Guest Editorial Preface

Mobile Services and Ontologies: An Overview

Christoph Bussler, BEA Systems, Inc., USA
Birgitta König-Ries, Friedrich-Schiller-Universität Jena, Germany
Dumitru Roman, University of Innsbruck / DERI Innsbruck, Austria
Jari Veijalainen, University of Jyväskylä, Finland

Abstract

It is a fair question to ask whether or not services, ontologies, and mobility all thrown together in one issue will make a strange and somewhat arbitrary mix of themes. As we will demonstrate in this article, this is most definitely not the case. In the contrary, it is our belief that only the combination of ontologies and services will provide an appropriate platform to support mobile applications. In the next few sections, we will elaborate on this combination. In our discussion, we also summarize contributions that constitute this special issue.

Vision

In the following, we will use an example to show the potential benefits of combining services and ontologies in mobile environments. Of course, the example below is just a tiny glimpse of what would be possible. There are many other mobile application scenarios where the combination of services and ontologies would be beneficial. These examples range from smart production environments and the seamless integration of mobile workers in business processes to mixed reality multiplayer games, where physical location determines the outlook on the virtual world and the scope of possible actions. While all these scenarios are exciting, they require quite a bit of explanation before one can introduce the aspects relevant for us. Therefore, we stick to the maybe less exciting, but time-tested, well understood, and possibly—at least in the near future—more realistic travel scenario.

Anna, a computer scientist, is on her way to a conference to give a talk. Since she likes to travel light, she only brings her smart phone along. When she arrives at her destination airport, a local map is being pushed onto her cell phone by a service that she subscribed to from home. With the help of this map, she finds her way to the bus station where she can access an up-to-date time table. While she waits for her bus to arrive, she notices an advertisement for the local cinema describing this week’s shows. That evening, a movie will be shown that Anna had been planning to see for a while. The ad is equipped with NFC tags. She reads the one next to the movie that she is interested in and is connected to the cinemas online reservation system. She makes a reservation which will be billed to her phone bill. She receives a token on her cell phone that will allow her entry to the cinema later on. After a relaxing evening at the theater, the next day, at the conference, she uses an application provided by the conference organizers that lets her know, which other participants have interests similar to her own and alerts her when any of those are in her vicinity.
vicinity. For her talk, Anna “tells” the system in the meeting room that she wants to use a display medium and have the lights adjusted to optimize the viewing of her slides. Anna could achieve all this by manually looking for appropriate information sources and addressing them—however, this would be cumbersome and unattractive.

At lunchtime, Anna goes to a nearby cafeteria to grab something to eat. Anna has some allergies and thus needs to be careful about the food she chooses. Luckily for her, the items in the cafeteria are equipped with RFID tags. Anna is able to obtain information about the ingredients from these tags, and can therefore easily choose a meal that is safe for her to eat.

The service-oriented computing paradigm offers a means to achieve the functionality described above without the need for manual intervention: devices describe the functionality they can offer to the network in terms of services.

Examples for such services could be the provision of a display medium, the ability to use CPU time, or access to information stored on a device. On the other hand, devices can describe their needs in terms of service requests. A device could, for instance, request a service providing information regarding train connections from Tokyo to Kyoto or request a service converting a document from postscript to PDF format.

Service descriptions are the part where services and ontologies meet: in order for Anna’s device to be able to interpret what services are available around it, it needs to be able to interpret their descriptions in a correct way. This will only be possible if they use an agreed upon formal vocabulary, that is, an ontology.

The example should make it obvious why the automatic usage of services is particularly compelling in mobile environments; Anna’s device is neither powerful enough to store all the information she might need nor to provide all the functionality she might want to use. On the other hand, Anna cannot statically attach her device to some external service or content provider as she is moving. She therefore needs to be able to find appropriate providers in her current environment. And actually, not Anna needs to be able to find them, but her device. If we use the right technology, Anna does not need to be bothered to do this.

