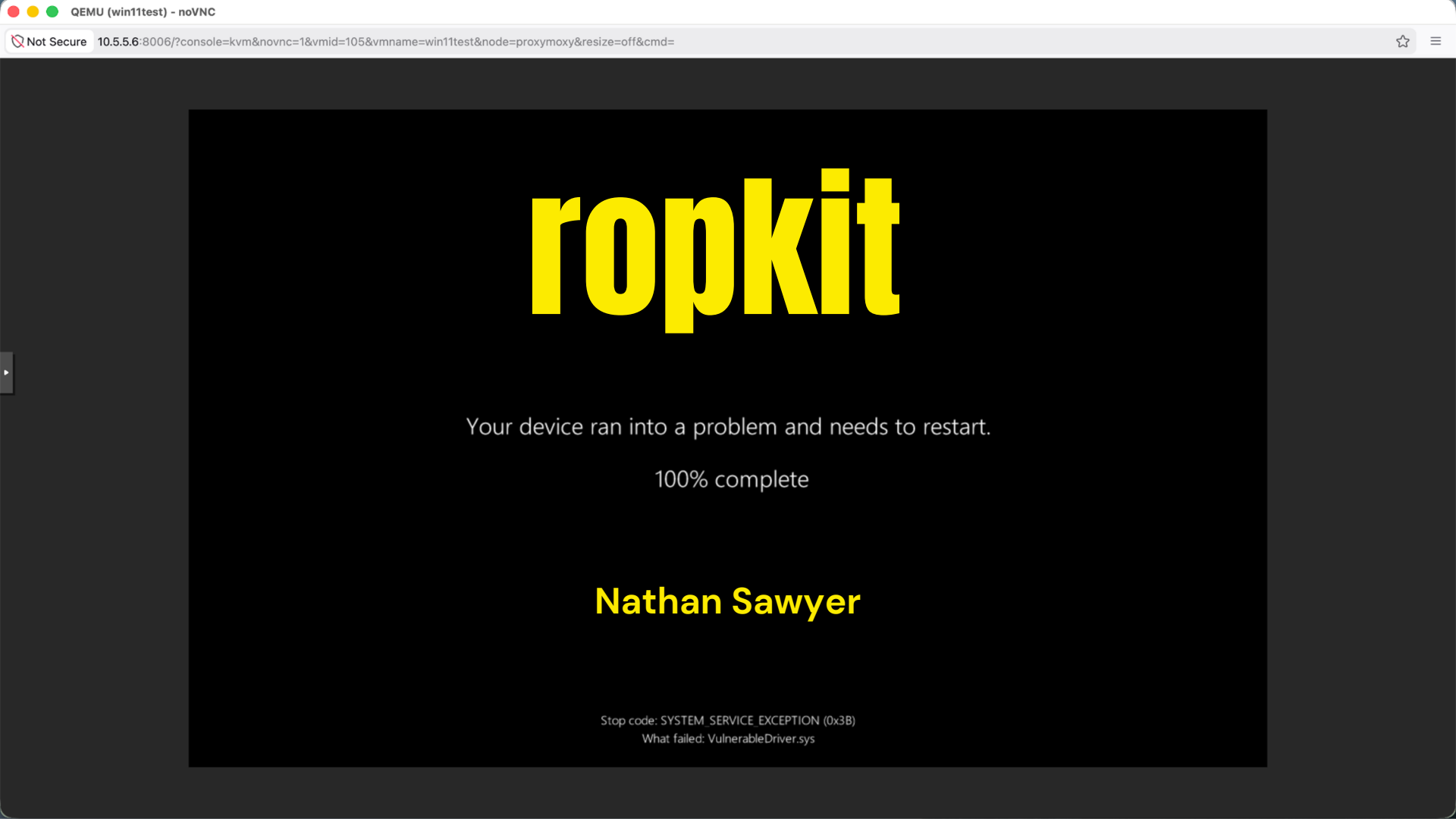

QEMU (win11test) - noVNC
Not Secure
10.5.5.6:8006/?console=kvm&novnc=1&vmid=105&vmname=win11test&node=proxymoxy&resize=off&cmd=
ropkit
Your device ran into a problem and needs to restart.
100% complete
Nathan Sawyer
Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

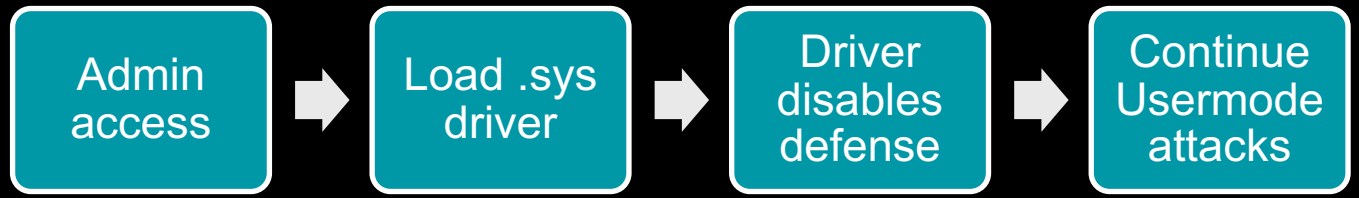
Challenge

- We want kernel code execution
- Windows Hypervisor blocks this
- BYOVD attacks only work for one driver
- No free public framework for BYOVD yet! (sort of)
- HVCI blocks all (HV code integrity)
- Shadow Stacks block code execution

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

What is BYOVD?

- Bring your own vulnerable driver!
- Used for persistence
- EDR killing/muting
- Password dumping
- General mayhem



Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

Solution

- Framework for BYOVD attacks
- You provide the driver and the library, I provide a large framework
- Many built in attacks!
- With HVCI, the question is:

How much of Windows can we change without editing executable code?

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

What is HVCI?

