

**Joint Workshop on Engineering  
the Web of Things and Liquid  
Multi-Device Software**

# Preface

The Web is evolving to a platform where the worlds of physical and virtual meet. The emerging Web-based services are extending human abilities for socializing and collaboration. Now, the cheap connectivity technologies foster this evolution for the rest of the things. From software development perspective, the world of computing is shifting from the era of single device computing to a new era where literally every thing is interconnected, online, and programmable.

The Joint Workshop on Engineering the Web of Things and Liquid Multi-Device Software was arranged to present the latest research and to discuss about software engineering and development in the new era of computing. The workshop was held on June 5th, 2017 in conjunction with the 17th International Conference on Web Engineering (ICWE 2017) in Rome, Italy. As the name suggests, the joint workshop focused on two themes, engineering the Internet of Things (IoT) from the perspective of Web, and on user experience from the perspective of multi device software engineering.

Web of Things is the general term used for describing all the approaches of connecting physical things to the World Wide Web. In the new era of computing the development is evolving from traditional client-server architectures to decentralized multi-device architectures in which people use various types of Web-enabled client devices, and data are stored simultaneously in numerous devices and cloud-based services. This new era will dramatically raise the expectations for device interoperability, implying significant changes for software architecture as well.

Liquid software refers to the approaches in which applications and data can seamlessly flow from one device to another, allowing the users to roam freely across all the computing devices that they have. The goal is that users of liquid software do not need to worry about data copying, manual synchronization of device settings, application installation, or other burdensome device management tasks. Rather, things should work with minimal effort. From the software development perspective, liquid software should dynamically adapt to the set of devices that are available to run it, as opposed to responsive software, which adapts to different devices, under the assumption that only one device at a time is used to run the application.

After the peer-review process, 11 papers were selected to be presented at the joint workshop. The papers covered various aspects of engineering the Web of Things and developing multi-device liquid software.

The 1st paper was “IoT Application Deployment Using Request-response Pattern with MQTT” by Antti Luoto and Kari Systä from the Tampere University of Technology. The paper describes how request-response design pattern can be implemented on top of message passing architectural style.

The 2nd paper was “Challenges when Moving from Monolith to Microservice Architecture” by Miika Kalske, Niko Mäkitalo and Tommi Mikkonen from the University of Helsinki. The paper describes what kind of organizational and technical

challenges companies face while shifting from traditional monolith software architecture to decentralized microservice architecture.

The 3rd paper was “Engineering Task Automation Systems for Domain Specificity” by Carmelo Ardito, Giuseppe Desolda and Maristella Matera from the University of Bari “Aldo Moro”, and from the Politecnico di Milano. The paper presents an architecture that fosters the development of Task Automation Systems that are customizable with respect to varying users and usage domains.

The 4th paper was “An adaptive formal metamodel for Semantic Complex Event Processing-driven Social Internet of Things Network” by Francesco Nocera and Angelo Parchitelli from the Polytechnic University of Bari. The paper propose a formal model for a SIIoT network driven by a Semantic Complex Event Processing (CEP) where “things” are capable of establishing social relationships with respect to their owners, according to the monitoring of sensors value, changed behavioral properties, state and/or context variables and user’s preference.

The 5th paper was “Towards an Acceptance Testing Approach for Internet of Things Systems” by Maurizio Leotta, Filippo Ricca, Diego Clerissi, Davide Ancona, Giorgio Delzanno, Marina Ribauda and Luca Franceschini from the Università di Genova. The paper describes an approach for acceptance testing of IIoT systems by using a realistic m-Health system composed by local sensors and actuators and a remote cloud-based healthcare system.

The 6th paper was “Semantic Discovery in the Web of Things” by Fernando Serena, María Poveda-Villalón and Raúl García-Castro from the Universidad Politécnica de Madrid. The paper presents an ontology-based approach to leverage web things discovery that is transparent to the syntax, protocols and formats used in things interfaces and propose a semantic model for describing web things and how to extract and understand the relevant information for discovery.

