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Part 1

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Preface

This book contains a selection of papers accepted for presentation and discussion at The 2015 World Conference on Information Systems and Technologies (WorldCIST'15). This Conference had the support of the University of the Azores, AISTI (Iberian Association for Information Systems and Technologies / Associação Ibérica de Sistemas e Tecnologias de Informação), ATI (Informatics Technical Association / Asociación de Técnicos de Informática), LIACC (Artificial Intelligence and Computer Science Laboratory) and GIIM (Global Institute for IT Management). It took place at University of the Azores, Ponta Delgada, São Miguel, Azores, Portugal, from 1st to 3rd April 2015.

The World Conference on Information Systems and Technologies (WorldCIST) is a global forum for researchers and practitioners to present and discuss recent results and innovations, current trends, professional experiences and challenges of modern Information Systems and Technologies research, technological development and applications. One of its main aims is to strengthen the drive towards a holistic symbiosis between academy, society and industry. WorldCIST'15 built on the successes of WorldCIST'13, held in 2013 in Olhão, Algarve, Portugal and WorldCIST'14 which took place on 2014 in Funchal, Madeira, Portugal

The Program Committee of WorldCIST'15 was composed of a multidisciplinary group of experts and those who are intimately concerned with Information Systems and Technologies. They have had the responsibility for evaluating, in a 'blind review' process, the papers received for each of the main themes proposed for the Conference: A) Information and Knowledge Management (IKM); B) Organizational Models and Information Systems (OMIS); C) Intelligent and Decision Support Systems (IDSS); D) Big Data Analytics and Applications (BDAA); E) Software Systems, Architectures, Applications and Tools (SSAAT); F) Multimedia Systems and Applications (MSA); G) Computer Networks, Mobility and Pervasive Systems (CNMPS); H) Human-Computer Interaction (HCI); I) Health Informatics (HIS); J) Information Technologies in Education (ITE); K) Information Technologies in Radiocommunications (ITR).

WorldCIST'15 also included workshop sessions taking place in parallel with the conference ones. Workshop sessions covered themes such as i) Applied Statistics and Data Analysis using Computer Science – ASDACS; ii) Big Data Systems and Technologies – BDST; iii) Business Intelligence in Organisations – BIO; iv) Computer Supported

Qualitative Analysis – CSQA; v) Educational and Serious Games – ESG; vi) Healthcare Information Systems Interoperability, Security and Efficiency – HISISE; vii) Intelligent Systems and Machines – ISM; viii) Internet of Things – IoT; ix) Pervasive Information Systems – PIS; x) Safety, Ergonomics and Efficiency in Human-Machine Interfaces – SEEHMI; xi) Stealth and Anti-Forensics Techniques – SAFT.

WorldCIST'15 received contributions from 43 countries around the world. The papers accepted for presentation and discussion at the Conference are published by Springer (this book) and by AISTI (another e-book) and will be submitted to be indexed by ISI, EI, SCOPUS, DBLP and/or EBSCO, among others. Extended versions of best selected papers will be published in relevant journals, including SCI/SSCI and Scopus indexed journals.

We acknowledge all those who contributed to the staging of WorldCIST15 (authors, committees and sponsors); their involvement and support is very much appreciated.

Azores, April 2015

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Architecture for Wireless Grids

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Abstract. Evolving consumer expectations will require changes to the existing access network – next generation access networks (NGNs). Emerging services leads to a great increase in bandwidth demand. Another great challenge to access networks is mobility. By other side, wireless mobile devices have become an indispensable tool for households and businesses. The increase of wireless devices, motivated by the rapid decrease of the cost and ease installation, leads to the redesign of the way applications and services are delivered. So, the integration of wireless grids with NGNs is extremely important. This paper presents a new architecture to integrate wireless grids in access networks.

Keywords: NGNs; Wireless Grids; Broadband Access Networks; Architecture.

1 Introduction

Access networks, services, and driving technologies are currently undergoing changes that have never occurred before. Whereas traditional networks were designed to provide narrowband single-service connections between buildings, commercial operators now have to offer multiple broadband services to a moving target [1].

Two of the main challenges for access networks are the increasing bandwidth demand and mobility trends. Triple play services (i.e., Internet, telephone, and television) lead to a significant increase in bandwidth demand. In addition to the bandwidth, another major challenge to access networks is mobility, given that users need to have Internet access anywhere and anytime. The mobility of the end user also introduces unprecedented volatility to the network architecture. Nomadicity causes end users to pop up and disappear at different locations in the network, which requires fundamental changes to the operations of access networks and the functionality of network nodes and the architecture itself.

