MIT WORLD PEACE UNIVERSITY

Digital Forensics and Investigation
Third Year B. Tech, Semester 5

ANALYSING EMAIL HEADERS

LAB ASSIGNMENT 5

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Contents

1 Aim

To learn about the various types of email headers, and how to analyse them. To perform a live practical upon sent and received mails, while analysing the headers of the same.

2 Objectives

1. Understand the various types of email headers.
2. Learn how to analyse email headers.

3 Theory

3.1 Email Clients

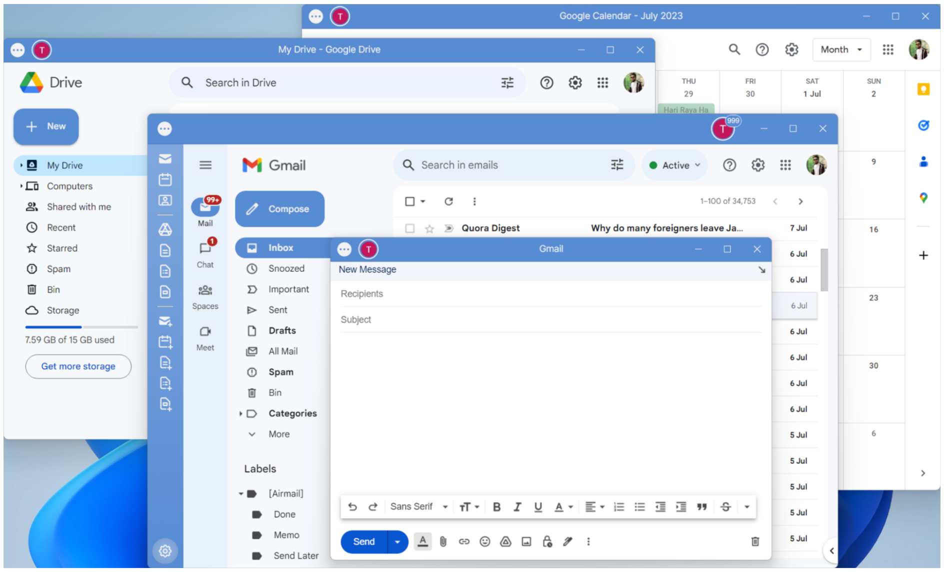
Email clients, also known as email programs or email software, are applications or platforms designed for managing, sending, and receiving email messages. They are essential tools for communication in both personal and professional settings. Here are key points related to email clients:

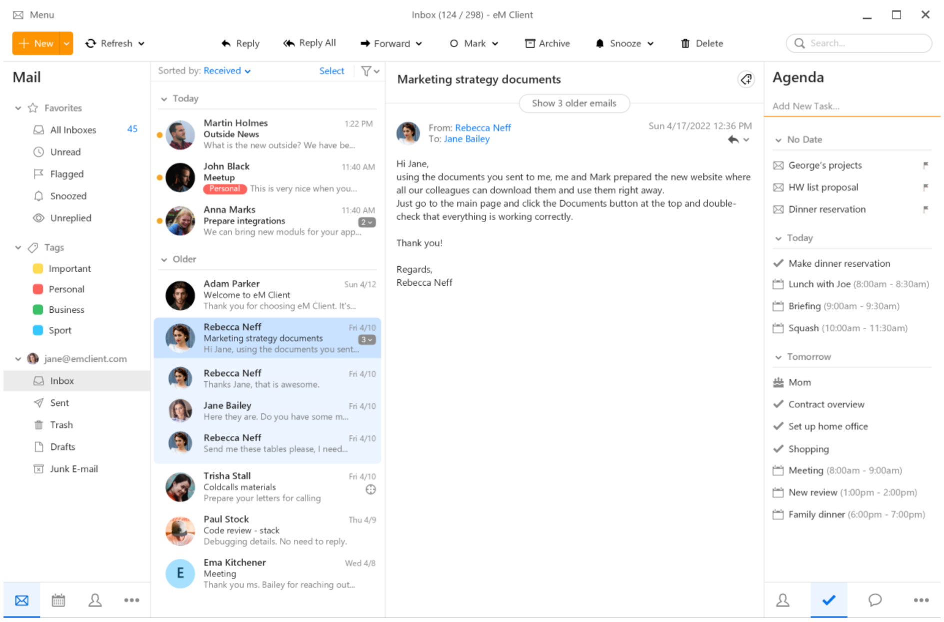
1. **Purpose of Email Clients:** - Email clients are designed to provide a user-friendly interface for managing email communication. They allow users to read, compose, send, and organize emails.
2. **Types of Email Clients:** - There are various types of email clients, including desktop clients (e.g., Microsoft Outlook, Mozilla Thunderbird), web-based clients (e.g., Gmail, Outlook.com), and mobile clients (e.g., Apple Mail, Gmail app).
3. **Features of Email Clients:** - Email clients offer a wide range of features, including the ability to access multiple email accounts, organize emails into folders, set up filters and rules, and manage attachments.

4. **Integration with Protocols:** - Email clients integrate with email protocols such as IMAP (Internet Message Access Protocol) and POP3 (Post Office Protocol) to retrieve and store emails on local devices or remote servers.

5. **User Interface:** - The user interface of email clients varies, but it typically includes an inbox, folders for organization, a compose window, and options for formatting emails.
6. **Cross-Platform Compatibility:** - Many email clients are available on multiple platforms, making it easy for users to access their emails on different devices such as computers, smartphones, and tablets.
7. **Security and Encryption:** - Email clients often support encryption and security features to protect sensitive information, including SSL/TLS for secure connections and S/MIME for email message encryption.
8. **Customization:** - Users can often customize the appearance and behavior of email clients through themes, plugins, and settings to suit their preferences and needs.
9. **Productivity Tools:** - Some email clients offer productivity tools like calendars, task management, and contact organization, making them comprehensive communication hubs.
10. **Email Standards:** - Email clients adhere to email standards such as RFC 5322 for formatting and displaying emails, ensuring compatibility and consistent rendering.

