World Class Standards

SmartBAN introduction

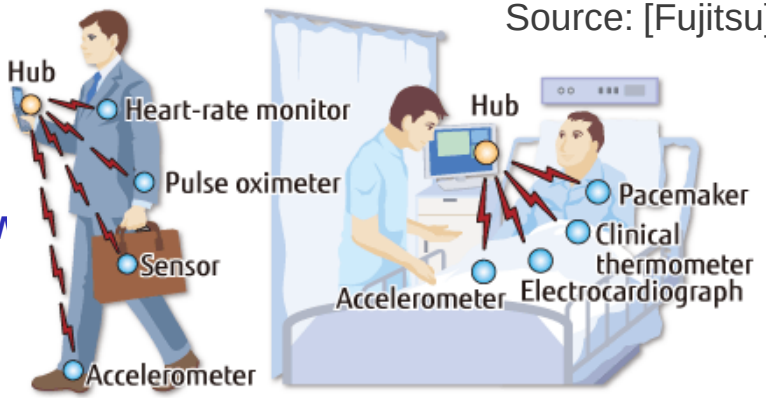
ETSI TC Smart BAN

July 15, 2013

The need and focus

- As the world's population ages, the need for solutions, such as eHealth, that help people live longer at home and with a better quality of life increases.
- eHealth is one such solution. It is a broad topic with many facets. Solutions may be used at home, in the hospital or on the move.
- For the purposes of this presentation, the focus is on **Body Area Networks (BAN)** in support of **"Health"** related applications and services such as:
  - Health and wellness monitoring
  - Personalised Medicine
  - Assisted living (including social netw
  - Sports training and rehabilitation
  - Safety / emergency

Source: [Fujitsu]



From devices to applications and services

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Body Area Network

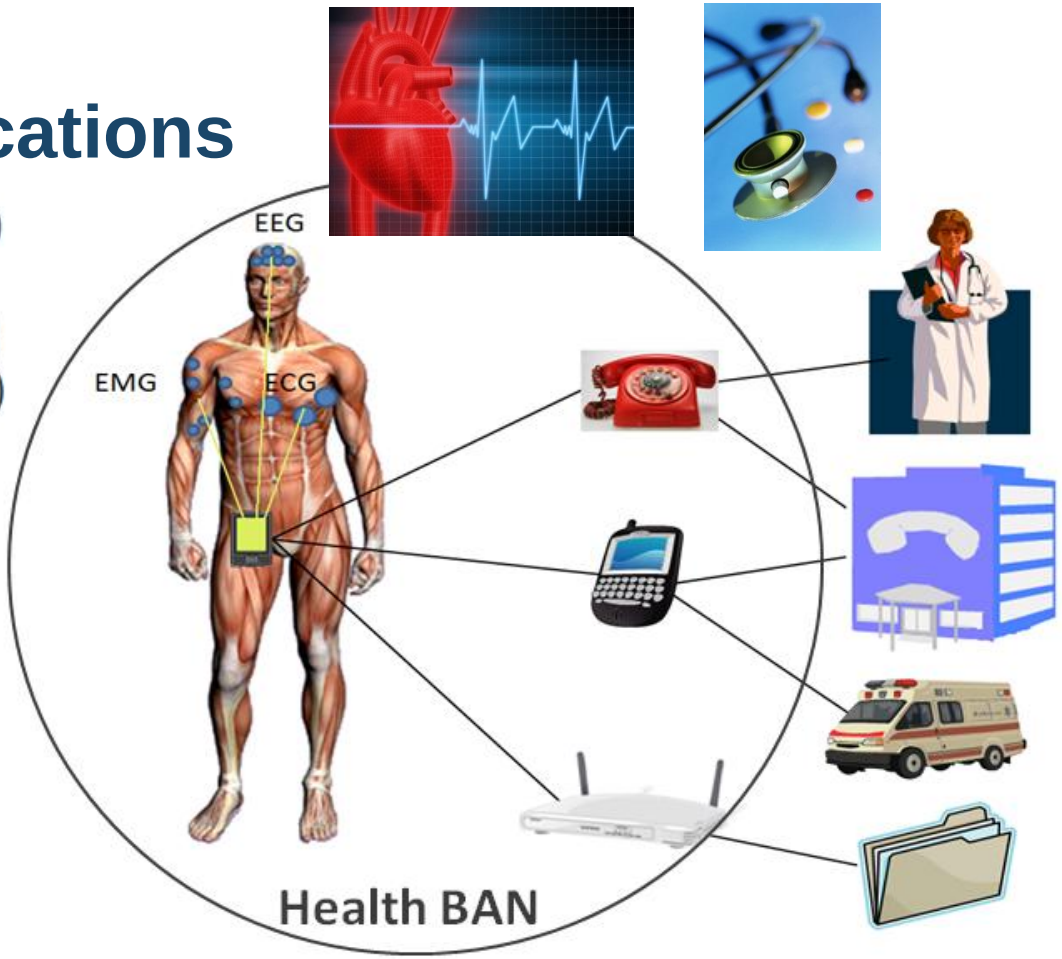
- Definition of a Body Area Network (BAN)
  - BAN consists of one or more body sensor devices connected in a short range communication network about the body.
  - Wireless body sensor devices may be wearable or implantable.
  - Connectivity within a BAN may be wired, wireless or a combination.
  - Devices may include: biomedical sensors, watches, handsets, hearing aids, necklaces…
  - A BAN may be a stand-alone solution or part of a larger system connected via a wide area network (e.g. the Internet)
- BAN may be viewed as a kind of access network. Communication may be machine-to-machine (M2M), person-to-machine, person-to-person…
- Potential applications include Health, Wellness, Medical, safety, gaming and more.

