IERC
European Research Cluster
on the Internet of Things

European Research Cluster on the Internet of Things

Is a city packet with electronics smarter than a city that is not?

The number of sensors and fancy screens is probably not a good measure for the smartness of a city, but it might be an indication of its ambition.

Let's take for instance Santander, a city in northern Spain that set itself the target of deploying 12,000 sensors and actuators as part of an FP7 FIRE project called SmartSantander; and surpassed itself. But it is not the actual sensors that matter in my opinion; it is the experience that comes out of the project and of course the services.

What SmartSantander achieved is a platform of course in the technological sense, but much more. It has achieved partnerships between actors in the city as well as reaching out internationally, gaining knowledge, understanding and insights into uniting ICT with citizen life and city hall processes. Overall improving the quality of life of citizens. SmartSantander provided an innovation towards building an Internet of Things ecosystem.

To understand this better, let's go back in time. Frank J. Sprague invented electric traction at the turn of the 19th Century. His invention was made into an innovation of the metro train and the elevator – so suddenly Frank's invention made it possible that people could move vertically and horizontally – fast and in masses. Suddenly cities could grow vertically and horizontally. Frank made cities huge.

Today innovation happens in cities around ICT – specifically the Internet of Things. How this innovation will change cities is still open. Certainly there are many promises such as resource efficiency, citizen participation and open innovation – and each city has to explore their capacity and ambitions, after all, Frank did not make every city huge.

The projects that just have been funded by the European commission and that are introduced in this newsletter are fantastic examples of our research and innovation potential here in Europe; working from data streams, cloud services and applications to societal issues and open innovation.

Many challenges are still to be overcome. We need to create real eco-systems for cities to become truly smart and help citizens to improve their quality of life. At the same time we cannot address the Internet of Things completely blue eyed.

Privacy issues, ethics and user acceptance overall are issues that we need to address by design. And build on results form projects such as FP7 IoT-A around interoperability to build the Internet of Things and not Intranets of Things.

We should be excited to be part of this push, I certainly am. And I am looking forward to these projects building a bright future for all of us.

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COSMOS: Cultivate Resilient Smart City Objects for Sustainable City Applications

COSMOS will provide an environment that enables things to evolve and act in a more autonomous way, becoming more reliable and smarter, while incorporating technologies for managing the exponentially increasing "born digital" data and for facilitating end-to-end security and privacy.

Objectives
COSMOS aims in particular at developing an IoT framework where:

- Things are able to learn from each other based on experiences sharing
- Situational knowledge acquisition and analysis mechanisms make things aware of conditions and events affecting their behaviour
- Adaptive selection approaches facilitate to manage the uncertainty and volatility introduced due to real-world dynamics
- Decentralized management mechanisms in IoT based systems allowing applications to exploit increasing amount of interconnected things
- Socially-enriched coordination will consider the role and participation scheme of things in and across networks
- End-to-end security and privacy, with hardware-coded security approaches for security and privacy on storage
- Extended complex event processing and social media technologies will extract only the valuable knowledge from the information flows
- Workload-optimized data object stores will facilitate efficient storage by also exploring the interplay between storage and analytics on networks of data objects

Scenarios
COSMOS enables smart city IoT applications to take full advantage of its technologies, through 2 representative scenarios:

- **Smart heat and electricity management (Candem)**, the goal of which is to manage and adjust electricity consumption based on real-time information regarding buildings and appliances
- **Eco-conscious cruise control for public transportation (Madrid)**, the goal of which is to optimize the driving conditions for buses in order to minimize air pollution

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SMART-ACTION: Coordination Action for Smart Cities

The high level of interdisciplinary research produced in the areas of Smart Cities and the Internet of Things (IoT), requires to understand, coordinate, support and engage the technological elements, and combine them with areas such as biotechnology, social sciences and nanotechnologies, that provide the right context in which IoT concepts can be embedded and will be used to provide solutions that can benefit society at large. Such coordination is of uttermost importance and a crucial part of this support lies in the efficient coordination of dissemination efforts both inside and outside of Europe.
SMART-ACTION will provide support for the development of strategic research agendas as well as serve as an enabler for the dissemination and further integration of results into future research and industrial developments, while coordinating international cooperation.

