Intelligent eHealth Infrastructures in the Future Internet

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Introduction

Intelligent eHealth infrastructures in the Future Internet will need to support the various tasks and services of the healthcare systems of the European member states. They play an important role to tackle the challenges arising from the constantly growing demand and the limited resources for improved healthcare services for all citizens. In this context, especially the prevention of chronic diseases has a high potential to meet the challenges of the demographic change. eHealth services in the Future Internet could for example aid to early detect organic manifestations that may be treated with relatively low expenses or even aid to lower the occurrence of diseases.

Internet-based eHealth systems and *personalized* services are also the answer to an emerging consumer market in the eHealth sector. Today, almost 60 percent of adults (in the US) use the Internet as a basic resource for health and wellness information. The FI PPP addresses platforms for eServices that will not only provide a secure, personalized and *trustworthy access to information* but also new kinds of consumer services that support healthy behavior, prophylaxis and personal monitoring. For example, patients suffering from a manifested chronic disease can be prevented from life-threatening complications by remote patient monitoring. Next to that, the eService platform will also allow for *intelligent* new ways of supporting patient management, medical treatment and rehabilitation.

(1) What use case and scenario in your area would you consider the most appropriate and representative one for large-scale experimentation with the Future Internet platform to be built starting from 2013?

In Germany alone there are about 100,000 cases of sudden cardiac death per year. We propose an early warning system to prevent myocardial infarction in risk groups affecting traffic situations (e.g. bus drivers, truck drivers, drivers over the age of 70). These persons would receive a continuous ECG monitoring with the objective to immediately detect marker arrhythmias. In parallel, their positioning (GPS) data would be monitored to immediately initiate a (medical) intervention in case of emergency.

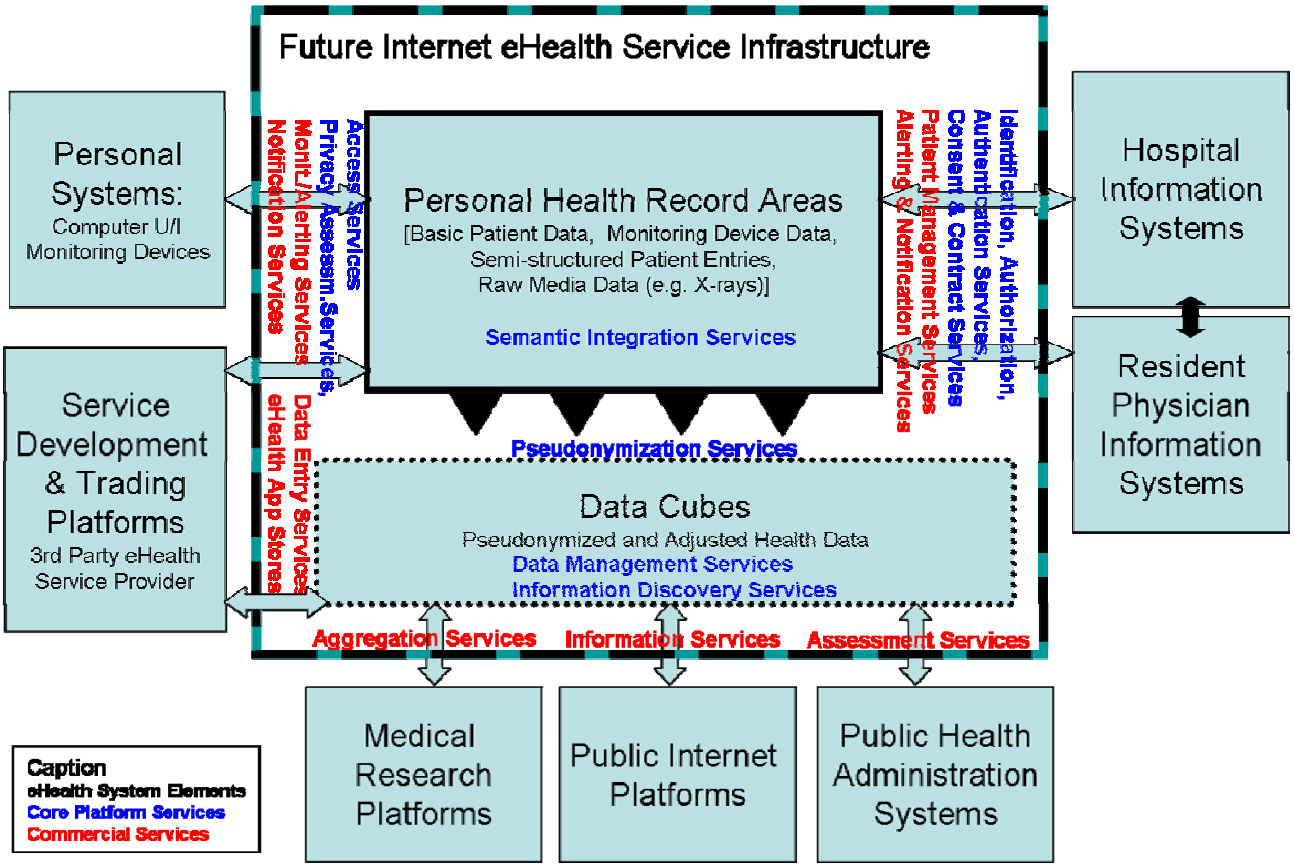
As a pretest for determining the mobile network infrastructure requirements, field tests in the context of marathons with about 20,000 runners and about 5,000 ECG streamings (via foot sensors) in a relatively narrow area would provide information on the requirements for mobile bandwidths and mobile services.

