



EXP-401: Advanced Windows Exploitation (OSEE)

Course Overview

The OSEE is the most difficult exploit development certification you can earn. We recommend completing the 300- level certifications before registering for this course.

Students who complete EXP-401 and pass the exam will earn the Offensive Security Exploitation Expert (OSEE) certification. The OSEE exam assesses not only the course content, but also the ability to think laterally and adapt to new challenges.

The virtual lab environment has a limited number of target systems. The software within contains specific, unknown vulnerabilities. Students have 72 hours to develop and document exploits. The exam requires a stable, high-speed internet connection.

You must submit a comprehensive penetration test report as part of the exam. It should contain in-depth notes and screenshots detailing the steps taken and the exploit methods used.

Target Audience

- Cyber Network Professional
- Sr. Pentester / Red Team Operator
- Information Security Penetration Tester
- Threat Hunter Cybersecurity
- Cybersecurity Exploit Developer

Course Objectives

- Bypass and evasion of user mode security mitigations such as DEP, ASLR, CFG, ACG and CET
- Advanced heap manipulations to obtain code execution along with guest-to-host and sandbox escapes
- Disarming WDEG mitigations and creating version independence for weaponization
- 64-Bit Windows Kernel Driver reverse engineering and vulnerability discovery
- Bypass of kernel mode security mitigations such as KASLR, NX, SMEP, SMAP, KCFG and HVCI

Prerequisites

Learners should be experienced in developing windows exploits and understand how to operate a debugger. Familiarity with WinDBG, x86_64 assembly, IDA Pro and basic C/C++ programming is highly recommended. A willingness to work and put in real effort will greatly help students succeed in this security training course.

Duration

5 Days

Certifications

OSEE

Contact Us

800.674.3550

2151 W. Hillsboro Blvd.,
Suite 210
Deerfield Beach, FL 33442

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Course Outline

- 1 Introduction
- 2 Custom Shellcode Creation
 - 2.1 64-bit Architecture
 - 2.1.1 64-bit Memory Enhancements
 - 2.1.2 Calling Conventions
 - 2.1.3 Win32 APIs
 - 2.2 Writing Exploit Code
 - 2.2.1 Position-Independent-Code
 - 2.2.2 Visual Studio
 - 2.3 Shellcode Framework Creation
 - 2.3.1 Finding KERNEL32.DLL Base Address: PEB Method
 - 2.3.2 Resolving Symbols: Export Directory Table Method
 - 2.3.3 Fetching Function's VMA
 - 2.4 Reverse Shell
 - 2.4.1 Create a Connection
 - 2.4.2 Launch the Shell
 - 2.5 Wrapping Up
- 3 VMware Workstation Guest-To-Host Escape
 - 3.1 Vulnerability Classes
 - 3.2 Data Execution Prevention (DEP)
 - 3.2.1 DEP Theory
 - 3.2.2 Ret2Lib Attacks and Their Evolution
 - 3.2.3 Return Oriented Programming
 - 3.2.4 Locating Gadgets: rp++
 - 3.3 Address Space Layout Randomization
 - 3.4 VMware Workstation Internals
 - 3.4.1 VMware Backdoor RPC Guest-to-Host Communication
 - 3.4.2 Backdoor_InOut
 - 3.4.3 Opening a RPC Communication Channel
 - 3.4.4 Sending the Command Data
 - 3.4.5 Receiving the Reply
 - 3.4.6 Closing the RPC Communication Channel
 - 3.5 UaF Case Study: VMware Workstation Drag & Drop Vulnerability
 - 3.6 The Windows Heap Memory Manager
 - 3.6.1 Front-End Allocator
 - 3.6.2 Back-End Allocator
 - 3.7 Low Fragmentation Heap
 - 3.7.1 LFH Architecture
 - 3.7.2 LFH Logic
 - 3.8 UaF Case Study: Triggering the Bug
 - 3.9 UaF Case Study: A Deeper Look at the Bug
 - 3.10 UaF Case Study: Reallocation Control
 - 3.10.1 guest.upgrader_send_cmd_line_args
 - 3.10.2 The NULL Byte Issue
 - 3.11 UaF Case Study: Fake Virtual Table
 - 3.12 UaF Case Study: ROP Storage
 - 3.12.1 unity.window.contents.start : Locating the Function
 - 3.12.2 unity.window.contents.start : Arg Processing
 - 3.12.3 unity.window.contents.chunk : Expanded Data Storage
 - 3.13 UaF Case Study: Bypassing ASLR
 - 3.13.1 Hunting for Pointers
 - 3.14 UaF Case Study: Stack Pivoting
 - 3.15 UaF Case Study: Defeating DEP
 - 3.15.1 GetModuleHandle ROP Chain
 - 3.15.2 GetProcAddress ROP Chain
 - 3.15.3 WriteProcessMemory ROP Chain
 - 3.16 Restoring the Execution Flow
 - 3.17 Executing Shellcode
 - 3.18 Windows Defender Exploit Guard
 - 3.19 Testing the WDEG Protections
 - 3.19.1 The Ghost of ASLR Returns
 - 3.20 ROP Mitigations
 - 3.20.1 Disarming WDEG: Theory
 - 3.20.2 Disabling WDEG: Practice
 - 3.20.3 Defeating EAF
 - 3.21 Wrapping Up
- 4 Microsoft Edge Type Confusion
 - 4.1 Edge Internals
 - 4.1.1 JavaScript Engine
 - 4.1.2 Chakra Internals
 - 4.1.3 JIT and Type Confusion
 - 4.2 Type Confusion Case Study
 - 4.2.1 Triggering the Vulnerability
 - 4.2.2 Root Cause Analysis
 - 4.3 Exploiting Type Confusion
 - 4.3.1 Controlling the auxSlots Pointer
 - 4.3.2 Abuse AuxSlots Pointer
 - 4.3.3 Create Read and Write Primitive

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Course Outline

- 4.4 Going for RIP
 - 4.4.1 Vanilla Attack
 - 4.4.2 CFG Internals
- 4.5 CFG Bypass
 - 4.5.1 Return Address Overwrite
 - 4.5.2 Intel CET
 - 4.5.3 Out-of-Context Calls
- 4.6 Data Only Attack
 - 4.6.1 Parallel DLL Loading
 - 4.6.2 Injecting Fake Work
 - 4.6.3 Faking the Work
 - 4.6.4 Hot Patching DLLs
- 4.7 Arbitrary Code Guard (ACG)
 - 4.7.1 ACG Theory
 - 4.7.2 ACG Bypasses
- 4.8 Advanced Out-of-Context Calls
 - 4.8.1 Faking it to Make it
 - 4.8.2 Fixing the Crash
- 4.9 Remote Procedure Calls
 - 4.9.1 RPC Theory
 - 4.9.2 Is That My Structure
 - 4.9.3 Analyzing the Buffers
 - 4.9.4 Calling an API
 - 4.9.5 Return of Mitigations
- 4.10 Perfecting Out-of-Context Calls
 - 4.10.1 Come Back to JavaScript
 - 4.10.2 Return Value Alignment
 - 4.10.3 Call Me Again
- 4.11 Combining the Work
 - 4.11.1 NOP'ing CFG
 - 4.11.2 Call Arbitrary API
- 4.12 Browser Sandbox
 - 4.12.1 Sandbox Theory Introduction
 - 4.12.2 Sandbox Escape Theory
 - 4.12.3 The Glue That Binds
- 4.13 Sandbox Escape Practice
 - 4.13.1 Insecure Access
 - 4.13.2 The Problem of Languages
- 4.14 The Great Escape
 - 4.14.1 Activation Factory
 - 4.14.2 GetTemplateContent
 - 4.14.3 What Is As?
 - 4.14.4 Loading the XML
 - 4.14.5 Allowing Scripts
 - 4.14.6 Pop That Notepad
 - 4.14.7 Getting a Shell
- 4.15 Upping The Game - Making the Exploit Version Independent
 - 4.15.1 Locating the Base
 - 4.15.2 Locating Internal Functions and Imports
 - 4.15.3 Locating Exported Functions
- 4.16 Wrapping Up
- 5 Driver Callback Overwrite
 - 5.1 The Windows Kernel
 - 5.1.1 Privilege Levels
 - 5.1.2 Interrupt Request Level (IRQL)
 - 5.2 Kernel-Mode Debugging on Windows
 - 5.2.1 Remote Kernel Debugging Over TCP/IP
 - 5.2.2 Remote Kernel Debugging Over Serial Ports
 - 5.2.3 Local Kernel Debugging Through VMware (VirtualKD)
 - 5.3 Communicating with the Kernel
 - 5.3.1 Native System Calls
 - 5.3.2 Device Drivers
 - 5.4 Windows Kernel Security Mitigations
 - 5.5 Vulnerability Classes
 - 5.6 Kernel-Mode Shellcode
 - 5.6.1 Token Stealing
 - 5.6.2 ACL NULL-ing / Editing
 - 5.6.3 Rookits
- 5.7 Vulnerability Overview and Exploitation
 - 5.7.1 Triggering the Vulnerability
 - 5.7.2 Controlling the Callback Context
 - 5.7.3 Redirecting Execution to Usermode
 - 5.7.4 SMEP Says Hello
 - 5.7.5 Introduction to Memory Paging and Structures
 - 5.7.6 The PML4 Self-Reference Entry
 - 5.7.7 PML4 Self-Reference Entry Randomization
- 5.8 ROP-Based Attack
 - 5.8.1 Stack Pivoting
 - 5.8.2 Kernel Read/Write Primitive
 - 5.8.3 Restoring the Execution Flow
 - 5.8.4 Leaking Virtual PTE Start
 - 5.8.5 Flipping U/S Bit
 - 5.8.6 Meltdown and KVA Shadow
 - 5.8.7 Flipping the PML4 EXB Bit
 - 5.8.8 Token Stealing

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Course Outline

- 5.9 Version Independence
 - 5.9.1 Dynamic Gadget Location
 - 5.10 Wrapping Up
- 6 Unsantized User-mode Callback
- 6.1 Windows Desktop Applications
 - 6.1.1 Windows Kernel Pool Memory
 - 6.1.2 Creating Windows Desktop Applications
 - 6.1.3 Reversing the TagWND Object
 - 6.1.4 Kernel User-mode Callbacks
 - 6.1.5 Leaking pWND User-Mode Objects
- 6.2 Triggering the Vulnerability
 - 6.2.1 Spraying the Desktop Heap
 - 6.2.2 Hooking the Callback
 - 6.2.3 Arbitrary WndExtra
- 6.3 TagWND Write Primitive
 - 6.3.1 Overwrite pWND[0].cbWndExtra
 - 6.3.2 Overwrite pWND[1].WndExtra
- 6.4 TagWND Leak and Read Primitive
 - 6.4.1 Changing pWND[1].dwStyle
 - 6.4.2 Setting The TagWND[1].spmenu
 - 6.4.3 Creating a fake TagWND[1].spmenu
 - 6.4.4 GetMenuBarInfo Read Primitive
- 6.5 Privilege Escalation
 - 6.5.1 Low integrity
- 6.6 Virtualization-Based Security
 - 6.6.1 Windows Hypervisor Theory
 - 6.6.2 Windows Hypervisor Debugging
 - 6.6.3 Data Only Attack
 - 6.6.4 Restoring The Execution Flow
- 6.7 Executing Code in Kernel-Mode
 - 6.7.1 Leaking Nt and Win32k Base
 - 6.7.2 NOP-ing kCFG
 - 6.7.3 Hijacking a Kernel-Mode Routine
 - 6.7.4 Wrapping Up

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