ANTI-INCIDENT RESPONSE

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Nick Harbour - Bio

- 14 Years of Intrusion Analysis

- DoD Computer Forensic Lab, (1998-2002, 2004)
- Mandiant (2006-2012)
  - Co-developer of OpenIOC format
- Author of dcfldd, red curtain, IOCE, pe-scrambler, tcpxtract, findevil, etc.…
- Taught Advanced Malware Analysis at BlackHat for the past 5 years

Outline

- Anti Live Response
- Anti Disk Forensics
- Anti Reverse Engineering
- Anti Incident Response

Anti-Live Response

- Avoiding detection by sysadmins and first responders

- Hiding from running process lists
  - ps, top, windows process list
- Hiding network connections from view of common tools
  - netstat

Rootkits

- Originally Unix file replacement
- Mostly kernel-level post-1999

- Hides Attacker activity from live view
  - Process
  - Network connections
  - Resources

- Once Detectable, is a Red Herring

Process Injection

- Make good processes do evil things
- Avoids Having a “Malware Process” that needs hiding
- Typically Injects a DLL or block of code as a new thread

Windows Process Injection Mechanisms

- `VirtualAllocEx()`
- `VirtualProtect()`
- `WriteProcessMemory()`
- `CreateRemoteThread()`

- SetWindowsHookEx()

- QueueUserAPC()

Windows Process Injection

- Inject a DLL
  - Allocate and write the DLL name in the process
  - `CreateRemoteThread()` with `LoadLibrary()` as the thread start address
- `SetWindowsHookEx()` can also force a DLL load

- Inject shellcode
  - Allocate and write the shellcode in the process
  - `CreateRemoteThread()` with the start of the shellcode as the thread start address
  - Or `QueueUserAPC()` to launch code

Windows Thread Hijacking

- `SuspendThread()` on a thread
- Store its context with `GetThreadContext()`
- Make a new stack segment with `VirtualAllocEx()`
- Replace EIP and ESP with `SetThreadContext()`
- Resume the Thread with `ResumeThread()`
- Wait a for a period of time or unique event
- Set thread context back to its original state
- `ResumeThread()`

Unix Process Injection Mechanisms

- **`ptrace()`**
  - `PTRACE_POKEDATA`
  - `PTRACE_SYSCALL`
    - `sbrk()`
  - `PTRACE_DETACH`

Thread Hijacking Troubles

- Resuming a thread that is in the middle of a System Call

- Problem under Windows and Unix

Getting Around the Syscall Problem

- Windows: Detect if EIP is within NTDLL.DLL range, if so, resume thread and try again later.
- Unix: Detect if EIP is within range of a library object (if dynamically-linked), or disassemble previous instruction and determine if it was a syscall interrupt, and try again later

Hiding Network Activity

- Invoke the Internet Explorer COM object to communicate via HTTP through the IEXPLORE process
- `UrlDownloadToFile()` API function simplifies downloading functionality, calls IE COM object in the back end.

Anti-Forensics

- Avoiding Detection from Forensic Analysts

- Make it difficult to find the malware in the first place

- Obvious stuff I'm not going to talk about:
  - Hit sdelete like it owes you money
  - Timestomp

Evading Forensic Detection of Persistence

- Tools such as Autoruns examine Registry locations for persistence

- Avoid the Registry Like the Plague as much as possible

Service Replacement

- Replace Existing but useless service with a new DLL
  - Wzcsvc on servers

- Many IR shops don’t have the capability to audit at the DLL level

DLL Search Order Hijacking

- Causing legitimate programs to accidently load a malicious DLL instead of the real one

- Program expects the DLL to reside in System32
- Program does not run from System32
- DLL is not protected by KnownDlls Registry Key

- KnownDlls shortcuts the DLL search order by going directly to System32

- *https://blog.mandiant.com/archives/1207

DLL Search Order (Safe Search mode)

1. The directory from which the application loaded.
2. The system directory.
3. The 16-bit system directory.
4. The Windows directory.
5. The current directory.
6. The directories that are listed in the PATH environment variable.

