A Web 2.0 Citizen-Centric Model for T-Government Services

Alexandros Dais, Mara Nikolaidou, and Dimosthenis Anagnostopoulos,
Harokopio University of Athens

To fully realize the potential of IT governmental services, or T-Government, proponents must enhance and encourage active citizen involvement. A citizen-centric interaction model that uses the Web 2.0 paradigm helps citizens better control their private data through profiles and combine services provided by the government or third-party entities.

The transformation of IT governmental services (T-Government, or T-Gov for short) from the traditional e-Government strategy to the citizen–centric paradigm has become an emergent challenge, requiring the adoption of a whole new paradigm in terms of service delivery to citizens. In the last decade, government efforts focused on the implementation of "one-stop" government portals, but this approach isn't delivering the intended results in terms of citizen interaction, and public agencies have experienced substantial difficulties in collaborating to deliver common services.

T-Gov poses new requirements—specifically, a citizen-centric delivery of public services and effective management of resources and skills within government.[1,2] To achieve T-Gov, interaction between citizens and government must be explored from a new perspective, one that enhances and encourages citizens' active involvement and awareness.[3] The utilization of a Web 2.0 technology model to provide T-Gov services could move us in this direction.[4]

The Web 2.0 paradigm and the wide acceptance of social computing have already made a big impact on e-participation and e-collaboration projects,[5,6] but these domains focus on information sharing and knowledge discovery, not e-Gov service delivery. In the case of e-participation, social networking empowers citizens to participate in policy making and communicate with their elected representatives. In the case of e-collaboration, citizens can exchange information on specific issues, such as the condition of roads in a specific municipality, and promote active government reaction. These cases are well served by existing social networking technology, which encourages citizens' involvement; we believe this technology could work for e-service delivery as well.

This article describes an alternative Web 2.0 citizen-centric interaction model for T-Gov that facilitates e-service delivery and complex cross-organizational service composition. Such a model should take into account all types of government interaction—citizens to government, businesses to government, or government to government—as well as the intermediaries acting on citizens' behalf. Citizens, representing themselves or businesses, often need to collaborate to perform complex cross-organizational tasks with the e-Gov services provided by the government or third-party entities. Our model promotes awareness

1541-1672/13/$31.00 © 2013 IEEE
Published by the IEEE Computer Society

about the usage of private data, along with an alternative way to accomplish cross-organizational tasks, letting citizens participate in a "governmental" network similar to a social network by taking advantage of existing social networking technology; Web 2.0 features help with service discovery via concepts like collaborative tagging. We chose Google's OpenSocial platform[7] for our implementation because it targets social application development via a common API and has the potential to become a de facto standard. It's also open source and easily extended based on standard interfaces. OpenSocial extensions to support our proposed T-Gov interaction model are packaged in the *OpenSocialGov* framework, which we developed to establish corresponding "governmental" networks.

Service Composition and Interoperability Issues

Early e-Government efforts were based on an "online government" approach, and in many cases, this is still what's available to citizens. Individual agencies manage websites, usually to provide informational and transactional services—successful examples include the early tax-filing services hosted on tax and revenue agency websites. Although this approach offers citizen-to-government (C2G) interaction, cross-organizational interoperability is still an issue.

An attempt to effectively promote interoperability was the approach implemented by "one-stop" portals, where a single point of access (or just a few) serves all C2G interaction. Citizens aren't required to know how the government is organized to obtain information or to conduct a transaction involving multiple agencies, or even tiers of the government. Individual agencies' services are integrated and coordinated to fulfil citizen requests in a fully automated and transparent fashion, with complex cross-organizational tasks implemented as workflows, precomposed of existing e-services and passively executed by the citizen as a single application—successful examples include national portals such as www.usa.gov, www.direct.gov.uk, and www.servicepublic.fr. programming languages, such as Business Process Execution Language (BPEL 2.0), do all the work.

The ability to provide complex cross-organizational services through one-stop portals requires interoperability among frameworks, such as Integrated Public Sector Vocabulary (IPSV; UK) and Standards and Architectures for e-Government Applications (SAGA; Germany). Members of the European Union (EU) opted for the European Interoperability Framework v2.0 (EIF v2).[8] Given the numerous economic, legal, and cultural backgrounds of the agencies involved, achieving interoperability by imposing standards is tedious,[9] and standardizing the ontologies and vocabularies used to promote interoperability poses its own restrictions, because they must be constantly updated and extended.

