

A framework to provide eBusiness support for African SMEs.

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Abstract: Using Grid Services this paper presents an architecture and deployment pattern for a new generation of eBusiness applications for African SMEs. Existing eBusiness enabling technologies are an ineffective way of investing in African eBusiness infrastructure when compared to the solution that is presented by the BDIFS project [1]. This solution based upon an Application Service Provider (ASP) Grid design introduces a community based hierarchical deployment pattern.

1. Introduction

BDFIS uses emerging Grid Service technology to present dynamic and tailored eBusiness environments for SMEs in North Wales. BDIFS therefore sits as a gateway between the SME and the Enterprise systems of the larger partner in an eBusiness process. In this paper this model is applied to the African SME and changed slightly to reflect typical African ICT infrastructures. Key to this African re-design is the deployment model and the use of neutral organisations to host the BDIFS services, breaking the reliance on third party software suppliers in Marketplace models. The paper presents the architecture deployed in a three zone model, similar to that of European Organization for Nuclear Research (CERN) [Large Hadron Collider \(LHC\)](#) Computing Grid project (LCG), except in BDIFS users link to the tiers to retrieve dynamic eBusiness process resources [2].

2. Background

The internet connectivity required to engage in eCommerce activity has been slow to penetrate many African countries, and many towns and cities have been slow in receiving adequate connections [3]. The stifling of eCommerce by lack of internet connectivity has been compounded by few computing resources being present in many African communities and businesses. These restrictive factors to eCommerce are supported by often inadequate governance to support eCommerce in African countries, which fails to present the required legal and financial support eCommerce requires [4].

In many African countries projects to increase internet connectivity have been the focus of investment, the aim of this investment is to aid industrial development via eCommerce. However these initial projects to increase African connections to the World Wide Web have revealed an initial picture of imbalance. This imbalance threatens to stifle the effective adoption of eBusiness and eCommerce in these economies before it has chance to flourish. The

source of the imbalance is the routing of internet traffic through the developed world. For example an e-mail sent from a town in Mozambique to another town in Mozambique could see the message routed via France. This is due to the key computing infrastructure being often hosted outside Africa, and this therefore adds extra cost that many Africans have on their internet use, for example 75 per cent of Internet traffic in Africa first goes through Europe or the US and is then routed back [5]. This problem has been recognised and efforts are being made in pan African projects such as the EASSy project to increase access to African routed internet connectivity [6]. But in the short term the lack of effective connectivity and connectivity in general has led to recommendations that eBusiness applications for SMEs need to be developed using mobile phones.

Internet connectivity can be seen as the root of African eCommerce, the movement to establish African internet infrastructure is therefore vital. However from this root stems the software on which eCommerce and eBusiness solutions exist. As mentioned many African business lack computing infrastructure and technically skilled personnel to exploit adequate network access (if it is available). Therefore in order for African businesses to reach eBusiness communities to enable Business to Business (B2B) or Business to Customer (B2C) commerce support in the development, implementation and use of eBusiness software is needed. This software as will be discussed often introduces another middleman to the African eCommerce enablement process [7].

3. Enabling Technologies

The most popular form of enabling African eBusiness is via the Marketplace approach which is built on the Application Service Provider (ASP) model [8]. Here the infrastructure is remotely hosted by a third party that the user interacts with via a portal. In North West Wales the eBusiness scenario has developed differently, mainly due to internet connectivity developing at a faster pace and being available to the mass population of existing computer users at an earlier stage when compared to Africa. As a result Welsh businesses have been open to the eCommerce and eBusiness technological advances in their initial popularisation phases and therefore legacy application integration into eBusiness frameworks is more of an issue. As a result the eBusiness integration in Wales has often been done via the Enterprise Application Integration server approach, or by customised workarounds to link existing legacy systems [9]. In both cases third party provided Marketplaces and Enterprise Application Integration (EAI) solutions are popular

