PUBLIC RESEARCH CENTRE HENRI TUDOR

Workshop 2

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> *Interoperability* <

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Interoperability definition

Interoperability: Ability of two or more systems or components to exchange information and to *predictably* use the information that has been exchanged.

Syntactic interoperability *(interchange)*

Syntax → Structure

Semantic interoperability

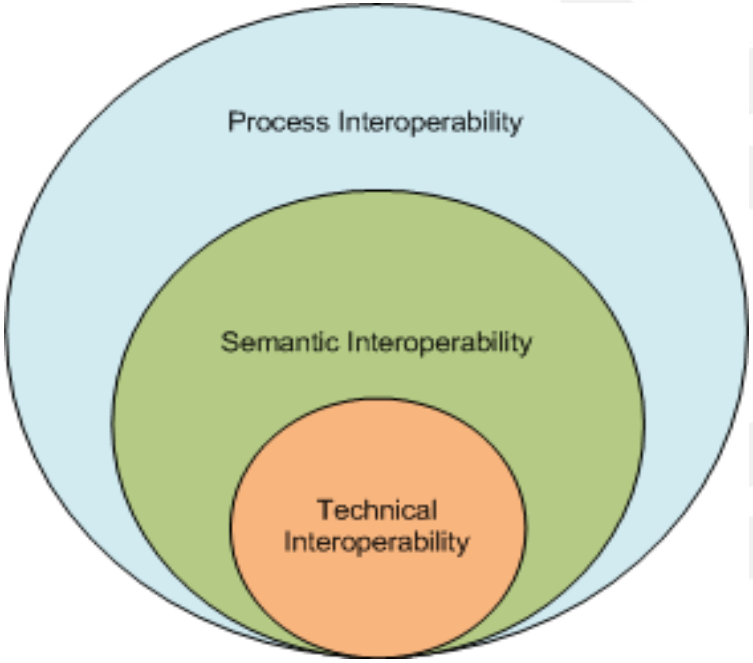
Semantics → Meaning

Semantic Interoperability *means reliable, predictable exchange of meaning between two parties, be they machines or persons.*

Picture from NCI-Wiki (https://wiki.nci.nih.gov)

Interoperability in healthcare

- **Three Interoperability classification types**
  - **Technical Interoperability**
    - … neutralizes the effect of distance
  - **Semantic Interoperability**
    - … communicates meaning
  - **Process Interoperability**
    - … coordinates work processes



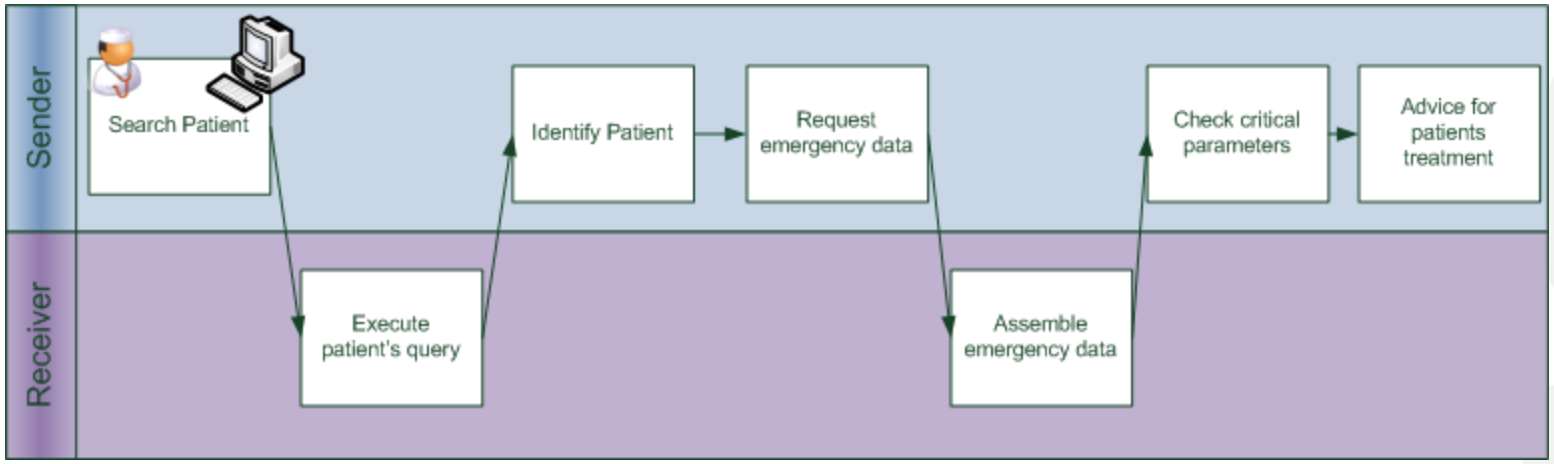
Technical Interoperability

- Connectivity across the network and across applications
- Reliable data transport, no interpretation on it's meaning
- Simple exchange:
  - Sender sends a message through the network, receiver receives it in complete and correct form
- Exchange with defined message format:
  - Sender structures the message in an expected form (data elements appear in a defined way within the message, but no meaning is specified) e.g. HL7 version 2.x
- More complex exchange:
  - The data are mapped in an agreed-upon form, where data models define how data in the message are related to other data e.g. HL7 Reference Information Model (RIM)
  - Receiving system can understand how the data received fits into a predefined model

