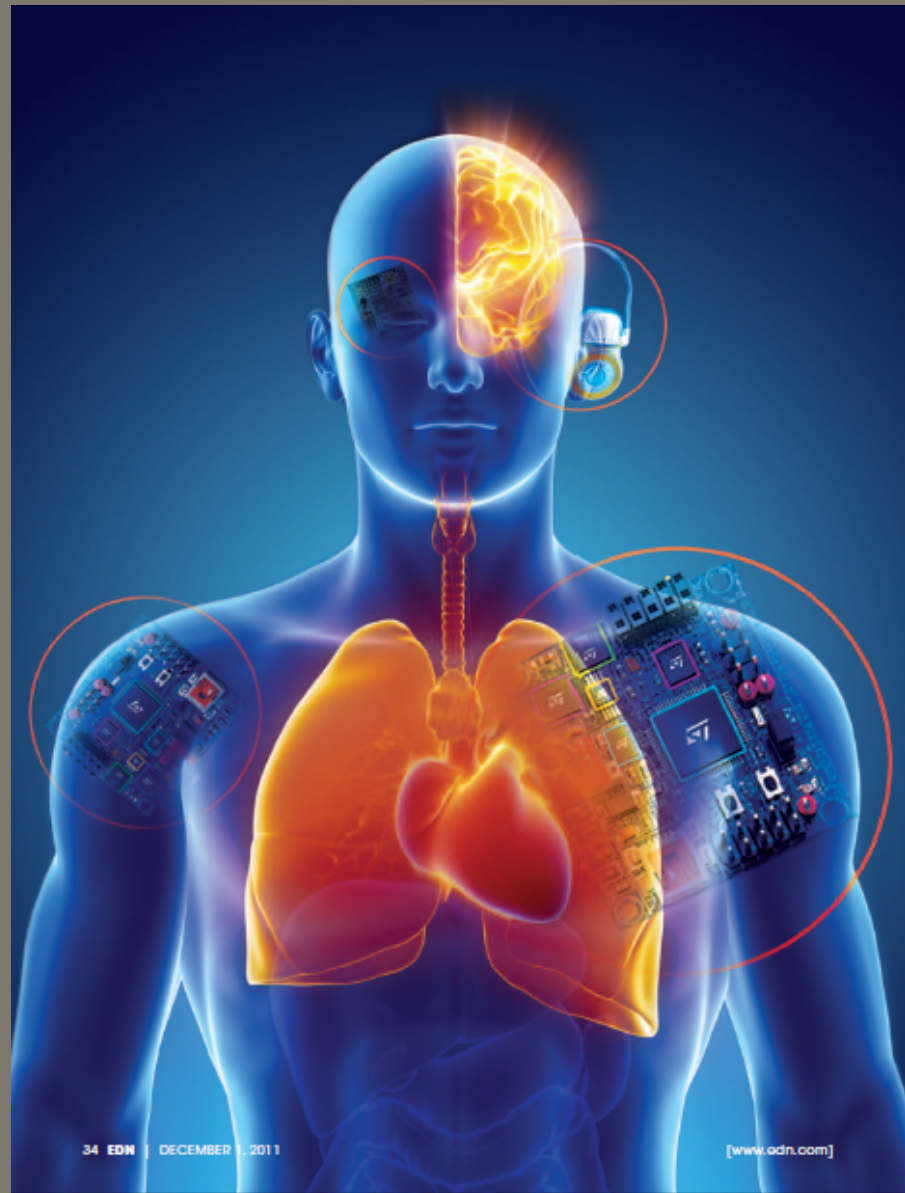


SMART MEDICAL DEVICES

STEFAN LAUNER

VP SCIENCE AND TECHNOLOGY
SONOVA, SWITZERLAND

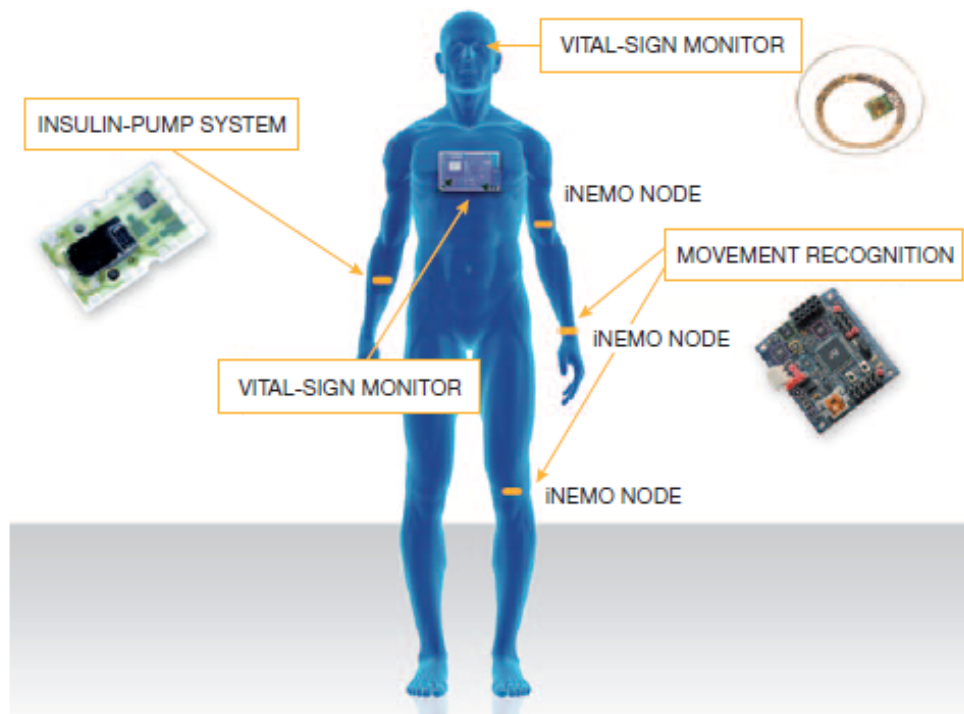


Content

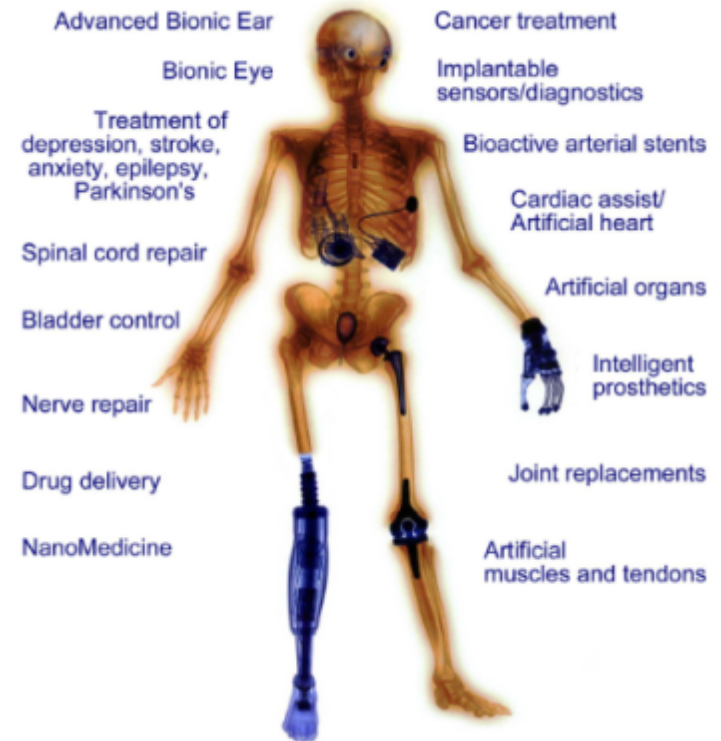
- Neuroimplants: trends
- Connectivity
- Telehealth
- Ambient assisted living
- Health care well being, fitness monitoring
- Personalization

Smart Medical Devices – Artificial & Integrated

sonova

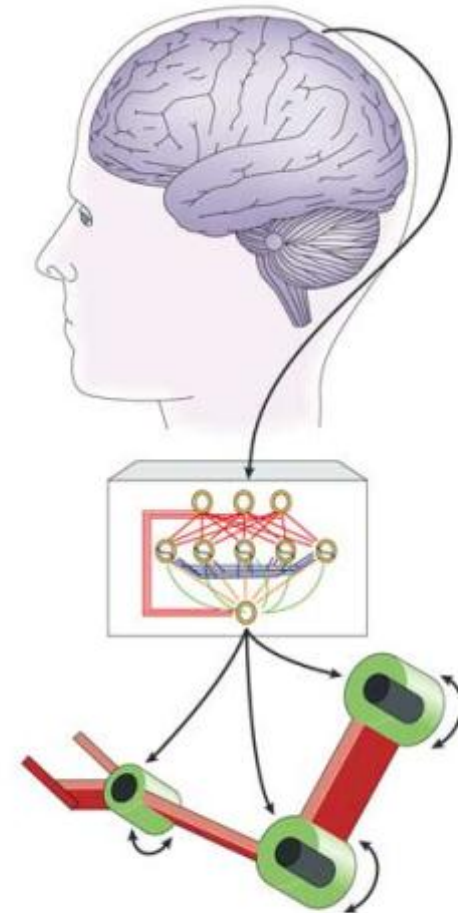
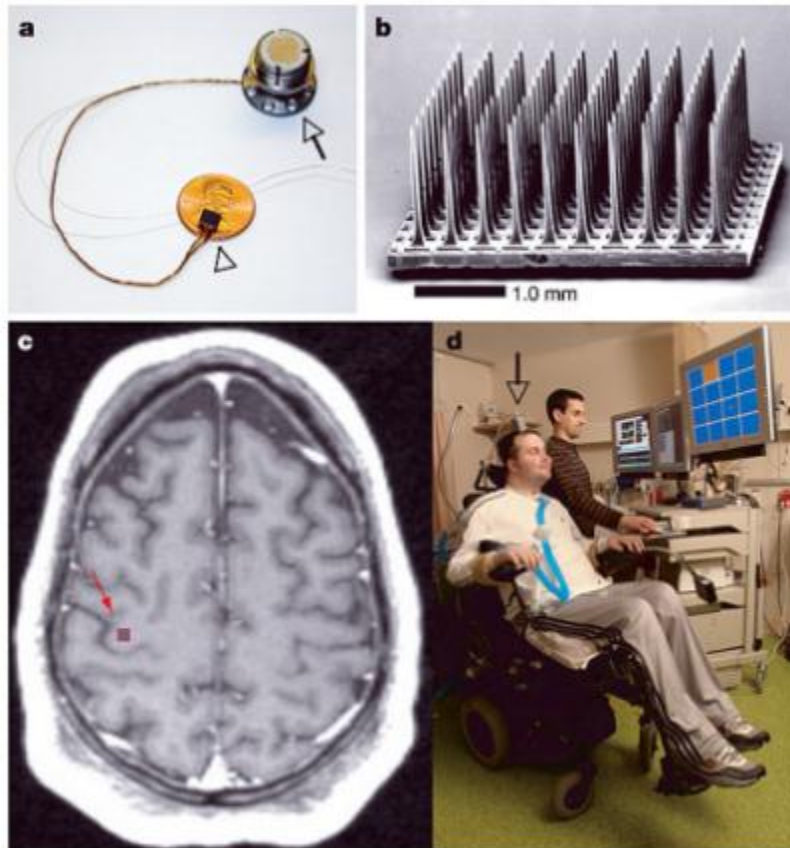