Objectives
- SMART-ACTION will work on achieving the following scientific and technical objectives:
- Identification of research topics, gaps and a strategic roadmap for their integration.
- Support for established activities such as *IERC-Internet of Things European Research Cluster* and integration into new activities
- Identification of interdisciplinary research for the implementation of selected applications as part of the concepts of Smart Cities
- Integration of IoT into a broader Future Internet and Cloud Computing
- Key promotion of IoT research and in particular along promotion material and well organized demonstrations
- Overall business focus dissemination within and outside of Europe
- Ensure policy relevance of the roadmap activities and support to European policies

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CityPulse: Real-Time IoT Stream Processing and Large-scale Data Analytics for Smart City Applications

An increasing number of cities have started to introduce new Information and Communication Technology (ICT) enabled services with the objective of addressing sustainability as well as improving the operational efficiency of services and infrastructure. In addition, there is an increasing interest in providing novel or enhanced service offerings and improved experiences to citizens and businesses. The smart cities are evolving into a larger eco-system or ecosystems that were previously disconnected. More and more applications and services in these ecosystems are going on-line. The city council is the pivotal facilitator in making this online ecosystem of ecosystems become a reality.

The CityPulse project designs, develops and tests a distributed framework for semantic discovery, processing and interpretation of large-scale real-time Internet of Things and relevant social data streams for knowledge extraction in a city environment. CityPulse will develop innovative smart city applications by using an integrated approach to the Internet of Things and the Internet of People. It will facilitate the creation and provision of reliable real-time smart city applications by bringing together the two disciplines of knowledge-based computing and reliability testing.
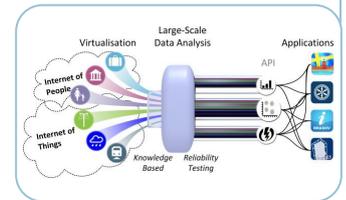
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OSMOSE: OSMOsis applications for the Sensing Enterprise

The main objective of the OSMOSE project is to develop a reference architecture, a middleware and some prototypal applications for the Sensing-Liquid Enterprise, by interconnecting Real, Digital and Virtual Worlds in the same way a semi-permeable membrane permits the flow of liquid particles through itself.

Objectives
In concrete terms, the OSMOSE project will design and develop:
- A Reference Architecture for modeling and managing shadow images of the same Sensing-Liquid Enterprise in the three interconnected worlds regarding both immaterial and material liquid flows under flexible security and privacy capability rules. A Triple A architecture is proposed where Actors (RW) Agents (DW) Avatars (VW), representing humans and smart objects, interact and negotiate;
- An Event-driven and Service-oriented Osmiotic Middleware (osmosis semi-permeable membranes) to constantly and automatically keep background consistency between the three worlds through the implementation of three pairs of basic processes: Virtualization RW-VW; Augmentation VW-RW; Digitalization RW-DW; Actuation DW-RW; Simulation DW-VW; Enrichment VW-DW;
- A Liquid Stargate which allows human users to browse the relevant real-digital-virtual assets in an integrated multi world representation view, to configure the behaviour of their human RW Actors- DW Agents- VW Avatars and to support knowledge sharing and experiences / emotions exchange, by crossing seamlessly the three worlds' gates;
- An innovative "Sensing-Liquid Maintenance & Support" application in the Aerospace Domain concerned with helicopters' flight simulators operation;
- An innovative "Sensing-Liquid Quality Inspection & Control" application in the Automotive Domain concerned with camshafts supply and production traceability.

The project has 36 months duration and has started on October 2013.

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ALMANAC: Reliable Smart Secure Internet of Things for Smart Cities

The aim of ALMANAC is to develop a service delivery platform which integrates Internet of Things (IoT) edge networks with metro access networks thereby enabling an integrated Smart City Information System for green and sustainable Smart City applications.

Objective

The objective of ALMANAC is to develop a comprehensive platform that enables the definition of an integrated Smart City information system for green and sustainable Smart City applications. This includes the creation of business models based on public-private partnerships, combining business needs with governance requirements as well as active citizen engagement. In terms of network infrastructure, ALMANAC will ensure interoperability by supporting authorised data flows among private and/or public networks originally designed to achieve specific goals, therefore characterised by heterogeneous architectures, technologies, performance, architecture and policies. ALMANAC will enable communication interoperability among devices, sub-systems, existing urban services and external service providers allowing them to operate coherently in response to the Smart City application requirements.

