Report[1] on the NCCR MICS Industry Forum 2006

Management summary

Sensor and actuator networks, integrated with the Internet space, will dramatically change the way information and communication technology is used. How large will the economical opportunities and the societal impact be? The NCCR MICS Industry Forum 2006 gathered a hundred people representing a number of key players from industry, in order to bring elements of answer to this question. Due to its unique position, MICS can play a major role not only in research, but also in becoming a space where managers from different industry segments can meet each other and share visions about the future of this field.

Three areas of potential applications were developed by the morning keynote speakers. Pierre Tournassoud of Alcatel sees this “Internet of things” as the third wave of telecom service adoption, coming in the 2010 decade after the new connectivity services and the broadband ones. These services will essentially be personal and user-centric. Smart buildings are raising the interest of many players, and Philipp Blum of Siemens represents a major one. In this domain, in particular for fire safety and security applications, several hard issues still need to be resolved before wireless sensor networks can be fully implemented. The cooperation between industry and academy to overcome these issues, often seen as difficult because of the very different viewpoints of the two

[1] Edited by Jacques Bovay, with contributions by Karl Aberer, Christophe Ancey, Guillermo Barrenetxea, Philippe Cudré-Mauroux, Jean-Pierre Hubaux and Yves Pigneur

worlds, may be handled in a satisfactory way by developing methods and tools rather than prototypes. Closer to science, Marc Parlange of the NCCR MICS is persuaded that the use of new technologies such as wireless sensors is important in environmental monitoring. It will enable a high spatial monitoring of many parameters over sufficiently long periods of time, in order to validate the models developed with mathematical tools.

The afternoon workshops revealed many interesting viewpoints and ideas, and raised a lot of important questions, with participants from various players in the field. Everybody agreed that wireless sensor networks (WSN) have a huge potential, but that there is still work to be done to reach this goal. In particular, interoperability and standardization are important enabling aspects, as well as cost, while privacy and security can be considered both as resistance factors and as business opportunities. WSN will probably remain a research domain for a few years, with questions and issues like handling the complexity linked to trillions of terminals, master the network scalability and behaviour, dealing with the amount of gathered data, coping with the time needed to prove feasibilities and defining business models. Game-theoretic questions and questions of self-organization seem to be long-term issues also of interest to industry (e.g. because of trust issues, fair resource sharing, but also for autonomous management of very large networks).

From an economic point of view, a (cost-driven) business market is already emerging, with existing niche applications. The (value-driven) consumer market is still to be developed. In any case, wireless sensor networks are an enabling technology, based upon which services have to be elaborated, which end-users will eventually buy. A few success stories would be welcome to give an impulse to the market!

1. Keynote presentations

Karl Aberer, NCCR MICS

Started in 2001, the NCCR MICS is one of the largest coherent research activities worldwide in mobile information and communication. Beside research, technology transfer is a key mission of this center. The NCCR MICS has developed an original vision, the Smart Earth, where wireless sensor networks (WSN) are changing the way people interact with one another and with their environment. At the confluence of computation and wireless communication in small devices, new types of applications are emerging, based on WSN and large-scale, self-organizing systems.

Sensor (and actuator) networks integrated with the Internet space will dramatically change the way information and communication technology is used. How large will the economical and societal opportunities be? This Forum gathers interested people from many actors to bring elements of answer to this question.

Pierre Tournassoud, Alcatel

The “Internet of things” is seen as the 3rd wave (2010 decade) of telecom service adoption, after new connectivity services (1990 decade) and broadband ones (2000 decade). It will be essentially user-centric, using technologies such as WiMax, 4G, optical fiber and sensor networks. Video applications are driving the consumers’ need for more bandwidth (up to 20 Mbps downstream and 1 Mbps upstream), with the possibility to create and share personal TV contents and channels.

WSN will be an essential part of this coming wave. A wide catalogue of sensors will be available, with cameras and RFID tags as current examples. Features common to all kinds of such devices include the gathering of information, the complete or partial processing of data and the communication with other equipments. Sensors will be interconnected by wireless networks, giving them the ability to be easily deployed and to exchange data, as well as to communicate with each other and with external, larger-area public or private networks. Applications of sensor networks are numerous, from disaster relief operations, biodiversity mapping and optimized agriculture to

intelligent buildings (e.g., bridges), facility management and machine surveillance/maintenance, through medicine/healthcare and logistics.

