Imaging Deployment in Europe: IHE profiles in use

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I. Introduction

During the winter 2019-2020, a survey was prepared by the IHE imaging taskforce with four objectives:

- To know more on the landscape on Imaging Shared Platform projects deployed in Europe;
- To learn on which profiles and standards solutions are implemented by vendors;
- To better understand the strengths and weaknesses of IHE profiles
- To Identify what are the needs that IHE profiles have not yet covered

Methodology

- Two questionnaires were sent:
  - one asking the users to give feedbacks on their projects
  - one dedicated to vendors and the implementation of IHE profiles in their products
- 16 questionnaires were finally collected: 8 from users (AT, FR, CH, FI, BE) and 8 from Vendors

Questionnaires

User questionnaire

- Contact information
- Project information
  - General description
  - Business cases
  - Scope and functionalities
- Project Management
  - Status and scale of the implementation
  - Technology
  - Systems used
  - Content and images
- Comments on the deployment
  - Expectations/benefits
  - IHE profiles impact
  - Improvement
  - Performance
  - Security aspects

Vendor Questionnaire

- Contact information
- Product and Profiles
  - Product
  - Profiles
  - Comments on the use of the profiles
- Project using your product/profiles
  - Contact
  - Description
- Development Roadmap for integrating profiles

Part I - USER QUESTIONNAIRE

Description of Imaging shared platform

Projects have been distributed at different scales from local (for example healthcare providers geographically closed), regional (with more broader actors are involved) and national level (where national authority is also involved).

- **National Projects**
  - Framework for Image Sharing
  - Nationwide repository for Imaging data
  - Exchange of consultation and notes
- **Regional projects**
  - Radiological and nuclear medicine
  - Images sharing for 27 hospitals
  - Images sharing for 40 organisations in one side and 20 organisations in other side that will be connected in the coming years
  - Remote access to locally stored images (Regional Healthcare Network, interconnecting hospitals with ambulatory healthcare professionnals)
- **Local project**
  - This Project includes three hospitals and one cancer hospital

The projects (1/3)

Projects	Description	Status	Method	Techno	Products
TéléO (France) Regional scale	The region Occitanie is the result of the merge of two regions in the South of France. Each of them has been deployed a telemedicine system where Imaging shared platform is one of the component. Today, about 40 healthcare providers are sending examinations with one system and about 20 other from the second region with the other one. Santé Occitanie (the regional centre of competence) is working on a new images sharing project in relation of the first project: the goal is to allow a community of doctors to access all of a patient's exams (according to some rules)	In use	Push	DICOM web	Several PACS (GE, Fuji, Maincare, Philips,…)
Kanta Imaging Data Repository (Finland) National scale	This project is part of the nationwide Kanta services in Finland. The main functionalities are - Storing imaging data and related patient clinical data to the national repository; - Enabling access to the stored imaging and patient clinical data - Updates and change management of stored data Future features might be deployed: - Secondary use of data - Management of radiation exposure data	In Progress In use	Push Pull	XDS-I XCA-I + proprietary	Archiving PACS : Local Image Manager*, Change Requestor Retrieving PACS : Local Image Manager* Viewer (Imaging) : Document Consumer XDS Registry : XDS Registry XDS Repository : XDS Repository Kvarkki DICOM archive (storing) : Centralized Image Manager* (/ Image Archive) Kvarkki DICOM archive (retrieval) : Imaging Document Source XCA(-I) Gateway : XCA Initiating Gateway, XCA Responding Gateway, Initiating Imaging Gateway, Responding Img. Gateway CDA r2 and HL7 v3 messages National patient archive(+adapter) : XDS Repository * IHE MIMA (Multiple Image Manager Archive) actor Several PACS and RIS (clients)
IRIS Aquitaine (France) Local scale	Image and report Sharing between Public hospitals (Three main hospitals) , private practice (10 providers) and cancer hospital in a big town and its suburbs. The objective is to provide access to previous examinations and to follow the pathologies and cancer of the patients	In use	Pull	XDS-I	Several PACS (Fuji, Agfa, Medasys) RIS (Penaranda, Agfa, Xplore)