Nevertheless, citizens increasingly ask for more choices to access and combine e-Gov services. They also want to work through the intermediaries they already deal with, such as banks, accounting firms, and professional associations. As more citizens move their sensitive data online, they request better personal data handling in terms of privacy, security, and trust.[10]

The Open Government Data initiative[11] suggests a different approach for developing governmental services. Open Government Data, produced or commissioned by the government, can be freely used, reused, and redistributed by anyone, including third-party stakeholders (citizens, businesses, non-governmental organizations, and so on) to develop their own services. Open Government Data can include statistical records, criminality rates, economic figures, and so forth.

As currently identified in the European e-government action plan for efficient and effective cross-border governmental services,[12] an alternative interaction model for providing and combining governmental services should be explored to achieve T-Gov. Specifically, it should enhance the functionality offered by one-stop governmental portals and actively promote third-party stakeholder engagement and citizen cooperation to accomplish cross-organizational tasks.[13]

A Web 2.0 Citizen-Centric Model

The adoption of the Web 2.0 paradigm for citizen-centric service delivery is a challenge, considering the technical and organizational barriers that hinder the realization of public service benefits. A corresponding interaction model should take into consideration the relationships among T-Gov participants—namely, citizens, businesses, public agencies, and any type of intermediates—and allow them to communicate in a seamless, simple fashion, similar to one they're used to in real life. Data exchange should be simplified, yet still consider issues such as data and privacy protection. Such issues primarily concern the transfer and processing of citizens' data among different public agencies without explicit knowledge and consent to accomplish cross-organizational processes—for example, national health care agencies should explicitly ask for citizens' medical data (provided by public hospitals) rather than accessing and processing sensitive data without consent.

Most government processes and services are based on the assumption that government agencies own all the information maintained about citizens, while the citizen has limited or no access specifically to the data that characterizes him or her. Following Web 2.0 concepts, especially the social networking interaction model, our model lets citizens hold their private data in profiles that act as personal data vaults. In a sense, these profiles are the digital representation of the citizens, who in turn own, manage, and decide who can access their data.[14] Under the profile concept, it's up to the citizens to decide whether to share their private data with government agencies or intermediaries.

Business-to-government (B2G) interaction is served by business profiles that retain organizational or business data. Following our model's citizen-centric nature, properly authorized citizens administer business profiles and interact with government agencies to accomplish business tasks.[15] Government-to-government interaction (G2G) is accomplished through multiple C2G and B2G interactions. Such a perspective places the citizen in the center of the model, transforming the interaction from a provider-centric (multiple citizens related to a public agent) to a citizen-centric (multiple public agents related to a citizen) context.

Based on privacy laws, several issues related to legal or governance limitations could arise regarding the transfer and processing of citizen data among different public agencies—in many countries, for example, legislation prohibits sharing data between different agencies. European regulations also prohibit the sharing of personal data across different IT platforms without giving users the chance to give their prior consent.

Profiles overcome these limitations because they're private, and information can only be accessed by authorized applications with the citizen's consent. The profile owner is the data owner is the citizen himself or herself. Additionally, it's up to that citizen to define whether this data will be permanently stored in the profile or acquired in real time from public agencies upon log-in and stored in a temporal session.

In our model, citizens orchestrate cross-organizational tasks by combining the functionality of discrete applications. In this way, such tasks aren't predefined using an activity-based modeling approach; rather, they're composed during execution, following a data-based workflow composition approach that's more suitable for cross-organizational interaction.[16] To execute a specific application, the data required becomes available in the corresponding profile to other applications. Cross-organizational task representation is simplified, while exceptions and errors occurring during related application execution are handled by the platform supporting the proposed interaction model.

Government, citizens, and businesses are the main participants in a T-Gov system. Our proposed Web 2.0 interaction model should thus be described using entities related to them, as illustrated in Figure 1's class diagram. The model defines the structure of a social network that facilitates interaction among T-Gov participants.

Citizen and Business Representation

As the figure shows, citizens are represented through a Citizen Profile, in which citizens can store data generated or used by governmental services. The Business Profile is considered a separate entity that acts as the reference point for the corresponding B2G interaction. The Business Profile is administered by a citizen who's liable to governmental laws, acts, and regulations as far as the business is concerned, and can install and execute applications in the Business Profile. Whether they're administrating their personal profile or a business one, citizens are responsible for interacting with the government or other citizens to accomplish a task, as discussed in the following.