OVERVIEW OF THE SPECIAL ISSUE

The call for articles for this special issue has its roots in the MoSO (Mobile Services and Ontologies) Workshop Series held in conjunction with the international conference on Mobile Data Management in 2006 (MosO, 2006) and 2007 (MoSO, 2007). In the call for articles, we asked for submissions dealing with, among other things, architectures for mobile service-oriented environments, semantic annotation and reasoning involving semantic metadata and the combination of thematic metadata with locational/georeferenced metadata in mobile applications. After publishing the call, we received quite a number of submissions. Thanks to the support of the IJSWIS editors, and the hard work of our theme issue’s distinguished Program Committee, through two rounds of peer review, we are able to deliver into your hands now four high quality articles chosen from these submissions. Taken together, these articles illuminate different aspects of the combination of services and ontologies in mobile environments. In the following sections, after briefly presenting the notions of ontology and service, we will introduce you to all four of these articles and will put them in a broader perspective by giving a brief overview of the areas they relate to. The first area deals with the meeting of ontologies and mobility. On the one hand, ontologies can be used to overcome some of the difficulties present in mobile environments; on the other hand, the usage of ontologies in resource-restricted mobile environments is a challenge in itself. One of our articles, thus, deals with the important question: Where will these ontologies come from? How will they be administered? Could a separate ontology market emerge one day? The latter ones are among the most challenging questions in this context. A second article explores the usage of ontologies in mobile agent systems.

The second, still very young area of interest, is the inclusion of real-world artifacts into mobile computing. This has become feasible via the widespread use of, for example, NFC and RFID tags. Two of the articles examine the implications of this new technological trend and methods to take advantage of the information that becomes available via their usage.
BACKGROUND: ONTOLOGIES AND SERVICES

In the most general sense, the study of ontology is the study of conceptions of reality and the nature of being. Ontology has been studied in philosophy, where the emphasis is on the study of being or existence; in the context of the Western philosophy, the study of ontology forms the basic subject matter of metaphysics (because these books came “after the physics” in Aristotle’s collection). Ontology is always closely related with epistemology that asks “what can we know (about reality)”. If we cannot know anything, then we cannot tell whether there is more than one reality, whether there are objects in the other reality and which of them really exist. One fundamental question addressed by all cultures is the nature of movement and change. Is the deepest essence of reality continuous movement and change? Are stable “real” objects just human illusion or a particular way to perceive the external reality (using discrete concepts)? Are movement and change human illusions and is the deepest reality stable? All these questions have been studied prior to the Greeks in the human history, for example, by Chinese and Indian philosophers and they are still relevant in the information era. For instance, the logic first formulated by Aristotle and used in a further refined form in computer circuitry is not the only possibility (see e.g., Stcherbatsky, 2004). This, in spite of the fact that Western analytical philosophy, highly influential in the computer science field, turned its attention to natural and formal languages and the meanings of words and expressions, and reinterpreted ontology to mean language-centered analysis (cf. Smith, 2005).

It is in this light just understandable, that scientists in the field of computer science (and information science, in general) have borrowed the term “ontology” from philosophy with similar connotations. In computer science the term was first coined in the context of artificial intelligence (AI), where ontologies were seen as computational models that enable certain kinds of automated reasoning, as part of knowledge-based systems. Because there can be many different domains in the reality, it makes sense to speak about many ontologies. Concretely, ontologies are used as data models to represent a set of concepts/classes within a domain, their attributes/properties, and the various relationships between those concepts. Ontologies are typically specified in ontology languages which range from very informal, to formal languages.

T.R. Gruber is usually credited with a deliberate definition of ontology as a technical term in computer science. Gruber (1993) states “ontology is an explicit conceptualization of a domain”; and further “A specification of a representational vocabulary for a shared domain of discourse— definitions of classes, relations, functions, and other objects—is called an ontology.” These formulations reveal that there are ontological and epistemological commitments (in the original philosophical sense), because existence of objects and entities and the possibility to gain knowledge about them are alluded to. These commitments are usually not, however, explicated by those who develop and use ontologies in the above technical sense. For instance, one can ask if two groups of people have developed two different ontologies for the same domain are both representing genuine knowledge. What are the criteria for knowledge in this context—and in general? Can a domain be reasonably defined, if everything is fluid and changing all the time? If a domain evolves over time, what is the validity period of ontology developed for this changing domain? And so on. We do not discuss here further these more fundamental issues, but urge the reader to consult suitable philosophical literature.