- Hypervisor Code Integrity
- Part of VBS (virtualization based security)
- Blocks almost all kernel code execution
- Prevents RWX memory in the kernel
- Ensures that we cannot execute our own code within the kernel

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

Background

- Juan Sacco has already created a similar framework
- Then took it all off Github and is selling it
- Fundamentally different framework
- Luckily scammers put back some libraries, with virus

ntoskrnlwalker Private
this is a virus do not build!
C++ Updated 4 minutes ago

NTKernelWalkerLib Private
clone of ntkernelwalkerlib from jsacco
C++ Updated 7 minutes ago

DataOnlyGadget Private
clone of dog from jsacco
C++ Updated 17 minutes ago

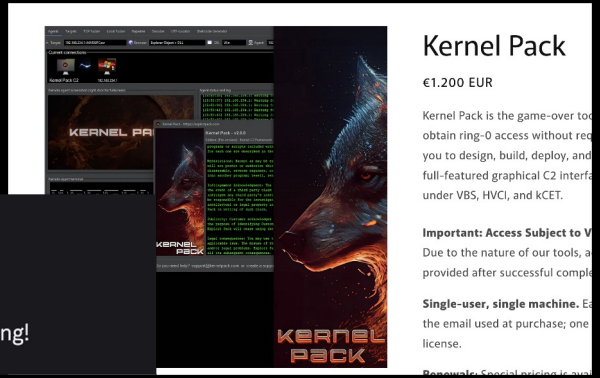
ropkit Private
General rootkit for a virtual kernel r/w prim
C++ MIT License Updated 20 hours ago

April 17, 2026

jSacco 4/17/26, 12:41 AM
Funny how he copied my project and gave no credits
I have everything on my PC. But not planning to share it on Github

nathan 4/17/26, 12:46 AM

jSacco 4/23/26, 1:18 AM
That's great! Yes the r/w shouldn't matter
The physical r/w is translated into VA in any case
If you are interested in learning more check out my training!



Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

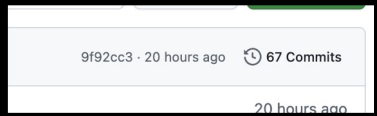
QEMU (win11test) - noVNC

Not Secure 10.5.5.6:8006/?console=kvm&novnc=1&vmid=105&vmname=win11test&node=proxymoxy&resize=off&cmd=

Differences

- Framework for virtual r/w prim, not just physical
- Not just data only attacks!
- I include different code execution methods
- Free & open source

ropkit was born



Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

How To use:

- You provide the virtual r/w primitive
- The framework handles the attacks and offsets
- You possibly write your own attack
- If you cannot leak kernel memory in your driver, this must run as admin. If you can, launch at medium integrity!
- Two methods of automatic offset determination working on 25H2

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

QEMU (win11test) - noVNC

Not Secure 10.5.5.6:8006/?console=kvm&novnc=1&vmid=105&vmname=win11test&node=proxymoxy&resize=off&cmd=

Features

- Hiding a process completely
- Privilege escalation to system
- Protected Process Light (PPL) removal
- Keylogging

- Code Execution!!!
- Dynamic Offsets!

```
KDTARGET: Refreshing KD connection

*** Fatal System Error: 0x0000003b
                       (0x00000000C0000005,0xFFFFF807E2621C97,0xFFFFC609EB65FCE0,0x0000000000000000)

Break instruction exception - code 80000003 (first chance)

A fatal system error has occurred.
Debugger entered on first try; Bugcheck callbacks have not been invoked.

A fatal system error has occurred.

nt!DbgBreakPointWithStatus:
fffff804`de98b1b0 cc              int     3
```

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

QEMU (win11test) - noVNC

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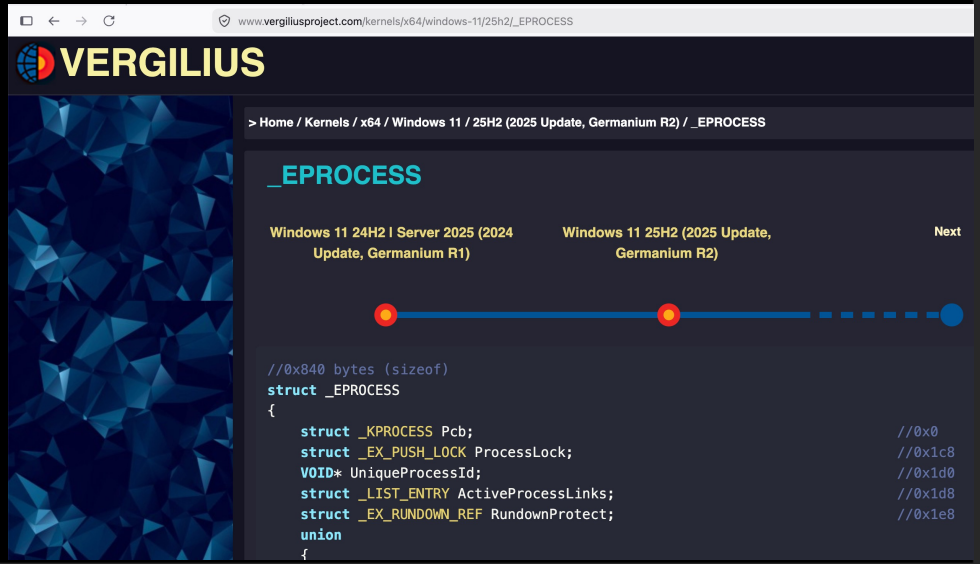
How is this possible? Data first

- Find and edit EPROCESS structure
- Holds process information , like protected process light (PPL) status
- Not novel



