

**DiY Smart Experiences**  
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# Internet of Things platform enables user-generated applications

The ITEA 2 DiY Smart Experiences (DiYSE) project set out to overcome the barriers to user-generated Internet of Things (IoT) applications. More than 40 partners from a broad cross-section of disciplines worked closely together to develop a technical platform to enable such applications for ordinary people, developers and other ecosystem actors alike. Key outcomes are a live public experimental Internet site and a lot of underlying technical assets, many of which are already being exploited.

IoT marks the next major revolution in worldwide connectivity as the Internet evolves from a network of interconnected computers to one of interconnected objects. Smart domestic appliances, heating and ventilation systems, electronic books, road transport and even goods in transit will all have their own IP addresses, a range of sensors to measure their environment and actuators to interact with it.

However, this poses major problems in terms of the exploding heterogeneity of devices, the many application domains and an extreme diversity of customised installations and applications. There is a need, therefore, for a platform to enable the cost-effective exploitation and management of IoT systems.

DiYSE set out to combine two trends to accelerate the IoT industry: the IoT itself and do-it-yourself, the advent of very cheap, accessible, programmable and easy-to-use hardware with sensors enabling ordinary people to build their own applications in much the same way as the DIY self-sufficiency ethic of the 1960s saw more and more people making things without the intervention of experts.

## BUILDING AN OPEN PLATFORM

The goal was an open platform enabling the masses to share and control their creations in a 'smart things' environment. DiYSE initially imagined people composing real physical smart objects. It quickly shifted focus to the smartness of the data produced by these objects, offering

a technical platform for further reasoning and reusable abstraction. It also demonstrated how this technology could act as an enabler for an ecosystem of players working in an IoT.

DiYSE attracted a huge consortium involving a wide range of disciplines – from technical experts keen to start programming, through systems and concept researchers looking at interaction concepts and at what the system would look like, to a perhaps unique element in the form of non-technological partners looking at human beings and how they socialise.

An initial challenge was to get the partners engaged in dialogue. It was a real experience for a lot of them, and working together with many other disciplines opened up minds while putting their own disciplines into the context of the whole cross-disciplinary team. The topic also had resonance with many other projects. A workshop at the end of DiYSE brought together seven European projects – ITEA and FP7 – working together on the IoT topic; a mix of closing and starting projects.

## CONSTRUCTING THE ESSENTIAL STAGES OF CREATION

DiYSE identified a series of essential creation stages in an ecosystem to launch IoT applications:

1. *Install and connect* – sensors and other items to connect objects to the Internet;
2. *Sense* – extracting and abstracting data meaningfully and aggregating it;

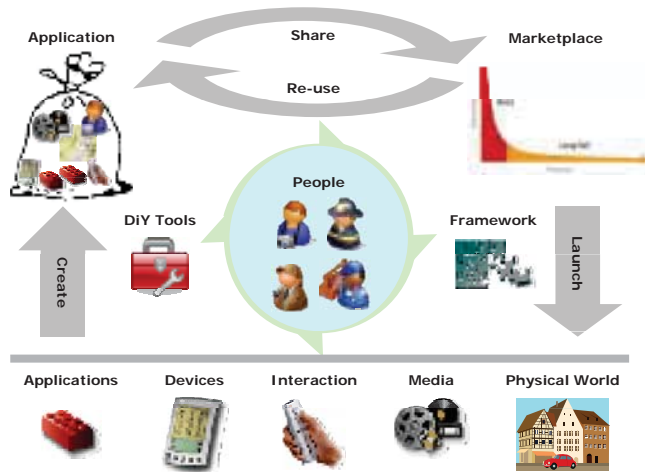
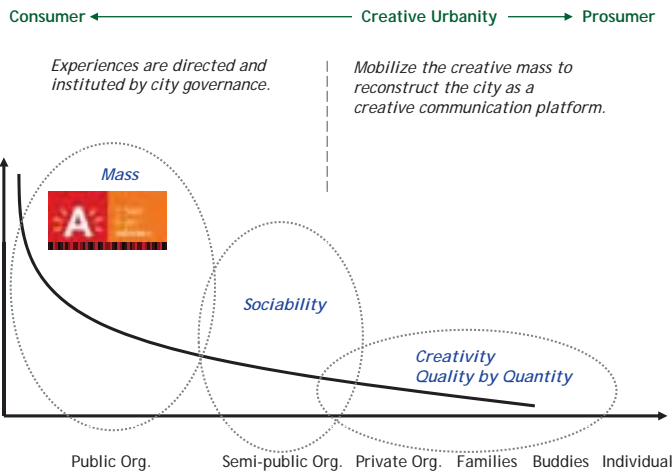
3. *Create* – building applications and reusable paradigms based on this meaningful data;
4. *Execute* – defining the necessary technology to run the multitude of applications.