The development of wireless technology and mobile devices enables individuals to access network services from anywhere at any time [2]. Wireless devices, such as mobile phones, PDAs, laptops, and sensors, have an important role in people's daily lives. Computing and communication networks have evolved from centralized, hierarchical systems under the management of a single entity to decentralized, distributed systems under the collective management of many entities. Today, all the intelligence is in the edge nodes of the networks, which implies that information is now scattered across different devices [3, 4]. Therefore, one of the most important trends for NGNs is to consider an integrated approach to the communication infrastructure and the processing layer [5].

Grid technology enables organizations to share geographically distributed computing and information resources in a secure and efficient manner [6]. Shared resources can involve computers, storage devices, data, software applications, or dedicated devices, such as scientific instruments and sensors. Traditional grid infrastructures are primarily based on wired network resources that are owned by various individuals and/or institutions and structured in virtual organizations, which are subjected to specific sharing policies. Wireless grid computing extends the traditional grid computing paradigm to include a diverse collection of mobile devices enabled to communicate using radio frequency, infrared, optical, and other wireless mechanisms [7]. In this context, we propose a new approach - The approach has two main objectives: a) Provide broadband access to end users, and b) Support the implementation of wireless grids (our architecture assumes that the wireless grids must have some access to the access network infrastructure

2 Wireless Grids Concepts, Classification and Application

Wireless grid is an emerging communication and resource-sharing architecture that has been discussed in recent years [8-12]. The wireless grids expand the scope of resources to include peripherals, such as display, camera, and microphone. In a wireless grid, the edge nodes are the network. Wireless peripherals and the access device form an ad hoc network and communicate with each other. They also allow the ad hoc sharing of resources, including microphones, screens, and processing power, of edge devices, such as a mobile phone, laptop, or PDA [13]. Wireless grid solutions offer home broadband users the maximum ability to share necessary documents, DVDs, music, displays, cameras, printers, and sensors [14].

Wired grid devices are typically stationary, and wireless devices frequently enter or leave the grid. Generally, a large number of these devices often arrive and depart on wireless grids (see Figure 1). As wireless devices have different spatial behavior, they are normally divided into three main categories: mobile, nomadic, and fixed-location.

The resources of wireless grid devices include the standard processing power, memory, and storage capacity available in wired grids but in more limited amounts. However, wireless devices can also include additions, such as a camera, microphone, bar code and RFID reader, GPS receiver, and satellite receiver or transmitter as well as a wide variety of special-purpose sensors [15, 16].

[17] argues that wireless grids could support many applications in different areas: Disaster management, mitigation and response – includes applications like earthquakes, wildfire, floods, tsunamis, etc.; Critical infrastructure systems – includes condition monitoring and prediction of future capability; Energy and environment – includes safe and efficient power grids; Health – reliable and cost effective health care

systems with improved outcomes; Enterprise-wide decision making - coordination of dynamic distributed decisions for supply chains under uncertainty.

It is possible to classify wireless grid architectures based on several criteria, including the devices predominant in the grid, relative mobility of the devices in the grid, architecture of the grid, and function of the grid (see Fig. 1).

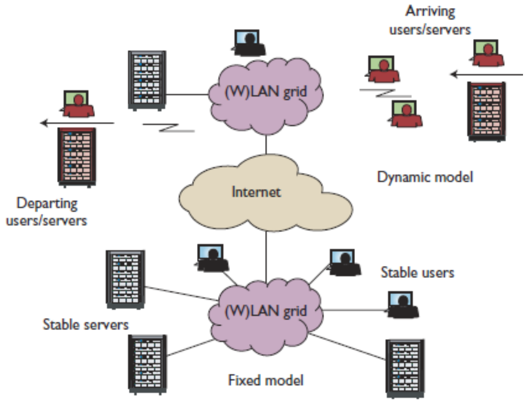

Fig. 1. Dynamic and fixed wireless grids [15]

Based on the devices predominant in the grid and the relative mobility of the devices in the grid, it is possible to classify wireless grids into three main categories [7, 15, 18]: (1) Sensor networks and grids: They composed of small devices that are generally dedicated to a single purpose that can be a sensor, battery, or radio transmitter. These networks integrate detection, processing, and communication into the grid; (2) Dynamic (mobile) wireless grids: As the processing power and other capabilities of the mobile devices, particularly PDAs and cell phones, increases, researchers and commercial organizations are discovering new ways to use and share their resources. Through ad hoc grid connections, these devices are able to connect to the Internet, provide P2P networking, take advantage of the resources of wired grid networks, and make their own resources available to wired grids [15]; and (3) Fixed wireless grids: In most respects, a fixed wireless network or grid is identical to a fixed wired network or grid, except that the wireless variety communicates using RF or optical mechanisms, rather than wires or cables. These grids are generally unchanging in nature and provide the same level of trust provided by a wired grid.

