Cybersecurity Investigations and Digital Forensics: Mini-track Overview

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Abstract

The continuous amalgamation of technology into everyday life is creating an environment that is conducive to encouraging cybercrimes. As a result, it is becoming increasingly important that organizations and law enforcement agencies have the capability to conduct in-depth and detailed investigations. Hence, corporate and legal responses that address the resulting concerns presented in this mini-track include 'DNA Feature Selection for Discriminating WirelessHART IIoT Devices' and 'Container and VM Visualization for Rapid Forensic Analysis'. These contributions highlight the growing need to investigate and address cyber-security vulnerabilities in the broad context of today's information-driven society.

1. Introduction

As technology is increasingly incorporated into aspects of daily life, cybersecurity and digital forensics investigations need to evolve and diversify [1-9]. This results in the necessity of innovative managerial, technological, and strategic solutions to address resulting concerns [10-13]. This environment presents the opportunity to research a) technology investigations, b) technical integration and solution impact, c) the abuse of technology through attacks along with d) the effective analysis and evaluation of proposed solutions. Identifying and validating technical solutions to access data from new technologies, investigating the impact that these solutions have on the industry, and understanding how technologies can be abused is crucial to the viability of commercial, government, and legal communities.

This mini-track is dedicated to reporting state-of-the-art research in the emerging area of cybersecurity investigations and digital forensics. This year, the mini-track received multiple submissions, of which two were accepted for publication. Each paper went through a rigorous peer-review process, as well as follow-up rounds with the authors. A summary of each paper is provided below.

2. DNA Feature Selection

The proliferation of Wireless Highway Addressable Remote Transducer (WirelessHART) communications in support of Industrial Internet of Things (IIoT) applications are accompanied by increased vulnerability concerns that amplify the need for improved pre-attack security and post-attack forensic methods. In their paper 'DNA Feature Selection for Discriminating WirelessHART IIoT Devices,' Rondeau, Temple, and Kabban [14] investigate activities aimed at applying Time Domain Distinct Native Attribute (TD-DNA) fingerprinting and improving feature selection to increase computational efficiency and the potential for near-real-time operational application. Assessments include both pre-classification and post-classification dimensional reduction using TD-DNA fingerprint features extracted from experimentally collected WirelessHART signals. Results show that pre-classification selection methods are superior, with average percent correct classification differential of 8% $< \%C_\Delta < 1\%$ being maintained using selected feature subsets containing only 24 (10%) of the 243 full-dimensional features.

3. Container and VM Visualization

Cloud-based and virtualization-centric digital forensic investigations continue to pose problems for forensic investigators. Hence, further socio-technical and technical solutions are needed to provide investigators with the tools and techniques to collect evidence from such environments.

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In their paper titled 'Container and VM Visualization for Rapid Forensic Analysis,' Shropshire and Benton [15] argue that most cloud security incidents are initially detected by automated monitoring tools. Because they are tuned to minimize the risk of false-negative errors, these tools cast a wide net of suspicion. Depending on the incident scale, the automated tools may implicate rather long lists of virtual machines and containers. Hence, this approach proposes a new intermediate step aimed at reducing the number of virtual machines and containers awaiting forensic investigation. The proposed method renders two-dimensional visualizations of container contents and virtual machine disk images. The visualizations can be used to fingerprint containers, pinpoint instances of embedded malware, and find modified code.

4. Summary

In summary, the papers presented in this mini-track contribute to addressing the knowledge gap between existing scholarship and challenges in the field of cybersecurity investigation and digital forensics. However, a number of challenges remain in this emerging research area that includes but is not limited to technical solutions to cyber-crime, resolution of digital forensic issues, and security vulnerabilities. The challenges include the identification of solutions and approaches to solving complex investigation that involves technology such as smart cities, cyber-physical systems, and internet of things environments. In addition, growing storage capacities warrant further research into retrieval, analysis, and evaluation of large data repositories.

5. References

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