Semantic Interoperability

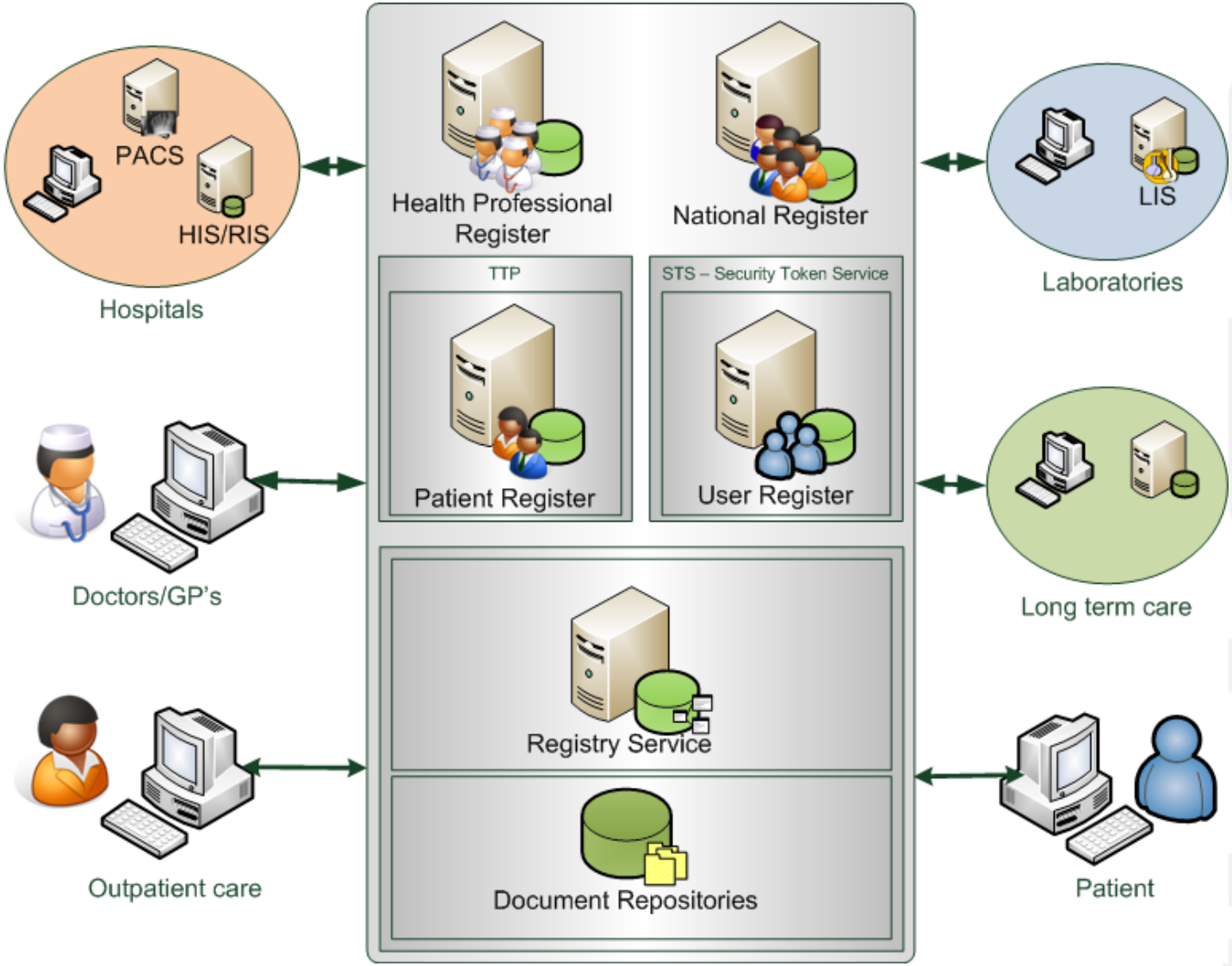
- The content will be understood in exactly the same way by both sender and receiver
- Regardless of how the data is transmitted technically
- Provides structured, sequenced, unambigious content
- Meaning is based on Controlled Vocabularies, for example:
  - Terminology or thesaurus: Set of words or word groups with a specific meaning in a domain. These sets are called « terms »
  - Nomenclature: Sub-set of a terminology, made up of the « terms » or groups of terms and their relationships
- The greater the level of software-level semantic interoperability, the less « human » interaction is required

Process Interoperability



- Workflow- and systems engineering as key to improving safety and quality in health care
- Design and implementation of human work processes, which increasingly include interaction with computer systems
- Requirements and constraints on how information is provided for use in real-life situations e.g. when critical summary information is needed, current diagnosis, medication, allergies, sensitivities, relevant lab results to support best patient treatment
- Process-driven characteristics, such as filtering, summarization and alert triggers where time is critical and workflows must be optimized