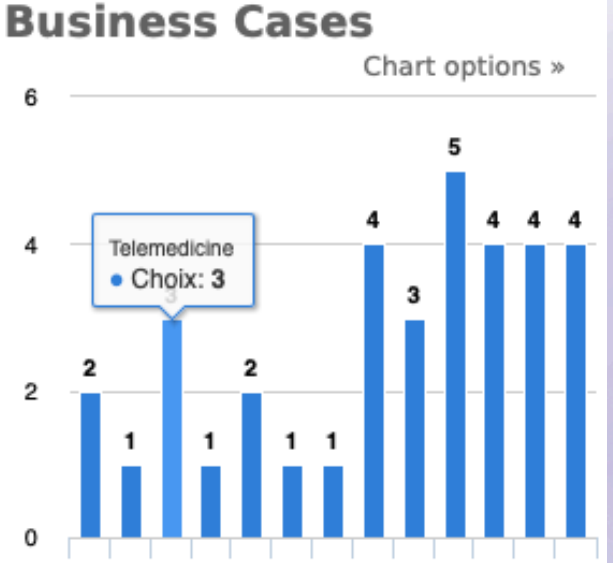
The projects (2/3)

Projects	Description	Statut	Method	Techno	Products
Additional Services to the Swiss EPR (Suisse) National scale	The Suisse law covers only the EPR (Electronic Patient Record). However eHealth Suisse (the national centre of competence) is working on offering additional services such as point to point communication (e.g. radiology referral and results) all over Switzerland. eHealth Suisse just published a recommendation on the use of ORF (order and referral by form), a FHIR Imlementation Guide based on Structured Data Capture. The document adresses decision makers (https://www.e-health-suisse.ch/fileadmin/user_upload/Dokumente/F/recommandations-services-supplementaires-interoperables.pdf). Specifications and Implementation Guides for radiology use cases will follow.	In concept In progress	Push	HL7 FHIR	Several PACS and RIS FHIR based point ot point communication
NÖBIS Image Sharing	This Project provides Image sharing for all the 27 Hospitals in Lower Austria and is based on IHE XDS & XDS-I. As soon an image acquisition is finished on the modality, the study is transferred to the PACS and immediately forwarded to the local IHE compliant Imaging document source (IDS) called NEC which generate a KOS-object and store it in the country wide XDS affinity.	In use	Pull	XDS-I Dicom Web	Several PACS (Vepro, non XDS SIEMENS (non XDS) SIEMENS (Imaging Document Consumer Dedalus: Imaging document consumer GE: Imaging document Consumer RIS: VEPRO, AGFA, SIEMENS? GE All provide CDA documents
KRYPTON ESEA Nouvelle-Aquitaine (France) Regional scale	Image exchange and image sharing for medical images at the Nouvelle-Aquitaine region level. Radiological and Nuclear medicine images are the first images shared.	In use	Pull	XDS-I	Several PACS (Telemis, carestream, Dedalus, GE RIS (Penaranda, Agfa, Xplore, Crossway, etc)

Projects (3/3)

Projects	Description	Statut	Method	Techno	Products
Réseau Santé Wallon (RSW) (Belgium) Regional scale	Regional Healthcare Network, interconnecting hospitals with ambulatory healthcare professionnals with the following features: -Remote access to locally stored images; -Regional secured index with all references to available radiology reports; -Access to the content of the report through a secured tunnel and national SAML authentification; -Access to the images through a link to a secured url. Each image provider chooses its preferable web application to give access to its images. The regional server just manages the references and controls the access rights.	In use	Pull	DICOM web Proprietary	Several PACS (Telemis, carestream, vue motion, ets) 50 Hospitals Several RIS: no link
Brusafe+ Belgium Regional Scale	XDS repository for multidisciplinary (medical and non-medical data) exchange in the region of Brussels.	In use	Pull	XDS	Several PACS and RIS

