

## GUEST EDITORIAL PREFACE

# Special Issue on the Ubiquitous Semantic Web

*Jeff Z. Pan, University of Aberdeen, Aberdeen, UK*

*Shonali Krishnaswamy, Institute for Infocomm Research (I2R), Fusionopolis Way, Singapore*

*Yuan-Fang Li, Monash University, Melbourne, Australia*

*Manfred Hauswirth, Technical University of Berlin, Berlin, Germany, & Fraunhofer FOKUS, Berlin, Germany*

After more than a decade of active research, tremendous progress has been made in fundamental research areas in the Semantic Web, including ontology reasoning, query answering, Linked Data, among others. At the same time, computing has become truly ubiquitous, witnessed by the explosive growth and deep penetration of smart phones, tablets, and various types of connected devices, appliances and sensors. As such, ubiquitous computing presents both unique opportunities and challenges for Semantic Web research. These challenges include, for example, limited computing capabilities, battery power, connectivity and bandwidth of portal devices, processing of streaming data, context-aware semantic computing,

user profiling, privacy issues, to name a few. Addressing these challenges requires theoretical advances as well practical tools and systems.

In the past few years the importance of ubiquitous computing has been recognised by the Semantic Web community, with a growing body of efforts to bridge the two areas to form the *ubiquitous Semantic Web*. The purpose of this special issue is to highlight a few studies that represent current research into this topic. Following our call for papers, we received nineteen submissions that cover a wide array of topics. Through two rounds of rigorous reviews with up to three reviews per submission, we selected three full research articles and

drafted one overview article for inclusion in this special issue.

In our overview article, we motivate the case for the ubiquitous Semantic Web with a hypothetical scenario of mobile service discovery; provide a broad landscape survey of major research topics in the Semantic Web; present a more detailed discussion of two particular topics: context modelling and reasoning on mobile devices; and discuss a few important research challenges.

The increasing available smart sensors, mobile devices and Internet of Things have resulted in the rapid increases in streaming data. In the semantic Web domain, several extensions of RDF and SPARQL have been proposed to support the so-called RDF Stream Processing (RSP). These extensions differ in syntax and query capabilities. Moreover, they differ in subtle ways in their assumptions and evaluation semantics. Such differences results in incompatibility and thus may hinder the deployment of RSP.

In their article, *RSP-QL Semantics: a Unifying Query Model to Explain Heterogeneity of RDF Stream Processing Systems*, Daniele Dell’Aglia, Emanuele Della Valle, Jean-Paul Calbimonte and Oscar Corcho propose RSP-QL, a formal semantics model that extends SPARQL for evaluation of continuous queries of streaming RDF. RSP-QL unifies semantics of existing RSP systems. It thus is able to explain their heterogeneity. Moreover, they demonstrate that based on RSP-QL, an oracle can be developed to validate the correctness of RSP implementations. Errors in existing systems are detected by such an oracle, demonstrating the effectiveness of RSP-QL.

In the ubiquitous Semantic Web, a semantics-aware application running on a mobile device may operate on constantly changing environment and deal with het-

erogeneous data sources. In such a setting, the application cannot assume data schemas (e.g., ontologies) are always known or present. Therefore, understanding the *context* facilitates the adaptation of relevant contents, allowing more effective consumption and presentation of Linked Data on mobile devices.

The article *Context-Aware Presentation of Linked Data on Mobile* by Luca Costabello and Fabien Gandon presents PRISSMA, a context-aware presentation framework for Linked Data in a mobile setting. PRISSMA extends Fresnel, a widely used presentation vocabulary for RDF data with context information. However, a number of issues complicate context-based presentation: the inherent imprecision of the context, the heterogeneous nature of contextual dimensions, users’ privacy concern, as well as the limited computational capabilities of mobile devices. Taking into consideration these constraints, PRISSMA also presents an efficient polynomial-time ( $O(n^2)$ ) error-tolerant context matching algorithm. This presentation framework has been implemented in a prototype PRISSMA browser for the Android platform.

Presentation is not the only challenge facing semantic-enabled applications running on mobile, embedded devices and sensors. Inference is a fundamental task in the Semantic Web. However, traditional reasoners are mostly designed and optimized for a desktop or server environment and they tend to support the common standard inference tasks such as ontology consistency checking and classification.