In order to investigate the motivations behind the investment in eBusiness technology to enable integration of SMEs, the BDIFS project in analysed the eBusiness integration partnerships of various businesses [10]. The key feature found was that the larger company often has the power to influence the integration terms of the SME, forcing the SME to rely on third party integration [11]. This issue is of real significance and has been raised in larger research projects such as the EU Framework 6 project Trustcom [12]. In Africa it is likely that the choice of Marketplace is influenced in a similar way. As the larger partners that African SMEs wish to integrate with are likely to have advanced eBusiness infrastructure and favoured choices of marketplace to enable integration. This influence takes the choice of integration methodology away from the SME in order to keep or gain partnerships with larger partners. This often can compromise the SMEs internal workflow and internal ICT resources. In terms of EAI often third party Enterprise Application Integration (EAI) servers are introduced at the SME, these devices often require licensing charges and create costs associated with infrastructure changes in order for the eBusiness integration to be supported.

For the African SME when compared to the traditional EAI software licensing model Marketplaces present the chance for a pay-per-use or monthly subscription models, which gives the

SME more flexibility in Marketplace choice and can work out to be a more cost effective choice. However the weakness within many of the current Marketplaces is that they are often developed along commercial guidelines. Often these eBusiness enablers can be seen as middlemen who take a cut out of the trades conducted within them, or in other cases the Marketplaces are provided by a large consumer or sufficiently influenced by one, to present the SME a trading environment that is stacked in the larger partners favour. Thus costs associated with Marketplace subscription, transaction fees and rules associated with trades can be seen to place a similar compromise to the one facing the SMEs in North Wales.

4. The Enablement Footprint

Thus many of the eBusiness enabling technologies for both North Wales and Africa often present solutions that absorb investment and do not necessarily present the business with a long terms solution. The use of third party commercially supplied software raises significant questions about the use of money given to aid eBusiness integration in grants in both Wales and Africa. Within Wales (an Objective 1 EU funded area); money is available to SMEs to invest in ICT to enable eBusiness [13]. It is likely that out of this money a huge chunk could conceivably be going in software licences and investment to install eBusiness software in SMEs. In terms of licenses the money is likely to go to companies who develop the software outside of the area targeted for the funding, leaving only a small footprint in terms of the success of the eBusiness partnerships the software enables. If Open Source software is used the likely cost of on site support and customisation is also likely to render the investment money into a one off application.

The BDIFS vision is to increase the size of this footprint by providing an integration platform and enablement functions at designated BDIFS supporting local organisations physically outside of the SMEs. These organisations will receive funding to add new functionality for the SME on the BDIFS system, with the BDIFS system expanding and becoming more functional as each SME joins and the system is customised to support the new businesses. Thus the expansion of BDIFS for African SMEs can be seen as a logical step and a way to increase the footprint of African aid money within the local communities to enable eBusiness innovation. The BDIFS software aim is to present a free to use remotely hosted solution with the aim of developing a global community of SMEs pushing for fair eBusiness integration solution.

The need to remove eBusiness middleman who profit from the process, has been recognised in research and attempts have been made at producing wide scale remotely hosted projects like the LAURA project, which is designed to encourage collaboration and business-to-business co-operation through a neutral middleware in specific trading zones [14]. This research provided two means of controlling integration servers. Either the server is controlled by the SME, or the data from the SME is sent to openly accessible remotely hosted integration networks led by organisations outside the company. Further research to establish the trust and financial infrastructures in these models has been further investigated by projects such as the EU projects, for example TrustCom, GRASP [15, 16].

These research projects are being developed using emerging technology in the form of Grid Services. The use of Grid Services is a way of providing 'ICT services on tap' and is an ideal method to provide complex eBusiness functionality to SMEs [17]. However within these EU scale projects the mix large software vendors and EU pressure to break research barriers, can be seen to neglect the production of usable solutions for the SME. The BDIFS project in order to address the needs of SMEs in North Wales using Grid Services aims to fill this gap.

5. BDIFS Architecture

The BDIFS framework has been developed to support multiple types of integration, cross industry and cross vendor. This is possible as the framework creates dynamic environments for SMEs using the framework using emerging Web / Grid Service technology. The technology used to create this in BDIFS is Grid Services implemented using the Web Services Resource Framework (WSRF) set of standards [18].

