

# Internet of Things Day 2012

## Talks & Demos

Arranged by SICS in collaboration with KTH, Wisenet and Stockholm University. Sponsored by VINNOVA and EIT ICT Labs.

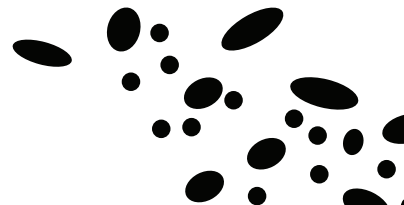
Arranged by:

**SICS**



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# The Swedish Internet of Things Center

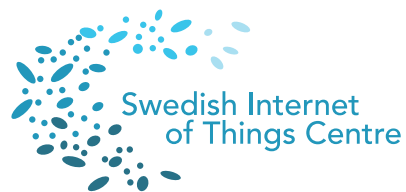
The Swedish Internet of Things Centre is a new centre for the next Internet, where the things that surround us are networked and connected to the Internet, just like ourselves. The Swedish Internet of Things Centre is finding its shape in Kista right now, together with big companies such as Ericsson and Microsoft and a number of small technology based companies. We will launch the initiative with one inspirational day together, when we can discuss our goals, describe the possibilities and invite you all to be part of this grand challenge: a new Internet to serve human life.

As oppose to other initiatives, The Swedish Internet of Things Centre will focus on the consumer. As consumers we look for technical solutions for everyday life, in our homes, in our pockets or even on our bodies – not primarily because they are useful but because they are fun or attractive. To create the future's attractive consumer-oriented Internet of Things applications we need three basic competences: interaction design, handling of big data, and software to connect the embedded systems with the Internet. SICS has a long experience and world class expertise in all three domains.

At the Internet of Things Day you will meet the research leaders Kristina Höök, Ali Ghodsi and Adam Dunkels. Take this chance to chat with them and discuss what needs to be done and how we can do it together!

The Swedish Internet of Things Centre is started by SICS in collaboration with Ericsson, Microsoft, KTH, Mobile Life, Stockholm University, Wisenet, Swedish ICT and a number of small companies including Company P, Ant Micro, and Vendolocus. The centre, which offers a strong research environment and a unique network, is still open for participation. The centre is led by Kristina Höök, professor at KTH and research leader at SICS.

Welcome to join us!



## Agenda

- 09.30** Welcome, Christer Norström, CEO of SICS
- 09.35** Why a consumer-oriented Internet of Things centre in Sweden? Kristina Höök, head of the centre
- 10:10** Keynote by Bu Fanjin, deputy Chief Engineer of CESI, Ministry of Industry and Information Technology of China: China Internet of Things Plan 2011-2015
- 10.45** Keynote by Mike Kuniavsky, Orangecone, US: The Internet of people: integrating Internet of Things technologies is not a technical problem
- 11.30** Living with Internet of Things, Oskar Juhlin, Mobile Life
- 12.00** Lunch (included) and mingle
- 13.00** Device software challenges, Adam Dunkels, SICS
- 13.30** Internet of Things meets the Cloud, Ali Ghodsi, KTH
- 14.00** Finding values in big data, Jan Höller, Ericsson Research
- 14.30** .NET Gadgeteer: A Platform for Custom Devices, Steve Hodges, Microsoft Research
- 15.00** A training app for the Swedish Olympic cross country ski team, Christer Norström
- 15.30** Coffee and a large exhibition

**NOTE :** Twitter account: @siotcentre  
Hashtag of the day: #iotd12

Wifi: Electrum.  
Username: IT  
Password: radiogotland

# Talks

## Why a consumer-oriented Internet of Things centre in Sweden?

Around the globe, we can see a shift towards Internet of Things interactions. Companies and research centres focus mainly on utility applications, such as SmartGrids (distribution of electricity in the networks), dealing with traffic in cities, or M2M-communication to solve problems of automation. There are visions like China's intelligent cities, IBM's vision of a Smarter Planet, Ericsson's focus on 50 billion connected devices, Berkeley's Mobile Millennium, and many, many other utility-oriented vision statements.