ALMANAC expects service level interoperability by allowing different developers to design and implement Smart City applications through a common set of tools and open, possibly cloud-based, interfaces. Development work in ALMANAC will be based on smart city applications in the City of Torino

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RERUM

The rapid growth of cities aggravates many challenges associated with living in urban environments, such as public safety, transportation management, waste disposal, noise, air, and water pollution. Smart Cities provide ICT enabled services and applications to citizens, companies and authorities, driving competitiveness and improving quality of life. The Internet of Things (IoT) paradigm has been suggested as a solution. With IoT, objects like phones, cars, household appliances, or clothes become wirelessly connected and can sense and share data. A key challenge for IoT towards Smart City applications is ensuring its reliability, incorporating the issues of security, privacy, availability, robustness and flexibility to changing environmental conditions. Without guarantees that Smart City IoT objects are: (i) sensing correctly the environment, (ii) exchanging the information securely, (iii) safeguarding private information, users are reluctant to adopt this new technology that will be a part of their everyday lives, which decreases the market value of Smart City applications for the service providers.

Objective

The ultimate goal of RERUM is to allow IoT to become the fundamental enabler towards a *truly* Smart City, having the citizen at the centre of attention. The key objectives of RERUM are:

- Identify common threats and open security/privacy/reliability issues in existing IoT frameworks for Smart City applications.

- Develop an architectural framework for the interconnectivity of a large number of heterogeneous smart objects based on the concept of "security, privacy and reliability by design".

- Embed security and reliability on the hardware smart objects, providing reliable, self-managed, robust and context-aware communications minimizing energy consumption.

- Investigate the adaptation of Cognitive Radio (CR) technology in smart objects to minimize wireless interference and ensure the "always connected" concept.

- Evaluate the performance of the framework in two real-world Smart City environments: Tarragona and Heraklion.

RERUM considers four smart city applications to drive the requirements for system development and these will be developed and tested in the trials: Smart Transportation, Environmental monitoring, Home energy management and comfort quality monitoring.

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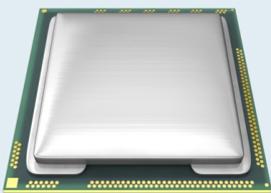
ClouT: Cloud of Things for empowering the citizen clout in smart cities

Cities have been experiencing emerging challenges such as efficient energy management, economic growth and development, security and quality of life of its habitants.

To tackle these issues, two recently emerged set of technologies from ICT have great potential to provide the necessary enablers: Internet of Things and Cloud Computing. ClouT's overall concept is leveraging the Cloud Computing as an enabler to bridge the Internet of Things with Internet of People via Internet of Services, to establish an efficient communication and collaboration platform exploiting all possible information sources to make the cities smarter. ClouT will help cities to provide their infrastructures as services that can be reused by different platforms and service providers.

Objectives

ClouT, with its user-centric approach, aims at making citizens aware of city resources and helping them to use and care them by mean of smart IoT services in the Cloud. ClouT will also offer to end-users the possibility of creating their own Cloud services and share them with other citizens. ClouT will support the following major features:

- City data acquisition capability leveraging Internet of Things and Internet of People; data from trillions of things and billions of people are integrated in the Cloud data hosting functionality keeping their universal interoperability;
- City data provision functionality to easily develop scalable, dependable, and semantic services;
- Innovative city applications in four pilot cities: Santander and Genova in EU, Mitaka and Fujisawa in Japan.
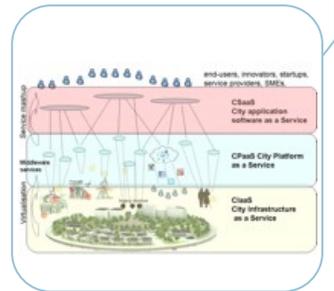
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SOCIOTAL: Creating a socially aware citizen-centric Internet of Things

SOCIOTAL aims at creating a reliable and secure environment that will encourage citizens to contribute their devices and corresponding information flows to the Internet of Things, making them available for the creation of a new generation of services of high socio-economic value.

