Dias.net: A Virtual Platform of IT Services for Small Organizations

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Abstract

This work describes Dias.net, a virtual platform offering IT services to small organisations, both public and private (SME's, small local councils…) and in disperse geographical locations. It was proposed as a solution for those organisations with neither the financial resources nor the technological knowledge necessary for them to be able to exploit information technologies using the technological environments that are standard in large organisations. The work discusses the motivation and describes the conceptual model and the architecture of the platform. At present, the platform is in the trial and evaluation stage in a group of organisations. Dias.grid is the deliverable of the project, which is carried out under the 5th Framework Programme of European Research.

1. Motivation

Not all individuals, communities or organisations have the same ability to make effective use of new technologies. There are large sections of the population that, while having the potential to access the use of such technologies, find that access impossible for various reasons. In the present situation, IT (Information Technologies) has become a fundamental factor for effectiveness in organisations and for competitiveness in the global economy. This means that unequal adoption of technologies may exclude significant sectors from the productive chain when they wish to compete in the market. The computerisation of economic, social and business management may produce differences between individuals, countries and firms. The term "digital divide" refers to that situation and can be defined in terms of unequal opportunities to use IT to access information, knowledge and education.

Information and its technologies constitute a powerful weapon that small organisations, in particular SME's (Small and medium-sized Enterprises) in an economic sense, can use to compete, to obtain qualitative improvements in their products and to anticipate the actions of competitors. The IT revolution offers considerable new challenges to SME's and it is evident that their competitiveness will, to a large extent, depend on their ability to innovate and to incorporate these technologies into their business processes. In most cases this aspect has not been developed and many firms have restricted themselves to offering corporate information on the Web instead of considering the use of technologies as a strategic tool.

In general, small organisations do not have the same possibilities to access IT as large ones, basically for financial reasons; hence the appearance of a digital divide. This situation arises basically from the lack of infrastructures, inappropriate policies and inability to obtain financial profits from IT [2].

2. Socio-Economic Context And Technological Proposal

In the case of islands and other peripheral regions, the economic reality is marked by a series of factors that hinder and influence economic growth. Among those factors, it is interesting to consider: their reduced domestic market, the shortage of natural resources that serve as the raw material for their economic activity, insufficiently developed communications with the rest of the world, and strong foreign competition. In those regions, where SME's are the cornerstone of the economy and companies are not large, the digital divide between them and continental regions is obvious, and is especially critical because technology could help them to overcome geographical barriers and provide new ways of functioning, business, training and knowledge opportunities.

On the whole, the small organisations in those regions are not prepared to use IT as tools for their business or as instruments that enable them to be more competitive

since they have neither the financial resources nor the access to knowledge that larger firms may have.

A technological solution based on a shared IT infrastructure would enable those organisations to make an information system viable, reduce costs, undertake technological improvements and establish strategic alliances among themselves. Sharing the IT infrastructure would permit them to develop a common strategy in order to express their needs and orient each organisation's efforts in the same direction and towards a broad common goal (Figure 1). Individual organisations' efforts are limited by their very nature, but this proposal is to accumulate those efforts in order to reduce costs and take advantage of the efforts of other organisations.

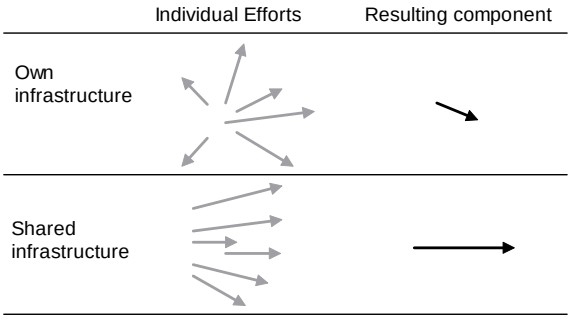

Figure 1.Efforts and investments made by the organisations

This solution would also be oriented to cooperation among those involved (firms, associations, governments), which would permit the appearance of synergies and the creation of chains of value that would enable them to work as a whole. The aim is to propose a viable, shared solution in a type of IT retail market.

This vision provides organisations with more flexibility to respond rapidly to market changes and with higher performance by being able to: a) have a flexible Information System that adapts to their needs, and b) coordinate the efforts of geographically separated individuals/firms.

