



Adaptability of Intranet Grids in HEIs to Leverage Dream of Africa Connect

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ABSTRACT

Institutions of higher learning depend very much on access to other knowledge resources. Therefore, commercial distribution of knowledge resources can become a barrier for academic communication by raising costs for higher education. At the same time collaboration within higher education, particularly in research, has long been part of accepted practice, often driven by the scale of the challenge but usually from a collegiate ethos and a desire to impart knowledge and experience as widely as possible. The information and communications technology (ICT) community in higher education shares in and benefits from this spirit of collaboration both in terms of creating leading-edge infrastructures and through a free exchange of knowledge and experience. To take full advantage of the opportunities offered requires a professional approach to procuring intranet grid services such as reduced costs, improved flexibility of services and culture change in the way ICT is provided and exploited within research, learning, and the management of universities. While the advancement and the sophistication of the grid computing for Africa is progressing tremendously, research on intranet grid utilization is still very scant. The researchers envisions that intranet grids in higher education institutions (HEIs) can greatly open up knowledge resources thus making it accessible to the general public while at the same time reducing costs for higher education and making it more accessible. The paper also attempts to provide a conceptual understanding of the intranet utilization and the corresponding antecedents and impacts through the proposed conceptual model. Based on several research frameworks built through past research, the authors attempt to propose a framework of intranet utilization in HEIs and thereby leveraging the grid computing initiatives in Africa. The usage framework helps prioritizing investment decisions and evaluating return on investment. The paper makes a number of recommendations for policy and research and long term sustainability of the Africa grid connect projects.

Keywords: *Information communication technology; intranet grids; usage framework; higher education institutions; knowledge resources; service quality*

I. INTRODUCTION

The advent of grid and cloud computing is slowly reshaping the learning ecology from individual learning to collaborative learning via Internet resulting to new e-pedagogy. Introduction of GRID technology in institutions of higher Learning in the recent times is bound to bring realignment in conceptual and technical aspects of electronic learning. Furthermore, this concept is being extended toward knowledge GRID, GRID Intelligence, and distributed artificial intelligence for effective knowledge communication, building and management. HEIs can develop intranet Grid portals to reap from internal organizational infrastructure and then have a global Grid connectivity. The connection, itself, is more important [1] [2]. Through the grid portals a user navigates to the portal page, and afterward, the portal presents the appropriate applications that the user may interact with, derived from their identity and the authorization policies. Like this, a virtual organization may be formed.

A. Issues of Corporate intranets

The fact that intranet infrastructure has an important democratizing effect— data can be made available to everyone, not only to professional scientists but also at the same time to students and teachers [3] and

this can be measured by looking at its effectiveness in support of business requirements [4] in which institutions of higher learning are part. Beyond new scientific discoveries, we are at the dawn of a new revolution in learning due to information and communication technologies.

According to Lytras et al. [6], in our emerging knowledge society, a firm understanding of the interplay between the management of knowledge and learning is of strategic importance to create and maintain effective learning processes in a large variety of non-traditional learning situations. Intranets allow people to work in a manner that best corresponds to their personality, style and work habits [5]. There is need for a centralized management system that can exercise control and ensure that consistency is maintained to curb tradeoffs in intranet management [7]. Through collaboration, intranet grid information system can function efficiently within the system to drive sustainability [8].

B. Intranet Usage

The mode of intranet utilization depends upon the complexities and maturity of the intranet. The literature suggests that intranet maturity can be identified as low, medium or high [9] [10]. Low maturity signifies that information is published on the intranet for one-way

communication. Medium maturity indicates that the intranet is used for groupware and collaborative application. High maturity denotes that the intranet serves as a common user interface to back-end applications. In a situation where intranet is of high maturity, five different modes of utilization are possible, publishing, transacting, interacting, searching and recording [21].

