# Lecture 8- Email Investigations

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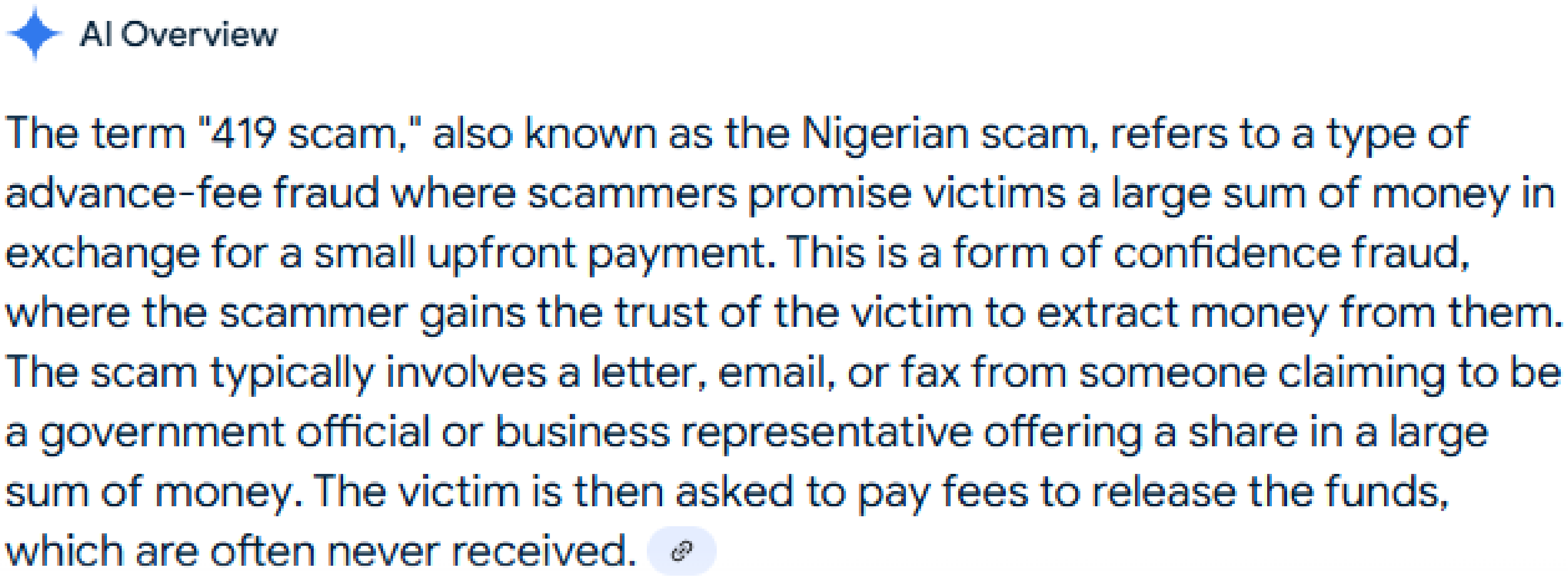
# Exploring the Role of E-mail in Investigations

- An increase in e-mail scams and fraud attempts with **phishing or spoofing**
  - Investigators need to know how to examine and interpret the unique content of e-mail messages
- **Phishing** e-mails contain links to text on a Web page
  - Attempts to get personal information from reader
- **Pharming** - DNS poisoning takes user to a fake site
- A noteworthy e-mail scam was **419, or the Nigerian Scam**



AI Overview

The term "419 scam," also known as the Nigerian scam, refers to a type of advance-fee fraud where scammers promise victims a large sum of money in exchange for a small upfront payment. This is a form of confidence fraud, where the scammer gains the trust of the victim to extract money from them. The scam typically involves a letter, email, or fax from someone claiming to be a government official or business representative offering a share in a large sum of money. The victim is then asked to pay fees to release the funds, which are often never received.

# Exploring the Role of E-mail in Investigations..

- **Spoofing** e-mail can be used to commit fraud
- Investigators can use the **Enhanced/Extended Simple Mail Transfer Protocol (ESMTP)** number in the message's header to check for legitimacy of email

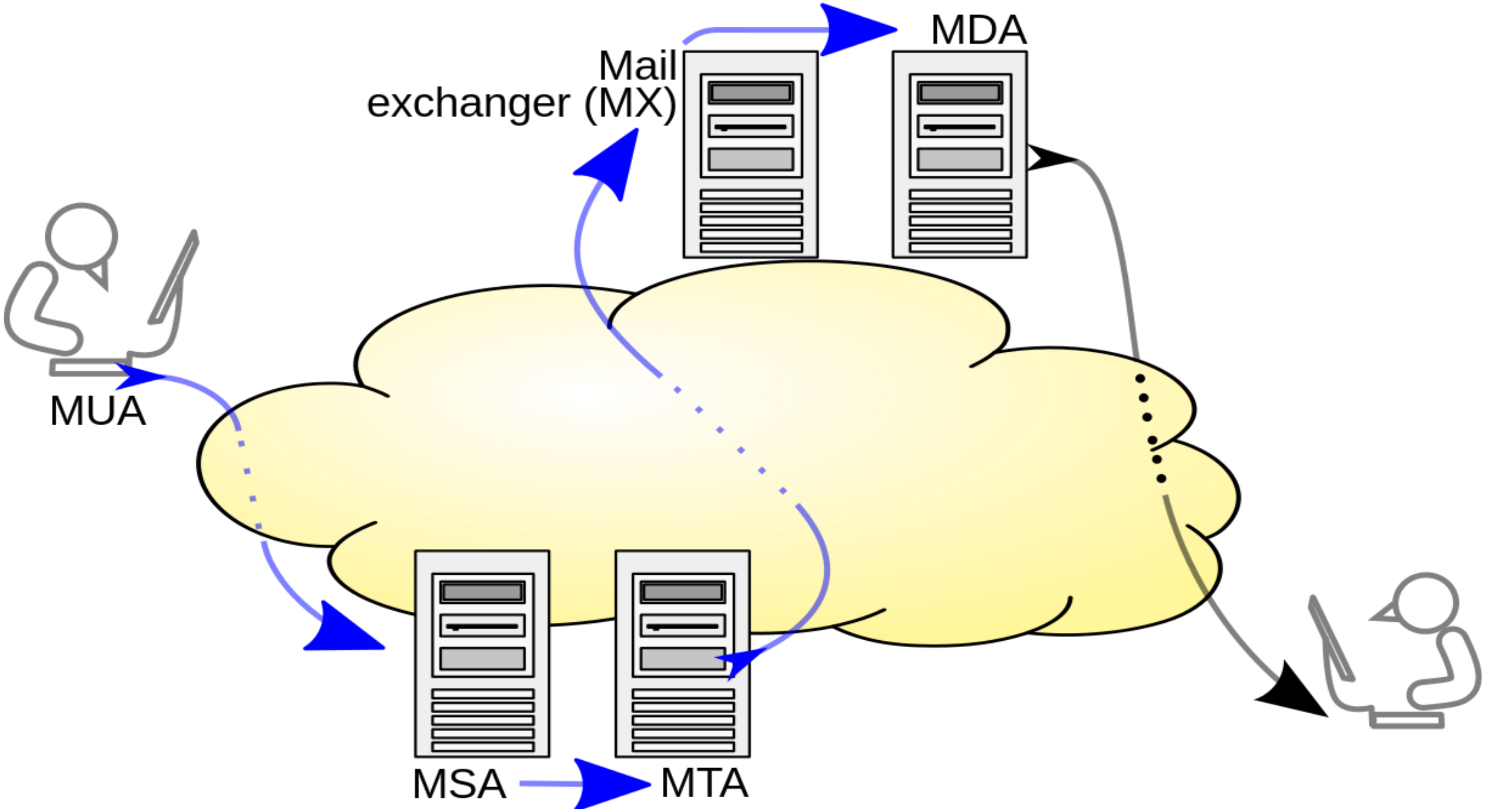
# Roles of the Client & Server in E-mail

- **E-mail can be sent and received in two environments**
  - Internet
  - Intranet (an internal network)
- **Client/server architecture**
  - Server OS and e-mail software differs from those on the client side
- **Protected accounts**
  - Require usernames and passwords

# Terminologies

- Mail User agent (MUA)
  - Email client
- Mail Submission Agent (MSA)
- Mail Transfer Agent (MTA)
  - Software that transfers electronic mail messages from one computer to another using a client–server application architecture.
- Mail Exchange (MX)
- Mail Delivery agent (MDA)
  - a computer software component that is responsible for the delivery of e-mail messages to a local recipient's mailbox
- End User

# Email Delivery



# Exploring the roles of server and client

- **Two environments**
  - Internet
  - Controlled LAN, MAN, or WAN
- **Client/server architecture**
  - Server OS and e-mail software differ from those on the client side
  - Protected accounts
  - Require usernames and passwords

# Roles of the Client & Server in E-mail

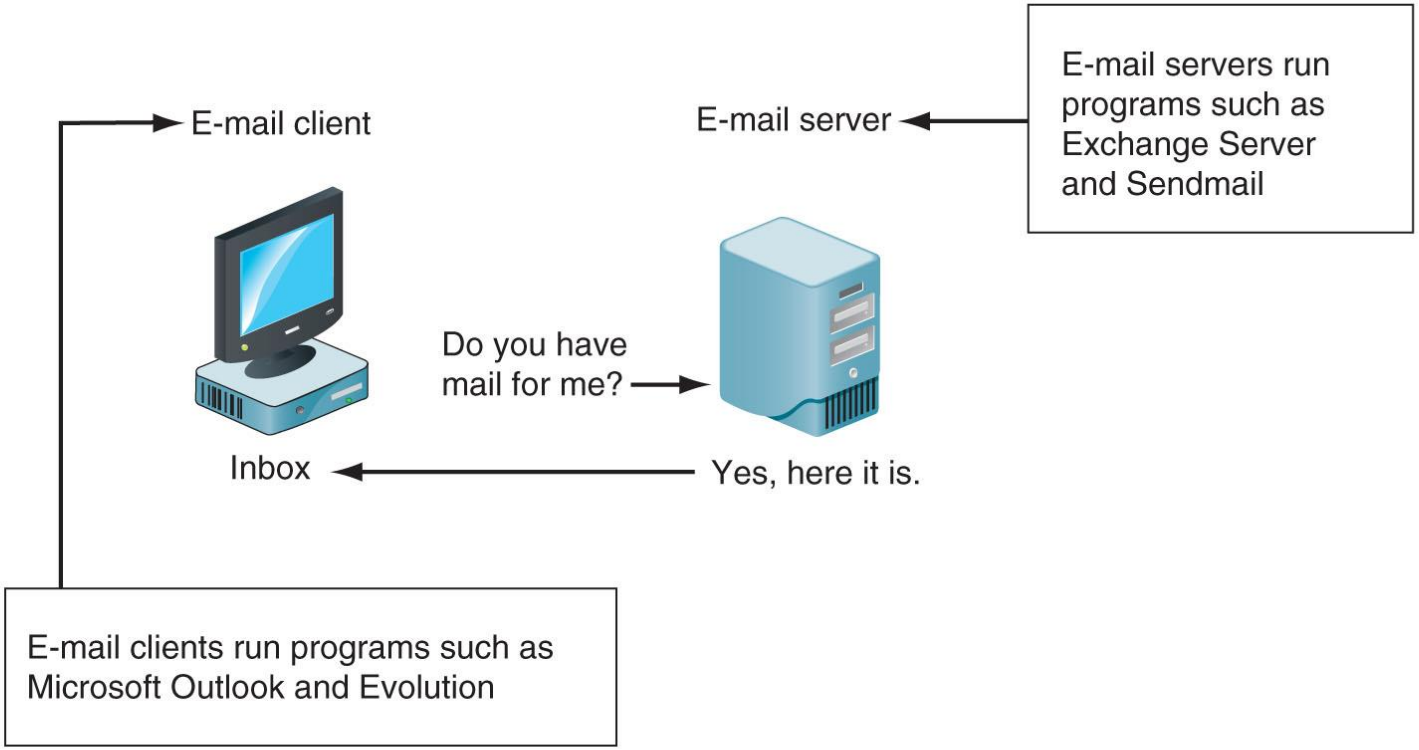

E-mail client
E-mail server
E-mail servers run programs such as Exchange Server and Sendmail
Do you have mail for me?
Inbox
Yes, here it is.
E-mail clients run programs such as Microsoft Outlook and Evolution

**Figure 11-1** E-mail in a client/server architecture

# Roles of the Client & Server in E-mail

- **Name conventions**
  - Corporate: john.smith@somecompany.com
  - Public: whatever@gmail.com
  - Everything after @ belongs to the domain name
- **Tracing corporate e-mails is easier**
  - Because accounts use standard names the administrator establishes
- **Many companies are migrating their e-mail services to the cloud**

# How Email Works

- Organizations offer email as a service to their employees, and employees typically connect to a corporate mail server via a client such as Microsoft Outlook

- Risks are associated with corporate mail, and far greater risks are associated with Web mail

- In corporate environments, a user who intends to sneak data out of the company can attach a  file to the outgoing message and send the file anywhere. Such activities can be tracked via the corporate mail server.