QEMU (win11test) - noVNC

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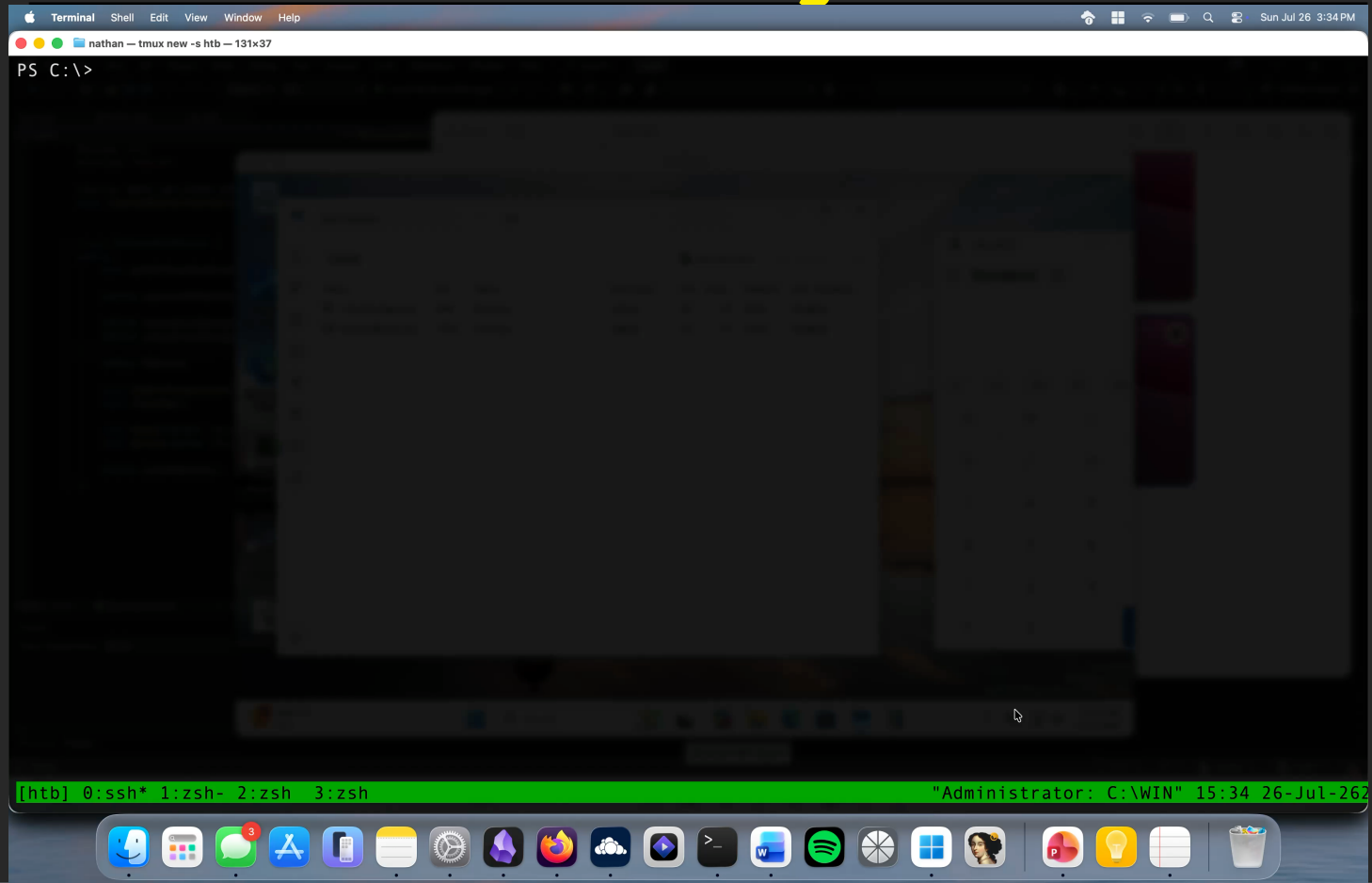
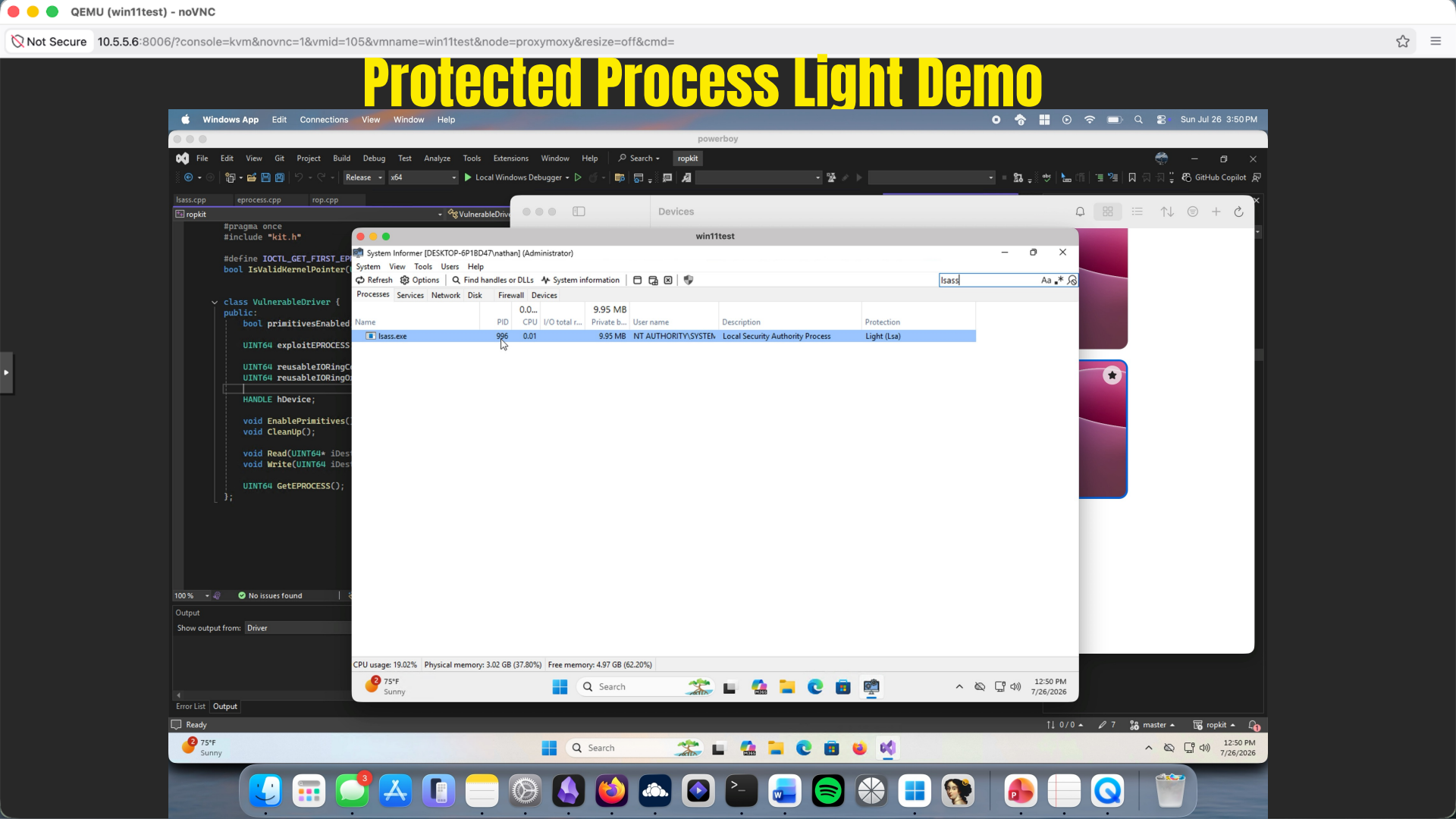
Privesc and Hiding Demo!




QEMU (win11test) - noVNC
Not Secure
10.5.5.6:8006/?console=kvm&novnc=1&vmid=105&vmname=win11test&node=proxymoxy&resize=off&cmd=
Protected Process Light Demo
Windows App Edit Connections View Window Help
Sun Jul 26 3:50 PM
powerboy
File Edit View Git Project Build Debug Test Analyze Tools Extensions Window Help
ropkit
Release x64
Local Windows Debugger
GitHub Copilot
lsass.cpp
eprocess.cpp
rop.cpp
#pragma once
#include "kit.h"
#define IOCTL_GET_FIRST_EP
bool IsValidKernelPointer(
class VulnerableDriver {
public:
bool primitivesEnabled
UINT64 exploitEPROCESS
UINT64 reusableIORingC
UINT64 reusableIORingO
HANDLE hDevice;
void EnablePrimitives(
void CleanUp();
void Read(UINT64* iDes
void Write(UINT64 iDes
UINT64 GetEPROCESS();
};
100 %
No issues found
Output
Show output from: Driver
Error List
Output
Ready
Devices
win11test
System Informer [DESKTOP-6P1BD47\nathan] (Administrator)
System View Tools Users Help
Refresh Options Find handles or DLLs System information
lsass
Processes Services Network Disk Firewall Devices
Name PID CPU I/O total r... Private b... User name Description Protection
lsass.exe 996 0.01 9.95 MB NT AUTHORITY\SYSTEM Local Security Authority Process Light (Lsa)
CPU usage: 19.02% Physical memory: 3.02 GB (37.80%) Free memory: 4.97 GB (62.20%)
75°F Sunny
Search
12:50 PM 7/26/2026
master
ropkit

Keylogging!

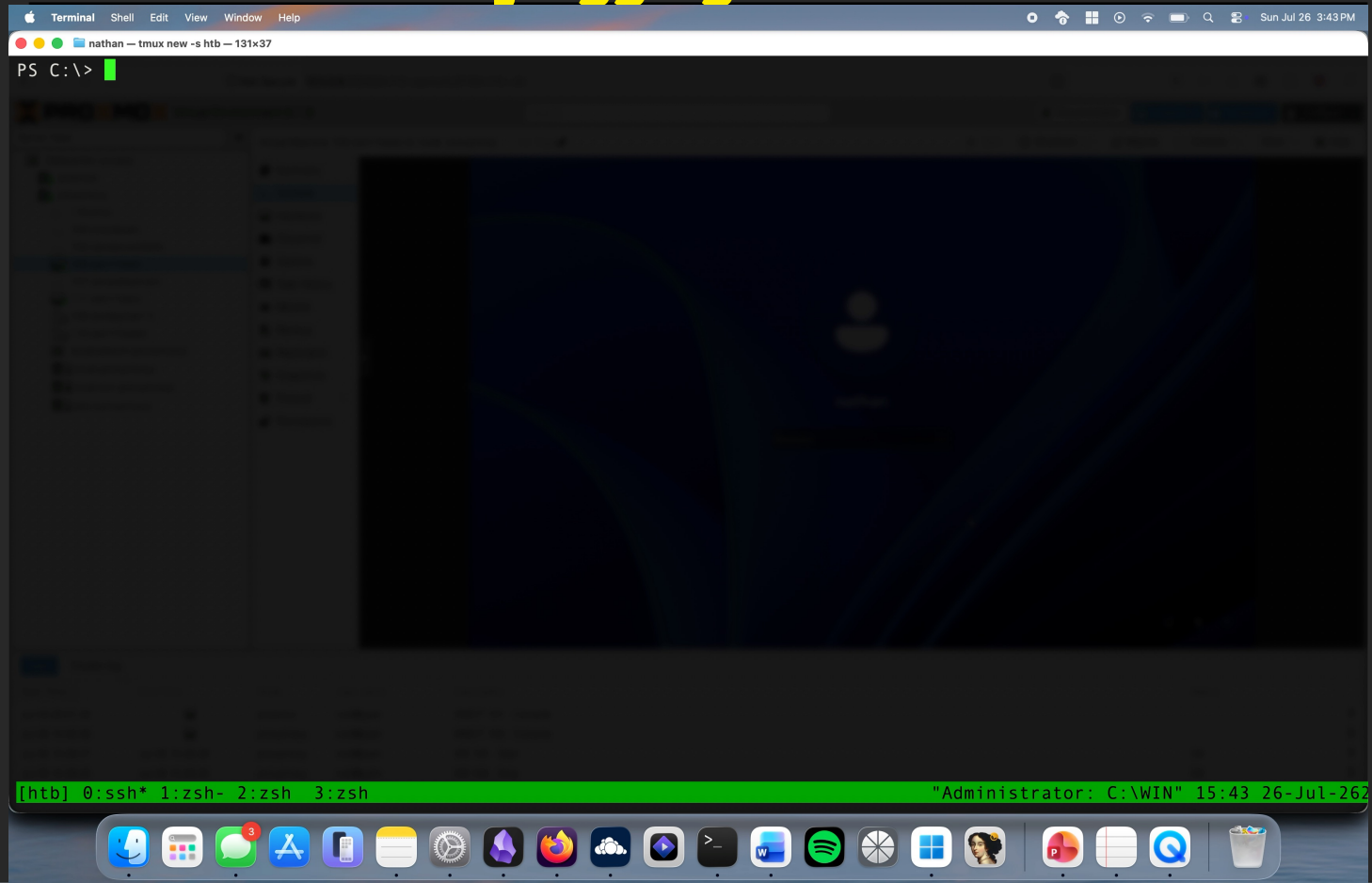
- We have access to reading kernel memory, so let's view driver memory
- We can view keystrokes as a result!

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

QEMU (win11test) - noVNC

Not Secure 10.5.5.6:8006/?console=kvm&novnc=1&vmid=105&vmname=win11test&node=proxymoxy&resize=off&cmd=

Keylogging Demo



Code Execution Methods

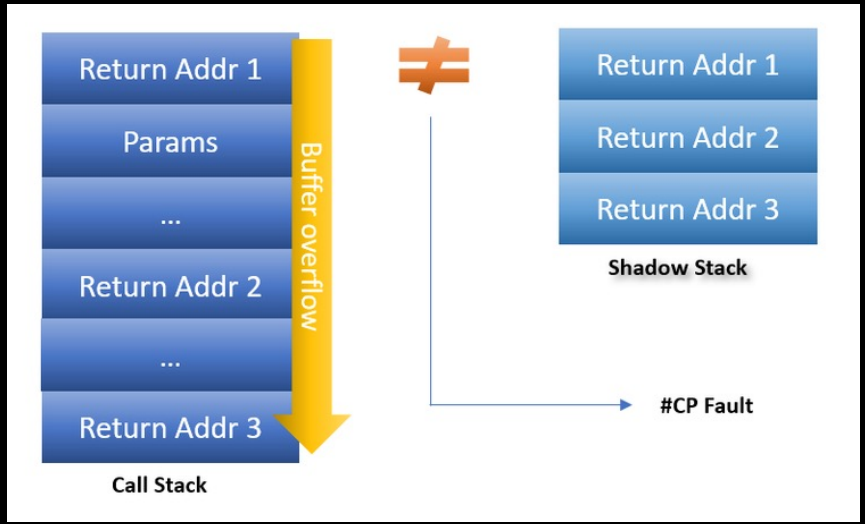
Method	Blocked by	Requires
Rop chain	Shadow stacks	N/A
Callback hijack	N/A with DKOM, otherwise HLAT/Intel VT-RP	N/A in my implementation, otherwise Driver without CFG
COP/JOP chain	N/A	Driver without CFG
SSDT hijack	HLAT/Intel VT-RP	N/A
Trap Frame Edit	N/A	N/A

- Implemented ROP chain: this is Connar McGarr's strategy
- Callback Hijack: Amazing, completed by Worawit, but not implemented
- JOP: Implemented JOP chain
- SSDT hijack: Blocked by KDP, bypasssed by remap
- Trap Frame Edit: FUN!!

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

Shadow Stack

- Compares Stack to a saved copy, crashes if they do not match
- Compares on a return
- Return addresses are pushed on a call instruction
- Not commonly enabled in computers still. Intel 11th gen or AMD Zen 3



JOP chain

- Shadow stacks block overwriting stack, KDP and HVCI block forward attacks, so how can you run shellcode?
- Start a JOP chain!

General plan:

- Use IRP hooking to overwrite Dispatch Table of a driver without Control Flow Guard to jump to a separate driver with gadgets!

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

JOP chain

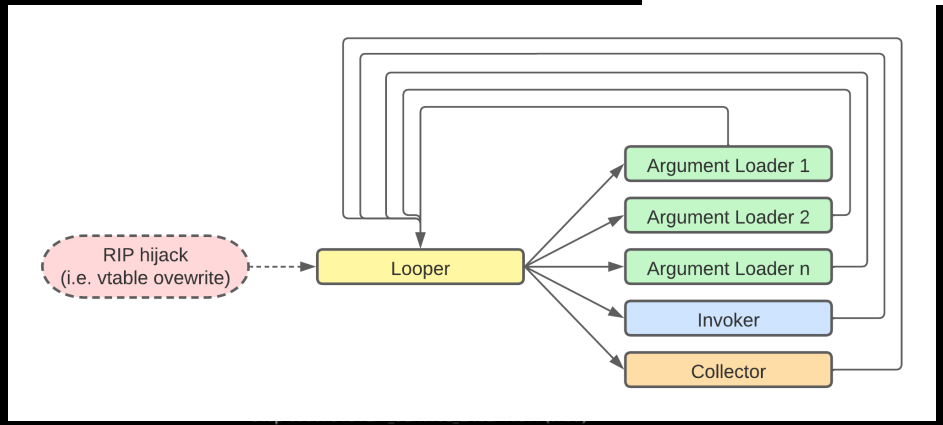
- Every instruction must end in JMP qword [rax+offset]
- Load a second Nvidia driver for more gadgets
- Utilized gadgets to suspend a process
- Can easily change this!

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

JOP Gadgets

- We can issue a driver request to start chain
- Use primitive to overwrite Device_Object with gadgets
- Gadgets end with jmp reg + offset

```
jmp qword [rcx+0x20]
```



Picture from Offsec – Exploiting Control flow enforcement Technology

QEMU (win11test) - noVNC

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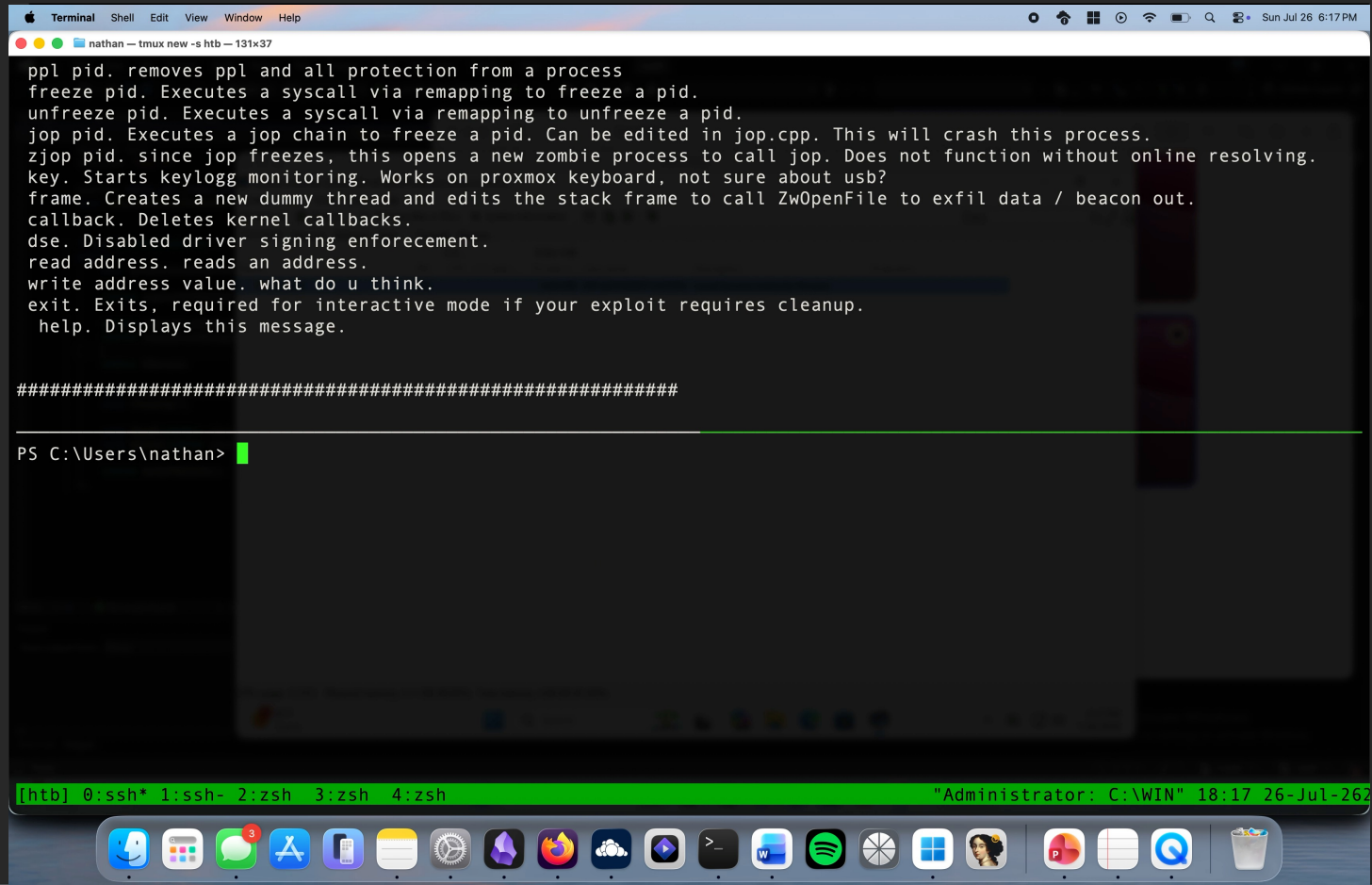
JOP Demo



JOP Drawbacks

- Leaves a zombie process
- IRP request is never completed
- Requires two extra drivers
- Does work under Shadow Stacks!
- Working Kernel Code Execution!

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

SSDT hijack

- System service descriptor table
- Holds locations of syscalls
- Can change the offsets, so one syscall = another syscall

Why is this important?

- Previously privileged action is now unprivileged
- Hiding actions

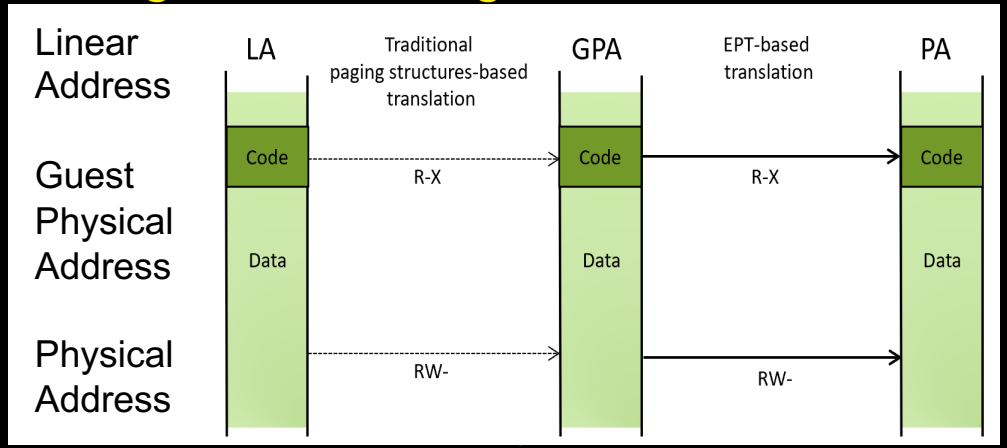
- Blocked by Kernel Data Protection

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

Understanding Paging

- Linear Address is translated to a Guest Physical Address, done with CR3 register
- Guest Physical Address is translated to a true Physical Address, using Extended Page Tables

Remap attack source and pictures: Satoshi Tanda



Kernel Data Protection and Remap

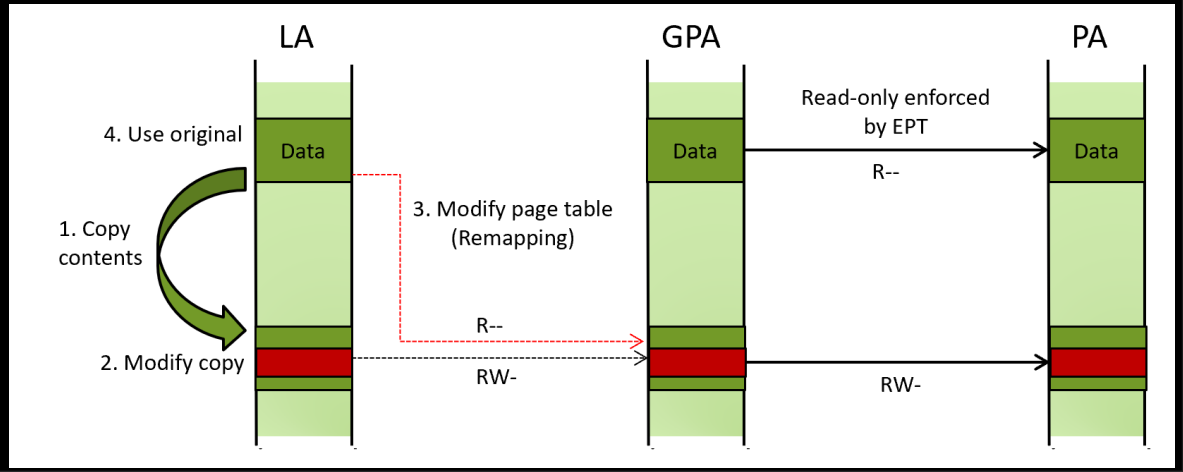
- Enforces specific sensitive memory is read only
- Kernel Data Protection enforces memory permissions between Guest Physical Address -> Physical Address
- Remap the Linear Address!
- Edit the the Linear Address -> Guest Physical Address translation
- Edit the page tables (not EPT!) and point GPA to different LA

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

SSDT hijack

- With a read/write primitive can copy the contents, modify them, and update the page structure to point to our fake copy. This bypasses Kernel Data Protection!
- Blocked by Intel VT-RP. No AMD equivalent.

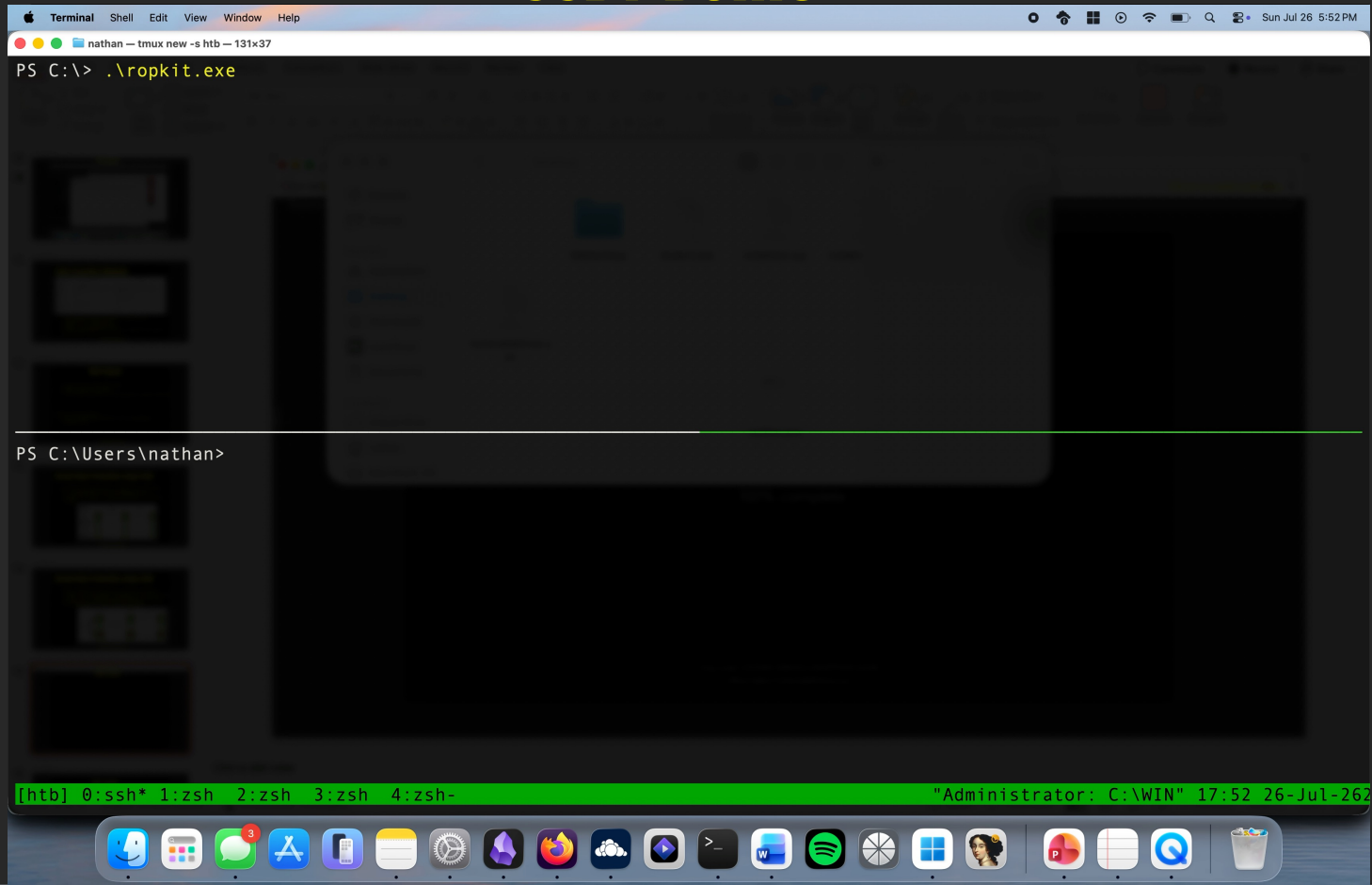
Remap attack source and pictures: Satoshi Tanda



QEMU (win11test) - noVNC

Not Secure 10.5.5.6:8006/?console=kvm&novnc=1&vmid=105&vmname=win11test&node=proxymoxy&resize=off&cmd=

SSDT Demo



SSDT Drawbacks

- Blocked by Intel VT-RP in 12th gen CPUs
- No AMD Equivalent
- Detecting this would kill performance

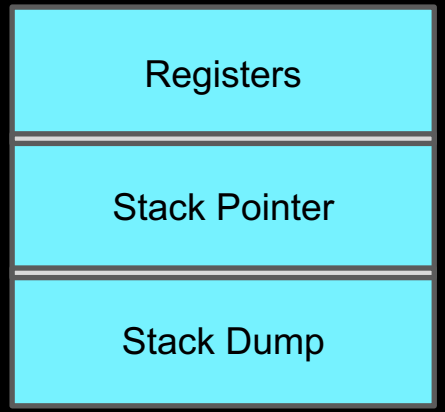
How does a CPU stop this?