Database systems research is another field in which ontologies found applicability. Here, ontologies can be seen as a level of abstraction of data models similar to, for example, relational, object-oriented, or hierarchical models, but intended for modeling knowledge about individuals, their properties, and their relationships to other individuals. The ontology languages, by being closer in expressive power to first-order logic than languages used to model databases, are meant to abstract away from data structures and implementation strategies. For this reason, ontologies are said to be at the “semantic” level, whereas database schema are models of data at the “logical” or “physical” level (Gruber, 2008). Here, because of their abstraction mechanism and independence from lower level data models, ontologies are extensively used for database integration, enabling interoperability among heterogeneous and distributed databases.
With the emergence of the Semantic Web (Berners-Lee, 2001), the applicability of ontologies took a new dimension. The W3C vision of the Semantic Web incorporates ontologies as a key element for enabling a common framework to allow data to be shared and reused across application, enterprise, and community boundaries. In this framework, ontologies are used to specify standard conceptual vocabularies in which to exchange data among systems, provide services for answering queries, publish reusable knowledge bases, and offer services to facilitate interoperability across distributed and heterogeneous systems. The ontology language for the Semantic Web is the “OWL Web Ontology Language,” which is a W3C Candidate Recommendation (W3C, 2004). OWL is an expressive Web-based ontology language which builds on top of the RDF data model (W3C, 2004b) and the RDF Schema—a primitive ontology language (W3C, 2004c). RDF is a data model for objects/resources and the relations between them. RDF Schema is a vocabulary for describing properties and classes of RDF resources with a semantics for generalization-hierarchies of such properties and classes. OWL extends the RDF Schema and adds more vocabulary for describing properties and classes, for example, relations between classes (such as intersection or disjointness), cardinality, equality, richer typing of properties, characteristics of properties (e.g., symmetry), and so forth. OWL comes with three increasingly expressive sublanguages designed for use by specific communities of implementers and users.

The emerging paradigm of service orientation is another area in which ontologies are currently finding applicability. Service orientation is emerging nowadays as a new way of developing solutions for distributed applications and e-business processing, in which “services” (autonomous platform-independent computational elements that can be described, published, discovered, composed, and accessed over the Internet using standard protocols) are seen as fundamental elements for developing applications/solutions. Service orientation is widely regarded as the software paradigm for the next decade and enjoys considerable support throughout industry. Currently, service orientation is mostly realized via Web services. There exists an ever-growing number of standards in this area, ranging from the basic set of WSDL (for service description), SOAP (as protocol), and UDDI (as a service registry) to transaction support, security, workflows, and so forth.

The main supporting argument for service orientation is that it offers the potential for scalable, flexible, and robust integration of resources. In order to reach its full potential, service orientation requires a dynamic and scalable environment, where huge numbers of service requester and providers interact in a loosely coupled manner. In such an environment, the need for automated support for service-related tasks such as modeling, discovery, selection, contracting, composition, mediation, enactment, monitoring, invocation, and so forth, is evident. Here, ontologies are used as a specification and reasoning mechanism for both domain-specific knowledge, and for service-related elements such as service functionality, behavior, quality of service and grounding. Such issues are addressed in the area of Semantic Web Service, where various ontology-based frameworks have been proposed. Amongst them, the OWL-based Web Service Ontology (DARPA, 2007) and the Web Service Modeling Ontology (WSMO, 2007) are the most important. OWL-S is ontology for services written in OWL, whereas the elements of WSMO are defined in a language-independent manner. Additionally, the WSMO framework consists of the Web Service Modeling Language (WSML) (WSMO-WSML, 2007) which defines a set of languages to formalize and reason about domain-specific knowledge, as well as service functionality and behavior.

Since ontologies were first proposed in the context of computer science, they have been applied in various areas, such as AI, databases, Semantic Web, and more recently, Semantic Web Services. Mobile environments are another area in which the applicability of ontologies as a means for representing and reasoning about knowledge is gaining momentum, and this special issue is an example of the potential benefits of applying ontologies in such environments. This issue will, however, not only highlight the benefits, but will also address the obstacles that need to be overcome to make the usage of ontologies feasible in mobile environments.
MOBILE ENVIRONMENTS
During the last ten to fifteen years, mobility and mobile networks have become an important buzzword. The reason is the exponential growth of wireless telecom networks, Wi-Fi networks, and the number of subscribers to these networks. The number of subscribers of wireless 2G and 3G telecom networks, for example, was at the end of April 2007 2.83 billion worldwide (GSM Association, 2007) and it will reach 3 billion already during Q4/2007 or Q1/2008, if the growth continues at the same pace as during the last few years. Projecting from the fact that the first billion subscribers were reached in Q1/2004, companies estimate that the number of “mobile” subscribers will reach 4 billion around 2010/2011. Even if these estimates might be too optimistic, the fact is that currently 29% of the world population has access to wireless telecom networks (GSM Association, 2007) and a major part of the youth and adult population on earth is soon reachable through wireless access networks. This population is much larger than the Internet subscriber population 1.25 billion (Internet World Stats, 2007) and presents a huge business potential. This is one reason for the term «mobile» to erode. It has acquired many meanings, as various actors have attached it to rather different contexts and usages.

