INTERNATIONAL CONFERENCE

ICT FOR SUSTAINABLE PLACES

9-11 SEPTEMBER 2013

NICE | FRANCE

www.resilient-project.eu

CONFERENCE INFORMATION BOOKLET

Foreword

On behalf of the Organizing Committee, we would like to welcome you to the 1st ICT for Sustainable Places International Conference in the city of Nice, France.

This first ICT4SP conference is an original initiative from the Resilient FP7 European project consortium, and is organized as part of the project, with the aim to generate a successful, sustainable and world-class series of annual conferences.
The objectives of the conference are to bring together scientists, researchers, and engineers, from research institutes and the industry, around one of the greatest challenge that our societies have ever faced: ensuring long-term environmental sustainability of ever-growing, densifying urban areas, in a resource-constrained world.

The recognition of this challenge has been quick and has generated numerous initiatives worldwide these last years. Specifically in Europe, this awareness has translated into a considerable creation of political and financial incentives and regulations to guide the transition towards more sustainable, energy-efficient practices.

In this respect, the Architecture, Engineering and Construction (AEC) economic sector, with an acknowledged impact of 40 % of total EU energy consumption and 36% of Green-House Gases emission, is considered as a strategic target. The recast of the European Public Building Directive (EPBD), which requires all EU countries to shift towards new and retrofitted nearly-zero energy buildings by 2020, or the 500 M€ Energy-efficient Building (EeB) Public-Private-Partnership (PPP) set up by the European Commission in the frame of the 7th Framework Program on the 2010-2013 period, both impressively illustrate the willingness of the European Authorities to stimulate this transition to sustainability.

It is the belief of the organizers and of the program committee that we, as members of the industry and academic research community, are among the key players of this European-wide effort. For this effort to be successful, we need to act collectively, being aware of each other's goals and achievements. The ICT4SP conference is an attempt to support this collective awareness and – hopefully – one further step towards an EU-wide integrated research effort on cities & their Regions' sustainability.

It is the intent of the organizing committee to bring each year a new batch of key topics. In setting up this first edition, we essentially had in mind to raise awareness, and foster networking and clustering among the projects funded in the frame of the 2010-2013 EeB PPP. We also chose to focus on the major contributions that Information and Communications Technology (ICT) could bring to sustainability and on how ICT complements the improvements brought by the other research domains (energy, materials, methods and practices, etc).

The conference program is quite dense, with six thematic sessions – opening session, district-scale, building scale & building to district interfaces, case studies, and two technical focus sessions –, and two workshops – the 4th edition of the Energy-efficient Building (EeB) Data Models workshop and the 1st edition of the Key Performances Indicators (KPI) workshop – both organized under the auspices of the European Commission (DG Connect). The challenge was to deal with a broad spectrum of topics (methodologies, data models, software tools, etc.), to consider different scales (building, district), and to highlight both theoretical and field results. We hope this program includes topics of interest for each and every conference attendee.

Before closing this foreword, the organizers would like to warmly thank the European Commission Directorate-General for Research & Innovation and Directorate-General for Communications Networks, Content and Technology, for their kind support. We would also like to thank the initiator of the EeB Data Models & EeB KPI workshops, namely M. Rogelio Segovia (DG CONNECT), for having given us the opportunity to organize these workshops in the scope of the conference. We also express our warm thanks to the Energy Efficient Buildings Association, and to Dr. Luc Bourdeau, its Secretary General, for their help.

And – last but not least - thank *you* for your participation. We hope you will spend an enjoyable and stimulating event.

Régis Decorme & Sylvain Robert

ICT4SP co-chairs

Table of Content

WELCOME TO NICE

Nice | Capital of *The French Riviera*

DISCOVER NICE

Nice is located in the heart of one of the world's most visited regions: the Côte d'Azur. Its central position is a key asset for the organisation of discovery-trips. Indeed, the most popular sites of the French Riviera and the backcountry are all within a 70 miles radius of the city centre!

The city cultivates the charm of its difference by offering a range of countless tours and activities. Whether it is by tourist train, by segway, by sightseeing bus or by boat, you won't run out of options to discover the capital of the Côte d'Azur!

For more information, please visit:

http://en.nicetourisme.com/pdf/DOC/Doc_appel_pros_EN.pdf

International Conference: ICT For Sustainable Places

Technical Programme Committee co-Chairs

Régis Decorme, CSTB
Sylvain Robert, CEA

Technical Programme Committee members

Lola Alacreu, ETRA I+D
Miguel Angel Oltra Rodriguez, Telvent
Tracey Crosbie, Teesside University
Edward Owens, Heriot-Watt University
Nashwan Dawood, Teesside University
Stefano Pizzuti, ENEA
Javier Grávalos, ACCIONA
Yacine Rezgui, Cardiff University
Noemi Jiménez-Redondo, CEMOSA
Johan Roef, INFRAX
Desmedt Johan, VITO
Alfredo Samperio, Schneider Electric
Frans Koene, TNO
Ernst Schmachtenberg, Aachen University
Veijo Lappalainen, VTT
Afzal Siddiqui, Stockholm University
Maja Skrjanc, Jozef Stefan Institute
Martine Tommis, Manchester Digital Development Agency
Vicente Madero Ayora, ACCIONA
Dimitrios Tzovaras, Informatics and Telematics Institute, CERTH
Christian Mastrodonato, D'Appolonia
Juliusz Zach, Mostostal Warszawa
Javier Gil Quijano, CEA
Michael Dibley, Cardiff University
Denis Gras, IBM

CONFERENCE AGENDA

As of September 3, 2013

MONDAY, SEPTEMBER 9

9:00 - 18:00	**OPEN/PRIVATE MEETINGS ORGANISED BY EU-FUNDED PROJECTS**
18:30 - 19:30	*Welcome reception*

TUESDAY, SEPTEMBER 10

9:00 — OPENING CEREMONY — MASSENA

Master of ceremony: **Roger Torrenti**, Sigma Orionis, Conference coordinator

Welcome addresses

Régis Decorme, CSTB and **Sylvain Robert**, CEA, Technical Programme Committee co-Chairs

Keynote addresses

Jeff Perren, Professor, School of Engineering in Cardiff University

Jean-Christophe Clément, Energy Expert, French Riviera Chamber of Commerce and Industry

10:30 *Coffee/Tea break*

11:00 — DISTRICT SCALE — MASSENA

Chaired by **Michel Bohms**, TNO

"Energy positive neighbourhoods as key elements towards resource efficient and carbon neutral cities"
I. Pinto-Seppä (VTT - Materials and Built Environment, Finland)

"The Odysseus Project: dynamic Energy Profile Card for ICT Energy Efficiency decision making"
M. Oltra (Telvent, Spain)

"IDEAS, Intelligent Neighbourhood Energy Allocation & Supervision"
T. Crosbie (Teesside University, Technologies Future Institute, UK), **D. Gras** (IBM, France)

"A Smart Energy Efficiency Service Platform for Smart cities"
L. Alacreu Garcia (ETRA I+D, Spain)

"RESILIENT: coupling renewable, storage and ICTs, for low carbon intelligent energy management at district level"
A. Paraboschi (D'Appolonia, Italy)

"The COOPERATE Project: Control and Optimisation for Energy Positive Neighbourhoods"
Y. Assef (EMBIX, France)

11:00 — BUILDING SCALE & BUILDING TO DISTRICT INTERFACES — LOUISIANE

Chaired by **Noemi Jimenez Redondo**, CEMOSA

"An innovative Building Energy Management System. Preliminary results of the SEEDS project"
N. Jimenez Redondo (CEMOSA, Spain)

"Introduction to TEDS4BEE (Test of Digital Services for Buildings Energy Efficiency) project"
D. Martinez Calleja (Madrid Network, Spain)

"Towards an integrated information system for energy management in buildings"
M. Dibley (Cardiff University, UK)

"INTrEPID project - INTelligent systems for Energy Prosumer buildIngs at District level"
M. Ramiro Mauleon (Advanticsys, Spain)

"The INGRID project: Combining Solid-state hydrogen-based storage and smart grids for multi-carrier optimization in smart city energy systems"
M. Bertoncini (Engineering Ingegneria Informatica, Italy)

"CAMPUS21: Control and automation management of buildings and public spaces"
D. Browne (UCC, Ireland)

12:30 *Lunch break*

14:00 — WORKSHOP ON EEB DATA MODELS — MASSENA

Chaired by **Rogelio Segovia**, Scientific Officer, DG CONNECT, European Commission

"BIM to Energy: Extending BIM for Multi-Model Domain Tasks"
T. Liebich, M. Weise (AEC3 Deutschland GmbH, Germany), **P. Katranuschkov, R. Guruz, R. Scherer** (TU Dresden, Germany)

"1st VoCamp - Energy Efficiency Modeling for ADAPT4EE"
J. Hreno, M. Skokan (Technical University of Kosice, Slovakia), **D. Ioannidis, D. Tzovaras** (Center for Research and Technology Hellas / Information Technologies Institute, Greece)

"Low carbon district - Energy and behaviour modelling"
C. Gay, P. Schetelat (CSTB, France)

"Using a BIM flow for the design and operation of Building Energy Management Systems"
P. Stenzel, J. Haufe (Fraunhofer Institute for Integrated Circuits IIS, Design Automation Division EAS, Germany), **N. Jimenez Redondo** (CEMOSA, Spain)

"3rd VoCamp Energy using and producing Products Management"
C. Grimm (TU Kaiserslautern, Germany), **D. Bonino** (Polytechnique Torino, Italy)

"French AGORA and Other Initiatives to foster Smart Home ecosystem development"
P. Martigne (Orange, France)

14:00 — TECHNICAL FOCUS SESSION 1 — LOUISIANE

Chaired by **Javier Gil Quijano**, CEA

Keynote address

Sarvapali Ramchurn, University of Southampton

Presentations

"SEEDS-SENS: A modular Wireless Sensor Actuator Hardware/Software Platform for Building Automation"
M. Diaz (SoftCrits, Spain)

"Ontologies for Autonomous Management System Developed for Building and District Levels"
M. Oltra (Telvent, Spain)

"Self Powered Wireless sensor Network for Energy Improvement of Building level HVAC system"
J. Berzosa (Tekniker, Spain)

"AEM: an Agent platform for smart-grid Energy Management"
J. Gil Quijano (CEA, France)

16:00 *Coffee/Tea break*

16:30 — WORKSHOP ON EEB DATA MODELS (continued) — MASSENA

Chaired by **Rogelio Segovia**, Scientific Officer, DG CONNECT, European Commission

"CITYGML Digital mockup to support Sustainable Cities"
J. Soula, B. Fies, O. Tournaire (CSTB, France)

"An ee-district ontology to support the development of the ee-District Information Model of the RESILIENT project"
J. L. Hippolyte, Y. Rezgui, H. Li, B. Jayan (Cardiff University, School of engineering, BRE, Institute of sustainable engineering, UK)

"Towards an integrated information system for energy management in buildings"
M. J. Dibley, Y. Rezgui, H. Li (Cardiff University, School of engineering, UK)

"Shared Vocabularies to Support the Creation of Energy Urban Systems Models"
L. Madrazo, A. Sicilia (Ramon Llull University, Arc Engineering and Architecture La Salle, Spain), **G. Nemirovski** (Albstadt-Sigmaringen University, Germany)

"Conclusion of the 4th Ws EeB Data Models"
R. Segovia (Scientific Officer, DG CONNECT, European Commission)

16:30 — CASE STUDIES — LOUISIANE

Chaired by **Martine Tommis**, Manchester City Council

"ICT Roadmap for Energy Efficient Neighbourhoods"
M. Sepponen (VTT Technical Research Centre of Finland, Finland)

"ICT for Energy Efficiency in Cities: Green Digital Charter and the NiCE toolkit"
S. Wille (IOER, Germany)

"Simulation and experimental validation of a Model Predictive Control for an energy district"
S. Barberis (UNIGE, Italy)

"A unified Cloud service for real-time optimum building energy management"
Y. Rezgui, H. Li, B. Jayan (Cardiff University, UK)

18:00 *Open Networking*

19:00 — NETWORKING DINNER

WEDNESDAY, SEPTEMBER 11

9:00 — WORKSHOP ON EEB KPIs — MASSENA

Chaired by **Rogelio Segovia**, Scientific Officer, DG CONNECT, European Commission

"RFSC - Reference Framework for European Sustainable Cities"
S. Maïssa (CSTB, France)

"Visualising the 'Big Picture': Key Performance indicators and sustainable urban design"
T. Crosbie, M. Crilly, N. Dawood (Teesside University, Technologies Future Institute, UK), **J. Oliveras** (Foment de la rehabilitacio urbana de Manresa, Spain), **N. Niwaz** (Ramboll, Energy supply and planning, Denmark)

"Key Performance Indicators (KPI) for Continuous Commissioning"
D. Antonucci, F. Noris, M. Castagna, R. Lollini (Eurac Research, Italy)

"Validation Methodology for a Self-Learning Building Energy Management System"
L. Nieto, V. Castaño (Fundacion Cidaut, Foundation for transport and energy research and development, Spain)

"KPIs for S.M.A.R.T. Cities"
G. Vogt, S. Robinson, E. Dashja (Empirica, Germany)

9:00 — TECHNICAL FOCUS SESSION 2 — LOUISIANE

Chaired by **Arturs Purvins**, DERlab

"Generation of Diagnostic Support Systems (DSSs) from Domain Ontologies and State Machines"
A. Tacchella (Università degli Studi di Genova, Italy)

"Simulation framework for simulation and control of a hybrid energy network"
G. Davy (VITO, Belgium)

"Towards an optimal infrastructure for district heating networks"
W. Mazairac (VITO, Belgium)

"Energy management in neighbourhoods: EEPOS platform specification"
A. Purvins (DERlab, Germany)

10:30 *Coffee/Tea break*

11:00 — CLOSING SESSION — MASSENA

Chaired by **Stefano Carosio**, D'Appolonia SPA

Keynote addresses

Luc Bourdeau, Secretary General, ECTP/E2BA

Wolfgang Loibl, Senior Scientist, Energy Department, Austrian Institute of Technology

Stéphane Pouffary, CEO & founder, Energies 2050, United Nations Environment Programme - Sustainable Buildings and Climate Initiative Advisory Board Chair

Best Paper Award

Session reports

11:00 — DIGITAL CITY / VILLE NUMERIQUE — LOUISIANE

Final event - Private meeting

12:30 *Lunch break*

14:00 — VISIT OF PILOTS AND LABORATORIES (until 18:00)

NICE GRID show-room, Carros

IBM Industry Solution Centre, La Gaude

14:00 — DIGITAL CITY / VILLE NUMERIQUE (continued) — MASSENA

Final event - Open session in French

THURSDAY, SEPTEMBER 12

9:00 - 18:00	**OPEN/PRIVATE MEETINGS ORGANISED BY EU-FUNDED PROJECTS**

Keynote Speakers

Luc Bourdeau

Secretary General

ECTP/E2BA

http://goo.gl/D44YsN

Wolfgang Loibl

Senior Scientist,

Austrian Institute of Technology, Energy Department, Sustainable Building Technologies

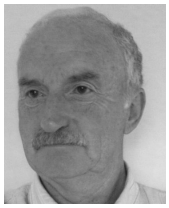
http://goo.gl/z29CdQ

Sarvapali D. Ramchurn

Electronics and Computer Science

University of Southampton

http://goo.gl/iRGBTD



Jeff Perren

Professor

School of Engineering, Cardiff University

http://goo.gl/pZXaTp

Jean-Christophe Clément

Energy expert

French Riviera Chamber of Commerce & Industry

http://goo.gl/H81uIn

Stéphane Pouffary

Chief Executive Officer and Founder

ENERGIES 2050 (NGO)

http://goo.gl/fMWGFh

DISTRICT SCALE

Chaired by Michel Bohms, TNO

Abstracts

Energy Positive neighbourhoods as key elements towards resource efficiency and carbon neutral cities

Summary

The focus is on the contribution of EEPOS FP7 project for realizing energy positive neighborhoods by developing open integrated urban neighbourhood energy management and decision support systems in which local consumers & producers as well as the main electrical and heating grids will be integrated.

