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Email forensic tools: A roadmap to email header analysis through a cybercrime use case

Keywords

email forensics, cybercrime, digital forensic tools, digital crime

Abstract

Email is one of the primary sources of numerous criminal activities, on the Internet, of which some threaten human lives. Email analysis is challenging due to not only various fields that can be forged by hackers or the wide range email applications in use, but also due to imposed law restrictions in the analysis of email body. Despite this being a relatively new area, a number of both open source and proprietary forensic tools, with varying possibilities and versatility, have been developed aiding use by practitioners. In this paper, we review existing email forensic tools for email header analysis, as part of email investigation, with emphasis on aspects related to online crime while still considering legal constraints. Through our analysis, we investigate a common case of cybercrime and examine the breadth of information one may gain solely through email forensics analysis. Additionally, a roadmap for email forensic analysis is presented, combining features and functionality already available, to assist the process of digital forensic analysis.

1. Introduction

We span the information age where information is maintained in digital form aiding improved efficiency and productivity [34]. The internet is a network of networks, connecting millions of computing devices [24] performing information interchange throughout the world; producing a large amount of electronic messages. As a result, e-mail has emerged as the most important application on Internet for communication of information, used not only from computers but many other electronic gadgets. Royal Pingdom, which monitors the Internet usage, stated that in 2010, 107 trillion e-mails were sent; tha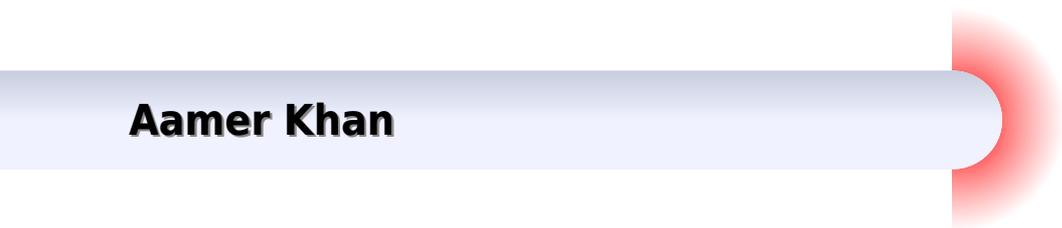t is 294 billion e-mails sent per day [21]. The heavy exchange of electronic messages coupled with the right of anonymity, result in increased number of criminal and terrorism activity [27]

mainly due to two inherent limitations [12]. There is rarely any encryption at the sender end and/or integrity checks at the recipient end, while the widely used e-mail protocol SMTP (Simple Mail Transfer Protocol) lacks a source authentication mechanism. Although there have been many attempts into securing e-mail systems, most are still inadequately secured. Installing antiviruses, filters, firewalls and scanners is simply not enough to secure e-mail communications.

Some common examples of illegitimate uses of emails are spam, phishing, cyber bullying, racial abuse, disclosure of confidential information, child pornography and sexual harassment. In the vast majority of these e-mail cybercrimes the tactics used vary from simple anonymity to impersonation and identity theft. Therefore, a forensic investigator needs efficient tools and techniques to perform the

Email Forensic Tools A Roadmap To Email Header Analysis

Aamer Khan

Email Forensic Tools A Roadmap To Email Header Analysis:

   Smart Data Intelligence R. Asokan,Diego P. Ruiz,Vasile-Daniel Păvăloaia,2025-11-07 This book presents high quality research papers presented at 5th International Conference on Smart Data Intelligence ICSMDI 2025 organized by Kongunadu College of Engineering and Technology at Trichy Tamil Nadu India during January 2025 This book brings out the new advances and research results in the fields of algorithmic design data analysis and implementation on various real time applications It discusses many emerging related fields like big data data science artificial intelligence machine learning and deep learning which have deployed a paradigm shift in various data driven approaches that tends to evolve new data driven research opportunities in various influential domains like social networks health care information and communication applications   Intelligent Systems and Networks Duc-Tan Tran,Gwanggil Jeon,Thi Dieu Linh Nguyen,Joan Lu,Thu-Do Xuan,2021-05-12 This book presents Proceedings of the International Conference on Intelligent Systems and Networks ICISN 2021 held at Hanoi in Vietnam It includes peer reviewed high quality articles on intelligent system and networks It brings together professionals and researchers in the area and presents a platform for exchange of ideas and to foster future collaboration The topics covered in this book include foundations of computer science computational intelligence language and speech processing software engineering software development methods wireless communications signal processing for communications electronics track IoT and sensor systems embedded systems etc   Information and Cyber Security Hein Venter,Mariki Eloff,Jan Eloff,Reinhardt Botha,Marianne Loock,Umer Mushtaq,2025-12-16 This book constitutes the refereed post conference proceedings of the 23rd International Conference on Information Security ISSA 2024 held in Gqeberha South Africa during December 2 3 2024 The 21 full papers presented were carefully reviewed and selected from 55 submissions The papers focus on topics such as Cyber security Information Security Network Security Computer Security Digital Forensics Botnets Security in Cloud Computing ChatBot security Insider Threats NIDS GANs and Malware Privacy Cyber security Education Cyber security Digital Forensics AI   **Email Forensics** Craw Security,2022-04-20 Email Communication first evolved in the 1960s and since then emails are being used as the primary communication mode in enterprises for business communication Today a mass number of internet users are dependent on emails to receive information and deals from their service providers The growing dependence on email for daily communication given raise to email crimes Cybercriminals are now using email to target innocent users to lure them with attractive deals via spam emails Therefore forensic investigators need to have a thorough understanding of an email system and different techniques used by cyber criminals to conduct email crimes Email forensics refers to the study of the source and content of emails as evidence to spot the actual sender and recipient of a message data time and intent of the sender In this module of the computer forensics investigation series we will learn various steps involved in the investigation of email crime We will learn to investigate the meta data of malicious emails You will understand port scanning keyword searching and analysis of headers in emails Here

the primary goal for a forensics investigator is to find the person behind the email crime Hence he has to investigate the server of the email network devices software and fingerprints of the sender mailer Further we will understand various components involved in email communication We will learn about mail user agents mail transfer agents and various protocols used to send emails As we know an email system works on the basic client server architecture that allows clients to send and receive emails An email client software helps the sender to compose the mail Most of them have a text editor which helps the sender to compose the email for the receiver Here while composing emails malicious people embed malicious scripts and attach malware and viruses which are then sent to people The goal of this ebook is not to help you set up an email server rather we will focus on understanding the basic functionality of the email server We will understand what components an email system consists of which allows users to send and receive emails Furthermore we will dive deeper into the forensics part to investigate and discover evidence We will understand the investigation procedure for email crimes **Investigating and Implementing an Email Forensic Readiness Architecture** Franscois Ruan Van Staden,2017 Email forensic investigations rely on the collection and analysis of digital forensic evidence collected from email systems Problems arise when the digital forensic evidence needed for the email forensic investigation is no longer available or there is a huge amount of email data that can be collected which take time to sift through to find the digital forensic evidence that is actually needed The email digital forensic readiness eDFR architecture as proposed in this dissertation endeavours to address these problems The eDFR architecture is based on the digital forensic readiness process described in ISO 27043 To ensure that the collected email data can be used as digital forensic evidence a process to validate the collected email data was created The validation process uses data collected from the email IP headers to validate the data in the SMTP headers ensuring that the SMTP header data was not spoofed or in any way changed The IP header data is stored in an audit database together with the email data so that the validation process can be executed at any time An audit database is used to store the collected data to ensure that once the data is stored it cannot be tampered with The digital forensic evidence collected using the eDFR architecture was found to be useable as part of an email forensic investigation It was also found to be useful for other processes such as creating a graph representation of email sent and received by an email system or a group of email systems It was shown that implementing the eDFR architecture could be achieved in an economical way that has almost no impact on current email systems <u>Evaluation of Some SMTP Testing, Email Verification, Header Analysis, SSL Checkers, Email Delivery, Email Forwarding and WordPress Email Tools</u> Dr. Hidaia Mahmood Alassouli,2023-07-01 Simple Mail Transfer Protocol SMTP is a set of rules used while sending emails Usually this protocol is associated with IMAP or POP3 However SMTP is utilized to deliver messages while POP3 and IMAP are utilized to receive them The SMTP testing tool identifies issues with email security in your server that can hinder your email delivery It checks the health status of your outgoing email server and notifies you about the detected problems such as connectivity issues and how to tackle them An SMTP test

