2006

Socially targeted mobile services: towards an upper level ontology of social roles for mobile environments

Nikolaos Korfiatis
Department of Informatics, Copenhagen Business School, nk.inf@cbs.dk

Ioanna D. Constantiou
Copenhagen Business School, ic.inf@cbs.dk

SOCIALLY TARGETED MOBILE SERVICES: TOWARDS AN UPPER LEVEL ONTOLOGY OF SOCIAL ROLES FOR MOBILE ENVIRONMENTS

Nikolaos Korfiatis, Ioanna Constantiou

nk.inf@cbs.dk, ic.inf@cbs.dk

Department of Informatics, Copenhagen Business School (CBS)
Howitzvej 60, DK-2000, Frederiksberg
Denmark

Abstract

The Semantic Web has recently attracted the attention of both researchers and practitioners in the information systems field. In this paper we explore an application of Semantic Web in mobile context. In particular we focus on the development of advanced models of mobile service provision by contextualizing users' interaction characteristics through an upper level annotation ontology. The Semantic Web enables richer representations of context, which combined with the interaction and communication modalities attached to the device enrich user experience. We propose an ontological representation of user stereotypes through the concept of social roles. This representation can be used in further research on content negotiation and deployment of different interaction styles that are subject to the stereotype.

Key-Words: Semantic Web; Social Roles; Mobile Services; Content Provisioning; Ontologies.

1 INTRODUCTION

Advances of mobile technologies and telecommunication networks have changed the use of mobile phones from voice transmission devices to means of social expression which have transformed the way people communicate and coordinate their activities (Persson, 2001). As the features of mobile devices are continuously extended, apart from the communication side, other usage aspects such as entertainment, task oriented or informational ones have emerged. At the current state of research on usage and adoption of mobile devices and services, a discussion about the interaction capabilities of the mobile phone and thin clients in general (Tarasewich *et al*, 2001; Buchanan *et al*, 2001; Lindholm *et al*, 2003) has been initiated. However, the research on factors affecting device's usage based on contextual and inter-personal parameters that arise from the social environment of the user (Palen *et al*, 2000; Kaasinen, 2003; Tamminen *et al*, 2004) is not abundant in mobile domain. Research efforts on human computer interaction such as "*persona*" oriented research (Pruit *et al*, 2006; Mcbreen *et al*, 2000) offer a research paradigm that provides a ground on modelling and individualizing behaviours and usage of the mobile phone from archetypes/persons. However, the mobile phone is a social device which is exposed to our contextual surroundings such as the workplace, the entertainment areas etc. and research on individualistic level can often limit the understanding of scope of mobile device's usage (Rodden *et al*, 1998, Henricksen *et al*, 2002). Thus, context specific research may offer more rationalistic and systematic understanding of the factors that influence device's usage and adoption of mobile services (Pedersen and Ling, 2003).

Content based services that may be offered through a partnership of a mobile operator with a content provider are affected by context (Podnar *et al*, 2002). For example an operator may form a partnership with a newspaper in order to provide a service that delivers the headlines to the subscriber. However, we observe that the development of content based and other type of mobile services is uniform in terms of the provided content, the interaction capabilities of the device, the usage habits of the subscriber and the surrounding context. Operators use methods that customise content and service provision mechanisms based on the particular device used by the subscriber (Wagner *et al*, 2002). We believe that the potential of mobile services can be further exploited when context information is used as an input to the adaptation and personalization of the service provision model. Current content encoding and provision standards such as WAP/GPRS use technology that is implemented for the web (HTML/XHTML, embedded multimedia) and targets primarily web browsers deployed on desktop computers. In case of mobile platforms a set of problems may arise with the most significant being the interaction capacity that the current encoding demands (Tyrväinen, 2003). For example, a large website is easy to navigate when using a desktop computer but on the other hand the interaction when navigating the website and getting information is reduced when it comes to the mobile device.