Innovation

New business models and ICT-based tools for energy management systems at neighbourhood level. New Tools for engagement and motivation of users utilising new approaches as social media, serious gaming, or crowd sourcing.

Author

Isabel Pinto-Seppä

Isabel.pinto-seppa@vtt.fi

VTT

Finland

Isabel Pinto Seppä has key expertise in technologies and services in the Sustainability of the Build Environment and in the field of Forest products industries. Current research is focused on Energy efficient buildings and neighbourhoods, and on eco efficient product solutions. She is/has been involved in domain projects such as EEPOS (Energy positive neighbourhoods) and MEEFS (multifunctional EE façade system for building retrofitting) and, in coordination actions for research roadmaps on ICT for energy efficiency (REEB and ICT4E2B Forum).

Abstract

The population living in urban areas is projected to grow by 75% during the next 40 years. The UN estimated that urban population will grow from 3.6 billion in 2011 to 6.3 billion 2050. This brings challenges on safety, security, mobility and increasing resource consumption, including energy, among other demands. The global challenge is to reduce environmental impact and carbon footprint. Decisions made now in preparation for these challenges are crucial for the future of these urban areas, keeping the citizens' well-being and the cities' global competitiveness. Expenditures on improving energy efficiency, modernizing infrastructure and on creating high quality living environments are enormous. At the same time, cities have limited and less financial and human means.

In this context smart energy management in buildings and neighbourhoods are key elements for maintaining people's well-being with resources efficiency. One of the key issues is the smart integration, management and operation of energy supply and demand. In addition the optimal use of local and renewable energy sources is important. These are within the scope of "smart city solutions". Holistic solutions based on the integration of advanced ICT, energy and construction technologies and, addressing sustainability and energy efficiency at building, district, and city levels will deliver added value cities towards carbon free cities. The key are open systems that open the data also to business innovations without high costs and utilises advanced system designing as dispersed concept with open interfaces. This is the core of EEPOS, research and development project funded by the EC under the 7th Framework Programme.

EEPOS aims at realizing the idea of energy positive neighbourhoods. The project develops methods and tools for neighbourhood energy management and decision support systems that will integrate operationally local consumers & producers (prosumers) with the main electrical and heating grids. The innovation on EEPOS system is based on the integration of 5 dimensions:

- New business models and services.
- Neighbourhood level energy management system with open interfaces to the grids and local prosumers
- Information and decision support system for optimising the use of energy beyond the buildings.
- Collaboration tools for engagement and motivation of users utilising new approaches like social media, serious gaming, crowd sourcing etc.

The EEPOS system will be validated in two extensive field tests in Finland and in Germany as well as in a complementary laboratory tests in Germany and simulation based virtual prototype study for the municipality of Asparrena, Spain.

The project consortium includes eight academic, industrial and public organisations from four European countries located in different EU climate zones They combine unique expertise in building services, building management systems, energy efficiency services, end-user needs and interfaces, renewable energy systems, monitoring and energy efficiency focused productivity tools.

The Implementation of key solutions and services for reaching the required change in urban energy efficiency is crucial. The development of energy positive neighbourhoods can achieve a significant reduction in energy consumption. EEPOS results will impact on the reduction of urban CO2 emissions being a step towards energy efficient and carbon free cities.

The Odysseus Project: dynamic Energy Profile Card for ICT Energy Efficiency decision making

Summary

The Odysseus project aims to develop an Open Dynamic System (ODYS) enabling the 'holistic energy management' of the dynamics of energy supply, demand and storage in urban areas. The paper describes the main objectives and the experimentations in the cities of Manchester and Rome Municipality XI and the first results in the definition of the project platform services in support to the experimentations.

Innovation

For addressing both business pilot cases, Odysseus project, will address the energy lifecycle phases (production, consumption and storage), by modeling the dEPCs concept for energy nodes at neighborhood urban level. How to deal with the semantic modeling or energy nodes by means of the definition of a full taxonomy of energy node types and their associated properties and inter-relationships (modelling energy nodes in urban areas implemented in a modelling ontology) and how to provide a network cartography of dEPCs (positioning according to GIS standards), with optimized schemes for interaction and trading of energy between network nodes for DSS making (Semantic and GIS part connected) is one of the strategic innovation challenges to be addressed by Odysseus.

Author

Miguel Oltra

miguel.oltra@telvent.com

Telvent

Spain

Miguel A. Oltra holds a MsC in Telecommunication Engineering at the University of Seville, with more than 10 years in R&D projects, where his whole professional career has been developed under Telvent R&D department (currently part of Schneider Electric), participating with different roles in R&D projects and programs both at EU level (ITEA program) and Spanish level (CENIT, Avanza and CTA programs), realizing activities such as project, work package and tasks coordination. He has participated as an invited expert to brainstorming sessions during the edition phase of the 2nd edition of the ITEA Roamap and has also been a member of the programme committee of the SPLC2006 (Software Product Line Conference 2006).

Abstract

The aim of the Odysseus project is to develop an Open Dynamic System (ODYS) enabling the 'holistic energy management' of the dynamics of energy supply, demand and storage in urban areas, on top of an open integration platform supporting the integration scenarios for designated urban areas (exemplified in the cities of Rome and Manchester). The two project city pilots represent totally different scenarios: in Manchester project results are validated on a mature energy efficiency environment, in Rome it is in the early stages of dealing with energy efficiency in public building.
Odysseus Project Objectives are:

- Building an integration scenario
- The development of an open integration platform
- A holistic energy management system
- The validation of the previous objectives

The project and its objectives together with development tool for energy efficiency measurement are experimented in two different cities and two different energetic cases.

In Manchester, the Town Hall complex is part of the Corridor Low Carbon Economic Area initiative, which is an area of 4 sq. km. centred on the two main universities, the University of Manchester and Manchester Metropolitan University together with the City's main teaching hospital complex, Manchester Science Park and a diverse set of small neighbourhoods ranging from high value apartments, to student and key worker accommodation to social housing. The Town Hall complex is at the northern tip of the Corridor area.

The project aims at creating a core 'smart environment' within the two main buildings, the Town Hall Extension and Central Library, which will, in the short term, improve energy efficiency and reduce environmental impact, particularly CO2 emissions reduction, and, in the longer term, act as the central part of a new heat exchange network with other buildings in the immediate neighbourhood. This, in turn, is part of a long-term objective to extend this across the wider district, i.e. the Corridor Partnership area.

The pilot case Municipality of Roma XI is based on the use of the energy produced by the photovoltaic plant of CesareBattisti school (Building A). Currently the energy produced by the photovoltaic plant of building A (CesareBattisti school) is used for the consumption of the loads of the school as the energy produced in excess is given to the Acea (Utility) network. The target is using all the photovoltaic energy produced for own use without giving back the remaining energy produced by the photovoltaic plant to the grid and therefore to simulate the transfer of electricity in surplus (especially during the summer when most of the school building is closed) from the building A of the CesareBattisti school to the CesareBattisti offices of building B for charging the batteries of electric bicycles.

The first definition of the implementation of the Odysseus system to the city of Manchester and Rome has just started, and many requirements and functionalities on the project have been identified. The Odysseus challenge in the ICT for Energy Efficiency has just started.

IDEAS "Intelligent Neighbourhood Energy Allocation & Supervision"

Summary

The IDEAS R&D project supported by the European Commission. Its' main focus is developing and testing the technologies and business models required for financially and socially viable energy positive neighbourhoods. Key components of the technologies and business models will be tested at two pilot sites. The project will also explore the possibilities for the incremental rollout of energy positive neighbourhoods across the EU.

Innovation

The unique selling point of IDEAS is that it considers the potential offered by the wholesale energy markets to support the incremental implementation and financial viability of energy positive neighbourhoods. In an energy positive neighbourhood more renewable energy is generated within that neighbourhood than is consumed. However, it is not possible to provide the business, regulatory, cultural and urban environments required for energy positive neighbourhoods 'overnight'. The approach adopted in IDEAS will support and adapt to the incremental rollout of the, local energy infrastructures, energy efficient buildings and cultural and regulatory environments required for energy positive neighbourhoods.

Authors

Tracey Crosbie

T.Crosbie@tees.ac.uk

University Of Teesside

UK

Denis Gras

denis.gras@fr.ibm.com

IBM

France

Dr Tracey Crosbie (PhD) is a Senior Research Fellow, School of Science & Engineering, working in the Technology Futures Institute at Teesside University. She has been researching issues associated to the development of sustainable urban environments for more than fifteen years. She supports Prof. Nashwan Dawood in the co-ordination the IDEAS project and leads the work package concerned with the development of the business models. She also leads a work package concerned with requirements capture in another current FP7 R&D project SEMANCO - Semantic Tools for Carbon Reduction in Urban Planning.

Denis Gras, MBA, is an IT Architect at IBM-F Innovation Lab. He has 12 years of experience working for a global System Integrator in different areas (System Integration, Application Management & Outsourcing activities). Denis is currently an engagement leader within the IBM Montpellier Innovation Lab focusing on Smarter Cities initiatives and Collaborative R&D projects at both French and European levels.

Abstract

The IDEAS project aims to develop and validate the tools and business models required for the cost effective and incremental implementation of energy positive neighbourhoods. These include

- A Neighbourhood energy management tool: to optimise energy production and consumption;
- User interfaces: to engage communities and individuals in the operation of energy positive neighbourhoods;
- A Decision support urban planning tool: to optimise the planning of neighbourhood energy infrastructures;
- Business models: to underpin energy positive neighbourhoods that engage end users, public authorities and utility companies

The neighbourhood energy management tool will enable intelligent energy trading and operation of equipment and buildings along with local energy generation and storage. It will consist of:

- an internet-based infrastructure to manage real-time information flows;
- an optimisation and decision support system for the management of energy production and consumption and energy trading;
- data management and storage services.

The business models and tools will support local energy infrastructures that optimise energy supply and demand, while exploiting wholesale energy markets and local renewables, in ways which make real business sense.

The concept underpinning the business and technical approach is that energy is drawn from national grids only when there is an imbalance in neighbourhood energy supply and demand; or importantly, when it is more economically viable to buy or sell energy from/to the national grid.

With the right pricing structure for renewable energy, as a neighbourhood becomes more energy positive it will rely less and less on national energy resources. On reaching energy positivity the surplus energy produced by an energy positive neighbourhood will be a source of revenue profit from intelligent energy trading with national grids.

Energy positivity will become a realistic business goal, for utility companies and public authorities, as tools under development will support a joined up approach to the development and operation of local energy systems. The energy management tool will optimise the current energy supply and demand in real time. While the urban planning tool will improve future urban development to reduce energy demand and increase local renewable energy supply.

Two demonstration sites in France and Finland will be used to validate key elements of the tools and business models developed with different business stakeholders, users and building typologies.

A Smart Energy Efficiency Service Platform for Smart cities

Summary

SmartKYE proposes to develop a system for the future smart grid neighbourhood that will enable better business decisions to be made based on real-time fine-grained data coming from heterogeneous energy systems. Key end-users targeted are the public authorities who can monitor and manage key indicators in neighbourhoods with the goal of better energy efficiency and CO2 reduction.

Innovation

The challenge of the project is to coordinate efforts at city level, creating opportunities and exploiting synergies. This is not only relevant to the energy management within a smart city, but also to the intersection of areas of actuation. On the other hand, the focus of SmartKYE will not be so much to develop breakthrough technologies from scratch but instead to integrate different innovative technologies so that their combined use leads to increased energy savings and emission reduction. This approach will allow having a rapid impact on the market, in the spirit of the European Economic Recovery Plan 2010-2013 (PPP in Research Areas).

Author

Lola Alacreu García

Lalacreu.etra-id@grupoetra.com

ETRA I+D

Spain

Lola ALACREU is an Industrial Engineer from the Polytechnic University of Valencia (Spain), performing the last year of the degree at Manchester University (United Kingdom). She is working in ETRA I+D since 2008, where she has been involved in several ICT European and national projects, including the coordination of NOBEL (http://www.ict-nobel.eu/) and SmartKYE (http://smartkye.eu/) projects.

Abstract

Future Smart Cities will rely upon their districts/ neighbourhoods to be monitored and managed efficiently in the smart grid era. However the various neighbourhoods might significantly differ from each other and follow their own goals. The infrastructure on the districts is expected to be highly heterogeneous e.g. with public lighting system, urban heating system, public buildings, commercial centres, electric vehicles, micro-generation, residential prosumers, etc.

There is a need for tools to enable the monitoring of Key Performance Indicators at district-wide level, being able to assess the behaviour of the Energy Infrastructure deployed in the neighbourhoods based on real-time analytics and take the necessary business decisions. Additionally, these would enable enforcement of decisions taken at management level to be propagated to the infrastructure itself.

SmartKYE proposes the development of an advanced, integrated, management system which enables energy efficiency in neighbourhoods from a holistic perspective. To that end, the Energy Management Systems deployed in a typical district that are consuming or producing energy, and which nowadays normally count with an isolated IT management solution, will be able to share data and services through and open platform among themselves and to external third party applications. This enables the design and development of higher level applications that are able to process real-time data and generate valuable analytics to affect the business and Monitoring and Control strategies that operate a district - or a subset of the energy services deployed.

Current industrial access to electricity already considers the interruptibility of the service as a demand management tool –a rough one indeed- to give a rapid and efficient response to the needs of the electricity system in emergency situations. It consists of reducing the active power demanded to a required residual power level, in response to a power reduction order issued by the main grid operator, to consumers subscribed to this service.

The deployment of the open platform proposed by SMARTKYE will provide a more granular and accurate tool to respond to emergency situations without actually interrupting the service. In this way, to avoid an overload, the grid operator could request to reduce the consumption from public lighting, or EV points of charge; it could request the generation of energy in the case of facilities with their own generators, or the access to previously stored energy, etc.

SMARTKYE targets specifically public authorities –i.e. municipalities - responsible of a number of public services demanding energy. These services can be run by ESCOs – as it is the case for most EV sharing systems – or directly by the local authority. In any case, it is the responsibility of the district operator to grant the efficiency – also from the energy point of view – of such public services. Thus, the SMARTKYE cockpits will offer public authorities with a high level view of the energy and business processes on going in a neighbourhood.
The project will validate this approach in two high profile pilot sites:

- The 22@ district in Barcelona, Spain.
- The area of Lasithi in Crete, Greece.

RESILIENT: coupling renewable, storage and ICTs, for low carbon intelligent energy management at district level

Summary

Coupling renewable, storage and ICTs can foster low carbon intelligent management at district level. The proposed integrated concept will be modeled, simulated, and finally evaluated in three Demo sites in Italy, UK and Belgium, through the assessment of energy and environmental benefits.

Innovation

Demonstration at pilot sites of effective integration of RES and Smart grid fostering a sustainable development.

Author

Anna Paraboschi

anna.paraboschi@dappolonia.it

D'Appolonia S.p.A.

