Gary J. Minden Kenneth L. Calvert Marcin Solarski Miki Yamamoto (Eds.)

Active Networks

IFIP TC6 6th International Working Conference, IWAN 2004 Lawrence, KS, USA, October 27-29, 2004 Revised Papers



Volume Editors

Gary J. Minden University of Kansas Information and Telecommunications Technology Center 2335 Irving Hill Road, Lawrence, KS 66045, USA E-mail: gminden@ittc.ku.edu

Kenneth L. Calvert University of Kentucky

Department of Computer Science, Laboratory for Advanced Networking Hardymon Building, 301 Rose Street, Lexington, KY 40506-0495, USA

E-mail: calvert@netlab.uky.edu

Marcin Solarski Deutsche Telekom A.G.Laboratories Ernst-Reuter-Platz 7, 10587 Berlin, Germany

Miki Yamamoto Kansai University Department of Electrical Engineering and Computer Science 3-3-35 Yamate-cho, Suita, Osaka 564-8680, Japan E-mail: yama-m@ipcku.kansai-u.ac.jp

Library of Congress Control Number: 2007923238

CR Subject Classification (1998): C.2, D.2, H.3.4-5, K.6, D.4.4, H.4.3

LNCS Sublibrary: SL 5 – Computer Communication Networks and **Telecommunications**

ISSN 0302-9743

ISBN-10 3-540-71499-5 Springer Berlin Heidelberg New York ISBN-13 978-3-540-71499-6 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media

springer.com

©2007 IFIP International Federation for Information Processing, Hofstraße 3,2361 Laxenburg, Austria Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India 06/3142 5 4 3 2 1 0 Printed on acid-free paper SPIN: 12038831

Preface

We are pleased to present to you the proceedings of the sixth Annual International Working Conference on Active Networks, which took place in October 2004 at The Information and Telecommunications Technology Center, The University of Kansas, USA. The proceedings of IWAN 2004 mark a transition between the funded active networking programs in Europe, Japan, and the United States and a strong, continued interest in the architectures of programmable networks.

The technical committee accepted 14 papers for presentation from 32 submitted papers. The papers are organized into sections on active network systems and architectures, security in active networking, active network applications, mobile active networks and active network management. Whereas the contributions on active network architectures and management build upon mature concepts devised in the previous years and are incremental follow-ups of the related research, the security considerations are of primary importance to the active networks practitioners. The papers on mobile applications of active networks, like TCP gateways between wireless and wireline networks, provide additional inspirations to the active network researchers.

Featured in the program were a keynote address by Jonathan M. Smith of DARPA and two invited papers, one by Takashi Egawa, Yoshiaki Kiriha, and Akira Arutaki on "Tackling the Complexity of Future Networks", and one by Bernhard Plattner and James Sterbenz, titled "Programmable Networks: Alternative Mechanisms and Design Choices". Based on the reviewer feedback, the authors of the paper "Dynamic Link Measurements Using Active Components", Dimitrios Pezaros, Manolis Sifalakis, Stefan Schmid and David Hutchison, all of Lancaster University, were awarded this year's Best Paper Award. During the two days of the conference there were several lively discussions, including one at the end of the first day on the scope and future of IWAN itself. The social event, barbecue at the Circle-S ranch, provided a most enjoyable venue for discussion and collegiality.

We would like to thank the members of the Program Committee for their excellent work in reviewing, selecting, and in some cases shepherding papers for the program. V. Rory Petty and F. "Ted" Weidling supported the Web site and conference organization.

We appreciate the work of all the authors, they are the core of this workshop and proceedings. The participation of all the attendees made an outstanding conference. Enjoy the fruits of all their labors. We trust you will find these proceedings interesting.

October 2004

Gary J. Minden Ken Calvert Marcin Solarski Miki Yamamoto

Organization

IWAN 2004 was organized by The Information and Telecommunications Technology Center (ITTC) at The University of Kansas. We would like to acknowledge the support of our sponsors, The Information and Telecommunications Technology Center, The University of Kansas, and Hitachi Ltd., and we thank them for their contributions. Their support and the research presented in these proceedings continue to demonstrate international interest in active networking.

Executive Committee

General Chair Gary J. Minden, The University of Kansas, USA

General Co-chairs Tadanobu Okada, NTT, Japan

Bernhard Plattner, ETH Zürich, Switzerland

Program Co-chairs Marcin Solarski, Fraunhofer FOKUS, Germany

Ken Calvert, The University of Kentucky, USA Miki Yamamoto, Osaka University, Japan

Technical Program Committee

| Stephane Amarger | Toru Hasegawa | Guy Pujolle |
|---------------------|-------------------|---------------------|
| Bobby Bhattacharjee | Michael Hicks | Lukas Ruf |
| Matthias Bossardt | David Hutchison | Nadia Shalaby |
| Bob Braden | Javed Kahn | Yuval Shavitt |
| Torsten Braun | Andreas Kind | Marcin Solarski |
| Marcus Brunner | Yoshiaki Kiriha | James Sterbenz |
| Ken Calvert | Akira Kurokawa | Christian Tschudin |
| Hermann DeMeer | Laurent Lefevre | Naoki Wakamiya |
| Takashi Egawa | John Lockwood | Marcel Waldvogel |
| Ted Faber | Douglas Maughan | Tilman Wolf |
| Mike Fisher | Gary Minden | Miki Yamamoto |
| Alex Galis | Toshiaki Miyazaki | Krzysztof Zielinski |
| Anastasius Gavras | Sandy Murphy | Martina Zitterbart |
| Jim Griffioen | Scott Nettles | |

Bernhard Plattner

Sponsoring Institutions

Robert Haas

The University of Kansas The Information and Telecommunications Technology Center Hitichai

Table of Contents

IWAN 2004

| Active Networking Systems | |
|---|-----|
| GateScript: A Scripting Language for Generic Active Gateways | 1 |
| Management and Performance of Virtual and Execution Environments in FAIN | 21 |
| Active Networking Security | |
| Secure, Customizable, Many-to-One Communication | 35 |
| Distributed Instrusion Prevention in Active and Extensible Networks Todd Sproull and John Lockwood | 54 |
| Secure Service Signaling and Fast Authorization in Programmable Networks | 66 |
| Invited Papers | |
| Tackling the Complexity of Future Networks | 78 |
| Active Networking Applications | |
| Evaluation of Integration Effect of Content Location and Request Routing in Content Distribution Networks | 88 |
| Building a Reliable Multicast Service Based on Composite Protocols for Active Networks | 101 |

VIII Table of Contents

| Network Programmability for VPN Overlay Construction and Bandwidth Management | 114 |
|---|-----|
| Mobile Active Networks | |
| A Framework for Developing Mobile Network Services | 126 |
| Using Active Networking's Adaptability in Ad Hoc Routing Seong-Kyu Song and Scott M. Nettles | 138 |
| Active Networking for TCP over Wireless | 156 |
| Active Networking Management | |
| A Detection and Filter System for Use Against Large-Scale DDoS Attacks in the Internet Backbone | 169 |
| Dynamic Link Measurements Using Active Components | 188 |
| Simple Active Mechanisms for Measuring and Monitoring Service Level Topologies | 205 |
| Author Index | 217 |