Semantic Web technology as a vision of creating a machine processable web (Berners-Lee *et al*, 2001) can provide a unique value proposition for the advancement of mobile service provision models (Lassila *et al*, 2003). The improved representations of content for mobile services can lead to new service provision models offering more personalized and value added service (Subramanya and Yi, 2005). Moreover the definition of context can be enriched allowing reasoning techniques to extract the required knowledge in order to provide an enhanced service to the subscriber.

The objective of this paper is to propose an ontological representation of user stereotypes which take into account the interpersonal and social aspects of context such as interaction in massive networking scenarios along with the device interaction capabilities. In particular we use insights from social role theory (Biddle, 1979) to model stereotypes of users that can be subscribers of

mobile services. This is expected to advance the service provision model by enhancing the partnership of the content provider with the mobile operator.

Following this objective, the paper is organized accordingly. Section 2 reviews the current research on context representation from a Semantic Web perspective. Section 3 briefly introduces the main insights of social role theory. Then in section 4 we construct an ontology of social roles and incorporate them as an input to the service provision model discussed in section 5. Finally the paper concludes with an outline of future research steps.

2 REPRESENTATIONS OF CONTEXT IN THE SEMANTIC WEB

In pervasive and ubiquitous computing research, context is used as a concept to describe the state under which a person uses a pervasive capable device (Abowd *et al*, 1998). The context mainly describes spatiotemporal characteristics of the circumstances under which a person is invoking a service and initiates an interaction scenario. According to Schlit *et al* (2002) context in a pervasive environment often consists of:

- the physical or virtual location of the user,
- the identity of the user including a user model with information about the user's interests, preferences and knowledge, the time (day/night time working hours, weekend, etc) and the environment (the task or activity in a current situation; other users)

However the context information may need to be expressed with richer definitions such as those prescribed by ontologies and rich vocabularies. In the related literature definitions of context often involve meta-characteristics of information such as application and system state (Dix et al, 2000; Abowd *et al*, 1999). The importance of context has been highlighted in context-aware computing with several instances involved in different aspects (see table 1). The richer the definition becomes the more adaptive and value added the provided service is (Schlit *et al*, 1994). Furthermore a value added service often prescribes the need for adaptivity based on the context characteristics of the interaction scenario.

Definition of Context	***Instances Involved***
Locational	Space, Movement, Virtual
Spatial	Time, Calendar, Time Line
Social	Public, Personal, Group

Table 1: Context's use on the Representation of States in Pervasive Scenarios. Adapted from (Dix, 2000)

The interoperability perspective of the Semantic Web addresses the need of providing different forms of representation regarding the same information resource. To this end a resource may be characterized by different instances which result a richer definition of the context related information such as domain, application and higher level such as communication etc. Semantic Web is addressing this need through:

(a) Semantic Web Languages and Appropriate Vocabularies that have representation power to describe the various associations between the different levels of context information.

(b) Expressiveness that can be attached to the user behaviour or the service and establish a negotiation layer that can be supported by the availability of logic inference engines. This

becomes important because context information is incomplete and needs a stage of reasoning to be accurate.

(c) Development of scenario's specific vocabularies for the description of usage and the interaction with the service, which can be achieved through using the meta-languages.

Application Scenario	***Ontological Approach***
Semantic Web as a paradigm for Ubiquitous Computing (Masuoka *et al*, 2003)	Ontologies as a way of manipulation and composition of complex tasks over an interaction paradigm.
Semantic Web as enabling infrastructure for m-Commerce (Sadeh *et al*, 2003)	Ontology languages as a way of interoperable representation of contextual parameters regarding products and recommendations in m-commerce scenarios
Semantic Web as an interoperability framework for mobile agents (Chen *et al*, 2003)	Representation of context and states using ontologies that provides a ground for inference based on different states.

Table 2: Examples of Mobile and Pervasive Scenarios for the Semantic Web

Table 2 provides some examples of Semantic Web approaches on different scenarios. For instance Semantic Web has been used in modelling pervasive context information in computing paradigms such as Task Computing (Masuoka *et al*, 2003) and richer definitions of context for m-commerce scenarios like the expression of customer's preferences (Sadeh *et al*, 2003).

