



SOHARD

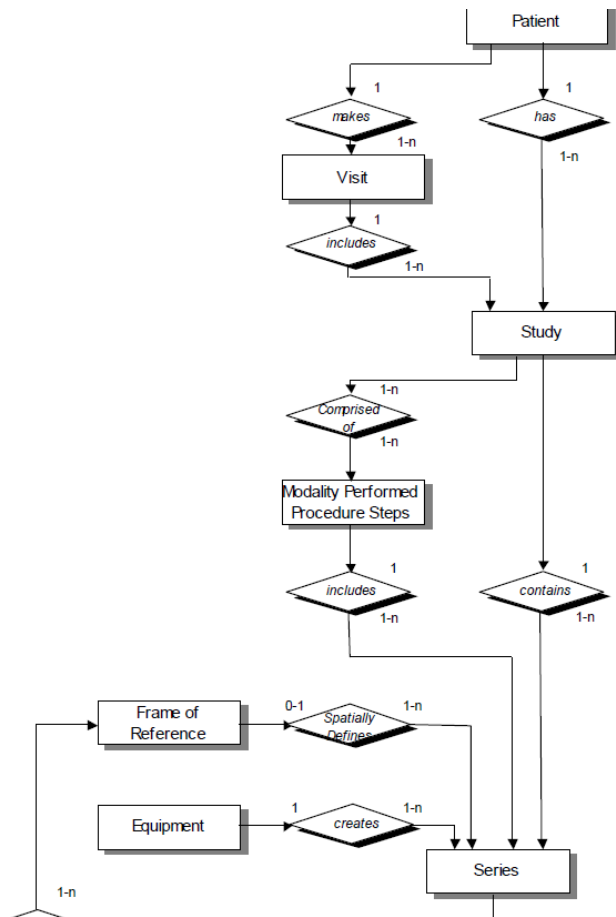
Semantic Dicom: SeDI Prototype

Detlef Grittner

DICOM: short introduction

- Digital Imaging and Communications in Medicine
- Based on binary exchange protocol over TCP/IP or external media
- Meta Data and Image Data
- Concept of an attribute (example)
 - tag name: Patient Name
 - tab number: 0x00100010
 - value representation: PN

DICOM: Model of the Real-World



Model image taken from Nema: PS 3.3
2008 p. 54

A partial ontology might look like this
(namespace omitted):

Patient hasStudy Study
Study containsSeries Series
Series isSeriesOf Study

DICOM and RDF state of the art

- DFKI: MEDICO
DICOM annotations stored in RDF
(<http://www.manuelm.org/blog/?tag=dicom>)
- Stanford University: DICOM ontology
(http://bmir.stanford.edu/projects/view.php/dicom_ontology_do_project)
- Mostly focusing on making images semantically accessible

RDF Resources in SeDI

- Resources
 - Patient
 - Study (DICOM: StudyInstanceUID)
 - Series (DICOM: SeriesInstanceUID)
- Problem
 - DICOM has no Patient UID
 - Several patient merge criteria, e.g. PatientName, PatientBirthDate, etc.

RDF Resources in SeDI

- Patient Resource URI
 - Study Centric Model
 - Each Study has exactly one Patient
 - For example: dcm#Patient_StudyInstanceUID
(dcm#Patient_1.2.392.200036.9116.2.1.1.8812167.235)
 - Used by SeDI
 - Hashing Patient Information
 - Defined by vendor or institution
 - For example: dcm#Patient_Name_BirthDate

SeDI: going beyond DICOM

- DICOM has no separate concept for a physician
 - ReferringPhysician (Study)
 - PerformingPhysician (Series)
- A common sense concept – though impractical for DICOM – is to introduce a physician Resource

Physician Resource in SeDI

- Defined in the ontology as

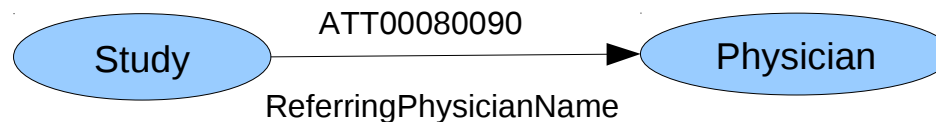
```
:Physician rdf:type owl:Class ;
```

```
:ATT00080090 rdf:type owl:ObjectProperty ;
```

```
  rdfs:range :Physician ;
```

```
  owl:equivalentProperty :ReferringPhysicianName ;
```