Let us look at the usage of the terms. First, one speaks about mobile networks and mobile users. In the latter context, mobility refers to the potential or actual physical movement of the user on earth. There is a qualitative difference from the network point of view, if a user moves within a small area on earth (e.g., in the same city, micro-mobility), or if she goes from one continent to another (macro-mobility). In the former case, the same network can serve her and offer continuous service, although she moves from one cell to another while enjoying the service (hand-over functionality). In the latter case, she usually has to connect to another network and get the communication services (roaming functionality). Digital 2G and 3G telecom networks were designed to support both micro-mobility and macro-mobility. Some Wi-Fi networks do support roaming, but not hand-over, like Sparknet (Sparknet, 2007). WiMax networks do not support roaming per se, but the newest standard 802.16 supports handover.

A mobile network is usually not one that moves physically on earth or in space, but rather a network that offers continuous services to a user who is physically moving on earth. The network infrastructure is usually stationary. The satellite networks are an exception in this respect, and are in stronger sense mobile networks, because satellites move continuously around the earth, while the ground stations are still stationary. Because it is in practice impossible to support micro-mobility without wireless cell networks, that is, “un-tethering” users, mobile networks are without exception wireless. For this reason, the terms wireless and mobile are often used interchangeably. But one has to remember that there are wireless technologies that do not support even micro-mobility, such as short-range radio links (Bluetooth) and Infrared connections. And further, standards of the Wi-Fi networks (IEEE 802.11x, 2007) do not specify hand-over or roaming. Thus, user movements are possible only within one cell or wireless distribution area without a loss of connection. One has still built interconnected Wi-Fi networks that support single sign-on and roaming (Sparknet, 2007).

Mobile terminal is also an often-used term. Again, only few terminals, if any, are by themselves capable of moving around; perhaps only those that are mounted on vehicles could be considered to approach this. In this context “mobile” means actually a portable terminal that is light and small enough to be carried by a human being, even by a child. Again, in order for them to be of any use, mobile terminals must be wireless and capable of communicating with as many wireless networks as possible.

Mobile commerce or mobile businesses were coined soon after the vast business potential of the mobile user population became apparent. In this context, the physical movement of the customer or service provider is not of primary importance, but rather that the customer can access the business services and contents from anywhere and anytime, using a portable terminal, irrespective of the location or further circumstance of the customer. Thus, she could be stationary or moving somewhere on earth or in the air. In this vein, mobile X currently often refers to the aspect that user can do with X activities anywhere, anytime, or X enables them.

In 2005, W3C launched the Mobile Web Initiative. The current goal is “to make browsing the web from mobile devices a reality” (W3C, 2007). This combination of mobile with Web is again a
slightly different usage of the term mobile. We believe that rather soon, also semantic aspects of Web and thus ontologies will be addressed by this initiative as well.

For stationary, computing in computing centers or offices context was implicit and it was not an issue, except perhaps from an ergonomic point of view. As part of the anywhere/anytime computing paradigm, the particular context of the mobile user became an important issue. One of the first ideas was that the user’s location on earth could be used to deliver services or contents that are relevant at that moment in that place. Examples include: ordering a taxi in an unfamiliar city, getting discount coupons in a shopping mall, or finding the closest Thai restaurant or bus stop in a city. These location-based services (LBS) are now taking off on the market, cheap portable navigation systems and fixed car navigation system being among the first ones to fly on the market. LBS can be understood as a special case of context-aware computing. Not only location can be included into the context, but also, for example, the social situation the user is currently in, her physical and mental state, and the state of the physical environment in her vicinity. Based on this additional information, the mobile services and applications can adapt themselves to the situation, that is, they become context-aware and further context-adaptive. From the service’s point of view, a user’s identity can be perceived as a dimension of the context. This leads to personalized services that can in addition be context-adaptive in a further sense. Anywhere/anytime personalized context-adaptive services—this is the great promise of mobile computing.