Italy

Mrs. Paraboschi graduated in Civil Engineering and got Ph.D. in Hydraulic Engineering at the Politecnico di Milano University. Starting from her background in civil and hydraulic engineering, Mrs. Paraboschi has developed skills in theoretical modeling, numerical programming and laboratory testing. She has been involved in optimization of water supply networks management, hydrologic models, river simulations and multimedia development. Her activity in D'Appolonia is focused both in industrial consultancy projects, combining inventive problem solving methodologies with up-to-date use of ICT resources, enabling the identification of trends and opportunities in technological developments, and in the management of several FP6/FP7 and IEE projects.

Abstract

The aim of this presentation is to provide a description of the framework and to show preliminary results achieved within RESILIENT, a novel project funded by EC in the ambit of the EeB.NMP.2012-1 theme: Interaction and integration between buildings, grids, heating and cooling networks, and energy storage and energy generation systems. The project, involving 14 partners from different EU Countries, and coordinated by D'Appolonia, started in September 2012 and will last 4 years. RESILIENT aims to design, develop, install and assess the energy and environmental benefits of a new integrated concept of interconnectivity between buildings, distributed energy resources, grids, and other networks, at a district level, by combining innovative technologies. Overview of the project S/T objectives, Exploitable results, preliminary achievements, and Demonstration sites is presented.

The COOPERATE Project: Control and Optimisation for Energy Positive Neighbourhoods

Summary

Launched in November 2012, the COOPERaTE project aims to develop an IT platform offering energy management services across a cluster of buildings in order to develop positive-energy districts. The presentation focuses on the main goals of the project, the challenges to overcome and its current progress.

Innovation

Development of energy and non-energy services for the neighbourhood in a cloud environment. Application of big data technologies in the Smart City Energy Management Systems, including cyber security and confidentiality aspects. Interoperability. Business Model analysis.

Author

Yasmine Assef

yasmine.assef@embix.fr

EMBIX

France

Dr Yasmine Assef obtained her electrical engineering MS degree from Ecole Spéciale des Travaux Publics in Paris, France in 1993, and her PhD in electrical engineering in 1997. Yasmine joined Alstom Grid (Formerly Alstom T&D, Areva T&D) in 1998, as Power System engineer. Between 1997 and 2000, Yasmine was teaching Electrical Engineering and Power Electronics at Ecole Spéciale des Travaux Publics. From 2000 to 2011, she held different positions inside Alstom Grid, as Energy Management System Project Manager, Service and Support Operations Manager for Europe, Africa and Asia. In 2007, she was responsible for the worldwide tendering activities of Alstom Grid Network Management System Business Unit. Since 2011, Yasmine joined EMBIX as Deputy CEO. Among her responsibilities, she is in charge of Smart Grid demonstration projects.

Abstract

Buildings are responsible for 40% of energy consumption and 36% of EU CO2 emissions. They are the largest energy-consuming sector in the EU, but also offer the largest cost-effective opportunity for savings, in order to achieve the EU Climate & Energy objectives, namely a reduction of 20% of greenhouse gas emissions compared to 1990 levels by 2020 and 20% energy savings in primary energy use by 2020 and the use of 20% of renewable energy in the total energy consumption in the EU by 2020.

The information and Communication Technologies play a key role, by helping to change the way in which the energy infrastructure is operated. These "Smart Grids" technologies will enable the efficient operation of different grids and their interaction, through the integration of Smart Buildings, local renewable generation, and other component of the neighborhood or city (Electrical Vehicles, street lightings, etc…).

COOPERaTE addresses these challenges by developing management and control systems, as well as decision support systems addressing the dynamics of energy supply and demand in neighborhoods. COOPERaTE will optimise the use of energy beyond the buildings, including the integration of renewable energy sources and the connection to the electricity distribution grid, and will consider appropriate business models.

This platform will link local monitoring and controls systems such as building automation systems, SCADA systems used for microgrid control and other power systems control functions in the neighbourhood with a cloud based service delivery platform. This will be achieved by developing a local middleware layer with service interfaces that link to the cloud platform. The local middleware layer will also allow local, real-time control functions to be implemented which are required to execute local demand and supply balancing and grid connection control. Optimisation algorithms will be developed for energy management services including energy usage detection, state estimation for the multi-energy system, electric vehicle charging and demand side management that measures and controls to shape demand.

BUILDING SCALE & BUILDING TO DISTRICT INTERFACES

Chaired by Noemi Jimenez Redondo, CEMOSA

Abstracts

An innovative Building Energy Management System. Preliminary results of the SEEDS project

Summary

This paper presents an innovative Building Energy Management System (BEMS) which is being developed for the ongoing FP7 project SEEDS. It is based on measurements, self-learning and optimization techniques and wireless technologies suitable for a building or group of buildings and open spaces. It is especially attractive for retrofitting of existing buildings.

Innovation

The main innovations of SEEDS are:
i) SEEDS can be easily applied to any building even if little information on its architecture characteristics are available. SEEDS' BEMS only needs the available information on building facilities and the appropriate set of measurements captured by sensors which are also required for the control system;
ii) SEEDS is a dynamic system that can learn user behavior;
iii) SEEDS can be easily deployed and implemented because of the use of wireless technologies and the modeling methodology referenced in item i) above;
iv) the modeling of the energy equipment in the building is based on BIM methodology

Author

Noemi Jimenez-Redondo

noemi.jimenez@cemosa.es

CEMOSA

Spain

Noemi Jimenez Redondo received her MSc in Industrial Engineering from Universidad Pontificia Comillas Madrid (Spain) in 1991 and her PhD from Universidad de Malaga (Spain) in 1999. She worked for the Railway Division of Abengoa (now Telvent) and for Instituto de Investigación Tecnológica (U. Pontificia Comillas Madrid). In 1993 she joined Universidad de Malaga as lecturer and researcher. Since 2001, she is an Associate Professor at Universidad de Malaga. Since 2007, she is the head of the R&D Division of the Spanish Consultancy Company CEMOSA. Since 2010 she is on a temporally unpaid leave from the University of Malaga working full time for CEMOSA. She is the Project Coordinator of two ongoing FP7 projects: ACEM-Rail (Grant Agreement no. 265954) and SEEDS (Grant Agreement no. 285150)

Abstract

There are several stages along the life of a building to be faced by different stakeholders of the Building field: from the Design & Construction to the Operation & Management until the end of the cycle of the building. Much effort and tools have been developed for the design of the building covering a whole range of issues such as architectural, structural, system and facilities and including energy simulations. In order to make best use of such developments and to integrate different actors on the building business, the technology is evolving towards the use of BIM methodology.

On the other hand there is a gap between the Design & Construction stage and the Operation & Management stage of a building. Often the Design is more focused on architectural issues with little emphasis on the facilities and installations. At the Operation & Management stage, Facility Management is the core business. At this stage, due to the aforementioned lack of coordination between the Design and the Operation stages, little information from the BIM is available for the Facility Management.

This paper presents an ICT tool for the optimal management of the energy behavior of a building (or group of buildings) and surrounding open spaces. This tool is being developed for the on-going FP7 project SEEDS.

The SEEDS project focuses on the Operation stage of the building. It develops a Building Energy Management Systems to optimize energy behavior of the building over a time period. It performs detailed modeling of the HVAC equipment which is by far the largest energy consumer in buildings. The modeling of the energy equipment in the building is based on IFC – an Open BIM data exchange format.

SEEDS implements an innovative model predictive control strategy based on sensor measurements and self-learning techniques. This methodology allows taking into account the properties of a building and its energy behavior without the need of having explicitly the architecture model (usually in BIM) of the building. If available, SEEDS uses BIM data about the building floorplan/layout and the building services structure. In other words, SEEDS allows designing a BEMS for a building starting using only the information available on the building facilities and the appropriate set of measurements that are captured by wireless sensor nodes which are also required to implement the most energy efficient control strategy. There is no need to have detailed architecture information (such as material parameters, thermal capacities etc.) and thus, SEEDS can be easily applied to the energy-aware upgrading/ optimization of existing building services systems and to the retrofitting of old buildings which may lack constructional specification details necessary for traditional systems. Moreover, the use of wireless technologies allows an easy and fast deployment.

This paper will focus on the SEEDS architecture and the modeling and control methodology. SEEDS architecture is based on the definition of 5 main components, 4 active ones (Building Facility Model, Optimizing, Self-learning and WISAN) and 1 passive one (Archiving or Data Management) organized in three layers: the controller layer (which includes Building Model, Self-Learning and Optimizing), the data management (or Archiving) and the process interface layer (WISAN and the Graphical User Interface). Preliminary results are presented.

Introduction to TEDS4BEE (Test of Digital Services for Buildings Energy Efficiency) project.

Summary

The project aims to provide and deploy the Digital Service EMMOS (Energy Management and Monitoring Operational System) in pilot buildings located in 5 countries. It has a total budget of EUR 4.3 million and is funded 50% by the European Commission via the Competitiveness and Innovation Framework Programme 2007-2013 within the ICT Policy Support Programme (ICT-PSP).

Innovation

The most innovative and useful characteristics of EMMOS are:

- Innovative functionalities that allow a complete analysis and wide variety of reports and predictions to identify possible areas of improvement.
- High flexibility and adaptability, to ensure that can be applied in every type of buildings and any location.
- As a web-based application (service), easy and worldwide access through any device (PCs, tablets, smart phones) with an Internet connection and a web navigator.
- Easy-quick plugging and high-adaptability for different levels of connection to the buildings. EMMOS interface allows three levels of data gathering: connecting to the BMS (Building Management System) of the building, connecting to one or several SM (Smart Meter) and through the web interface (manually).

Author

David Martínez Calleja

david.martinez@madridnetwork.org

Cluster for Sustainability and Renewable Energies. Madrid Network

Spain

David Martínez Calleja, holds a degree in Biology (Universidad de Oviedo, Asturias, Spain) and a Master's degree in Renewable Energies and Energy Market. He is currently the Managing Director of The Cluster for Sustainability and Renewable Energies at Madrid Network. In previous jobs he has worked both for the public and the private sectors such as Invest in Spain (Ministry Of Economy and Competitiveness), as Investor Services Manager for the Renewable Energy sector, as project developer for SunEdison (Solar Photovoltaic multinational) or in Centrica Energy as Electricity market operator. He has experience in areas such as searching for business opportunities (Renewable Energies, Energy Saving and Efficiency, Smart Cities, etc.), developing networking Services for Companies and Investors or planning promotion activities.

Abstract

Buildings account for 40% of energy end-use in the EU and making them more efficient is therefore key in order for the EU to achieve its goals of reducing CO2 emissions by 20%, improving the energy efficiency by 20% and achieving 20% renewable generation by 2020 (20-20-20 UE objectives).

TEDS4BEE is fully aligned not only with the objectives of the "20-20-20" initiative but also with other European initiatives and programmes aimed at energy savings and sustainability such as: Energy Efficiency for 2020 initiative, action Plan for energy efficiency 2007-2012, the Green Paper on Energy Efficiency, the Global Energy Efficiency and Renewable Energy Fund and the Green Digital Charter. All these programmes emphasize the need to involve citizens, public decision-makers, market players, technological development and partnership with other countries.

TEDS4BEE project aims to provide and deploy the Digital Service EMMOS (Energy Management and Monitoring Operational System) in pilot buildings located in 5 countries. EMMOS will make possible to collect, storage and analyse consumption data and other parameters that influences the energy consumption such as temperature, humidity, NOx, CO2, comfort level, light intensity, etc. This will help building managers and ESCO's (Energy Service Companies) identify energy efficiency improvement actions and will help local authorities to define better energy policies. EMMOS allows the building managers to analyze their buildings energy parameters using innovative functionalities:

- Report generation
- Benchmarking Building to Building (B2B)
- Benchmarking Building to N-buil dings (B2N)
- Projected energy (PE)
- Return of energy (ROE)

The TEDS4BEE main objectives are the integration and validation of EMMOS as the Digital Service in the pilot buildings; assessment of the collected data in terms of energy efficiency and savings; definition of the business and exploitation plans to ensure the sustainability and the scalability beyond these pilots and user's acceptance through surveys and expected impact emissions reduction in buildings between 15% and 30%.

TEDS4BEE gathers in the consortium the full value chain (ICT providers, ESCOs and public building owners) and some more (universities, research centres and clusters association) in seven European countries. This variety of partners and buildings will make a very comprehensive set of testing cases empowering the replication.

Moreover, at national dimension, TeDS4BEE will help to establish and/or refine the national Building Energy Audit programmes and activities.
All the information related to the project will be available soon in the TEDS4BEE website (www.teds4bee.eu).

Towards an integrated information system for energy management in buildings

Summary

The paper proposes the use of a metamodel to facilitate the integration of a holistic energy related knowledge management system. The approach promotes consistency and the application of principled engineering techniques.

Innovation

In the (metamodel) mechanism proposed, the innovation is the presentation of the means to render fundamental engineering principles into an energy management system in a consistent way across the whole system, where that system consists of disparate and distributed sub systems and technologies. By building on the metamodel proposed, core system formulations and best practices etc. are manifested in each 'view', reducing to a minimum the transformations needed between views.

Author

Michael Dibley

dibleymj@cardiff.ac.uk

Cardiff University

UK

Michael's interests lie in the integration of software and hardware systems for mutual benefit, specifically the design of sensor infrastructures and the semantic elaboration of the generated raw data. His work is focused in the context of the built environment, for the delivery of smart energy management advice.

Abstract

For the purpose of automated holistic building energy management within the knoholEM FP7 project, a technique for the explicit and consistent integration of system 'perspectives' that include a number of knowledge, data and run time models is presented. The technique employing a metamodel allows the systems development process to exploit native and mature domain specific modelling and shifts the developer away from implementation of data format transformations, focusing on conformance to modelling syntax and implied semantics. The integration of model 'perspectives' is realised with the definition of a metamodel using OMG's meta object facility (MOF). The metamodel defines the perspectives and establishes relevant relationships between the high level (abstract) entities that manifest in the various domain models, incorporating relevant theories and patterns. Further system wide theories and specifications (aspects) cross the perspectives in the metamodel are used to render consistency and uniformity. The metamodel is easily extendible to facilitate the integration of further perspectives such as those that interface to numerical simulation and optimisation tools.

INTrEPID project- INTelligent systems for Energy Prosumer buildIngs at District level

Summary

INTrEPID will develop technologies that will enable the energy optimization of residential buildings performing an optimal control of internal sub-systems in the Home Area Network and also providing advanced mechanisms for effective interaction with the external world, including other buildings, local producers, electricity distributors, and enabling energy exchange capabilities at district level.

Innovation

Innovative home environment technologies will be developed such as middleware for device discovery and automated synthesis of control programs, smart energy meters, non-intrusive load monitoring, Complex Event Processing for anomalies detection in individual components within sub-systems like HVAC, lighting, etc., integrated control of such sub-systems and creation of systems for photovoltaic generation synchronization with consumption according forecasts. Furthermore, the project will implement the “fit-and-forget” concept for low cost controllers and thermostats installation. Finally, this project will provide Business Intelligence integrated within a Building Energy Management Systems (BEMS) with the functionality to support dynamic participation in the market.

Author

Manuel Ramiro Mauleon

manuel.ramiro@advanticsys.com

Advanticsys

Spain

Manuel Ramiro is a Telecommunications Engineer; he works at Advanticsys where he has a position of responsibility in the Product development department. His research activities are focused on Wireless Sensor and Actuators Networks, RFID Technology, embedded systems and ICT solutions. He has been involved in various national and European projects (e3SoHo (CIP-ICT-PSP),HosPilot (CIP-ICT-PSP), uSWN(EC-FP6), ESNA(ITEA), EnergyWarden (EC-FP7),Teach (EC-FP7), eDiana (ARTEMIS), REEB (EC FP7), FIEMSER (EC FP7)) related with ICT, Energy Efficiency and IoT.