Email clients play a pivotal role in modern communication, providing users with a centralized platform for managing their electronic correspondence.





Martin Holmes 1:22 PM
Outside News
What is the new outside? We have be...

John Black 11:40 AM
Meetup
Personal This is very nice when you...

Anna Marks 11:40 AM
Prepare integrations 2
We can bring new moduls for your app...

Adam Parker Sun 4/12
Welcome to eM Client
Thank you for choosing eM Client. It's...

Rebecca Neff Fri 4/10
Marketing strategy documents 3
Hi Jane, using the documents you sent...

Rebecca Neff Fri 4/10
Thanks Jane, that is awesome.

Jane Bailey Fri 4/10
Here they are. Do you have some m...

Rebecca Neff Fri 4/10
Send me these tables please, I need...

Trisha Stall Fri 4/10
Coldcalls materials
Prepare your letters for calling

Paul Stock Thu 4/9
Code review - stack
Debugging details. No need to reply.

Ema Kitchener Wed 4/8
Meeting
Thank you ms. Bailey for reaching out...

Marketing strategy documents

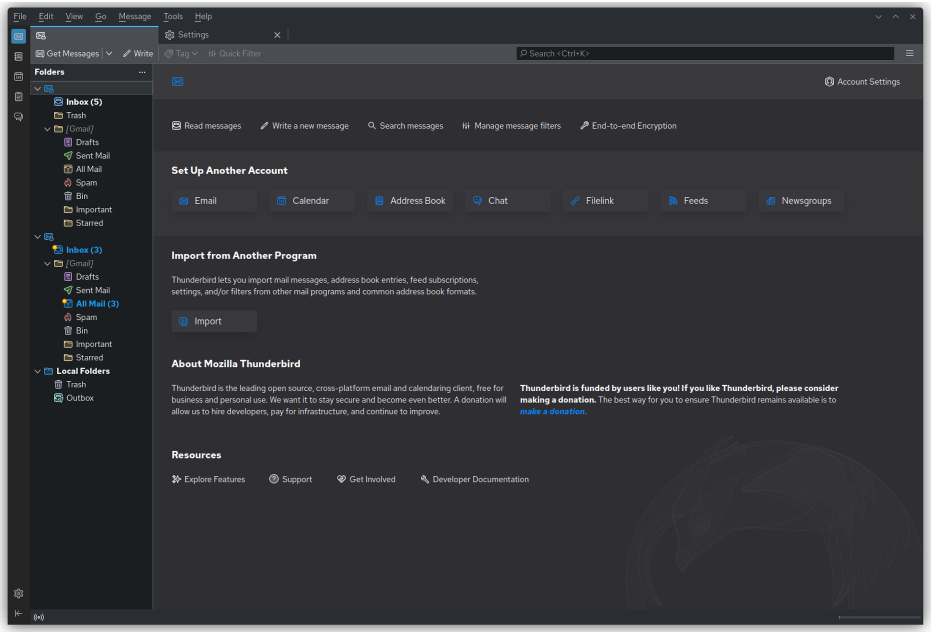
Show 3 older emails

From: Rebecca Neff
To: Jane Bailey
Sun 4/17/2022 12:36 PM

Hi Jane,
using the documents you sent to me, me and Mark prepared the new website where all our colleagues can download them and use them right away.
Just go to the main page and click the Documents button at the top and double-check that everything is working correctly.

Thank you!

Regards,
Rebecca Neff



Thunderbird lets you import mail messages, address book entries, feed subscriptions, settings, and/or filters from other mail programs and common address book formats.

Thunderbird is the leading open source, cross-platform email and calendaring client, free for business and personal use. We want it to stay secure and become even better. A donation will allow us to hire developers, pay for infrastructure, and continue to improve.

Thunderbird is funded by users like you! If you like Thunderbird, please consider making a donation. The best way for you to ensure Thunderbird remains available is to ***make a donation***.

3.2 Email Headers

Email headers are crucial components of every email message, providing essential information about the email's origin, routing, and content. They are often hidden from the average email user but are invaluable for analysis and troubleshooting. Here are the key points related to email headers:

1. **Purpose of Email Headers:** - Email headers serve the purpose of facilitating the smooth transmission of email messages from the sender to the recipient.

2. **Structure of Email Headers:** - Email headers are structured as a set of key-value pairs. Each pair is on a separate line, and the header section is separated from the email body by a blank line.

3. **Common Header Fields:** - Email headers consist of various fields, including "From," "To," "Subject," "Date," and "Message-ID." These fields provide information about the sender, recipient, subject, timestamp, and a unique identifier for the email.

4. **Received Headers:** - One of the most critical sections of an email header is the "Received" field. It provides a trail of servers through which the email passed, helping trace the email's path and verify its authenticity.

5. **Message Routing:** - Email headers contain information about how the message traveled from the sender's email client to the recipient's email server. This routing information is useful for diagnosing email delivery issues.

3.3 Types of Email Headers

There are several types of email headers, each serving a specific purpose:

1. **MIME Headers:** - MIME (Multipurpose Internet Mail Extensions) headers are used to specify the type and structure of the email's content, allowing for the inclusion of multimedia elements like images and attachments.

2. **Authentication Headers:** - Authentication headers, such as SPF (Sender Policy Framework) and DKIM (DomainKeys Identified Mail), are used to verify the authenticity of the sender and prevent email spoofing.

3. **User-Agent Headers:** - User-Agent headers provide information about the email client or software used by the sender. This helps in identifying the source of the message.

4. **Custom Headers:** - Email headers can also include custom fields created by the sender or email servers. These fields are specific to certain applications or organizations.

3.4 Email Header Analysis

Email header analysis is a crucial skill in various fields, including cybersecurity, digital forensics, and troubleshooting email delivery issues. Here are key aspects of email header analysis:

1. **IP Address Tracking:** - Analyzing email headers allows one to trace the path of the email through IP addresses, helping identify potential issues or suspicious activity.

2. **Email Authentication:** - Authentication headers like SPF and DKIM can be scrutinized to verify the sender's authenticity, ensuring the email is not a forgery.

