (both 'internal' and 'external') about this area. Registered users can also upload content (e.g. textual, image or video files) and attach it to a particular location (point or area) on the map; this user-uploaded content, after being subject to moderation that verifies the quality of it, becomes publicly available, so that all the other users of the platform (both registered and non-registered) can view it. This capability creates a strong mechanism of interaction among the users. All map pages of this module are split into four sections, as shown in the following Figure 2.

The screenshot shows a web application interface for a map-based platform. At the top left is the 'FEED' logo. To the right is a search bar and a 'Moderator Login' field with a 'LOGIN' button. Below this is a 'Participation' button with a red gavel icon. The main content area features a map of the Netherlands with various regions labeled, a 'Forum' icon, and a 'Petition' icon. Below the map is a 'Legal' tabbed menu with options like 'Europe', 'Research', 'Minutes', 'News', 'Cases', and 'Docs'. A search bar is present, and a 'Plain Speak' button is visible. On the right, there is a 'layers section' with a tree view showing folders like 'handreiking', 'agrarisch gebied', 'stedelijk gebied', and 'zoekgebied'.

Figure 2: A typical Map Page

In particular, the 'map section' shows the map of the area of interest selected by the user, with all relevant data available marked thereon, while the 'layers section' to the right allows the user to select various thematic layers of information to appear on the map, based on various environmental, recreation, etc. categories. The 'tabbed documents section' below lists documents available for the area of interest, categorized under various tabs, while the 'search section' allows the user to enter plain text or a taxonomical phrase in order to filter the information appearing in the documents tab.

The History module presents a map of an area selected by the user and provides controls that allow the user to see how this area has changed over time. The user has zoom control over the map area, while a slider over a timeline offers the capability to select different past times; as the slider is moved, the map changes reflecting the level of development of this area at the corresponding time. Finally the Vision module allows users to run "what if" scenarios for regional planning. This module allows any interested party (individual, organization, or public administration) to mark a map area and declare their vision concerning the development of this area in terms of industry, transport, energy, environment, etc. The system can also present information about the current status and the national and European laws and conditions applying to the specific area, as well as possible implications of such a vision, e.g. conflicting laws and disagreeing parties, allowing the user to refine and improve their visions and plans prior to formal submission.

In addition to the above map-related modules, the platform provides modules offering information retrieval capabilities. The Meetings module lists webcasts associated with the topic of the deliberation, while clicking on a particular webcast provides further information, shows location information

associated with the webcast on an interactive map and allows users to watch the webcast. The Topic module is a text-based search page where the user can choose to search based on structured search terms contained in a taxonomy or by entering “free text”. Resulting content is returned to the page and the user can click on any of these results in order to see the corresponding document or webcast, and also, if applicable, its location on the map. Throughout the pages of the platform users are offered the capability to rate any content item they select, be it a document, webcast or discussion message. Based on these user ratings the popularity of content items is determined, and the most popular of them are shown in the What’s Hot page, which provides a single place where the user can go and discover what are the most interesting and popular items in the platform; as with the Topic page, the user can then click on any of these items and get further information and map location, where available.

Finally the platform provides additional modules offering interaction capabilities. The Forum module provides discussion - deliberation spaces in the form of online bulletin boards, where users can read existing messages on the topic under discussion in a ‘threads structure’, respond to any of these messages in a particular thread by entering a new message connected to the former, or create a new thread of discussion. The Petition module offers the capability to start online petitions about different types of issues (e.g. concerning environment, city planning, etc.) in order to increase the influence of public opinion in the public policy and decision making process.

#### 4 PLATFORM ANNOTATION ENGINE

Since users need to have the potential to search, catalog, classify, secure, activate, update and delete content, emphasis has been laid to the semantic annotation of structured and unstructured information, such as scanned documents, rich media (audio and video), application files (word documents, spreadsheets, pdf files), e-mail and Web content. The following paragraphs describe the various semantic frameworks incorporated in the platform, the interconnections among them as well as a variety of sample queries that show the semantic capabilities of the platform.

The annotation engine is mostly based on Semantic Web Technology (Fensel et al 2003). The knowledge models about the cross border deliberation models and the domain knowledge of the working scenarios are all described with RDF/OWL. The reason why RDF/OWL has been chosen, is that it provides the ability to do inference and reasoning with these models. For publishing this information as a service the OpenRDF Sesame server is used. This server has an SPARQL-endpoint which is an access point for queries. The SPARQL endpoint is accessible over the web. It is used in order to fill up the portal with information. The portal can be seen as a user interface for the OpenRDF Sesame server and the SPARQL-endpoint is the interface between them.

In Figure 3 is shown the architecture of the interaction between the portal and the annotation engine. The portal gets its information by sending the appropriate queries to the SPARQL Endpoint, which is an access point to the OpenRDF Sesame server. The OWLIM is an inference layer within the OpenRDF Sesame server. The portal also provides an interface for adding data, which are then processed by the OWLIM module and the result is propagated to the portal by the same SPARQL endpoint.