# How Email Works

- Typically, when an employee is being investigated, all of his/her past emails will be investigated to determine any wrongdoing or to build a case against her/him

- The difficulty arises when users begin to access Web mail servers such as Yahoo or Gmail, these sites allow users to connect from within an organization and attach the same file and send mail to anyone but without leaving any sort of record of what they have done.

- Email transactions are generally not analyzed in real time, they are being used as a part of forensic investigations. Once an employee is suspected of wrongdoing, any email messages he or she has sent are questioned.

# Mail Server

- A mail server is the computerized equivalent of your friendly neighborhood mailman. Every email that is sent passes through a series of mail servers along its way to its intended recipient

- Although it may seem like a message is sent instantly - zipping from one PC to another in the blink of an eye - the reality is that a complex series of transfers takes place

- Without this series of mail servers, you would only be able to send emails to people whose email address domains matched your own - i.e., you could only send messages from one example.com account to another example.com account

# Types of Mail Server

- **Mail servers can be broken down into two main categories: outgoing mail servers and incoming mail servers**

  - Outgoing mail servers are known as SMTP, or Simple Mail Transfer Protocol, servers

  - Incoming mail servers come in two main varieties:
    - POP3 or Post Office Protocol, version 3 servers are best known for storing sent and received messages on PCs' local hard drives.
    - IMAP, or Internet Message Access Protocol, servers always store copies of messages on servers

# Email Lifecycle

- **STEP: 1**
  - After composing a message and hitting send, your email client - whether it's Outlook Express or Gmail - connects to your domain's SMTP server. Let’s call it smtp.example.com

- **STEP: 2**
  - Your email client communicates with the SMTP server, giving it your email address, the recipient's email address, the message body and any attachments.

- **STEP: 3**
  - The SMTP server processes the recipient's email address - especially its domain. If the domain name is the same as the sender's, the message is routed directly over to the domain's POP3 or IMAP server - no routing between servers is needed. If the domain is different, though, the SMTP server will have to communicate with the other domain's server.

# Email Lifecycle

- **STEP: 4**
  - In order to find the recipient's server, the sender's SMTP server has to communicate with the DNS, or Domain Name Server. The DNS takes the recipient's email domain name and translates it into an IP address
  - The sender's SMTP server cannot route an email properly with a domain name alone; an IP address is a unique number that is assigned to every computer that is connected to the Internet
  - By knowing this information, an outgoing mail server can perform its work more efficiently

# Email Lifecycle

- **STEP: 5**
  - Now that the SMTP server has the recipient's IP address, it can connect to its SMTP server. This isn't usually done directly, though; instead, the message is routed along a series of unrelated SMTP servers until it arrives at its destination.

- **STEP: 6**
  - The recipient's SMTP server scans the incoming message. If it recognizes the domain and the user name, it forwards the message along to the domain's POP3 or IMAP server. From there, it is placed in a sendmail queue until the recipient's email client allows it to be downloaded. At that point, the message can be read by the recipient.

# SMTP

- SMTP is part of the application layer of the TCP/IP protocol. Using a process called "store and forward," SMTP moves your email on and across networks. It works closely with something called the Mail Transfer Agent (MTA) to send your communication to the right computer and email inbox.

- SMTP spells out and directs how your email moves from your computer's MTA to an MTA on another computer, and even several computers. Using that "store and forward" feature mentioned before, the message can move in steps from your computer to its destination. At each step, Simple Mail Transfer Protocol is doing its job. Lucky for us, this all takes place behind the scenes, and we don't need to understand or operate SMTP

# POP3

- Much like the physical version of a post office clerk, POP3 receives and holds email for an individual until they pick it up

- And much as the post office does not make copies of the mail it receives, in previous versions of POP3, when an individual downloaded email from the server into their email program, there were no more copies of the email on the server; POP automatically deleted them.

# IMAP

- IMAP allows you to access your email messages wherever you are; much of the time, it is accessed via the Internet.

- Basically, email messages are stored on servers. Whenever you check your inbox, your email client contacts the server to connect you with your messages

- When you read an email message using IMAP, you aren't actually downloading or storing it on your computer; instead, you are reading it off of the server

- As a result, it's possible to check your email from several different devices without missing a thing.

# IMAP vs. POP3

- If you think that IMAP and POP are interchangeable, think again

- POP works by contacting your email server and downloading all of your new messages from it

- Once they are downloaded, they disappear from the server. If you decide to check your email from a different device, the messages that have been downloaded previously will not be available to you.

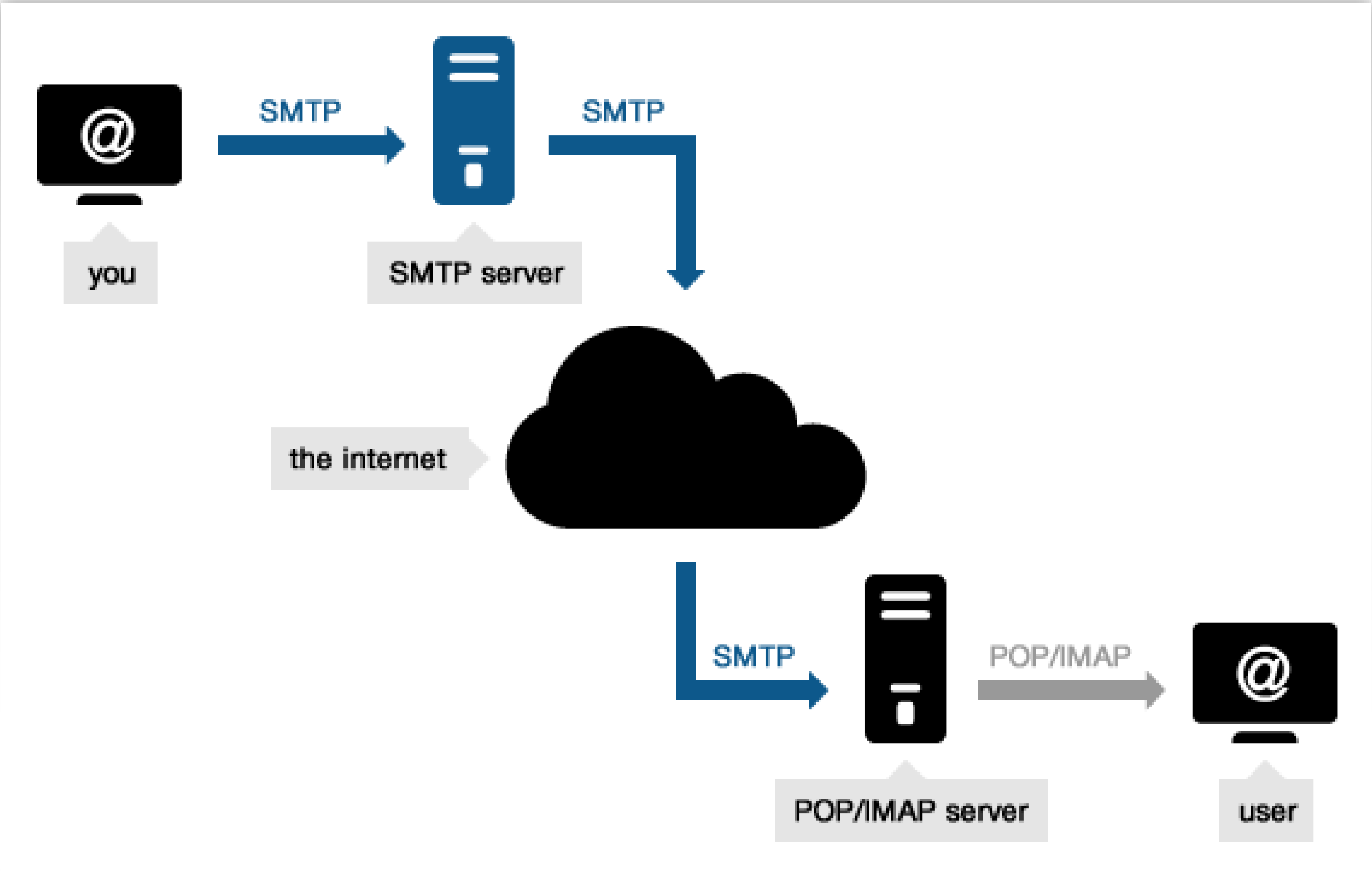
- POP works fine for those who generally only check their email messages from a single device; those who travel or need to access their email from various devices are much better off with IMAP-based email service.

# IMAP vs. POP3

- Unlike POP, IMAP allows you to access, organize, read and sort your email messages without having to download them first. As a result, IMAP is very fast and efficient.

- The server also keeps a record of all of the messages that you send, allowing you to access your sent messages from anywhere. IMAP does not move messages from the server to your computer; instead, it synchronizes the email that's on your computer with the email that's on the server

# IMAP vs. POP3


SMTP
SMTP
you
SMTP server
the internet
SMTP
POP/IMAP
POP/IMAP server
user

# Investigating E-mail Crimes and Violations

- Similar to other types of investigations
- **Goals**
  - Find who is behind the crime
  - Collect the evidence
  - Present your findings
  - Build a case
- Know the applicable privacy laws for your jurisdiction
  - **Electronic Communications Privacy Act (ECPA)** and the **Stored Communications Act (SCA)** apply to e-mail.

# Investigating E-mail Crimes and Violations..

- E-mail crimes depend on the city, state, or country
  - Example: spam may not be a crime in some states
  - Always consult with an attorney
- **Examples of crimes involving e-mails**
  - Narcotics trafficking
  - Extortion
  - Sexual harassment and stalking
  - Fraud
  - Child abductions and pornography
  - Terrorism

# Understanding Forensic Linguistics

- **Forensic Linguistics**
  - Where language and law intersect
- Four categories:
  - Language and law
  - Language in the legal process
  - Language as evidence
  - Research/teaching
- Encompasses civil cases, criminal cases, cyberterrorism cases, and other legal proceedings

# Examining E-mail Messages

- Access victim’s computer or mobile device to recover the evidence
- Using the victim’s e-mail client
  - Find and copy any potential evidence
  - Access protected or encrypted material
  - **Print e-mails**
- Guide victim on the phone
  - Open and copy e-mail including headers
- You may have to recover deleted e-mails

# Examining E-mail Messages…

- Copying an e-mail message
  - Before you start an e-mail investigation
    - You need to copy and print the e-mail involved in the crime or policy violation
  - You might also want to forward the message as an attachment to another e-mail address
- With many GUI e-mail programs, you can copy an e-mail by dragging it to a storage medium
  - Or by saving it in a different location

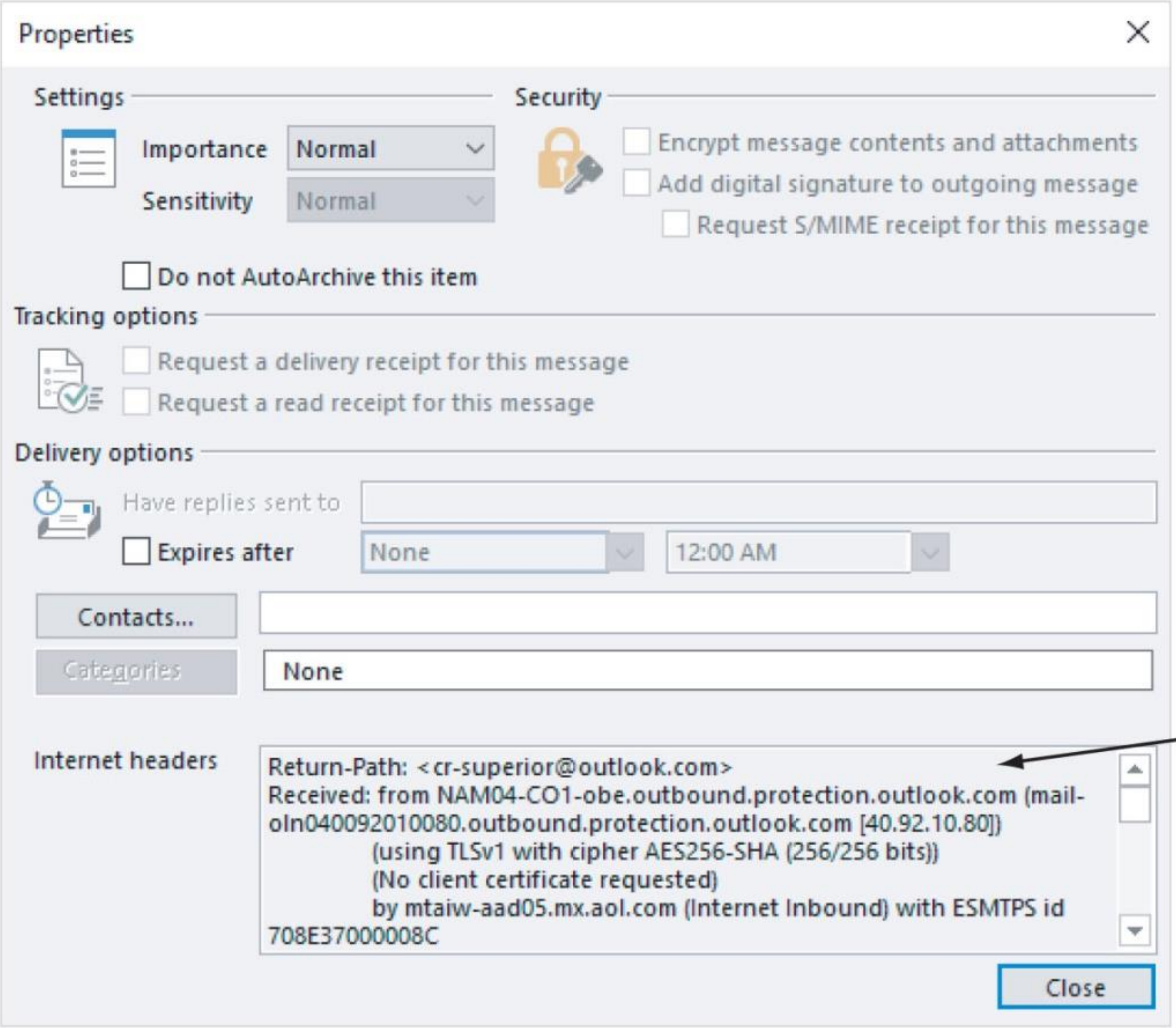
# Viewing E-mail Headers (1 of 5)