(2) What innovative Internet functionality and technologies would you consider important for your suggested use case and scenario?
In connection with the scenario we consider 3 objectives as important for the FI PPP eHealth Service Infrastructure:

- Leveraging patient monitoring to individual prevention and healthcare assistance. Personalized services so far may lead to safety gains for the patient while the contribution for an individualized and optimized therapy is still limited. A perspective towards individual disease prevention and health assistance is to integrate structured monitoring data and semi-structured individual patient entries along a time line, e.g. through personal eDiaries. Data aggregation and analysis from the diaries may lead to treatment assistance and will furthermore provide consolidated findings on relevant monitoring parameters.
- Overcoming the contradicting demands for interoperability and privacy. A major key challenge of FI technologies in the health sector is interoperability within healthcare organizations (intramural) and even more in exchange with other players (extramural). Conventional healthcare organizations are regulated for their storing and exchanging of medical health records for security and privacy reasons. These regulations differ among the EU member states. Personal electronic health records (PHR) governed and maintained by the citizens themselves could be a key factor for optional information sharing between citizens and health professionals, but as well for information sharing between regional health information systems. This approach, pioneered by Google in the US, has already swapped over to some European member states, e.g. the U.K., and is accompanied by continuous privacy and security discussions.
- Realizing eHealth data pooling for medical research / disease prevention through user-empowered information sharing. This requires pseudonymization technologies that will allow the citizens and medical professionals to publish health data absolutely anonymously and collect them in a (virtual) data cube.

(3) Which of the identified functionalities would you expect the Future Internet core technology platform to deliver to support your and other usage area scenarios?
The Internet core technology platform should comprise at least:

- Access Services
- Privacy Assessment Services
- Identification, Authorization, Authentication Services
- Consent and Contracting Services
- Alerting & Notification Services
- Semantic Integration Services
- Data Management Services
- Information Discovery Services



(4) What kind of experimentation environment would you consider necessary for broad large-scale testing of the platform to be developed in your use area? What would be needed to experiment new services and applications cutting across use areas (services and application mash-up) and building a new services and application ecosystem around the prototype implementations of the platform?

The experimentation environment could be built up around the German pilot project »Fontane« run by a consortium of Charité, Deutsche Telecom AG and Hasso Plattner Institute. Fontane today already successfully demonstrates the benefits of remote monitoring of patients living in undersupplied areas of Brandenburg. Data provided by the patients are computed and transferred via a »telemedicine box« to the Charité hospital (Berlin) where emergency cases are detected in real time and a fast treatment can be initiated. Fontane can be extended to meet the full range of functionality as previously described.

The experimentation environment would as well integrate experiences from epSOS, one of the most advanced European eHealth projects. In epSOS, a framework and ICT infrastructure for secure access to patient health information between the different European healthcare systems is developed.

New services and applications would be at least:
- Continuous ECG monitoring in mobile environments (e.g. vehicles)
- Invention of citizen-controlled personal health records
- Invention of eHealth data cubes and corresponding pseudonymization technologies
- Invention of privately organized eHealth App Stores and innovative Service Development & Trading Platforms
- Development of interfaces for the communication of hospital information systems and personal health records according to regulations in different EU member states.

(5) How do you see the potential role of your organization in the FI PPP, in the context of usage areas taking a prominent role in the initiative, to ensure an appropriate application-driven approach?
As we understand it, the use scenarios in the FI PPP will specify requirements for the eHealth infrastructure, align them with the technologies of the core service delivery platform, and test them in large-scale, »real life« environments. For our participation in a use case consortium, we can offer the following:
- Charité Berlin is one of the largest European Health Centers. It is experienced in providing remote patient care (e.g. »Fontane«, »Partnership for the Heart«) and provides a »real life« test bed in urban as well as in rural environments.
- Fraunhofer ISST has broad experience in the specification and realization of eHealth infrastructures (epSOS, German EHR, German eHealth ID) as well as with telemedicine applications and with service certification.

We are in touch with a great number of potential complementary partners such as Asklepios, Germany (network of private healthcare centers); CareCom, Denmark (semantic technologies); CompuGROUP, Germany (one of the leading eHealth providers in Europe); DFKI, Germany (semantic technologies, e.g. THESEUS MEDICO, M2M-/RFID-project »SemProM«); FZI, Germany (biosignal processing, mobile sensor technologies, health monitoring, smart clothing); Hasso Plattner Institute, Germany (eHealth and telemedicine research); NetSmart, Greece (identification, authentication, pseudonymization); Secunet, Germany (identification, authentication, pseudonymization); Siemens Medical, Germany (e.g. THESEUS MEDICO); Tiani Spirit, Austria (data registries and repositories); Transinsight, Germany (software / search engine for semantic gene and protein identification); T-Mobile, Germany (telecom provider); University of Ankara, Turkey (authorization and trust engineering).
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