

# Preface

## *Introduction*

With the fast development of the Internet, we are experiencing a shift from the traditional sharing of information and applications as the main purpose of the Web to an emergent paradigm, which locates people at the very center of networks and exploits the value of people's connections and relations. Web 2.0 has come to play a major role in this context by enabling a new generation of social networks and web-based communities and dramatically changing the way we use and interact with the Web. Social network analysis is also a rapidly growing field to investigate the dynamics and structure of intelligent Web-based networking and collaborative systems.

Virtual campuses and organizations strongly leverage intelligent networking and collaborative systems by a great variety of formal and informal electronic relations, such as business-to-business, peer-to-peer and many types of online collaborative learning interactions. This has resulted in entangled systems that need to be managed efficiently and in an autonomous way. In addition, latest and powerful technologies based on Grid and Wireless infrastructure as well as Cloud computing are currently enhancing collaborative and networking applications a great deal but also facing new issues and challenges. Well-known social networks lack of knowledge management and adaptive solutions and the information shared among peers is rather static. Virtual communities of practice also provide poorly interactive solutions and lack of full support for organization, management, mobility and security.

The ultimate aim of this book is to stimulate research that leads to the creation of responsive environments for networking and, at longer-term, the development of adaptive, secure, mobile, and intuitive intelligent systems for collaborative work and learning.

This book follows the International Conference on Intelligent Networking and Collaborative Systems (INCoS 2009), held on November 4-6, 2009 at the Open University of Catalonia, Barcelona, Spain (<http://www.uoc.edu/symposia/incos2009>).

## *Main contributions of this book*

This book covers the latest advances in intelligent networking and collaborative systems that lead to gain competitive advantages in business and academia scenarios.

Overall, the book contributes with the following:

- *Social network* analysis is a rapidly growing field to investigate the dynamics and structure of intelligent Web-based networking and collaborative systems. The book provides knowledge management and adaptive solutions to enhance the information shared among peers in well-known social networks.
- *Virtual organizations* strongly leverage intelligent networking and collaborative systems by a great variety of formal and informal electronic relations, such as business-to-business, peer-to-peer and many types of online collaborative interactions. The book proposes solutions for the resulting entangled systems that need to be managed efficiently and in an autonomous way.

- *Emerging powerful infrastructures based on Grid, Cloud and Wireless technologies* are currently enhancing collaborative and networking applications a great deal but also facing new issues and challenges, some of them are addressed in the book. Also, the book provides solutions to virtual communities of practice that lack of full support for organization, management, mobility and security.
- *Security and resilience* are important and critical issues in networking and collaborative systems that the book covers extensively.

### ***Organization of the book***

The 13 chapters of this book are organized as follows:

#### **I. Intelligent Collaborative Systems and Applications**

##### **Chapter 1: Wikipedia as a Source of Ontological Knowledge: State of the Art and Application**

This chapter motivates that Wikipedia can be used as a source of knowledge for creating semantic enabled applications, and consists of two parts. First, we provide an overview over different research fields which attempt to extract knowledge encoded by humans inside Wikipedia. The extracted knowledge can then be used for creating a new generation of intelligent applications based on the collaborative character of Wikipedia, rather than on domain ontologies which require the intervention of knowledge engineers and domain experts. Second, as a proof of concept, we describe an application whose intelligent behavior is achieved by using Wikipedia knowledge for automatic annotation and representation of multimedia presentations.

##### **Chapter 2: Toward a methodology of collaborative Modeling and Simulation of Complex Systems**

Complex Systems Modeling and simulation are activities where collaboration between researchers with complementary points of view, skills and knowledge is well established and constitutes the usual working way rather than an exception. To manage difficulties of traditional modeling projects (how to translate informal knowledge into implemented software, which intermediate model needed to be created...), lots of methodologies have been proposed. But to be well adapted to the particular case of complex systems, they need to go further. In this chapter, the aim is to provide a complete methodology taking into account the collaborative aspect of the Complex Systems Modeling and Simulation task. Then, collaboration between various participants is described and a minimal set of tools necessary for a modeling platform is proposed.

##### **Chapter 3: Role-Based Collaboration Extended to Pervasive Computing**

Computer Supported Collaborative Work (CSCW) has been a hot point in researches for some decades. Recent progresses in software and hardware technologies have allowed the use of more and more advanced applications and services. It also brought computing capabilities to mobile devices such as smartphones and laptops. This has led to an extensive use of computers to collaborate in some un-expected manners. Among the abundance of models designed to support collaboration some are particularly promising: tasks models, roles models and collaboration's context models.

