

Preface

ABOUT THE SUBJECT

The advances in mobile and ubiquitous technologies have more than 35 years of research. After all these years the ubiquity vision is becoming a reality, due to the evolution and new features of the hardware and software components. The advent of Web services and the progress on wearable devices, ambient components, user-generated content, mobile communications, and many other gave origin to new applications and services.

Recently advances in web services technologies allowed the integration into mobility. With these two components appeared new business models which imply improvements in technical infrastructure that enables the progress of mobile services and applications. These include dynamic and on-demand service, context-aware services, and mobile web services. While driving new business models and new online services, particular techniques must be developed for web service composition, web service-driven system design methodology, creation of web services, and on-demand web services.

The technological, social and organizational dimensions of mobile and ubiquitous computing will be supported by new educational paradigm. Two trends converge to make this possible; increasingly powerful cell phones and PDAs, and improved access to wireless broadband.

This handbook of research represents a collection of the most recent developments on the technological, organizational and social dimensions of this highly potential technology of mobility and computing, that dictate a paradigm shift in organizations, society and people. It covers the following dimensions:

- The technological dimension, addressing emerging technologies such as Wireless data communication networks; Mobile technologies; Standards and reference models; and Security.
- The organizational, human and social perspectives, comprising: New business models; Collaborative work; Learning and teaching; Social networks; Studies on adoption; Studies of impact; Critical success factors; and level of preparedness of organizations and people.
- Applications and solutions developed or under development, and research and development results that address a broad range of sectors, from business to government services, from education to e-Health.

The chapters included in the handbook,

- discuss the importance of this technologies and their support to new applications and solutions, namely in sectors of activity such as business, new organizational and ubiquitous models, e-Commerce, government, e-Health, e-Learning, etc.;

- present practical solutions and recent developments;
- introduce the state-of-the-art technologies;
- discuss organizational preparedness for new organizational models potentiated by ubiquity and mobility;
- discuss the impact on society and on people;
- discuss critical success factors;
- introduce future generations of communications and networks.

ORGANIZATION OF THE HANDBOOK

This handbook is a compilation of 77 contributions to the discussion of the main issues, challenges, opportunities and developments related with mobility and computing, in a very comprehensive way, in order to disseminate current achievements and practical solutions and applications.

These 77 chapters are written by a group of near 240 authors that include many internationally renowned and experienced researchers and specialists in the e-Business field and a set of younger authors, showing a promising potential for research and development. Contributions came from the five continents, and are included contributions from academia, research institutions and industry, representing a good and comprehensive representation of the state-of-the-art approaches and developments that address the several dimensions of this fast evolutionary thematic.

The “Handbook of Research on Mobility and Computing: Evolving Technologies and Ubiquitous Impacts” is organized in six sections:

Section 1: *Mobile Technologies*

Section 2: *Emerging Technologies*

Section 3: *Critical Success Factors*

Section 4: *New Business Models*

Section 5: *Security*

Section 6: *Applications, Surveys and Case Studies*

The first section, *Mobile Technologies* is composed by 36 chapters that address relevant research and development contributions to the field of mobility and computing, summarized below.

Chapter one, *Evaluating the Context Aware Browser: A Benchmark for Proactive, Mobile, and Contextual Web Search*, discusses the evaluation of highly interactive and novel context-aware system with a methodology based on a TREC-like benchmark. The authors take as a case study an application for Web content perusal by means of context-aware mobile devices, named Context-Aware Browser. In this application, starting from the representation of the user's current context, queries are automatically constructed and used to retrieve the most relevant Web contents. Since several alternatives for query construction exist, it is important to compare their effectiveness, and to this aim we developed a TREC-like benchmark. The authors present their approach to an early stage evaluation, describing their aims and the techniques applied, underlining for, for the evaluation of context-aware retrieval systems, the benchmark methodology adopted could be an extensible and reliable tool.

Routing is the process of finding a path from a source node to a destination node. Proposed routing schemes can be divided into topological and position based, depending on the availability of geographic

location for nodes. Topological routing may be proactive or reactive, while position based routing consists of greedy approaches applied when a neighbor closer to the destination (than the node currently holding the packet) exists, and recovery schemes otherwise. In order to preserve bandwidth and power which are critical resources in ad hoc and sensor networks, localized approaches are proposed, where each node acts based solely on the location of itself, its neighbors, and the destination. There are various measures of optimality which lead to various schemes which optimize hop count, power, network lifetime, delay, or other metrics. This second chapter, *Routing in Wireless Ad Hoc and Sensor Networks*, describes a uniform solution based on ratio of cost and progress.

Mobile communication networks have become an integral part of our society, significantly enhancing communication capabilities. Mobile ad hoc networks (MANETs) extend this capability to any time/anywhere communication, providing connectivity without the need of an underlying infrastructure. Chapter three, *Mobile Ad Hoc Networks: Protocol Design and Implementation* investigates the new coming realm of mobile ad hoc networks, focusing on research problems related to the design and development of routing protocols, both from a formal and technical point of view. Then the link stability in a high mobility environment is examined, and a route discovery mechanism is analyzed, together with a practical implementation of a routing protocol in ad hoc multi-rate environments which privileges link stability instead of traditional speed and minimum distance approaches.

The convergence of wireless applications presents a greater hope for consolidating e-Government applications even in resource-constrained countries such as those in Africa. Chapter four, *Convergence of Wireless Technologies in Consolidating E-Government Applications in Sub-Saharan Africa*, presents an exploratory study that aims at discussing the extent as to how convergence of wireless technologies from different vendors promises to contribute to the consolidation of e-Government applications in Sub-Saharan-Africa (SSA). This is done by reviewing the different adoption stages of ICT and e-Government in SSA. It looks at challenges facing adoption of wireless technologies (GSMs, Wireless Internet Access, satellite transmission, etc.) across all the socio-economic value chains in SSA. The chapter looks at Botswana and South Africa as case studies by bringing out the different interventions that have been done in the realm of facilitating a conducive environment for the convergence of different wireless technologies. Out of the analysis of legal, regulatory, market and spectrum policies affecting the adoption of wireless communications in SSAs, the chapter draws out recommendations on how to consolidate wireless communications to be adopted in different socio-economic setups (e.g. e-government, e-Health, e-Banking, etc.).

The fifth chapter, *Process Innovation with Ambient Intelligence (AmI) Technologies: A Comparison of Australian and German Small and Medium Enterprise (SME) Manufacturers*, considers the potential for absorptive capacity limitations to prevent SME manufacturers benefiting from the implementation of Ambient Intelligence (AmI) technologies. The chapter also examines the role of intermediary organisations in alleviating these absorptive capacity constraints. In order to understand the context of the research, a review of the role of SMEs in the Australian manufacturing industry, plus the impacts of government innovation policy and absorptive capacity constraints in SMEs in Australia is provided. Advances in the development of ICT industry standards, and the proliferation of software and support for the Windows/Intel platform have brought technology to SMEs without the need for bespoke development. The results from the joint European and Australian AmI-4-SME projects suggest that SMEs can successfully use "external research sub-units" in the form of industry networks, research organisations and technology providers to offset internal absorptive capacity limitations.

Chapter six, *Providing Ubiquitous Access to Synthetic Sign Language Contents Over Multiple Platforms*, presents the design of distributed sign language synthesis architecture. The main objective of this design is to adapt the synthesis process to the diversity of user devices. The synthesis process has been divided into several independent modules that can be run either in a dedicated server or in the client device. Depending on the modules assigned to the server or to the client, four different scenarios have been defined. These scenarios may vary from a heavy client design which executes the whole synthesis process, to a light client design similar to a video player. These four scenarios will provide equivalent signed message quality independently of the device's hardware and software resources.

Chapter seven, *The Impact of MIMO Communication on Non-Frequency Selective Channels Performance*, reviews the basic concepts of multiple-input multiple-output (MIMO) communication systems and analyses their performance within non-frequency selective channels. The MIMO system model is established and by applying the singular value decomposition (SVD) to the channel matrix, the whole MIMO system can be transformed into multiple single-input single-output (SISO) channels having unequal gains. In order to analyze the system performance, the quality criteria needed to calculate the error probability of M-ary QAM (Quadrature Amplitude Modulation) are briefly reviewed and used as reference to measure the improvements when applying different signal processing techniques. Bit and power allocation is a well-known technique that allows improvement in the bit-error rate (BER) by managing appropriately the different properties of the multiple SISO channels. It can be used to balance the BER's in the multiple SISO channels when minimizing the overall BER. In order to compare the various results, the efficiency of fixed transmission modes is studied in this work regardless of the channel quality. It is demonstrated that only an appropriate number of MIMO layers should be activated when minimizing the overall BER under the constraints of a given fixed data rate.

