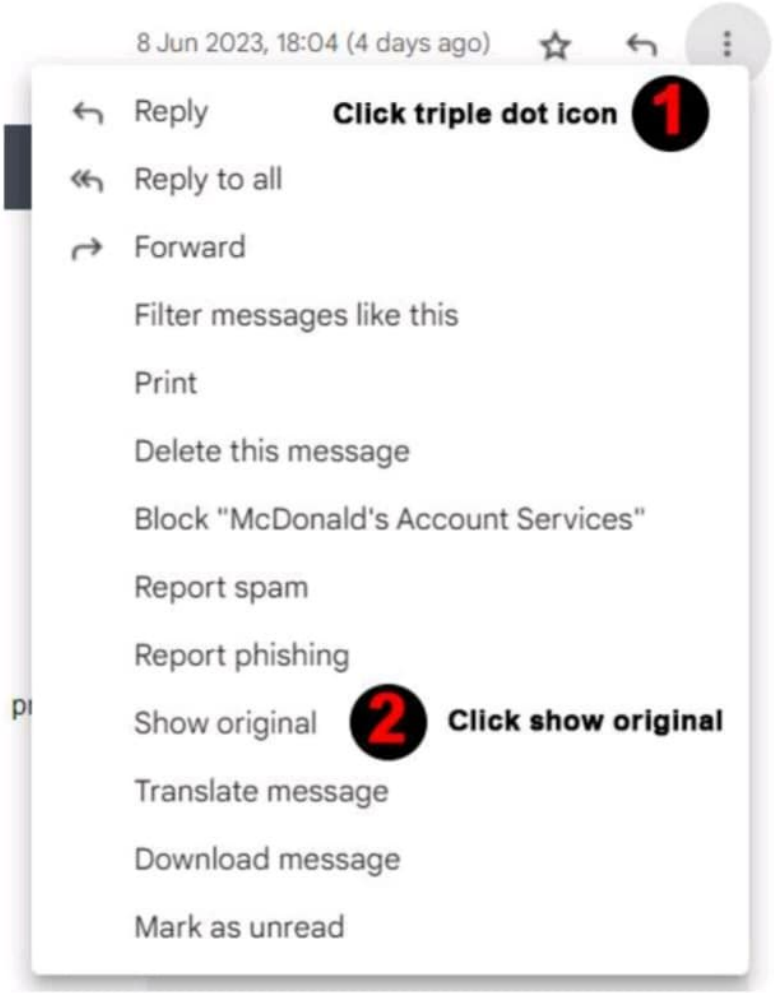
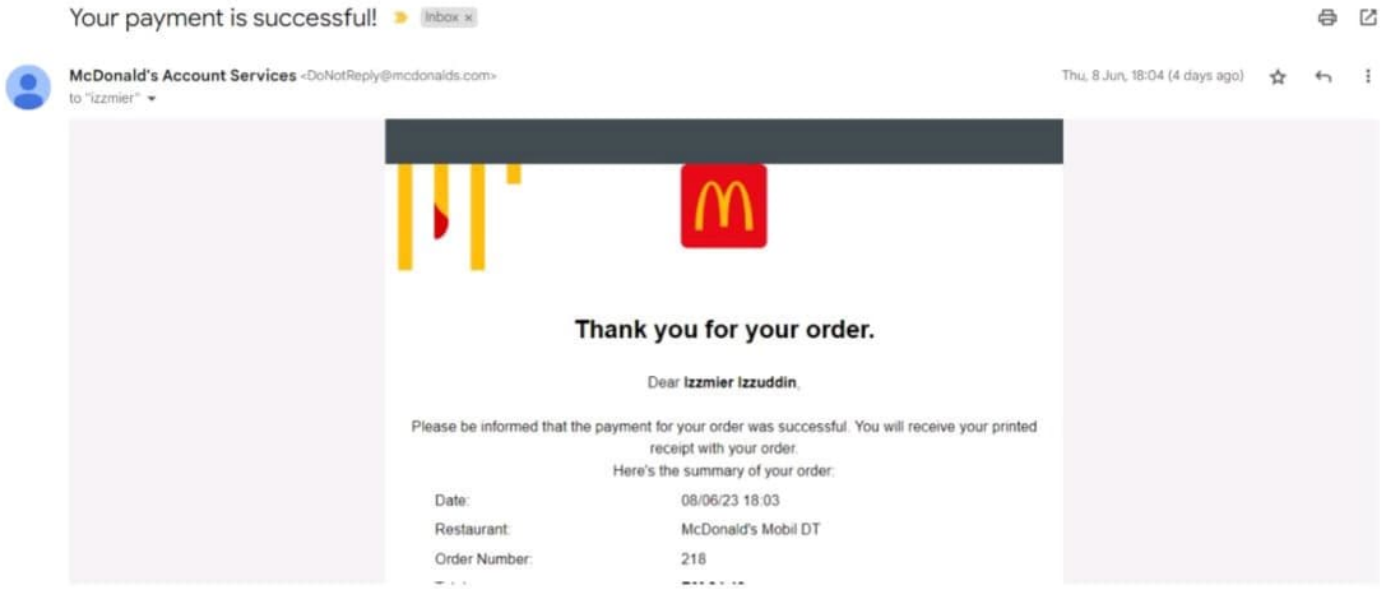
EMAIL HEADER ANALYSIS

