International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol.3, Issue.1, Jan-Feb. 2013 pp-178-182 ISSN: 2249-6645

Hgrid: An Economical Model for Mass-Health Care System Using Latest Technology (Grid Computing)

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ABSTRACT: The large Hospitals and healthcare institutions consist of different Medical equipments and computers hardware software resources scattered across their campus. Rarely these resources are totally utilized to their fullest capacities and most of the times they remain idle. This situation seems to be alright for the rich and developed countries. Definitely for developing countries like India, we cannot afford huge investments in Computer Hardware's, embedded equipments (which are generally costlier), system software (including proprietary systems) and Application software based on expert systems. In order to efficiently and enormously utilize the resources across the health centres/hospitals/medical universities, the grid computing technology deployed in massive health care maintenance requirements

I. Introduction

This Paper analyse the need for health grid, the architectural framework is designed to develop a health grid system for kattankulathur campus.

II. Need for the Study

Most of the Health centres and medical institutions have powerful collection of computing resources and health related instruments on their campus for use in areas from high performance computing to general access medical laboratories(in the form of image processing, preserving health parameters of individuals, availability of drugs, blood banks and other treatment related facilities). However, these resources are rarely used to their fullest potential. Due to paucity of funds and exponential increase in patient registrations, most often it is required to ensure the minimum facilities to reach the needy patients. Therefore, it is mandatory to search and find out the right technology to ensure the full utilization of the computing resources to be passed on to the needy and poor patient by exploiting the computing power to the maximum possible extent. Though the telemedicine system through internet emerges now, the important aspects of secured access & Information are lacking as per most of the users. Moreover, the internet based systems are more vulnerable to spam and viruses. Therefore, the requirement boils down to find out a system of making optimal usage of these resources to different patients by deploying appropriate current state of our technology. The vast requirements are confined to not only to multi speciality hospitals, but also to various major healthcare institutions attached to medical colleges, private banking centres and universities too.

III. Objectives

Keeping the above needs in mind, the objective of this paper is to device an Architectural framework for Health Care system to utilize the human knowledge power and other hospital resources effectively. The term "Health grids" means that encompassing the Grid Computing technology on the Internet based health care system. Grid infrastructure comprises applications, services or middleware components that deal with the specific problems arising in the processing of biomedical data.

IV. Hypotheses

The large Hospitals and medical institutions has limited computing resources, but are scattered at different departments at different places. To achieve our stated objectives, the possible hypotheses is to frame optimal usage of all these resources (Including massive storages intermittently required by different departments surgeons)through the latest cutting edge technology of grid computing.

V. Scope of research

This framework provides resource utilization in a proper way across multiple industries including health enters& Engineering industries. Researchers can use grid computing processing power to hunt for new viruses, search for new drugs, model disease outbreaks, image the body's organs and determine treatments for patients. Doctors can gain access to relevant health data regardless of where it is stored. Patients can receive a more individualized form of healthcare. Healthcare workers are better able to collaborate and share large amounts of information.

V.1 for a healthcare Professional/Biomedical Researcher

From the individualised care point of view, for the clinicians to make the best diagnosis and decide on treatment all the relevant health information of the patient needs to be available and transparently accessible to them regardless of the location where it is stored. Moreover, computer-aided tools are now essential for interpreting patient-specific data in order to determine the most suitable therapy from the diagnosis.

To store and process medical images, genetic information and other patient data, a large amount of computing power is needed. Large computing resources are also needed for keeping statistics of patient records, for knowledge extraction using data mining, and for the simulation of organisms and diseases using complex biomedical models. Grid technology has undoubtedly much to offer medical professionals, as illustrated by the following examples. The delivery of medical information and certain services through the internet is familiar. In health grid computing, we seek an extension of the concept

to consider how to provide large scale services to the user on demand. Some case study quoted by SHARE PROJECT Supporting and Structuring Health grid activities & Research in Europe, Developing a Roadmap [3].

1) Consider a radiologist who needs to manipulate an image: we want to provide a set of services, some of which may require heavy processing, making them available on her desktop 'transparently', as if they were programs simply running on her computer.
2) Consider a public health service which monitors certain infectious diseases and has to trigger an alert in case of a suspected epidemic. The identification of unusual patterns would in many cases be the critical step to halting the problem.
3) Consider a surgical simulation prior to maxillofacial surgery, to determine how the patient's face may appear after one manoeuvre versus another, the presence of sufficient tissue to allow the operation or to demand transplantation, and even to involve the patient in the decision.
4) Consider a 'neglected disease' like malaria. Malaria is neglected by the pharmaceutical industry because there is no prospect of profit in it. Relatively little progress has been made towards the eradication of this well understood disease, notwithstanding substantial investments of public funds in research projects. In silico lead generation may possibly be coupled with investment in plant by the poorer nations that suffer from it to lead to a locally sustainable solution.
5) Consider the possibility of linking genomic information to imaging in diseases like juvenile idiopathic arthritis. The genome will indicate susceptibility long before the disease is expressed, but equally, signs picked up from imaging may obviate the need for genetic screening, thus avoiding some of the most acute problems associated with it.
6) Consider more abstractly the nature of evidence based practice, the volume of scientific literature that provides the evidence base and the accumulation of evidence from practice that occurs as a matter of routine healthcare. How can these be integrated?**.** How can they be used without violating any ethical restrictions on use of data, confidentiality, privacy, security? How can they be shared without violating any data protection laws?

