A Proposal for Building the European Patient Summary using Triple Space Computing

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One of the **key action items** of the European Community in the field of *eHealth* is the **patient summary** [1] as an instrument to facilitate the pervasive delivery of healthcare, thus ensuring the right to patient mobility throughout Europe.

The achievement of this objective requires powerful middleware which is able to cope with the stringent requirements of the eHealth setting (e.g., privacy, cost effectiveness, reliability) further stressed by the European dimension of the problem. Due to the **international requirement,** the **prospective** European Patient Summary (EPS) must address the problem of **multilingualism** and adopt a **multilateral solution** that respects the **principle of subsidiarity**.

- **Multilingualism** requires that information is captured in a linguistically neutral manner (e.g., by resorting to one or more of the available coding systems as ICD, ATC, SNOMED-CT), and to be presented to the user in the suitable natural language.
- Envisioning a **multilateral solution** imposes the requirement for a virtual common IT infrastructure that is distributed among healthcare organizations, while still guaranteeing the (authorized) access to citizens' critical health data anytime and anywhere in Europe.
- The **principle of subsidiarity** requires the underlying infrastructure to be able to cope with the heterogeneity of data, protocols, and processes (cf. IHE) among existing systems and established eHealth standards.

Semantic Web Services are a promising technology with which to build the European Patient Summary. Several European projects are working in this direction: ARTEMIS, RIDE, COCOON, SemanticHEALTH, to name a few. However, the current Semantic Web Service infrastructure does not provide support for decoupling of messages in space and time so that data can outlive the services publishing or consuming it. What is needed is a distributed system that enables **asynchronous, reliable and meaningful communication among heterogeneous information systems** [2]**.** Triple Space Computing [3] (see http://www.tripcom.org) is an innovative computing paradigm that improves: i). classical coordination systems based on **tuplespaces** and **Linda** [4] by adding awareness of semantic; and ii). (Semantic) Web Services by adopting the flexible and powerful asynchronous communication model of tuplespaces.

To illustrate how the European Patient Summery (EPS) can be realized using Triple Space Computing we present briefly a hypothetical use case of an English citizen traveling to Italy.

On day three of his coach-trip to Italy Mr. J. Smith is involved in a major traffic accident. Many of the travelers on his bus are injured. J. Smith suffers a fracture and shows symptoms of shock.

Due to the seriousness of the accident most ambulances of the region are called. The medical staff has access to the newly established EPS triple space system through mobile devices. This allows them to *instantly have access to relevant information* about the injured persons in order to provide the best possible treatment on the spot. Moreover, the system permits the different care units to *collaboratively treat the victims* and *to synchronize their activities*.

A. Bonardi, the rescue worker that first finds J. Smith, searches in the EPS for his clinical data by first *identifying the correct person* with the available information -- here he uses the passport number -- and then *requesting a reference* (e.g., a unique URI expressed in UHID) to his patient record. According to European *privacy policies*, A. Bonardi is allowed to *read all necessary information about allergies, immunizations, currently prescribed medication and contagious diseases*. This is controlled in the EPS by appropriate Access Control Lists (ACLs) based on predefined roles. The information requested by A. Bonardi is *presented to him in Italian*, as the application running on his mobile device can query terms inside the EPS through the HL7-CDA format, which follows multiple (*in accordance with the subsidiarity principle*) standardized medical terminologies with an official translation for their terms in Italian language.

For instance, under normal conditions A. Bonardi would provide J. Smith with a dose of "morfina" (the Italian name of the analgesic "morphine"). According to John's record (*which was written in English using a different coding system*) he however repeatedly showed allergic reactions to morphine and the first aid assistant prefers to administer "oxycodone".

Only shortly thereafter the ambulance doctor Dr. L. Crisanti and her team take over the care of J. Smith. From his latest EPS entry they notice the medication and treatment he already received and a description of the injury published by A. Bonardi.

Back home in England, the eHR of the general practitioner responsible for J. Smith receives from the EPS in OpenEHR format (*different from the HL7-CDA used in Italy*) the update of the information about the emergency recovery and the treatment received by J. Smith.

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