Integrating Data and Network Standards into an Interoperable E-Health Solution

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Introduction

- E-Health
  - Raised expectations on improving the quality of health services
  - While simultaneously enabling health services cost reductions
- Adoption is growing
  - User self-monitoring, home monitoring, hospital systems, online consultations or online information, etc.
  - Efforts: too disparate and not concerted
- Systems for collection of medical data and its usage in EHR are unrelated and developed to suit a need
Future Health project

www.dcc.fc.up.pt/i-city/health

digiscope.up.pt

Sensemycity

Interoperable E-Health Solution

Auscultation
Oximetry
Blood pressure
Weight
Glucose level

Health Kiosk
@Primary Care Unit

Patient @Home

Environ. Temperature
Heart rate, QRS detection
Movement/position
Auscultation
Future Health project – Objectives

- Collect health data
- Apply signal processing to data to estimate/detect conditions
- Enhanced health information flow
- Smartphones as a continuous health monitoring device
Future Health project – Scenarios

- Health Kiosk
  - Self pre-consult checkup by patient
  - Transmitted to the EHR

- Home monitoring
  - Monitor a group of elder patients (around 10) at home
  - Transmit the data to the EHR either real-time or sporadically
  - Allow nurse’s home visits to also upload data to EHR
Future Health project

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EHR

Environ. Temperature
Heart rate, QRS detection
Movement/position
Auscultation

Sensemycity

Patient @Home
Mrs. Maria

- Elderly woman of 73 years
- Lives on the 3rd floor of a building near the town
- Wears a monitoring system
  - She is at risk of developing Alzheimer
  - Control heart condition

Has a wearable system

- Collects heart rate (variability, R-R interval), breathing rate, posture, activity level, geographical position and steps taken
- Uploads the data, using a mobile phone, to her primary care unit
- Data is stored in her EHR, indexed by her health id number
E-Health Service

- System
  - Analyses the data
  - Searches for patterns that indicate problematic conditions

The system detects the occurrence of arrhythmias!
  - Alarm is sent to her primary care unit and nurse phones Mrs. Maria
    - Recommend that Mrs. Maria rests the rest of the day
  - Doctor visits Mrs. Maria the next day
    - Change in medication
    - Rest the next day
  - The monitored values return to normal
  - Mrs. Maria resumes her daily walks
Our Proposal

- **Combine**
  - Machine-to-Machine (M2M) architecture to enable the simple integration of monitoring devices into the system
  - OpenEHR for storing health records
  - Health Level 7 (HL7) for conveying medical information

- **Goal**
  - Define a framework that interconnects these standard structures
Our Proposal – Benefits

- Leverage accepted (de-facto or other) standards
  - ETSI M2M is the ref architecture for global, end-to-end M2M communications.
  - OpenEHR is a non-proprietary standard architecture for electronic health records
  - HL7 is the most widely implemented standard for health care information worldwide

- Provide a modular, scalable, and inter-operating architecture
Interoperable E-Health Solution – Architecture

Event-based M2M communications
Flow is possible in both directions: M2M devices ⇔ OpenEHR
Events examples

- Processor (NA)
- Mobile Phone (M2M GW)
- Processor (NA)
- M2M Broker (NSCL)
- OpenEHR (NA)
- GPS
- RR
- RR
- RR
- RR

Subscribed to GPS
Interoperable E-Health Solution – Mapping Resources

- structure follows ETSI M2M
- RESTful architecture
Interoperable E-Health Solution – Subscriptions

M2M GW

Bootstrap/ Autentication

M2M NSCL

Bootstrap/ Autentication

NA

EHR
Interoperable E-Health Solution – Event Notification

M2M GW → M2M NSCL
- POST /m2m/scls/userID/applications/Position/containers, ID=GPS
- POST /m2m/scls/userID/applications/Position/containers/GPS/contentInstances/, <RAW payload>

M2M NSCL → NA
- POST /m2m/scls/userID/applications/ProcessedData/containers/HL7_Location/contentInstances/, <PROCESSED payload>

NA → EHR
- POST /m2m/scls/userID/applications/ProcessedData/containers/HL7_Location/contentInstances/, <PROCESSED payload>
Conclusions and Future Work

Advantages

- Scalability and reliability of M2M systems
- Fast reaction in critical conditions due to publication mechanism
- Inter-relation between M2M and OpenEHR using HL7

Further Study

- Data redundancy
- Study delay between NSCL and OpenEHR introduced by the use of intermediaries

Implement framework with a primary care unit and 10 elders
Thank you for listening
Questions? Feedback?

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