



nano-tera.ch

**swiss scientific initiative in
health / security / environment
systems**

www.nano-tera.ch



Engineering Systems for Health, Security and the Environment

Prof. Giovanni De Micheli — Program Leader

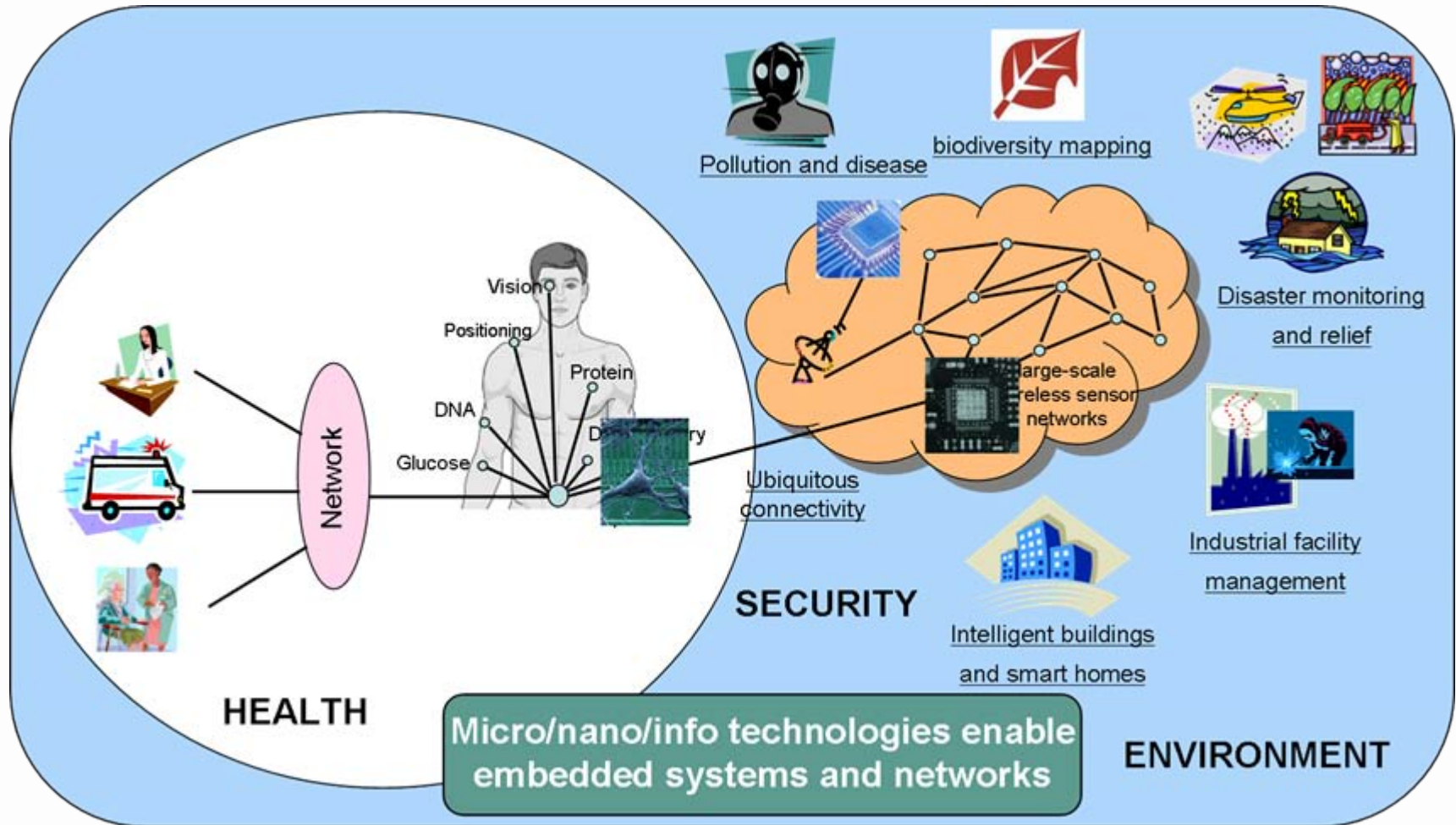


Objectives

Health, Security and Environment Systems Engineering for the well being of humans by:

- Creating a *collaborative research program*
 - Micro/nano-system engineering for
tera-scale distributed embedded system design
- Developing an *educational program*
 - New courses and curricula
- Constructing *demonstrators* of the technology
 - Engineer complex systems
- *Transferring results* to the Swiss Industry
 - Involve industry as R&D partner

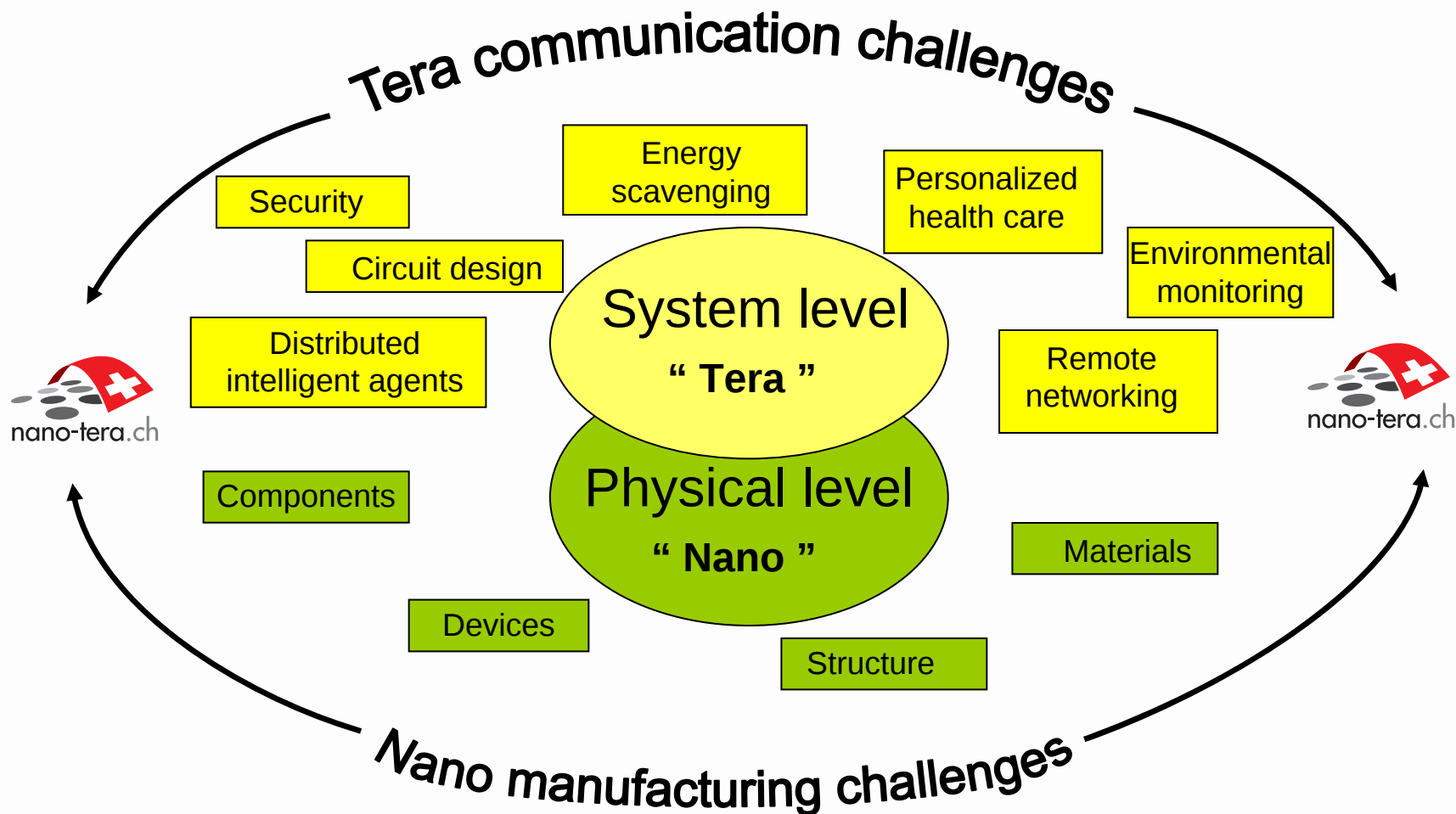
Vision



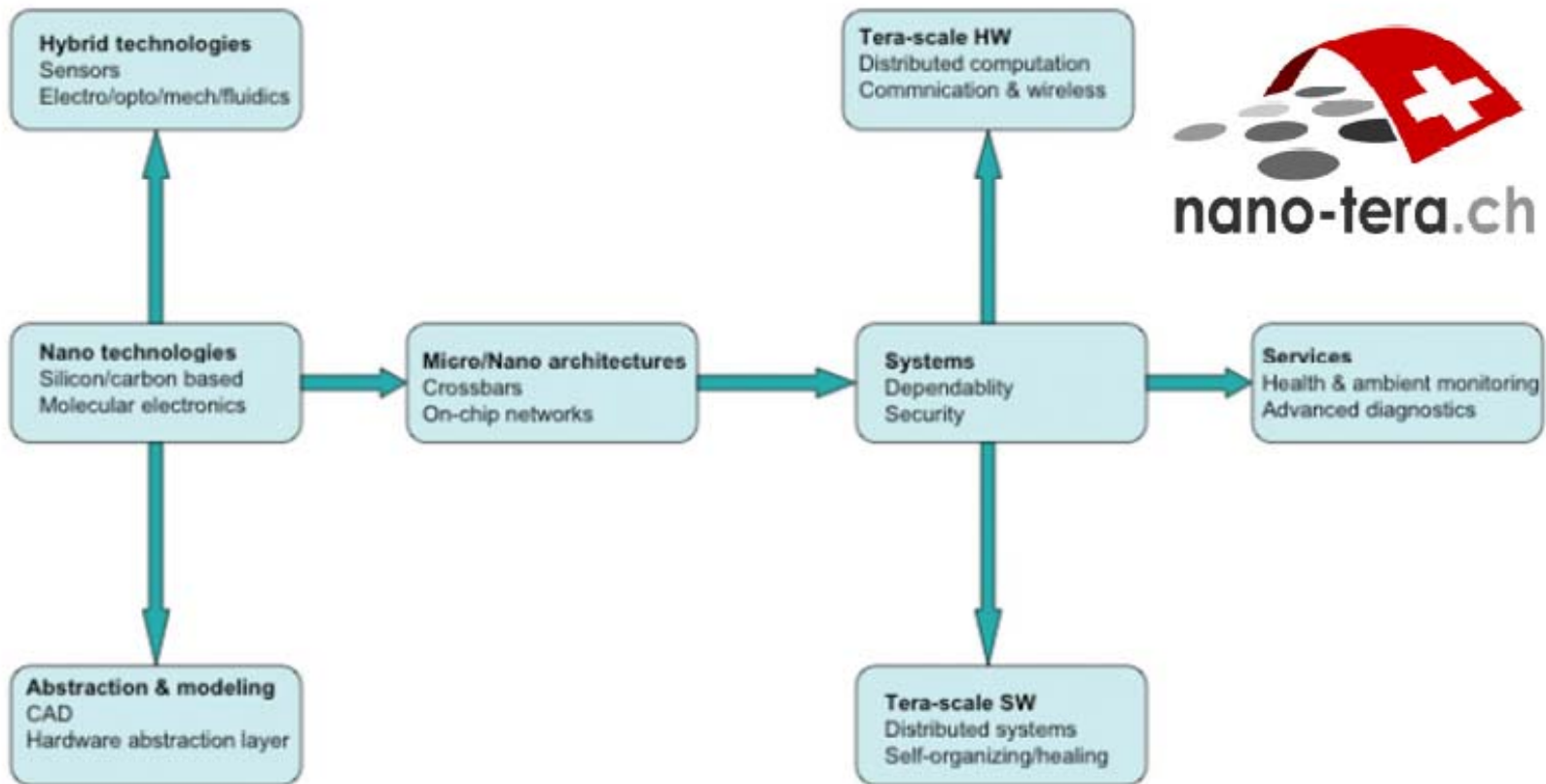


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Converging Challenges



Interplay of enabling technologies





Technical Scope

	MICRO & NANO ELECTRONICS	SENSORS	MEMS/NEMS	SYSTEMS & SOFTWARE	INFORMATION & COMMUNICATION
WEARABLE SYSTEMS					
AMBIENT SYSTEMS					
REMOTE SYSTEMS					

