

# Internet of Things

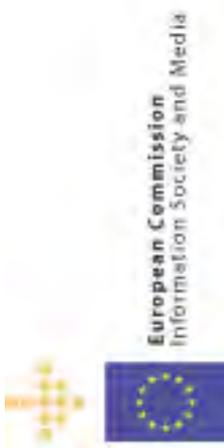
Pan European Research and Innovation Vision

## EUROPEAN RESEARCH CLUSTER ON THE INTERNET OF THINGS

October, 2011

“Without change there is no innovation, creativity, or incentive for improvement. Those who initiate change will have a better opportunity to manage the change that is inevitable.”

William Pollard





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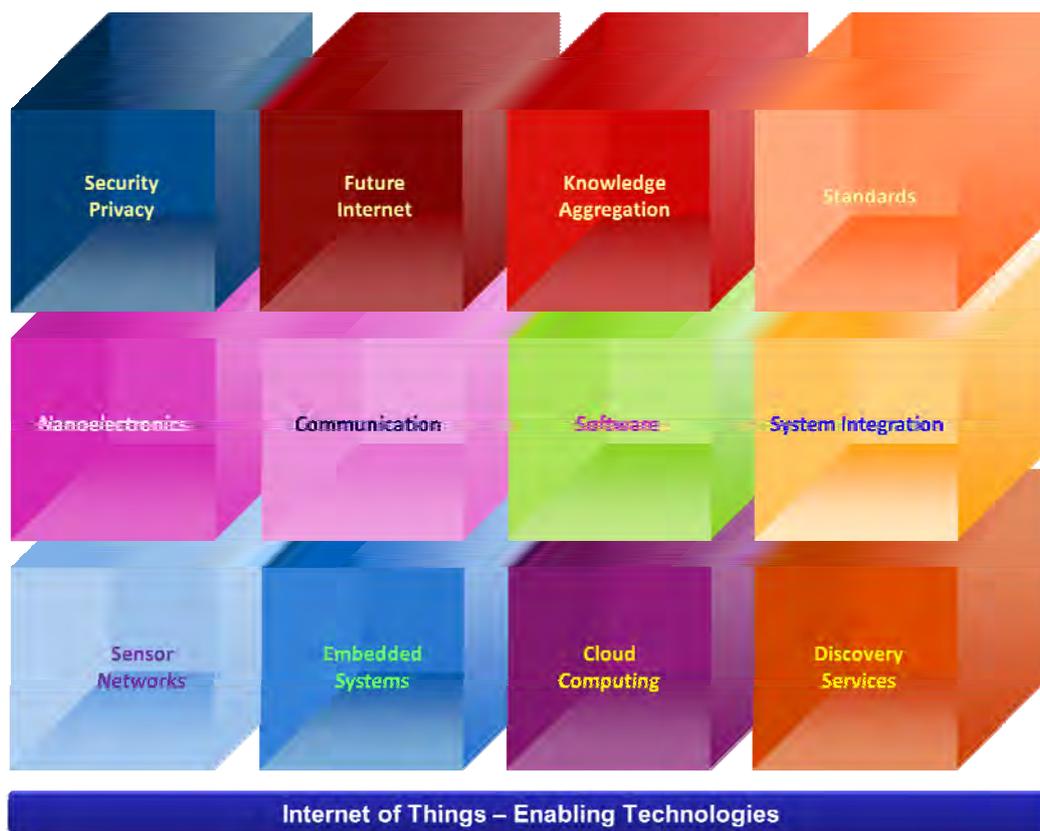
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# European IoT Research and Innovation Challenges

The Information and Communication Technology development generates more and more things/objects that are becoming embedded with sensors and having the ability to communicate with other objects, that is transforming the physical world itself into an information and knowledge system.

Internet of Things (IoT) enables the things/objects in our environment to be active participants, i.e., they share information with other stakeholders or members of the network; wired/wireless, often using the same Internet Protocol (IP) that connects the Internet. In this way the things/objects are capable of recognizing events and changes in their surroundings and are acting and reacting autonomously largely without human intervention in an appropriate way.

In this context the research and development challenges to create a smart planet where the physical, digital and virtual worlds are converging to create smart environments that would make energy, transport, cities and many other areas more intelligent are enormous.



The development of certain enabling technologies such as nanoelectronics, communications, sensors, smart phones, embedded systems, cloud computing and software will be essential to support important future IoT product innovations affecting many different industrial sectors.

Today many European projects and initiatives address the Internet of Things technologies and knowledge. Given the fact that the topics can be highly diverse and specialized, it exists a strong need for integration of the individual results.