3 APPROACHING HIGHER LEVEL CONTEXT: AN ONTOLOGY OF SOCIAL ROLES

In our research approach we assume that an individual who uses a mobile device, depending on the task, the device's interaction capacity and his usage habits/interaction style, is enacted to a role that might be changed due to the context, either being locational, spatial or social. Aspects of social roles and social interaction (Kelley, 1972) have been studied extensively in Sociology. In particular individual's changes in behaviour in different contextual settings have been studied extensively in social psychology where the concept of social roles was introduced by pioneers such as Bidle (1960), Nadel (1957), and Homans (1961). Sarbin (1954) provided the basic definition of a social role as to be *"….a patterned sequence of learned actions or deeds performed by a person in an interaction situation"* (p.255). We prefer the definition of social roles rather than the HCI widely used *"personas"* that focus on characteristics attached to a person. Social role is more flexible and can be changed according to the context

Mobile devices are solely attached to their owners and are often used as intermediaries on the interaction situations. For instance, a mobile user wants to interact with another user who is having a meeting and due to the context of that particular situation, the social role is being changed. Besides a mobile user may wish to use a service that is dependant on the device characteristics but these characteristics may not be needed for an invocation of another mobile service. The service should be invoked in such a way that the interaction will be indisputable regarding the input and output modalities as well as the acquisition of relevant information required for executing a specific task.

An important design challenge involves the integration of the characteristics of a social setting (while i.e. performing an activity or sitting in a workplace or a bar) with the services characteristics

and interaction styles available. We develop an upper level ontology for the description of mobile content services as well as design classes that are specific to different social roles and their characteristics. In particular we elaborate on the results Mobiconomy Project[1] (Constantiou *et al*, 2005a) that included several field studies to explore mobile users' behaviour in Denmark. In these studies the authors proposed four groups of mobile users with specific interaction characteristics. We model the profiles of these groups in four indicative social roles (Table 3):

Social Role	***Characteristics***	***Interaction Characteristics***
Talker	Uses Voice Services only	Voice Interface,
Writer	Uses SMS in addition to voice	Keyboard, Stylus
Photographer	Uses of MMS in addition to voice and SMS	Camera, Colour Display
Surfer	Uses data services in addition to SMS,MMS and voice services	GPRS, Bluetooth, Broadband internet

Table 3: The proposed Social Roles and the related interaction characteristics as adapted by (Constantiou et al, 2005b)

Based on the definition of major instances of social roles we build an ontology service model. This is expected to combine the social role with the prescribed characteristics in order to address a value added mobile service provision model.

4 THE DREAMS ANNOTATION ONTOLOGY

In the ontology development we attempt to integrate and explore representational aspect of contexts from existing applications. For example standards such as the Composite Capabilities / Preference Profiles part of the Device Independence activity of W3C (Klyne *et al*, 2004) as well as industrial applications towards their integration (Buttler, 2002; Indulska *et al*, 2003) provide input for their application in our project. Therefore our final goal is to define an annotation ontology (we name it DREAMS Ontology) to support both knowledge representation and communication interoperability regarding different aspects of context and in particular definitions of social context and its surrounding activities. In the development of the ontology we take an extra step for the definition of social roles requiring the adaptation of the service environment.

[1] For more details about the Mobiconomy project see: http://www.mobiconomy.dk

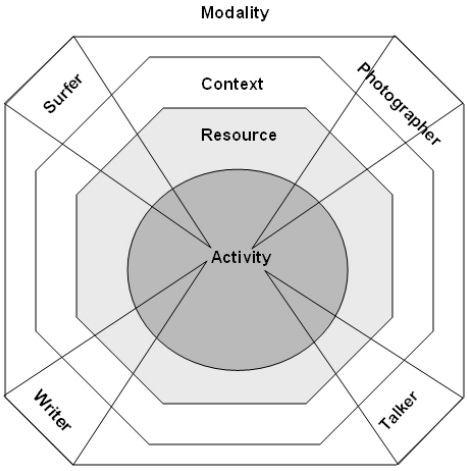

Figure 1: The layers of the DREAMS ontology

The DREAMS ontology is structured in five different layers (Figure 1). Each layer involves a representation of a state supporting the provision of the mobile service. These layers are:

- **Activity** that contains predicates regarding the physical or social state of a mobile user that is requesting the service. In particular the activity describes the properties of a role attached to the user requesting the service. Such predicates may be the interaction characteristics described in Table 3. Yet, participation in one activity doesn't necessary exclude participation in another.
- **Resource**: that describes the type of information resource requested. For instance content requested from a web page, Media file such as an image etc.
- **Context**: that includes entities sensitive to the social settings located and communicated through an activity. A context layer can represent a category of activities with different demands and expectations which derive from the social settings. For instance the use of the camera and the associated service by a professional (e.g. a real estate agent pictures a house) and the use of the same service by a teenager define a different domain of activities regarding the service's context of use.
- **Modality** that represents the necessary input, output and communication characteristics (modalities) of the device such as Screen Resolution, Stylus Input or Data Access (e.g. via WiFI or GPRS).

The four layers are represented by classes in the ontology that we develop with the collaboration of domain experts such us mobile device manufacturers, mobile service operators and content providers.

To describe the classes representing the aforementioned layers of the DREAMS ontology we use the web ontology language (OWL) and in particular a variance of OWL, OWL-Lite which is the least expressive sub-language of OWL (McGuinness and Van Harmelen, 2002). A key reason to use OWL-Lite is ease to migrate from existing thesauri such as those developed in field studies. Furthermore the web ontology language belongs to the family of web languages deployed by W3C's Semantic Web activity[2] and is a language that facilitates a wider level of interoperability due to the facts that provides a more generic vocabulary on describing properties and classes. Moreover it describes relationships between these classes providing support for richer semantics than the

[2] http://www.w3.org/2001/sw/

widely deployed resource description framework (RDF). The following fragments represent annotations of the social roles of “Photographer” and “Surfer” along with the required properties.

```
ROLE(Photographer,uses(InputModality(Camera)),requires(OutputModal
ity(CollourDisplay))
```

```
ROLE(Surfer,uses(InputModality(*)),requires(OutputModality(*),requ
ires(CommunicationModality(GPRS|BroadBand|WAP))
```

Figure 2: Upper and Sub-Class Hierarchy in the DREAMS Ontology

The definition of interaction and communication modalities is based on the CC/PP vocabulary which is extended to cover the interaction properties. The following fragment of code represents the input capabilities of the device Nokia 3250 with the expression of the characteristics of the camera.

```
<owl:Class rdf:about="http://mobiconomy.dk/dreams/Camera">
<rdfs:subClassOf  rdf:resource="http://www.mobiconomy.dk/dreams/input_modality"/>
</owl:Class>
<ccpp:component>
<rdf:Description rdf:about="http://mobiconomy.dk/dreams/device">
  <rdf:type rdf:resource=" http://mobiconomy.dk/dreams/device#InputModality" />
       <ccpp:defaults>
     <rdf:Description rdf:about=" http://mobiconomy.dk/dreams/device/nokia3250">
       <rdf:type rdf:resource=" http://mobiconomy.dk/dreams/device#Camera"/>
            <prf:name>ColourCamera</prf:name>
            <prf:vendor>CarlZeis</prf:vendor>
```

```
          <prf:resolution>1.8mpx</prf:version>
        </rdf:Description>
      </ccpp:defaults>
    </rdf:Description>
  </ccpp:component>
```

An example representation of context can be based on extensions of the existing FOAF vocabulary (Brikley and Miller, 2001) as follows:

```
<foaf:Person>
 <foaf:device><model>Nokia3250</model></foaf:device>
  <owl:ObjectProperty  rdf:about="http://www.mobiconomy.dk/dreams/inContext">
    <rdfs:domain rdf:resource="http://www.mobiconomy.dk/dreams/Social_Role"/>
    <rdfs:range rdf:resource="http://www.mobiconomy.dk/dreams/Context"/>
  </owl:ObjectProperty>
</foaf:Person>
```

The above fragments are examples of input on application scenarios that can be explored in a service provision model that will be built on top of the DREAMS ontology.

