

Evaluation of Open Source DICOM Frameworks

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Introduction

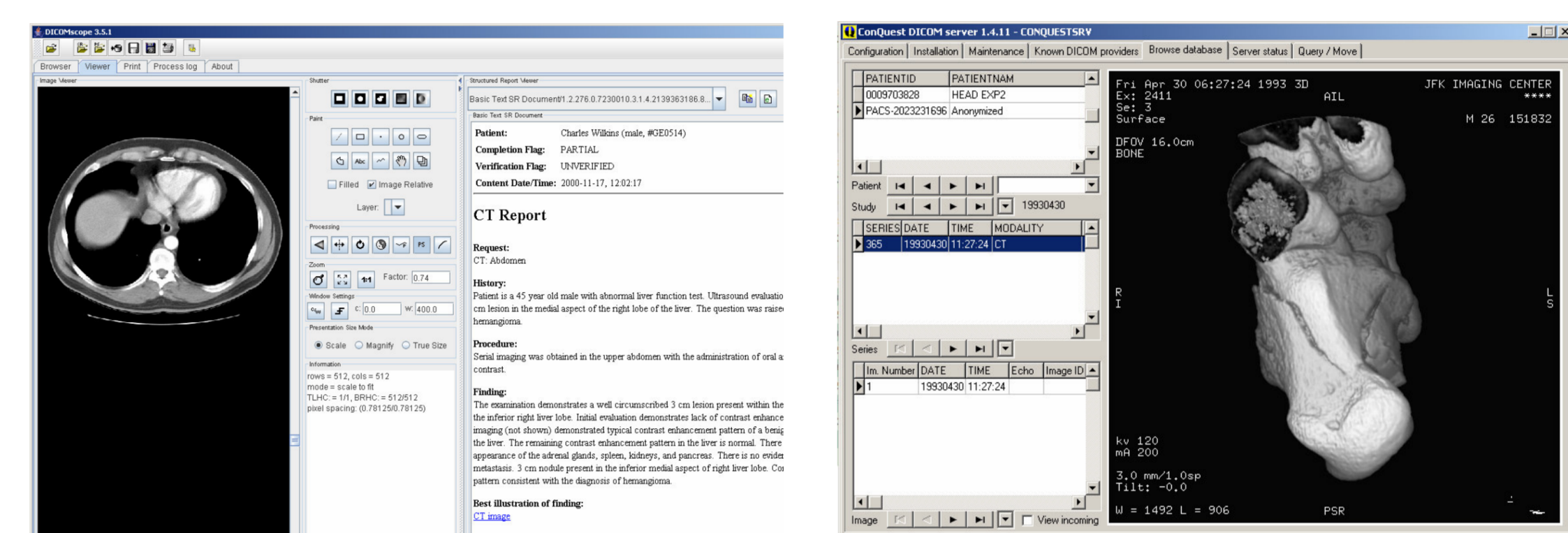
Open source DICOM frameworks seem to be suitable for building experimental PACS in research environments. The careful evaluation of such frameworks according to a well defined set of requirements and criteria is a mandatory step. In this work the evaluation of open source frameworks based on the PECA (Plan, Establish, Collect, and Analyze) process [1] is presented. The goal of this evaluation was to find the open source DICOM framework which best fits our requirements for deploying a PACS Controller, an Image Archive Server, and to develop a set of software components to create a Surgical PACS (S-PACS) prototype.

Methods

The first survey of existing open source DICOM solutions identified 28 products [2]. In the first round only three products were pre-selected: DCM4CHE (DICOM Toolkit 2.0.7 and Image Archive Server 2.9.5), DCMTK 3.5.4 and CONQUEST 1.4.11, (see Fig. 1). The evaluation requirements were sorted in two categories: Generals (Software Quality) and Specifics (DICOM requirements). Twenty-three requirements were identified and prioritized according to negotiability levels, i.e. from a hard requirement which must be fulfilled to a very-negotiable requirement. Each requirement had its own set of evaluation criteria. The measurement methods applied were: Reviewing of the documentation and the source code for the General requirements, and a set of experiments to test the accuracy of the Frameworks' DICOM Conformance Statement, and determine the one that best fitted the Specific requirements (see Table 1).