What is the relationship of mobility and ontologies? As the domain of ontology can be anything, it can describe “mobile X”, in some of the above senses. These could be called “mobile (domain) ontologies”. Thus, an ontology conceptualizing “mobile terminal”, “mobile network”, “mobile commerce”, or “mobile context” might all be instances of mobile ontologies in this sense. Some authors would like to see the term mobile ontology to refer only to conceptualizations whose domain is an aspect of context-awareness. This is perhaps too narrow. In fact, a further view is represented by the article of J. Veijalainen (ibid); the term mobile can also refer to the mobility of the ontology itself, similarly to (or even as part of) mobile agents. The article by Baousis et al. (ibid) follows the path, where the ontologies are carried as part of the agent state, but the ontology could also move in the network as a separate entity. Referring to Anna’s device, it could download such ontology from its vicinity and begin to understand the services around it. In general, these kind of moving ontologies do not need to conceptualize any mobile domain, but the domains can be anything. These could be called flowing ontologies. The latter might be a viable technical basis for a mobile ontology business analyzed in the above article by J. Veijalainen. If the tags in real-world objects contained their own description as a formal ontology, that could be used to interpret their data and properties unambiguously.

REAL-WORLD OBJECTS
Location and context-aware services like the ones described above are a first step towards taking the environment of the user into account when interacting with the information system. We can take this one step further, however: While up to now, the real world surrounding the user (cars, advertisements, timetables, rooms, etc.) was separate from the information system; nowadays we can integrate the two. Sinking costs, miniaturization, and widely available wireless communication means allow the “computerization” of real-world objects: RFID and NFC tags can be attached to basically arbitrary objects, displays can be augmented with bar codes, simple and powerful sensors ranging from temperature sensors to cameras can deployed anywhere, and so forth. With this, the amount of information available and the interaction possibilities grow tremendously. Real-world and information system are no longer isolated, but grow together to form a new kind of reality (Weiser, 1991; Hauswirth, 2007).

The challenges related to tagging real-world objects and interacting with them through their tags are manifold. In the following, a few categories of challenges are discussed that have to be resolved by any infrastructure that interacts with the tags reliably in order to make the interaction with real-world objects successful in terms of data processing but also easy in terms of the user experience.

• Types of real-world objects: Real-world objects can be in principle any physical ob-
ject, including cars, airplanes, bikes, books, posters, timetables, laptops, just to name a few. These real-world objects can be tagged using different types of tags in order to interact with them (or better the tags that are associated with them).

- **Types of tags:** Different types of tags are RFID, 2D tags, bar codes, identification numbers, including graphical symbols. The tags can be active in the sense that they keep sending information related to the physical object they are attached to. They can be semi-active in that they do not emit any data until explicitly triggered to do so by a reader. And tags can be passive in the sense that they do not emit any data at all but need to be inspected, like reading a 2D tag’s pattern (which might be difficult when it is dark).

- **Number of tags:** A physical object can be tagged by a single tag, but also by multiple tags. Multiple tags can denote different data in isolation, like the various barcode stickers at the bottom of a laptop that each refers to a different part, like installed software, the MAC address, or blue tooth device. In other cases, tags in their combination contain information about the object, for example, tags on a cinema poster which define the playing times of a movie, cinema location, cost, travel information, menu of the cinema snack shop and more. The playing time would be worthless without the title of the movie or the location of the cinema.

- **Data volume:** The amount of data that a tag can carry varies. It can be as simple as a type identifier (like this is an airplane engine) or an instance identifier (like a bar code on a car identifying the specific car). But a tag can contain a lot more information that not only includes properties about the physical object itself, but also possibly about its contents, too (or its destination, amongst other data).

- **Data relevance:** Depending on the particular physical object, a tag’s data can be outdated at a certain point in time, for example, a tag describing the contents of a container. After the container’s contents is changed the tag might contain inconsistent data until it is updated (which might never happen).

- **Data consistency:** Printed tags can become unreadable if some portion is scratched, erased or overwritten. If a combination of tags is necessary, a single unavailable tag can make the whole set of tags completely useless or incomplete to some extent. Active tags transmitting data can become defect transmitting false data or no data at all.

- **Power management:** If tags are active, then power management becomes an important element as power does not last forever (unless the tag is connected to an energy source, like a solar panel). And, tag readers themselves need power to read tags.

- **Tag reader:** Tags have to be read or their information has to be received by a tag reader in case of active tags. A tag reader can be a special device like a bar code or RFID reader or a cell phone able to read different types of tags or even able to receive the data from active tags. A tag reader has to be able to deal with all challenges mentioned above and more. It has to first of all receive the data and store it for further processing. It needs to determine what to do with the received data. Both of these challenges are separately discussed next.

