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An Ontology for Social Networking Sites Interoperability

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Abstract: The Social Networking Sites (SNS) comprise a pool from which developers can pump functionality and data. Usable REST APIs are providing access to two valuable business assets: the users' generated content and social graph. The lack of standards and the antagonistic nature of the SNSs have resulted in the use of proprietary API specifications and -in turn- data models. Each SNS uses a different method to access and a different way to describe notions which are largely similar, e.g. “friends” or shared “multimedia items”. The conceptual similarity between entities “living” in the SNS, creates a remarkable opportunity: The aggregation of the social functionality and data can provide the basis for a unique platform on top of which third parties can deploy new added value services, seamlessly using the underlying SNSs APIs. This paper presents an attempt to implement this concept by means of building a core ontology for supporting SNS interoperability.

1 INTRODUCTION

The advent of mashups and web APIs enabled the routinely use of third parties' platform tools so as to build new applications by leveraging on their content and core functionality. The advantage is immense: without any significant cost for development (just for maintaining the API) on the platform owner's side and by taking advantage of the creativity of external developers, the platform's functionality is extended by added value applications.

Coping with this concept, the Social Networking Sites comprise a typical pool of functionality and data. Their REST APIs are providing access to two valuable assets: the user generated content and social graph. The lack of standards and the antagonistic nature of the SNS have resulted in the use of proprietary API specifications and -in turn- data models. Each SNS uses different ways to access and describe notions which are largely similar, e.g. “friends” or shared "media items”. The conceptual similarity between entities “living” in the SNS, creates a remarkable opportunity: The aggregation of the social functionality and data can provide the basis for a unique platform on top of which third parties can deploy new added value services, seamlessly using the underlying SNSs APIs.

Providing developers with a cross-platform tool that enables them to manage the dynamically generated content and complex social interactions by allowing them to build, deploy and potentially sell services that combine data and functionality from two or more different SNS services disregarding the underlying API implementation, will create an agile and profitable market of services and will bring the Internet of Services concept a step closer to realization.

The proposed solution aims directly at the heart of this challenge: Develop an SNS-like API that will manage to aggregate data and functionality from underlying SNSs that deliver their functionality through web APIs. We call this API "SocIoS API" and it is the core component of the SocIoS integrated solution (http://www.sociosproject.eu).

The SocIoS API is essentially an object model in which on one hand unifies the domain of SNS APIs in order to expose certain concepts that appear repeatedly in the SNS API worlds, while on the other hand, leverages on these concepts and allows services to use them in added value application scenarios. This twofold task presents some interesting characteristics that need to be considered in order to define this specification.

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Our method fosters ideas from both approaches: it defines the core objects of the SocIoS API domain through an ontology which helps to modeling these objects to the underlying SNS APIs using software wrappers (formally called SocIoS adaptors). To build this ontology we start with the conceptual analysis of the application scenario in order to capture the main domain concepts. These include the notions of User, Activity, Group, Multimedia item, Event, Location and Message. Next, we study a number of SNSs in order to identify the API objects that are semantically equivalent to the domain concepts. This helps us to place the domain concepts in the SNS context and examine their relationships and position in the object model hierarchy. The combination of these approaches leads to a conceptualization of the SocIoS domain that is formally captured in the presented SocIoS ontology.

The objective of this ontology is to provide the necessary flexibility of the SocIoS object model so as to be extended as necessary when new SNS APIs or application domains are to be included later in its lifetime. The model is captured using the ontology specification language (OWL) (McGuinness, 2004) that only includes the information that is necessary for an object model. We directly derive the initial SocIoS object model from this ontology. When in the future the SocIoS object model needs to be expanded, the ontology will have to be expanded first, adding the logical relationships between classes that provide a real ontological definition. This ensures that the new definitions are logically correct, i.e. satisfy the conceptualization of the SocIoS ontology. Then, a new SocIoS object model is derived by simplifying from the new ontology.

The document is structured as such: Section 2 provides the related work in specifications and APIs that have similar goals as ours as well as ontologies from which our approach can adopt concepts so as to be extendible. Section 3 presents the domain concepts of SocIoS as the conclusion of an analysis of three real-world application scenarios. In Section 4 the derived domain concepts are projected to existing objects of a group of an appropriate selection of SNS APIs. Finally, Section 5 gives the SocIoS ontology as a result of this analysis and discusses the lower level parameters of the concepts.