tool can identify SMTP server issues and troubleshoot them to keep your email secure and safe SSL certificates are what enable websites to use HTTPS which is more secure than HTTP An SSL certificate is a data file hosted in a website s origin server SSL certificates make SSL TLS encryption possible and they contain the website s public key and the website s identity along with related information Devices attempting to communicate with the origin server will reference this file to obtain the public key and verify the server s identity The private key is kept secret and secure The SSL Checker tool can verify that the SSL Certificate on your web server is properly installed and trusted Email headers are present on every email you receive via the Internet The email header is generated by the client mail program that first sends it and by all the mail servers on route to the destination Each node adds more text including from to addresses subject content type time stamp and identification data You can trace the path of the message from source to destination by reviewing the email header text Header Analyzers can help you view and analyze message headers by displaying the information in a user friendly manner and also by calling out various issues such as suspected delivery delays that may require your attention Microsoft Remote Connectivity Analyzer provides many tests including tests for Inbound and outbound SMTP emails The Inbound SMTP Email test shows you the various steps taken by an email server to send your domain an inbound SMTP email Similarly an Outbound SMTP Email test finds out your outbound IPs for some requirements It includes Reverse DNS RBL checks and Sender ID Cloudflare Inc is an American company that provides content delivery network services cloud cybersecurity DDoS mitigation and ICANN accredited domain registration services Registration of international domains can be done through https NIC UA website Mailtrap io is Email Delivery Platform for individuals and businesses to test send and control email infrastructure in one place Windows PowerShell is mostly known as a command line shell used to solve some administration tasks in Windows and apps running on this OS At the same time it is a scripting language that allows you to tailor cmdlets lightweight commands to perform specific functions You can use the built in Send MailMessage cmdlet to send SMTP e mails from PowerShell Infinityfree com provide free website hosting with PHP and MySQL and no Ads in your website WP Mail SMTP is the best WordPress SMTP plugin that allows you to easily send WordPress emails using a simple mail transfer protocol SMTP If you send an email via your WordPress form you will then be able to keep track of it Improvmx com is good Email Forwarding website to be used to receive and send emails with your domain name You can setup business Email and Email forwarding through improvmx com It is possible to add any ImprovMX alias as a sending email on Gmail The book consists from the following sections 1 Types of DNS Records 2 SSL and TLS Certificates 3 Replacing the Default FortiMail Certificate 4 Header Analysis 5 Some Tools for Email Verification 6 Evaluation of Some SMPT Testing Tools 7 Microsoft Remote Connectivity Analyzer 8 Creating Free Domain in https nic ua and Linking it to Cloudflare com 9 Mailtrap io Email Delivery Platform 10 Sending Emails Using Windows Power Shell 11 Free Web Hosting from infinityfree com 12 Installing Different Types of Plugins Related to Mail on the WordPress Website 13 Setting Up a Business Email and Email Forwarding