- Investigators should learn how to find e-mail headers
  - GUI clients
  - Web-based clients
- After you open e-mail headers, copy and paste them into a text document
  - So that you can read them with a text editor
- Become familiar with as many e-mail programs as possible
  - Often more than one e-mail program is installed

# Viewing E-mail Headers (2 of 5)

- **Outlook**
  - Double-click the message and then click **File, Properties**
  - Copy headers
  - Paste them to any text editor
  - Save the document as `Outlook header.txt` in your work folder

# Viewing E-mail Headers (3 of 5)



Properties

Settings

Importance: Normal

Sensitivity: Normal

□ Do not AutoArchive this item

Security

□ Encrypt message contents and attachments

□ Add digital signature to outgoing message

□ Request S/MIME receipt for this message

Tracking options

□ Request a delivery receipt for this message

□ Request a read receipt for this message

Delivery options

Have replies sent to:

□ Expires after: None 12:00 AM

Contacts...

Categories: None

Internet headers:

```
Return-Path: <cr-superior@outlook.com>
Received: from NAM04-CO1-obe.outbound.protection.outlook.com (mail-
oln040092010080.outbound.protection.outlook.com [40.92.10.80])
            (using TLSv1 with cipher AES256-SHA (256/256 bits))
            (No client certificate requested)
            by mtaiw-aad05.mx.aol.com (Internet Inbound) with ESMTPS id
708E37000008C
```

Close

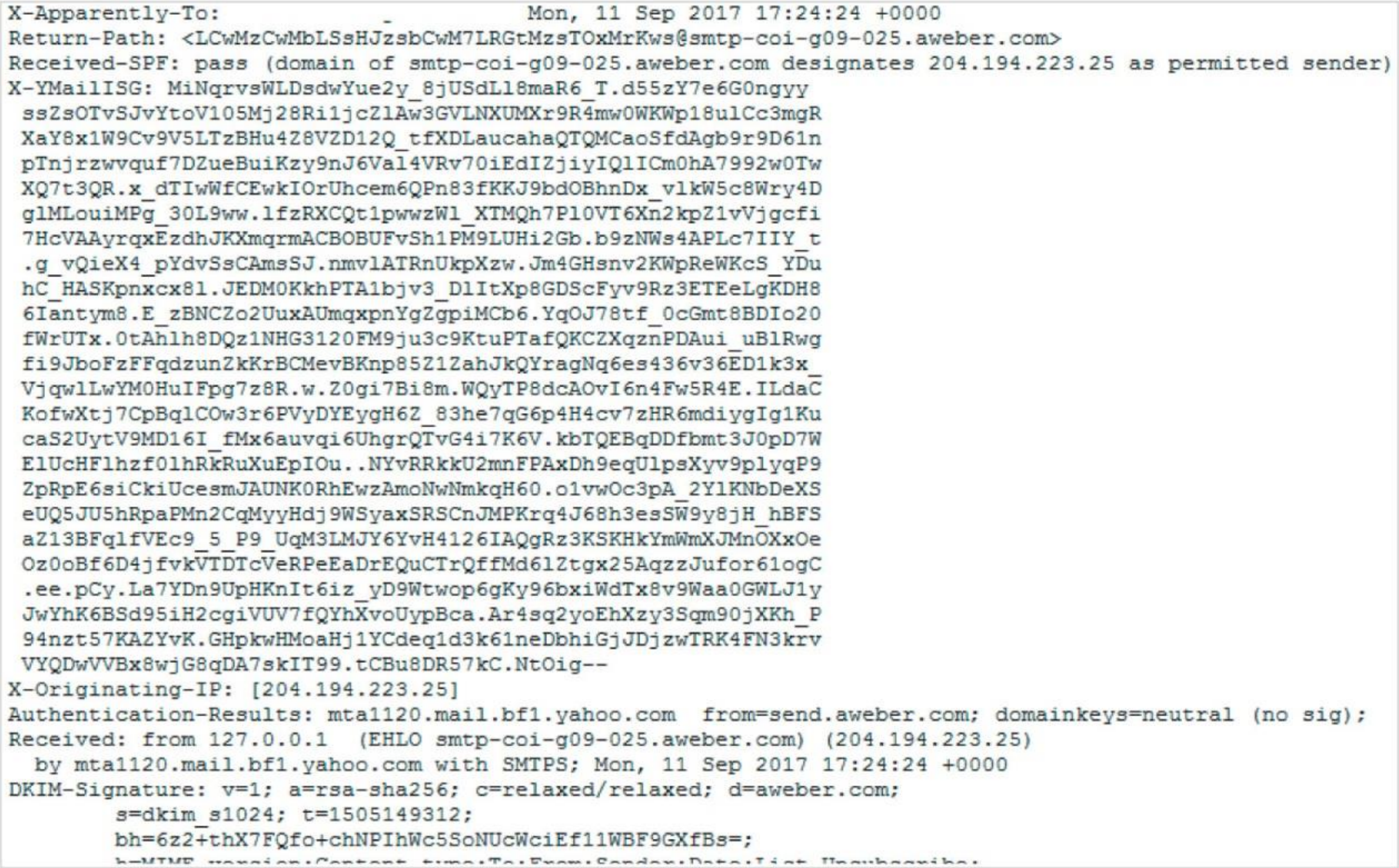
Message header

**Figure 11-2** An Outlook e-mail header

# Viewing E-mail Headers (4 of 5)

- **Gmail**
  - Click the down arrow next to the Reply circular arrow, and click **Show original**
  - Click the **Download Original** link to open the “Opening original_msg.txt” dialog box
  - Click **Open with Notepad (default)** and click **Okay**
  - Save the file in your work folder with the default name
- **Yahoo**
  - Click **Inbox** to view a list of messages
  - Above the message window, click **More** and click **View Raw Message**
  - Copy and paste headers to a text file

# Viewing E-mail Headers (5 of 5)



```
X-Apparently-To:                          Mon, 11 Sep 2017 17:24:24 +0000
Return-Path: <LCwMzCwMbLSsHJzsbCwM7LRGtMzsTOxMrKws@smtp-coi-g09-025.aweber.com>
Received-SPF: pass (domain of smtp-coi-g09-025.aweber.com designates 204.194.223.25 as permitted sender)
X-YMailISG: MiNqrvsWLDsdwYue2y_8jUSdLl8maR6_T.d55zY7e6G0ngyy
 ssZsOTvSJvYtoV105Mj28Ri1jcZ1Aw3GVLNXUMXr9R4mw0WKWp18ulCc3mgR
 XaY8x1W9Cv9V5LTzBHu4Z8VZD12Q_tfXDLaucahaQTQMCaoSfdAgb9r9D61n
 pTnjrzwvquf7DZueBuiKzy9nJ6Val4VRv70iEdIZjiyIQlICm0hA7992w0Tw
 XQ7t3QR.x_dTIwWfCEwkIOrUhcem6QPn83fKKJ9bdOBhnDx_vlkW5c8Wry4D
 glMLouiMPg_30L9ww.lfzRXCQt1pwwzWl_XTMQh7P10VT6Xn2kpZ1vVjgcfi
 7HcVAAyrqxEzdhJKXmqrmACBOBUFvSh1PM9LUHi2Gb.b9zNWs4APLc7IIY_t
 .g_vQieX4_pYdvSsCAmsSJ.nmvlATRnUkpXzw.Jm4GHsnv2KWpReWKcS_YDu
 hC_HASKpnxcx8l.JEDM0KkhPTA1bjv3_DlItXp8GDScFyv9Rz3ETEeLgKDH8
 6Iantym8.E_zBNCZo2UuxAUmqxpnYgZgpiMCb6.YqOJ78tf_0cGmt8BDIo20
 fWrUTx.0tAhlh8DQz1NHG3120FM9ju3c9KtuPTafQKCZXqznPDAui_uBlRwg
 fi9JboFzFFqdzunZkKrBCMevBKnp85Z1ZahJkQYragNq6es436v36ED1k3x_
 VjqwlLwYM0HuIFpg7z8R.w.Z0gi7Bi8m.WQyTP8dcAOvI6n4Fw5R4E.ILdaC
 KofwXtj7CpBqlCOw3r6PVyDYEygH6Z_83he7qG6p4H4cv7zHR6mdiygIg1Ku
 caS2UytV9MD16I_fMx6auvqi6UhgrQTvG4i7K6V.kbTQEBqDDfbmt3J0pD7W
 ElUcHFlhzf0lhRkRuXuEpIOu..NYvRRkkU2mnFPAxDh9eqUlpsXyv9plyqP9
 ZpRpE6siCkiUcesmJAUNK0RhEwzAmoNwNmkqH60.o1vwOc3pA_2YlKNbDeXS
 eUQ5JU5hRpaPMn2CqMyyHdj9WSyaxSRSCnJMPKrq4J68h3esSW9y8jH_hBFS
 aZ13BFqlfVEc9_5_P9_UqM3LMJY6YvH4126IAQgRz3KSKHkYmWmXJMnOXxOe
 Oz0oBf6D4jfvkVTDTcVeRPeEaDrEQuCTrQffMd6lZtgx25AqzzJufor61ogC
 .ee.pCy.La7YDn9UpHKnIt6iz_yD9Wtwop6gKy96bxiWdTx8v9Waa0GWLJ1y
 JwYhK6BSd95iH2cgiVUV7fQYhXvoUypBca.Ar4sq2yoEhXzy3Sqm90jXKh_P
 94nzt57KAZYvK.GHpkwHMoaHj1YCdeq1d3k61neDbhiGjJDjzwTRK4FN3krv
 VYQDwVVBx8wjG8qDA7skIT99.tCBu8DR57kC.NtOig--
X-Originating-IP: [204.194.223.25]
Authentication-Results: mta1120.mail.bf1.yahoo.com  from=send.aweber.com; domainkeys=neutral (no sig);
Received: from 127.0.0.1  (EHLO smtp-coi-g09-025.aweber.com) (204.194.223.25)
  by mta1120.mail.bf1.yahoo.com with SMTPS; Mon, 11 Sep 2017 17:24:24 +0000
DKIM-Signature: v=1; a=rsa-sha256; c=relaxed/relaxed; d=aweber.com;
        s=dkim_s1024; t=1505149312;
        bh=6z2+thX7FQfo+chNPIhWc5SoNUcWciEf11WBF9GXfBs=;
        h=MIME-version:Content-type:To:From:Sender:Date:List-Unsubscribe:
```

