Informatics

Standards-based Clinical Data Repository

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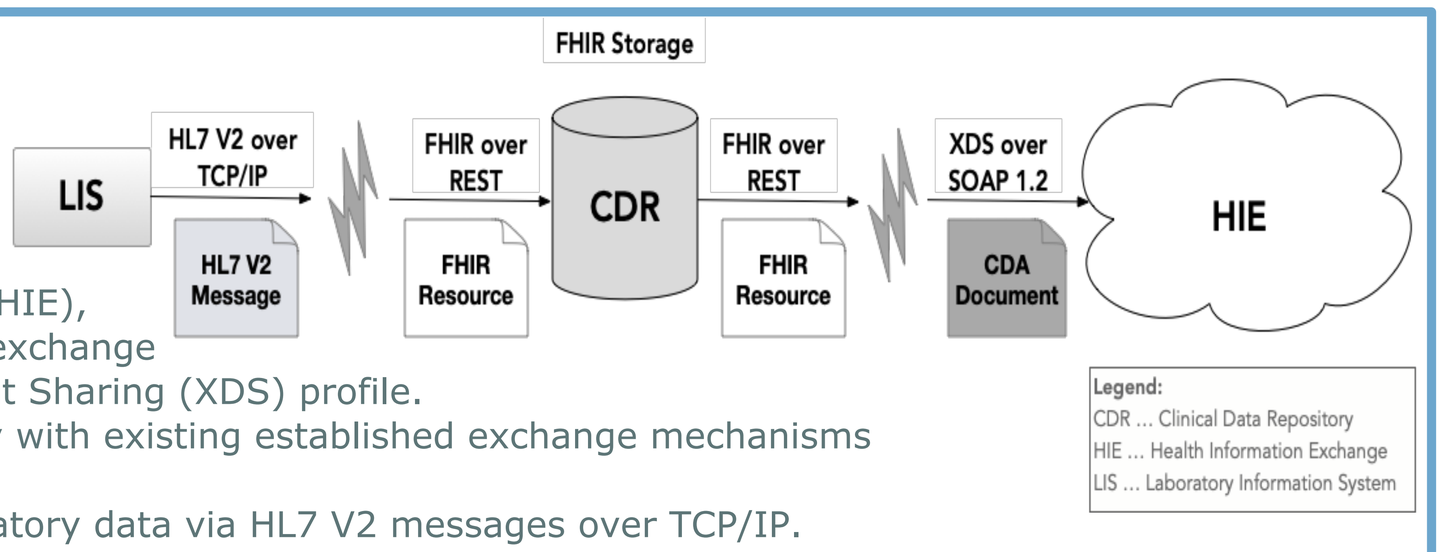
Problem

- Enabling the electronic data exchange between a laboratory and relevant healthcare providers improves the current treatment processes.
- The aim is the connection between a laboratory and an existing distributed Health Information Exchange (HIE), where several healthcare providers are connected to exchange medical documents via the Cross-Enterprise Document Sharing (XDS) profile.
- A challenge is to perform the integration transparently with existing established exchange mechanisms and interfaces.
- The Laboratory Information System (LIS) sends laboratory data via HL7 V2 messages over TCP/IP.
- A FHIR-based Clinical Data Repository (CDR) has to be established for the storage and management of the laboratory data.
- The Clinical Document Architecture (CDA) standard is used to create a structured document, which has to be exchanged with the participating healthcare providers of the HIE.
- A Health Service Bus (HSB) has to be developed to support the communication between the LIS, the CDR, and the HIE participating systems and components.