Objectives

SOCIOTAL addresses a crucial next step in the transformation of an emerging business driven Internet of Things (IoT) infrastructure into an all-inclusive one for the society by accelerating the creation of a socially aware citizen-centric Internet of Things.

It will close the emerging gap between business centric IoT enterprise systems and citizen provided infrastructure.

Today much of the IoT is based on business centric deployments which are used by enterprises for the optimisation of business processes through the extraction of real world knowledge from environments and consumer intelligence. They are in fact private so called "intra-nets" in which data flows and derived real-world knowledge are accessible only to privileged entities. Our goal is to move towards more participatory open eco-systems in which IoT devices and information flows can be freely shared in a secure and trusted manner and made available to the benefits of communities and its citizens.

SOCIOTAL will establish an IoT eco-system that puts trust, user control and transparency at its heart in order to gain the confidence of everyday users and citizens. By providing adequate socially aware tools and mechanisms that simplify complexity and lower the barriers of entry it will encourage citizen participation in the Internet of Things. This will add a novel and rich dimension to the emerging IoT ecosystem, providing a wealth of opportunities for the creation of new services and applications that address true societal needs and allow the improvement of the quality of life across European cities and communities.

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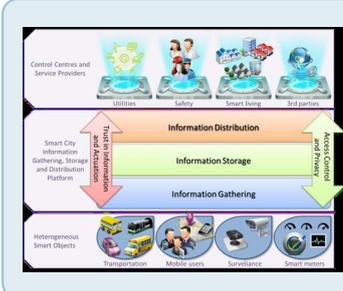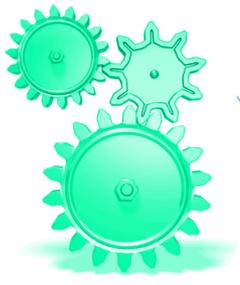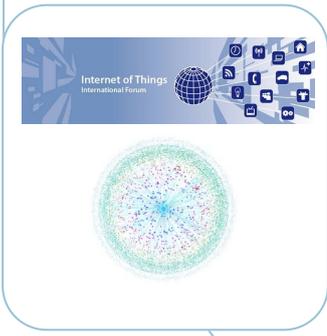(Project Coordinator)
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VITAL: Smart, secure and cost-effective integrated IoT deployments in smart cities

VITAL

Internet-of-Things (IoT) applications are currently based on multiple architectures, standards and platforms, which have led to a highly fragmented IoT landscape specifically in the area of smart cities. Smart cities typically comprise several different IoT deployments that have been developed and deployed independently, e.g., for smart homes, smart industrial automation, smart transport, and smart buildings. These technological silos are in many cases caused by organizational silos in local government, e.g., the separation of law enforcement from the department of transportation. There is a pressing need to remove these silos, allowing cities to share data across systems and to coordinate processes across domains, thereby improving sustainability and quality of life. In response to this need, VITAL realizes a radical shift in the development, deployment and operation of IoT applications. It introduces an abstract virtualized digital layer that will operate across multiple IoT architectures, platforms and business contexts.

- VITAL will provide platform and business agnostic access to Internet-Connected-Objects (ICO), boosting interoperability at the technical and business levels.
- It will research virtualized filtering, complex event processing (CEP) and business process management mechanisms, which will be operational over a variety of IoT architectures and ecosystems.
- It will provide development and governance tools, which will leverage the project's interfaces for virtualized access to ICOs.

This will allow solution providers to (re-) use a wider range of data streams, thereby increasing the scope of potential applications and enabling a more connected approach to smart city development. VITAL will be validated in realistic deployments in London and Istanbul.

Key issues

VITAL will address a number of key issues. First, it will investigate how to use ICO data and services in an IoT platform/agnostic way to enable the practical development of smart cities applications in an integrating way that eliminates existing silos. Second, it will examine how to migrate existing IoT platforms and ICOs to the VITAL virtualization paradigm, thereby boosting backward compatibility of existing IoT technologies and applications. Third, VITAL will research how to provide platform agnostic added-value functionalities like discovery, filtering and event processing on top of such a virtualized interface. Forth, VITAL will study how to enable business process management and orchestration for ICO driven business processes taking into account the uncertainly and/or lack of accuracy associated with these processes.

