

CIOT2010 Workshop: "What can the Internet of Things do for the Citizen?"
In conjunction with International Conference on Pervasive Computing 2010
<http://www.autoidlabs.org/events/ciot2010>

User Innovation for the Internet of Things

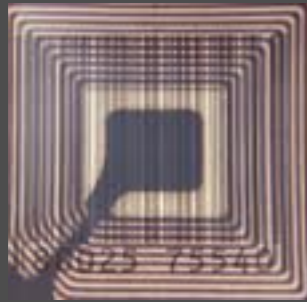
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The Internet of Things is overwhelmingly driven by industrial players

This ...

- **limits innovation potential**
- **limits public discourse**
- **makes it likely that non-commercial concerns are ignored → privacy**



According to the Open Source Sensing Foundation “a long and expensive battle is looming” over privacy, accuracy, ownership and sovereignty “between those using sensors to collect data and those whose data is being collected” [opensourceensing.org]

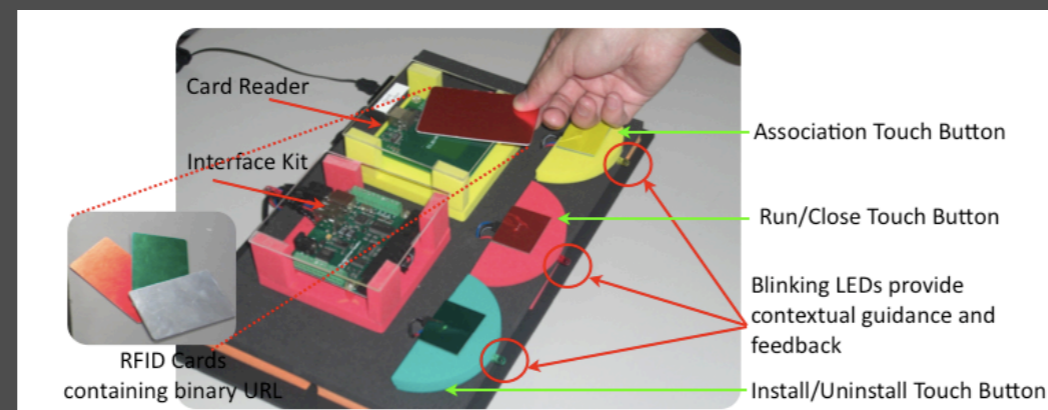
There are at least two ways to address the current situation...

1. Develop systems and applications that directly benefit end-users

For example: Guinard, D., Baecker, O., & Michahelles, F. (2008). Supporting a Mobile Lost and Found Community. In Proceedings of the 10th International Conference on Interaction with Mobile Devices and Services (pp. 407-410). New York.

2. Empower citizens to become innovators

von Hippel, E., & Katz, R. (2002). Shifting Innovation to Users via Toolkits. *Management Science*, 48(7), 821-833



Kawsar F. (2009). A Document-Based Framework for User Centric Smart Object Systems, PhD dissertation, Dept. Computer Science, Waseda Univ., Feb. 2009.

Providing tools is not enough.

**Invention \neq Innovation. Innovation requires
creation and diffusion and adoption.**

The iPhone shows how market-based mechanisms can support effective diffusion of user-led innovation.

By combining programming tools, application platform and distribution channel, the iPhone has created an environment that effectively supports user innovation networks [8] in which innovation development, production, distribution and consumption are performed by users (or more precisely by user/developers and micro software firms).

[8] von Hippel, E. (2002). Open Source Projects as Horizontal Innovation Networks - By and For Users (June 2002). MIT Sloan Working Paper No. 4366-02.

The iPhone ecosystem has “democratized innovation”.

This has led to the successful development, diffusion and adoption of applications for social activism, citizen science, and citizen journalism.



EcoSnoop.com - Sustainability through Activism. EcoSnoop for iPhone is an activism tool that allows green-aware users to assist and encourage corporate green initiatives.



360news – putting the power of full featured news reporting in the hands of citizen journalists and news enthusiasts. Featured on Macworld, PCworld, CNet,