- Intel VT-RP adds a separate Hypervisor Linear Address Translation Register (HLAT) field to stop this
- Translation is now fully done through hypervisor

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

Trap Frame Editing

- Looks a little like this:
- Not protected!
- We can freeze a thread and edit



Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

Trap Frame Editing

- What if we edited a frozen Trap Frame?
- This bypasses Shadow Stacks – for the launch
- We can directly change the Instruction Pointer
- Manually edit stack for complex calls

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

Trap Frame Editing

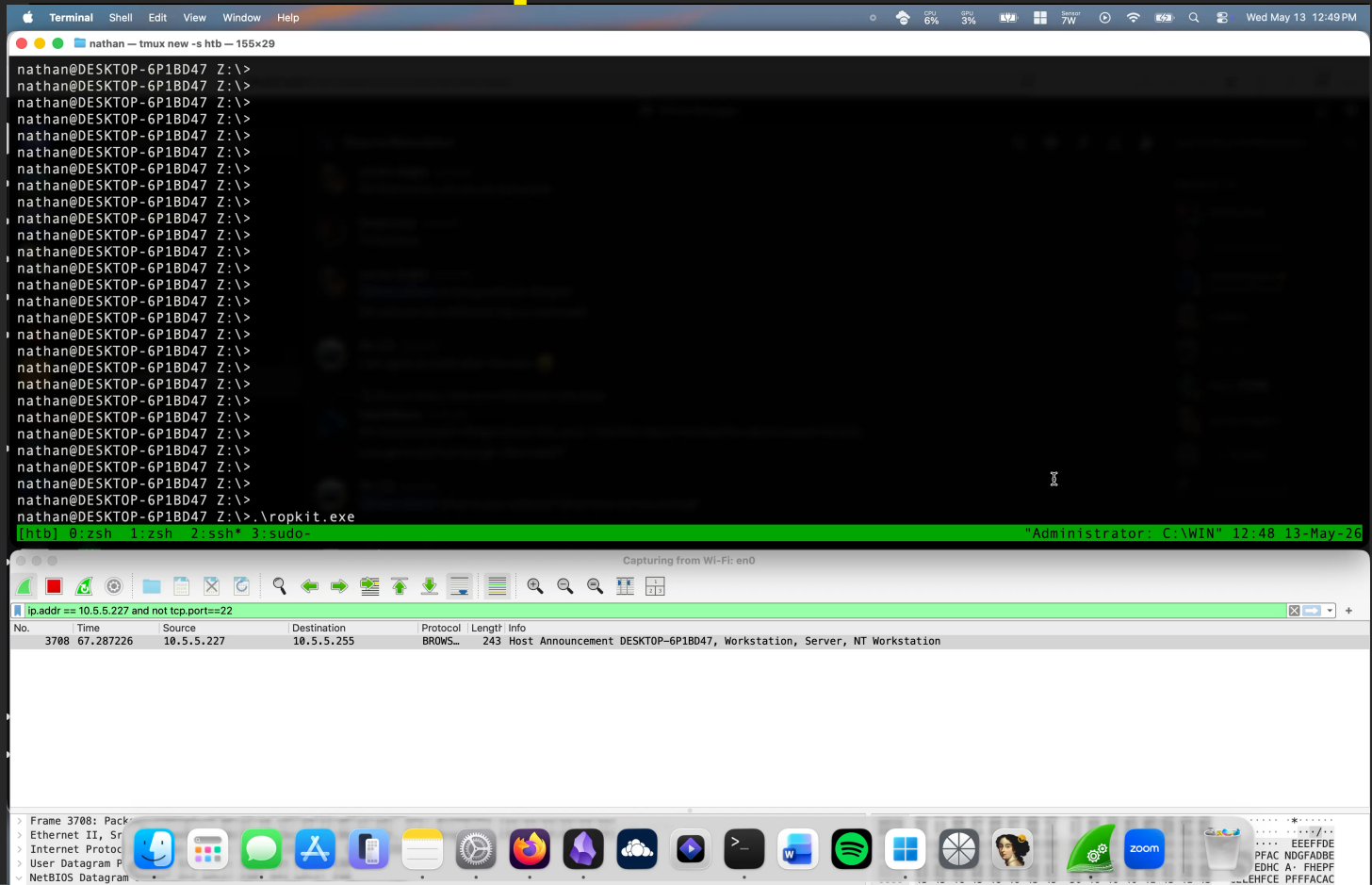
- The stack can be edited for complex function calls!
- Let's issue a call to ZwOpenFile to ping an IP address from the kernel
- Can exfiltrate data over UDP requests to LAN using an address that does not exist

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

QEMU (win11test) - noVNC

Not Secure 10.5.5.6:8006/?console=kvm&novnc=1&vmid=105&vmname=win11test&node=proxymoxy&resize=off&cmd=

Trap Frame Demo



Trap Frame Downsides

- After payload is sent, this will crash with Shadow Stacks
- Likely recoverable!
- Fully recoverable (through editing return addresses)
- Can likely be explored/combined to become stable
- No zombie process or second driver needed!

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

Wrap up!

- HVCI does a great job!
- Shadow Stacks and remap protection kill most attacks

- Many of these great protections are not enabled
- Shadow Stacks is not commonly enabled still

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

Future Work

- Full network stack in Shadow Stacks
- More stable trap frame hijack
- No zombie processes
- Implement crypto mining
- Act as a kernel C2

nathan@nathan2.com
nathan2.com/posts/ropkit
github.com/nasawyer/ropkit

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

Thank you!

- Connor McGarr: Initial Rop chain and HVCI breakdown
- Satoshi Tanda: Remap explanation and attack
- Worawit Wangwarunyoo: KDP remap attack
- Jordan Higgins: Initial driver code, trap frame idea
- Juan Sacco: Offset resolution

nathan@nathan2.com
nathan2.com/posts/ropkit
github.com/nasawyer/ropkit

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys

References

Remapping method: https://tandasat.github.io/blog/2023/07/05/intel-vt-rp-part-1.html
SSDT hijack method: ttps://www.exploitpack.com/blogs/news/bypassing-kernel-code-execution-a-data-only-ssdt-hijack-under-hvci-but-how
Vergilius project for initial offsets:
https://www.vergiliusproject.com/kernels/x64/windows-11/25h2/_MI_VISIBLE_STATE

Connor mgcar rop kit setup: https://connormcgarr.github.io/hvci/

jop ideas: https://www.offsec.com/blog/bypassing-intel-cet-with-counterfeit-objects/

kernel callback method: https://github.com/worawit/malk
kernel callbacks: https://datafarm-cybersecurity.medium.com/code-execution-against-windows-hvci-f617570e9df0

This was built using Jodan's https://github.com/Kalagious/VulnerableDriver and https://github.com/Kalagious/VulnerableDriverReadWrite library.

Stop code: SYSTEM_SERVICE_EXCEPTION (0x3B)
What failed: VulnerableDriver.sys