Business Cases



Telemedicine during the WE	2
Telemedicine beyond usual operation time (afternoon and night)	1
Telemedicine	3
Traumatology network	1
Stroke units	2
Tumorboards	1
Integrating Center of excellence	1
Transfer to other hospitals	4
External treatments	3
Moving of the patient from one location to another	5
Request of expertise	4
Multidisciplanry consultation meeting	4
Other:	4

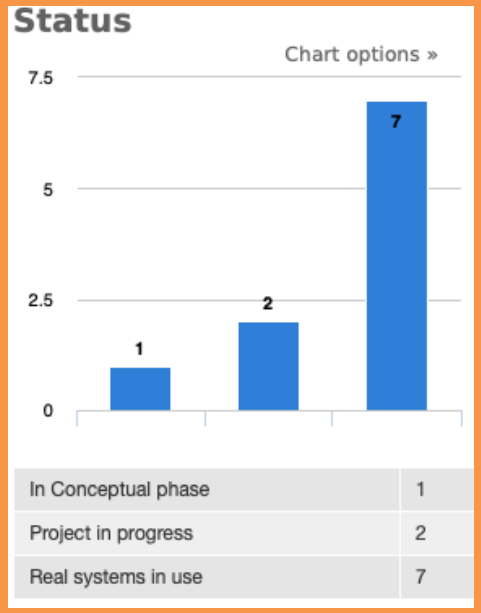
- Others:
  - production of examen in one location and interpretation from another
  - sharing one examen to physicien located out of the hospital thanks to a code given to the patient
  - Access to previous examinations in order to give a report that consider other examinations
  - Follow up of pathologies and cancer

Scope

- Nationwide service
  - Storing imaging data and related patient data to the national repository
  - Enabling access to the stored imaging and patient data
  - Updates and change management of stored data
  - Possible future functionalities:
    - Secondary use of data
    - Management of radiation exposure data
- Regional folder to secure diagnosis
- Order and referral, bidirectional communication
- Centralized neutral archive

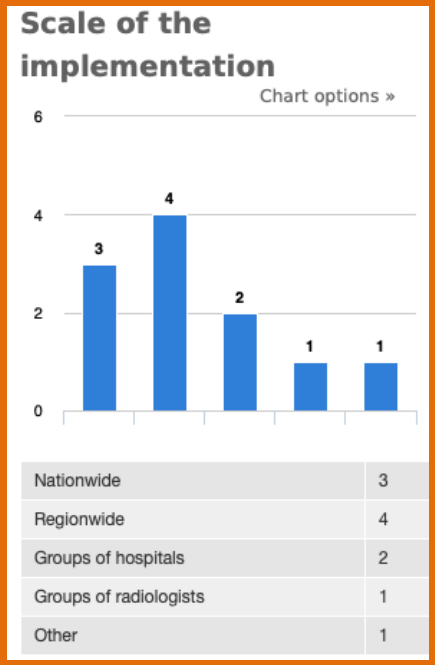
Characteristics

7 projects are in use wih real systems



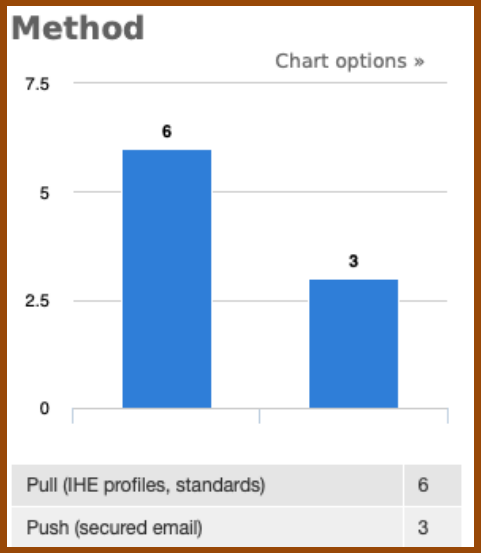
In Conceptual phase	1
Project in progress	2
Real systems in use	7

Most of them are at the national or regional scales



Nationwide	3
Regionwide	4
Groups of hospitals	2
Groups of radiologists	1
Other	1

and use a pull method (based on IHE profiles and standards)