3. **Server Timestamps:** - Email headers include timestamps from servers, which can be compared to identify delays or bottlenecks in email delivery.

4. **Identifying Email Spoofing:** - By examining routing and authentication information, one can detect instances of email spoofing or phishing attempts.

5. **Legal and Compliance:** - In legal matters, email headers can serve as evidence, proving the origin and path of an email message.

When analyzing email headers, it's essential to refer to email standards and protocols, such as RFC 5322, for a comprehensive understanding of the header fields and their meanings.

4 Platform

Operating System: Arch Linux x86-64
IDEs or Text Editors Used: Visual Studio Code
Compilers or Interpreters: Python 3.12

5 Analysis

5.1 Downloading Email Headers

[1]:

```python
username = "krishnaraj.kpt@outlook.com"
password = "BBQtJTSs8uQh57aw"
imap_server = "outlook.office365.com"
```

[5]:

```python
import imaplib
import email
from email.header import decode_header
from email.parser import BytesParser
import json
```

Creating Imap Object

[6]:

```python
# create an IMAP4 class with SSL
imap = imaplib.IMAP4_SSL(imap_server)
# authenticate
imap.login(username, password)
status, messages = imap.select("INBOX")

# number of top emails to fetch
N = 15

# total number of emails
messages = int(messages[0])
print("The Total Number of Messages in your account are: ", messages)
```

```
The Total Number of Messages in your account are:  1017
```

Downloading Headers

[7]:

```python
# create a list to store the emails
emails = []

# fetch the top N email headers
for i in range(messages - N, messages + 1):
    # fetch the email header
    result, data = imap.fetch(str(i + 1), "(RFC822.HEADER)")
    if result == "OK":
        # parse the email header
        email_parser = BytesParser()
        email_header = email_parser.parsebytes(data[0][1])

        # create a dictionary to store the email header
        email = {
            "subject": email_header["Subject"],
            "headers": [],
        }

        # add the email headers to the dictionary
        for header in email_header.items():
            email["headers"].append({
                "header": header[0],
                "value": header[1],
            })

        # add the email to the list of emails
        emails.append(email)

# close the IMAP connection
imap.close()

# write the emails to a JSON file
with open("emails.json", "w") as f:
    json.dump(emails, f, indent=4)
```

Converting the json file to a python dictionary

[23]:
```
import json
with open("emails.json", "r") as f:
    emails = json.load(f)
```

Looking at Header keys of one of the emails

[29]:
```
header_names = [i['header'] for i in emails[1]["headers"]]
```

Focusing on 8 Test Emails

[24]:
```
emails = emails[2:10]
```

Looking at their Subjects

[26]:
```
[i['subject'] for i in emails]
```

[26]:
```
['Sending from phone gmail app',
 'Self mail from web outlook client',
 'Self test mail from gmail web client',
 'self test mail from mit gmail client',
 'From movile outlook app',
 'Mail sent from phone',
 "Mother's phone Gmail app",
 'Sending from browser with vpn connection on']
```

Analyse each header and find out what it means

[59]:

```python
print("Total number of headers in provided email: ", len(header_names))
```

```
Total number of headers in provided email:  77
```

[45]:

```python
# print header names with their index
for index, header in enumerate(header_names):
    print(index, header)
```

```
0 MIME-Version
1 Received
2 ARC-Seal
3 ARC-Message-Signature
4 ARC-Authentication-Results
5 Received
6 Received
7 Authentication-Results
8 Received-SPF
9 Received
10 X-IncomingTopHeaderMarker
11 ARC-Seal
12 ARC-Message-Signature
13 ARC-Authentication-Results
14 DKIM-Signature
15 Received
16 Received
17 From
18 To
19 Subject
20 Thread-Topic
21 Thread-Index
22 Date
23 Message-ID
24 Accept-Language
25 Content-Language
26 X-MS-Has-Attach
27 X-MS-TNEF-Correlator
28 msip_labels
29 x-tmn
30 x-ms-traffictypediagnostic
31 X-MS-Office365-Filtering-Correlation-Id
32 X-Microsoft-Antispam-Untrusted
33 X-Microsoft-Antispam-Message-Info-Original
34 X-MS-Exchange-AntiSpam-MessageData-Original-ChunkCount
```

```
35 X-MS-Exchange-AntiSpam-MessageData-Original-0
36 Content-Type
37 X-MS-Exchange-Transport-CrossTenantHeadersStamped
38 X-IncomingHeaderCount
39 Return-Path
40 X-MS-Exchange-Organization-ExpirationStartTime
41 X-MS-Exchange-Organization-ExpirationStartTimeReason
42 X-MS-Exchange-Organization-ExpirationInterval
43 X-MS-Exchange-Organization-ExpirationIntervalReason
44 X-MS-Exchange-Organization-Network-Message-Id
45 X-EOPAttributedMessage
46 X-EOPTenantAttributedMessage
47 X-MS-Exchange-Organization-MessageDirectionality
48 X-MS-Exchange-Transport-CrossTenantHeadersStripped
49 X-MS-Exchange-Transport-CrossTenantHeadersPromoted
50 X-MS-PublicTrafficType
51 X-MS-Exchange-Organization-AuthSource
52 X-MS-Exchange-Organization-AuthAs
53 X-MS-UserLastLogonTime
54 X-MS-Office365-Filtering-Correlation-Id-Prvs
55 X-MS-Exchange-EOPDirect
56 X-Sender-IP
57 X-SID-PRA
58 X-SID-Result
59 X-MS-Exchange-Organization-PCL
60 X-MS-Exchange-Organization-SCL
61 X-Microsoft-Antispam
62 X-MS-Exchange-CrossTenant-OriginalArrivalTime
63 X-MS-Exchange-CrossTenant-Network-Message-Id
64 X-MS-Exchange-CrossTenant-Id
65 X-MS-Exchange-CrossTenant-RMS-PersistedConsumerOrg
66 X-MS-Exchange-CrossTenant-rms-persistedconsumerorg
67 X-MS-Exchange-CrossTenant-AuthSource
68 X-MS-Exchange-CrossTenant-AuthAs
69 X-MS-Exchange-CrossTenant-FromEntityHeader
70 X-MS-Exchange-Transport-CrossTenantHeadersStamped
71 X-MS-Exchange-Transport-EndToEndLatency
72 X-MS-Exchange-Processed-By-BccFoldering
73 X-Microsoft-Antispam-Mailbox-Delivery
74 X-Message-Info
75 X-Message-Delivery
76 X-Microsoft-Antispam-Message-Info
```