Simultaneously the Pervasive Computing paradigm has emerged from recent researches. In this chapter, a model to integrate the pervasive computing perspective into the collaborative work is proposed by the use of an original model: the PCSCW model (Pervasive Computing Supported Collaborative Work). This model relies on some robust concepts: a role model inspired by some recent works, a classical task model coupled to a precise resource model and the development of device collaboration rules. The resulting model provides a seamless and transparent cooperation of devices to simplify and facilitate the collaboration of humans.

## **II. Intelligent Networking and Resource Management**

### **Chapter 4: Evolving Schedules of Independent Tasks by Differential Evolution**

Scheduling is one of the core steps to efficiently exploit the capabilities of heterogeneous distributed computing systems and it is also an appealing NP-complete problem. There is a number of heuristic and meta-heuristic algorithms that were tailored to deal with scheduling of independent jobs. In this chapter, the authors investigate the efficiency of differential evolution for the scheduling problem and compare it with existing approaches. The analysis shows that the differential evolution is a promising method that can compete with well-established scheduling algorithms.

### **Chapter 5: A Lightweight Approach to Distributed Network Diagnosis under Uncertainty**

Management applications have not kept the fast changing pace of networks and services and still rely on centralized and deterministic approaches. Besides, distribution and uncertainty are intrinsic issues in the telecommunications environment. Therefore, new approaches to network and service management have to be explored that can deal with these challenges. In this chapter, a lightweight collaborative framework for network trouble-shooting is presented. This framework is based on multi-agent platforms and probabilistic techniques and it has been prototyped and applied to three different network environments. A summary of the most relevant results obtained and conclusions reached is also provided.

### **Chapter 6: A Multi-Lane Double Auction for Economic-Based Service Management in the Cloud**

Economic models have shown their suitability to allocate resources efficiently, considering an unbalanced supply and demand. As the use of the Cloud is extending, a numerous set of distributed resource allocation frameworks have been developed to attain efficient resource management while keeping the scalability of the infrastructure. However, those frameworks make use of either simple double auction mechanisms or complex approximations to the NP-complete problem of the combinatorial auction. The problem of those mechanisms is that of its generality, that is, they have not been specially designed for the trading of time-leased computational resources. In this chapter, the authors present a novel variant of the double auction that has been specially adapted to trade time-differentiated items as Cloud services can be considered. The chapter presents the data structures, algorithms and architecture of the economic mechanism as well as it presents the evaluation of the mechanism through simulation. Simulated results are compared with the main double auction implementations found in the literature. The chapter constitutes an approach to

improve efficiency of service management and allocation in the Cloud from the point of view of the economic model and not from architectural aspects addressed by most of the contributions found in the literature.

### **Chapter 7: Decentralized Self-Optimization in Shared Resource Pools**

Resource pools are collections of computational resources which can be shared by different applications. The goal is to accommodate the workload of each application, by splitting the total amount of resources in the pool among them. In this sense, utility functions have been pointed as the main tool for enabling self-optimizing behavior in such pools. The ultimate goal is to allow resources from the pool to be split among applications, in a way that the best outcome is obtained. Whereas different solutions in this context exist, it has been found that none of them tackles the problem we deal with in a total decentralized way. To this end, in this chapter, the authors present a decentralized and self-optimizing approach for resource management in shared resource pools.

### **Chapter 8: Monitoring and Performance Analysis of Workflow Applications in Large Scale Distributed Systems**

The chapter presents the design, implementation and testing of the monitoring solution created for integration with a workflow execution platform. The monitoring solution is a key for modeling and performance analysis of Grid systems considered as a networking and collaborative systems. The monitoring solution constantly checks the system evolution in order to facilitate performance tuning and improvement. The novelty of the work presented in this chapter is the improvement of distributed application obtained using the real-time information to compute estimates of runtime which are used to improve scheduling. Monitoring is accomplished at application level, by monitoring each job from each workflow and at system level, by aggregating state information from each processing node. The scheduling performance in distributed systems can be improved through better runtime estimation and the error detection can automatically detect several types of errors.

