IRSN
INSTITUT
DE RADIOPROTECTION
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Faire avancer la sûreté nucléaire

The work in IEC, DICOM and IHE to improve exchange of dose information between imaging modalities

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Problem

- Knowledge of patient exposure due to imaging procedures using ionizing radiation is essential to:
  - Perform quality assurance;
  - Estimate risk;
  - Undertake any optimization approach.

- In recent years the need to know the patient's exposure has increased:
  - To comply with national or international regulations or standards such as European directive 97/43 (DRLs), ACR guidelines, IEC guidance…;
  - To improve knowledge of population exposure (DoseDataMed);
  - To collect dose over time for individual dose report (SmartCard).

Problem

- To know, monitor and manage the dose it is mandatory to:
  - Harmonize the data and their units (specially dosimetric data),
  - Standardise exchange of information between imaging devices and PACS (Picture Archiving and Communication System), RIS (Radiology Information system) or HIS (Hospital Information System) from different manufacturers.

- Unfortunately systematic exposure monitoring is difficult:
  - The transition from film to digital imaging is always in progress so several devices still do not inform on the dose;
  - When the dosimetric information exists (i.e. DAP) it is often necessary to record it manually;
  - With digital radiology, dosimetric information may exist but is often incomplete, not transmitted or associated to an image;
  - Units of dosimetric quantities are not always standardised.

How to exchange data?

- However for many years efforts have been made to **standardize** and **facilitate the exchange of information**.

- DICOM (Digital Imaging and Communications in Medicine) is a standard to enable the integration of imaging modalities, workstations, printers, and network hardware from multiple manufacturers into a picture archiving and communication system (PACS), and **since 1993 some dosimetric data are transmitted.**

- But dose information in DICOM header:
  - **is not always mandatory** (stored in manufacturer private field);
  - **can vary** from model to model;
  - **is not saved** if the image is deleted.

Dose reporting evolution

- To overcome limitations of DICOM header, a work was undertaken by DICOM in liaison with IEC to register, separately from the images, dosimetric and related data.
- This work led to the creation in 2004 of a DSR (Dose Structured Report) to capture and collect all information dedicated to dosimetry.
- The DSR contains a set of individual Irradiation Event (IE) which contains the relevant technical and dosimetric details for one single continuous irradiation. Whether or not the images are stored, IE and DSR are registered.
- Two Dose SR exist :
  - Supplement 94: Diagnostic X-Ray Radiation Dose Reporting (2005).
  - Supplement 127: CT Radiation Dose Reporting (2007).

Dose reporting evolution

- In 2007 IEC published a **Publicly Available Specification (PAS)** (IEC/PAS 61910-1 Medical electrical equipment - Radiation dose documentation - Part 1: Equipment for radiography and radioscopy).

- This PAS defines **the relevant radiation quantities** required in a DSR and establishes the equipment relevant levels.

- Two conformance levels are defined:
  - **Level 1** is intended for equipment that produces dose levels below significant deterministic thresholds for all intended uses **(general radiography and fluoroscopy)**;
  - **Level 2** is intended for equipment used for procedures that could cause significant deterministic injuries **(interventional systems)**.

Dose reporting evolution

- To fulfil the demand of professionals to monitor the radiation dose delivered to their patient, IHE has developed a profile « Radiation Exposure Monitoring (REM) Integration Profile ».

- Integrating the Healthcare Enterprise (IHE) is an initiative of professional societies to collaborate with industry and coordinate standards-based solutions to problems that span multiple vendors systems.

- This REM Profile facilitates the collection and distribution of information about estimated patient radiation exposure resulting from imaging procedures.

