

# Habilitation Thesis of Florin Pop

*Title: Adaptive Resource Management in Heterogeneous Distributed Systems*

## *Abstract*

In the last few years there has been considerable interest in using distributed systems in any domains. Resource management in distributed systems contributes to ensure quality of services for any type of application. The main subject of this habilitation is the adaptive resource management in heterogeneous distributed systems. The scientific results presented in this thesis refer to Cluster Computing, Grid Computing, Peer-to-Peer Computing, and Cloud Computing all involving elements of heterogeneity. These computing distributed systems are often characterized by a variety of resources that may or may not be coupled with specific platforms or environments. The publications used to summarize my achievements contain theoretical and experimental results: models for adaptive resource management, evolutionary algorithms for task scheduling, dependable services for large scale distributed systems, adaptive methods for resource management in dynamic distributed systems, resource management for efficient data handling and service-oriented based frameworks. The experimental results have been conducted in real-environments or by simulation.

The habilitation thesis presents the scientific, professional and academic works that I had chance to be involved in as member of Distributed Systems Laboratory at the Department of Computer Science and Engineering, Faculty of Automatic Control and Computers, University *Politehnica* of Bucharest after I finished my PhD studies, between 2009 and 2014. During this part of my professional and research career, I have been involved in different research and academic projects (DEPSYS, PEGAF, GEEA, CYBERWATER, ERRIC, EGEE, SEE-GRID, EU-NCIT, etc.) that allowed me to have national and international collaborations. I conducted as director several research and collaborative national projects (SideSTEP, SideDOWN, SORMSYS, CollectGATE, DIOGENES), I am member in the management committee for a COST action (KEYSTONE, IC1302), and I have been involved in project proposal writing. I collaborated and I maintain close connection with many international partners (INRIA, UPMC, VU Amsterdam, etc.) and national partners (Universitatea Tehnică din Cluj-Napoca, Universitatea de Vest din Timișoara, Universitatea Politehnica din Timișoara, Universitatea “Lucian Blaga” din Sibiu, Universitatea Tehnică “Gheorghe Asachi” Iași, Academia de Studii Economice București).

These activities kept me close to the newest research issues and offered me the possibility to explore in details the state of the art in my research domain. By working in research projects, I have been able to design new solution, algorithms, models, and to implement them in different tools and frameworks. I published my research and scientific results obtained with my collaborators in journal articles (more than 30), conference and workshop papers (more than 70), edited and authored books (more than 10), I disseminated our results during scientific events by oral presentation and posters. Moreover, the exchange of ideas has been particularly successful in the conferences and workshops including those I have organised.

The academic activity offered me the possibility to interact with many people: colleagues and students. I had the chance to work for defining new master programs in collaboration with other universities (VU Amsterdam), new courses for different levels: bachelor, master, long-life learning, etc. It is a great pleasure for me to coordinate students, to work with them, to find solutions for open problems, to validate and then to publish them. I have been involved in

extending our current academic and research infrastructure and defining new one. One of the insufficient studied scientific problem address the adapting of the existing and used methods in distributed systems and/or creating a new one which will guarantee the applications' performance (with respect to the SLA) and resource utilization (especially for scalability and costs). The heterogeneity of systems (Internet, Enterprise Information Systems, Clouds, Peer- to-Peer Systems, Grids, Utility Computer Systems, and others) makes the resource management process to be more difficult. The main purpose of an efficient scheduler (that has also the role of resources' manager) is to reduce the computational costs and to maximize the productivity. The scheduling process is difficult because the systems are also dynamic, so the faults in this type of system could affect the scheduling process. In this context of variety, the stimulating relationship between users, who require better computing services, and providers, who discover new ways to satisfy them, is the motivation to introduce future trends oriented on self-\* capabilities.

The ideas presented in this habilitation thesis highlight the contributions in this field and envision new research perspectives. The main research perspectives presented in this thesis are: asymptotic scheduling in many-task computing systems, adaptive overlays for data distribution and gathering with flying Clouds, confluence of Big Data and Cyberinfrastructures. I hope that these immediate perspectives of the scientific works may be the topic of a doctoral thesis.

I strongly believe that *adaptive resource management in heterogeneous distributed systems* has important impact in supporting many challenges (scientific, technological and social) in our days when Clouds and Mobile Systems are everywhere. I hope and I wish that the ideas and contributions presented in this thesis will pave the way to new projects, collaborations, ideas and contributions, closing the loop that will always move the exiting limits in any domains.