Pull (IHE profiles, standards)	6
Push (secured email)	3

Patient Consent

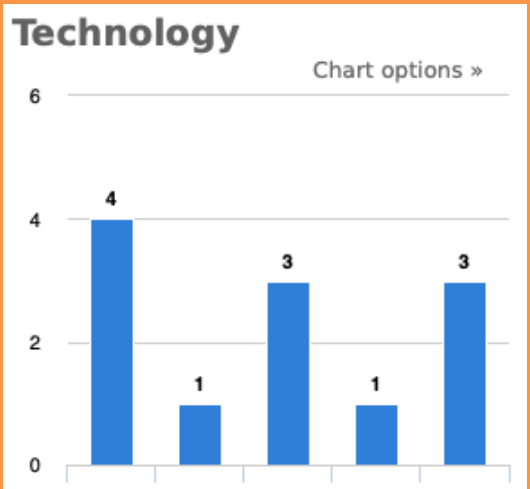
The consent patient policies are various from one project to another:

1. By oral: the healthcare professionals ask the patient if he/she gives his/her consent;
2. Opt out policies:
    1. The patient consent is presumed. If he doesn't want to participate, his Identity is not available in the system
    2. The patient can oppose to participate to the project (project requested by the Ministry of Health)
    3. Via BPPC profiles
    4. Consent documents and restrictions are srored as CDA document. Consent data is automatically applied in the data sharing infrastructure. The solution is not based on IHE profiles.
3. National policy for medical exchange

Technical environments

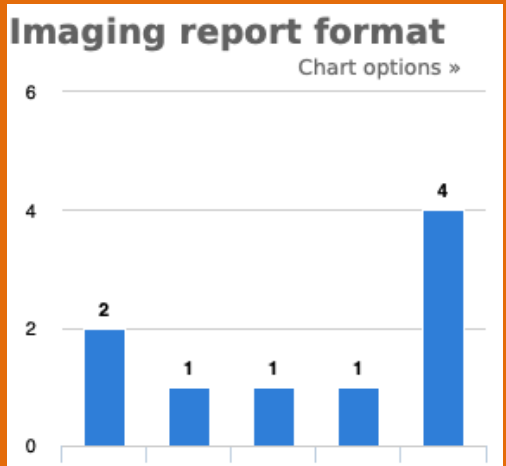
The projects use XDS environment but also other environments

They are also multi vendor for PACS and RIS



XDS : XDS-I Environment	4
XCA : XCA-I Environment	1
DICOM Web	3
HL7 FHIR	1
Proprietary solutions	3

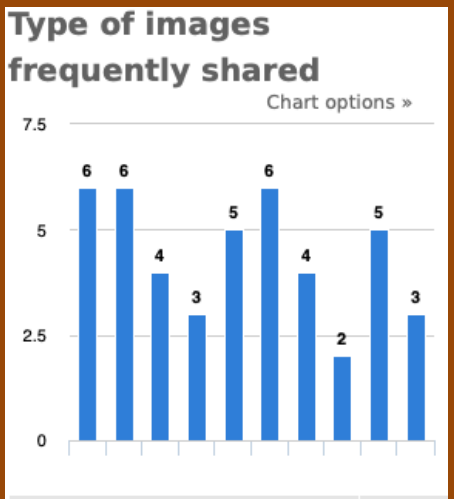
Various imaging reports are implemented



CDA r2 with structured sections (coded header + Body text) as specified in XDS-I	2
CDA r2 with UNICODE test body (non XML) as specified in XDS-I	1
CDA r2 header + PDF body as specified in XDS-SD	1
FHIR document	1
Other	4

Others: HL7v3 medical records, FHIR based point to point, KHMER Hub, CDA referral Summary, National belgian standard interface/xml with encapsulated PDF for report and lnk to DICOM server

Various types of images



CT	6
MR	6
PET	4
Mammo	3
Angiography	5
Radiography	6
Tomosynthesis	4
Endoscopy	2
Ultrasound	5
Other	3

Others: Secondary capture, Digital X Ray, X Ray Radiation, Other Nuclear Medecine studies (Spect-CT; Spect)