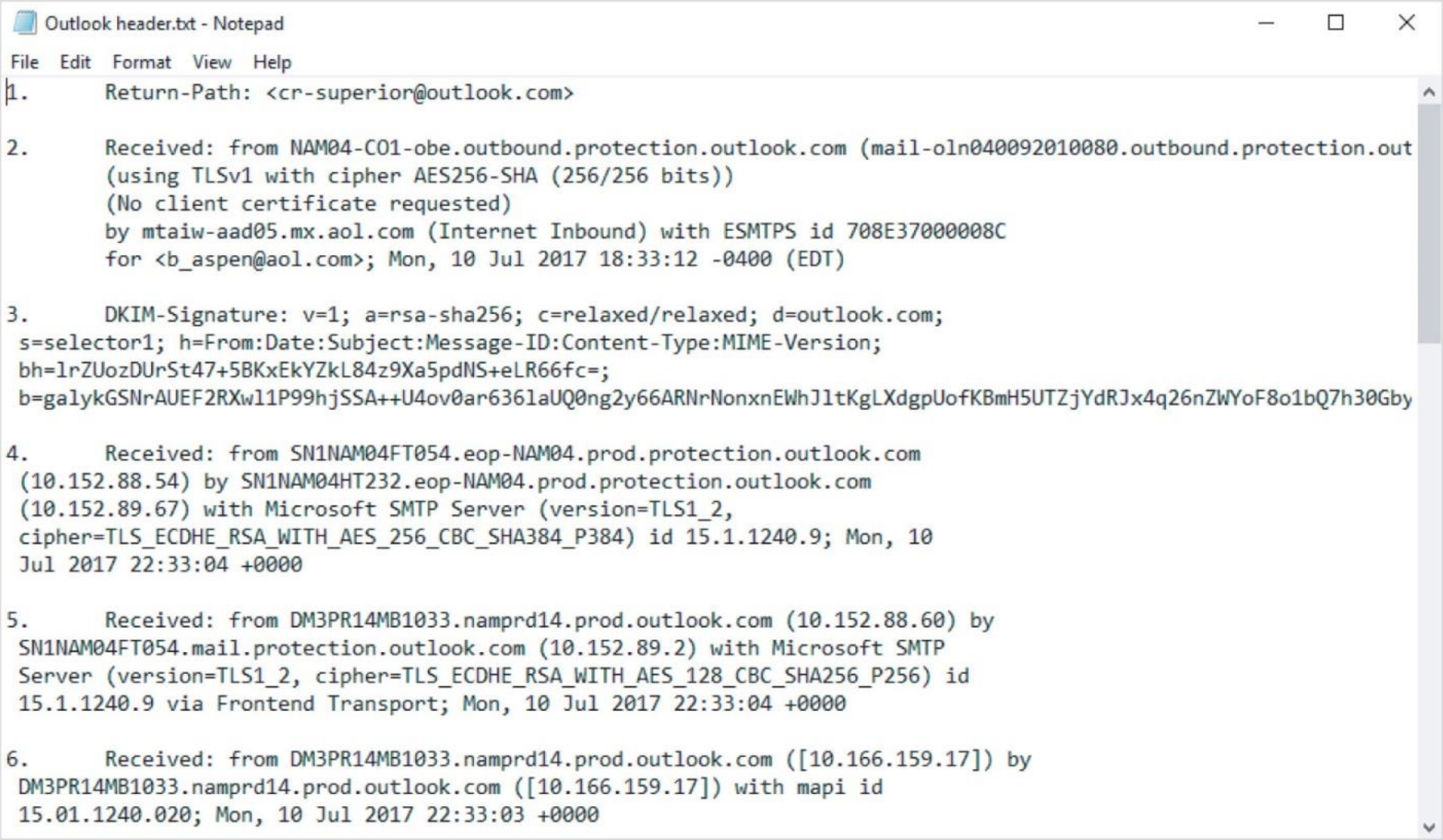
**Figure 11-3** Viewing headers in Yahoo!

Source: Yahoo! Inc., *www.yahoo.com*

# Examining E-mail Headers (1 of 2)

- Headers contain useful information
  - The main piece of information you’re looking for is the originating e-mail’s IP address
  - Date and time the message was sent
  - Filenames of any attachments
  - Unique message number (if supplied)

# Examining E-mail Headers (2 of 2)



```
1.       Return-Path: <cr-superior@outlook.com>

2.       Received: from NAM04-CO1-obe.outbound.protection.outlook.com (mail-oln040092010080.outbound.protection.out
         (using TLSv1 with cipher AES256-SHA (256/256 bits))
         (No client certificate requested)
         by mtaiw-aad05.mx.aol.com (Internet Inbound) with ESMTPS id 708E37000008C
         for <b_aspen@aol.com>; Mon, 10 Jul 2017 18:33:12 -0400 (EDT)

3.       DKIM-Signature: v=1; a=rsa-sha256; c=relaxed/relaxed; d=outlook.com;
 s=selector1; h=From:Date:Subject:Message-ID:Content-Type:MIME-Version;
 bh=lrZUozDUrSt47+5BKxEkYZkL84z9Xa5pdNS+eLR66fc=;
 b=galykGSNrAUEF2RXwl1P99hjSSA++U4ov0ar636laUQ0ng2y66ARNrNonxnEWhJ1tKgLXdgpUofKBmH5UTZjYdRJx4q26nZWYoF8o1bQ7h30Gby

4.       Received: from SN1NAM04FT054.eop-NAM04.prod.protection.outlook.com
 (10.152.88.54) by SN1NAM04HT232.eop-NAM04.prod.protection.outlook.com
 (10.152.89.67) with Microsoft SMTP Server (version=TLS1_2,
 cipher=TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384_P384) id 15.1.1240.9; Mon, 10
 Jul 2017 22:33:04 +0000

5.       Received: from DM3PR14MB1033.namprd14.prod.outlook.com (10.152.88.60) by
 SN1NAM04FT054.mail.protection.outlook.com (10.152.89.2) with Microsoft SMTP
 Server (version=TLS1_2, cipher=TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256_P256) id
 15.1.1240.9 via Frontend Transport; Mon, 10 Jul 2017 22:33:04 +0000

6.       Received: from DM3PR14MB1033.namprd14.prod.outlook.com ([10.166.159.17]) by
 DM3PR14MB1033.namprd14.prod.outlook.com ([10.166.159.17]) with mapi id
 15.01.1240.020; Mon, 10 Jul 2017 22:33:03 +0000
```

**Figure 11-4** An e-mail header with line numbers added

# Viewing e-mail headers

- In case of web-based email
  - Copy emails
  - Observe cache and cookies
  - Network Logs

- Client based emails
  - Defined policy
  - Copy *pst files in case of outlook client
  - Network Logs

# Viewing Email Header

- The email header is the most valuable thing which contain information regarding
  - IP’s
  - Sender and Receiver addresses
  - Time stamps
  - SMTP ID’s
  - Protocol Information
  - Content Information
  - Time Zone Details

# Fields in Header

- From

This displays who the message is from, however, this can be easily forged and can be the least reliable.

- Subject

This is what the sender placed as a topic of the email content.

- Date

This shows the date and time the email message was composed.

- To

This shows to whom the message was addressed.

# Fields in Header

- Return-Path

The email address for return mail. This is the same as "**Reply-To**:".

- Delivery Date

This shows the date and time at which the email was received by your (mt) service or email client.

- Received

The received is the most important part of the email header and is usually the most reliable. They form a list of all the servers/computers through which the message traveled in order to reach you. The received lines are best read from **bottom to top**.

That is, the first "Received:" line is your own system or mail server. The last "Received:" line is where the mail originated.

A "Received:" line typically identifies the machine that received the mail and the machine from which the mail was received.

# Fields in Header

- Message-id

A unique string assigned by the mail system when the message is first created. These can easily be forged.

- Mime-Version

Multipurpose Internet Mail Extensions (MIME) is an internet standard that extends the format of email.

- Content-Type

Generally, this will tell you the format of the message, such as html or plaintext.

# Fields in Header

- DKIM-Signature & Domainkey-Signature

DomainKeys Identified Mail (**DKIM**) allows senders to associate a domain name with an email message, thus vouching for its authenticity. This is done by "**signing**" the email with a digital signature, a field that is added to the message's header..

- Sender Policy Framework - SPF

It is used to describe what **mail** server is allowed to send messages for a domain". It's used to avoid fake **email** addresses (as sender **email** address). The system can detect if the **mail** server, which wants to send a message to the recipients **mail**-exchanger, is valid for the senders **email** address (domain).

## Authenticated Received Chain – ARC

It helps preserve email authentication results and verifies the identity of email intermediaries that forward a message on to its final destination. There are three key components to ARC:

- **ARC Authentication Results header:** a header containing email authentication results like SPF, DKIM, and DMARC
- **ARC Signature:** a DKIM-like signature that takes a snapshot of the message header information, including the to, from, subject, and body
- **ARC Seal:** another DKIM-like signature that includes the ARC Signature and the ARC Authentication Results header information

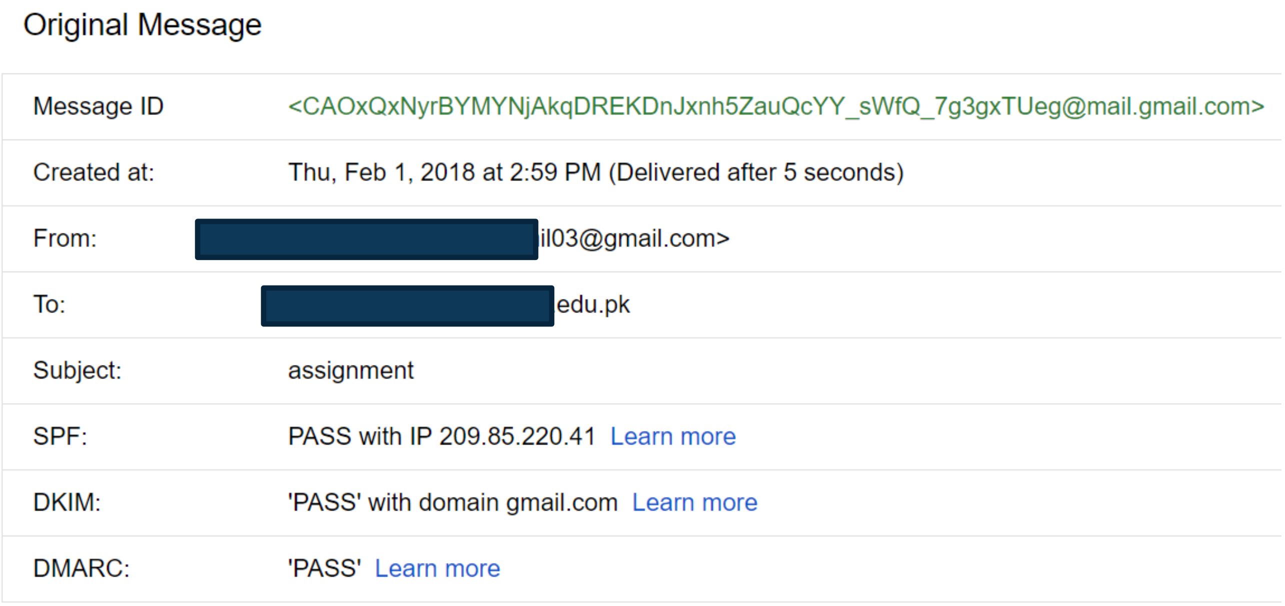
# What Are Spoofed Emails?

- Fake emails or spoofed mails are those emails which pretend to come from a specific email address but are sent from some **fake email senders**.

- emkei.cz is the most popular fake mail sending website.

- Its recommended to examine the header of the email by clicking on down arrow at the right side of the reply icon and click on show original. Now it will open plain text email content with header information in a new tab.
  - **SPF (Sender Policy Framework):** SPF records tell receiving mail servers whether the server sending the email is allowed to send for your domain or not
  - **DKIM (Domain Key Identified Mail):** An **email** authentication method designed to detect **email** spoofing. ... Usually, **DKIM** signatures are not visible to end-users, and are affixed or verified by the infrastructure rather than message's authors and recipients.
  - **DMARC (Domain-based Message Authentication, Reporting, and Conformance):** this policy gives a sender the option to let the receiver know whether its email is protected by SPF or DKIM and what actions to take and who to report to when dealing with emails that fail authentication

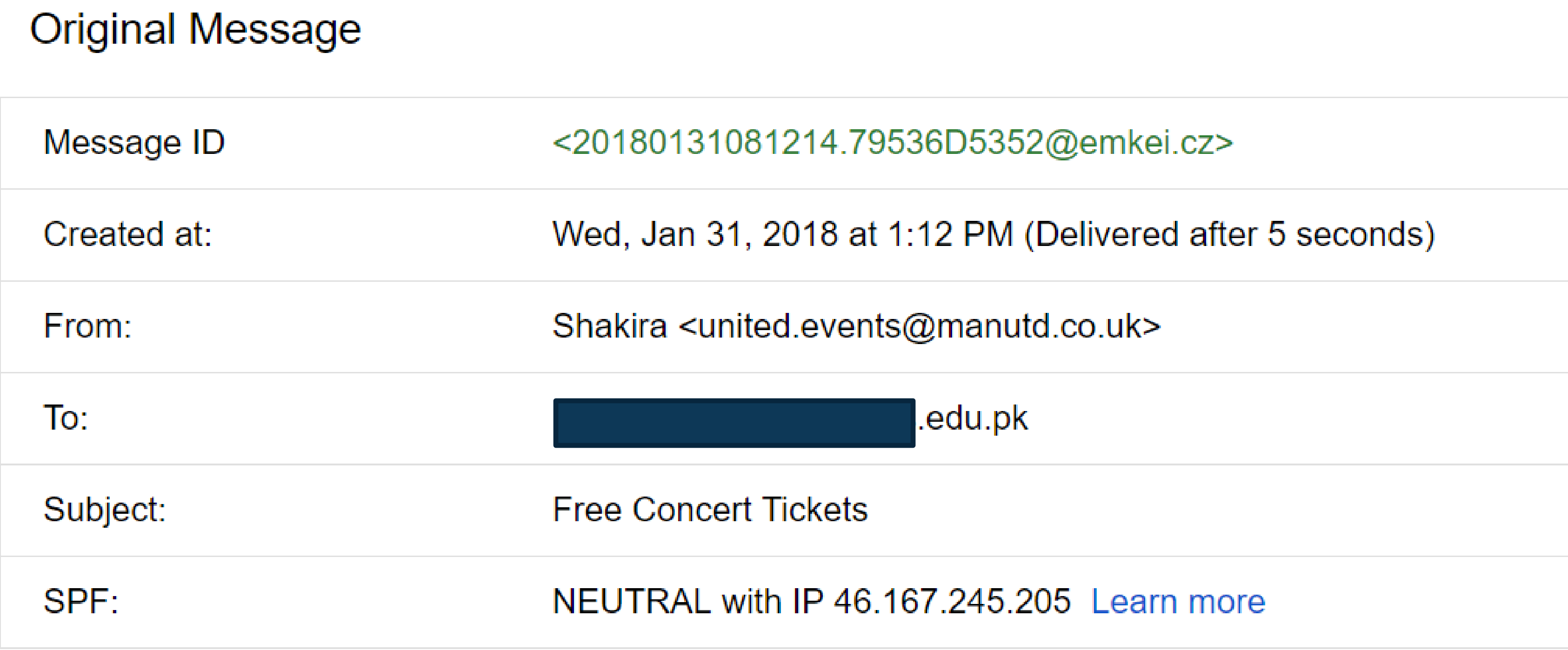
# Legitimate Email



Original Message

| | |
|---|---|
| Message ID | <CAOxQxNyrBYMYNjAkqDREKDnJxnh5ZauQcYY_sWfQ_7g3gxTUeg@mail.gmail.com> |
| Created at: | Thu, Feb 1, 2018 at 2:59 PM (Delivered after 5 seconds) |
| From: | [redacted]il03@gmail.com> |
| To: | [redacted]edu.pk |
| Subject: | assignment |
| SPF: | PASS with IP 209.85.220.41 Learn more |
| DKIM: | 'PASS' with domain gmail.com Learn more |
| DMARC: | 'PASS' Learn more |

