



UniversitätsKlinikum Heidelberg

# Open Source Software for Regional Health Networks

## Assessment of Existing Projects and Implementation of a Demonstrator

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# Agenda

1. Background / Motivation / Objective
2. Methods
3. Results
  - OSS Analysis
  - First implementation experiences
4. Discussion



## **Background / Motivation**



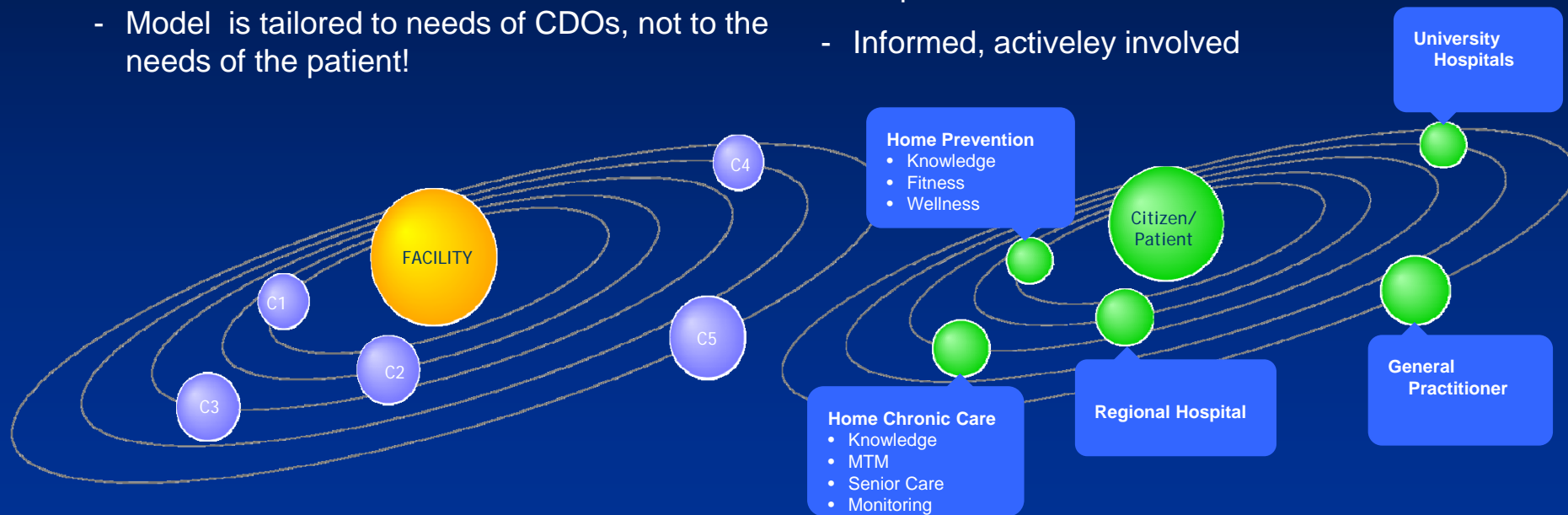
# Copernican Shift in Healthcare

## Traditional Healthcare

- Patients (C1-C5) have to interact with care delivery organizations (CDOs)
- Model is tailored to needs of CDOs, not to the needs of the patient!