3. Orientation of the Work

This paper is a result of a European project and describes the delivered software. This project has contributed to the IST Programme under the 5th Framework Programme of European Research, as a demonstration project under action line 2. The main goal of this project is to help the local actors of islands, and peripheral and lesser developed regions of Europe on their way towards the Information Society and the digital economy.

The conditions in those regions (small firms, poor technological training, low IT investment capacity, geographical isolation and dispersal) create a particular problem.

It is complicated for a small organisation, whether private or public, (SME's, trade associations, small town councils, etc.) to design an IT infrastructure that adapts completely to its needs, permits it to deal with temporarily high workloads, guarantees availability without being oversized, and facilitates integration with other organisations. Furthermore, those organisations encounter problems in maintaining obsolete technologies (hardware, software) or in not having access to certain technologies due to the cost of contracting specialised personnel to manage the systems. The rules of our economy dictate that IT costs must be reduced and must be related to the contribution to the organisation's objectives [10]. The IT infrastructure must be perfectly integrated with the relevant organisations, streamlined and ready for change, while its costs must be related to profitability.

In spite of real differences, this problem can be compared to that facing the developers of systems distributed for scientific research and with a need for supercomputing. Very few small organisations have the capacity to invest in supercomputers; however, supercomputing is possible by combining the computing capacities of many computers in such a way that the end user has the impression of interacting with a single computer. The computers comprising this "meta-computer" can be physically located at a single site or geographically disperse and united in a network.

The key is to have a common infrastructure that represents a virtual computing platform and provides an environment for the development of specific applications. This concept has led to the development of Grid technology.

Therefore, in order to promote the information society's bringing IT to small organisations in isolated regions, an innovative platform called *Dias.net* [9], with a Grid-based architecture, has been proposed and developed in this project. The initial requirements of this platform were the following: a single access point for information and applications, a groupware environment, safe information access wherever that information may be, customised visits and large-scale access, fast, cheap and easily-maintained development, an easy-to-manage architecture, optimum performance of web sites at all times, with minimum costs and maximum service quality, a consolidated and customised view of the information regarding an individual or group, a common and integrated entrance point for customised access to the platform's information resources, the ability to obtain a customised and integrated view of the platform's services, typical portal content management, ability to

view the portal's content from mobile devices such as WAP, WML, etc.

The starting point is the conception expressed by Foster et al [3], where the "Grid problem" is defined in terms of support for virtual organisations. The work also makes use of the ideas of Foster et al [4], in which an "Open Grid Services Architecture", is expressed as "…a synthesis of Grid and Web services technologies, and how this architecture can enable the application of Grids to e-business as well as e-science". Along the same lines, in this work, two technological concepts, the Grid and service orientation, merge to provide technological services to small organisations.

Also, there are considerations of how user interaction with the platform should be, so that users in geographically disperse organisations are able to work together and collaborate. The term Groupware, coined by Peter and Trudy Johnson-Lenz [6] in the early 80's, generically covers the technology that gives support to group work. In line with that thinking, this platform aims to provide an environment comprising different tools for teams that need to work in collaboration, but not necessarily physically together, either in space or time.

There follows a short introduction to Grids from the perspective of how this technology and service orientation are an advantage in the organisational and business framework. The following sections describe the conceptual model and the architecture of the solution developed within this project, with the conclusions presented in the final section.

4. Introduction to Grids

Grid technology provides mechanisms to share and coordinate the use of various IT resources, and so permit the creation of virtual computer systems based on geographically disperse components that are sufficiently integrated to provide the desired Quality of Service (QoS) [5].

The traditional approach to Grids allows organisations to run computing jobs on one another's computers, sending input and output data back and forth as required. However, in the future, Grids will be mainly about outsourcing all sorts of computing, using increasingly sophisticated combinations of services to locate information, applications to process it, and computer systems to run them on. The emphasis of the third generation of Grids has shifted from distributed computing to distributed global collaboration, a service oriented approach and information layer issues [8].

The Grid provides a cost-effective way for small organisations to access high-end systems and software while enabling those needing such systems enough to invest in the necessary equipment and expertise to sell any spare capacity over the Grid to other users, and to ensure that their investment is productive almost 100% of the time. Those benefits make the Grid a natural place for organisation operations in general, and in particular for business support in SME's, in terms of computing capabilities. Grids are changing from a research tool to become the next generation of IT infrastructure.