# Spoofed Email

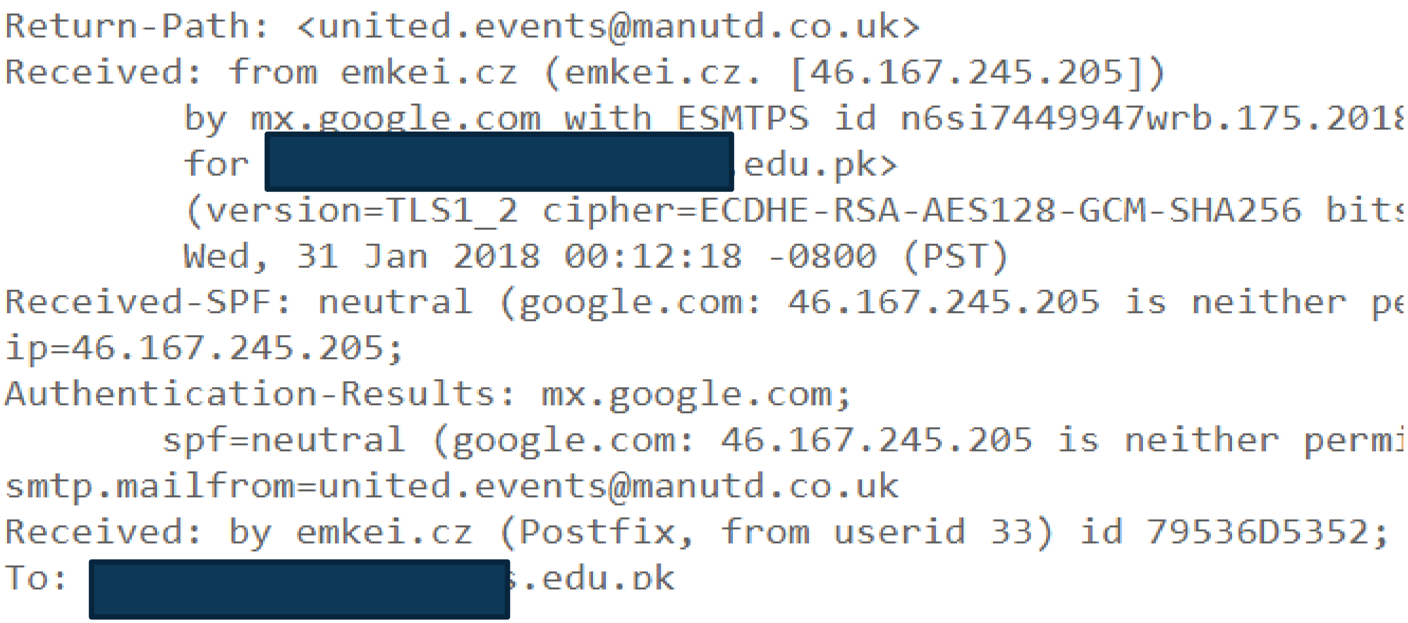


Original Message

| | |
|---|---|
| Message ID | <20180131081214.79536D5352@emkei.cz> |
| Created at: | Wed, Jan 31, 2018 at 1:12 PM (Delivered after 5 seconds) |
| From: | Shakira <united.events@manutd.co.uk> |
| To: | [redacted].edu.pk |
| Subject: | Free Concert Tickets |
| SPF: | NEUTRAL with IP 46.167.245.205 Learn more |

# Spoofed Email

- It shows emkei.cz in the fake mail. Now look the website **emkei.cz** and you will know that the domain belongs to a fake mail sender website.



```
Return-Path: <united.events@manutd.co.uk>
Received: from emkei.cz (emkei.cz. [46.167.245.205])
        by mx.google.com with ESMTPS id n6si7449947wrb.175.2018
        for [redacted] edu.pk>
        (version=TLS1_2 cipher=ECDHE-RSA-AES128-GCM-SHA256 bits
        Wed, 31 Jan 2018 00:12:18 -0800 (PST)
Received-SPF: neutral (google.com: 46.167.245.205 is neither pe
ip=46.167.245.205;
Authentication-Results: mx.google.com;
       spf=neutral (google.com: 46.167.245.205 is neither permi
smtp.mailfrom=united.events@manutd.co.uk
Received: by emkei.cz (Postfix, from userid 33) id 79536D5352;
To: [redacted] .edu.pk
```

WhatIsMyAddress Ip Lookup tool

# Examining Additional E-mail Files

- E-mail messages are saved on the client side or left at the server
- Microsoft Outlook uses .pst and .ost files
- Most e-mail programs also include an electronic address book, calendar, task list, and memos
- In Web-based e-mail
  - Messages are displayed and saved as Web pages in the browser’s cache folders
  - Many Web-based e-mail providers also offer instant messaging (IM) services

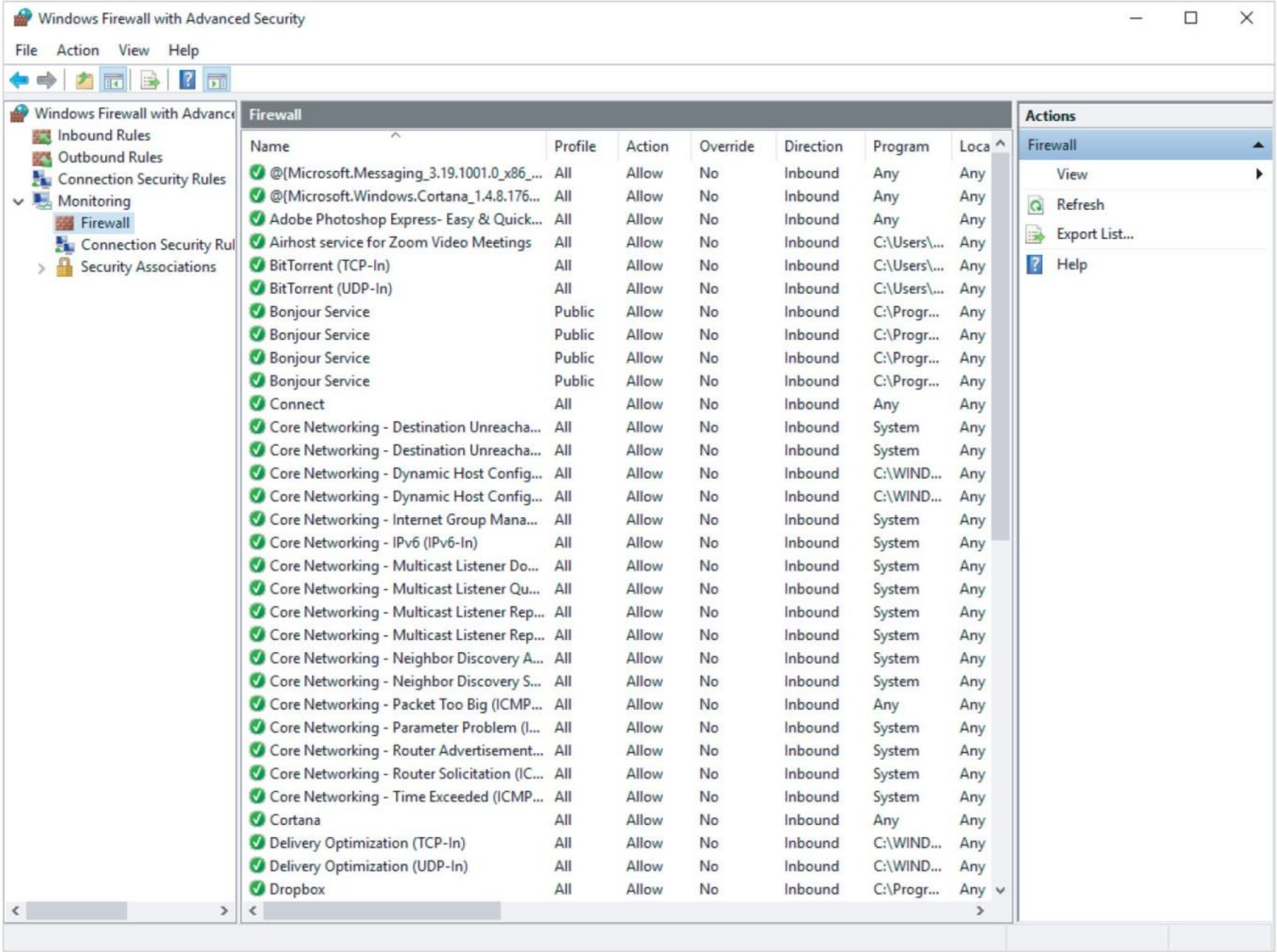
# Tracing an E-mail Message

- Determining message origin is referred to as “tracing”
- Contact the administrator responsible for the sending server
- Use a registry site to find point of contact:
  - www.arin.net
  - www.internic.com
  - www.google.com
- Verify your findings by checking network e-mail logs against e-mail addresses

# Using Network E-mail Logs (1 of 2)

- **Router logs**
  - Record all incoming and outgoing traffic
  - Have rules to allow or disallow traffic
  - You can resolve the path a transmitted e-mail has taken
- **Firewall logs**
  - Filter e-mail traffic
  - Verify whether the e-mail passed through
- You can use any text editor or specialized tools

# Using Network E-mail Logs (2 of 2)



| Name | Profile | Action | Override | Direction | Program | Loca |
|---|---|---|---|---|---|---|
| @{Microsoft.Messaging_3.19.1001.0_x86_... | All | Allow | No | Inbound | Any | Any |
| @{Microsoft.Windows.Cortana_1.4.8.176... | All | Allow | No | Inbound | Any | Any |
| Adobe Photoshop Express- Easy & Quick... | All | Allow | No | Inbound | Any | Any |
| Airhost service for Zoom Video Meetings | All | Allow | No | Inbound | C:\Users\... | Any |
| BitTorrent (TCP-In) | All | Allow | No | Inbound | C:\Users\... | Any |
| BitTorrent (UDP-In) | All | Allow | No | Inbound | C:\Users\... | Any |
| Bonjour Service | Public | Allow | No | Inbound | C:\Progr... | Any |
| Bonjour Service | Public | Allow | No | Inbound | C:\Progr... | Any |
| Bonjour Service | Public | Allow | No | Inbound | C:\Progr... | Any |
| Bonjour Service | Public | Allow | No | Inbound | C:\Progr... | Any |
| Connect | All | Allow | No | Inbound | Any | Any |
| Core Networking - Destination Unreacha... | All | Allow | No | Inbound | System | Any |
| Core Networking - Destination Unreacha... | All | Allow | No | Inbound | System | Any |
| Core Networking - Dynamic Host Config... | All | Allow | No | Inbound | C:\WIND... | Any |
| Core Networking - Dynamic Host Config... | All | Allow | No | Inbound | C:\WIND... | Any |
| Core Networking - Internet Group Mana... | All | Allow | No | Inbound | System | Any |
| Core Networking - IPv6 (IPv6-In) | All | Allow | No | Inbound | System | Any |
| Core Networking - Multicast Listener Do... | All | Allow | No | Inbound | System | Any |
| Core Networking - Multicast Listener Qu... | All | Allow | No | Inbound | System | Any |
| Core Networking - Multicast Listener Rep... | All | Allow | No | Inbound | System | Any |
| Core Networking - Multicast Listener Rep... | All | Allow | No | Inbound | System | Any |
| Core Networking - Neighbor Discovery A... | All | Allow | No | Inbound | System | Any |
| Core Networking - Neighbor Discovery S... | All | Allow | No | Inbound | System | Any |
| Core Networking - Packet Too Big (ICMP... | All | Allow | No | Inbound | Any | Any |
| Core Networking - Parameter Problem (I... | All | Allow | No | Inbound | System | Any |
| Core Networking - Router Advertisement... | All | Allow | No | Inbound | System | Any |
| Core Networking - Router Solicitation (IC... | All | Allow | No | Inbound | System | Any |
| Core Networking - Time Exceeded (ICMP... | All | Allow | No | Inbound | System | Any |
| Cortana | All | Allow | No | Inbound | Any | Any |
| Delivery Optimization (TCP-In) | All | Allow | No | Inbound | C:\WIND... | Any |
| Delivery Optimization (UDP-In) | All | Allow | No | Inbound | C:\WIND... | Any |
| Dropbox | All | Allow | No | Inbound | C:\Progr... | Any |