## The Patient in the core – integrated care

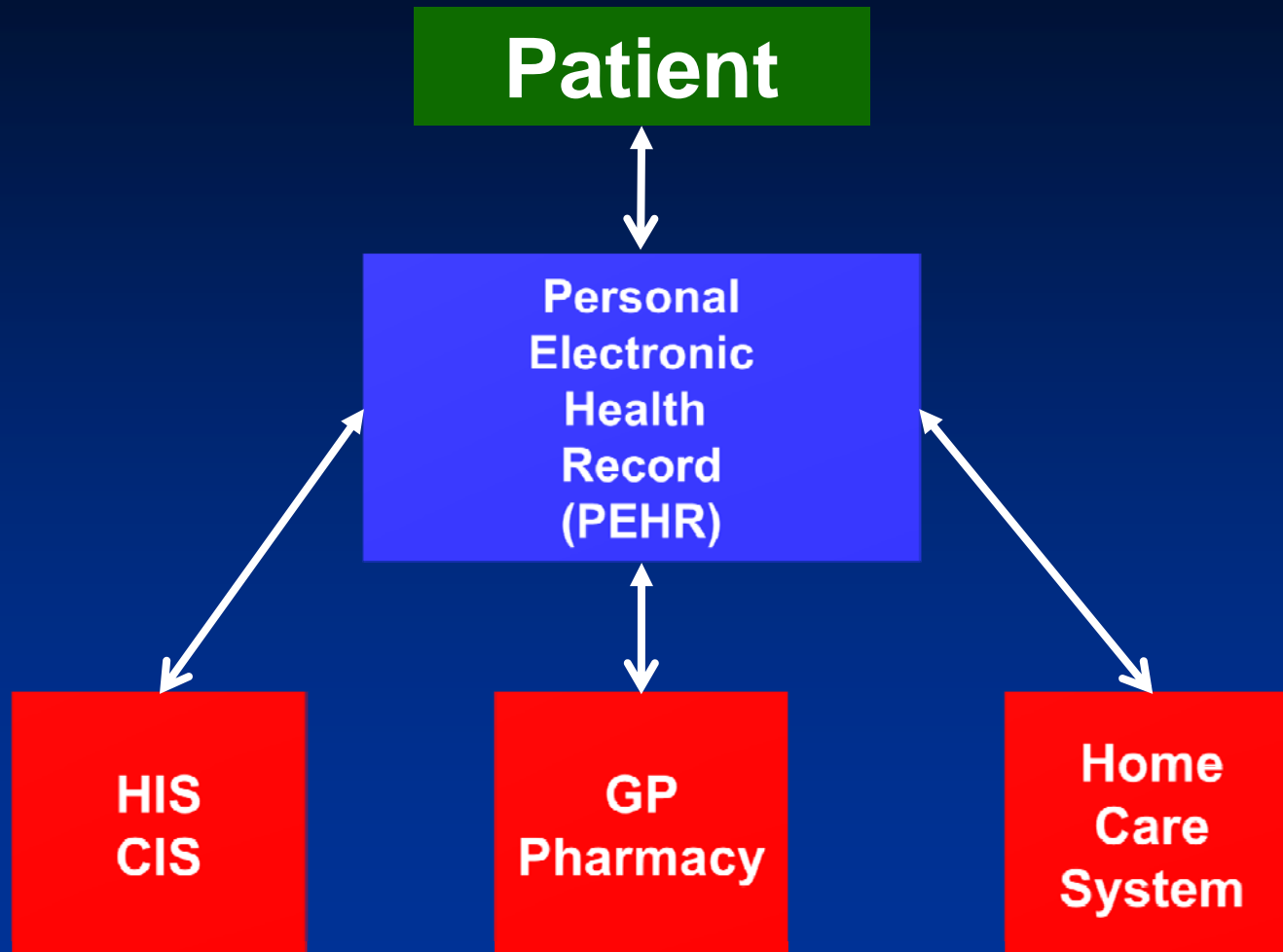
- Health-conscious
- Empowered
- Informed, actively involved



In 1543, Copernicus was the first to propose that the Earth rotated around the sun, while accepted scientific thought at the time believed that the Earth was the center of the universe. Copernicus effectively “changed the center of the universe”.