STEP 2: To analyse the email header and email body begin with downloading the email in .eml format.



Email Header Analysis [Gmail]

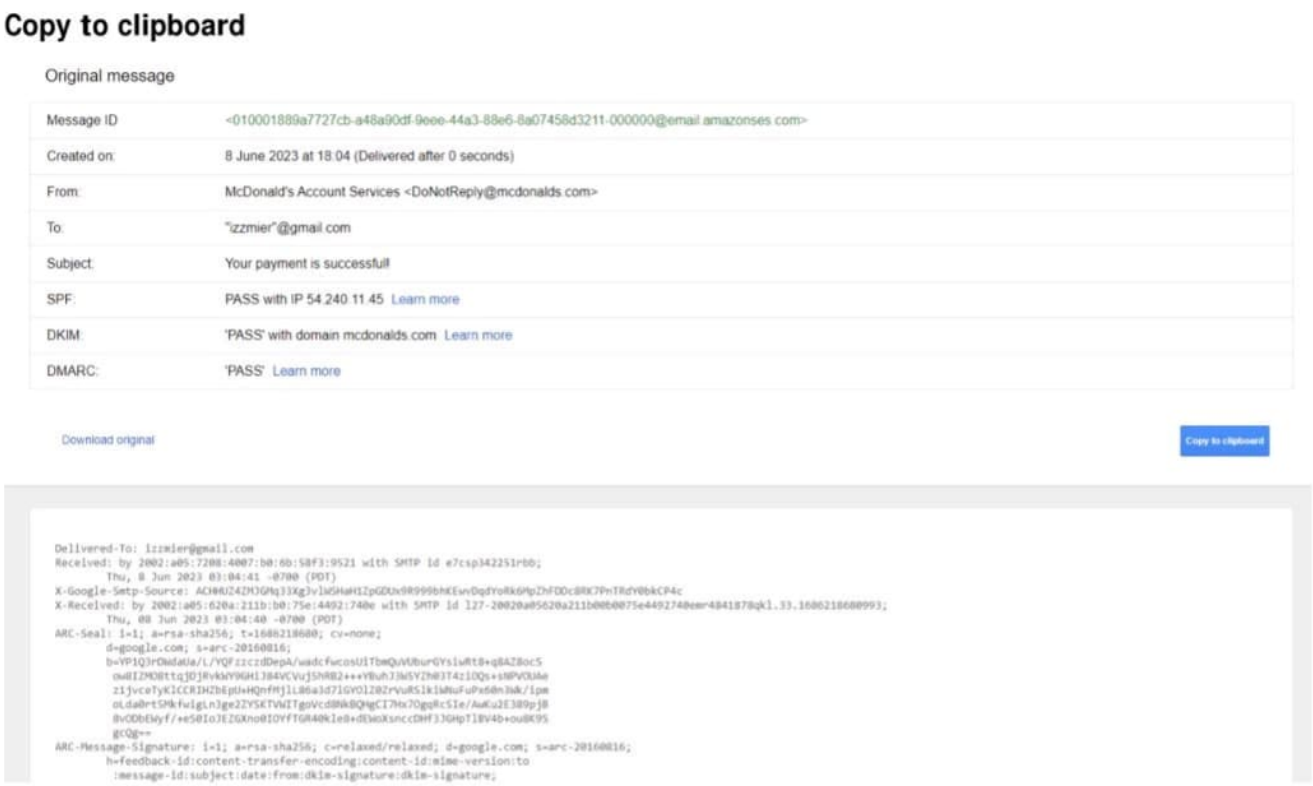
STEP 1: Go through how the email body looks, if there are URLs and Attachments you will need to test them in sandbox environment [Virtual Machine]