Assignment Process

A citizen often assigns other citizens to accomplish tasks on his or her behalf, as indicated in Figure 1 with the *assign* association defined between profiles (either citizen or business). For consistency, there's an Assignor Profile and an Assignee Profile. Assignees can install and execute applications on the assignor's behalf. The Assignor Profile is the reference point for coordinating and exchanging information between applications executed by the assignor or assignees.

Task assignment requires a notification of the assignee profile and the explicit consent of the assignee profile administrator (citizen). The assignment process is based on two factors: the assignor authorizes the assignee to do something for a certain period of time. The citizen/business declares a domain of tasks that the assignee can handle for a specified amount of time—this assignment can be granted permanently or for a specific task. The assignment process can also involve more than one step, and a citizen or business can assign a task to some other citizen or business, which in turn assigns the initial task or part of it to someone else, and so on.

Applications Development and Deployment

Applications are programs installed in Citizen and Business Profiles. As

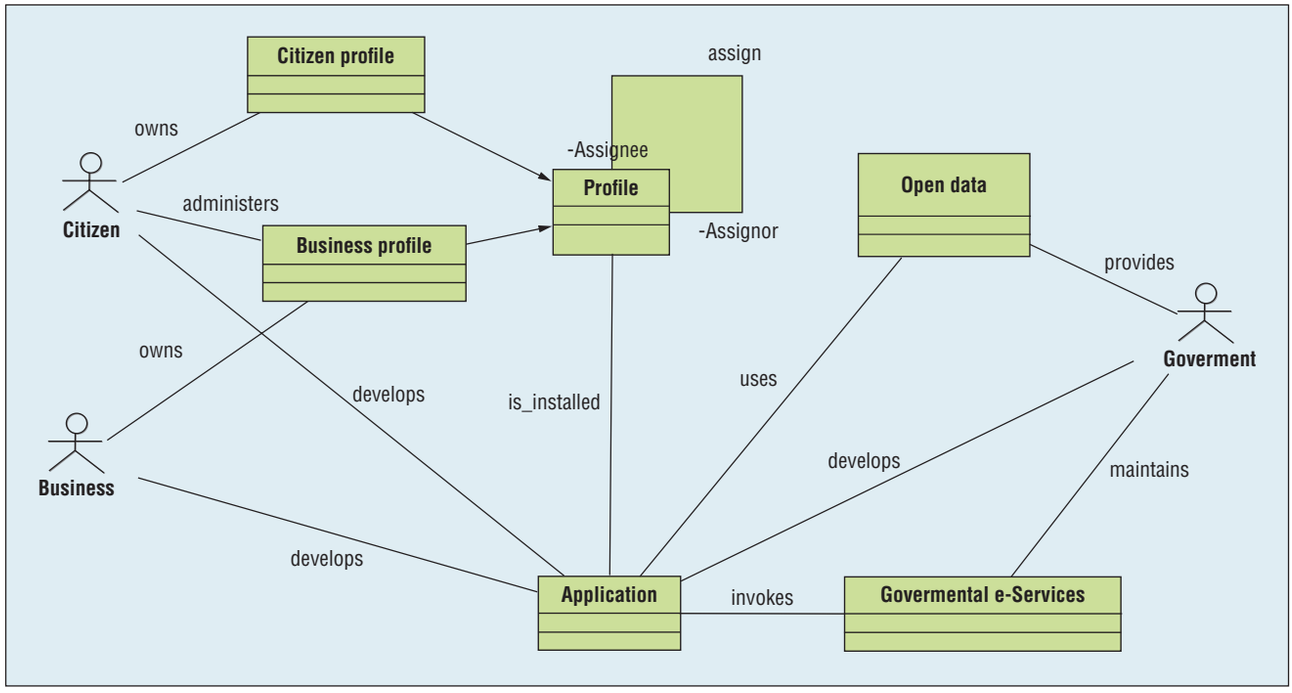

Figure 1. Interaction model entities. In this figure, the main stakeholders of the model (the government, citizens, and businesses) are interacting with their profiles through applications that utilize governmental services and open data.

Figure 1 shows, they invoke governmental e-services executed on external IT infrastructure. Applications can operate on citizen and business data stored in profiles and exchange information through them.

Cross-organizational tasks can be accomplished by installing several applications (depicted by the installed association in Figure 1), which share data residing in the profile in which they're installed. The process of discovering and installing the appropriate application to obtain specific data can be assisted by a recommendation service that takes into account the existing information provided in the profile, the desired output to be added, and the preferred applications installed in other profiles when performing the same or a similar task. Information regarding available applications and related data can be maintained in an application registry.