An area where we do not see as strong, coherent visions is in consumer-oriented applications: play, games, social media, sports, health, wellness, and recreation. But from the past, we know that entertainment - like computer games - have been important drivers behind technological innovations and dissemination. We already see many applications that combine sensors and actuators interacting directly with end-users, connecting to the cloud and cloud services, opening a whole space of possibilities for consumer-oriented applications: Kinect tracks your bodily movements, there are accelerometers integrating in shoes from Nike, FitBits from Philips collecting movement, pulse meters from Polar check your pulse, Runkeeper keeps track of your jogging. As these applications start thriving on the data generated by thousands of users, we truly shift into Internet of Things for consumers. This begs the question: what are the desirable consumer-oriented Internet of Things applications we should be building?

**/Kristina Höök**

### **Kristina Höök**

is professor in Human-Machine Interaction at Stockholm University and lab manager at SICS. She started the Mobile Life centre in 2007 - a centre that has now grown into being 50 researchers, working in close contact with industrial partners such as Microsoft Research, Ericsson, Nokia, TeliaSonera and Stockholm City. Her research focuses on bodily and emotional interaction. She has published in high-rated venues such as ACM SIGCHI, DIS, NordiCHI, ToCHI, IJHCS, and the Royal Society in the U.K.



## China Internet of Things Plan 2011-2015

As the core of the new generation information technology industry, the mobile Internet is becoming an important force of promoting China's economic development. According to statistics, China's mobile Internet users reached 600 million, and it is showing rapid growth. Advantages of a large population and the background of the current economic development mode, transformation provides a huge development space for China's mobile Internet industry. As a new industry area, we face many challenges, both technical and organizational.

**/Bu Fanjin**

### **Bu Fanjin**

is the deputy Chief Engineer of CESI (China Electronics Standardization Institute), and the main initiator and author of Chinese IoT action plan from 2011 -2015, which is the guide of Chinese Internet of Things, including Technology, Standard, Industry, Application and so on.





## The Internet of people: integrating Internet of Things technologies is not a technical problem

The technologies underlying most current Internet of Things visions are not particularly revolutionary. That of course doesn't mean that the visions are not compelling, just that the challenges in creating these visions have little to do with building new technologies. The real challenge is to identify what people want and need, and how -- or if -- automatic identification, distributed processing, and pervasive networking can help address those needs and desires. History is littered with failed technological visions. It is only by moving beyond an attachment to technological novelty for its own sake that any agenda for the Internet of Things will help people live happier, more productive lives.

/Mike Kuniavsky

### Mike Kuniavsky

is a user experience designer focused on ubiquitous computing user experience design. He co-founded Adaptive Path, an influential design firm, and ThingM, a micro-OEM. He wrote 'Observing the User Experience,' a book on user experience research, and "Smart Things," on the design of novel networked computing devices. Both books are widely used as university textbooks. As a consultant he has designed software, hardware, services, events and company cultures.

## Living with Internet of Things

The Mobile Life VinnExcellence Centre provides a view into a future life with digital technology, and an enjoyment society where happiness, pleasure and play are adopted into all aspects. Already, these activities and experiences are fundamental parts of our daily lives and we orient towards them during leisure time and when engaging with other people. At the Centre, we show how enjoyment will be pursued given services that combine mobile technology and internet of things.

/Oskar Juhlin

### Oskar Juhlin

is Director at the Mobile Life VinnExcellence Center and Professor at the Department of Computer and System Sciences at Stockholm University. He is Associate Professor ("Docent") in applied information technology at the IT-university of Göteborg. He has been a research fellow at the Section for Science and Technology Studies at Göteborg University, and researched at the Viktoria Institute. Oskar is most known for his work on the use of mobile technology to enhance social interaction in road traffic, and lately for the research on collaborative social video production, fashion and human animal interaction.