Knowledge integration, in this context is conceptualized as the process through which disparate, specialized knowledge located in multiple projects across Europe is combined, applied and assimilated.

The IoT European Research Cluster (IERC) - European Research Cluster on the Internet of Things aims at defining the IoT technology and development research challenges at the European level in the view of global development. IERC brings together the European projects in the field of IoT technology, thus underpinning the basic multidisciplinary science. The rationale for IoT is to address the large potential for IoT-based capabilities in Europe - coordinate/encourage the convergence of on-going work on the most important issues - to build a broadly based consensus on the ways to realise IoT in Europe.



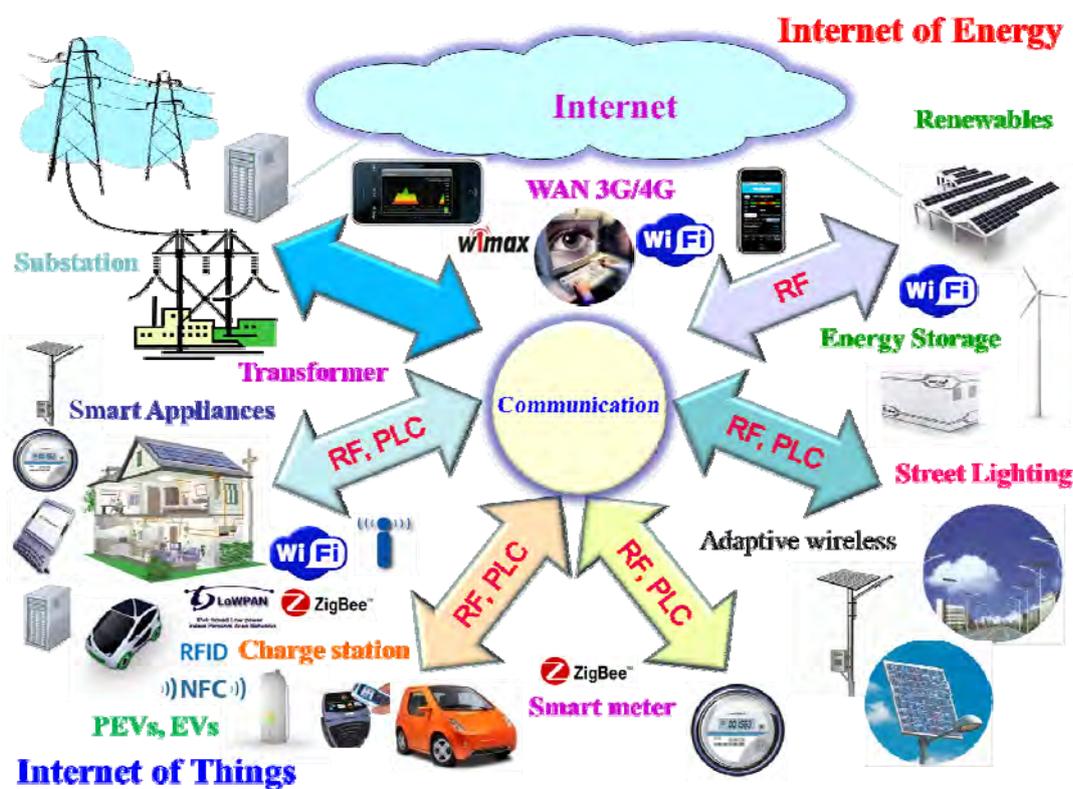
The outlook for the future is the emerging of a network of interconnected uniquely identifiable objects and their virtual representations in an Internet alike structure that is over positioned over a network of interconnected computers allows creating a new platform for economic growth.

The major application fields for IoT are the creation of smart environments/spaces and self-aware things (for example. smart transport, cities, buildings, energy, living, etc.) for climate, food, energy, mobility, digital society and health applications.

In this context the new concept of Internet of Energy requires web based architectures to readily guarantee information delivery on demand and to change the traditional power system into a networked Smart Grid that is largely automated, by applying greater intelligence to operate, enforce policies, monitor and self-healing when necessary. This requires the integration and

interfacing of the power grid to the network of data represented by the Internet, embracing energy generation, transmission, delivery, substations, distribution control, metering & billing, diagnostics, and information systems to work seamlessly and consistently.

This concept would enable the ability to produce, store and efficiently use energy, while balancing the supply/demand by using a cognitive Internet of Energy that harmonizes the energy grid by processing the data, information and knowledge via the Internet. In fact, the Internet of Energy will leverage on the information highway provided by Internet to link computers, devices and services with the distributed smart energy grid that is the freight highway for renewable energy resources allowing stakeholders to invest in green technologies and sell excess energy back to the utility.