Operational

Type	For Reports since	Imaging reports per year	For Imaging Studies since	Studies per year	KOS per year	Patients per year
Region (France)	-	-	2014	25 000	-	-
Nation (Finland)	2018	-	2018	200 000	200 000	165 000
Local (Suisse)	2013	700 000	2013	750 000		300 000
Region (Austria))	2007	1 200 000	2011	1 200 000	1 200 000	200 000
Region (France)	2019	1 500 000	2019	2 100 000	-	1 500 000
Region (Belgium)	2019	500 000	2017	100 000	-	-

Expected benefits

- Cooperation between professionals
- Emergencies management
- Multidisciplinary meetings
- Speed, quality and security of transfers
- To decrease spendings on handling imaging data
- To improve healthcare delivery processes through streamlining the access to data.
- Reduce examination redundancy
- interoperable order and referral as well as result transfer between order placers and order fillers in different institutions (practice, hospitals etc.)
- To share Imaging examination rapidly so that they can be used in Everyday practice
- Good return on investement
- Accelerate access to information Reduce duplicate acts

Reasons of a low impact of IHE profiles for Imaging Sharing

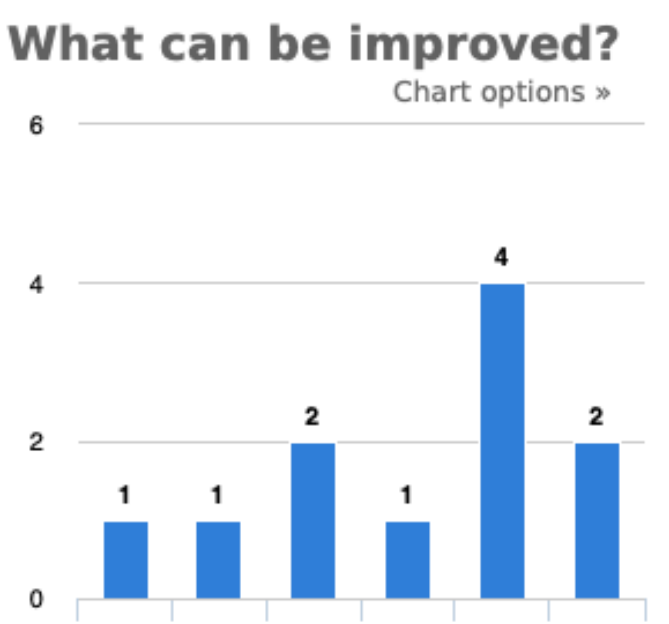
- Extensive and complex documentation that is sometimes difficult to understand, interpret and apply
- Some profiles are staying in the Trial Implementation mode for too long
- Availability of compliant implementations that would be easy to procure, install and maintain
- Vendors promoting proprietary solutions
- It isn't used by enough institutions yet.
- Inertia of vendors
- Availability of a former national standard

Performance

- How long does it take to transfer from the system source to the consumer 1- On CR
  - 2 seconds, 10-20 seconds, Seconds
- How long does it take to transfer from the system source to the consumer 1- On CT study (500-1000 images)
  - 15 minutes !
  - 20 seconds
  - 10-20 seconds for the first image if the systems are performant.
  - Several minutes (<30 min) if the systems are not well configured.
  - Different from site to site.
  - Depends on the PACS, bandwidth, architecture, size of disk storage

Conclusion: the performance is not related to the choice of the profiles or standards but it depends on the configuration of the systems

What Can be improved?



1. Authentication and access to data	1
2. Possible design flaw - Trust in the providing source of information	1
3. Advocate for clear rules surrounding opposing risks at the EU level (cf. granularity of patient consent) :	2
3.1. Privacy	1
4. Performance	4
Other	2

- Others:
  - Change management processes with regards to imaging studies
  - Facilitate image sharing for doctors who don't work for big hospital/clinics.
  - Give the opportunity to patient to know who looks at his/her examinations
  - Financial incentives Political constraints

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Part II - Vendor QUESTIONNAIRE

Introduction

- The following slides provide:
  - For each vendor, their products (PACS or VNA) and the profiles that are used (based on their Integration Statment (IS)
  - Some projects supported by the vendors