Depending on the nature and design of the job, the five different modes of utilization vary across various users (employees and students). In situation where employees' daily job has to engage with organizational information systems such as financial or marketing, then the degree of utilization on transacting mode would be definitely high. Likewise, a head of a department or supervisors with many subordinates would heavily publish memos or notices, thus suggesting that their intranet utilization in terms of publishing mode would be relatively high. However, as a typical intranet user in these institutions, three commonly found utilization mode are transacting, interacting and searching. In a transacting mode of utilization, users inevitably commit to HR systems that are integrated into the intranet.

To interact with other staff in the institution, users engaged in interacting mode via e-mail, forum room, e-sms or e-chatting. To facilitate their jobs in locating organizational documents or tracing the whereabouts of specific individuals, users commit to searching mode via the use of search engines or directory that are built into the intranet. In addition to these common modes of utilization, users exploit the intranet for decision support and knowledge sharing purposes and in the case of learning, the students can be able to acquire all related information from the teachers/lecturers.

II. METHODOLOGY

The researchers adopted integrated literature in this study. They examined the intranet building blocks by scrutinizing artifacts such as project websites, research papers and reports. Ongoing research projects funded by HP catalysts initiative and UNESCO-HP were examined to understand the collaboration design model used and thereby provide relevant information for adapting intranet grids in these HEIs.

III. FUNDAMENTAL ASPECTS

In this section, we discuss the intranet and grid architectures and Africa's status of connectivity.

A. Intranets architecture

A number of different definitions of an intranet exists where some of them focuses on technology while others based on purpose and use [21][23] [10]. Technically, an intranet is an application based on Internet technology, hyperlinked, richly networked, flexible and organizationally bounded [11] [20]. Intranets differ from traditional IT systems although they don't exclude the

presence of other IT systems and work as a unifier in terms of integrating IT systems [22]. Initially the technology is used for simple publication of more or less static information. When the organization becomes more familiar with the technology it is used for more advanced purposes. Intranet can be said to go from simple use modes towards more advanced ones [20]. The chat below shows the basic architecture of the intranet building blocks.

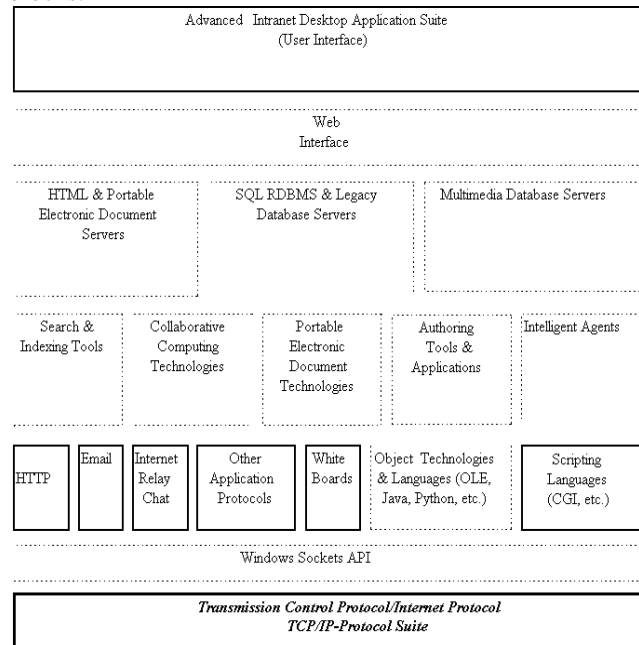


Fig. 1 Intranet building Blocks (Source: Hummingbird Communication Inc. 1996)

B. Grid Architecture

A Grid is a collection of independently owned and administered resources which have been joined together by a software and hardware infrastructure that interacts with the resources and the users of the resources to provide coordinated dynamic resource sharing in a dependable and consistent way according to policies that have been agreed to by all parties [11][15].

Grid service-based infrastructure allows academic institutions to enhance e-learning technologies and innovate in e-learning experiences through the provision and mutualisation of various services. Grid computing enhances e-learning by providing the following capabilities:

1. Ability to create virtual labs using the power of distributed computers in grid network which is more cost-effective use of a given amount of computer resources
2. Ability to create a completely customized class for learners using distributed content.
3. Collaboration between education resources, contents and services within grid network [18].

