Programming models for mobile environments

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EXTENDED ABSTRACT

In the recent years, we have assisted to a revolution in IT technologies. The traditional centralized paradigm, where the whole application is hosted in local resources, has evolved into a distributed model where users have a simple device to interact with the application, but the heavy-weighted computation is performed remotely.

On one end, smartphones and tablets are devices with little computing capability that stand out for their high mobility and the wide range of possibilities to interact with the user: multi-touch screens, cameras or a large set of sensors such as GPS, light, movement,... People permanently bring a mobile device that connects them to the Internet and provides them with immediate access to all kind of services that support them in their work or daily life. For instance, a doctor who is visiting interned patients in their rooms can check on a tablet the results of previous tests and the patient evolution within the last hours to decide the most suitable treatment.

On the other end, the Cloud has emerged as the response to the growing need of computing power. Cloud technologies allow any person or organization to use an infinity of computing resources. These services have reduced the costs of owning a large computing infrastructure by converting the expenses of purchase, maintenance and operation into a pay-as-you-go bill.

Mobile Cloud Computing (MCC) brings together the benefits of both: it gathers the immediacy of access of mobile devices with the infinite computing capacity of the Cloud. Thus, mobile users can increase the computing capacity of their devices and solve more complex computational problems. Instead of consulting the evolution of the patients, doctors could simulate the impact of several treatments on them and pick the most suitable one.

Developing applications that fully exploit MCC is not straight-forward. To achieve a high performance on complex applications, developers must face all the concerns of parallelizing the application and the distribution of its components. Besides, the developer has to deal with the rapid variability of the network conditions induced by the high mobility of the mobile device. Applications should adapt their execution according to the current conditions; thus avoids harming the energy-efficiency and performance of the application. Facing these issues taking into account all the variables requires a high level of expertise. For experts in distributed computing, dealing with them means to increase the development time of the application. For developers without the expertise, they are an impassable wall.

In this article, we present COMPSs-Mobile: a framework that aims to ease the development of MCC applications by freeing the developer of all these concerns. At packaging time, applications, written following its own programming model, are modified to invoke a runtime toolkit included in the application bundle as a library. This toolkit manages the parallelization and distribution of the application execution aiming to reduce the execution time and the energy consumption of the mobile device. To the best of our knowledge, COMPSs-Mobile is the first framework that applies the automatic parallelization and distribution of applications on mobile environments.

The main contributions can be summarized in 9 points:

- Transparent instrumentation of Android applications
- The re-designed architecture of the COMPSs runtime targeting MCC environments
- Execution of tasks within the computing devices embedded on the mobile device (CPU, GPU and accelerators)
- Mechanism to offload task execution on cloud resource
- Modeling the temporal, economic and energetic cost to decide whether to offload a task execution
- Scheduling algorithm to optimize the performance, energy consumption and price of the execution
- The data-sharing mechanism via a distributed data directory
- Fault tolerance mechanisms to handle network disruptions and a checkpointing mechanism to avoid the re-execution of the whole application
- Secured communications (secrecy with federated identities)

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B. List of publications

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Author biography

Francesc Lordan was born in Barcelona, Spain, in 1987. He received the B.E. degree in informatics engineering from the Universitat Politècnica de Catalunya, Barcelona, Spain, in 2010, and the M.Tech. Degree in computer architecture, network and systems from the Universitat Politècnica de Catalunya (UPC), Barcelona, Spain, in 2013.

Since February 2010, he has been part of the Workflows and Distributed Computing group of the Barcelona Supercomputing Center (BSC) and developing extensions of the COMPSs programming model to support the execution on Cloud environments. Currently, he is working on his PhD thesis, advised by Rosa M. Badia, studying the problems of distributed programming for mobile cloud computing.