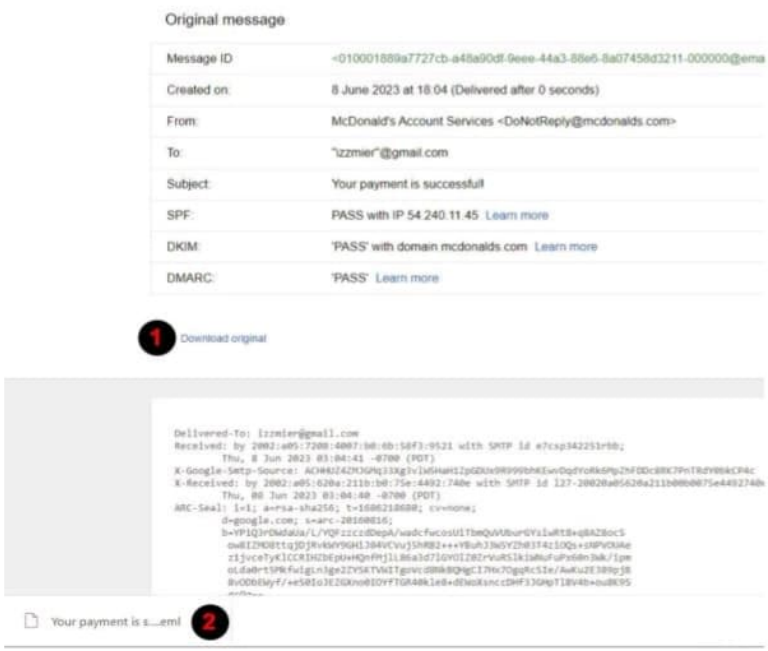
Sandbox Environment — (static & dynamic analysis)

To test the links/attachments in sandbox environment make use of Virus Total for URL reputation check/ file hash check, Urlscan.io, palo alto url filtering, whois domaintools, haveibeenpwned, Inspect element of webpage -> check network activity, google dorks, Browserling, can run E-discovery check for user click actions on the links/attachments. You can also use other OSINT tools for analysing the links/attachments within sandbox environment.

STEP 3: You will be greeted with Original Message page. If you select “Download Original” you will be able to download email in .eml format for header analysis or if you prefer using “Copy to Clipboard” to directly copy the header and paste in any email header analyzer tool for header analysis.

