

Globus MEDICUS - A HealthGrid Platform for Diagnostic and Therapeutic Medical Image Exchange in Clinical Research and Healthcare

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Invited talk

Summary

Medical image management remains one of the most challenging fields in health informatics. Both clinical and research image workflows require some form of publication, storage, and discovery. Data scale and appropriate semantic description /annotation of images create significant complexity of these workflows. On the other side expectations of the user community are demanding distributed access and reliable uninterrupted workflows reusing existing applications and infrastructure. In addition regulatory compliance, e.g. HIPAA and FDA conformance, are required specifically for clinical and research use.

Radiological imaging presents the advantage that standards for storage and communication of images exist and thus present an ideal candidate for middleware solutions. The Digital Imaging and Communications in Medicine (DICOM) standard (www.nema.org) defines the image and meta-data format and the network protocol between medical imaging devices. Since then DICOM has become the de-facto standard for medical imaging adopted by all medical equipment vendors.

The latest DICOM standard, release v3, defines the image format and a peer-to-peer network transport protocol. DICOM objects contain meta information about patient, study, series, and image attributes. Together image format, meta data, and network model, define a medical image specific application domain, referred here as DICOM domain.

Healthcare image management comprises primarily (i) storage, (ii) availability (fault-tolerance and disaster recovery), and (iii) recently interoperability and information exchange. However DICOM does not provide image management, but leaves it to the vendors to implement. As a consequence, we see a variety of silo implementations today making it almost impossible to achieve interoperability. The Integrating the Healthcare Enterprise (IHE, www.ihe.net) initiative has been created to address the issue of interoperability with the approach to interface existing silos with significant success in recent years. The latest interface, the cross-enterprise document exchange (XDS) and its medical imaging cousin XDS-I are taking shape.

However XDS and XDS-I only address interoperability. Still missing is an open standards based architecture that provides an overarching and scalable infrastructure to implement all aspects of healthcare image management (i-iii). Such an infrastructure must keep the integrity of DICOM intact to preserve compatibility to existing and future investments into imaging devices, Picture Archiving and Communication Systems

(PACS), and display workstations a \$1.9 Billion annual business.

Globus Alliance Grid technology (Globus Toolkit, www.globus.org) is an open Grid architecture providing reliable industry standards for the most challenging problems associated with network collaborative environments: (i) high-speed reliable data transport utilizing high-bandwidth networks (cite), (ii) enterprise level security (data, authentication, authorization), (iii) large scale data management and replication, and (iv) publication, discovery, sharing, and use of distributed, independently owned and operated computational, storage, and data resources federated in the Grid as web-services (WS, www.oasis-open.org). The Grid paradigm spawns a virtual organization (VO) over public and/or private networks between resource providers, e.g. imaging devices, and consumers, e.g. radiologists or researchers.

The Globus MEDICUS project (Medical Imaging and Computing for Unified Information Sharing) is a seamless integration of DICOM devices into Grids. As such MEDICUS builds on the overarching Grid infrastructure to implement (i-iii). In the Grid, medical images become transparently available anywhere within a VO, comparable to a Regional Health Information Organizations (RHIO) of hospitals or practices, and between VOs.

Because the images are available within the Grid infrastructure, standards based WS, e.g. storage, image processing, data mining, become easier to develop and to deploy. We believe that such an overarching open standards infrastructure, like MEDICUS, will enable image availability at the point-of-care and thus helps to eliminate redundant imaging to the benefit of the patient and subsequently reduces cost.

Two image workflow use-cases will be described using the Globus MEDICUS platform: (i) Patient Centric Authorization clinical workflow with County, State, Federal PKI credentialing and (ii) Multi-Center Clinical Trial image workflows in the Childrens Oncology Group (COG) 40 sites production Grid.