The Fig. 2 illustrates possible grid connectivity infrastructure within an institution.

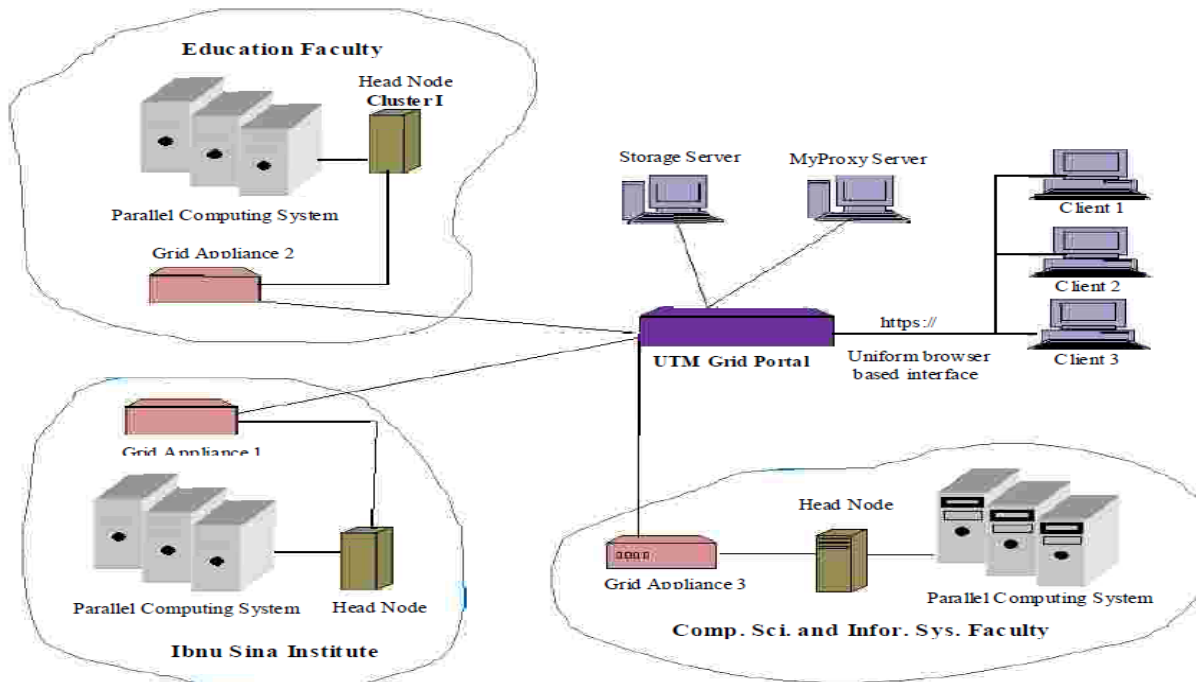


Fig. 2 Infrastructure of grid portal technology [11]

Adaptive web-based learning systems over institutional intranets are suited to such situations. In order for an adaptive learning system to be able to provide learning support, it needs to build a model of each individual student and then to use the attribute values for each student as stored in the student model to determining the kind of learning support that is suitable for each student.

Through this infrastructural setup the following benefits will be accrued to students and participating universities [12] [13]:

1. Facilitate and support work group students in their design and developing a courseware.
2. The successful application of authoring activities environment through grid technology provides enhancements in work group performance, helps to lower cost, and encourages innovation.
3. Learners and faculties can promote the exchange of ideas, information, knowledge, and joint research and development of Web-based teaching materials.
4. Help member universities build a network of facilitators to support e-learners (forum with advanced Information and Communication Technology (ICT), i.e., with the use of massive parallel processors of globally distributed and yet interconnected mini-supercomputers through global neural computer network).
5. Researchers can partner with colleagues in more advanced faculties, and perform joint collaborative research and development with the use of the emerging global GRID computer networking technology.

