eideon

ABOUT ME

Tales of a Threat Hunter 2

Following the trace of WMI Backdoors & other nastiness

Posted on March 2, 2018

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What is WMI?

WMI is Microsoft's implementation of WBEM (Web Based Enterprise Management) which is based on CIM and allows for the remote management of multiple system components in Windows environments. WMI is used on a daily basis by sysadmins across large domains due to its flexibility and scalability. Easy to deploy, scripts that leverage WMI can be seen everywhere. Unfortunately, as with everything that is widely deployed, has "remote" capabilities and runs on "windows": the dark force is strong around it (just for fun: MS17-010).

It is known that WMI can be abused in many ways to either gather information, make changes and create persistence mechanisms. An excellent article by Matt Graeber (@mattifestation) called Abusing Windows Management Instrumentation (WMI) to Build a Persistent, Asyncronous, and Fileless Backdoor was an eye opener for many of us in the cybersec world. We knew this was possible, but forgot how flexible it was. The main strength of WMI persistence is its stealthiness and effectiveness. When a command is executed by WMI as a result of "evil" the only thing you will see is **WmiPrvse.exe** as the process. Distinguishing a valid system action from an invalid one is very hard under these circumstances. In other words, WMI persistence defeats non-repudiation!

What I will cover here are different methods for detecting WMI persistence that you could leverage within your network to hunt for this treat.

Understanding WMI Persistence

- Matt Graeber's article (mentioned above)
- Pentestarmoury article "Creeping on Users with WMI Events" by Sw4mp_f0x. He also developed PowerLurk (see below)
- Permanent WMI Subscriptions
- Derbycon 2015 presentation by Matt

How does a WMI persistent object look like?

Let's use two scripts that allow us to easily create a malicious persistence without having to do it step by step (have a look at the PS files to understand all the bits and pieces involved), namely:

- PowerLurk by Sw4mp_f0x
- WMI Persistence Template Gist by Matt G.
- Alternatively, you can also use an adaptation of Matt's work by **n0pe-sled** WMI-Persistence.ps1

WMI Persistence Template by Matt G.

We tweaked some of the parameters in the script to make sure the timer event launches every minute and that no cleanup is performed at the end. After launching it, we can inspect the newly created Event Consumers/Filters/Bindings as follows:

EventFilter

```
Get-WmiObject -Namespace root\subscription -Class __EventFilter
```

Result:

```
__GENUS          : 2
__CLASS          : __EventFilter
__SUPERCLASS     : __IndicationRelated
__DYNASTY        : __SystemClass
__RELPATH        : __EventFilter.Name="TimerTrigger"
__PROPERTY_COUNT : 6
__DERIVATION     : {__IndicationRelated, __SystemClass}
__SERVER         : W10B1
__NAMESPACE      : ROOT\subscription
__PATH           : \\W10B1\ROOT\subscription:__EventFilter.Name="TimerTrigger"
CreatorSID       : {1, 5, 0, 0...}
EventAccess      :
EventNamespace   : root/cimv2
Name             : TimerTrigger
**Query            : SELECT * FROM __TimerEvent WHERE TimerID = 'PayloadTrigger'**
QueryLanguage    : WQL
PSComputerName   : W10B1
```

EventConsumer

Result: [snip]

```
__GENUS               : 2
__CLASS               : CommandLineEventConsumer
__SUPERCLASS          : __EventConsumer
__DYNASTY             : __SystemClass
__RELPATH             : CommandLineEventConsumer.Name="ExecuteEvilPowerShell"
__PROPERTY_COUNT      : 27
__DERIVATION          : {__EventConsumer, __IndicationRelated, __SystemClass}
__SERVER              : W10B1
__NAMESPACE           : ROOT\subscription
__PATH                : \\W10B1\ROOT\subscription:CommandLineEventConsumer.Name="ExecuteEvilPowerShell"
**CommandLineTemplate   : powershell.exe -NoP -C "iex ([Text.Encoding]::Unicode.GetString([Convert]::FromBase64String((Get-ItemProperty -Path HKLM:\SOFTWARE\PayloadKey -Name PayloadValue).PayloadValue))"**
```