Medical Bionics of the Future

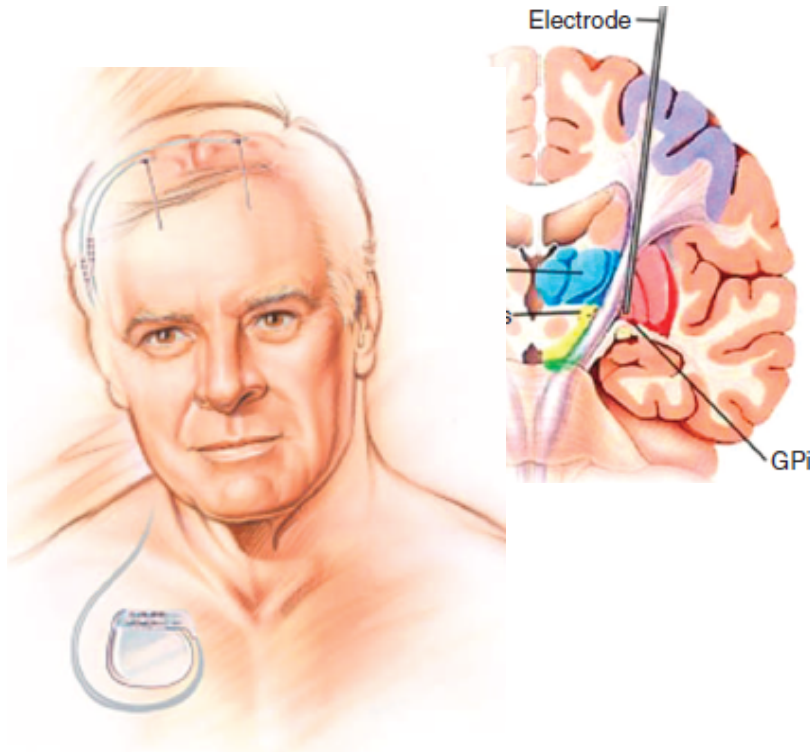


Brain-Machine Interfaces

sonova



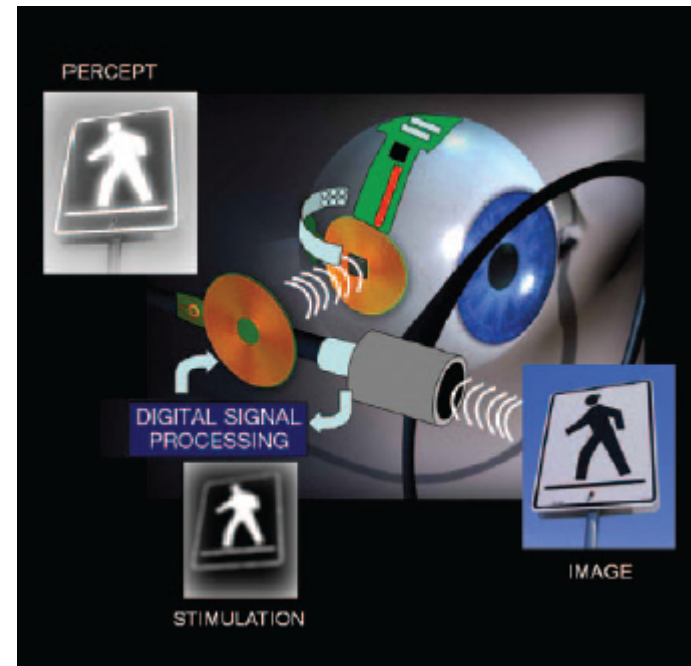
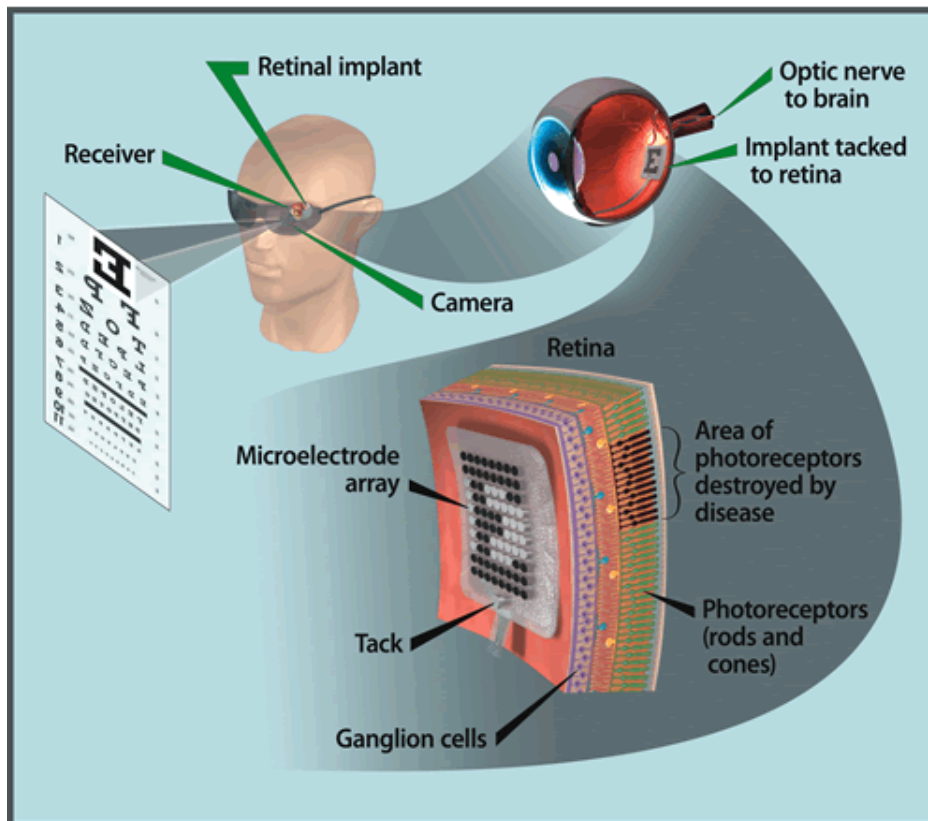
Nature Reviews | Neuroscience



- Parkinson, Depression, Epilepsy
- Chronic pain
- Migraine

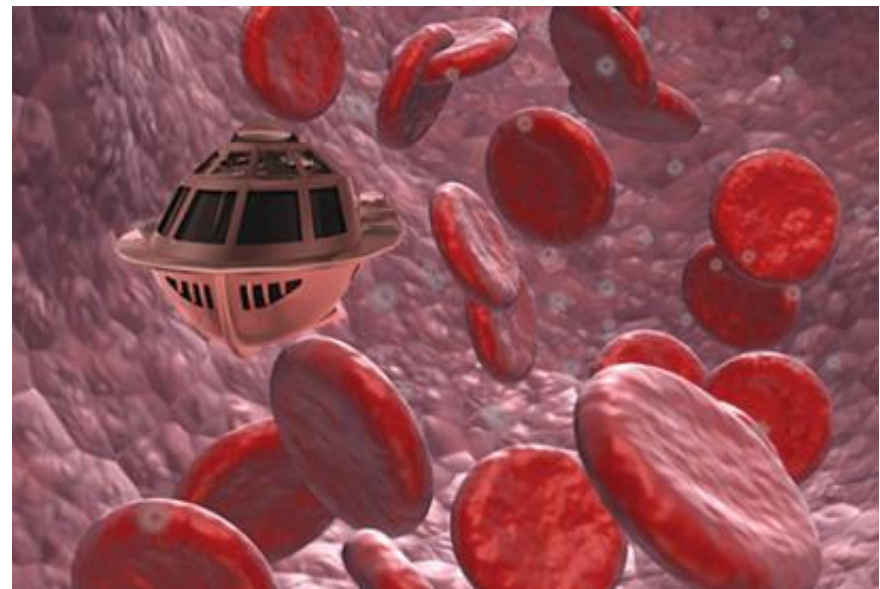
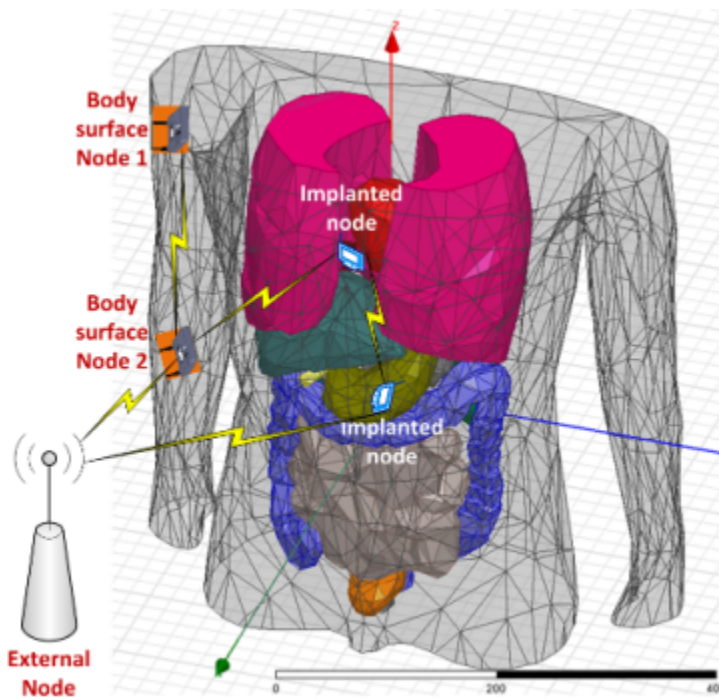