Our proposed model assumes that the governmental sector offers interfaces—that it maintains government e-services to its back-end IT infrastructure. Third-party developers could also participate in application development. As depicted in Figure 1, Open Data provided by the government can be used by other participants to create mash-up applications.

An Interaction Example

To demonstrate the potential of the proposed citizen-centric interaction model, we created a cross-organizational service example that involves both citizens and businesses. In either case, a citizen is responsible for interacting with the government in cooperation with others to complete a specific task. Let's assume that a mid-scale software company, called Synapses, participates in a public agency's call for proposals to purchase software. According to EU legislation, any proposal should be accompanied by tax and insurance clearance. Figure 2's activity diagram depicts the intermediate assignment process.

Jason, the company's CEO, administers the Synapses Business Profile and decides to participate in the call. He assigns Helena to act as Synapses' lawyer; she's able to execute specific applications on behalf of Synapses, such as obtaining insurance clearance for the current fiscal year. Helena accepts the assignment, which means she can install and execute these applications on behalf of Synapses.

A more complex interaction takes place when Synapses assigns tasks to another business. Suppose that Jason assigns to Ermis all the Synapses accounting tasks. No time limitations are specified. The Ermis Business Profile is administered by Dave. Alice is an accountant working for Ermis, and Dave assigns her to act as the Synapses taxation consultant. Alice accepts this assignment, thus she's able to execute taxation applications on behalf of Synapses.

The "submit an offer" application, provided by the public agency to submit offers, requires a taxation and insurance clearance certification as input data. Jason installs and executes the application in the Synapses profile. Because the corresponding input data