- **Data format recognition:** A tag reader needs to be able to interpret the received data to some extent. If it is a URL then the tag reader must not confuse this with an identifier or a graphical symbol. It is therefore important for a reader to be able to deal with many different forms of data.

- **Data interpretation:** The read data can serve different purposes. First, it could be that the data is simply displayed on the tag reader and of no use beyond that. Another interpretation can be that data is stored on the tag reader as proof that the reader was near a tag. Furthermore, a tag reader can use the data to lookup information, like the price of a ticket or a train schedule. And finally, data can be used for further processing, like paying for a drink from a vending machine, thereby initiating a money transfer and causing the vending machine to dispense a Coke (or Pepsi).

- **Data processing:** Once the format of data is recognized and the data is interpreted, data processing has to take place. In the advanced case, some service has to be invoked from the tag reader in order to initiate the processing.
Tag readers might know the services for given data formats, or they might have to dynamically determine the services. The latter situation allows a tag reader to learn about new services dynamically. Of course, if a PDA is a tag reader, then some processing can be done on the device itself, like for example the conversion of currency information or adjustment of time zones.

• **Recursion:** Tagged objects, like a car, can be tag readers themselves, for example, reading street information when approaching a major highway intersection or a rental car return station. A tag reader itself can be tagged. In these situations it is necessary to carefully distinguish the roles a physical object can play in order to achieve consistent tag data processing.

• **Security and privacy:** If a cell phone is also a tag reader, privacy issues arise, not only when a phone reads tags, but also when a phone is tagged itself. Privacy has to be ensured in both cases so that the owner of the data as well as the owner of the tag reader can define and ensure the proposer use of the information. An employee driving in a car and carrying the phone could be traced the whole day.

These are only some of the challenges that interacting with real objects bring with them. Correct interpretation and acting on the data, however, is one of the most important issues and Semantic Web technology is one possibility to increase the reliability of this particular challenge.

The article titled “Bringing Semantic Services to Real-World Objects” from Paolucci et al. (ibid) addresses some of the above mentioned challenges. In the area of data interpretation and processing, it introduces the Semantic Web technology as well as Semantic Web Services to provide a consistent data interpretation and dynamic service discovery and execution. It also introduces cell phones as tag readers for consumers that can read information about cinema movie advertisements for purchasing movie tickets and public transportation tickets. In context of public transportation, it shows how a tag reader can be used to determine the price of a trip and purchase it too.

In their article “Semantic-based Bluetooth RFID interaction for advanced resource discovery in pervasive contexts” Ruta et al. (ibid) describe a framework that combines enhanced RFID tags semantically describing the objects they are attached to with a Bluetooth-based service discovery and matchmaking component. Together, this allows for semantic resource discovery in an ad hoc mobile environment. What happens is basically the following: The annotations on the RFID tag are read and are then transmitted using Bluetooth to a hotspot where matchmaking takes place. Furthermore, to adapt to the mobile environment, compression techniques are introduced. This is necessary as semantic descriptions tend to be somewhat verbose, which is not a good thing in environments with limited energy resources for sending and receiving information.

**CONCLUSION**

Service orientation seems to be an appropriate paradigm to allow for more powerful mobile environments that transparently support user needs. Taking advantage of tagging technologies to integrate real-world objects into the information system offers new and exciting opportunities. All these approaches will, however, only really work if ontologies are added to the mix. Only if resources can be described in a machine-understandable way will it be possible to automatically integrate and combine them. The articles presented in this special issue show first attempts to approach this topic. They also show that there is still room for more research.