The 7th we had demo paper “Four key factors to design a Web of things architecture” by Francesco Bruni, Pomo Claudio and Gaetano Murgolo from the Planetek Italia SRL, from the Polytechnic University of Bari, and from the Engineering Consulting SRL. The paper presents a model for exposing electrical based measurements data over the Web to monitor consumptions, breakdown and preventing unforeseen events.

The 8th paper was “Liquid Transfer of User Identity” by Sivamani Thangavel and Kari Systä from the Tampere University of Technology. The paper presented an implementation of how the user’s digital identity can follow the user while roaming from one device to another.

The 9th paper was “Wireless Brain-Computer Interface for Wheelchair Control by Using Fast Machine Learning and Real-Time Hyper-Dimensional Classification” by Valerio Francesco Anese, Giovanni Mezzina and Daniela De Venuto from the University of Glasgow, and from the Polytechnic University of Bari. The paper presents a noninvasive brain-controlled P300-based wheelchair driven by EEG signals to be used by tetraplegic and paralytic users.

The 10th paper was “Case Study: Building a Serverless Messenger Chatbot” by Jyri Lehvä, Niko Mäkitalo and Tommi Mikkonen from the University of Helsinki. The paper reported a case study where a chatbot was build for a Finish media company using Facebook Messenger platform and serverless computing.

The 11th we had a demo paper “A Homemade Pill Dispenser Prototype Supporting Elderly” by Paolo Buono, Fabio Cassano, Alessandra Legretto and Antonio Piccinno from the University of Bari “Aldo Moro”. The paper describes a device for the management of pills according to the user’s therapy, with Internet of things (IoT) devices and by allowing users to manage the pill dispenser by themselves.

We are grateful to the Program Committee members for their work on the paper review and selection process. We would also like to thank all the authors and workshop participants for the interesting discussions.

Niko Mäkitalo  
Marina Mongiello  
Francesco Nocera  
Tommaso Di Noia  
Eugenio Di Sciascio  
Tommi Mikkonen  
Cesare Pautasso  
Kari Systä  
Antero Taivalsaari

# Organization

## Program Committee

Robert Hirschfeld	Hasso-Platter Institute, Univ. of Potsdam, Germany
Kari Systä	Tampere University of Technology, Finland
Daniele Bonetta	Oracle, USA
Hallvard Trætteberg	Norwegian Institute of Technology, Norway
Tommi Mikkonen	University of Helsinki, Finland
Michael Nebeling	University of Michigan, USA
Cesare Pautasso	University of Lugano, Switzerland
Maria Husmann	ETH Zürich, Switzerland
Antero Taivalsaari	Nokia Technologies, Finland
Jose Garcia-Alonso	University of Extremadura, Spain
Mirjana Ivanovic	University of Novi Sad, Serbia
Javier Berrocal	University of Extremadura, Spain
Niko Mäkitalo	University of Helsinki, Finland
Muhammad Ali Babar	University of Adelaide, Australia
Marco Autili	University of L'Aquila, Italy
Stefano Bistarelli	University of Perugia, Italy
Antonio Bucchiarone	Fondazione Bruno Kessler, Italy
Radu Calinescu	University of York, UK
Rafael Capilla	Universidad Rey Juan Carlos, Spain
Patricia Lago	Vrije Universiteit Amsterdam, Netherlands
Ivano Malavolta	Vrije Universiteit Amsterdam, Netherlands
Raffaella Mirandola	Politecnico di Milano, Italy
Henry Muccini	University of L'Aquila, Italy
Diego Pérez	Politecnico di Milano, Italy
Liliana Pasquale	Lero - The Irish Software Research Centre, Ireland
Azzurra Ragone	University of Milano-Bicocca, Italy
Patrizia Scandurra	University of Bergamo, Italy
Ronny Siebes	Vrije Universiteit Amsterdam, Netherlands
Romina Spalazzese	Malmö University, Sweden
Danny Weyns	Katholieke Uviversiteit Leuven, Belgium
Uwe Zdun	University of Vienna, Austria