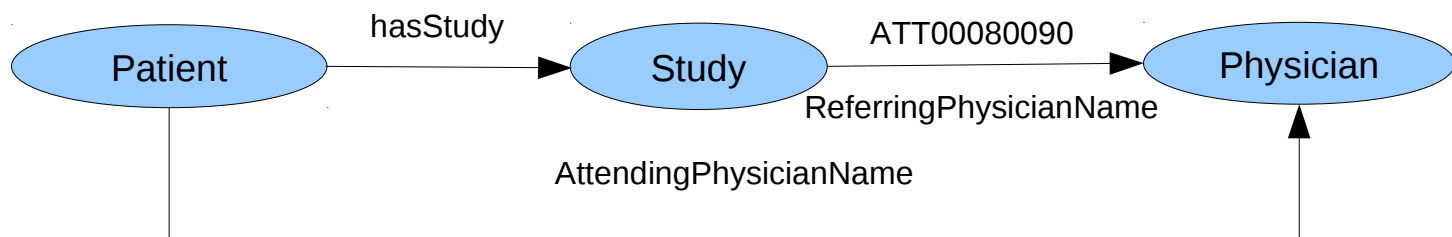
```
  rdfs:domain :Study .
```



Physician Resource in SeDI

- Defined in ontology (cont'd)

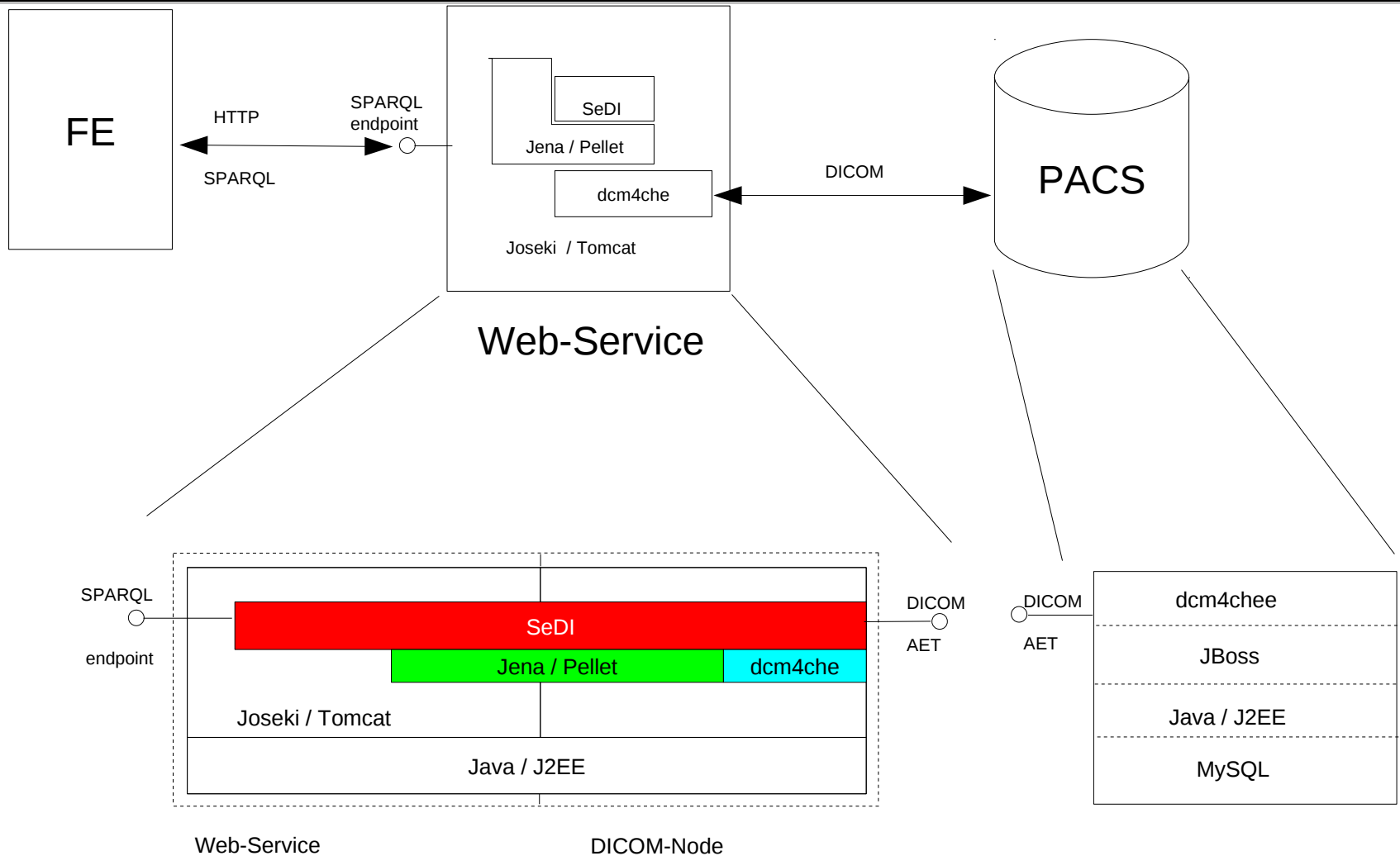
```
AttendingPhysicianName rdf:type owl:ObjectProperty ;  
  owl:propertyChainAxiom ( :hasStudy  
    :ReferringPhysicianName ) .
```