The major strength in WSRF Grid Services is the ability of the services to maintain state. For example a stateless Web service when invoked by a user performs the same operation each time. A stateful service can perform the operation based on the number of times the user has invoked it, thus it maintains knowledge of the state of past invocations. This enables the services to provide a larger range of functionality when compared to traditional Web services, and also makes the use of this type of service more flexible in the sense that multiple instances can be created out of one service.

At the centre of the BDIFS functionality is the creation of Dynamic/Operative Virtual Organisations VO's. These are used to select specific externally hosted integration services for the workflow being executed for the users. These services in BDIFS are specific to the target system being integrated with, thus the development of these services increases the BDFIS functionality and the number of eBusiness partner systems that can be partnered with. The distributed nature of BDIFS enables the use of services that are a member of BDIFS from all over the globe. The VO structure can be seen in Figure 1.

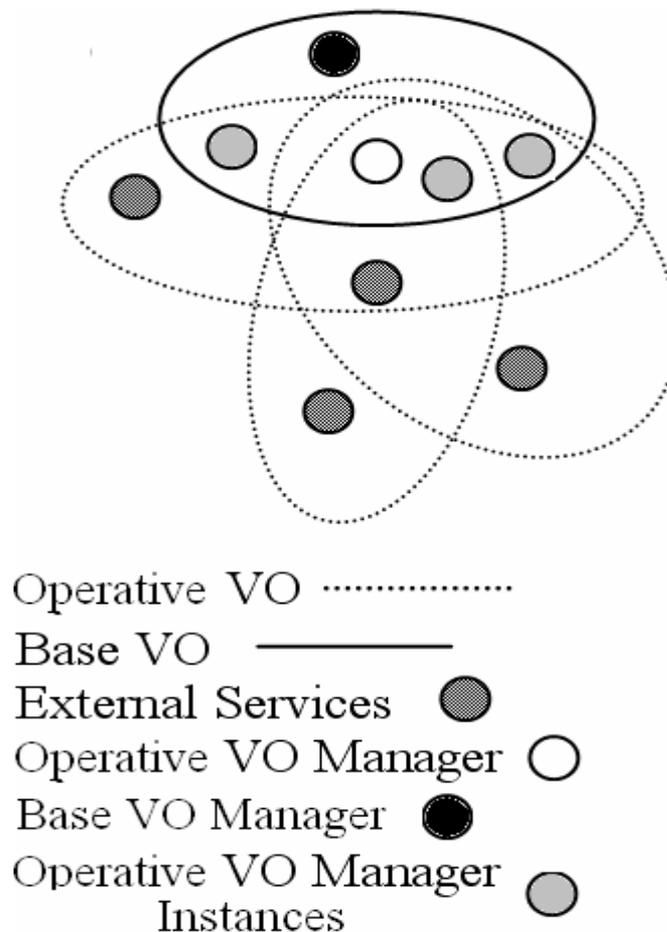


Figure 1: VO Management in the Base and Operative VOs.

In order to establish trust in the system and encourage innovation in service and workflow creation the global view of BDFIS is to have a hierarchical deployment structure. In this structure the main BDIFS functionality within the Base VO is provided at a level where the system can be well supported and developed. In the North Wales vision for the BDIFS deployment the system is hosted at the University of Wales Bangor. This organisation has excellent connectivity and skilled staff to support the BDIFS servers. Furthermore the role of the University to establish links with local SMEs and support ICT in the community is supported by BDIFS. Significantly the University has no commercial interest in the project except to use its development to provide work for staff and research projects for students. The individual SMEs use clients to connect to the BDIFS systems from their individual business premises. This is summarised in a simple integration scenario viewed in Figure 2.