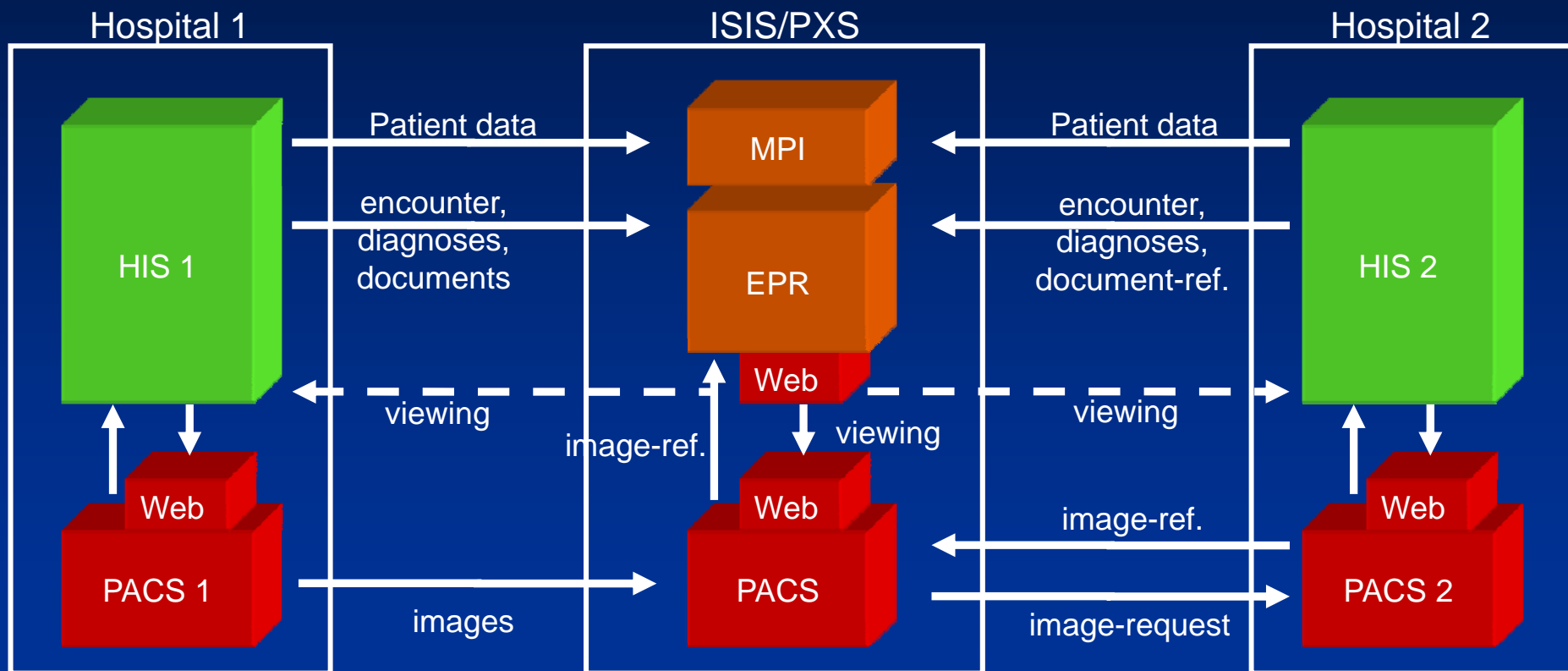


# PEHR Vision





# Patient allocation, document sharing and integration of PACS





# Software Master Class (SMC)

- Cooperation with study course MI Heidelberg/Heilbronn, Industry partner ICW AG and Center of Information Technology and medical Engineering
- Students can work in real project scenarios
- E.g. last term: Development of an Provider and Organization Registry Service
- Hosted on gforge as OSS project together with the Open eHealth Foundation:  
<http://gforge.openehealth.org/gf/project/pors/>

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## DEVELOPMENT OF AN OPEN SOURCE PROVIDER AND ORGANIZATION REGISTRY SERVICE (PORS) FOR REGIONAL HEALTH NETWORKS

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### 1 Introduction

The University Hospital Heidelberg is implementing a Personal Electronic Health Record (PEHR) to improve the information exchange between other hospitals, primary care givers, and the patient itself. Based on the first experiences of a pilot of two hospitals and one medical practice a regional Healthcare Information Exchange Network (HIEN) should be implemented as part of a joint initiative led by the Metropolitan Region Rhein-Neckar in the mid-west region of Germany. The HIEN should provide a PEHR and other services for citizen, patients and health professionals. The sub-project "Health IT Platform" of this initiative led by the University Hospital Heidelberg has conceptualized a standards-based Health IT architecture using IHE (integrating the Healthcare Enterprise) profiles in a service oriented architecture (Fig. 1). The following profiles are considered to be used: ATNA, BPPC, CT, PDQ, PIX, XDS.b, XDS.i, XPHR. The implementation itself and all of the applied software components have to be open source software. An important component of this architecture is a Provider and Organization Registry Service (PORS) whose principles and architecture will be described here.

### 2 Objectives

By now in Germany a unique identification for physicians, the so called "lifelong physician number" and for organizations, the so called "permanent establishment number" are available for billing purposes but there is no central electronically repository to use them in other systems. Hence, the Provider and Organization Registry Service (PORS) was determined to be one of the first essential components of the HIEN to be implemented. Every organization and its providers participating to the HIEN in the Rhein-Neckar Region have to be registered to PORS in order to enable their administration and unique identification.