Through Improvmx com 14 SSL Certificates Checkers 15 References   **Automation of Email Analysis Using a Database** Jasbinder Singh Bali,2007 ABSTRACT Phishing scams which use emails to trick users into revealing personal data have become pandemic in the world Analyzing such emails to extract maximum information about them and make intelligent forensic decisions based on such an analysis is a major task for law enforcement agencies To date such analysis is done by manually checking various headers of a raw email and running various Unix tools on its constituent parts such as IP addresses links domain names This thesis describes the design and development of a database system used for automation of a system called the Undercover Multipurpose Anti Spoofing Kit UnMASK that will enable investigators to reduce the time and effort needed for digital forensic investigations of email based crimes It also describes how the database is used to perform such automation UnMASK uses a database for organizing a work flow to automatically launch Unix tools to collect additional information from the Internet The retrieved information is in turn added to the database UnMASK is a working system To the best of our knowledge UnMASK is the first comprehensive system that can automate the process of analyzing emails using a database and then generate forensic reports that can be used for subsequent investigation and prosecution
Investigating Email Crimes Vijay Kumar Gupta,2024-08-03 In the digital age email remains one of the most essential tools for communication but it also opens the door to a multitude of cybercrimes Investigating Email Crimes Unmasking Digital Deceit is your essential guide to understanding uncovering and preventing email fraud This comprehensive ebook delves into the intricate world of email crimes offering readers detailed insights into various types of email based threats such as phishing spoofing and ransomware Whether you re a cybersecurity professional an IT specialist or simply a concerned user this book provides practical strategies and techniques for investigating email crimes Learn how to trace email origins analyze email headers and implement robust security measures to protect your digital communications Filled with real world examples case studies and step by step instructions Investigating Email Crimes equips you with the knowledge to stay one step ahead of cybercriminals Empower yourself with the tools and understanding needed to combat email fraud Protect your inbox and ensure your online safety with this indispensable resource   *A Framework for Extended Acquisition and Uniform Representation of Forensic Email Evidence* Justin W. Paglierani,2013 The digital forensics community has neglected email forensics as a process despite the fact that email remains an important tool in the commission of crime Current forensic practices focus mostly on that of disk forensics while email forensics is left as an analysis task stemming from that practice As there is no well defined process to be used for email forensics the comprehensiveness extensibility of tools uniformity of evidence usefulness in collaborative distributed environments and consistency of investigations are hindered At present there exists little support for discovering acquiring and representing web based email despite its widespread use To remedy this a systematic process which includes discovering acquiring and representing web based email for email forensics which is integrated into the normal forensic analysis workflow and which accommodates the distinct characteristics of email evidence

will be presented This process focuses on detecting the presence of non obvious artifacts related to email accounts retrieving the data from the service provider and representing email in a well structured format based on existing standards As a result developers and organizations can collaboratively create and use analysis tools that can analyze email evidence from any source in the same fashion and the examiner can access additional data relevant to their forensic cases Following an extensible framework implementing this novel process driven approach has been implemented in an attempt to address the problems of comprehensiveness extensibility uniformity collaboration distribution and consistency within forensic investigations involving email evidence *Evaluation of Some SMTP Testing, SSL Checkers, Email Delivery, Email Forwarding and WP Email Tools* Dr. Hedaya Alasooly,2023-07-02 Simple Mail Transfer Protocol SMTP is a set of rules used while sending emails Usually this protocol is associated with IMAP or POP3 However SMTP is utilized to deliver messages while POP3 and IMAP are utilized to receive them The SMTP testing tool identifies issues with email security in your server that can hinder your email delivery It checks the health status of your outgoing email server and notifies you about the detected problems such as connectivity issues and how to tackle them An SMTP test tool can identify SMTP server issues and troubleshoot them to keep your email secure and safe The SSL Checker tool can verify that the SSL Certificate on your web server is properly installed and trusted Cloudflare Inc is an American company that provides content delivery network services cloud cybersecurity DDoS mitigation and ICANN accredited domain registration services Registration of international domains can be done through NIC UA website Mailtrap io is Email Delivery Platform for individuals and businesses to test send and control email infrastructure in one place Infinityfree com provide free website hosting with PHP and MySQL and no Ads in your website The book consists from the following sections 1 Types of DNS Records 2 SSL and TLS Certificates 3 Replacing the Default FortiMail Certificate 4 Header Analysis 5 Some Tools for Email Verification 6 Evaluation of Some SMPT Testing Tools 7 Microsoft Remote Connectivity Analyzer 8 Creating Free Domain in nic ua and Linking it to Cloudflare com 9 Mailtrap io Email Delivery Platform 10 Sending Emails Using Windows Power Shell 11 Free Web Hosting from infinityfree com 12 Installing Different Types of Plugins Related to Mail on the WordPress Website 13 Setting Up a Business Email and Email Forwarding Through Improvmx com 14 SSL Certificates Checkers 15 References *Digital Forensics, Investigation, and Response* Chuck Easttom,2021-08-10 Digital Forensics Investigation and Response Fourth Edition examines the fundamentals of system forensics addresses the tools techniques and methods used to perform computer forensics and investigation and explores incident and intrusion response **Ethical Hacking & Digital Forensics** Aamer Khan, This book Ethical Hacking Digital Forensics is for those who desire to learn more about investigating and fighting digital crimes It covers latest challenges faced in digital forensic like email forensic mobile forensic and cloud forensic It also sequentially explains disk forensic network forensic memory forensic mobile forensic and cloud forensic The lucid content of the book and the questions provided in each chapter help the learners to prepare themselves for digital