Neuroimplants – Sensory Organs



Intra-body Robots

sonova



Technology News

Patient status engine combines wireless body-worn sensors with cloud-based electronic health record

May 21, 2012 // Julien Happich

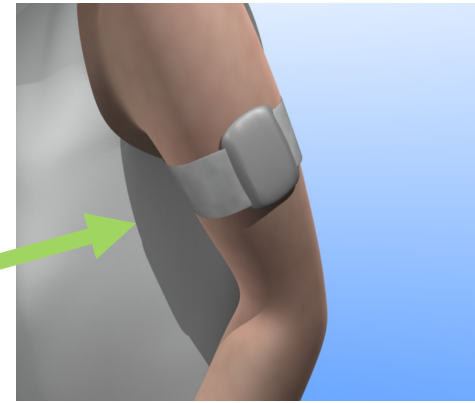
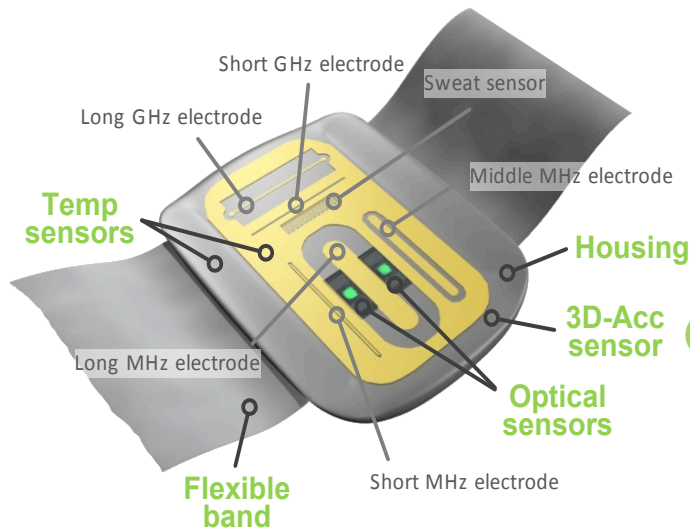


Isansys Lifecare introduced the Patient Status Engine, a cloud-based wireless sensor vigilance system for real-time and predictive patient status monitoring.

The Patient Status Engine is a complete end-to-end system that integrates wireless body-worn sensors with a cloud-based HIPAA/HL7 compliant Electronic Health Record (EHR), to transform real-time and historical continuous vital sign data into clinical status indicators and prediction tools. With the availability of these new cloud-based indicators and tools, healthcare providers can be notified of any change in a patient's health status as it happens or predict changes that may happen in the future. This can address issues of in-hospital patient safety and avoidable deteriorations and significantly reduce hospital admission times. The Patient Status Engine allows healthcare providers to continue 24/7 surveillance of patients even after they have been discharged from hospital. As a networked and cloud-based system, patients and clinicians may be located anywhere. A further benefit is that a quantified record of a patient's physiological status is established that can be used for audit purposes or to determine the effectiveness and quality of care.

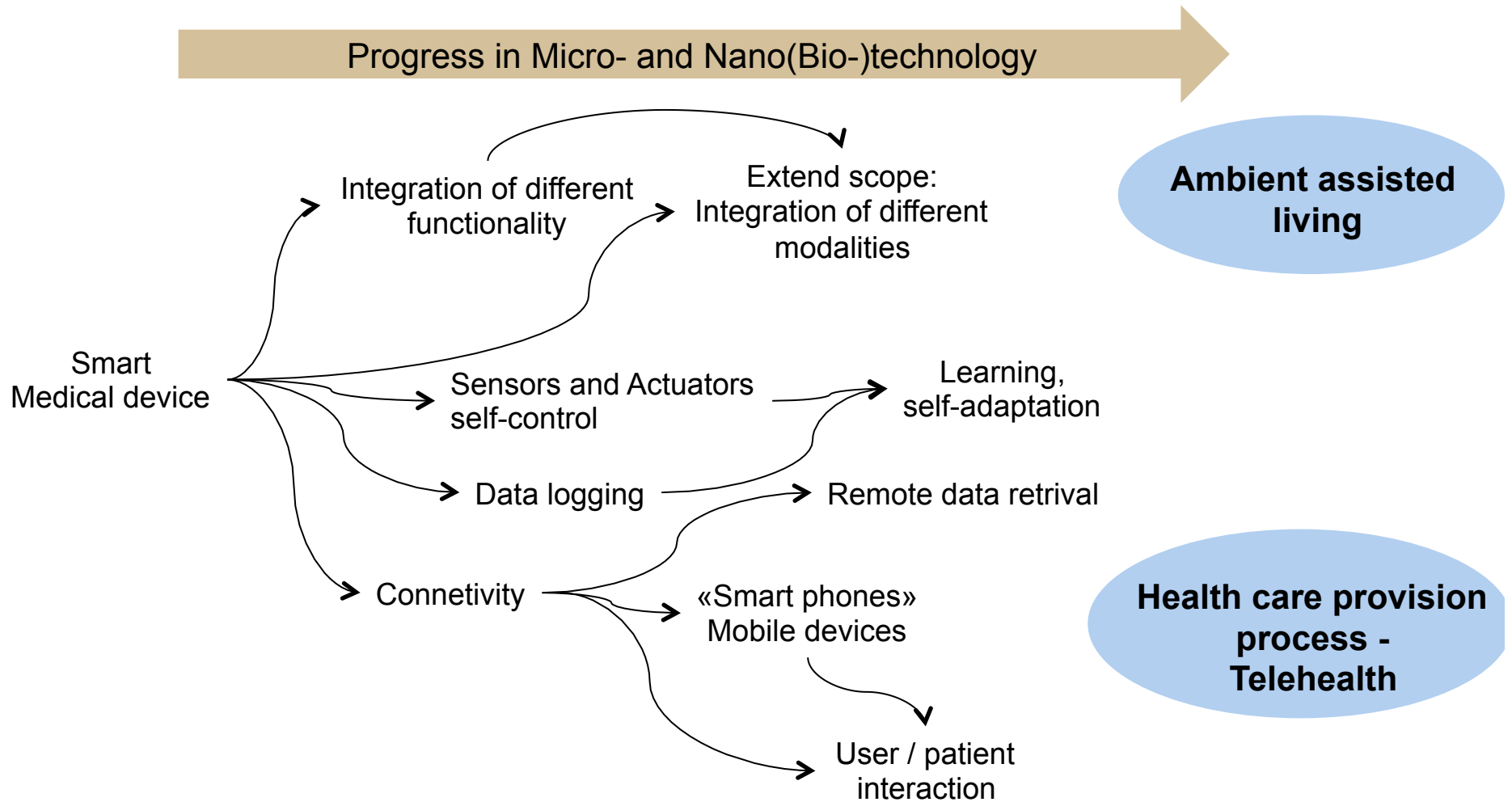
Multi-sensor device for vital sign (remote) monitoring

sonova



Smart Medical Devices – Future Trends

sonova



Vast range of new solutions for various applications

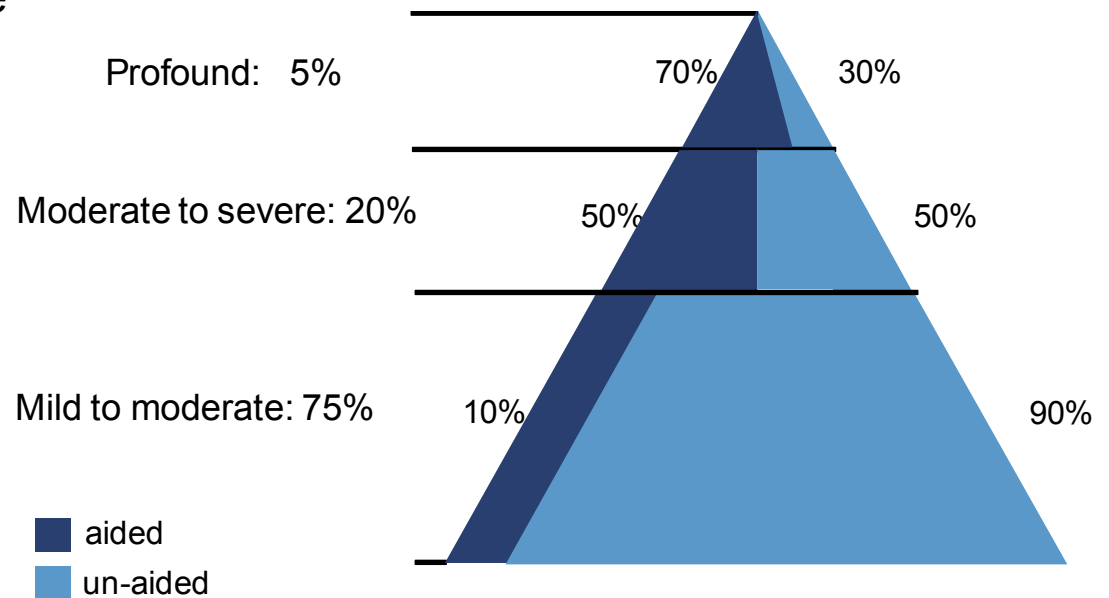
- Neuroimplants: Parkinson, Depression, Brain-Machine interface to control limbs, sensory organs: inner ear, eye/retina, taste/smell
- Health monitoring: vital signs, nutrition, medication, ...
- Diagnostics
- Future trends:
 - Combination of actuators and sensors
 - Integration of intelligence into devices ↔ decision making
 - Connectivity ↔ remote monitoring, counselling, controlling/reacting