- 1.PORS will enable other services and components to resolve an ID to specific information about a provider or organization to e.g. enhance document meta-data located in the XDS Registry with the 'confidentiality codes' to ensure legal data access to authorized providers.
- 2.PORS can be used as yellow pages providing unique and consistent information about all participating healthcare providers.
3. Providing, updating and querying information should be only possible for authorized users and systems via a graphical user interface as well as via a HL7 v2 message-based or file-based web service interfaces.
4. The access should be secure, auditable and controlled. For that reason other components of the HIEN will be used following the IHE IT architecture webpage: 'Access control'.

### 3 Methods

The PORS will be developed as Open Source Software (OSS) hosted on the gforge platform as a project of the Open eHealth Foundation under the Apache Software License 2.0. Using the first stage (Fig. 2) will be a closed project. The technical implementation is based on Java and Groovy. In addition to the Open eHealth Integration Platform (OEP) the Open eHealth Framework (eHF) is used. eHF is an enterprise service bus with a Groovy-based domain specific language (DSL) which enables easy HL7 message parsing, processing and sending. The eHF focuses on modularization and supports model driven software development. Because the framework provides modules for standard functionalities like security and authorization it is possible to spend most of the development time on the functional aspects. Supported standard-based messages are the functionalities add, update and delete of the master file notation HL7 v2 MFI M02. The graphical user interface (GUI) for manual administration is based on Java Server Faces (JSF). Data storage for testing is realized via HSQL data base.

### 4 Results

The PORS is designed to fit into a service oriented IHE compliant HIEN architecture. As the PORS will be published as open source software the service can be used in any other HIEN. The PORS can be tried to each health system uniquely identifying all providers (hospitals, physicians, nurses, pharmacists and dentists) allowing all the information related to a healthcare provider to be pulled from multiple sources into a single holistic view. The PORS itself consists of a multiple-tier-layer architecture (Fig. 2). To add, update and delete data sets in PORS automatically, flat files (XML, CSV) as well as HL7 v2 MFI M02 messages (Fig. 3) can be received via a web service interface provided by the eHF. eHF has two adapters, one for flat files and one for HL7 messages, to receive data sets and to route them to the application logic layer provided by eHF. On this layer data will be extracted, processed and converted into Java objects according to the specific domain model (Fig. 4). These objects can be stored to the database. All changes will be stored in a history. Additionally PORS can be administrated through a web based GUI realized with JSF. A web service interface is foreseen to query the PORS using the GUI or by HL7 query/response conformant statements or HL7 Master File Query (MFIQ) interfaces.

### 5 Conclusions

The PORS will assist healthcare providers in communicating with each other by acting as a type of electronic 'yellow pages', making it easier for them to coordinate care for patients. Without a PORS a regional HIEN will not be realizable because it is a central component necessary for all other services to have a unique identifier. The fact that it will be open source will make it easier for other related projects to make a quick progress because it is not necessary to reinvent the wheel. Another issue is to enforce security and authentication. Technically in this project it is not vital to cope with it due to the use of eHF which focuses to provide security to all eHF-based applications. If the implemented service will be plugged into the overall architecture these security mechanisms will be used. Authentication can be supported by client certificates. It is possible to run in problems due to the lack of certificate support of older applications like many primary systems are.



## Factors of success

- Build up on things we already have
- Make heavy use of existing Standards!
- Don't forget the users!
  - Easy to use (usability)
  - Entertainment (joy of use)
  - Integration into existing processes
- Consider the spirit of the age
  - The patient has to be in the center (due to ethical and privacy issues)



# Integrating the Healthcare Enterprise (IHE)

- Initiative (healthcare professionals and industry) to improve electronic data exchange and interoperability in health care using standards (e.g. HL7)
- Definition of Integration Profiles (Actors and Transactions)



- i.e. XDS-I: Cross-enterprise Document Sharing for Imaging Integration Profile
  - 5 Actors (e.g. Image Document Source and Consumer)
  - 2 Transactions (e.g. Provide and register Image Document Set)



Can we realize a  
regional document exchange  
between several partners  
based on an XDS szenario  
with open source  
components?