Our focus is on Wireless BAN for «Health» applications

Health BAN applications

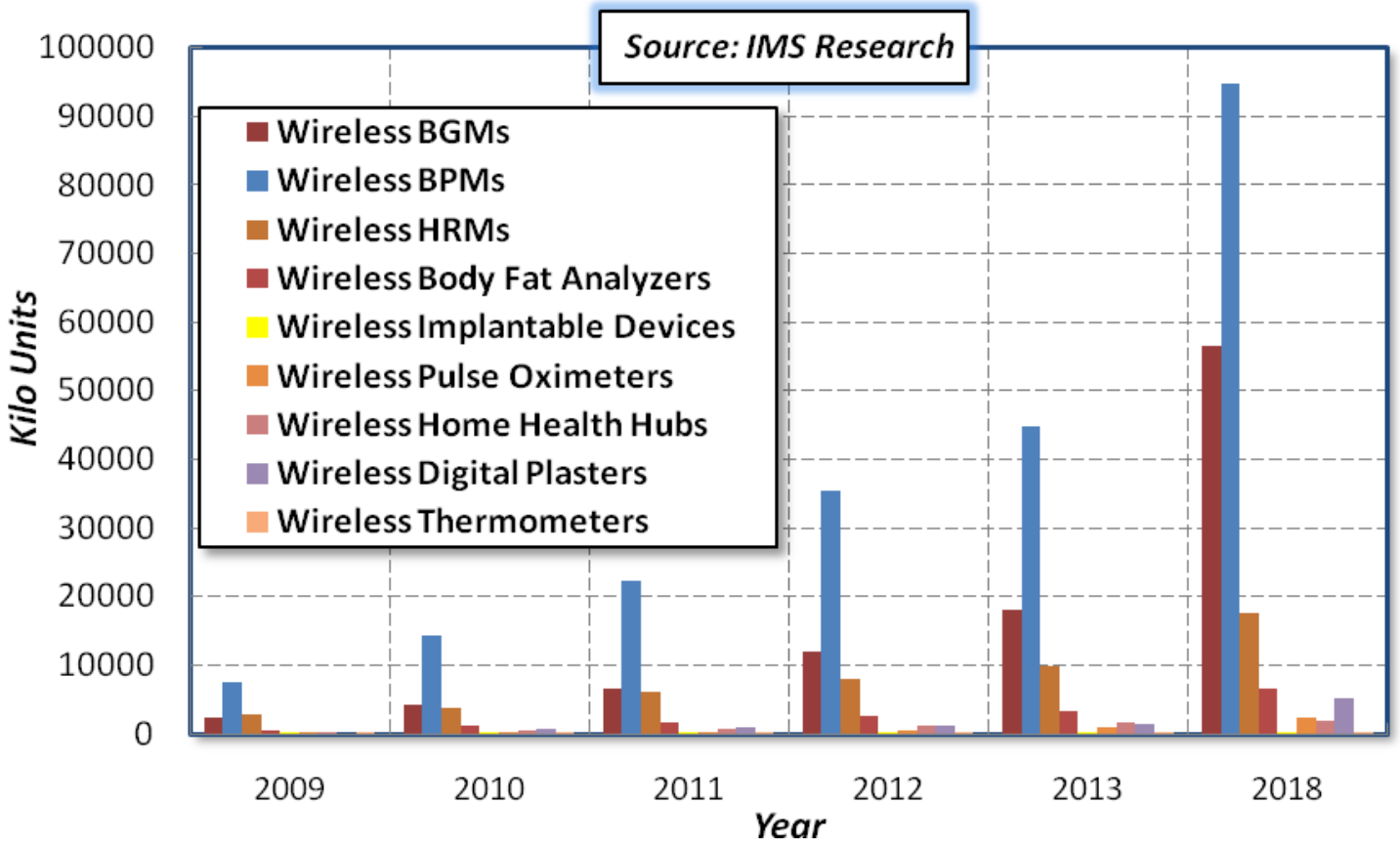
Bio-Medical (with average data rate)
- Blood pressure (0.01-0.1 kbps)
- SpO2, CO2, pH (0.01 – 0.1 kbps)
- Glucose sensor (0.01 – 0.1 kbps)
- Temperature (0.01 – 0.1 kbps)
- EEG (10-100 kbps)
- ECG (2-8kbps/lead)
- Respiration, fall detection…

