Dismantling PACS: separating image viewing from the data storage and sharing

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Overview

- Introduction
- Key factors driving PACS' evolution
- Trend: separating storing/archiving and viewing / processing components
- Added value and related issues
- Conclusion

Introduction

- PACS has become a mature technology, widely implemented, but is still evolving
- Regarding PACS evolution, one should distinguish between
  - the evolution of PACS products offer
  - and the evolution of local PACS settings, which depends on local choices, local history (existing infrastructure), continuity of service, …

    and, ultimately, on the PACS products offer.

Key factors driving PACS evolution

Four major factors

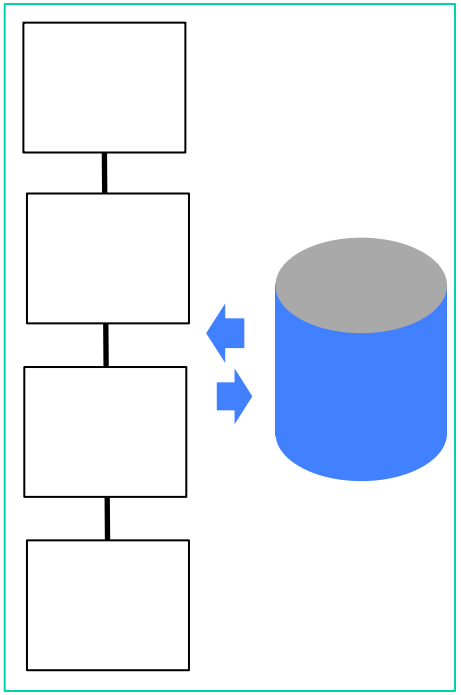
- Evolution of
  - Functional needs
  - Basic IT technology
  - Interoperability standards
  - Economical context

Evolution of functional needs (1/4)

- 1. Organize information processing according to explicit workflows,
  - at a departmental level
  - at the enterprise-level

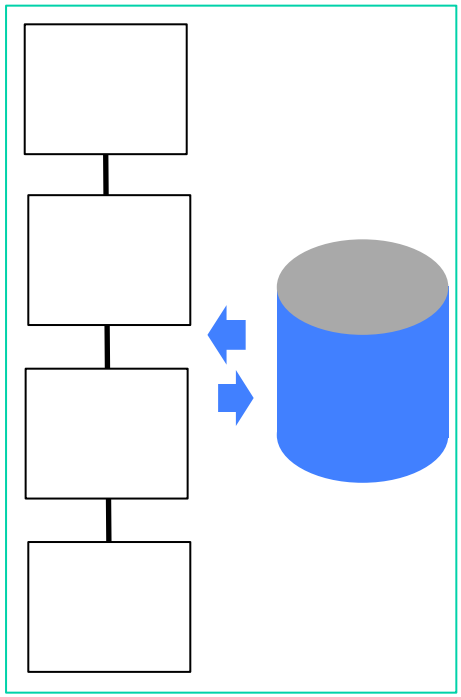
- Why ?
  - Rationalizes activity
    - Relies on an explicit model of activities
    - Facilitates quality assurance
  - Automates repetitive tasks

Ex: Departmental workflow radiology

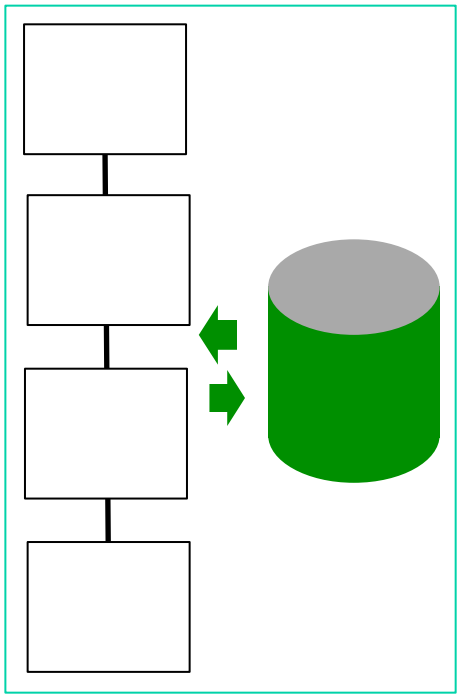


Evolution of functional needs (2/4)

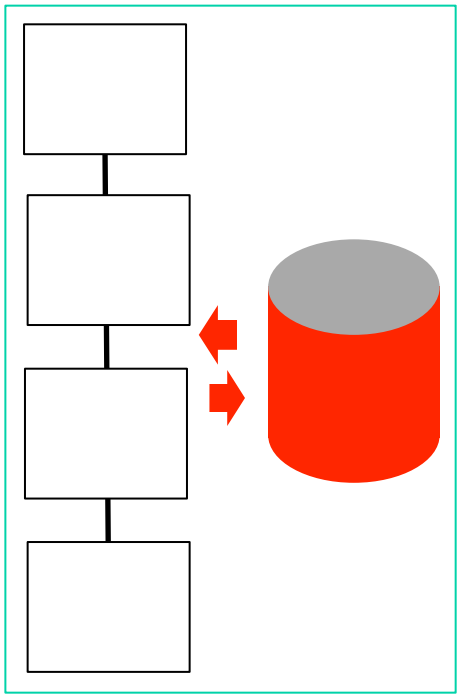
- 2. Support of many new domains of imaging
  - Endoscopy
  - Dentistry
  - Ophthalmology
  - Pathology
  - Radiotherapy
  - Surgery
  - …
- besides the traditional one: radiology, cardiology, oncology