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SMARTIE: Secure and smarter cities data management

The SMARTIE project works on security, privacy and trust for data exchange between IoT devices and consumers of their information. Results are demonstrated in smart cities in Germany, Serbia and Spain. Further partners are from Portugal and the UK.

Objective

The vision of SMARTIE is to create a distributed framework to share large volumes of heterogeneous information for the use in smart-city applications, enabling **end-to-end security and trust in information** delivery for decision-making purposes following data owner's privacy requirements. A secure, trusted, but easy to use IoT system for a Smart City will benefit the various stakeholders of a smart city:

The **City Administration** will have it easier to get information from their citizens while protecting their privacy. Furthermore, the services offered will be more reliable if quality and trust of the underlying information is ensured. Privacy and Trust are a key prerequisite for **citizens** to participate in Smart City activities. A Smart City can improve the Smart and Comfort Live of their citizens enormously. **Enterprises** benefit from the securely provided information. They can optimize their business processes and deal with peak demands introduced by the dynamics of the Smart City. Furthermore, they can offer more tailored solutions for their customers based on the status of the Smart City. More

precisely the Objectives of SMARTIE are:

- Understanding requirements for data and application security and creating a policy-enabled framework supporting data sharing across applications.
- Developing new technologies that establish trust and security in the perception layer and network layer.
- Develop new technologies for trusted information creation and secure storage for the information service layer.
- Develop new technologies for information retrieval and processing guided by access control policies in the application layer.
- Demonstrate the project results in real use cases

IoT and IERC News

Icore @ ICT 2013 Vilnius: A. Rahim will chair a networking session entitled "IoT Centric Cloud: A Catalyst for Innovation in Europe" at ICT 2013 Vilnius (see http://ec.europa.eu/digital-agenda/ events/cf/ict2013/item-display.cfm?id=10332). You can shape the contents of the session posting questions to be addressed, remarks, challenges etc. via the above referenced link, besides of course participating directly to the session. Besides provoking debates on the integration between IoT and the Cloud, during the same ICT 2013 event iCore will also showcase some of its results at a separate booth in this important event (the iCore booth will also include the award winning demo which recently received the best-demo award at Future Network Mobile Summit 2013).

Icore @ ETSI M2M Workshop 2013: iCore will present some of its results at the 4th ETSI M2M Workshop in Mandelieu (France), which will be held on the 5th-7th of November 2013. The presentation, which will be given by Gianmarco Baldini, from the European Commission Joint Research Centre, focuses on enabling Smart Cities through the iCore cognitive management framework for the Internet of Things (IoT). The presentation will address aspect of the iCore framework that aims at enabling, besides the widely addressed issue of how objects should be connected, why and when objects need to be connected, and what value they can bring in enhancing existing services and applications.

iCore @ Korea-EU workshop: iCore took part in the recent Korea-EU Workshop setup by EU DG Connect and the Korean counterparts NICA to explore common research interests in the Future Internet. The workshop took place between 30 September & 1st of October 2013 in Seoul and R. Giaffreda represented iCore in the IoT related session (find here link to the presentation) where good synergies were found with participating Korean institutions like KAIST, IBM Korea Lab and DGIST. The following discussions paved the way for a potential collaboration between iCore and Korea which is currently being explored.

GAMBAS: The GAMBAS consortium is happy to announce the upcoming 1st International IEEE Workshop on Pervasive Systems for Smart Cities held in conjunction with this year's PerCom. Given its focus on IoT and Smart Cities, we believe it is relevant for most of you. Find below the call for papers. More details on the workshop can be found at http://www.ubicitec.org/percity.

INSIDE IoT-A: IoT-A Book. The book is structured in two parts. Part A introduces the general concepts developed for and applied in the ARM. It is aimed at end users who want to use IoT technologies, managers interested in understanding the opportunities generated by these novel technologies, and system architects who are interested in an overview of the underlying basic models. It also includes several case studies to illustrate how the ARM has been used in real-life scenarios. Part B then addresses the topic at a more detailed technical level and is targeted at readers with a more scientific or technical background. It provides in-depth guidance on the ARM, including a detailed description of a process for generating concrete architectures, as well as reference manuals with guidelines on how to use the various models and perspectives presented to create a concrete architecture. Furthermore, best practices and tips on how system engineers can use the ARM to develop specific IoT architectures for dedicated IoT solutions are illustrated and exemplified in reverse mapping exercises of existing standards and platforms.
*"Enabling Things to Talk: Designing IoT solutions with the IoT Architectural Reference Model".*
Bassi, A.; Bauer, M.; Fiedler, M.; Kramp, T.; Kranenburg, R.; Lange, S.; Meissner, S. (Eds.) 2013, (Due November 30)