Sports performance
- Distance
- Speed
- Posture (Body Position)
- Sports training aid



Not only measurements, but increasingly towards continuous updates of data for tracking performance and conditions as well as better diagnosis

Market growth projections for wireless enabled monitoring devices in kilo units (KU)



Exponential growth on the device side. Similar growth on the application-service side, perhaps especially given continuous monitoring systems

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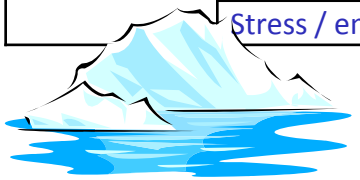
Snapshot of applications

Category	Application	Metrics, sensors, actuators	Nature of devices
Assited living	Altzheimers / dementia	Localization of persons, memory aids	Wearable
	Assistance	Remote personal assistant, Social Network support group	Wearable, portable
	Fall alarm	Fall detection and alarm	Wearable, portable
	Medication compliance	Dosage, vital signs monitoring, reminders	Dispenser, wearable sensors
Fitness	Activity and metabolism	Activity detection (e.g. accelerometer), heat flux (calories)	Wearable, portable
	Weight and body fat	Weight and calorie management, body fat analyzer (BMI), scale	Portable
	Rehabilitation	Motion, posture, stress	Wearable devices
	Sports training	Motion, pulse, temperature, heat flux, GSR	Wearable devices
Hospital	Vital signs / eICU	Real-time vital sign monitoring	Wearable
	Location	Patients, new born babies	Wearable
Medical	Bowels, colon, esophagus	Camera pill, endoscopy	Swallowable capsule
	Diabetes	Blood glucose level monitor, insulin delivery monitor	Wearable, portable
	Enhanced diagnostics	Various, sensors and vital signs monitoring	Wearable, portable
	Heart / vital signs	Pulse, ECG, blood pressure, respiration, temp, SpO2	Wearable, portable
	Heart arrythmia	Heart rhythm monitoring and defibrialtor	Implant, portable
	Parkinsons	Deep brain stimulator	Implant
Wellbeing	Sleep	EEG monitor	Wearable
	Stress / emotion	Heat rate, muscle tension, GSR (skin conductance	Wearable, portable



Tip of the iceberg! And most either use or could benefit from wireless

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Overview of technical requirements