DLL Search Order Hijacking

- Main Culprit: C:\Windows\explorer.exe

- Recursive Problem:
  - Ws2_32.dll is protected by KnownDlls
    - It loads iphlpapi.dll, which is not

Special Case Vulnerable DLLs

- System DLLs which perform LoadLibrary() to load an optional DLL during system startup

- No Evidence of loading in registry
- Disassembly of system binaries required.

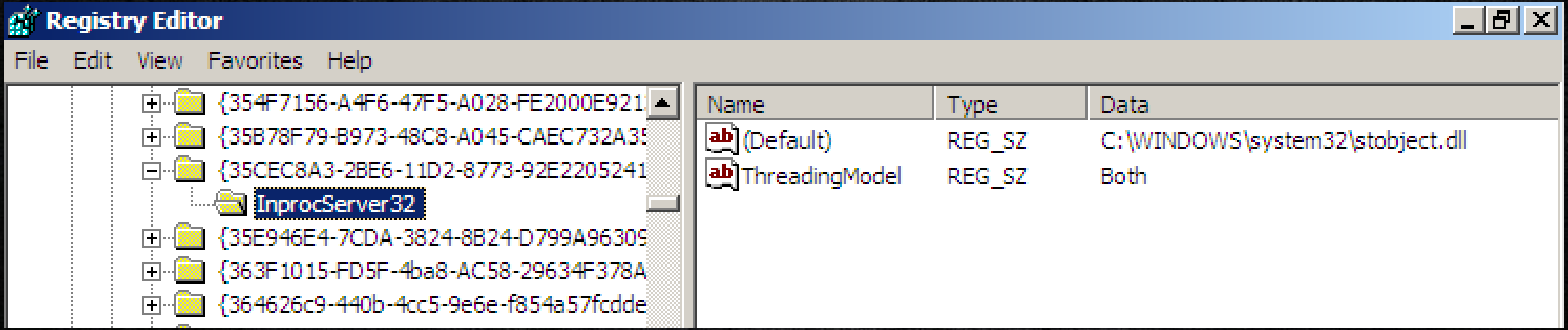
- Fxsst.dll
  - Not the only case

Fxsst.dll

- Fxsst.dll
  - A fax server DLL, used by Windows Explorer
  - Who uses windows to send or receive faxes?
    - Oh, you do?
      - How is life in 1988?
        - Cool story bro
          - Why you disrespecting me bro?
            - I’m not your bro, pal
              - I’m not your pal, friend
                - I’m not your friend, guy

Fxsst.dll

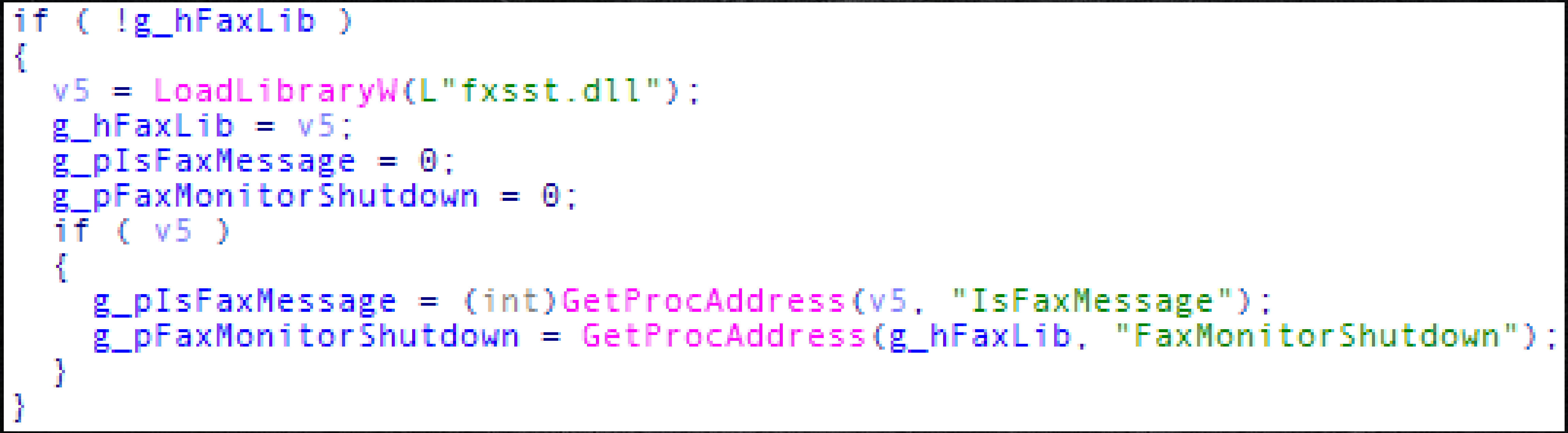
- An optional DLL which is usually* not present on a system
- Even if you replace the legit one, no one will notice
  - Pro-Tip: Nobody uses fax services on windows



```
{354F7156-A4F6-47F5-A028-FE2000E921
{35B78F79-B973-48C8-A045-CAEC732A35
{35CEC8A3-2BE6-11D2-8773-92E2205241
    InprocServer32
{35E946E4-7CDA-3824-8B24-D799A96309
{363F1015-FD5F-4ba8-AC58-29634F378A
{364626c9-440b-4cc5-9e6e-f854a57fcdde
```