In short, WSN have a huge potential (their population is estimated to grow to trillions of pieces in 2010), but a lot of work is still needed. Uncertain scalability and bandwidth needs, due to myriad of terminals, as well as many other issues, are among the challenges to be overcome in order for these complex systems to become a reality. One of the directions explored is the use of XML for routing.

The context, ie a set of values from a given set of sensors defining the user's environment, is expected to form the base for future human communication. It will give birth to so-called contextual services with, for instance, applications based on Fröbel (founder of the kindergarten) spaces in the home: learning (language, materials), personal memory, interactive puppet theatre and story creation (re-enacting events).

WSN will remain a research domain for a few years, with questions and issues like handling the complexity linked to trillions of terminals, master the network scalability and behaviour, coping with the time needed to prove feasibilities and defining business models. The expected impacts are significant, in domain like societal aspects, services, networks & terminals, processing & storage and data analysis.

Philipp Blum, Siemens Building Technologies

With its worldwide headquarters in Switzerland, Siemens Building technologies (SBT) is a global player, in particular in fire safety and security products. These systems need to be certified to have access to the market: reliability & fault tolerance (-> alarm guarantee), hard real time constraints and ultra low power with duty cycle ~0.1% are critical issues.

The use of multi-hop mesh networks for residential and/or industrial applications is presently under study. Given the very tough requirements (in particular with regards to energy consumption, visible at the MAC layer and in the modulation technique) of fire detection and security applications, the use of WSN is far from being justified at this stage. Several hard issues still need to be resolved, like bounded alarm latencies, reliable monitoring and fault-tolerant communication, before the expected advantages (ease of deployment, cost) can be fully exploited.

Despite of the discrepancies in the views of industry and academia (in particular on development timescales), a collaboration has been initiated in form of a project co-financed by the Swiss Innovation Promotion Agency (KTI/CTI). The idea is to develop methods and tools (like formal verification, simulation and implementation), not products. The expected outcomes of this collaboration are a shorter time-to-market, an increased confidence in system reliability, and an improved documentation and implementation quality.

Marc Parlange, NCCR MICS - EPFL

The use of new technologies such as wireless sensors is important in environmental monitoring. It enables high spatial monitoring over sufficiently long periods of time, so that the dynamical system of rain, soil moisture, evaporation and surface temperature etc. can be monitored at the field scale, in order to validate the models developed with mathematical tools.

The research work consists in a combination of experiments, numerics, and models leading to improved predictive capacity in land-atmosphere exchange at regional scales. The development of new instrumentation (e.g. lidar) along with advances in communications and wireless sensing (not expensive) allows to measure at scales of interest across the natural landscape. Starting with 110 stations on the EPFL campus, the experience is planned to evolve towards the Swiss Experiment, an ETH-wide project covering a 40x20 km^2 catchment area.

2. Workshops

2.1. Workshop 1 - Human activities

Moderator: Yves Pigneur

2.1.1. Presentations

Ramun Berger, Swisscom Innovations

Sensors are viewed as service enablers and part of the Internet, with applications for business customers (eg RFID systems) and for residential ones (eg in relation with home security or e-health). These 2 categories have different requirements: cheap, cool and easy to use for the private customer; reliable, secure and standardized for the business environment. The first market is now slowly growing, while the second one is expected to follow later. No killer application is visible today.

Tapani Ryhänen, Nokia Research Center

The mobile device plays a central role as a user interface and a gateway to wireless sensor networks. The market is currently moving from innovator phase to early adoption, while real commercialization is expected to start around 2009. The everyday life, given all the possible interactions that we have with our environment (talking, hearing, seeing, touching, sharing, etc.), can be envisaged as the “killer application”. However, it is not clear today how the value chain will eventually look like (from technology providers to consumers, through solution, application and service providers, advertisers and channels).
In partnership with research institutions, Nokia is deploying SensorPlanet, a global test platform for mobile-centric wireless sensor network research.

Sabine Süsstrunk, NCCR MICS - EPFL

The camera is currently the most popular mobile application, generating a profusion of images. The main players around pictures are the Internet (blogs, social networks), the printer manufacturers and a variety of service providers offering a number of features. Sharing images is becoming more and more popular, conditioned by the ease of access, the search facilities and the handling simplicity. The use of overlay networks allow the distributed implementation of “servers” based on the end-users’ resources, and the easy search of photos based on annotations as well as additional context/content information.
Image sharing is a first step towards more general forms of sensor data sharing, with many similar problems involved.