Chapter eight, *Node Localization in Ad-hoc Networks*, introduces node localization techniques in ad-hoc networks including received signal strength (RSS), time-of-arrival (TOA) and direction-of-arrival (DOA). Wireless channels in ad-hoc networks can be categorized as LOS and NLOS. In LOS channels, the majority of localization techniques perform properly. However, in NLOS channels, the performance of these techniques reduces. Therefore, non-line-of-sight (NLOS) identification and mitigation techniques, and localization techniques for NLOS scenarios are briefly reviewed.

The technological revolution that has created a vast health problem due to a drastic change in lifestyle also holds great potential for individuals to take better care of their own health. This is the focus of the presented overview of current applications, and prospects for future research and innovations, addressed by chapter nine, *Wireless and Mobile Technologies Improving Diabetes Self-Management*. The presented overview and the main goals of the systems included are to utilize ICT as aids in self-management of individual health challenges, for the disease Diabetes, both for Type 1 and Type 2 diabetes. People with diabetes are generally as mobile as the rest of the population, and should have access to mobile technologies for managing their disease. Forty-seven relevant studies and prototypes of mobile, diabetes-specific self-management tools meeting our inclusion criteria have been identified; 27 publicly available products and services, nine relevant patent applications, and 31 examples of other disease-related mobile self-management systems are included to provide a broader overview of the state of the art. Finally, the reviewed systems are compared, and future research directions are suggested.

Chapter ten, *Adaptive Multicarrier Frequency Hopping Spread Spectrum Combined with Channel Coding*, presents an adaptive Multicarrier Frequency Hopping Spread Spectrum (MCFH-SS) system employing proposed Quasi Cyclic Low Density Parity Check (QC-LDPC) codes instead of the conventional LDPC codes. A new technique for constructing the QC-LDPC codes based on row division method

is proposed. The new codes offer more flexibility in terms of girth, code rates and codeword length. Moreover, a new scheme for channel prediction in MCFH-SS system is also proposed. The technique adaptively estimates the channel conditions and eliminates the need for the system to transmit a request message prior to transmitting the packet data. The proposed adaptive MCFH-SS system uses PN sequences to spread out frequency spectrum, reduce the power spectral density and minimize the jammer effects.

Although B2B e-commerce provides healthcare organizations a wealth of new opportunities and ways of doing business, it also presents them with a series of challenges. B2B e-commerce adoption remain poorly understood and it is also a relatively under-researched area. Therefore, case studies were conducted to investigate the challenges and issues in adopting and utilizing B2B e-commerce systems in the healthcare sector. The major aims of the study presented in chapter eleven, *Key Adoption Challenges and Issues of B2B E-Commerce in the Healthcare Sector* are to: (a) identify and examine main B2B e-commerce adoption challenges and issues for healthcare organizations; and (b) develop a B2B e-commerce adoption challenges and issues table to assist healthcare organizations in identifying and managing them.

Chapter twelve, *A Pervasive Polling Secret-Sharing Based Access Control Protocol for Sensitive Information*, presents a novel access control mechanism for sensitive information which requires permission from different entities or persons to be accessed. The mechanism consists of a file structure and a protocol which extend the features of the OpenPGP Message Format standard by using secret sharing techniques. Several authors are allowed to work in the same file, while access is blocked for not authorized users. Access control rules can be set indicating the minimum number of authors that need to be gathered together in order to open the file. Furthermore, these rules can be different for each section of the document, allowing collaborative work. Non-repudiation and authentication are achieved by means of a shared signature. The scheme's features are best appreciated when using it in a mobile scenario. Deployment in such an environment is easy and straight.

Mobile devices, including cell phones, capable of geo-positioning (or localization) are paving the way for new computer assisted systems called mobile location-based recommenders (MLBRs). MLBRs are systems that combine information on user's location with information about user's interests and requests to provide recommendations that are based on "location". MLBR applications are numerous and emerging. One MLBR application is in advertisement where stores announce their coupons and users try to find the coupons of their interests nearby their locations through their cell phones. Chapter thirteen, *Mobile Location-Based Recommenders: An Advertisement Case Study* discusses the concept and characteristics of MLBRs and presents the architecture and components of a MLBR for advertisement.

Mobile devices have become a new platform with many possibilities to develop studies and implementation projects. The power and current capabilities of these devices besides its market penetration makes applications and services in the area of mobility particularly interesting. Mobile terminals have become small computers, they have an operating system, storage capacity so it is possible to develop applications that run on them. Today these applications are highly valued by users. Nowadays we want not only to talk or send messages by mobile terminal, but also to play games, to buy cinema tickets, to read email... We can bring these capabilities in our pocket. The University may not be aware of this fact. The students, due to their age, are the main users and purchasers. In this sense, chapter 14, *Services for Mobile Devices in a University Scenario*, presents three applications developed for mobile devices, that are being used in Universidad Pontificia de Salamanca. All of them work on a university scenario and use different kind of services.

Wireless Sensor Networks (WSNs) have experienced an amazing evolution during the last decade. Compared with other wired or wireless networks, wireless sensor networks extend the range of data collection and make it possible for us to get information from every corner of the world. The chapter begins with an introduction to WSNs and their applications. Chapter 15, *Event Detection in Wireless Sensor Networks* recognizes event detection as a key component for WSN applications. The chapter provides a structured and comprehensive overview of various techniques used for event detection in WSNs. Existing event detection techniques have been grouped into threshold based and pattern based mechanisms. For each category of event detection mechanism, the chapter surveys some representative technical schemes. The chapter also provides some analyses on the relative strengths and weaknesses of these technical schemes. Towards the end, the trends in the research regarding the event detection in WSNs are described.

At the beginning of the 21st century in a world dominated by technology it is essential to enhance and update the school, creating conditions for the students to succeed, consolidating the role of ICT as a key resource for learning and teaching in this new era. In Chapter 16, *M-English – Podcast: A Tool for Mobile Devices*, the authors describe a study that was carried out in a Portuguese school. As a means to overcome some of the existing logistical obstacles in the school, where the possibility of carrying out ICT activities without restrictions was still dreamlike, the podcast was implemented as an m-learning tool. Being aware of the fact that nowadays mobile phones and mp3 players are part of our students' lives, the authors took advantage of this fact and the podcast was used as a tool to support, to enhance and to motivate students to learn English, used thus as a complement to traditional (face-to-face) learning.

Disaster can be defined as the onset of an extreme event causing profound damage or loss as perceived by the afflicted people. The networks built in order to detect and handle these events are called Public safety networks (PSNs). These networks have the fundamental role of providing communication and coordination for emergency operations. Many of the problems of the PSN field come from the heterogeneity of systems and agencies involved in the crisis site and from their mobility at the disaster site. The main aim of Chapter 17, *Public Safety Networks*, is to provide a broad view of the PSN field, presenting the different emergency management phases, PSNs requirements, technologies and some of the future research directions for this field.

The purpose of Chapter 18, *Mobile Applications as Mobile Learning and Performance Support Tools in Psychotherapy Activities*, is the analysis of mobile applications as performance and informal learning support tools that facilitate the development of the psychotherapy process. The “e-therapy” has become a common term to refer the delivery of mental health services, on-line or related to a computer mediated communication between a psychotherapist and the patient. Initially, a background on e-therapy is provided and after the “self-help therapy”—a kind of e-therapy where the concept of patient empowerment is important— is exposed. Then, the integration of mobile devices in the psychotherapy process will be explained considering how their technological features support patient therapeutic activities like behavior assessment and informal mobile learning. The relation of the mobile devices with psychotherapist work activities such as evidence gathering and patient monitoring will also be explained. The chapter includes a discussion on the mobile learning practices as a source of potential strategies that can be applied in the therapeutic field and finally a set of recommendations and future directions are described to explore new lines of research.