An institution may do business with other institutions within the enterprise or with external institutions. As a result, grids may involve only internal partners or both internal and external partners. The complexity of the business requirements of such integration depends on the virtualization requirements, business impact, trust relationships, security considerations, globalization, and time-to-market requirements [14].

- **Infra-grids**— this grid architecture enables optimizing resource sharing within departments in one division of a HEI.
- **Intra-grid**—this more complex grid implementation is a scenario for resource integration by using the computing and data/storage resources of various divisions within a HEI. These types of grids need well-defined policies for the sharing of resources within the institution, and valuable experience can be gained in dealing with the more complex security, data-sharing and resource-sharing policies required.
- **Extra-grid**—these grids deal with sharing of resources, including those belonging to a trusted external partner with whom a business relationship has already been established.
- **Inter-grid**—an inter-grid enables the sharing of computing and data/storage resources across a public Web. This is where international grid computing projects lie. Fig. 3 depicts the various factors for grid projects.

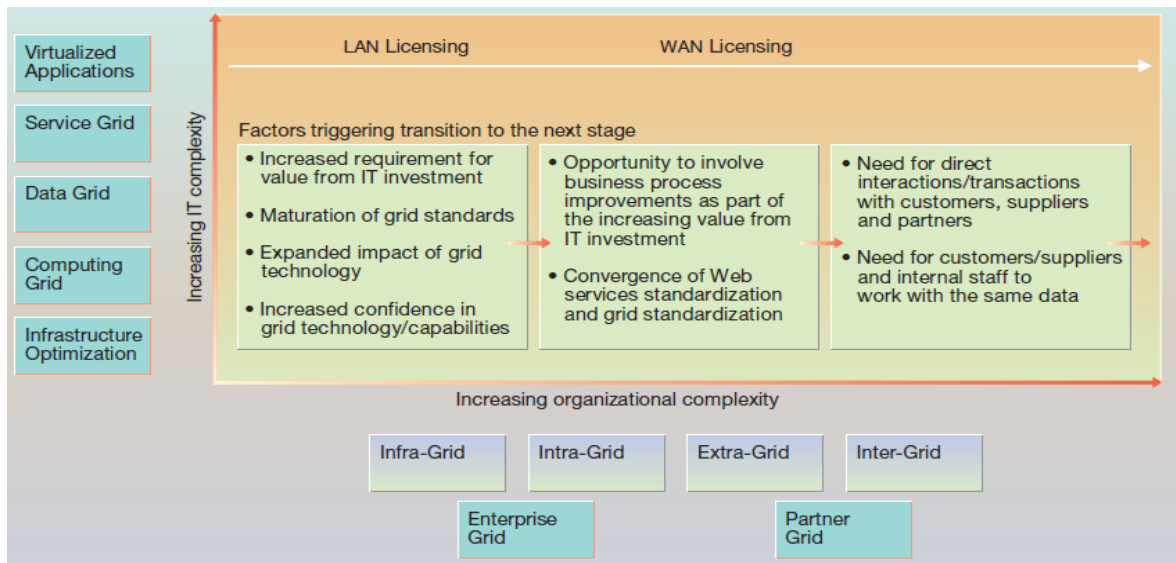


Fig. 3 Grid adaption factors [14]

C. Africa’s Grid Initiatives and status of Connectivity

There are a number of Grid initiatives in Africa. The impetus to grid computing activities in Africa was being curtailed by the lack of terrestrial infrastructure leading to a strong dependence on expensive narrowband satellite links [2]. However deployment of submarine cable has greatly improved interconnectivity. This has led to a large extent favored HEI which are the major consumers of internet. With improved connectivity speeds, the grid activities in Africa have been re-energized. This scenario has led to previous grid activities aggressively publicizing their activities e.g. the South African Grid lead by Dr. Bruce Backer of Maleka Institute. UNESCO-HP Brain Gain Initiative have expanded the initiatives Grid project to cover 20 [16] more HEI from the previous 5 [17]. Table 1 contains universities in Africa involved in grid activities. Other grid initiatives such as HP catalyst initiative have seen African HEI submit quality proposals that have been selected and are being implemented [25]