Market Potential for Hearing Systems

Market potential ⇔ market penetration

- 15 % of population suffer from hearing loss, strongly increasing with age
- Hearing Instruments: 10 Mio devices / year, 5-10 Bn \$, 3-5 % growth / year
- Cochlear Implants: 30'000 devices / year, 1-2 Bn \$, 10-15 % growth / year

- Acceptance of product
- Infrastructure to distribute

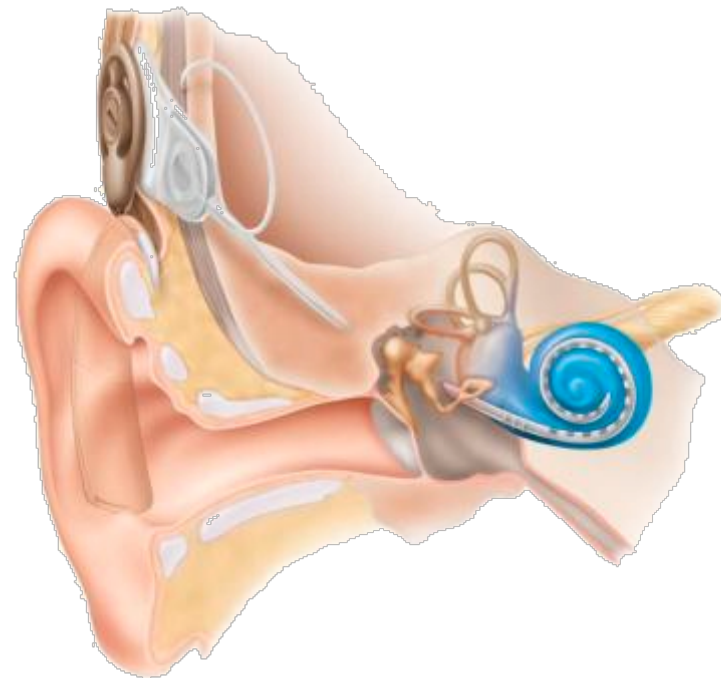


Cochlear Implants

sonova

Cochlear Implants – 30+ years of experience

- Today: 30'000 devices / year, 1,- Bn \$ market
- About 60/40 % adults / pediatrics
- Mainly focused on developed countries
- Surgery => rehabilitation process
- Cost over life time: 150'000,- \$
- Much larger potential
- Trend
 - Milder hearing losses
 - Combination of electric and acoustic stimulation



Hearing Systems – Smart Microsystems

sonova

Hearing Systems

- Highly integrated micro systems
- Power consumption: 1-2 mW
- Personalized, mass produced
- Design, ergonomics
- Intelligent and learning
 - situation and context sensitive



Hearing Instruments - connected

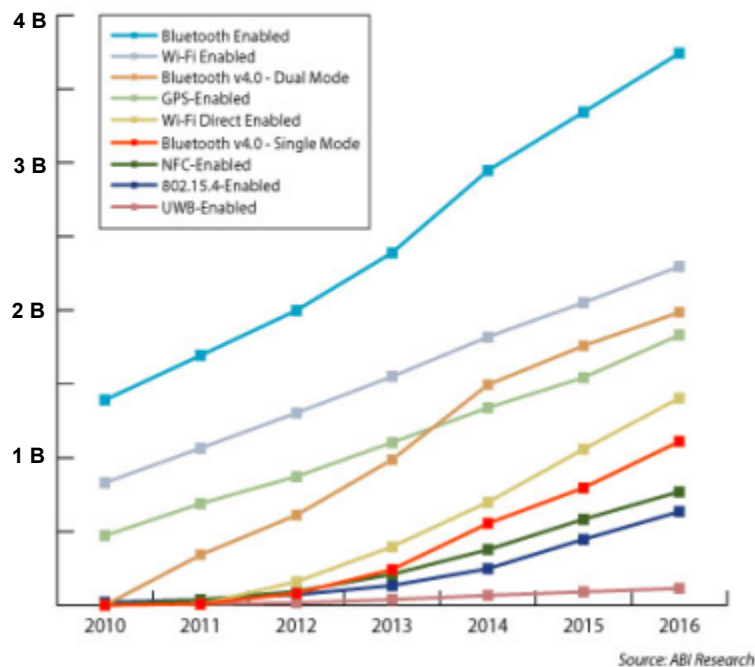
sonova



Wireless Connectivity Devices - Market Grows!

sonova

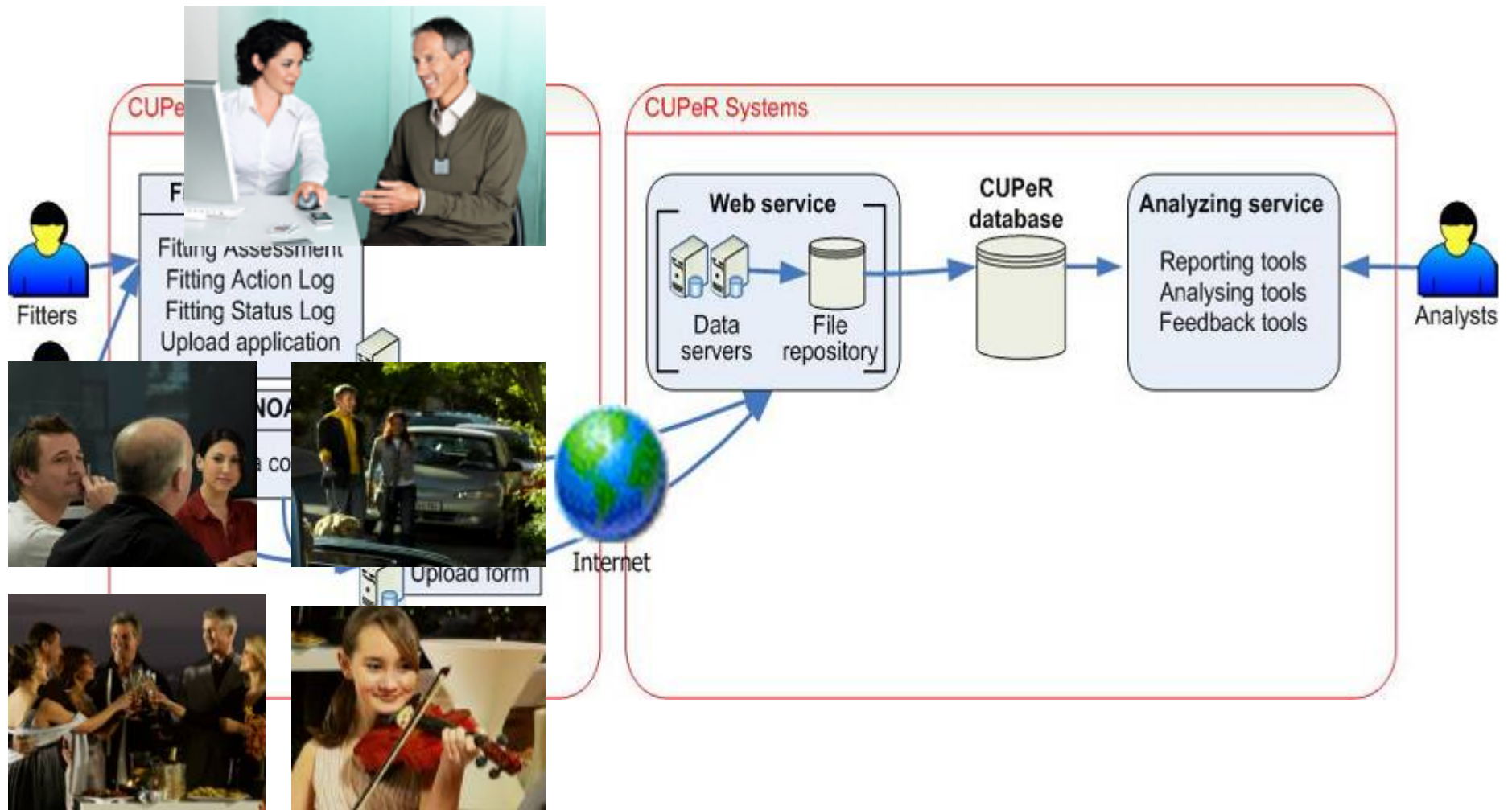
Total Wireless Connectivity Enabled Devices Shipments
World Market, Forecast: 2010 - 2016



- Mobile phone penetration is growing strongly, all around the world
- Smart phones
- All age groups

Data Retrieval

sonova



Remote Control => Information and Connectivity *sonova*

Informations- & Service Center

- State of hearing instrument
- Which source are available - Information in public spaces
- “Apps” ...