Products (1/3)

Company	PACS	VNA	Profiles/ators	IS	Comments
DOBCO Medical systems	PACSoNWEB		Document Registry, Document Repository, Document Source	yes	PACSonWEB can be used in the context of an XDS framework, but supports all kind of workflows that are not IHE.
Chili GmbH	CHILI PACS		PIX Conumer Document Source Imaging Document Responder , Other proprietary messages Profiles: ARI, ATNA, SEC, CPI, CT, XDM, XDS-I.b, ED, HPD, IOCM, IRWF, IRWF.b, IID, KIN, MAMMO, PAM, PDQ, PIX, PIR, REM, SWF, SWF.b, SINR, TCE, WIC, WIA	yes	Fully native
Siemens	eHealth solutions VA37 (Levante Halifax)		PIX Manager, PIX Concumer, Document Registry, Document Repository, Document Source, Imaging Document Responder , Imaging Document Consumer (WIA), XCA initiating Gateway, Responding Gateway, Profiles: APPC, ATNA, BPPC, CRD, CT, XCA, XCA-I, XCF, XCPD, XDM, XDR, XDS, XDS-I.B, XDS-SD, XUA, XDW, DSG, DSUB	yes	In particular, eHealth Solutions allows cross-enterprise patient identification, secure and traceable health data access, easy participation for contributors, harmonized terminologies, and collaborative workflows
Siemens		Syngo.Share VA26	PIX Manager, PIX Concumer, Document Repository, Document Source, Imaging Document Responder , Imaging Document Consumer (WIA), Profiles: ARI, ATNA, ED-CARD,CPI, CT, XDS, XDS-I.b, XUA, XUA++,EUA,ED,IOCM, IRWF.b, IUA	yes	The Archiving Solutions serve to centralize interfaces, storage requirements, and data management functions. Medical data is managed uniformly and independently of format or source. As a data hub in the healthcare company, syngo.share enables simple, standards-compliant connectivity into existing information systems and subsystems (including HIS and RIS). Furthermore, the company-wide provisioning of clinical documents in eHealth networks via syngo.share is simple.

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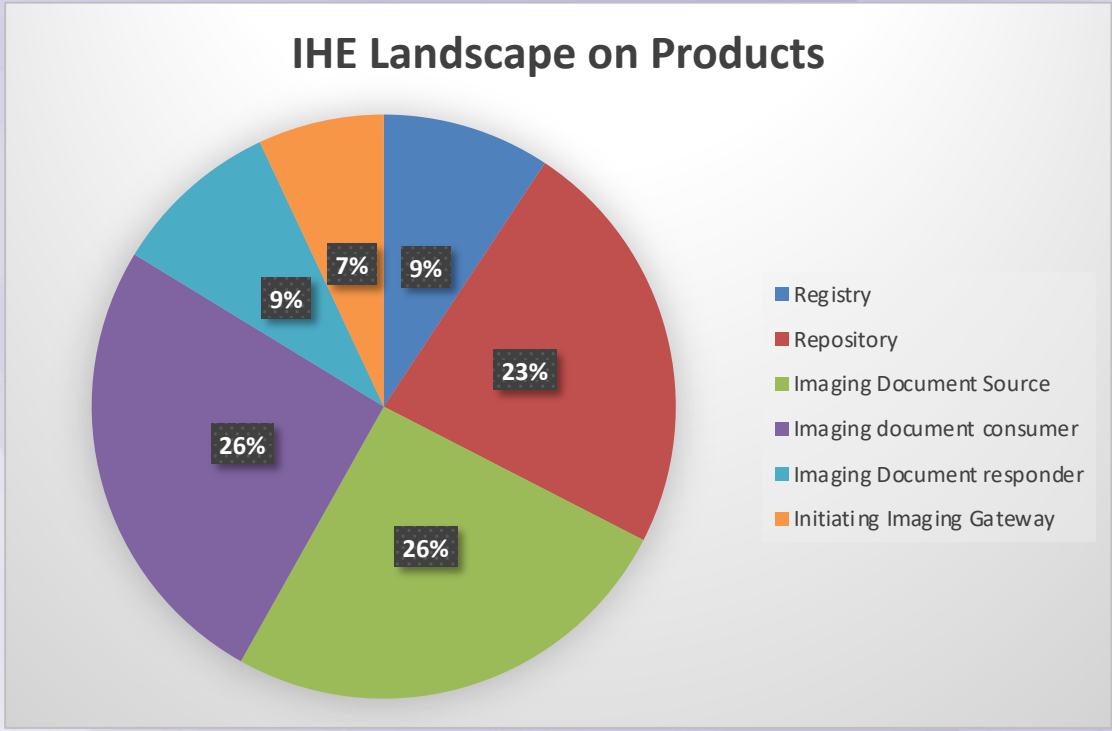
Products (2/3)