## The Internet of Things: Time for Action

We have developed the Internet of Things more than ten years, always with a technical focus. And we succeeded. The open source Contiki operating system, developed and used by developers and companies from all across the world, provides Internet IPv6 connectivity for battery-operated systems. The technology is standardized, interoperable, stable, and efficient. We have now reached the point where the technology is ready to be used on a larger scale: to provide a tremendous value that make our lives better, more fun, and more efficient.

**/Adam Dunkels**

### **Adam Dunkels**

is a researcher at SICS, founder and co-director of the Networked Embedded Systems group, and a pioneer in the Internet of Things area. For his work on the Internet of Things, the MIT Technology Review named him a top 35 innovator under 35 in 2009. He has also received the 2008 Roger Needham award, the 2008 Cor Baayen award, and the 2007 Chester Carlson prize. In 2011, he was selected as the #2 Swedish super talent by Swedish business magazine Veckans Affärer. In 2008, he co-founded the IPSO Alliance together with a group of major IoT industry vendors. His software, the Contiki operating system, the uIP and lwIP TCP/IP stacks, and protothreads, has been used in a large number of commercial and academic IoT systems for over a decade. He regularly publishes papers on the IoT in high-profile venues and his IoT book, "Interconnecting Smart Objects with IP - the Next Internet", co-authored with JP Vasseur and with a foreword by Vint Cerf, was published in 2010.

## Internet of Things meets the Cloud

Internet-enabled devices are omnipresent. These devices collect data about us, lets us check our email, calendars, or just keep in touch with our friends on Facebook or Twitter. Even though there is a surge in Internet-enabled computing devices, the bulk of their computation is happening on the cloud. Evermore computation and data is moving to the cloud, where it can be analyzed, computed, and stored. The datacenter is the new computer. Yet, there is no software stack that enables us to use it as one computer. This talk will outline what such a stack might look like, and how future applications might benefit from running on it.

**/Ali Ghodsi**

### **Ali Ghodsi**

got his PhD from KTH, Royal Institute of Technology in 2006. He is visiting researcher at UC Berkeley since 2009 and is on leave as an Assistant Professor from KTH. His research interests include distributed computing in general, and cloud computing specifically.



## Finding values in big data

Jan will talk about the transition of M2M, which can be referred to as “Intranet of Things”, towards a true Internet of Things. This transition will bring a new set of challenges and will also require a new set of solution tools. The challenges and new tools will be briefly introduced.

**/Jan Höller**



### Jan Höller

is a Master Researcher at Ericsson Research where he is responsible for Architecture and Strategies on Internet of Things and M2M. He was part of the team that created and established the Ericsson vision of “50 Billion Connected Devices” leading up to the corporate vision of the Networked Society. Jan is also on the Board of Directors of the IPSO Alliance which promotes IP in Smart Objects. He has been with Ericsson since 1989 and held various positions in strategic product management and research management in the IP networking and Services areas.

## .NET Gadgeteer: A Platform for Custom Devices

.NET Gadgeteer is a new prototyping platform conceived to make it easier to design and build custom electronic devices and systems. It is comprised of three main elements: solderless plug-and-play modular electronic hardware; object-oriented managed software libraries which are accessible using a high-level programming language and established development environment; and 3D design and construction tools designed to facilitate a great deal of control over the form factor of the resulting electronic devices. Each of these elements is designed to be accessible to a wide range of people with varying backgrounds and levels of experience and at the same time provide enough flexibility to allow experts to build relatively sophisticated devices and complex systems in less time than they are used to.

**/Steve Hodges**

### Steve Hodges

runs a group at Microsoft Research Cambridge which develops a broad range of technologies relating to ubiquitous and mobile computing, sensing and sensor data processing, displays and interaction. The aim of this research is to uncover compelling new tools, techniques and devices and to understand how these could change the ways in which people use and interact with electronic devices. Prior to joining Microsoft, Steve was Technical Director of the Cambridge Auto-ID Lab and he also co-founded an RFID training and consultancy company, Easy-EPC Ltd.