Connectivity

- Wireless Connectivity to external audio sources

Diagnostic and Trainings center

- Diagnostic tools
- Rehabilitation and training

User manual

Computation

- Complex algorithms
- New functions: text to speech



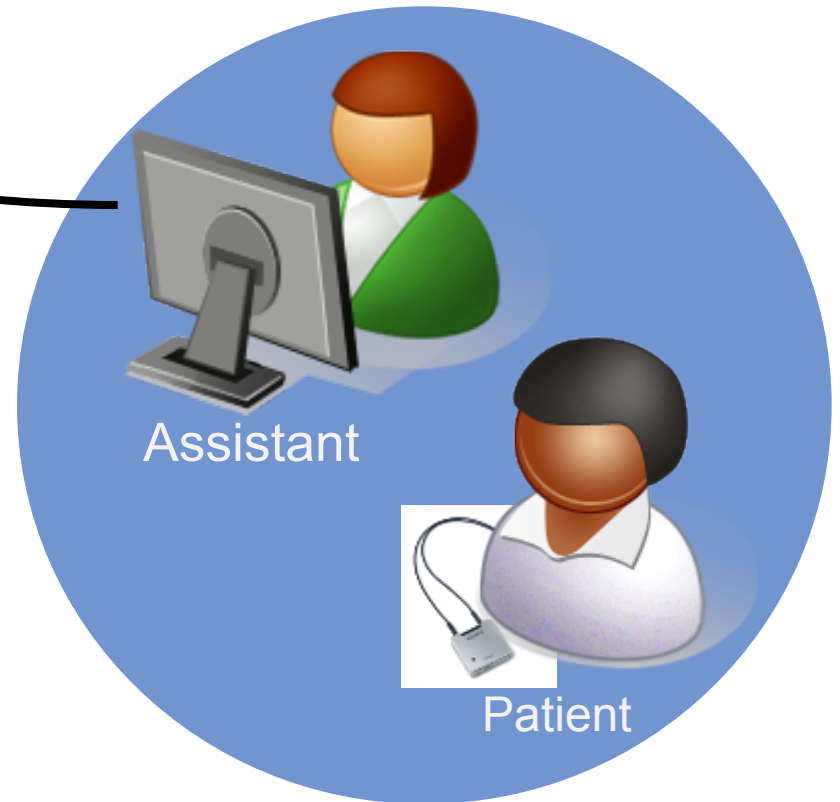
Central Office



- Secure Internet Connection
- Phone / Video Conferencing



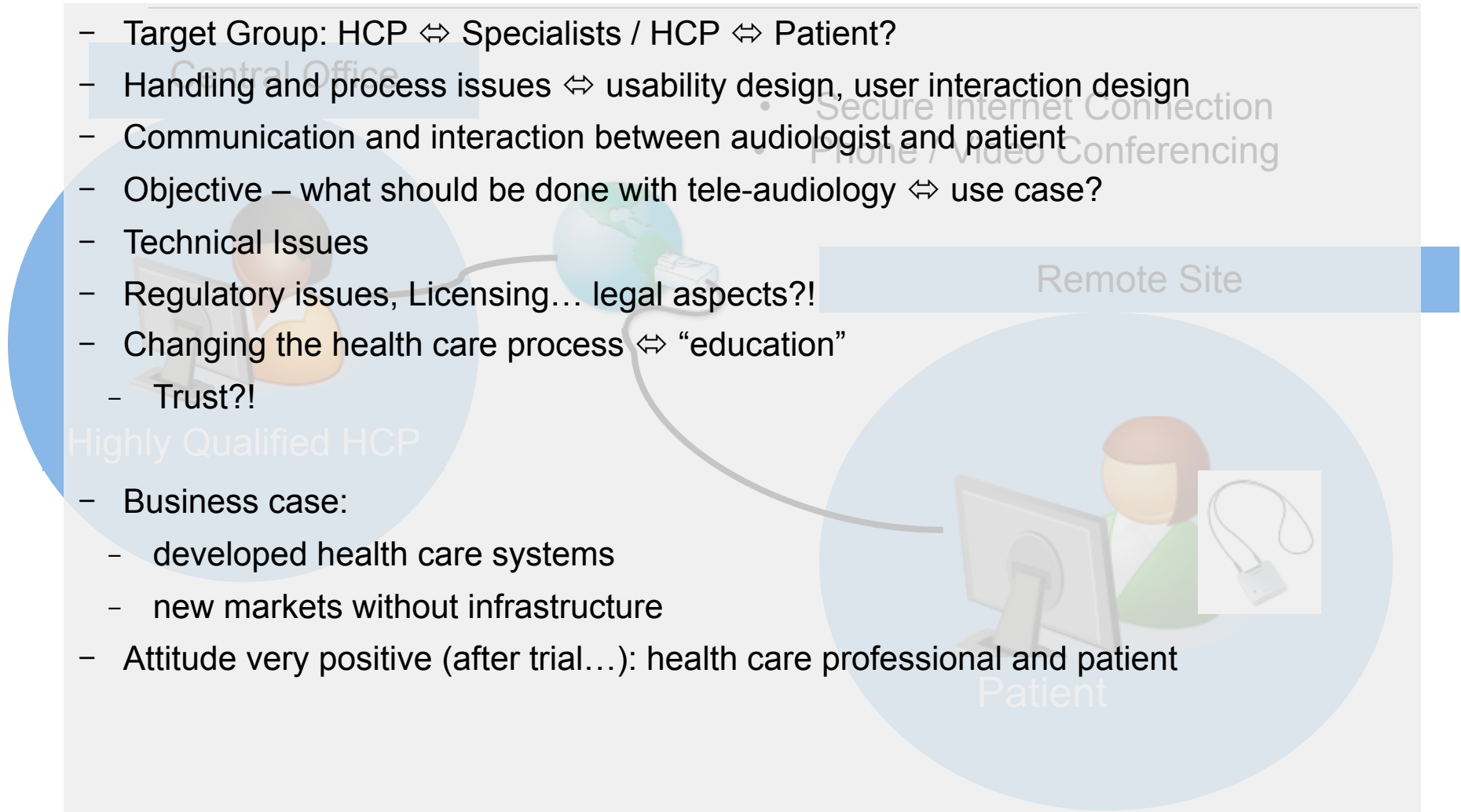
Remote Site



Telehealth

sonova

- Target Group: HCP ⇔ Specialists / HCP ⇔ Patient?
- Handling and process issues ⇔ usability design, user interaction design
- Communication and interaction between audiologist and patient
- Objective – what should be done with tele-audiology ⇔ use case?
- Technical Issues
- Regulatory issues, Licensing... legal aspects?!
- Changing the health care process ⇔ “education”
 - Trust?!
- Business case:
 - developed health care systems
 - new markets without infrastructure
- Attitude very positive (after trial...): health care professional and patient