The application of grid technology is intended to help solve the problems faced by small organisations and to permit the dynamic configuration of the IT infrastructure in line with needs. While an organisation's own resources physically exist within the organisation, which is, therefore, responsible for configuring, managing and updating them, an outside resource exists virtually in the organisation by means of a service offered by another organisation. Ideally, an organisation can configure its IT infrastructure completely from external resources supplied by numerous other organisations.

This solution permits the infrastructure to be independent of the ownership of resources, in other words, the IT infrastructure can be implemented with the organisation's own resources or with external resources.

From the same view, Grid technology could also support the integration of the organisation's external departments. This means that a department that has been outsourced can operate exactly as if it were an internal department. This would be the case of an information system of an outsourced department as an external resource integrated into the organisation's infrastructure.

5. *Dias.grid*

Dias.net platform is based on *Dias.grid*, a software system that must manage resources, connect organisations and provide programming facilities. From the resource management view, *Dias.grid* is an open architecture that defines a common framework able to manage resource sharing in disperse communities. *Dias.grid* controls shared resources; it allocates, intermediates and monitors access to resources, either granting or denying requests to use them. It enables reliable and transparent sharing of resources across remote locations. The right resources are allocated to the right community of users for maximum efficiency while observing sharing policies of resource owners who define how it can be used.

The main point of *Dias.grid* is that organisations can focus on the services needed to perform their activities rather than on the resources required to carry out such services. A specific organisation accesses their services through a virtual space, where the space concept represents a virtual place in Internet where organisation members can interact with other members and make use of services, e.g. hosting, content management, bulletin

board, digital signature, project management, marketplace, employment bureau, telework, e-learning, and many more. Services are transparently supported by Grid resources, that is, resources of *Dias.grid* are dynamically allocated to provide a specific service of a concrete organisation.

There are two kinds of resources: hosts and software tools. Hosts are servers with typical services to provide hosting in internet: operating system, file storage, database server, web server, firewall, DNS, and backup system. Software tools are normally open source applications that support the functionality for carrying out operations and business objectives.

Dias.grid allows the creation of spaces for organisations and is open to easily integrate new services and resources.

5.1 Space models: a “prêt-a-porter” approach

A space model represents a set of typical requirements that can be identified in organisations of a same type. These requirements are translated to the structure that a *Dias.grid* space should have and the services that these organisations could need.

A space model results form a “prêt a porter” requirement analysis, in which the needs of a “dummy” organisation are identified. It can be used to classify the organisation needs effortlessly, and as a mechanism for easy creation of a space.

Every space is created based on a specific space model. The space inherits the structure and configuration of the space model, and so an organisation has available an immediate space on internet with a structure adapted, to a great extent, to its needs. However, once the space is created, it can be tailored in order to fine tune the specific requirements of the organisation, that is, the structure and services can be modified by the space administrator.

The space administration consists of: definition of the structure, activation of services, allocation of resources to activated services, modification of space appearance, user management and incident management.

Flexibility of IT infrastructure is achieved because organisations can decide at any moment which resource is used to support each service. The resource used to provide a specific service can be changed without restrictions, even migrating data from the previous resource to the new one.

5.2 Spaces: the user environment

Interaction requirements of organisation members are focused on Spaces, that is, all interactions of organisation members with other members and with services are achieved through spaces.

A Space is a "place" metaphor, where organisation members can work together, irrespective of their physical location, in other words, a virtual workplace to support communication, collaboration and coordination activities in a disperse environment. Such virtual workplaces literally provide a ‘place to inhabit’; individuals share the space with other individuals and use the tools that they need to work. The use of space-based systems permits the construction of more flexible systems, in which the physical configuration of the group is not important. Moreover, shared virtual work spaces enable users to know what the other users are doing [1].

This space-oriented view allows common definition mechanisms, transparency and uniform semantics to define the space structure to be addressed. The space structure is composed of desktops that give support to configure the user environment and thus provide the users with the space functions. Desktops allow users to: view documents; use available services; be aware of the other users, where awareness means the understanding of who is in the Space and what they are doing. A view of space front-end is shown in figure 2.

Desktops can either be public, where anonymous users access freely, or restricted, where users must be registered members with assigned roles having to be granted.

Figure 2. A view of a space front-end

5.3 Service orientation

The tendency of information systems in organisations is to be organised around the idea of services. Service orientation avoids the rebuilding of applications when changing the resources and so allows TIC to respond much more rapidly to new changing requirements.

