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Introduction

Emerging technologies such as pervasive computing and grid computing are blending multiple different resources and services (e.g., CPU cycles, data storage, sensors, visualization devices, and a wide variety of internet-ready instruments) into a single vast pool of virtual resources that are easily and transparently accessed and utilised for demanding applications. The marriage of pervasive computing and grid computing technologies is a fascinating research area, making possible for light devices, sensors, actuators, to enter the Grids in a win-win schema where each platform benefit from the collaboration.

This special issue is in response to the increasing convergence between grids and pervasive computing, while different approaches exist, challenges and opportunities are numerous in this context (Parashar and Pierson, to appear). The research papers selected for this special issue represent recent progresses in the field, including works on mobile ad-hoc grids, service and data discovery, context-aware application building and context accuracy, and communication. All of these papers not only provide novel ideas and state-of-the-art techniques in the field, but also stimulate future research in the Pervasive Grid environment.

Mobile ad hoc grids

We can visualize a grid over an ad hoc network that effectively utilizes the heterogeneous and dynamic mobile devices such as laptops, PDAs and cell phones. Each device has different computational capability, power, hardware and software, which forms a heterogeneous network. (Ko et al., 2008) deal with the issue of conglomerating and utilising several resource-limited devices as an ad hoc system to execute a complex computing task. They present a software infrastructure called FRAME in the context of Ad hoc Grids that autonomously redistributes some part of the tasks to potentially several resource-limited mobile devices in the environment. Following previous works, they investigate more precisely in this contribution an intuitive approach for constituting the ad hoc grid, and to monitor the reassembly problem at the end of the computation distribution.

Recently, the realm of grid computing has been extended from the original aim of sharing computing resources among wired members to include wireless domain as well (Abawajy,
2008). The union of wired and wireless communities into grid computing will certainly add complexities emanating from the nature of the mobile devices (e.g. limited power, processing capacity and storage), wireless network constraints (e.g. the limited bandwidth) and the increased dynamic nature of the interactions involved. Also, based on the nature of the interactions among the wired and wireless members served by the system, various architectures can be envisaged (Abawajy, 2008). In the same context of mobile ad hoc grids, (Gomes et al., 2008) present two different approaches for the interoperation of wired (traditional) and mobile grids. They complete their paper with an analysis of qualitative assessment of the implications of these approaches and experiments conducted with two actual grid middleware (MoGrid and Globus).

Service and data discovery

Service management and service discovery mechanisms are vital component of the grid and pervasive computing environments. For example, the amount of stored data is substantially increasing rendering data localization techniques no longer sufficient. One way to address this problem is to rely on compact database summaries. To this end, Hayek et al. (2008) propose a service called PeerSum for managing summaries over shared data in large P2P and Grid applications. They define a summary model for P2P systems as well as the algorithms for summary management. The summaries are synthetic, multidimensional views with two main virtues:

1. they can be directly queried and used to approximately answer a query without exploring the original data; and
2. as semantic indexes, they support locating relevant nodes based on data content.

Service discovery protocols suited for the mobile ad hoc networks environment provide features to spontaneously lookup services with a low communication overhead. In ad-hoc networks, mobile devices communicate via wireless links without the help of any centralised networking infrastructure. These devices must be able to discover services dynamically and share them safely, taking into account ad-hoc net-works requirements such as limited processing and communication power, decentralised management, and dynamic network topology, among others. These service discovery (SD) protocols form the cornerstone of the reconfiguration capability of the architecture and enable its effective management. Villa et al. (2008) address the problem of service and resource discovery in the specific context of wireless sensor network (WSN) domain. They present a service discovery protocol (SDP) suitable for wireless sensor networks (WSN) while taking into account the constraints imposed by ultra low-cost sensor and actuators devices (basic components of a WSN) to minimize the overall footprint.

Context awareness

Context awareness (e.g. location, time, preferences, etc.) is key factor in pervasive grids developments. The primary goal of pervasive computing is to seamlessly augment end-users knowledge and decision-making ability with little or no direct user interaction. Also, as computing become more pervasive, the nature of applications must change accordingly. The recognition of this vision requires context-aware functionality. To facilitate context-awareness, an infrastructure is required to collect, manage, and distribute context information to applications.
Satoh (2008) presents a framework that enables end-users to easily and naturally build visual interfaces for monitoring and customizing context-aware services. The framework is built on an exiting symbolic location model to represent the containment relationships between physical entities, computing devices, and places. It supports a compound document framework for visualizing and customizing the model. It provides physical entities, places, computing devices, and services in smart spaces with visual components to annotate and control them and to dynamically assemble visual components into a visual interface for managing the spaces. It can visualize and configure the spatial structure of physical entities and places and the status and attributes of computing devices and services, e.g. the location in which context-aware services are available. By using the framework, end-users can monitor and customize pervasive computing environments by viewing and editing documents.

The multiplicity of the sources of context information strongly impacts the quality of context information. As high quality context information is a primary requirement for context-awareness, designing applications for pervasive computing environments faces a stern challenge. Thus, high quality context information plays an essential role in pervasive computing. Aiming to provide the support of quality of context, Cheng et al. (2008) propose a transaction-based model for context information and a context management mechanism for inconsistency resolution. In this model, context-aware applications are organized as a number of logic units and each unit may have a compensation module, which will be executed when errors or exceptions occur during the execution of those applications in order to minimize the bad infection.

All-to-all communication model performance

Distributed applications (e.g. scientific, engineering and graphics computations) exhibit a range of communication patterns. All-to-all communication is one of the most important collective communication patterns used in scientific applications. Communication performance is an important factor that affects the performance of message-passing parallel applications running on distributed systems.

Steffenel et al. (2008) present an integrated approach to model the performance of the all-to-all collective operation, which consists of identifying a contention signature that characterizes a given network environment, using it to augment a contention-free communication model. They experimentally show that the proposed approach provides an accurate prediction of the performance of the all-to-all operation over different network architectures with a small overhead.

Conclusions

This special issue of International Journal of Pervasive Computing and Communications covers different aspects of the problem, both from the theoretical to practical side. The papers in this special issue were selected after rigorous reviews by at least three reviewers following the "Grid and pervasive conference", held in Paris in May 2007.

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References

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