FilterToConsumerBinding

```
Get-WmiObject -Namespace root\subscription -Class __FilterToConsumerBinding
```

Result: [snip]

```
__NAMESPACE             : ROOT\subscription
**__PATH                  : \\W10B1\ROOT\subscription:__FilterToConsumerBinding.Consumer="CommandLineEventConsumer.Name=\"ExecuteEvilPowerShell\"",Filter="__EventFilter.Name=\"TimerTrigger\""**
**Consumer                : CommandLineEventConsumer.Name="ExecuteEvilPowerShell"**
CreatorSID              : {1, 5, 0, 0...}
DeliverSynchronously    : False
DeliveryQoS             :
**Filter                  : __EventFilter.Name="TimerTrigger"**
```

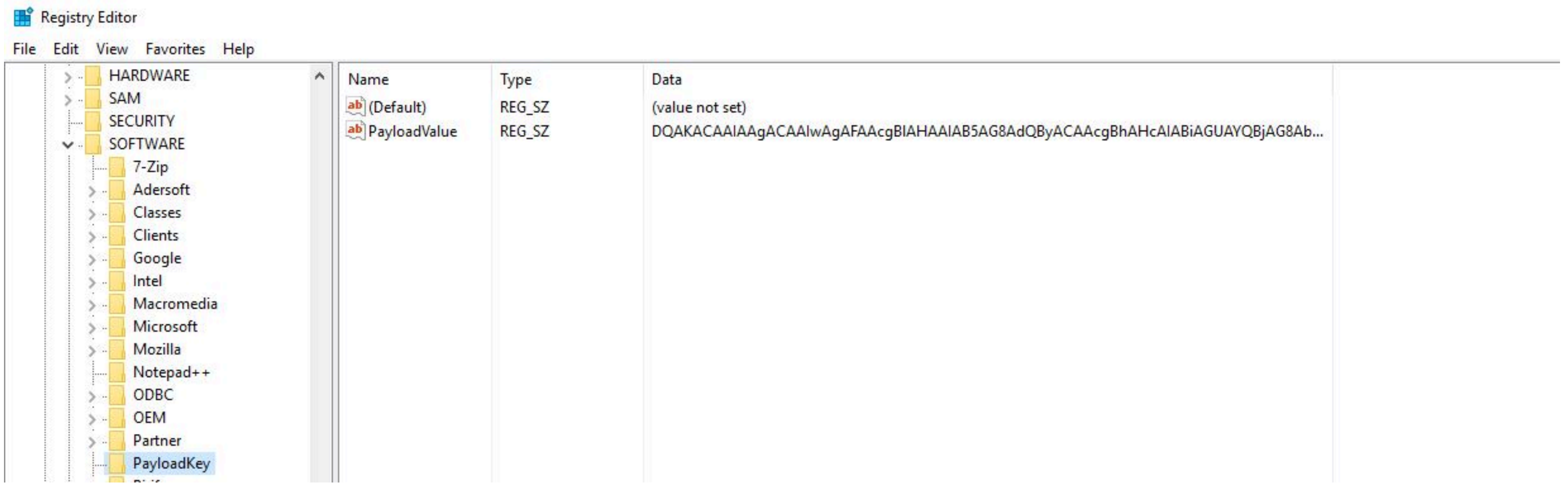
As we can observe, this persistence is based off a Timer *intrinsic* Event type. If you launched it and head to C:\ you will see the *payload_result.txt* file as per the script:

```
$TimerArgs = @{
    IntervalBetweenEvents = ([UInt32] 6000) # 6000 ms == 1 min
    SkipIfPassed = $False
    TimerId = $TimerName
}

$Payload = {
    # Prep your raw beacon stager along with Invoke-Shellcode here
    "Owned at $(Get-Date)" | Out-File C:\payload_result.txt
}
```

