Personal Health Records, Mobile Biosensors and Smartphones for Developing Countries

Sternly K. SIMON and H. Lee SELDON
Faculty of Information Science & Technology
Multimedia University, 75450 Melaka, Malaysia

Telehealth is for

- Everybody, even those who are not ill
- People who do not have 24/7 broadband Internet access.
- People who probably do have cellphones or nowadays smartphones.

Christine Horn 2011

Basis of Telehealth

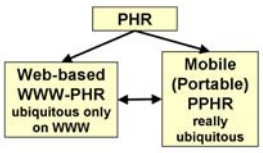
- Information about the person's health status. (Person, not Patient)
- Contained in the health record
- more specifically the Personal (or Personally Controlled) Health Record **PHR**

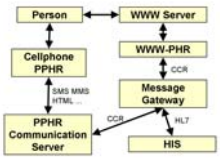
The PHR contains (ideally)

- Data stored by User / Owner (Person)
- Data stored by healthcare providers
- Data from measurements
  - Biosensors for temperature, blood pressure, heart rate, etc
- Contextual information (see Ahsan & Seldon)

The PHR is located

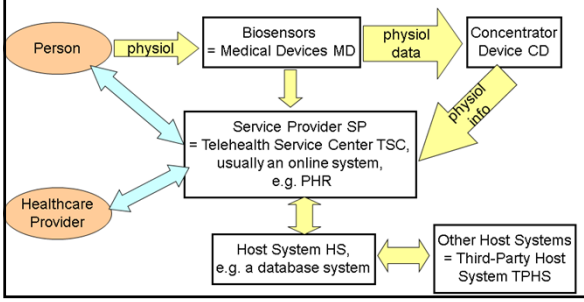
- online
  - Indivo (3.1 ...X), DOSSIA, MyOSCAR
  - Microsoft Health Vault
- on the phone
  - H'andy Sana 210, OnTrack Diabetes.





Biosensor "system"

- Overview Model

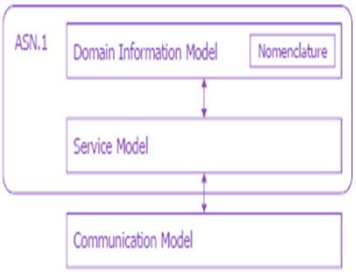


Biosensor standards

- Device standards
- Communication standards
  - USB Personal Healthcare Device Class
  - Bluetooth Health Device Profile
  - Zigbee Health Care Profile (802.15.4)
- ISO/IEEE 11073 Personal Health Devices (X73PHD)

Methods: Devices - Standards

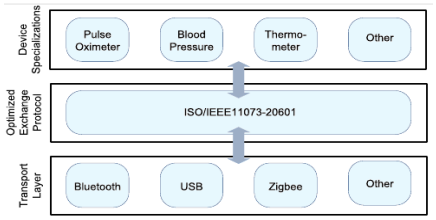
IEEE 11073-20601-2008 -an openly defined, independent standard for converting the information profile [of personal health devices] into an interoperable transmission format, so the information can be exchanged between personal biosensor devices and compute engines with this overall System Model.



X.73, Wikipedia 2008

Methods: Device Specialization

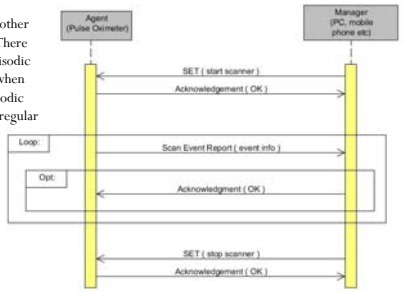
- IEEE 10404™- Pulse Oximeter
- IEEE 10406™ –Basic Electrocardiograph (1- to 3-lead-ECG)



X.73, Wikipedia 2008

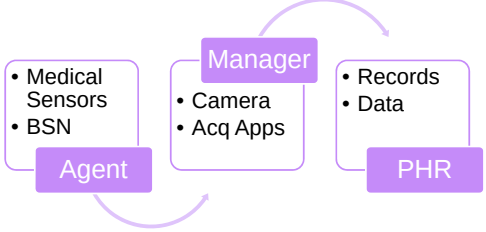
Methods: Device Message Exchange

A scanner can report measurements from several other objects in a single message. There are two types of scanner: episodic (which sends a notification when some event occurs) and periodic (which send notifications at regular intervals).