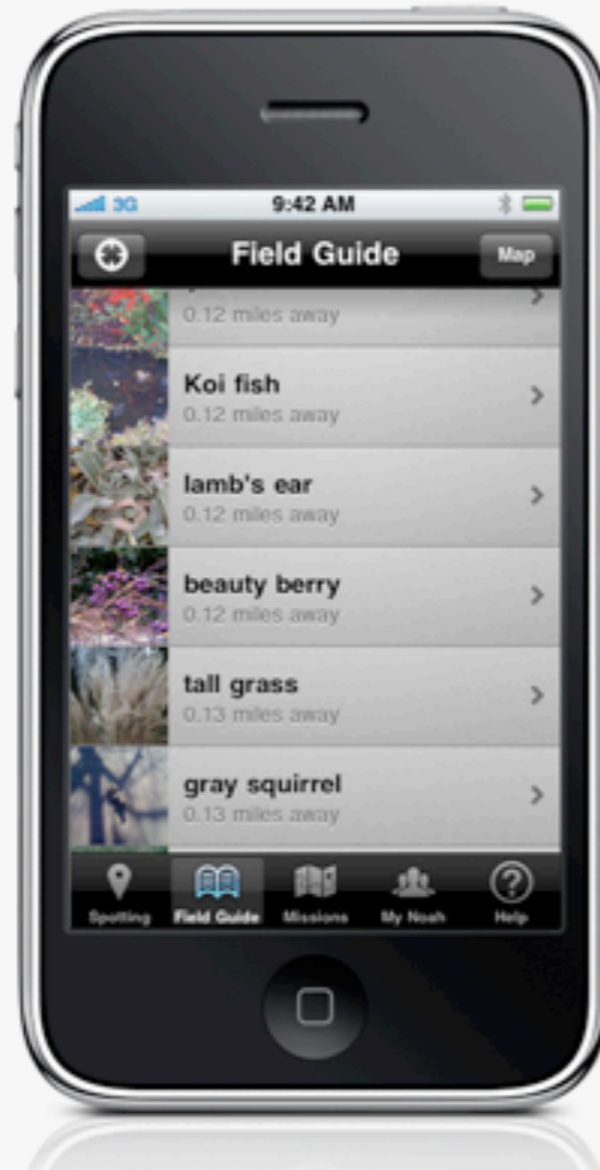


Jungfrau Climate Guide. The Climate Guide gives you a whole new view of Switzerland's Jungfrau region. The app shows you where the effects of climate change are already visible, and what scientists know about the subject.

about

[view map](#) [my noah](#) [species database](#) [missions](#) **[about](#)**

Noah is a tool that nature lovers can use to explore and document local wildlife and a common technology platform that research groups can use to harness the power of citizen scientists everywhere.



Spottings

Grab a photograph of an interesting organism that you want to share or learn more about, select the appropriate category, add some descriptive tags, and click submit. We'll capture the location details along with some other information and store it in the species database.

Field Guide

See what kinds of organisms are near you right now. Search through a list or explore a map of the most recent spottings based on your location, all on your mobile phone. We are working with local experts and provide you with as much species information as possible.

My Noah

Sign in with a new or existing Google account to link up with My Noah. Once you've logged in from your phone, all of your spottings will be associated with your account. Keep track of your stats, browse your spottings, and see how you rank among other Noah users.

Missions

Noah is all about discovering and documenting local wildlife. We work with research groups and organizations to help gather important data and we want you to help! Missions can range from photographing specific frogs or flowers to tracking migrating birds or invasive species. Missions can also be just for fun.



How can we give ordinary citizens a voice, not just as commentators of ongoing IoT developments, but as innovators and shapers of technology?

How can we ensure that the Internet allows for user-led innovation?