## A training app for the Swedish Olympic cross country ski team

Winter sports science is growing with the ever-increasing focus on achieving the best results possible. To maximize performance and stay at the top in cross country skiing, research in bio mechanics, physiology, and skiing techniques is required, as well as in equipment such as skis, poles and waxes. In this talk we will present a concept for using sensor technology in the field for improving technique, training methodology and tactical skills in cross country skiing. The concept is built on sampling of inertia sensors, advanced data analysis and visualization. The goal of the project is GOLD medals in the next Olympics in Sochi. The project is a collaboration between Nationellt Vintersportcentrum in Östersund, SICS and KTH.

/Christer Norström

### Christer Norström

is the CEO of SICS and professor in Computer Science and Engineering at Mälardalen University, Sweden. Christer is also a cross country skiing trainer for kids and has a deep interest in cross country skiing. Christer leads currently a cross country skiing project applying sensor technology to improve technique and training methodology together with Nationellt Vintersportcentrum in Östersund, SICS and KTH.

## Demos

### 01. XC-Trainer

To be a top nation in cross country skiing requires research in many areas including bio mechanics, physiology, skiing techniques as well as skiing equipment such as skis, poles and waxes. SICS and Swedish Winter sports research centre at Mithögskolan has joined forces to create innovative IoT-based tools that provide the best possible services to skiers and coaches by giving feedback that can help maximize performance in training and competition. In the XC-trainer application, standard sensors log the movement of the skier throughout a workout. Together with novel activity recognition algorithms this creates an innovative Internet-of-Things application for real-time as well as off-line biomechanical analysis of cross country skiing techniques. In the current version the system analyses what “gear” that a skier is using at each particular instance. The analysis is then mapped to a number of aspects such as heart rate, speed, gradient, etc, which in turn can support analysis of key factors to successful improvement such as energy usage, symmetry and variability of movement. We also explore how this kind of tool can be adapted to give the recreational skier access to the same advanced performance technology as the world class athletes, but adapted to their unique skills and requirements.

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### 02. SNAP

– Rapid Sensor network Deployment with a Sensor network Appstore

Despite ease of deployment being seen as a primary advantage of sensor networks, deployment remains difficult. We present Snap, a system for rapid sensor network deployment that allows sensor networks to be deployed, positioned, and reprogrammed through a sensor network appstore. Snap uses a smartphone interface that uses QR codes for node identification, a map interface for node positioning, and dynamic loading of applications on the nodes. Snap nodes run the Contiki operating system and its low-power IPv6 network stack that provides direct access from nodes to the smartphone application. We demonstrate rapid sensor node deployment, identification, positioning, and node reprogramming within seconds, over a multi-hop sensor network routing path with a WiFi-connected smartphone.

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### 03. Increasing energy efficiency

#### - Monitoring and control of Smart Homes and Grids

Europe and the rest of the world share common goals towards energy efficiency and sustainability. To achieve these goals, distribution and control of energy needs to be made more efficient. A number of projects where SICS is involved are making improvements in this area. A parallel goal is to give energy consumers convenient tools for managing their environments. The demo shows how power consumption by end users can be monitored and controlled using standard tools and protocols from devices in homes, via data aggregation in the Smart Grid, to cloud level business services.

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### 04. Low-Power Wireless IPv6 Routing with ContikiRPL

RPL is the IETF candidate standard for IPv6 routing in low-power wireless sensor networks. This demo shows Contiki's RPL implementation running in the Cooja simulator. After starting the sensor nodes, RPL builds a routing graph, providing connectivity between all the nodes in the networks.

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### 05. Low-Power RESTful Querying with CoAP

The RESTful paradigm is the idealized model of the Web, where nodes in the Internet are accessed via a stateless request-response scheme. CoAP is the IETF candidate standard for RESTful interaction in low-power wireless sensor networks. This demo shows how individual sensors can be accessed via Contiki's CoAP implementation. We deploy a set of nodes with brightness, temperature and humidity sensors, and we query sensor values from a Web browser.