Physician Resource in SeDI

- Currently SeDI uses StudyInstanceUID for encoding:
dcm#Physician_StudyInstanceUID
- Problem
 - Physician can be connected to Series instead of Study
 - No common concept for identifying physicians in DICOM

Architecture of SeDI



Generating Resources from DICOM query result sets

- Study Centric Model
 - DICOM query result set contains attributes and their values for a Study, e.g.:
[StudyInstanceUID] 1.23.2323.2323232.23
[PatientName] John^Doe
 - PatientName (DICOM Attribute 00100010):
:ATT00100010 rdf:type owl:DatatypeProperty ;
 rdfs:domain :Patient ;
 owl:equivalentProperty :PatientName ;
 rdfs:range xsd:string .

Generating Resources from DICOM query result sets

- Algorithm:
 - DICOM attribute is a property in the ontology
 - Take the domain of the attribute
 - Generate a resource from the domain
 - Put this resource and attribute encoded as property in the RDF result

example from above:

dcm#Patient_1.23.2323.2323232.23 a Patient

dcm#Patient dcm#PatientName "John^Doe"

DICOM Query with SPARQL

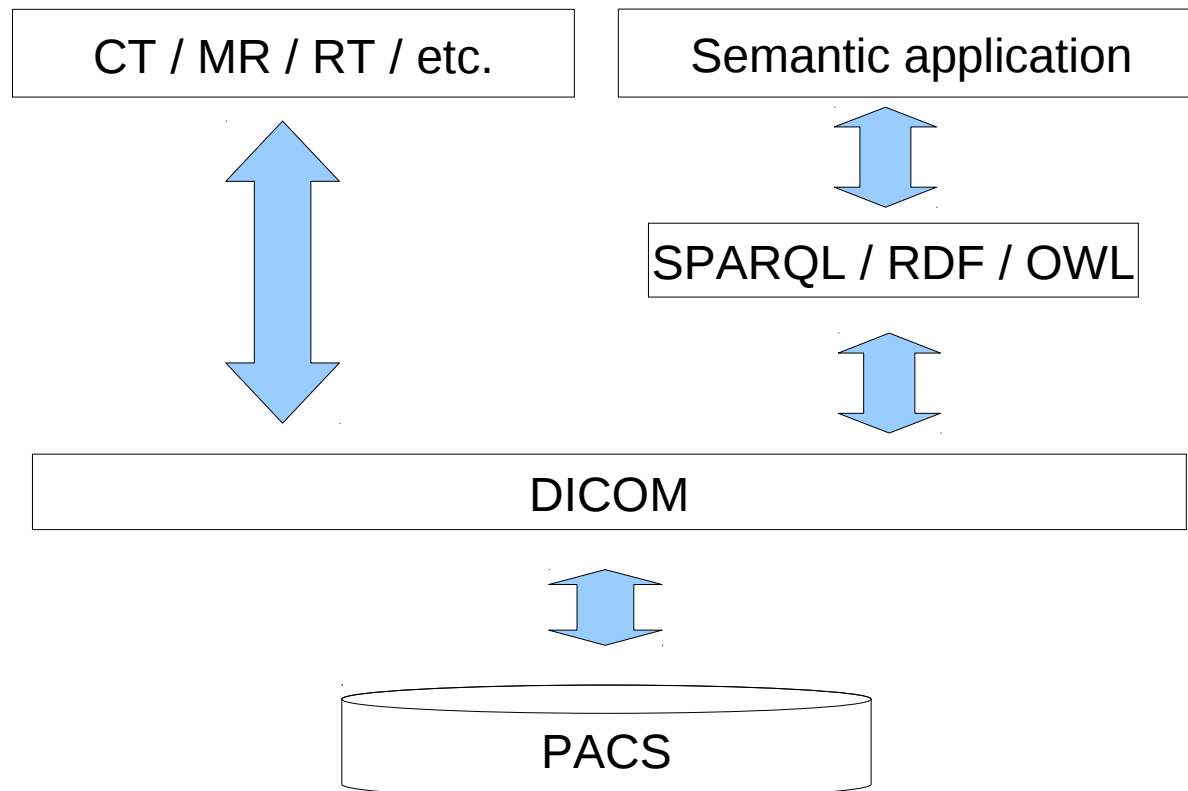
- Demo

Generating Resources from DICOM query result sets

- Planned Improvements
 - owl:HasKey for indentifying identical resources despite of different URIs
 - Merging criteria defined for specific vendors, machines, which have a defined Instance Root UID
 - Merging criteria written in owl in a seperate ontology

Wrap Up

- Architecture Overview



Conclusion

- Semantic Approach
 - Accessible for domain experts
 - Integration of new semantical data stores
 - One layer of abstraction for developers
- Combined with traditional Approach
 - Securing investments
 - No impact on running projects
 - Engineers still can use proven technologies