The realisation of the Semantic Internet of Things (SWoT) requires, among other things, efficient query answering and semantic match-making support for resource-limited devices. In *A mobile matchmaker for the Ubiquitous Semantic Web*, Floriano Scioscia et al present

Mini-ME, a novel mobile inference engine for the SWoT.

Mini-ME supports a simple Description Logic, the *ALN*, with reduced expressivity, giving rise to improved efficiency and resource consumption on mobile devices. Mini-ME supports two stand inference tasks, namely concept satisfiability checking and subsumption checking. In support for mobile service discovery and semantic match-making, Mini-ME also supports three non-standard inference tasks, namely concept contraction, concept abduction and concept covering. These features make Mini-ME applicable in a number of scenarios, two of which are discussed in the article. Through experiments comparing the performance of Mini-ME, the mobile and desktop version, as well as well-known ontology reasoners FaCT++, HermiT and Pellet, it is shown Mini-ME exhibits acceptable performance on mobile devices.

A special issue like this is impossible without the hard work of many contributors. We would like to thank the Editor-in-Chief, Professor Amit Sheth, for making this special issue a reality. We would also like to express our sincere gratitude to the reviewers who evaluated submissions for this special issue on Ubiquitous Semantic Web from July 2013 to February 2015. Their generous contribution of time and expertise makes this special issue a reality:

Karl Aberer  
Panos Alexopoulos  
Payam Barnaghi  
Andreas Billig  
Carlos Bobed  
Michael Compton  
Oscar Corcho  
David Corsar  
Philippe Cudré-Mauroux  
Julien Eberle  
Tao Gu  
Wei Hu  
Odej Kao  
Alexander Kroeller  
Danh Le Phuoc  
Kevin Lee  
Seng Loke  
Pedro Jose Marron  
Hai Nguyen  
Daniela Nicklas  
Ivana Podnar Zarko  
Kay Roemer  
Yuqing Tang  
Kerry Taylor  
Haofen Wang  
Honghan Wu  
Arkady Zaslavsky

*Jeff Z. Pan,*  
*Shonali Krishnaswamy*  
*Yuan-Fang Li*  
*Manfred Hauswirth*  
*Guest Editors*  
*IJSWIS*

*Jeff Z. Pan is a Reader in the Department of Computing Science at the University of Aberdeen. His research focuses primarily on knowledge representation and data exploitation, where he has over 150 refereed publications. He is an editor of the International Journal on Semantic Web and Information Systems (IJSWIS) and serves on the Editorial Board of the Journal of Web Semantics (JoWS) and the Journal of Big Data Research. He is a general chair of the 4<sup>th</sup> Joint International Semantic Technology Conference (JIST2014) and 8th China Semantic Web & Web Science Conference (CSWS2014). He served as a program chair of the 1st International Conference on Web Reasoning and Rule System (RR2007), of the 1st Joint International Semantic Technology Conference (JIST2011), and of the Doctoral Consortiums in the top Semantic Web conferences ISWC2010 and ESWC2011. He is widely recognised as a key contributor to the W3C OWL2 standard (see e.g. the TrOWL Tractable OWL2 reasoner that he leads, <http://trowl.eu/>).*

*Shonali Krishnaswamy is Head of the Data Analytics Department at Institute for Infocomm Research (I2R), Singapore. Her research interests include ontology reasoning and data stream mining in mobile and embedded environments, distributed data mining and web services/service oriented computing (where her focus is on quality of service and reputation models).*

*Yuan-Fang Li is a Lecturer at the Faculty of Information Technology at Monash University, Australia. He received both his Bachelor of Computing (with honors) and PhD degrees from National University of Singapore in 2002 and 2006, respectively. His main research interests include ontology languages, semantic query & inference, knowledge representation, data management. He has published more than 40 papers on these topics, in venues such as AAAI, ISWC, WWW and JWS.*

*Manfred Hauswirth the managing director of Fraunhofer FOKUS since October 2014 and a full professor for Open Distributed Systems at the Technical University of Berlin since September 2014. He holds an M.S. (1994) and a Ph.D. (1999) in computer science from the Technical University of Vienna. His main research interests are on large-scale semantics-enabled distributed information systems and applications, peer-to-peer systems, sensor networks middleware, Internet of things, self-organization and self-management, Semantic Web services, and distributed systems security. He has published over 45 papers in these domains, he has co-authored a book on distributed software architectures and several book chapters on P2P data management and semantics. He has served in over 100 program committees of international scientific conferences.*