Virtual Desktop Infrastructure (VDI) Technology: FI4VDI project

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Abstract. This paper presents an analysis of the FI4VDI project, the goal of which was to develop an innovative model of service provision using cloud computing in order to create an infrastructure suite aimed at large companies and SMEs alike, educational institutions, universities and/or research centers that would contribute to competitiveness and provide an efficient solution to reducing the carbon footprint derived from the use of information technology.

Keywords: VDI - Smart Data Centre - SMART IT Infrastructure - Energy Efficiency - Carbon Footprint.

1 Introduction

The aim of the *FI4VDI* project was: *to develop a federated infrastructure network for the creation of virtual desktop services*. Firstly, by evaluating the position and perception of public and private organizations in the SUDOE Space as regards the desirability of the virtualising IT operating environments, and secondly, by promoting the spread of cloud computing as a means to achieve savings, efficiency and simplicity with the primary objective of ensuring improved productivity.

The provision of cloud computing services by supercomputing centers has a positive effect on the ecological footprint; dependence on physical ICT infrastructures is reduced when these are replaced by virtual ones, and this in turn produces a marked reduction in energy consumption in these institutions.

With a federated cloud computing model, desktops can be connected to dedicated servers with high rates of effective utilization, greatly increasing energy efficiency and reducing the carbon footprint associated with the service.

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The goal of the project was to develop a federated infrastructure network for the creation and management of energy efficient ICT services.

Organizations that participated actively as infrastructure providers included the Supercomputing Centre in Castile and Leon [1] - Castile and Leon Region ES41 (Spain), the Computing and Advanced Technologies Centre in Extremadura - Extremadura Region ES43 (Spain), the University of Lerida Faculty of Arts Computer Centre in Ponent - Catalonia Region ES51 (Spain) and the University of Montpellier 2 Sciences et Techniques - Languedoc-Roussillon Region FR81 (France). Organizations actively participating as business associations included the Innovative Business Association for Network Security and Information Systems (Spain), Inovaria – Association of Companies for an Innovation Network in Aveiro - Central Region PT16 (Portugal) and the Science and Technology Park Agri-Food Consortium in Lerida - Catalonia Region ES51 (Spain).

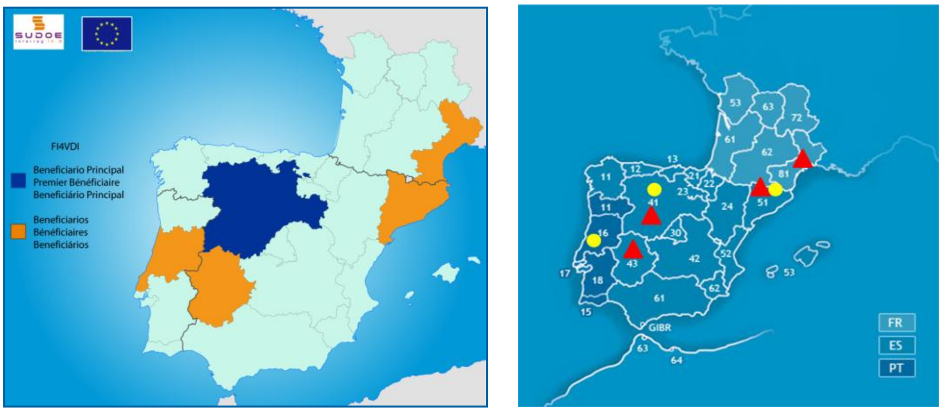

Figure 1. Scope of the FI4VDI project in the SUDOE Space www.sudoe.eu
Setting of the FI4VDI project: profile of the partners participating in the project.

▲ Location of Centres providing the infrastructure

● Location of business associations

2 FI4VDI-SUDOE project

2.1 Objectives

The aim of the FI4VDI project was to develop a federated infrastructure network for the generation of virtual desktop services, and to promote sustainable development by leveraging the benefits deriving from transnational cooperation.

In brief, the project proposed the creation of a private cloud infrastructure using the resources available in various supercomputing centers located in different SUDOE regions, with the goal of ensuring protection of users' data and compliance with regulations pertaining to information security and the service-level agreements established. Implementation of this service would entail improved competitiveness and cost savings in the sectors targeted, where energy savings and efficiency are a distinguishing feature.

The problem addressed by the project was the need to determine the position and perception of public and private entities located in the SUDOE Space as regards the desirability of virtualisation of IT operating environments, and to promote the spread of cloud computing as a means to achieve savings, efficiency and simplicity with the primary objective of ensuring improved productivity.

Origin of the project: The provision of cloud computing services by supercomputing centers has a positive effect on ecological footprints; dependence on physical ICT infrastructures is reduced when these are replaced by virtual ones, and this in turn produces a marked reduction in energy consumption in these institutions.

Project objectives and results: With a federated cloud computing model, desktops can be connected to dedicated servers with high rates of effective utilization, greatly increasing energy efficiency and reducing the carbon footprint associated with the service.

