

Windows HIPS evaluation with Slipfest

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What is a HIPS?

- **Host** intrusion prevention system
 - ▶ Tries to generically prevent the exploitation of security flaws
 - ▶ Tries to mitigate their consequences
- State of the art on Linux with PaX (and GrSecurity)
 - ▶ Emulates non-executable pages semantic using splitted TLBs or segmentation (when not supported in hardware)
 - ▶ Prevents the injection of arbitrary code in the address space using this semantic
 - ▶ Prevents reusing of existing code by an exploit with address space layout randomization (ASLR)
 - ▶ Restricts the privileges of a process with mandatory access control (GrSecurity)



What is Slipfest (SF)?

- A tool developed by France Telecom R&D to help the evaluation of Windows HIPS products
- The name is basically a french joke meaning "Panty's party"
- Officially it's an acronym for "System-Level Intrusion Prevention Framework Evaluation Suite and Toolkit"
 - ▶ Who would believe that? :)
- It can be used to:
 - ▶ understand how your HIPS works
 - ▶ see its limitations

Windows HIPS



- There are a lot of products
- Some big companies bought a smaller one for their HIPS product
 - ▶ Cisco CSA, McAfee Entercept, Symantec client security . . .
- Wehntrust, Ozone, Eeye Blink, Ossurance, Prevx, Geswall, Buffer-Shield, NGSEC's StackDefender . . .
- Windows XP SP2 and Vista include HIPS-like features
- Features
 - ▶ Prevents shellcode execution (NOEXEC)
 - ▶ Address space layout randomization (ASLR)
 - ▶ Mandatory access control (MAC)

NOEXEC, technique #1, NX emulation



- Some products are doing PaX-like NX emulation using pentium's splitted TLBs
 - ▶ They are rare and quite hackish
 - ▶ Significant impact on performances (most people use segmentation instead in PaX)
 - ▶ SecureStack, BufferShield, StackDefender
 - ▶ If supported by the processor, XP SP2 uses NX, but not at its full potential

- Slipfest can test whether a non-executable semantic is present

NOEXEC, technique #2, behavioral analysis



- Instead of relying on non-executability:
 - ▶ Most products will let you run your shellcode
 - ▶ But they'll try to catch you when you call an API
 - ▶ Some vendors call this "behavioral analysis"
- You can get arbitrary code execution
 - ▶ They use SDT or userland (in libraries) hooks
 - ▶ When a hook catches you, the HIPS runs a heuristic
 - If something seems wrong (e.g. you're returning to the stack) it kills your process
 - If everything seems fine, it lets you run

Behavioral analysis is by essence very weak



- When you've got arbitrary code execution all bets are off
 - ▶ You can do whatever the process can do
 - ▶ The only real remaining line of defense is privilege limitation (e.g. with MAC)
- You can bypass kernel and library based BA:
 - ▶ Fool the heuristic: make it think you're the legitimate program
- Additional techniques for library-based BA:
 - ▶ CPL-3 code is not more privileged than you are, you can emulate the hooked library
 - ▶ You can "jump above" the hook or even unhook it (depends on MAC)

SLIPFEST against behavioral analysis



- You can use Slipfest to find out what is hooked
 - ▶ List hooks in SDT, and see which module they are pointing to
 - ▶ List hooks in Libraries, and see where they're pointing to (SF resolves calls and jumps)
 - ▶ You can unhook libraries
 - This allows to easily find out if the interesting hook is in the SDT or in a library

- You can use Slipfest to find out how smart the heuristic is
 - ▶ Inject different shellcodes in the process
 - ▶ The shellcodes will try to fool the heuristic by proxying through existing code

HIPS Internals, ASLR



- Some products implement some address space layout randomization
 - ▶ ASLR makes it harder for your exploit to rely on fixed addresses
 - ▶ Wehnus Wehntrust, Ozone, Eeye Blink . . .
 - ▶ Windows XP SP2 and Vista add some randomization (TEB, stack, heap)
- Slipfest can tell you what is randomized and how much it is randomized
 - ▶ Creates a bunch of processes reporting back through a pipe

HIPS Internals, mandatory access control



- Mitigates the consequences of an exploitation by making a process less privileged
- Example: shareware.exe cannot modify a file in WINDIR
- You need to write a policy
 - ▶ It's hard
 - ▶ Most of the time there is no automatic consistency checking mechanism
 - ▶ For instance if you forbid a process to write to WINDIR you must also forbid it to access the NtWriteProcessMemory service
 - Otherwise it could inject a shellcode in another process which would write to WINDIR

HIPS Internals, mandatory access control (2)



- Most products (if not all) have some inconsistencies that you cannot fix, especially if the vulnerable process runs with administrator privileges
 - ▶ Slipfest can test some of them: loading a driver the "other" - undocumented - way, writing to physical memory device ...
- Access control is implemented using hooks too
 - ▶ Kernel hooks (the correct way)
 - ▶ Userland hooks (the bad way)
 - They can be bypassed (it's CPL-3 code)
 - ▶ Slipfest can help you understand how it is implemented (see BA)

Why userland hooks are bad



Demo



- ASLR detection
- List SDT and userland hooks
 - ▶ See where they are pointing to
- Shellcode generation and injection
 - ▶ Hash based find_proc with forwarders support
- Bypass the heuristic by proxying API return through existing code
 - ▶ e.g. we return to an address in the PE just after a call and gain control back with the next 'ret'



Conclusion

- Future
 - ▶ Make the GUI actually usable (help appreciated)
 - ▶ Document the hidden features so that you don't have to read the source (almost 6000 lines) to find them
 - ▶ Port to Metasploit stagers some of the shellcodes and bypass techniques (WIP)
- Thanks for attending!
- Any questions ?
- Available in a few minutes at <http://slipfest.cr0.org> with a GPL licence