2 RELATED WORK

There have been a number of approaches to build a meta-API so as to implement functionality federation and data marshaling from numerous SNSs. However, as stated above, the majority comprise proprietary solutions which limits the extensibility of the platforms to non-supported APIs. Such examples are GNIP®, hootsuite® and Stroodle®.

Even though we study a number of SNS APIs so as to identify the dominant objects that they commonly use, our solution uses mainly OpenSocial (OpenSocial, 2010) as a reference specification. OpenSocial defines a common API for social applications across multiple websites. As it is a product of collaboration of a broad set of members of the web community it naturally encompasses the most dominant SNS concepts. However, OpenSocial is not meant to be used as a meta-API or an aggregator. This results in two reasons for which OpenSocial cannot meet our requirements: a) it is not meant to be adaptive, but rather requires from the underlying APIs to adapt it, and; b) it is overdetailed, providing an extreme number of second-class objects that cannot be mapped to existing API concepts. The issue of adaptability, is the one that mainly led us into seeking an ontology solution.

By defining the SocIoS universe of discourse, we assume that we will manage to capture the common denominator of the core SNS applications. This universe can be used at a higher layer by any service. However, here, we need to make a clear separation. With this work we do not want to model the real world concepts that appear in the SNS as a result of their use. E.g. we are not interested in concepts that derive from tagging multimedia content since this involves practically everything. Various efforts have been put on that aspect with the most prominent work being the one of (Mika, 2007). It is obvious that in the frame of an SNS a user can essentially import and define anything using any type of description, essentially capturing the whole world (or a new world for what is worth). Various crowdsourcing techniques have been proposed for that purpose and most of the SNS encompass functionality for meeting this particular objective (e.g. tagging mechanisms).

Instead we are focusing on conceptual entities that are manifested in the object models of the existing SNSs. By using agreed-upon Semantic Web formats to describe people, content objects, and the connections that bind them together, SNSs can interoperate by appealing to common semantics (Breslin, 2007).

To this end we analyze the existing work in the area of formal specifications of the SNS domain so as to investigate if and how there are ontologies that already capture notions that our approach would like

to define. As such, perhaps the most relevant ontology is the Friend of a Friend (FOAF) (http://www.foaf-project.org/) project the puporse of which is to allow people define their profile, content and relationship to other people and contents so as to interconnect all web resources in a distributed manner.

Another relevant approach is the Semantically-Interlinked Online Communities (SIOC) Core Ontology (Bojārs, 2010) which provides the main concepts and properties required to describe information from online communities (e.g., message boards, wikis, weblogs, etc.) on the Semantic Web (Berrueta, 2010).

Finally, the Linking Open Descriptions of Events (LODE) is an ontology for publishing descriptions of historical events as Linked Data, and for mapping between other event-related vocabularies and ontologies (Shaw, 2010). Thus, the compatibility to SocIoS revolves around the notion of Event and the interplay between real world and SNS world events.

3 APPLICATION SCENARIOS DOMAIN CONCEPTS

As a starting point to our analysis, we employ three application scenarios that stem from real end-user requirements. One scenario is related to journalism and the use of SNS users as a source of information to a multimedia dossier article and two are related to TV commercial production and particularly to the use of social media for location scouting and casting extras. All three applications relate to the exploitation of abstract social networks created on the fly based on demographic and social criteria (e.g. credibility, influences, etc), for finding and retrieving information in a reliable, timely and cost-efficient manner. We analyze these applications so as to define the SocIoS domain of discourse so as to have a reference conceptual classification of our universe.

The conceptual analysis of the abovementioned scenarios leads to the following conclusions:

The SNS **user** is central to the scenario. Their **activity** is important to the end-users who want to monitor it. SNS users can be classified in **groups** so as to allow the end-users better monitor their activity. However, not all users are equally reliable. Their **reliability** is assessed through a rating that is assigned by other SNS users. Furthermore, the basic functionality allows journalists to look for **multimedia items** which are owned by SNS users. Multimedia items can steer end-users' interest if they directly fit to their criteria or if they emerge as central objects in occasions of intense and unusual activity, i.e. an **event**. Typically, an event is taking place at a **location** and this affects greatly the definition of events of interest of the end-users. Finally, communication between SNS users and end-users is achieved through the basic communication channel, which is the **message**.