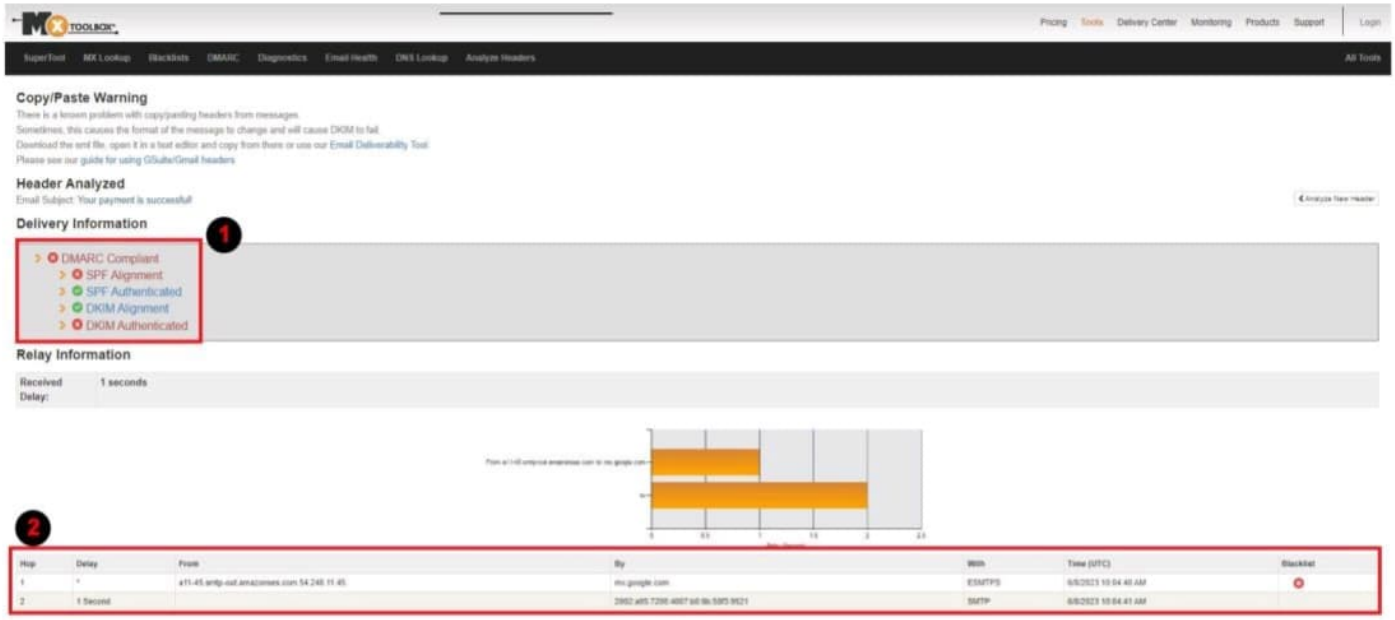


Download original



STEP 4: Email Header Analysis: SPF, DKIM, DMARC, SCL & BCL score

Header analysis is done on MxtoolBox



We see that SPF Alignment, SPF Authenticated, DKIM Alignment, and DKIM Authenticated all are PASS.

· To check Spoof → click on three dots

→ original message → check Message ID [If there is difference between Message IDvalue and “From” Field value, then indication is of spoofing]

· SPF Alignment — The SPF Alignment is PASS only when “Return-Path” And “From” domain is same. Different between which helps us understand email could be spoofed.

· SPF Authentication — If SPF authentication is FAIL, it means the sender IP address is not authorized to send email on behalf of the legit domain.

· DKIM Alignment- compare the DKIM Signature field [d=domain.com] with “From” , if it does not match then the result marks DKIM Alignment as FAIL.

· DKIM Authentication- If DKIM Signature field [b=……..] is not verified so we can say that the email has been modified or tempered.