5.1.1 MIME-Version

MIME-Version indicates the email's message format. It's important in investigations to understand how the message is structured and if it includes multimedia or attachments.

```
[38]: emails[1]['headers'][0]['header'], emails[1]['headers'][0]['value']
```

```
[38]: ('MIME-Version', '1.0')
```

5.1.2 Received

Received headers track the path of the email through various servers. This is crucial for tracing the email's journey, identifying potential anomalies, or investigating its source.

```
[40]: emails[1]['headers'][1]['header'], emails[1]['headers'][1]['value']
```

```
Received from SJ0PR17MB4837.namprd17.prod.outlook.com (2603:10b6:a03:37a::10)
 by DS7PR17MB6730.namprd17.prod.outlook.com with HTTPS; Sun, 29 Oct 2023
 17:32:29 +0000
```

5.1.3 ARC-Seal

ARC (Authenticated Received Chain) headers help verify the authenticity of email forwarding. ARC-Seal ensures the integrity of email headers, reducing the risk of spoofing.

```
[41]: emails[1]['headers'][2]['header'], emails[1]['headers'][2]['value']
```

```
[41]: ('ARC-Seal',
       'i=2; a=rsa-sha256; s=arcselector9901; d=microsoft.com; cv=pass;\r\n b=UERZv4Bl
      U4weLVUXdoohvbjGYpYf4pb9pFtOwayMK+mtwTbjMhWrqskYHiEhqgH1rrxhnvYgrK7YkvSkKXiEypdA
      Oak0f4KcLaHNb/KEBpCVvQoKhVUX2zWzFMxVLsIRkMgoltrKRs0JShcFwrbt6XCvxCZUTbsGQs/hFpaN
      0sYlFys1Qu41etiVDrmS8ZYpq4ZnHuXxdBzxW6A8Aql06f5sr4CF2fSeAIjAFu5JB5/tTHlu9wFIYa49
      rmvL4i2S8QLHI8IdHsvPpz0oNrK0BVzf8bFat2iF7qnIX2J1lkXo21nWrGEioqJjPP6uusrYJBc5R+Sa
      tB5i3rmSYpqn0w==')
```

5.1.4 ARC-Message-Signature

ARC-Message-Signature is part of ARC headers and provides cryptographic assurance of email header integrity, aiding in detecting email tampering.

```
[42]: emails[1]['headers'][3]['header'], emails[1]['headers'][3]['value']
```

```
[42]: ('ARC-Message-Signature',
       'i=2; a=rsa-sha256; c=relaxed/relaxed; d=microsoft.com;\r\n
      s=arcselector9901;\r\n h=From:Date:Subject:Message-ID:Content-Type:MIME-
      Version:X-MS-Exchange-AntiSpam-MessageData-ChunkCount:X-MS-Exchange-AntiSpam-
      MessageData-0:X-MS-Exchange-AntiSpam-MessageData-1;\r\n
      bh=6+cClN22oIrc2YH61nPV02IScRJCb64tf03+C6e0M4c=;\r\n b=eM0/ekjq2KehxMnRBghHFpHhg
      VKFTyGOnc/ccplTJ7KonRY/xFz58qfR9ixNv6igINRBz+QQaWFKprBg57YvrEJRPljNUKGOWmKJXKF1C
      zif79KmQpGcyxrjMBkNfga0hZWdPpPgOAVbNEGOz2uYUQ4zIqpiqq0wJ69EUaestV84DGs3O14jqflXj
      ihcktRdZBX6zL/WD1gnOdr6ParkWfeJUaCV1BjMcpoUFXMnCZwlB2ST1aNgUdXHrqvxty4c2Q0/1uDWW
      r9Wu/Vx5h/kN9LqqjvwNmvzTLuRE1oPLaIch8T2dBnIf6leWeKENffAjFK+Kba43a68mbAnbxlvsg=='
      )
```

5.1.5 ARC-Authentication-Results

These headers indicate the email's authentication status. Investigators can use this to assess the email's legitimacy and potential for phishing.

```
[43]: emails[1]['headers'][4]['header'], emails[1]['headers'][4]['value']
```

```
[43]: ('ARC-Authentication-Results',
       'i=2; mx.microsoft.com 1; spf=pass (sender ip is\r\n 40.92.20.10)
      smtp.rcpttodomain=outlook.com smtp.mailfrom=outlook.com;\r\n dmarc=pass (p=none
      sp=quarantine pct=100) action=none\r\n header.from=outlook.com; dkim=pass
      (signature was verified)\r\n header.d=outlook.com; arc=pass (0 oda=0 ltdi=1)')
```

5.1.6 DKIM-Signature

DKIM (DomainKeys Identified Mail) verifies that the email content hasn't been altered in transit. It's crucial for email integrity checks and source verification.

```
[46]: emails[1]['headers'][14]['header'], emails[1]['headers'][14]['value']
```

```
[46]: ('DKIM-Signature',
       'v=1; a=rsa-sha256; c=relaxed/relaxed; d=outlook.com;\r\n s=selector1;\r\n
      h=From:Date:Subject:Message-ID:Content-Type:MIME-Version:X-MS-Exchange-
      SenderADCheck;\r\n bh=6+cClN22oIrc2YH61nPV02IScRJCb64tf03+C6e0M4c=;\r\n b=aZNfYl
      N+/lbQqIqDR1Cblhb9/x28HgNh+pAywoD+43Be+F/5cGPhWuKGP6InowbprEEutN/A5RLJ20qRurKixC
      RrzUMNtv/QnJXQFkFCvHBOWiZyEANGeA5iUHQ38WwdNG0IsLWgyb4s82CjKshEyYgkgfPcpP854CN9Is
      qJ1EUA3TIayHNbGwRilfGqwSFICBp4EODwvlXl+WWU4ihYg7HwlSaKgC/gn2WSnmIo3G/L3YbZkI9X41
      B3ttxHTCeCTjAktqE29Ww13fLEgMB4F+gD8xJSmNQlYvSAcM6unCowj5AjXRLPHJ5aCseQL0Mnq5aFVu
      foGrR9yFUn45RoYA==')
```