Abstract

The INTrEPID project's goal is to create technologies to achieve energy efficiency at home level and at the same time integrate residential buildings in the Smart Grid. This goal will be achieved by realizing by three main objectives:

A. Energy optimization, which is provided by the development of three INTrEPID technological components (Indoor Home networks, Supervisory control strategies and Energy Brokerage);

B. Integration and validation of the integrated system: the system will be tested in RSE and Telecom Italia labs and it will be installed and validated in real houses. The installation in real buildings will involve 50 homes, partly located in Italy and partly located in Denmark. The system will include devices such as energy gateways, smart meter or smart info (depending on the location, smart info will work in ENEL electricity grid), smart plugs, a smart appliance, connected thermostats to control HVAC system. The specific devices to be installed in the system will be evaluated during the project development.

C. Dissemination and Exploitation: dissemination will be achieved both with contribution to scientific conferences, industrial fairs and leveraging the Telecom Italia show room; dissemination will have a special focus on Standardization activities.

The energy optimization objectives will be achieved in following complementary ways:

- Developing advanced monitoring and diagnostics concepts and ensuring that the achieved savings are sustained over long period of time without being degraded by deteriorated performance of both mechanical equipment and the monitoring and control system itself;
- Developing supervisory control strategies that will be enable to coordinate larger subsystems (heating, ventilation, air conditioning, lighting, renewable energy generation, thermal storage, etc.) and orchestrate operation of the numerous devices in such systems;
- Supporting inter-building energy exchange. A brokerage agent will communicate directly with other buildings and local producers to negotiate possible use of the electricity produced locally in their premises in order to increase the interoperability of buildings and to address the challenges related to deployment the future Smart Grid concepts and technologies.

The INTrEPID consortium includes a significant involvement of large enterprises and SMEs from different sectors, including home automation equipment providers, smart appliances manufacturers, telecom operators and energy distributors.

The INGRID project: Combining Solid-state hydrogen-based storage and smart grids for multi-carrier optimization in smart city energy systems

Summary

INGRID European R&D project contributes to the emerging vision of future multi-carrier smart interconnected energy which are conceived as a collection of networked distributed physical hubs coupled with embedded smart monitoring and control devices or service hubs supporting the optimized operations of energy (electricity, gas) network operators. INGRID aims at designing and demonstrating the sustainable operation of a Service Storage-based Node for Future Interconnected Smart Energy Systems)

Innovation

INGRID will be the first real life demonstrator which will be operating in a Smart City context based on the combination of green-hydrogen solid state energy storage and smart grid tu integrate to the largest possible extent intermittent renewable energy sources and alleviate the power network congestion)

Author

Massimo Bertoncini

Massimo.bertoncini@eng.it

Engineering Ingegneria Informatica

Italy

Massimo Bertoncini is the director of R&D EU projects with a specific mandate to lead on ICT for Sustainable Energy at the Engineering R&D Lab. Since May 2001, he has been working in the R&D Laboratory of Engineering S.p.A, where he was involved as coordinator in many FP5, FP6 and FP7 projects. Currently he is the Director of the INGRID (High-capacity hydrogen-based green-energy storage solutions for grid balancing) FP7 project and will be the director of the GEYSER (Green nEtworked Data Centres as EnergY ProSumErs in smaRt city environments) project, starting next October. Main research competences concern soft artificial intelligence and control systems (Fuzzy Systems, Genetic algorithms, Neural Networks) for Smart Energy Systems. He is a member of the CEN-CENELEC-ETSI Coordination Group on Green Data Centres on behalf of Engineering Group. He is the author of several papers published in international conferences. He has been serving DG Smart Cities and Sustainability as Scientific Expert and Evaluators for many years.

Abstract

We intend to present the supporting vision and the preliminary results of the on-going four year FP7 INGRID (http://www.ingridproject.eu) project, now at the end of its project year. INGRID project aims at researching and demonstrating how and to what extent the effective combination of solid-state high-density hydrogen storage systems and electrolysis with advanced ICT technologies for smart distribution grids real time monitoring and control will be enable to balance power supply and demand, in a scenario of high penetration of intermittent renewable energy sources, while ensuring security and stability of the power distribution network.

The INGRID project will design, build, deploy and operate a 39 MWh energy storage facility using French McPhy SME partner hydrogen-based solid state storage and Belgian Hydrogenics partner electrolysis technology and fuel cell power systems in the Puglia region in Italy, where over 3.500 MW of solar, wind, and biomass are already installed. The hydrogen energy storage installation, with more than 1 ton of safely stored hydrogen including a novel fast responding 1.2 MW hydrogen generator, will be fully controlled by advanced smart grid solutions provided by Engineering and will provide effective and smart balancing support for the local grid managed by Enel Distribuzione DSO. In that respect the real life demonstrator will take place in Foggia, one of the Puglia's cities mostly involved in Smart Cities city programs.

The overall project objective is to demonstrate the effectiveness of originally combining the hydrogen solid-storage systems with Smart Grid cutting-edge sensing, monitoring and control technologies for balancing highly variable power supply and demand in a Smart City scenario with high penetration of renewable energy sources.

In that respect INGRID has been investigating on innovative technological and business aspects of future smart interconnected power2gas/gas2power energy systems, which are modeled as a collection of networked distributed physical hubs coupled with embedded smart monitoring and control devices (consumption, production, or service hubs supporting the optimized operations of energy (electricity, gas) network operators). In that respect hydrogen is undoubtedly a high-promising storage technology due to its high energy density and high reversibility, but it currently faces security and cost problems preventing it to be largely exploited into the energy storage market. Metal hydrides provide a much higher volume density than compressed or liquid gas. In particular magnesium hydrides (MgH2) will be used for mass storage with clear advantages in terms of safety, stability, modularity, high density, high dynamic and reversibility.

INGRID has been demonstrating the sustainable operation of a Service solid-hydrogen-based Storage-based Node for Future Interconnected Smart Energy Systems where energy conversions take place and which can offer services to the energy carriers while pursuing its own independent business.

The core component of the INGRID node concept is the Energy Management System, which is in charge of managing and optimizing energy production, storage and control determining, by supervising and optimizing how much hydrogen should be produced with a view to flow out an optimized amount.

INGRID EMS embodied as intelligent device and smart software component positioned at the interface between DSO and combined Renewable Energy Sources and Green energy Storage. Hydrogen-base storage is realized within the Green Energy Storage, composed of:

- Water Electrolyzer (WE), powered instantaneously by the RES electricity reflowed;
- Hydrogen Solid Storage (HSS) which accepts all the pure hydrogen flowing out from the WE and store in solid-state
- Fuel Cell (FC), connected directly with the HSS storage subunits, that can, on-demand, de-absorb H2 gas again from the storage HSS sub-units in order to process and recombine it into air and heat (previously dispersed by the HSS) producing electricity.

INGRID system will be operated either as a Closed loop where all the hydrogen will be supporting power injecting into the grid either as Open Loop, where hydrogen surplus can be managed through the traditional hydrogen value chain (i.e. physically transported or injected as fuel into biomass plants)
Thanks to INGRID project:

- the role of hydrogen-based technologies in supporting renewable energy integration and power supply and demand balancing will be fully unveiled.
- the combination of solid-state hydrogen storage with smart grid will become a promising solutions to alleviate congestion in the power networks, reducing transmission losses in transferring electricity far away.

CAMPUS 21

Summary

CAMPUS21 will develop, deploy and test methodologies and related software platforms supporting the integrated usage of existing ICT-subsystems, including energy, building, and security management systems. The integration aims to improve the energy performance of groups of public buildings and surrounding spaces. This work is complemented by the development of a Performance Monitoring and Evaluation Strategy and corresponding business models, to allow the verification of energy savings.

Innovation

A methodology that allows the holistic, integrated analysis of descriptive and performance driven data from two distinct, currently de-coupled IT- sources, namely BMS and BIM. The integration methodology, the corresponding hardware-software platform and the complementing business and procurement models are expected to lead to
(1) an optimisation of the cost of ownership of advanced building management and control systems,
(2) a reduction of energy required to operate public buildings, and
(3) the introduction of advanced building performance analysis tools to ensure that the results from savings and optimisations are permanently and sustainably implemented.

Authors

Karsten Menzel
k.menzel@ucc.ie
University College Cork
Ireland

Donal Browne
d.browne@ucc.ie

Karsten is a Professor and Principal Investigator at University College Cork, Ireland. He is the Director of the Informatics Research Unit for Sustainable Engineering and the Co-ordinator of the CAMPUS21 project. His primary expertise is in Facilities and Energy Management, in Information Systems development and Business Process Modelling.

Donal is a Chartered Engineer with a wide range of Building Services experience in Design, Construction and Facilities Management and Research/Educational Experience in Business Models BIM 5D CAD/Virtual Construction Building Energy Simulation 3rd/4th Level Tutoring & Lecturing. Before joining UCC Donal worked for five years as an Engineer with a multi-national consultancy firm.

Abstract

CAMPUS 21 aims to improve the operation of public buildings and surrounding spaces, including the energy-efficiency of building services systems, the optimisation of the cost of ownership and the introduction of sustainable maintenance processes. As part of the project a hardware-software platform will be developed demonstrating cost effective buildings' operation and energy savings resulting from predictive control and load balancing.

Predictive control and advanced load balancing are based on the exploitation of data from continuously updated timetabling systems, real-time user occupancy data from security systems (proximity cards, RFID-readers), and the analysis of live weather data from local weather stations.

Efficiency gains and optimised "cost of ownership" is expected from the analysis of performance monitoring data and the introduction of novel, robust and easy measurable Key Performance Indicators. Additionally, the influence and practicability of extended maintenance activities, such as sensor calibration, is analysed and proposed for inclusion in the "next generation" of business models for Facilities and Energy Management.

The verification of efficiency gains and energy savings is achieved through the introduction of a data warehouse-driven performance evaluation tool which integrates fact data compiled from Building Management Systems (BMS) and dimensional data compiled from Building Information Modelling systems (BIM). This integration will contribute to the harmonisation of two major "open information modelling standards" – ifc and BACnet.

CAMPUS 21 brings together the expertise of national research centres from Germany (Telecommunications), Ireland (IT in AEC, Artificial Intelligence), Austria (Building Physics), and Spain (Information Technology) in addition to the management experience of Public Authorities. These are grouped with process expertise from multiple industry sectors, such as construction and facilities management, building services systems manufacturers and energy providers. Aside from technical solutions, Campus21 will provide business models and economic solutions to ensure maximum commercial impact for the project.

CAMPUS21 spans the entire innovation chain due to its cross-sectorial membership. It contributes to the establishment of world-class infrastructures and the economic recovery plan of the European Union.

Key technological innovations of CAMPUS21 are:

- Integration concepts for energy management systems including related middleware components
- Methodologies for intelligent, optimised control of building services systems
- Algorithms and tools to support load-balancing between renewable micro-generation, storage systems, and energy consuming devices in buildings and public spaces

This is complemented by the development of key business elements, including:

- New business models for integrated energy management and the underpinning novel procurement schemes
- The development of performance metrics and a holistic evaluation concept for systems' integration.

CAMPUS21 uses existing demonstrators and living laboratories for research and validation of energy and cost savings:

- A large university campus located in Cork, Ireland; featuring steam and electricity distribution grids with CHP, access control systems and buildings with large co-generation capacity from multiple renewable sources.
- A Swimming Pool, benefitting from solar-thermal co-generation, being part of an indoor sports complex in Valladolid, Spain
- A multi-purpose sports arena in Frankfurt, Germany; in demand for an optimisation of peak-loads and improved prediction for maintenance cycles.

WORKSHOP ON EEB DATA MODELS

Chaired by Rogelio Segovia, Scientific Officer,
DG Connect, European Commission

This workshop is organised by the European Commission - DG CONNECT and the IDEAS project

The aim is to foster interoperability between R&D sister-projects, through the use of shared IT semantic and data models. The objectives is to disseminate the main findings from recent European VoCamps – Vocabulary Camps – and relevant initiatives developed at the National level in EU countries around 4 application clusters:

- eeBIM
- eeBEMS
- Smart Appliances
- ee Beyond the building (neighbourhood scale)

Full papers are available into a booklet distributed by the European Commission, and will be published at the eeSemantics Wiki

Abstracts

Session 1 : eeBIM

Session 2 : eeBEMs

Session 3 : Smart Appliances

BIM to Energy: Extending BIM for Multi-Model Domain Tasks

Authors

T. Liebich

tl@aec3.de

AEC3 Deutschland GMBH

Germany

M. Weise

mw@aec3.de

AEC3 Deutschland GMBH

Germany

P. Katranuschkov

peter.katranuschkov@tu-dresden.de

Tu Dresden (Institute of construction informatics)

Germany

R. Guruz

romy.guruz@tu-dresden.de

Tu Dresden (Institute of construction informatics)

Germany

R. Scherer

raimar.scherer@tu-dresden.de

Tu Dresden (Institute of construction informatics)

Germany

Abstract

Integrated analyses and simulations of building energy system performance throughout the whole lifecycle can be efficiently achieved only if a sound integration approach with regard to the needed underlying data is provided. This data is highly distributed and heterogeneous, thereby implying the use of multiple models and resources. This paper addresses the issue of BIM extensions for such multi-model domain tasks on the basis of work done in the EU project HESMOS for the development of an energy-enhanced BIM framework (eeBIM) enabling the integration of multiple needed resources (climate, occupancy, material data etc.) and the interoperability of a number of energy analysis, cost analysis, CAD, FM and monitoring tools in an Integrated Virtual Energy Lab Platform [3]. The underlying multi-model framework is based on a flexible and simple link approach, but without higher level semantics that is needed for more sophisticated domain-specific multi-model management features. As an outlook for further research work the paper shortly discusses potential extensions, also reflecting results of the 2nd VoCamp meeting held in Brussels beginning of 2013.

[3] Liebich, T., Stuhlmacher, K., Katranuschkov, P., Guruz, R. et al.: HESMOS Deliverable D2.1: BIM Enhancement Specification, © HESMOS Consortium, Brussels, 54 p., 2011.

1st VoCamp Energy Efficiency Modeling for ADAPT4EE

Authors

J. Hreno

Jan.Hreno@tuke.sk

Technical University of Kosice

Slovakia

M. Skokan

Marek.Skokan@tuke.sk

Technical University of Kosice

Slovakia

D. Ioannidis

djoannid@iti.gr

Center for Research and Technology

Hellas/ Information Technologies institute

Greece

D. Tzovaras

Dimitrios.Tzovaras@iti.gr

Center for Research and Technology

Hellas/ Information Technologies institute

Greece

Abstract

In the current available building performance simulation programs the presence of occupants and their influence on a building are (at best) based on predefined activity/presence schedules. These schedules however, are often assumptions rather than based on measured observations and resulting descriptive and predicting models. The main topic addressed by the 1st Adapt4EE VoCamp was to foster the fusion of two disjoint worlds of Building Information Modelling (BIM) and Business Process Modelling (BPM) by delivering vocabularies and ontologies that associate the relationships among these domains. Participants of the VoCamp were experts from area of Energy Efficiency in Buildings as well as knowledge engineers. Example ontology from scratch was first prepared at the VoCamp to foster common understanding of the topic. Following the example ontology exercise, an already existing complex ontology model was presented and the vocabulary used to create this model was then modified on the VoCamp in a cooperative manner. Following topics were discussed and models of these were added to the existing vocabularies: skeleton activities, occupancy profiles, key performance indicators (KPIs), building occupants as producers of energy, building simulation results visualizations, high-level events inferring based on measurements stemming from semantically enriched devices. The most discussed models were KPIs and skeleton activities. KPIs model combines energy performance attributes with business performance and occupant comfort attributes. Skeleton activity specification enables to describe necessary characteristics of business activity such as resources needed, involved roles and relations to other activities for the construction of business process map. As a result of the VoCamp, modified Adapt4EE ontologies are available on the eeSemantics wiki page. This paper describes the process and presents outcomes of the VoCamp. The presented research is performed in the frames of the EU Project Adapt4EE (2011-2014).