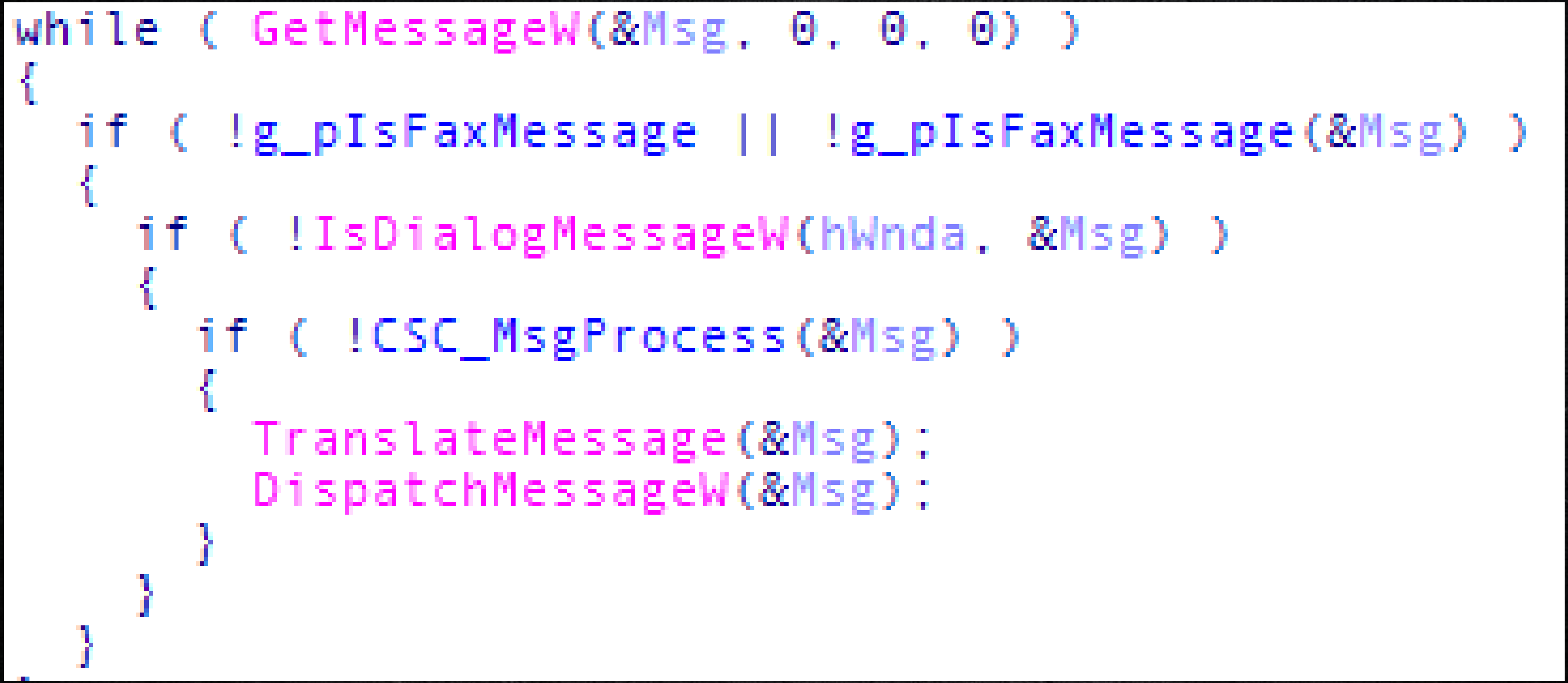
Name	Type	Data
(Default)	REG_SZ	C:\WINDOWS\system32\stobject.dll
ThreadingModel	REG_SZ	Both