Eelco Dijkstra, Philips Research

The main area of development for WSN is in the home and body environment (prevention-oriented healthcare, assistance to elderly people, home security & control, toys), whereas security and privacy issues need to be carefully taken care of. In these applications, the market is expected to include end-users and (possibly) insurance companies. The offer, with an emphasis on the service rather than on the technology, will come from global companies like Philips, as well as from specialized service providers. Currently, the funding for research and development stages is provided by public research organizations and big technology developers.

Benz Ledin, Shockfish

Building trust is the main selling strategy to adopt: show real cases, focus on easy deployment and on reliability. At this early stage, the solution provider needs to fully understand the end-user needs and to master the whole solution (no fractioning of the value chain). For a small company, the growth spiral lies at the interface between academy and industry.

Claude Stricker, International Academy of Sports Science and Technology (AISTS)

Technology is one of the main factors driving the evolution of sport. It does not only influence the athletes' performance level, but also the audience (by making the shows more attractive, as media are a major source of money in sport), the size of events, the fairness, etc. Symmetrically, sports are impacting technologies by challenging and asking for solutions not existing yet. Sensors will allow to increase the sportspersons' perception of the reality and sensing of their environment. However, the openness to new rules and uses of technologies varies from sport to sport.

2.1.2. Discussion

	Swisscom	Nokia	Philips	Shockfish	AISTS
What applications are technologically feasible?	No killer application, sensor networks are service enabler, sensors foundation of new ecosystems	Everyday life, personalized life interface, mobile device as gateway to wireless sensor networks	Personal and home health care, security home control, intelligent toys, gap between technology and applications	Every technology gets used! Surveillance!	Sports is in need for new technologies to evolve
Which are the markets? Who will buy?	Business customers (slowly growing, reliability), residential customers (will develop after enterprise, prize)	Consumers!	Consumers, health, service based offerings, vertical business model in combination with horizontal technology model		
Who are the actors? Who will sell?	3rd-party service providers, Telcos	Solution providers, advertisers	Philips, service providers		
Who will invest?			Nokia, Philips (device manufacturers), Governments, Telcom unclear?	Problem of building trust into the technology, requires steady investments	
Which are the expected societal impact, legal and regulatory aspects?	Privacy concerns, spectrum usage, standardization important		Standardization important, the more you know the more worried you are (health), privacy		

What applications are technologically feasible?

The presentations and the discussion clearly indicate that the service is key, not the technology. 5 kinds of value propositions are identified:

- augmenting senses (body network): sport, healthcare, games
- avoiding the cost of a fixed infrastructure: home control, building automation
- supporting mobility (linking WSN and phone device/PDA): healthcare, transportation, mobile workers
- improving convergence (linking WSN and camera): image sharing, video, etc.
- connecting to the Internet (linking WSN and Internet): objects, people and computers.

The location-based services have not been mentioned during the panel.

These value propositions should be evaluated by means of criteria like
- community-building effect
- cost
- trust & security
- interoperability.

Which are the markets? Who will buy?

The 2 “traditional” market types are also expected to exist for WSN applications:
- A value-driven consumer market, which is still to be developed: there is currently a mismatch between users' needs and suppliers' ideas.
- A cost-driven business market, for which niche applications already exist.

The question arises if WSN applications should be envisaged as part of the “luxe” industry or as commonality. The example of the sport industry shows an interesting concept: the openness or awareness of a market segment can be measured.

Which are the actors? Who will sell?

Some actors are already active, however mainly at R&D, demo or pilot trial stages:
- equipment manufacturers (technology providers)
- telecom operators.

The value chain (who creates and absorbs the value) is not established yet, and the interest of further actors, such as service providers, content providers and advertisers, is only hypothetical at this stage.

Who will invest?

The leitmotiv can be expressed as "invest prudently". The following actors are identified:
- Equipment manufacturers and telecom operators are investing in R&D activities, in collaboration with public research organizations (eg in EU projects).
- Industrial groups and banks have a “wait and see” attitude.
- Startups and small companies, helped by venture capital, are investing in developing technologies and niche applications.

Which is the expected societal impact? What about legal and regulatory aspects?