Company	PACS/Other	VNA	Profiles/ators	IS	Comments
Siemens	Syngo.plaza VB301		Document Source, Imaging Document Consumer (WIA), Profiles: SWF, SWF.b, PIR, PDI, ARI, CPI, SIR, MAMMO, CT, NMI, EUA, ATNA, IOCM, XDS, KIN	yes	syngo.plaza IHE profiles are used to fulfil the radiology workflow needs and the image sharing needs.
AGFA	Enterprise Imaging 8.1.x		PIX Consumer, Imaging Document Consumer (WIA), Profiles: CATH, ECHO, ATNA, CT, PIX, PDQ, XDS.b, XDS-SD, ARI, CPI, DBT, ED, IOCM	yes	
AGFA		IMPAX DATA CENTER 3.1.1	PIX Consumer,, Document Repository, Document Source Profiles: CATH, ECHO, STRESS, ECED, EYECARE, ATNA, CT, PIX,, XDS.b, XDS-SD, ARI, CPI, DIFF, ED, FUS, IOCM, IRWF, KIN, MAMMO, NM, PERF, PGP, PIR, PWF, REM, RWF,SINR, SWF, XDS-I.b	yes	Native IHE product
AGFA	IMPAX EE R20 XVIII Server 2.18.1		PIX Consumer, Document Registry, Document Repository, Document Source, XCA Initiating Gateway, XCA responding Gateway, Responding Imaging Gateway, Profiles: CATH, DRPT, ECG, ECHO,ED CARD, PGP,, STRESS, ECED, EYECARE, ATNA, CT, PAM, PIX,RID, XDS.b, XUA,, ARI, CPI, ED, FUS, IOCM, IRWF, KIN, MAMMO, NMI, PDI, PIR, PWF, REM, RWF,SINR, SWF, TCE, XDS-I.b	yes	Native IHE product
AGFA	HYDMEDIA G5 5.11.12		PIX Consumer, Document Repository, Document Source Profile: XDS.B, PIX, CR, ATNA	yes	Native IHE product

Products (3/3)

Company	PACS/Other	VNA	Profiles/ators	IS	Comments
GEH	Edison Datalogue (Centricty Clinical Archive)		PIX Consumer, Imaging Document Consumer (WIA), Document Registry, Document Repository, Document Source, Imaging Document Responder Profiles: ARI, ATNA, ED CARD, CPI, CT, XCA-I, XDS.b, XDS-I.b, PERF, EUA, ED, FUS, KIN,DIFF, NM, PIX, REM, SINR	yes	Multiple products required, Enterprise Archive and XDS Registry
GEH	Edison Datalogue Connect		See above	yes	Paired with Edison Datalogue (above) as an edge server for onsite interoperability
SYNEDRA IT GmbH	SYNEDRA AIM19 Zephyr &SYNEDRA VIEW		PIX Consumer, Document Repository, Document Source, Imaging Document Source, Imaging Document Consumer (WIA), Profiles: ARI, CT, CPI, HPD, IOCM, PAM, PDI, PDQ, PDQv3, PIX, PIX V3,RMD, SINR, SWF, SWF.b, XDR, XDS.B, XDS-I.b, XDS-SD, XUA	yes	The product 'synedra AIM' is a healthcare content platform holding DICOM data (PACS) as well as non-dicom data (e.g. documents as pdf, CDA, FHIR). Together with 'synedra View', a multi-format viewer suitable for imaging diagnostics, the product covers radiological and clinical workflows.
FUJIFILM Europe GmbH	SYNAPSE PACS		PIX Consumer, Document Repository, Document Source, Imaging Document Consumer (WIA), Imaging Document Source Profile: XDS.B, PDQ, BPPC, ATNA	yes	Native XDS product
FUJIFILM Europe GmbH		SYNAPSE VNA	PIX Consumer, Imaging Document Consumer (WIA), Document Registry, Document Repository, Imaging Document Source, Imaging Document Consumer (WIA), Imaging Document Responder, XCA Inititating Gateway, Responding Imaging Gateway		Fujifilm Synapse VNA supports core feature natively (Repository, Source, Pix Consumer)