Fxsst.dll



```
if ( !g_hFaxLib )
{
  v5 = LoadLibraryW(L"fxsst.dll");
  g_hFaxLib = v5;
  g_pIsFaxMessage = 0;
  g_pFaxMonitorShutdown = 0;
  if ( v5 )
  {
    g_pIsFaxMessage = (int)GetProcAddress(v5, "IsFaxMessage");
    g_pFaxMonitorShutdown = GetProcAddress(g_hFaxLib, "FaxMonitorShutdown");
  }
}
```

Fxsst.dll



```
while ( GetMessageW(&Msg, 0, 0, 0) )
{
  if ( !g_pIsFaxMessage || !g_pIsFaxMessage(&Msg) )
  {
    if ( !IsDialogMessageW(hWnda, &Msg) )
    {
      if ( !CSC_MsgProcess(&Msg) )
      {
        TranslateMessage(&Msg);
        DispatchMessageW(&Msg);
      }
    }
  }
```

Anti-Incident Response

- Disrupting, out-maneuvering or confusing the Incident Responders across the enterprise

- Makes Remediation a pain
- Essential to maintaining a long-time foothold on a network, even when detected

Anti-Incident Response Practices

- Maintain a wide variety of malware on the network
- Unique malware instances per host, or low population

Anti-Incident Response Practices

- Pre-deploy multiple stages of inactive backdoors
- Do so as quietly as possible
- Never touch these systems

Anti-Incident Response Practices

- Agile Lateral Movement

- Keep your total number of infected hosts moderate but not large, and keep them fresh

- Create a trail of activity at a faster pace than it takes to investigate

Anti-Incident Response Practices

- Chose busy servers as internal hop-points
  - Event logs cycle within minutes to hours
  - Network activity not out of place
- Chose enormous file servers as a data staging areas

Anti-Incident Response Practices

- Obscure the source of malware transmission

- Example:
  - Login via RDP
  - Paste .eml file text into notepad and save
  - Open .eml on victim host (outlook express)
  - Save attachment
- Example:
  - Lines of an input file for DOS debug inserted into a database
  - Dumped and executed with commandline tools already on the host

Anti-Incident Response Practices

- Replicate a Domain Controller

- Join it to the network

Anti-Incident Response Practices

- Establish a means to split-tunnel VPN clients for C2 communication
- Bypassing most network monitoring infrastructure

Anti-Reverse Engineering

- To prevent or delay discovery of malware or generation of detection mechanisms for the malware
- Can overlap with anti-forensics
- Target is still the responder, not the seasoned malware analyst

Packers

- The more extreme the packer is, the more detectable it is
- Maintain a large pool of custom packers
  - And don’t make unique section names

Packer Detection Woes

- Entropy analysis identifies many packed binaries
  - As well as a lot of non-packed binaries

- Requires a fair amount of expert manpower to review results on a single host
- Infeasible across an enterprise

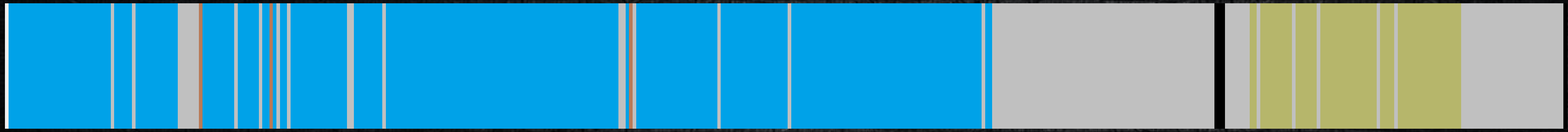
Packer Detection Woes

- Who says your packed binary needs to be high entropy?