5 APPLICATION SCENARIOS

Before combining the different layers of the ontology with the associated content an annotation process needs to be instantiated in order to provide the necessary input for the service provision model.

In the proposed model we separate mobile service provision in three different layers:

- The Annotation Layer: The content provider offers content and an annotation process is instantiated by the mobile operator in order to enrich the mobile content using the DREAMS ontology.
- The Service Provision Layer: The context information expressed with the FOAF vocabulary and the device's interaction capabilities are input to the model in order to deliver the service. Content negotiation is initiated as an input to the next layer.
- The interaction layer: the subscriber interacts with the service having the maximum interaction capability that his/her device permits.

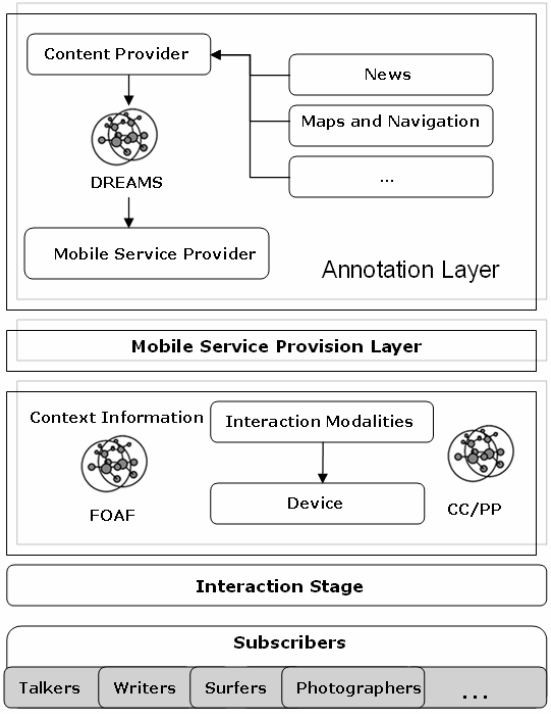

Figure 3: The DREAMS Service Provision model

However in order to implement the proposed service provision model a set of preliminary steps need to be carried out such as the extension of FOAF vocabulary to reflect lower and higher level definitions of context and the richer expression of input and output modalities with the CC/PP ontology. Furthermore the incorporation of the annotation ontology in the content and the matchmaking between the interaction capability and the provided content may need support for richer reasoning than the reasoning provided in the OWL-Lite definition.

6 FUTURE RESEARCH

The paper presents research in progress that aims to redefine a model of mobile service provision to exploit the interaction capacity of modern mobile devices and serve as a testbed for experiments to explore behavioural characteristics that influence the adoption and the use of services on mobile and wireless networks. To this end a set of important steps have to be carried:

(a) *Organizational Level:* the Content Provider and the Mobile Operator have to align their partnership and separate the annotation and channel definition process

(b) *Ontological Level:* the current ontology has to be extended to provide support for multiple profiles based upon the interaction capabilities of the device. In that case an ontological engineering process with the support of domain experts needs to be established.

(c) *Operational Level:* The development of the necessary tools to support the annotation and the matchmaking of the interaction and service provision profiles.

(d) *Evaluation Level:* the definition of scenarios for the evaluation of the service model.

Balancing the above four levels is the key answer to the success and further advancement of the presented research.

Acknowledgements

This research was conducted as part of the DREAMS Project at Copenhagen Business School. DREAMS is partially supported by the Danish Research Agency, grant number 2106-04-0007.

