Technische Universität Dresden – Fakultät Informatik
Professur für Multimediatechnik, Privat-Dozentur für Angewandte Informatik

Prof. Dr.-Ing. Klaus Meißner
PD Dr.-Ing. habil. Martin Engelien
(Hrsg.)

GeNeMe '11

Gemeinschaften in Neuen Medien

an der
Fakultät Informatik der Technischen Universität Dresden

mit Unterstützung der

3m5. Media GmbH, Dresden
Communardo Software GmbH, Dresden
GI-Regionalgruppe, Dresden
FERCHAU Engineering GmbH, Dresden
IBM, Dresden
itsax.de | pludoni GmbH, Dresden
Kontext E GmbH, Dresden
objectFab GmbH, Dresden
queo GmbH, Dresden
Robotron Datenbank-Software GmbH, Dresden
SALT Solutions GmbH, Dresden
SAP AG, Resarch Center Dresden
Saxonia Systems AG, Dresden
T-Systems Multimedia Solutions GmbH, Dresden
Transinsight GmbH, Dresden
xima media GmbH, Dresden

am 07. und 08. September 2011 in Dresden

www.geneme.de
info@geneme.de

E.4 On Modeling a Social Networking Service Description

Katja Tietze, Thomas Schlegel
Technische Universität Dresden,
Juniorprofessur Software Engineering ubiquitärer Systeme

1 Introduction

Social network is a notion from sociology and denotes the structure in which individuals or groups are interrelated and, hence, interact with each other by ties of friendship, kinship, work etc. This way, relationships and information spread among members of the social network.

With the proliferation of the Internet, different online representations of social networks emerged, so-called online social networks (OSN), which allow for reflecting and building durable social networks over large distances. Unlike relationships in the physical world, OSN do not require a user to keep a connection alive by communicating at least sporadically. Instead, they foster the passive acquisition of information, so sources of information in form of passing acquaintances will not be lost. Mobile computing supports the use of OSN even more. Due to mobile devices and mobile Internet, online social networking becomes ubiquitous and people are able to exchange information over OSN at any time or place. Most online social networking platforms (OSNP) especially enhance mobile use cases, e.g., by offering push notification. This way, users are enabled to benefit fully from the knowledge of their contacts.

The relevance of OSN in today's communication is pointed out by Heidemann (1), who quotes different surveys on OSN usage. In 2009, 42% of all European internet users were member of an OSN, and 14% of all Facebook users used the platform from their mobile phone. Studies forecast that by the year 2013, 140 million users will be engaging in mobile social networking.

In summary, the mobile use of OSN fosters availability, broad acceptance, and support for quick information exchange over larger distances in ubiquitous contexts. These advantages can be used to improve services in different application domains.

We currently conduct research in the BMWi funded project IP-KOM-ÖV, which aims at developing models and interface standards for information exchange between entities in the public transport. Such entities are control centers of different transport companies as well as (mobile) devices used by passengers. Analysis in the frame of this project showed that public transport in Germany is not centrally organized. Instead, it is state- or even county-specific, so structures, data, or procedures differ between regions and transport companies. As a result, a cross-regional central database holding all relevant information is not possible. Moreover, in public transport, information (e.g., about a deviation from schedule) is time-critical and should be delivered to the user, who can be a passenger or another transport company, at the time of need. Although there are information systems run by individual transportation companies, official real-time data are not usually available directly. This is because a company will not distribute data that it has not checked, but data processing and evaluation are time-consuming. In contrast, in OSN provided data may be created, updated, and published quickly based on collective intelligence, which denotes the phenomenon of self-regulation of content trustworthiness (2). Hence, we argue that extending official information with user-generated content from OSN will help to provide users with nearly real-time information relevant to them at a certain time, for a specific task, or regarding a particular interest. This will also involve users more in the public transport community with benefits for companies and users. As a result, they can react quickly and appropriately to problems in the public transport, e.g., traffic congestions or a lack of serviceability.