Location-based services (LBSs) are impacting different aspects of human's life. To date, different SBSs have been emerged, each supporting a specific application or service. While some SBSs have aimed at addressing the needs of general populations, such as navigation systems, others have been focused

on addressing the needs of specific populations, including kids, youths, elderly, and people with special needs. In recent years, interest in taking a LBS approach in education and learning has grown. The main purpose of such educational LBSs is facilitating a means for learners to be more efficient and effective in their learning activities using their location as the underlying information in decision making. In *CampusLocator: A Mobile Location-Based Service for Learning Resources* the authors present a novel LBS, called CampusLocator, whose main goal is to assist students in locating and accessing learning resources including libraries, seminars, and tutorials that are available on a campus.

WiMAX is being promoted as a potential solution to a number of problems that have plagued the wired and wireless broadband industry since it originated. Can WiMAX fulfill this promise in a crowded and competitive market? If so, what factors are critical to its success? Who will use WiMAX and for what purposes? This chapter, *The Future of WiMAX*, identifies both the critical success factors that will give WiMAX an edge over other existing wireless technologies and the key applications that will contribute to its success. The top three critical success factors for WiMAX are availability of handset devices and consumer premise equipment, bandwidth speed, and interoperability and standardization. A panel of WiMAX experts concludes that broadband on demand, wireless services provider access, and Voice over IP are the top three killer applications for WiMAX.

Chapter 21, *Determinants of Loyalty Intention in Portuguese Mobile Market*, conceptualizes and highlights the determinants of customers' loyalty in the Portuguese mobile market. The authors raise questions about the interrelationships of the cost and values dimensions and the consequences of these relationships on customer satisfaction and trust and consequently loyalty among different operators, addressing some recent models. By organizing and synthesizing the major research streams and tests empirically a conceptual framework through a SEM, with data gathered in a survey of Portuguese clients, the present study advances knowledge on the nature of the relative importance of different components of loyalty to mobile communications operators. Some useful preliminary insights were produced related to customers' retention process in primary mobile operator, which appears strongly related to price/quality, followed by the emotional connection to the operator staff and others clients. Nonetheless, a considerable number of issues were left for future research, including the possibility of extending the investigation to other countries.

Current technological advances and the increasing diffusion of its use for scientific, financial and social activities, make Internet the de facto platform for providing worldwide distributed data storage, distributed computing and communication. It creates new opportunities for the development of new kinds of applications, but it will also create several challenges in managing the information distributed on the Internet and in guaranteeing its "on-time" access through the network infrastructures that realize the Internet. Many researchers believed and still believe that the mobile agents could propose several attractive solutions to deal with such challenges and problems. Chapter 22, *Mobile Agents: Concepts and Technologies*, presents the core concepts of mobile agents, and attempts to provide a clear idea of the possibility of their use by introducing the problems they cope with, the application areas where they provide advantages with respect to other technologies and the available mobile agent technologies.

Traditional networks suppose the existence of some path between endpoints, small end to end round-trip Delay time, and loss ratio. Today, however, new applications, environments and types of devices are challenging these assumptions. In Delay Tolerant Networks (DTNs), an end-to-end path from source to destination may not exist. Nodes may connect and exchange information in an opportunistic way. Chapter 23, *Vehicular Delay Tolerant Networks*, presents a broad overview of DTNs, particularly focusing on Vehicular DTNs, their main characteristics, challenges, and research projects on this field. In the near

future, cars are expected to be equipped with devices that will allow them to communicate wirelessly. However, there will be strict restrictions to the duration of their connections with other vehicles, whereas the conditions of their links will greatly vary; DTNs present an attractive solution. Therefore, VDTNs constitute an attractive research field.

It has been substantially proven that the use of new technologies can improve a child's learning process. However, the main problem for the teacher continues to be that he/she cannot pay attention to all children at the same time. Sometimes it is necessary to decide which child must be first attended to. It is in this context that we believe our system has the ability to greatly help teachers: we have developed a learning process control system that allows teachers to determine which students have problems, how many times a child has failed, which activities they are working on and other such useful information, in order to decide how to distribute his/her time. Furthermore, bearing in mind the attention required by kindergarten students, Chapter 24, *Monitoring the Learning Process through the use of Mobile Devices*, proposes the provision of mobile devices (PDA - Personal Digital Assistant) for teachers, permitting free movement in the classroom and allowing the teacher to continue to help children while information about other students is being received. Therefore if a new problem arises the teacher is immediately notified and can act accordingly.

Computer technologies, especially ICT have become ubiquitous in people's lives. Nowadays, mobile phones, PDAs, laptops and a constellation of software tools are more and more used for a variety of activities carried out in both personal and professional lives. Given the features that these technologies provide and are provided with, for example, connectivity and portability, it can be said that ICTs have the potential to support nomadic work practices which are seen as increasingly characteristic of the knowledge economy. Chapter 25, *The Making of Nomadic Work: Understanding the Mediatonal Role of ICTs*, presents a review of the concept of nomadic work and, based on a broad literature analysis, discusses the ways in which ICTs may empower people who are involved with nomadic work practices. It aims to give a starting point for those who intend to develop further research on technologically-mediated nomadic work practices in the knowledge economy.

Chapter 26, *I-GATE: Interperception - Get All The Environments*, introduces the I-GATE architecture, a new approach, which includes a set of rules and software architecture, to connect users from different interfaces and devices in the same virtual environment, transparently, even with low capacity of resources. The system detects the user resources and provides transformations on the data in order for its visualization in 3D, 2D and textual-only (1D) interfaces. This allows users from any interface to get a connection in the system using any device and to access and exchange information with other users (including ones with other interface types) in a straightforward way, without need to changing hardware or software. The authors formalize the problem, including modeling, implementation, and usage of the system, also introducing some applications that they have created and implemented in order to evaluate the proposal. Authors have used these applications in cell phones, PDAs, Digital Television, and heterogeneous computers, using the same architecture, with success.

The widespread and availability of increasingly powerful mobile devices is contributing for the incorporation of new services and features on our daily communications and social relationships. In this context, geolocation of users and points of interest in mobile devices may contribute, in a natural way, to support either the mediation of remote conversations as the promotion of face-to-face meetings between users, leveraging social networks. The CONNECTOR system is based on geolocation data (people, content and activities), enabling users to create and develop their personal relations with other members of the CONNECTOR social network. Users, maps, sharing features and multimedia content

are actors in this social network allowing CONNECTOR to address the promotion of geolocated social networks driven by physical proximity and common interests among users. Chapter 27, *CONNECTOR: A Geolocated Mobile Social Service*, discusses the work undertaken for the conceptualization and development of the CONNECTOR system. Preliminary evaluation results along with usage contexts are also presented. The chapter concludes with a discussion about future developments in geolocation and personalization in mobile communication services.

Nowadays, triple-play services are offered in both wireless and wired networks. The network convergence and the new services such as VoIP and IPTV are a reality. However, the future of these networks will have a different concept, the ubiquity. The solutions must be based on the structures and current environments to carry out those challenges in a correct way. In order to reach this ubiquity, the science community has to take into account that its implementation should not assume a high cost to the user and that the system must comply with the quality of service measurements to satisfy the user. Chapter 28, *Providing VoIP and IPTV Services in WLANs*, introduces the main VoIP and IPTV (IP Television) transmission protocols and the compression formats most used as also the bandwidth needed. The goal is to provide ubiquity into multimedia scenarios in WLANs. Authors will carry out tests to guarantee the appropriate values in some network parameters such jitter, delay, number of lost packets and enough effective bandwidth that should be satisfied. They demonstrate the measurements taken from several test benches. They show the parameter values that the devices should perform in order to stay connected from anywhere at any time to these services.

One of the sectors that have a great potential to use and exploit the new communication technologies is the healthcare sector. Nowadays, the application of all these new technologies to support the clinical procedures has taken part in the definition of a new concept known as e-Health. This concept involves a lot of different services related with the medicine/health terms and the information technologies. However, to provide emergency transportation with better care capabilities to the patient is something that still has a lot to improve. Within this context SIe-Health comes into being a software platform oriented for developing Telemedicine solutions. The solution model proposed in Chapter 29 *SIe-Health, e-Health Information System*, allows remote assistance for a mobile health emergency, integrating in this service electro-medical devices and videoconference services.