5.1.7 From

The "From" header shows the sender's email address. It's essential for identifying the sender, although it can be spoofed.

```
[47]: emails[1]['headers'][17]['header'], emails[1]['headers'][17]['value']
```

```
[47]: ('From', 'Krishnaraj Thadesar <Krishnaraj.kpt@outlook.com>')
```

5.1.8 To

The "To" header reveals the email's recipient, which is significant for understanding the email's target and potential threat actors.

```
[48]: emails[1]['headers'][18]['header'], emails[1]['headers'][18]['value']
```

```
[48]: ('To', 'Krishnaraj Thadesar <krishnaraj.kpt@outlook.com>')
```

5.1.9 Subject

The subject line provides insight into the email's content, which is crucial for assessing the email's purpose and relevance to an investigation.

```
[49]: emails[1]['headers'][19]['header'], emails[1]['headers'][19]['value']
```

```
[49]: ('Subject', 'Self mail from web outlook client')
```

5.1.10 Date

The date header shows when the email was sent. It's valuable for establishing timelines and correlations with other events.

```
[50]: emails[1]['headers'][22]['header'], emails[1]['headers'][22]['value']
```

```
[50]: ('Date', 'Sun, 29 Oct 2023 17:32:25 +0000')
```

5.1.11 Message-ID

The Message-ID is unique to each email and can be used for tracking and associating related messages in an investigation.

```
[51]: emails[1]['headers'][23]['header'], emails[1]['headers'][23]['value']
```

```
[51]: ('Message-ID',
       '\r\n <DS7PR17MB6730EE7BE9EA14814BB3AFE980A2A@DS7PR17MB6730.namprd17.prod.outlo
      ok.com>')
```

5.1.12 Content-Type

Content-Type specifies the format of the email content. It helps investigators interpret the email's structure and potential for malicious attachments.

```
[52]: emails[1]['headers'][36]['header'], emails[1]['headers'][36]['value']
```

```
[52]: ('Content-Type',
       'multipart/alternative;\r\n\tboundary="_000_DS7PR17MB6730EE7BE9EA14814BB3AFE980
      A2ADS7PR17MB6730namp_"')
```

5.1.13 Return-Path

Return-Path indicates where undeliverable emails should be sent. It can assist in identifying email redirection or bouncing patterns.

```
[54]: emails[1]['headers'][39]['header'], emails[1]['headers'][39]['value']
```

```
[54]: ('Return-Path', 'krishnaraj.kpt@outlook.com')
```

5.1.14 X-Sender-IP

This header contains the IP address of the sender, which is essential for tracking the origin of the email and potential geolocation.

[55]:
```
emails[1]['headers'][56]['header'], emails[1]['headers'][56]['value']
```

[55]:
```
('X-Sender-IP', '40.92.20.10')
```

5.1.15 X-MS-Exchange-Transport-EndToEndLatency

End-to-end latency is crucial for assessing the email's delivery speed, which might reveal anomalies or delays in transit.

[56]:
```
emails[1]['headers'][71]['header'], emails[1]['headers'][71]['value']
```

[56]:
```
('X-MS-Exchange-Transport-EndToEndLatency', '00:00:02.4306131')
```

5.1.16 X-Microsoft-Antispam-Mailbox-Delivery

This header provides information about the email's delivery and its classification as spam or not, aiding in filtering and threat analysis.

[57]:
```
emails[1]['headers'][73]['header'], emails[1]['headers'][73]['value']
```

[57]:
```
('X-Microsoft-Antispam-Mailbox-Delivery',
 '\r\n\tucf:0;jmr:0;ex:0;auth:1;dest:I;OFR:SpamFilterPass;ENG:(5062000305)(92022
1119095)(90000117)(920221120095)(90013020)(91025020)(91040095)(9050020)(9065024)
(9100341)(1000006)(944500132)(2008001134)(4810010)(4910033)(9920006)(9510006)(10
105021)(9320005)(9230038)(120001);')
```

5.1.17 X-Message-Info and X-Message-Delivery

These headers contain miscellaneous information about the email's handling, which can be valuable for tracking and understanding the email's journey.

[58]:
```
emails[1]['headers'][75]['header'], emails[1]['headers'][75]['value']
```

[58]:
```
('X-Message-Delivery', 'Vj0xLjE7dXM9MDtsPTA7YT0xO0Q9MTtHRD0xO1NDTD0tMQ==')
```

Defining a function to get information about an ip address for sender ip analysis

[65]:
```
import requests

def get_ip_information(ip_address):
    def get_ip_location():
        # Make a GET request to ipinfo.io with the IP address
        url = f"https://ipinfo.io/{ip_address}/json"
        response = requests.get(url)
        if response.status_code == 200:
            data = response.json()
            return data
        else:
            return None

    location_info = get_ip_location()
    # print(location_info)
    if location_info:
        # Print the location information
        print(f"IP Address: {location_info['ip']}")
        print(f"Hostname: {location_info['hostname']}")
        print(f"City: {location_info['city']}")
        # print(f"Region: {location_info['region']}")
        print(f"Country: {location_info['country']}")
        print(f"Location: {location_info['loc']}")
        # print(f"Organization: {location_info['org']}")
        print(f"Timezone: {location_info['timezone']}")
    else:
        print("Unable to retrieve location information for the IP address.")
```