The Internet of Energy applications are connected through the Future Internet and “Internet of Things” enabling seamless and secure interactions and cooperation of intelligent embedded systems over heterogeneous communication infrastructures.

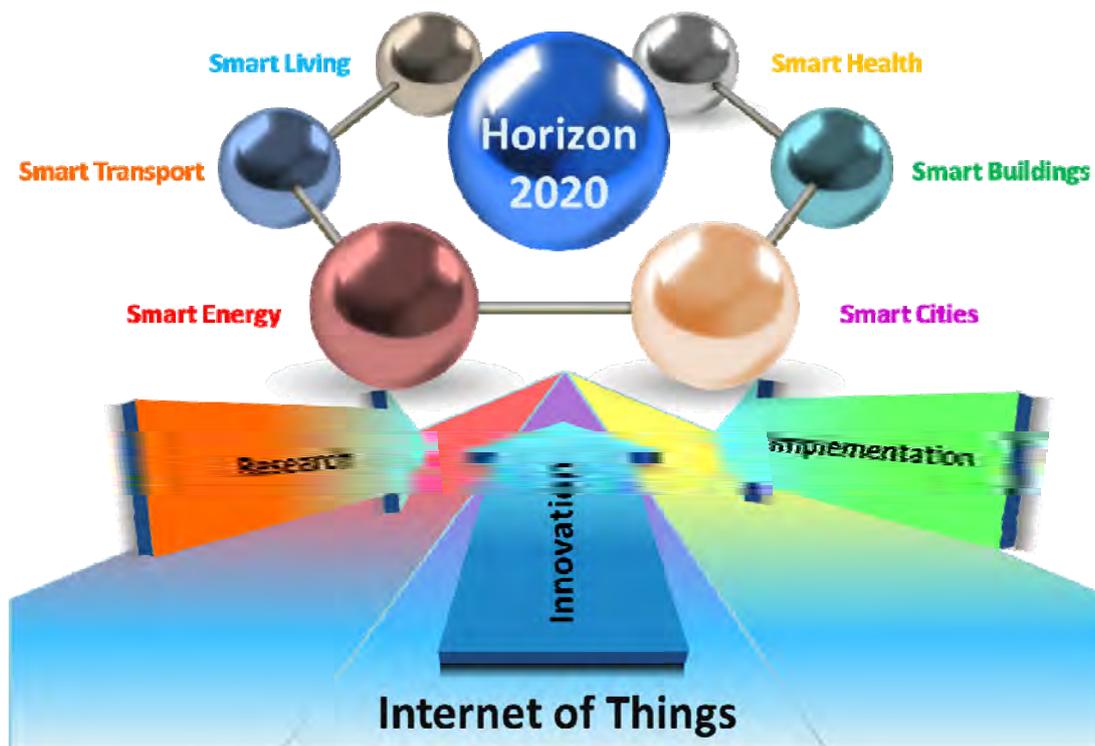
## Cross Fertilisation and Integration of IoT Programmes and Initiatives

In the area of IoT, Europe is addressing the competitiveness in the context of globalisation. The technological specialisations built up over decades are transforming rapidly. In the area of IoT the IERC is focusing on increasing the link of projects, companies, organizations, people and knowledge at European level as a way of making projects more innovative and competitive.

This new approach is visible across a number of different policy fields implemented by the IoT Cluster. One of them is the creation of common activity chains (ACs) to favour close cooperation between the IoT Cluster projects and to form an arena for exchange of ideas and open dialog on important research challenges.

The activity chains are defined as work streams that group together partners or specific participants from partners around well-defined technical activities that will result into at least one output or delivery that will be used in addressing the IERC objectives.

Evolutions in the global environment and evolutions in national policy, science and technology policy and industrial/enterprise policy are converging on the objective of supporting these linkages at the national level. One of the vehicles proposed by the IoT Cluster in order to achieve a real pan European coordination and cooperation is to support the national cluster liaison with “national value creation networks/clusters, innovation/research incubators” (concentrations of projects and supporting actors financed by the national public authorities) in every European country.



The creation of national IoT value creation networks/clusters, innovation/research incubators linked with the IERC will allow a better coordination of knowledge-producing projects in the area of IoT at the national level with inter-linkages among different countries and cooperation at the European level through the integration with the IERC.