**Figure 11-5** A Windows firewall log

# Understanding E-mail Servers (1 of 2)

- An e-mail server is loaded with software that uses e-mail protocols for its services
  - And maintains logs you can examine and use in your investigation
- E-mail storage
  - Database
  - Flat file system
- Logs
  - Some servers are set up to log e-mail transactions by default; others have to be configured to do so

# Understanding E-mail Servers (2 of 2)

- E-mail logs generally identify the following:
  - E-mail messages an account received
  - Sending IP address
  - Receiving and reading date and time
  - E-mail content
  - System-specific information
- Contact suspect’s network e-mail administrator as soon as possible
- Servers can recover deleted e-mails
  - Similar to deletion of files on a hard drive

# Examining UNIX E-mail Server Logs (1 of 2)

- Common UNIX e-mail servers: Postfix and Sendmail
- `/etc/sendmail.cf`
    - Configuration file for Sendmail
- `/etc/syslog.conf`
    - Specifies how and which events Sendmail logs
- Postfix has two configuration files
    - `master. cf` and `main.cf` (found in `/etc/postfix`)

# Examining UNIX E-mail Server Logs (2 of 2)

- `/var/log/maillog`
  - Records **SMTP**, **POP3, and IMAP4** communications
    - Contains an IP address and time stamp that you can compare with the e-mail the victim received
- Default location for storing log files:
  - `/var/log`
  - An administrator can change the log location
  - Use the `find` or `locate` command to find them
- Check UNIX man pages for more information

# Examining Microsoft E-mail Server Logs (1 of 4)

- **Microsoft Exchange Server (Exchange)**
  - Uses a database
  - Based on Microsoft Extensible Storage Engine (ESE)
- Most useful files in an investigation:
  - **.edb** database files, **checkpoint files**, and **temporary files**
- Information Store files
  - Database files *.edb
    - Responsible for **MAPI** information

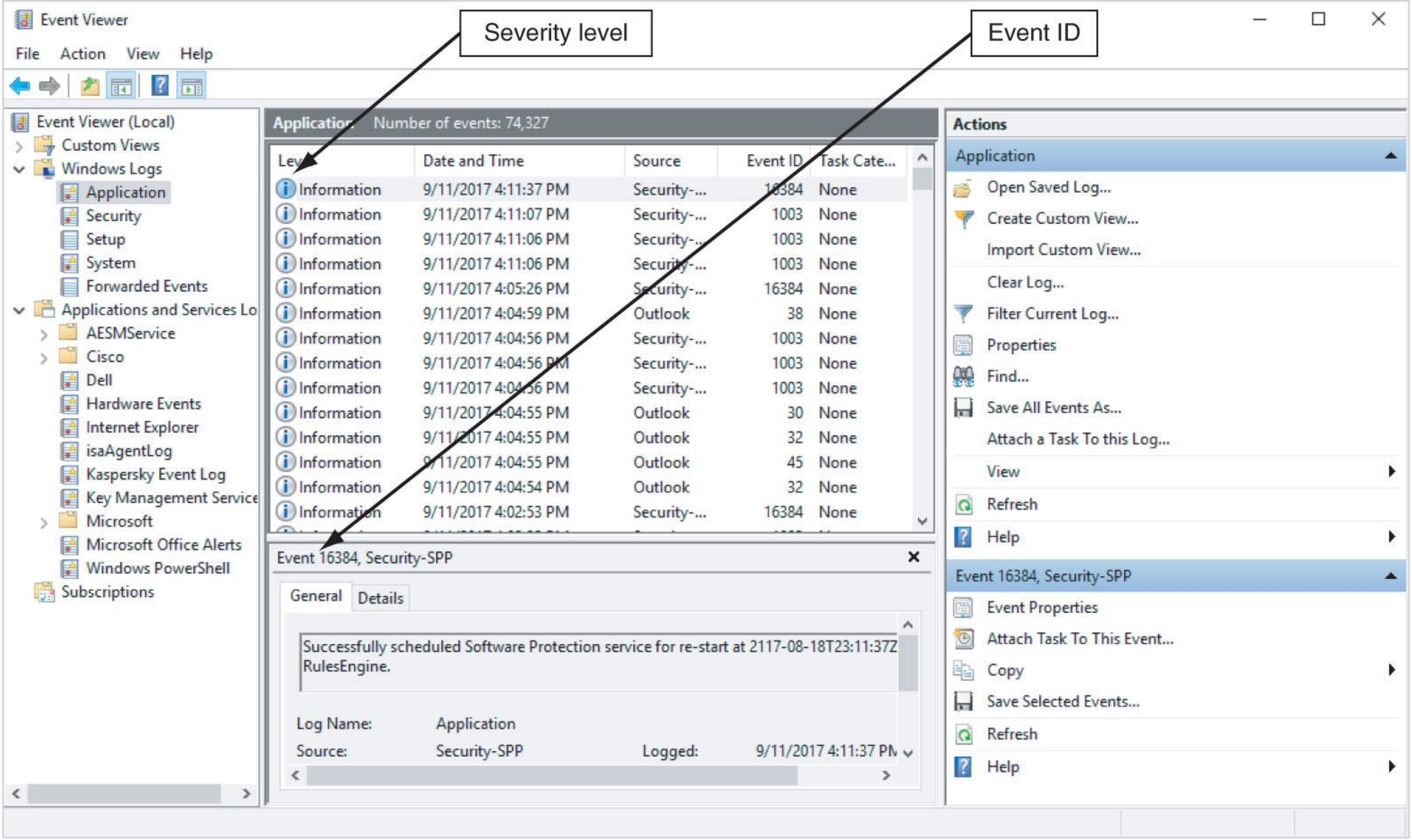
# Examining Microsoft E-mail Server Logs (2 of 4)

- **Transaction logs**
  - Keep track of changes to its data
- **Checkpoints**
  - Marks the last point at which the database was written to disk
- **Temporary files**
  - Created to prevent loss when the server is busy converting binary data to readable text

# Examining Microsoft E-mail Server Logs (3 of 4)

- To retrieve log files created by Exchange
  - Use the Windows PowerShell cmdlet `GetTransactionLogStats.ps1 -Gather`
- Tracking.log
  - An Exchange server log that tracks messages
- Another log used for investigating the Exchange environment is the troubleshooting log
  - Use Windows Event Viewer to read the log

# Examining Microsoft E-mail Server Logs (4 of 4)



Application Number of events: 74,327

| Level | Date and Time | Source | Event ID | Task Cate... |
|---|---|---|---|---|
| Information | 9/11/2017 4:11:37 PM | Security-... | 16384 | None |
| Information | 9/11/2017 4:11:07 PM | Security-... | 1003 | None |
| Information | 9/11/2017 4:11:06 PM | Security-... | 1003 | None |
| Information | 9/11/2017 4:11:06 PM | Security-... | 1003 | None |
| Information | 9/11/2017 4:05:26 PM | Security-... | 16384 | None |
| Information | 9/11/2017 4:04:59 PM | Outlook | 38 | None |
| Information | 9/11/2017 4:04:56 PM | Security-... | 1003 | None |
| Information | 9/11/2017 4:04:56 PM | Security-... | 1003 | None |
| Information | 9/11/2017 4:04:56 PM | Security-... | 1003 | None |
| Information | 9/11/2017 4:04:55 PM | Outlook | 30 | None |
| Information | 9/11/2017 4:04:55 PM | Outlook | 32 | None |
| Information | 9/11/2017 4:04:55 PM | Outlook | 45 | None |
| Information | 9/11/2017 4:04:54 PM | Outlook | 32 | None |
| Information | 9/11/2017 4:02:53 PM | Security-... | 16384 | None |

Event 16384, Security-SPP

Successfully scheduled Software Protection service for re-start at 2117-08-18T23:11:37Z
RulesEngine.

Log Name: Application
Source: Security-SPP Logged: 9/11/2017 4:11:37 PM

**Figure 11-6** Viewing a log in Event Viewer

# Using Specialized E-mail Forensics Tools (1 of 3)

- Tools include:
  - DataNumen for Outlook and Outlook Express
  - FINALeMAIL for Outlook Express and Eudora
  - Sawmill-Novell GroupWise for log analysis
  - MailXaminer for multiple e-mail formatas and large data sets
  - Fookes Aid4Mail and MailBag Assistant
  - Paraben E-Mail Examiner
  - AccessData FTK for Outlook and Outlook Express
  - Ontrack Easy Recovery EmailRepair
  - R-Tools R-Mail
  - OfficeRecovery's MailRecovery

# Using Specialized E-mail Forensics Tools (2 of 3)

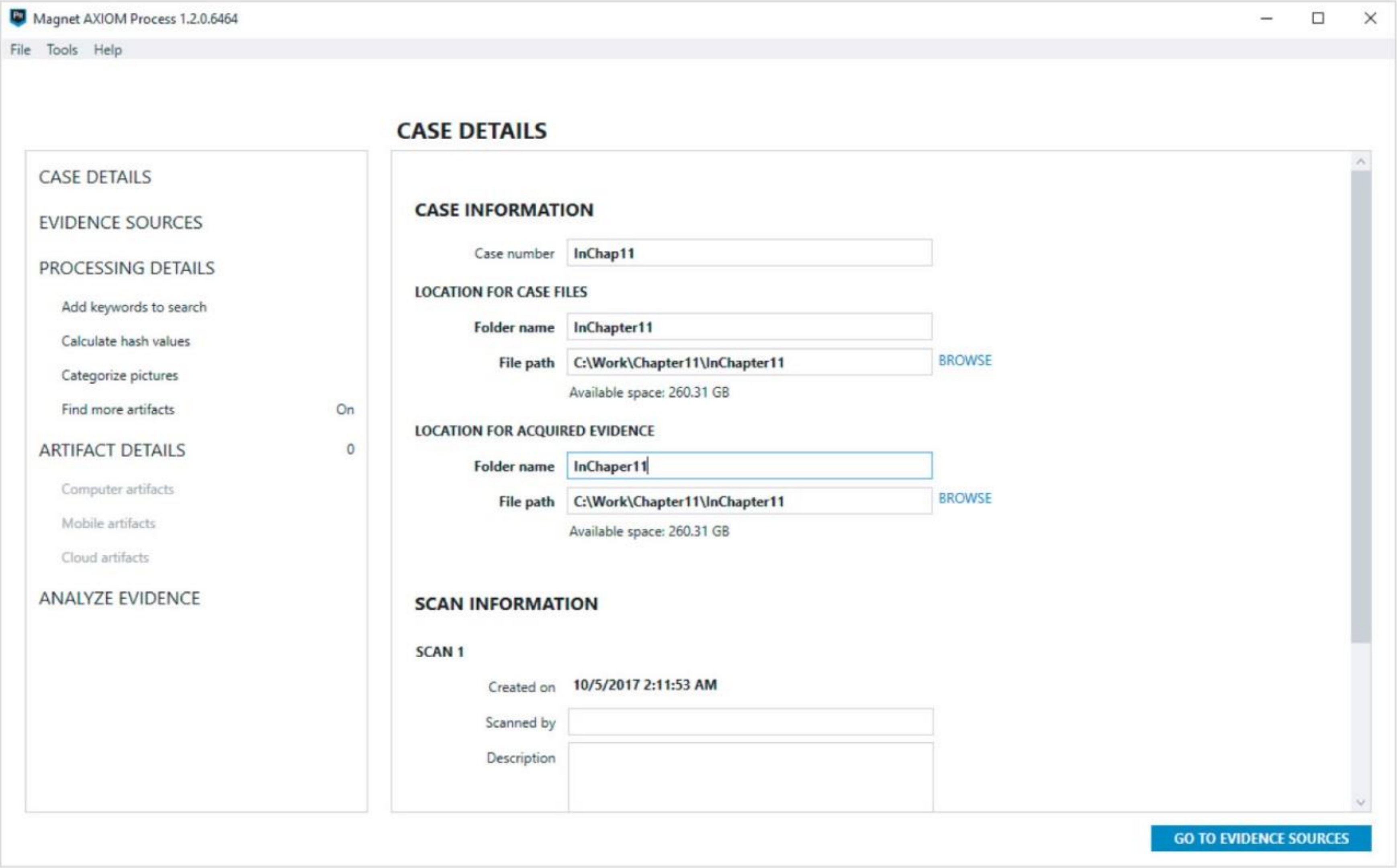
- Tools (continued)
    - MXToolBox for decoding e-mail headers
    - FreeViewer with free tools for various servers
- Tools allow you to find:
    - E-mail database files
    - Personal e-mail files
    - Offline storage files
    - Log files
- Advantage of using data recovery tools
    - You don’t need to know how e-mail servers and clients work to extract data from them