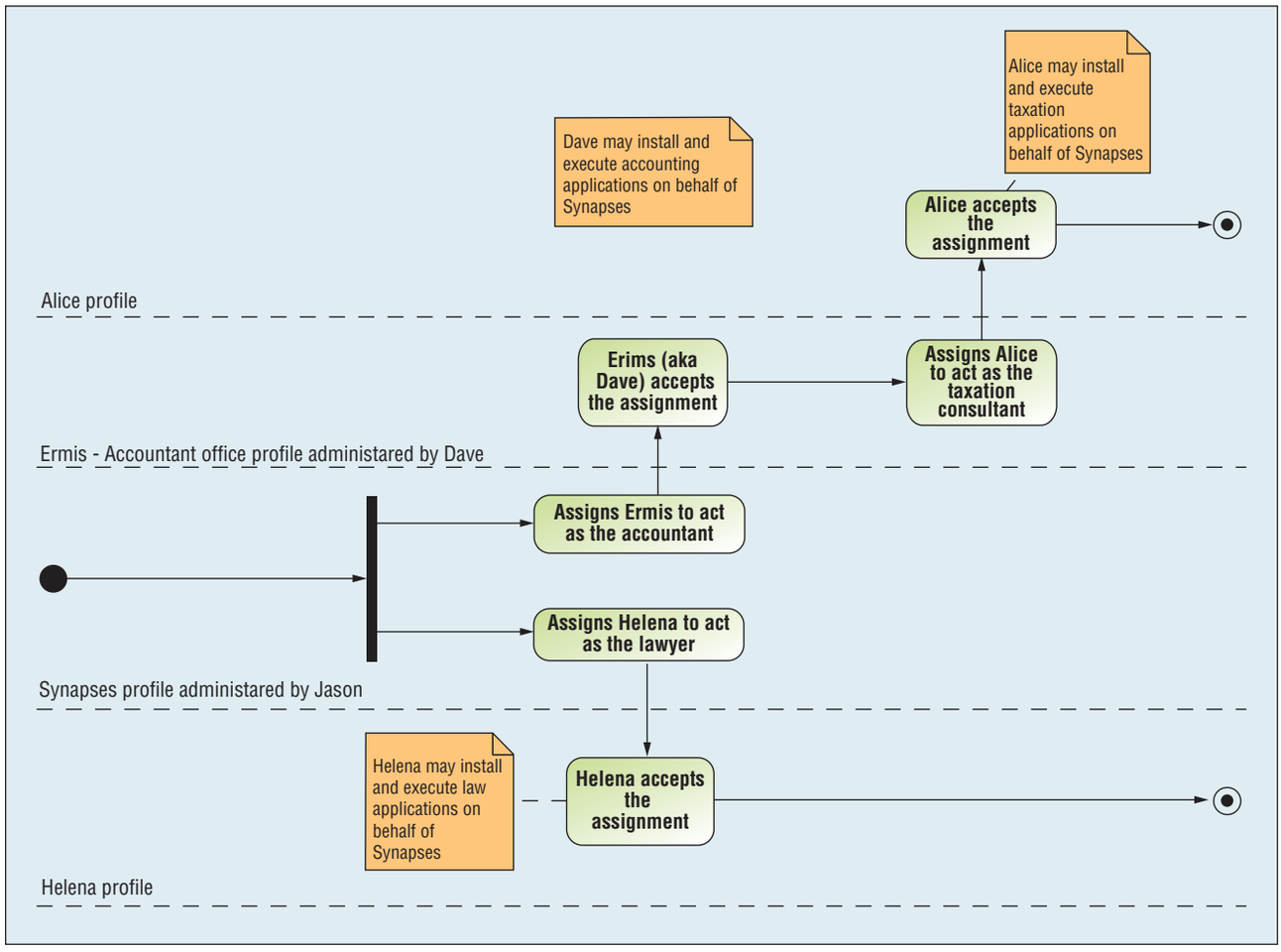

Figure 2. Assignment process. Jason assigns Helena to act as Synapses' lawyer and Alice to act as the taxation consultant.

aren't available in that profile, intermediate profile administrators (Dave, Alice, and Helena) are notified. Alice and Helena execute taxation and insurance clearance applications in their profiles, respectively, on behalf of Synapses, reading their input data and adding their output data from/in the Synapses profile.

Jason, as the Synapses profile administrator, receives full notification of the applications executed and the information added in the profile. Intermediaries, such as Alice, are unaware of tasks performed by other intermediaries, such as Helena. When all prerequisite input is available, Jason is notified to execute the "submit an offer" application. Figure 3's activity diagram depicts the steps constituting this task.

The proposed model allows for citizen-centric service provision: the citizen (Jason) can accomplish complex tasks for himself or the business he administers as well as declare intermediates to help him. Complex tasks, such as the "submit an offer" service, are executed in a step-by-step fashion, enabling the citizen to explicitly allow governmental services to process his personal data. Likewise, intermediaries are explicitly declared to assist him in specific steps, while he's notified of all their actions. The data flow is transparent because citizens either initiate applications or consent to any application execution and data exchange.

One drawback is the increased complexity in terms of service composition. A recommendation mechanism based on application input and output could assist citizens when combining applications to accomplish complex tasks, to take advantage of the flexibility provided. The same mechanism could also help citizens manage their profile and intermediates. As citizens take control over T-Gov service delivery, participating in a "governmental" network, they become responsible for the validity of their actions, taking this responsibility from the government, which still maintains control over the services offered by specific agencies. An important caveat is that such a transition is based on the assumption that citizens are aware of social media technology and its usage.

