XIP: the eXtensible Imaging Platform

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Abstract
To encourage the use of imaging in clinical trials the caBIG in Vivo Imaging Workspace is developing the open-source eXtensible Imaging Platform™ (XIP). XIP™ supports rapid development of ‘plug-in’ applications for image analysis and visualization. These applications utilize a host-system-independent interface being standardized by DICOM WG-23, and could, therefore, be launched and controlled by any system that supports that interface. Host independence facilitates translational research across multiple centers by allowing the same application to be deployed into a wide variety of settings, both research-oriented and clinically-oriented. XIP applications can be customized for specific clinical trials to assure uniformity in analysis across centers. The XIP package includes a reference XIP Host™ that can utilize DICOM services as well as caGRID data and analytic services to support XIP applications. The XIP Libraries™ are based on Open Inventor™, with extensions to support medical imaging applications. These extensions include both custom-built objects as well as automatically-generated wrapper objects for commonly used toolkits such as ITK and VTK. A developer can use the XIP Builder™ tool with the XIP Libraries to rapidly create and debug medical imaging applications.

What is XIP?
• XIP is an open source environment for rapidly developing medical imaging applications from an extensible set of modular elements
• Researchers can easily develop and evaluate new approaches to medical imaging problems, and use them in a translational research setting
• caGRID makes it possible to develop an XIP architecture that allows users to choose between remotely hosted grid-based components and data sources as well as locally available components and sources
• Components may include analytic services, e.g. CAD algorithms, algorithms for quantifying changes in consecutive imaging studies, 3-D visualization pipeline etc.
• Available data sources include NCIA, caGRID data services, DICOM data repositories, local databases, etc.

XIP Host
• Provides the infrastructure in which XIP or DICOM WG-23 Applications run
  - Authenticates user
  - Manages installation, launching, and termination of XIP Applications
  - Provides data and services to XIP Applications
  - Accepts status information and results back from XIP Applications
  - Deals with auditing and controls access to services and data
• Isolates the XIP application from the nature of databases, archives, networks, and possibly image data formats
  - Manages caGRID interactions and security
  - Manages access to DICOM networks, objects, and services
  - Maps images and associated meta-data from various sources between their native form and a common form usable by the XIP application
• Provides General Purpose Worklist support.

XIP is the reference implementation of the DICOM WG-23 application hosting interface

WG-23 addresses clinical integration and vendor inter-operability by defining standardized “plugs” and “sockets” (APIs)
caBIG XIP addresses an open-architecture, integrated development environment for rapid prototyping & collaboration based on WG 23 APIs.

XIP Current Status
• The initial phase of XIP development is complete. The source code, reference implementations, the XIP Builder Tool, the XIP Libraries, and all documentation are available from: http://www.opengrid.org and http://gforge.nci.nih.gov/projects/xip/
• Other caBIG projects such as AVT are based on XIP and new projects outside of the caBIG community are adopting XIP.
• caBIG is finalizing requirements for XIP extensions that will provide additional applications and hosting options and full integration with the NCIA storage system.

REFERENCES

XIP Application
XIP Libraries
XIP Builder
Auto Conversion Tool

XIP Integration: AIM and NCIA
• XIP is a full participant in caGRID and has the ability to query and retrieve from the National Cancer Image Archive (NCIA).
  - The Electronic Radiology Laboratory has established an independent NCIA instance using open source Virtual Machine technologies and is actively working to extend NCIA.
  - The combination of NCIA and XIP provides a powerful platform for multi-center clinical trials.
• XIP incorporates the caBIG Annotation and Image Markup (AIM) model.
  - AIM provides tools for capturing and sharing text and graphics associated with an image
  - Using caGRID AIM data structures can be shared and stored in caGRID data services

XIP Application Builder
XIP Class Library