These are simple examples of foreseeable beneficial advances within the next generation of developments. For the radiologist or the maxillofacial surgeon, the services described would be important new tools, while for the provider of such services the underlying grid would be an ideal e-market place. For the public health service concerned with infectious diseases or the academic unit concerned with neglected diseases, health grids would provide power and flexibility beyond what could be achieved using traditional approaches. For a group of physicians seeking to improved treatment through research, grid offers a completely new concept.

VI. Socio-Economic benefits

Modern healthcare services are expected to be available around the clock, seven days a week, so that systems with pervasive access and near-absolute fault tolerance are indispensable. However, it is difficult for these applications to run non-stop with a high quality of service. Grids could help by providing a platform of collaboration, allowing the linking centres which co-operate to achieve better continuity and quality of service. Medical staff will then be able to share experience, knowledge and 'second opinion' with other internal and external staff. The distributed architecture of grids with the availability of high-bandwidth networks responds well to the requirements of healthcare provision. There are also optimistic stakeholders' views towards medical research, healthcare and computing capabilities combined to better satisfy the patient

Health grids promise many benefits to mobile patients as well as citizens. It could help a travelling individual to receive the right treatment in an emergency situation, thanks to the ability of the grid to facilitate communication between the local hospital of the patient and the admitting hospital far away in order to exchange necessary heath related information.

VII. Research Questions

What is the nature of implementation of Grid computing technology over the healthcare maintenance? , What are the technologies trade off the architectural components? [3], what are the Socio economical benefits of the health grid system?

VIII. Architectural Model

This section describes the logical representation of the architectural model. The Grid System designed for the health centre is "campus grid" which is one of the types of grid. Health grid architectural framework designed consists of several sub systems. The sub systems are described as grid layers such as application (Higher) layer, Management (Middle) Layer, Computing (Low) layer. Highest layer is application layer deals with clinical applications and consists of user interfaces, next is management that and routing requests and responses, manages job queue along with job scheduling algorithms and methodologies, allocating resources for the job queue. The Third layer is Computing layer which is responsible for mapping the resources to the jobs and controls the execution. The groups are virtual nodes of health grid system.

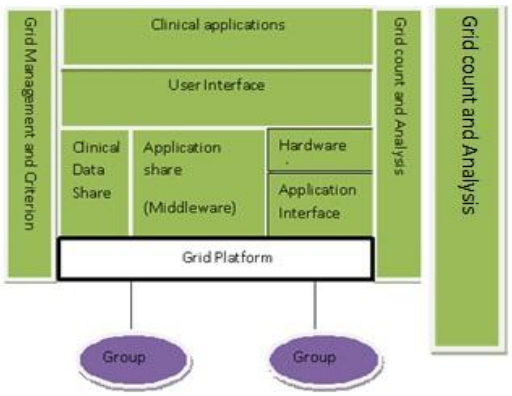

Figure1.Health grid system Architecture

The Grid is connected to the three layer architecture through Globus Toolkit which provides the grid Environment. The group could be able to complete the jobs adjusted run automatically according to the user's need and return the result to users. Integrations are intended to be transparent and seamless to the developer. The group is mainly responsible for two functions: the management function of works and the management function of system adjustment. The work management function include shading over interface, management interface and the parallel work management; the system management function includes system supervision, the allotment strategy, the management of works PRI and SLA management.

The Overall architecture is bounded by the Grid Management and criterion component that enables Grid authentication, resource authorization, and security concerns.

VIII.1 Technologies to build the architecture

Based on the architectural model the grid topology is defined as specified in figure.2.This section specifies the physical structure of campus grid and the table provides various technologies can be used to build the model for healthcare system.

VIII.2 Architectural Tradeoffs for Health grid resources

The following table list the technologies available to enable the activity of each Component in the physical topological structure specified at figure 2.

S.No	Component in the Architecture of campus grid	Technology
1	Grid Management Centre (Resource Management, job scheduling, files management	Cluster Installation- At head node. 1.Rocks is based on Redhat Linux, Provides less flexibility, easy to install [9] 2.Alternate is OSCAR(Open Source Cluster Application Resource) gives more flexible management but complex to install[5]
2	Local Scheduler- Load balancing, file staging, and other administrative task	1.PBS[8] 2. LSF 3.Condor 4.Computing centre software(CCS)
3	Grid Architecture, Resource Identification, Authorization, Authentication and security	1.Globus Toolkit 4.0, 2.latest Globus Toolkit 5.0[10], 3.Gridshib[25]
4	Grid Portal	1.Jetspear is a IBM product, provides out-of-box web portal for enterprise settings[6] 2.Jetspeed is an open source Apache product built as an enterprise information portal 3.Gridspear is an open source project that is part of grid lab[35]
5	Portlets	1.Gridportlets are JSR-168 complaint are compatible with all portlets 2. The Open Grid Computing Environment (OGCE) [39] develops open source portlets with the intention for them to be used under multiple portal frameworks.