However, to allow for using different OSN in order to support a user in the public transport, it is necessary to find answers to the overall research question: How to integrate data and functionalities of different OSN to support a particular task, e.g., sharing data related to a particular journey using the public transport. In this paper, we will address the foundation for answering this question by proposing an approach to decide, in an automated way, which OSN offers functionalities that are best suited to fulfill a particular task. We argue that to facilitate systematic use of OSN especially in the context of public transport, an OSN service description is needed to orchestrate different service providers and customers' applications. Such a description has to be able to classify services including their capabilities and communication channels. In addition, it needs to provide a model infrastructure to discover new and better communication channels and develop a meta-infrastructure for the communication and information structuring based on OSN. It should therefore describe in a machine-readable way which functionality a particular OSN offers. Based on this, a user's application can then automatically pick the best-suited OSN for sending or retrieving particular information.

Apart from passengers, also transport companies can benefit from using OSN. Currently, there is hardly any explicit information exchange between passengers and public transportation service providers although public transport companies replied to us that they see it as an important future information source for them. At present, feedback from customers is usually received via surveys or one-to-one communication in service points. In contrast, OSN foster bidirectional and even multilateral information exchange with a bigger set of customers, transport companies, or other service providers without requiring a lot of time, organizational effort, or financial expenses. This way, service providers can receive data, service evaluation, or recommendations from customers. Such information can help to improve service quality and traffic management.

2 Social Network

In 1954, sociologist Barnes (3) coined the notion of social network to describe a system of interrelated people or groups that does not consist of delimited classes. Instead, an individual or group has very different kinds of relationships to others, even though there are still clusters of heavily interconnected entities. Barnes imagined a social network as a graph and pointed out that "this network runs across the whole of society" and is not restricted to a particular territory or social class.

Others advanced Barnes' notion with focus on the flow of communications. Mitchell (4) comes up with criteria characterizing the interactional process, one of them being directedness. Whether a relation between two nodes in the graph is unidirectional or reciprocal influences how information spread in a social network. Mitchell suggested this interaction criterion to be expressed by the use of asymmetric adjacency matrices, which describe social ties as unidirectional links in a directed graph.

In 1973, Granovetter (5) claimed that the strength[1] of a relationship influences information exchange. The stronger a tie between two people the more similar they are to each other, e.g., regarding interests, workplace, or domicile. Thus, they have many mutual acquaintances, so strong ties form social clusters. In contrast, weak ties can form "bridges", which Granovetter defines to be the only tie between two nodes[2]. As weak ties connect clusters, they foster information exchange between different domains that are not accessible over strong ties. Hence, weak ties help to gain information advantages. This can be helpful in public transport because weak ties allow for retrieving information that would not be accessible by strong ties. Examples are data about traffic congestion in another part of town that causes a bus to be behind schedule, or a cultural event leading to unexpectedly high occupancy rates in public transport. Using OSN, a passenger can receive such data quickly from acquaintances (weak ties) and share them with other users, e.g., close friends (strong ties). This way, data circulate better than they might without the strongly networked structure of OSN.

The notions from sociology were taken up for developing online social networks, which represent social networks and reflect most of the characteristics regarding structure and interactions. Heidemann (1) defines that users are linked by a common aim, interest, or need that permits a corporate feeling even without direct physical presence. Hence, also mobile use of OSN, e.g., on a smartphone, has emerged quickly along with technical developments in mobile computing. As a result, users can benefit from information provided by weak ties any time, any place.

Heidemann (1) points out that most current OSN focus on a particular target audience, e.g., students, business people, or sportsmen. Put in the context of public

---

1 The strength of a tie is a "combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services".

2 To reduce complexity, Granovetter only examines positive and symmetric ties but proposes future research towards directedness.

transportation, this classification is of no use. There is no OSN dedicated to this target group. Instead, passengers are a representative cross-section of the population. As no OSN is explicitly used to support public transportation, users are not gathered in one particular OSN but are distributed over different ones. Hence, these should be combined to help passengers benefit from social networking structures and interaction regardless of the underlying OSN.

For combining different OSN, we propose to use a service description, which has to be based on their offered functionalities. Quan (6) distinguishes between online social network platforms (OSNP), e.g. Twitter, and social networking services (SNS), e.g., micro-blogging, which are offered by these platforms to end users. In this paper, we adopt Quan's terminology. An OSNP's usefulness regarding a particular task, e.g., the distribution of data related to public transportation, strongly depends on the offered SNS. For example, for presenting general information for time-independent retrieval, e.g., schedules, Facebook's static pages are suited, while real-time ad hoc information might better be sent over an OSN providing push notification to users, e.g., Twitter.