References

Abowd, G. D., Dey, A. K., Orr, R. Brotherton, J.,(1998) Context-awareness in wearable and ubiquitous computing, Virtual Reality,3,(3), Pages 200 - 211

Abowd, G. D., Dey, A. K., Brown, P. J., Davies, N., Smith, M., and Steggles, P. (1999). Towards a better understanding of context and context-awareness. In *HUC '99: Proceedings of the 1st international symposium on Handheld and Ubiquitous Computing*, pages 304-307, London, UK. Springer-Verlag.

Berners-Lee, T., Hendler, J., and Lassila, O. (2001). The Semantic Web. *Scientific American*.

Biddle, Bruce J. (1979). *Role Theory: Expectations, Identities, and Behaviours*. NY: Academic Press.

Brickley, D. and Miller, L. (2005). FOAF Vocabulary Specification. W3C Technical Report

Buchanan, G., Farrant, S., Jones, M., Thimbleby, H., Marsden, G., and Pazzani, M. (2001). Improving mobile internet usability. In *WWW '01: Proceedings of the 10th international conference on World Wide Web*, pages 673-680, New York, NY, USA. ACM Press.

Buttler, M. (2002). CC/PP and UAProf: Issues, improvements and future directions. Technical Report. Hewlet Packard Labs

Chen, H., Finin, T., and Joshi, A. (2003). An ontology for context-aware pervasive computing environments. *The Knowledge Engineering Review*.

Constantiou, I.D., Blechar, J. and J. Damsgaard, (2005). "New Mobile Services and the Internet: Friend or Foe?" IRIS28 : Kristiansand, Norway August 6-9, 2005

Constantiou, I.D., Damsgaard J. and L. Knutsen, (2005). "Beware of Dane-Geld: Even if Paid, M-Service Adoption Can be Slow" In the proceedings of European Conference on Information Systems, May 26- 28,Regensburg, Germany.

Dix, A., Rodden, T., Davies, N., Trevor, J., Friday, A., and Palfreyman, K. (2000). Exploiting space and location as a design framework for interactive mobile systems. *ACM Trans. Comput.-Hum. Interact.*, 7(3):285-321.

Henricksen, K., Indulska, J. and Rakotonirainy, A. (2002). Modelling Context Information in Pervasive Computing Systems, *in* 'Pervasive '02: Proceedings of the First International Conference on Pervasive Computing', Springer-Verlag, London, UK, pp. 167--180.

Homans, G. C., (1961) Social Behaviour: Its Elementary Forms . NewYork. Harcourt, Brace& World.

Indulska, J, Robinson R, Rakotonirainy A, Henricksen K,(2003) Experiences in Using CC/PP in Context-Aware Systems, Lecture Notes in Computer Science, Volume 2574, Jan, Pages 247 - 261

Kaasinen, E. (2003). User needs for location-aware mobile services. *Personal and Ubiquitous Computing*, 7(1):70-79.

Kelley, H. H. (1972). Attribution in social interaction. In E. E. Jones, D. E. Kanouse, H. H. Kelley, R. E. Nisbett, S. Valins, & B. Weiner (Eds.), *Attribution: Perceiving the causes of Behaviour* (pp. 1-26). Morristown, NJ: General Learning Press.

Klyne, G., Reynolds, F., Woodrow, C., Ohto, H., Hjelm, J., Buttler, M.H. and Tran, L. (2004), Composite Capability/Preference Profiles (CC/PP): Structure and Vocabularies 1.0, Technical report, W3C Recommendation

Lassila, Ora and Adler, Mark. "Semantic Gadgets: Ubiquitous Computing Meets the Semantic Web", in Dieter Fensel *et al* (eds.): “Spinning the Semantic Web ". pp.363-376. MIT Press. 2003

Lindholm, C. and Keinonen, T. (2003). *Mobile Usability: How Nokia Changed the Face of the Mobile Phone*. McGraw-Hill Professional.