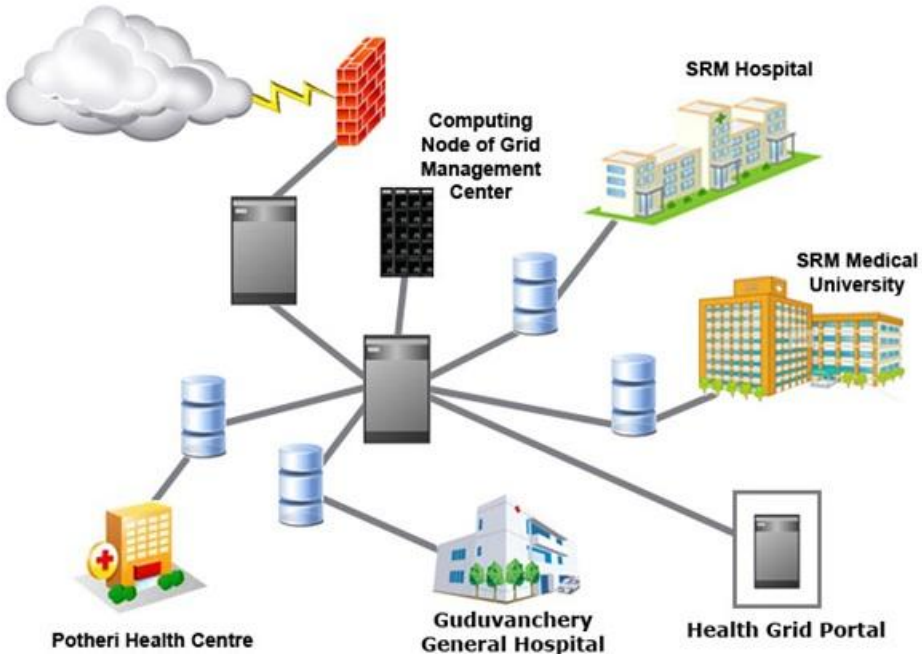

Figure 2: Campus Grid Topology Structure

The Globus Toolkit [10] has become widely accepted as the standard tool for building grid architecture and boasts success stories including GriPhyN [11], Open Science Grid [12], TeraGrid [13], and NEES grid [14]. The Globus Toolkit provides identification, authentication, authorization, and security for connecting the resources of the grid, as shown in Figure 2. The infrastructure allows for strict local control of a given resource but still allows users from anywhere to perform a variety of tasks related to resource and service discovery, file management, system and job monitoring, and job submission.

VIII.3 Health grid physical structure

Geographically the Hospitals, health centres and the medical institutions are situated at different places. This paper designed a topological structure to establish and to show the communication manner in between the layers.There is a control node which logically controls the grid environment to which the other health nodes are connected by network structure. Web portal for the Health grid is enabling the raw and processed information.

The Grid network is connected to internet provided with grid security. The network routers are routing the requests and responses in between the nodes.

IX. Socio-economic recommendations

This section discusses the socio economic requirement for the successful development and implementation of campus grid for health centres and medical institutions across Kattankulathur region and in future across the country.

IX.1 Trust and Acceptance from society.

Trust is a very important element in any interaction between the different members of a society. In the market context, trust is crucial for successful business to business collaborations. Similarly, in a health grid domain a good collaboration will not be achieved unless a trust relationship exists between the different users and stakeholders. Pilot projects and prototype applications, which are an inherent part of the technology health grid, need to be future oriented in the sense that the ultimate routine operation users have to be persuaded both of their value and their applicability, i.e. their ability to fit into real clinical or research workflows. This has to be taken seriously from the very beginning, even in proof-of-technology demonstrators. The goal should always be to give users, especially clinicians, tools that they would consider using with patients in real healthcare situations. Trust and acceptance can be greatly enhanced by the establishment of appropriate ethics committee structures to advice on the observance of ethical principles.

IX. 2 Cross-Organisational Interoperability.

The effective deployment of knowledge grids will crucially depend on collaboration between institutions, meaning more than "simple" access to each others' data and computing resources. This collaboration requires the utilization of human resources and in some cases a significant strategic re-orientation and re-organisation of working processes and even management structures. Particular attention should be given to flexibility of government regulated budgets and reimbursement schemes.

X. Future work and Conclusion

In this paper, the architectural model has been designed and the technologies can be used to deploy the system are stated. The security establishment for campus grid

is analysed from distributed systems security and developed for this system. Implementing the campus grid for the hospitals helps to utilize the man power and other computational and medical devices effectively across the country and across the universe through different exclusive architectures. The future work of this paper could be actual implementation in such a way that generating clusters, development of forms, reports along with the data and establish resource security. United Kingdom [3] started the development of health grid on 2002 itself. Though the noise of health grid echoes in India, there is no architectural model available for health grid as of now. The main advantage of this model is the cost effectiveness.

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