What is SPF, DKIM, DMARC?

Sender Policy Framework (SPF) is a way for a domain to list all the servers they send emails from. Think of it like a publicly available employee directory that helps someone to confirm if an employee works for an organization.

```
SPF record typically looks like v=spf1 ip4:123.123.123.123 ~all
```

SPF distinguishes between **"soft" and "hard" fails.** Writing `~all` in your header indicates a soft fail when an unauthorized sender is encountered; `-all` instructs the receiving server to use a hard fail.

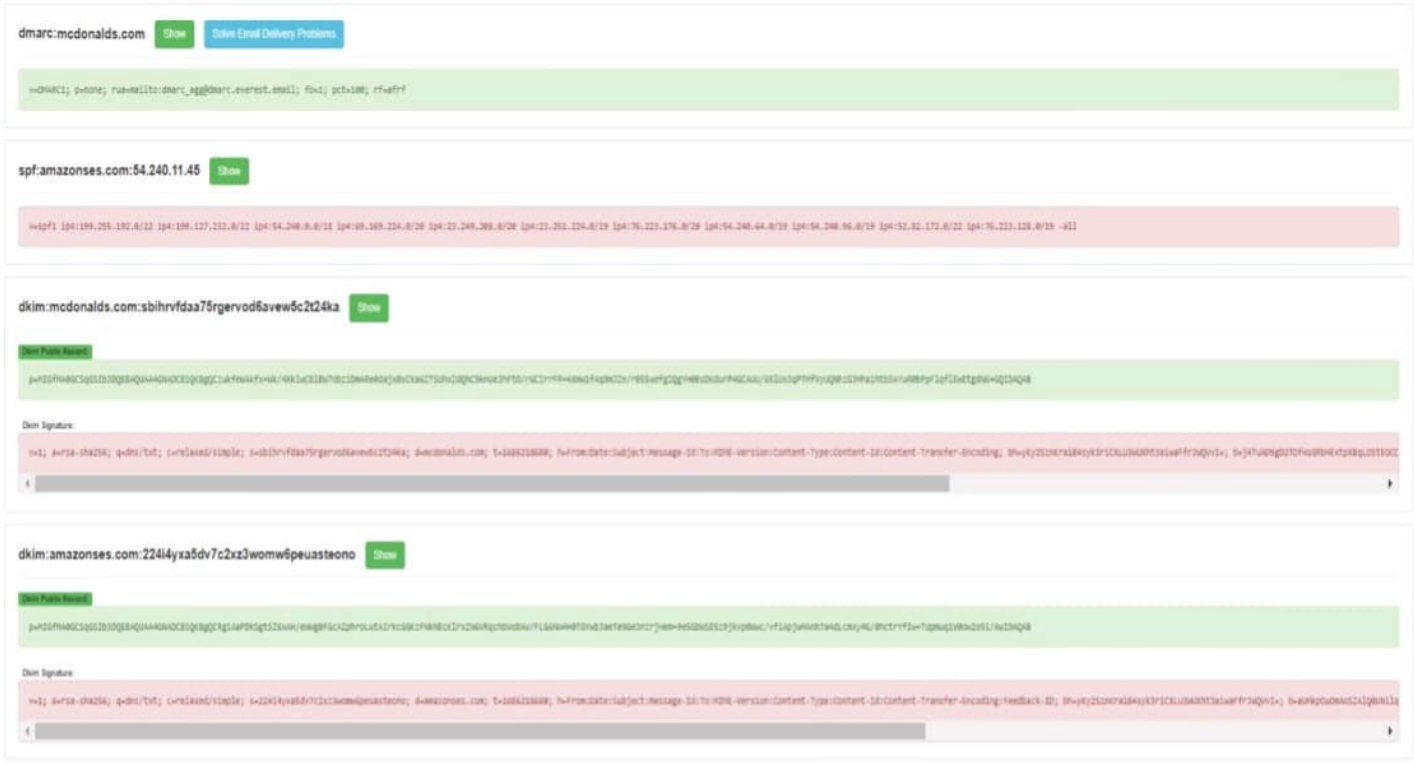
The email will be discarded entirely in a hard fail scenario. Soft fails may permit the email to be delivered to the recipient's junk folder. Now DMARC is widely available, which we'll see below, it's generally recommended to use `~all` (soft fail). This avoids false positives with legitimate emails, hands more control to DMARC, and can aid debugging in later verification stages.