Another way to characterize the architecture of wireless grids is based on their architecture. [19] proposed three categories for wireless grids: (1) Local cluster or homogeneous wireless grids: They are characterized by the similarity of the wireless devices involved and their close proximity. These devices share the same hardware architecture and operation systems. Generally, they will be contained within a single department or division of an organization; (2) Wireless intra-grids: They exist within a single organization, but are shared across multiple departments or divisions; and (3) Wireless inter-grids: They are shared across multiple organizations.

Based on the function of the grid (or usage pattern), it is possible to classify wireless grids into three main categories [19]: (1) Computational grids: They are involved with the sharing of processing power when producing solutions in the process of completing a common task; (2) Data grids: They are concerned with the sharing of data across a multitude of devices; and (3) Utility grids: Generally in the form of sensor networks, they are involved with the sharing of responsibility for data collection, such as the detection of targets moving within a region or the measurement of environmental conditions.

Wireless grids offer a variety of possible applications. McKnight [15] categorized wireless applications into three main classes: (1) Applications aggregating information from the range of input/output interfaces found in nomadic devices; (2) Applications leveraging the locations and contexts in which the devices exist; and (3) Applications leveraging the mesh network capabilities of groups of nomadic devices.

[20] described the integration of wireless sensors networks with grid technology and proposed two different applications: emergency medical services and supply chain management. This integration permits the transfer of information across the physical world to a plethora of Web-based information utilities and computational services. The net result might be a network infrastructure that supports, yet pervades, everyday life in unimaginable ways. Another application example is the distributed ad hoc resource coordination (DARC) project. The system allows devices with no prior knowledge of one another collectively record and mix an audio signal, such as a concert, speech, lecture, or emergency event [15]. DARC demonstrates the potential of wireless grids to control the combined ability of mobile devices in social contexts outside of the expected environments for computing.

5 Wireless Grids Architecture

The new architecture to wireless communications is comprised of several different devices with different characteristics. Wireless grid architecture mainly consists of backbone networks and wireless ad hoc sub networks that are somewhat similar to a P2P network [15, 21].

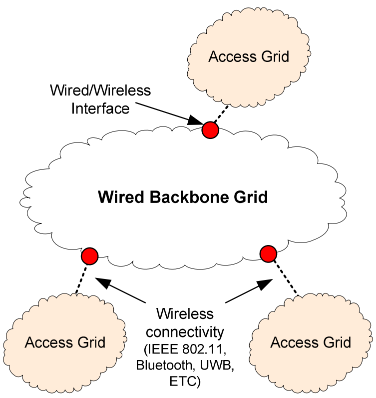

Fig. 2. Dynamic Pervasive wireless grid [3]

[3] argued that wireless grids were limited by the device resources. He also stated that there was a typical architecture that comprised a backbone grid of wired and

fixed grid devices and several access grids composed of wireless devices that could access the processing, storage, and bandwidth of the backbone grid (see Fig. 2).

As seen in the previous figure, the access grid connects to the backbone grid by wireless mode, such as ultra-wideband (UWB), ZigBee, WLAN, or cellular network (2G, 2.5G, 3G, B3G, 4G). [19] argued that commercial grids would possess some access to the wired Internet infrastructure (see Fig. 3).

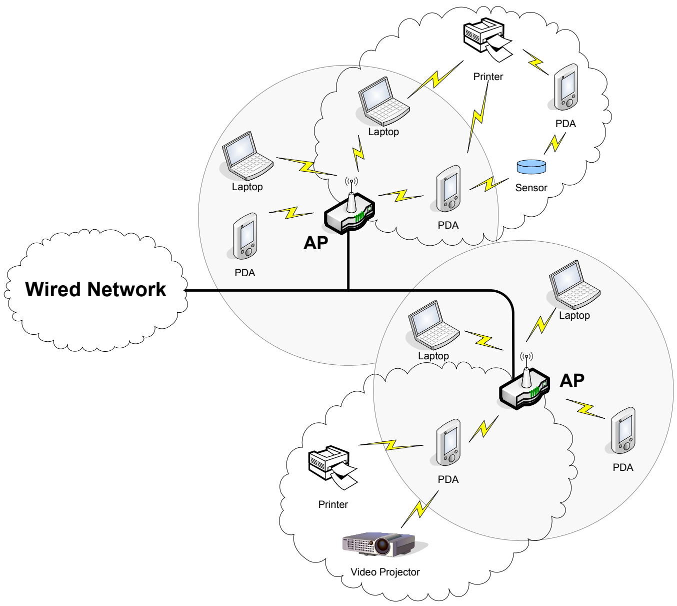

Fig. 3. Hybrid wireless network [19]

In the proposed architecture (see Fig. 4), edge devices are connected via ad hoc wireless networks. In addition, the devices may come and go (i.e., spatial behavior). The architecture assumes that the wireless grids must have some access to the access network infrastructure.

