Lecture Notes in Computer Science

10446

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

Lancaster University, Lancaster, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Friedemann Mattern

ETH Zurich, Zurich, Switzerland

John C. Mitchell

Stanford University, Stanford, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

TU Dortmund University, Dortmund, Germany

Demetri Terzopoulos

University of California, Los Angeles, CA, USA

Doug Tygar

University of California, Berkeley, CA, USA

Gerhard Weikum

Max Planck Institute for Informatics, Saarbrücken, Germany

More information about this series at http://www.springer.com/series/7411

Jacek Rak · John Bay · Igor Kotenko Leonard Popyack · Victor Skormin Krzysztof Szczypiorski (Eds.)

Computer Network Security

7th International Conference on Mathematical Methods, Models, and Architectures for Computer Network Security, MMM-ACNS 2017 Warsaw, Poland, August 28–30, 2017 Proceedings



Editors Jacek Rak

Gdansk University of Technology

Gdansk Poland

John Bay

Binghamton University Binghamton, NY

USA

Igor Kotenko
St. Petersburg Institute
for Informatics and Automation

St. Petersburg

Russia

Leonard Popyack Utica College Utica, NY USA

Victor Skormin Binghamton University Binghamton, NY

USA

Krzysztof Szczypiorski

Warsaw University of Technology

Warsaw Poland

ISSN 0302-9743 ISSN 1611-3349 (electronic) Lecture Notes in Computer Science ISBN 978-3-319-65126-2 ISBN 978-3-319-65127-9 (eBook) DOI 10.1007/978-3-319-65127-9

Library of Congress Control Number: 2017948184

LNCS Sublibrary: SL5 - Computer Communication Networks and Telecommunications

© Springer International Publishing AG 2017

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This volume contains papers presented at the 7th International Conference on Mathematical Methods, Models, and Architectures for Computer Network Security (MMM-ACNS 2017) held in Warsaw, Poland during August 28–30, 2017. The conference was organized by Gdansk University of Technology, in cooperation with Binghamton University (State University of New York), USA, and the Polish Association of Telecommunication Engineers (SIT), Poland.

MMM-ACNS 2017 followed six former editions of MMM-ACNS all hosted by St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences (SPIIRAS), RU. MMM-ACNS 2017 provided an international forum for sharing the original results referring to fundamental as well as applied problems in the context of computer network security. Special focus was put on mathematical aspects of information and computer network security.

In all, 40 regular papers submitted to the conference were subject to extensive reviews. Each paper received at least three reviews (and some of them as many as five reviews). Finally, 12 papers were accepted as full papers, and 13 papers as short papers. Approved regular papers were organized into seven technical sessions, namely:

- Critical Infrastructure Protection and Visualization
- Security and Resilience of Network Systems
- Adaptive Security
- Anti-malware Techniques: Detection, Analysis, Prevention
- Security of Emerging Technologies
- Applied Cryptography
- · New Ideas and Paradigms for Security

The conference program was enhanced by three invited talks and two keynote speeches (by Dipankar Dasgupta from USA, and Antanas Cenys from Lithuania, accordingly).

The success of the conference was undoubtedly due to the team effort of the organizers, reviewers, and participants. In particular, we would like to acknowledge the individual contributions of the Technical Program Committee members and reviewers. Our sincere gratitude goes to all the participants of the conference as well as to Polish Association of Telecommunication Engineers, SIT, Poland (in particular to Ewa Woroszyło and Mirosław Stando), for their great help in solving the local arrangement issues.

August 2017

Jacek Rak John Bay Igor Kotenko Leonard Popyack Victor Skormin Krzysztof Szczypiorski

Organization

General Co-chairs

Jacek Rak Gdansk University of Technology, Poland

John Bay Binghamton University

(State University of New York), USA

Steering Committee

John Bay Binghamton University

(State University of New York), USA

Igor Kotenko St. Petersburg Institute for Informatics

and Automation of the Russian Academy

of Sciences, SPIIRAS, Russia

Leonard Popyack Utica College, USA

Jacek Rak Gdansk University of Technology, Poland

Victor Skormin Binghamton University

(State University of New York), USA

Publication Chair

Krzysztof Szczypiorski Warsaw University of Technology, Poland

Local Organizing Committee

Andrzej Dulka Polish Association of Telecommunication Engineers,

Poland

Wojciech Halka Polish Association of Telecommunication Engineers,

Poland

Miroslaw Stando Polish Association of Telecommunication Engineers,

Poland

Ewa Woroszylo Polish Association of Telecommunication Engineers,

Poland

Program Committee

Ryszard Antkiewicz Military University of Technology, Poland

Cataldo Basile Politecnico di Torino, Italy Fabrizio Bayardi University of Pisa, Italy

Nataliia Bielova Inria, France

Elias Bou-Harb Florida Atlantic University, USA

Julien Bourgeois University of Franche-Comté/FEMTO-ST, France

VIII Organization

Mariano Ceccato Fondazione Bruno Kessler, Italy Shiu-Kai Chin Syracuse University, USA

Michal Choras University of Technology and Life Sciences, Poland

Miguel Correia INESC-ID, Portugal

Frédéric Cuppens TELECOM Bretagne, France
Changyu Dong Newcastle University, UK
Paolo Falcarin University of East London, UK