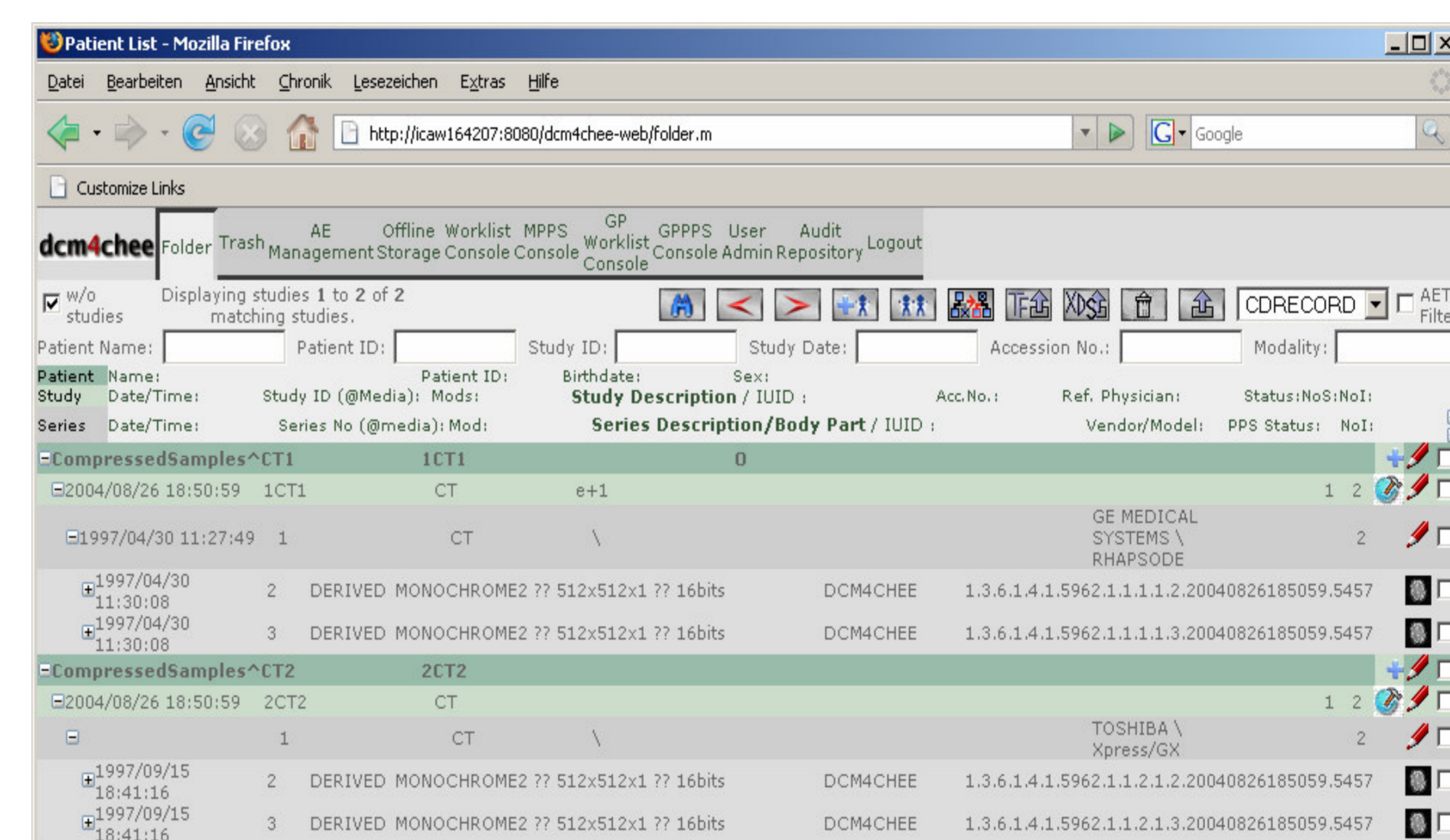
Results

The successful evaluation of the open source DICOM solutions: dcm4chee 2.9.5, DCMTK 3.5.4, ConQuest 1.4.11 following the PECA methodology. The definition of 23 evaluation requirements and 66 Evaluation Criteria for assessing open source DICOM frameworks. The successful installation of the open source DICOM Archive Server DCM4CHEE, selected as the most suitable solution for our purposes, at ICCAS.



a – DICOMScope based on DCMTK

b – CONQUEST



c – DCM4CHEE

Fig. 1: Open Source DICOM Frameworks evaluated at ICCAS (Winter 2006)

	DCMTK	DCM4CHEE	CONQUEST
Documentation	Comprehensive	Not-enough	Poor
Maintainability	High	High	Lower
Programming Language	C/C++	Java, XML	C/C++
Extendibility	Add new SOP's, requires modify and rebuild the source code	Add new SOP's don't always require modify the source code.	Add new SOP's requires modify and rebuild the source code
Operating Systems	UNIX, Linux, Windows	Multiplatform	Windows, UNIX
Client/Server PACS Model	As Server: Modality Worklist and Storage	Provides complete support	As Server: Modality Worklist and Storage
IHE Integration Profiles	None	Several	None, but support some HL7 messages
DICOM Services	No Hanging Protocol support	Hanging Protocol, Storage Commitment, Basic Worklist	No Hanging Protocol support
DICOM IOD's (Image Types)	US, CT, MR, SC, DX, XA, VL, RT	US, CT, MR, SC, DX, XA, VL, RT	US, CT, MR, SC, DX, XA

Table 1: Excerpt of data collected during the Evaluation Process (ICCAS Winter 2006) ■ Best ■ Average ■ Worst

Conclusions

- 1.The DCM4CHE DICOM open source frameworks best fits our General and Specific requirements necessary to develop an S-PACS prototype.
- 2.DCMTK and particularly its DICOMScope application are suitable for developing DICOM interfaces to our client applications.
- 3.CONQUEST is death as open source project now maintained by Netherlands Cancer Institute and its use was not recommended.

References

- [1] Comella-Dorda, S., Dean, J. C., Morris, E. J. and Oberndorf, P. A., "A Process for COTS Software Product Evaluation", International Conference on COTS-Based Software Systems (ICCBSS), pp.86-96, 2002.
- [2] Source of information September 2006:
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