Based on this short summary, SocIoS concluded to the fact that the domain concepts are the following: User, Activity, Group, Multimedia item, Event, Location, Reliability and Message.

In what follows, we explain how we formally capture and extend these notions based on the actual vocabulary used by the object models of the underlying SNSs.

4 SNS API ANALYSIS

Conceptually, SocIoS, sees the SNS universe as a single social network, in which people are socially connected to each other and the basic social interaction is the sharing of content (text, visual and audio). In order to achieve that, it needs to consider the section of the groups of all the common basic entities of the underlying SNS. This task by itself is rather complex given the highly diverse nature of SNS applications. The entities "living" in them are generally different with the exception of few basic ones (like the notion of people).

This Section explains in a practical way what the main objects in the SNS API domain are which fit to the descriptions of the domain concepts as they generated from the SocIoS scenarios. This analysis is pivotal in the definition of the SocIoS API and the intermediate ontology.

The objective is to identify the common entities that appear in the SNS APIs which follow the semantics of the domain concepts presented above, define them and understand their relationships. For that, we used a list of specific SNS APIs. The selection of these SNS APIs is made according to criteria such as: SNS Popularity, API Popularity, Scope, Openness and Maturity.

Following these criteria, we conducted an analysis of the following APIs: OpenSocial, Facebook, Twitter, FlickR and Youtube. In these SNS APIs, there are objects that express notions that are equivalent to the SocIoS domain concepts, however, they differ in the naming as well as in the hierarchy in the formal description (others are first-class objects, while others are mere object properties). Therefore the relationship is not always

one-to-one, nor the objects are the exact semantic match.

The analysis resulted to a number of objects in the selected SNSs that are semantically equivalent to the abovementioned concepts. These are depicted in Table 1 (in Appendix) and are: Person, Group, MediaItem, Message, Activity, Event, Location and Rating.

A number of conclusions can be extracted from this analysis. Firstly, not all the concepts are supported by all the SNS APIs (marked as "N/S"). Secondly, some objects are implicitly related to the concepts, e.g. a Tweet object is semantically equivalent to a Message. Furthermore, not all conceptually similar objects are of the same class (Location is second-class in OpenSocial, Facebook and Youtube and first-class in all the rest). Finally, the notion of Events in the way it is defined in this document is only existent in Twitter.

Having defined and examined the domain concepts under an SNS context we can move to the designing of the SocIoS Core Ontology.

5 SOCIOS CORE ONTOLOGY

From the abovementioned analysis, it is clear that the method to conceptually model the domain, is a combination of two efforts: map the underlying SNS object models into a single point of reference and model the SocIoS scenarios universe. As seen in Section 4, other domain concepts can be promoted to classes, whereas others remain as properties. Furthermore, the analysis of the objects and their members also assisted in the identification of the most prevalent data properties.

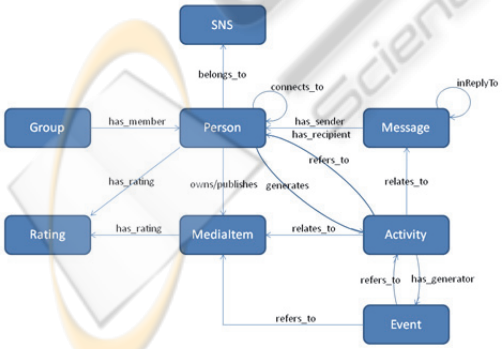

Figure 1: Overview of simplified SocIoS ontology.

Given the above we drafted an ontology that captures the basic context and rules behind the SocIoS domain that we attempted to record. The ontology starts by putting Person and MediaItem as the central entities. Then, it analyzes the relationship that bind these two entities with the rest of the core entities. For practical reasons, a new entity is introduced so as to record the SNS in which a Person is active, publishing and sharing MediaItems. The overview of this ontology is presented in Figure 1.

In what follows we present the classes depicted above along with their properties.

5.1 Person

Properties

- connects_to: Other person entities with whom the person in question shares some kind of relationship (is a friend, follows, etc).
- owns: Photos that are published and owned by this person.
- has_rating: A person has a rating assigned by other people
- belongs_to: The SNS in which the Person exists
- birthday: The birthday of this person.
- displayName: The name of this Person, suitable for display to end-users.
- ethnicity: Person's ethnicity.
- gender: The gender of this person.
- location: Description of a person's location.
- name: The complete person's real name.
- tags: A user-defined category label for this person.

