Bo Luo · Mohamed Mosbah · Frédéric Cuppens · Lotfi Ben Othmane · Nora Cuppens · Slim Kallel (Eds.)

# Risks and Security of Internet and Systems

16th International Conference, CRiSIS 2021 Virtual Event, Ames, USA, November 12–13, 2021 Revised Selected Papers



# Lecture Notes in Computer Science 13204

#### Founding Editors

Gerhard Goos Karlsruhe Institute of Technology, Karlsruhe, Germany

Juris Hartmanis Cornell University, Ithaca, NY, USA

#### **Editorial Board Members**

Elisa Bertino Purdue University, West Lafayette, IN, USA

Wen Gao Peking University, Beijing, China

Bernhard Steffen D TU Dortmund University, Dortmund, Germany

Gerhard Woeginger D *RWTH Aachen, Aachen, Germany* 

#### Moti Yung D

Columbia University, New York, NY, USA

More information about this series at https://link.springer.com/bookseries/558

Bo Luo · Mohamed Mosbah · Frédéric Cuppens · Lotfi Ben Othmane · Nora Cuppens · Slim Kallel (Eds.)

# Risks and Security of Internet and Systems

16th International Conference, CRiSIS 2021 Virtual Event, Ames, USA, November 12–13, 2021 Revised Selected Papers



*Editors* Bo Luo University of Kansas Lawrence, KS, USA

Frédéric Cuppens D Polytechnique Montréal Montréal, QC, Canada

Nora Cuppens 🕩 Polytechnique Montréal Montréal, QC, Canada Mohamed Mosbah University of Bordeaux Bordeaux, France

Lotfi Ben Othmane D Iowa State University Iowa City, IA, USA

Slim Kallel D University of Sfax Sfax, Tunisia

ISSN 0302-9743 ISSN 1611-3349 (electronic) Lecture Notes in Computer Science ISBN 978-3-031-02066-7 ISBN 978-3-031-02067-4 (eBook) https://doi.org/10.1007/978-3-031-02067-4

© The Editor(s) (if applicable) and The Author(s), under exclusive license

to Springer Nature Switzerland AG 2022

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, expressed 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.

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

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.

### Preface

This volume contains the papers presented at the 16th International Conference on Risks and Security of Internet and Systems (CRISIS 2021). Due to the COVID-19 pandemic, CRISIS 2021 was held both virtually and onsite at Iowa State University, Ames, USA. It continued a tradition of successful conferences: Bourges (2005), Marrakech (2007), Tozeur (2008), Toulouse (2009), Montréal (2010), Timisoara (2011), Cork (2012), La Rochelle (2013), Trento (2014), Mytilene (2015), Roscoff (2016), Dinard (2017), Arcachon (2018), Hammamet (2019), and Online (2020).

In response to the call for papers, 23 papers were submitted. Each paper was reviewed by at least three reviewers. The Program Committee was composed of 54 members from 15 countries, completed by five external reviewers. The Program Committee selected nine regular papers and three short papers. The accepted papers cover the following research themes: cyber-physical systems, hardware security, network security, data security, attacks, responses, and security management. Ashfaq Khokar, chair of the Electrical and Computer Department at Iowa State University, USA, opened the conference and welcomed the participants and Bharat Bhargava from Purdue University, USA, gave the conference keynote.

We thank the people who contributed to the success of CRISIS 2021. In particular, we express our appreciation to the authors of the submitted papers, the Program Committee members, the external reviewers, and the organizing committee for the hard work they did locally at Iowa State University.

December 2021

Bo Luo Mohamed Mosbah

# Organization

#### **General Chairs**

Frédéric Cuppens	Polytechnique Montreal, Canada
Nora Cuppens	Polytechnique Montreal, Canada
Lotfi Ben Othmane	Iowa State University, USA

#### **Program Committee Chairs**

Bo Luo	University of Kansas, USA
Mohamed Mosbah	University of Bordeaux, France

#### **Publicity Chairs**

Reda Yaich	IRT SystemX, France
Slim Kallel	University of Sfax, Tunisia

#### **Organizing Committee**

Lotfi Ben Othmane	Iowa State University, USA
Jian Kai Lee	Iowa State University, USA

#### **Program Committee**

Saed Alrabaee

Esma Aïmeur Michel Barbeau Sébastien Bardin Lotfi Ben Othmane Razvan Beuran

Anis Bkakria Ismael Bouassida Aymen Boudguiga Ana Rosa Cavalli Frederic Cuppens Nora Cuppens Soufiene Djahel United Arab Emirates University, United Arab Emirates University of Montreal, Canada Carleton University, Canada CEA LIST, France Iowa State University, USA Japan Advanced Institute of Science and Technology, Japan IRT SystemX, France LAAS-CNRS, France IRT SystemX, France Telecom SudParis, France Polytechnique de Montreal, Canada Polytechnique de Montreal, Canada Manchester Metropolitan University, UK Jiankuo Dong Mohamed Ghazel Bogdan Groza Yong Guan Berk Gulmezoglu Pinyao Guo Philippe Jaillon Shijie Jia Christos Kalloniatis Sokratis Katsikas Igor Kotenko **Evangelos Kranakis** Marc Lacoste Jean Leneutre Fengjun Li Luigi Logrippo Bo Luo Sanjay Madria Ahmed Meddahi Mohamed Mosbah Guillermo Navarro Kai Rannenberg Michael Rusinowitch Siraj A. Shaikh Jun Shao Seungwon Shin Lingyun Situ Natalia Stakhanova Ketil Stoelen Qiang Tang Nadia Tawbi Eugene Vasserman Lingyu Wang Hasan Yasar Lingjing Yu Akka Zemmari Wenhui Zhang

Nanjing University of Posts and Telecommunications, China **IFSTTAR – ESTAS. France** Politehnica University of Timisoara, Romania Iowa State University, USA Iowa State University, USA Pennsylvania State University, USA Ecole des Mines de Saint-Etienne, France Chinese Academy of Sciences, China University of the Aegean, Greece Norwegian University of Science and Technology, Norway St. Petersburg Federal Research Center of the Russian Academy of Sciences, Russia Carleton University, Canada Orange Labs, France Telecom Paris, France University of Kansas, USA Universite du Quebec en Outaouais, Canada University of Kansas, USA Missouri University of Science and Technology, USA IMT Nord Europe, France University of Bordeaux, France Autonomous University of Barcelona, Spain Goethe University Frankfurt, Germany Loria - Inria Nancy, France Coventry University, UK Zhejiang Gongshang University, China Texas A&M University, USA Nanjing University, China University of Saskatchewan, Canada SINTEF, Norway Luxembourg Institute of Science and Technology, Luxembourg Laval University, Canada Kansas State University, USA Concordia University, Canada Carnegie Mellon University, USA Chinese Academy of Sciences, China Universite de Bordeaux, France Pennsylvania State University, USA

Bin Zhao	Pennsylvania State University, USA
Junwei Zhou	Wuhan University of Technology, China
Wei Zhou	Pennsylvania State University, USA

# **Additional Reviewers**

Manh-Dung Nguyen Congdong Lv Farzaneh Abazari Michael Schmid David Harborth

# Contents

#### **CPS and Hardware Security**

Threat Modeling of Cyber-Physical Systems in Practice   Ameerah-Muhsinah Jamil, Lotfi Ben Othmane, and Altaz Valani	
AVSDA: Autonomous Vehicle Security Decay Assessment Lama Moukahal, Mohammad Zulkernine, and Martin Soukup	20
A TSX-Based KASLR Break: Bypassing UMIP and Descriptor-Table Exiting	38
Attacks, Responses, and Security Management	
A Stakeholder-Centric Approach for Defining Metrics for Information Security Management Systems	57
A Novel Approach for Attack Tree to Attack Graph Transformation Nathan Daniel Schiele and Olga Gadyatskaya	74
Intelligent Decision Support for Cybersecurity Incident Response Teams: Autonomic Architecture and Mitigation Search <i>Camilo Correa, Jacques Robin, Raul Mazo, and Salvador Abreu</i>	91
Using Garbled Circuit for Secure Brokering Lotfi Ben Othmane and Noor Ahmed	108
Network and Data Security	
Path-Preserving Anonymization for Inter-domain Routing Policies Xiaozhe Shao, Hossein Pishro-Nik, and Lixin Gao	121
Policy Modeling and Anomaly Detection in ABAC Policies Maryam Davari and Mohammad Zulkernine	137

#### xii Contents

#### **Short Papers**

Designing a Service for Compliant Sharing of Sensitive Research Data Aakash Sharma, Thomas Bye Nilsen, Sivert Johansen, Dag Johansen, and Håvard D. Johansen	
Authenticated Multi-proxy Accumulation Schemes for Delegated	162
Hannes Salin, Dennis Fokin, and Alexander Johansson	102
Extending the Exposure Score of Web Browsers by Incorporating CVSS Fadi Mohsen, Adel Shtayyeh, Riham Naser, Lena Mohammad, and Marten Struijk	172
Author Index	183