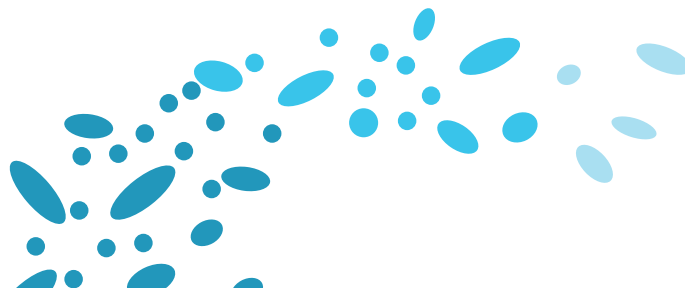
Contact person:  
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### 06. Affective Health

The Affective Health project explores mobile services that empower people to reflect upon themselves, detect patterns and deal with different situations in their lives. Through the use of biosensors we provide users with a visualization of affect and energy, in real time and over time, this creates bio-feedback loops. The relationship between activities in the world and the information from the sensor data helps users to build meaningful relationships between their experiences and how that affects them. This in turn empowers them to increase control of different events in their everyday life and to relate and deal with them.

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## 07. FascinatE

The FascinatE project is developing a system that allows end-users to interactively view and navigate around an ultra-high resolution video panorama showing live events, with the accompanying audio automatically changing to match the selected view. The output is adapted to their particular kind of device, covering anything from a mobile handset to an immersive panoramic display. The system adapts the content to suit different device types and support innovative interaction methods that allow viewers to control and display the content.

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## 08. Outfit-centric Mobile design

Mfashion project deals with the issues of fashion and its influence on mobile design. The concept of Outfit-Centric Accessories is inspired by fashion accessory, emphasizing on the integration of accessories into the ensemble of a person. The first version of the Mobile application using the concept has been developed. This application enables users to match the mobile phone with their outfit in the form of a background image, phone cover, and/or a printable sticker.

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## 09. Ecofriends

– Social voices of Season

By combing people's everyday grocery shopping behavior with analysis of social media, the Eco-friends application provides a subjective view on the current season of various fruits and vegetables. Through analysis of people's twittering and blogging about fruits and vegetable Ecofriends portrays various seasons through three different voices: friends, experts, and everyday people.

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## 10. Spotisquare

What if every place you visit had its own soundtrack? This is a mash-up of two popular services: Spotify for streaming music, and Foursquare for locations. Spotisquare lets you create playlists that are unique for each Foursquare venue. You can enjoy and add to the music associated with your favourite café, your workplace, or anywhere else you check in.

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## 11. Pic-In

- The camera on your mobile phone can do more than you think

Pic-In allows you to check-in on location-sharing service foursquare by simply taking a picture. Your venue is recognized based on your photo and your mobile phone's position. Pic-In is one of Mobile Life's new concept apps, and combines crowdsourcing and sensor-data. It doesn't work the first time? Well, we need some images to compare them to your photo. If you come to the same place again and take a similar image, your venue will be recognized. Pic-In shows the potential of using computer vision techniques in mobile applications to create new user experiences, and usage of the mobile camera as a sensor to detect objects and places.

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More information: [pic-in.com](http://pic-in.com)

## 12. $\phi^2$

In location-based social networks like 'foursquare' users can share their location to friends by doing a so called 'check-in'.  $\phi^2$  is a project within the Mobile 2.0 project at the Mobile Life Centre exploring different ways of physical check-ins for foursquare. Our first approach - the  $\phi^2$  Scanner - is an Android app that let users check-in to foursquare by scanning 2D barcode stickers. You can download our application in the Android market: just search for Phi2. If you want to generate your own barcodes for your favourite venue, use the  $\phi^2$  Barcode Generator at <http://phi2.mobilelifecentre.org>

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## 13. Mobile ActDresses

- How can you make your phone more punk?

Mobile ActDresses is a design concept where the things we already do to express ourselves through the outer design of our mobile phones, rub off on the behaviour of the phone.