Privacy is a resistance factor on the consumer side, but it also represents a business opportunity for companies working in the security area.
Interoperability (or even standardization) is perceived as a condition for mass market development. It is not clear if some form of regulation (for example in the wireless communication part) is envisaged by the relevant authorities, which are rather observing and not acting so far.

2.2. Workshop 2 - Infrastructures

Moderator: Jean-Pierre Hubaux

2.2.1. Presentations

Pierre Chevillat, IBM Zurich Research

Networked smart sensors will eventually inhabit every object, resulting in a world of 7 trillion devices for 7 billion people. IBM’s primary interest is in the integration of sensor technologies and enterprise software. The primary applications will be in asset monitoring (eg goods sent in containers), retail stores through RFID-tagged merchandise and On-Demand Business through

automated communication between demand and supply chains. Scalability, messaging (eg publish/subscribe for low-end devices) and networking challenges still need to be met.

Rudolf Sollacher, Siemens Research

Siemens will be active on two fronts, both as a supplier of sensor network products and as a solution provider. Several technical issues need to be addressed for the market to grow, including: quality-of-service, energy efficiency (a lifetime of up to 8 years is required in some cases), interoperability and standardized access. Sensor networks will have an impact on the job market, destroying jobs due to an increased level of automation, but creating jobs in new business areas. Also, legal aspects such as licensing and country-specific regulations will play an important role.

Christian Dannegger, Whitestein Technologies

Software agents are software artifacts that act proactively. Agent technology is helpful in several areas including simulation (of catastrophes, of wars) and dynamic allocation of resources (in finance or logistics). Agent technology is today ready, and can be used jointly with sensor networks in decentralized communication networks, traffic monitoring or homeland security applications. The main challenges in the area relate to data fusion, low bandwidth capacities and interoperability.

Alain Ries, Iriscapital

From the point of view of an investor, there seem to be few opportunities for start-ups in the sensor network area. Today, the main investor is still academia, and big industrial players are expected to dominate the market in the future, leaving only niche markets to smaller companies. The main application domain will be smart buildings equipped with sensors for energy saving, increased security and comfort. The speaker already equipped his home with a variety of sensors for semi-automatically manage temperature, humidity, light, fuel, or water consumption.

Jan Beutel, NCCR MICS - ETHZ

A few large-scale sensor applications are already deployed today, for global ocean observation (ARGO), anti-submarine surveillance or weather monitoring. However, significant efforts need to be made for simplifying the deployment process: today, the deployment of applications relying on more the 20 nodes is still impractical. The speaker argues for a dual deployment strategy revolving around a temporary deployment support network to ease the process.

Jean-Luc Mossier, Silentsoft

Silentsoft is a company with 5 years of experience in sensor-based monitoring of oil tanks and 15000 sensors deployed. As machines increasingly talk to business applications, there is an opportunity for sensor networks to bridge the gap in the machine-to-machine market. Customers, however, will not buy technology but services. Sensor networks might play an important role in industrial telemetry, for collecting, transporting, storing and processing data.

Stephan Haller, SAP

SAP foresees several emerging application domains for sensor networks, including environmental monitoring, homeland security and remote asset management. Its first application trial was related to the monitoring of hazardous goods, ensuring security constraints with regards to storage limits and incompatibility of goods. The two main advantages of sensor network technologies lie in their timely delivery of data and local execution of business logic. Technical challenges include issues related to the reliability, energy consumption and maturity of the technology. Success stories are still missing in the area and would be a big push for the rapid adoption of the technology. From a business perspective, there are still concerns on the deployment, maintenance, cost and lack of privacy of the technology.

2.2.2. Discussion

	IBM Research	Siemens	Whitestein	Iris Capital	ETHZ	SilentSoft	SAP
What applications are technologically feasible?	Integrate sensors with enterprise computing, asset management	Industrial applications, large-scale monitoring, predictive maintenance	Simulation, dynamic resource allocation via agents	RFIDs for tracking, smart buildings	Large-scale environmental observation, surveillance, localisation	Monitoring of oil tanks, data to business application communication	Technology not yet mature
Which are the markets? Who will buy?	Business, logistics	Markets are conservative	Telecommunications, transport, security	Governments, security, end-consumers	Too early for big industrial players	Building management companies, security, telemetry	Industrial applications, e.g. hazardous goods, efficient business processes
Who are the actors? Who will sell?	IBM via enterprise solutions	Solution providers for end customers, vs. component providers	IT manufacturers	Strong industrial players in IT, niches for start-ups, academics (patents)			Enterprise software providers and startup companies
Who will invest?	IBM for devices, deployment, data analysis		Government, services	Mostly academic at this point, some more mature backed by investment / business	Too early for big investors		Missing success stories, companies struggle still with RFID
Which are the expected societal impact, legal and regulatory aspects?	7 trillion devices for 7 billion people	Impact on jobs, licenses, differences among countries in regulations		Standards impact on industrial developments	Need blending with service support and regulations		Privacy threat?