3 Classification of Social Networking Services

Regarding the automatic choice of an OSN that is best suited for publishing or retrieving information for a particular context of use, a classification of OSN service features, i.e., offered SNS, is needed. For example, while most OSN reflect individuals or groups and ties between them, unidirectional relationships are not possible in all of them. However, as Mitchell (4) points out, directedness of ties influences information exchange; hence it is an important service feature. That is because symmetric ties require the confirmation of the relationship, i.e., authorization is necessary for access on data.

Quan (6) classifies SNS as follows. First, *Identification and Profile Service* reflects a user's authentic personality by means of profiles, which include data about personal attributes, a photo, and privacy settings for the visibility of these profiles. Second, *Social Graph Service* manages relationships between users based on shared affinities. It consists of components managing connection types, i.e., directedness of ties as pointed out by Mitchell (4), user reputation and search of data in the OSN. Third, *Social Presence Service* allows for user-generated content (e.g., adding multimedia content, status messages, information about done activities or attended events, etc.) and context sensitivity (e.g., tracking of time or location). Fourth, *Social Interaction Service* is meant to foster building and maintaining communities. Examples are multiplayer online games, online feedback services for reviewing (e.g., consumer products), or simply topic-based groups, like an artist's fan club.

Richter and Koch (7) stress that people are knowledge repositories and that social networking can increase productivity and speed of innovation. While the authors put their ideas in the context of company work, we argue that the same is also true for other areas of application, e.g., public transportation. Based on communication theories and analysis of OSN, the authors identify the following six basic functionalities: *Identity management*, *expert finding* (criteria-based search), *context awareness*, *contact management*, *network awareness* (awareness of the actions of contacts), and *exchange*. Obviously, identity management, contact management, network awareness, and exchange can be mapped to the service classification stated by Quan (6).

Rodríguez-Covili et al. (8) classify OSN depending on their original purpose, i.e., the tasks to be fulfilled. The authors identified the following three types of OSN. First, *Friends Social Networks* are used to represent the individual by sharing personal content and communicating with other individuals or groups. Second, *Contacts Social Networks* focus on ties between users, i.e., contact management. Third, *Real-time Information Networks* are used for information exchange and content discovery. Among this category are micro-blogging platforms (e.g., Twitter, Tumblr) as well as location-based networking services (e.g., Foursquare). Apart from OSN, the authors consider so-called MANET-enabled social networks (MESN), which are based on Mobile Ad hoc Networks (MANET). MESN extend the current interaction paradigm of OSN by providing information about the physical presence of other community members in the surroundings of the user. Overall functionality of MESN, as presented by the authors, mainly corresponds to OSN functionality as defined by Richter and Koch (7).

A similar classification, enhanced with a graphical presentation in form of a honeycomb (depicted in Figure 1), is the so-called Webb/Butterfield/Smith Model by Smith (9), The Model includes the following classes of SNS: *Identity*, *presence*, *relationships*, *conversations*, *groups*, *reputation*, and *sharing*. According to Smith, most OSN offer a combination of multiple of these classes but focus on only a few. In the Figure, this is expressed by different shades, darker cells marking the major SNS of the OSN.

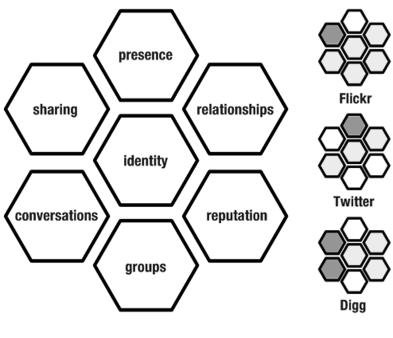

Figure 1: Webb/Butterfield/Smith Model of SNS (9)

4 Service Description

Based on these conceptualizations, research and own considerations we identify the following SNS classes, which are groups of services that can be offered by OSN. Example attributes are given, which characterize the respective class. An attribute set will not be exhaustive, as new functionalities can emerge along with further developments in OSN. Therefore, such attributes are examined that are important regarding public transport from today's point of view.