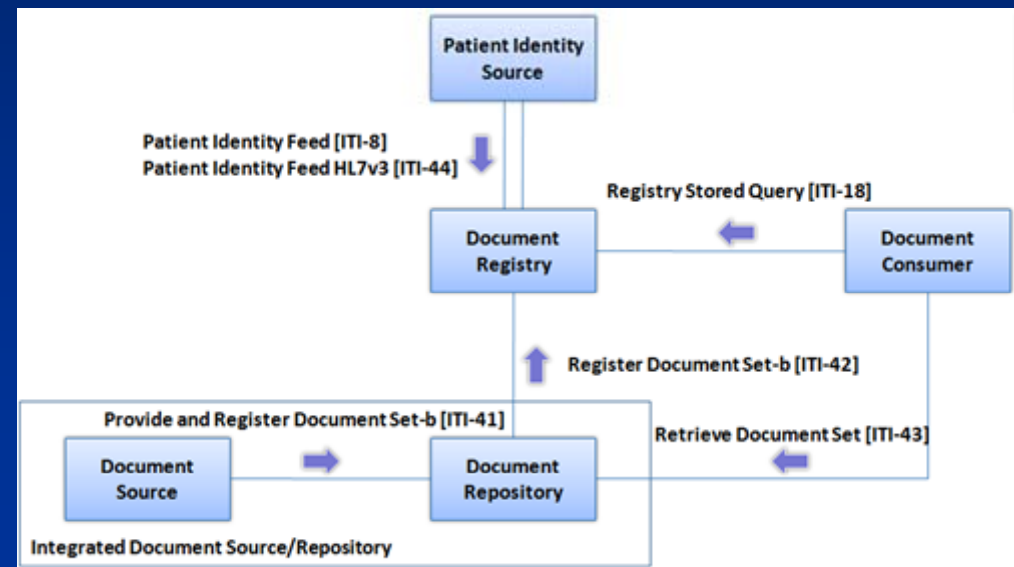


# Objectives



# The IHE XDS-based szenario

- MPI
- Document Source e.g. a CIS / HIS
- Registry and Repository
- Document Consumer e.g. PHR





# Methods



- Internet Research on OSS Tools for healthcare in general
- Filter them due to certain criteria such as supported standards (HL7, DICOM, IHE)
- Select a tool for
  1. Document source: Primary Systems
  2. Communication Server
  3. Registry and Repository
  4. Document consumer: PHR
- Start building the XDS demonstrator



# Results



de animal bika bioimaged biomedical biosig bots brainstorm brainvisa calis cancer care  
ts clearcanvas clearhealth clinic conquest cottagemedtm ctsim data dcm4  
**dicom** dicom4j diseases k elemental elementalklink  
change ffehr free med free viri tel gdsm ume gnuvet grassro gwyddion hapi hames  
l7 h7v3 hospital xp idart fhri n gagej indio health influsiv informatics infrastru  
vika light films lipsia manager master med me medcon me medical medic medintac mergence mi  
ring nat nhapi niftlib octave odtr ze ogler **open** open da pencl pandicom ope openamed open  
or openrep opentapas envista master adrx or eak outcomes pa  
i phesp praxisprogramm project pyepi pynpa quckylewh? real-time record res rods rt ruby  
cofa software sql stratos suite **surveillance** system temp test tolven **to**  
ox ultimate upde utilities **validation viewer** rillonhm rllta vreen vr-render vtk web workstation wordvitsa whart



What is about standards like  
HL7, DICOM and  
IHE-support?