Let's look at the persistent registry key generated by the script via `Invoke-WmiMethod -Namespace root/default -Class StdRegProv -Name CreateKey -ArgumentList @($HiveVal, $PayloadKey)` (*creating the Registry Key*) & `Invoke-WmiMethod -Namespace root/default -Class StdRegProv -Name SetStringValue -ArgumentList @($HiveVal, $PayloadKey, $EncodedPayload, $PayloadValue)` (*storing the payload value inside the key*)

```
PS C:\Windows\system32> Get-ItemProperty 'HKLM:\SOFTWARE\PayloadKey'

PayloadValue : DQAKACAAIAAgACAAIwAgAFAAcgBlAHAAIAB5AG8AdQByACAAcgBhAHcAIABiAGUAYQBjAG8AbgAgAHMAdABhAGcAZQByACAAYQBsAG8AbgBnACAAdwBpAHQAaAAgAEkAbgB2AG8AawBlAC0AUwBoAGUAbABsAGMAbwBkAGUAIABoAGUAcgBlAA0ACgANAAoAIAAgACAAIAAiAE8AdwBuAGUAZAAgAGEAdAAgACQAKABHAGUAdAAtAEQAYQB0AGUAKQAiACAAfAAgAE8AdQB0AC0ARgBpAGwAZQAgAEMAOgBcAHAAYQB5AGwAbwBhAGQAXwByAGUAcwB1AGwAdAAuAHQAeAB0AA0ACgA=
PSPath       : Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SOFTWARE\PayloadKey
PSParentPath : Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SOFTWARE
```

Alternatively:



Registry Editor

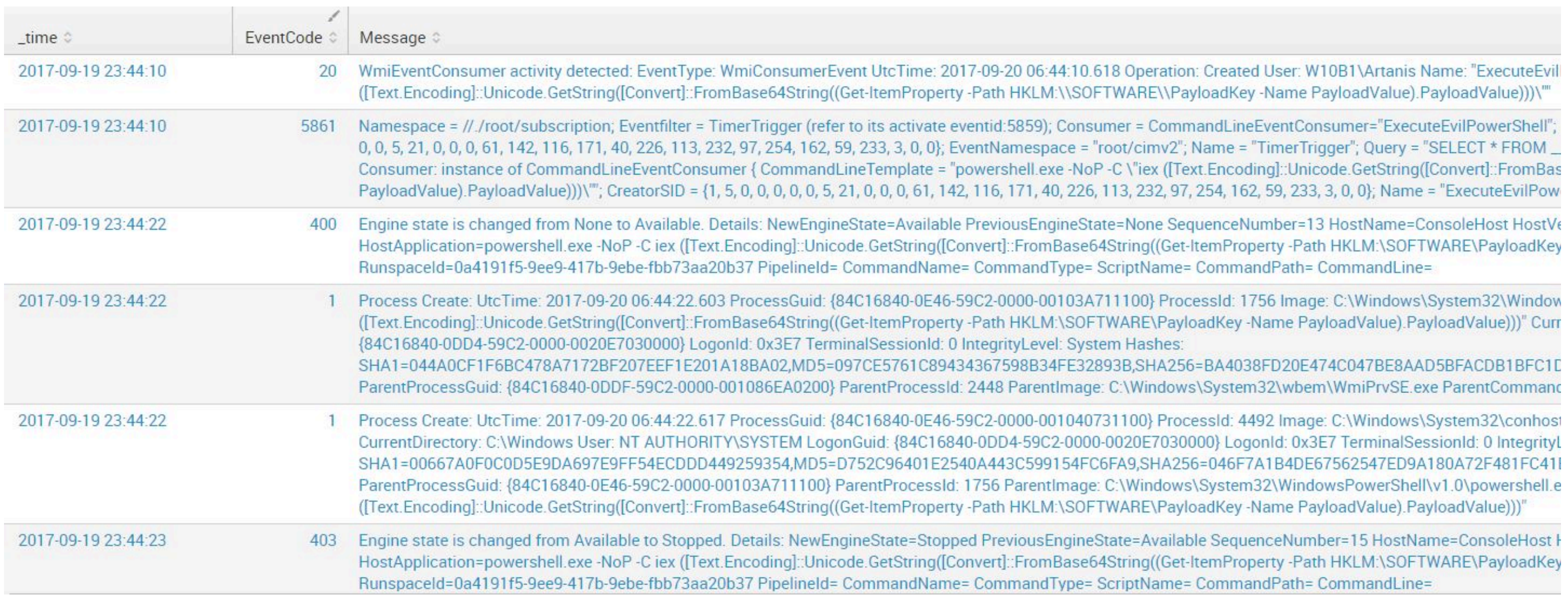
File Edit View Favorites Help

HARDWARE
SAM
SECURITY
SOFTWARE
7-Zip
Adersoft
Classes
Clients
Google
Intel
Macromedia
Microsoft
Mozilla
Notepad++
ODBC
OEM
Partner
PayloadKey

Name	Type	Data
(Default)	REG_SZ	(value not set)
PayloadValue	REG_SZ	DQAKACAAIAAgACAAIwAgAFAAcgBIAHAAIAB5AG8AdQByACAAcgBhAHcAIABiAGUAYQBjAG8Ab...