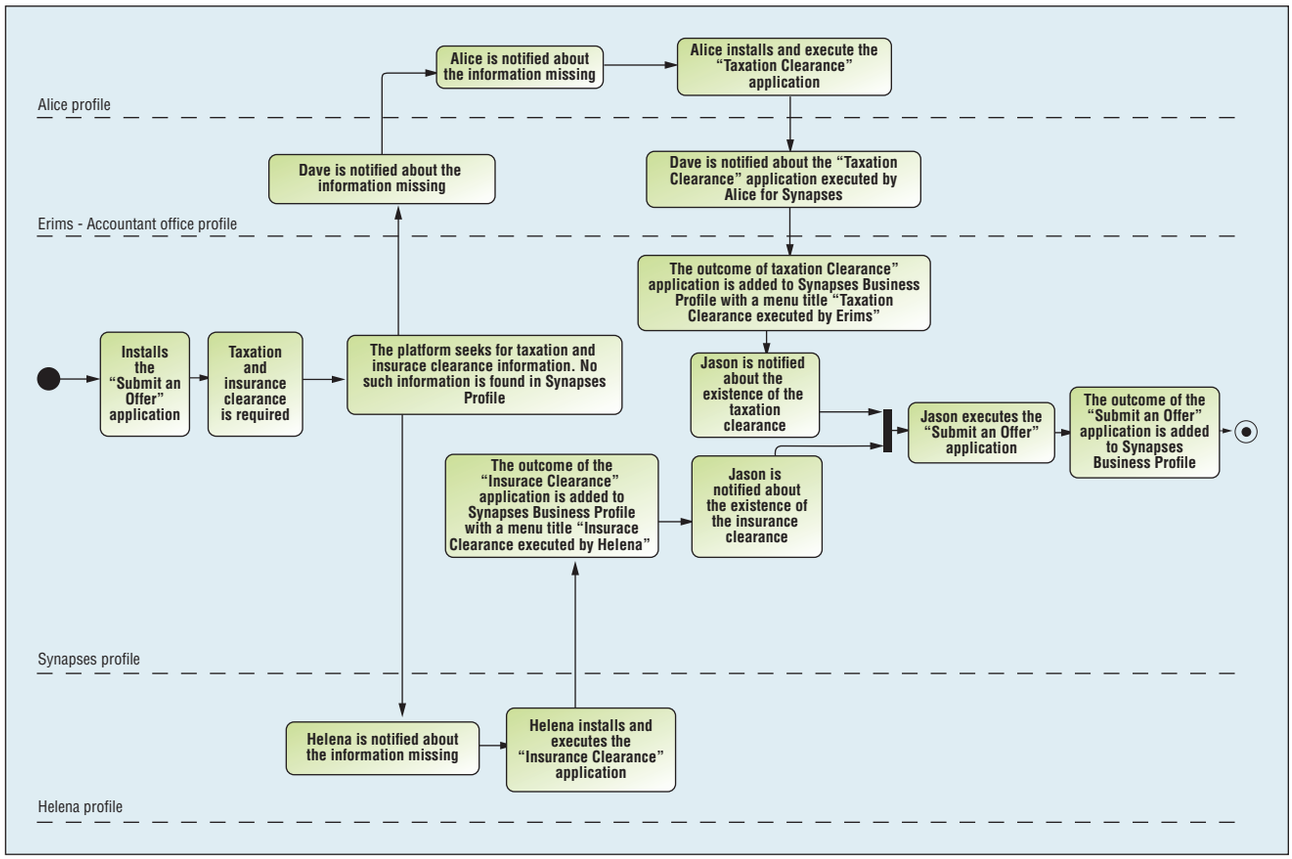

Figure 3. Performing the "submit an offer" task. Jason, Helena and Alice install the appropriate applications to their profiles in order to accomplish the task of submitting the offer.

OpenSocialGov Web 2.0 Framework

We explored the realization of our interaction model and its corresponding governmental network based on current social networking technology by using the Google OpenSocial framework. OpenSocial provides a set of libraries to develop applications, called Gadgets, executed in interoperable social networks, called OpenSocial containers.

To support our model, we extended the OpenSocial libraries and integrated the extensions within the OpenSocialGov framework, developed as a "governmental" network platform that facilitates the interaction model presented in Figure 1. We based this implementation on Apache Shindig, an open source OpenSocial container; the OpenSocial extensions were straightforward, verifying the potential of our interaction model.

Figure 4 shows the OpenSocialGov framework's architecture. It consists of the OpenSocialGov container and OpenSocialGov Services, namely, Application Registry to manage applications and a Recommendation mechanism to assist citizens when adding applications in their profile.

The OpenSocialGov container consists of three modules: OpenSocial Services, featuring basic message exchange; Application Proxy, facilitating communication with external governmental services; and Extended OpenSocial Services, consisting of OpenSocial methods used to program applications (or Gadgets) extended to support our model.

OpenSocial Extensions

OpenSocialGov framework extensions accommodate

- the management of business profiles and the administration of multiple profiles by the same user;
- the definition and management of the assign relation between participants;
- applications accessing data in different profiles than the one they're executed in, to implement the execution of applications on behalf of other participants; and
- enhanced notification mechanisms incorporating the concept of assignor and assignees.