Departmental workflow radiology



Departmental workflow surgery



Departmental workflow radiotherapy

- does not facilitate reusing data from other domains
- however, it can sometimes be achieved
  - either automatically (can be part of the workflow)
  - or under user control

Evolution of functional needs (3/4)

- 3. Cross-enterprise data communication, e.g.
  - importation of outpatient images (instead of CDs)
  - open PACS to telemedicine and health care networks
    - Collaborative decision in domains such as
    - Oncology
    - Cardiac surgery
    - Diabetes
- As well as clinical and translational research
  - Not supported by commercial PACS

Evolution of functional needs (4/4)

- 4. Need of data migration
  - in case of decommissioning and renewal of PACS
    - Many problems with non-standard items such as
      - key images,
      - image annotations,
      - ECG,
      - non standard structured reports
  - Need to minimize migration costs

Evolution of basic technology

- Basic communication technology
  - high speed networking, both intranet and internet
  - web services and Service Oriented Architecture (SOA)
- Data storage
  - Increase of capacity of hard disks
  - Decrease of cost
  - Attractive cloud storage offer
- Data processing
  - Extremely flexible
  - Local processing (GPU) or remote processing

Evolution of interoperability standards

- General
  - e.g. XML (syntax), SOAP (protocol)
- Domain specific
  - DICOM: New objects and services
    - e.g. Whole Slide Imaging IOD, New RT objects
    - WADO-RS
  - IHE: Cross-enterprise document Sharing (XDS.b, XDS-I.b)
    Teaching files and clinical trials export (TCE)
  - HL7 CDA

Evolution of economical context

- Need to reduce investment and operating costs
  - Mutualizing resources
    - Economy of scale (data storage)
    - Teleradiology / telemedicine
  - Rationalizing the use of resources
    - Promote common environments (one size fits all)
    - Encourage outsourcing, e.g. from Storage Service Providers
    - Scalable service-based solutions (rather than investment)

Heavy trend

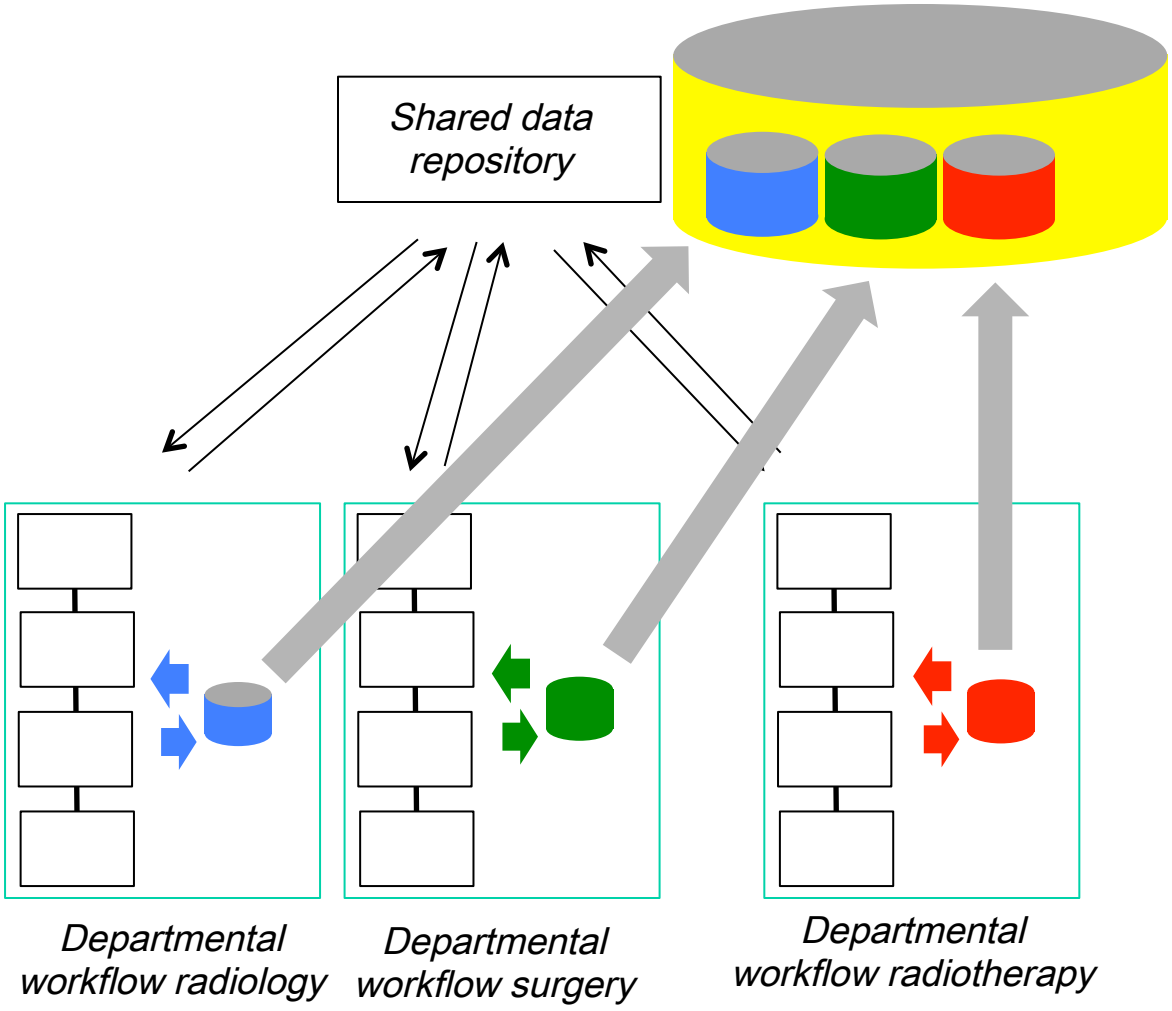
Is to try addressing those needs through Dismantling *image viewing* from *storage and sharing*

