The Orthanc ecosystem for medical imaging
Sébastien Jodogne
“Big imaging” workflow inside hospitals

PET
CT
MRI
“Big imaging” workflow inside hospitals

PET

CT

MRI

PACS (Picture Archiving and Communication System)
“Big imaging” workflow inside hospitals

PACS (Picture Archiving and Communication System)

PET
CT
MRI
“Big imaging” workflow inside hospitals

- PET
- CT
- MRI
- PACS (Picture Archiving and Communication System)
- Specialized devices or applications (radiotherapy...)
- Web portals (or CDs)
Interoperability in medical imaging

“One OPEN standard to rule them all...”
DICOM is everywhere!
Every vendor uses it!
Also “small imaging” and out of hospitals!
Acquisition data (kind of XML)

One slice of image (kind of PNG)

Early example of Web service: «store / query / retrieve»

Large variations in the volume of one medical image: radiography – 10MB, mammography – 100MB, CT-scan – 500MB, histology – 10GB
Orthanc
2011: “We want to make use of our medical images by ourselves”

2012: The first free and open-source DICOM server with a REST API that just starts out-of-the-box
Basic ideas behind Orthanc

“Let’s create a **microservice (SOA)** for medical imaging that leverages the worldwide **DICOM open standard**”

“Let’s release it as **free software (GPL)**, as it is our responsibility as a University to **share knowledge** and to **foster innovation**”
Lightweight DICOM server for medical imaging (PACS) used in clinical, industrial, and research setups

Inter-site exchanges (e.g., for artificial intelligence or multi-site studies)

Teleradiology portals
Key features of Orthanc

- Reference, free and open-source implementation of a DICOM server
- Lightweight: Focused on simplicity, portability and small footprint (C++)
- Built-in support of Web technologies (Web interface, REST API)
- Highly versatile, extensible and scriptable (plugins)
- Industrial grade (QA), large-scale project (over 400,000 LOCs)
Integrated Web viewers for teleradiology
Hospital PACS in emerging economies (e.g., Malaysia)

100,000+ studies
2,800,000+ instances
2.8Tb
Installing Orthanc

Installers / packages for end users

For developers / sysadmins

$ docker run --rm -t -i -p 8042:8042 \\
   -p 4242:4242 jodogne/orthanc-plugins:1.12.3
Advanced features
Support for digital pathology
Automating workflows with Orthanc

Python plugin for Orthanc

Python interpreter

User Python script
Automating workflows with Orthanc

Python plugin for Orthanc

Python interpreter

User Python script

# This Python plugin implements a basic AI gateway

```python
import orthanc

def OnChange(changeType, level, resource):
    if changeType == orthanc.ChangeType.NEW_INSTANCE:
        # A new DICOM file was received by Orthanc!

        # Anonymize the instance
        anonymized = orthanc.RestApiPost(
            '/instances/%s/anonymize' % resource, '[]')

        # Send the instance to the vendor
        orthanc.RestApiPost(
            '/peers/vendor/store-straight', anonymized)

    orthanc.RegisterOnChangeCallback(OnChange)
```
Physicians are excited about artificial intelligence!
Physicians are excited about artificial intelligence!
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Legend:
- **CAD**: Computer Aided Diagnosis
- **Brain**: Brain Modality
- **CT**: Computed Tomography
- **MRI**: Magnetic Resonance Imaging
- **Neuroradiology**: Specialty in Brain Imaging
Urgent need to democratize such a technical knowledge!
Bringing deep learning to end users

The entire computations are done client-side by the Web browser. DICOM never leaves the PACS/viewer environment → **Security by design**

No cloud/on-promise infrastructure required → **Web browser is enough**
Cultural heritage: Volume rendering of micro-CT
Viewer for radiotherapy and nuclear medicine
Conclusions
Our mission statement

“Freely share knowledge about medical imaging”

...including about artificial intelligence!