Communication with health care professional & patients

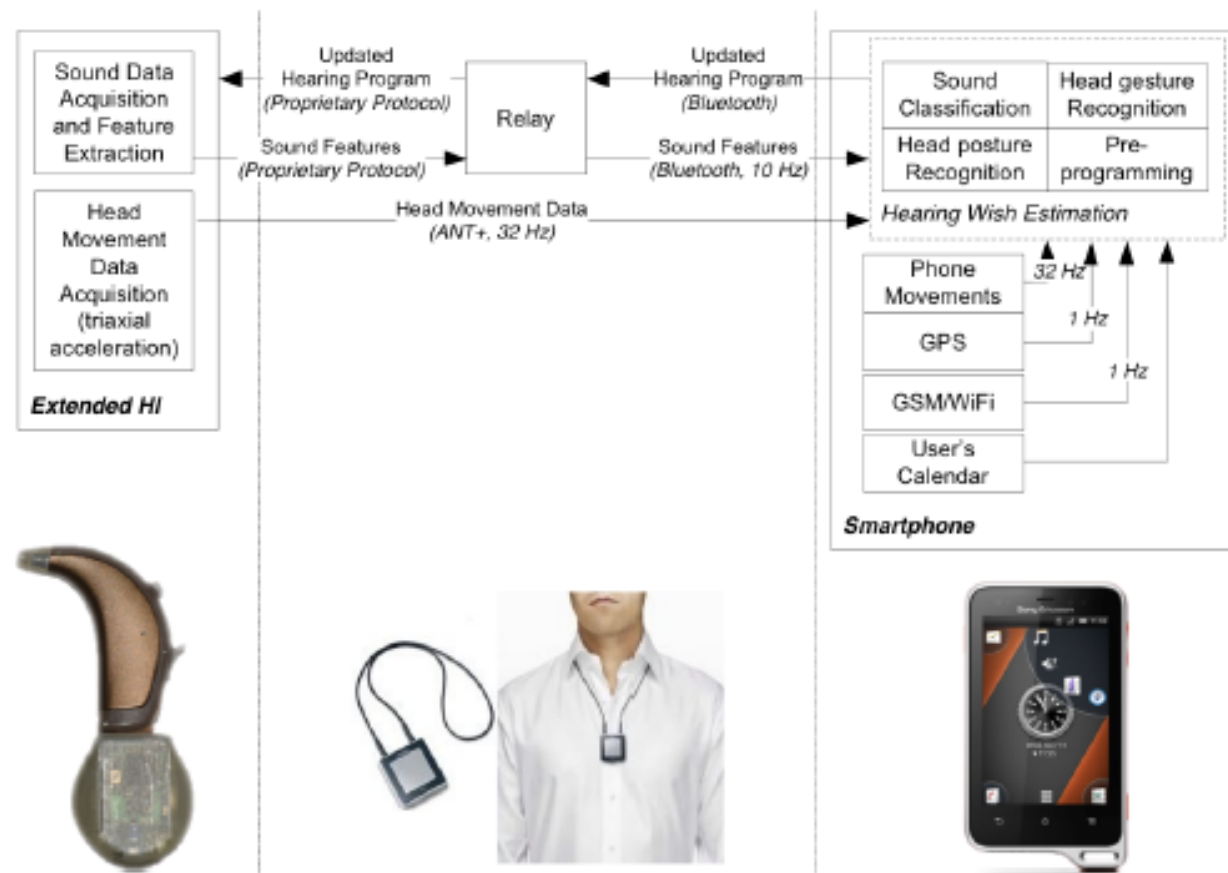
sonova



Multi-Modal (Hearing)-System

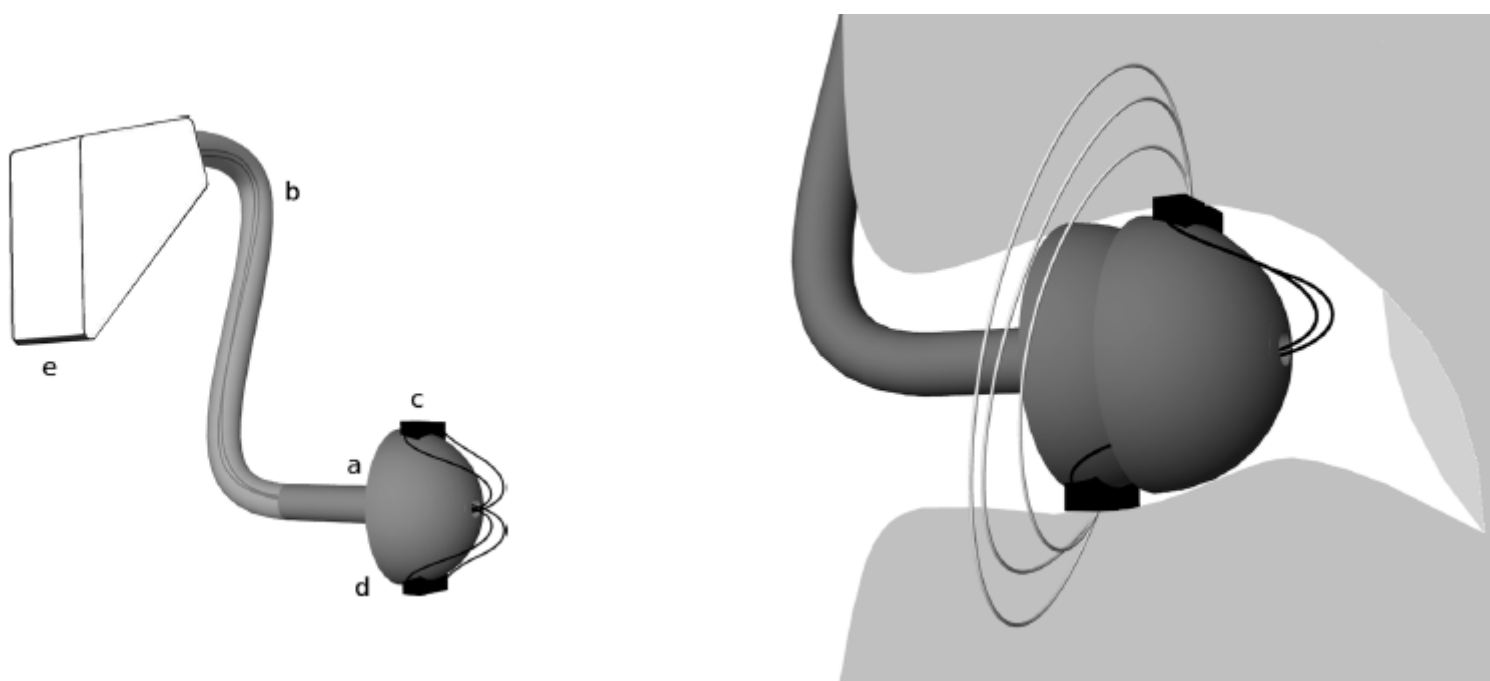
sonova

Tassendorf et al 2012, ETH Zürich



Pulse Oximetry in the External Auditory Canal— A New Method of Mobile Vital Monitoring

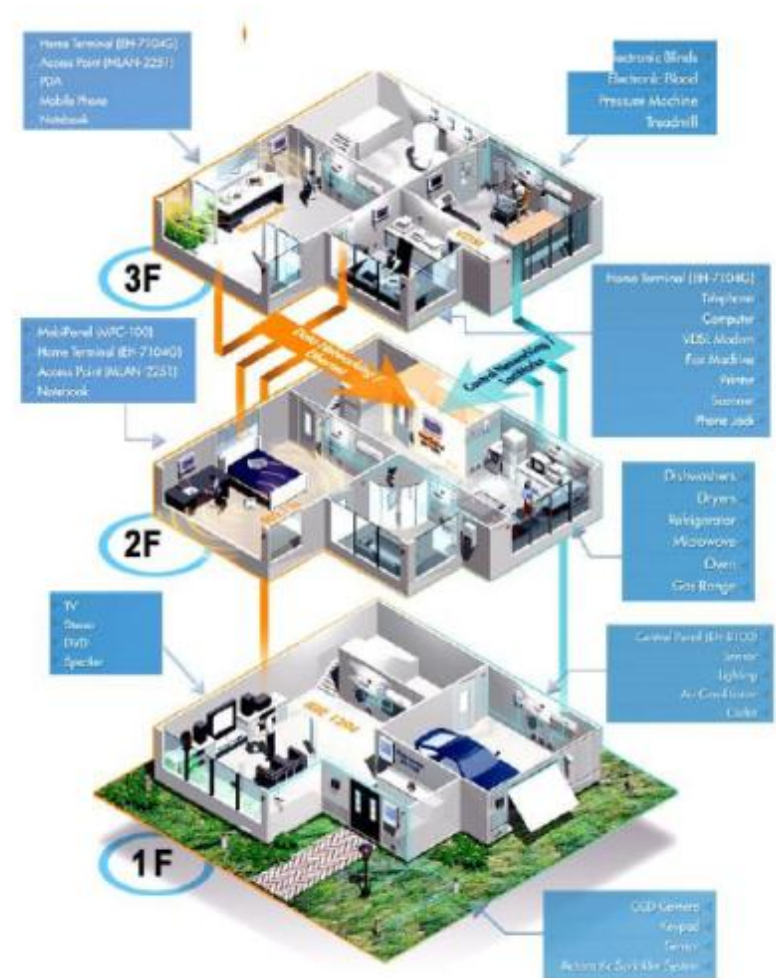
Johannes P. Buschmann and Jin Huang, *Student Member, IEEE*



Fiction: Body-Area-Networks ... Internet of Things *sonova*

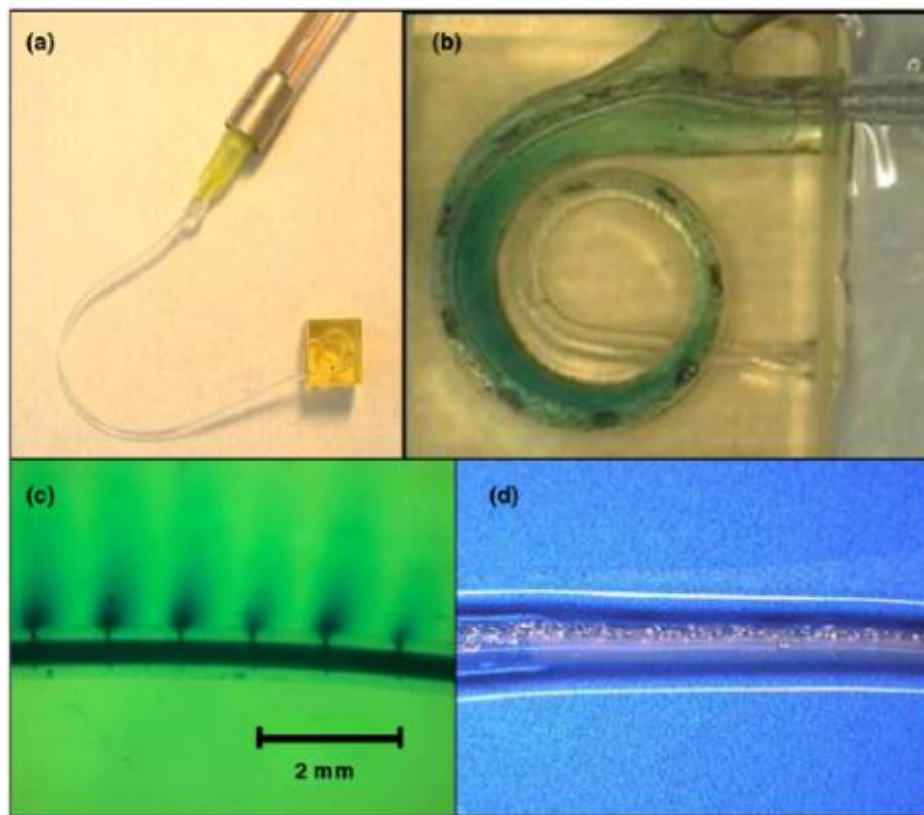
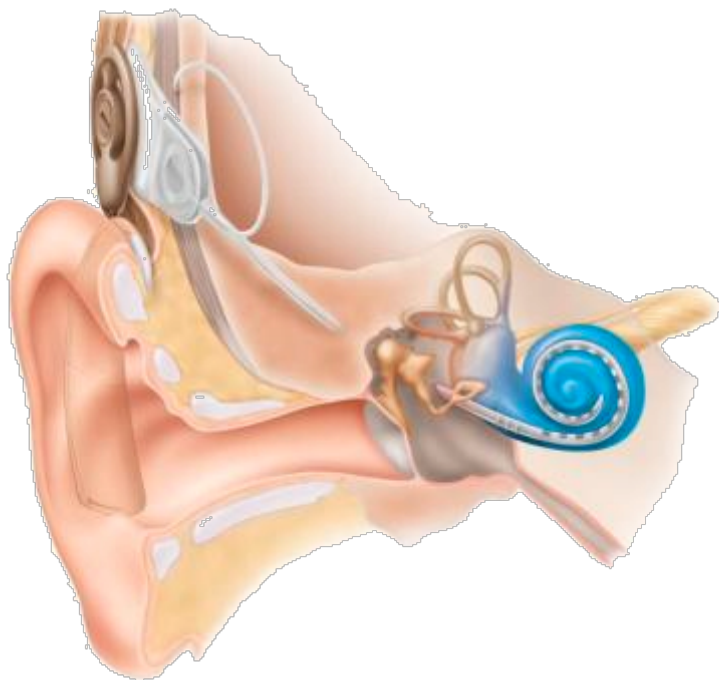
Hearing Instrument ... Communication Assistant

- Communication device, wireless communication
- Multimodal system: integration of other sensor modalities
- Body Area Network: integration of various sensors on the body