Low carbon district - Energy and behaviour modelling

Authors

C. Gay

charly.gay@cstb.fr

CSTB (Scientific and Technical Centre for Building)

France

P. Schetelat

pascal.schetelat@cstb.fr

CSTB (Scientific and Technical Centre for Building)

France

Abstract

The main objective of the CSTB Low Carbon District program is to develop a set of new energy management tools to reduce carbon footprint at the district scale. Such tools should allow the development of strategies aiming at electrical load reduction, such as demand response, distributed energy resources energy integration and load management. In that context, a high resolution (1 minute) load curve simulator framework has been developed. It aims at being a virtual benchmark for local smart grid strategies.

The framework proposed in this paper is a combination of top-down and bottom-up approaches. On the first hand the district information model is described in a top down fashion by a joint distribution allowing the generation of a statistically representative sample of buildings, appliances and dwellers. The joint distribution is derived from publicly available census data and expert knowledge whenever experimental data are missing.
On the second hand, the dwellings load curves are simulated using a bottom up approach. In this work, appliances are stochastically triggered conditionally to the dwellers activity. The behaviour models are based on the homogeneous Markov chains used in (Richardson et al. 2008) .

Deterministic part of the electrical load, such as heating and cooling consumption, is simulated through a reduced model of the multi-zone building model from the SIMBAD library (Husaunndee et al. 1997).
This paper presents the general approach and modelling hypothesis of the load curve simulator and shows first results of behavioural load curves simulations.

Using a BIM flow for the design and operation of Building Energy Management Systems

Authors

Pit Stenzel

pit.stenzel@eas.iss.fraunhofer.de

Fraunhofer (Institute for Integrated circuits IIS, Design Automation Division EAS)

Germany

Jürgen Haufe

juergen.haufe@eas.iis.fraunhofer.de

Fraunhofer (Institute for Integrated circuits IIS, Design Automation Division EAS)

Germany

Noemi Jimenez Redondo

noemi.jimenez@cemosa.es

CEMOSA

Spain

Abstract

This paper reports our experiences using the Building Information Modeling (BIM) approach within the FP7 project SEEDS (Self Learning Energy Efficient Buildings and open Spaces). SEEDS focuses on the development of an optimized Building Energy Management System (BEMS) that reduces the energy consumption and the CO2 emission of the building services during its operation phase based on self-learning techniques. One of the core components of the SEEDS architecture is the Building Model which calculates the energy consumption of the building at building operation time. In this paper, we introduce an approach for the automatic creation of this SEEDS' Building Model from an IFC data model. For an application case, the ability of IFC data models to describe building services is discussed. The introduced methodology was implemented for the energy management of an HVAC system using the CAD tool DDS-CAD 7.3.

Towards standardization of M2M communication in Smart Appliances

Authors

Christoph Grimm

grimm@cs.uni-kl.de

TU Kaiserslautern

Germany

Dario Bonino

dario.bonino@polito.it

Politecnico di Torino

Italy

Abstract

Smart appliances are appliances that are networked with their ambient and use information from the home environment to autonomously make decisions, e.g. to switch a service off to save energy. While communication at physical layer is supported by a variety of standards (e.g. X10, ZigBee, KNX, Z-Wave, WLAN, LON), communication at the semantic layer lacks agreed and applicable standards. This has become a major showstopper for the market success of smart appliances.

This paper gives an overview of the outcomes of the discussions developed during the 3rd VoCamp on "Energy Using and Producing Products Management", introducing objectives, requirements, and existing standardization efforts. Particular focus is put on joining the different views by which the semantics of M2M communication can be organized, device-centric or service based, typically. The firs approach describes the composition of appliances and their integration within the home ecosystem; the second, instead, represents appliances as set of services contributing to different home tasks, e.g., energy management.

French AGORA and Other Initiatives to foster Smart Home ecosystem development

Author

Patricia Martigne

patricia.martigne@orange.com

Orange

France

Abstract

The Smart Home landscape today is composed of siloed solutions, which results in various types of devices and different communication technologies being proposed to the end-user. This situation may be not satisfying when targeting a real take-off for the Smart Home market. It was indeed realized that the end-user would require warranty on long-term usability of his Smart Home system. This raises the question of interoperability among the various devices deployed in the end-user's home, which in turn points out to the common data models needed as an enabler for various actors of the Smart Home domain to make their systems interoperate. The paper will present some initiatives, and their status, aiming at solving this question.

In particular, the French industrial forum "AGORA des réseaux domiciliaires" (Agora of the domestic networks) creation was impulsed by the French Ministry of the Industry, to encourage the synergy required among Smart Home industrial actors to define the "homebus".

Also the Home Gateway Initiative (HGI) is actively working on the Smart Home architecture and on defining data models for Smart Home particular needs, that will be made available via standardized APIs (Application Programming Interfaces).

The paper will also mention the ongoing standardization activity around abstraction and semantics in the M2M domain, pointing out the aspects that are relevant for Smart Home ecosystem. Examples will be given through details of the ETSI M2M guideline mapping a "home area network" e.g. ZigBee to ETSI M2M abstract data model. Moreover ETSI M2M had began a study on Semantics that is re-used in oneM2M Abstraction and Semantics work item. Last, the present paper will explain the relationship of this work item not only with "verticals" (such as HGI or the Continua Alliance), but also with European Research projects (such as FiWare, and projects coordinated by IERC AC4).

TECHNICAL FOCUS SESSION 1

Chaired by Javier Gil Quijano, CEA

Abstracts

SEEDS-SENS: A modular Wireless Sensor Actuator Hardware/ Software Platform for Building Automation

Summary

The paper will present the design of the hardware and software of the Wireless Intelligent Sensor and Actuator Networks (WISAN) platform specifically developed for Building Automation in the context of the SEEDS project. The platform includes modular configurable hardware, a reliable communication infrastructure and software tools for helping the maintenance and deployment of the monitoring and actuation system.

Innovation

SEEDS-SENS is a WISAN open platform specifically designed for BAS. It is based on standards and uses very low cost hardware. The hardware platform is highly modular and configurable, allowing to include their own sensors or the connection of existing ones. The communication infrastructure includes a fault-tolerant middleware and tools for network maintenance and deployment.

Author

Manuel Díaz

mdr@softcrits.es

Software for Critical Systems, S.L. (SoftCrits)

Spain

Prof. Manuel Diaz is the co-founder of SoftCrits, where he is the head of the R&D department. He is also a Full Professor at the University of Malaga since 2010, where he worked previously as Associate Professor (1995) and Assistant Professor (1991). He has a Master degree (1990) and a Ph.D. in Computer Engineering (1995). His main research interests are distributed real-time systems, wireless sensor networks and middleware for this type of systems. He was the coordinator of the FP6 project SMEPP and main researcher for the Univ. of Malaga in the FP7 WSAN4CIP project. He has published 26 papers in International Journals (JCR) and more than 60 papers in relevant International Congresses in these fields. He has directed more than 20 innovation, research and technology transfer projects with companies as Telefonica, Tecnatom or Abengoa. He is currently working in the SEEDS project as work-package leader of the WISAN.

Abstract

WISANs are gaining market acceptance in Building Automation Systems (BAS) because they are both cheaper and faster to deploy than traditional wired field-buses. However, a number of issues are raised when adapting this technology to the concrete domain of BAS.

Aspects such as reliability, timing constrains and security are of paramount importance in this systems. On the other hand, other features related to energy consumption and self-configuration are not as relevant as in other WISAN applications, as the topology is determined by the building and the location of the energy and HVAC components and power supply is available in most of the cases.

SEEDS-SENS requirements have been defined after a careful analysis of the monitoring needs and the equipment to be controlled. The hardware platform has been designed to include their own sensors when needed (temperature, humidity, air quality, presence, energy consumption) or to use the sensors previously existing in the building. The design has been carried out in two steps. In a first stage, three different prototypes were developed (room nodes, Air Handling Unit nodes and outdoor nodes). The prototypes were based on the Arduino hardware architecture standard and have been tested in the two SEEDS demonstrator sites.

In the second stage, a modular board has been developed in order to reduce costs and improve the configurability and reliability of the nodes. The design is still compatible with the Arduino standard, but the boards integrate the signal adaptation electronics and the Zigbee Pro wireless modem. The nodes can include only the processor and communication elements or can be configured to include a sensor board (with support for all the sensors identified during the requirements analysis) and an actuator board (including all the adaptation electronics needed for actuation).

The communication infrastructure is based on a 802.15.4 mesh network. The SEEDS-SENS communication middleware implements an efficient fault-tolerant routing algorithm, which ensures that in the event of communication errors (due to power-loss, environmental obstructions, etc.) critical data can still reach its destination. In addition the middleware implements the following features:

- Self-healing. Any node can enter and leave the network, transparently to the network operation.
- Quiet Protocol, using mechanism similar to AODV.
- Route Discovery.
- Selective Acknowledgement.
- Reliable delivery.

In addition to the middleware, the SEED-SENS platform includes two software tools for network maintenance and for network deployment and configuration. The network maintenance application allow the user to:

- Know the state of the nodes of WISAN
- Monitor data from WISAN in real-time
- Change the state of the actuators
- Change the configuration of the nodes
- Add/Remove/Suspend/Resume nodes

The network deployment tool is based on the IFC building standard. The tool allows loading and visualizing an IFC building model, where the user can position sensor and actuator. The tool performs a network coverage analysis, providing the number and position of network routers needed in order to achieve full connectivity among the nodes. The tool implements two different coverage analysis algorithms: Multiwall and Dominant Path Model.

Ontologies for Autonomous Management System Developed for Building and District Levels

Summary

The purpose of the AMBASSADOR project is to study, develop and experiment systems and tools for the optimal energy usage in the perimeter of a district by managing the energy flows. This contribution will explain the design decisions made and problems solved in the first phases of the AMBASSADOR project.

Innovation

Main innovation for AMBASSADOR is seeing the district as a whole instead of isolated elements (buildings). This will require some innovations to manage the energy flow between the district elements. Global energy efficiency will be reached by optimising energy fluxes at domestic level but above all by putting in communication all district energy players through a holistic approach.

Further activities will make sure that inputs requested by DEMIS and output produced by buildings will be compatible and standardized when possible. The creation of a new Technical Standardization Group which will deal with District level standards will be considered.

Author

Joseba Izaguirre Luquin

joseba.izaguirre@tekniker.es

IK4-TEKNIKER

Spain

Joseba Izaguirre Luquin holds a MSc in Telecommunications Engineering. He works as a Researcher in the Electronics and Communication Unit and is experienced in energy efficiency oriented development of embedded solutions for sensor and actuator platforms, mainly in the areas of WSN, domotics and healthcare systems. He is participating in several EU-research projects: TIBUCON (FP7), Epic-Hub (FP7) and URB-Grade (FP7).

Abstract

Thus far, all the investigation about energy savings has been focused in the building, and more precisely concentrated in some individual sub-systems. Nowadays we have the technology to connect these isolated elements, like buildings, with others smart elements in a wide area such a district. Based on this need was born AMBASSADOR, an ambitious project which will define and experiment with a system that optimises the cost of energy in a district, the cost being expressed in Primary Energy, CO2 or €.
These are the main objectives of AMBASSADOR:

- To develop a District Energy Management and Information System (DEMIS), a pivotal element to make an holistic energy optimisation for a district, taking advantage of the possible shared usage of the local energy production and storage and how the different energy consumption profiles complement each other, where also predicting and mastering energy consumption/production will play a key role;
- To validate through a number of selected scenarios some functions or services proposed by the system on the three validation sites;
- To study different business models that can be successfully implemented.

By utilizing the concept of Ontology modelling the technical characteristics of the district and its components are structured/classified, i.e. the semantics of the elements related to the installed energy management systems are modelled. This ontology is the core technology to build the transversal middleware which provides a homogeneous and common platform for all diverse devices, equipments for energy generation and storage, sensors and systems involved into the AMBASSADOR project.

The main objectives are:

- Defining the infrastructure of a district by classifying the range of installed elements relevant to the energy consumption domain;
- Providing means for technical characterization and semantic interpretation of signals going to/from the installed system/equipment;
- Providing the topological profile of the district and relationships between the installed elements.

The specification of the system is based on use cases that are expressed in the context of a Business Model whose main characteristic is that energy consumption is centrally managed within the district towards a common optimisation goal. The ontology is functionally-driven toward the services that are intended to be provided within the AMBASSADOR context. Although a deep review on existing ontologies in the energy efficiency field (ENERsip, eDIANA, IntUBE) has been carried out for convenience and partial reusability, the final objective in AMBASSADOR is to define an application ontology tailored to the needs that the AMBASSADOR project aims to reach.

The first version of the ontology defines the higher entities and layers of the system while it will be iteratively and progressively defined in more detail as the elements of the system are further developed. At this stage of development, AMBASSADOR ontology envisages the DEMIS as an interaction between energy management entities (specific and non-specific EnergyManagers), a broad set of energy production/storage/consumption systems (EnergyActors) and the energy users. Adding some external inputs (weather, energy price, …), this interaction is oriented to provide energy efficient services at district and building level, showing those benefits through the study of several performance indicators.

Self Powered Wireless sensor Network for Energy Improvement of Building level HVAC system.

Summary

The TIBUCON project aims to reduce energy consumption through HVAC system performance enhancement. This is achieved thanks to an ICT based building wireless connectivity system that can support a real time control and actuating scheme. This contribution will explain the outcomes of the project in terms of energy efficient communications.

Innovation

The TIBUCON project proposes to improve the efficiency of both used and newly installed HVAC systems at building level. The main innovation of the TIBUCON project is that, although the devices are powered by means of PH technologies, they must perform their sensing duty while participating in the communication process (within their energy capabilities). There are no nodes where the network load can be concentrated and it must be appropriately shared. The area where the network is to be deployed (a whole building) imposes many challenges related to the heterogeneous and changing external conditions such as different channel interference clusters.

Author

Jorge Berzosa Macho

jberzosa@tekniker.es

IK4-Tekniker

Spain

Jorge Berzosa Macho holds a MSc in Computer Science and is performing a PhD in the feasibility of High Level Data Models and Protocols over constrained Wireless Sensor Networks. He works as Researcher in ik4-Tekniker (Electronics and Communication Department) and his interests lay in the area of the WSNs (Data Models, constrained systems, routing, localization, monitoring…) and its application to pervasive systems (user interactions, ubiquity, constrained services,…). In this field, he is actively participating in TIBUCON (FP7), URBGrade (FP7) and AMBASSADOR (FP7) in this field.

Abstract

The main objective of the TIBUCON project proposal is the efficiency improvement of both used and newly installed HVAC system through thermal simulations of the HVAC system and continuous real time comparison between measured and simulated outputs. Depending on the situation, the results are to be passed to the building manager or the building users, so they can undertake the necessary actions. The cost effective and maintenance free wireless technology offered by TIBUCON solution will help construction companies in the cost reduction in HVAC system deployment.

