SENSEI: Integrating the Physical World with the Digital World of the Network of the Future

Applies to:

SAP Research, sensor technologies, Internet of Things, radio frequency identification, network embedded devices, Real World Internet, Wireless Sensor and Actuator Networks

Summary

Context awareness is one of the key components of Ambient Intelligence. The retrieval of physical context information about people and objects, their environment and situation and the capability to act upon them can be realized through the deployment of sensor and actuator networks everywhere. These sensor and actuator networks need to be closely tied into existing and future infrastructures and service platforms. Providing a real-time sensor and actuator dimension for next generation network infrastructures, applications and services is the goal of SENSEI. This article gives an introduction to the SENSEI project, its aims and objectives, challenges, and results achieved thus far.

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Created on: 17 April 2009

Author Bios

Mirko Presser is a research fellow in the Mobile Communications Research Group in the Centre for Communication and Systems Research (CCSR) at the University of Surrey. He received an MSci degree in physics with astrophysics from the University of Bristol, in 2001, and in 2002, an MSc with commendation in communication systems also from the University of Bristol. Since October 2002, he has been working in CCSR at the University of Surrey as a research fellow and part time PhD. During this time, he has received the Lord Lloyd of Kilgerran Memorial Prize and worked as a researcher in the Core 3 programme of the Mobile VCE in the UK. He has also been involved in several successful FP6 proposals including ISTMAGNET Beyond), DYVINE and IST-e-SENSE.

Markus Eurich is a research associate in the Smart Items Research Program at SAP Research in Zurich. In 2001, he started working for SAP and mainly worked in the fields of Internal Business Consulting and Costumer Relationship Management in Germany and India. In the SENSEI project he will take the leadership of the task “Business Modeling - Value Creation”. Markus received his Dipl. Wirtsch.-Inf. (M.Sc. in Business Informatics) from the University of Mannheim. As a PhD candidate, he also works as a scientific collaborator at the Swiss Federal Institute of Technology Zurich. He belongs to the research group of Prof. Dr. Roman Boutellier, who chairs the fields of Technology and Innovation Management at the Department “Management, Technology, and Economics”.

Claudia Villalonga joined SAP Research CEC Zurich in April 2008 and started her PhD in cooperation with the Wearable Computing Lab of ETH Zurich. She is currently working on SENSEI, an Integrated Project in the EU's Seventh Framework Programme in the Information and Communication Technologies (ICT). Before joining SAP she had worked at NEC Laboratories Europe for two years. She was mainly involved in the research areas of context awareness services, context management, utilization and collection, proactive service provisioning, service discovery, modeling and ontologies.

Payam Barnaghi is a researcher in the Mobile Communications Research Group in the Centre for Communication and Systems Research (CCSR) at the University of Surrey. He obtained his PhD in Computer Science from University of Malaya in 2007. He received an MSc in Artificial Intelligence and Robotics from Azad University of Tehran in 1998, and a BSc in Computer Hardware Engineering from Shahid Beheshti University in Tehran in 1996. His current research interests include semantic web, ontologies, machine learning, semantic sensor networks, semantic web services, and information search and retrieval.

Adrian Petcu is a Senior Researcher with SAP Research in Zurich, Switzerland. He is leading the SAP team participating in SENSEI. He has obtained a PhD from the Artificial Intelligence Lab of the EPFL (Lausanne) in 2007. His PhD dissertation won the ECCAI Artificial Intelligence Dissertation Award 2007 (i.e. the best European PhD thesis in Artificial Intelligence in 2007). He has published over 30 peer-reviewed papers in top international journals, conferences and workshops. His research is focused on the intersection between computer science (in particular artificial intelligence) and economics. He strives for leveraging formalisms, algorithms and techniques from Artificial Intelligence, Microeconomics, Optimization and Cryptography to enable Information Systems to become sufficiently intelligent and reliable to assist their users while taking complex decisions and to effectively act on their behalf while coordinating with peer information systems to increase global welfare.

Overview

The Internet extends its reach to the real world through innovations collectively termed the Internet of Things (IoT). The IoT aims at integrating technologies such as Radio Frequency Identification, Wireless Sensor and Actuator Networks (WSAN), and Networked Embedded Devices. Recent ideas envision the Internet as an all encompassing infrastructure that connects the physical into the digital world: the Real World Internet (RWI). The European project SENSEI plays a leading role within the current efforts to create an underlying architecture and services for the Future Internet and to realize the vision of the RWI.

SENSEI (Real World Dimension of the Network of the Future)

SENSEI is an Integrated Project (IP) in the EU's Seventh Framework Programme in Information and Communication Technology (ICT). SENSEI, with a budged over 23 million Euros and an effort of about 1900 person-months, is the biggest IP from Call 1, Challenge 1.1: The Network of the Future. The SENSEI project started in January 2008 and is set out to run for three years. The SENSEI consortium involves multi-disciplinary expertise split among 19 partners from eleven European countries. The consortium consists of eight industrial partners (Arup, Ericsson Sweden and Ireland, NEC, Nokia, SAP, Telefónica, and Thales), many of them being global leaders in their market. The consortium is complemented by two rapidly-developing European small and medium enterprises (Ambient Systems and Sensinode), two research centres (CEA-LETI and Consorzio Ferrara Ricerche), six universities (The University of Surrey, ETH Zurich, University Politehnica of Bucharest, University of Oulu, Université Pierre Mendès France and University of Twente) and a management company (ALMA).