Relevance for Switzerland

- **Promote engineering as a profession**
 - Educate, retain and retrain engineers
- **Foster the reindustrialization of Switzerland**
 - New job and start-up opportunities
 - Product redesign through new technologies
- **Federate research at various institutions**
 - Federal, Cantonal and Technical Universities, as well as Research Centers
 - Establish links to CCMX, CCES, QP NANO, MICS, ManuFuture

Application areas

- **Wearable systems**

- Monitor human body: sportsmen, elderly, sick
- Disease prevention and advanced therapy



Source: Interactive Architecture

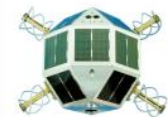
- **Ambient systems**

- Monitor environment through distributed sensing
- Enhance security on the individual and population



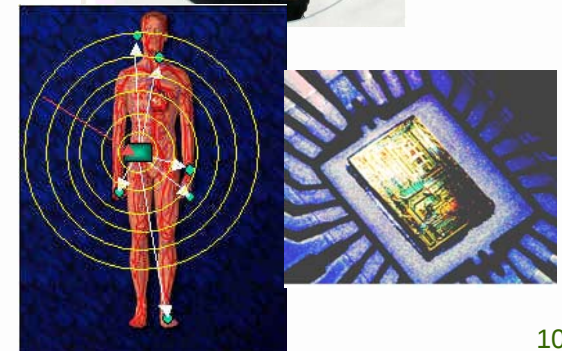
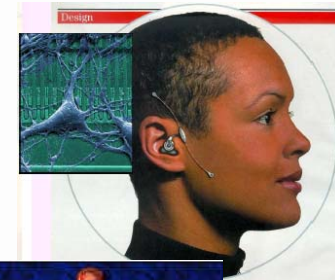
- **Remote systems**

- Enable space and ocean monitoring
- Perform micro-experiments in remote environments



Wearable Embedded Systems

- **Wearable embedded computing:**
 - High-performance, power-efficient
 - Non-intrusive, embedded into small personal device
- **Wearable embedded systems require novel technologies for:**
 - Sensing and bio-interfaces
 - Wireless body area networks for pervasive computing
 - Integration for small-form factor



Ambient Systems

- **Wireless sensor networks**
 - Environmental monitoring, ambient web
 - Extended to the physical/molecular level with bio-sensing
- **Security of the elderly by ubiquitous connectivity**
 - In the home, car, territory
 - Positioning, proximity to danger, alerts
- **Means for tracking diseases and disasters**
 - Migratory bird flu
 - Floods, avalanches, tidal waves, ...

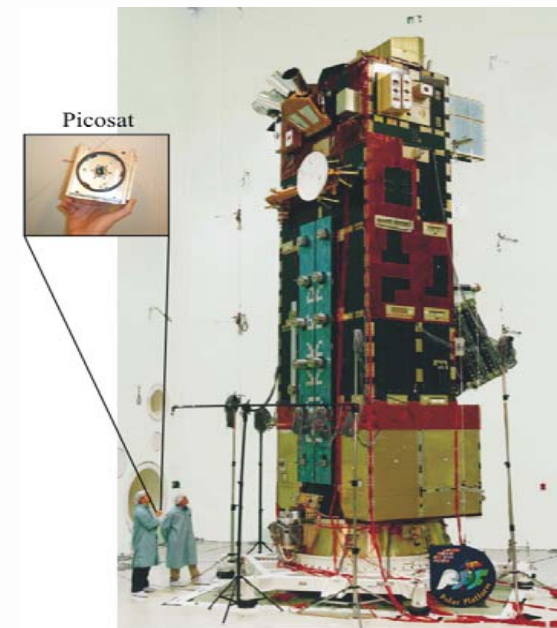


Source: MICS



Remote Systems

- **Nano/Pico-satellites**
 - Small, cheap, application-specific
 - Swarms of satellites
 - Inspector satellites piggy-backed on larger satellites
- **Applications**
 - Environmental monitoring
 - Scientific experimentation
- **Pico-satellites require a new set of electronic components**
 - Higher integration, lighter, ultra-low power
 - Application-specific micro-systems for space