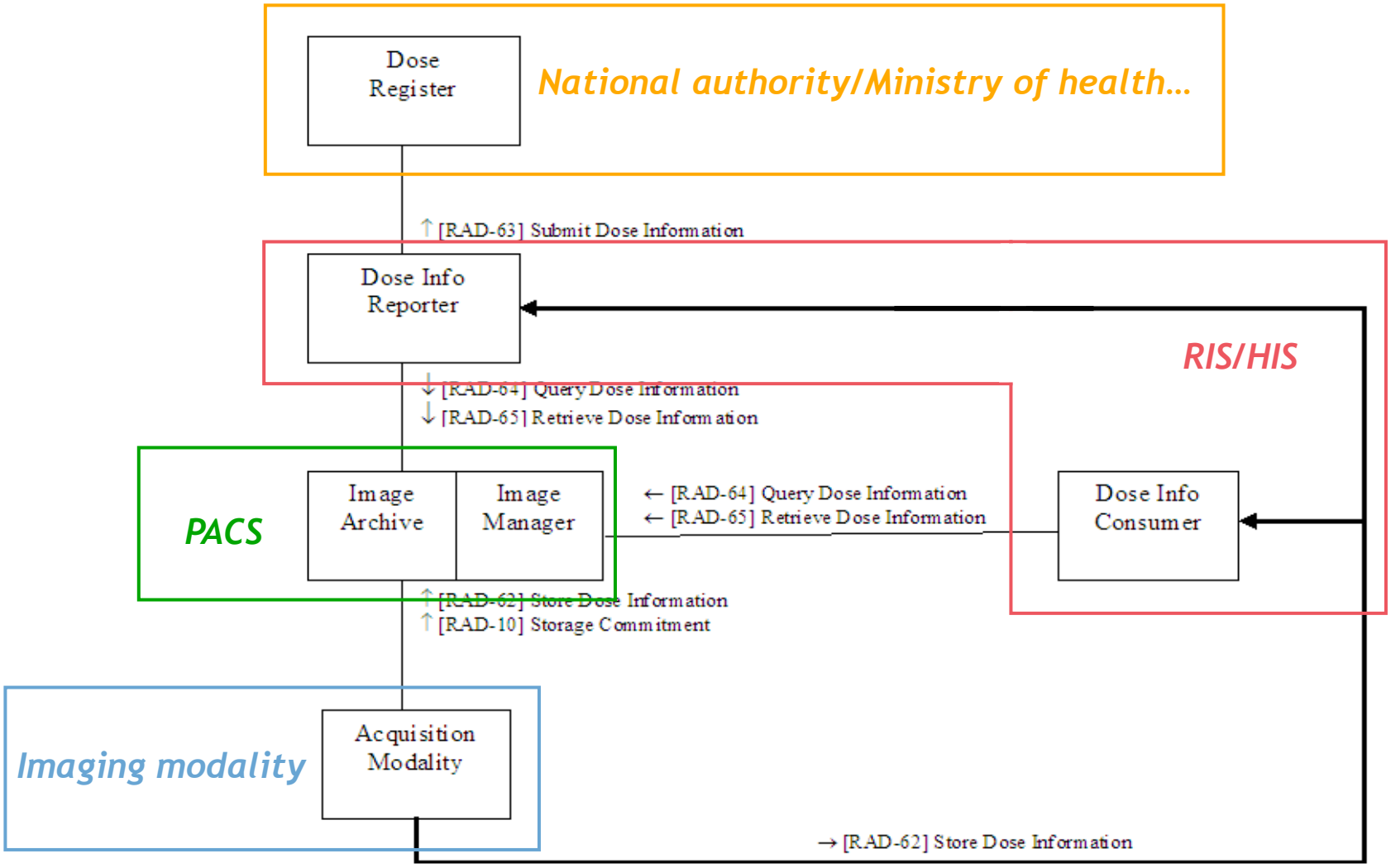
IHE REM Profile (www.ihe.net)

- The REM Profile addresses plain X-ray, CR, DR, fluoroscopy, angiography, mammography and CT.

- This profile is based on DICOM SR (Projection X-ray and CT) and uses 5 "actors" in order to realize the transactions.

- This profile provides:
  - Details (patient demographics, study information, imaging technique and geometry, and typical dose metrics like CTDIvol, DLP, DAP, AGD, and DRP) for each irradiation event (IE);
  - An implementation guide for vendors for the automatic capture of dose information during a procedure and making it part of a patient record;
  - An effective shorthand for sites to use in purchase specifications.

IHE REM Profile: Actors & Transactions



IHE REM Profile status

- The **first REM Profile demo** was presented at **JFR'2009.**

- In 2011 the REM profile was tested at two **Connectathons:**
  - IHE North America Connectathon 2011 - January 17-21, Chicago (USA)
  - IHE-Europe Connectathon 2011 - April 11-15, Pisa (Italy).

During **Connectathons** IHE provides a detailed implementation and testing process to promote the adoption of standards-based interoperability by vendors and users of healthcare information systems.