The project focuses on the space heating and cooling aspects, proposing a solution beyond the existing wireless based HVAC control systems, derived from the use of Self Powered Multi Magnitude Wireless Sensor Network (SP-MM-WSN) for building thermal condition monitoring. The use of SP-MM-WSN results in an easy to deploy and maintenance free building monitoring system that makes it the ideal candidate for either new or existing HVAC installations.

The network design tries to completely avoid the use of cables and removable batteries, thanks to the combination of extremely energy efficient wireless communication technology, ultra low power electronics, and power harvesting.

An energy efficient and flexible MAC protocol has been designed. The MAC protocol takes into account the special constraints of the TIBUCON scenario and shares the load of the network. The primary objective has been to keep a very low power consumption making the most of the available harvested energy.

The most challenging aspect of the system is that only the gateway is wall powered. Each device's participation in the communication depends on its own available/remaining energy and capabilities. This implies that even the nodes that will act as repeaters or routers will need to expend its energy carefully. As there are no nodes where the network load can be concentrate, the protocol must ensure that each node acts within its capabilities while optimizing the network overall functionalities.

Special considerations have been taken into account due to the particular dynamics of Power Harvesting systems. These include sudden and frequent connections/disconnections of the devices and selective activation and management of mechanisms for energy consumption adjustment.

Deploying a wireless network over a whole building imposes many challenges. The devices are scattered over a wide area where the conditions can change drastically. Heterogeneous energy scavenging opportunities, varying channel interference profiles and synchronization are only a few examples. Additionally, the deployment in apartment buildings could be understood as the deployment of a federated network over an unfederated space, where the behavior of the inhabitants has a direct impact on the performance of the system.

The first version of the sensor nodes has been fully produced and tested, both in lab and real scenarios. The data gathered helped in the validation of the system and provided the team with preliminary and valuable data to build the thermal simulations. Additionally, these tests helped in identifying different issues related to the energy consumption, efficiency of the harvested module management and communication in general. New design choices have been made in order to improve the overall communication system.

AEM : an Agent platform for smart-grid Energy Management

Summary

AEM is a multi-agent based platform for both the simulation and the optimal energy management of a smart-grid.

Innovation

The main contribution of our work lies on a generic ICT framework for real-time energy management in smart-grids. This framework is based on a comprehensive combination of distributed optimization algorithms with physical and expert modelling of individual components behaviours (i.e. production, distribution, consumption). This combination added to a hierarchical modelling approach, allows the framework to be used to optimize energy production and distribution at several scales and in various contexts (e.g. management of energy at the district level, in conjunction with the global network; management of production of clusters of offshore wind farms; heating distribution management; etc.).

Authors

Cédric Herpson

cedric.herpson@cea.fr
CEA
France

After a Ph.D. degree in Computer Science from the University Pierre and Marie Curie (France) he joined the CEA to pursue his work in the field of energy management for smartgrids. His research interests are in the area of artificial intelligence and include agents' autonomy, especially decision-making under uncertainty, and heuristic search and its applications.

Javier Gil Quijano

javier.gil-quijano@cea.fr
CEA
France

With a PhD in computer science and MSc in artificial intelligence, he works on multi-agent modelling and control of socio-technical systems. Throughout its different work experiences he has turned his interests into modelling of biological complex systems (Post-doc at IBISC – Université d'Evry) and modelling of human behaviours for energy usages (PhD and Post-doc at LIP6 / EDF). Since 2012 at CEA LIST, he is technical-leader on several projects involving the use of multi-agent systems for distributed monitoring of complex systems (buildings, distribution networks) and the distributed energy management and optimization at different scales (district management systems, virtual centrals for wind power generation).

Sylvain Robert

sylvain.robert@cea.fr
CEA
France

He has an initial background in embedded software and 10 years experience in software engineering and research management. He has been leading since 2009 the CEA's R&D activities dealing with software engineering and artificial intelligence techniques applied to smart city and smart energy grids domains – after having, until 2009, focused his technical activity on model-driven software engineering. His achievements include a significant record of involvements in European projects, including as task, WP leader and technical coordinator. In the field of ICT for energy and buildings, he is currently the coordinator of the PLUMES research project (French National Research agency, 2010-2013, 2 M€), WP leader in the RESILIENT European project (FP7, 2012-2016, 8M€), WP leader in the Enerficiency European project (ITEA2, 2011-2014, 10 M€). He is, since 2012, a member of the scientific council of the Energy Efficient Building Association (E2BA) and CEA representative in the association. He is also involved in the EERA smart cities and smart grids joint programs.

Abstract

A rapidly growing number of smart-grid experiments are conducted around the world, and each time the question is therefore: how to optimally manage the energy behaviour of the system? The difficulty to answer to this question comes as much from the variety of components of a smart-grid as for the heterogeneity of the constraints and objectives of the entities that compose it.

The AEM platform, based on a multiagent approach, addresses this problem. Being agent-based allows AEM to be a multi-layered, flexible and scalable platform. AEM is both a management and a simulation tool for smart-grid. From a simulation perspective, it allows modeling and simulating the behaviors of the various components of a smart-grid (production, distribution, storage and consumption) for different flow (electricity, heating). From a management perspective, it pilots and optimizes the energy behaviour of a smart-grid according to an objective given at the scale of the eco-district while taking into account the various behaviours, constraints and objectives of the entities that compose it. Environment agnostic, the management can be realized indifferently in a simulated or in a real environment.

AIM offers both market oriented and social-welfare oriented models. Each one is associated with optimization algorithms that integrate planning and demand side management capabilities.

Experimental evaluations of our platform have been realized as part of several projects, academics (RESILIENT, STRATEGE, WINPOWER) and industrials (EDENs). Results show that AEM is able to effectively simulate and optimize the energy behaviour of a smart-grid, adapting its optimization strategy to each eco-district policy.

WORKSHOP ON EEB DATA MODELS (continued)

Chaired by Rogelio Segovia, Scientific Officer,
DG Connect, European Commission

This workshop is organised by the European Commission - DG CONNECT and the IDEAS project

The aim is to foster interoperability between R&D sister-projects, through the use of shared IT semantic and data models. The objectives is to disseminate the main findings from recent European VoCamps – Vocabulary Camps – and relevant initiatives developed at the National level in EU countries around 4 application clusters:

- eeBIM
- eeBEMS
- Smart Appliances
- ee Beyond the building (neighbourhood scale)

Full papers are available into a booklet distributed by the European Commission, and will be published at the eeSemantics Wiki

Abstracts

Session 4 : ee Beyond the Building

CITYGML Digital Mock-up to support sustainable cities

Authors

Julien Soula

julien.soula@cstb.fr

CSTB, TIDS/MODEVE

France

Bruno FIES

bruno.fies@cstb.fr

CSTB, TIDS/I2S

France

Olivier TOURNAIRE

olivier.tournaire@cstb.fr

CSTB, TIDS/MODEVE

France

Abstract

In a context where sustainability becomes a crucial factor for cities and citizens, experts underline the confusion of decision-makers confronted to the mass of criteria to manage. Thus those need to change their practices involving plan, design and management. They seek for new powerful tools supporting their decisions, through an integrated multi-criteria evaluation tool. CSTB has worked for the last years on the potentiality of using a centralized and standardized data model to accommodate and support the different aspects of an urban project during its lifecycle, in a close connection with city experts, decision makers and citizens. CityGML, as an OGC standard, offers interesting features to share and manage the complexity of a city. Its model describes geometry and semantics at different levels of detail and can be expanded natively to new items thanks to generic elements. The paper illustrates how we developed our tool eveCity to implement and use a CityGML exclusive model. It describes some of its hosted “expert modules” that interoperate in real-time by picking and enriching the model. It also focuses on new automatic geometric reconstruction methods to speed up the acquisition process and an application offer of local authorities.

An ee-district ontology to support the development of the ee-District Information Model of the RESILIENT project

Authors

Y. Rezgui

rezguiy@cardiff.ac.uk

Cardiff University (School of Engineering, BRE Institute of Sustainable Engineering)

UK

H. Li

lih@cardiff.ac.uk

Cardiff University (School of Engineering, BRE Institute of Sustainable Engineering)

UK

B. Jayan

jayanb@cardiff.ac.uk

Cardiff University (School of Engineering, BRE Institute of Sustainable Engineering)

UK

J.L. Hippolyte

hippolytej@cardiff.ac.uk

Cardiff University (School of Engineering, BRE Institute of Sustainable Engineering)

UK

Abstract

This paper presents the district information model (ee-DIM), that is being developed in the framework of the RESILIENT project. It describes both the methodology we adopted to design the ee-DIM and its architecture. An iterative process will lead to the design of the final ee-DIM. This process includes: analysing and conceptualising relevant scientific literature, re-using and aligning existing generic and domain ontologies, gathering and conceptualising the knowledge of production system operators and facility managers, collecting and analysing monitored data from pilot districts, and integrating European standards.

Towards an integrated information system for energy management in buildings

Authors

M. J. Dibley

dibleymj@cardiff.ac.uk

Cardiff University (School of Engineering)

UK

H. Li

lih@cardiff.ac.uk

Cardiff University (School of Engineering)

UK

Y. Rezgui

rezguiy@cardiff.ac.uk

Cardiff University (School of Engineering)

UK

Abstract

For the purpose of automated holistic building energy management within the knoholEM FP7 project, a technique for the explicit and consistent integration of system 'perspectives' that include a number of knowledge, data and run time models is proposed. The technique employing a metamodel allows the systems development process to exploit native and mature domain specific modelling and shifts the developer away from implementation of data format transformations, focussing on conformance to modelling syntax and implied semantics. The integration of model 'perspectives' is realised with the definition of a metamodel using OMG's meta object facility (MOF). The metamodel defines the perspectives and establishes relevant relationships between the high level (abstract) entities that manifest in the various domain models, incorporating relevant theories and patterns. Further system wide theories and specifications (aspects) cross the perspectives in the metamodel are used to render consistency and uniformity. The metamodel is easily extendible to facilitate the integration of further perspectives such as those that interface to numerical simulation and optimisation tools.

Shared Vocabularies to Support the Creation of Energy Urban Systems Models

Authors

L. Madrazo

madrazo@salleurl.edu

Ramon Llull University (ARC Engineering and Architecture La Salle)

Spain

G. Nemirovski

nemirovskij@hs-albsig.de

Albstadt-Sigmaringen University (Faculty of Business and Computer Science)

Germany

A. Sicilia

sicilia@salleurl.edu

Ramon Llull University (ARC Engineering and Architecture La Salle)

Spain

Abstract

The problem of carbon emission reduction in urban areas cannot be constrained to a particular geographical area or scale, nor is it the concern of a particular discipline or expert: it is a systemic problem which involves multiple scales and domains and the collaboration of experts from various fields. The aim of models of urban energy systems is to identify the processes that determine the energy intensity in a specific urban area. Such models can help experts to understand the systems' behaviour and take measures to improve its performance. The application of semantic technologies can help to create urban energy models which integrate the knowledge from experts in various domains. The goal of the SEMANCO research project is to create a comprehensive framework – i.e. methods and tools– using semantic technologies which enable experts from different domains to devise and deploy urban energy models that help various stakeholders – planners, consultants, policy makers – to understand the complexity underlying carbon reduction in urban areas. A key component of the project is the Semantic Energy Information Framework (SEIF) which facilitates the link between the tools which are intrinsic to an energy model and the required data. This paper describes the process and results obtained in the development of this semantic framework. In particular, the paper discusses the creation of its underlying ontology, that is, the vocabulary shared by different domain experts which is necessary to access the contents of the different data sources required by an energy model. The configuration of the urban energy models and the access to the semantic data and the tools that characterise them take place through the SEMANCO integrated platform. Therefore, the current state of the development of this platform is also presented in the paper.

CASE STUDIES

Chaired by Martine Tommis, Manchester City Council

Abstracts

ICT for Energy Efficiency in Neighbourhoods (IREEN)

Summary

IREEN is an FP7 funded EC project focused on developing a strategy and roadmap for the use of technology for energy efficient neighbourhoods. The aim is to present the vision for ICT enabling energy efficiency at a neighbourhood level along with the needs and possibilities for research, technology development and innovation in the near future. The vision is to identify how ICT can contribute and support improving energy efficiency and energy positives in both urban and rural neighbourhoods. This contribution will present the results and findings of the project.

Innovation

The roadmap offers a new insight into the domain for energy efficiency beyond an individual building scale to the broader concept of energy efficiency for neighbourhoods.

Authors

Martine Tommis
m.tommis@manchesterdda.com
Manchester City Council
UK

Mari Sepponen
mari.sepponen@vtt.fi
VTT Technical Research of Finland
Finland

Martine Tommis is Principal Digital Development Officer, with a background in the public sector. Martine has worked at Manchester City Council for the past 13 years. Leading the Digital Engagement Team, she is responsible for a wide range of projects concerned with technology and sustainability. She has experience in over 20 EC projects (3 as coordinator) as well as range of UK funded initiatives.

Abstract

IREEN presents an overview of the recognised RTD and innovation needs for ICT for energy efficient neighbourhoods by describing background, state of the art, necessary new capabilities, vision, desired impacts, main barriers and drivers and key stakeholders.

Providing the background context, the project has considered the issues of neighbourhood planning, holistic energy efficiency at the neighbourhood level and the needs of rural neighbourhoods. Alongside this, the state of the art and vision has been documented.

The project has developed a structured scoping matrix, outlined as follows:

1) ICT needs for planning and decision making at different levels:
   - Neighbourhood level from holistic point of view;
   - Transportation in the neighbourhood;
   - Building and infrastructure level focusing on interconnections to the surrounding neighbourhood;
   - Energy production and storage level;
   - Energy distribution;

2) ICT for energy management from the holistic point of view at the neighbourhood level;

3) Integration technologies at the neighbourhood level

The vision has been developed via a process of :

- Questionnaires from experts focused on scenarios.
- Interviews of city representatives in both urban and rural areas across Europe.
- Questionnaires and literature search from non-EU countries.
- Feedback from the IREEN stakeholder network and expert workshops.

The strategy provides the foundation for developing an ICT roadmap for European scale innovation and take-up for energy efficient neighbourhoods.

ICT for Energy Efficiency in Cities: Green Digital Charter and the NiCE toolkit

Summary

The Green Digital Charter is a declaration committing signatory cities to deliver on the EU climate objectives through the use of ICT. NiCE is an FP7 funded project, which supports cities to translate the political commitments into practical and hands-on activities by providing a toolkit for action and monitoring.

Innovation

The Project provides for the first time a structured approach and toolkit for cities to evaluate and monitor their state and development in terms of green digital action ("ICT for green" as well as "greening ICT") towards sustainable development.

Authors

Sandra Wille

s.wille@ioer.de

Leibniz-Institute of Ecological Urban and Regional Development (IOER)

Germany

Sandra Wille is an economic geographer and has been involved in research addressing energy efficient settlement and innovation systems. She is also writing her Ph.D. on factors influencing energy efficiency refurbishments, using an action-theoretical approach.

Andreas Blum

a.blum@ioer.de

Leibniz-Institute of Ecological Urban and Regional Development (IOER)

Germany

Andreas Blum is sociologist and involved in research on implementing ressource efficient urban and regional development.