We can observe the BASE64 ciphered payload (hold on to this, as it will become one of our detection artifacts later).

Now let's throw in that juicy **iex** keyword to the Splunk mix and see what it comes up with: `Query: WmiPrvse OR powershell AND "iex" (NOT *google* NOT splunk NOT TargetImage=*powershell* NOT TargetImage=*wmiprvse* NOT TargetImage=*chrome* NOT TargetImage=*vmware* NOT EventCode=600) | reverse | table _time, EventCode, Message`



_time	EventCode	Message
2017-09-19 23:44:10	20	WmiEventConsumer activity detected: EventType: WmiConsumerEvent UtcTime: 2017-09-20 06:44:10.618 Operation: Created User: W10B1\Artanis Name: "ExecuteEvil ([Text.Encoding]::Unicode.GetString([Convert]::FromBase64String((Get-ItemProperty -Path HKLM:\\SOFTWARE\\PayloadKey -Name PayloadValue).PayloadValue)))\""
2017-09-19 23:44:10	5861	Namespace = //./root/subscription; Eventfilter = TimerTrigger (refer to its activate eventid:5859); Consumer = CommandLineEventConsumer="ExecuteEvilPowerShell"; 0, 0, 5, 21, 0, 0, 0, 61, 142, 116, 171, 40, 226, 113, 232, 97, 254, 162, 59, 233, 3, 0, 0}; EventNamespace = "root/cimv2"; Name = "TimerTrigger"; Query = "SELECT * FROM _ Consumer: instance of CommandLineEventConsumer { CommandLineTemplate = "powershell.exe -NoP -C \"iex ([Text.Encoding]::Unicode.GetString([Convert]::FromBas PayloadValue).PayloadValue)))\""; CreatorSID = {1, 5, 0, 0, 0, 0, 0, 5, 21, 0, 0, 0, 61, 142, 116, 171, 40, 226, 113, 232, 97, 254, 162, 59, 233, 3, 0, 0}; Name = "ExecuteEvilPow

2017-09-19 23:44:22	400	Engine state is changed from None to Available. Details: NewEngineState=Available PreviousEngineState=None SequenceNumber=13 HostName=ConsoleHost HostVe
		HostApplication=powershell.exe -NoP -C iex ([Text.Encoding]::Unicode.GetString([Convert]::FromBase64String((Get-ItemProperty -Path HKLM:\SOFTWARE\PayloadKey
		RunspaceId=0a4191f5-9ee9-417b-9ebe-fbb73aa20b37 PipelineId= CommandName= CommandType= ScriptName= CommandPath= CommandLine=

