Selected Papers from the Second IFIP Int'l Conference on Formal Methods for Open Object Based Distributed Systems, 1997

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Object-based distributed computing is now a well-established technique for constucting large, heterogeneous computing and telecommunications systems. Indeed, standards bodies and consortia such as, ITU, ISO, OMG, TINA-C, etc., have all defined distributed object-based frameworks as a foundation for open distributed computing.

The advent of open object-based distributed systems brings new challenges and opportunities for the use and development of formal methods. The FMOODS conference series has acted as a forum for presentation of research that addresses these challenges. It seeks to investigate how formal methods can be used to specify, develop, and verify open object-based distributed systems

More precisely, the objective of FMOODS is to represent work at the convergence of three important and related fields: formal methods, distributed systems, and object-based technology. This convergence is representative of some of the latest advances in the field of distributed systems (for example, the ODP reference model and the work of the OMG) and provides links between a number of important communities (for example, conferences such as, FORTE/PSTV, Middleware, and ECOOP).

The FMOODS conference series was first held in Paris in 1996 and the second event, from which this special issue derives, was held in Canterbury in 1997. Subsequently, the conference has been held in Florence, Italy, in 1999 and in Stanford, California, in 2000.

One of the central observations that led to the FMOODS conference series being set up was that the majority of formal notations that are available were developed with traditional distributed systems in mind. However, the practical concerns of modern distributed systems are somewhat different from those of traditional distributed systems. In particular, new concerns that are central to modern distributed systems include:

- *real-time* and, in particular, how to support multimedia applications;
- *mobility*, i.e., reconfigurable components;
- *OO*, e.g., how to support objects and their encapsulation;
- *open systems*: OO-based approaches to open systems such as ODP, CORBA, and TINA;
- *software development*: new software development strategies, such as viewpoints modeling; and
- *verification and testing*: how are existing approaches to verification and testing affected by all of the above.

All of these concerns were represented at the 1997 conference, which included themes such as mobility and Pi-Calculus, concurrent OO specification and programming, actors, ODP and CORBA, and formal specification. Of the technical contributions, a number were selected for this special issue, each one being a rewritten and extended version of that presented at the conference. The four selected papers reflect a number of the concerns identified above and are representative of the themes of the FMOODS conference.

1) The paper "Respectful Type Converters" by J. Wing and J. Ockerbloom makes an important contribution to the topic of behavioral subtyping. The paper builds upon the familiar previous work of Liskov and Wing by considering the conditions under which a type convertor can be seen to respect the behavior of another type. The approach is illustrated through the Typed Object Model Conversion Service (TOM).
2) T. Bolognesi's paper "Toward Constraint-Object-Oriented Development" combines two important styles of system description: constraint-oriented and object-oriented specification. The former arises from a formal methods tradition and is a powerful technique for compositional specification. The latter is the familiar object-oriented paradigm, here realized by the JAVA programming language. The paper makes a significant contribution to the combined use of these important styles in the system development process.
3) The third paper, "A Control-Flow Analysis for a Calculus of Concurrent Objects" by P. Di Blasio, K. Fisher, and C. Talcott, is, in contrast, more firmly

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placed in a single tradition, that of calculi of concurrent object oriented systems. Such calculi play an important role in providing a formal semantic basis for object-oriented programming languages. The contribution of this paper is to define a control flow analysis technique for concurrent OO calculi. This is an important first step toward using formal methods in optimizing programs in concurrent OO languages.

4) As was the case with T. Bolognesi's paper, the paper "A Formal Specification Framework for Object-Oriented Distributed Systems" (by D. Buchs and N. Guelfi) reconciles existing formal methods techniques with the OO paradigm. Specifically, the Concurrent Object-Oriented Petri Nets (CO-OPN/2) model is introduced, which is a hybrid approach to system specification in which order sorted algebra and algebraic Petri nets are used together within an OO framework. Consequently, the paper tackles the issue of how to define a complete formal framework for the specification of OO distributed systems.

The quality of the four papers included in this special section reflect, the strength of the FMOODS event, which continues to provide a forum for the presentation of core research at the junction of the formal methods, object-oriented systems, and distributed systems communities.

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Reviewers List for Special Section

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Howard Bowman received the PhD degree from Lancaster University in 1991. He is a senior lecturer in the Computing Laboratory at the University of Kent at Canterbury. His research focuses on the theory underlying formal methods and their use in diverse application areas. In particular, he has applied formal methods in distributed systems, multimedia systems, object-oriented systems, and human computer interaction. He is a grant holder for a number of projects in this area. He is on the editorial board of the journal *New Generation Computing* and on the program committees of a number of conferences, including, FORTE/PSTV. He was the program cochair of FMOODS '97, the IFIP conference on Formal Methods for Open Object Based Distributed Systems.

John Derrick is a reader in the Computing Laboratory at the University of Kent at Canterbury. He received his DPhil from Oxford University and worked briefly at University College North Wales before joining STC Technology Ltd. (now Nortel). In 1990, he joined the Computing Laboratory at the University of Kent. His interests include specification techniques for distributed systems, refinement, and testing, and he has published extensively within these areas. He is a grant holder for a number of projects. He is on the program committees of a number of conferences and was the program cochair of FMOODS '97, the second IFIP conference on Formal Methods for Open Object-Based Distributed Systems.

Ed Brinksma studied mathematics at the University of Groningen, The Netherlands, where he specialized in mathematical logic and computer science. In 1982, he joined the Faculty of Computer Science at the University of Twente, The Netherlands, where he has been a full professor since 1991, occupying the Chair of Formal Methods and Tools. His main research interests lie in the application of formal methods in the design of distributed systems, including specification, verification, implementation, testing, and software tool support. In the period 1983-1989, he was chairman of the committee of the International Organization for Standardization (ISO) that was responsible for the definition of the formal specification technique LOTOS. He has been involved in many international research programs of the European Union (SEDOS, LOTOSPHERE, REACT). For the last 10 years, he has collaborated extensively with industry (CMG, KPN, Lucent, Philips) on the application of formal methods. Recent research focuses on testing (test derivation), validation by model checking, formal methods for real-time systems, and linking performance models to formal specifications. He is a member of the Steering Committee of the IFIP WG 6.1 International Symposium FORTE/PSTV and is also a cofounder and member of the steering committee of the conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS). He is on the editorial boards of the new Springer *International Journal on Software Tools for Technology Transfer* (STTT) and *IEEE Transactions on Software Engineering*. He is a member of the ACM, *IEEE*, IFIP WG 6.1, and several national organizations and advisory committees in computer science.