Further issues

Application: The next big wave with regard to sensor networks is believed to be in smart buildings.

Cost: The cost of the ideal device is today still prohibitive, but applications can take advantage of multiple, correlated sources to get reliable measures from relatively cheap devices.

Standards: Some advocate for the parallel development of industrial solutions and standards, some fear that such an approach would create interoperability issues.

Further environmental and societal issues: WiFi is not always allowed (eg in medial institutions) because of privacy concerns. Societal and environmental concerns should always be taken into account when designing case studies or applications. Besides specific concerns, these technologies will also have quite some positive impact on the society.

2.3. Workshop 3 - Natural environments

Moderator: Christophe Ancey

2.3.1. Presentations

Walter Stockwell, Crossbow

Answering the questions addressed by the workshop with this talk presented wireless sensor networks as a business opportunity and a commercial success. However, WSN are an enabling technology not a final product.
Two communities are concerned with WSN:

- The developer community is involved in research and development along with business opportunities, but they have a poor knowledge of how useful a sensor network is in practice. At the end of the stick lies the end-user community, who has concerns (e.g., improving air quality in urban areas), but no specific ideas on how to progress for finding practical solutions.
- The market is not familiar with new technologies, notably it has only a vague view of the respective interests of sensor networks and more classical probes. Industrial standards are mandatory to convince the market to adopt this new technology.

There are still technological challenges in security, standards, energy consumption, and cost.

François Münger, Swiss Agency for Development and Cooperation (SDC)

This presentation underlined the number and the strength of applications for environmental issues in developing countries (e.g., water quality monitoring, watering control, prevention of catastrophic events). However, developing countries are not only facing funding issues, but also philosophical choices that are quite different from ours. Technology is not the most important factor in the development of sensor networks in these countries: social, political, economic, and knowledge factors play a major role.
In many countries, relief is easier than prevention, this is why technology is not a key issue/tool of public policies.

Ulrich Brandenberger, Swiss Re

Although insurance companies are *a priori* interested in this new technology, which will make it possible to get more information and provide better early-warning tools, they are at the same time intrigued by the liability problems that sensor networks pose: for self-learning systems and for devices where many actors intervene (end user, sensor developer, communication provider, etc.), who is liable in the event of a failure?

Martin Vetterli, NCCR MICS - EPFL

This talk presented several applications of large wireless sensor networks measuring physical phenomena for long periods of time: ultrasound wind speed measurements, environmental monitoring, and urban sensing.

Knut Siercks, Leica Geosystems

The importance of WSN can be summarized as follows: what matters gets measured and what is measurable starts to matter. This presentation pointed out the importance of real time measurements as well as the visualization and interpretation of data.

It also summarized some of the current challenges in WSN:
- smaller and more intelligent devices
- accuracy in fast motion: get information faster
- sensor fusion: get different sensors working together (heterogeneity)
- new applications for sensor networks (such as structure monitoring)
- feature extraction and decision support: information and interpretation
- visualization matters.

Edoardo Charbon, NCCR MICS - EPFL

This talk focused in the opportunity offered by sensor networks to validate and develop new theories: with the current external measurement approaches, no or limited information can be obtained. In particular, it analyzed the dynamics of avalanches and landslides, where sensor networks allow to obtaining data from inside the avalanche.