eSanté platform services overview

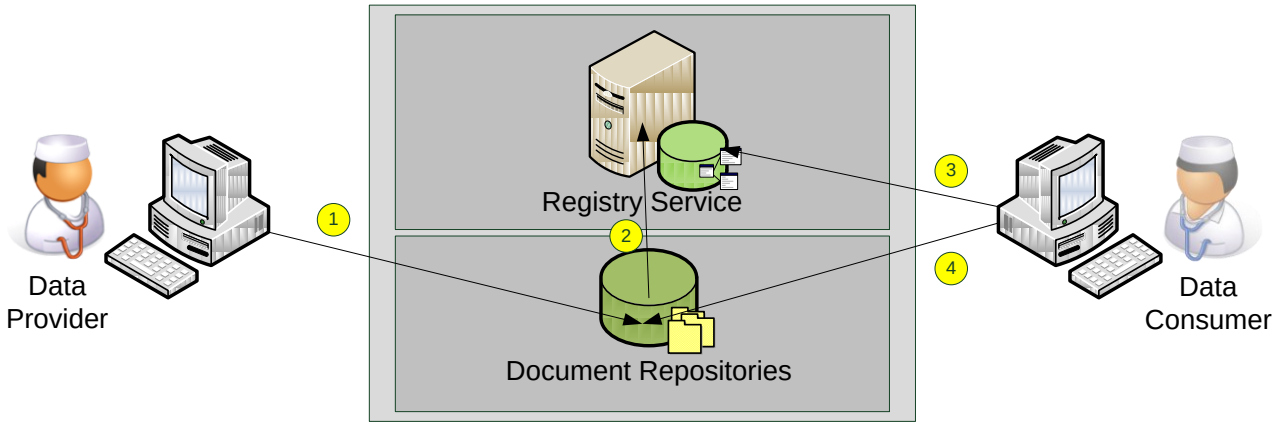


eSanté platform services overview (2)

- Health Professional Register
  - Demographic data
  - Medical profession, structural role in healthcare sector
- National Register
  - Demographic data of registered persons of Luxembourg (citizens, members of the social security insurance)
- Patient Register
  - Trusted Third-Party
- User Register
  - Authentication / Authorization
  - Security Token Service
- Document Registry
  - Index of health related documents
- Document Repositories
  - Storage for medical reports

Document sharing (1)

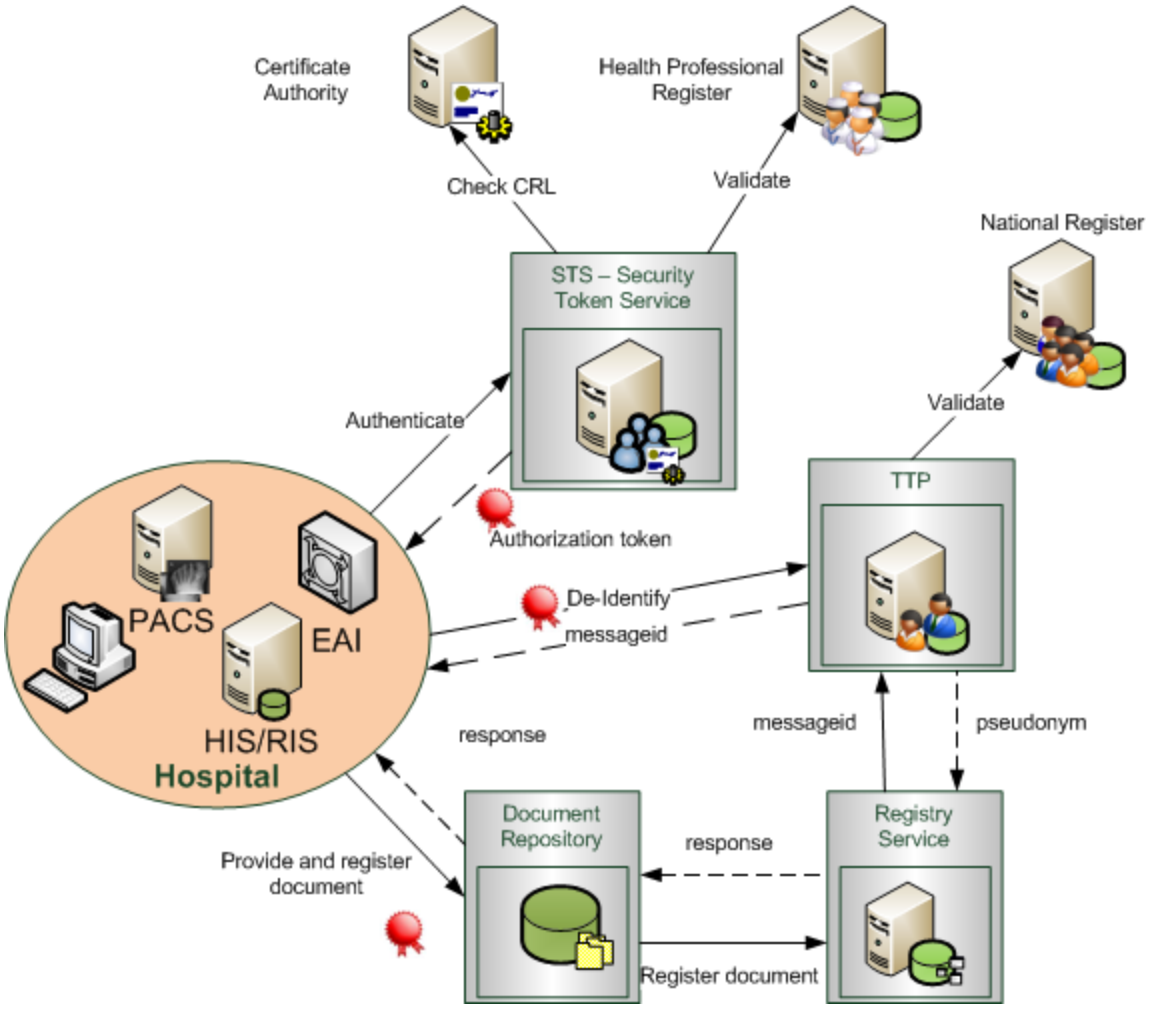
- **Standard approach**
  - **Creation of medical report e.g. as CDA R2 Level 2(not shown)**
  - **Data Provider authentication (not shown)**
  - **Submisson of metadata and encrypted medical report to a Repository, => persistent storage for documents**
  - **Registration of the report metadata inside the Registry**