# Using Specialized E-mail Forensics Tools (3 of 3)

- After you compare e-mail logs with messages, you should verify the:
  - Email account, message ID, IP address, date and time stamp to determine whether there's enough evidence for a warrant
- With some tools
  - You can scan e-mail database files on a suspect's Windows computer, locate any e-mails the suspect has deleted and restore them to their original state

# Using Magnet AXIOM to Recover E-mail

- Magnet AXIOM has two modules:
  - Process
  - Examine
- Follow the steps in the activity on page 472 to learn how to use Magnet AXIOM to recover e-mails



CASE DETAILS

CASE INFORMATION

Case number: InChap11

LOCATION FOR CASE FILES

Folder name: InChapter11

File path: C:\Work\Chapter11\InChapter11

Available space: 260.31 GB

LOCATION FOR ACQUIRED EVIDENCE

Folder name: InChaper11

File path: C:\Work\Chapter11\InChapter11

Available space: 260.31 GB

SCAN INFORMATION

SCAN 1

Created on: 10/5/2017 2:11:53 AM

Scanned by:

Description:

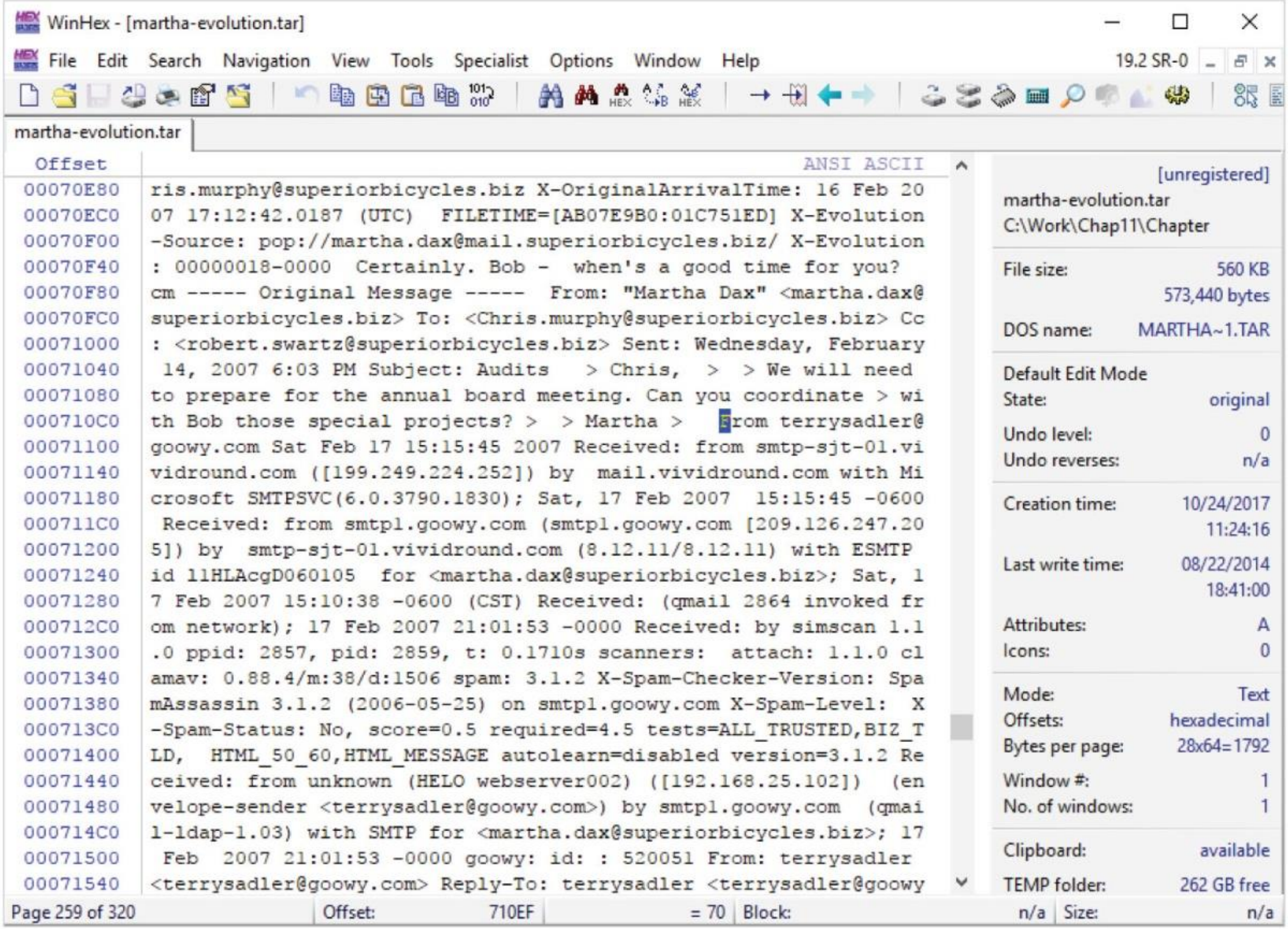
**Figure 11-7** Entering information in the CASE DETAILS window

Source: Magnet Forensics, *www.magnetforensics.com*

# Using a Hex Editor to Carve E-mail Messages (1 of 4)

- Few vendors have products for analyzing e-mail in systems other than Microsoft
- **mbox** format
  - Stores e-mails in flat plaintext files
- **Multipurpose Internet Mail Extensions (MIME)** format
  - Used by vendor-unique e-mail file systems, such as Microsoft .pst or .ost
- Example: carve e-mail messages from Evolution

# Using a Hex Editor to Carve E-mail Messages



```
Offset                                                                ANSI ASCII
00070E80  ris.murphy@superiorbicycles.biz X-OriginalArrivalTime: 16 Feb 20
00070EC0  07 17:12:42.0187 (UTC)  FILETIME=[AB07E9B0:01C751ED] X-Evolution
00070F00  -Source: pop://martha.dax@mail.superiorbicycles.biz/ X-Evolution
00070F40  : 00000018-0000  Certainly. Bob -  when's a good time for you?
00070F80  cm ----- Original Message -----  From: "Martha Dax" <martha.dax@
00070FC0  superiorbicycles.biz> To: <Chris.murphy@superiorbicycles.biz> Cc
00071000  : <robert.swartz@superiorbicycles.biz> Sent: Wednesday, February
00071040   14, 2007 6:03 PM Subject: Audits   > Chris,  >  > We will need
00071080  to prepare for the annual board meeting. Can you coordinate > wi
000710C0  th Bob those special projects? >  > Martha >   From terrysadler@
00071100  goowy.com Sat Feb 17 15:15:45 2007 Received: from smtp-sjt-01.vi
00071140  vidround.com ([199.249.224.252]) by  mail.vividround.com with Mi
00071180  crosoft SMTPSVC(6.0.3790.1830); Sat, 17 Feb 2007  15:15:45 -0600
000711C0   Received: from smtpl.goowy.com (smtpl.goowy.com [209.126.247.20
00071200  5]) by  smtp-sjt-01.vividround.com (8.12.11/8.12.11) with ESMTP
00071240  id l1HLAcgD060105  for <martha.dax@superiorbicycles.biz>; Sat, 1
00071280  7 Feb 2007 15:10:38 -0600 (CST) Received: (qmail 2864 invoked fr
000712C0  om network); 17 Feb 2007 21:01:53 -0000 Received: by simscan 1.1
00071300  .0 ppid: 2857, pid: 2859, t: 0.1710s scanners:  attach: 1.1.0 cl
00071340  amav: 0.88.4/m:38/d:1506 spam: 3.1.2 X-Spam-Checker-Version: Spa
00071380  mAssassin 3.1.2 (2006-05-25) on smtpl.goowy.com X-Spam-Level:  X
000713C0  -Spam-Status: No, score=0.5 required=4.5 tests=ALL_TRUSTED,BIZ_T
00071400  LD,  HTML_50_60,HTML_MESSAGE autolearn=disabled version=3.1.2 Re
00071440  ceived: from unknown (HELO webserver002) ([192.168.25.102])  (en
00071480  velope-sender <terrysadler@goowy.com>) by smtpl.goowy.com  (qmai
000714C0  l-ldap-1.03) with SMTP for <martha.dax@superiorbicycles.biz>; 17
00071500   Feb  2007 21:01:53 -0000 goowy: id: : 520051 From: terrysadler
00071540  <terrysadler@goowy.com> Reply-To: terrysadler <terrysadler@goowy
```

[unregistered]
martha-evolution.tar
C:\Work\Chap11\Chapter

File size: 560 KB
573,440 bytes
DOS name: MARTHA~1.TAR

Default Edit Mode
State: original
Undo level: 0
Undo reverses: n/a

Creation time: 10/24/2017
11:24:16
Last write time: 08/22/2014
18:41:00

Attributes: A
Icons: 0

Mode: Text
Offsets: hexadecimal
Bytes per page: 28x64=1792
Window #: 1
No. of windows: 1

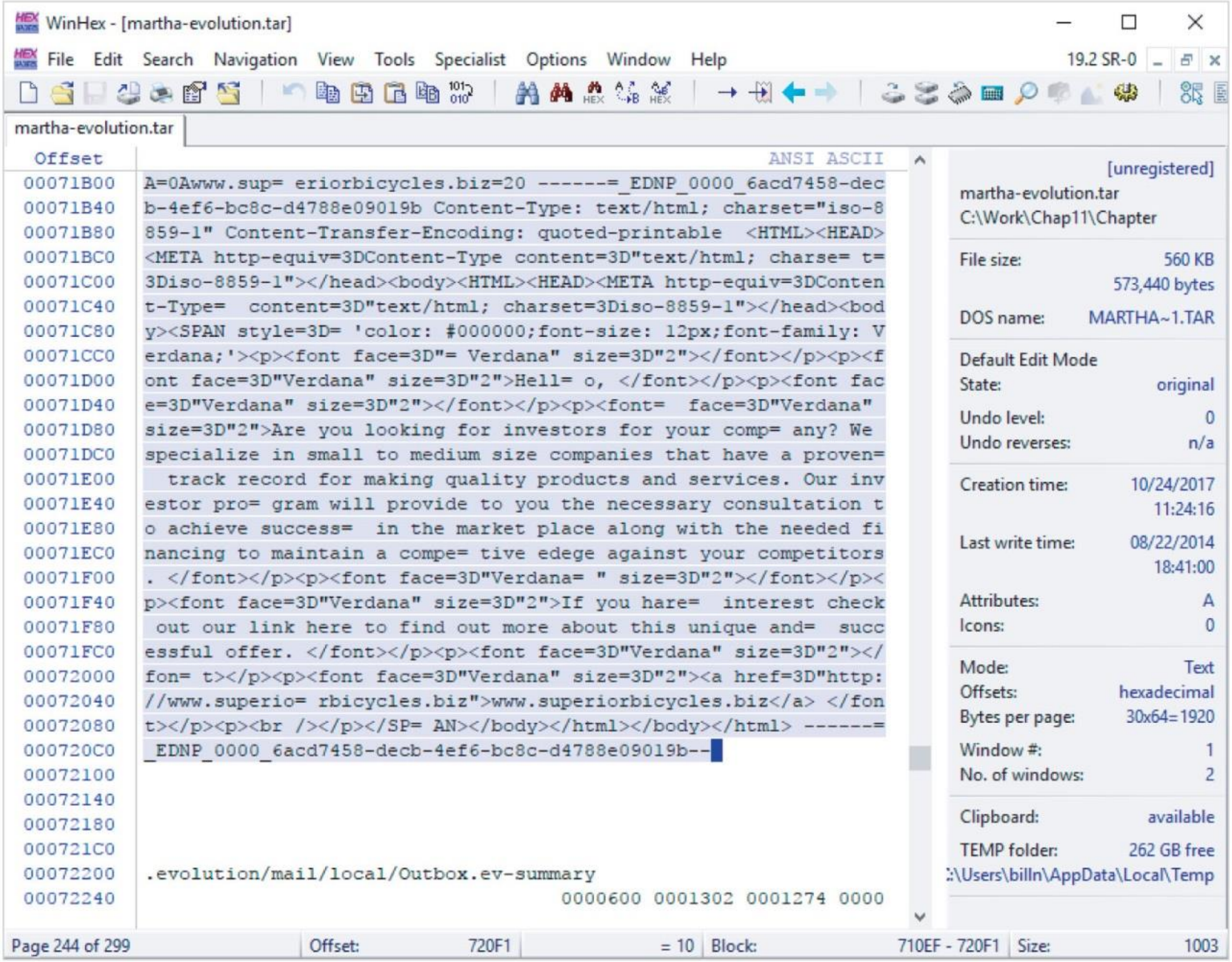
Clipboard: available
TEMP folder: 262 GB free