People personalise their digital devices physically in different ways. They put stickers on their laptops, they buy or make their own customized cases, and they attach mascots and charms to their mobile phone handsets. We know that the clothes people choose to wear serve a range of communicative functions, indicating e.g. appropriate behaviour, group belongings, or expected interaction. Similarly, physical accessories attached to a digital device could be used to indicate what mode the device is currently in, and what behaviour could be expected from it. This way Mobile actDresses can represent a broad and very flexible extension of mobile device user interface design.

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## 14. Impact

- Enabling rich, sensorial sharing of emotional experiences among friends

What if instead of sending a text message to your friends, you were able to send a warm sensation over their bodies? A gentle stroking sensation? Or perhaps you want to display your anger with a rough vibration? In the Impact project we want to enable richer communication among friends that take advantage of the richness and fullness of all our senses. A social system allowing you to share rich emotional and sensorial experiences among friends.

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Weblink: <http://mobilelifecentre.org/project/show/10>

## 15. Building and testing real devices and systems - with a simulated environment of interconnected virtual hardware

Today's devices, no longer stand-alone, form growing, constantly interacting networks. The important issue is how to design and model such environments so that building real systems becomes a natural step forward rather than an overwhelming, complicated operation. Our proposed solution enables the creation of virtual environments running real software on emulated hardware, giving the possibility to monitor and record the behaviour of both single devices and whole systems, letting you test and debug real scenarios.

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Links: [www.antmicro.se](http://www.antmicro.se), [www.rte.se](http://www.rte.se)

## 16. LiveNature - Bringing nature closer to home

The more advanced the technology, the more we feel nature slipping away from us. The LiveNature project is an initiative to reach back our roots and keep in touch with it. Throughout the creative process, we gather ideas to bring the wild life we left to our habitat and flesh them out into insightful experiences. We focus mostly on original applications of live video, sensors and data visualization to observe, understand or explore the world around us.

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## 17. Codename: Heroes

“Some humans have always been born with extraordinary powers. Thousands of years ago, these people lived in the open, but today they live in hiding. In the myths, they are depicted as gods, elves, witches and trolls. Today we dream About superheroes.”

Codename: Heroes is a long-term pervasive game. It plays in the world around you and is always active. The players take on the roles of secret superheroes, fighting for their beliefs and rights. With precise game design we strive to create an empowering experience and feelings you can bring back and use in your everyday life.

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## 18. The Traffic Planning Lamp

The traffic planning lamp builds upon a twist over the idea of the Internet of Things by using the Internet itself as a sensor, providing data that is further consumed by a Lamp. The lamp is a multi-coloured energy saving ambient display for the home. The colour of the lamp changes in sequence (various spectrum from green to red) to reflect the fluidity of the traffic along the various sections of the main motorway in Stockholm.

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## 19. Upwis

### - a modular Wireless Sensor Network system approach

UPWIS presents a modular Wireless Sensor Network system approach with application configurable modules; different types of low power Cpus,radio front ends and sensor modules. As demonstration system, a system with sensors is connected via internet server to an Android smartphone. Upwis is a system design house, providing design services related to Internet of Things with own hardware and software services.

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[www.upwis.com](http://www.upwis.com)

## 20. Sensei-UU

### - A Sensor Network Testbed with Support for Mobile Nodes

We demonstrate Sensei-UU, a sensor network testbed that supports mobile nodes and is easily relocatable. Running experiments with mobile nodes allows us to evaluate scenarios in which mobile users (e.g., people carrying cell phones) interact with more static networks. The ability to relocate the testbed enables us to evaluate applications in their intended target environments.

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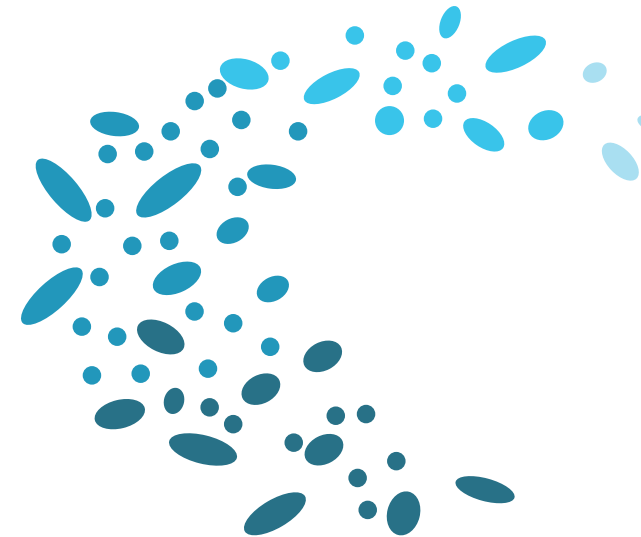
## 21. Diversity Enabled WBAN