The popularity of mobile computing creates new opportunities for information sharing and collaboration through technologies like radio frequency identification (RFID) tags and location awareness technologies. Chapter 30, *Combining Location Tracking and RFID Tagging toward an Improved Research Infrastructure*, discusses how these technologies, which provide subtly different information, can be used together toward increased benefit to users. This work introduces technologies for RFID and location awareness, including a survey of projects. The authors describe advantages of combining these technologies, illustrated through our system, TagIt, that uses these technologies in a traditional research poster environment to provide a rich multimedia experience and encourage ongoing feedback from poster viewers. An overview of TagIt is provided, including user commenting and information sharing capabilities that make use of RFID and location information. User feedback and an expert review highlights how TagIt could benefit authors, information consumers, and the research community, leading to future directions for the research community.

The appearance of concepts such as “Ambient Intelligent”, “Ubiquitous Computing” and “Context-Awareness” is causing the development of a new type of services called “Context-Aware Services” that in turn may affect users of mobile communications. This technology revolution is a complex process because of the heterogeneity of contents, devices, objects, technologies, resources and users that can be

coexist at the same local environment. The novel approach in Chapter 31, *Model and Infrastructure for Communications in Context-Aware Services*, is the development of a "Local Infrastructure" in order to provide intelligent, transparent and adaptable services to the user and solves the problem of local context control. Authors present a conceptual model for development of local infrastructure, an architecture design to control the service offered by the local infrastructure. This infrastructure proposed consists of an intelligent device network to link the personal portable device with the contextual services. The device design is modular, flexible, scalable, adaptable and reconfigurable remotely in order to tolerate new demand services whenever is needed. Finally, the result suggests that authors will be able to develop a wide range of new and useful applications, not conceived at origin.

The use of mobile devices with possible connection to the Internet is increasing tremendously. This mobility poses new challenges at various levels, including hardware, network services, and the development of applications. The user searches small and lightweight devices, easy to use, and with vast autonomy in terms of energy. She/He seeks also to connect the Internet "every time, everywhere", possibly using different access technologies. Given the interface limitations, and processing capabilities of small mobile devices, the software and the operating system used must be necessarily adapted. Chapter 32, *Network Mobility and Mobile Applications Development*, overviews the mobility area, provides deep insight in the field, and presents the main existing problems. Mobility and the development of mobile applications are closed related. The advances in network mobility lead to different approaches in the mobile applications development. The chapter proposes a model for developing mobile applications, based on our research.

Wireless sensor networks are composed of geographically dispersed sensors that work together to monitor physical or environmental conditions. In addition, wireless sensor networks are used in many industrial, social, and regulatory applications, including industrial process monitoring and control, environment and habitat monitoring, healthcare, home automation, and traffic control. Developers of wireless sensor networks face a number of programming and deployment challenges. Chapter 33, *Building Mobile Sensor Networks Using Smartphones and Web Services: Ramifications and Development Challenges*, shows how smartphones can help reduce the development, operation, and maintenance costs of wireless sensor networks, while also enabling these networks to use web services, high-level programming APIs, and increased hardware capability, such as powerful microprocessors. Moreover, this chapter examines key challenges associated with developing and maintaining a large wireless sensor network and presents a novel smartphone wireless sensor network that uses smartphones as sensor nodes. The work is validated in the context of Wreck Watch, which is a smartphone-based sensor network for detecting traffic accidents that authors use to demonstrate solutions to multiple challenges in current wireless sensor networks. The authors also describe common pitfalls of using smartphones as sensor nodes in wireless sensor networks and summarize how have addressed these pitfalls in Wreck Watch.

Modern life makes people internet-dependents. They want to move connected and care for always getting the best options for connectivity, hoping between providers. Freedom for choosing providers and the business options which these exchanges can offer are the motivations for Chapter 34, *Technologies to improve the quality of handovers: Ontologies, Contexts and Mobility Management*. After pointing out some characteristics which make the basics of the current handover technologies, we describe an information infrastructure, based on context and ontologies which can be used to foster an intelligent, efficient and profitable scenario for managing handovers in the Next Generation Networks. Some experiments are described and the potential of using these technologies are evaluated.

In smart environments, making a location-aware personal computing working accurately is a way of getting close to the pervasive computing vision. The best candidate to determine a user location in

indoor environment is by using IEEE 802.11 (Wi-Fi) signals, since it is more and more widely available and installed on most mobile devices used by users. Unfortunately, the signal strength, signals quality and noise of Wi-Fi, in worst scenario, it fluctuates up to 33% because of the reflection, refraction, temperature, humidity, the dynamic environment, etc. Chapter 35, *Making Location-Aware Computing Working Accurately in Smart Spaces*, presents the current development on a light-weight algorithm, which is easy, simple but robust in producing the determination of user location using WiFi signals. The algorithm is based on "multiple observers" on η k-Nearest Neighbour. The authors extend the approach in the estimation indoor-user location by using combination of different technologies, i.e. WiFi, GPS, GSM and Accelerometer. The algorithm is based on opportunistic localization algorithm and fuse different sensor data in order to be able to use the data which is available at the user position and processable in a mobile device.

Context-aware computing is a class of mobile computing that can sense its physical environment and adapt its behavior accordingly; it is a component of the ubiquitous or pervasive computing environment that has become apparent with innovations and challenges. Chapter 36, *User Pro-Activities Based on Context History*, reviews the concept of context-aware computing, with focus on the user activities that benefit from context history. How user activities in the smart environment can make use of context histories in applications that apply the concept of context prediction integrated with user pro-activity is explored. A brief summary of areas which benefit from these technologies as well as corresponding issues are also investigated.

The ten chapters of Section 2, *Emerging Technologies*, introduce emerging technologies able to dictate a complete shift of applications and services towards ubiquity.

Advances in wireless, sensor, mobile and wearable technologies present new challenges for data mining research on providing mobile applications with intelligence. Autonomy and adaptability requirements are the two most important challenges for data mining in this new environment. In Chapter 37, *Research Challenge of Locally Computed Ubiquitous Data Mining*, the authors analyse the challenges of designing ubiquitous data mining services by examining the issues and problems while paying special attention to context and resource awareness. The authors focused on the autonomous execution of a data mining algorithm and analyzed the situational factors that influence the quality of the result. Already existing solutions in this area and future directions of research are also covered.

Chapter 38, *Emerging Wireless Networks for Social Applications*, describes the implementation and performance evaluation of a novel routing protocol called Pandora, designed for social applications, and that can be implemented in a broad number of devices, such as commercial wireless routers and laptops. It also provides a robust backbone integrating and sharing data, voice and video between computers and mobile devices. Pandora offers great performance with both fixed and mobile devices and includes important features such as: geographic positioning, residual battery energy monitoring, and bandwidth utilization. In addition, Pandora also considers the number of devices attached to the network. Pandora is experimentally evaluated in a testbed with laptops for the first stage and commercial wireless routers for the second stage. The main goal of Pandora is to provide a reliable backbone for social applications requiring a quality of service (QoS) guarantee. With this in mind, the following evaluation of Pandora considers the following types of traffic sources: transport control protocol (TCP), voice, video and user datagram protocol (UDP) without marks. Pandora is also compared with different queuing disciplines, including: priority queuing discipline (PRIO), hierarchical token bucket (HTB) and DSMARK. Finally, an Internet radio transmission is employed to test the network re-configurability. Results show that queuing the PRIO and HTB disciplines, which prioritizes UDP traffic, performed the best.

Several complex and time-critical applications require the existence of novel distributed, heterogeneous and dynamic platforms composed of a variety of fixed and mobile processing nodes and networks. Such platforms, that can be called Pervasive Mobile Grids, aim to merge the features of Pervasive Computing and High-performance Grid Computing onto a new emerging paradigm. In this chapter we study a methodology for the design and the development of high-performance, adaptive and context-aware applications. Chapter 39, “*An Approach to Mobile Grid Platforms for the Development and Support of Complex Ubiquitous Applications*”, describes a programming model approach, and the authors compare it with other existing research works in the field of Pervasive Mobile Computing, discussing the rationales of the requirements and the features of a novel programming model for the target platforms and applications. In order to exemplify the proposed methodology, the authors introduce the programming framework ASSISTANT, and provide some interesting future directions in this research field.