Aims and Objectives

SENSEI aims at creating an open, business-driven architecture that integrates heterogeneous WSANs into a global framework that facilitates services and applications via universal interfaces (see Figure 1).

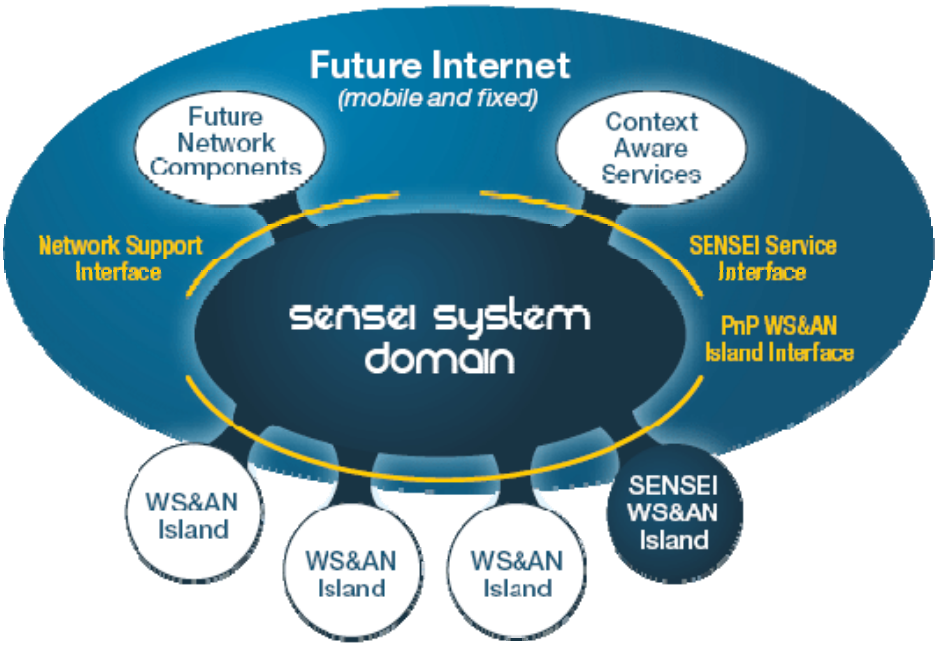

Figure 1: Overview of the SENSEI framework

The SENSEI system is therefore designed to provide network and information management services to enable reliable and efficient context information retrieval and interaction with the environment. By adding mechanisms for accounting, security, privacy, and trust it enables an open and secure market space for context-awareness and real world interaction. SENSEI is designed to satisfy the demands of multiple players in the RWI value network. Users desire reliable, secure, and easy-to-use services that are reasonably priced

at the same time, e.g. services that protect users' safety at work while optimizing the manufacturing process. However, satisfying users' needs and ensuring sustainable economic success requires insights into both the technological potential and the realisation of economic value latent in ICT. The SENSEI project therefore created a comprehensive usage scenario portfolio that focus on both, industrial user and ordinary consumers. This ranges from scenarios like "emergency management", "safety at work" over "smart plants" to "smart cities".

Challenges

One of the challenges the project is tackling is to define an architecture that provides scalability to deal with large numbers of globally distributed WSANs and interoperability of heterogeneous devices and platforms. In addition, another objective of SENSEI is to support information access and control for streaming of large data sets, information management to access real-time data, service continuity for mobile users, and traffic management to minimize the impact on network infrastructure. That implies that SENSEI has to provide means for the unification of metadata and semantics to describe resources and adequate security and privacy mechanisms to make a secure market-place.

In order to meet this multi-faceted, interdisciplinary challenge, a large number of experts from multiple domains collaborate in order to integrate existing technologies and innovative approaches into a homogeneous architecture. So does SENSEI employ, for instance, Service Oriented Architecture concepts on the current Internet to provide universal interfaces to access heterogeneous sensor and actuator devices. It also uses emerging Semantic Web technologies to enable automated reasoning of context-information, resource discovery and composition.

Achievements

After one year of extensive research, in which the project analyzed the state of the art of resource, context and information modelling and processing, WSAN middleware and frameworks, and WSAN islands, a portfolio illustrating the scenarios has been created and the first reference architecture is now defined. In the remaining two years the project will now shift its effort to the actual design of the enablers for the RWI and to the implementation of a Pan European test platform enabling the large scale experimental evaluation of the RWI vision and field trials.

Related Content

For more information about this large-scale and unique research initiative toward the Future Internet, we would like to encourage the interested reader to keep up to date at http://www.ict-sensei.org.

In addition, please refer to the following SDN page in the Research and Innovation wiki:

The Internet of Things (SAP Research)

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