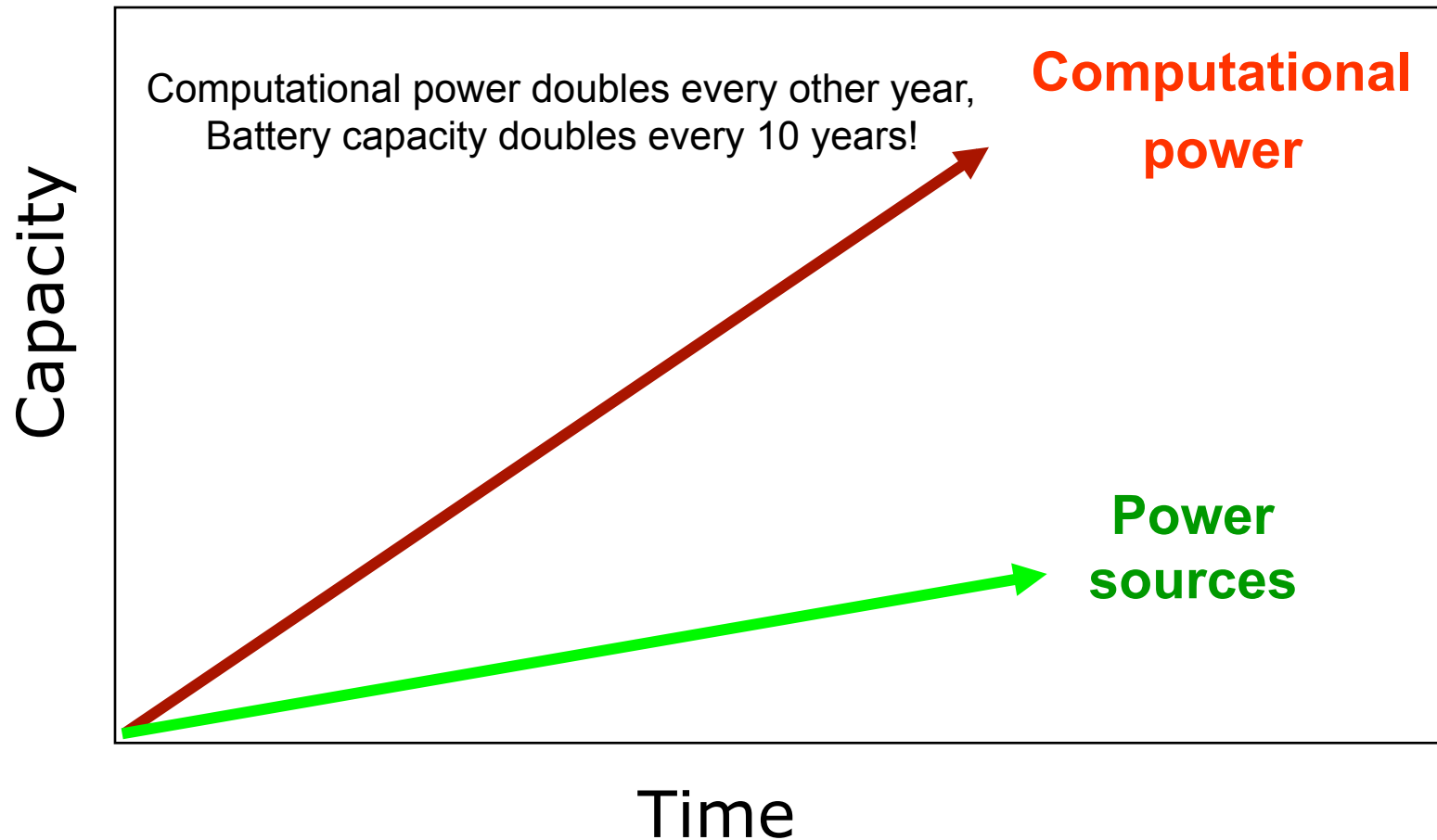
CI - Drug eluting electrodes

sonova



Drug Discovery Today

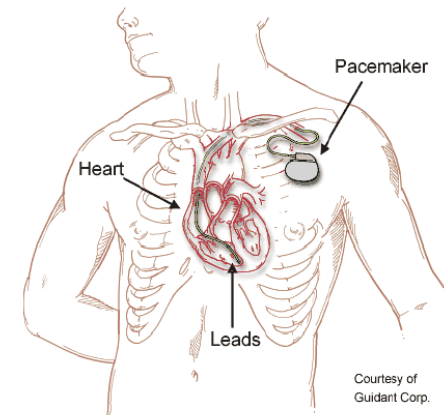
Computational power / capacity of power sources *sonova*



Power Sources - Energy Harvesting

Human Body (average 100W):

- Motion (muscle, blood, air, ...)
- Radiation
- Thermal (between body parts or environment)
- Chemical (fat, glucose, blood, methane☺, waste, ...)
- Electrical



CAVEATS

- Technical challenges: power, connectivity, ...
- Technical progress => vastly new health care solutions
- Educate and build up infrastructure for provision of health care and rehabilitation process
- Business potential ⇔ market uptake
- Regulatory aspects
- Changes in rehabilitation & health care management process
 - Telehealth
 - Ambient assisted living
- Technology meets humans: education, user interaction, care taking / rehabilitation process

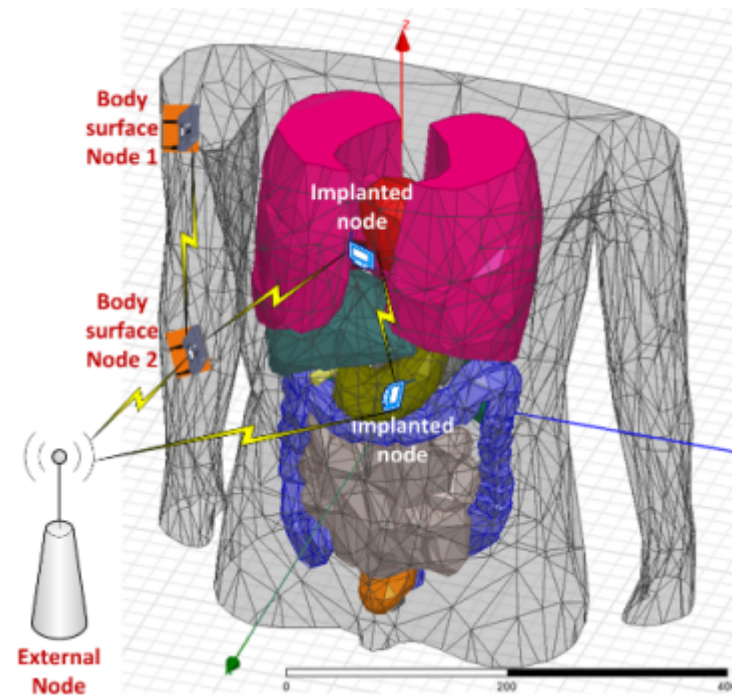
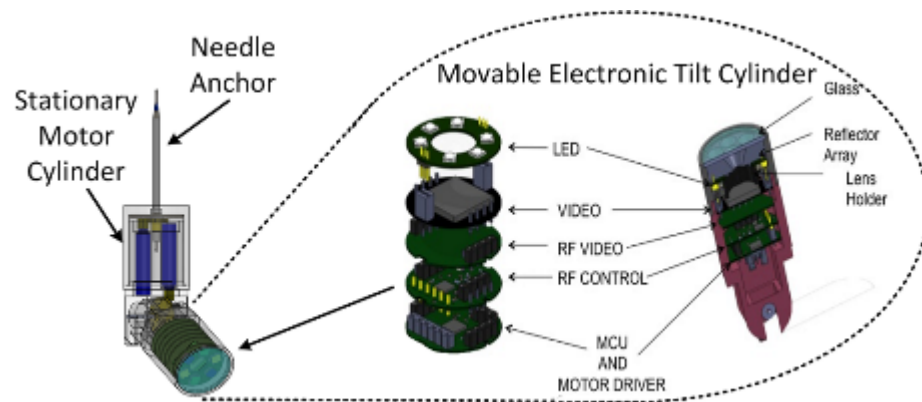
Ambient assisted living