110 proprietary or other



43 DICOM

30 HL7

5 IHE



# Useful tools for the XDS scenario?



# 10

care2x eclipse ehealth framework hapi health healthcare iheos

integration ipf mirth o3-xds ohf **open** openvista

openxds platform testpanel tools

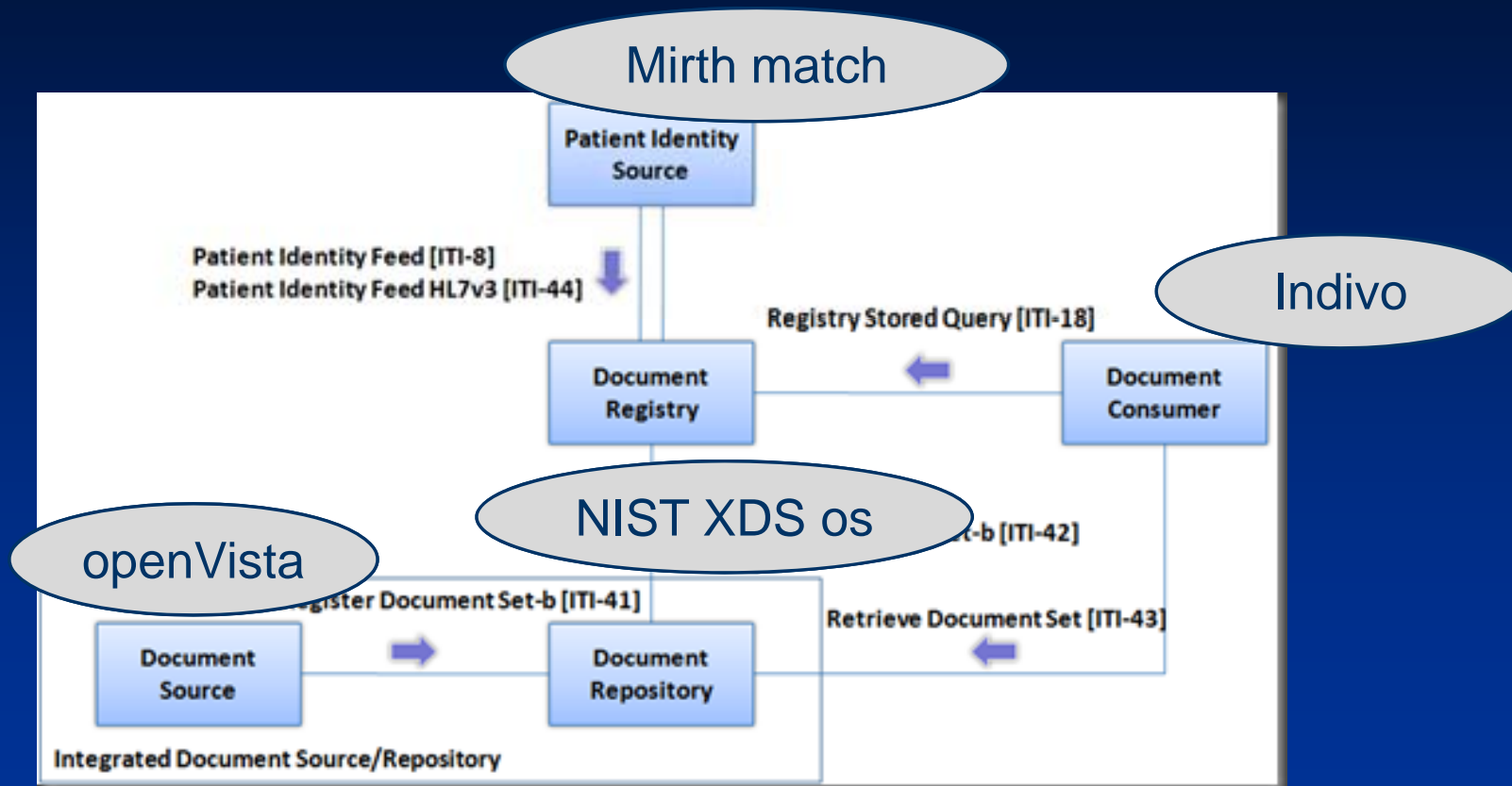


# Qualified tools by name

- Messaging
  - Open eHealth Integration Platform (IPF)
  - Mirth connect
- Primary Systems
  - Care2x
  - openVista
  - HAPI test panel
- XDS registry/repository + MPI
  - Open health tools IHE profiles formerly Eclipse OHF IHE components
  - NIST IHEos
  - O3 XDS
  - Mirth match
- PHR
  - Indivo



# Open source XDS demonstrator



Messaging: IPF



## First experiences of implementation

- High learning curve to get the tools run
  - Complexity
  - Bad documentation (e.g. NIST, OHT)
  - Small communities with little support
- Very good projects (e.g. Mirth, IPF)
  - Active communities
  - Good documentation
- Many tools seem to be in an early release state, usage is only recommended for research and testing



# Discussion



## Summary

- Many open source tools for usage in health care sector available
- but less than half of them support important healthcare standards
- Hurdles to take: bad documentation of some tools (e.g. NIST XDS os), unstable versions
- There are very good tools like Mirth and IPF
- Our scenario is realizable
- Implementation is ongoing



## Conclusions

- In other HC domains the use of open source software is more common e.g. PACS and teleradiology
- The trend using FLOSS in the area of regional health networks is ascending: many new promising projects
- The lack of bad interface descriptions and documentation is probably owed the reason that companies want to earn money with interfaces and know-how on interoperability



Thank you!

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