Document sharing (2)

- **Registry**
  - **Unique index of all medical reports**
  - **Provides queries to search for specific reports**
  - **Reference to the document's persistent storage location (URI)**
  - **Relationships between documents can be established**
- **Repositories**
  - **Multiple instances supported**
  - **Persistent storage of medical reports**
  - **Provides functions for document retrieval**
- **Works well for different kinds of documents e.g. PDF, CDA and images also.**

Technical Interoperability with the platform



Technical Interoperability with the platform (2)

First idea:

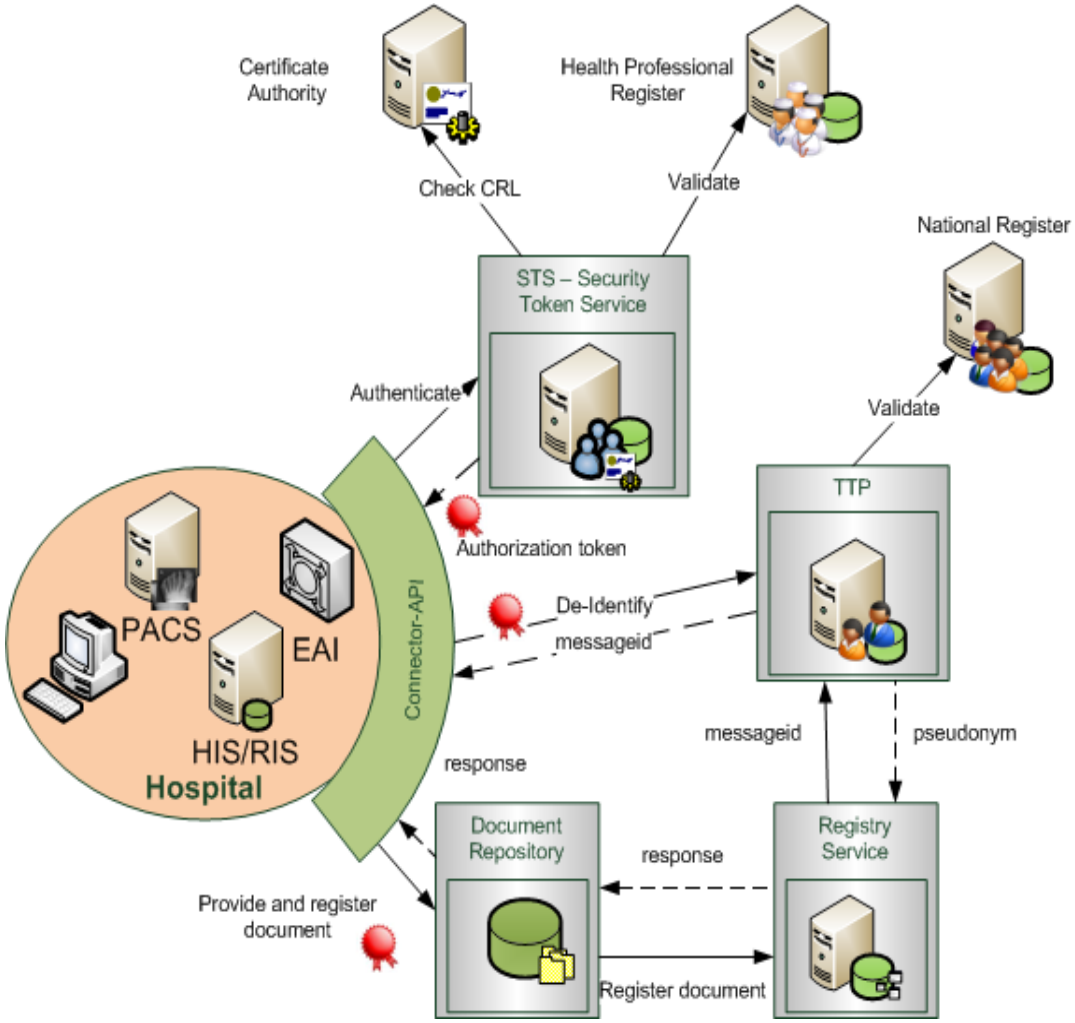
- Healthcare providers who want to share or retrieve medical data using the platform, have to integrate the required functionality in their software systems
- Platform protocols must be supported by their applications (e.g. ebXML, Https, SOAP, WS-Security, WS-Trust)

We are facing different problems:

- Different software systems in different versions are used by the healthcare providers (heterogeneous environment)
- Huge gap between requirements for the communication with the platform (e.g. Certificate handling, secure authentication, signature,encryption) and the functionality provided by the applications
- Even if we rely on standards (e.g. HL7, IHE profiles), it will not be easy to force the software vendors to fulfill the requirements