Potentially, in the mobile computing scenario, the users can move in different environments and the applications can automatically explore their surroundings. This kind of context-aware application is emerging, but is not yet widely disseminated. Based on perceived context, the application can modify its behavior. This process, in which software modifies itself according to sensed data, is named Adaptation and constitutes the core of Ubiquitous Computing. The ubiquitous computing scenario brings many new problems such as coping with the limited processing power of mobile devices, frequent disconnections, the migration of code and tasks between heterogeneous devices, and others. Current practical approaches to the ubiquitous computing problem usually rely upon traditional computing paradigms conceived back when distributed applications were not a concern. Holoparadigm (Holo) was proposed as a model to support the development of distributed systems. Based on Holo concepts, a new programming language called HoloLanguage (HoloL) was created. Chapter 40, *Towards a Programming Model for Ubiquitous Computing*, propose the use of Holo for developing and executing ubiquitous applications, explore the HoloL for ubiquitous programming and propose a full platform to develop and execute Holo programs. The execution environment is based on a virtual machine that implements the concepts proposed by Holo.

The Virtual Enterprise (VE) is a collaboration model between multiple business partners in a value chain that aims to cope with turbulent business environments, mainly characterized by demand unpredictability, shortening product lifecycles, and intense cost pressures. The VE model is particularly viable and applicable for SME and industry parks containing multiple SMEs that have different vertical competencies. As small firms collaborate effectively under VE model, it will be only possible to emerge products by joining their diverse competencies and mitigate the effects of market turbulence by minimizing their investment. A typical VE model has four phases; opportunity capture, formation, operation, and dissolution. The goal of Chapter 41, *An Agent-Based Operational Virtual Enterprise Framework Enabled by RFID*, is to present a conceptual VE framework, focusing on operation phase, that incorporates Multi Agent Systems (MAS) and Radio Frequency Identification Systems (RFID) which are emerging from research to industry with a great momentum. First, state of the art for VE and the two key enabling technologies are covered in detail. After presenting conceptual view of the framework, an Information and Communication Technology (ICT) view is also given to enhance technical integration with available industry standards and solutions. Finally, process views of how a VE can operate utilizing agent based and RFID systems in order to fulfill operational requirements, are presented.

Chapter 42, *Ontological Dimensions of Semantic Mobile Web 2.0. First Principles*, advances, from the point of view of Knowledge Representation and Reasoning, an analysis of which ontological dimensions are needed to develop Mobile Web 2.0 on top of Semantic Web. This analysis will be particularly focused on social networks and it will try to make an outlook about the new knowledge challenges on

this field. Some of these new challenges will be linked to Semantic Web context, while others will be inherent to Semantic Mobile Web 2.0.

Unobtrusiveness is a key factor in usability of mobile and ubiquitous computing systems. These systems are made of several ambient and mobile devices whose goal is supporting everyday life users' activities, hopefully without interfering with them. We intend to address the topic of obtrusiveness by assessing its impact in the design of interfaces for mobile and ubiquitous computing systems. The authors of Chapter 43, *Unobtrusive Interaction with Mobile and Ubiquitous Systems*, will make the case of how unobtrusive interfaces can be designed by means of Kinetic User Interfaces: an emerging interaction paradigm where input to system is provided through coordinated motion of objects and people in the physical space.

A huge amount of information is used nowadays by modern vehicles, and it may be accessed through an On Board Diagnosis (OBD) connection. A technique using the already installed OBD system to communicate with the vehicle together with a Global Position System (GPS) provides reliable data which allow a detailed analysis of real on road tests. Different kinds of circulation circuits (urban, extra-urban and highway) were analyzed in Chapter 44, *Impact of Advances on Computing and Communication Systems in Automotive Testing*, using the capabilities of OBD II installed on the tested vehicles. OBD provides an important set of information, namely related with data on the engine, fuel consumption, chassis and auxiliary systems and also on combustion efficiency. The use of GPS in all the road tests performed provides important information to further determine the more sustainable from all the different solutions tested, considering the different situations imposed on each circuit. It is a fact that bench tests or a chassis dynamometer allow a fine control of the operation conditions; however the simulation is not as real as on the road. So the present methodology will allow the possibility to perform tests on the road, allowing enough control on vehicles and providing complete information of the chosen route and of the trip history. This is a possibility that ensures new tools with more reliable data which can give faster answers for the development of high efficiency, economic and environmentally neutral automotive technologies.

RFID (Radio Frequency Identification) technology consists of a tag that can be used to identify an animal, a person or a product, and a device responsible for transmitting, receiving and decoding the radio waves. RFID tags work in two different modes: they wake up when they receive a radio wave signal and reflect it (Passive Mode) or they emit their own signal (Active Mode). The tags store information which allows univocally identifying something or someone. That information is stored in an IC (Integrated Circuit) which is connected to an antenna, responsible for transmitting the information. An evolution of this technology is the Near Field Communication (NFC). It consists of a contactless Smart Card technology, based in short-range RFID. Currently, there are mobile phones with NFC embedded in such a way that they work both as a tag and as a NFC reader. These technologies will be widely available both in mobile phones and other devices (e.g. personal digital assistants, etc.) in the near future allowing us to get closer to a ubiquitous and pervasive world. Chapter 45, *RFID and NFC in the Future of Mobile Computing* describe the most important aspects of RFID and NFC technology, illustrating their applicative potential, and provides a vision of the future in which the virtual and real worlds merge together as if an osmosis took place.

Chapter 46, *A Multi-Loop Development Process for a Wearable Computing System in Autonomous Logistics*, examines a multi-loop development process for a wearable computing system within a new paradigm in logistic applications. The implementation of this system will be demonstrated by an example from the field of autonomous logistics for automobile logistics. The development process is depicted from

selecting and combining hardware through to the adjustment to both user and operative environment. Further, this chapter discusses critical success factors like robustness and flexibility. The objective is to present problems and challenges as well as a possible approach to cope with them.

The next chapters, that form Section 3 *Critical Success Factors*, address the critical success factors affecting the full exploitation of the potential of the services and applications of mobility and computing.

A proper development of computing which penetrate our society more thoroughly with the availability of broadband services is provided by varied cooperative networks. However, the success of social dimension of computing requires collaboration within a multicultural environment to be considered. Aim of Chapter 47, *Collaboration within Social Dimension of Computing: Theoretical Background, Empirical Findings and Practical Development*, is to analyze collaboration within the social dimension of computing on the pedagogical discourse. The meaning of the key concepts of social dimension of computing, collaboration and its factors is studied within the search for the success of social dimension. The manuscript introduces the study conducted within the Baltic Summer School Technical Informatics and Information Technology in 2009. The conducted explorative research comprises four stages: exploration of the contexts of collaboration, analysis of the students' needs (content analysis), data processing, analysis and data interpretation, and analysis of the results and elaboration of conclusions and hypothesis for further studies.

Many factors converge when attempting to define the most adequate mobile learning model to be applied in a face-to-face university environment. As far as innovation related processes go, the implementation of mobile learning, implies defining a road map on the basis of strategic planning. It is also important to apply an action research approach in the implementation process of the model. In analyzing in depth this innovative mobile learning process, there are key factors to consider. First, there are factors related to the technology necessary for the implementation of the model—both hard and soft requirements. Second, there are cultural issues related to the use of non-native internet professors of innovative technologies. Finally, there are challenges related to defining, exactly, those educational strategies to be handled through mobile devices. Chapter 48, *Critical Factors In Defining The Mobile Learning Model. An Innovative Process For Hybrid Learning At The Tecnologico De Monterrey, A Mexican University*, focuses on the critical factors involved in integrating mobile learning into a hybrid educational model at a Mexican university.