Page 259 of 320 | Offset: 710EF | = 70 | Block: n/a | Size: n/a

**Figure 11-10** WinHex displaying the beginning of the e-mail from Terry Sadler

Source: X-Ways AG, www.x-ways.net

# Using a Hex Editor to Carve E-mail Messages



```
Offset                                                                   ANSI ASCII
00071B00  A=0Awww.sup= eriorbicycles.biz=20 -------=_EDNP_0000_6acd7458-dec
00071B40  b-4ef6-bc8c-d4788e09019b Content-Type: text/html; charset="iso-8
00071B80  859-1" Content-Transfer-Encoding: quoted-printable  <HTML><HEAD>
00071BC0  <META http-equiv=3DContent-Type content=3D"text/html; charse= t=
00071C00  3Diso-8859-1"></head><body><HTML><HEAD><META http-equiv=3DConten
00071C40  t-Type=  content=3D"text/html; charset=3Diso-8859-1"></head><bod
00071C80  y><SPAN style=3D= 'color: #000000;font-size: 12px;font-family: V
00071CC0  erdana;'><p><font face=3D"= Verdana" size=3D"2"></font></p><p><f
00071D00  ont face=3D"Verdana" size=3D"2">Hell= o, </font></p><p><font fac
00071D40  e=3D"Verdana" size=3D"2"></font></p><p><font=  face=3D"Verdana"
00071D80  size=3D"2">Are you looking for investors for your comp= any? We
00071DC0  specialize in small to medium size companies that have a proven=
00071E00    track record for making quality products and services. Our inv
00071E40  estor pro= gram will provide to you the necessary consultation t
00071E80  o achieve success=  in the market place along with the needed fi
00071EC0  nancing to maintain a compe= tive edege against your competitors
00071F00  . </font></p><p><font face=3D"Verdana= " size=3D"2"></font></p><
00071F40  p><font face=3D"Verdana" size=3D"2">If you hare=  interest check
00071F80   out our link here to find out more about this unique and=  succ
00071FC0  essful offer. </font></p><p><font face=3D"Verdana" size=3D"2"></
00072000  fon= t></p><p><font face=3D"Verdana" size=3D"2"><a href=3D"http:
00072040  //www.superio= rbicycles.biz">www.superiorbicycles.biz</a> </fon
00072080  t></p><p><br /></p></SP= AN></body></html></body></html> ------=
000720C0  _EDNP_0000_6acd7458-decb-4ef6-bc8c-d4788e09019b--
00072100
00072140
00072180
000721C0
00072200  .evolution/mail/local/Outbox.ev-summary
00072240                                       0000600 0001302 0001274 0000
```

[unregistered]
martha-evolution.tar
C:\Work\Chap11\Chapter

File size: 560 KB
573,440 bytes
DOS name: MARTHA~1.TAR

Default Edit Mode
State: original
Undo level: 0
Undo reverses: n/a

Creation time: 10/24/2017 11:24:16

Last write time: 08/22/2014 18:41:00

Attributes: A
Icons: 0

Mode: Text
Offsets: hexadecimal
Bytes per page: 30x64=1920

Window #: 1
No. of windows: 2

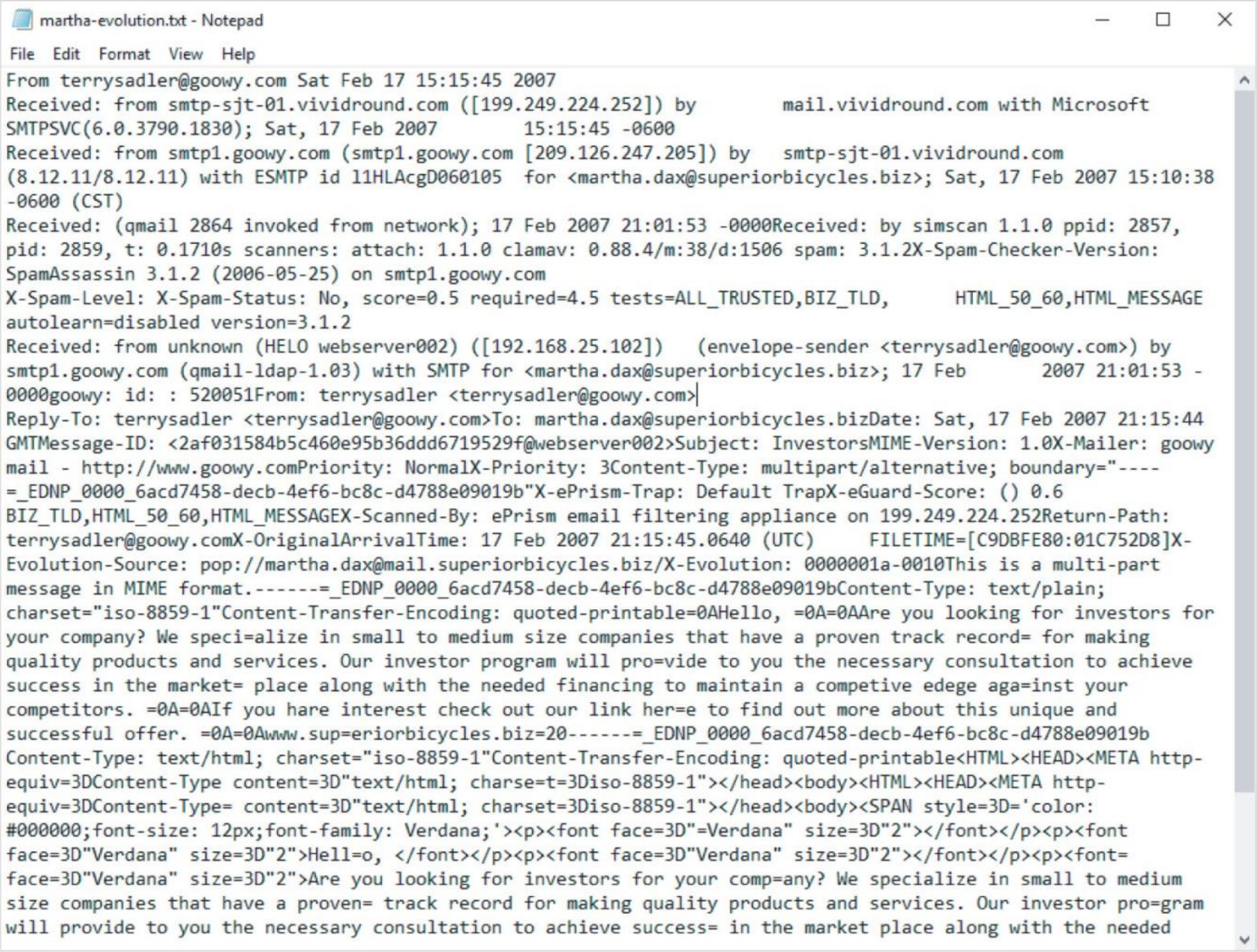
Clipboard: available
TEMP folder: 262 GB free
:\Users\billn\AppData\Local\Temp

Page 244 of 299 | Offset: 720F1 | = 10 | Block: 710EF - 720F1 | Size: 1003

**Figure 11-11** WinHex displaying the ending position of the e-mail from Terry Sadler

Source: X-Ways AG, *www.x-ways.net*

# Using a Hex Editor to Carve E-mail Messages



```
From terrysadler@goowy.com Sat Feb 17 15:15:45 2007
Received: from smtp-sjt-01.vividround.com ([199.249.224.252]) by       mail.vividround.com with Microsoft
SMTPSVC(6.0.3790.1830); Sat, 17 Feb 2007        15:15:45 -0600
Received: from smtp1.goowy.com (smtp1.goowy.com [209.126.247.205]) by   smtp-sjt-01.vividround.com
(8.12.11/8.12.11) with ESMTP id l1HLAcgD060105  for <martha.dax@superiorbicycles.biz>; Sat, 17 Feb 2007 15:10:38
-0600 (CST)
Received: (qmail 2864 invoked from network); 17 Feb 2007 21:01:53 -0000Received: by simscan 1.1.0 ppid: 2857,
pid: 2859, t: 0.1710s scanners: attach: 1.1.0 clamav: 0.88.4/m:38/d:1506 spam: 3.1.2X-Spam-Checker-Version:
SpamAssassin 3.1.2 (2006-05-25) on smtp1.goowy.com
X-Spam-Level: X-Spam-Status: No, score=0.5 required=4.5 tests=ALL_TRUSTED,BIZ_TLD,      HTML_50_60,HTML_MESSAGE
autolearn=disabled version=3.1.2
Received: from unknown (HELO webserver002) ([192.168.25.102])   (envelope-sender <terrysadler@goowy.com>) by
smtp1.goowy.com (qmail-ldap-1.03) with SMTP for <martha.dax@superiorbicycles.biz>; 17 Feb       2007 21:01:53 -
0000goowy: id: : 520051From: terrysadler <terrysadler@goowy.com>
Reply-To: terrysadler <terrysadler@goowy.com>To: martha.dax@superiorbicycles.bizDate: Sat, 17 Feb 2007 21:15:44
GMTMessage-ID: <2af031584b5c460e95b36ddd6719529f@webserver002>Subject: InvestorsMIME-Version: 1.0X-Mailer: goowy
mail - http://www.goowy.comPriority: NormalX-Priority: 3Content-Type: multipart/alternative; boundary="----
=_EDNP_0000_6acd7458-decb-4ef6-bc8c-d4788e09019b"X-ePrism-Trap: Default TrapX-eGuard-Score: () 0.6
BIZ_TLD,HTML_50_60,HTML_MESSAGEX-Scanned-By: ePrism email filtering appliance on 199.249.224.252Return-Path:
terrysadler@goowy.comX-OriginalArrivalTime: 17 Feb 2007 21:15:45.0640 (UTC)     FILETIME=[C9DBFE80:01C752D8]X-
Evolution-Source: pop://martha.dax@mail.superiorbicycles.biz/X-Evolution: 0000001a-0010This is a multi-part
message in MIME format.------=_EDNP_0000_6acd7458-decb-4ef6-bc8c-d4788e09019bContent-Type: text/plain;
charset="iso-8859-1"Content-Transfer-Encoding: quoted-printable=0AHello, =0A=0AAre you looking for investors for
your company? We speci=alize in small to medium size companies that have a proven track record= for making
quality products and services. Our investor program will pro=vide to you the necessary consultation to achieve
success in the market= place along with the needed financing to maintain a competive edege aga=inst your
competitors. =0A=0AIf you hare interest check out our link her=e to find out more about this unique and
successful offer. =0A=0Awww.sup=eriorbicycles.biz=20------=_EDNP_0000_6acd7458-decb-4ef6-bc8c-d4788e09019b
Content-Type: text/html; charset="iso-8859-1"Content-Transfer-Encoding: quoted-printable<HTML><HEAD><META http-
equiv=3DContent-Type content=3D"text/html; charse=t=3Diso-8859-1"></head><body><HTML><HEAD><META http-
equiv=3DContent-Type= content=3D"text/html; charset=3Diso-8859-1"></head><body><SPAN style=3D='color:
#000000;font-size: 12px;font-family: Verdana;'><p><font face=3D"=Verdana" size=3D"2"></font></p><p><font
face=3D"Verdana" size=3D"2">Hell=o, </font></p><p><font face=3D"Verdana" size=3D"2"></font></p><p><font=
face=3D"Verdana" size=3D"2">Are you looking for investors for your comp=any? We specialize in small to medium
size companies that have a proven= track record for making quality products and services. Our investor pro=gram
will provide to you the necessary consultation to achieve success= in the market place along with the needed
```

Figure 11-12 The Terry Sadler e-mail in Notepad

# Recovering Outlook Files (1 of 2)

- A forensics examiner recovering e-mail messages from **Outlook**
  - May need to reconstruct `.pst` files and messages
- With many advanced forensics tools
  - Deleted `.pst` files can be partially or completely recovered
- `Scanpst.exe` recovery tool
  - Comes with Microsoft Office
  - Can repair `.ost` files as well as `.pst` files

# Recovering Outlook Files (2 of 2)

- Guidance Software uses the SysTools plug-in
  - For Outlook e-mail through version 2013
  - Systools extracts .pst files from EnCase Forensic for analysis
- DataNumen Outlook Repair
  - One of the better e-mail recovery tools
  - Can recovery files from VMware and Virtual PC

# E-mail Case Studies

- In the **Enron Case**, more than 10,00 emails contained the following personal information:
  - 60 containing credit card numbers
  - 572 containing thousands of Social Security or other identity numbers
  - 292 containing birth dates
  - 532 containing information of a highly personal nature
    - Such as medical or legal matters

https://www.kaggle.com/datasets/wcukierski/enron-email-dataset

# ACTIVITY TIME

# Class Activity

- Visit the given link

  https://www.kaggle.com/datasets/wcukierski/enron-email-dataset

- Explore ways to extract the following from the dataset.
  1) Personal Identifiable Information (PII)
  2) Phishing email
  3) Harassment email
  4) Bullying email
  5) Hate Speech