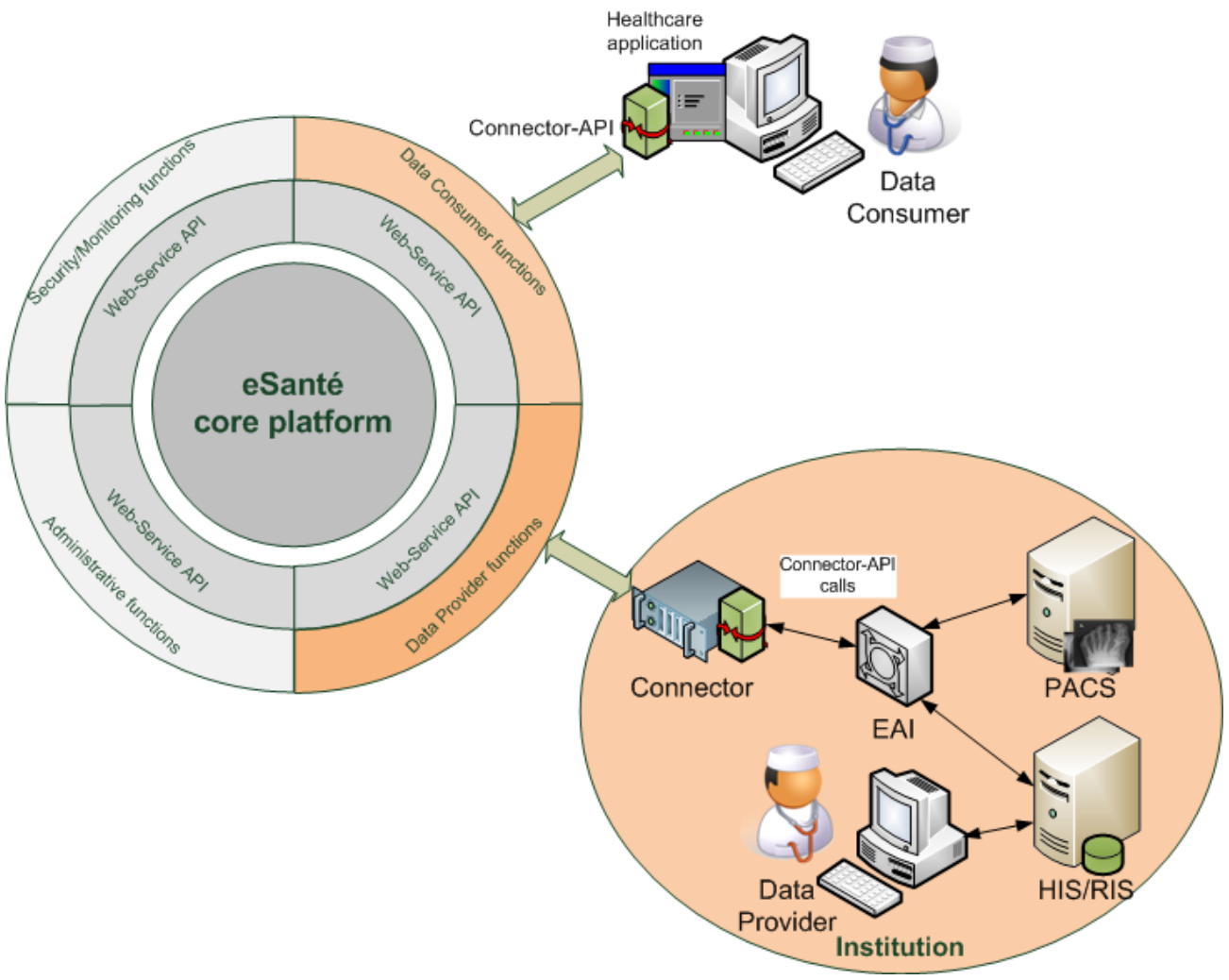
Technical Interoperability with the platform (3)

The proposed solution, introduction of a Connector-API



Technical Interoperability with the platform (3)

