Unpacking for Dummies

Aka “de-enmailloter sans ta mère” tabarnac !

About Us

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X86 aware anyone ??

Are you ready ?

- VM available online :
  - http://hacklu.local/Unpacking_WorkShop_VmWare.ova
  - http://hacklu.local/Unpacking_WorkShop_VirtualBox.ova

- VM (vmware) from USB keys:
  - In UnRar folder choose the unrar binary for your Os

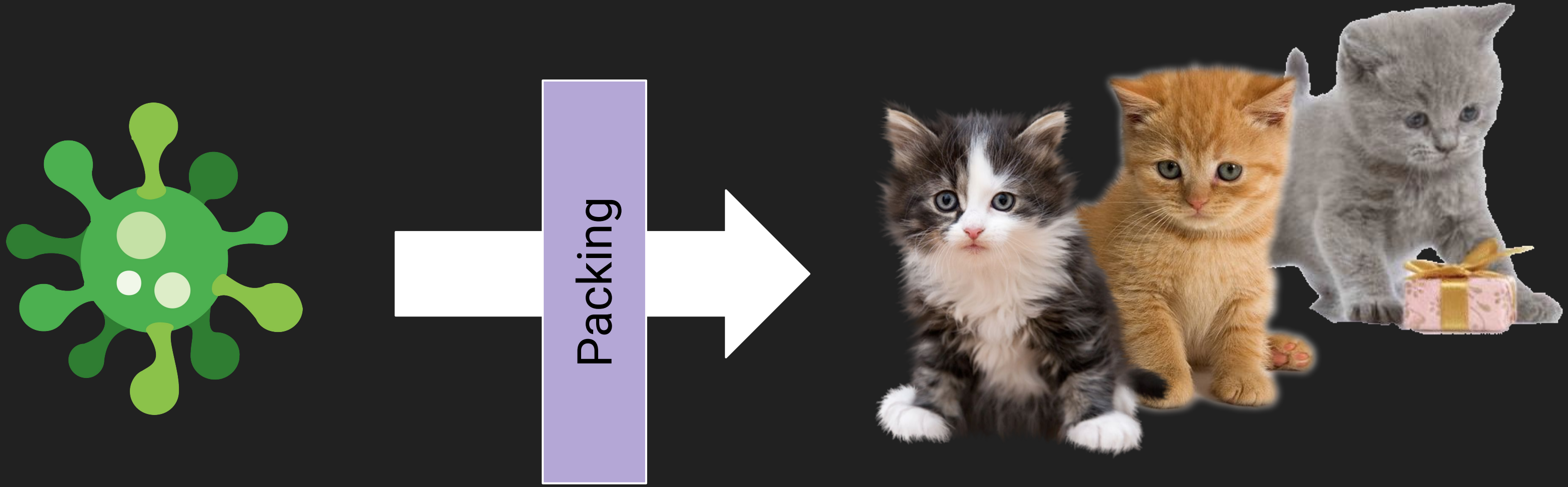
```
unrar.exe x UnPacking_WorkShop_VMWare.rar
```

the password is : “reverse”

Why Packers

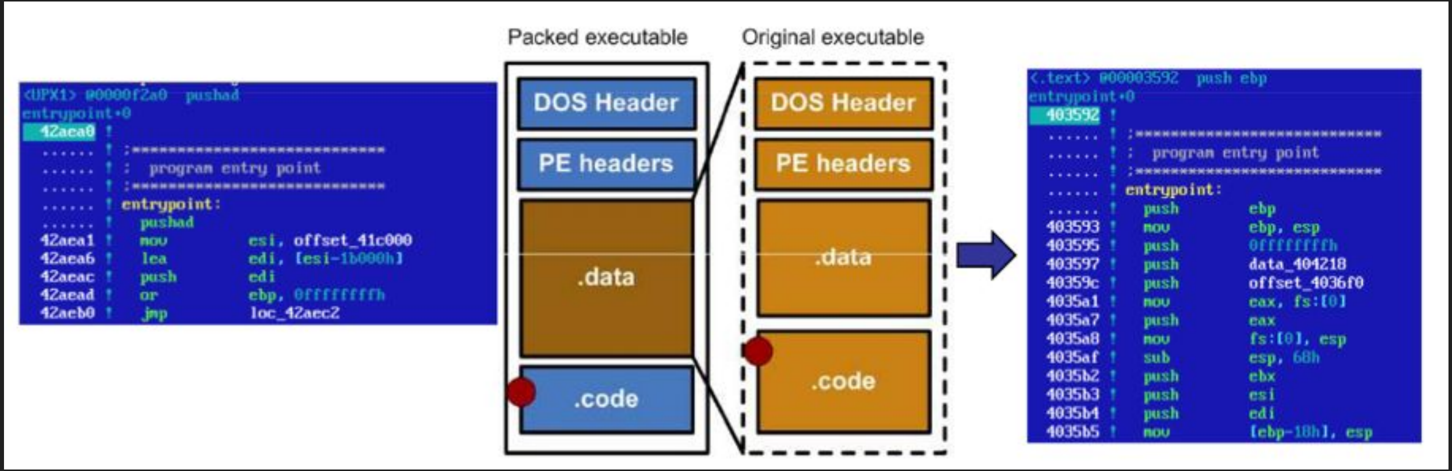
What is a Packer

- You may name it packer, cryptor or protector
- Convert a single executable into “army” of executable
- You may see it as a kind of matrioska



Why packers

- To avoid AV detection
- Get more time during the infection campaign
- Obfuscate globally the payload

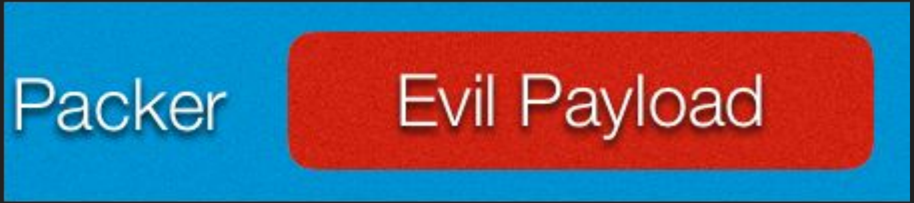


```
<UPX1> @0000f2a0  pushad
entrypoint+0
 42aca0 !
 ...... ! ;*****************************
 ...... ! :  program entry point
 ...... ! ;*****************************
 ...... ! entrypoint:
 ...... !   pushad
 42aca1 !   mov          esi, offset_41c000
 42aca6 !   lea          edi, [esi-1b000h]
 42acac !   push         edi
 42acad !   or           ebp, 0ffffffffh
 42acb0 !   jmp          loc_42acc2
```

```
<.text> @00003592  push ebp
entrypoint+0
 403592 !
 ...... ! ;*****************************
 ...... ! :  program entry point
 ...... ! ;*****************************
 ...... ! entrypoint:
 ...... !   push         ebp
 403593 !   mov          ebp, esp
 403595 !   push         0ffffffffh
 403597 !   push         data_404218
 40359c !   push         offset_4036f0
 4035a1 !   mov          eax, fs:[0]
 4035a7 !   push         eax
 4035a8 !   mov          fs:[0], esp
 4035af !   sub          esp, 68h
 4035b2 !   push         ebx
 4035b3 !   push         esi
 4035b4 !   push         edi
 4035b5 !   mov          [ebp-18h], esp
```

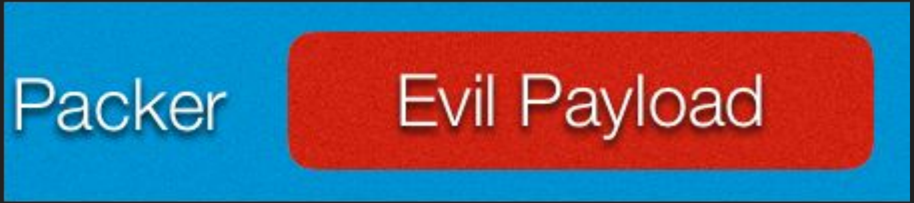
Why un-packing

- After unpacking:
  - Identification of the real threat might be possible
- If still unknown:
  - You can reverse the unpacked sample



Why un-packing

- If successful:
  - Dynamic analysis of sample becomes possible



What kind of tools people use to pack

- Known tools/packer (upx, petite)
- Known “pro” packer (themida, vmprotect, ...)
- Dirty things, Self Extracting tools (SFX Cabs, Msi)
- Mostly, unknown packer/cryptor (??) …

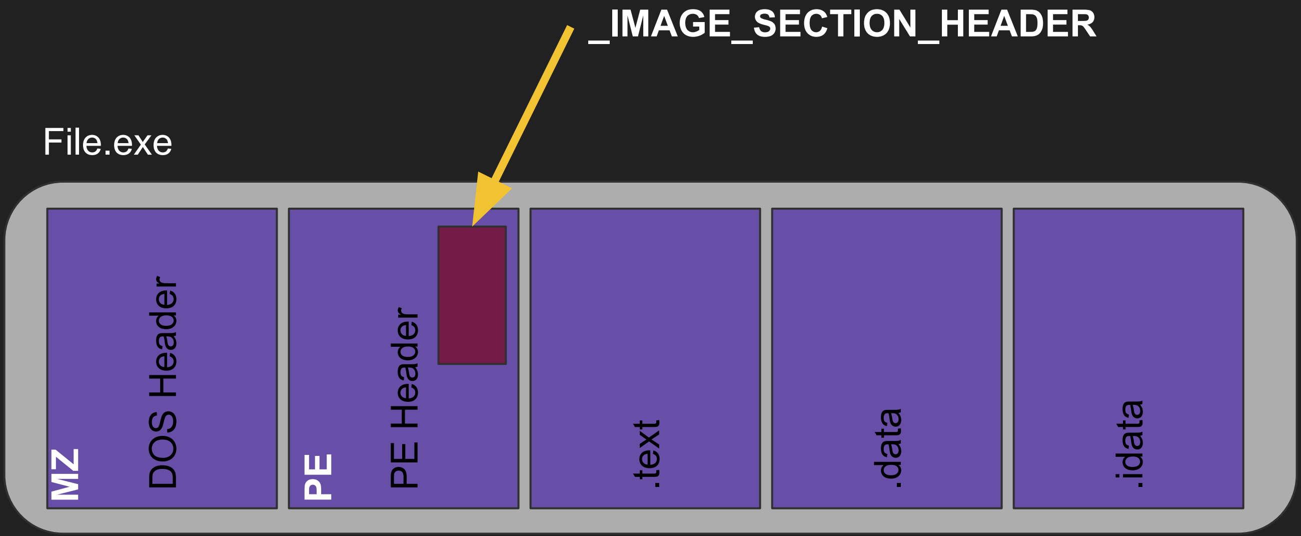
Concepts Needed

Mandatory to no leave the room in 10 minutes

Things to Know

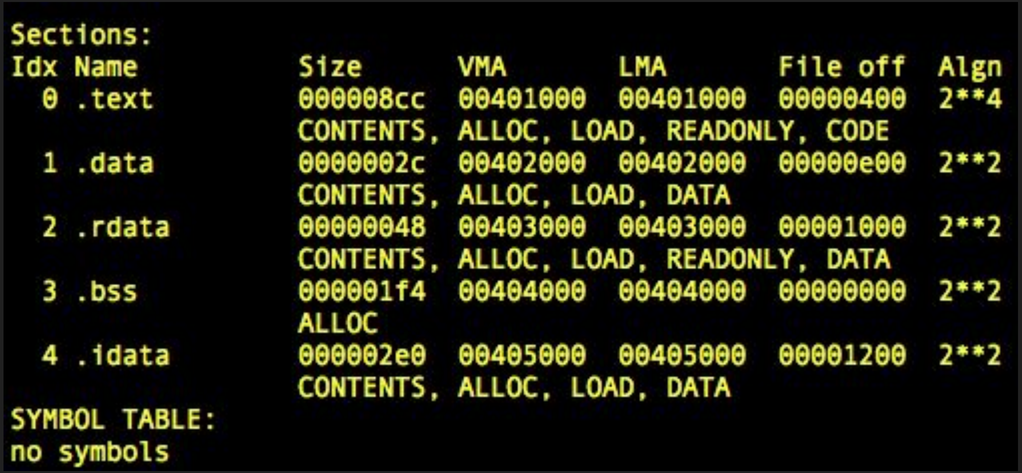
- Mapping File to Memory
- Entry Point
- Import table
- Process Environment Block
- Traversing module list

Entry Point & File Mapping



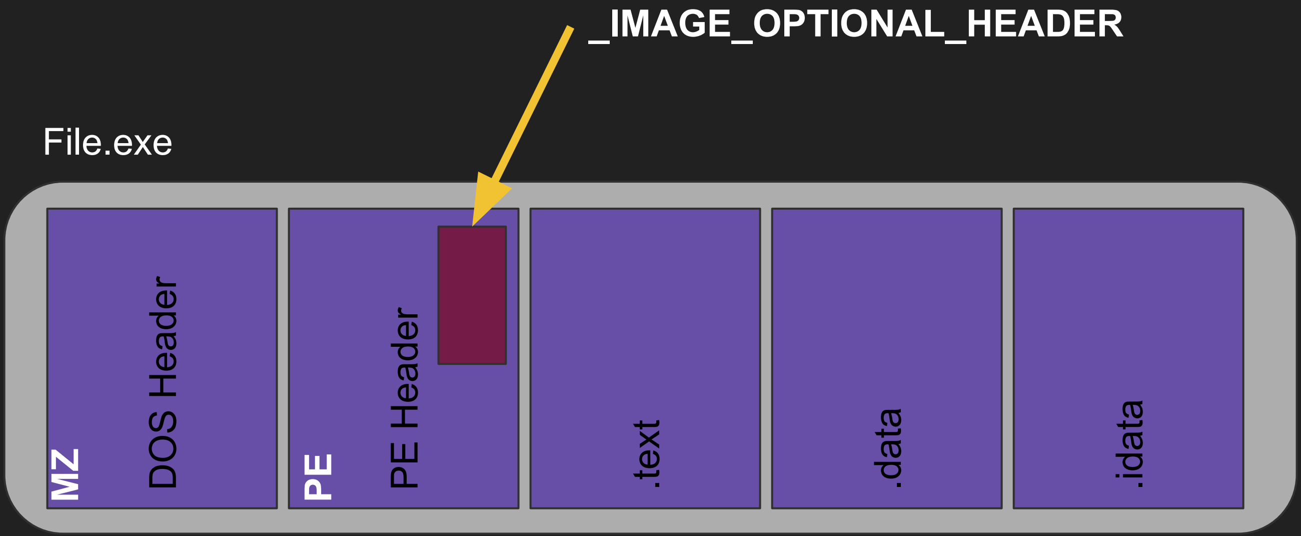
Sections

```
typedef struct _IMAGE_SECTION_HEADER {
  BYTE  Name[IMAGE_SIZEOF_SHORT_NAME];
  union {
    DWORD PhysicalAddress;
    DWORD VirtualSize;
  } Misc;
  DWORD VirtualAddress;
  DWORD SizeOfRawData;
  DWORD PointerToRawData;
  DWORD PointerToRelocations;
  DWORD PointerToLinenumbers;
  WORD  NumberOfRelocations;
  WORD  NumberOfLinenumbers;
  DWORD Characteristics;
} IMAGE_SECTION_HEADER, *PIMAGE_SECTION_HEADER;
```



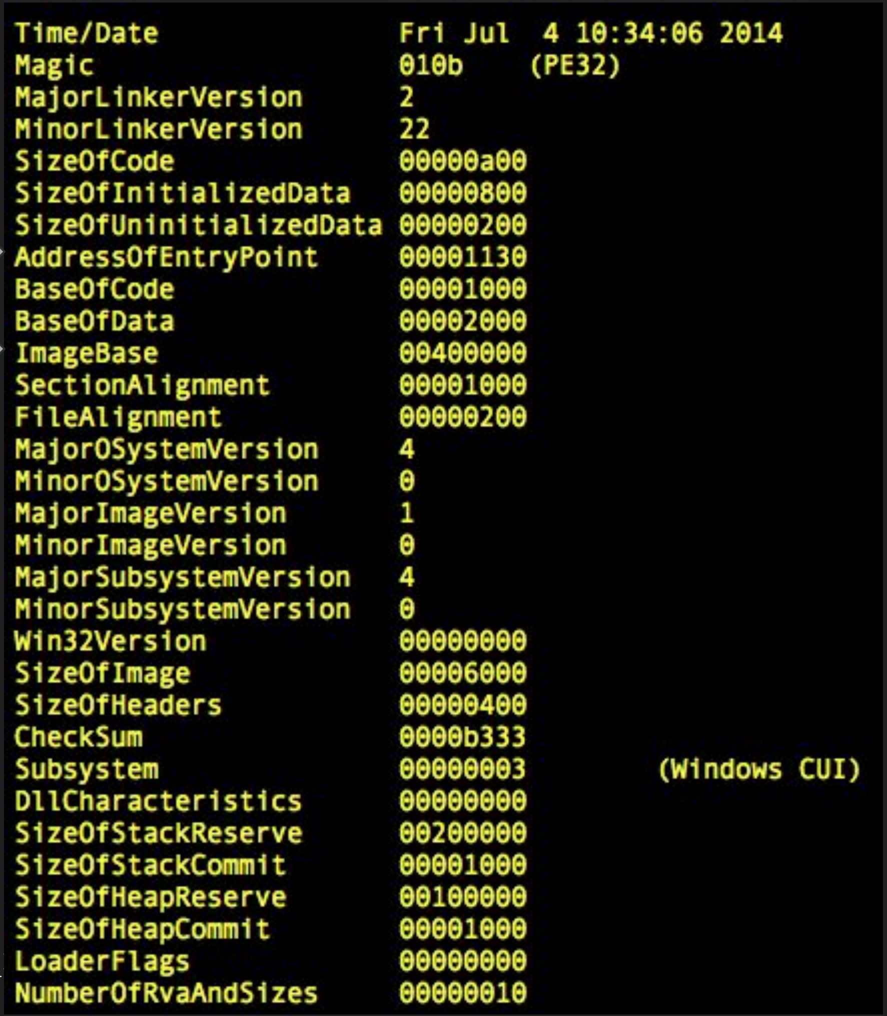
```
Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text         000008cc  00401000  00401000  00000400  2**4
                  CONTENTS, ALLOC, LOAD, READONLY, CODE
  1 .data         0000002c  00402000  00402000  00000e00  2**2
                  CONTENTS, ALLOC, LOAD, DATA
  2 .rdata        00000048  00403000  00403000  00001000  2**2
                  CONTENTS, ALLOC, LOAD, READONLY, DATA
  3 .bss          000001f4  00404000  00404000  00000000  2**2
                  ALLOC
  4 .idata        000002e0  00405000  00405000  00001200  2**2
                  CONTENTS, ALLOC, LOAD, DATA
SYMBOL TABLE:
no symbols
```

Entry Point


_IMAGE_OPTIONAL_HEADER
File.exe
MZ
DOS Header
PE
PE Header
.text
.data
.idata

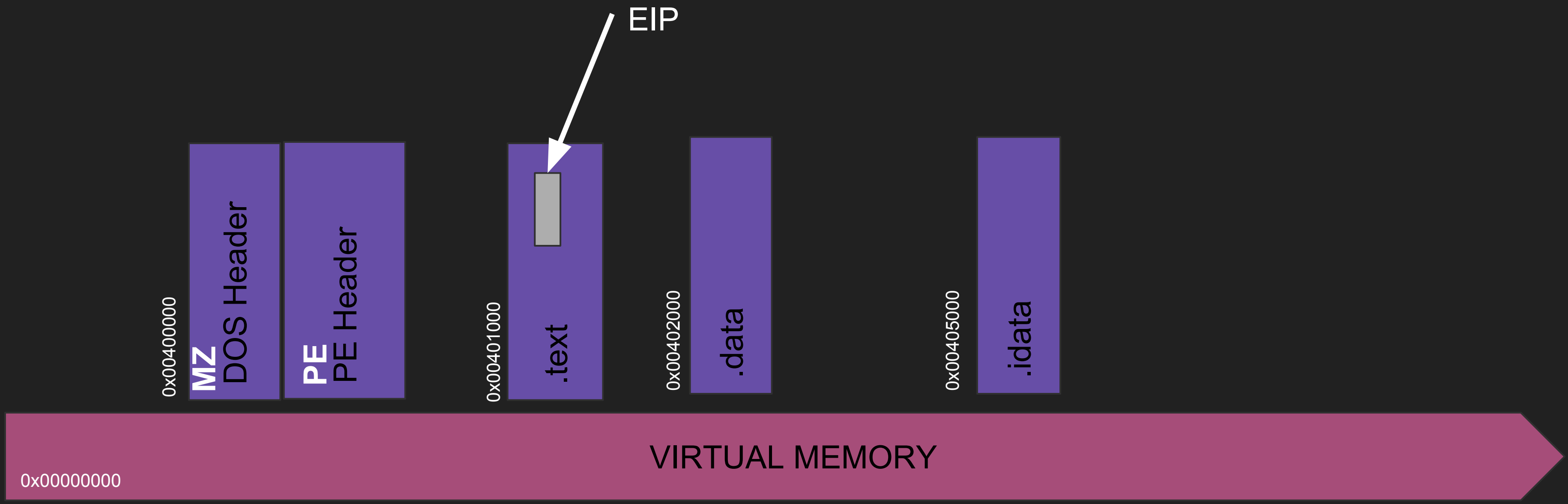
Entry Point

```
typedef struct _IMAGE_OPTIONAL_HEADER {
  WORD                     Magic;
  BYTE                     MajorLinkerVersion;
  BYTE                     MinorLinkerVersion;
  DWORD                    SizeOfCode;
  DWORD                    SizeOfInitializedData;
  DWORD                    SizeOfUninitializedData;
  DWORD                    AddressOfEntryPoint;
  DWORD                    BaseOfCode;
  DWORD                    BaseOfData;
  DWORD                    ImageBase;
  DWORD                    SectionAlignment;
  DWORD                    FileAlignment;
  WORD                     MajorOperatingSystemVersion;
  WORD                     MinorOperatingSystemVersion;
  WORD                     MajorImageVersion;
  WORD                     MinorImageVersion;
  WORD                     MajorSubsystemVersion;
  WORD                     MinorSubsystemVersion;
  . . .
  DWORD                    NumberOfRvaAndSizes;
  IMAGE_DATA_DIRECTORY DataDirectory[IMAGE_NUMBEROF_
} IMAGE_OPTIONAL_HEADER32, *PIMAGE_OPTIONAL_HEADER32
```



```
Time/Date               Fri Jul  4 10:34:06 2014
Magic                   010b    (PE32)
MajorLinkerVersion      2
MinorLinkerVersion      22
SizeOfCode              00000a00
SizeOfInitializedData   00000800
SizeOfUninitializedData 00000200
AddressOfEntryPoint     00001130
BaseOfCode              00001000
BaseOfData              00002000
ImageBase               00400000
SectionAlignment        00001000
FileAlignment           00000200
MajorOSystemVersion     4
MinorOSystemVersion     0
MajorImageVersion       1
MinorImageVersion       0
MajorSubsystemVersion   4
MinorSubsystemVersion   0
Win32Version            00000000
SizeOfImage             00006000
SizeOfHeaders           00000400
CheckSum                0000b333
Subsystem               00000003        (Windows CUI)
DllCharacteristics      00000000
SizeOfStackReserve      00200000
SizeOfStackCommit       00001000
SizeOfHeapReserve       00100000
SizeOfHeapCommit        00001000
LoaderFlags             00000000
NumberOfRvaAndSizes     00000010
```

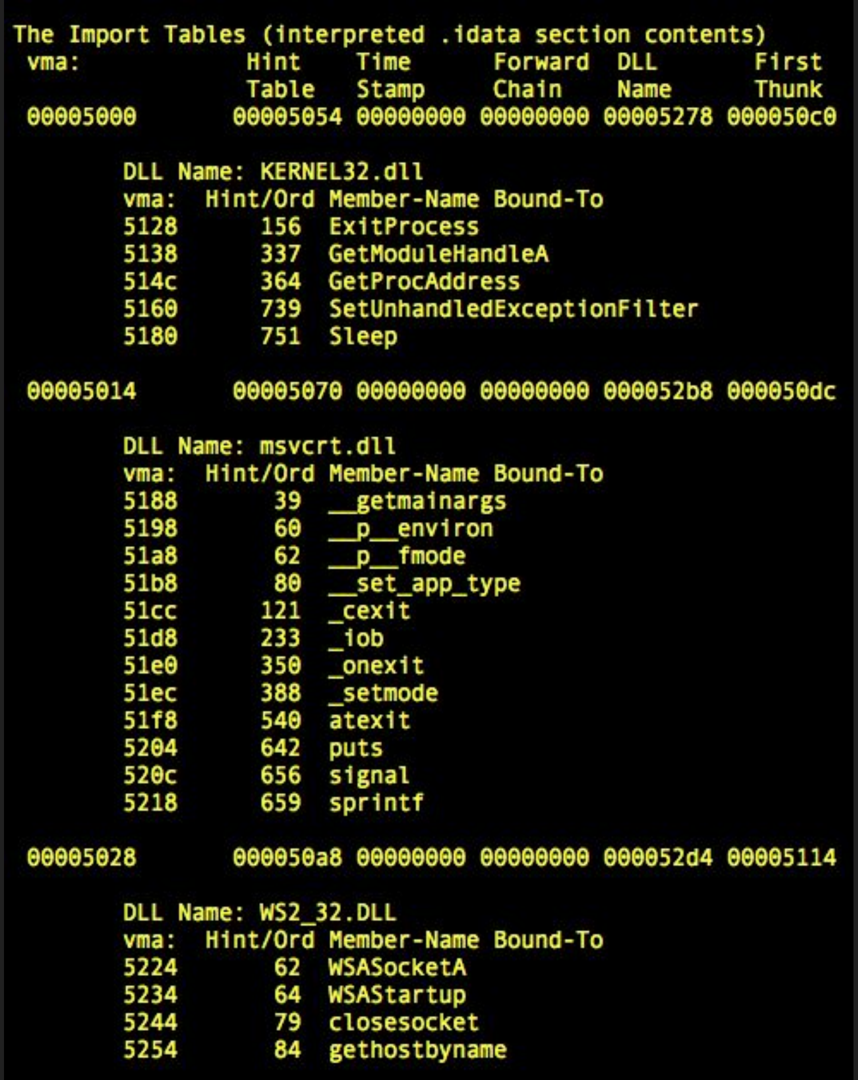
File Mapping



Import table

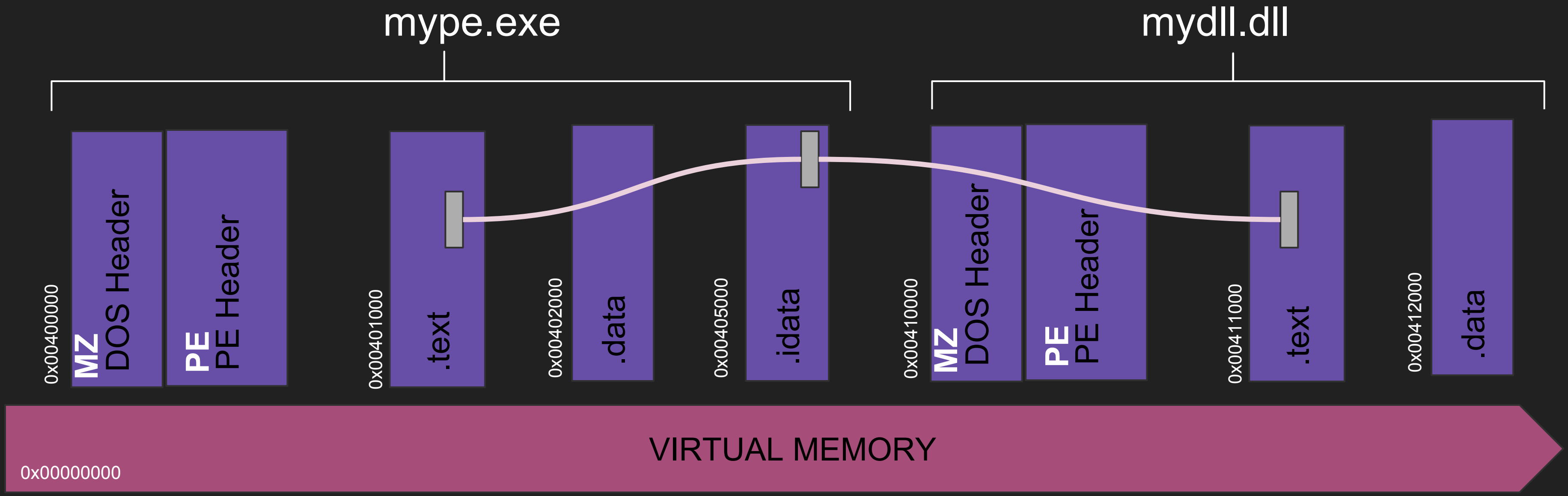
Import table list required functions for the PE.

A DLL is a PE



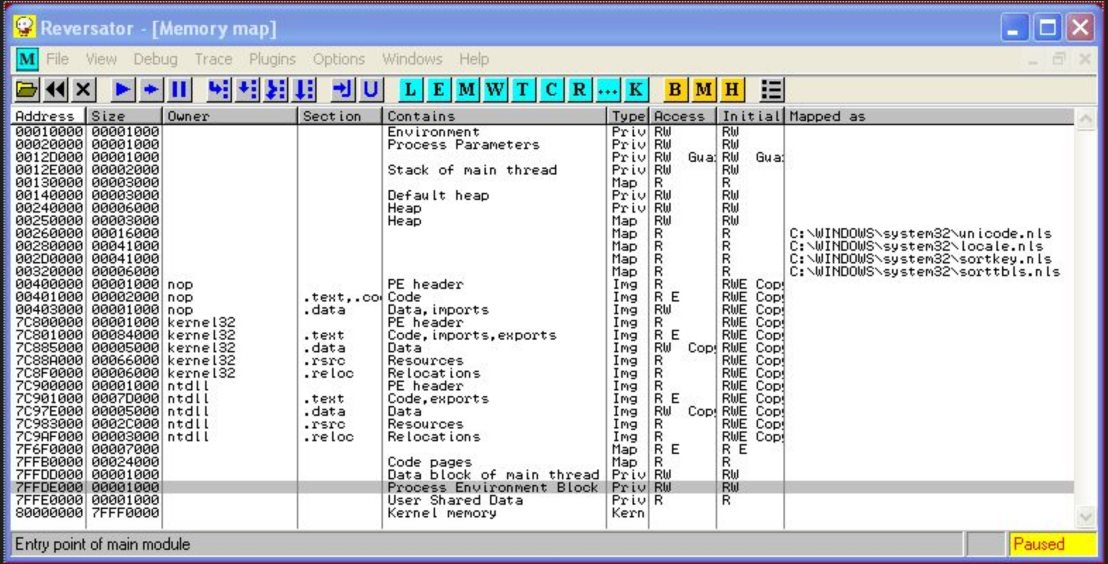
```
The Import Tables (interpreted .idata section contents)
 vma:            Hint     Time      Forward  DLL       First
                 Table    Stamp     Chain    Name      Thunk
 00005000       00005054 00000000 00000000 00005278 000050c0

        DLL Name: KERNEL32.dll
        vma:  Hint/Ord Member-Name Bound-To
        5128       156  ExitProcess
        5138       337  GetModuleHandleA
        514c       364  GetProcAddress
        5160       739  SetUnhandledExceptionFilter
        5180       751  Sleep

 00005014       00005070 00000000 00000000 000052b8 000050dc

        DLL Name: msvcrt.dll
        vma:  Hint/Ord Member-Name Bound-To
        5188        39  __getmainargs
        5198        60  __p__environ
        51a8        62  __p__fmode
        51b8        80  __set_app_type
        51cc       121  _cexit
        51d8       233  _iob
        51e0       350  _onexit
        51ec       388  _setmode
        51f8       540  atexit
        5204       642  puts
        520c       656  signal
        5218       659  sprintf

 00005028       000050a8 00000000 00000000 000052d4 00005114

        DLL Name: WS2_32.DLL
        vma:  Hint/Ord Member-Name Bound-To
        5224        62  WSASocketA
        5234        64  WSAStartup
        5244        79  closesocket
        5254        84  gethostbyname
```

File Mapping



PEB (Process Environment Block)

- **Memory structure with the process states**
- **Location**
    - **32 Bits FS[0x30]**
    - **64 Bits GS[0x60]**

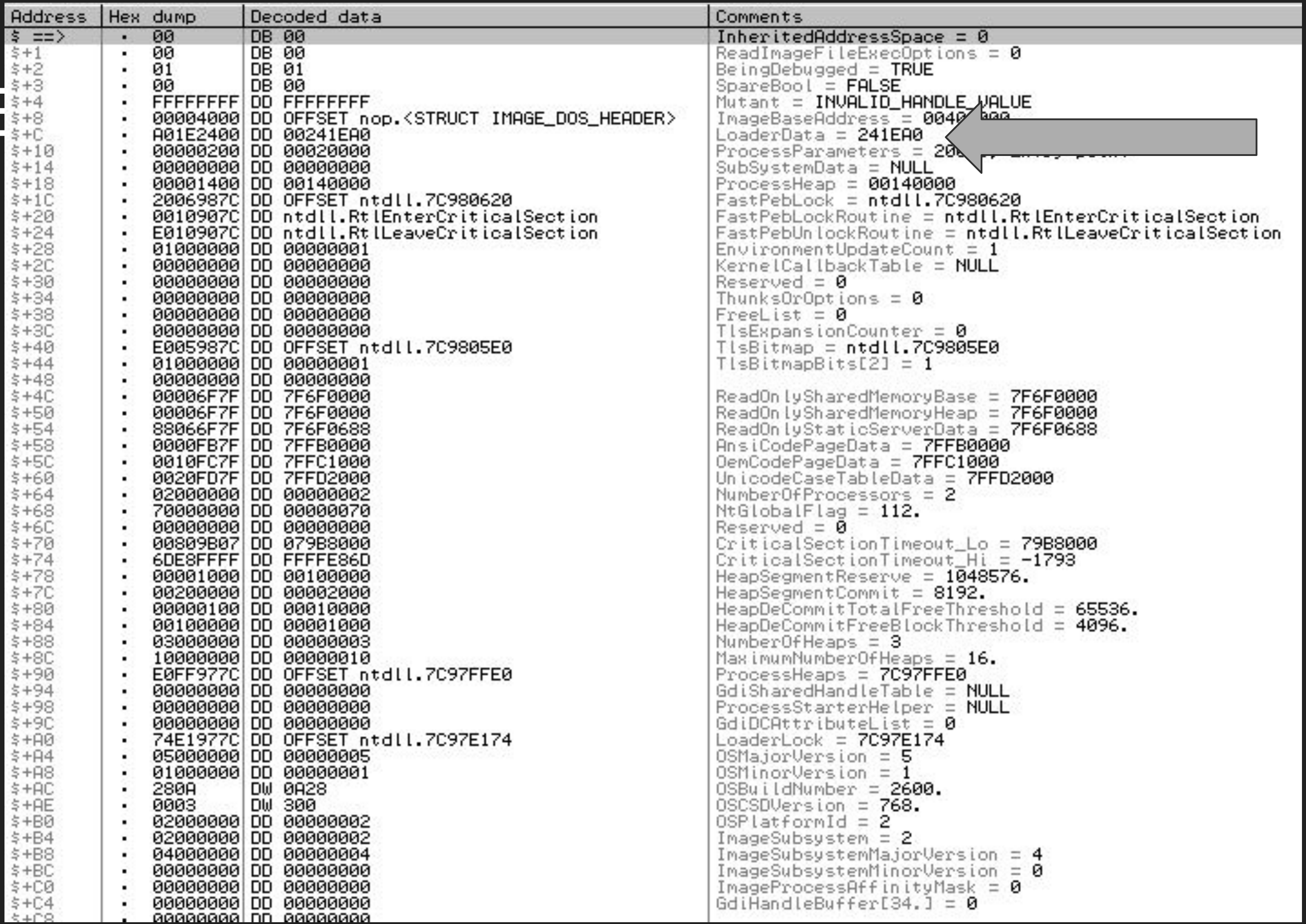

Reversator - [Memory map]
File View Debug Trace Plugins Options Windows Help
L E M W T C R ... K B M H

Address	Size	Owner	Section	Contains	Type	Access	Initial	Mapped as
00010000	00001000			Environment	Priv	RW	RW	
00020000	00001000			Process Parameters	Priv	RW	RW	
0012D000	00001000				Priv	RW Gua:	RW Gua:	
0012E000	00002000			Stack of main thread	Priv	RW	RW	
00130000	00003000				Map	R	R	
00140000	00003000			Default heap	Priv	RW	RW	
00240000	00006000			Heap	Priv	RW	RW	
00250000	00003000			Heap	Map	RW	RW	
00260000	00016000				Map	R	R	C:\WINDOWS\system32\unicode.nls
00280000	00041000				Map	R	R	C:\WINDOWS\system32\locale.nls
002D0000	00041000				Map	R	R	C:\WINDOWS\system32\sortkey.nls
00320000	00006000				Map	R	R	C:\WINDOWS\system32\sorttbls.nls
00400000	00001000	nop		PE header	Img	R	RWE Cop:	
00401000	00002000	nop	.text,.co	Code	Img	R E	RWE Cop:	
00403000	00001000	nop	.data	Data, imports	Img	RW	RWE Cop:	
7C800000	00001000	kernel32		PE header	Img	R	RWE Cop:	
7C801000	00084000	kernel32	.text	Code, imports, exports	Img	R E	RWE Cop:	
7C885000	00005000	kernel32	.data	Data	Img	RW Cop:	RWE Cop:	
7C88A000	00066000	kernel32	.rsrc	Resources	Img	R	RWE Cop:	
7C8F0000	00006000	kernel32	.reloc	Relocations	Img	R	RWE Cop:	
7C900000	00001000	ntdll		PE header	Img	R	RWE Cop:	
7C901000	0007D000	ntdll	.text	Code, exports	Img	R E	RWE Cop:	
7C97E000	00005000	ntdll	.data	Data	Img	RW Cop:	RWE Cop:	
7C983000	0002C000	ntdll	.rsrc	Resources	Img	R	RWE Cop:	
7C9AF000	00003000	ntdll	.reloc	Relocations	Img	R	RWE Cop:	
7F6F0000	00007000				Map	R E	R E	
7FFB0000	00024000			Code pages	Map	R	R	
7FFDD000	00001000			Data block of main thread	Priv	RW	RW	
7FFDE000	00001000			Process Environment Block	Priv	RW	RW	
7FFE0000	00001000			User Shared Data	Priv	R	R	
80000000	7FFF0000			Kernel memory	Kern			

Entry point of main module

Paused

PE



```
Address  Hex dump  Decoded data                              Comments
$ ==>   . 00       DB 00                                     InheritedAddressSpace = 0
$+1     . 00       DB 00                                     ReadImageFileExecOptions = 0
$+2     . 01       DB 01                                     BeingDebugged = TRUE
$+3     . 00       DB 00                                     SpareBool = FALSE
$+4     . FFFFFFFF DD FFFFFFFF                               Mutant = INVALID_HANDLE_VALUE
$+8     . 00004000 DD OFFSET nop.<STRUCT IMAGE_DOS_HEADER>   ImageBaseAddress = 0040[illegible]000
$+C     . A01E2400 DD 00241EA0                               LoaderData = 241EA0
$+10    . 00000200 DD 00020000                               ProcessParameters = 200[illegible]
$+14    . 00000000 DD 00000000                               SubSystemData = NULL
$+18    . 00001400 DD 00140000                               ProcessHeap = 00140000
$+1C    . 2006987C DD OFFSET ntdll.7C980620                  FastPebLock = ntdll.7C980620
$+20    . 0010907C DD ntdll.RtlEnterCriticalSection          FastPebLockRoutine = ntdll.RtlEnterCriticalSection
$+24    . E010907C DD ntdll.RtlLeaveCriticalSection          FastPebUnlockRoutine = ntdll.RtlLeaveCriticalSection
$+28    . 01000000 DD 00000001                               EnvironmentUpdateCount = 1
$+2C    . 00000000 DD 00000000                               KernelCallbackTable = NULL
$+30    . 00000000 DD 00000000                               Reserved = 0
$+34    . 00000000 DD 00000000                               ThunksOrOptions = 0
$+38    . 00000000 DD 00000000                               FreeList = 0
$+3C    . 00000000 DD 00000000                               TlsExpansionCounter = 0
$+40    . E005987C DD OFFSET ntdll.7C9805E0                  TlsBitmap = ntdll.7C9805E0
$+44    . 01000000 DD 00000001                               TlsBitmapBits[2] = 1
$+48    . 00000000 DD 00000000
$+4C    . 00006F7F DD 7F6F0000                               ReadOnlySharedMemoryBase = 7F6F0000
$+50    . 00006F7F DD 7F6F0000                               ReadOnlySharedMemoryHeap = 7F6F0000
$+54    . 88066F7F DD 7F6F0688                               ReadOnlyStaticServerData = 7F6F0688
$+58    . 0000FB7F DD 7FFB0000                               AnsiCodePageData = 7FFB0000
$+5C    . 0010FC7F DD 7FFC1000                               OemCodePageData = 7FFC1000
$+60    . 0020FD7F DD 7FFD2000                               UnicodeCaseTableData = 7FFD2000
$+64    . 02000000 DD 00000002                               NumberOfProcessors = 2
$+68    . 70000000 DD 00000070                               NtGlobalFlag = 112.
$+6C    . 00000000 DD 00000000                               Reserved = 0
$+70    . 00809B07 DD 079B8000                               CriticalSectionTimeout_Lo = 79B8000
$+74    . 6DE8FFFF DD FFFFE86D                               CriticalSectionTimeout_Hi = -1793
$+78    . 00001000 DD 00100000                               HeapSegmentReserve = 1048576.
$+7C    . 00200000 DD 00002000                               HeapSegmentCommit = 8192.
$+80    . 00000100 DD 00010000                               HeapDeCommitTotalFreeThreshold = 65536.
$+84    . 00100000 DD 00001000                               HeapDeCommitFreeBlockThreshold = 4096.
$+88    . 03000000 DD 00000003                               NumberOfHeaps = 3
$+8C    . 10000000 DD 00000010                               MaximumNumberOfHeaps = 16.
$+90    . E0FF977C DD OFFSET ntdll.7C97FFE0                  ProcessHeaps = 7C97FFE0
$+94    . 00000000 DD 00000000                               GdiSharedHandleTable = NULL
$+98    . 00000000 DD 00000000                               ProcessStarterHelper = NULL
$+9C    . 00000000 DD 00000000                               GdiDCAttributeList = 0
$+A0    . 74E1977C DD OFFSET ntdll.7C97E174                  LoaderLock = 7C97E174
$+A4    . 05000000 DD 00000005                               OSMajorVersion = 5
$+A8    . 01000000 DD 00000001                               OSMinorVersion = 1
$+AC    . 280A     DW 0A28                                   OSBuildNumber = 2600.
$+AE    . 0003     DW 300                                    OSCSDVersion = 768.
$+B0    . 02000000 DD 00000002                               OSPlatformId = 2
$+B4    . 02000000 DD 00000002                               ImageSubsystem = 2
$+B8    . 04000000 DD 00000004                               ImageSubsystemMajorVersion = 4
$+BC    . 00000000 DD 00000000                               ImageSubsystemMinorVersion = 0
$+C0    . 00000000 DD 00000000                               ImageProcessAffinityMask = 0
$+C4    . 00000000 DD 00000000                               GdiHandleBuffer[34.] = 0
$+C8    . 00000000 DD 00000000
```

Traversing module list

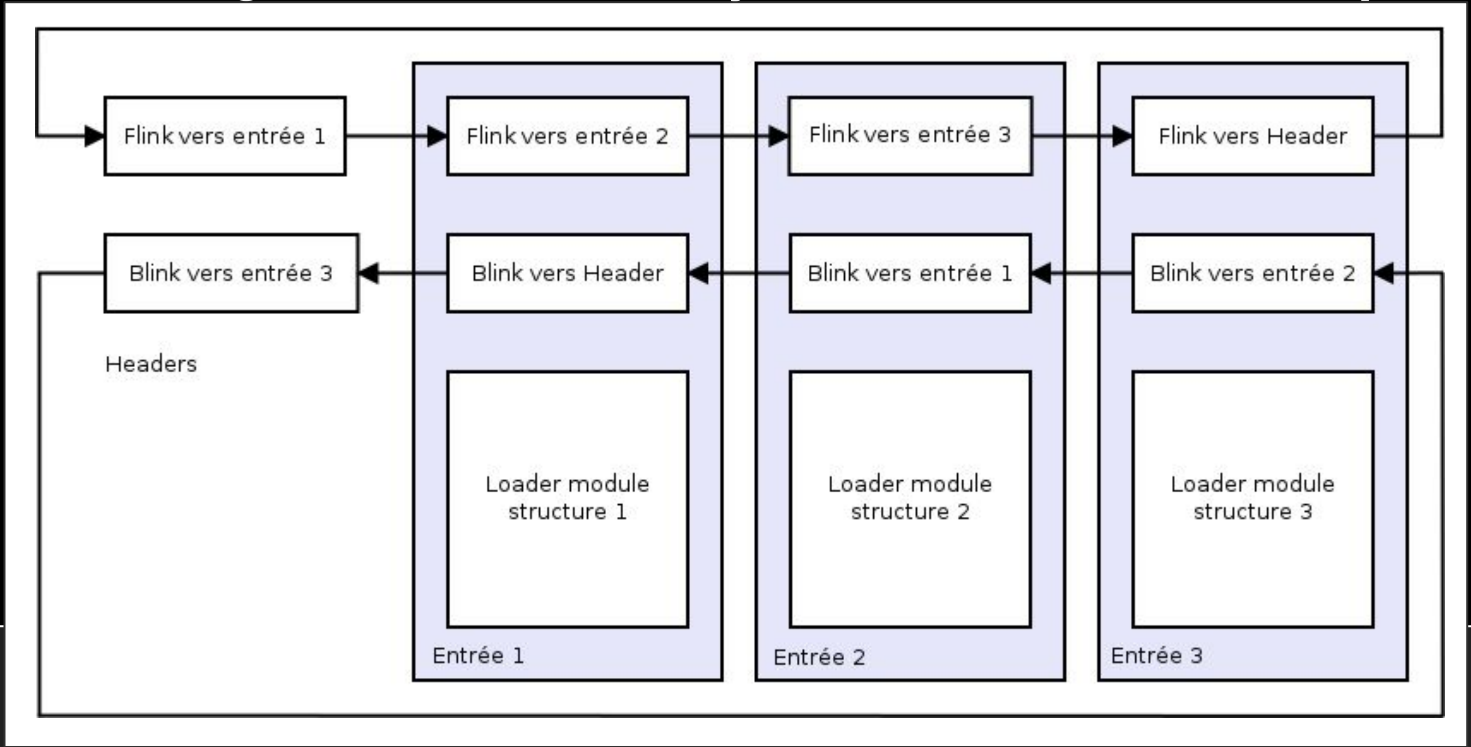
LoaderData gives DLL memory offset in the current process

3 Chained lists;

- **InLoadOrderModuleList**; DLL & PE at Start
- **InMemoryOrderModuleList**; DLL & PE, current state
- **InInitialisationOrderModuleList**; DLL loaded current state

Traversing module list

LoaderData gives DLL memory offset in the current process



Traversing module list

LoaderData gives DLL memory offset in the current process

```
push   30h
pop    ecx
mov    esi,fs:[ecx]    ; PEB (FS:[0x30])
mov    esi, [esi+0Ch]  ; ESI = LoaderData
mov    esi, [esi+1Ch]  ; ESI = Flink InInitialisationOrderModuleList
mov    ebp, [esi+8]    ; EBP = Base addresse de ntdll
mov    ds:ntdllbase, ebp
```

Traversing module list

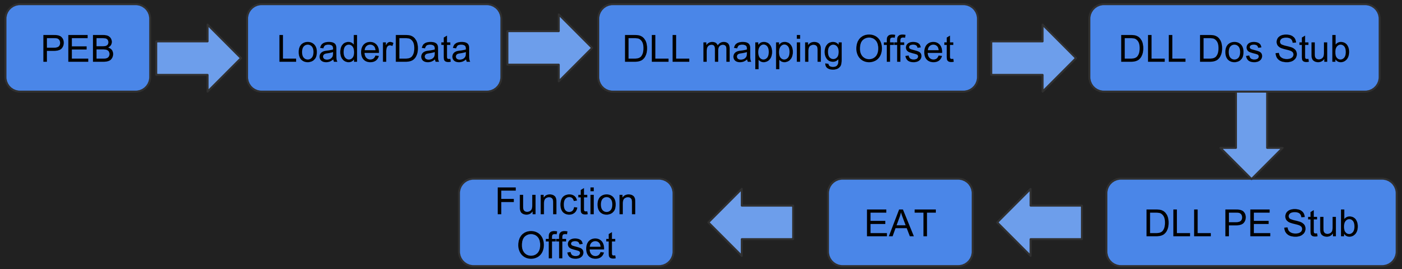
LoaderData gives DLL memory offset in the current process

- First one is always: **ntdll**
- Second one is always: **kernel32**

Traversing module list

LoaderData gives DLL memory offset in the current process

Parsing a PE (DLL) allows to find any function by hand.

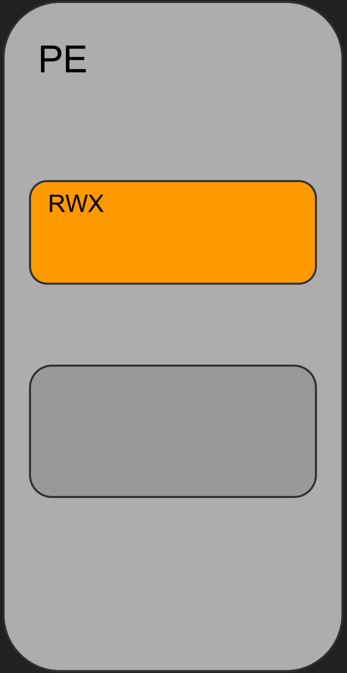


Packer families

How does it work

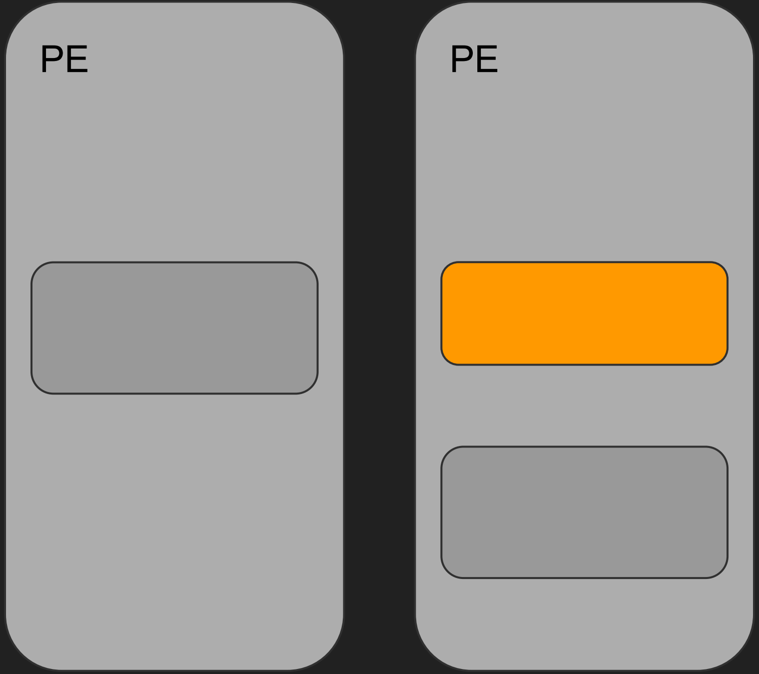
Mainly three kinds of techniques

- Unpack in the same process
  - Differents “flavors”
    - RWX native memory code segment in the PE:
      - Automodification of code,
      - Fix IAT,
      - Jump in it.
    - Allocate New RWX code segment:
      - Fill with code,
      - Fix IAT,
      - Jump in it.

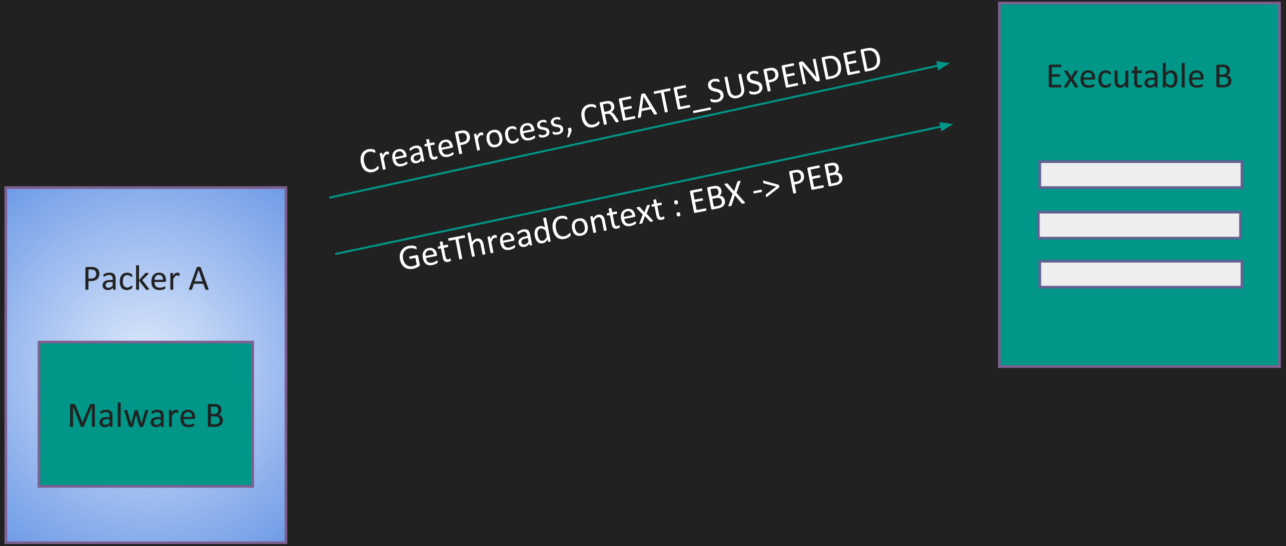


Mainly three kinds of techniques

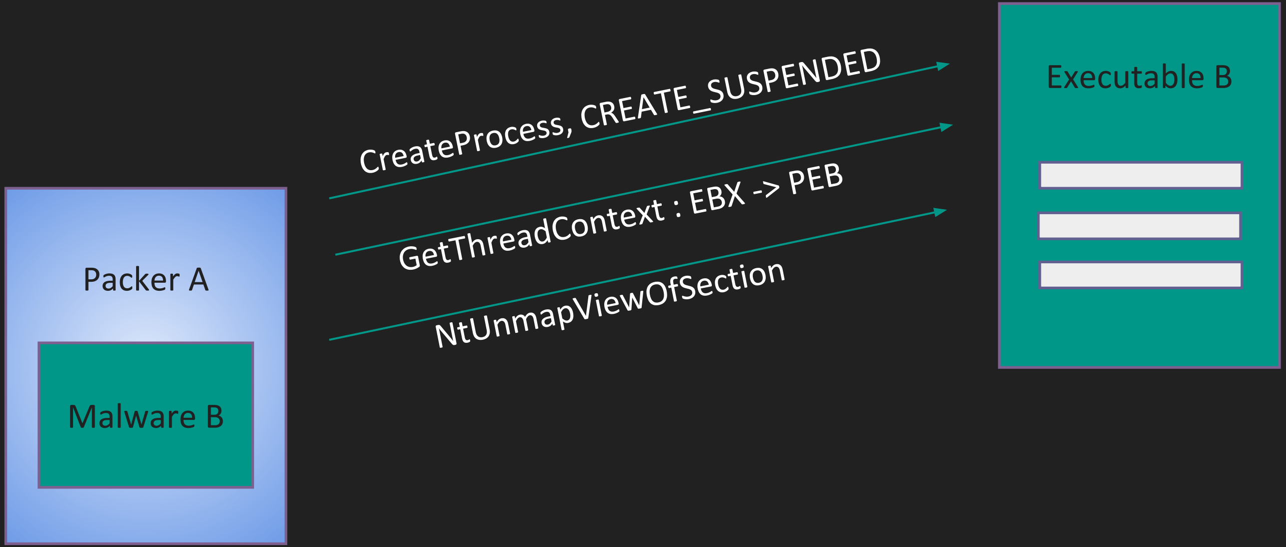
- Unpack in another process
  - Process hollowing aka RunPE
    - Create new “suspended” process
    - Unmap then replace all the segments
    - Set origin EIP
    - Release the Kraken !
    - exit



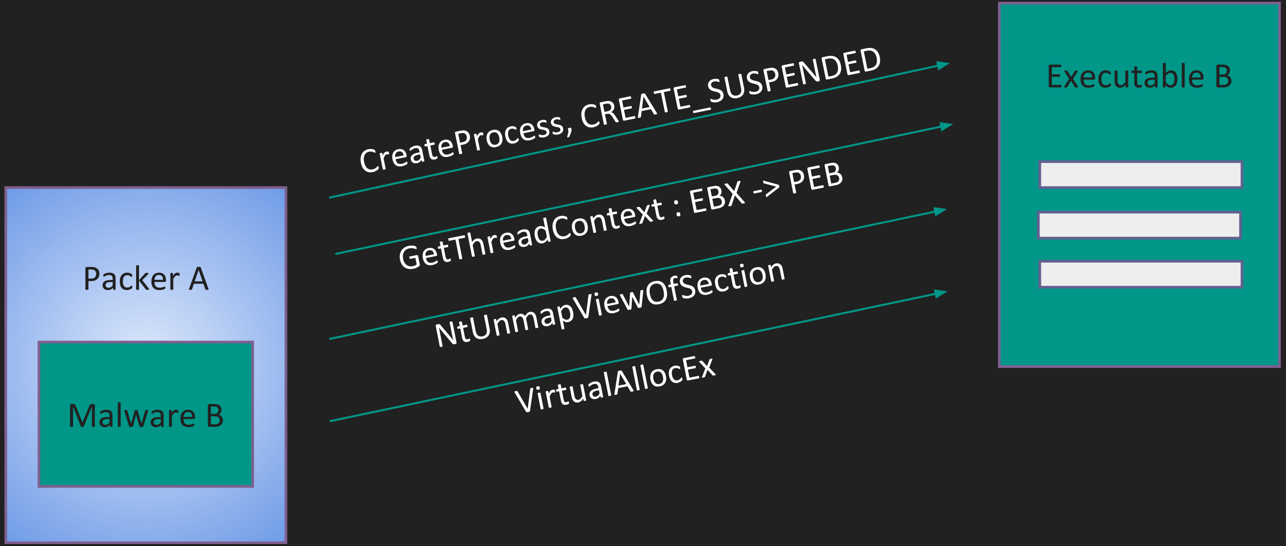
RunPE


Packer A
Malware B
CreateProcess, CREATE_SUSPENDED
GetThreadContext : EBX -> PEB
Executable B

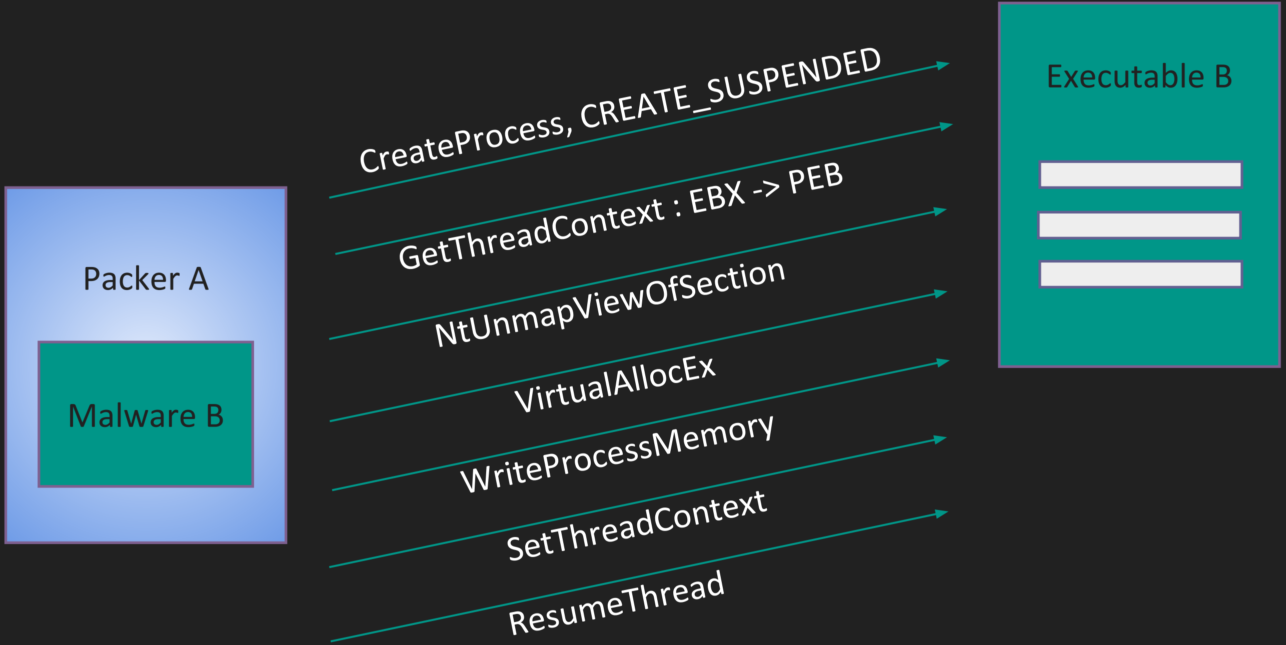
RunPE


Packer A
Malware B
CreateProcess, CREATE_SUSPENDED
GetThreadContext : EBX -> PEB
NtUnmapViewOfSection
Executable B

RunPE


Packer A
Malware B
CreateProcess, CREATE_SUSPENDED
GetThreadContext : EBX -> PEB
NtUnmapViewOfSection
VirtualAllocEx
Executable B

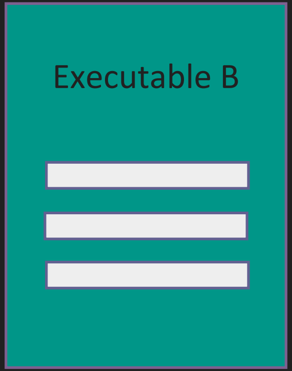
RunPE


Packer A
Malware B
CreateProcess, CREATE_SUSPENDED
GetThreadContext : EBX -> PEB
NtUnmapViewOfSection
VirtualAllocEx
WriteProcessMemory
SetThreadContext
ResumeThread
Executable B

RunPE

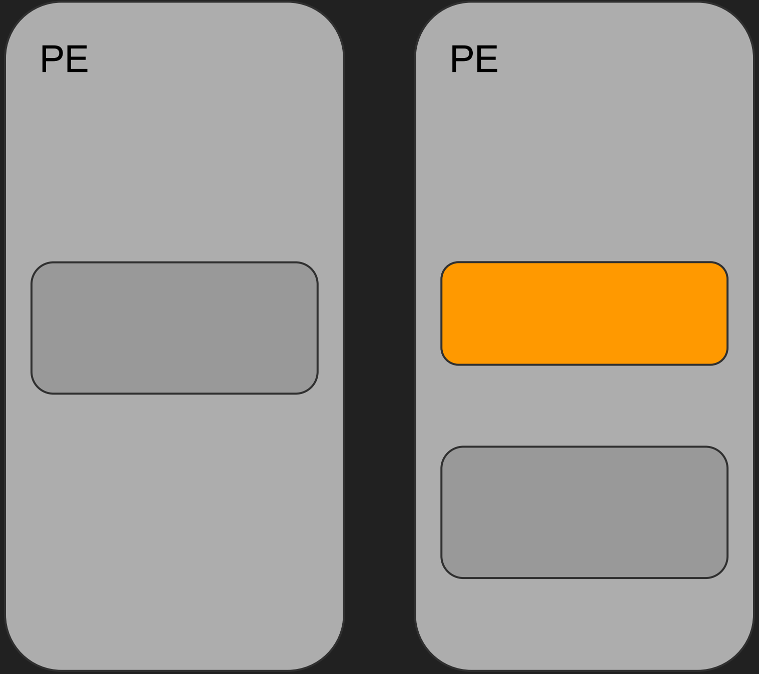
- Running executable is « Legit »
- No IAT fixing required

- Artefact
  - No parents



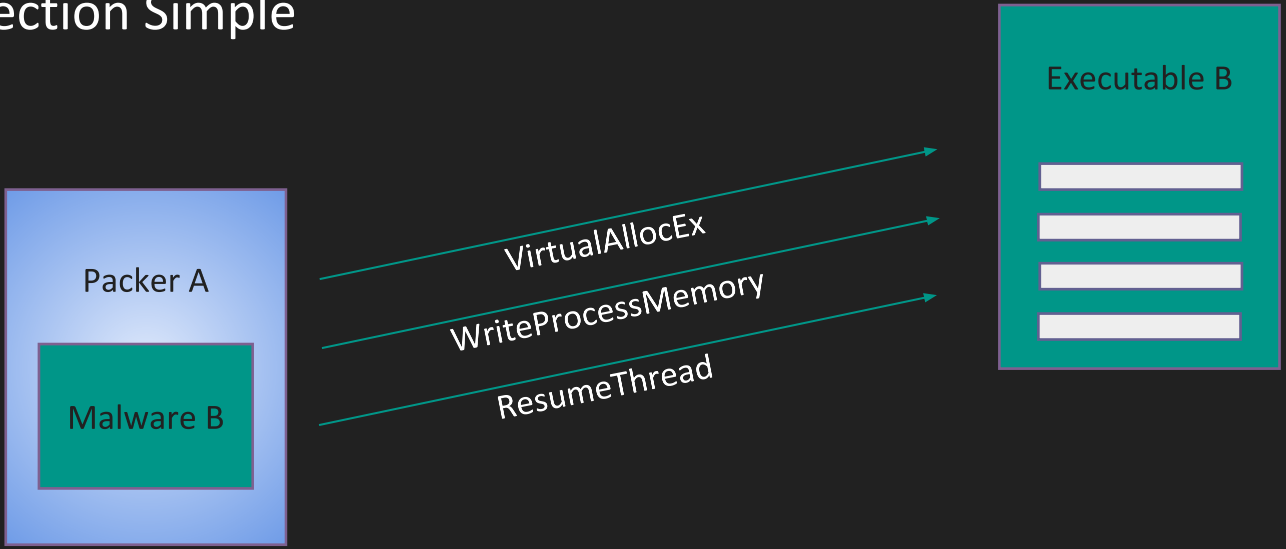
Mainly three kinds of techniques

- Unpack in another process
  - Create a new “thread” in another process
    - Create a section in a running process
    - Release the Kraken !
    - exit



Malware analysis

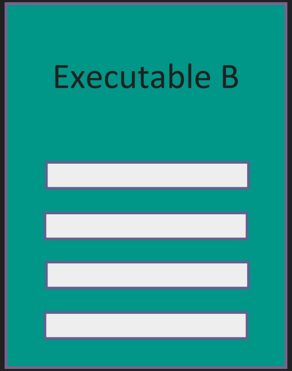
Injection Simple



Malware analysis

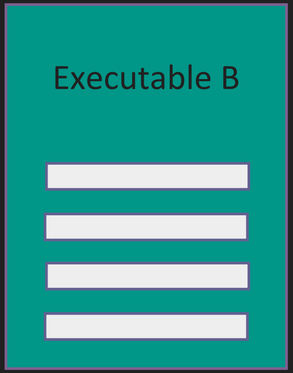
Injection simple

- Running executable is « Legit ».
- No IAT, direct function call required.
- Ends when Executable B is stopped.
  - Multiple injections usually



Malware analysis

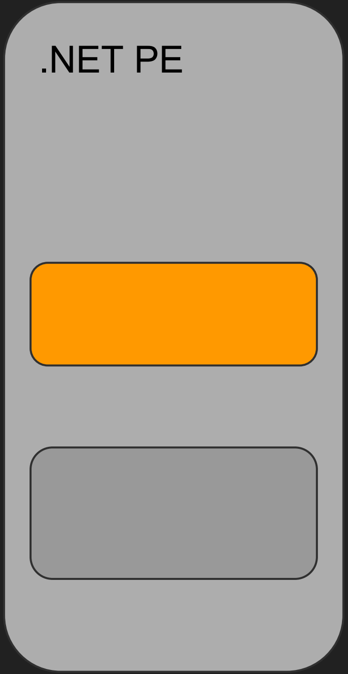
- They are other techniques
  - Using CreatefileMapping, etc…



But it’s enought for today !

On .NET, many kind of techniques

- Load another module:
    - Sort of loading a ".NET DLL"
- Launch "Msil" code:
    - Using "assembly.invoke" directive
- Launch "Native" code:
    - Using "_ _asm {}"
- .NET based process hollowing:
    - Simple RunPE, launch another process



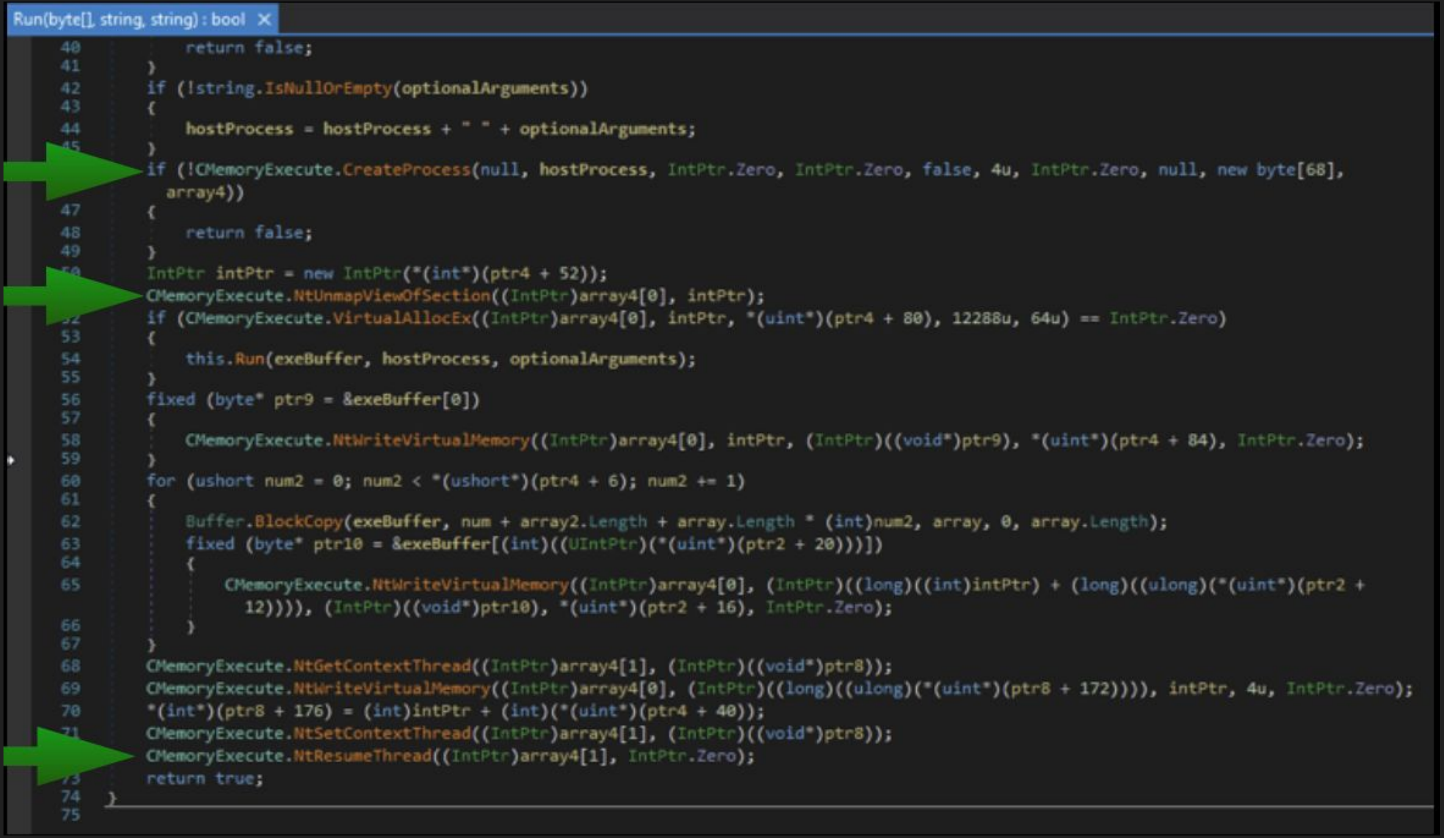
RunPE

Classical

RUNPE

In

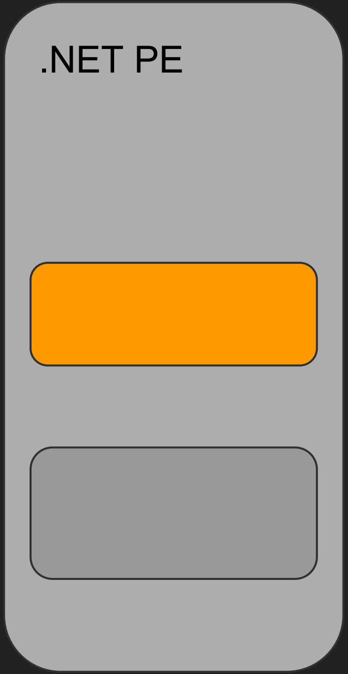
.NET code



```
        return false;
    }
    if (!string.IsNullOrEmpty(optionalArguments))
    {
        hostProcess = hostProcess + " " + optionalArguments;
    }
    if (!CMemoryExecute.CreateProcess(null, hostProcess, IntPtr.Zero, IntPtr.Zero, false, 4u, IntPtr.Zero, null, new byte[68],
      array4))
    {
        return false;
    }
    IntPtr intPtr = new IntPtr(*(int*)(ptr4 + 52));
    CMemoryExecute.NtUnmapViewOfSection((IntPtr)array4[0], intPtr);
    if (CMemoryExecute.VirtualAllocEx((IntPtr)array4[0], intPtr, *(uint*)(ptr4 + 80), 12288u, 64u) == IntPtr.Zero)
    {
        this.Run(exeBuffer, hostProcess, optionalArguments);
    }
    fixed (byte* ptr9 = &exeBuffer[0])
    {
        CMemoryExecute.NtWriteVirtualMemory((IntPtr)array4[0], intPtr, (IntPtr)((void*)ptr9), *(uint*)(ptr4 + 84), IntPtr.Zero);
    }
    for (ushort num2 = 0; num2 < *(ushort*)(ptr4 + 6); num2 += 1)
    {
        Buffer.BlockCopy(exeBuffer, num + array2.Length + array.Length * (int)num2, array, 0, array.Length);
        fixed (byte* ptr10 = &exeBuffer[(int)((UIntPtr)(*(uint*)(ptr2 + 20)))])
        {
            CMemoryExecute.NtWriteVirtualMemory((IntPtr)array4[0], (IntPtr)((long)((int)intPtr) + (long)((ulong)(*(uint*)(ptr2 +
              12)))), (IntPtr)((void*)ptr10), *(uint*)(ptr2 + 16), IntPtr.Zero);
        }
    }
    CMemoryExecute.NtGetContextThread((IntPtr)array4[1], (IntPtr)((void*)ptr8));
    CMemoryExecute.NtWriteVirtualMemory((IntPtr)array4[0], (IntPtr)((long)((ulong)(*(uint*)(ptr8 + 172)))), intPtr, 4u, IntPtr.Zero);
    *(int*)(ptr8 + 176) = (int)intPtr + (int)(*(uint*)(ptr4 + 40));
    CMemoryExecute.NtSetContextThread((IntPtr)array4[1], (IntPtr)((void*)ptr8));
    CMemoryExecute.NtResumeThread((IntPtr)array4[1], IntPtr.Zero);
    return true;
}
```

Where are the packed data ?

- Wherever it’s possible !
  - In a Data segment
  - In a code segment
  - In a ressource
- How ?
  - Xor, Aes, Base64, Bzip…
  - Or whatever it is possible to do
    - Who cares ?



Packer detection

How to know if it’s packed

Identifying that your sample is packed

A bunch of clues:

- **High section entropy (Above 6.5).. Maybe usual on ressources.**
- **Unusual small code segments.**
- **No clear strings in the whole PE.**
- **Few Import (not relevant in .net)**
- **Unusual segment names.**
  - **Home made scripts**
    - **https://github.com/Th4nat0s/Chall_Tools**

Identify that your sample is packed

- **A bunch of clues**
  - **None or very few winnt API calls present in the IAT**

```
$rabin2 -i mymalware.exe
[Imports]
ordinal=001 plt=0x00000000 bind=NONE type=FUNC name=kernel32.dll_GetModuleHandleA
ordinal=002 plt=0x00000000 bind=NONE type=FUNC name=kernel32.dll_GetProcAddress
ordinal=003 plt=0x00000000 bind=NONE type=FUNC name=kernel32.dll_ExitProcess
ordinal=004 plt=0x00000000 bind=NONE type=FUNC name=kernel32.dll_LoadLibraryA
ordinal=001 plt=0x00000000 bind=NONE type=FUNC name=user32.dll_MessageBoxA
ordinal=001 plt=0x00000000 bind=NONE type=FUNC name=advapi32.dll_RegCloseKey
ordinal=001 plt=0x00000000 bind=NONE type=FUNC name=oleaut32.dll_SysFreeString
ordinal=001 plt=0x00000000 bind=NONE type=FUNC name=gdi32.dll_CreateFontA
ordinal=001 plt=0x00000000 bind=NONE type=FUNC name=shell32.dll_ShellExecuteA
ordinal=001 plt=0x00000000 bind=NONE type=FUNC name=version.dll_GetFileVersionInfoA
ordinal=001 plt=0x00000000 bind=NONE type=FUNC name=mscoree.dll__CorExeMain

11 Imports
```

Identify that your sample is packed

A bunch of clues

- **High section entropy**
- **Unusual small code segments**
- **Unusual segment names**
  - **Home made scripts**
    - **https://github.com/Th4nat0s/Chall_Tools**

```
$peentro.py badfile.exe
Section         Entropy         Size    MD5                                     Remark
.text           4.40891301623   4096    3c25c7a8d445ed1528ba543d6ef35b81
.rdata          2.51973214733   4096    774e8378a9026e53a894eb2043a9cc69
.data           0.599092931135  4096    5c22f870e9c25a2e9331ea30ea55b0ee
.CODE           7.85331928916   86016   dfcbb76bec31c0be1091107edb6ce5d8        Unusal Segment,High Entropy
.rsrc           1.12323628339   4096    adfd501e3b4857ad481c68a07e2425f8
.reloc          0.8026442707    4096    5e07aef133521c73130ec441ed9fa82a
```

Identify the packer

Known tools/packers are easy to identify

- **Unix command *file* works «only» for Upx**
- **Some packers (Upx, Vmprotect) cannot pack .NET PE**
- **Yara rules or the old PEid**
    - **https://github.com/Yara-Rules/rules/blob/master/Packers/packer.yar**
    - **https://www.aldeid.com/wiki/PEiD**
- **RDG packer detector**
    - **http://www.rdgsoft.net (Mute the browser !!!)**
- **DIE (DetectItEasy)**
    - **https://github.com/horsicq/Detect-It-Easy | http://ntinfo.biz/**
- **Exeinfo**
    - **http://exeinfo.atwebpages.com/**

Identifier Tools Usage

- **DIE**

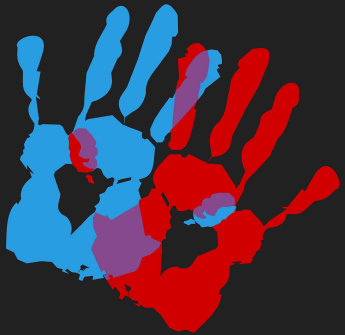
```
$./diec  /home/thanat0s/sample0.exe
PE+(64): compiler: Microsoft Visual C/C++(2008)[-]
PE+(64): linker: Microsoft Linker(9.0)[EXE64,console]

$./diec  /home/thanat0s/sample1.exe
PE: protector: ENIGMA(3.70 build 2015.6.14 20:50:1)[-]
PE: compiler: MinGW(-)[-]
PE: linker: GNU Linker(2.25)[EXE32,admin]

$./diec  /home/thanat0s/sample2.exe
PE: packer: UPX(0.39)[NRV,best]
PE: linker: Polink(2.50*)[EXE32]

$./diec  /home/thanat0s/sample3.exe
PE: protector: Confuser(1.X)[-]
PE: library: .NET(v2.0.50727)[-]
PE: linker: Microsoft Linker(8.0)[EXE32]
```

Identifier Tools Usage

- **File**
  - **file badfile.exe**
- **Yara**
  - **yara (peid|packer).yar badfile.exe**
- **Some homemade (& dirty) tools**
  - **peentro.py badfile.exe**

```
$peentro.py badfile.exe
Section          Entropy          Size    MD5                                 Remark
.text            4.40891301623    4096    3c25c7a8d445ed1528ba543d6ef35b81
.rdata           2.51973214733    4096    774e8378a9026e53a894eb2043a9cc69
.data            0.599092931135   4096    5c22f870e9c25a2e9331ea30ea55b0ee
.CODE            7.85331928916    86016   dfcbb76bec31c0be1091107edb6ce5d8    Unusal Segment,High Entropy
.rsrc            1.12323628339    4096    adfd501e3b4857ad481c68a07e2425f8
.reloc           0.8026442707     4096    5e07aef133521c73130ec441ed9fa82a
```

SNAPSHOT YOUR VM !!



Packed or not packed ?

Packing triage……. http://upload.trollprod.org/samples.7z

	Packed ?	Why ?
Sample A		
Sample B		
Sample C		
Sample D		
Sample E		
Sample F		
Sample G		
Sample H		
Sample I		
Sample J		

	Packed ?	Why ?
Sample K		
Sample L		
Sample M		
Sample N		
Sample O		
Sample P		
Sample Z		

Password is : infected

Packing triage…….

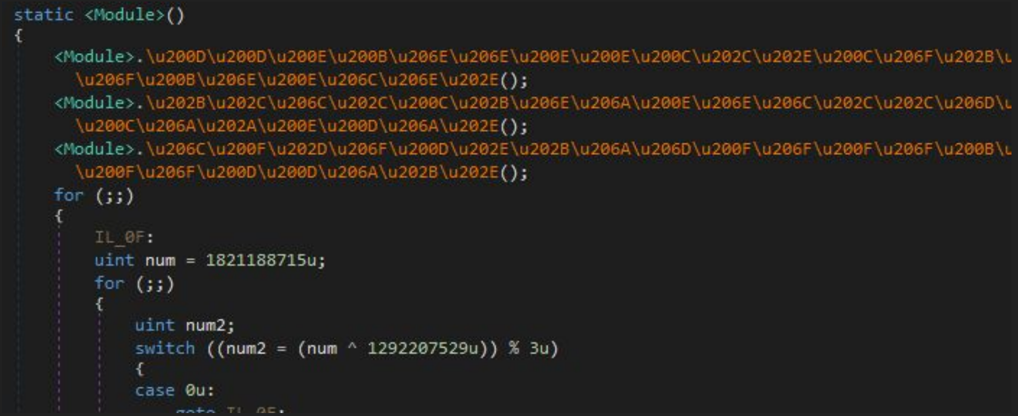
	Packed ? Why ?
Sample A	No but a lot of small B64 strings.
Sample B	Yes, Diec -> Upx
Sample C	Yes, Diec -> Confuser
Sample D	Yes No strings.. Ugly in DnSpy.
Sample E	Yes, Entropy, dual code segs.
Sample F	Yes, Entropy
Sample G	Yes, Entropy, weirds segs.
Sample H	No strings...but imports...
Sample I	Yes, Entropy in data
Sample J	Yes, Huge B64 Strings , Ugly in DnSpy

	Packed ? Why ?
Sample K	Yes, Entropy, weirds segs.
Sample L	...don’t know... weird seg.
Sample M	Yes, Entropy
Sample N	Yes, ~Entropy, weirds segs.
Sample O	Yes, Entropy ++
Sample P	it’ Notepad :)
Sample Z	Yes, Diec -> Enigma

.NET Packer UnPacking

Unpacking .NET samples

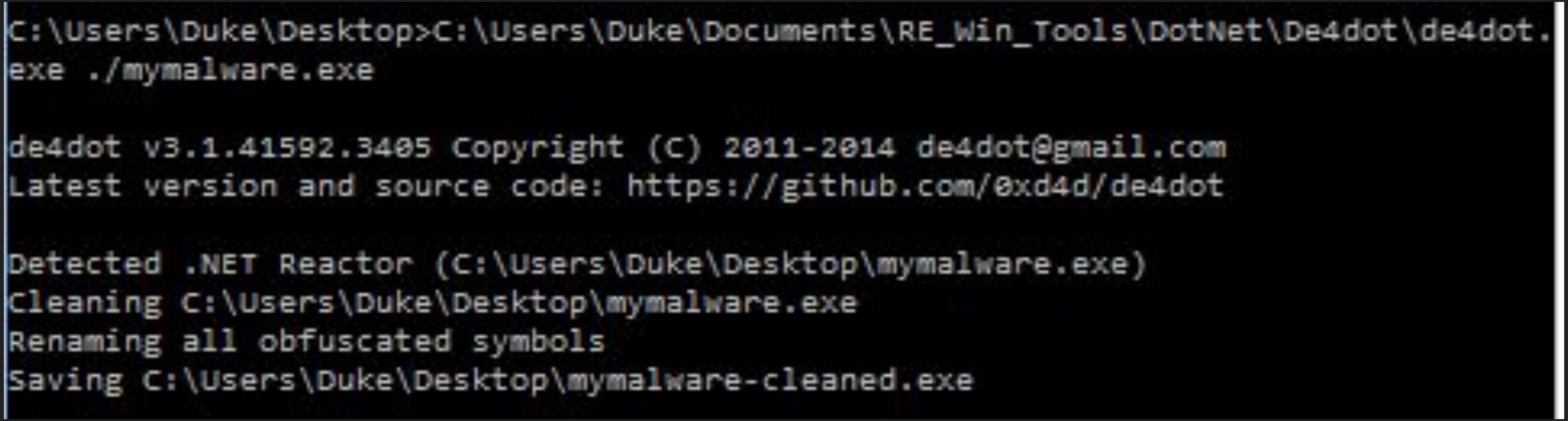
- **NEVER open a .NET sample in x86dbg...** (it hurts, badly...)
- **Detect .NET type with «file» or «die»**
- **.NET methods and variables are more than often obfuscated**



```
static <Module>()
{
    <Module>.\u200D\u200D\u200E\u200B\u206E\u206E\u200E\u200E\u200C\u202C\u202E\u200C\u206F\u202B\u
      \u206F\u200B\u206E\u200E\u206C\u206E\u202E();
    <Module>.\u202B\u202C\u206C\u202C\u200C\u202B\u206E\u206A\u200E\u206E\u206C\u202C\u202C\u206D\u
      \u200C\u206A\u202A\u200E\u200D\u206A\u202E();
    <Module>.\u206C\u200F\u202D\u206F\u200D\u202E\u202B\u206A\u206D\u200F\u206F\u200F\u206F\u200B\u
      \u200F\u206F\u200D\u200D\u206A\u202B\u202E();
    for (;;)
    {
        IL_0F:
        uint num = 1821188715u;
        for (;;)
        {
            uint num2;
            switch ((num2 = (num ^ 1292207529u)) % 3u)
            {
            case 0u:
```

Unpacking .NET samples

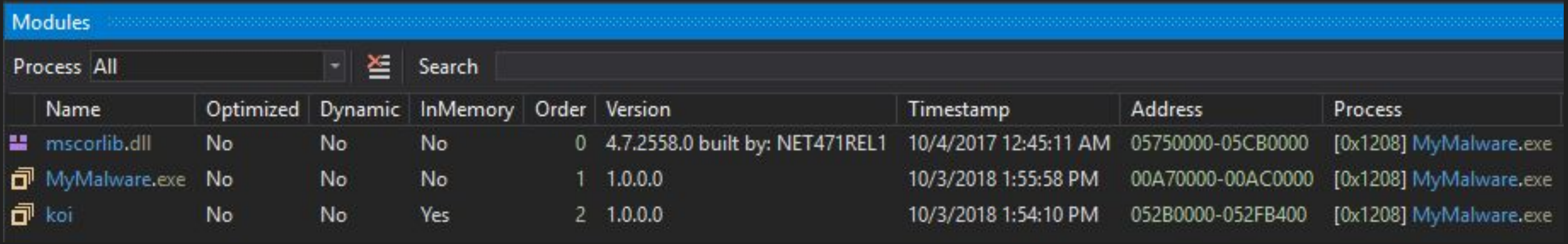
Unobfuscation with DE4DOT
https://github.com/0xd4d/de4dot



```
C:\Users\Duke\Desktop>C:\Users\Duke\Documents\RE_Win_Tools\DotNet\De4dot\de4dot.
exe ./mymalware.exe

de4dot v3.1.41592.3405 Copyright (C) 2011-2014 de4dot@gmail.com
Latest version and source code: https://github.com/0xd4d/de4dot

Detected .NET Reactor (C:\Users\Duke\Desktop\mymalware.exe)
Cleaning C:\Users\Duke\Desktop\mymalware.exe
Renaming all obfuscated symbols
Saving C:\Users\Duke\Desktop\mymalware-cleaned.exe
```

Unpacking .NET samples

Look for “New modules”



Modules

Process All

Search

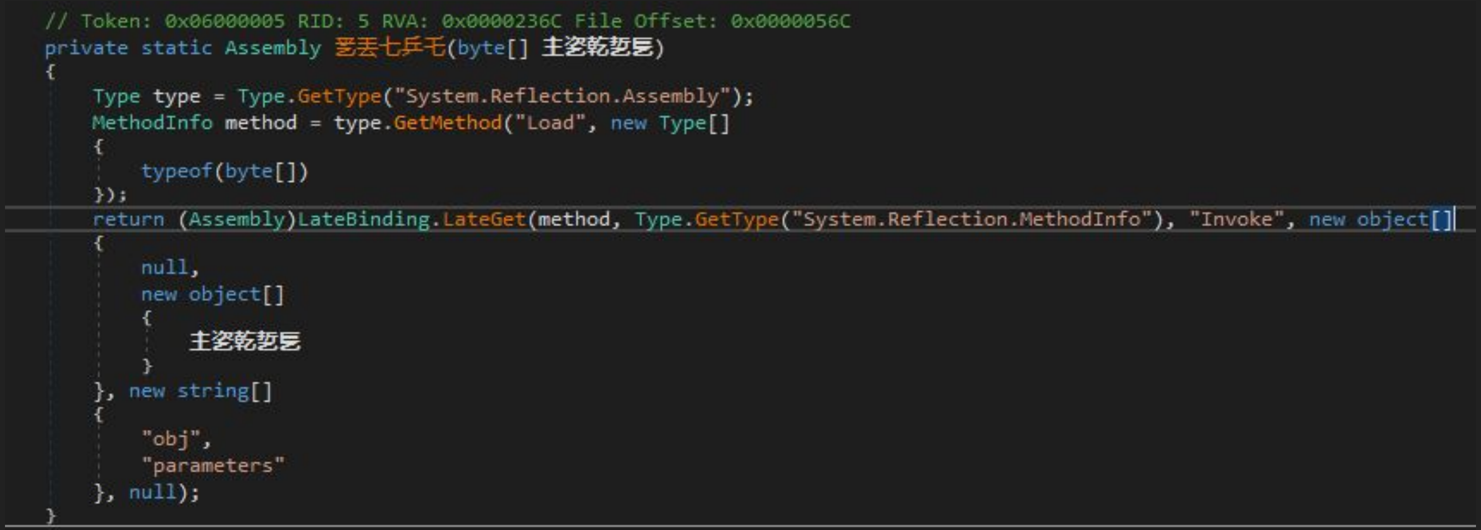
Name	Optimized	Dynamic	InMemory	Order	Version	Timestamp	Address	Process
mscorlib.dll	No	No	No	0	4.7.2558.0 built by: NET471REL1	10/4/2017 12:45:11 AM	05750000-05CB0000	[0x1208] MyMalware.exe
MyMalware.exe	No	No	No	1	1.0.0.0	10/3/2018 1:55:58 PM	00A70000-00AC0000	[0x1208] MyMalware.exe
koi	No	No	Yes	2	1.0.0.0	10/3/2018 1:54:10 PM	052B0000-052FB400	[0x1208] MyMalware.exe

Break and save...

Unpacking .NET samples

Also look for “assembly” or module loading in DnSpy

For us search is “sick”. Use export project / find instead.



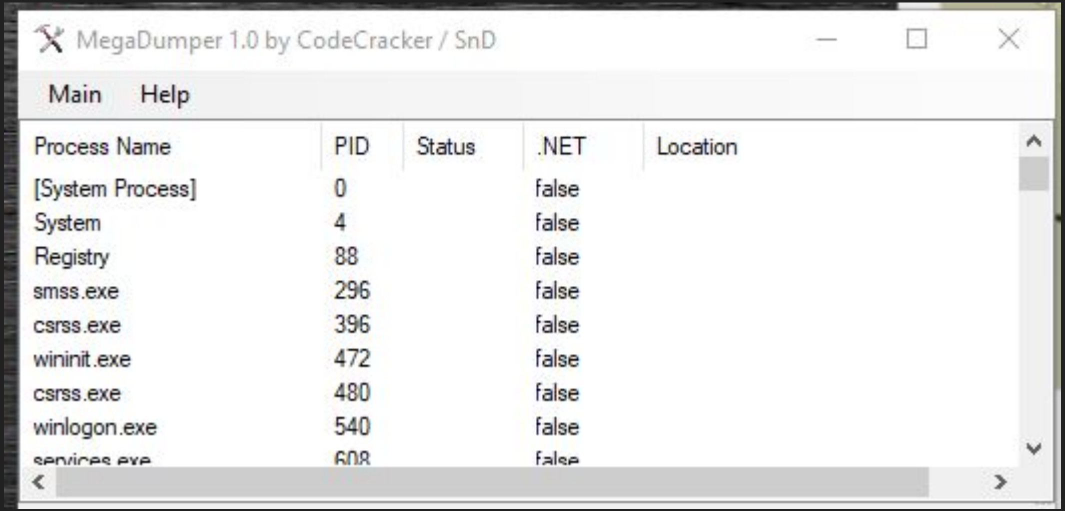
```
// Token: 0x06000005 RID: 5 RVA: 0x0000236C File Offset: 0x0000056C
private static Assembly 罢丢七乒毛(byte[] 主姿乾蜇乭)
{
    Type type = Type.GetType("System.Reflection.Assembly");
    MethodInfo method = type.GetMethod("Load", new Type[]
    {
        typeof(byte[])
    });
    return (Assembly)LateBinding.LateGet(method, Type.GetType("System.Reflection.MethodInfo"), "Invoke", new object[]
    {
        null,
        new object[]
        {
            主姿乾蜇乭
        }
    }, new string[]
    {
        "obj",
        "parameters"
    }, null);
}
```

save...

Unpacking .NET samples

MegaDumper is a nice tool to dump .NETPE

https://github.com/CodeCracker-Tools/MegaDumper



Process Name	PID	Status	.NET	Location
[System Process]	0		false	
System	4		false	
Registry	88		false	
smss.exe	296		false	
csrss.exe	396		false	
wininit.exe	472		false	
csrss.exe	480		false	
winlogon.exe	540		false	
services.exe	608		false	

Run and dump...

When possible,

Fetch sources, not compiled code

Some languages are reversible…

Again, don’t try it in IDA, it hurts… With a good tool, you will retrieve sources

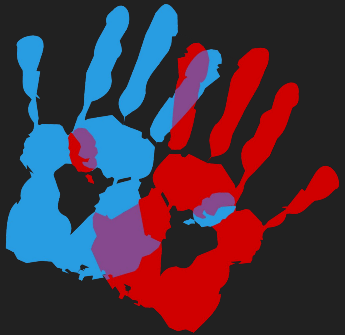
- **Python**
  - **Unpy2exe then uncompyle2 (or Py2ExeBinary Editor)**
- **AutoIT**
  - **exe2aut.exe**
- **AutoHotKey (AHK)**
  - **exe2ahk.exe**

Let’s unpack a .NET !

Sample_o.exe

http://upload.trollprod.org/MegaDumper.exe

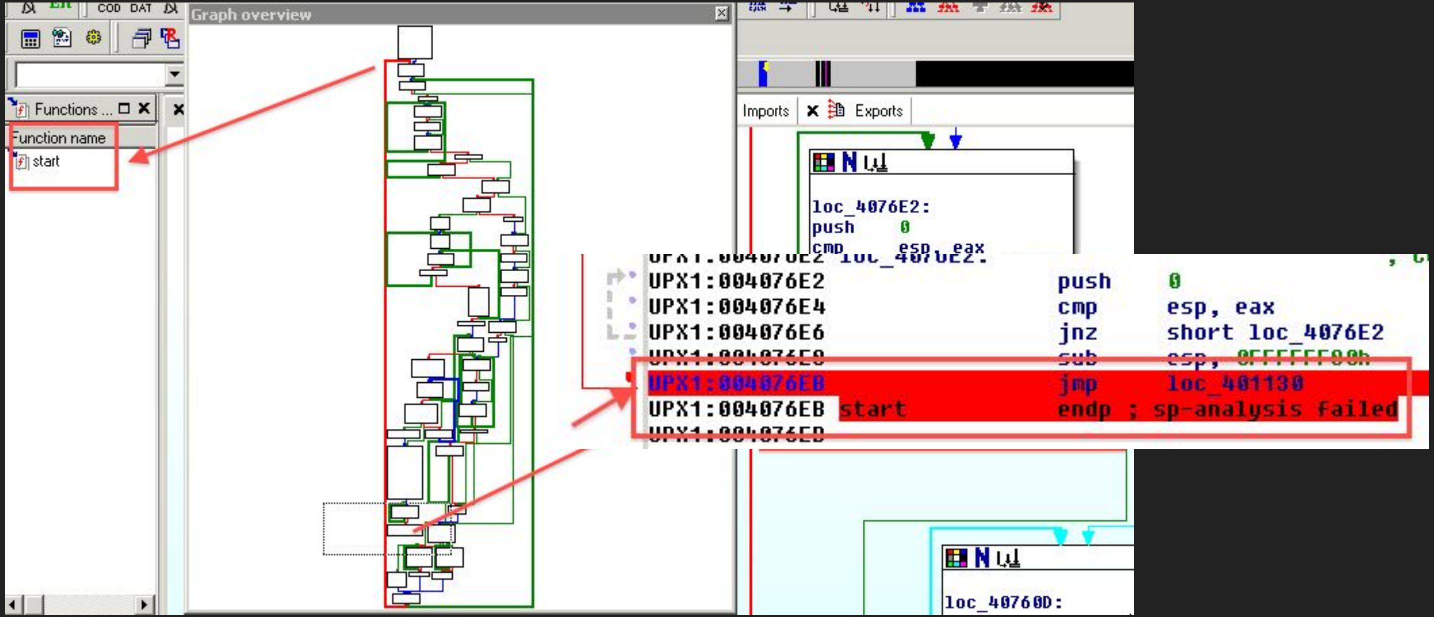
….. Unpack time



PE Packer UnPacking

“Find the jump” and dump :)

- **Find the jump after unpacking and dump**
- **Prefers hardware breakpoint since the code may move.**



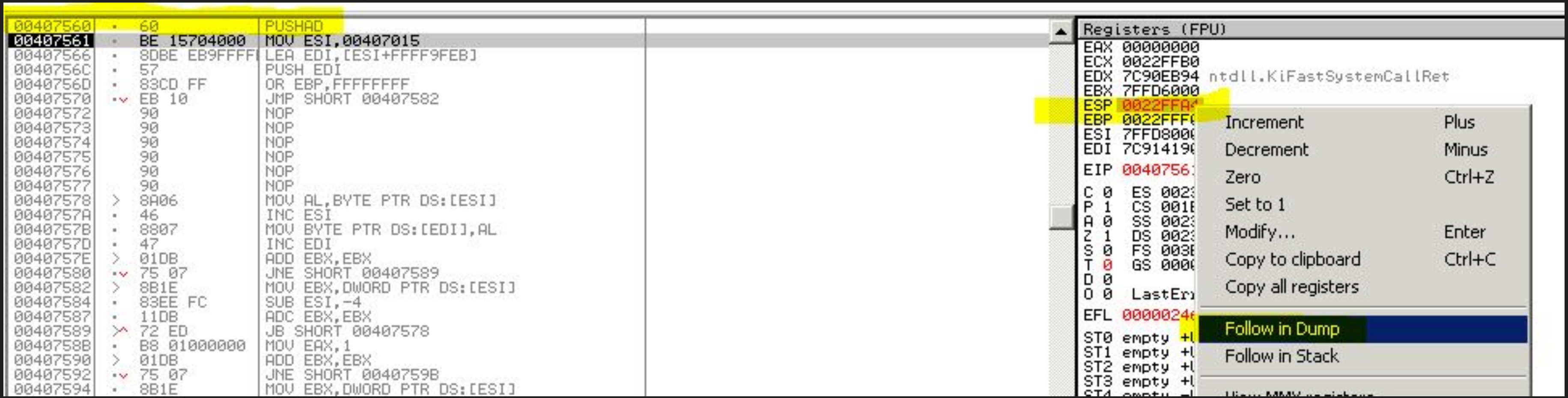
```
loc_4076E2:
push    0
cmp     esp, eax
```

```
UPX1:004076E2                          push    0
UPX1:004076E4                          cmp     esp, eax
UPX1:004076E6                          jnz     short loc_4076E2
UPX1:004076E8                          sub     esp, 0FFFFFF80h
UPX1:004076EB                          jmp     loc_401130
UPX1:004076EB start                    endp ; sp-analysis failed
```

```
loc_40760D:
```

“Find the stack gap” and dump :)

- **Ideal scenario**
  - **Find the pushad/popad after unpacking and dump**
  - **Prefers hardware breakpoint**
  - **Only 32 bits code**



```
00407560  .   60             PUSHAD
00407561  .   BE 15704000    MOV ESI,00407015
00407566  .   8DBE EB9FFFF   LEA EDI,[ESI+FFFF9FEB]
0040756C  .   57             PUSH EDI
0040756D  .   83CD FF        OR EBP,FFFFFFFF
00407570  .v  EB 10          JMP SHORT 00407582
00407572      90             NOP
00407573      90             NOP
00407574      90             NOP
00407575      90             NOP
00407576      90             NOP
00407577      90             NOP
00407578  >   8A06           MOV AL,BYTE PTR DS:[ESI]
0040757A  .   46             INC ESI
0040757B  .   8807           MOV BYTE PTR DS:[EDI],AL
0040757D  .   47             INC EDI
0040757E  >   01DB           ADD EBX,EBX
00407580  .v  75 07          JNE SHORT 00407589
00407582  >   8B1E           MOV EBX,DWORD PTR DS:[ESI]
00407584  .   83EE FC        SUB ESI,-4
00407587  .   11DB           ADC EBX,EBX
00407589  >^  72 ED          JB SHORT 00407578
0040758B  .   B8 01000000    MOV EAX,1
00407590  >   01DB           ADD EBX,EBX
00407592  .v  75 07          JNE SHORT 0040759B
00407594  .   8B1E           MOV EBX,DWORD PTR DS:[ESI]
```

```
Registers (FPU)
EAX 00000000
ECX 0022FFB0
EDX 7C90EB94 ntdll.KiFastSystemCallRet
EBX 7FFD6000
ESP 0022FFA
EBP 0022FFF
ESI 7FFD800
EDI 7C91419
EIP 0040756
C 0  ES 002
P 1  CS 001
A 0  SS 002
Z 1  DS 002
S 0  FS 003
T 0  GS 000
D 0
O 0  LastEr
EFL 0000024
ST0 empty +
ST1 empty +
ST2 empty +
ST3 empty +
```

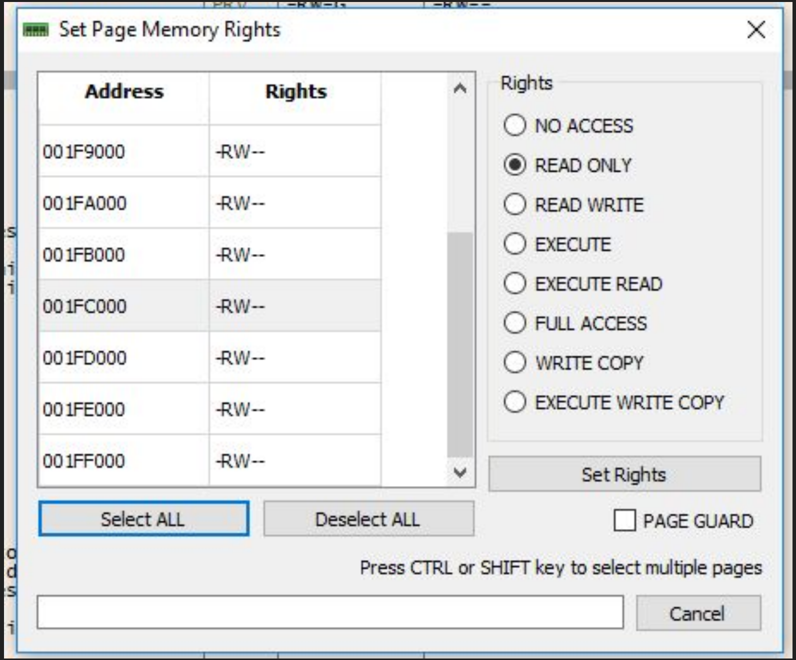
Endless loop trick

- Find the SetThreadContext call, and note the address of the CONTEXT structure.
- Find the child process EntryPoint at CONTEXT + 0xB0, open the suspended process with HxD or ProcessHacker.
- Change the opcode by ED FE (jmp eip) and launch the debugged process.
- Now you can attach to the child process, replace the jmp by the original opcode.

- The pain point is, your VM could run slowly (it’s an endless loop) use multiple CPUs.

“Find the new RWX segment” and dump :)

- **Break on new RWX segment creation**
  - **Convert it to RW and wait the exception.**



Set Page Memory Rights

Address	Rights
001F9000	-RW--
001FA000	-RW--
001FB000	-RW--
001FC000	-RW--
001FD000	-RW--
001FE000	-RW--
001FF000	-RW--

Rights
- NO ACCESS
- [✓ READ ONLY]
- READ WRITE
- EXECUTE
- EXECUTE READ
- FULL ACCESS
- WRITE COPY
- EXECUTE WRITE COPY

Press CTRL or SHIFT key to select multiple pages

But dumping is not that simple…

Rebuilding

- **IAT**
- **IEP**

Simply “Break” and dump :)

- **Find the unciphered protected PE in a memory segment**
  - **Break on**
    - **WriteProcessMemory**
    - **VirtualAlloc**
    - **VirtualAllocEx**
    - **MapViewOfFile**
    - **UnmapViewOfFile**
    - **….. A lot of them**

Simply “Break” and dump :)

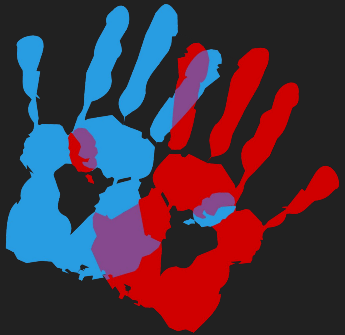
- **Be careful, sometimes the packer use the undocumented API**
    - **Kernel32.WriteProcessMemory**
        - **call ntdll.NtWriteVirtualMemory**
- **Why not calling directly NtWriteVirtualMemory ?**
- **Why not calling the alias ZwWriteVirtualMemory ?**

https://undocumented.ntinternals.net/

Let’s unpack a RunPE !

Sample_n.exe

….. Unpack time



BreakPoint on kernel32!WriteProcessMemory

Going further....

VM Based and Pro packers

Not so easy to extract…

VMProtect http://vmpsoft.com/

TheMida : https://www.oreans.com/themida.php

Real life is sometimes more complicated…

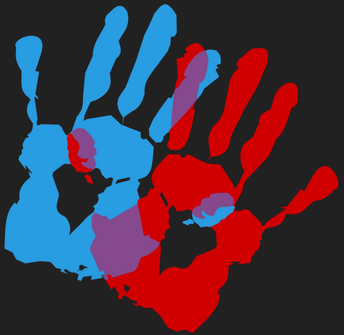
A lot of anti-debugging hidden in the code :)

Look at stack trace, find and bypass them...

Sometimes you may be successful…

Have Fun with samples…

Could you do the unpack challenge ?



WorkShop yourself !!

Easy :

Sample_N
Sample_E
Sample_F
Sample_L
Sample_J

Medium:

Sample_B
Sample_D
Sample_M
Sample_K

Hard:

Sample_G
Sample_L
Sample_Z … for fun...

Droppers if you have time (easy):

SSample_A.doc
SSample_B.doc
SSample_C.vbs
SSample_D.docx
SSample_E.vbe
SSample_F.js
SSample_G.pdf

Unpack Challenge for a free Beer ! :

The first one that finish

It starts with : https://futex.re/ctf/click.js

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