We extended both the OpenSocial database schema and the corresponding API calls. We further modified the

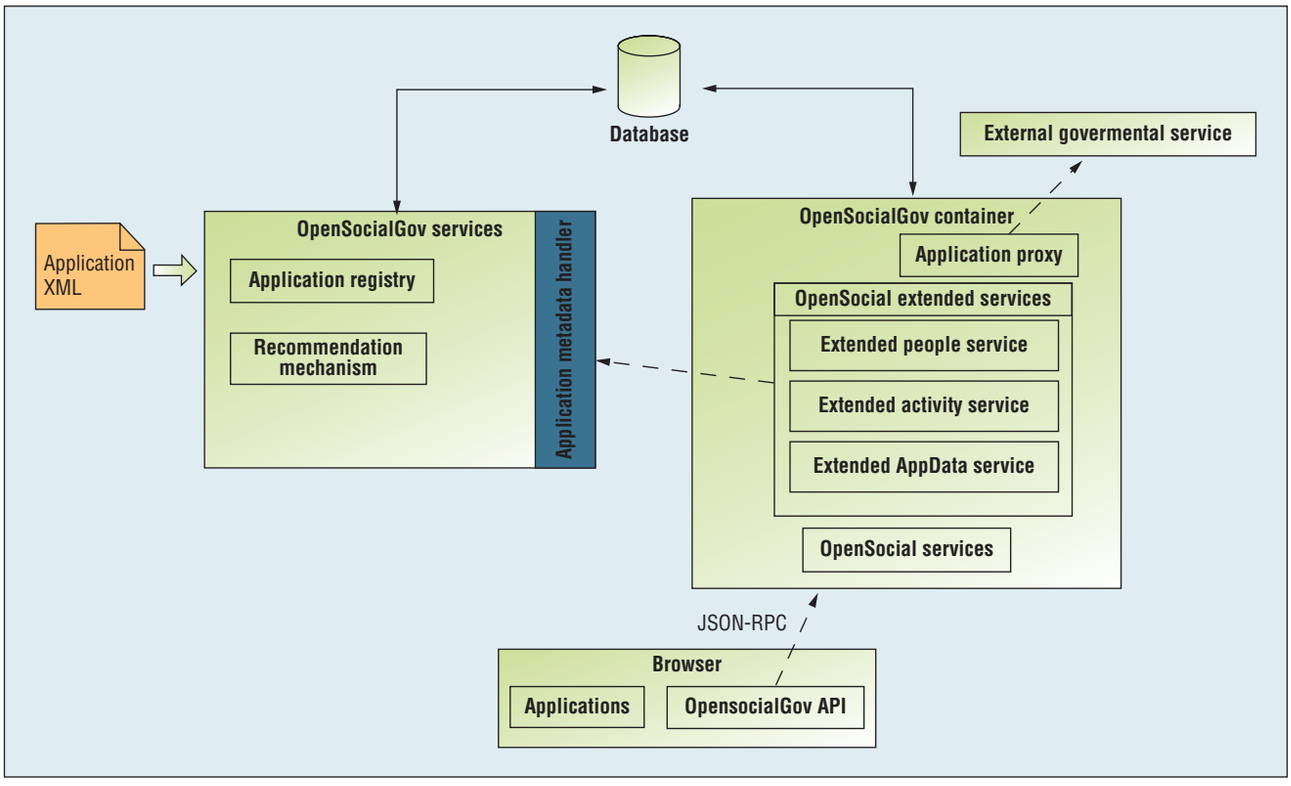

Figure 4. OpenSocialGov framework architecture. OpenSocialGov Container interacts with both OpenSocialGov Services and external Governmental Services to provide the Citizen with the necessary profile data.

extended API calls, either for gadget development (using the JavaScript Object Notation and remote procedure call, or JSON-RPC, interface) or to program the OpenSocial Container (the Representational State Transfer, or REST, interface), to support additional parameters or parameter values to accommodate database extensions. We created additional calls to support business profiles and multiple profile administration, and to assign relation management.

OpenSocial Extended Calls

The OpenSocial PeopleService API is responsible for handling profiles and relationships; we extended it to support the assign relationship, treated as a specialization of the friend relationship and its parameters. In our case study, the information related to all intermediates of Synapses is provided by the following call:

```
osapi.people.get(profileId:
'Synapses',groupId:'@assignees');
```

Furthermore, we also developed calls to indicate the profiles administered by a specific citizen—for example, the profiles administered by Jason can be retrieved by the call:

```
osapi.people.getprofiles
(userId: 'Jason', profileId: '');
```

Application development is based on Gadgets, autonomous software components that combine HTML, Cascading Style Sheets (CSS), and JavaScript. In the OpenSocialGov Container, the execution of a specific application is enabled when all necessary input data are available. Applications installed by the assignee should be executed with the assignor data.