X.73, Wikipedia 2008

Methods: Extending Device Message Exchange



Our approach is to extend the Agent – Manager data transmission to the PHR system

Reality check

- existing biosensor devices do not adhere to standards – e.g. digiO2 CardioCare, (Nonin 9560)
- Portable Health Devices have no good market in developing countries
- Advanced smart phones have capabilities to replace biosensors
- standardization should allow phone manufacturers to integrate health device profile and sensors with hardware and software for ease of application development.

Reality check

- Nonin 9560 Onyx II Specification:

Oxygen Saturation Display Range: 0 - 100% SpO2
Pulse Rate Display Range: 18 - 321 BPM

- digiO2 Cardio Care ECG recorder Specification:

Baud rate=9600bps,Databits=8,
Stop bits=1,Parity bit=none, Flow control=none

Cardio Care ECG/EKG

Byte Sequence	contents	Comments
1	0x55	Start byte
2~3	0x00	
4	0x01	
5	0x81~0x88	Sequence code
6~21		ECG data package (Sampling rate = 256 Hz) (range = 0~4096)
22	0xB6	Stop byte 1
23	0xBB	Stop byte 2
24		Checksum package

Nonin Onyx 9560

To select the data format the host must send the 9560 the following 6 byte command string:

Byte 1	Byte2	Byte3	Byte4	Byte5	Byte6
Start(STX)	Op Code	Data Size	Data Type	Data Format	ETX
0x02	0x70	0x02	0x02	0xZZ where ZZ is (0D, 08, 07, or 02)	0x03

Nonin Data Packet

Three bytes of data are transmitted 1 once per second.

Byte 1 - Status

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
1	R	OOT	LPRF	MPRF	ARTF	HR8	HR7

*Note: Bit 7 is always set

Byte 2 - Heart Rate (HR-D

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
0	HR6	HR5	HR4	HR3	HR2	HR1	HR0

*Note: Bit 7 is always clear

Byte 3 - SpO2-D

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
0	SP6	SP5	SP4	SP3	SP2	SP1	SP0

*Note: Bit 7 is always clear

Byte 4 – Status2

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
0	R	SPA	R	SNSF	R	R	LOW BAT

*Note: Bit 7 is always clear

Another option: the phone

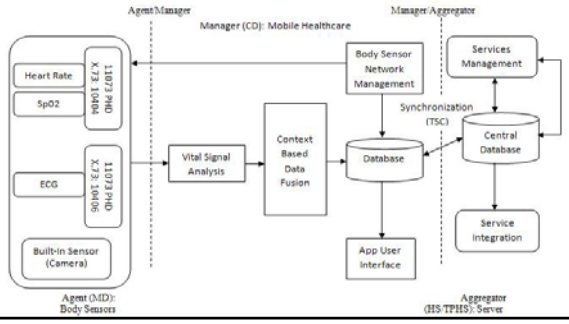
- Smartphone sensors
  - camera
  - accelerometer
  - gravity, etc
  - touchscreen

Phone sensors

- Camera
  - pictures of person
  - heart rate
  - SpO2??

Biosensor “system” phone

- Our Proposed Framework

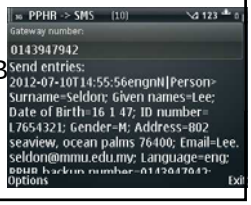


Putting health data online 1

- Most “remote data collection” systems require broadband
- SANA collects text, audio, images, video. Transmits via SMS & Wifi
- openRosa (openMRS) requires Internet connection
- X73 Specifies Agent – Manager data Transmission.

Putting health data online 2

- Opposite approach: reduce the volume of data with on-phone processing
  - mostly plain text
  - instead of ECG or PPG, transmit HRV parameters
  - shrink images to < 20 KB



Putting health data online 3

Issues of concern

- Transmission speeds/bandwidth
- Communication channel
- Security of transmitted data
- Integrity of data
- Privacy

Thank you!

- Collaborators since 2006
  - Hamid Moghaddasi, Tehran, Iran
  - Seo Wei Jye (Sam), Kuching, Malaysia
  - Jofry Sutanto, Pontianak, Indonesia
  - Wee JoNah (Shane), Kuching, Malaysia
  - Ali A.A. Al-Habsi, Yemen
  - S M Kalaiarasi, Melaka, Malaysia