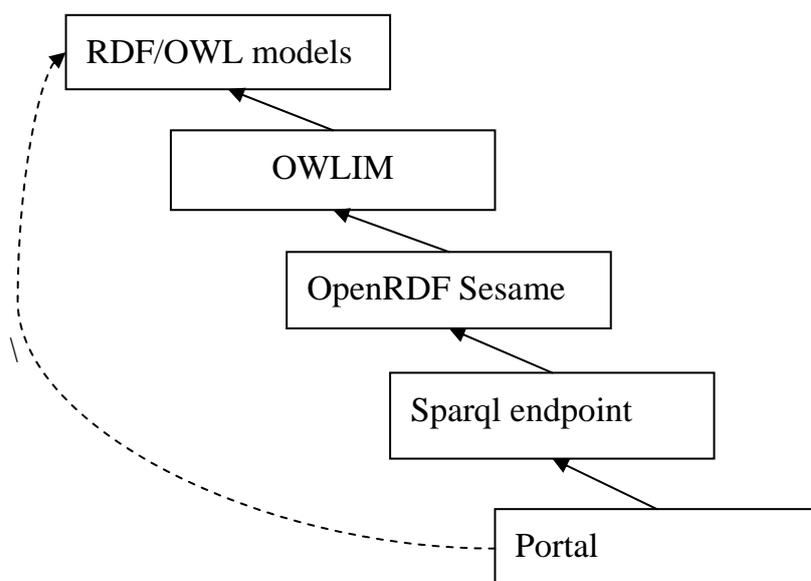


Figure 3 - Architecture of the annotation engine of the platform

## 5 A PILOT APPLICATION

A first pilot application has been designed by the project consortium for evaluating systematically the proposed eParticipation platform testing in the Flevoland region, Netherlands. This is an area that was reclaimed from the sea and was destined to become land; however, later it was decided to keep the water area intact, but this caused severe scarcity of land resources in the Amsterdam urban expansion area. The main reasons for having chosen this as our first pilot are:

- The Flevoland public authority has to coordinate the revision of the entire regional development plan with six cities in a concurrent manner. All the changes will be made available to all interested actors through a web-service. In this direction Flevoland has launched the “Geopolis” initiative in order to create the right spirit of collaboration among actors involved, for informing the public and businesses about the redevelopment plans.
- Flevoland had the vision to write the explanatory paragraphs on the 200 pages regional development plan in XML and in object oriented slices. This means that businesses and citizens or non-government organizations (NGOs) can find relevant and precise location-based interpretations of the usually very diplomatic language of such plans without having to rely on professionals, who are paid to read through these highly political documents and interpret them in a simple and ‘practical’ language.
- The area to be re-developed is under high pressure from many actors, who want to launch economic and recreational activities in a densely populated area, where one European directive demands that people stay away in order to save protected birds species, while another European directive demands large scale redesign operations to maintain water quality in the inner lake.

In this pilot the platform will be used for cases of environmental trade-offs and ‘NIMBY’ (‘Not In My Back Yard’) problems, such as the allocation of a water ski resorts near parts of the ecological protected surroundings, hotel and other recreation facilities and the construction of new islands for housing. The legal reasoning becomes relevant when the law offers limited possibilities of intrusion of “green” areas by compensation of other “green” elsewhere. For the purpose of European transferability it is intended to apply Google maps technology rather than GIS technology in order to

support “contour editing” by visitors of the website. The visitor will be able to indicate a specific area he/she is interested in by drawing a rectangle on the map, in order to discuss and support his case with documents, research reports, legislation and plans that can be uploaded, stored and downloaded for this drawn area.

The interface of the platform instance developed for this Flevoland pilot is shown in Figure 4. It is linked to the Oracle database of the regional authority of Flevoland; all map layers available can be projected on this Google map screen. In this way the conflict resolution system will maintain dynamic input from legal constraints and map layer updates.



Figure 4: Interface of the platform for the Flevoland pilot

## 5 CONCLUSIONS

In the previous sections of this paper has been described an advanced ICT e-participation platform that has been developed, as part of the FEED (Federated e-Participation Systems for Cross-Societal Deliberation on Environmental and Energy Issues) project of the European Commission, in order to improve the quantity and quality of interaction among citizens, and also with public administrations, concerning the formulation of public policies and decisions, with main emphasis on environmental and energy issues. The platform enables citizens and administrations to upload relevant geographically referenced multimedia content (e.g. pictures, videos, etc.) on an electronic map of the area which the public policy or decision under discussion concerns, so that other interested citizens or administrations can easily access and download them. The proposed e-participation platform provides federated

relevant content from various sources (managed, validated and non-validated) and also efficient mechanisms for accessing it based on maps (by drawing an area on the map we can access all content concerning this area), semantic annotation and ontologies. Beyond this powerful interaction mechanism, the platform offers additional interaction capabilities through the forum and petition functionalities. The capabilities provided by this platform can result in a significant improvement of the quantity and quality of interaction among citizens, and also with public administrations, concerning the formulation of public policies and decisions, therefore it can enhance considerably both 'traditional' and ICT-based citizens' participation.

In order to evaluate systematically this platform a first pilot application of it has been designed by the project consortium and is going to be implemented in the near future. It aims at supporting e-participation/e-deliberation concerning important environmental and zoning public policies and decisions in the Flevoland region, Netherlands. Furthermore, three additional pilots are going to be conducted in Greece, Great Britain and Czech Republic. After the end of these pilots a systematic and comprehensive evaluation of them will take place, based on the 'Technology Acceptance Model' (TAM) (Davis 1989, Davis et al 1989, Venkatesh et al 2003) and the e-Participation evaluation methodology developed by the first of the authors (Loukis and Xenakis 2008a and 2008b, Loukis et al 2009), and its conclusions will be used for improving the platform and the practice of its usage.

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