The Future of Personal Health: Requirements, Technology, Applications, Standards

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Person-Centered Care (pHealth)
“e-health” – Interaction and Integration Paths

E-Letter
E-Consultation
General Practitioner
EHR
ECG, Ultrasound, ...

Pharmacies

Insurance Companies

Labs, Care services etc.

Specialist

Hospital

Electronic Health Record

Intensive Care Units

HIS

HL7

DICOM

RIS

LIS

PDMS

Monitor, Pump, Respirometer, Agent

CT, MR, X-Ray

Analyser

E-prescription

E-Letter

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- Labs, Care services etc.
- Intensive Care Units
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- PDMS
- DICOM
- CT
- MR
- X-Ray
- Analyser
- Lab
- Home / mobile

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Pervasive Computing
Location-independent Service Delivery
Telematics, Telemedicine

Autonomous Computing
Self-organization
Health Information Systems

Mobile Computing
Accessibility
Tele-Consultation

Ubiquitous Computing
What is Personal Health?

- **Personal Health Systems** include portable medical devices or systems specifically designed for diagnostic and therapy-supporting (long-term) monitoring application in home or mobile environments.

- **Personal Health** identifies increasing *individual / private customer availability* of medical equipment, information and services that were traditionally only accessible for health care professionals / professional institutions (- similar to the establishment of **Personal Computers** complementing professional computing equipment).

  ⇒ **Technology is enabler and driving force**

- **Personal Health also** characterizes the transition from traditional organization-centric health organization of health services to *person-centric individualized services / personal responsibility* for prevention, diagnostics, therapy and care (eHealth / pHealth)
Technology as Enabler for Personal Health Systems

Components get smaller and cheaper, need less power

Active Transponder

Wireless Sensor Module
Technology as Enabler for Personal Health Systems

Mobile computers, intuitive UI, wireless communication…
Soon: Integration of Electronics into Smart Textiles

Crimping

Embroidering

Laser →Welding/Soldering

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Soon: Intelligent Clothes as Monitoring Platform

ECG  Respiration and Activity  Activity/Movement
Future: Smart Implants (Micro-Electronics / -Mechatronics)

Functional eye prosthesis – Moving eye with integrated camera

(Collaborative approach: Fraunhofer IZM / Moran Eye Center / Huntsman Cancer Institute)

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EC funded Cortivis Project

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But how can we make all these devices collaborate?
STMicroelectronics and Mobidiag Unveil Lab-on-Chip for Rapid Bacterial Diagnosis
Pharmaceutical Companies Start to Provide Pills with Embedded Microchips (Mike Adams, Reuters Communication, 15.11.2010)

Within its “Smart Pills Initiative“, Novartis AG, one of the biggest pharmaceutical companies worldwide, announced to implement the chip-in-a-pill technology developed by privately owned Proteus Biomedical of Redwood City, California in its products. The biotech start-up's ingestible chips are activated by stomach acid and send information to a small patch worn on the patient's skin, which can transmit data to a smartphone or send it over the Internet to a doctor.

Novartis agreed to spend $24 million to secure access to personal medical information provided by the chip.

In the future, the use of the technology is also planned to collect information about heart rate, body temperature, body movement as well as to check that drugs are working properly.
Talking Organs: Talking Hand

Phenotyping of persons
- eHealth card
- ePatient record

Person monitoring
- Attention
- Concentration
- Coordination
- Reactivity

Symptom assessment of neuromotor dysfunctions caused by diseases e.g.
- Parkinson
- Multiple Sclerosis
- Infarction
- Stroke

Symptom assessment and therapy in psychology and education e.g. ADHD

Patient monitoring and medication control (remote and mobile)
- Telemedicine
- Homecare

Clinical trials: testing drug administration and dosage

Monitoring of humans on drugs or under physical or mental stress
Retinal microangiopathy
Retinal bleedings
Micro-infarction of the retina
Diabetic alteration
Swelling of the optical nerve
Atrophy of the optical nerve
Glaucoma

Prevention and therapy
Promises of Bioinformatics to Health Sciences (After Brendan McConkey)

Genetic profiling
- Identification of genetic predispositions

Prognosis and treatment
- Prediction of response to treatment
- Tailoring treatment to tissue subtype

Diagnostics – early detection of disease
- Serum protein biomarkers
- Identification of novel drug targets
- Application to multi-factor diseases
Interoperability Challenge:

Which of these common standards are relevant for your Personal Health system?

- **Cabled Networks**: Ethernet (32 variants!), HomePlug, HomePlugAV
- **Point-to-Point**: DisplayPort, DVI, FireWire, HDMI, SCART, USB
- **Field Buses**: BACnet, BatiBUS, EHS, KNX/EIB, LON
- **Wireless Networks**: WLAN, ZigBee, Z-Wave, EnOcean, Bluetooth, DECT, HomeRF
- **Network Protocols**: AFP, BitTorrent, Bonjour/Zeroconf, CalDAV, CUPS, DHCP, DNS, DPWS, DynDNS, FTP, HTTP, IMAP, IPP, IRC, JetDirect, LDAP, LPR, NAT-PMP, NFS, OMA DM, POP3, RTP, RTSP, SIP, SMB, SMTP, SNMP, SSDP, SSH, TFTP, TR-069, UPnP, WebDAV, CHAIN/AIS, SML,
- **Health Application**: aECG, CCD, CCR, CDA, CEN/ISO/IEEE 11073, DICOM, EDF, EDIFACT, HL7, IHE, ISO/EN 13606, PHMR, SCP-ECG, xDT, XPHR, ICD-10, ICHI, ICPM, LOINC, OPS, SNOMED, UCUM, UMLS
- **Runtime**: OSGi, .NET, Linux, MIDP
- **Middleware**: Agent System, SOA, Event Based, URC