Dennis Gamayunov Lomonosov Moscow State University, Russia

Dieter Gollmann Technical University of Hamburg-Harburg, Germany

Kartik Gopalan Binghamton University

(State University of New York), USA

Stefanos Gritzalis University of the Aegean, Greece

Alexander Grusho Institute of Informatics Problems FRC CSC RAS,

Russia

Ming-Yuh Huang

Andrew Hutchison

Northwest Security Institute, USA

University of Cape Town, South Africa

Sushil Jajodia George Mason University, USA

Bartosz Jasiul Military Communication Institute, Poland

Alexey Kirichenko F-Secure Corporation, Finland

Kevin Kwiat Air Force Research Laboratory, USA Jean-François Lalande INSA Centre Val de Loire, France

Hanno Langweg Norwegian Information Security Laboratory, Norway

Peeter Laud University of Tartu, Estonia

Giovanni Livraga Università degli Studi di Milano, Italy

Fabio Martinelli CNR-IIT, Italy

Catherine Meadows Naval Research Laboratory, USA

Stig Frode Mjolsnes Norwegian University of Science and Technology,

Norway

Nikolay Moldovyan University of St. Petersburg, Russia Wojciech Molisz Gdansk University of Technology, Poland

Haris Mouratidis University of Brighton, UK Vladimir Oleshchuk University of Agder, Norway

Piotr Pacyna AGH University of Science and Technology, Poland Josef Pieprzyk Queensland University of Technology, Australia

Dmitry Ponomarev Binghamton University

(State University of New York), USA University of Luxembourg, Luxembourg

Roland Rieke Fraunhofer, Germany

Andrzej Rucinski
Igor Saenko
University of New Hampshire, USA
Saint-Petersburg Institute for Informatics
and Automation of Russian Academy

of Sciences (SPIIRAS), Russia

Françoise Sailhan CNAM, France

Alfredo Rial

Victor Skormin Binghamton University

(State University of New York), USA

Douglas Summerville Binghamton University

> (State University of New York), USA Warsaw School of Economics, Poland

Jerzy Surma Nadia Tawabi Laval University, Canada

Bhavani Thuraisingham The University of Texas at Dallas, USA

Arnur Tokhtabayev T&T Security LLP, Kazakhstan Shambhu Upadhyaya University at Buffalo, USA

Janusz Zalewski Florida Gulf Coast University, USA

Additional Reviewers

Marios Anagnostopoulos Singapore University of Technology and Design,

Singapore

University of the Aegean, Greece Spyros Kokolakis

Military University of Technology, Poland Michał Misztal Consiglio Nazionale delle Ricerche, Italy Francesco Mercaldo

Christos Kalloniatis University of the Aegean, Greece

University of California, Riverside, USA Nael Abu-Ghazaleh

Contents

Meeting Requirements Imposed by Secure Software Development Standards and Still Remaining Agile	3
Adapting Enterprise Security Approaches for Evolving Cloud Processing and Networking Models	16
Data Mining and Information Security	28
Critical Infrastructure Protection and Visualization	
Extending FAST-CPS for the Analysis of Data Flows	
in Cyber-Physical Systems	37
Visualization-Driven Approach to Anomaly Detection in the Movement of Critical Infrastructure	50
Detection and Mitigation of Time Delay Injection Attacks on Industrial Control Systems with PLCs	62
Choosing Models for Security Metrics Visualization	75
Security and Resilience of Network Systems	
iCrawl: A Visual High Interaction Web Crawler	91
Race Condition Faults in Multi-core Systems	104
Security Requirements for the Deployment of Services Across Tactical SOA	115
Vasileios Gkioulos and Stephen D. Wolthusen	

Adaptive Security

Nodal Cooperation Equilibrium Analysis in Multi-hop Wireless Ad Hoc Networks with a Reputation System	131
Network Anomaly Detection Based on an Ensemble of Adaptive Binary Classifiers	143
Cardholder's Reputation System for Contextual Risk Management in Payment Transactions	158
Towards Self-aware Approach for Mobile Devices Security	171
Anti-malware Techniques: Detection, Analysis, Prevention	
Resident Security System for Government/Industry Owned Computers	185
tLab: A System Enabling Malware Clustering Based on Suspicious Activity Trees	195
Malware Analysis and Detection via Activity Trees in User-Dependent Environment	211
A Concept of Clustering-Based Method for Botnet Detection	223
Security of Emerging Technologies	
Easy 4G/LTE IMSI Catchers for Non-Programmers	235
Anomaly Detection in Cognitive Radio Networks Exploiting Singular Spectrum Analysis	247
HEPPA: Highly Efficient Privacy Preserving Authentication for ITS An Braeken, Sergey Bezzateev, Abdellah Touhafi, and Natalia Voloshina	260

	Contents	AIII
Applied Cryptography		
Automated Cryptographic Analysis of the Pedersen Commitme Roberto Metere and Changyu Dong	ent Scheme	275
Steganalysis Based on Statistical Properties of the Encrypted N Valery Korzhik, Ivan Fedyanin, Artur Godlewski, and Guillermo Morales-Luna	lessages	288
Security Assessment of Cryptographic Algorithms		299
Quick Response Code Secure: A Cryptographically Secure And Tool for QR Code Attacks	_	313
New Ideas and Paradigms for Security		
A Novel and Unifying View of Trustworthiness in Cyberphysic Steven Drager and Janusz Zalewski	cal Systems	327
Information Security of SDN on the Basis of Meta Data Alexander Grusho, Nick Grusho, Michael Zabezhailo, Alexander Zatsarinny, and Elena Timonina		339
Toward Third-Party Immune Applications		348
Author Index		361