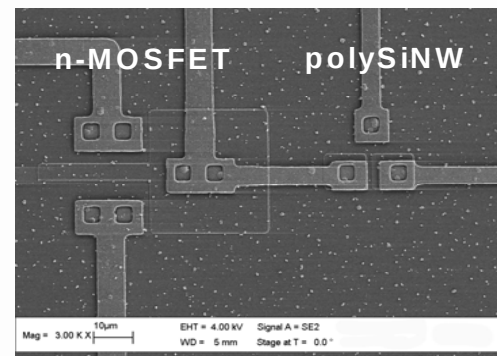
Source: ESA for the large satellite, Aalborg University for the picosat, montage EPFL

Enabling Technologies

- **Micro/Nano electronics**
 - Novel functional materials and processing means
 - Enable ubiquitous distributed computation
- **Sensors**
 - Biological and inorganic sensors
 - Front end of health and environmental systems
- **MEMS/NEMS**
 - Technology hybridization
 - Energy sources and harvesting
- **Software and Systems**
 - Reliable multi-processors software systems
 - Large-scale information management
- **Information and Communication**
 - Large-scale information processing
 - Data security in ubiquitous wireless communication

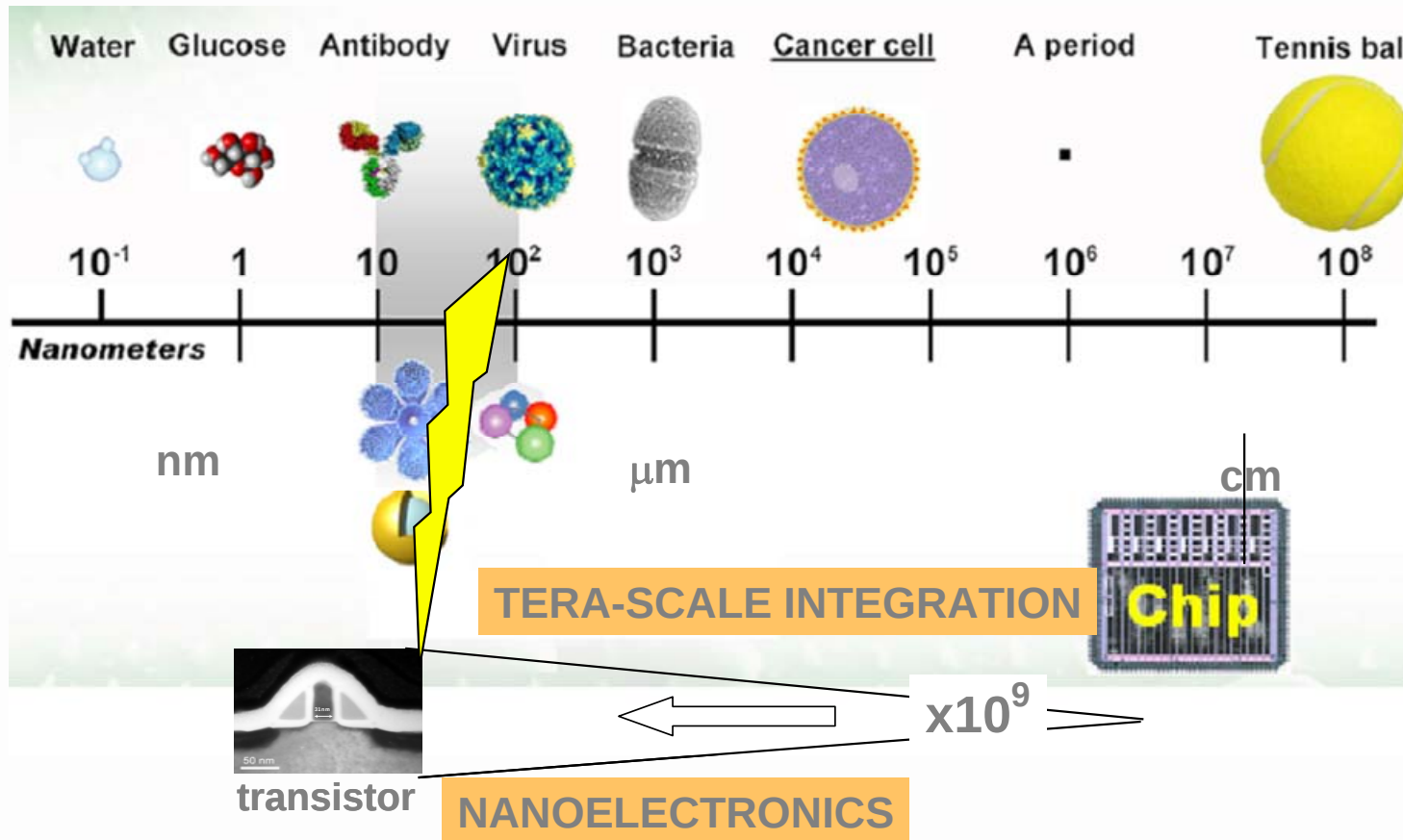
Micro/Nano-system Technology

- **Micro/nano circuits provide the underlying computing/communication mechanisms**
 - New materials to improve current technologies
 - New device structures for computing, storage and sensing
 - New circuit patterning means
- **Hybridize micro-technologies with revolutionary nano-technologies**
 - Integrated computation and sensing
 - New functionality
 - New circuits and architectures



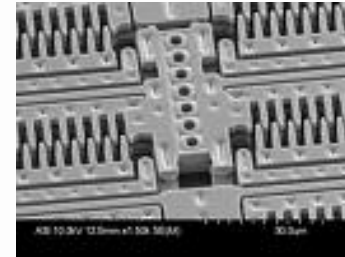
Source: EPFL

Sensors: Convergence on the Nano Scale

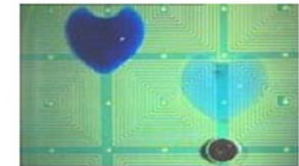


MEMS/NEMS

- **Micro/Nano Electro-Mechanical Systems**
 - Seamless integration of mechanical and electrical devices
- **Sensors and actuators**
 - Micro-mechanical feedback systems
- **Advanced biochemical systems**
 - Drug delivery
 - Artificial organs
- **Integrated micro/nano-fluidics**
 - Lab on chip



[Sandia]

University of California at Berkeley &
Lawrence Berkeley National Laboratory

[Gijs, EPFL]



[STMicroelectronics]

Software and Systems

Tera-scale distributed information systems require novel tools and concepts at the levels of:

- **Algorithm development**
 - Exploiting large-scale concurrency
 - Security (from system conception to implementation)
- **Software infrastructure**
 - Predictability
 - Dependability
- **Large-system infrastructure**
 - Processing, storage and retrieval
 - Self-organization and resource awareness

Information and Communication

- **Wireless sensor networks**
 - Efficient transmission and processing of (large scale) information gathered by large number of sensors
 - Transmission security and reliability
 - Ultra-low-power transceiver architectures
- **High-end wireless communications**
 - High-complexity signal processing
 - VLSI implementations
 - Adaptation to wearable, ambient and remote systems