Connector-API resides at Data Provider and Data Consumer side

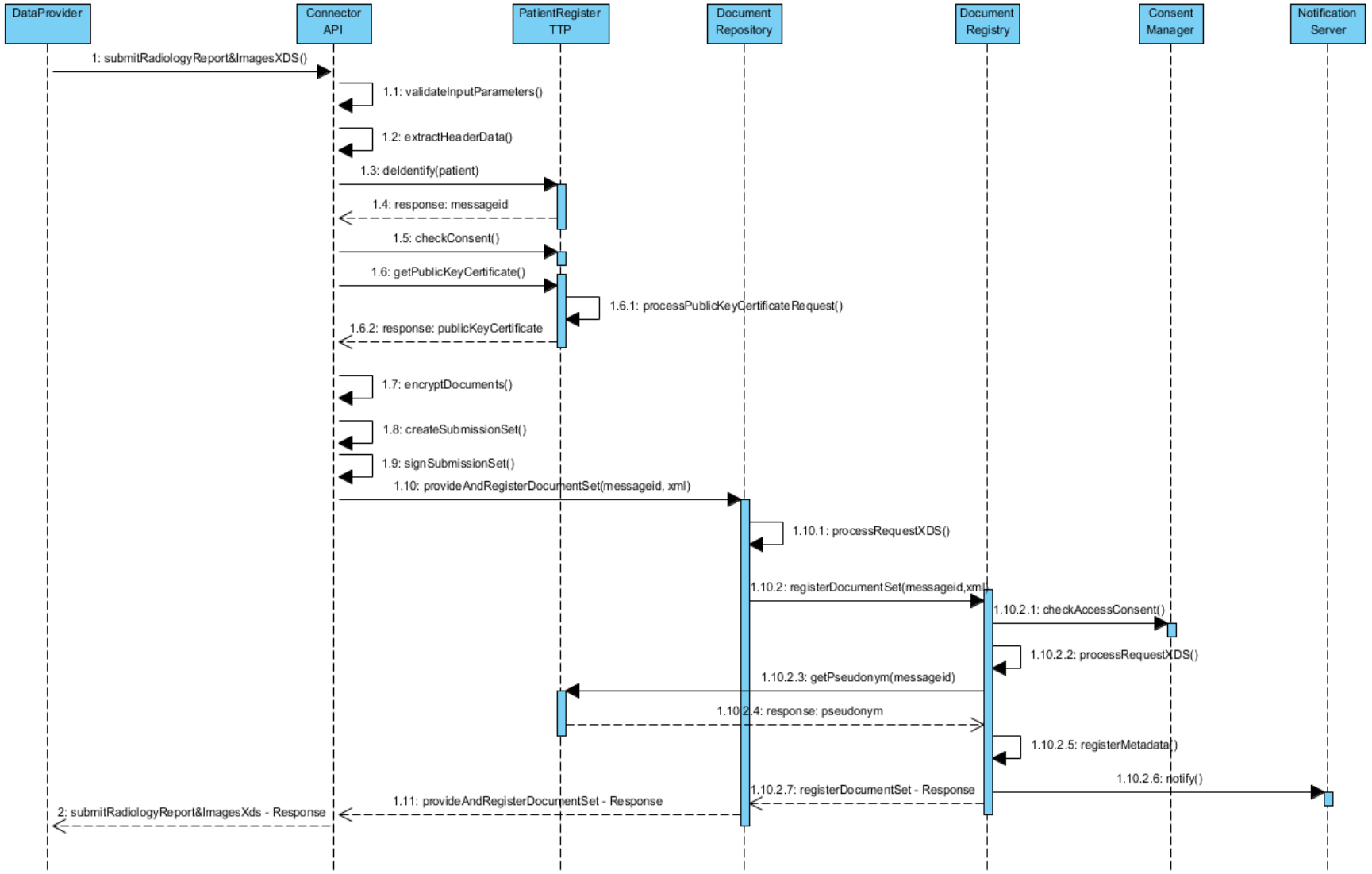


Technical Interoperability with the platform (4)

Connector-API

- Provides functional interface with well defined transactions for the Data Providers and Data Consumers
- Should be easier to call/integrate with third-party software
- Covers the whole communication with the services of the eSanté platform, including also security related functionalities
  - Signature
  - Encryption, Decryption
  - Certificate handling
- Runtime environment of the Connector-API could be used:
  - As standalone system e.g. as a Connector – server in hospitals
  - Integrated and linked with the third-party application or applet
- Connector does not add additional views for Data Consumer, third-party applications must provide this

Example sequence diagram



Semantic Interoperability with the platform

- Platform will be used for sharing medical documents
  - e.g. laboratory results, radiology reports, discharge letters, referral letters
- Shared documents should be in a processable format
  e.g. CDA R2 Level 2 (Clinical Document Architecture) document format
- Metadata of documents will be stored in the Document Registry
- Searching for documents should be based on these metadata which describe documents content
  - Document content could not be included into the search because documents are encrypted
- Metadata of documents must be understood by the Data Consumer
- The content of the documents should be used and be correctly processed at Data Consumer's side

Semantic Interoperability with the platform

Current problems:

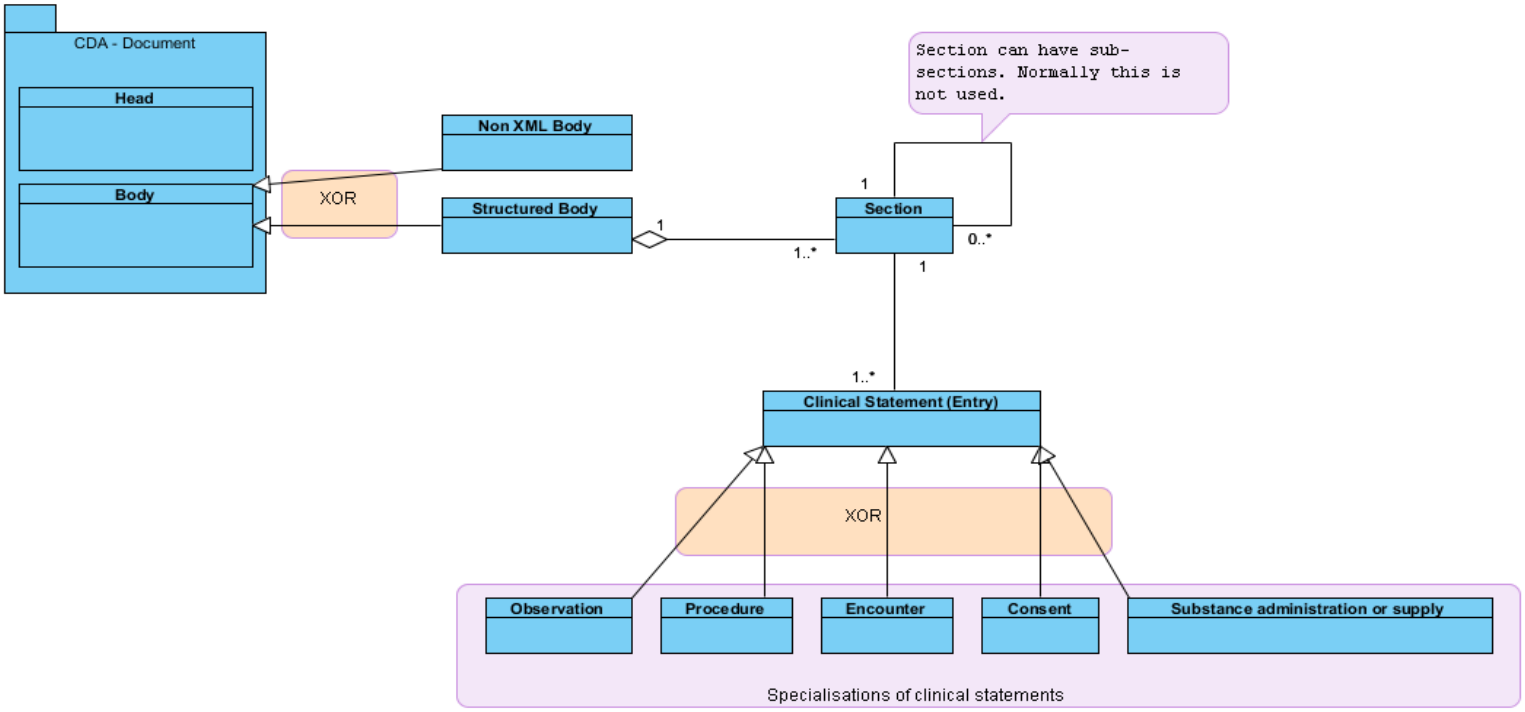
- Different coding systems exist but maybe not yet used
  - ICD-10: Classification for epidemiological purposes
  - LOINC: Logical Observation Identifiers Names and Codes, to exchange clinical observations e.g. in HL7 messages
  - SNOMED CT: Systemized Nomenclature of Medicine – Clinical Terms), for clinical and direct care of patients
- Creation of CDA documents is not supported by the third-party applications
- A common set of metadata for documents has to be defined
- Document content format for exchange and processing must be specified for different healthcare domains