Table 1: SNS classes as services offered by OSN

SNS class	Description	Attributes
Identity	representation of a user	Profile with personal attributes (e.g., domicile), avatar (for quick indication of identity), interests
Presence	indication of user or content presence in the network	online status (e.g., available, away, busy), status message, history (e.g., recently used bus lines), privacy (e.g., visibility, access restrictions), location (e.g., GPS coordinates, bus stop name)
Relationships	representation of ties to other people	affiliation type (e.g., strength of tie), degree of separation, directedness
Groups	topic-based affiliation without relationship	topic (e.g., a particular bus stop or line), privacy (e.g., visibility, access restrictions)
Content	shared information	content annotation (none / syntactic / semantic), creation dynamics (static contents / dynamic participation, e.g., comment functionality), forwarding (i.e., sharing data of others with own contacts), content types (text, link, file,…), size (e.g., character or byte limit)
Reputation	indication of opinions about contents or users	recommendations (e.g., favorites), warnings, a user's activity level
Conversations	communications among users	privacy (e.g., private / public messages), size (e.g., character limit), dynamics (e.g., comment functionality), time-dependency (synchronous / asynchronous)

Context Awareness	adaptation to a current state	based on: location (e.g., GPS coordinates, bus stop name), time, mobility, topic, affiliation type (e.g., contact / group)
Network Awareness	indication of presence and actions of other users or contents	network architecture (e.g., publish/subscribe), notification (push / pull), search functionality (e.g., none / user search / content-based / topic-based)

This ontology can be presented in different forms, e.g., as XML/RDF/OWL to make it easily exchangeable between entities, like client application and OSNP. An example scenario is given as follows and is depicted in Figure 2. For better understanding, we use a graphical presentation for explanation.

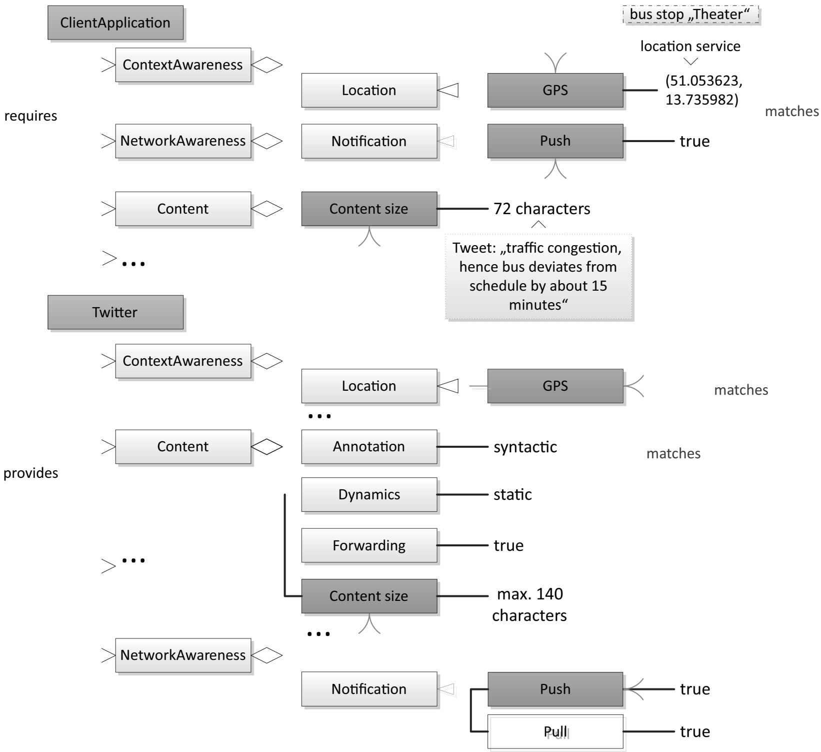

Figure 2: Example scenario with Twitter matched to a public transport case

In our scenario we assume a passenger Dave waiting at bus stop “Theater”. From his friend, who is just riding his bike, Dave receives the information about some traffic congestion. The friend tells about the bus being stuck and that he expects it to be late by about 15 minutes. Dave wants to inform other passengers about the delayed arrival and decides to share his knowledge via social networking. He types the message “traffic congestion, hence bus deviates from schedule by about 15 minutes”, attaches his geo location to it, and marks it as urgent. Dave has accounts in different OSN and does not want to bother to handle these accounts separately. Therefore, he uses the integrated client application, which aggregates the SNS of the different OSN to a Meta Online Social Network, i.e., they appear to be one single, feature-rich service to Dave. Based on service descriptions provided by the OSN the client application decides automatically which SNS is best suited to transport the message. In this case, it infers that an OSN offering immediate, i.e., push user notification (due to the message being urgent) and location-based context awareness (due to Dave having attached his geo data) is best suited to publish the message. By matching these requirements against SNS descriptions, the client application determines Twitter to be an appropriate service. However, Twitter has a size limitation of 140 characters per message, and the matching process will have to consider such requirements by the OSN. In this case, the message is short enough to be sent over Twitter.

