mantisGrid

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650.650: Special Topics in Medical Security and Privacy

Agenda

- Introduction to Grids
- What is
  - Requirements
  - Similar Implementations
  - RENATA Network
- DICOM and HL7
- Test Cases
- Future Works
Grid Networks

- Grid Goals
  - Storage, processing, and availability of data.
  - Facilitate collaboration across multiple institutions (e.g. clinical and research centers) in order to share data.
  - Provide increased computational power.
  - Present significant opportunities to developing countries.
    - special needs of different communities and epidemiologies (race, ethnics, diet, or even life style)
  - Present significant opportunities for healthcare and telemedicine.

What is mantisGrid

- Designed to deal with diverse medical imaging modalities
  - CT, Xray, MRI, ultrasound, nuclear medicine, and visible light digital medical photography.
- Uses a 30Mb bandwidth of the Colombian High Technology Academic Network, RENATA, connected to Internet 2.
- Uses XML schemas and databases to create DICOM objects, user authentication, and patient confidentiality.
mantisGrid Requirements

- Authentication/authorization (node) level
  - Each institution validates against individual databases.
- Dentistry and Dermatology DICOM studies
- Fulfillment of legal requirements regarding security of clinical information.
- Various interfaces are offered
  - Many relational database management systems

Similar Implementations

- Latin America and Europe
  - Biomedical applications, engineering, e-learning, physics, environmental sciences, and others.
  - Few projects, none seem to have been strongly established for medical imaging management.
- A number of grid projects and developments in the biomedical area include:
  - The European mammogram database MammoGrid
  - The biomedical platform MediGrid
  - VirtualPACS (a grid client application for the digital imaging and communications in medicine [DICOM] DataService)
  - caGrid (an open source grid software infrastructure aimed at enabling multi-institutional data sharing and analysis originated at the NCI Cancer Biomedical Informatics Grid [caBIG™]),
  - The European grid-based pediatrics platform Health-e-Child
All nodes are interconnected via RENATA.

The institutions create a virtual organization unifying their individual databases.

Each node is autonomous in the management of users and DICOM datasets.

OGSA-DAI™ is a middleware bundle
- Allows data resources, such as file systems, relational, or Extensible Markup Language (XML) databases, to be accessed, federated, and integrated across the network.

One of the nodes of the mantisGRID is denominated as the Master Node
- Responsible for managing the data sources and ensures security in the databases.

One special node contains a Globus Server
- Grid security infrastructure [GSI] with digital certificates and a digital certificate propagation service named MyProxy Server
- the functionality of a OGSA-DAI server (DQP coordinator)
- mantisGRID database
- mantisGRID Web application allows interaction of the users with the grid.

Other nodes
- The rest of the nodes contain the DQP evaluators
- mantisGRID databases and the compiled Globus Toolkit 4.2.0
- Services of a simpleCA certifying entity
- MyProxy client for the GRID certificates management.
Network Terminology

- **File Trower**
  - Application that coordinates the image data transport from a node to the mantisGRID user.
  - Must be present in each node.

- **The Distributed Query Processing (DQP) system**
  - Allows the evaluation of queries generated over distributed data sources.
  - Establishes two application containers for lodging and access.

- **The Query Evaluation Service** is used by the coordinator to execute its query plans.

- **OGSADAI service**
  - Grid data integration service

- **SimpleCA**
  - Trusted certificate authority on the network

- **MyProxy Server middleware**
  - Provides authentication with CA Server
  - Propagates mantisGRID

- **Globus Toolkit 4.0.5**
  - Deployment of Web Services Globus in OGSA-DAI.
  - WebApplication Tomcat for Web Services.

- **OGSA-DAI 3.0** for OGSA middleware implementation in Apache Tomcat containers.

- **OGSA Distributed Query Processing (OGSADQP)** version 3.2.1.
  - Supports queries over OGSA-DAI data resources and services.

**Note:**
- OGSADAI works natively with Java.
- mantisGRID was developed under PHP.
- Translation of query results from Java into PHP code necessary.
  - Introduces a performance overhead in mantisGRID.

Infrastructure: Software

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DICOM and HL7 Standardization

- HL7 is used in document standardization (RIM + CDA)
  - De facto communication standard within healthcare
- DICOM standards specifically describes:
  - Information content, including structure and coding;
  - DICOM services for information management
  - Messages protocol
- Globus Toolkit lacks the full integration of the DICOM standard
- mantisGRID supports DICOM standards for:
  - The DICOM SR documents based on DICOM SR templates
    - 2000 - Diagnostic Imaging Report Transformation Guide
    - 7000 - General Relevant Patient Information (mapped to HL7 CDA)
- The validation of the DICOM standard, for the created studies, was accomplished with the "DICOM Validation Tool" from the Osirix Viewer.

DICOM and HL7 Standardization (Cont.)

- The anonymizer application removes identifiers from the patient metadata at each institution's database according to privacy policies defined by the each institution/node.
- Anonymization will be of value for research purposes, such as in epidemiological studies.
Test Cases

- Initial clinical testing
  - Dentistry and dermatology
    - Using panoramic X-ray radiography and visible light medical photography.

- Performance Testing Results
  - Comparable query time to distributed MySQL databases.
  - As the query level increases, performance levels converge.

Future Work

- Proposed by the caBIG team
  - mantisGrid plans on adopting initiatives of controlled vocabularies to extend image annotation and markup.
Questions?