Health care provision process - Telehealth

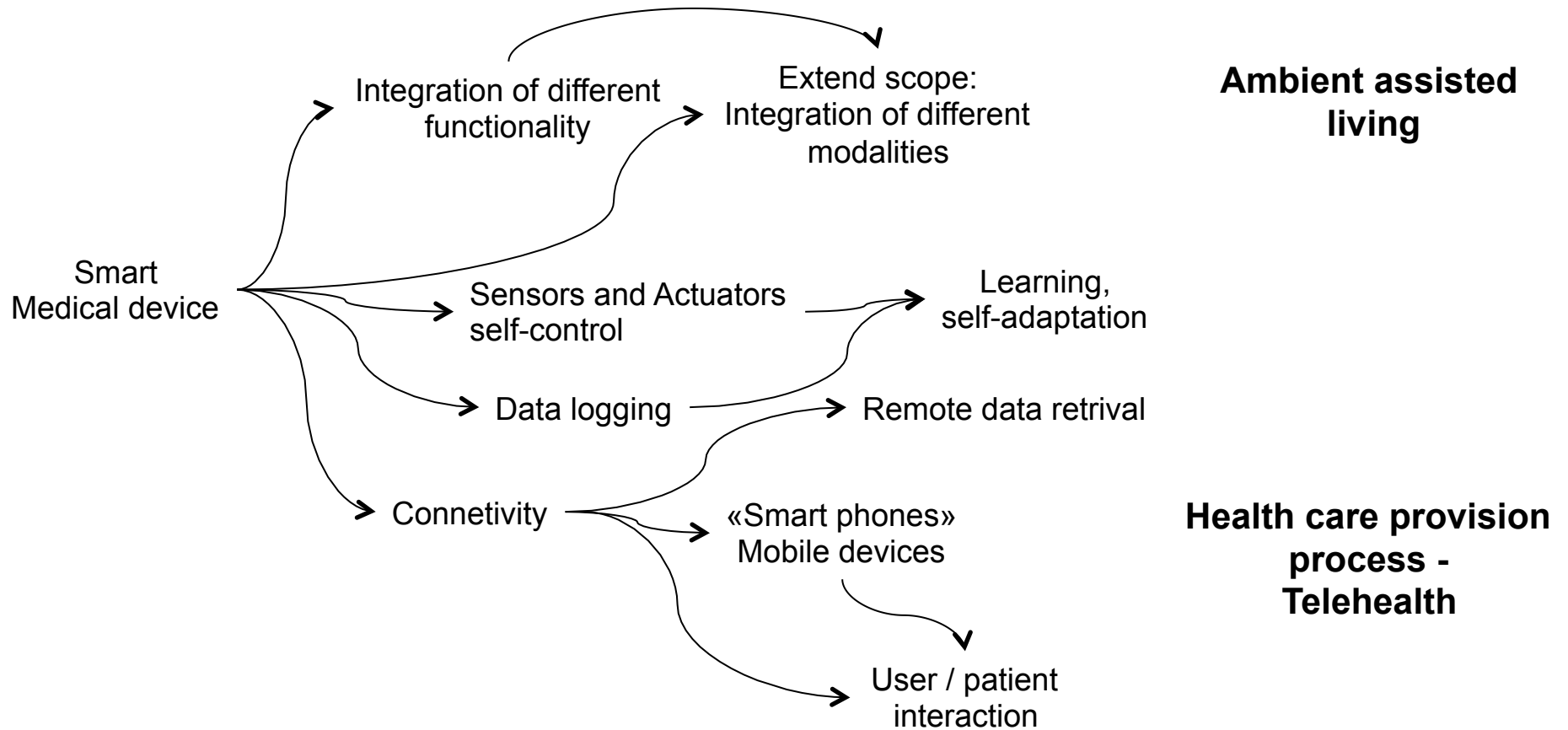


The world
listens in...

Robots in Body



Smart Medical Devices – Future Trends



Device Trends

Pervasiveness of Smartphones and Tablets

- Internet everywhere, any time
- Instantly connected
- No need for physical proximity
- Social media explosion
- Smartphone penetration in all age groups

Device & Service Integration

- Fewer, more integrated devices + apps
- Integration of voice, data, audio & video
- Island solutions → cloud services
- Physical media → streamed media
- Health care integration (Tele medicine)
- Ambient assisted living

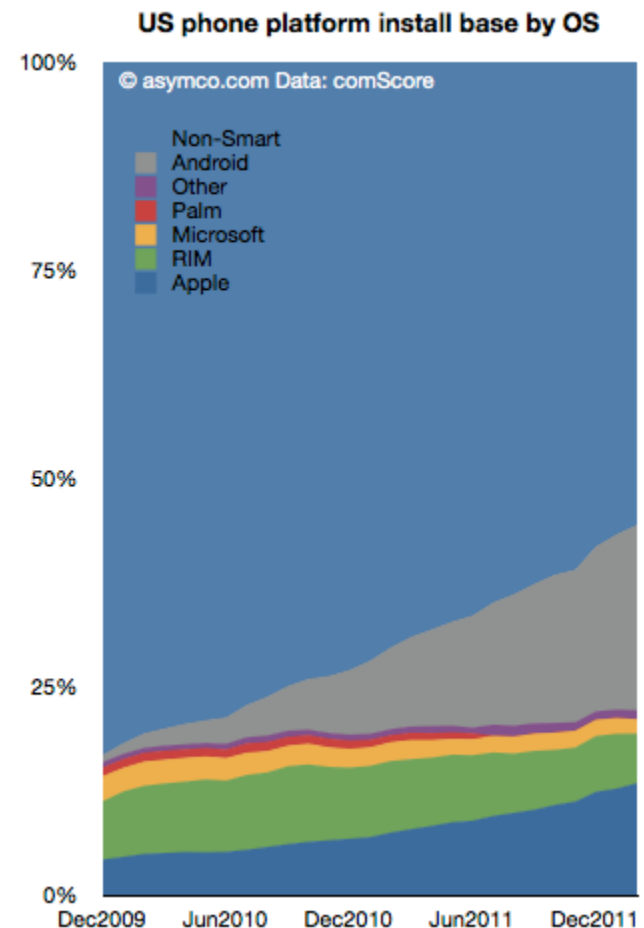
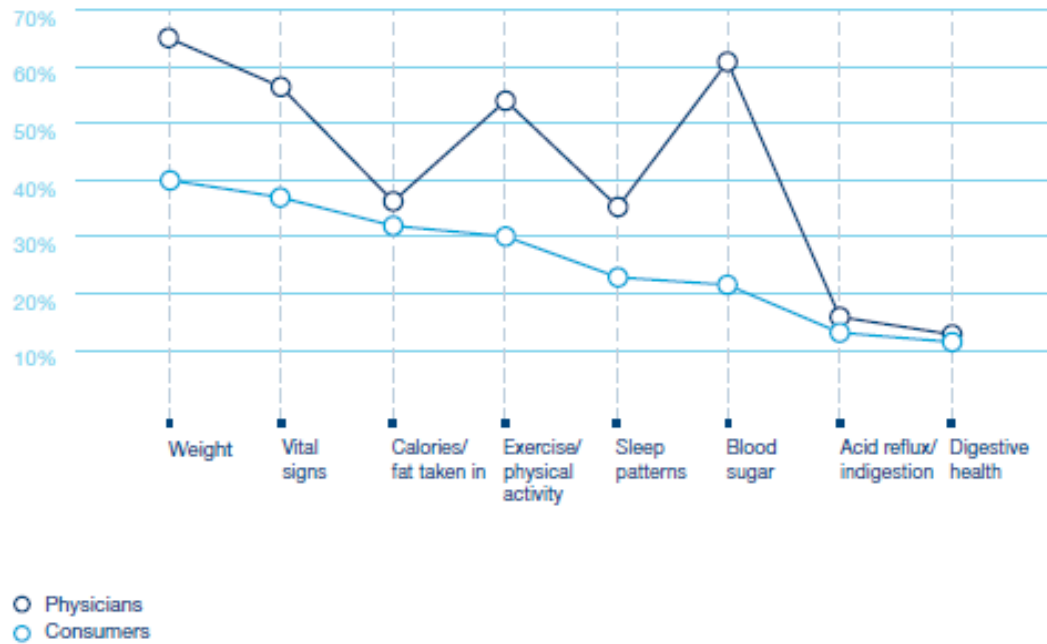
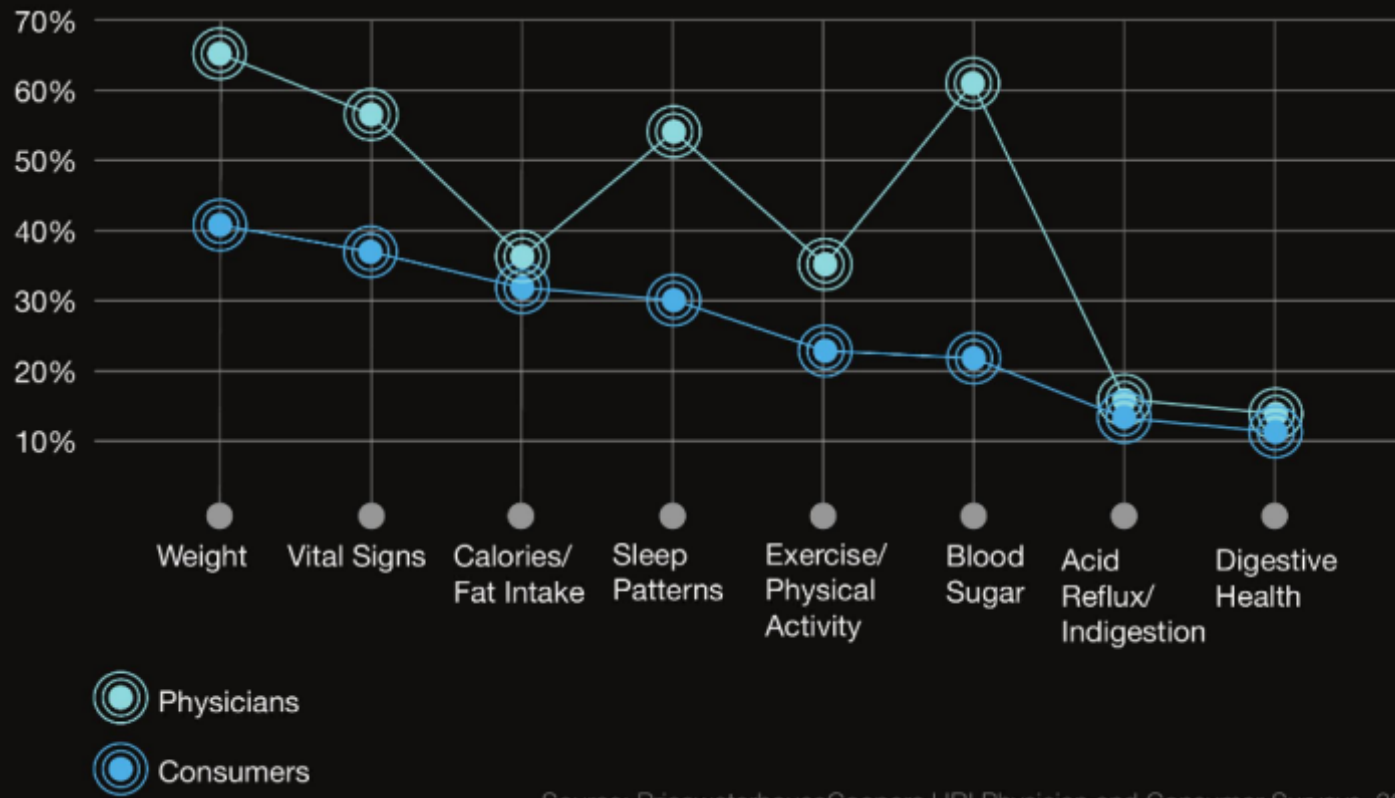


Figure 5: What consumers and physicians want to track regarding health



Source: PricewaterhouseCoopers HRI Physician and Consumer Surveys, 2010

What consumers and physicians want to track



Source: PricewaterhouseCoopers HRI Physician and Consumer Surveys, 2010