The purpose of Chapter 49, *Critical Human Factors on Mobile Applications for Tourism and Entertainment*, is to research some principles that can guide the design, development and marketing of mobile applications, with a particular focus on the tourism and entertainment application domains. This research also fills a gap concerning impact studies of mobile applications, since the majority of the literature available today is more focused on the design and development process and results. Besides describing a set of novel mobile applications, we aim at providing an overview on innovation processed used, and conducting several experiences, gathering results from questionnaires, surveys, log data and our own observations. Regarding the mobile tourism domain, the author studied the impact of media visibility, the impact of novel interaction paradigms. Regarding the mobile entertainment applications, he focused on studying the impact brought that realism and graphics quality have on mobile games.

Internet surveys offer important advantages over traditional survey methods: they can accomplish large samples within a relatively short period of time, questionnaires may have visual and navigational functionalities impossible to implement in paper-and-pencil questionnaires, data is more efficiently processed since it already comes in electronic format and costs can be lower. But the use of the Internet for survey purposes raises important concerns related to population coverage, lack of suitable sampling

frames and non-response. Despite its problems, Internet-based surveys are growing and will continue to expand presenting researchers with the challenge of finding the best way to adapt the methods and principles established in survey methodology to this new mode of data collection in order to make best use of it. Chapter 50, *Internet Surveys: Opportunities and Challenges*, describes the positive features of the Internet for survey activity and examines some of the challenges of conducting surveys via the Internet by looking at methodological issues such as coverage, sample selection, non-response and data quality.

The purpose of Chapter 51, *EPS A Coalition-Based Production Approach*, is to provide broad view of the rationale, fundamental principles, current developments and applications for Evolvable Production Systems (EPS). Special attention is given to how complexity is handled, the use of agent based and wireless technology, and how economical issues are affected by having an evolvable system. The rationale for EPS is based on current road mapping efforts, which have clearly underlined that true industrial sustainability requires far higher levels of system autonomy and adaptivity than what can be achieved within current production system paradigms. Since its inception in 2002 as a next generation of production systems, the EPS concept has been further developed and tested to emerge as a production system paradigm with technological solutions and mechanisms that support sustainability. Technically, EPS is based on the idea of using several re-configurable, process-oriented, agent-based and wireless intelligent modules of low granularity. This allows for a continuous adaption and evolution of the production system and the ability to explore emergent behavior of the system, which are imperative to remain fit with regards to the system environment.

The proposal of new business models, based on the emerging novelty and huge opportunities of mobility and computing is the theme of the next four chapters, which compose Section 4 *New Business Models*.

As mobile applications increase in popularity, the issue of how to build viable business models for the m-commerce industry is becoming a clear priority for both organizations and researchers. In order to address this issue, this chapter, *Viable Business Models for M-Commerce: The Key Components*, reports on five mini cases used as a guideline, and applies the theoretical business model from Chesbrough and Rosenbloom (2002) to each of them to find out the most important components of viable business models for their m-commerce applications. The study then uses cross cases analysis as a research tool to compare and contrast each of the mini cases and to find out how the different organizations fit within the researched theoretical business model. Finally, this chapter confirms that there are 7 important components of viable business models for m-commerce which are: value proposition, market segment, value chain, profit potential, value network, competitive strategy and firm capabilities. This study also highlights the fact that the public visibility of these 7 components is uneven. Some components such as value proposition, value chain, value network and firm's capabilities are more likely to be presented in public by organizations. However, aspects such as cost structure and profit potential, market segment and competitive strategy are more likely to be hidden from the public due to their commercial sensitivity.

Mobility is a relatively recent topic in the enterprise arena, but thanks to the widespread use of cell phones it has already changed much of the business landscape. It should be integrated in enterprise architectures (EAs) as an intrinsic feature and not as an add-on or as an afterthought transition. Current EA frameworks were not designed with mobility in mind and are usually based on the process paradigm, emphasizing functionality. Although the issue of establishing a systematized migration path from a non-mobile EA to a mobile one has already been tackled, the need for mobile-native EA modeling frameworks is still felt. Chapter 53, *A Service-Based Framework to Model Mobile Enterprise Architectures*, presents and discusses a resource-based and service-oriented metamodel and EA framework, in which mobility is introduced naturally from scratch, constituting the basis for some guidelines on which EA resources

should be mobilized. Several simple scenarios are presented in the light of this metamodel and framework.

Although mobile phones have become an extension of the workplace, organizations are still exploring their effectiveness for employee training and development. A 2009 joint collaborative study between Columbia University (New York, USA) and IBM of 400 IBM employees' use of mobile phones revealed unexpected insights into how employees use mobile applications to improve job performance. The findings are reshaping IBM Learning's mobile technologies strategy for networking, collaboration, and skills improvement. *Research-Based Insights Inform Change in IBM M-Learning Strategy* reveals the study's results and IBM's new direction for m-learning, highlighting IBM's preparedness for a shift in its organizational learning model potentiated by ubiquitous access and mobility.

Location-based mobile services (LBMS) are at present an ever growing trend, as found in the latest and most popular mobile applications launched. They are, indeed, supported by the hasty evolution of mobile devices capabilities; by users demand; and, lastly, by market drive. With e-commerce, products and services started arriving to potential customers through desktop computers, where they can be bought and fast delivered to a given address. However, expressions such as "being mobile", "always connected", "anytime anywhere" that already characterize life in the present will certainly continue to do so in the near future. Meanwhile, mobile devices centred commerce services seem to be the next step. Therefore, Chapter 55, *Location Based E-commerce System: An Architecture*, presents a system architecture designed for location-based e-commerce systems. These systems, where location plays the most important role, enable a remote products/services search, based in user parameters: after a product search, shops with that products are returned in the search results and are displayed in a map, around the user present location; and services like obtaining more information, reserving and purchasing are made available as well. This concept represents a mix between traditional client-oriented commerce and faceless mass-oriented e-commerce, enabling a proximity-based user-contextualized system, being well capable of conveying significant advantages and facilities to both service-providers/retailers and users.

The four chapters of Section 5, *Security*, address the topic of security in mobile systems and applications.

Vehicular ad-hoc networks (VANETs) are a promising communication scenario. Several new applications are envisioned, which will improve traffic management and safety. Nevertheless, those applications have stringent security requirements, as they affect road traffic safety. Moreover, VANETs face several security threats. As VANETs present some unique features (e.g. high mobility of nodes, geographic extension, etc.) traditional security mechanisms are not always suitable. Because of that, a plethora of research contributions have been presented so far. Chapter 56, *Overview of Security Issues in Vehicular Ad-hoc Networks*, aims to describe and analyze the most representative VANET security developments.

Access control in the domain of information system security refers to the process of deciding whether a particular request made by a user to perform a particular operation on a particular object under the control of the system should be allowed or denied. For example, the access control component of a file server might have to decide whether user "Alice" is allowed to perform the operation "delete" on the object "document.txt". For traditional access control this decision is based on the evaluation of the identity of the user and attributes of the object. The novel idea of location-aware access control is also to consider the user's current location which is determined by a location system like GPS. The main purpose of Chapter 57, *Modelling of Location-Aware Access Control Rules*, is to present several approaches for the modeling of location-aware access control rules.

The aim of Chapter 58, *Secure Techniques for Remote Reconfiguration of Wireless Embedded Systems*, is to give a thorough overview of secure remote reconfiguration technologies for wireless embedded systems, and of the communication standard commonly used in those systems. In particular, we focus

on basic security mechanisms both at hardware and protocol level. We will discuss the possible threats and their corresponding impact level. Different countermeasures for avoiding these security issues are explained. Finally, we present a complete and compact solution for a service-oriented architecture enabling secure remote reconfiguration of wireless embedded systems, called the STRES system.

The evolution of computer networking is moving from static wired networking towards wireless, mobile, infrastructureless, and ubiquitous networking. In next-generation computer networks, new mobility features such as, seamless roaming, vertical handover, and moving networks are introduced. Security is a major challenge in developing mobile and infrastructureless networks. Specific security threats in next-generation networks are related to the wireless access mediums, routing, and mobility features. Chapter 59, *Secure Routing and Mobility in Future IP Networks*, identifies these threats, and discuss the state of the art of security research and standardization within the area, proposing security architectures for mobile networking. A survey of security in routing is provided with special focus on mobile ad hoc networks (MANETs). The security of currently relevant protocols for management or node and network mobility, Mobile IP (MIP), Network Mobility (NEMO), Mobile Internet Key Exchange (MOBIKE), Host Identity Protocol (HIP), Mobile Stream Control Transmission Protocol (mSCTP), Datagram Congestion Control Protocol (DCCP), and Session Initiation Protocol (SIP), is described.