2017-09-19 23:44:22	1	Process Create: UtcTime: 2017-09-20 06:44:22.603 ProcessGuid: {84C16840-0E46-59C2-0000-00103A711100} ProcessId: 1756 Image: C:\Windows\System32\Window ([Text.Encoding]::Unicode.GetString([Convert]::FromBase64String((Get-ItemProperty -Path HKLM:\SOFTWARE\PayloadKey -Name PayloadValue).PayloadValue)))" Curr {84C16840-0DD4-59C2-0000-0020E7030000} LogonId: 0x3E7 TerminalSessionId: 0 IntegrityLevel: System Hashes: SHA1=044A0CF1F6BC478A7172BF207EEF1E201A18BA02,MD5=097CE5761C89434367598B34FE32893B,SHA256=BA4038FD20E474C047BE8AAD5BFACDB1BFC1D ParentProcessGuid: {84C16840-0DDF-59C2-0000-001086EA0200} ParentProcessId: 2448 ParentImage: C:\Windows\System32\wbem\WmiPrvSE.exe ParentCommand
2017-09-19 23:44:22	1	Process Create: UtcTime: 2017-09-20 06:44:22.617 ProcessGuid: {84C16840-0E46-59C2-0000-001040731100} ProcessId: 4492 Image: C:\Windows\System32\conhost CurrentDirectory: C:\Windows User: NT AUTHORITY\SYSTEM LogonGuid: {84C16840-0DD4-59C2-0000-0020E7030000} LogonId: 0x3E7 TerminalSessionId: 0 IntegrityL SHA1=00667A0F0C0D5E9DA697E9FF54ECDDD449259354,MD5=D752C96401E2540A443C599154FC6FA9,SHA256=046F7A1B4DE67562547ED9A180A72F481FC41 ParentProcessGuid: {84C16840-0E46-59C2-0000-00103A711100} ParentProcessId: 1756 ParentImage: C:\Windows\System32\WindowsPowerShell\v1.0\powershell.e ([Text.Encoding]::Unicode.GetString([Convert]::FromBase64String((Get-ItemProperty -Path HKLM:\SOFTWARE\PayloadKey -Name PayloadValue).PayloadValue)))"

2017-09-19 23:44:23	403	Engine state is changed from Available to Stopped. Details: NewEngineState=Stopped PreviousEngineState=Available SequenceNumber=15 HostName=ConsoleHost H
		HostApplication=powershell.exe -NoP -C iex ([Text.Encoding]::Unicode.GetString([Convert]::FromBase64String((Get-ItemProperty -Path HKLM:\SOFTWARE\PayloadKey
		RunspaceId=0a4191f5-9ee9-417b-9ebe-fbb73aa20b37 PipelineId= CommandName= CommandType= ScriptName= CommandPath= CommandLine=

We start observing some other interesting events popping up here. Disregarding Sysmon EventCode 20 (belongs to the new 6.10 version) which will be dissected later, we can see **5861** (Source: *Microsoft-Windows-WMI-Activity/Operational*), **400** (Source: *Windows Powershell* / Message: **Engine state is changed from None to Available**)[1] and 403 (Source: *Windows Powershell* / Message: **Engine state is changed from Available to Stopped**)[2]. All of them are standard Windows Events, I haven't "enabled" anything in particular here. I'm just farming what the OS already gives you by default.

The interesting thing about all these events is that they all reveal the powershell code used as payload: `powershell.exe -NoP -C iex ([Text.Encoding]::Unicode.GetString([Convert]::FromBase64String((Get-ItemProperty -Path HKLM:\SOFTWARE\PayloadKey -Name PayloadValue).PayloadValue)))`

— —

WMI Persistence via PowerLurk by Sw4mpf0x

We can reproduce the same Timer Triggered Event as above with more ease with this great script which allows for a lot of flexibility.

```
Register-MaliciousWMIEvent -EventName MaliciousWMIEvent -LocalScriptBlock {Invoke-Expression -Command "cmd /
c calc.exe"} -Trigger Interval -IntervalPeriod 60 -TimerId MaliciousTimer
```

this will simply start calc every 60 seconds and we can see the timer event

```
__GENUS                : 2
__CLASS                : __IntervalTimerInstruction
__SUPERCLASS           : __TimerInstruction
__DYNASTY              : __SystemClass
__RELPATH              : __IntervalTimerInstruction.TimerId="MaliciousTimer"
__PROPERTY_COUNT       : 3
__DERIVATION           : {__TimerInstruction, __EventGenerator, __IndicationRelated, __SystemClass}
__SERVER               : W10B1
__NAMESPACE            : ROOT\cimv2
__PATH                 : **\\W10B1\ROOT\cimv2:__IntervalTimerInstruction.TimerId="MaliciousTimer"**
IntervalBetweenEvents : 60000
SkipIfPassed           : False
TimerId                : MaliciousTimer
PSComputerName         : W10B1
```

Let’s go ahead and remove it though:

```
Get-WMIObject -Namespace root\Subscription -Class __FilterToConsumerBinding | Remove-WmiObject -Verbose
Get-WMIObject -Namespace root\Subscription -Class __EventFilter | Remove-WmiObject -Verbose
Get-WMIObject -Namespace root\Subscription -Class __EventConsumer | Remove-WmiObject -Verbose
Get-WmiObject -Class __IntervalTimerInstruction | Remove-WmiObject -Verbose
```

We can do many more things, but this post is mainly about how to detect such sneaky persistence mechanisms, so let’s go ahead and grab our majestic *free* install of Splunk Enterprise with a 60 day trial and let’s make use of our best friend Sysmon the Great.