Parameter	Wearable BAN Requirements
Coexistence/robustness	Good (low interference to other systems, high tolerance to interference)
Data Rates	Nominally 1-100 kbps (vital sign monitoring)
(De-) insertion	< 3 seconds
Network topology	Star (mandatory), mesh (optional)
Power consumption	Low, autonomy > 1 yr (1% duty cycle, MAC sleep modes, 500 mAh battery)
QoS (Medical BAN)	PER < 10%, delay < 125 ms
Reliability	Robust to multipath interference (> 99% link success/availability)
SAR regulations	< 1.6 mW (US) / < 2.0 mW (EU)
Scalability	High, up to 256 devices
Range	≥ 3m
Security / privacy	3-level: 1) unsecured, 2) authentication, 3) authentication and encryption

Source: IEEE802.15.6

Body sensor devices are typically miniature and low power

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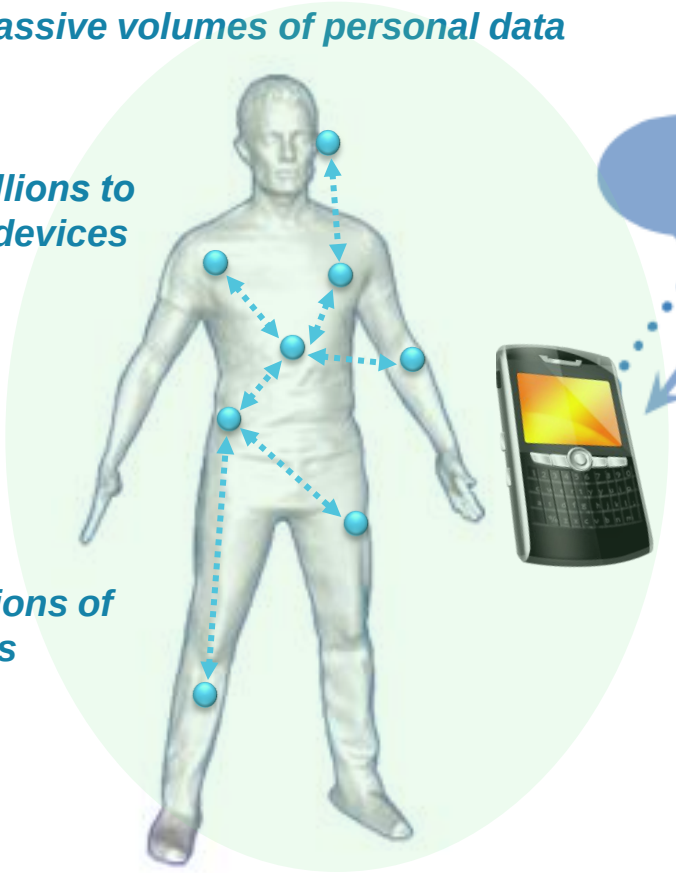
Where does the information go? Who is the service provider?

Massive volumes of personal data

100's of millions to billions of devices



Many millions of users

Heterogeneous networks

- ***Dependable***
- ***Secure / trusted***
- ***Flexible***
- ***Scalable***
- ***Simple***
- ***Mobile***

Virtual Machine (VM)

- **Personal healthcare communities**
  - Doctors, hospitals, continuous diagnostics….
- **Social Networks (wellbeing)**
  - Caregivers, relatives, support groups…
  - Fitness and training communities…
- **As well as games and many more…**

Personalized health services in an Internet based cloud computing environment…

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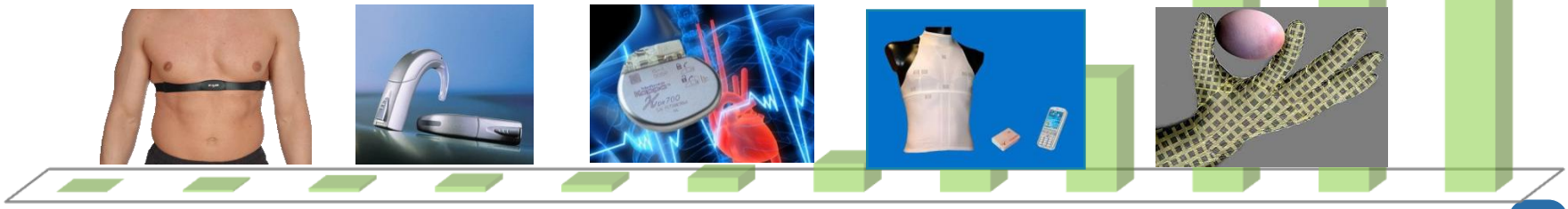
General issues and limitations of BAN today