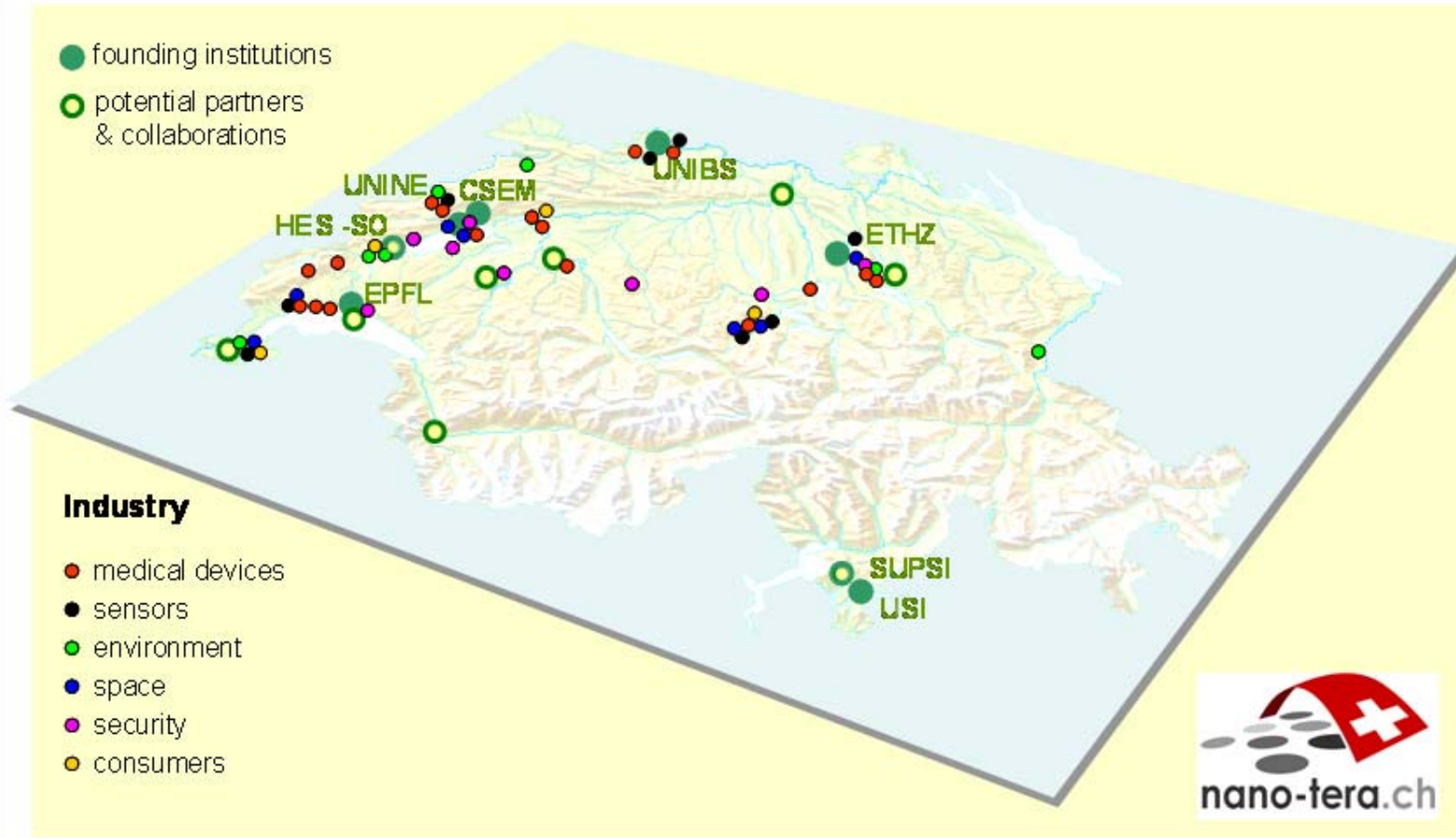
Educational Mission

- **The educational component is an integral part on the nano-tera.ch initiative**
 - The breadth of the domain requires new teaching ways
 - Create interdisciplinary courses and curricula
 - Develop advanced courses
- **Inter-university graduate-level programs**
 - Leveraging resources at various institution
- **Continuing education courses and retraining courses for industry**
 - Promoting engineering as a profession