The architecture uses an edge interface (edge router) to connect the wireless grids to the broadband infrastructure (access network). Then, the wireless grid solutions offer broadband users the maximum ability to share documents, music, cameras, displays, printers, and sensors.

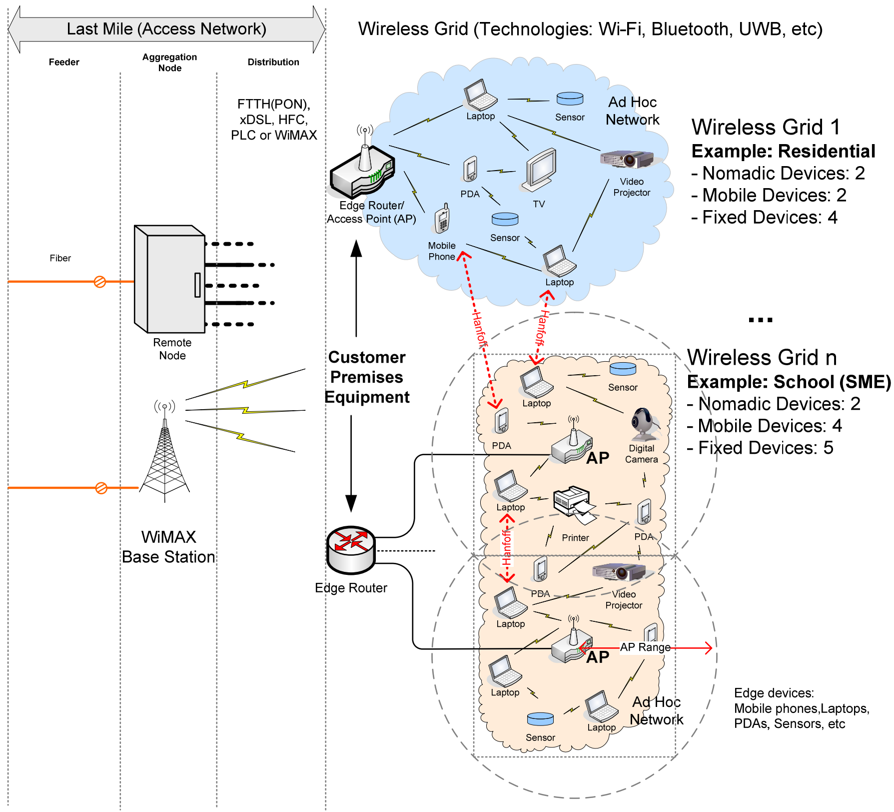

Fig. 4. Architecture for Wireless Grids [22]

The architecture uses an edge interface (edge router) to connect the wireless grids to the broadband infrastructure (access network). Then, the wireless grid solutions offer broadband users the maximum ability to share documents, music, cameras, displays, printers, and sensors.

We assume that edge devices are divided into three types: nomadic, mobile, and fixed. The wireless grid connects to the backbone by wireless mode (WiFi technology). The wireless links between the edge devices in the wireless grids can be supported by several wireless technologies (see Figure 5), including WiFi, Bluetooth, UWB, ZigBee, and 3G.

Then, in each wireless grid, the devices can use the WiFi links or other technology if it does not have WiFi technology (The WiFi signal is propagated in all area of the wireless grid).