TABLE 1: GRID ACTIVITIES IN AFRICA AND HEIS INVOLVED

	UNESCO-HP brain gain Initiative
1	Algeria: Centre de Développement des Energies Renouvelables (CDER)
	Senegal: Cheikh Anta Diop University, Dakar Computing Centre, Cheikh Anta Diop University (UCAD) Senegal
	Nigeria: University of Nigeria, Nsukka
	Ghana: College of Engineering, Kwame Nkrumah University of Science and Technology
	Zimbabwe: Chinhoyi University of Technology
	Ouagadougou University Burkina Faso
	Douala University Cameroon
	Yaoundé I University Cameroon

	Cocody University Côte d’Ivoire
	Mekelle University Ethiopia
	Masinde Muliro University Kenya
	Nairobi University Kenya
	Kuwait: Kuwait University
	Lebanon: Saint-Joseph University
	CNRST: Morocco
	Tunisia: Université de la Manouba
	Uganda: Makerere University
	Mbarara University: Uganda
	Senegal: Gaston Berger University
2	HP Catalyst Initiative
	Kenyatta University (Nairobi, Kenya)
	Cairo University,(Giza, Egypt) “Cairo Cloud Computer”
	Masinde Muliro University of Science and Technology (Kakamega, Kenya) “computational chemistry infrastructure”
	University of Fort Hare (Alice, South Africa) “ STEM+ Innovations for under-represented rural-based schools”
	North-west University (Gauteng, South Africa) “ Using machine learning to measure student learning”

Other ongoing e-infrastructure grid computing initiatives include: South Africa's Cyberinfrastructure program, EPIKH project, proposed CHAIN project, EUMed Support, UbuntuNet Alliance, EUMEDCONNECT2, and FEAST. However, it is clear that the grid computing agenda is gaining momentum in Africa [15]. The AfricaConnect project aims to establish a high-capacity Internet network for research and education in Southern and Eastern Africa to provide the region with a gateway to global research collaboration. AfricaConnect builds on the roadmap prepared by the FEAST study.

Figure 4 offers comparison of Africa’s grid.

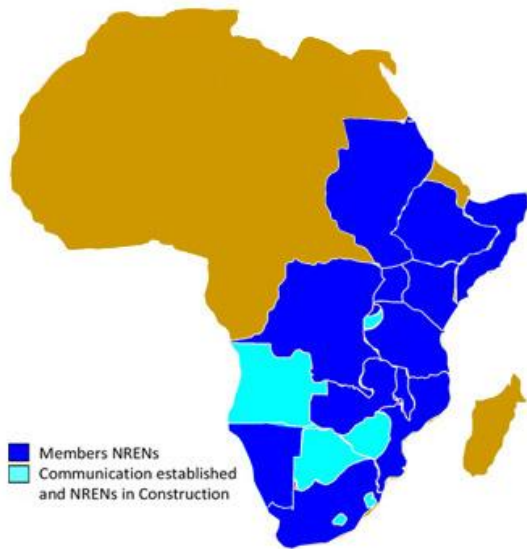


Fig. 4 Africa Grid connect geographical scope[26]

Figure 4 shows how the AfricaConnect project is established, most being on East central and southern Africa (NRENs) and aims to benefit researchers, educators and students in Southern and Eastern Africa, focusing on the member countries of the Ubuntunet Alliance. However, emergence of optical fibre, as depicted by Fig. 4, will provide Africa with improved and affordable regional and international connectivity. This will enable African Tertiary education and research institutions to generate a proportionate amount of intellectual property goods to achieve parity with the rest of the world [15]. So far TEAMS, Seacom, EASSy, and SEAS have been rolled out.