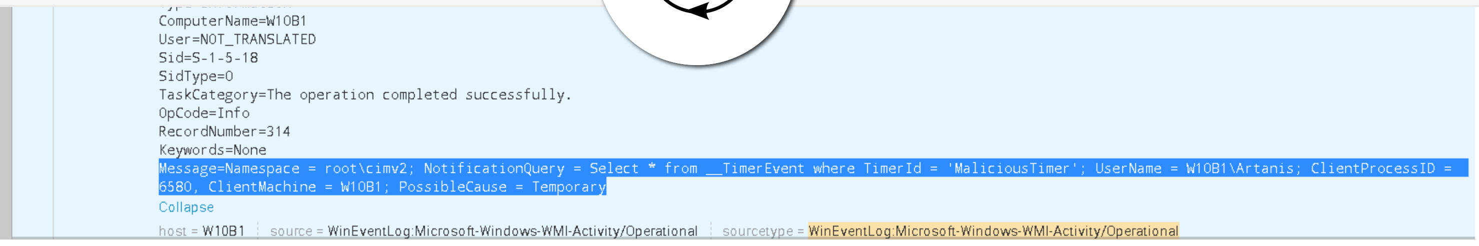
WMI Persistence Detection

For the purposes of this test, I’ve used a “log all” approach with Sysmon, you can find a sample config file here (*Threat Hunting Ecosystem as a Code* is my next project, don’t look at it yet, it’s ugly!)

So let’s go ahead and create a new TimerEvent and see what our logs come up with. We shall use the following search:

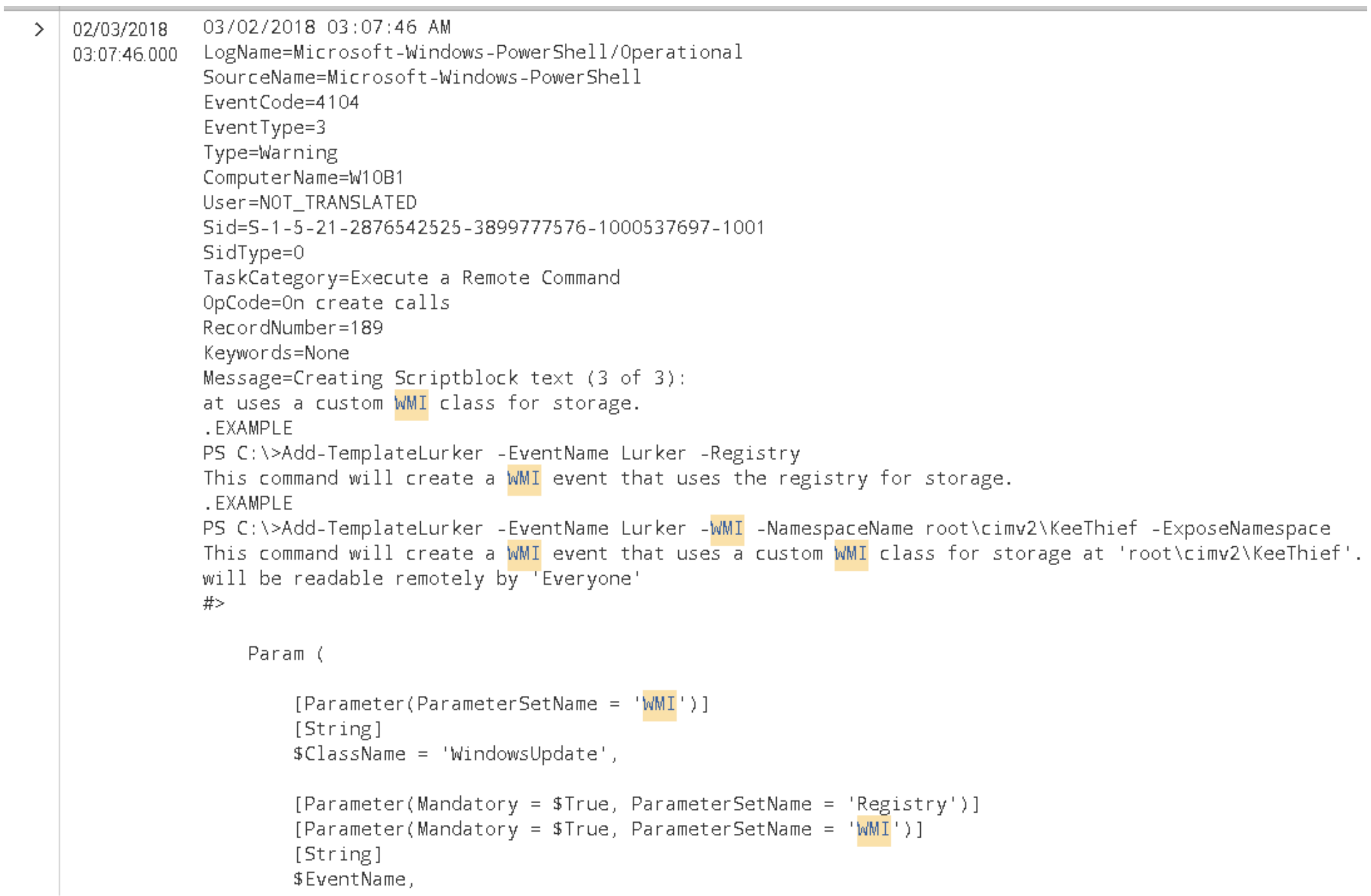
```
LogName=Microsoft-Windows-WMI-Activity/Operational AND NOT EventCode=5858 AND NOT "sysmon"
```