### **Chapter 9: Scaling relations of data gathering times in an epidemically data sharing system with opportunistically communicating mobile sensors**

In this chapter, the authors investigate data gathering time in an epidemically data sharing system with opportunistically communicating mobile sensors. A stochastic process of the system is proposed where  $N$  sensors moved randomly and independently on the  $d$ -dimensional square grid with size  $L$  and when meeting opportunistically at the same position on the grid, the sensors shared and stored all possessing data epidemically. The authors focus on three data gathering times, that is, latency times that (1) at least one sensor collects all (2) every sensor collects at least one common data (3) every sensor collects all. As a result, in general, the complementary cumulative distribution functions of these times decay exponentially in their asymptotic regions. A decay speed is also examined, which is also called relaxation time, of the exponential decay numerically with varying  $d$ ,  $L$ , and  $N$ . Finally, scaling relations of the relaxation times are shown. The authors conclude that these relations are useful for estimating the minimum required number of sensors to collect data within a certain short period of time when the sensors are densely covered on the system.

### **III. Intelligent Secure and Resilient Networking Systems**

#### **Chapter 10: Multilaterally Secure Ubiquitous Auditing**

This chapter addresses tracking information of individuals as a useful input to many Ubiquitous Computing (UbiComp) applications. As an example, a smart emergency management application: once mobile first responders are continuously tracked, a precise and safe coordination of rescue missions is possible, and also mission logs can be created for audit purposes. However, continuously tracking users and storing the data for later use is often in conflict with individual privacy preferences. This may ultimately lead to the non-acceptance and rejection of these new technologies by their users. In order to reconcile privacy and accountability requirements in location tracking systems, the authors introduce and evaluate the approach of using auditing mechanisms on two levels. They illustrate that, by employing carefully designed cryptographic mechanisms for selective pseudonym linkability based on efficient techniques of secure multiparty computation, it is possible to balance the conflicting interests to a certain extent. The work reported in this chapter, motivated by and applied to smart emergency management systems, is a step towards the realization of multilaterally secure and thus multilaterally acceptable UbiComp systems supporting collaborative work.

#### **Chapter 11: Intrusion Detection in Multi-Agent Systems**

In this chapter, the authors present an adaptive intrusion detection system for distributed environments dedicated to developing agent-based applications. To this end, they propose a scalable, flexible and reactive agent based architecture and a lightweight genetic algorithm that recognizes the intruders in an adaptive and automatic way. The approach is based on monitoring the level of physical resources usage and implies the detection of those agents that manifest an abusive behavior. The authors finally enhance Jade with their intrusion detection system and the results obtained in different scenario cases are analyzed and illustrated.

#### **Chapter 12: A Round-based Cover Traffic Algorithm for Anonymity Systems**

Anonymity is becoming more of an issue with the growing importance of networking. Examples include protecting privacy of Internet users or electronic voting. Several network anonymity systems have been deployed, the most popular of them is probably Tor. However, those systems do not protect against attackers who observe or modify the traffic to match sources with destinations. The protection method against such attacks by adding additional traffic is not usually implemented because of the high cost. In this chapter, the authors propose a new cover traffic generation algorithm for flow-based anonymity systems and compare it with other algorithms from the literature. The algorithm is based on four ideas: fixed time rounds, flow classification with different protection methods for different classes, protection depending on the potential cost and finally, use of history. In the chapter, the authors evaluate their algorithm both in theory and in practice. The analysis shows that this solution provides sufficient protection while reducing overhead traffic compared to the algorithms known from the literature.

## **Chapter 13: Fault Recovery Performance Analysis of Functionally Distributed Transport Networking System**

This chapter proposes a fault recovery method in functionally distributed transport networking that separates the control-plane processing part (control element, CE) from the forwarding-plane processing part (forwarding element, FE) of the router. In this architecture, one path-control process in the CE consolidates and processes the path computations and the path settings for multiple FEs. This leads to reduction in the path-control complexity and efficient operation of large scale networks. On the other hand, it is absolutely critical to ensure the high reliability of the CE. The authors analyze the performance of the proposed fault recovery method by using software implementation.

### ***Targeted audience and last words***

We expect that current complex virtual organizations and communities of practice strongly leverage the extensive research produced in this book, being the book's targeted audience, including industry and companies involved in intensive networking and collaborative systems. In particular, those organizations exploiting latest and powerful technologies based on Grid and Wireless infrastructures as well as Cloud computing can find many solutions in the book to alleviate complex issues and challenges arisen in this context, in terms of collaborative applications, resource management, mobility, security and system resilience.

Finally, academic researchers, professionals and practitioners in the field can also be inspired and put in practice the ideas and experiences proposed in the book in order to evaluate them for their specific research and work.

We hope that the readers find this book fruitful and help accomplish their goals. Enjoy the reading!

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