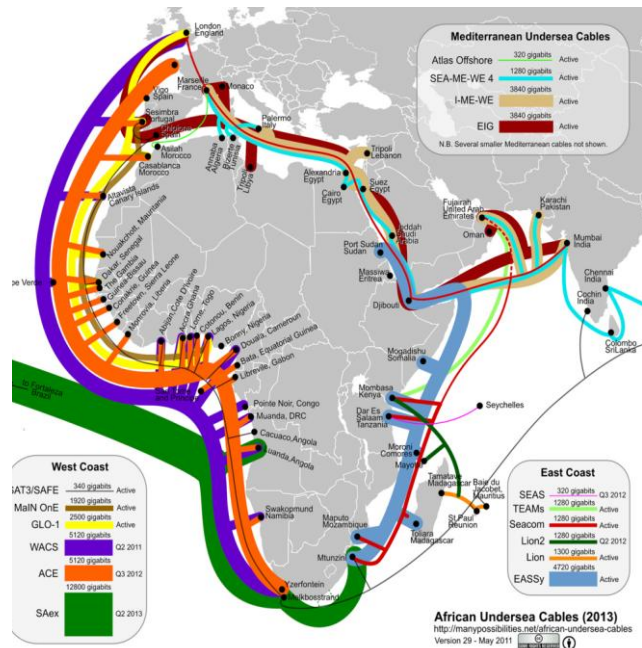


Figure 5 Status of connectivity in Africa [19]

IV. INTRANET UTILIZATION FRAMEWORK

The Framework of Intranet Efficiency and Effective Usage (IEEU) is an amalgamation of various metrics that can be used measure efficacy of a corporate intranet’s portals. When these metrics are collectively and uniformly applied in periodic measurements, they can indicate tractable improvements over time.

TABLE 2: Intranet efficiency & effective usage framework

Domain areas	Metrics description	Intranet Characteristics
IT Infrastructure	Intranet Architecture Information Architecture Application platform	Information grouping; Navigation Personalization; Search; User data; Taxonomy; Configurations; IT infrastructure flexibility; Information system Integration
Intranet management	Managerial support Planning Mission and Objectives management Intellectual Capital management	Intranet and IT investment policy; Intranet management personnel; Better Decisions; Intranet adaption; More creativity; Reach; New Opportunity ROI

User Involvement	Ideas management Usability issues Design decisions	Self development initiatives; Visual analysis; Ease of Navigation; Usability of intranet; Communication facilities; Ease of use of intranet services
Usage	Domain Integration Global search Across critical content Develop shared taxonomy Content	Traffic Volume; User documentation Call handling; No. of Hits per link; Explicit content; Access time; Information and Knowledge on Intranet
Individual factors	User experience User computer efficacy	Innovation activities, Self development Computer packages; Internet/ web search techniques; Programming and data analysis skills; Knowledge of chart/ e-mail/intranet tools
Quality Metrics	Accessibility; Navigation Reliability; Customization/Personalization User assistance/ Responsiveness; Satisfaction Empathy; User data	Time to locate Abandons Time to build No. of Errors No. of Clicks to find
Versioning	Intranet Versioning/improvement	Business Strategy Versioning, Business Process Versioning, Operational changes

However, there is need to ascertain the relationship between university policy and intranet usage in higher education.

V. CONCLUSIONS

Any technology that empowers, enables and connects people such as grid computing and other related technologies is a catalyst for change; organizations that ignore this will definitely wallow. We believe that recognizing the potential of corporate intranets in institutions of higher learning will encourage other companies/ organizations to develop this system. However, the difference in implementing effective intranet grids depends on institutional IT policies, structure and culture of University. The key is making sure that people, particularly in top management, understand the advantages of these information technologies (i.e. intranets) what makes them useful. Intranet grid portals present a new approach for procuring e-Learning services. As people become massively networked, the scale, even within niche

communities, reaches a critical mass and the ability to access and leverage the wealth of human knowledge across varied disciplines is boosted considerably. Thus, recognizing the value of intranet grids will in long run promote collaboration and overall Africa grid connects initiative

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