Section 6 *Applications, Surveys and Case Studies* is focused on the presentation of a wide variety of new applications and solutions, surveys related with adoption of technologies and case studies, along its 18 chapters.

In an educational context, technological applications and their supporting infrastructures have been evolved in a way that the use of learning objects is no longer limited to a personal computer, but has been extended to a number of mobile devices. Such evolution leads to the creation of a technological model called m-learning that offers great benefits to education. This educational model resulted in several research projects and some commercial products. Chapter 60, *Evaluation of a Mobile Platform to Support Collaborative Learning: Case Study*, describes the (re)use of an adapted platform from an API of MLE (Mobile Learning Engine), to create tests, quizzes, forums, SMS, audio, video, mobile learning objects, in combination with a learning platform in a particular setting. MLE is a special m-learning application for mobile phones (a J2ME application) that can access a LMS (Learning Management System) and use most of its activities and resources, and add new, even innovative, activities. With J2ME one can store, use content and learn without the need of further network access and even use interactive questions that can be directly solved on mobile devices. The MLE enables one to use the mobile phone as a constant way of learning. As a consequence it is possible to use every spare time to learn, no matter where we are, providing new opportunities to enhance learning.

Wireless ad-hoc and sensor networks are experiencing a widespread diffusion due to their flexibility and broad range of potential uses. Nowadays they are the underlying core technology of many industrial and remote sensing applications. Such networks rely on battery-operated nodes with a limited lifetime. Although, in the last decade, a significant research effort has been carried out to improve the energy efficiency and the power consumption of the sensor nodes, new power sources have to be considered to improve node lifetime and to guarantee a high network reliability and availability. Energy scavenging is the process by which the energy derived from external sources is captured, translated into an electric charge and stored internally to a node. At the moment, these new power sources are not intended to replace the batteries, since they cannot generate enough energy; however, working together with the conventional power sources they can significantly improve node lifetime. Low-power operation is the result of a complex cross-layer optimization process, for this reason, this chapter “*Power Issues and*

Energy Scavenging in Mobile Wireless ad-hoc and Sensor Networks”, thoroughly reviews all the traditional methods aimed at reducing power consumption at network, MAC and PHY levels of the TCP stack, to understand advantages and limitations of such techniques, and to justify the need of alternative power sources that may allow, in the future, the design of completely self-sustained and autonomous sensor nodes.

Chapter 62, *A Low Cost Wireless Sensors Network with Low-Complexity and Fast-Prototyping*, presents a low cost/fast prototyping wireless sensors network that was designed for a huge range of applications and making use of low cost commercial of the shelf components. Such applications includes industrial measurements, biomedical, domestic monitoring, remote sensing, among others. The concept of the wireless sensor network is presented and simultaneously, hot topics and their implementation are discussed. Such topics are valuable tools and can't be discarded when a wireless sensors network is planned. By the contrary, such tools must be taken in account to make the communications between the nodes and the base station the best possible reliable. The architecture, protocols and the reasons that were behind the selection of the components are also discussed. The chapter also presents performance metrics that are related to with the physical characteristics of sensors and with the radio specificity. Microcontrollers with a RISC architecture are used by the network nodes to control the communication and the data acquisition and operate in the 433 MHz ISM band with ASK modulation. Also, in order to improve the communication and to minimise the lost of data, it is predicted to put the wireless nodes to handle line and source coding schemes.

Failure detection is an important abstraction for the development of fault-tolerant middleware, such as group communication toolkits, replication and transaction services. Unreliable failure detector (namely, FD) can be seen as an oracle which provides information about process failures. The dynamics and self-organization of Mobile Ad-hoc Networks (MANETs) introduce new restrictions and challenges for the implementation of FDs with which static traditional networks do not have to cope. It is worth mentioning that in some way, fault tolerance is more critical for MANETs than for the latter, since wireless network can present high error rates and mobile nodes are more prone to failures, physical damages or transient disconnections. The aim of Chapter 63 *Unreliable Failure Detectors for Mobile Ad-hoc Networks* is thus to discuss the impact of all these characteristics, intrinsic to MANET, in the implementation of FDs. It presents a survey of the few works about FD implementations for wireless networks, including the different possible assumptions to overcome the dynamics and lack of both global view and synchrony of MANETs.

Adaptation of communication is needed to maintain the connectivity and quality of communication in group-wide collaborative activities. This becomes quite a challenge to handle when mobile entities are part of a wireless environment, in which responsiveness and availability of the communication system are required. In Chapter 64, *Mission-Aware Adaptive Communication for Collaborative Mobile Entities*, these challenges are addressed within the context of the ROSACE project where mobile ground and flying robots have to collaborate either between themselves or with remote artificial and human actors during save and rescue missions in the event of disasters such as forest fires. This chapter presents our first results. The final goal is to propose new concepts, models and architectures that supports cooperative adaptation which is aware of the mission being executed. Thus, the communication system can be adequately adapted in response to predictable or unpredictable evolutions of the activity requirements and to the unpredictable changes in the communication resource constraints.

In the last years ontologies are being used in the development of pervasive computing applications. It is habitual their use for facilitating the interoperability among context-aware applications and the entities

that may enter in the context at any time. Chapter 65 *OntoHealth: An Ontology Applied to Pervasive Hospital Environments* presents OntoHealth: an ontology applied to health pervasive environment and a tool to its processing. The main idea is that a hospital could be seen as this pervasive environment, where someone, through ubiquitous computing, engages a range of computational devices and systems simultaneously, in the course of ordinary activities, and may not necessarily even be aware that they are doing so. With the proposed ontology and the tool for its processing, the medical tasks can be shared by all components of this pervasive environment.

Chapter 66 *Adoption of Mobile and Information Technology in an Energy Utility in Brazil* deals with the adoption of mobile technology. The case illustrated here is the implementation of mobile and wireless technology – MIT and smartphones – at an energy utility. The objective was to understand the human and social aspects of the adoption of this technology. This paper makes use of the metaphor of hospitality proposed by Ciborra in the late 1990s. The hospitality metaphor was a useful alternative for describing the process of adopting a new technology. It touches on technical aspects and notes human reactions that become evident when a technician comes across an unknown ‘guest’, the new technology: the doubtful character of the guest, the reinterpretation of the identities of guest and host during the process, learning through trial and error, the technology’s ‘drift’, the participants’ emotions and state of mind, and the appropriation of, and the care for, the new technology.

Context-aware mobile applications are becoming popular, as a consequence of the technological advances in mobile devices, sensors and wireless networking. Nevertheless, developing a context-aware system involves several challenges. For example, what will be the contextual information, how to represent, acquire and process this information and how it will be used by the system. Some frameworks and middleware have been proposed in the literature to help programmers to overcome these challenges. Most of the proposed solutions, however, neither have an extensible ontology-based context model nor uses a communication method that allows a better use of the potentialities of the models of this kind, as discussed in Chapter 67 *Infrastructures for Development of Context-Aware Mobile Applications*.

Chapter 68 *A Practice Perspective on Transforming Mobile Work* introduces a study that explores users’ experiences during an organizational implementation of a new mobile information technology in public home care environment. The home care case illustrates differences between implementation project goals and expectations, and on the other hand, the daily organizing and carrying out care work, where previously, no information technology was utilized. While implementing mobile technology was expected to enhance the efficiency of care working, the project outcomes include resistance due to surveillance aspect of the new technology as well as technological problems during the implementation. Successful outcomes of the implementation include better planning of working hours and more even distribution of work resources.

In Chapter 69, *Data Replication Support for Collaboration in Mobile and Ubiquitous Computing Environments*, the authors address techniques to improve the productivity of collaborative users by supporting highly available data sharing in poorly connected environments such as ubiquitous and mobile computing environments. We focus on optimistic replication, a well known technique to attain such a goal. However, the poor connectivity of such environments and the resource limitations of the equipments used are crucial obstacles to useful and effective optimistic replication. The authors analyze state-of-the-art solutions, discussing their strengths and weaknesses along three main effectiveness dimensions: (i) faster strong consistency, (ii) with less aborted work, while (iii) minimizing both the amount of data exchanged between and stored at replicas; and identify open research issues.