Analysing Sender IP Address for all emails

[66]:

```
for email in emails:
    for header in email['headers']:
        if header['header'] == 'X-Sender-IP':
            print("Subject of Email: ", email['subject'])
            print("IP Address Information:")
            get_ip_information(header['value'])

            print()
```

```
Subject of Email:  Sending from phone gmail app
IP Address Information:
IP Address: 209.85.218.48
Hostname: mail-ej1-f48.google.com
City: Oudeschip
Country: NL
Location: 53.4300,6.8264
Timezone: Europe/Amsterdam

Subject of Email:  Self mail from web outlook client
IP Address Information:
IP Address: 40.92.20.10
Hostname: mail-bn8nam11olkn2010.outbound.protection.outlook.com
City: Boydton
Country: US
Location: 36.6676,-78.3875
```

```
Timezone: America/New_York

Subject of Email:  Self test mail from gmail web client
IP Address Information:
IP Address: 209.85.167.178
Hostname: mail-oi1-f178.google.com
City: Tulsa
Country: US
Location: 36.1540,-95.9928
Timezone: America/Chicago

Subject of Email:  self test mail from mit gmail client
IP Address Information:
IP Address: 209.85.219.47
Hostname: mail-qv1-f47.google.com
City: Raleigh
Country: US
Location: 35.7721,-78.6386
Timezone: America/New_York

Subject of Email:  From movile outlook app
IP Address Information:
IP Address: 40.92.242.29
Hostname: mail-ps2kor01olkn2029.outbound.protection.outlook.com
City: Busan
Country: KR
Location: 35.1017,129.0300
Timezone: Asia/Seoul

Subject of Email:  Mail sent from phone
IP Address Information:
IP Address: 209.85.160.175
Hostname: mail-qt1-f175.google.com
City: Charlotte
Country: US
Location: 35.2271,-80.8431
Timezone: America/New_York

Subject of Email:  Mother's phone Gmail app
IP Address Information:
IP Address: 209.85.160.171
Hostname: mail-qt1-f171.google.com
City: Charlotte
Country: US
Location: 35.2271,-80.8431
Timezone: America/New_York

Subject of Email:  Sending from browser with vpn connection on
```

```
IP Address Information:
IP Address: 209.85.208.52
Hostname: mail-ed1-f52.google.com
City: Oudeschip
Country: NL
Location: 53.4300,6.8264
Timezone: Europe/Amsterdam
```

6 Analysing Effect of Network Connection on IP Headers

6.1 Using VPN

Emails were sent by "parthzarekar3@outlook.com" to "krishnaraj.kpt@outlook.com" with connection to a VPN.

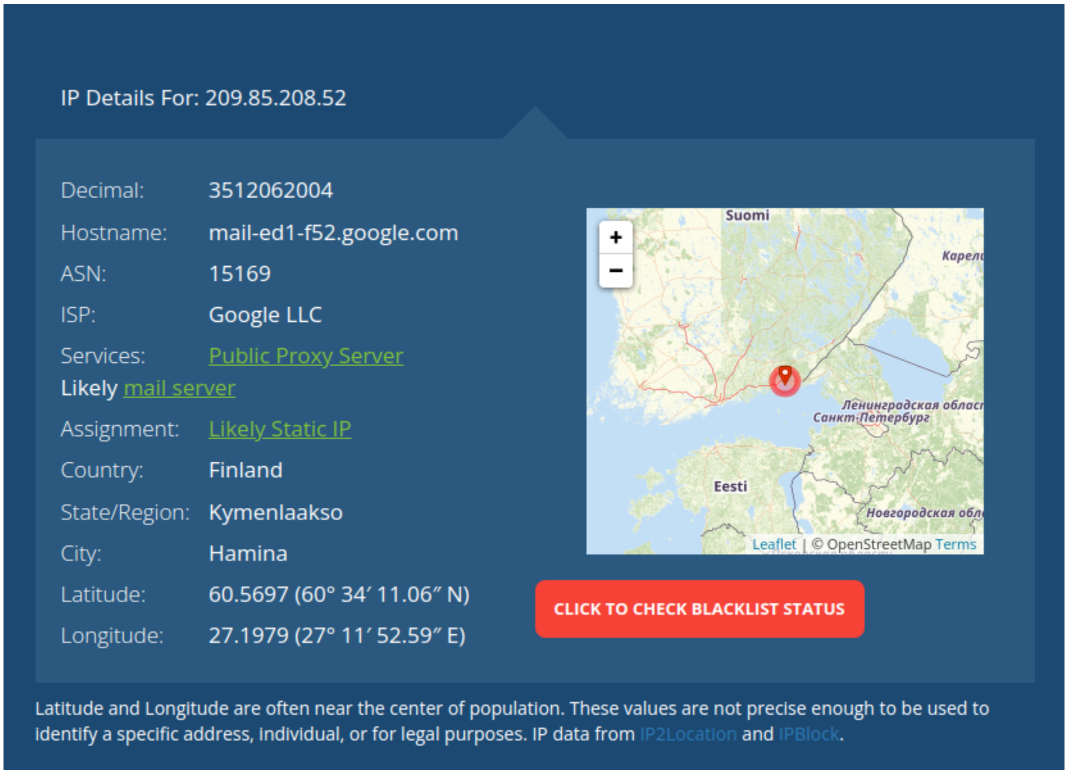
The IP Information was taken from the headers.

```
{
    "header": "X-Sender-IP",
    "value": "209.85.208.52"
},
```

From This the IP Address was taken and searched on iplookup.com

The IP Information was:

```
IP Address Information:
IP Address: 209.85.208.52
Hostname: mail-ed1-f52.google.com
City: Oudeschip
Country: NL
Location: 53.4300,6.8264
Timezone: Europe/Amsterdam
```



IP Details For: 209.85.208.52

Decimal: 3512062004
Hostname: mail-ed1-f52.google.com
ASN: 15169
ISP: Google LLC
Services: Public Proxy Server
Likely mail server
Assignment: Likely Static IP
Country: Finland
State/Region: Kymenlaakso
City: Hamina
Latitude: 60.5697 (60° 34′ 11.06″ N)
Longitude: 27.1979 (27° 11′ 52.59″ E)

Latitude and Longitude are often near the center of population. These values are not precise enough to be used to identify a specific address, individual, or for legal purposes. IP data from IP2Location and IPBlock.