DomainKeys Identified Mail (DKIM) enables domain owners to automatically "sign" emails from their domain, just as the signature on a check helps confirm who wrote the check. The DKIM "signature" is a digital signature that uses cryptography to mathematically verify that the email came from the domain.

Domain-based Message Authentication Reporting and Conformance (DMARC) tells a receiving email server what to do given the results after checking SPF and DKIM. A domain's DMARC policy can be set in a variety of ways — it can instruct mail servers to quarantine emails that fail SPF or DKIM (or both), to reject such emails, or to deliver them.

```
DMARC DNS Record v=DMARC1; p=none; rua=mailto:user@example.com
```

SPF and DKIM Information



Header Name	Header Value
Delivered-To	izzmier@gmail.com
X-Google-Smtp-Source	ACHHUZ4ZMJGMq33Xg3vfWSHaH1ZpGDUx9R999bhKEwvDqdYoRk6MpZhFDDc8RK7PnTRdY0bkCP4c
X-Received	by 2002:a05:620a:211b:b0:75e:4492:740e with SMTP id l27-20020a05620a211b00b0075e4492740emr4841878qkl.33.1686218680993; Thu, 08 Jun 2023 03:04:40 -0700 (PDT)
ARC-Seal	i=1; a=rsa-sha256; t=1686218680; cv=none; d=google.com; s=arc-20160816; b=YP1Q3rDWdaUa/L/YQFzzczdDepA/wadcfwcosUiTbmQuVUburGYsiwR8+q8AZ8ocS ow6IZMO8ttqjDj wigLn3ge2ZYSKTVWITgoVcd8NkBQHgCI7Hx7OgqRcSIe/AwKu2E389pjB 8vODbEWyf/+eS0IoJEZGXno0IOYfTGR40kle8+dEWoXsnccDHf3JGHpTIBV4b+ou8K9S gcQg==
ARC-Message-Signature	i=1; a=rsa-sha256; c=relaxed/relaxed; d=google.com; s=arc-20160816; h=feedback-id:content-transfer-encoding:content-id:mime-version:to :message-id:subject:date :from:dkim-signatu oeDqckoa8EoYoOWdV5lOPmqoAi/5rKvKTvVmVlIqYDzESF0icB0J0YkYJ3e6sjmO HOcCk2XFhu+yp4uKCnssIlFPfO/aiKr0OJz0pua7Wv1wYFkIR8WhRoM5mYdXnWWQEwLM BEUEI OP SraQ==
ARC-Authentication-Results	i=1; mx.google.com; dkim=pass header.i=@mcdonalds.com header.s=sbihrvfdaa75rgervod6avew5c2t24ka header.b=j4TuAD9g; dkim=pass header.i=@amazonses.com header.s=224i onses.com designates 54.240.11.45 as permitted sender) smtp.mailfrom=010001889a7727cb-a48a90df-9eee-44a3-88e6-8a07458d3211-000000@amazonses.com; dmarc=pass (p=N
Return-Path	<010001889a7727cb-a48a90df-9eee-44a3-88e6-8a07458d3211-000000@amazonses.com>
Received-SPF	pass (google.com: domain of 010001889a7727cb-a48a90df-9eee-44a3-88e6-8a07458d3211-000000@amazonses.com designates 54.240.11.45 as permitted sender) client-ip=54.240
Authentication-Results	mx.google.com; dkim=pass header.i=@mcdonalds.com header.s=sbihrvfdaa75rgervod6avew5c2t24ka header.b=j4TuAD9g; dkim=pass header.i=@amazonses.com header.s=224i4yxa es.com designates 54.240.11.45 as permitted sender) smtp.mailfrom=010001889a7727cb-a48a90df-9eee-44a3-88e6-8a07458d3211-000000@amazonses.com; dmarc=pass (p=NONE
DKIM-Signature	v=1; a=rsa-sha256; q=dns/txt; c=relaxed/simple; s=sbihrvfdaa75rgervod6avew5c2t24ka; d=mcdonalds.com; t=1686218680; h=From:Date:Subject:Message-Id:To:MIME-Version:Conter 5AiFzs6sxevHOrqj 6a7B7J2lPKRRT5OmC8xhoY2GmrU7OQhxB49uFoXDOUhRI7ERHFEIYT1E73H93/TDg7K ukGpwTSOKbNMgfBS+mRAGpinrbMe/6+Yax09nS6o=
From	"McDonald's Account Services" <DoNotReply@mcdonalds.com>
Date	Thu, 8 Jun 2023 10:04:40 +0000
Subject	Your payment is successful!
Message-ID	<010001889a7727cb-a48a90df-9eee-44a3-88e6-8a07458d3211-000000@email.amazonses.com>
To	"izzmier"@gmail.com
MIME-Version	1.0
Content-Type	text/html; charset=utf-8
Content-Id	<DY4JBQCG5KU4.Q34JOA30H8H51@169.254.178.201>
Content-Transfer-Encoding	quoted-printable
Feedback-ID	1.us-east-1.uSkbSFk9Rxz1+oiPy3rSprgKsRG1lwJqymZ/FLF2s40=:AmazonSES
X-SES-Outgoing	2023.06.08-54.240.11.45

In addition to the headers discussed so far, we can see three additional headers as shown below.

- ARC-Seal
- ARC-Message-Signature
- ARC-Authentication-Results

ARC-XXXX headers help preserve email authentication results and verify the identity of email intermediaries that forward a message on to its final destination.

- **ARC Authentication Results**: This header contains email authentication results like SPF, DKIM, and DMARC
- **ARC-Message-Signature:** This is a DKIM-like signature and takes a snapshot of the message header information. This includes to, from, subject and body
- **ARC-Seal**: This header contains a signature which includes the ARC-Message-Signature and the ARC Authentication Results header information.

Breaking Down an Email:

Let us first go through some of the important headers to understand what they represent. It is ideal to read message headers from bottom to top to be able to properly understand where the email is originated from.

- **X-priority:** X-priority is an optional parameter in the email spec used to specify the priority of the email. Values can be 1 (Highest), 2 (High), 3 (Normal), 4 (Low) or 5 (Lowest). Three is default if the field is omitted. Most email programs don't fill it in unless it is set low or high. Client side programs will highlight the inbound message (!) if it is 1 or 2.
- **Content-Type:** This header specifies the type of content in the email. The preceding email is of plain text.
- **Reply-To:** This header specifies whom to send the reply when the receiver replies to the email received.
- **Message-Id:** Message Id is a unique identifier that can be used to identify the message.
- **From:** This header is used to display the username or email from which email is sent. Note that spoofed emails typically modify this header to appear to have come from a known source.
- **Received:** This header represents the recipient details. There can be multiple entries of this header as the email traverses through multiple servers.
- **Received-SPF:** This header represents the Sender Policy Framework (SPF) results, which tells whether the sender is a permitted sender or not.
- **Delivered-To:** This header represents the destination email id that the email is delivered to.