Wireless Local Area Networks are very useful for the most applications based on network. It can be developed in almost all environments and products are cheap and robust. Moreover, these networks can be formed by different devices with wireless interfaces like IP cameras, laptops, PDAs, sensors, etc. WLANs provide high bandwidth at large coverage areas, which it is necessary in many applications at different research areas. All these characteristics let WLANs be a useful technology to provide ubiquity for any type of service. If they are deployed from a good and exhaustive design, they can provide connection to any device, everywhere at anytime. Chapter 70, *Providing Outdoor and Indoor Ubiquity with WLANs*, presents a complete guideline about how to design and deploy WLANs and to get their best performance. The authors start from an analytical point of view and we use mathematical expressions to design WLANs in both indoor and outdoor environments. Then, the authors introduce a method proposed by some authors of this chapter some years ago and how it can be used to design WLANs in indoor environments. The authors also show WLANs design in outdoor environments and describe two projects developed in order to provide ubiquity in real indoor and outdoor environments.

Chapter 71, *INTIC for Mobile Devices: Support System for Communication with Mobile Devices for the Disabled* introduces the In-TIC system for mobile devices (Integration with ICT system for mobile devices) that represents an approach towards the area of technical aids for mobile devices. The mobile telephone is a device that makes our lives easier, allowing us to be permanently accessible and in contact, to save relevant information, and also for entertainment purposes. However, people with visual, auditory or motor impairment or the elderly still find these devices difficult to use. They have to overcome a range of difficulties when using mobile telephones: the screens are difficult to read, the buttons are too small to use, and the technical features are too complicated to understand. At present, the main advances in mobile technology have been aimed at improving multimedia-messaging services and reproducing videos and music. This new support system adds accessibility to mobile telephones, making them easier to use for the people who need them the most, people with reduced physical or mental capacities who cannot use a conventional mobile.

Granxafamiliar.com is a project for developing the Galician rural milieu both socio-economically and culturally in order to appreciate the quality of life and rural culture, to create communication links between the rural and urban world, to emphasize the importance of the traditional self-supply production market of Galician family farms, and to promote the spread of new technologies as a social intervention tool against the phenomenon of social and territorial exclusion known as the "Digital Divide". The authors of *New Ways to Buy and Sell: An Information Management Web System for the Commercialization of Agricultural Products from Family Farms without Intermediaries* are planning the architecture of www.granxafamiliar.com, which is developing the creation of a virtual community based on boosting commercial transactions and the possibilities for buying and selling traditional self-supply products that exist in the rural environment. The authors expect to promote it globally across the Internet by promoting the use and spread of ICTs as tools and commercial channels for agricultural products and intend to carry out an in-depth empirical and theoretical study of the territorial and social effects linked to the development of the information and communication society in rural communities. Their aim is to assist the progress of public decision-making and administrative efficiency for when the time comes to invest in suitable services and activities related to the information society in the rural environment.

The continuous growth of the available throughput, especially in the uplink of mobile phone networks is opening the doors to new services and business opportunities without references in the past. In more concrete, new standards HSDPA/HSUPA, introduced to complement and enhance 3G networks, together with the advances in audio and especially video coding, like those adopted by the standard H.264 AVC

have boosted the appearance of a new service: exploiting the mobile telephony networks for contributing broadcast quality videos. This new service is offering just now a low cost, high flexibility alternative that, in a brief period of time, will substitute the current Electronic News Gathering (ENG) Units, giving rise to what is being to be called Wireless Journalism (WENG or WiNG). Chapter 73, *Broadcast Quality Video Contribution in Mobility*, discusses both the technologies involved and the business opportunities offered by this sector. Once reviewed the state of the art, different solutions will be compared, some of them recently appeared as commercial solutions, like QuickLink 3.5G Live Encoder or AirNow! and others still in research and development processes.

Mobile devices are rapidly becoming the most common interface for accessing network resources (Hall 2008). By 2015 the average 18-year old will spend the majority of their computing time on mobile devices (Basso 2009). These trends directly affect institutions of higher learning. Many universities are offering learning initiatives and m-services designed to distribute content and services to mobile devices. Chapter 74, *Mobile Device Selection in Higher Education: iPhone vs. iPod Touch*, reports findings from an exploratory, longitudinal study at Abilene Christian University, where incoming freshmen received their choice of an Apple iPhone or iPod touch. The findings indicate that users' device selections were affected by their perceptions of the costs of the devices, the devices' relative characteristics, and the social influence of parents. We also found that users' attitude, satisfaction, and confidence about their device selection varied across devices, with iPhone users having more favorable perceptions. The chapter concludes with recommendations for mobile learning initiatives and directions for future research.

Chapter 75, *Design of Wearable Computing Systems for Future Industrial Environments*, investigates the role of context, particularly in future industrial environments, and elaborates how context can be incorporated in a design method in order to support the design process of wearable computing systems. The chapter is initiated by an overview of basic research in the area of context-aware mobile computing. The aim is to identify the main context elements which have an impact upon the technical properties of a wearable computing system. Therefore the authors describe a systematic and quantitative study of the advantages of context recognition, specifically task tracking, for a wearable maintenance assistance system. Based upon the experiences from this study, a context reference model is proposed, which can be considered supportive for the design of wearable computing systems in industrial settings, thus goes beyond existing context models, e.g. for context-aware mobile computing. The final part of this chapter discusses the benefits of applying model-based approaches during the early design stages of wearable computing systems. Existing design methods in the area of wearable computing are critically examined and their shortcomings highlighted. Based upon the context reference model, a design approach is proposed through the realization of a model-driven software tool which supports the design process of a wearable computing system while taking advantage of concise experience manifested in a well-defined context model.

In 2002, Belgium has adopted an electronic identity card as one of the first countries in Europe. By the end of 2009, the roll-out of the eID card will be completed, and this means that each Belgian citizen will possess an eID card. The card enables her to digitally prove her identity and to legally sign electronic documents. The Belgian eID card opens up new opportunities for the government, its citizens, service providers and application developers. The Belgian eID technology originally aimed at facilitating transactions between Belgian citizens and the government and although many eID applications have been developed, the success of the Belgian eID technology has not been what was expected. Therefore, the Belgian government encourages developers to build commercial applications that use the eID card (for authentication or e-signatures). However, extending the scope of the Belgian eID technology from

e-government to the commercial sector is no sinecure and not without risks. These issues are analysed in *Extending the Scope of eID Technology: Threats and Opportunities in a Commercial Setting*.

Mobile information work, an extreme type of information work, is progressively becoming commonplace in various corporations. The availability of cheap and portable information technologies as well as the development of pervasive communication infrastructure in some parts of the world is creating scenarios where people can work from almost anyplace. Nevertheless up to now there has not been sufficient research on the particular work practices and strategies these professional workers use to be productive as they face the particular challenges of being mobile. Based on an ethnographic investigation of the experiences of mobile professional workers in a multi-national accountancy company, Chapter 77 *Mobility and Connectivity: On the Character of Mobile Information Work*, discusses some characteristics defining the character of modern information work with regards mobility and connectivity while operating outside the workplace. The study highlights the importance of: location in terms of providing an adequate atmosphere and infrastructure to conduct work; regularity in terms of giving workers flexibility to connect and reconnect whenever it was more convenient for them; space in terms of letting people preserve and reconstruct their information workspaces; and balance while juggling between personal and work related commitments. The findings presented can be useful for defining the processes and technological tools supporting mobile professional workers.

EXPECTATIONS

Along these 77 chapters, the reader is faced with the discussions and confirmation of the relevance and impact of this hot topic, providing professionals, researchers and scholars, with some of the most advanced research developments, solutions, state-of-the-art enabling technologies, discussions and case studies on mobility and computing.

The handbook is expected to support a professional audience of top managers, IT professionals, technology solution providers and an academic audience (teachers, researchers and students, mainly of post-graduate studies). As an academic tool, it can be a support to disciplines of post-graduate studies on IT/IS.

We hope you find it useful. Enjoy your reading and study!

Maria Manuela Cruz-Cunha
Polytechnic Institute of Cávado e Ave, Portugal

Fernando Moreira
Universidade Portucalense, Portugal