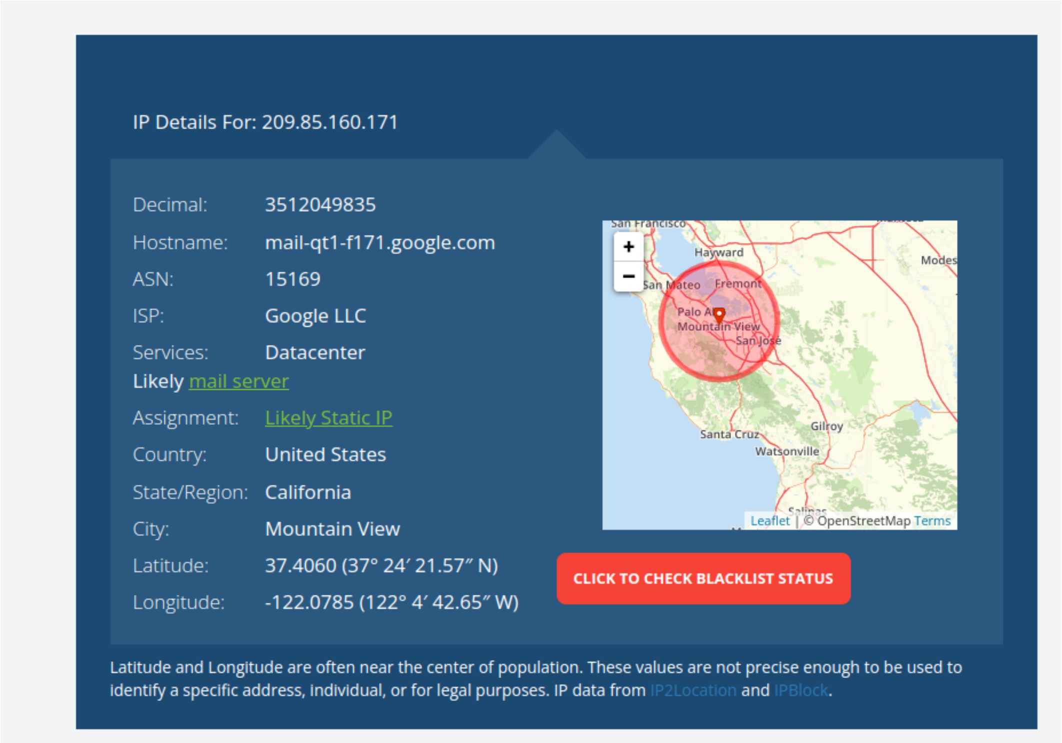
6.2 Without using VPN, on Wifi

```
{
    "header": "X-Sender-IP",
    "value": "209.85.160.171"
},
```

From This the IP Address was taken and searched on iplookup.com

The IP Information was:

```
Subject of Email:  Mother's phone Gmail app
IP Address Information:
IP Address: 209.85.160.171
Hostname: mail-qt1-f171.google.com
City: Charlotte
Country: US
Location: 35.2271,-80.8431
Timezone: America/New\_York
```



IP Details For: 209.85.160.171

Decimal: 3512049835
Hostname: mail-qt1-f171.google.com
ASN: 15169
ISP: Google LLC
Services: Datacenter
Likely mail server
Assignment: Likely Static IP
Country: United States
State/Region: California
City: Mountain View
Latitude: 37.4060 (37° 24′ 21.57″ N)
Longitude: -122.0785 (122° 4′ 42.65″ W)

Latitude and Longitude are often near the center of population. These values are not precise enough to be used to identify a specific address, individual, or for legal purposes. IP data from IP2Location and IPBlock.

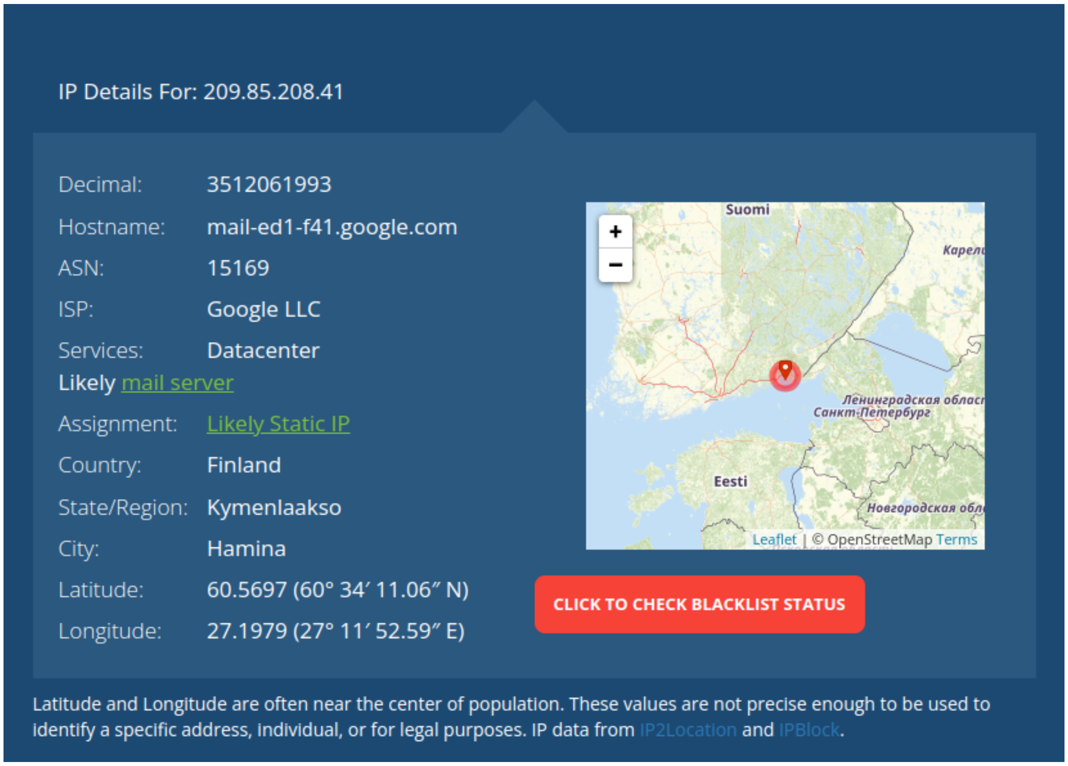
6.3 Without using VPN, on Mobile Data

```
{
    "header": "X-Sender-IP",
    "value": "209.85.208.41"
},
```

