Chapter 12
Wireless Grids:
Recent Advances in Resource and Job Management

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ABSTRACT

Wireless grids extend the capability of Grid Computing by including a collection of wireless devices of diverse characteristics, such as sensors, mobile phones, laptops and special instruments. These new resources increase the power and accessibility of grids. Wireless devices can be grid resource consumers or grid resource providers. This chapter focuses in the use of mobile devices as resource providers. Some characteristics of these resources, such as limited CPU power, small screen, short battery life, and intermittent disconnection, are genuine challenges for the development of job management strategies. Our goal is to depict recent proposals in resource discovering, monitoring and job scheduling. The main contributions of the last five years will be described along the chapter. The highlights of the review includes: the use of agent technology; solutions oriented to applications composed of independent tasks and the lack of studies using either real platforms or real data in simulation models.

INTRODUCTION

Grid Computing involves the aggregation of geographically-disperse and heterogeneous resources from different organizations to solve computationally complex problems (Foster, Kesselman, Nick, & Tuecke, 2003; Foster, Kesselman, & Tuecke, 2001).

The rise of wireless technology and mobile devices has increased the number and types of resources to be integrated to the grid. As a result, the concept of grid has been enriched and new categories have emerged (Kurdi, Li, & Al-Raweshidy, 2008). One of these new categories is the Accessible Grid, whose resources are available regardless of their physical capabilities and geographical locations. Accessible Grids consist of a group of mobile or fixed devices with wired or wireless connectivity and predefined or ad hoc infrastructure (Hijab & Avula, 2011). Wireless, mobile, and ad hoc grids belong to this category. Table 1 shows the main characteristics of Accessible Grids with respect to traditional grids.

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Table 1. Characteristics of accessible grids (Kurdi et al., 2008)

Grid category	Main difference from traditional grids
Ad hoc grids	Have not predefined entry points.
Mobile grids	Support mobility of clients, services, or both.
Wireless grids	Support wireless connections between grid nodes and interfaces.

In Wireless Grids, wireless devices can be either resource providers, which contribute to data processing and/or storage, or only be mere consumers of grid services (Furthmüller & Waldhorst, 2010). The concept of Mobile Grids is very similar to Wireless Grids concept; in fact, many authors used both terms indistinguishably. While wireless grids integrate resources of varying sizes and capabilities (e.g. sensors, mobile phones, laptops, special instruments, and edge devices), mobile grids make grid services accessible through mobile devices such as PDAs and smartphones (Kurdi et al., 2008). Furthmüller and Waldhorst (2010) define a mobile grid as a grid that includes at least a mobile device. Finally, some researchers strictly define Ad Hoc Grids as grid environments without fixed infrastructures, i.e., all their components are mobile (D. Marinescu, G. Marinescu, Ji, Boloni, & Siegel, 2003; Kurdi et al., 2008). This chapter will focus mainly on wireless and mobile grids where mobile devices are used as resource providers. The terms mobile and wireless grid are used indistinguishably.

The integration of wireless and/or mobile devices to the grid provides advantages for both typical grid users and for owners of mobile devices. At least four advantages have been identified:

1. The grid processing and storage capabilities can increase with the entry of mobile devices. Although one of the characteristics of mobile devices is their limited capacity (low processing power, finite battery life and constrained storage space), this is compensated by the quantity of devices. However, nowadays this limitation is also being questioned: some studies point out the power of some of these devices (smartphones) for scientific computing (Duan et al., 2014; Rodríguez, Mateos, & Zunino, 2012).
2. Previously mentioned limitations of mobile devices would benefit from the opportunity of using a considerable amount of resources offered by the grid.
3. In addition, as mobile devices move with their owners most of the time, grid resources can be available in anyplace and anytime, thus the grid becomes ubiquitous (da Costa, Yamin, & Geyer, 2008; Davies, Friday, & Storz, 2004; Kurkovsky & Bhagyavati, 2003).
4. Finally, another possible application of mobile devices in grid systems is the use of their embedded sensors, such as cameras, microphones and GPS, to collect information from the environment, which can be processed in the grid (Rodríguez, Zunino, & Campo, 2011).

According to Kelleher (2013) Mobile Technology "it's the biggest shift in technology since the advent of the Internet" (p. 001). Additionally, the growth of mobile devices market is huge: Cisco (2014) reported that the number of smartphones, tablets, laptops and internet-capable phones would exceed number of humans at the end of the year. Although, these facts encourage the development of wireless or mobile grids, the technology is not still totally established due to the large number of obstacles to be overcome (Ahuja & Myers, 2006; Manvi, 2010; Parmar, Jani, Shrivastav, & Patel, 2013; Phan, Huang, & Dulan, 2002). Some of the challenges come from the characteristics of the devices: heterogeneity, limited CPU power, limited memory, small screen, short battery life, mobility and intermittent disconnection. Additionally, wireless networks are characterized by low bandwidth, low reliability and high latency.

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