STEP 5: Email Body Analysis: sender, subject, email body, embedded URL/Attachments

Check the subject of the email to understand what it is about. Check the sender domain in Virus Total, Whois DomainTools, Urlscan.io, Browserling, and Palo Alto Url Filtering. You can test your personal email ID in Have I been Pwned to check if your id is breached or safe. Don't enter professional/ Corporate email ID here — Have I been Pwned (as it is a public repo). Use of Inspect element -> Network is also important to check the redirected URL activity and real intent of the Base/original URL.

Fields to check are Subject, Sender, Sender Domain, Recipient, Recipient Domain, Network Message ID, Latest email delivery, Original email delivery.

Later check the tone of the email body/email content. If any link (URL) or Attachment is embedded in the email, extract the URL/Attachment not by clicking it (don't interact with it) Instead by coping it [Right click -> Copy Hyperlink / Copy] and paste to test the URL/File in Windows sandbox / Sandbox Environment or test the Attachment within the sandbox environment (example — windows sandbox)

REMEDIATION/MITIGATION- (Personal / Corporate)

STEP 6: Remediation/Mitigation — If the users have either received phishing or spam email

· Enable multi-factor authentication (MFA) systems in place for accounts that can contain personal (PII)/ confidential/ Highly-Confidential/ Sensitive information.

· Perform email purge (email deletion) from the mailbox.

· Report the email as abuse of Phishing/Spam to your email service provider.

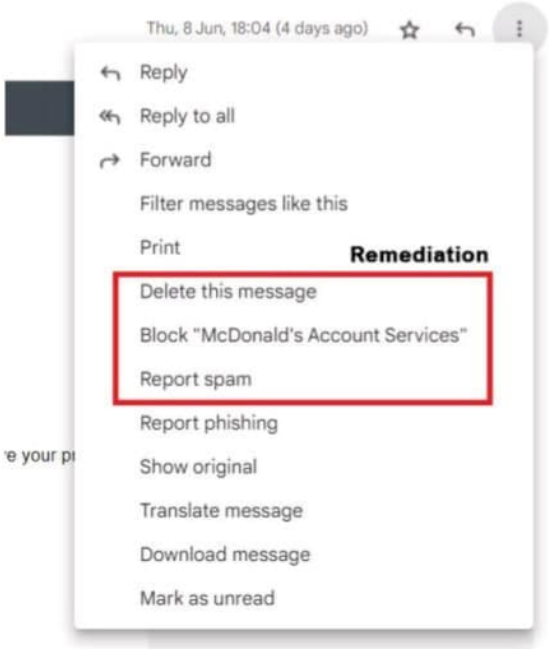
· Educate the mail service provider (eg- gmail) or tool used within corporate environment by reporting it as either phishing or spam based on your findings.

· If needed, you can also perform URL block for Malicious/suspicious URL/Domain.

· Or Submit Request to decommission of base URL/ Redirected URL to your mail service provider.

· Now look for number of users who might have clicked on the URL/attachment of the email, if identified any reset credential for that/those user(s)

· You can also perform actions from the below image.



USER AWARENESS

STEP 7: USER Awareness / Phishing Simulation emails

Create awareness banners, brochures for the users to keep them educated on how to spot phishing email & protect themselves.

For company, Scheduled events on phishing simulation activity within the environment helps the organization evaluate employees' understanding about phishing attacks.

```
 suspectscore=10 phishscore=0 bulkscore=0 spamscore=1 clxscore=195
 lowprioritycore=0 impostorscore=0 adultscore=0 classifier=spam adjust=0
 reason=mlx scancount=1 engine=8.0.1-1706020000 definitions=main-1707120363
Return-Path: smartprof@loki.ist.unomaha.edu
X-MS-Exchange-Organization-Network-Message-Id: c0790240-3fdc-4b35-078d-08d4c9783957
X-EOPAttributedMessage: 0
X-EOPTenantAttributedMessage: f1f4be86-d048-47e8-aa26-15b01dcdb13d:0
X-MS-Exchange-Organization-MessageDirectionality: Incoming
X-Forefront-Antispam-Report: CIP:148.163.152.157;IPV:NLI;CTRY:US;EFV:NLI;SFV:SKN;SFS:;DI
R:INB;SFP:;SCL:-1;SRVR:CY1PR0701MB1819;H:mx0b-00261b01.pphosted.com;FPR:;SPF:None;LANG:e
n;
MIME-Version: 1.0
<html><head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">    </head>    <
body style="word-wrap: break-word; -webkit-nbsp-mode: space; -webkit-line-break: after-w
hite-space;" class="">    Dear Dr. Gandhi,<br class="">    <br class="">    You are doin
g very very good work with the Gencyber Camp. <br class="">    Just let me know wha
t you need to make it bigly successful next year!<br class="">    Please put in your fun
ding request here: <a href="https://robinagandhi.github.io/phishing-demo/encoding.h
tml" class="">Grant Application</a><br class=""> <br class=""><div class="">~Yours Truly
<br class=""><font color="#ff2600" class="">Donald</font></div></body></html>
```

