Guest Editorial Advances in Digital Forensics for Communications and Networking

Computer and Internet crimes are on the rise due to the fast-paced development of computer and Internet technology. Information security in Internet communications and electronic business is essential, and techniques to combat these crimes are required more and more on a daily basis. Network forensics has been an emerging research area for IT-related professionals, researchers, and practitioners since the turn of the century. Crimes committed using data embedding/mining systems, computer systems, network communications, or system detections pose a great threat to information security. Another area of focus in network forensics is how to collect and analyze digital evidence in an existing communication and network environment.

Digital forensics has many challenges, including effective evidence collection and efficient forensic procedures in data mining for evidence trace, custody of evidence chain, digital evidence management and data/image authentication and forensics, cryptography and cryptanalysis in forensics, and network forensics. The interest in digital forensics in network systems can be seen in industrial and standardization efforts accomplished in recent years, including commercial integrated forensic tools developments, the standardization efforts of text-interface to graphic interface to facilitate evidence mining and speed up investigations, and forensic procedures in communication and network systems. This special issue gives a state-of-the-art overview of problems and solution guidelines emerging in current digital forensic research efforts for communication and network systems. A wide variety of topics are addressed, from the physical views such as forensic developments in computer and communication-link environments, to logical views programming of interface connections and testing of forensic tools; from conceptual views, such as effective management of seized evidence and diverse system operations, to user views - in security issues such as authentications, forensic procedures, and ethical and policy issues related to network forensics.

The goal of this special issue is to report on cutting-edge research achievements covering aspects of the forensics and security areas in communications and networks that are distinctively different from security protocols in computer and network systems in general, including information and communication technologies, law, social sciences and business administration. In response to the call for papers, we received a total of 34 submissions, of which 13 papers were selected for publication.

The first six papers in this issue are related to Forensics and Anti-forensics Technologies.

The paper "Attack Pattern Discovery in Forensic Investigation of Network Attacks" by Zhu presents an iterative algorithm for discovering attack patterns via a feedback mechanism, with the degrees of belief for attack instances propagated to the next iteration to further refine the search. The simulations verify that the algorithm achieves accuracy in the digital forensic task of discovering attack patterns.

In "Joint Forensics-Scheduling Strategy for Delay-Sensitive Multimedia Applications over Heterogeneous Networks," Zhou, Chao, and Vasilakos develop a joint forensics-scheduling scheme, which allocates the available network resources based on the affordable forensics overhead and expected quality of service, adaptively adjusts the scalable media-aware forensics, and schedules the transmissions to meet the applications delay constraints.

In "Live Data Mining Concerning Social Networking Forensics Based on a Facebook Session Through Aggregation of Social Data," Chu, Deng, and Park investigate live data acquisition within the RAM of the desktop PC with emphasis on some distinct strings that could be found in order to reconstruct the previous session in a Facebook platform, which plays an extremely precious role for digital forensics investigators to incubate additional thoughtful decisions concerning the discovery of breadcrumb digital evidence.

In "A Plausibly-Deniable, Practical Trusted Platform Module Based Anti-Forensics Client-Server System," Goh, Leong, and Yeo demonstrate a novel approach of using a TPM-enabled computer in a client-server system to hinder forensic examination. The system allows for data confidentiality, plausible deniability, and hiding of traces that data containing incriminating information was present on the client.

The next paper, "Anti-Forensics with Steganographic Data Embedding in Digital Images" by Sun, Weng, Lee, and Yang proposes an anti-forensic steganography method that can embed and extract messages from images. There are two novel approaches developed: the Highlight of Exploiting Modification Direction (HoEMD) and the Adaptive Exploiting Modification Direction (AdEMD). These achieve high efficiency, high quality and large embedding ratios. The proposed steganography system has a larger embedding capacity and a higher image quality. The effectiveness of the proposed steganography schemes over that of a previous blind steganalyzer is demonstrated using the statistical attack of Chi-square analysis.

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In "On the Typical Statistic Features for Image Blind Steganalysis," Luo, Liu, Lian, Yang, and Gritzalis study steganalysis techniques in multimedia carriers. Such techniques are used to detect the existence of secret messages embedded in digital media. This paper reviews existing feature computing algorithms, compares the two kinds of features, the PDF moments and the CF moments, by analyzing the change trends of the statistic distribution parameters of various frequency subbands before and after message embedding. This provides a theoretical basis for the steganalysis feature selection and extraction. These theoretical results are further confirmed by experimental results. It is expected to provide valuable information to researchers or engineers working in the field of steganography forensics or steganalysis.

The next five papers are related to Evidence Investigations in Attacks.

In "Blacklisting Recommendation System: Using Spatio-Temporal Patterns to Predict Future Attacks," Soldo, Le, and Markopoulou address the problem of forecasting attack sources based on past attack logs from several contributors. This paper formulates this problem as an implicit recommendation system and proposes a multi-level prediction model to solve it.