5.2 MediaItems

Properties

- has_rating: Average rating of the media item on a scale of 0-10.
- created: Creation datetime associated with the media item.
- description: Description of the media item.
- duration: For audio/video clips - playtime length.
- last_updated: Update datetime associated with the media item.
- location: Location corresponding to the media item.
- num_comments: Number of comments on the media item.
- num_views: Number of views for the media item.
- num_votes: Number of votes received for voting.
- start_time: For streaming/live content, datetime when the content is available.

- tagged_people: Array of string (IDs) of people tagged in the media item.
- tags: Tags associated with this media item.
- title: Describing the media item.
- type: The type of media.

5.3 Activity

Properties

- relates_to: MediaItem that may accompany the activity
- has_generator: An activity may be generated or related to an event
- refers_to: The person who triggered the activity
- body: Specifying an optional expanded version of an activity.
- publishes: Any photos, videos, or images that should be associated with the activity.
- postedTime: Specifying the time at which this activity took place.
- title: Specifying the primary text of an activity.

5.4 Events

Properties

- refers_to: a (physical, social, or mental) object involved in an event. In SocIoS this is related to MediaItems or Activity.
- atPlace: a named or relatively specified place that is where an event happened.
- atTime: an abstract instant or interval of time that is when an event happened.
- circa: an interval of time that can be precisely described using calendar dates and clock times.
- illustrates: an event illustrated by some thing (typically a MediaItem object)
- location: an abstract region of space (e.g. a geospatial point or region) that is where an event happened.

5.5 Messages

Properties

- has_recipients: Person entities who receive the message.
- has_sender: The person who sent the message.
- body: The main text of the message.
- collections: Identifies the messages collection this message is contained in.
- inReplyTo: Use for threaded comments/messages.
- status: Status of the message. (NEW, READ, DELETED)
- timeSent: The time that the message was sent.
- subject: The subject of the message.

5.6 Rating

Properties

- score: The score that depicts the rating
- range: The score range (min, max).

5.7 Group

Properties

- has_member: Person entities who are members of the group.
- title: Title of the group.
- description: Description of group.

5.8 SNS

The SNS concept captures the notion of the container in which a typical social network is manifested for a person and the mediaitems are shared. Typical examples are Facebook, Twitter, MySpace, YouTube, FlickR.

Properties

- container: The platform SNS, e.g. Facebook, Twitter, etc.

Relevant Definitions

No equivalent notions in other ontologies.

6 CONCLUSIONS

This document summarizes the procedure and the results of the conceptualization of the SocIoS domain as an intermediate step to define the SocIoS Object Model (API). The analysis starts from the domain concepts defined by the SocIoS scenarios and continues with the identification of conceptually common data specifications from various APIs that semantically fit to the domain concepts. The result of this work is captured in the SocIoS core ontology that is expected to assist the developers to better comprehend the notions behind the SocIoS object model and extend it as appropriate.

The ontology permits the extension of the SocIoS API towards any direction, either for including new applications or for supporting further SNS APIs. This flexibility is also crucial in cases of strong dependence on third parties because it allows for quick cope with possible changes. Furthermore, we present how the ontology is linked to semantic

web specifications, a fact that adds to the extendibility of our proposed solution.

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APPENDIX

Table 1: Domain concepts and semantically equivalent objects in selected SNS API (N/S stands for "not supported").

SNS API objects	*Youtube*	users	N/S	media	gd:comments	activity	N/S	ratings	yt:location
	FlickR	people	groups:members	photos	activity:userComments	activity	N/S	stats	places
	Twitter	Users	Lists	Tweets	Tweets and direct_messages	Timeline	Trends	Users:suggestions	geo
	Facebook	User	Group and Friendslist	Photo and Video	Message	N/S	N/S	Review:Rating	Album:Location
	OpenSocial	Person	Group	MediaItems	Message	Activity	N/S	N/S	Person/ MediaItem:Location
Concept		*User*	*Group*	*MediaItem*	*Message*	*Activity*	*Event*	*Reputation*	*Location*