5 Conclusion and Outlook

In this article, we have described a basic ontology for Online Social Networks (OSN) that can be used systematically to support users of public transportation services. To allow for such systematic facilitation of OSN, the ontology has been created in a way, which groups services by capability classes and indicates attributes relevant for the usage of an OSN’s Service (Social Networking Service, SNS).

Based on the proposed classification, the ontology can be refined and a full online social network description language can be developed in future research. This description language can then be used to describe OSN in a machine-readable way. Such descriptions can be exchanged, and they will allow client applications to understand about offered functionalities and capabilities. Therefore, client applications can be developed, which allow for systematic and task-oriented facilitation of a combination of different OSN. For the domain of public transport, this will foster new applications to aid passengers, e.g. near real-time information about delays and supportive re-scheduling of planned activities. Due to its abstract and generalized nature, the ontology is suitable for other domains as well.

Having an OSN service description, a global directory of OSN can be provided (so-called Yellow Pages), comparable to UDDI for web-services. The resulting online social networking directory will allow for automatically finding virtual environments and contents that are appropriate to support a user in his current activities, e.g., when

travelling in public transportation systems. Due to the strongly networked structure of OSN, individuals and companies will be able to publish and retrieve information, e.g. about transport infrastructure, schedules, events, or real-time data.
Described SNS classes form a basis for classifying and semantically describing services made available by OSN. They can be used as a basis for the service discovery described above as well as for developing a meta-service that is capable of distributing information across different OSN.
As a result, a cross-platform Meta online social network (MOSN) can emerge, which integrates different OSN so that information can be exchanged semantically between passengers, transportation companies, and service providers crossing OSN and system borders. This exchange can be done by selecting exactly those available communication channels supporting the intended task best, e.g., by offering push notification of users who are interested in particular time-critical information.
Using inheritance mechanisms SNS classes and attributes in the ontology can be extended to fit future needs. For example, an extended service description can allow for matching specialized data: like converting a bus stop location to GPS via a semantic web-service and filling it into the correct parameter of an OSN API – going beyond today's service description and integration. Other factors that should be studied in further research include social aspects. Examples include that users have different audiences and contacts in different OSN, or that they base their choice on their perception of the target audience, style, or reputation of the respective OSN.
SNS description and discovery is only the first, foundational step towards a MOSN enabling its users and organizations to communicate via existing and future OSN in an individualized and powerful way.

Acknowledgements

Part of this work has been conducted in IP-KOM-ÖV project funded by the German Federal Ministry of Economics and Technology (BMWi) under the grant number 19P10003O.

References

[1] Heidemann, Julia. Online Social Networks - Ein sozialer und technischer Überblick. Informatik-Spektrum. 2010, Bd. 3, 33.
[2] Roman Hoegg, Robert Martignoni, Miriam Meckel, Katarina Stanoevska-Slabeva. Overview of business models for Web 2.0 communities. Proceedings of GeNeMe. s.l. : Universität St. Gallen, 2006.
[3] Barnes, John Arundel. Class and Committees in a Norwegian Island Parish. Human Relations. 7, February 1954, Vol. 1, pp. 39-58.
[4] Mitchell, James Clyde. The Concept and Use of Social Networks. Social Networks in Urban Situations. s.l. : Manchester University Press, 1969.

[5] Granovetter, Mark S. The Strength of Weak Ties. American Journal of Sociology. 1973, Bd. 78, 6.
[6] Quan, Huangmao. Online Social Networks & Social Network Services: A Technical Survey. Pervasive Communication Handbook. s.l. : CRC Press, 2011.
[7] Richter, Alexander and Koch, Michael. Functions of Social Networking Services. Carry-le-rouet, France : 8th International Conference on the Design of Cooperative Systems, 2008.
[8] Rodríguez-Covili, Juan, Ochoa, Sergio F. und Aliaga, Raúl. Extending Internet-Enabled Social Networks. 2011.
[9] Smith, Gene. Social Software Building Blocks. nForm. [Online] 04. April 2007. [Zitat vom: 07. May 2011.] http://nform.com/publications/social-software-building-block.