

# Preface

Every year we witness acceleration in the availability, deployment, and use of distributed applications. However building increasingly sophisticated applications for extant and emerging networked systems continues to be challenging for several reasons:

- Abstract models of computation used in distributed systems research often do not fully capture the limitations and the unpredictable nature of realistic distributed computing platforms;
- Fault-tolerance and efficiency of computation are difficult to combine when the computing medium is subject to changes, asynchrony, and failures;
- Middleware used for constructing distributed software does not provide services most suitable for sophisticated distributed applications;
- Middleware services are specified informally and without precise guarantees of efficiency, fault-tolerance, scalability, and compositionality;
- Specification of distributed deployment of software systems is often left out of the development process;
- Finally, there persists an organizational and cultural gap between engineering groups developing systems in a commercial enterprise, and research groups advancing the scientific state-of-the-art in academic and industrial settings.

The objectives of this book are: (1) to serve as a motivation for defining future research programs in distributed computing, (2) to help identify areas where practitioners and engineers on the one hand and scientists and researchers on the other can improve the state of distributed computing through synergistic efforts, and (3) to motivate graduate students interested in entering the exciting research field of distributed computing.

The title of this volume, *Future Directions in Distributed Computing*, captures the unifying theme for this collection of 38 position and research papers dealing with a variety of topics in distributed computing, ranging from theoretical foundations to emerging distributed applications, and from advanced distributed data services to innovative network communication paradigms. Thirty-one of the 38 papers in this volume are based on the preliminary reports that appeared in the proceedings of the *2002 International Workshop on Future Directions in Distributed Computing*, held on 3–7 June 2002 at the University of Bologna Residential Center located in the medieval hilltop town of Bertinoro, Italy. The workshop was organized by Özalp Babaoğlu, Ken Birman, and Keith Marzullo, and this book was envisioned by them. Without their efforts in organizing the Bertinoro workshop this book would not exist.

The plan to compile this volume was developed during the workshop. The numerous technical discussions at the workshop inspired many of the workshop participants to

substantially revise their position papers, and several decided to produce completely new papers. This volume is the culmination of this development and, in addition to the refined workshop papers, it includes seven completely new contributions. All papers were anonymously cross-refereed; the editorial team accepted papers following their revision based on the referee comments.

The papers are grouped into four parts, preceded by two papers with insights into technological and social processes that are a part of the development of distributed computing technology and its applications. The first paper presents a historical perspective on the development of group communication technology. Group communication services is an example of reusable and sophisticated building blocks that have been successfully used in developing dependable distributed applications and that improve our ability to construct such applications. The second paper discusses the social interactions along the boundary between academic distributed systems research and the real-world practice of distributed computing, and tackles the question of the academic research impact on the real world.

The other papers are grouped in the following four parts. Part I includes 12 papers dealing with the theoretical foundations of distributed computing, selected current research projects, and future directions. Part II consists of eight papers presenting research on novel communication and network services for distributed systems. Part III includes eight papers dealing with data and file services, and coherence and replication in network computing. Part IV includes eight papers dealing with system solutions, pervasive computing, and applications of distributed computing technologies.

We are certain that the papers in this volume contain numerous research topics that ought to be addressed in future research or that are already being addressed by forward-looking research in distributed computing. We are also certain that it is impossible to include all worthwhile future research topics in a single volume, and that some topics identified in this volume will turn out to be only moderately interesting. At the same time, we consider it necessary to identify the research topics that a broad cross-section of the research community views as important for the future of distributed computing.

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