In the 'install and connect' phase, partners developed:

- Hardware for sensors;
- Middleware for tiny footprint sensor boards (the Contiki operating system developed in previous projects was extended with security mechanisms for secure transport and ownership of the data) and
- Semantic enrichment of the sensor data through enhanced driver sensor gateway technology.

For the 'sense' phase, a number of prototypes furnish semantic abstraction on top of the sensors. Device vendors know what the sensor data mean and can make annotations for the DiYSE system using this semantic information, while systems developers interacting with the DiYSE system can describe what it can be used for and the transformations which can be applied by introducing a sensor. An additional important innovation for the 'sense' stage, was feature extraction from video and speech. The result is a rich stream of data flowing into the DiYSE system.

The 'create' category involves two types of systems: generic – public or carrier grade in the Internet or in the cloud – and application domain-specific. Examples of the latter include Finnish partners developing musical



installations or musical instrument creations for the mentally disabled or the elderly, allowing them to produce music themselves.

So, as an integral creation flow, the hardware designer can offer a device type and enrich it immediately with device sensor possibilities while developers have a marketplace where they can start building transformations of those data automatically incorporated in the catalogue for end users. In their turn, end users can build their own applications with a simple PowerPoint style paradigm. These applications can be shared with friends or used as templates for other applications. The result is an ecosystem at end-user level.

The 'execute' phase requires skill and ability. Hundreds of people use the experimental system with tens of sensors actively sending data and tens of thousands

of applications deployed in the cloud on distributed architecture. Underlying that is a distributed dataflow component architecture which contains the translation on a lower technical layer of what the ecosystem partners co-create as applications. This efficient and scalable collection of component graphs processes all the data end-to-end from the sensor to the visual application in real time.

**FAST EXPLOITATION OF RESULTS**

Telecommunications partner Alcatel-Lucent has developed SenseTale, a live public experimental DiYSE system. The underlying technology assets are currently being transferred to business units within the company for machine-to-machine (M2M) solutions.

Alcatel-Lucent also plans enhancements for telecommunications operators, making it possible to

offer cost-effective and scalable solutions to enable third parties to bring new applications to market. A typical case is the New York marathon, where the city wanted an application to track runners and so enable spectators to follow their favourite runners live on screen. A dedicated implementation worked in small-scale tests, but was not sufficiently scalable and failed in practice when the 50,000 people started running. SenseTale would be able to handle this reliably at lower development cost.

Mobile phone operator Turkcell is equally looking at DiYSE components in the M2M market. And Thales is planning to use this technology in the surveillance and emergency management market for easy deployment of reliable ad hoc systems in the field for emergency situations. However, because this is a security market, Thales predicts that exploitation could take up to five years as many different approvals are required.

Philips has developed jointSPACE, an open-source middleware architecture on its latest range of TVs that follows the DiYSE principle. It offers an open platform where people can install their own IoT applications. A minor registration application makes it possible to connect the sensors in a TV to the SenseTale platform to allow, for example, use of the TV by children to be monitored.

Other companies offering fast exploitation include:

- Archos – with remote control Android and a range of wireless accessories for home automation, surveillance and video communications;
- Finwe – extending its Key2phone for assisted living and a parking pilot;
- Neotiq – as the basis for its next-generation voice and video platform; and
- There – with novel home automation user interface concepts.

**CRITICAL FOR EUROPE**

With DiYSE and other European IoT projects before it, Europe has addressed some key IoT technology areas beyond what is available in the rest of the world. The adoption of IoT will change lives but acceptance by people is essential. DiYSE addresses this by offering an ecosystem which gives control to end users, developers and other ecosystem actors alike. Designers get a single horizontal platform allowing reuse of elements. The underlying technology will be used in many more applications in future.

**MORE INFORMATION:**

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