Chapter V
The Ubiquitous Grid

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ABSTRACT

The strength of grid computing, namely being able to aggregate distributed computing and data storage capacities for solving larger, more complex problems, can currently only be partially exploited because of difficulties in accessing grid infrastructures, lack of usability, security or legal concerns, and missing performance guarantees or billing mechanisms. In this chapter, we present application scenarios where some of those weaknesses are overcome by presenting the user with transparent, intuitive, location independent access to grid resources using techniques from mobile and pervasive computing. Two approaches are suggested. In the implicit approach, user needs and context information are to be captured by means of smart devices and objects trying to perceive the jobs and tasks users want or need to delegate for computation in the grid. In the user-controlled approach, users explicitly provide meta-information on the type of tasks to be solved and the underlying supporting infrastructure provides the most suitable type of applications as well as mechanisms for returning the results to the user. Both approaches are briefly described in the chapter by means of a specific sample scenario in the field of image analysis. Other application areas for mobile and ubiquitous grids based on our experiences gained in the Austrian grid project are also presented in the paper.

VISION

Grid computing is an emerging technology providing the possibility to aggregate resources for the solution of computation- or data-intensive scientific tasks. Taking the evolution of mobile computing into consideration, new Grid concepts are conceivable, fully exploiting the advantage of mobile devices and ubiquitous access. By decoupling resource availability from the core grid infrastructure and hardware, the user has always the same computational power, data or storage available, regardless of a device or location. Thus restricted capabilities of thin clients can be extended and new fields of application can be made accessible.

The key concept is "The invisible grid" – the grid environment should just be there for the

use of applications in science, business, health care, environment, or culture domains. Having this concept in mind, the following scenario is conceivable: Equipped with your mobile phone, which you always have with you, you are walking around and are taking a picture of an object you are interested in. You are sending the picture to the grid, where the visual information is extracted. After the analysis, information about the captured object is sent to you. Thus you have a search engine on a visual base at your permanent disposal, information captured as seen by your eyes – without the need of textural translations or the need to know the object's name or ID in order to retrieve information about it.

Realizing the scenario above, the user obtains a smart tool, easing information retrieval considerably by making use of ubiquity in combination with grid computing. But the scenario has even more potential in terms of pervasiveness. The use of mobile devices can provide a user with additional location bound information. With a portable device the user is able to access location-based services or to collect environmental information to be processed within a grid. At this stage research activities in the field of pervasive computing come into play. Pervasive computing pursues the goal to enhance the environment with sensors and smart objects in order to provide the user with suitable context-based and/or location-based services.

Expanding the introduced setting with the capabilities from pervasive computing, the following scenario is conceivable: You are an invited speaker on a conference and you are moving through the rooms of the venue. All rooms are equipped with cameras covering all perspectives of view. You are looking at a person from whom you want to know the research interests. You flick with your finger, to capture the camera picture from your perspective. The picture is processed within the grid and the ambient display next to you shows the requested information.

INTRODUCTION

The scenarios described in the foregoing section aim to combine strengths of three main disciplines: grid computing, pervasive computing, and mobile computing.

Grid Computing

The term "grid" was coined in the mid-1990s to refer to a proposed distributed computing infrastructure for advanced science and engineering (Foster & Kesselman, 2004). A grid is an infrastructure of geographically distributed resources, comprising hardware components such as processors, memory media, or scientific instrumentation and software components such as services, applications, licenses, and so forth. Its infrastructure consists of hard- and software elements to aggregate and to coordinate resources.

The first grid that has been developed, for the European Organization for Nuclear Research (CERN) to support the research of the particle physics laboratory (Colasanti, 2004), uses a large scale distributed system by taking the advantage of the rich infrastructure provided by the Internet. By using a grid of computers, it is possible to aggregate computational power to generate a huge virtual multi-computer ready for processing, storage, and communication. Since a grid can be made up of a set of geographically separate networks, enormous computational power can be made available for solving complex or data intensive problems.

Grid computing is still at its early stages of evolution. Anyhow it is no longer the exclusive realm of researchers aiming to solve sophisticated scientific tasks (Gentsch, 2004). Alike the evolution of the Internet, main grid initiatives aim to successively establish a global grid, providing users with infinite resources, just by plugging the computer.