Service orientation yields not only flexibility but also integration. Organisations exhibit their services to one another by using common interfaces to make collaborative computing a reality. Service orientation

provides: implementation transparency, where multiple implementations may be rationalised, or an older implementation upgraded, with minimal impact on the consumer of the service; loosely-coupled architecture of services that have minimum dependences and that can be reused with minimum overhead costs.

It is possible and very simple to change dynamically the resource that provides a service. This characteristic gives the configuration of the infrastructure a high degree of flexibility since migration to a new resource entails no cost to the organisation (Figure 3). The normalisation of resources to allow this migration is achieved with standard descriptions of services using XML. Each service is defined as a set of functions that organisations could use for their own purposes and that must be provided by specific resources.

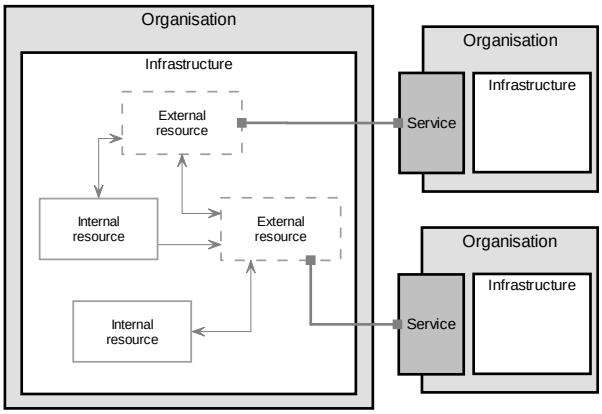

Figure 3. The infrastructure of an organisation configured with internal and/or external resources

5.4 Resources

A resource is seen as a service provider, that is, a system that provides other systems with access to information and/or computing. Resources are included in *Dias.grid* by means of their services (Figure 4).

Dias.grid enables the pooling of resources across disparate systems into a single consolidated view. A pool of resources provides a view of heterogeneous resources that should be easily composed. *Dias.grid* enables the pooling of hosts across disparate systems into a single consolidated view.

For example, host pool comprises two hosts: Amadeus and Ludwig. Amadeus can host php applications, mySQL and postgreSQL databases and register domain names for communities, while Ludwig is able to host PHP, Java and Perl applications and provide email domains to user communities. Virtually, this pool provides the aggregation of Amadeus and Ludwig services.

With regard to the heterogeneity of resources, every resource included in *Dias.grid* must be associated with a driver that acts as a translator and allows architecture components to communicate transparently with it. The integration of a resource in DIAS.grid requires the development of the corresponding drivers for each service that permit the specificities of the resources to be addressed. For example, each service provided by Amadeus must be associated with a specific driver able to manage it (Figure 4).

Every driver must comply with an interface specification defined for each type of service (Figure 4) and each driver's interface is defined according to the relevant service.

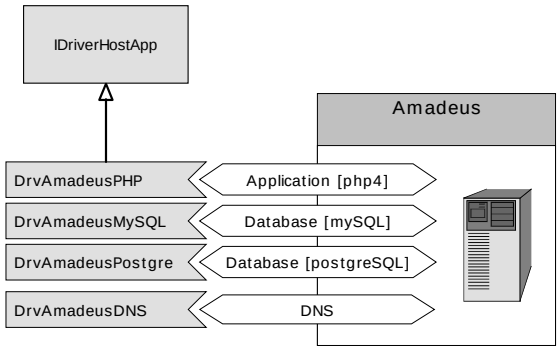

Figure 4. A specific driver must be implemented to manage every resource service

6. *Dias.grid* architecture

Dias.grid follows a layered architecture model. The layers are resource pool, kernel and applications. The following sections contain a brief description of these layers.

6.1 Resource pool layer

Resource pool is the common IT infrastructure, a heterogeneous set of resources that can be assigned to meeting the needs of organisations while observing sharing constraints.

The resource pool is a set of carefully selected resources that must be integrated into the platform. These resources are used to support the services offered to organisations. If services that were unavailable were requested, the viability of incorporating new resources in the platform would be evaluated. On the other hand, those resources with a bad quality level will have to be eliminated from the platform. Organisations are required to provide information that helps the search for resources and the evaluation of the selected resources. The purpose of the platform is to offer a wide variety of quality

functions and to guarantee the continuous improvement of these services.

The platform acts as a digital ecosystem in the meaning of Nachira [7]: digital species (resources) are in competition with other species to survive. Outside the platform, these species must evolve if they are to last.