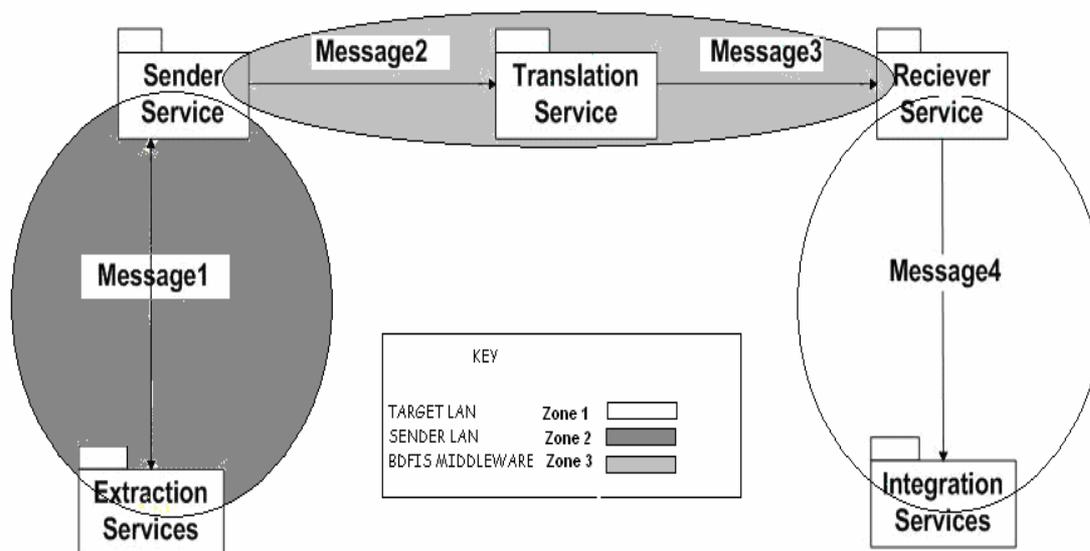


Figure 2: BDIFS Main Zones of Functionality

In Figure 2, the basic BDIFS functionality and structure can be seen to exist of essentially three zones. The Sender LAN is the most lightweight technically, and essentially consists of a sender service which communicates with the main services in the BDFIS middleware that provide the functionality. This zone is will be occupied by the business using the BDIFS framework. Zone 3 is reserved for target services that are part of the workflows executed in the top tier (Zone 2 in the Figure) which hosts the core BDIFS services.

6. BDIFS For Africa

The three zone model presented by BDIFS for use in Welsh SMEs has been modified to suit African businesses in Figure 3. The main change is that the middleware zone has been staggered into two pieces, presenting staggered deployment architecture, similar to Grid project like the LCG Grid at CERN. An extra layer has been added presenting portals that have been added to reach the BDIFS middleware zone. The Portal layer acts as the gateway to the BDIFS system for the users and can be hosted at an organisation with a stronger connection to the internet and better support. This enables the business interfacing with the BDIFS middleware to do so intermittently or even as part of an intranet, ideal for African SMEs where network connectivity is still a large issue.