CDA format

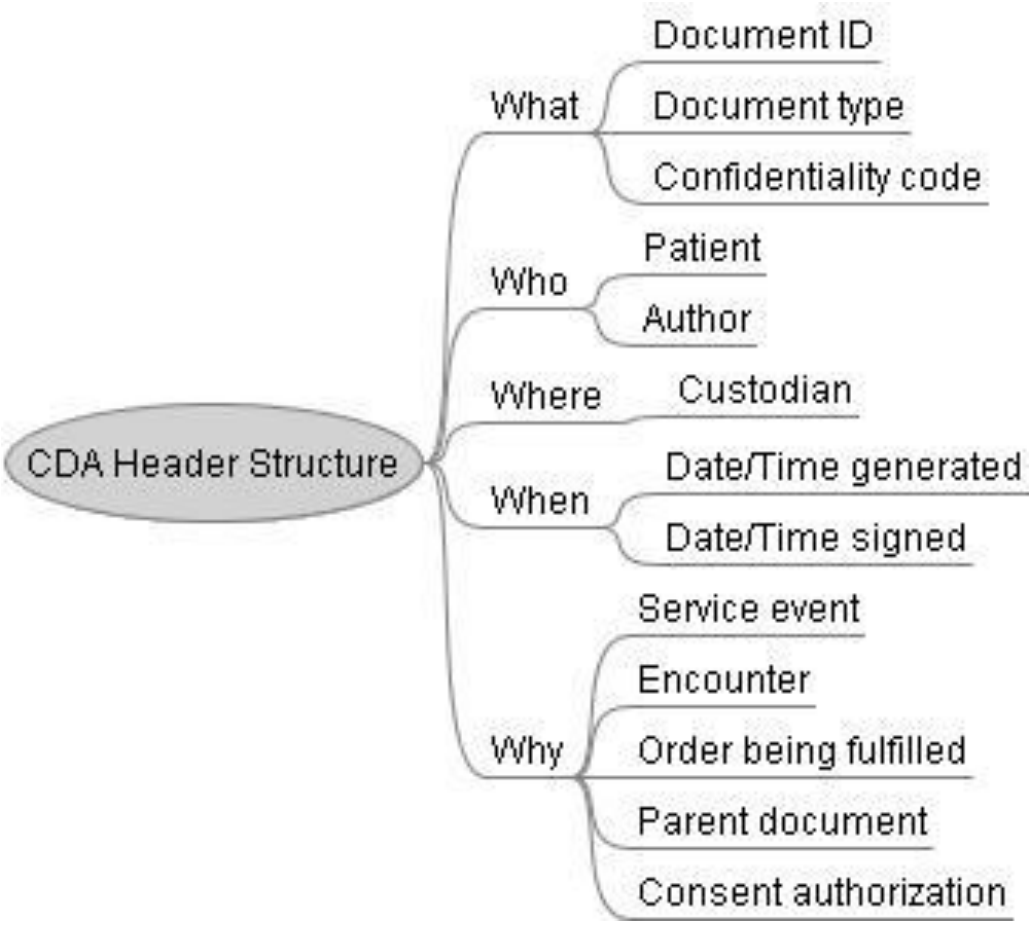
- CDA documents consists of mainly two parts
  - The CDA header which contains metadata of the document content
  - The CDA body which contains the document content
- HL7 introduced so far three versions of the CDA standard
  - CDA R2 Level 1:
    - Header contains basic metadata, body contains text or image, e.g. a pdf document, jpeg image or a text document.
    - Focuses on visualisation of the document, with layout information and is not useable for interoperability because the content isn't structured in a way that it can be machine-processed.
  - CDA R2 Level 2:
    - Constraint set of allowable structures and semantics based on document type code.
    - Body containing one or more structured sections
    - The goal of Level 2 is, to define the structure of the elements of the CDA Body, while using well known and accepted standard codes for the classification (LOINC, SNOMED).