→ A real challenge for product designers, developers, integrators

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2011: 250+ Continua members developing Personal Health solutions
Supported Domains

- Disease Management
  - Agent Examples: Pulse oximeter, Heart rate monitor, Blood pressure monitor, Thermometer, Weighing scale, Glucose meter

- Health and Fitness
  - Agent Examples: Heart rate monitor, Weighing scale, Thermometer, Cardiovascular fitness and activity monitor, Strength fitness equipment

- Independent Living (Aging Independently)
  - Agent Examples: Disease management devices plus Independent living activity hub, Medication monitor
Continua Version One Device Connectivity Standards

- ISO/IEEE 11073-20601 = Base Protocol
- ISO/IEEE 11073-10404 = Pulse Oximeter
- ISO/IEEE 11073-10406 = Pulse / Heart Rate
- ISO/IEEE 11073-10407 = Blood Pressure
- ISO/IEEE 11073-10408 = Thermometer
- ISO/IEEE 11073-10415 = Weighing Scale
- ISO/IEEE 11073-10417 = Glucose
- ISO/IEEE 11073-10441 = Cardiovascular Fitness Monitor
- ISO/IEEE 11073-10442 = Strength Fitness Equipment
- ISO/IEEE 11073-10471 = Independent Living Activity
- ISO/IEEE 11073-10472 = Medication Monitor

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Why were ISO/IEEE 11073 standards & group selected for (Continua) Personal Health standardization?

- Respected standards body with open participation
- Harmonized with ISO for International Standards
- Also harmonized with NCCLS/CLSI, HL7, CEN TC251, ISO TC215, IHE, FDA, and NIST
- ISO/IEEE 11073 already formed and active
- ISO/IEEE 11073 Charter contains health care devices
- Standards structured to be transport portable
- Able to support Disease Management, Health and Fitness, and Independent Living
- Low cost for membership and access to standards
CEN/ISO/IEEE 11073 | HL7 | IHE PCD Domain
from Clinical to Personal Health devices and applications

Topological Areas of Interest

Medical - Point of Care (PoC)
- Home Monitoring
- SubAcute PoC
- Hospital
- Ambulatory
- Transport/Inter-PoC
- Acute, Intensive/Critical
- PerOperative (ICU, OR)
- Emergency
- ER/Trauma (ETU), eg Burn (Unit)
- Rescue (Ambulance/NedEvac)
- Ancillary (Radiology, EKG, etc.)
- Maternity/Ob (LR/CR)
- Other - eg Nursing Home, MD Office/Suit

Institutional - eg. Hospital
- Layer 3 Switch
- VNA (Network)
- DICOM
- PACS
- HIS

Clinical
- Cardiology
- Cardiac Monitoring/Surveillance
- ICU
- CCU
- PT/IntelliCare

Inter-Institutional
- Home
- MedEvac or Ambulance
- Phone/Internet
- WAN
- 802.11 AP

User Cases (UC)
1) Home Monitoring
2) Hospital
3) Ambulatory
4) Transport/Inter-PoC
5) PerOperative (ICU, OR)
6) Emergency
7) ER/Trauma (ETU), eg Burn (Unit)
8) Rescue (Ambulance/NedEvac)
9) Ancillary (Radiology, EKG, etc.)
10) Maternity/Ob (LR/CR)

Orlando, 13 May 2011

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Personal Health Data Standards Work

-00103 Technical Report - Overview

Device Specializations
- 10404 Pulse Oximeter
- 10407 Blood Pressure
- 10417 Glucose
- 10406 Pulse
- 10415 Weighing Scale
- 10408 Thermometer
- 10415 Phase II
- ...
IEEE 11073-20601 Modeling

ASN.1 – language used in the abstract modeling of data and interactions
Domain Information Model (DIM) – describes the device and physiological data
Nomenclature – provides binary codes for terminology
Service Model – defines interactions with the device and data
Communication Model – manages the connection state machine and communication characteristics
AAL = Ambient Assisted Living, an application domain of Ambient Intelligence

Smart assistive environments that are sensitive and responsive to the presence, behavior, physical and mental state of people.

Components / devices cooperate to support / assist healthy, handicapped and diseased people in carrying out their everyday life activities using information and intelligence in the network connecting these components / devices.

As components / devices get smaller, more connected and more integrated into environments, technology virtually disappears until only the user interface remains perceivable by users.

Future Ambient Assisted Living (AAL) also includes Personal Health aspects and applications
Summary: Requirements and Services in eHealth/pHealth/ mHealth

- Confidentiality
- Integrity
- Availability
- Identification
- Authentication
- Authorization
- Non-Repudiation
- Privacy
- Usability
- Reliability
- Simplicity
- Auditability
- Transparency
- Robustness
- Handiness
- Efficiency
- Efficacy
- Scalability
- Self-Adaptation
- Range
- Power Consumption
- Reduction of Weight and Size
Thank you for your attention!

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