**REFERENCES**


Christoph Bussler is staff software engineer at BEA Systems, Inc., working in the core WebLogic application server product development organization. Before joining BEA, Bussler was architect at Cisco Systems, Inc. in San Jose, CA, USA, responsible for the service-oriented architecture at Cisco Systems’ Quote-to-Cash business unit. Before taking this position he was Science Foundation Ireland Professor at the National University of Ireland, Galway in Ireland and Executive Director of the Digital Enterprise Research Institute (DERI). In addition to his role as Executive Director of DERI, Chris led the Semantic Web Services research group at DERI. Before DERI he was member of Oracle’s Integration Platform Architecture Group based in Redwood Shores, CA, USA. He was responsible for the architecture of Oracle’s next generation integration product providing EAI, B2B and ASP integration. Prior to joining Oracle he was at Jamcracker, Cupertino, CA, USA, responsible for defining Jamcracker’s ASP aggregation architecture, Netfish Technologies (acquired by IONA), Santa Clara, CA, USA, responsible for Netfish’s B2B integration server, The Boeing Company, Seattle, WA, USA, leading Boeing’s workflow research and Digital Equipment Corporation (acquired by Compaq, acquired by Hewlett-Packard), Mountain View, CA, USA, defining the policy resolution component of Digital’s workflow product. Chris has a PhD in computer science from the University of Erlangen, Germany and a Master in computer science from the Technical University of Munich, Germany. Bussler published a book titled ‘B2B Integration’, two books on workflow management, over 100 research papers in journals and academic conferences, he gave tutorials on several topics including B2B integration, workflow management and service-oriented architectures and he was keynote speaker at many conferences and workshops on topics like workflow management, B2B and EAI integration as well as Semantic Web.

Birgitta König-Ries holds the Heinz-Nixdorf endowed professorship at the Friedrich-Schiller University in Jena, Germany. The central theme of the group’s work is the distributed, automated usage of resources, i.e., information and functionality, in heterogeneous, dynamic environments. Service-orientation is used as the base
paradigm to achieve the desired goals. Particular emphasis is being put on automatic discovery, composition and invocation of services on the one hand and on the engineering of incentive schemes to ensure cooperation in open, dynamic environments on the other hand. More recently, the group has started working onportlet standardization and semantic portal adaptation. Birgitta is co-chair of the special interest group on mobility and mobile information management of the German Computer Society and co-author of a German textbook on mobile information systems. Birgitta has both a diploma (equivalent to Master) and PhD in computer science from the University of Karlsruhe, Germany. Prior to joining Friedrich-Schiller University, Birgitta has worked as Postdoc with the University of Louisiana at Lafayette and Florida International University and as a temporary professor at the TU Munich.

Dumitru Roman works as a researcher at Digital Enterprise Research Institute Innsbruck (http://www.deri.at) in the area of semantically-enabled service-oriented architectures. Since joining DERI he has been involved in several FP5, FP6, and FP7 EU funded projects, e.g. SWWS, DIP, ASG, SWING, SUPER, etc., in the area of semantic Web and Web services. He is the main author of the Web Service Modeling Ontology (WSMO) and co-authored many WSMO related publications, including the Springer book “Enabling Semantic Web Services”. Before joining DERI Innsbruck, he received a Diploma Engineer in Computer Science from the University of Cluj-Napoca, Romania. His previous research includes composition of semantically enabled services in the context of open agent architectures, planning techniques, reconfigurable hardware-software co-design, and networking (he is also CCNA). Dumitru Roman initiated and chaired various conferences and workshops in the area of service-orientation, e.g. ICIW, MoSO, SerComp, mda4soa, semantics4ws, etc., and currently serves as an associate editor of the International Journal of Web Services Practices (IJWSP). He was invited speaker and gave tutorials at various events on several topics including Semantic Web, knowledge representation, Web Services and service-orientation.

Jari Veijalainen is a full professor at the Department of Computer Science and Information Systems of University of Jyväskylä, Finland, since August 1996. He is also a Docent in Computer Science at the University of Helsinki, Finland since May 1996. He holds a M.Sc. degree from Univ. of Helsinki, Finland (1983), and Dr-Ing. degree from the Technical University of Berlin, Germany (1989), both in computer science. He has published tens of scientific papers in conference proceedings, monographs, and journals and is a member of editorial board of IJWET and WINE. He has just retired from the editorial board of the VLDB Journal. He has been participating in Adaptive Services Grid project (EU-IST2002-004617, 2004-2007) as a partner and was also a member of its scientific board, contributing to the project as a visiting professor at Hasso-Plattner-Institut, University of Potsdam, Germany. During 2003 he has spent six months at Waseda University, Tokyo, working as a visiting professor and studying the Mobile Internet in Japan. He has been leading an international Master’s program “Mobile Technology and Business” at the University of Jyväskylä. Dr. Veijalainen was one of the initiators of MoSo workshop series at MDM conference and has been a co-chair in them and a co-editor of this special issue. He was a key note speaker at MDM 2005. He is a member of ACM, IEEE Computer Society, and the Finnish Computer Science Association.