Project strategy and structure:

Task group 0. Preparation
Task group 1. Project coordination and management
Task group 2. Technical infrastructure development
Task group 3. Adapting applications to the cloud environment
Task group 4. Integration. Prototypes.
Task group 5. Project monitoring and evaluation
Task group 6. Publicity and information. Market capitalization

2.2 Virtual Desktop Infrastructure - VDI as a technology proposal [1] [2]

The term "desktop virtualisation" was introduced in the 1990s to describe the process of separation between the desktop, which encompasses the data and programmes that users employ for their work, and the physical machine. A "virtual" desktop is stored remotely on a central server rather than on the hard disk of an individual personal computer. This means that when users work on their desktop from their laptop or PC, all their programmes, applications, processes and data are stored and run centrally, allowing users to access their desktops from any device that can connect remotely to the central server, such as laptops, PCs, smartphones, or thin clients.

Through desktop virtualisation, the entire environment of an information system or the environment itself is encapsulated and delivered to a remote device. This device can be based on a completely different hardware architecture from the one used by the projected desktop environment. It can also be based on a completely different operating system.

Desktop virtualisation consists of the use of virtual machines to enable multiple network users to maintain their individual desktops on a single server or host computer. The central computer may be located in a residence, in the company or in a data centre. Users may be geographically dispersed and connected to the central computer via a local area network (LAN), wide area network (WAN) or via the Internet.

Desktop virtualisation offers advantages over the traditional model, in which each computer functions as a complete and independent unit with its own operating system, peripherals and applications. Energy costs are reduced because resources can be shared and allocated to users according to their needs, and the integrity of user information is enhanced because the data centre stores and safeguards all data and backups. Furthermore, software conflicts are minimized by reducing the total number of programmes stored on computers, and although the resources are distributed, all users can personalize and customize their desktops to meet their specific needs. Thus, desktop virtualisation provides greater flexibility than the client/server paradigm.

The limitations of desktop virtualisation include the possibility of security risks if the network is not well managed, the loss of user autonomy and privacy, the challenges involved in creating and maintaining drivers for printers and other peripherals, difficulties in managing complex multimedia applications and problems in maintaining the addresses of virtual machine users consistent with those held by the data centre.

2.2.1 Benefits

Like any other technology, desktop virtualisation provides a number of key benefits that render this technology the first choice for a large number of users:

- Enhanced security and reduced desktop support costs [3].
- Reduced general hardware costs [4]
- Ensured business continuity [5]
- An eco-friendly alternative [6]
- Improved data security

2.2.2 Advantages

The main advantages are [7] as follows:

- Instant implementation of new desktops and use of applications
- Virtually zero downtime in the case of hardware failure

- Significant reduction in the cost of new deployments
- Sound capacity for managing the desktop image
- The PC replacement cycle is extended from 2-3 years to 5-6 years or more
- Existing desktops include multiple monitors, bidirectional audio/video, video streaming, USB port supports, etc.
- Company employees can access their virtual desktops from any PC, including a PC in the employee's home
- Resources tailored to desktop needs
- Multiple desktops on demand
- Free provision of desktop computers (controlled by the policies of each corporation)

2.2 Description of the technical task groups

Technical infrastructure development.

Design of a federated cloud infrastructure capable of providing the selected applications.
Actions focused on definition, implementation and deployment of the system architecture, considering the hardware and software of the different cloud servers as well as the most suitable middleware to interrelate it all.

Adapting applications to the Cloud environment.

Selection of different applications and environments.
Implementation of a federated infrastructure, optimizing the resources and efficiency of the processes involved.
Adaptation focused not solely on computing implementation and functionality, but also on modeling functional paradigms and services that respond to the growing needs of these environments.

Integration. Prototypes.

Each of these involved the following actions:

Prototype design
Integration of prototypes into the federated infrastructure
Functional implementation
Validation
Battery of functional tests
Stress tests
User training
Dissemination and value enhancement

2.3 Adoption of cloud computing

As regards the use of software solutions, not necessarily in the cloud, the rate of use from high to low is as follows:

Storage: technological resources offered by providers, the function of which is to store client data in their databases, 75.5%.

Email: a computer programme that allows clients to manage electronic mail (writing, sending, receiving, storing, organising, etc.), 74.1%.
Computing: computing resources offered by providers (computing capacity on provider's servers), 65.4%.
Backup: technological resources that allow temporary storage of client information, for recovery in the event of loss, 59.8%.
Office applications: collection of applications that enable clients to create, modify, organise, scan, print, etc., files and documents, 46.4%.
Virtual desktops: technology that enables clients to work on a computer using their desktop, from a terminal located elsewhere, 40.4%.
Database management systems (DBMS): systems used for storage and organisation of public authority data, 38.1%.
Collaborative tools: systems that provide access to certain services that enable clients to communicate and work together whether or not they are located in the same physical location, 34.2%.
Content Creation and Control (CCC): computer systems that enable the creation and management of content (text, images, video, etc.) and provide the option of sharing this content among members of a team, 33.6%.
Managed File Transfer (MFT): software that facilitates the secure transfer of data from one computer to another over a network, 32.1%.
Customer Relationship Management (CRM): software tools for integrated management of customer or citizen information, 28.3%.
Enterprise Resource Planning (ERP): set of tools which provide integrated management of processes and information corresponding to different business areas, 25.5%.
Application Lifecycle Management (ALM): process of managing the lifecycle of a software application through governance, development and maintenance of the same, 18.2%.
Project Portfolio Management (PPM): a process which incorporates analysis and collective management of a group of ongoing, envisaged or imposed projects, and Supply **Chain Management (SCM):** application of tools for improving and automating supply by controlling stock, delivery times and other aspects, 7.6%.