Actors and Vendors involved in the 2009 demo

Company	Product name	Acquis. Modality	Image Manager	Dose Info Consumer	Dose Info Reporter	Dose Register
SIEMENS	Artis Zee	**x**				
AGFA Healthcare			**x**	**x**		
SOFTWAY	Medseen		**x**	**x**		
EDL	Xplore			**x**	**x**	
IRSN	Experimental					**x**

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Demo scenario

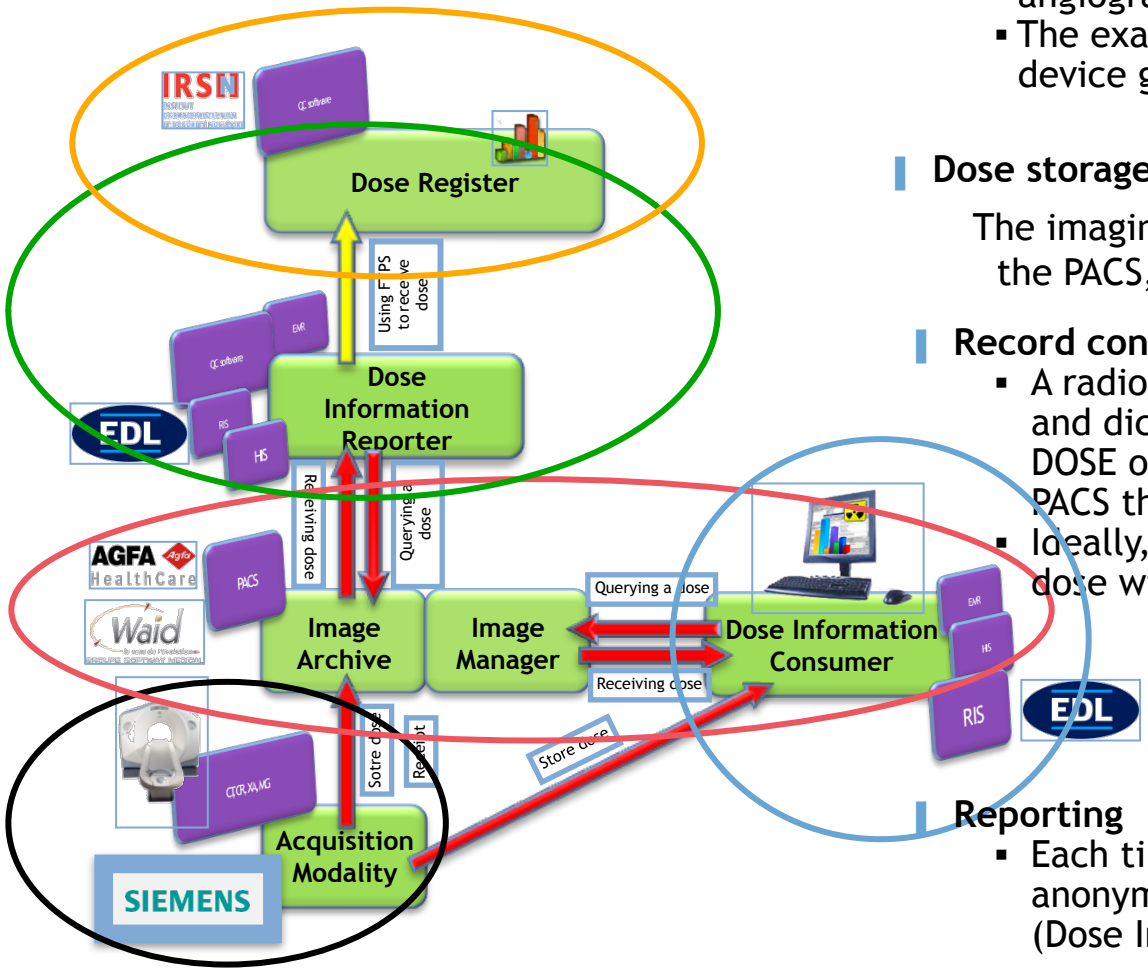

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Image acquisition

- A patient is referred to the hospital for an angiography.
- The examination is performed and the imaging device generates a new DICOM SR object

Dose storage

The imaging device pushes the DICOM SR objects to the PACS, as well as the RIS.

Record consultation

- A radiologist reviews the patient's study on the PACS and dictates on the RIS. He views the presence of a DOSE object and can read the report as well on the PACS that on the RIS.
- Ideally, the RIS would be able to compare current dose with recommended values.

Reporting

- Each time a study is dictated, the RIS pushes an anonymized DOSE SR to the registry using FTPS. (Dose Information reporter).

Dose management for public health

- All dose reports, coming from different modalities are centralized in the registry.