2.3.2. Discussion

	Leica	Swiss Re	Crossbow	SDC
What applications are technologically feasible?	Convergence with geospatial data, smaller, more accurate, fusion of many data, sensor networks for construc-tions, visualization	Ambient intelligence, asset tracking, structures, natural disaster protection	What can be done wireless, that could not be done wired, WSN are an enabling technology not a product, still many challenges	WSN are ideal for applications in remote places, bottom-up approach, but increase in performance of systems required
Which are the markets? Who will buy?	Improving land usage (what gets measured matters)	Highly computerized environments, multinationals, governments, only after consumers	Industrial, agricultural applications	Environmental sustainability, also direct reduction of poverty, natural disaster prevention
Who are the actors? Who will sell?		Include regulators and insurance companies, device providers	Device manufacturers	
Who will invest?		As long as RFID is not taking off, no take off for sensor networks, insurance companies may invest if risks can be reduced		Collective systems, PP partnerships
Which are the expected societal impact, legal and regulatory aspects?		Technology risk management becomes necessary, dissipation of resources, widening the gap between good and uninsurable risks, more detailed statistics, liability issues with self-organizing systems, instable systems, value of information		Legislators and regulators to take actions, good governance, embedded into a larger concept of sustainable development

What is the added value? What can be measured that cannot be measured wireless?

The reasons for using sensor networks are numerous:
a. lower cost than standard sensors
b. easier to deploy than standard (wired) sensors
c. denser deployment of sensors to get more information on spatial distribution of key variables
d. easily removable/reconfigurable
e. sometimes, the only possibility to obtain information on a system
f. involving the end-user in the information process.

A few examples of applications in environment are available in Table 2.3.2-1.

Speaker	Reasons for selecting WSN	Type of measurements	Goal
Martin Vetterli	a-d	meteorological variables (temperature, wind intensity/direction, etc.) cost of a miniaturized meteorological station: 500 euros	in line with the computational investigation into the atmospheric boundary layer
Martin Vetterli	a-d, f	Ozone concentration: end-user community equipped with sensors	air quality control
Knut Siercks	c	elevation (aircraft-based LIDAR + GPS)	thematic map (including elevation curve + information related to a given field, e.g., gun crime map)
Knut Siercks	c-e	deformation, temperature, etc.	structure monitoring (e.g., bridge, dam) and early warning
Knut Siercks	c	3D visualization	on-line/real-time photogrammetry (e.g., reconstruction of downtown building)
Edoardo Charbon	a-e	position, velocity, temperature, etc. (triangularization techniques: inverse GPS system)	to obtain the velocity profile and the structure of powder-snow avalanches/landslides
Walter Stockwell	a-f	soil moisture, temperature, light, etc.	seed management: enhancing seed germination rate and reducing watering cost
Walter Stockwell	b-d	temperature	pipeline monitoring

Table 2.3.2-1: examples of environmental applications

What are the problems?

A number of problems encountered in the development of sensor networks for environmental settings are not specific to this particular context:

- How to ensure privacy protection?
- Who is the owner?
- Who will pay for sensors, for the deployment, and for information transmission and processing?
- Are industrial standards a prerequisite before any further development?

Reliability has been repeatedly put forward as a key issue when using sensor networks in practical problems. This probably means that comparing the different available technologies and carrying out extensive and thorough benchmarks will be of prime importance to give confidence of this emerging technology and pinpoint potential problems.

What are the challenges in this emerging technology?

Sensor-network technology has still to cope with a number of issues, which motivate further research and development activities:

- Individual components are simple, but the combination of many elements is not so simple especially if they are mobile (pulse detection, fading signals, failure treatment, etc.)
- How to properly treat the failure of a sensor within a sensor network?
- Are real-time/online measurement and processing realistic for environmental problems, where a great deal of data must be acquired?
- Reducing power supply is a leitmotiv
- Security (encryption, spoofing) is a major source of concerns.