IHE Landscape on Products



Registry	4
Repository	10
Imaging Document Source	11
Imaging document consumer	11
Imaging Document responder	4
Initiating Imaging Gateway	3

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Projects in deployment (1/2)

Companies	Projects	Start date
SYNEDRA IT	Various EPD (Switzerland) Primarely we fulfill the role of an (imaging) document source in several EPD projects. For some of the customers we also take the role of an (Imaging) Document Consumer.	2018
AGFA and Dedalus	Various Teleradiology sites using ORBIS RIS and IMPAX EE (Germany, Austria, Switzerland)	
	Web application is provided to allow access to DICOM studies of a patient. This is typically used to replace physical media (CD/DVD) to share images of a specific patient.	
GEH	NHS EMRAD (East Midlands Radiology NHS EMRAD (East Midlands Radiology), a consortium of seven trusts utilizing Enterprise Archive and Edison Datalogue Connect	2015
GEH	AHPM France	
AGFA	VUMC Amsterdam - The Netherlands Project with Agfa Enterprise imaging http://3f4fgv1h77fa41lbai1qpcj7.wpengine.netdna-cdn.com/wp-content/uploads/2017/03/VUMC_01_LowRes.pdf	2017
AGFA	SIMRAL (e-mage) - East region France Simral (e-mage) is a image data sharing service deployed in the east region of France. The PACS of the various hospitals of the region can archive their images in a central XDS-I repository (Agfa IDC). And the external physicians / patients can get access to the patient images through a secured portal based on patient consent. They can display the images using Agfa Web viewer XERO.	2015

Projects in deployment (2/2)

Companies	Projects	Start date
SIEMENS	Image exchange based on the electronical health record in Austria. Project in test environment https://www.elga.gv.at/fileadmin/user_upload/Dokumente_PDF_MP4/Technisches/Anbindung_von_Bilddaten_V1.51.pdf anbindung_von_bilddaten_v1.jpg	2018
CHILI	INFOPAT www.infopat.eu, https://mis-hd.eu/en/projects/infopat/ The 'Raum für Gesundheit' health region in the Rhine-Neckar Metropolitan Region is one of the five BMBF-funded "Health Regions of the Future" in Germany. The aim is to connect all actors involved in health care and thus to establish structures and processes that allow the cross-sectoral care of chronically ill people. Starting from the premise of "the citizen and the patient at the center", technologies are developed that take into account complex treatment processes, the need for care, and the requirements for efficiency and quality. For this purpose, a number of application and development projects involving a wide range of research projects in collaboration with 26 partners from science, research, industry, social services and the public sector are being carried out for diabetes and colorectal carcinoma, around a patient-controlled personal cross-enterprise patient record.	2012
DOBCO	Belgium - 75% Coverage (with a coverage of 95% in Flanders) of Private and Public medical imaging departments.	2012
DOBCO	Patient portal / Referring phycician portal / Direct exchange of images / integration with e-health (all workflows to eliminate the need for a CD Burn Robot / other portal / ...)	2015

In Summary

- More thorough gap analysis should be investigated in order
  - To highlight evidence on the interoperability solutions used in the projects as presented in the previous slides
  - To collect numbers of systems/actors that are really implemented in a multi vendors environment

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QUESTIONS ?

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