Companies and actors involved in 2011 Connectathons for REM Profile

Company	Acquis. Modality	Image Manager	Dose Info Consumer	Dose Info Reporter	Dose Register
AGFA Healthcare	X	X	X		
American College of Radiology					X
Aware, Inc		X		X	
Cerner Corporation		X			
EDL			X	X	
ETIAM	X				
GE Healthcare	X	X	X		
Global Imaging OnLine		X	X		
InfiMed, Inc.	X				
INFINITT				X	
Karos Health		X			
Krucom AB		X		X	X
medavis		X			
MedicalCommunications		X			
Philips Medical Systems	X				
Sectra Imtec AB		X			
Siemens Medical Solutions	X				
SOFTWAY MEDICAL		X			
Swissray Medical AG	X				
TELEMIS S.A.		X			
Toshiba Medical Systems	X				
VISUS Technology Transfer		X			

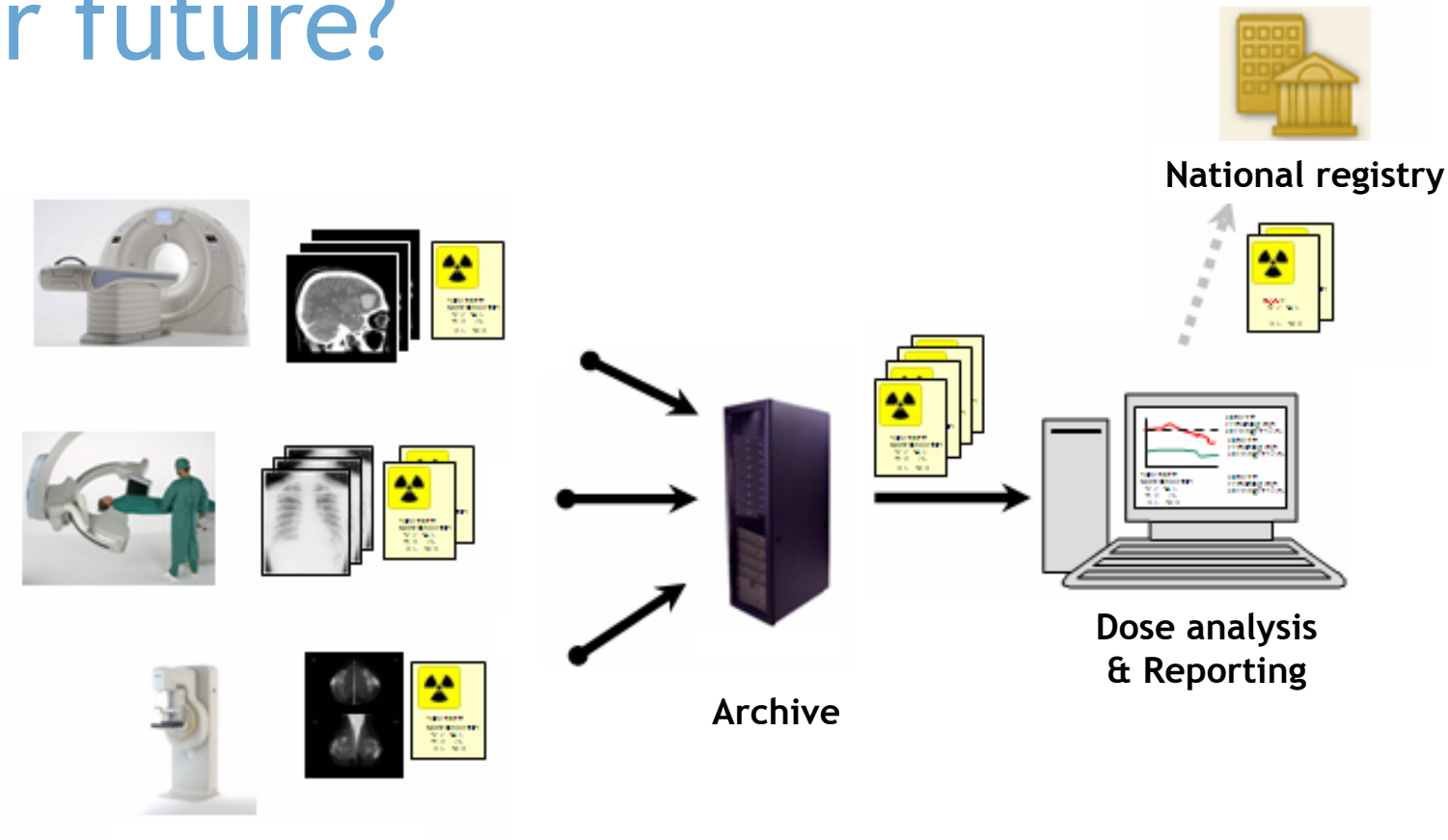
Conclusion

- Today the **standards** to collect, exchange and store dosimetric information exist and are coordinated by the **IHE REM Profile**.

- This profile allows to answer to the main needs **to follow the patient dose** either at the level of patient file, of service or institution. It allows to transmit data to regional and/or national registers.

- Therefore, radiologists, physicists... **must** require suppliers of equipment (imaging modality, PACS, RIS), **implementation of the IHE REM Profile** when a new equipment is acquired or when a recently installed system is upgraded.

Near future?



Thank you for your attention