- Available **frequency bands** vary around the world
- Today's solutions are too large & **power consuming** - not BAN optimized.
- Solutions for monitoring exercise a few hours / week fall far short of the requirements for **unobtrusive 24/7 monitoring** (e.g. heart patients at home)
- Solutions must be **robust**, generally based on standards (incl. defacto IND standards), support **worldwide** operation, **compatible** with existing solutions, **simple** and **low cost**.
- Miniature, ULP wireless solutions tailored to the **unique requirements of BAN** are needed.
- At the same time, we must gain **user acceptance** and **confidence.**
- Additionally, the **business case** may need to be clarified

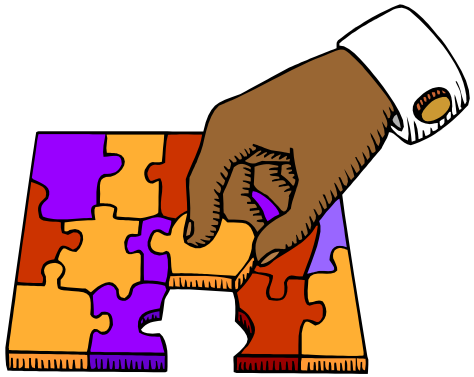
Devices

Single body worn sensor devices

Many, ultra miniature, ULP body sensor devices



Key technical / R&D subjects for BAN today



- Radio co-existence, robustness, QoS, security
- ULP multi-radio PHY and enhancements
- Low complexity, ULP MAC
- Multi-layer solutions (PHY-MAC through API and applications)
- Heterogeneous networks
- End-to-end system, handling and presentation of data
- Interoperability
- Security / privacy (low complexity means)
- Smart control, coordination and management
- Implant communication

Use what exists, fill in the gaps, and make it work better.
This is the mission of the new ETSI TC SmartBAN

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ETSI TC SmartBAN

- ETSI Technical Committee (TC) SmartBAN was approved March 2013 for a 6 month trial period
- Responsible for development and maintenance of ETSI standards, specifications, reports, etc…
- Support development and implementation of SmartBAN network technologies (Wireless BAN, Personal BAN, Personal Networks etc.) in health, wellness, leisure, sport and more.

- Initial ETSI members supporting SmartBAN
  - CNIT (University of Florence)
  - CSEM
  - Cybernetic Medical Systems
  - CWC Oulu
  - IMEC
  - iMinds
  - Medtronic Bakken Research
  - IMT/Telecom Sud Paris
  - Toshiba Research Europe

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ETSI TC SmartBAN organization

- At the SmartBAN workshop held at BodyNETS 2012 in Oslo, key technical challenges for SmartBAN were identified.
- These were refined at the ETSI eHealth meeting held in Geneva on 23 November 2012 and organized according to six main tracks or projects:
  1. Heterogeneity management, data representation and transfer
  2. Smart control, network management, interoperability & security
  3. Multi-layer, co-existence and dependability for SmartBAN
  4. Low complexity MAC and routing for SmartBAN
  5. Enhanced, ultra-low power PHY for SmartBAN
  6. SmartBAN implant communication

These projects are incldued in the Terms of Reference (ToR) which defines the basis for TC SmartBAN

Initial Work Items (WI)

- **Project 1: Heterogeneity management, data representation and transfer**
  - **WI 1.1 - Service, application and data representation (IMT/Telecom SudParis)**

To define service and application enablers, data representation and transfer formats and to identify the required management and control information

- **Project 3: Multi-layer, co-existence and dependability for SmartBAN**
  - **WI 3.1 - 2.4 GHz band coexistence (CNIT)**

To study Smart BAN coexistence with all the users in the 2.4 GHz band

- **Project 4: Low complexity MAC and routing for SmartBAN**
  - **WI 4.1 - Low complexity MAC and routing requirements for SmartBAN (Toshiba Research Europe)**

To study the requirements for low complexity MAC and routing for SmartBAN

Currently, three open Work items.

Thank you for your attention