A demonstration of a prototype network for evaluation of performance enhancements in wireless body area networks (WBAN) developed within the WISENET WBAN cluster. The system is designed to provide data on performance gain and tradeoffs when implementing diversity in a WBAN system.

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[www.wisenet.uu.se/](http://www.wisenet.uu.se/)



# Posters

## 22. makeSense:

### - Easy Programming of Integrated Wireless Sensor Networks

WSNs are expected to play a critical role in the next computing revolution, as depicted in the visions of Cooperating Objects and the Internet of Things. However, designing and developing WSN software is currently very difficult. This may prevent WSNs from reaching large-scale adoption, especially in industry. The makeSense project aims at enabling an easier integration of WSNs in business processes, by allowing business process experts and WSN developers to express the high-level functionality required, while leaving low-level details to the compiler and run-time system. We envision the results of makeSense to be not only a landmark for WSN software development, but also a new way to look at WSN programming that increases productivity and business value, enabling a far-reaching adoption in key industrial domains.

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[www.project-makesense.eu/](http://www.project-makesense.eu/)

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## 23. Antelope:

### - The Database System for the Internet of Things

Preserving energy is a key issue in the Internet of Things, where battery-powered devices are common. Most efforts toward this objective have focused on communication energy. Taking a drastically different approach, we have designed and implemented Antelope, a database system that runs on each device. Antelope saves energy by indexing and processing data efficiently in the devices, and thereby reduces the energy-consuming radio traffic. Antelope has been published in ACM SenSys'11, the premier conference in the sensor networking field.

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## 24. End-to-end security

### - In the IoT with IPsec and IKEv2

In order to bring IoT out of the lab and into the society it needs to be secure. A pair of hosts in the network must be able to authenticate each other and protect their communication from prying eyes by means of encryption. The solution concerned also needs to be standards-compliant with the rest of the Internet. SICS is therefore working on bringing the Internet protocol IPsec and its associated key management system (IKEv2) to Contiki.

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## 25. Traveur:

### - Athletes and Street Acrobats: Designing for play as a Community Value in Parkour

Parkour is a type of sportive leisure activity, which takes place in urban space. Traveur is a service and training aid which brings information to the “here and now” of the traceurs out in the streets. Previously communication was ad-hoc and dispersed through many mediums. Traveur binds videos, skills and comments to a particular location on a map and combines this with a specialized communication mechanism which allows users to see and find other traceurs in real time. We report on our process of designing with, and for, an identified youth group: the Parkour and Freerunning community

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<http://www.traveur.se>

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## 26. Low Power, Low Delay:

### - Opportunistic Routing meets Duty Cycling

Traditionally, routing in wireless sensor networks consists of two steps: First, the routing protocol selects a next hop, and, second, the MAC protocol waits for the intended destination to wake-up and receive the data.

This design makes it difficult to adapt to short-term link dynamics and often introduces delays while waiting for the intended destination to wake up. In this work we introduce ORW, a practical opportunistic routing scheme for wireless sensor networks. In a duty-cycled setting, packets are addressed to sets of potential receivers and forwarded by the neighbor that wakes up first and successfully receives the packet. This allows ORW to increase resilience to wireless link dynamics by exploiting spatial diversity. Furthermore, it reduces delay and energy consumption by utilizing all neighbors as potential forwarders. Our results show that it reduces radio duty-cycles on average by 50% (up to 90% on individual nodes) and delays by 30% to 90% when compared to the state of the art.

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Notes:

