ASSESSMENT 2: SPLUNK FOR SECURITY MONITORING

Cyber Security Operations Centres (7015ICT_3245)

In this assessment, we use Splunk to monitor, detect, and respond to security threats targeting Hungry Hustle's online platform.

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Case Scenario:

Some datasets are collected from Hungry Hustle network based on different simulated security attacks such as Unauthorised access, DDoS attack, SQL injection, XSS attack, and Website downtime. The dataset is already available in Splunk (index="hungryhustle").

Task 1: Security Operations Analysis Using Splunk

In this assessment, you will be provided with log files from a simulated environment related to a fictional website called Hungry Hustle. Your task is to analyze the logs using Splunk and answer a series of questions that test your understanding of network security and data analysis.

The following scenarios are based on different potential security incidents, and you are required to use Splunk to investigate and derive the necessary insights. Each question is designed to help you understand and apply various security monitoring techniques. You will also need to identify unauthorized access attempts, analyze network traffic, and detect potential security breaches.

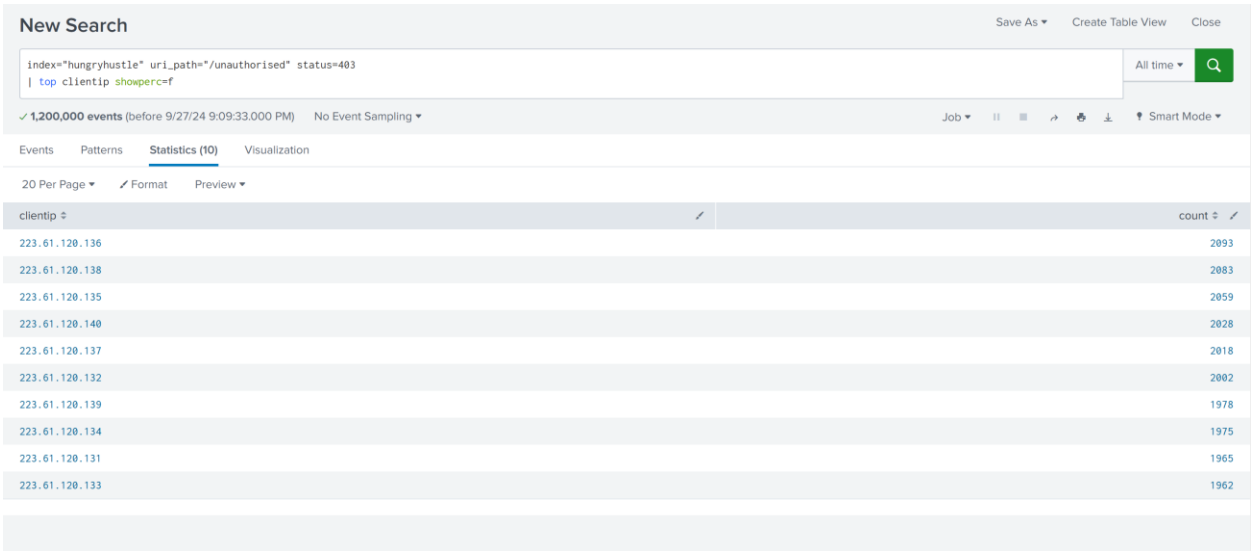
Question 1: Identify the top 10 IP addresses attempting unauthorized web connections to the hungryhustle website. Focus on identifying the most frequent unauthorized access attempts regardless of connection duration. Use the log data provided to generate HTTP GET requests to the target URL using random IP addresses and user-agents. You will identify IPs that have made unauthorized access attempts by logging and analyzing HTTP responses, particularly 403 Forbidden errors.

Solution:

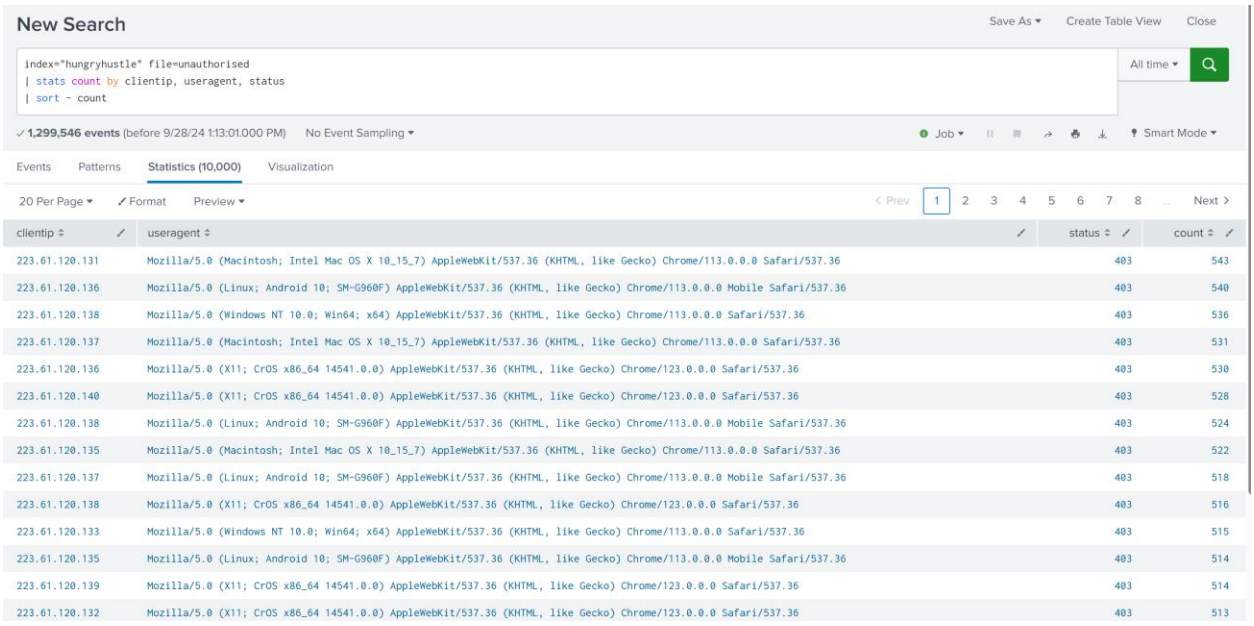
In order to analyse and display the 'HungryHustle' dataset we need to start by looking at the index (index='hungryhustle'), this is going to be the first step in all searches within splunk as this directs the search to the dataset you want to analyse.

Once the index results are obtained, the next step is to try to filter the content, for this it is necessary to see the fields that we have available, the type of sourcetype that in this case to access information related to the hungryhustle web page is 'access_combined'. In addition, there is a value within the files field called 'unauthorised' which particularly has the same events as the 'uri_path' field where the value is '/unathorised'. By filtering by these two fields we can start to unbundle all the unauthorised access attempts. At this point we have something like this in our splunk browser: (index='hungryhustle' sourcetype=Access_combined file=unauthorised). After this, we check if the fields give us the IP of the client, as if we have this field, we can use the command 'top' to check which are the 10 IPs that have tried to enter the hungryhustle site without some kind of authorization, then we can indicate that we don't need the percentage of participation to focus only on the accounts that it gives us specific for each IP. The final command to see this is:

```
index="hungryhustle" sourcetype=Access_combined file=unauthorised
| top clientip showperc=f
```



We can also modify the search to have more detailed information, with the stats count command we can start counting by several fields, the following example shows how this command helps us to visualise by client IP, the useragent, the status and the account. In addition, we use the sort command to sort the values from highest to lowest and see which ones have had the most interactions.



Question 2: Identify the countries that visited the website. Which countries have the most unauthorised access attempt?

In order to identify the countries that most visit the website we must start filtering by the hungryhustle idex and a satisfactory status, this means that we must filter with a status=200 to eliminate possible unauthorised access, downtimes or even maintenance responses.

One of the functions or commands that splunk offers us to verify the origin of the IP is 'iplocation' this function reads the IP and delimits its geolocation giving us options such as city, country and even latitudes. With this we can organize the data obtained with the previous filters and verify by country, then the stats count command helps us to count the interactions by country, the sort command helps us to organize the 10 countries with more interactions and the rename command helps us to change the titles of the final table so that it can be understood in a better way.

The final command would be:

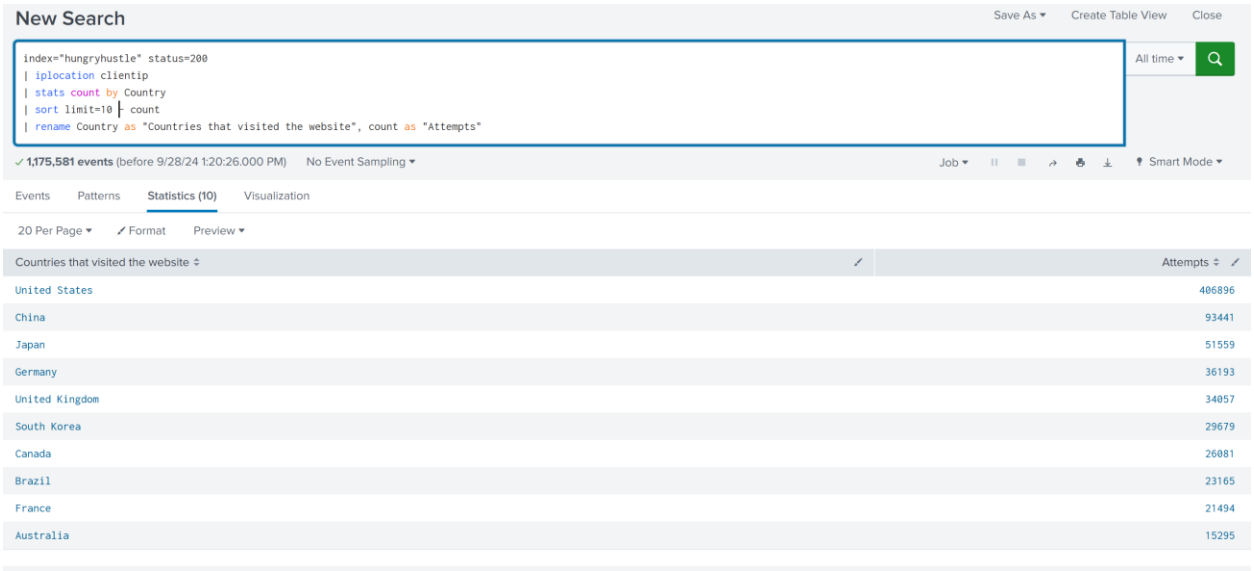
Index= "hungryhustle" status=200

| iplocation clientip

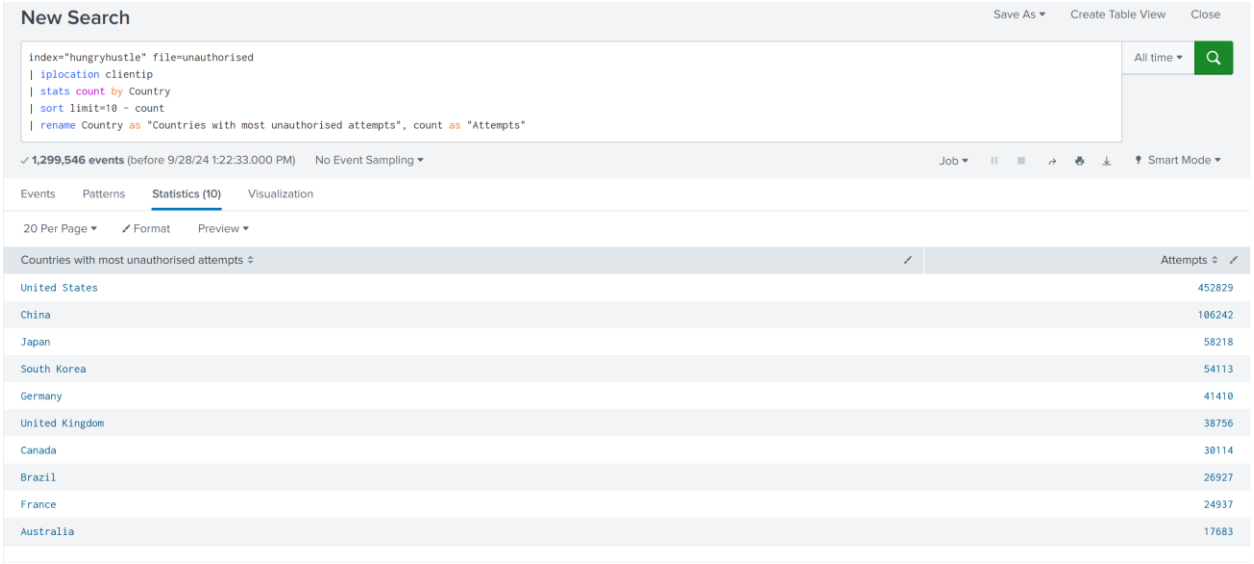
| stats count by Country

| sort limit=10 – count

|rename Country as "Countries that visited the website", count as "Attempts"



We also wanted to know which are the countries that try the most to enter the site without authorization or there is a type of non-affirmative answer by the website, that they do not have a status=200. For this in the beginning of the search we changed status=200 by file=unauthorised and this is how the new table would look like.



Question 3: Given Sam Muller is the only system administrator, he seeks his friend's help to manage the network infrastructure of Hungry Hustle, while he is on a brief leave for 5 days. He gave him his access, however, a separate email address. However, there have been some strange movements from Sam's machine. What information has been leaked from Sam's account and who leaked it?

In order to resolve this concern, we must review the data provided by the work team's e-mails, as this type of data does not have an established or well-defined extraction of fields (they only provide us with matadata) that we are not interested in at the moment, a field was extracted in order to begin to filter and find the person responsible for the information leakage. For this exercise we can extract some data that will be useful in the future. When we see the data thrown by the e-mails we can see that in the first line there is a Return path that gives us information of the person who sends and where he sends the e-mails, for this reason it was decided to extract this type of data and create a new field with this. The result is the field 'Return_path' with which we can work.

In addition, we know that Sam's IP is 192-168-1-25 which we can verify by looking at his email logs. Then we can refine our search with the rare command which helps us to see the fields that are less used, since this person's access was very short the interaction he could have had is less and the documents or event he manipulated should have a minimum of accounting. This is why we use the "where" command to delimit less than 1000 interactions in the rare commands and thus make a double filter since with rare we have delimited the 5 strangest previously.

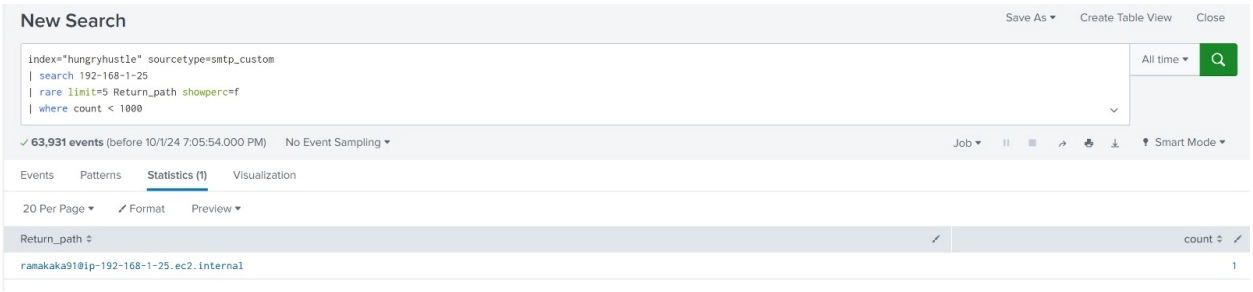
The final command to view this event is:

index="hungryhustle" sourcetype=smtp_custom

| search 192-168-1-25

| rare limit=5 Return_path showperc=f

| where count < 1000



By following the event we can see the date of the event (5/26/24) and looking at the metadata we can see that it was done by ramakaka91 using the SAM IP, for jack@hungrybites.website with a subject 'SSH Key' this means that the document (empe.ppk) that was transferred was the key to decrypt the hungryhustle website.

i	Time	Event
>	5/26/24 2:21:02.000 AM	Return-Path: <ramakaka91@ip-192-168-1-25.ec2.internal> Received: from ip-192-168-1-25.ec2.internal (localhost [127.0.0.1]) by ip-192-168-1-25.ec2.internal (8.14.7/8.14.7) with ESMTP id 44N21axB004440 for <jack@hungrybites.website>; Thu, 26 May 2024 02:21:02 GMT Received: (from ramakaka91@localhost) by ip-192-168-1-25.ec2.internal (8.14.7/8.14.7/Submit) id 44N21afU004438 for jack@hungrybites.website; Thu, 26 May 2024 02:21:02 GMT From: EC2 Default User <ramakaka91@ip-192-168-1-25.ec2.internal> Message-Id: <202405230201.44N21afU004438@ip-192-168-1-25.ec2.internal> Date: Thu, 26 May 2024 02:21:02 +0000 To: jack@hungrybites.website Subject: SSH Key User-Agent: Heirloom mailx 12.5 7/5/10 MIME-Version: 1.0 Content-Type: multipart/mixed; boundary="=_664ea380.qgQ85nKUgYGm0gm9405NlGbA2nYbx0L3fpVvhi2IHLy84stK" This is a multi-part message in MIME format. --=_664ea380.qgQ85nKUgYGm0gm9405NlGbA2nYbx0L3fpVvhi2IHLy84stK Content-Type: text/plain; charset=us-ascii Content-Transfer-Encoding: 7bit Content-Disposition: inline Please find the attached SSH key file. --=_664ea380.qgQ85nKUgYGm0gm9405NlGbA2nYbx0L3fpVvhi2IHLy84stK Content-Type: text/plain; charset=us-ascii Content-Transfer-Encoding: 7bit Content-Disposition: attachment; filename="empe.ppk" dummy-ssh-key-content --=_664ea380.qgQ85nKUgYGm0gm9405NlGbA2nYbx0L3fpVvhi2IHLy84stK-- --44NCVg40003003.1716467802/ip-192-168-1-25.ec2.internal-- Collapse

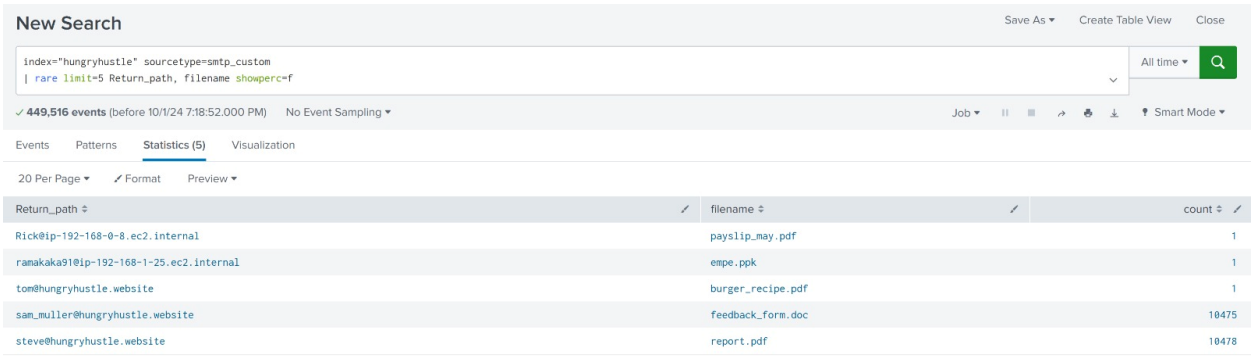
Question 4: Steve is an employee of Hungry Hustle and has recently gone through a rough breakup. Rick, an employee, made fun of Steve's breakup which led to a heated argument. Steve complained to HR that Rick is the reason for the breakup, is there any evidence backing up his claim? Analyze email logs to find evidence supporting Steve's claim against Rick regarding a workplace conflict.

By filtering and investigating the results of the previous searches we can see that there are some specific events over time in the company, this is key to answer the following questions which are also related to Rick and Steve, we see that by filtering the emailslogs and see the results of 'rare command' that this time we indicated that we wanted to return the Return_path and filename which was sent, we see that there is one in particular that was sent by Rick and has as a file the payslip of May.

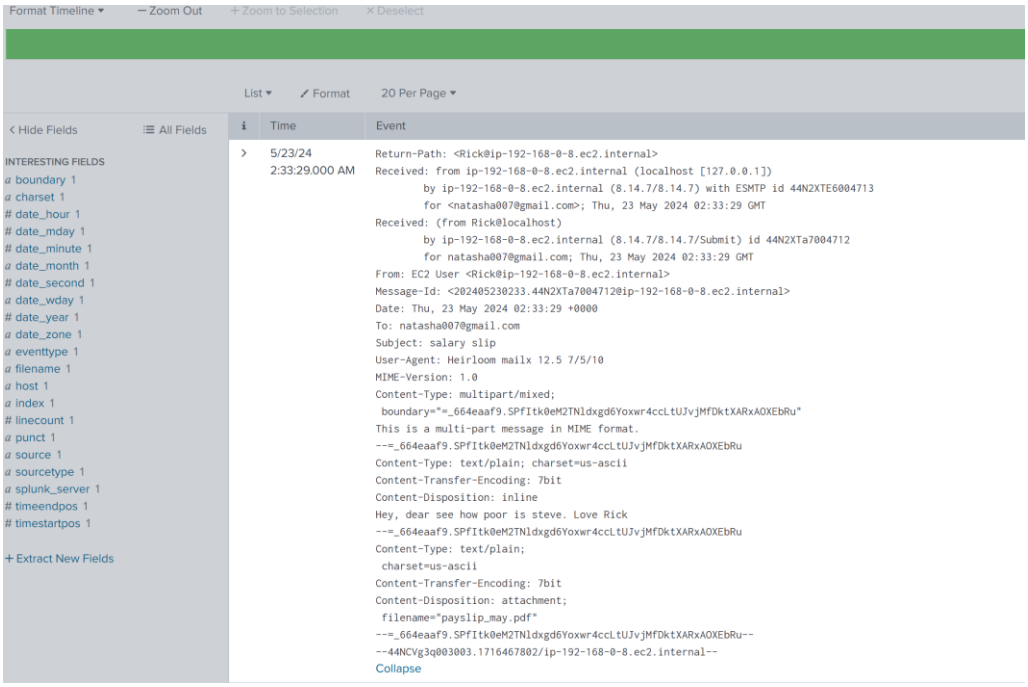
The command used was:

index="hungryhustle" sourcetype=smtp_custom

| rare limit=5 Return_path, filename showperc=f



Following the path of this event we can see that the message or email was to natasha007@gmail.com, this could be the email from Steve's girlfriend as in the context of the message sent, we can see that it says 'Hey, dear see how por is Steve. Love Rick' this would confirm Steve's suspicions about Rick.



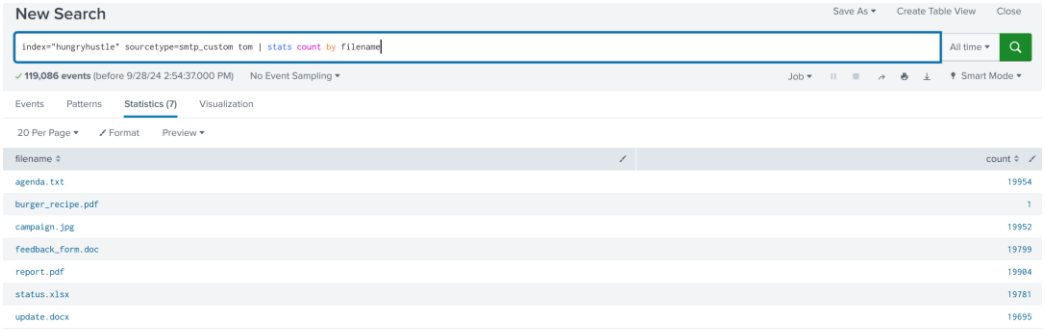
Question 5: Tom is an employee and has been upto some suspicious activity recently. An important file was transferred from his system, what was the file? To whom did he share the file?

Similarly using our extracted fields, we can see that Tom is linked to the hamburger recipe, this makes us suspect what he might have done with the recipe, the command used was the same as above as it encompasses all the email logs and links them to the documents that were transferred. Another way to find this event is to filter from the start of the search for Tom or with 'search' and use the 'stats count' command to count the filenames that Tom used during the time.

Index= "hungryhustle" sourcetype=smtp_custom

| search tom

| stats count by filename

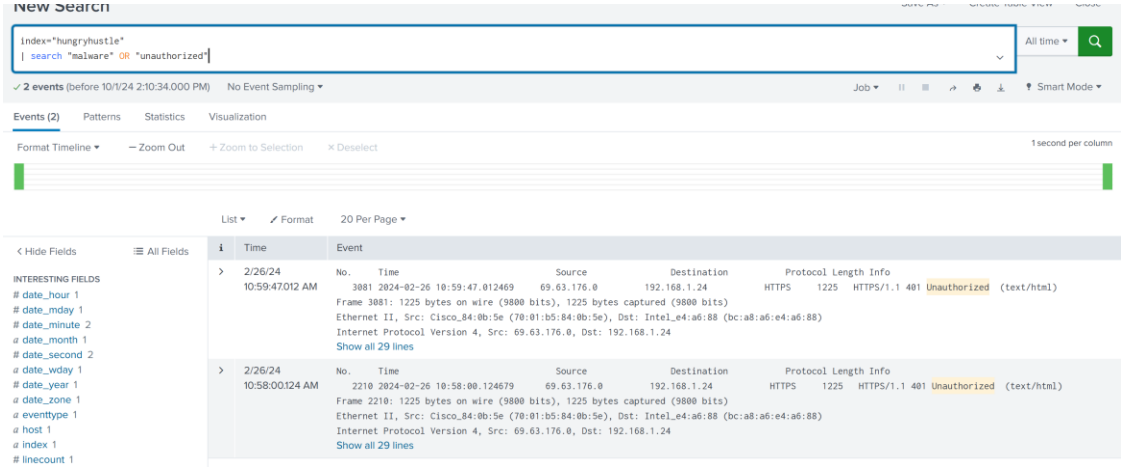


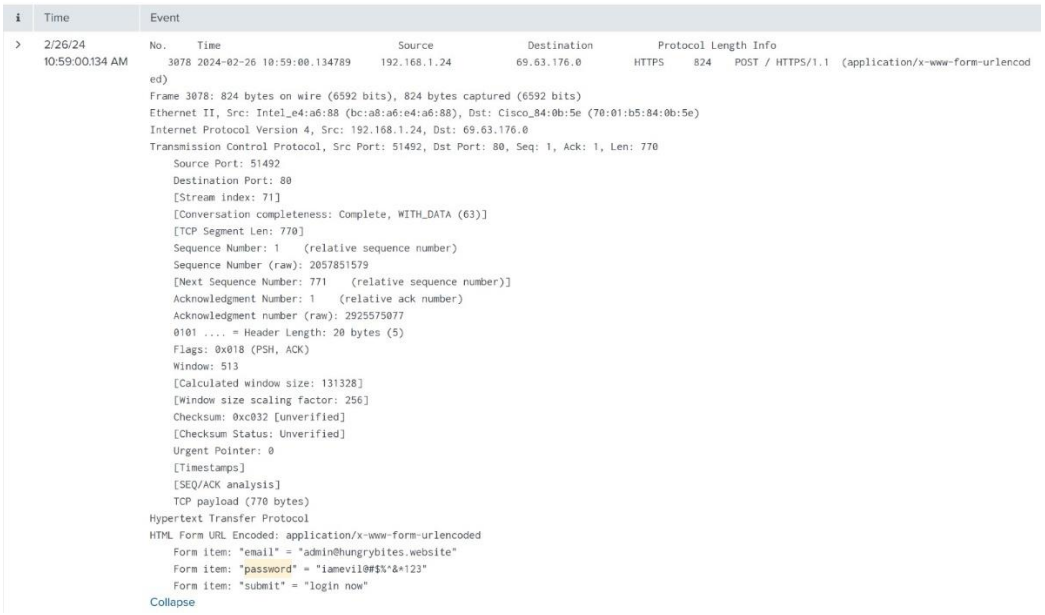
Looking at the event Tom is involved in; we can see that it is a conversation with the hungrybites manager. He sends the recipe and asks for a payment in bitcoins, this confirms the theory that he leaked sensitive information to the competition.

```
>  5/26/24
   10:05:09.000 AM   Return-Path: <tom@hungryhustle.website>
                     Received: from ip-192-168-1-24.ec2.internal (localhost [127.0.0.1])
                            by ip-192-168-1-24.ec2.internal (8.14.7/8.14.7) with ESMTP id 7915
                            for <manager@hungrybites.website>; Sun, 26 May 2024 10:05:09
                     Received: (from tom@localhost)
                            by ip-192-168-1-24.ec2.internal (8.14.7/8.14.7/Submit) id 3017
                            for manager@hungrybites.website; Sun, 26 May 2024 10:05:09
                     From: EC2 User <tom@hungryhustle.website>
                     Message-Id: <202301010000.3413@ip-192-168-1-24.ec2.internal>
                     Date: Sun, 26 May 2024 10:05:09
                     To: manager@hungrybites.website
                     Subject: recipie
                     User-Agent: Heirloom mailx 12.5 7/5/10
                     MIME-Version: 1.0
                     Content-Type: multipart/mixed;
                      boundary="=2163"
                     pay me in bitcoin.
                     --=3042
                     Content-Type: text/plain; charset=us-ascii
                     Content-Transfer-Encoding: 7bit
                     Content-Disposition: inline
                     See the attachment.
                     --=4335
                     Content-Type: text/plain;
                      charset=us-ascii
                     Content-Transfer-Encoding: 7bit
                     Content-Disposition: attachment;
                      filename="burger_recipe.pdf"
                     Collapse
```

Question 6: Identify the vulnerability that was exploited by an attacker on the Hungry Hustle website.

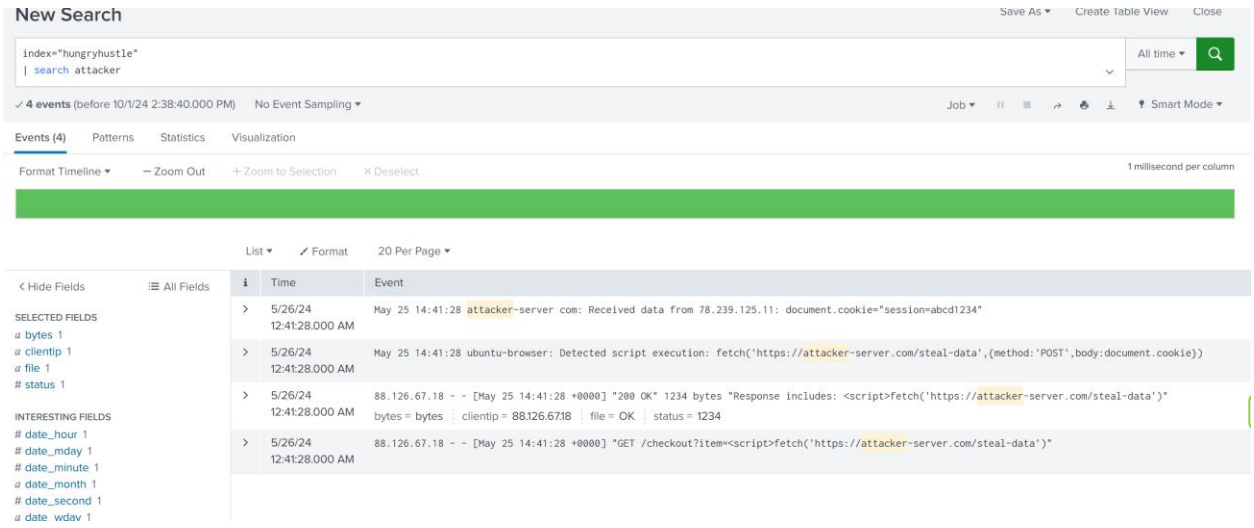
To analyse the vulnerabilities that the company may have, we must take into account several factors such as unauthorised access, SQL injection or XSS attack, for this we must refine the searches to see what patterns we can find, using the search command and giving as keywords malware or unauthorized we can see that it gives us two attempts to violate the security of the website, the https response was '401 unauthorized', however by modifying the search by IP and trying to search for leaks like passwords we can see that this same IP with the help of a POST request and the data that can be seen that was extracted is bob's credentials. You can also see the credentials by which this person entered this site and was able to extract these authorizations, the person is admin@hungrybites.website and his password 'iamevil@#$%^&*123' this makes us see that obtaining unauthorized data was successful.





Another way we can search is through keywords where we can verify whether or not there was an attempt to breach the system, one of the common ways to hack a system is XSS attack, this can be done through cookies where the credentials are stolen by the attacker's infiltrated code, for this we search for cookies or attacker in the search command and we can see that there was an interaction, cookies and even a destination for the information to be filtered.

Where the first interaction the query parameter contains a script tag that executes a fetch request. This is a clear indication of a Cross-Site Scripting (XSS) attack, the second interaction was the fetch request is designed to send data to https://attacker-server.com/steal-data. This could be used to exfiltrate sensitive information, such as cookies or other data from the user's browser. The third attempts to steal cookies, which may include session tokens, authentication tokens or other sensitive information. The last one uses the command document.cookie='session=abcd1234' is used to set a cookie called session with the value abcd1234.



Question 7: Rick is an employee working for Hungry Hustle. Recently his performance has worsened. Sam has captured the company's network traffic. Determine why Rick's performance has been negatively affected by analyzing network traffic logs and bandwidth consumption. His workstation has an IP 192.168.0.8.

For this case, we need to start splitting the search by Rick's IP, for this we will use the command search, when we see the fields that we see that we can work with the bytes consumed by that IP, so you can use a useful command like 'stats sum() by' this command will add the bytes consumed daily by that IP and finally 'timechart' helps us to organize in a time interval the answers obtained so that the command is like this:

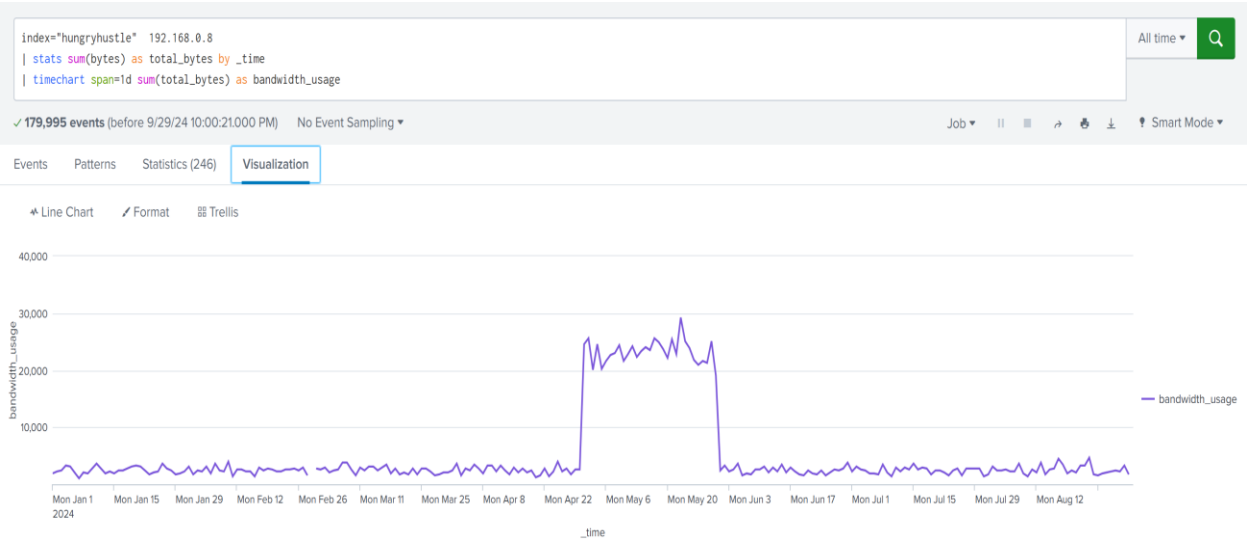
index="hungryhustle'

| search 192.168.0.8

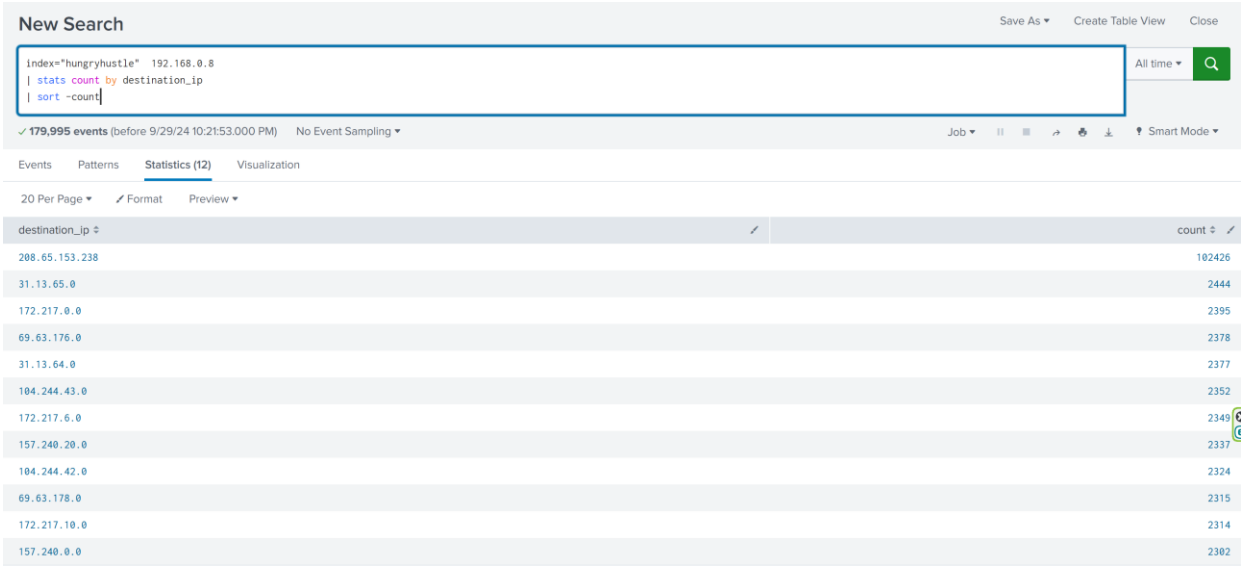
| stats sum(bytes) as total_bytes by _time

| timechart span=1d sum(total_bytes) as 'Bandwidth Usage'.

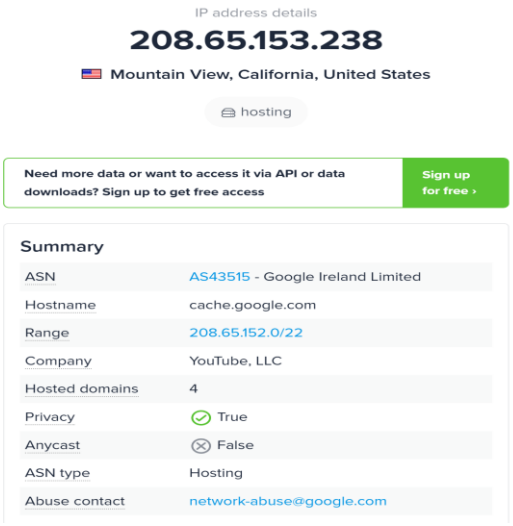
For a better visualisation and in concrete time we go to the 'Visualisation' tab and choose the lines during the time.

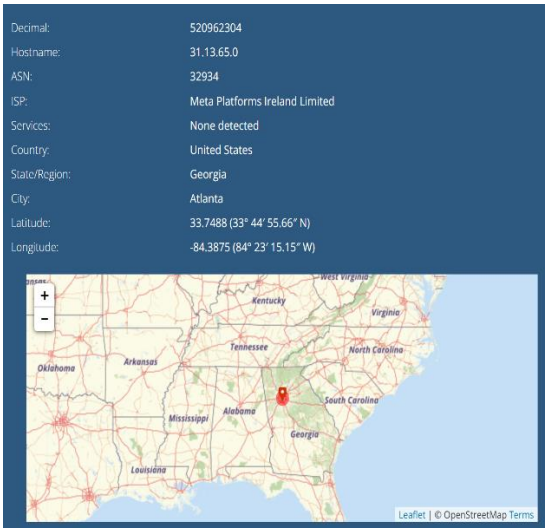


Now that we know that this IP had an excessive data consumption during May, we are going to filter to see to which destinations the data consumption is going. For this, we use the 'stast count by' and 'sort' commands to help us narrow down the most frequented destinations.



With the help of external tools we can see that Rick and his IP are most used on Youtube and Meta (Facebook).



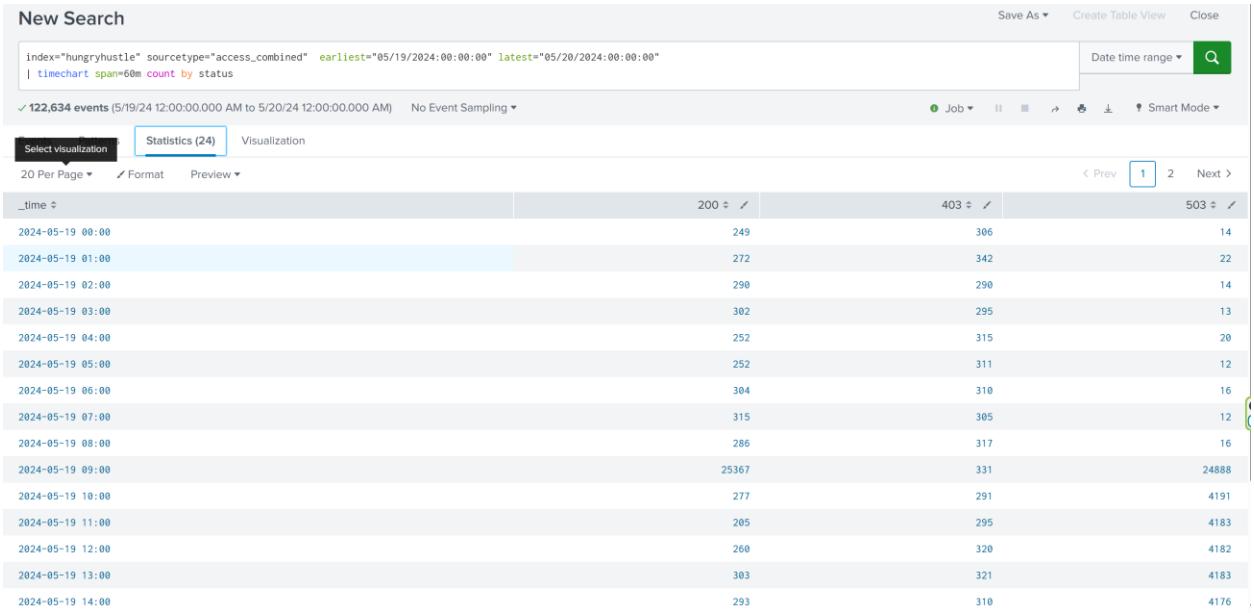


Question 8: The website was down from 19/05/2024. What was the reason the website was down?

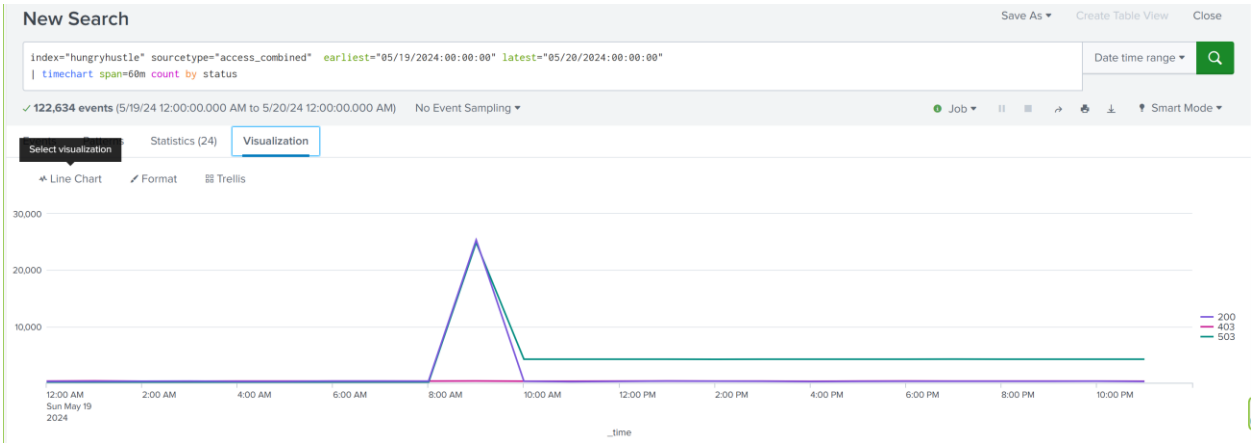
Since we know the exact day the wesite was down, we can start filtering to see the events that occurred that day, this can be with ‘earliest’ and ‘lastest’ or we can even modify the time window. After this, we can filter and use the ‘timechart’ command to be able to see in one hour time intervals and filter by status. The command used was:

Index= “hungryhustle” sourcetype= “Access_combined” earliest=”05/19/2024:00:00:00” latest= “05/20/2024:00:00:00”

| timechart span=60m count by status



For a better visualisation we use graphs to help us understand what happened, in this time interval we can see that there was a precise moment when an abrupt amount of requests were accepted but there were also requests that the system could not handle, this type of event is typical in DDos attacks, so that the system fails. After this, there continued to be more negative responses than usual from the system.



Question 9: There was a maintenance activity on hungry hustle website on a particular day, for how long the site went down?

When reviewing the fields we can see that the maintenance system is present, for this reason we filter the search from the beginning, so we can work strictly with such requests, with the help of 'stats' we can filter from the first event of maintenimineto the last with 'latest', to obtain the duration we use the command 'eval' that helps us to evaluate a certain number of values and returns a different answer, for this, we use 'tostring' to return us the duration of the event. To create a table that returns time data we must first transform to a value we understand since time is handled in epoch time, for this 'eval' and 'strftime' help us to convert to a normal value. The final command used was:

index="hungryhustle" sourcetype=access_combined file=maintenance

| stats earliest(_time) as start_time, latest(_time) as end_time

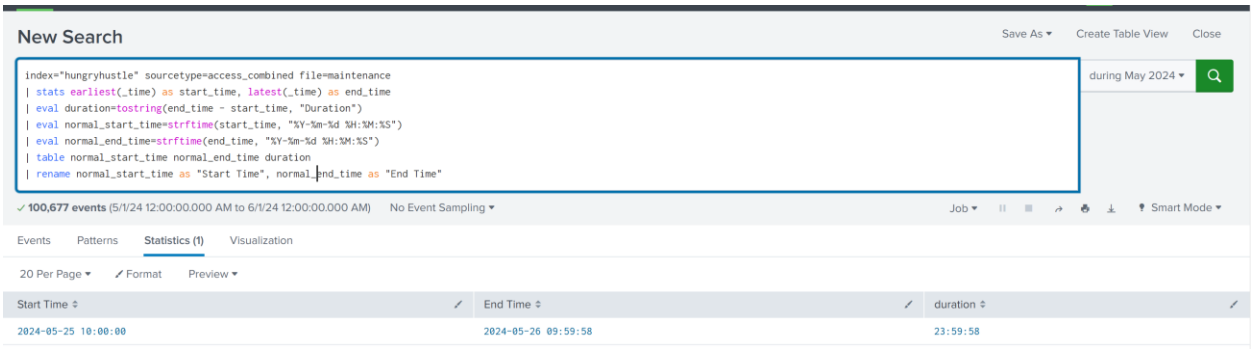
| eval duration=tostring(end_time - start_time, "Duration")

| eval normal_start_time=strftime(start_time, "%Y-%m-%d %H:%M:%S")

| eval normal_end_time=strftime(end_time, "%Y-%m-%d %H:%M:%S")

| table normal_start_time normal_end_time duration

| rename normal_start_time as "Start Time", normal_end_time as "End Time"



Question 10: Which food item is mostly visited by customers.

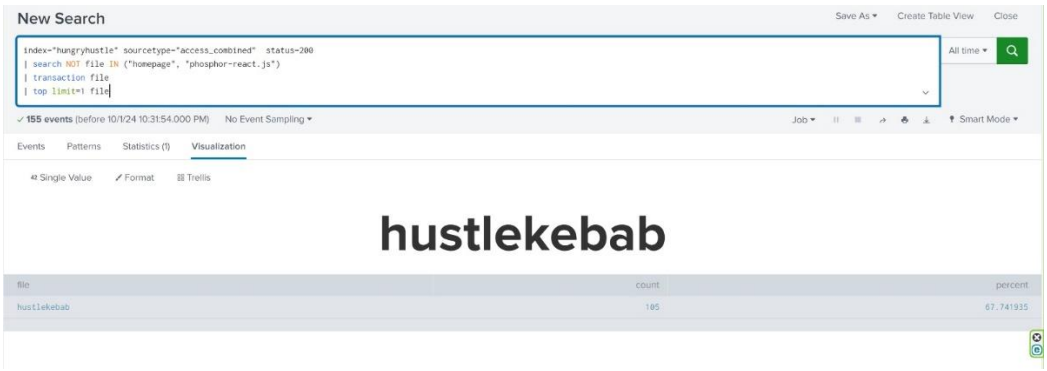
To get this result we filter by status where we only want to see those who successfully entered the page and saw the product so it must have a status=200, we also filter by file, because there are items in the field file that do not correspond to food products as homepage, we decided to remove them from the search and then with the help of 'transaction' filter by files, this tool filters all similar entries and joins them together. Then we limit with 'top' the most famous result.

index="hungryhustle" sourcetype="access_combined" status=200

| search NOT file IN ("homepage", "phosphor-react.js")

| transaction file

| top limit=1 file

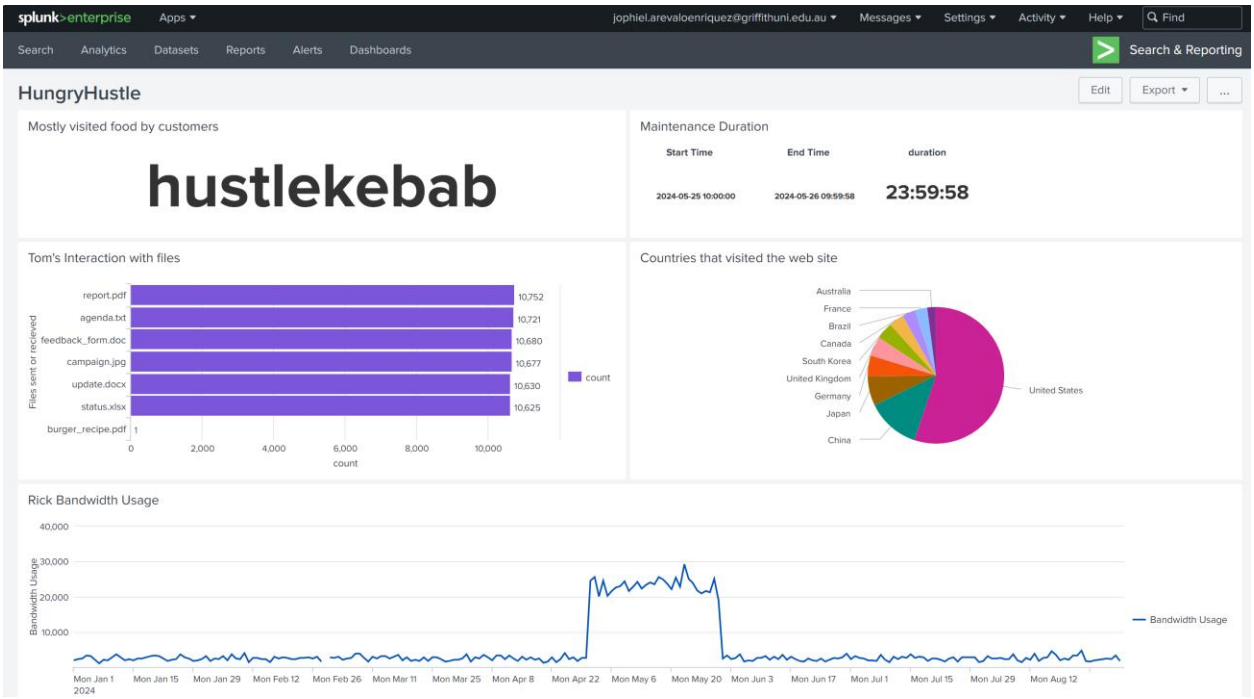


Task 2: Metrics and Visualisation

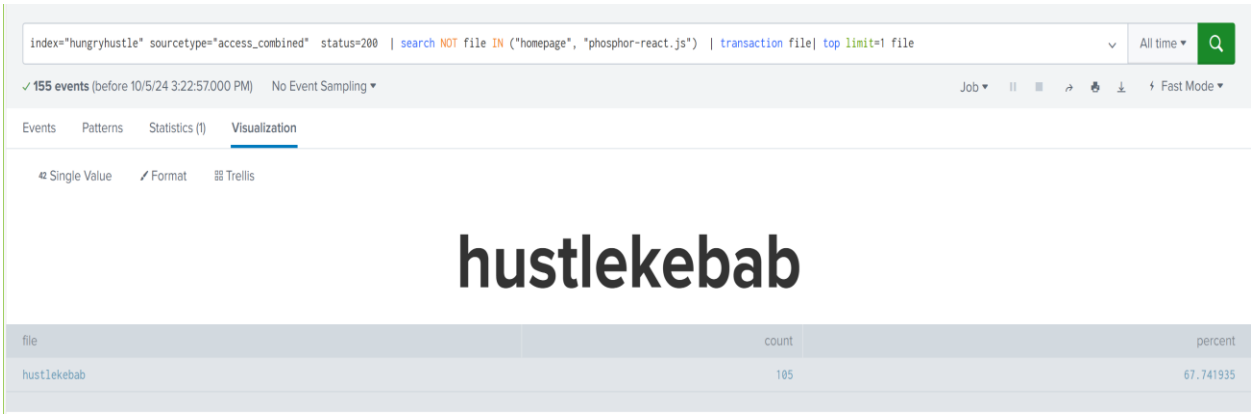
Develop a Splunk cyber security related dashboard for the Hungry Hustle data. The dashboard should include 4 panels with a variation of visualisations with at least one single value display. The dashboard should use at least the following Splunk functions:

- eval
- Transaction
- Custom Field Extraction

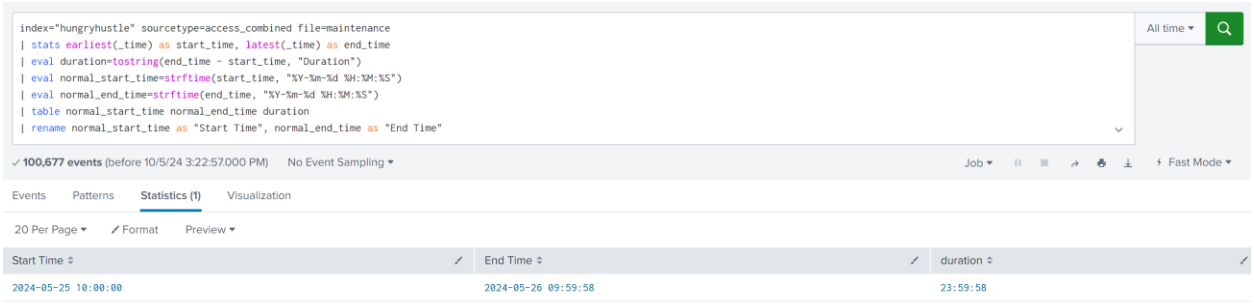
Dashboard:



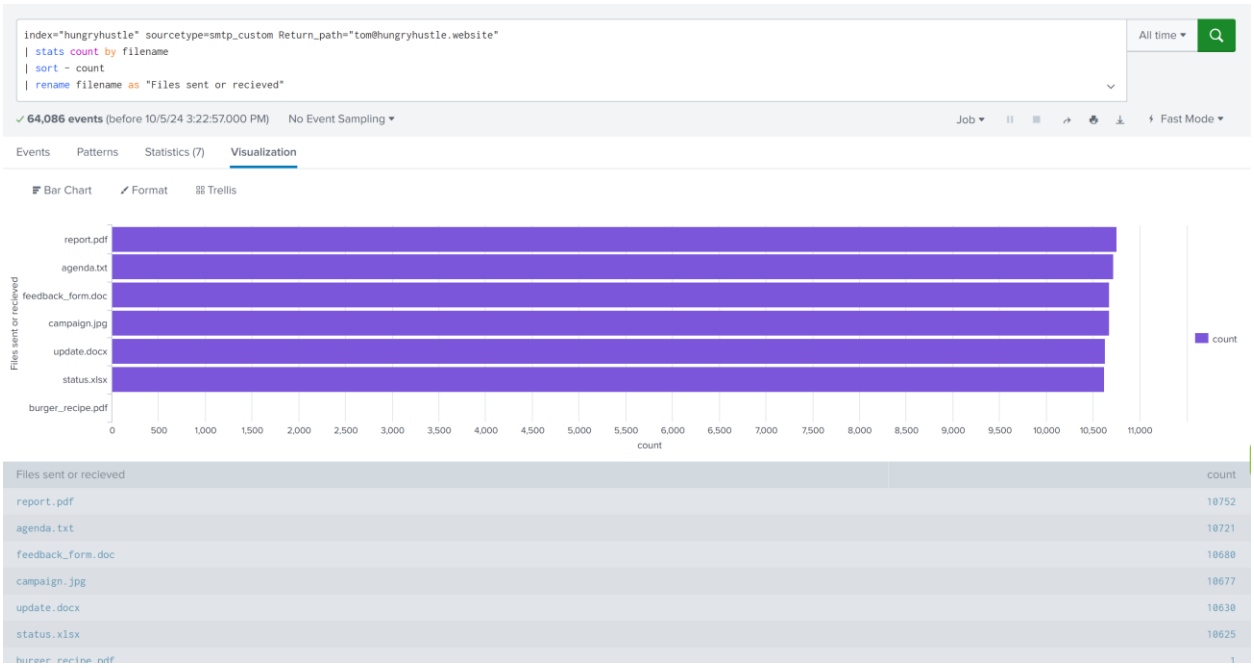
Transaction on dashboard:



Eval on dashboard:



Field extraction (Return_path) to organize by emails



Incident Response Plan for Hungry Hustle

1. Preparation

Develop an Incident Response Team (IRT): Assign roles and responsibilities to team members.

Create an Incident Response Plan (IRP): Document procedures for handling incidents.

Train Employees: Conduct regular training sessions on security awareness and incident response.

Implement Security Tools: Deploy tools like firewalls, intrusion detection systems (IDS), and antivirus software.

2. Detection

Monitor Systems: Use Splunk to continuously monitor network traffic and system logs for suspicious activities.

Set Up Alerts: Configure alerts for unusual activities, such as multiple failed login attempts or data exfiltration.

Regular Audits: Perform regular security audits and vulnerability assessments.

3. Containment

Immediate Containment: Isolate affected systems to prevent further damage.

Short-Term Containment: Apply temporary fixes, such as blocking malicious IP addresses and disabling compromised accounts.

Long-Term Containment: Implement more permanent solutions, such as patching vulnerabilities and enhancing security controls.

4. Eradication

Identify Root Cause: Use forensic analysis to determine the source and method of the breach.

Remove Malware: Clean infected systems and remove any malicious code.

Patch Vulnerabilities: Apply patches to fix security flaws and prevent re-exploitation.

5. Recovery

Restore Systems: Recover systems from clean backups and ensure they are fully operational.

Monitor Systems: Continue to monitor systems for any signs of residual threats.

Validate Security: Conduct thorough testing to ensure that all vulnerabilities have been addressed.

6. Lessons Learned

Post-Incident Review: Conduct a review meeting to discuss what happened, what was done well, and what could be improved.

Update IRP: Revise the incident response plan based on lessons learned.

Implement Improvements: Apply the insights gained to enhance security measures and prevent future incidents.

Specific Actions for Addressing the Data Breach

Immediate Actions:

- Isolate affected systems.
- Notify stakeholders and regulatory bodies.
- Begin forensic analysis to identify the breach source.

Short-Term Actions:

- Block malicious IP addresses.
- Reset passwords for affected accounts.
- Apply patches to vulnerable systems.

Long-Term Actions:

- Enhance monitoring and logging.
- Conduct regular security training.
- Implement multi-factor authentication (MFA).

Methods for Identifying and Analyzing the Source of the Breach

Log Analysis: Use Splunk to analyze logs for unusual activities and trace the attack path.

Network Traffic Analysis: Monitor network traffic for signs of data exfiltration or communication with malicious servers.

Forensic Tools: Utilize forensic tools to examine compromised systems and identify malware or other indicators of compromise (IOCs).

Recommendations for Mitigating Future Incidents

Short-Term Strategies:

- Implement MFA for all accounts.
- Conduct regular vulnerability assessments.
- Enhance email security to prevent phishing attacks.

Long-Term Strategies:

- Develop a comprehensive security awareness program.
- Invest in advanced threat detection and response tools.
- Establish a continuous improvement process for security policies and procedures.

Threat Intelligence Recommendations

Policies and Processes for Threat Intelligence

Threat Intelligence Program: Establish a formal threat intelligence program to collect, analyze, and act on threat data.

Sources of Intelligence: Utilize multiple sources, including open-source intelligence (OSINT), commercial threat feeds, and information sharing with industry peers.

Threat Analysis: Regularly analyze threat data to identify trends and emerging threats.

Actionable Intelligence: Translate threat intelligence into actionable measures, such as updating firewall rules or blocking malicious IP addresses.

Addressing Recent Breaches and Vulnerabilities

Example of Actionable Intelligence:

Phishing Campaign: If threat intelligence indicates a rise in phishing attacks, implement email filtering and train employees to recognize phishing attempts.

Zero-Day Vulnerability: If a new zero-day vulnerability is discovered, apply virtual patching and monitor for exploitation attempts.

Sharing intelligence: This method can help the platform to be updated on trends or new ways to exploit vulnerabilities in the system, there are several platforms that should be continuously reviewed such as IBM X-FORCE Exchange, splunk (which we are using at the moment) or CrowdStrike Falcon X.