The OpenSocial AppDataService API contains methods for fetching, updating, and deleting application data by applications executed within a specific profile. We extended it to accommodate the execution of applications on behalf of the assignor in the assignee profile. In this case, applications access application data stored within the assignor profile. Assignees can execute applications on an assignor's behalf provided they belong to the domain in which this relationship is valid. For example, we extended the `osapi.appdata.get(profileId, appId, appDataName, value)` used to retrieve the value of the appDataname data field created by appId application in profileId profile to be executed in assignees' profiles. In a similar way, the extended call `osapi.appdata.update (profileId:'Alice', assignorId:'Synapses', appId: 'Tax001', appDataName: 'Clearance', value: '1')` can be executed by the Tax Clearance application in Alice's profile to add the Tax001.Clearance

output data in the Synapses profile. These calls can be used to execute program applications (gadgets) on behalf of others.

The OpenSocial ActivityService API includes calls for storing activities and retrieving activity streams for each user. In practice, activity streams are the mechanisms for creating notifications for social network participants. The OpenSocialGov container uses an activity stream to provide an efficient way for the assignor and assignees to interact. When an application is unable to find the necessary application data for its execution in a citizen or business profile, an activity thread is created and the profile administrator and assignees are notified of it. The assignees authorized for obtaining the application input data are informed and can participate in the overall process.

In our proposed framework, the Activities mechanism follows the structure of the ActivityStreams format (actor, verb, object, target), where *Actor* indicates the application responsible for creating the activity, verb indicates the activity type (for example, "application executed," "data input required," and so on), object indicates the entity receiving the effect of an activity (in this case, the corresponding profile), and target indicates the notification's recipients (either a specific citizen or a group of citizens such as the assignees). We extended the OpenSocial JSON-RPC calls to handle additional verb and target values from a predefined list—for example, the following call generated by the OpenSocialGov container notifies Jason and all assignees of the Synapses profile about the information missing for the "submit an offer" application execution (see Figure 3):

```
osapi.activities.create(
      userId:'Jason',
      actor: 'Submit an Offer'
      verb: 'Input Data missing'+
      'TaxClearance'+'Insurance
      Clearance',
      object: 'Synapses',
      target: '@administrator,
      @assignees');
```

OpenSocialGov Services

Registries facilitate application discovery; they particularly help when combining applications or performing other complex tasks. However, data are often registered by different organizations, thus compatibility in the terms used to describe them must be ensured. Semantic interoperability between different organization vocabularies is based on a hybrid system that involves a predefined taxonomy maintained by public agencies and a folksonomy formed by citizens using the applications. The application creator lists the input and output data from a vocabulary populated by public agencies, while citizens tag input and output data using their own terms.

The recommendation mechanism is invoked through both the OpenSocialGov container and the application registry. The recommendation mechanism can assist citizens in finding and adding to their profile the necessary applications for a cross-organization task to be accomplished. It can also assist the developer to effectively register the application by indicating the appropriate tag for the input and output data.

Most people today are familiar with social networking technology—especially the supported communication schema and the way relations are established or dropped. Our proposed model gives them a tool that they can easily use to connect with government agencies and services. From the government side, this approach provides a common framework for application integration, avoiding complex interaction schemes and leaving cross-organizational service composition to the citizens themselves. Applications can be developed and integrated in an OpenSocialGov framework at any level (for example, European, federal, and local) in a distributed fashion.

Our future work involves integrating the OpenSocialGov API into our university's private academic social network, called Unity, for the provision of e-Gov services either supported by the university or third-party governmental entities, so that we can test our approach in real-world scenarios. ■

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THE AUTHORS

Alexandros Dais is a PhD candidate and research associate in the Department of Informatics and Telematics at Harokopio University of Athens. His research interests are focused on transformational government, social networks, Web 2.0, information system modeling, and knowledge extraction. Dais has an MSc in advanced information systems from the University of Athens. Contact him via http://galaxy.hua.gr/~adais.

Mara Nikolaidou is a professor in the Department of Informatics and Telematics at Harokopio University of Athens. Her research interests include software and information system engineering, service-oriented architectures, e-government, and digital libraries. Nikolaidou has a PhD in computer science from the University of Athens. Contact her via http://galaxy.hua.gr/~mara.

Dimosthenis Anagnostopoulos is a professor in the Department of Informatics and Telematics at Harokopio University of Athens. His research interests include discrete event simulation, faster-than-real-time simulation, modeling, and simulation of distributed information systems. Anagnostopoulos has a PhD in computer science from the University of Athens. Contact him via http://galaxy.hua.gr/~dimosthe.

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