forensic competitive exams It covers complete Ethical Hacking with Practicals Digital Forensics **A Comparison of tools in email forensic investigation** Aleš Grm,Miroslav Bača,2014 *E-Mail Forensics* Les Hatton,2011 This is the first book of its kind to document the detailed application of forensic analysis techniques to the field of e mail security Both investigative and preventative techniques are described but the focus is on prevention The world has been subjected to an increasing wave of spam and more recently scamming and phishing attacks in the last twenty years Such attacks now include industrial espionage and government sponsored spying The volume and sophistication of such attacks has rendered existing technologies only partially effective leaving the end user vulnerable and the number of successful attacks is increasing The seeds of this book were sown three years ago when the author a Professor of Forensic Software Engineering was trying to recover his 20 year old e mail address from the clutches of spammers who had rendered it almost unusable with more than 140 000 junk messages a day It got to the point where he was invited by his ISP to either change it or take it elsewhere Instead he decided to find out how to prevent the deluge acquired his own servers and began researching The book is a mixture of analysis experiment and implementation in almost equal proportions with detailed description of the defence in depth necessary to turn the tidal wave of junk aside leaving only what the end user wants to see no more and no less It covers 1 The rise of e mail 2 How it all works 3 Scams spam and other abuse 4 Protection the principles of filtering 5 Going deeper setting up a mail server 6 Advanced content filtering 7 The bottom line how well can we do 8 Where is all this going There is something here for everyone Chapters 1 4 are suitable for the general reader who just wants to understand how spammers and scammers work and find out a little more about the many forms of attack Chapters 5 and 6 are highly technical and suitable for both e mail administrators and theoreticians and include a discussion of the latest computational and mathematical techniques for detecting textual patterns Chapter 7 presents the results of applying the techniques in this book on the several million junk messages the author s servers received over a 10 month period Chapter 8 tries to see into the future a little to predict how the arms race between the attackers and defenders might go Finally those interested in governance will find discussions of the dangers of release of e mail addresses under Freedom of Information Requests The book contains many illustrations of attacks and is supported by numerous code examples in Perl and C Perfection is impossible but if you follow the advice in this book you can build mail systems which provably make no more than 5 mistakes per million messages received very close to the definitive manufacturing standard of six sigma The threat from viruses effectively disappears and the e mail user is secured from toxic content **Digital Forensics Handbook** H. Mitchel, Digital Forensics Handbook by H Mitchel offers a practical and accessible approach to the science of digital investigation Designed for students professionals and legal experts this guide walks you through the process of identifying preserving analyzing and presenting digital evidence in cybercrime cases Learn about forensic tools incident response file system analysis mobile forensics and more Whether you re working in law enforcement cybersecurity or digital litigation this book helps you uncover