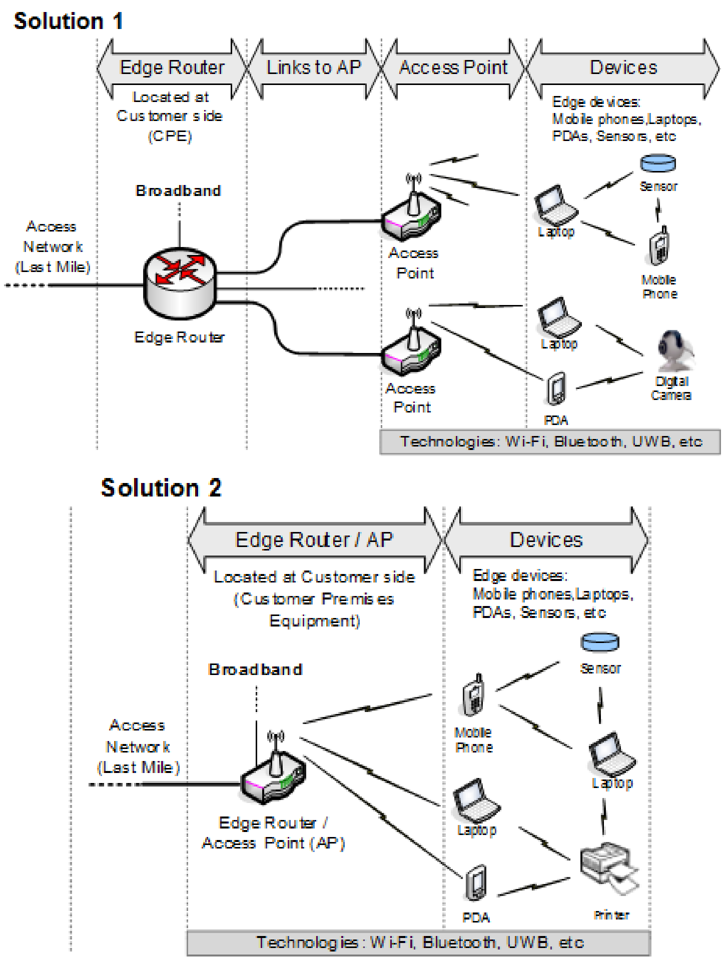

Fig. 5. Block diagram of wireless grids systems architecture [22]

As seen in Fig. 5, the wireless grid system architecture is divided into two or four main segments (depending on the solution): edge router, link to access point equipment, access point equipment, and devices.

The components used to compute the results for wireless grids are presented in Table 1. The costs of devices are covered by the costumers.

Table 1. Wireless grids architecture components

Edge Router	Links to APs	Wireless Access Points	Devices
1) Router equipment; 2) Equipment installation.	1) Cable; 2) Cable installation.	1) AP equipment; 2) Equipment installation.	Cost supported by the customer. 1) Equipment: Nomadic, Mobile, and Fixed devices.

Fig. 6 presents an example of a geometrical model definition required to calculate the length of the cables (from the edge router to the wireless gateways) and the total cells required to cover the entire wireless grid area (0).

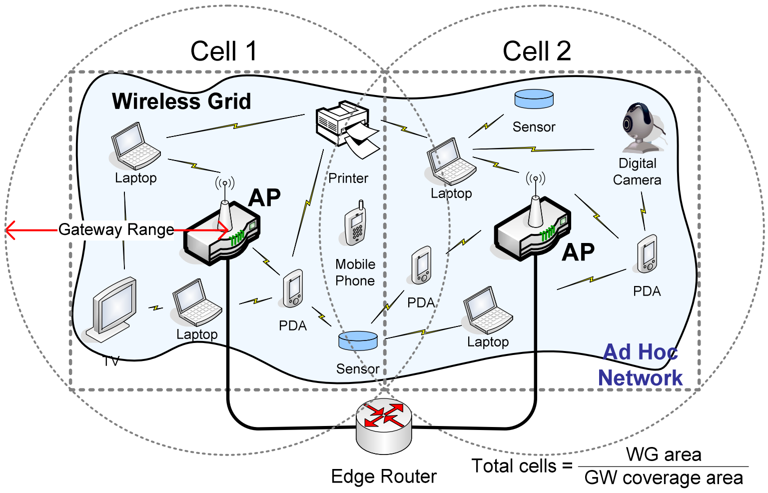

Fig. 6. Geometric model for wireless grids

6 Conclusion

The paper presents a new architecture to support the new requirements of broadband access and wireless grids in an integrated way. The evolution of computing and communication networks toward decentralized and distributed systems implies that all the intelligence is on the edge nodes of the networks. Integrating wireless devices with the traditional wired grid infrastructure will allow the access (transfer, processing, etc.) to the information that is now scattered across the different devices.

Today, the access networks face two main challenges: the increasing bandwidth demand and mobility trends. All this will require fundamental changes to the operations of access networks, the functionality of network nodes and the architecture itself. By other side, the evolution of computing and communication networks toward decentralized and distributed systems implies that all the intelligence is on the edge nodes of the networks. Integrating wireless devices with the traditional wired grid infrastructure will allow the access (transfer, processing, etc.) to the information that is now scattered across the different devices. In this paper, we present a new architecture to support the new requirements of broadband access and wireless grids in an integrated way

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