Questions:

- What are the `From` and `Return-Path` email addresses. Do they match? What are they?
- What is the name of the sending computer or server?
- Where is the sending computer geo-located?
- What website is linked to "Grant funding request." in the message?
- How likely is it that this message is spam?

Exercise Email Header Analysis

What about that email from President Donald Trump?

Here is the raw header:

```
Received: from CY1PR0701MB1819.namprd07.prod.outlook.com (10.163.42.152) by
 SN1PR0701MB1822.namprd07.prod.outlook.com (10.162.100.151) with Microsoft
 SMTP Server (version=TLS1_2,
 cipher=TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256_P256) id 15.1.1240.13 via
 Mailbox Transport; Wed, 12 Jul 2017 22:49:17 +0000
Received: from SN1PR0701CA0032.namprd07.prod.outlook.com (10.162.96.42) by
 CY1PR0701MB1819.namprd07.prod.outlook.com (10.163.42.152) with Microsoft SMTP
 Server (version=TLS1_2, cipher=TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256_P256) id
 15.1.1261.13; Wed, 12 Jul 2017 22:49:16 +0000
Received: from BY2NAM01FT042.eop-nam01.prod.protection.outlook.com
 (2a01:111:f400:7e42::203) by SN1PR0701CA0032.outlook.office365.com
 (2a01:111:e400:5173::42) with Microsoft SMTP Server (version=TLS1_2,
 cipher=TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256_P256) id 15.1.1261.13 via
 Frontend Transport; Wed, 12 Jul 2017 22:49:16 +0000
Authentication-Results: spf=none (sender IP is 148.163.152.157)
 smtp.mailfrom=loki.ist.unomaha.edu; unomaha.edu; dkim=none (message not
 signed) header.d=none;unomaha.edu; dmarc=none action=none
 header.from=whitehouse.gov;
Received-SPF: None (protection.outlook.com: loki.ist.unomaha.edu does not
 designate permitted sender hosts)
Received: from mx0b-00261b01.pphosted.com (148.163.152.157) by
 BY2NAM01FT042.mail.protection.outlook.com (10.152.68.172) with Microsoft SMTP
 Server (version=TLS1_2, cipher=TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384_P384) id
 15.1.1240.9 via Frontend Transport; Wed, 12 Jul 2017 22:49:15 +0000
Received: from pps.filterd (m0104361.ppops.net [127.0.0.1])
    by mx0b-00261b01.pphosted.com (8.16.0.21/8.16.0.21) with SMTP id v6CMlhnA032537
    for <smartprof@unomaha.edu>; Wed, 12 Jul 2017 17:49:15 -0500
Authentication-Results-Original: ppops.net;    spf=none
 smtp.mailfrom=smartprof@loki.ist.unomaha.edu
Received: from loki.ist.unomaha.edu (loki.ist.unomaha.edu [137.48.187.123])
    by mx0b-00261b01.pphosted.com with ESMTP id 2bnsq8rykp-1
    for <smartprof@unomaha.edu>; Wed, 12 Jul 2017 17:49:15 -0500
Received: by loki.ist.unomaha.edu (Postfix, from userid 13823)
    id 958031E5EE0; Wed, 12 Jul 2017 17:49:14 -0500 (CDT)
To: <smartprof@unomaha.edu>
Subject: Make Cybersecurity Great Again!
X-PHP-Originating-Script: 13823:spoof.php
From: Donald Trump <therealdonaldtrump@whitehouse.gov>
Reply-To: Robin Gandhi <smartprof@unomaha.edu>
Content-Type: text/html; charset="ISO-8859-1"
Message-ID: <20170712224914.958031E5EE0@loki.ist.unomaha.edu>
Date: Wed, 12 Jul 2017 17:49:14 -0500
X-Proofpoint-Spam-Details: rule=inbound_notspam policy=inbound score=1 priorityscore=0 m
alwarescore=0
```