

## **The First International Working Conference on Active Networks — IWAN '99**

The network model is changing from the traditional „store-forward“ towards the „store-compute-forward“ one. We are moving from a passive network, where the level of abstraction is the protocol (service model), towards an active network where the level of abstraction is raised to APIs (programming model) for programming the new network resources (communication, processing and storage). The network becomes a distributed computer capable of routing at gigabit and terrabit per second speeds and hosting several programming environments. This is going to change the whole network service and application design paradigm, enabling a new generation of network-aware software following the model of „compute while travelling“. For example, packets will carry their custom network service which will be computed in the active nodes. The implications of the active network infrastructure go beyond the technical issues and also address the way business will be created and managed in the future networked environment. Service creation, deployment and operations will no longer be the sole business of the owners and manufacturers of the infrastructure, but will become a customized business shared with the users of this infrastructure, too. In this sense the Active Network Operators will be adopting a new outsourcing-based business model in order to be capable of hosting an increased number of network-aware applications and also to manage an applications-aware network.

The *1<sup>st</sup> International Working Conference on Active Networks – IWAN'99* has set itself the goal of pulling together the main streams of activities in the area of Active Networks in order to strengthen synergies and create a common view of the domain and its most difficult problems.

Although no widely agreed taxonomy exists to this end, the contributions have demonstrated that a general architecture will include several dimensions such as active code distribution, active code execution (EE-execution environment, programming language, safety), active code communication (cooperation), active node resource control (NodeOS) and active network security. Each of these subarchitectures is component-based and includes a management component that could offer an API to be used by applications. Important aspects like autonomy (degree of self-management) and asynchronicity start to be addressed in the context of scalability and fault tolerance, and technologies such as mobile agents and CORBA are the first ones to provide the right support. Another important aspect is the integration of active networks with the legacy networks as well as the interoperability at the level of active networks. Issues related to active network architecture are well represented in the program and this is reflected in 9 papers in this volume.

The challenge in implementing such architectures is to find the right balance between flexibility, usability, security, robustness, and performance. Solutions to this problem are assessed by a number of prototype platforms and results are presented by 8 papers in this volume.

As one of the main advantages of active networks is based upon the rapid introduction of customized network services and applications, we continue to see a growing number of examples primarily related to the Internet. The next generation of Internet will provide its users with dynamically managed QoS, multicast and security

and could rely on active networking as an ideal infrastructure for such implementations. Most of the papers about applications (14) relate to infrastructure owner applications – management, control — but some also address the class of customer - owned applications.

The papers also give a clear indication that service and application creation paradigms and supporting methods and tools are going to come into focus once the field matures.

The proof that active networks are gaining momentum is apparent considering the large number and high quality of papers submitted to this first international working conference – some 80 submissions of which the best 30 have been accepted and published in this volume.

This book provides a unique state-of-the-art account of architectural approaches, technologies and prototype systems that will impact the way future networked businesses will be created and managed. It is unique not only in that it reflects all relevant achievements to date from every continent, but also because via its cooperative preparation, it has led to a truly Active Network of authoritative persons in the field. I hope you will benefit from reading it.

June 1999

Stefan Covaci  
IWAN'99 Program Chair

# Acknowledgements

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# **IWAN'99**

## **Message from the Conference General Chairs**

Internet technologies have begun to affect our lives and work. We are still talking about network protocols, reservation mechanisms, performance, and applications. It is time, based on the experience we have and the lessons we are learning from the large deployment of the Internet, to consider new research and development directions for the future. One of the most attractive areas is that of ACTIVE NETWORKS.

Welcome to the first International Working Conference on Active Networks 'IWAN 99' in Berlin, a city which, similar to this new domain, is in the process of developing its structure and image for the future.

We hope that this first workshop will become a forum for the exchange of ideas and results in this domain on an international level. Already a network of R&D activities worldwide in Active Networks can be identified. Most of them are presented at this workshop.

The positive answers we received during the organization of the workshop from authors, industry, research groups from all over the world guarantee that this event will continue and grow in the future.

We are sure that you will find the program stimulating and that you will take advantage of the opportunity to meet your colleagues from around the world. The success of the symposium depends on the dedication and contribution of many volunteers, committee members, authors, reviewers, invited speakers, and sponsors.

Our personal thanks go to all of them and to you who, we are confident, will make IWAN '99 a success.

Prof. Dr. Dr. h.c. Radu Popescu-Zeletin  
Technical University of Berlin, Germany

Masanori Kataoka  
Hitachi Ltd, Japan

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