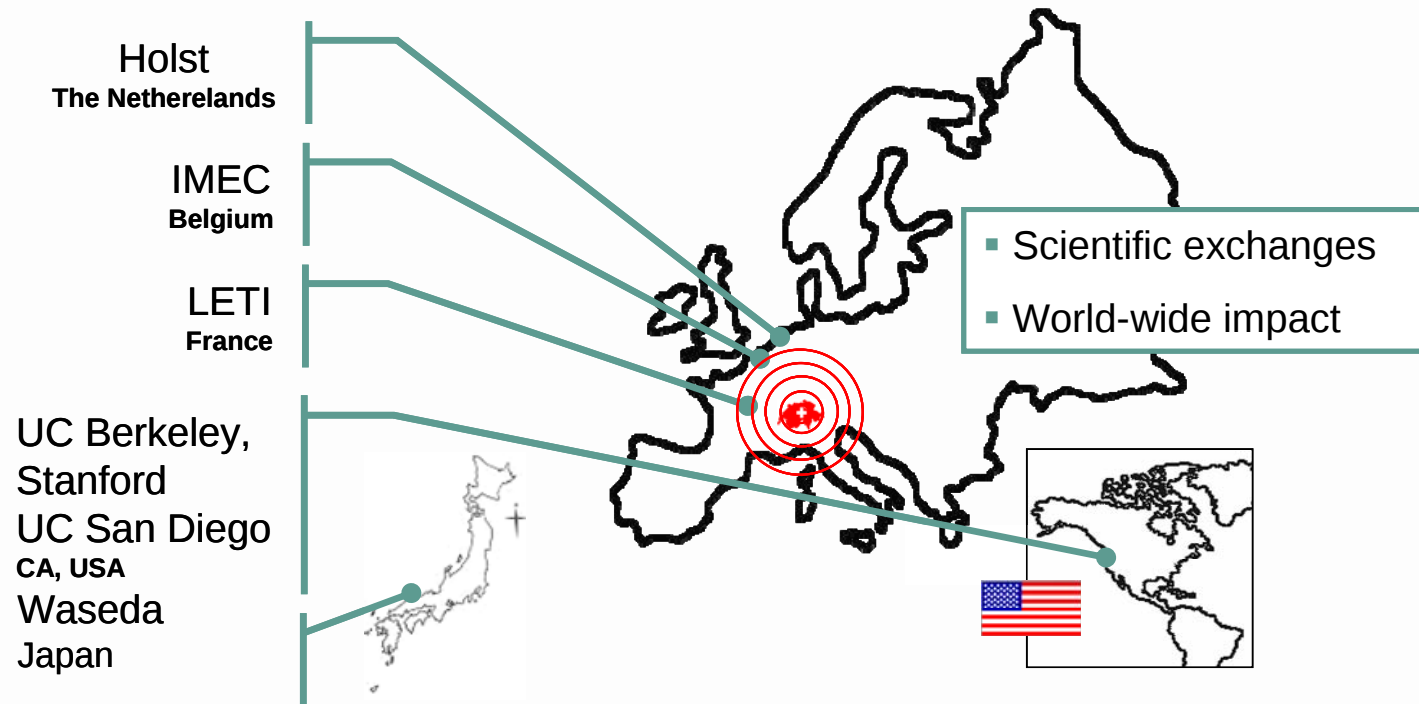


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Swiss competences



World-Wide Positioning

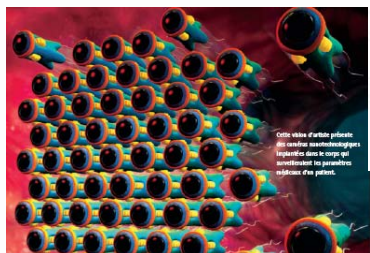


By **linking bio-sensing** into **wireless networks**,
nano-tera.ch has a **unique** positioning in the world



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Some echoes from the press



ENTREPRENDRE **technologie**
BILAN N° 244 71

Le high-tech de demain est helvétique

Des minicapteurs qui changeront la vie

Le Temps
Mardi 29 janvier 2008
Olivier Dessibourg, Berne

L'AGEFI

MARDI 29 JANVIER 2008

PIERRE-YVES FREI
À BERNE

Nano-tera.ch relance l'avenir
des sciences de l'ingénieur

MARDI 29 JANVIER 2008
24 HEURES

EMMANUEL BARRAUD BERNE

Des millions pour faire parler
l'infiniment petit

**TRIBUNE
DE GENÈVE**

Emmanuel Barraud, Berne

La Suisse investit 120 millions de francs pour
ne pas rater le virage des nanotechnologies

Neue Zürcher Zeitung
Dienstag, 29. Januar 2008
C. W. Bern, 28. Januar

Integrierte Sensor- und Informationssysteme



Conclusions

- **An ambitious collaborative project**
 - Various universities and research centers
 - Involvement of local industry
- **Engineer complex systems by leveraging micro/nano-system technology**
- **A social objective to create enthusiasm among students and support from the people**
- **Creation of new products, jobs and growth**

For more information: www.nano-tera.ch

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