the truth in a world where evidence is often hidden in bits and bytes   How to Catch a Phish Nicholas Oles,2023 Learn how to detect analyze and respond to phishing emails the top infection vector used by cybercriminals The repeatable process described in this book has been cultivated and tested in real life incidents and validated across multiple threat landscapes and environments Every organization and individual with an email account is susceptible to deceptive emails sent by attackers with nefarious intentions This activity known as phishing involves an attacker attempting to lure individuals into providing sensitive information or performing a predetermined action Attacks vary in sophistication but the core skills and process to detect analyze and respond to a suspicious message does not change Attackers have preyed on victims with convincing and not so convincing phishing emails to gain initial footholds into networks around the world for over 30 years This attack method has been rapidly growing in popularity and continues to be the number one method that organizations and individuals struggle to defend against Regardless of what any vendor or organization will tell you no infallible tool exists to eliminate this threat completely This book teaches you how to analyze suspicious messages using free tools and resources You will understand the basics of email tactics used by attackers and a repeatable process to systematically analyze messages and respond to suspicious activity You Will Learn How to Safely save email messages as attachments for analysis Identify what information is in an email header Review header information and extract key indicators or patterns used for detection Identify signs of a suspicious or malicious email message Detect the tactics that attackers use in phishing emails Safely examine email links and attachments Use a variety of free and simple tools to analyze email messages

    Deconstruction and Analysis of Email Messages Zhenghui Zhu,2007 It addresses the following problems how can we parse a raw email message and find the information for investigation What kind of information can we gather from the Internet And which UNIX tools can be used for our investigation In contrast to other work in this area this research comprehensively considers exploits in phishing emails and defines a well provided raw email parser for law enforcement investigations And we also design and implement a new protocol used in the UNIX tool system It not only tries to identify suspicious emails but also emphasizes the gathering of evidence of crime To the best of our knowledge UnMASK is the first system that can automatically deconstruct email messages and present related forensic information in a convenient format to law enforcement Test results show that the parser and the UNIX tool system of UnMASK are stable and useful It can correctly extract information that law enforcement officers want to check in raw emails and it also correctly gathers information from the Internet It generally takes a couple of minutes for our system to complete the report for one raw email message Compared to the hours investigators spent to do the same work our system greatly improves their efficiency

    Cell Phone Forensic Tools Rick Ayers,National Institute of Standards and Technology (U.S.),2007-08 When cell phones or other cellular devices are involved in a crime or other incident forensic examiners require tools that allow the proper retrieval and speedy examination of information present on the device This report provides an overview on current tools

designed for acquisition examination and reporting of data discovered on cellular handheld devices and an understanding of their capabilities and limitations   **Cell Phone Forensic Tools** ,2005

Unveiling the Power of Verbal Beauty: An Emotional Sojourn through **Email Forensic Tools A Roadmap To Email Header Analysis**

In a world inundated with screens and the cacophony of immediate communication, the profound power and emotional resonance of verbal beauty frequently fade into obscurity, eclipsed by the constant onslaught of sound and distractions. However, located within the lyrical pages of **Email Forensic Tools A Roadmap To Email Header Analysis**, a charming perform of literary elegance that pulses with natural feelings, lies an wonderful trip waiting to be embarked upon. Written by way of a virtuoso wordsmith, that magical opus courses viewers on a psychological odyssey, lightly revealing the latent potential and profound impact stuck within the elaborate internet of language. Within the heart-wrenching expanse with this evocative evaluation, we shall embark upon an introspective exploration of the book is main themes, dissect its fascinating writing type, and immerse ourselves in the indelible impact it leaves upon the depths of readers souls.

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