The paper "A Novel Probabilistic Matching Algorithm for Multi-Stage Attack Forecasts" by Cheng, Liao, Huang, and Yu proposes Judge Evaluation of Attack intensioN (JEAN), an algorithm that inspects the security alerts in the network and provides a probabilistic approach for the prediction of a multi-stage attack by measuring the difference between the stored and the actual multi-stage attack session graphs (ASG).

In "A Flow Classifier with Tamper-Resistant Features and an Evaluation of Its Portability to New Domains," Zou, Kesidis, and Miller propose a TCP flow classifier that employs neither packet header information that is protocol-specific (including port numbers) nor packet-payload information. Techniques based on the former are readily evadable, while detailed yet scalable inspection of packet payloads is difficult to achieve, may violate privacy laws, and is defeated by data encryption. Besides this, it also investigates and evaluates a hypothesis testing approach to detect port spoofing by exploiting confusion matrix statistics.

The next paper "BrowserGuard: A Behavior-Based Solution to Drive-by-Download Attacks" by Tso, Hsu, Yeh, Wang and Chen presents a runtime, browser-based solution, BrowserGuard, to protect a browser against drive-by-download attacks. BrowserGuard records the download scenario of every file that is loaded into a host through a browser. Then based on the download scenario, BrowserGuard blocks the execution of any file that is loaded into a host without the consent of a browser user.

In the paper "Identifying Wireless Users via Transmitter Imperfections," Polak, Dolatshahi, and Goeckel develop algorithms based on statistical signal processing methods to exploit non-linearities of wireless transmitters for the purpose of user identification in wireless systems. The decision rules are derived and their performance is analyzed. In order to establish the viability of the proposed approach, practical variations of transmitter chain components are analyzed based on simulations, measurements and manufacturers' specifications.

The remaining papers are related to Privacy and Secure Protocols.

In "Location Privacy in Unattended Wireless Sensor Networks upon the Requirement of Data Survivability," Chen and Tsai study the trade-off between the data survival rate and the location privacy of a critical node in an UWSN. Obviously, an increase in the number of data replicas can improve the data survival rate, but could severely degrade the location privacy of a critical node. There are three location estimation algorithms proposed: the coordinate median, average of overlapping area and expectation-maximization approaches. The location estimation performance of the proposed schemes is evaluated and the trade-off between the data survival rate and the location privacy is investigated. According to the simulation results, location privacy degrades severely with an increase in the number of data replicas.

In "Optimistic Fair Exchange with Strong Resolution-Ambiguity," Huang, Mu, Susilo, Wu, and Xiang introduce and define a new property for OFE (Optimistic Fair Exchange): Strong Resolution-Ambiguity. The paper shows that many existing OFE protocols have the new property, but its formal investigation has been missing in those protocols. It turns out that in the certified-key model, an OFE protocol is secure in the multi-user setting if it is secure in the single-user setting and has the property of strong resolution-ambiguity.

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Prof. Wang has published over 200 papers in referred Journals/Conference proceedings/Technique reports so far. He is a full professor and a member of the IEEE, ACM. His current interests include information security, digital investigation and computer forensics, steganography, cryptography, data construction and engineering. He served a lot of academic and reputable journals in the position of guest-editors. He is currently the corresponding editor- IEEE J-SAC (IEEE Journal on Selected Areas in Communications), at http://www.comsoc.org/livepubs/sac/index.html

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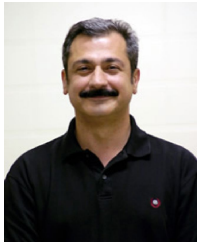

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Dr. Arabnia has received a number of prestigious awards; in 2006, he received the Distinguished Service Award "in recognition and appreciation of his contributions to the profession of computer science and his assistance and support to students and scholars from all over the world"; this award was formally presented to him on June 26, 2006 by Professor Barry Vercoe (a founding member of the MIT Media Lab). More recently (October 14, 2007), Dr. Arabnia received an "Outstanding Achievement Award in Recognition of His Leadership and Outstanding Research Contributions to the Field of Supercomputing"; this award was formally presented to him at Harvard University Medical School (signatories: Lawrence O. Hall, President of IEEE/SMC; Zhi-Pei Liang, Vice President of IEEE/EMB; Jack. Y. Yang, General Chair of IEEE BIBE and Harvard University; Mary Qu Yang, Chair of Steering Committee, IEEE BIBE and NIH).

Dr. Arabnia has published extensively in journals and refereed conference proceedings. He has over 300 publications (journals, proceedings, editorship) in his areas of research. He has been a PI/Co-PI on over $8 Million externally funded projects/initiatives. In addition, Dr. Arabnia, during his tenure as Graduate Coordinator/Director of Computer Science (August 2002 – January 2009), secured the largest level of funding in the history of the department for supporting the research and education of graduate students (PhD, MS).

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