From This the IP Address was taken and searched on iplookup.com

The IP Information was:

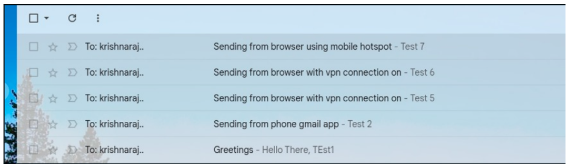
```
Subject of Email:  Sending from browser using mobile hotspot
IP Address Information:
IP Address: 209.85.208.41
Hostname: mail-ed1-f41.google.com
City: Oudeschip
Country: NL
Location: 53.4300,6.8264
Timezone: Europe/Amsterdam
```



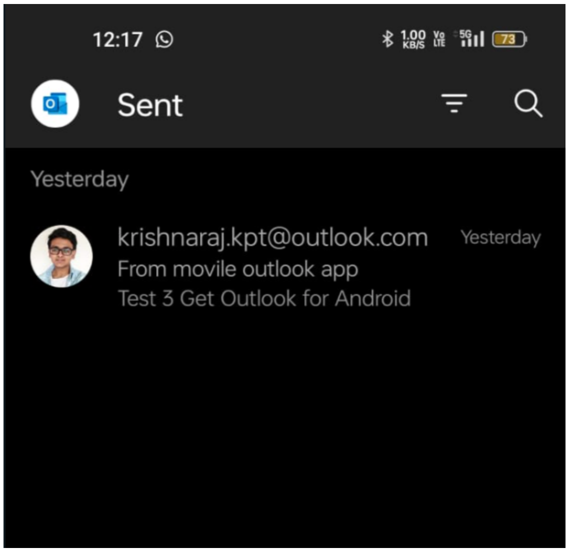
IP Details For: 209.85.208.41

Decimal: 3512061993
Hostname: mail-ed1-f41.google.com
ASN: 15169
ISP: Google LLC
Services: Datacenter
Likely mail server
Assignment: Likely Static IP
Country: Finland
State/Region: Kymenlaakso
City: Hamina
Latitude: 60.5697 (60° 34′ 11.06″ N)
Longitude: 27.1979 (27° 11′ 52.59″ E)

Latitude and Longitude are often near the center of population. These values are not precise enough to be used to identify a specific address, individual, or for legal purposes. IP data from IP2Location and IPBlock.



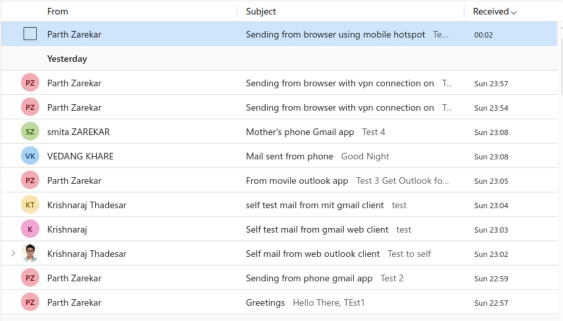
To: krishnaraj.. Sending from browser using mobile hotspot - Test 7
To: krishnaraj.. Sending from browser with vpn connection on - Test 6
To: krishnaraj.. Sending from browser with vpn connection on - Test 5
To: krishnaraj.. Sending from phone gmail app - Test 2
To: krishnaraj.. Greetings - Hello There, TEst1



Sent

Yesterday

krishnaraj.kpt@outlook.com Yesterday
From movile outlook app
Test 3 Get Outlook for Android



	From	Subject	Received
□	Parth Zarekar	Sending from browser using mobile hotspot Te...	00:02
	Yesterday		
PZ	Parth Zarekar	Sending from browser with vpn connection on T...	Sun 23:57
PZ	Parth Zarekar	Sending from browser with vpn connection on T...	Sun 23:54
SZ	smita ZAREKAR	Mother's phone Gmail app Test 4	Sun 23:08
VK	VEDANG KHARE	Mail sent from phone Good Night	Sun 23:08
PZ	Parth Zarekar	From movile outlook app Test 3 Get Outlook fo...	Sun 23:05
KT	Krishnaraj Thadesar	self test mail from mit gmail client test	Sun 23:04
K	Krishnaraj	Self test mail from gmail web client test	Sun 23:03
	Krishnaraj Thadesar	Self mail from web outlook client Test to self	Sun 23:02
PZ	Parth Zarekar	Sending from phone gmail app Test 2	Sun 22:59
PZ	Parth Zarekar	Greetings Hello There, TEst1	Sun 22:57

7 Conclusion

We have explored how to analyze email headers and understand their significance:

1. Email headers contain vital information about the email's origin, routing, and content.
2. Analyzing email headers is crucial for diagnosing email delivery issues, ensuring authenticity, and enhancing cybersecurity.
3. Key header fields include "From," "To," "Received," and "Message-ID."

We have also learned about email routing:

1. Regardless of the user's connection method (VPN, Mobile Data, or WiFi), emails are routed through servers.
2. Standard email protocol involves servers sending emails from one server to another.

Additionally, it was discovered that Outlook has security vulnerabilities:

1. Outlook's security, especially regarding password protection, has been found lacking.
2. Even after enabling 2 Factor Authentication (2FA), a simple Python script using the imaplib package can extract emails with just the password.

References

[1] Internet Message Format
Internet Message Format

[2] Email Headers
"Email Headers: What They Are and How to Analyze Them" by Email on Acid

[3] How to Read Email Headers
MX Toolbox