Triple Space Communication

An infrastructure for seamlessly and securely sharing healthcare data

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eHealth is a very demanding field populated by organisations of any dimension (from large hospitals, to small laboratories and even single practitioners surgeries) in which the common problems of any e-business scenario are amplified by the intensive use of knowledge, the need to accurately handle citizens' privacy, and life or death implications. For these reasons, the actors involved ask at the same time for autonomy in information gathering and in decision making and for the completeness, accuracy and reliability of information exchanged. Autonomy induces heterogeneity whereas completeness and accuracy call for seamless and frictionless information sharing. For these reasons e-health has been seeking for semantic interoperability for more then a decade.

An open challenge in e-health is factually and securely sharing health data among healthcare organisations (such as realising a multi-language interoperable European patient summary and a Personal Health Record), thus providing authorised healthcare professionals with a complete array of patient information. Many standardisation activities (e.g. HL7 CDA, openEHR, CEN ENV 13606 / EHRcom, DICOM, IHE) are addressing this problem, but none of them have achieved the desirable level of flexibility.

TripCom is a European Commission funded 6th Framework Programme project starting in April 2006, which aims to develop a highly scalable, semantically enhanced communication infrastructure named Triple Space Communication. Such an infrastructure is the result of the integration of Tuple Space, Semantic Web (triple), and Web service technologies. Tuple Space and Web services provide a platform for application integration based on persistent publication. Semantic Web provides machine processable semantics in order to allow the mechanised integration of services (data and processes). By decoupling communications, TripCom will reduce (if not eliminate) the need for *a priori* knowledge of the partner and communication channel thus enabling multi-party interaction for free.

Just as the web revolutionised Internet usage through humans, so Triple Space Communication will change Internet usage through computers.

Limitations of existing approaches

Currently, there are two existing approaches to sharing healthcare data:

- building centralised databases that would
    - contain all medical records on every patient
    - incorporate all of the different access rules and policies regarding different users and different levels of access

- exchanging messages only when needed
    - in this way, no central repository is required and the ownership of the data seems respected

However, each of these approaches has its limitations. In terms of the centralised approach, the cost of building the infrastructure and collecting the data is enormous, the centralised repository approach creates competitive and security issues about who controls and has access to information on a specific patient, it is difficult to keep up-to-date a repository originating from a large number of independently evolving systems and a message once sent gives the owner a sense of disengagement instead of strengthening the sense of ownership.

In terms of the message-based approach, each recipient must know in advance where to look for information and the terminology to use when asking for a specific record content. Furthermore, each recipient ends up maintaining a specific interface for each system it has to interact with and mining (for disease prevention, early diagnosis, pharmaceutical research, enhancement of patient safety) becomes almost impossible due to the large amount of messages to be exchanged.

Benefits of the Triple Space approach

The Triple Space approach is a realistic solution to the data ownership problem because healthcare organisations will not lose their control over resources and they will be able to share the information only with those that are authorised. It provides a simple way to guarantee consistency because health data will not be transmitted or copied but simply used, it provides a straightforward way to deal with integrity because data will not be transmitted and it should be impossible for anybody but the owner to modify the data. Finally, it is a cost-effective solution because additional storage resources (and the related management costs) are drastically reduced.

Advantages of Triple Space Communication

Time autonomy

Providers of data can publish data at any point in time

Location autonomy

Once published, the data becomes independent of providers' internal storage (thus available even if the providers are not online)

Reference autonomy

Providers are independent of the knowledge about potential readers

Schema autonomy

The data is represented independently for any provider internal data schema

Conclusion

Sharing healthcare data while respecting parties' autonomy and citizens' privacy is a very demanding test-bed for the TripCom infrastructure because it poses significant challenges in terms of

- Interoperability: TripCom should provide a distributed infrastructure that enables the maximum decoupling (i.e. time, space, information schema and terminologies) between the various recipients that own the information (e.g. labs, GP's patient file, hospital information systems, etc.) and those recipients that need to elaborate such information (e.g. an application on board ambulance). In other words, TripCom is required to support different e-health services (ranging from general practitioner electronic patient records to hospital information systems, including mobile devices like those used by nurses in home care) by writing information in a way that other e-health services can later access it without regards to the standard they implement (HL7, ENV13606, etc.).

- Information security and trust: TripCom should enable the enforcement of Authentication and Authorisation rules in a way which is not commonly available and quite worthy in highly decentralised scenarios such as healthcare, in which every party involved is responsible for keeping the ownership of the data, but the health of citizens depends on the ability to reliably share data.

To visit the project site: www.tripcom.org

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