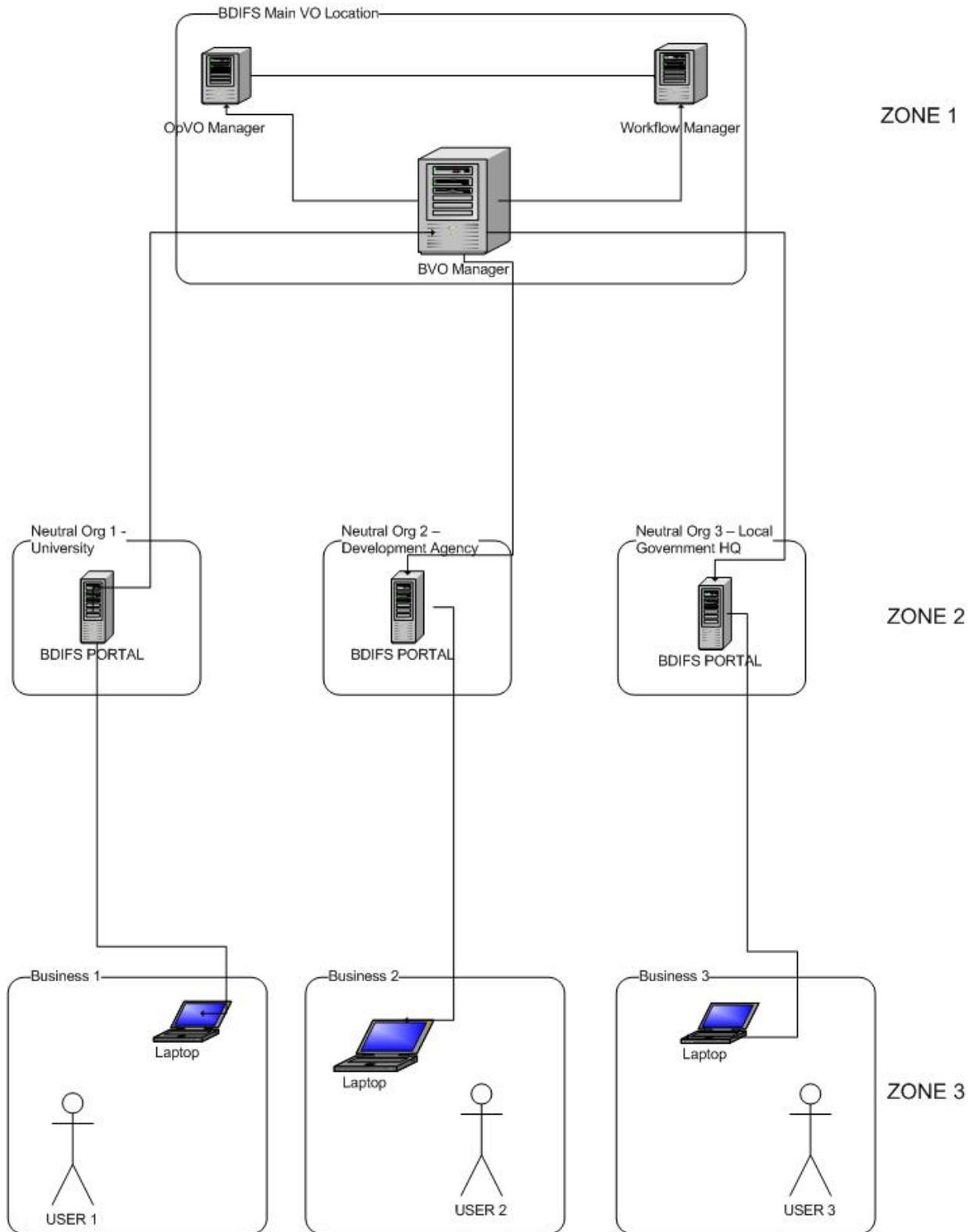


Figure 3: The three tier BDIFS deployment architecture for African SMEs.

Because this portal will also interface with other businesses in the community it will need to be hosted in a secure manner at a neutral local organisation. This organisation neutrality is important as the investment in the technology to establish and support the portal can be kept

within the community. The idea for a host at portal level could be a local development office, school or other business neutral office with good connectivity and infrastructure.

The top tier (zone 1) of the model is the main functionality providing the workflow and linking to the services behind the eBusiness applications. This main area of software and infrastructure requires more support and maintenance than the portal services. Furthermore the vision for BDIFS is that the needs of the user community will constantly be addressed with new workflows. Thus in order to achieve this, the organisation that hosts this would have to be more technically competent. An ideal organisation here could be a national or international organisation such as a leading University, here developers for the new functions could be enlisted from the staff and student populations.

7. Future Work

The BDIFS model is currently being implemented in North Wales. Although an African implementation is yet to materialise, it is the aim of the BDIFS application in Wales to demonstrate that this approach can work, and the software is available for download. At the moment the model only supports simple eBusiness integration functionality and an eCommerce front end and charging facility will have to be incorporated for African SMEs to use the framework to conduct Business to Consumer trade.

8. Summary

Increasing the local footprint of eBusiness investment from development agencies, is a significant idea presented in the paper and enabled by BDIFS. The multi-tiered deployment approach of the eBusiness solution using Grid/Web service standards, presents a new business model for Africa, which challenge directly existing eBusiness solutions. This paper demonstrated how EAI and Marketplaces presented by vendors and larger trading partners can be bypassed for the first time by this emerging technology by developing service orientated architectures. Building on the use of neutral organisations to host and be bases for the focus of development of the BDIFS the benefits of the framework reach beyond the SME.

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