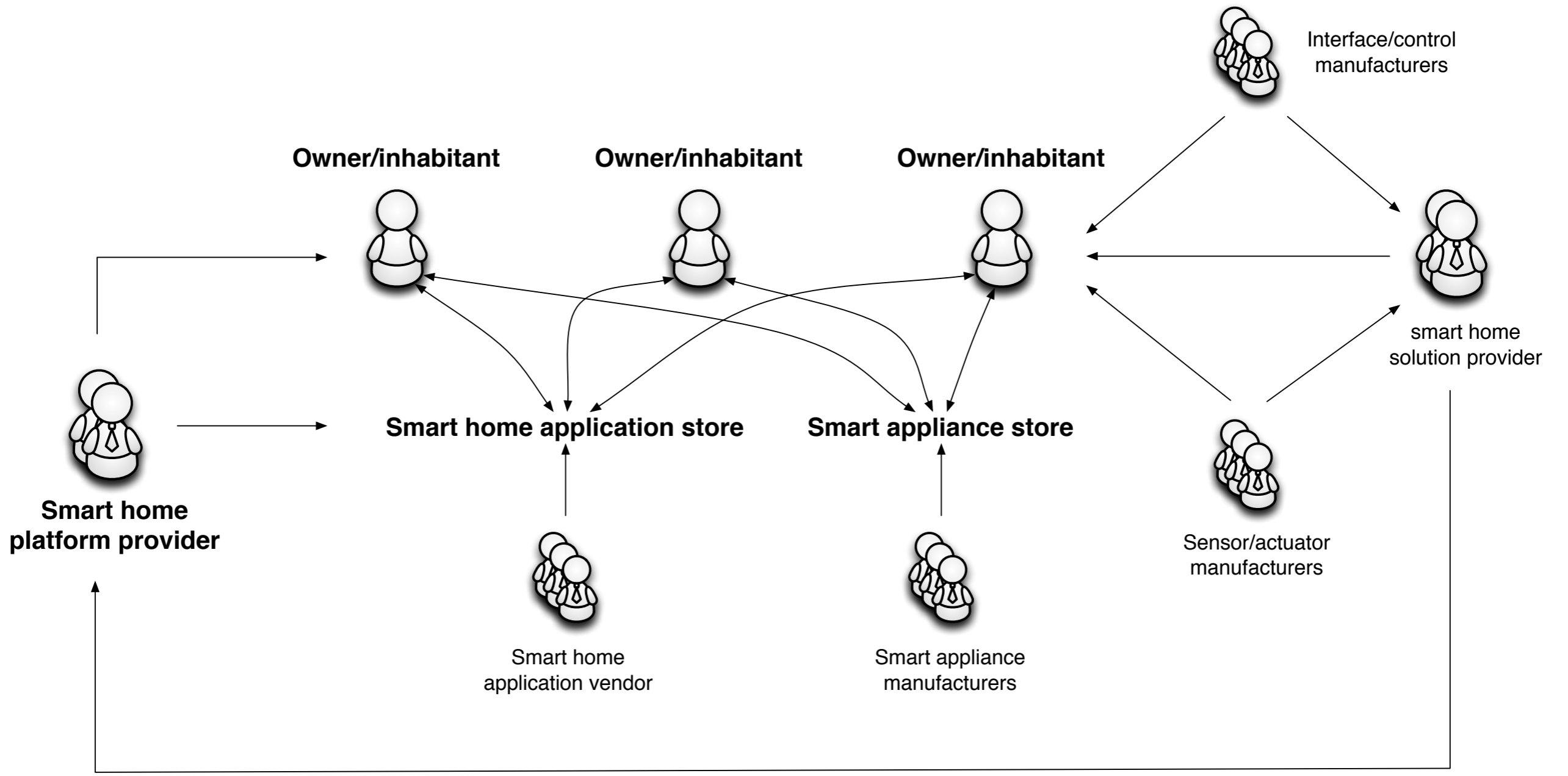
Smart Homes

Traditionally smart-home research has focused on enabling technologies and applications [26]. Increasingly, research projects aim at establishing technical and business ecosystems [27,28], but these efforts are primarily vendor-driven and supply-side focused without looking at end-user innovation. (The only notable exception is the Do-it-Yourself Smart Experiences project - DiYSE - but concrete results are still sparse [29]). Academic researchers, on the other hand, have investigated end-user programming and tailorability of smhomes [30,31], but this work ignores the important diffusion aspect of innovation.

User-Centered Smart-Home Ecosystem

= as a set of actors (business and individuals) that interact and collaborate in the construction, upkeep and use of smart-homes, together with enabling software/hardware components.

The key purpose of the user-centered ecosystem (and the main difference to non-user-centered ecosystems) is to enable owner/inhabitants to create, deploy and disseminate smart home innovation in the form of new hardware and software applications.



Most research views smart homes as a single complex system that is designed and constructed from the ground up, and assumes that most aspects (physical building, digital infrastructure, furniture, appliances) are under the control of a single smart-home developer. This is wrong.

This might be the right if one considers research facilities such as Georgia Tech's smart-home [32], but is certainly wrong if one takes into account the typical life cycle and evolution of homes [33]. The user-centered ecosystem reflects the fact that buildings are assemblies put together by many contributors and that do-it-yourself home improvements by owners/inhabitants play an important role over the lifetime of a home.

Challenge 1: Understanding and supporting user innovation touchpoints

User innovation in the smart-home example can occur in many ways:

- by developing innovative smart-home applications
- by creating or modifying smart objects and appliances
- by upgrading the sensor/actuator infrastructure etc.

The challenge is to identify these innovation touchpoints and to provide adequate tools.

- How do toolkits look like for modifying smart appliances?
- How can these modifications be disseminated to other owner/users in effective ways?
- How can sharing of user-generated physical artefacts be supported by the ecosystem?

Challenge 2: Understanding the characteristics of open innovation platforms

Platforms are at the heart of many hardware/software ecosystems [36] and will likely play an important role for the IoT.

What makes a compelling IoT platform from an

- end-user/developer,
- business and
- software engineering point of view?

What abstractions should these platforms expose to maximize adoption and innovation?

IoT platforms are complex in that they must dynamically integrate sensors and actuators as well as smart objects. How do these platforms manage interoperability between components and products from different vendors?

Challenge 3: Understanding and supporting user incentives

Incentives are at the core of user innovation. On the one extreme, user/developers may simply value the process of innovating because of the enjoyment or learning that it brings them; on the other extreme, they may be able to monetize their innovation by selling products on an open market place.

The sensor richness of the Internet of Things adds novel trading and monetization opportunities related to user-generated data.

- What are suitable monetization strategies for user-generated data?
- How can users resolve the conflict between maintaining privacy and realizing potential value of data?
- How can users trade or collect user-generated data without involving monetary transactions?

What we currently do

HomeSense Project (Tinker London, EDF R&D)

Homesense brings the open collaboration methods of online communities to physical infrastructures in the home. Instead of having products forced on them through a top-down design process, selected households will create their own smart homes and live with the technologies that they have developed themselves without any prior technical expertise.

THANK YOU

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the Eighth International Conference on
Pervasive Computing (Pervasive 2010),
Helsinki, Finland, 17 - 20 May 2010

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