Base: Public authority users of cloud computing (n=152)[1].

2.3 Performance indicators

Indicadores de realización.

Entidades que han colaborado en el desarrollo de los proyectos (Nº)
Empresas y PYMES que han formado parte de los partenariados de innovación financiados (Nº)
Proyectos de I+D que aportan mejoras desde una perspectiva ambiental (Nº)
Proyectos sobre el desarrollo de la I+D y de redes de innovación (Nº)
Tipología de implementación: Privada/Pública/Híbrida/Comunitaria

Indicadores de resultado.

[1] *Study on cloud computing in the public sector in Spain* Spanish National Institute of Communication Technologies (INTECO) July 2012. Study funded as part of the SERPLAGO project (cloud platform services for e-government and e-administration processes), funded by the 2011 INNPACTO sub-programme of the 2008-2011 National Plan of the Spanish Ministry of Economy and Competitiveness, and co-financed by the EU ERDF programme.

Empresas y PYMEs que se han beneficiado de resultados de los proyectos llevados a cabo (Nº)
Nuevas tecnologías desarrolladas (Nº)
Herramientas (aplicaciones y servicios) para la transferencia tecnológica entre centros tecnológicos y empresas y PYMEs adoptadas en los países/regiones del SUDOE (Nº)
Redes de cooperación transnacional en innovación creadas (Nº)
Área del SUDOE con accesos mejorados a las NTICs (km2)
Nivel de mejora de la productividad
Nivel de cumplimiento de expectativas

Indicadores de impacto.

Redes de cooperación permanentes establecidas (Nº)
Nuevas tecnologías transferidas a las empresas, PYMEs y/o entidades de gestión (Nº)
Tasa de conocimiento del Cloud computing y de la tecnología de virtualización
Tasa de adopción del modelo cloud computing
Tasa de satisfacción con proveedores por la calidad del servicio: facilidad de contacto y disponibilidad
Nivel de ahorro de tiempo de gestión recursos TI
Tasa de satisfacción con proveedores por la calidad del servicio: instalación y Redimensionamiento
Nivel de ahorro de costes de gestión de recursos TI
Intención de mantener soluciones Cloud
Tasa de satisfacción con proveedores por la calidad del servicio: soporte y respuesta ante contingencias

2.3 Results

Creation of a Platform as a Service (PaaS) for mass deployment of virtual desktops.

Federation of the participant supercomputing centers infrastructures.

Creation of an innovative cloud computing service aimed at users in the public and private sectors.

Enhanced competitiveness and cost savings in the sectors targeted by the service created.

Establishment of strategic recommendations: definition of reliable models for cloud computing (service levels, system capacity, system restoration, interoperability through shared service infrastructures, migration models), identification of service areas and evaluate and promotion of cloud computing as a tool for achieving cost savings and technological optimization.

Establishment of technological recommendations: identification of existing solutions and possibilities, assessment of the real capacity of suppliers, selection of an applications and systems map, initiation of a cloud computing strategy by adopting private clouds and infrastructure and platform services, establishment of system migration plans and identification of cloud computing as a model that fosters other technologies which are either emerging or in the process of expansion, such as energy sustainability in the area of IT or open source solutions.

Establishment of management recommendations: definition of systems for assessing investment returns, analysis of organizational impact and identification of change management models, development of new contracting models and practices, standardization and organization of common services and definition of risk analysis models.

Conclusions

The spread of cloud computing in the Spanish public sector is still limited, and is more common among local authorities than among regional and state institutions.

In general, the most common mode of deployment is private.

Savings, efficiency and simplicity are the reasons that have prompted public authority institutions to contract cloud computing services.

Those public institutions that decided to adopt cloud computing did so after carrying out a legal analysis focused primarily on data protection legislation.

According to the public authority bodies that have adopted cloud computing, the principle benefits of this model are the savings in costs and time it represents, whilst integrity of services and data was identified as the main difficulty.

The Spanish public sector perceived the cloud as a technological and, above all, operational advantage which has met their initial expectations regarding cloud computing.

Among the public authority bodies already using cloud computing, the future prospects are very bright: they intended to continue working in the cloud, they would recommend this technology to other institutions and they expected to continue to obtain future benefits from using the cloud.

However, those public institutions that are not yet using the cloud were more wary: few intended to incorporate technological solutions, and only a minority of these would consider cloud computing.

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Ref. SOE4/P3/E804-FI4VDI

Project FI4VDI-SUDOE Corporate Logo

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