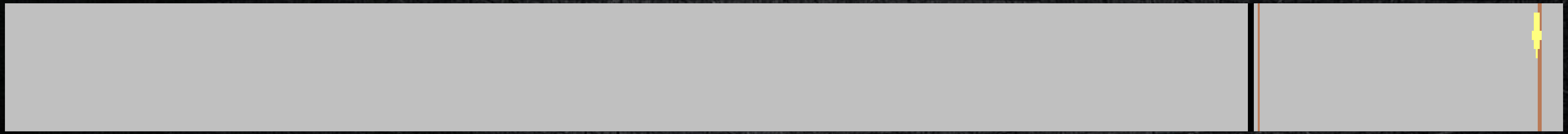
- Simple XOR packer defeats entropy detection

Packer Detection

- FindEvil
  - Not Packed:



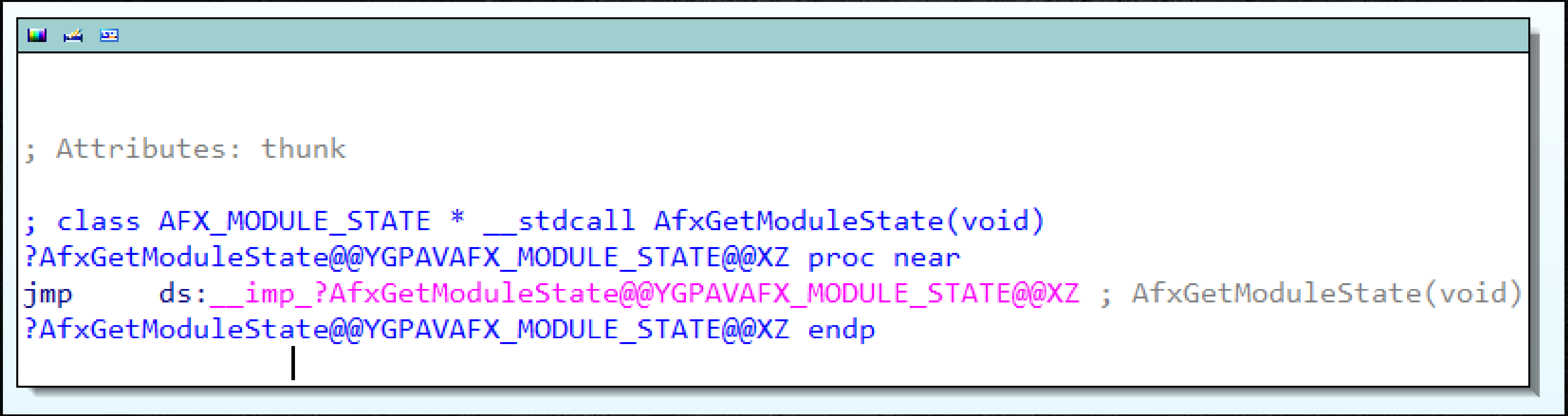
  - Packed:



Hiding in Plain Sight

- Use string encoding only
- Delphi/C++
- Delphi Libraries shared with Borland Builder C++
- C++ MFC Default Template App: 232kb

Hiding in Plain Sight



```
; Attributes: thunk

; class AFX_MODULE_STATE * __stdcall AfxGetModuleState(void)
?AfxGetModuleState@@YGPAVAFX_MODULE_STATE@@XZ proc near
jmp     ds:__imp_?AfxGetModuleState@@YGPAVAFX_MODULE_STATE@@XZ ; AfxGetModuleState(void)
?AfxGetModuleState@@YGPAVAFX_MODULE_STATE@@XZ endp
```

CrowdStrike