CDA format (2)

- CDA R2 Level 3:
  - Adds additional markups, enabling clinical content to be formally expressed
  - Each section can include machine-processed entries of different levels of granularity
  - Combines the benefits of both human-readable and machine-processed documents
  - Machine-processed data is encoded using the HL7 V3 Clinical Statement pattern



CDA-Header metadata



CDA-Body

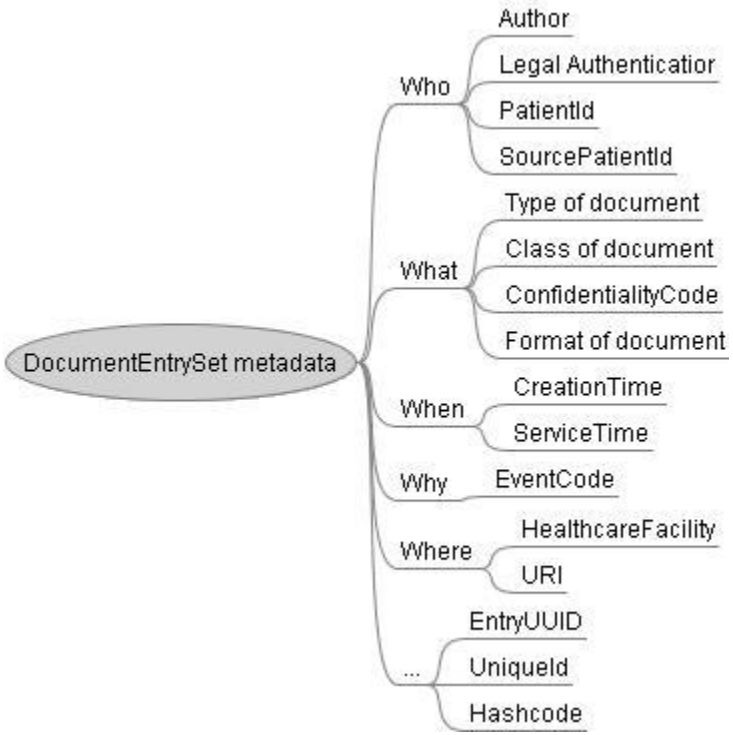
- Contains the document data e.g. the laboratory report
- Structured Body templates are defined for different medical domains
  - e.g. in IHE XD-LAB for laboratory reports
  - e.g. for medical summaries in IHE PCC
- Validation of documents can be done using these templates
- Vocabularies and Coding systems which should be used are described when using this templates

CDA-Example

```
<ClinicalDocument xmlns='urn:hl7-org:v3'>
  <typeId extension="POCD_HD000040" root="2.16.840.1.113883.1.3"/>
  <templateId root='1.3.6.1.4.1.19376.1.5.3.1.1.6'/>
  <id root=' ' extension=' '/>
  <code code=' ' displayName=' '
    codeSystem='2.16.840.1.113883.6.1' codeSystemName='LOINC'/>
  <title>PHR Update</title>
  <effectiveTime value='20081004012005'/>
  <confidentialityCode code='N' displayName='Normal'
    codeSystem='2.16.840.1.113883.5.25' codeSystemName='Confidentiality' />
  <languageCode code='en-US'/>
     :
  <component><structuredBody>
     <component>
      <section>
        <templateId root='1.3.6.1.4.1.19376.1.5.3.1.3.13'/>
        <!-- Required Allergies and Drug Sensitivities Section content -->
      </section>
    </component>
  </structuredBody></component>
</ClinicalDocument>
```

XDS metadata

- Defined for documents (DocumentEntrySet) and the transaction (SubmissionSet)
- Required for Registration of documents at the Document Registry
- Contain mandatory fields which must have values from defined vocabularies



Semantic Interoperability with the platform

- Semantic Interoperability on different levels
  - XDS - Metadata level (Submissionset, DocumentEntrySet)
  - Document metadata level (CDA-Header)
  - Document content (CDA-Body)

- Requirements for semantic interoperability with the platform
  - CDA document formats for the healthcare domains and document types have to be defined or already existing document formats have to be taken into account (and maybe extended)
  - A decision about which Vocabularies and Classifications to use, has to be done
  - National extensions which are needed, have to be determined, both for document formats and Vocabularies
  - Set of metadata for storage and retrieval of documents at Document Registry side has to be extended

Semantic Interoperability with the platform

Connector – API can bridge the gap by:

- Processing or creation of CDA documents
- Validate CDA documents
- Extraction of metadata out of CDA – Header for the creation of the metadata for the platform
- Mapping local codifications and codifications of the platform
  - For the short term period, long term goal should be the usage of a common shared codification and type system by all participants
- Providing the additional information for the metadata of the Document Registry
- Creating the submission set

Conclusion

- **Technical and Semantical Interoperability is a must, but although not easy to ensure**
  - **Lot of specification work has to be done**
  - **Healthcare providers have to be involved**
- **Integration of Connector-API to support Technical and Semantical Interoperability**
- **Process Interoperability with the eSanté platform should be a target too**

Thank you for your attention !

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