IERC AC4: Semantic Interoperability: IERC Activity Chain 4 on interoperability is pleased to announce the release of the first version of the document called Semantic Interoperability: Research Challenges, Best Practices, Solutions and Next Steps - IERC AC4 Manifesto . The document is the result of about 18 months collective discussion under coordination of Probe-IT (P. Cousin), OpenIoT (M. Serrano) and IoTest (P. Barnaghi). A version 2 is under preparation as well as a short summary and recommendations towards a position paper for the end of the year. Any comments and contributions are welcome . *Contact philippe.cousin@eglobalmark.com*

EAR-IT: Traffic monitoring for Smart Cities and audio streaming
The EAR-IT project on acoustic-IoT sensing (www.ear-it.eu) has made research progress succeeding to demonstrate the use of audio sensors for traffic monitoring in the Smart City of Santander. Demo will be presented at ICT 2013 Vilnius in November. The project also demonstrated that IoT with limited processing capability can still provide small chunk of audio streaming directly or which the help of a small audio board doing the coding the project has designed. See EAR-IT news for more information. Meet the experts in Vilnius or contact Pedro Malo pmm@uninova.pt for more information. Note the project has won in last August at IEEE iThings'2013 the best paper award, which is worth reading here http://www.ear-it.eu/papers.
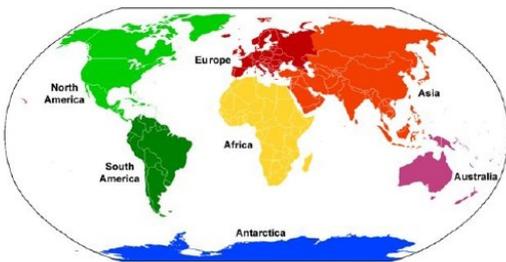
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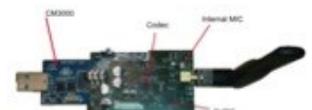
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ABOUT IERC
IoT European Research Cluster
The aim of European Research Cluster on the Internet of Things is to address the large potential for IoT-based capabilities in Europe and to coordinate the convergence of ongoing activities.

European Dimension
IoT has the potential to enhance Europe's competitiveness and is an important driver for the development of an information based economy and society. A wide range of research and application projects in Europe have been set up in different application fields. Communication between these projects is an essential requirement for a competitive industry and for a secure, safe and privacy preserving deployment of IoT in Europe.

Global Dimension
IERC will facilitate the knowledge sharing at the global level and will encourage and exchange best practice and new business models that are emerging in different parts of the world. In this way, measures accompanying research and innovation efforts are considered to assess the impact of the Internet of Things at global and industrial level, as well as at the organisational level.

IoT Events

November 2013

06th - 08th	ICT'2013 - CREATE/CONNECT/GROW. Vilnius—Lithuania Information @ ec.europa.eu/digital-agenda/en/ict-2013
12th - 13th	Living Bits and Things 2013. Bled, Slovenia Information @ www.livingbitsandthings.com/lbt13/2013/1
12th	Intelligent Sensor Networks Conference. Eindhoven, The Netherlands Information @ www.isnconference.com
26th - 27th	Telecoms Tech World 2012. London, UK Information @ www.telecomstechworld.com/agenda/m2m-conference
27th	M2M HackFest. London, UK. Part of Telecoms Tech World 2012 Information @ www.the-hackfest.com

March 2014

06th - 08th	IEEE 2014 Internet of Things World Forum. Seoul, South-Korea Information @ sites.ieee.org/wf-iot/

April 2014

21st - 22nd	IoT Asia 2014. Singapore Information @ www.internetofthingsasia.com/

The "European Research Cluster on the Internet of Things-IERC" was established by the DG Information Society and Media, as part of Europe's ambition to shape a future Internet of Things for its businesses and citizens.

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