This liaison concept will help strengthen and replicate the success factors that achieved by specific projects in the area of IoT and will be an instrument that can help promote exchange of ideas, solutions, results and validation of these among different projects at national and European level. In the new global environment with increased competition and scarce financial resources this

approach is a convenient and pragmatic organising principle at the European and national level by which to focus resources and build cooperation, partnerships and avoid duplicate the efforts.

IoT is considered in the global context and in order to compete globally Europe has to use the enormous potential existing in the synergies among national science and technology programmes and the European programmes by favouring a multi-sector approaches towards policies that push for co-operative, multi-projects and often integration of national-based and European activities in order to achieve the ultimate goal of improving competitiveness and innovation capacity in the area of IoT.

This approach provides a more transparent, inclusive and competitive framework for efforts to strengthen European IoT research efforts and Entrepreneurship and Innovation Programmes and will allow easier the involved SMEs that are participants in the national programmes.

## Instruments for Pan European Coordination of IoT Activities

The instruments proposed by the IERC to create and integrate the national projects into a common European framework are of five distinct types:

- Engagement of national public funding authorities and the national actors actively involved in the area of IoT,
- Creation of national value creation networks/clusters, innovation/research incubators” (concentrations of projects and supporting actors financed by the national public authorities) in the respective European country,
- Integration and liaison of the national activities with the IERC
- Common/collective exchange of ideas through the IERC activity chains including European strategic research agenda for IoT
- Creation of larger-scale collaborative research and innovation initiatives in specific selected area that requires a certain critical mass in order to be successful.

The knowledge is created through innovative processes, and research/innovation is a critical input into those processes and through an increased pan European coordination in the area of IoT will allow the promotion and preservation of future national and European corporate competitiveness.

The IERC promotes in this way the integration of technological, structural, national system of innovation under one framework where the active participants in the system are European and national companies, universities, academic research institutions, private and public-sector educational facilities involved in projects addressing the IoT technology.

The common framework will help the efforts of the researchers involved in these IoT projects to generate new ideas, to pass on their knowledge, and to translate it into marketable IoT products/services/concepts, with all the surrounding circumstances of research and innovation in the area of IoT. This

common framework and integration concept for IoT activities at national and European level is in line with the overall strategy of the European research Cluster on the Internet of Things.

It builds on the ideas put forward by the Cluster Strategic Research Agenda and extensive discussions among the Cluster projects on overall priorities for Horizon 2020 – the Framework Programme for Research and Innovation and shows how the framework programme could support the research and innovation objectives of the Europe 2020 strategy and the Framework Programme for Research and Innovation and connects/coordinates the new framework programme with national initiatives.

The concept creates a real integrated funding system and coordination of technical activities.

## Internet of Things Research and Innovation Implementation

IoT research and innovation activities should be interlinked and integrated across Horizon 2020 Framework Programme for Research and Innovation. These innovation activities must address important IoT advancements such as infrastructure development, standardisation, education programmes and measures to support important industrial sectors or innovation-conducive environments such as smart cities or regions.



The integration and coordination between the European programmes and national initiatives in the area of IoT offers the needed innovation-oriented, industry-driven approach as an integral part of Horizon 2020 Framework Programme for Research and Innovation where the involvement of SMEs as drivers of innovation is ensured.

This facilitates dissemination of the IoT knowledge and technology transfer including applications that address social and societal challenges.

# Internet of Things Research and Innovation Expected Results

The common framework and integration concept for IoT activities at national and European level generates programmes for innovative actions with a view to developing international networks and providing support for national programmes on knowledge and technological innovation.

This is making better use of and is increasing the knowledge generated and improves the capacity of the IoT cluster to interact with SMEs and to allow them to enter new market niches and obtain high levels of knowledge. This will generate cooperation in developing clusters and networks of businesses; innovative projects by SMEs with universities and technology centres; funding of innovation, investments, venture capital, start-ups and spin-offs.

The common framework and integration concept for IoT activities at national and European level is expected to:

- Diversify and strengthen IoT research and innovation at the European level in partnership with national programmes by improving the innovation systems.
- Improve IERC capability for drawing up and cooperating with national innovation strategies.
- Build and sustain new partnerships with member states.
- Improve the quality of IERC partners' programmes.
- Assist EU, and national policies with new examples of good practices.
- A new framework for SMEs and IoT technology cluster.
- Creation of new transnational links among enterprises working in the area of IoT.
- Exchange of good IoT applications and technology developments practices for business networks.
- Transfer of IoT technology between scientific institutions and SMEs.
- New measures through venture capital for financial support for start-ups and spin-offs for new IoT developments.
- Testing of innovative IoT pilot measures.