Medical Services on Grid

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Challenges for Health Grid

- Data acquisition
- Security for hospital connections
- HIPPA regulations
- Massive data volume
  - Storage capacity and network bandwidth
- Storage/Retrieval model (Check-out/check-in criteria)
- Requires IRB (Institutional Review Board) approval
Digital Data in a Hospital

Images

- X-ray
  - Chest, KUB…etc.
  - Mammograms
- CT, MRI
- Sonograms
- Visible light
  - Endoscope, microscope…etc.
Digital Data in a Hospital (cont.)

- Video and Sound
  - Angiogram, heart echo, heart sound, lung sound…etc.
- Signals
  - EEG, EKG, EMG…etc.
- Text and numbers
- Estimated 7 terabytes / year / hospital
Grid for Health Care

- **USA**
  - NDMA
  - BIRN

- **EU**
  - GEMSS
  - E-Diamond, MammoGrid
NDMA
NDMA

- National Digital Mammography Archive

Funded by the National Library of Medicine under the Bio-Medical Applications for the Next Generation Internet program

Phase I: 1998/10~1999/06, Phase II: 1999/12~2002/11, now in Phase III
Why NDMA

- The trend of Digital Radiology
  - 28 PetaBytes per year from the 2000+ hospitals in the US
  - NDMA pilot, 56 Terabytes/year
  - Mammogram: 57% of all digital images in a hospital (in terms of size)
- Great value when integrated
NDMA Focus

- Digital Archive
- Advanced Networking
- Information Security
- Computer-Aided Diagnosis
- Education and Training
Petabyte data for
• computer algorithm training
• radiologist training
• and clinical use

Terabyte Index metadata for
• search and retrieval
• data set collection
BIRN
BIRN

- Biomedical Informatics Research Network
- Mouse BIRN
- Brain Morphology BIRN
- BIRN-CC (Coordination Center)
- Based on SRB
- Supported by NCRR
Objectives

- Establish a stable high-performance infrastructure linking key NCRR-supported P41 and GCRC sites using the Internet 2 network
- Establish distributed and linked data collections for the testbed projects
- Enable the use of distributed, heterogeneous, grid-based computing resources for project-specific data storage and collaborative analysis
- Enable data mining from multiple data collections or databases on neuroimaging
- Develop stable software and hardware infrastructure that can be reapplied and/or expanded to include other sites with different research foci
- Demonstrate effectiveness of these technologies in improving and extending research results (needs pull not technology push)
# of Portal Accounts

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Storage Breakdown by Site (81.00GB)

- UCSD-NCMIR: 46%
- UCSD-fMRI: 15%
- BIRN-CC: 1%
- UCLA-LONI: 11%
- Cal Tech: 7%
- HPSS: 0%
- Duke-CIVM: 3%
- Duke-UMC: 4%
- Harvard-BWH: 2%
- Harvard-MGH: 11%
GridStart
GEMSS

- **Grid-Enabled Medical Simulation System**
- Funded by the European Commission in the Information Society Technologies (IST) Programme
- Funding: 2.63 million €
- 2002/09~2005/02
Medical simulation service Portal + networked compute resources

User-site (SW installed)

Pre- & Post-processing

GRID SW

Could also be moved to the services portal

Simulation Service System

GRID SW (interface)

Applications SW

GRID SW (service use)

Internet or Intranet

Center for Biomedical Informatics
GEMSS Applications

- Maxillo-facial surgery simulation: a virtual pre-operative planning space
- Neuro-surgery support: prediction of the brain-shift during neuro-surgery
- Radio-surgery simulation: improved treatment planning for cancer destruction
- Inhaled drug delivery simulation: virtual drug delivery to the lung
- Cardio-vascular system simulation: simulation of the entire cardio-vascular system for improved treatment plans and surgical procedures.
- Advanced Medical Image Reconstruction for SPECT
MammoGrid Consortium

- Technical Coordinator: CERN, Started 2002/09
- Mirada Solutions (UK) - Medical Image Analysis S/W
- Univ of Oxford (UK) - Medical Vision Laboratory
- Univ of Pisa (I) - Medical Physics section
- Univ of Sassari (I) - Maths & Physics Dept
- Univ West of England (UK) - Computing Research
- Univ of Cambridge (UK) - Addenbrookes Hospital
- Univ Hospital of Udine (I) - Inst of Diagnostic Imaging
A GRID INFRASTRUCTURE IS IDEAL

The databases to statistically validate image-based clinical hypothesis are:

- Populated by large number of cases
- Contain large files (1 mammogram 10Mb+)
- Geographically distributed repositories
- Heterogeneous database formats
- Need to be accessible to co-workers

Development and validation of medical image analysis solutions demands:

- Computationally expensive simulations.
- Repeated runs for optimal parameter tuning.
- Statistical test rigs.
- Remote execution and maintenance
Grid Architecture

Application Layer
Collective Layer
Resource Layer
Fabric Layer

UNICORE
Legion
Condor

Globus toolkit

Which one to use?
Questions and Comments

http://gimi.tmu.edu.tw/
http://bcc.tmu.edu.tw
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