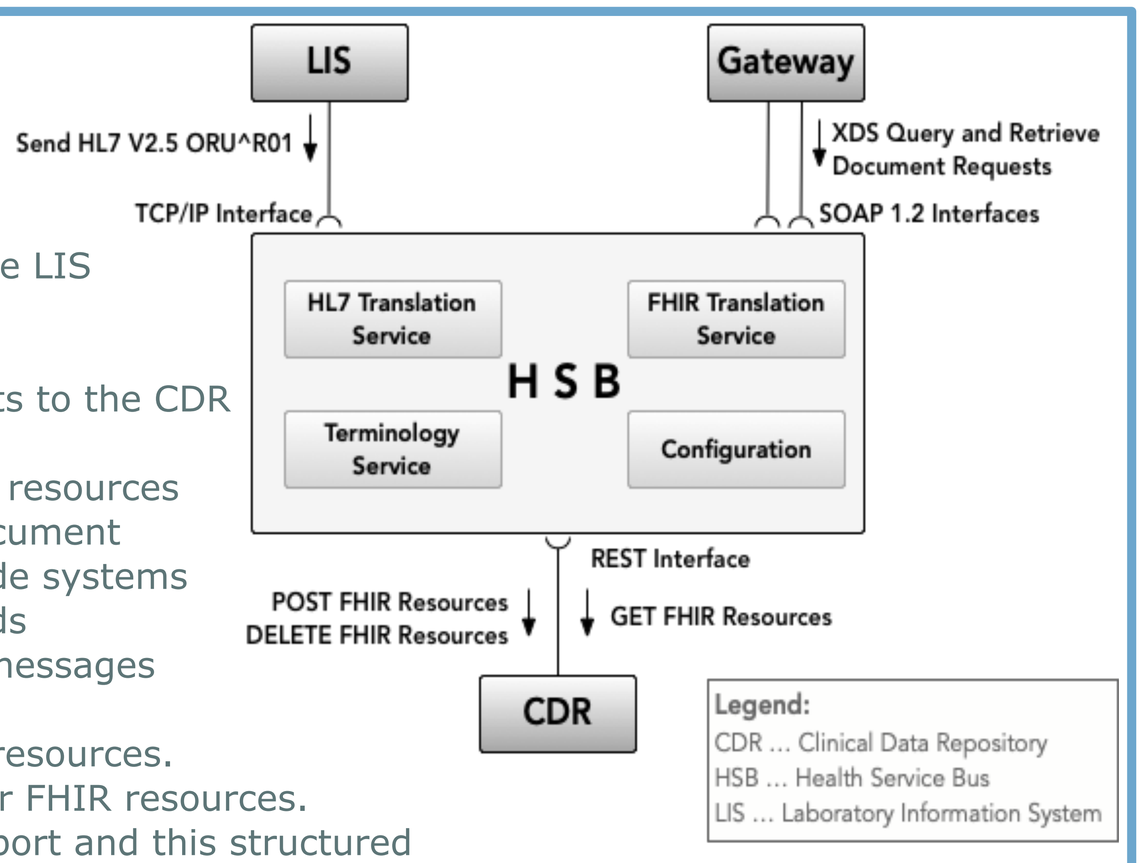


Approach

- Examination of the standards HL7 V2, FHIR, and CDA and identification of their strengths and weaknesses.
- Analysis of the HL7 V2 ORU^R01 message to get an understanding of the sent laboratory data.
- Definition of the HL7 interface and specification of the mappings from HL7 V2 into FHIR.
- Definition of the XDS interface and specification of the mappings from FHIR into CDA.
- Development and deployment of the software components.
- Evaluation of the developed software solution and in particular the translation engines.

Implementation

- Setup of a laboratory environment with a Java-based HSB and a Java-based FHIR server, which acts as a CDR.
- Development of the following HSB endpoints:
  - An incoming TCP/IP endpoint for receiving HL7 V2 messages from the LIS
  - An incoming SOAP 1.2 endpoint for receiving XDS requests from the HIE Gateway
  - An outgoing REST endpoint to send, store, delete, and query requests to the CDR
- Development of the following HSB services:
  - HL7 V2 Translation Service to transform HL7 V2 messages into FHIR resources
  - FHIR Translation Service to transform FHIR resources into a CDA document
  - Terminology Service, which persists and manages value sets and code systems and provides mappings between the codes of the particular standards
- The HSB receives HL7 V2 messages from the LIS and transforms the messages into FHIR resources.
- The HSB transmits the FHIR resources to the CDR, which persists the resources.
- The Gateway sends XDS requests to the HSB, which queries the proper FHIR resources. The retrieved FHIR resources are converted into a CDA Laboratory Report and this structured document is returned to the HIE Gateway.



Conclusion

- The integration of the laboratory with the HIE was successful.
- An adequate mapping from HL7 V2 into FHIR and further from FHIR into CDA has been defined.
- Gaps between the particular standards have been identified and where necessary an extension of the data structure has been defined.
- FHIR has proven its suitability as a flexible and robust storage format and it is able to provide the appropriate data structure to map laboratory data from HL7 V2 and convert FHIR resources to a CDA document.
- There are clear benefits in using open standards like HL7 V2, FHIR, and CDA compared with the development of a proprietary solution. Using open standards saves time and costs. It allows to gain from the experience of experts, who continuously improve these standards.
- The HSB fits for the purpose of supporting the communication between the participating systems and components. It controls the data flows between the particular systems and provides an adequate message translation.
- Furthermore, the developed approach could be adapted to bridge connection gaps for other domains like radiology or pharmacy.