Abstract

Cities today face the unprecedented challenge of achieving environmental, social and economic sustainability. One of the core challenges on this way is tackling carbon emissions. Information and Communications Technologies (ICT) have an important part to play in this process: They are an enabling technology ("ICT for green") as well as an energy consuming infrastructure themselves ("greening ICT"). The Green Digital Charter (GDC; http://www.greendigitalcharter.eu/) is a declaration committing signatory cities to work together to deliver on the EU climate objectives through the innovative use of ICT. Signing the Green Digital Charter allows for both political commitment and a step-by-step practical process, so cities can use ICT to address climate change issues, as well as improve their resource management, cooperate with other cities and stimulate their economies and citizens' wellbeing.

NiCE (Networking intelligent Cities for Energy Efficiency) is an FP7 funded project under the lead of EUROCITIES, which supports cities in the achievement of their goals as outlined by the Green Digital Charter promotes cities to translate the political commitments into practical and hands-on activities. NiCE is supporting cities in three key areas:

- Tools for cities – establishing monitoring and reporting tools for cities and developing frameworks for action to aid cities at all stages during their efforts to green ICT.
- City support and action – offering support to cities through a series of targeted exchange and learning activities (e.g. exchange on best practice examples).
- Outreach and engagement – organising a series of networking and visibility events to increase the number of Green Digital Charter signatories and showcase cooperation opportunities with relevant stakeholders.

This paper focuses on the development of the toolkit, in particular the assessment and monitoring of activities. The toolkit is the main supporting mechanism for cities in the roll-out of their green digital activities. It provides an action framework, application guidance, and monitoring tools that will increasingly become available over the course of the project and are implemented as a growing online platform. In collaboration with the "Reference City Group" NiCE furthermore supports information events, advanced trainings, Technical Trainings, Study Tours and Roadshows.

«We signed the Green Digital Charter on Friday. What should we do on Monday?» The Leibniz-Institute of Ecological Urban and Regional Development (IOER) elaborates an analytical tool for cities to review their local situation. The "self-assessment questions" (SAQ) allow cities to easily assess their current state on green digital activities, their strengths and weaknesses in regard to their green digital development and to monitor progress. The questions refer to the Commitments of the Green Digital Charter and they are based on the "Action Framework", the foundation structure and document of the NiCE toolkit. The core challenge was to extract and structure the detailed commitments and targets behind the political phrasing of the document. The broad variety of issues was then structured into a comprehensive set of coverage indicators from which a consistent set of self assessment questions was derived. The self assessment tool is implemented online and each question is associated with defined activity types and practical examples, providing starting points for action. Close cooperation with the NiCE partner cities (Reference City Group) assures that the final SAQ are at the same time meaningful and operable for practitioners in the cities.

Simulation and experimental validation of a Model Predictive Control for an energy district

Summary

In this paper we present an innovative control for a energy district to optimize cost and production of different types of microCHP.

Innovation

MPC is a stable and multiporpose controller that can easily change its behaviour choosing the goal of your control.

Author

Stefano Barberis

stefano.barberis@edu.unige.it

University of Genoa

Italy

Stefano Barberis was born in Genoa in 1988. He obtained his Master Degree in Mechanical Engineering at University of Genoa in 2012 with the Thesis “Thermoeconomic Analysis and Optimization of Innovative Concentrating Solar Power Plants”. He is a PhD student (2013) and he carries out research about renewable energy, smart grids and energy district collaborating to RESILIENT project.

Abstract

This paper is based on the experimental Energy-Hub, developed by TPG (Thermochemical Power Group) of the University of Genoa . In the Savona campus, TPG set up an “E-Hub” laboratory where a real Energy District can be physically simulated, including renewable and energy storage.

In cooperation with the West Virgina University, a Model Predictive Control has been conceived and implemented to manage the generators to follow thermal and electrical demands of a representative group of buildings.

In the first stage of the work, a MPC was built in Matlab-Simulink, particularly focusing on thermal loads and building thermal requests. Models for each generators were built basing on experimental data.

Building consumptions are emulated through fan coolers and the electrical grid. Thermal storage is extensible used in the test rig: each user (building) is equipped with an independent stratified water storage; moreover large energy distric energy storage is also available (5 + 5 m3 water tanks). Also meteorological conditions were considered as important and influent parameters on generator control.

After testing of the MPC on a simulation-only basis, the control algorithm was conneted to the real Energy-Hub simulating the requests as a series of step change demands imposed on the electrical and thermal energy. The steps are constructed to test the ability of the MPC controller to pursue the best economic strategy for satisfying the energy demands. Two controllers were tested. The first one used a 1s sample time and a 100 sample-period prediction horizon, 6 sample-period control horizon. The second controller used a 10s sample time and a 100 sample-period prediction horizon, and 6-sample-period control horizon.

The paper presents the architecture of the MPC controller and discusses the experimental results obtained.

A unified Cloud service for real time optimum building energy management

Summary

The approach uses a unified Cloud service supported by a computing systems ontology to combine the advances both from Artificial Neural Network (ANN) and high performance parallel and distributed building energy simulation to provide the best possible real time optimum decision autonomously to respond to the real time sensor data hence to further actuate the relevant facilities to achieve the relevant multi-objectives.

Innovation

A holistic and generic optimization algorithm/solution, integrated with distributed/parallel simulation based and ANN based optimization and training process , has been developed and implemented as a Cloud service, which is able to unify different underlying high power computing resources, and map them with the different computing, controlling and storage requirements from user ends. The distributed optimization solution implements different levels of innovation both on the algorithm development – leveraging the distributed computing power; and system integration – supported by computing system ontology to seamlessly provide real time decision making capability.

Authors

Haijiang Li

lih@cardiff.ac.uk

Cardiff University

UK

Yacine Rezgui

rezguiy@cardiff.ac.uk

Cardiff University

UK

Bejay Jayan

jayanb@cardiff.ac.uk

Cardiff University

UK

Dr. HAIJIANG LI (BSc, MSc, PhD, MBCS) is a lecturer (Engineering Informatics & Structural Applications) working in the BRE Institute of Sustainable Engineering, Engineering School, Cardiff University. His main research interest lies on Advanced and Innovative Computing supported large scale systems integration and decision making applied in buildings (BIM) and district / city infrastructure. Dr. Haijiang LI (as a principle investigator or co-investigator) has been working on several research projects (EPSRC / TSB / A4B / EU FP7, total cost about £16M, about 20 full time research associates and PhD researchers). He has about 50 various peer reviewed publications.

Abstract

To provide a real time solution (with satisfactory level for practical use) to enable the optimum building energy management (e.g. to actuate the relevant facilities accordingly) according to the real time monitored data is not an easy task. This document reports the solution adopted by SportE2 (EU FP7 project).

Generally speaking, for optimum building energy management, the normal starting point is to understand the 'energy behaviour' of building systems to enable the process of modelling those different systems by using various simulation tools. During the process, the iterative energy audit and involvement with end user / domain experts' are needed to conclude the main use cases and scenarios, within which reasonable input parameters and feasible outputs and hence the required optimization objectives will then become clearly indentified (further confirmed via sensitivity analysis). The modelling process is the second step. Different relevant components have been modelled and calibrated iteratively, and the developed building energy simulation model is then executed (as the calculation engine) within a generic optimization program to find out the most optimum solution according to the given conditions (real time monitored sensor data and relevant constrains).

The problem lies on the 'real time (or near real time) solution'. For most of the existing simulation tools, e.g. EnergyPlus, TRNSYS etc., the simulation process (for a comprehensive analysis) is normally very time consuming; and for an optimization process, it normally needs tens/hundreds repeating simulation runs (fed in with different data sets), the time spent to find out the most optimum solutions normally makes 'real time' solution impossible.

The natural further step is then to find ways to speed up the 'calculation engine' for optimization. Except to simplify the simulation model, another way is to utilize high power computing facility to parallelize the calculation engine (simulation), but the complexity of utilizing those facilities makes it very hard to be integrated into normal practices; another way is to try not using 'simulation' at all - using artificial intelligence instead, e.g. neural network like heuristic learning algorithms, to try to make sense out of those large amount of historical monitored data/ simulated (manufactured) data sets, there are some arguments / limitations for ANN – the accuracy and again, it will take long time to train the ANN to be practically utilized and continuously updated.

SportE2 project faces three pilot sport facilities in EU, each pilot has different application situation. With intensive energy consumption audits and involvements of end-users and domain experts, representative scenarios have been concluded (ideally, comprehensive scenarios need to be generated in order to model the building energy behaviour comprehensively); for each scenario, there are different simulation tools that have been used to produce the simulation models, such as EnergyPlus, Design Builder, Matlab, HAP; even for EnergyPlus, there are 6.0, 7.1, 7.2 versions; different sensor systems have been installed in different pilot facilities, and different pilot also has different actuating system in place or to be installed according to the requirements proposed by those concluded scenarios.

In response to the above various conditions, it really needs an innovative holistic approach to be able to provide a universal and practical 'real time' solution. SportE2 adopts sound systems engineering approach. Based on the full understanding of the required targets (proposed by end user), the overall system has been de-composed and individually implemented, tested, verified; then re-configured to provide a holistic approach. The underlying and unifying core is an autonomous Cloud service, where high performance computing cluster (HPC), high-through computation environment (Condor), distributed application and database controlling service have been seamlessly integrated by a supporting computing systems ontology. The generic optimization flow provides a universal decision making process to external computing requirements.

Several key components for the proposed system have been completed and under testing; the system already starts to provide the required integrated solution, and the achieved outputs show the good feasibility and sound implementation.

WORKSHOP ON EEB KPIs

Chaired by Rogelio Segovia, Scientific Officer,
DG Connect, European Commission

This workshop is organised by the European Commission - DG CONNECT and the IDEAS project

The aim is to encourage R&D sister-projects to adopt and implement comparable evaluation methodologies to facilitate a comparative analysis, benchmarking and exploitation of their outcomes. The workshop will support knowledge transfer of best practice in the measurement and application of KPIs for urban sustainability. Existing reference frameworks for evaluating the energy performance and sustainability of buildings, districts and cities will be presented.

Full papers are available into a booklet distributed by the European Commission, and will be published at ValMet Wiki

Abstracts

RFSC - Reference Framework for European Sustainable Cities: A toolkit for the integrated approach

Author

Sandrine Maïssa

sandrine.maissa@cstb.fr

CSTB

France

Abstract

The Reference Framework for European Sustainable Cities (RFSC) is an online toolkit designed to help cities promote and enhance their work on integrated sustainable urban development. It is available free of charge to all European local authorities and offers practical support in integrating sustainability principles into local policies and actions.

A joint initiative of the Member States, the European Commission and European organizations of local governments, the RFSC gives a common space and language to the community of cities that are interested in learning from each other, while respecting the diversity of local priorities.

Visualising the 'Big Picture': Key Performance Indicators and sustainable urban design

Authors

T. Crosbie
t.crosbie@tees.ac.uk
Teesside University (Technology Futures Institute)
UK

M. Crilly
m.crilly@tees.ac.uk
Teesside University (Technology Futures Institute)
UK

N. Dawood
n.n.dawood@tees.ac.uk
Teesside University (Technology Futures Institute)
UK

J. Oliveras
joliveras@forumsa.cat
Foment de la Rehabilitacio Urbana de Manresa
Spain

N. Niwaz
ndn@ramboll.dk
Ramboll (Energy Supply and Planning)
Denmark

Abstract

This paper explores the scope of key performance indicators [KPIs] used in urban development plans and international, national and local government policies and initiatives. The key focus of the paper is how KPIs may be used to support the delivery of carbon reduction initiatives and urban planning projects.

The work presented sets out the scope of sustainability KPIs used during the different procedural stages of a project brief. As such it illustrates how KPIs are used to assess the viability of a project's 'business case' and how KPIs can be used to inform the delivery and on-going monitoring and evaluation of a project.

More significantly, the paper also describes the connections between KPIs at different operational scales of statutory regulation. Drawing from a series of European case studies, it examines policy indicators used within the statutory urban planning and building regulation processes and how these are represented and modelled within currently available ICT decision-support tools. It is suggested that current practice in the use of urban indicators is largely scale dependent and reflects limited, or professionally-defined, remits that restrict the benefits similar KPIs can have over the course of a 'live project' from concept to completion.

The case studies describe scenarios made up of a series of measures seeking to optimise individual project stages rather than work holistically. They highlight some of the unintended consequences of approaches that inadvertently isolate and optimise individual stages of the urban development process. The paper concludes that there is potential to work more systemically and holistically, using existing data sources more effectively across different procedural actions and at different policy scales.

Key Performance Indicators (KPIs) for Continuous Commissioning

Authors

D. Antonucci
daniele.antonucci@eurac.edu
EURAC Research
Italy

F. Noris
federico.noris@eurac.edu
EURAC Research
Italy

M. Castagna
marco.castagna@eurac.edu
EURAC Research
Italy

R. Lollini
roberto.lollini@eurac.edu
EURAC Research
Italy

Abstract

The use of ICT devices, building automatic control system and technical building management, with an appropriate building operation management, can decrease energy consumption from 5% to 30% [1]. Only rarely building performance are continuously evaluated in order to verify that the design performance are maintained both in term of energy efficiency and indoor environmental quality (IEQ) or to improve the system operation and set up. As a result, often the real building performance are quite different from how the building was intended to behave. Therefore, the Continuous Commissioning plays a relevant role in the energy assessment to solve operation problems, improve comfort, optimize energy use and identify retrofit strategies for existing buildings and plant facilities. In the current paper, we present a methodological approach of KPI-based continuous commissioning with example application on two case studies (one apartment building and office building). Through the application of this methodology was possible to identify the importance of resident behaviour for the apartment building and of the system regulations for the office case study. Resident education and corrective actions are being undertaken to achieve savings and improve comfort conditions.

Validation Methodology for a Self-Learning Building Energy Management System

Authors

L. Nieto

luinie@cidaut.es

Fundación CIDAUT (Foundation for Transport and Energy Research and Development)

Spain

V. Castaño

valcas@cidaut.es

Fundación CIDAUT (Foundation for Transport and Energy Research and Development)

Spain

Abstract

A novel general validation methodology has been developed in the SEEDS project and applied in two real cases with energy conservation measures from the ICT. The methodology identifies the most significant variables and develops statistical correlations between them and the building energy consumption in order to predict the hypothetical consumption if ECMs – Energy Conservation Measurements - were not applied.

The methodology includes the following stages:

1) Collection of information about location and building features such as envelope, distribution, energy supply and demand. After that the measurement and verification plan is developed.

2) The baseline and reporting periods are characterised using bills of energy suppliers and building monitored data. This information helps to take into consideration equations in order to foreseen building behaviour based on dynamic variables, mainly HDD, CDD and Solar Irradiance. Energy consumption equations are obtained and after that some routine adjustments, such as the occupancy schedule, are foreseen to correct them.

3) These equations allow us to compare the results obtained during the reporting period with the results that would have been during this period if ECM had not been applied.

The information generated will be:

- Observed data of the reporting period: the measurement period start and end points in time, the energy data, and the values of the independent variables.
- Description and justification for any corrections made to observed data.
- All details of any baseline non-routine adjustment performed. Details should include an explanation of the change in conditions since the baseline period; all observed facts and assumptions, and the engineering calculations leading to the adjustment.

Finally a data analysis procedure has been developed in order to detect and understand the effects obtained by the Energy Conservations Measurements. Final results are not included because the reporting period has not yet been performed.

KPIs for S.M.A.R.T. Cities

Authors

G. Vogt

Georg.Vogt@empirica.com

Empirica

Germany

S. Robinson

Simon.Robinson@empirica.com

Empirica

Germany

E. Dashja

Eriona.Dashja@empirica.com

Empirica

Germany

Abstract

Smart cities promise major contributions to achieving the EU 20/20/20 goals. With EC policy documents repeatedly underlining the energy and cost savings potential that public and residential buildings have, various solutions are being trialled in projects including FP7, CIP and IEE among others. This paper presents a framework for defining and implementing key performance indicators (KPIs) based on S.M.A.R.T. principles and provides examples for indicators fitting these principles. A brief guide and examples on how KPIs can be easily adopted by a large number of projects show a path towards widespread usage.