Masuoka, R., Parsia, B. and Labrou, Y. (2003), "Task Computing - the Semantic Web meets Pervasive Computing", *in Proceedings of 2nd International Semantic Web Conference (ISWC2003)*

Mcbreen, H., Shade, P., Jack, M., and Wyard, P. (2000). Experimental assessment of the effectiveness of synthetic personae for multi-modal e-retail applications. In *AGENTS '00: Proceedings of the fourth international conference on Autonomous agents*, pages 39-45, New York, NY, USA. ACM Press.

McGuinness, D. and van Harmelen, F (2002). Feature Synopsis for OWL Lite and OWL.W3C Technical Report

Nadel, S.F. (1957). “The Theory of Social Structure”. London

Palen, L., Salzman, M., and Youngs, E. (2000). Going Wireless: Behaviour & Practice of New Mobile Phone Users. In *CSCW '00: Proceedings of the 2000 ACM conference on Computer supported cooperative work*, pages 201-210, New York, NY, USA. ACM Press.

Pedersen, P. E. and R. Ling (2003). Modifying adoption research for mobile Internet service adoption: Crossdisciplinary interactions. HICSS, Hawaii.

Persson, P. (2001). Social ubiquitous computing. In *Workshop on Building the Ubiquitous Computing User Experience. Proceeding of the ACM SIGHCI Conference*, Seattle.

Podnar, I., Hauswirth, M. and Jazayeri, M. (2002), "Mobile push: delivering content to mobile users". *Proceedings of 22nd International Conference on Distributed Computing Systems Workshops*, p. 563- 568,

Rodden, T., Cheverst, K., Davies, K., and Dix, A. (1998). Exploiting Context in HCI Design For Mobile Systems. In Johnson, C., editor, *Proceedings of the First Workshop on Human Computer Interaction with Mobile Devices*, Glasgow, Scotland.

Pruitt, J., & Adlin, T. (2006). *The persona lifecycle: Keeping people in mind throughout product design. The Morgan Kaufmann Series in Interactive Technologies*. First Edition. Morgan Kaufmann.

Sadeh, N.M., Chan, T., Van, L., Kwon, O. and Takizawa, K. (2003), A Semantic Web environment for context-aware m-commerce, *in EC '03: Proceedings of the 4th ACM conference on Electronic commerce*, ACM Press, New York, NY, USA, pp. 268--269.

Sarbin, T. R. 1954. “Role Theory.” In *Handbook of Social Psychology*, vol. I., edited by B. Gardner Lindzey, pp. 223-258. Cambridge, MT: Addison-Wesley.

Schilit, B, Adams, N . and Want, R. (1994). Context-Aware Computing Applications, in *Proceedings of the Workshop on Mobile Computing Systems and Applications*, Santa Cruz, CA. IEEE Computer Society.

Schilit, B. N., Hilbert, D. M., and Trevor, J. (2002). Context-aware communication. *IEEE Wireless Communications*, 9(5):46-54.

Subramanya, S. R. and Yi, B. K. (2005). Mobile content customization. *IEEE Multimedia*, 12(4):104-104..

Tamminen, S., Oulasvirta, A., Toiskallio, K., and Kankainen, A. (2004). Understanding mobile contexts. *Personal and Ubiquitous Computing*, 8(2):135-143.

Tarasewich, P., Nickerson, R., and Warkentin, M. (2002). Issues in mobile e-commerce. *Communications of the AIS*, 8.

Tyrväinen, P. (2003). "Estimating Applicability of New Mobile Content Formats to Organizational Use," *Proceedings of the 36th Hawaii International Conference on Systems Sciences*. Hawaii, IEEE Computer Society Press,

Wagner M., Balke W.-T., Hirschfeld R. and Kellerer W. (2002). A Roadmap to Advanced Personalization of Mobile Services. In *Proc. of the Int. Federated Conferences DOA/ODBASE/ CoopIS (Industry Program)*. Irvine, CA,.

Van Mulken, S., Andre, E., and Muller, J.(1998). The Persona Effect: How Substantial Is It? In *HCI '98: Proceedings of HCI on People and Computers XIII*, London, UK.