Appendix: list of participants

Karl	Aberer	Director	NCCR MICS - EPFL
Radhakrishna	Achanta	PhD student	EPFL IC
Christophe	Ancey	Professor	NCCR MICS - EPFL
Xavier	Arreguit	Managing Director	Innobridge
Serge	Ayer	CTO	Dartfish
Hadi	Barkat	Associate	Logispring
Guillermo	Barrenetxea	Senior Researcher	EPFL IC
Ramun	Berger	ICT Engineer	Swisscom Innovations
Heidi	Bernau	Administrator	NCCR MICS - ETHZ
Jan	Beutel	Senior Researcher	NCCR MICS - EPFL
Philippe	Blanchard	Director of Information Management	International Olympic Committee
Remy	Blank	Research & Development	BlueBotics SA
Philipp	Blum	Senior Engineer	Siemens Building Technologies
Sven	Bolomey	Project Manager Sustainable Urban Development	EPFL VPRI
Jacques	Bovay	Coordinator	NCCR MICS - EPFL
Ulrich	Brandenberger	Risk Analyst	Swiss Re
Hadi	Buchenau	CTO	Edifice Communications SA
José	Camacho	Student	EPFL IC
Edoardo	Charbon	Professor	NCCR MICS - EPFL
Pierre	Chevillat	Manager Sensor Networks	IBM Research
Urs	Christ	NCCR Deputy	Swiss National Science Foundation
Chris	Cianci	PhD student	EPFL IC
Fabrice	Consenti	CEO	Edifice Communications SA
Alexandre	Coquoz	Associate Director	Innobridge
Philippe	Cudre-Mauroux	Senior Researcher	NCCR MICS - EPFL
Christian	Dannegger	Vice President Logistcs & control systems	Whitestein technologies
Eelco	Dijkstra	Department Head	Philips Research
Henry	Dubois-Ferrière	Senior Researcher	NCCR MICS - EPFL
Matthias	Dyer	PhD Student	NCCR MICS - ETHZ
Anja	Feldmann	Professor	Technical University Munich
Marcelo	Fernandez	Student	EPFL IC
Manuel	Flury	PhD student	EPFL IC
Bernard	Gander	Vice President Corporate Business Development	Logitech
David	Garces	CEO	Particle Computer GMBH (SAP)
Matthias	Gäumann	Head of Partnership Development	EPFL VPIV
Matt	Grossglauser	Professor	NCCR MICS - EPFL
François	Gueissaz	Head of Sensors Group	Swatch Group R&D Division
Stephan	Haller	Senior Researcher	SAP Research
Ludger	Hovestadt	Professor	NCCR MICS - ETHZ
Jean-Pierre	Hubaux	Professor	NCCR MICS - EPFL
Ali	Hussein	Vice President Sales & Marketing	Novasys
Placidus	Jaeger	Private Consultant	
Stéphane	Kanah	Internet Manager	International Olympic Committee
Lorenzo	Keller	Student	EPFL IC
P. R.	Kumar	Professor	University of Illinois
Jim	Kurose	Professor	University of Massachusetts
Quentin	Ladetto	CTO	Géomatic Ingénierie SA
Peter	Landrock	CEO	Cryptomatic
Bänz	Ledin	CEO	Shockfish
David	Lindelöf	PhD student	EPFL ENAC
Thomas	Lochmatter	Senior Researcher	EPFL IC
Florence	Luy	Press Officer	NCCR MICS - EPFL
Gian Mario	Maggio	Research & Innovation	STMicroelectronics
Giorgio	Margaritondo	Vice President for Academic Affairs	EPFL VPAA
Lorenzo	Massa	Project Manager	Techselesta Engineering SA

James L.	Massey	Professor	ETHZ ISI
Max	Monti	Industrail Liaison Officer	NCCR MICS - EPFL
Nicolas	Morel	Project Leader	EPFL ENAC
Jean-Luc	Mossier	CTO	SilentSoft
Reshad	Moussa	System and Technology Manager	Aginova
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François	Münger	Senior Water Advisor	Swiss Agency for Development & Cooperation
Agata	Opalach	Research Content Manager	Accenture Technology Labs
Toru	Otsu	CEO	DoCoMo Communications Laboratories Europe
Jacques	Panchard	PhD student	NCCR MICS - EPFL
Marc	Parlange	Professor	EPFL ENAC
Didier	Pelluet	CEO	SASW (Smart And Secure Way)
Adrian	Petcu	Senior Researcher	EPFL IC
Yves	Pigneur	Professor	NCCR MICS - UNIL
Vincent	Piguet	Director	ISTF International Sport & Technology forum
Sandra	Pochon	Project Officer	NCCR Quantum Photonics
Vishwambhar	Rathi	PhD student	EPFL IC
Julien	Reichel	Research Scientist	General Electric Security
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Alain	Ries	Venture Partner	Iris Capital
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Denis	Rochat	System Engineer	NCCR MICS - EPFL
Jérôme	Rousselot	PhD Student	NCCR MICS - CSEM
Tapani	Ryhänen	Head of Strategic Research Mobile Devices	Nokia Research Center
Diego	Santa Cruz	Research Scientist	General Electric Security - Visiowave
Beat	Schmid	Project Manager	Siemens Building Technologies
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Knut	Siercks	Director	Leica Geosystems Lab
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