TECHNICAL FOCUS SESSION 2

Chaired by Arturs Purvins, DERlab

Abstracts

Generation of Diagnostic Support Systems (DSSs) from Domain Ontologies and State Machines

Summary

We describe a framework to automate the generation of DSSs by providing ontologies to conceptualize application domains, and state machines to describe the required computations. Given the diversity of demands in the sustainability arena, we expect to decrease the development time of ICT-based monitoring and diagnosis in a substantial way.

Innovation

The availability of digital sensors, reliable and high-capacity networks and powerful digital processing units, is now making system observation cost-effective for an increasing number of applications, and it is creating the conditions for an increasing demand of DSSs solutions that can meet the – often competing – needs of system developers, system maintainers and end-users.
The goal of ONDA "ONtology-based Diagnostic Application generator" is to satisfy requirements of different stakeholders in the ICT for sustainability arena: system developers needing fast, cost-effective and easy-to-deploy solutions; system maintainers needing to understand the logic of the DSS and to participate in its design; and end-users needing reliable and timely information.

Authors

Armando Tacchella **Giuseppe Cicala** **Marco De Luca** **Marco Oreggia**

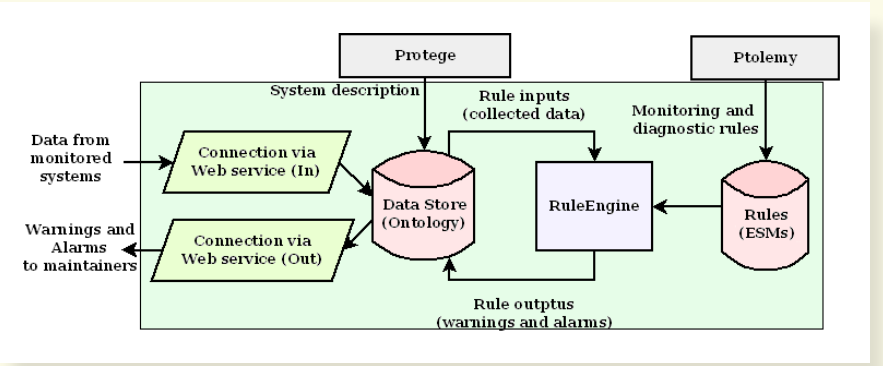
armando.tacchella@unige.it

Università degli Studi di Genova

Italy

Armando Tacchella is an Associate Professor of Information Processing Systems at the Department of Informatics, Bioengineering, Robotics and Systems Engineering at the University of Genoa. He obtained his Ph.D in Electrical and Computer Engineering from the University of Genoa in 2001. Teaching activities include courses in AI, formal languages, design and analysis of algorithms. His research focuses on engineering intelligent systems for verification, monitoring and diagnosis of cyber-physical systems. He has published more than sixty papers in major international conferences and journals. In 2007 he won the AI*IA prize "Marco Somalvico" for the best young Italian researcher in AI.

Abstract



ONDA functional diagram

Our framework is called ONDA for "ONtology-based Diagnostic Application generator". ONDA generates an ISO-13374 compliant Diagnostic Support Systems (DSSs) starting from a domain ontology and a set of diagnostic rules. Data from the Observed System (OS) is acquired via input web-services which isolate the physical details of data acquisition from the rest of the system. Similarly, warnings, alarms and other descriptors are made available to maintainers through web services in order to accommodate customized interfaces. The domain ontology should contain a static part describing the OS, and a dynamic part describing the events generated by the OS and its components (incoming events), and those output by the DSS generated by ONDA (outgoing events). Diagnostic rules describe the kind of processing to be applied to data as a set of interconnected Extended State Machines (ESMs), each one describing a task to be performed. In particular, we may have ESMs to describe data manipulation operations such as, e.g., noise filtering, averaging or smoothing, state detection operations such as, e.g., state estimation, and health assessment operations. The DSS is generated according to the ESMs provided as Rules, and the corresponding RuleEngine reads and writes external inputs and outputs by accessing the Data Store through automatically generated connectors.

ONDA assumes that the domain ontology is designed using Protégé (Gennari et al. 2003) and rules are designed using Ptolemy (Eker et al. 2003). The output of Protégé is an XML file containing entities and relationships between them, as well as descriptions of various events and associated data (ontology file). The output of Ptolemy is also an XML file which can be converted to running code inside the Ptolemy suite (rule file). The main algorithm of ONDA can be described as follows:

1. Given the ontology file, a data store is generated to memorize the data acquired from the OS as well as data generated by the diagnostic application itself. Given the classification of events into incoming and outgoing, it is possible to tag data differently according to whether the supplier is the OS, or the DSS itself.
2. Once the data store is in place, input and output web services are generated starting from the descriptions supplied in the ontology file. Input web services are those where to the DA modules of the OS must register to supply data, and whose task is to add such data to the data store. Output web services are accessed by end-user applications to display and organize the information generated by the diagnostic support system. The main task of output web services is to query the data store in order to obtain the data requested on the end-user's side.
3. RuleEngine is generated by combining boiler-plate code to access Data Store and the code corresponding to ESMs in the rule file. Code generation for ESMs is carried out using built-in functions of the Ptolemy suite.

Simulation framework for simulation and control of a hybrid energy network

Summary

This paper discusses a simulation framework for simulating multi-commodity flows on a district level. A market-based multi-commodity algorithm is integrated in the framework for coordination of these flows.

Author

Davy Geysen

davy.geysen@vito.be

VITO

Belgium

Davy Geysen was born in Mol, Belgium. He received the M.S degree in electrical engineering from the Katholieke Hogeschool Kempen (KHK), and the M.Sc. Computer Science degree from the Katholieke Universiteit Leuven (KUL), Belgium. In 2007 he started working at Cronos as a business integration engineer. Since May 2009 he has been working at the Vlaamse Instelling voor Technologisch onderzoek (VITO), Mol, where he is working on smart grid related technology.

Abstract

For the built environment it is envisaged that in the next decades the total annual energy demand, both thermal and electric, could be covered by renewable sources generated within the built environment. More and more thermoelectric elements, such as heat pumps and thermal storage, will enable conversion from heat to electricity and vice versa. Control in this environment therefore requires an integral management of both heat network and the electricity network. In this paper we present a simulation framework which is able to simulate and coordinate multi-commodity flows on a district level using a wide variety of models to represent numerous types of appliances, taking into account different types of business objectives. To manage these flows a market-based multi-commodity algorithm for integrated coordination of electricity and heat flows was developed and integrated in the simulation framework. The algorithm is an enhancement of the PowerMatcher concept and inherits its advantages such as scalability and user autonomy. An example is given to demonstrate the usage of the simulation framework and integrated algorithm, in residential areas, to unleash a large flexibility potential of heat and electricity flows in support of the integration of renewable energy.

Towards an optimal infrastructure for district heating networks

Summary

In this paper we present an approach for determining the layout of the optimal district heating network by combining path finding algorithms with thermal energy flow models.

Innovation

Instead of relying on common practice, the combination of path finding algorithms and energy flow models is used to find the layout of the optimal district heating network.

Author

Wiet Mazairac

wiet.mazairac@vito.be

VITO

Belgium

Wiet Mazairac started his PhD on the optimization of hybrid energy networks in January after completing the master Design and Decision Support Systems at the Eindhoven Technical University.

Abstract

During the last few decades many district heating networks have been built. Classically, these district heating networks distribute heat from one central location to multiple consumers located elsewhere. This possibility to distribute heat can prevent waste heat - generated during e.g. industrial processes - from being lost; instead this heat can be put to good use. In practice, the layout of a district heating network is based on rules of thumb and on the gut feeling and experience of the engineer. Ideally it would be based on a sequence of procedures which can be easily repeated or verified by others. Additionally, by relying on common practice only, it is not certain that the network layout proposed by the engineer is close to the optimal layout. A layout can be considered optimal when capital and operational costs or energy losses are minimized, or when the number of consumers connected is maximized. In reality a layout will not be optimized by considering only one criterion. If for example the loss of energy was the only criterion considered, the costs would increase drastically. Therefore the concept of multi-objective optimization will be applied.

In this paper we present an approach for determining the layout of the optimal district heating network. This method combines path finding algorithms, which help minimize the total length of all the edges in the graph, representing the pipelines in the district heating network, and which help maximizing the connected nodes, representing the consumers, with thermal energy flow models, which help minimize energy losses. The number of junctions, of which the production and maintenance costs are relatively high, can also be minimized by intelligently applying a path finding algorithm. Finally, after assigning weighting factors, an optimization algorithm can be applied. This algorithm determines the optimal district heating network, considering costs, energy losses and the number of consumers connected. In the near future, where this approach might be applied, district energy networks will require a lower capital investment, will require less maintenance and will be more energy efficient.

Energy management in neighbourhoods: EEPOS platform specification

Summary

This contribution will provide a specification of a novel approach towards automation of distribution energy systems: EEPOS neighbourhood energy management platform. EEPOS is a research project funded under FP7 of the European Commission. First project results will be listed and discussed addressing management priorities, key services and functional capabilities.

Innovation

NEMS platform proposes a novel approach to distribution automation. It performs energy management in a semi-centralised way on two levels: building and neighbourhood. Building management allows maximizing the utilisation of flexible demand resources in the neighbourhood since it has direct access to the controllable building appliances; whereas neighbourhood management provides efficient utilisation of local DER and supports the local electricity grid. Thus, the neighbourhood management provides buildings with neighbourhood supportive management information, which is then applied in buildings in efficient way. Such semi-centralised management combines benefits of centralised and decentralised systems. This may increase the feasibility of 'smart' grids.

Author

Arturs Purvins

arturs.purvins@der-lab.net

European Distributed Energy Resources Laboratories (DERlab) e.V.

Germany

Dr. Arturs Purvins was born in Riga in Latvia on the 28th August 1981. He obtained a Doctor's degree in Engineering Sciences in Riga Technical University in 2008. From 2009 to 2012 he worked for the European Commission DG JRC Institute for Energy and Transport on assessment of techno-economic performance of Low Carbon energy technologies related to high Renewable Energy penetration challenges. Since the beginning of 2013, A. Purvins is employed by DERlab performing research on energy management in buildings and neighbourhoods. His interests are in development of Energy Systems in distribution grids with high deployment of Renewable Energy Sources.

Abstract

The EEPOS neighbourhood energy management platform will provide a contribution to the on-going automation of distribution grids. The EEPOS platform will perform energy management in a neighbourhood supportive way through communications with Energy Management Systems in Buildings (BEMS) within the neighbourhoods, with Combined Heat and Power plants (CHP), with Distributed Energy Resources (DER) and loads on the neighbourhood level (other than BEMS and CHP, e.g. street lighting). For this management additional information on predicted electricity price profiles and weather forecast is required.

The main tasks of the EEPOS platform are focused on electricity systems with high deployment of DER and are as follows:

- Maximum utilisation of local DER in the neighbourhood
- Electricity market support with load shifting services
- Optional: Distribution grid support (congestion management, peak load shaving, voltage management, phase balance)

The main instrument for performing these tasks will be load shifting within the neighbourhood. Following these tasks, the EEPOS management platform may reduce the overall electricity generation costs introducing neighbourhood load shifting services to the electricity market and in the neighbourhood grid. In other words, the aim of the NEMS is to provide a cost effective support to electricity systems with high deployment of DER.

Optional services such as distribution grid support may increase the feasibility of the EEPOS platform and thus may indirectly support one of the main project objectives: reduction of energy losses.
NEMS management is performed in a semi-centralised way including two management levels:

- Buildings (decentralised)
- Neighbourhood (centralised)

Building management systems perform direct management of controllable building appliances following recommendations from the neighbourhood management system. These recommendations are a product of neighbourhood management, which is performed focussing on the three aforementioned EEPOS platform tasks.

Furthermore, EEPOS platform requirements are discussed from two perspectives: (i) stakeholder support services and (ii) functional capabilities. The former should provide stakeholders with a simple installation and utilisation of the platform like Plug & Play or modularity services and should address specific needs as Human Computer Interface. Functional capabilities of the EEPOS platform are the functions which the platform should exhibit in order to fulfil its tasks in the neighbourhood energy management:

- Data management functions such as data collection, data transfer and calculation
- Energy management functions such as high DER utilisation through load shifting etc.

The contribution will conclude with possible application scenarios for the EEPOS neighbourhood energy management platform identifying business models and potential platform operators.

DIGITAL CITY
VILLE NUMERIQUE
FINAL EVENT

This project, led by CSTB, brings together five high-level national research centres (CSTB, ENPC, IFSTTAR, IGN, and METEO-FRANCE) under the global assignment of French Ecology Ministry.

It aims to bring together the various expertise (in simulation, picture and geometrical analysis, data standard and sharing, mesh generator, scientific computing, software engineering, scientific visualization…) within a common software platform. This implies the interoperability of various mathematical models and data with their own data format, vocabulary, working scale, uncertainty, validity model, etc.

To overcome this barrier, the partners decided to build together a “Digital City Charter ” designed to gather all the rules and necessary practices to make this possible, especially through the potentiality of using a centralized and standardized data model to accommodate and support the different aspects of urban projects during their lifecycle, in close connection with city experts, decision makers and citizens.

For more information:

http://www.cstb.fr/fileadmin/documents/actualites/R_D_actu/Plaquette_seminaire_Ville_Numerique_-_Nice_2013.pdf

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

Ministère
de l'Écologie,
du Développement
durable
et de l'Énergie

NICE GRID
SHOW-ROOM

NICE GRID
UN QUARTIER SOLAIRE INTELLIGENT

Press Release Booklet
http://goo.gl/X9rWqr

IBM INDUSTRY SOLUTION CENTRE

Smarter City Solution Area Website

http://goo.gl/HtQLMj

About ICT for Sustainable Places

What are the energy and environmental benefits of an integrated concept of interconnectivity, at a district level, between buildings, distributed energy resources, grids and other networks? What innovative technologies should be combined to provide real time accounts of energy demand and supply, and support for decision-making process? How can we make quick progress on energy efficiency knowledge engineering and on assessment methodologies of energy performances, that are so critical for the European industry to overcome current technological limitations and ensure a wide breakthrough of energy-efficient technologies?

Answers to these questions constitute the main objectives of the RESILIENT FP7 project and, logically, the main focus of the «ICT for sustainable places» organized in Nice, from September 9 to 11, 2013.

This event, benefitting from the support of the European Construction Technology Platform (ECTP/E2BA), is meant to be an open research forum, offering a key opportunity to manufacturers, service providers, research laboratories, standard development organizations, urban planners, etc. to meet and network, share information, assess outcomes from the most advanced projects, discuss possible synergies, envision possible standards evolution, etc.

The event particularly aims at fostering collaborations between FP7 projects involved at the crossroads of ICT, energy and construction, addressing sustainability and energy efficiency at building, district, and city levels.

Event partners

RESILIENT

IDEAS

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

Ministère de l'Écologie, du Développement durable et de l'Énergie

European Commission

ECTP
EUROPEAN CONSTRUCTION TECHNOLOGY PLATFORM

E2B
Energy Efficient Buildings

sigma·orionis
SUPPORTING GLOBAL ICT DEVELOPMENTS

CSTB
le futur en construction

DE LA RECHERCHE À L'INDUSTRIE
cea