6.2 Kernel layer

Kernel is responsible for managing the resource pool, federations of users, and spaces, and acts as a middleware providing an Application Programming Interface (API) to develop applications. In turn, kernel comprises three sub-layers:

a) The coordination layer allows applications to deal with spaces, models and services. It is the layer responsible for the spaces, models and services management. This layer makes it possible to create, modify or delete spaces, models and services. Additionally, spaces can be launched creating new space sessions. In order to achieve transparent access to resources, this layer is also responsible for managing user sessions. This layer allows a user to log in to resources automatically; the user simply logs in to *Dias.grid* and the Coordination layer does it all.

b) Production is the layer that allows the management of the different *Dias.grid* resources. This layer conceals the resources implementation and makes the use of these resources transparent. Production is responsible for resource creation and configuration. This layer provides functionality in order to add or remove different resources. Furthermore, the resources must be installed for the different spaces and in some cases they must be set, and it is the production layer that performs those functions.

c) The security layer provides the functionality required to authenticate and validate all federation members and administrators. It also manages all federations that have been registered in *Dias.grid*. The Security layer defines the authentication protocols required for transactions. Authentication protocols build on communication services to provide cryptographically secure mechanisms for verification of the identity of users and resources. The complexity of the security problem makes it important that any solutions are based on existing standards whenever possible.

6.3 Application layer

The final layer of the architecture is applications. A variety of applications can be developed using Kernel's API's. An application developer will use these API's to build custom tools on top of the Grid (Figure 5).

To date, four web applications have been designed:

a) Shell is the application in charge of space access. This application provides the user with the ability to browse a space and executes desktop functions.

b) Space Control is responsible for space management. This application allows an organisation administrator to manage the space features.

c) Service Control is an application providing control and support to service providers.

d) Grid Control provides Grid Administrator with the ability to create spaces and user federations.

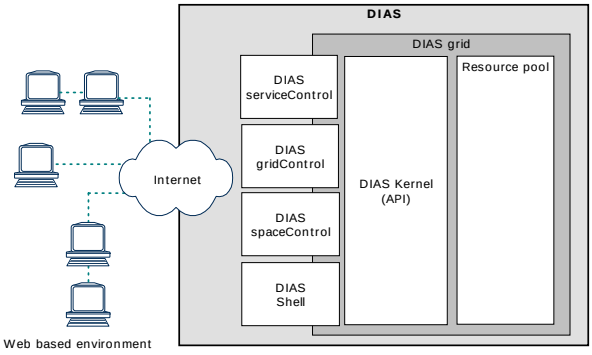

Figure 5. Four web applications have been designed to support basic operations of *Dias.grid* users

7. Conclusion

In this paper, a platform, called *Dias.net* has been introduced. It allows organisations to configure an IT infrastructure in the web with ease. This platform has been developed in the context of a European project and provides small organisations in peripheral and island regions with several IT services (content management, e-learning, digital signature…) to configure their IT infrastructure by outsourcing it. The main aim of the *Dias.net* platform is to make IT resources available to organisations in order to spread the use of the information society.

It deals with making a technological environment available to small organisations at a reasonable cost and with all the power and resources (technological and human) of large organisations' systems. The target organisations, public or private, are those where the budget is rather low and the needs often change. *Dias.net* is currently used by 15 organisations, but the forecast is that 40 will be using it within a year, once the trial phase has been completed. Moreover, the aim is to create another platform with *Dias.grid* providing similar

services to those of *Dias.net* within that period to integrate occupational training services.

Dias.grid is an open architecture that supports this platform and has been conceived from the view of service orientation and Grids applied to configure IT infrastructure of organisations:

Organisations can focus on the services needed to perform their activities rather than on the resources required to carry out such services.

Services are transparently supported by a pool of resources that are managed and allocated dynamically to provide the service.

Acknowledgement

Dias.net platform has been made possible by the financing of the European Commission under the Fifth Framework Programme (IST-2001-35077). This support is gratefully acknowledged.

The authors are especially grateful to Mr. Miguel Montesdeoca, Executive Manager of DIAS.net project, for his continuous support and encouragement. We would also like to thank the reviewers of 5th Framework Program of the European Commission and particularly Mr. Francesco Nachira for helping to orient this work. Lastly we would like to express our thanks to the anonymous reviewers of this Conference.

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