Dismantling
image viewing from *storage and sharing*

- What does it mean ?
  - Avoid storage of patients' data (and especially long term storage) in departmental silos
  - Prefer shared enterprise-wide
    or cross-enterprise wide data repositories

Toward « Vendor Neutral Archive »

Introducing a *shared data repository*



Vendor neutral archive (1/2)

- Medical device, supporting
- the management of images and associated data
  - according to a patient-centric approach
  - including
    - DICOM Presentation States
    - DICOM Structured Reports,
    - significant images (DICOM KOS)
    - multimedia documents (e.g. native MPEG)
  - storage, query/retrieval
  - life cycle (i.e. retention, deletion)
  - incl. patient privacy
- …

Adapted from H Oosterwijk (O Tech)

Vendor neutral archive (2/2)

- …
- based on open standards (DICOM, IHE)
  - enabling true vendor-independence
- at department, enterprise, regional level
- scalable (size of images, studies, etc.)
- robust w.r.t. replacement of domain specific data management systems (architecture, protocols, formats)

Adapted from H Oosterwijk (O Tech)

Dismantling *image viewing* from *storage and sharing*

- Functional Added value
  - easier data sharing at enterprise or cross-enterprise level
    - Comprehensive view of patient EMR
    - Homogeneous management of archiving (e.g. retention duration)
    - Better security (e.g. disaster recovery)
  - easier data sharing between collaborating institutions
    - Teleradiology / telemedicine
    - Healthcare networks
    - Research (clinical and translational)
  - easier migration in case of departmental system renewal

Dismantling *image viewing* from *storage and sharing*

- Economical added value
  - Economy of scale (for data storage)
  - Common standards-based environment (no ad-hoc developments)

Dismantling *image viewing* from *storage and sharing*

- Interoperability standards
  - IHE XDS.b, XDS-I.b
  - DICOM Classical Q&R
  - DICOM WADO
  - DICOM RESTful services WADO-RS
- Coming soon
  - S163: DICOM RESTful services STOW-RS

Moving to shared enterprise-wide storage

- Difficulties: 1. not trivial migration of data
  - Non standard objects (e.g. key images)
  - Non standard use of DICOM tags
  - Use of proprietary tags, triggering specific behaviour, e.g. use of hanging protocols

- « bidirectional (DICOM) tag morphing »
  - presented as a way to make any pair of departmental PACS interoperate

    (I am very sceptical)

Moving to shared enterprise-wide storage

- Difficulties: 2. data administration
  - Archives administrated by the institution's IT department (rather than the PACS vendor)
  - Access control managed centrally
    - Requires a consistent architecture and policy of security

Moving to shared enterprise-wide storage

- Difficulties: 3. interfacing with workstations
  - in departmental PACS the interfacing between the image manager / image archive and the workstation often relies on non-standard protocols

    (for the sake of performance and flexibility)
  - so, query/retrieval from/to a shared repository may be non trivial
  - in pratice, the deployment of the shared repository may complement but not necessarily replace legacy departmental data management

Conclusion / Summary

- PACS still undergo a strong evolution as a result of changes in functional needs, available technology and standards and economical context

- Dismantling image viewing from storage and sharing
  - seems appealing and solves some of the pending issues
  - however, it is essentially a repository of documents, which semantics are defined by the standards involved (DICOM+IHE)

Some references

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- Wikipedia. Article on Vendor Neutral Archive
- Bellon E. *et al.* Trends in PACS architecture. EJR 78 (2011) 199-204
- IHE: http://www.ihe.net/technical_framework
- DICOM standard: http://medical.nema.org/