1. First thing we notice is that Windows already comes with a default “WMI-Event Detector” which is **Event Id 5860** in the *Microsoft-Windows-WMI-Activity/Operational* Log



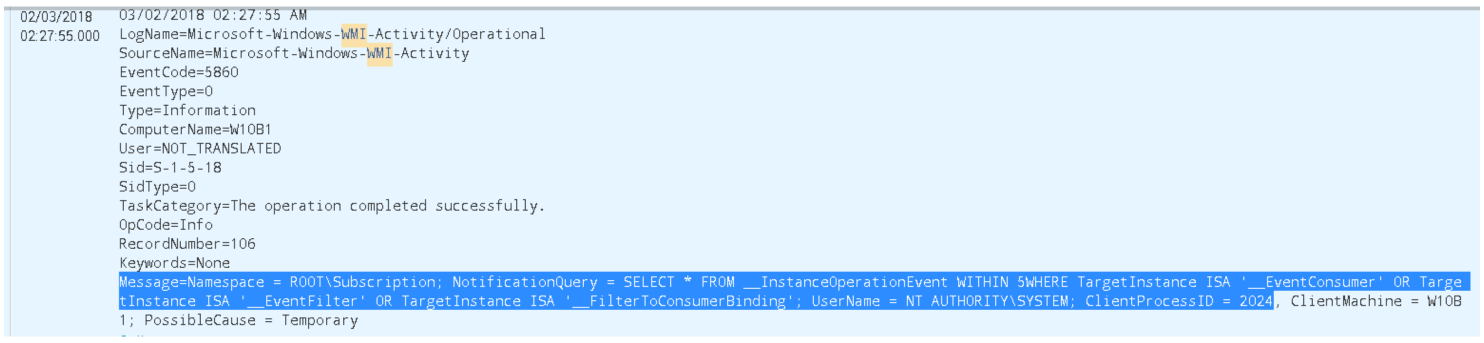
```
ComputerName=W10B1
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
TaskCategory=The operation completed successfully.
OpCode=Info
RecordNumber=314
Keywords=None
Message=Namespace = root\cimv2; NotificationQuery = Select * from __TimerEvent where TimerId = 'MaliciousTimer'; UserName = W10B1\Artanis; ClientProcessID =
6580, ClientMachine = W10B1; PossibleCause = Temporary
Collapse
host = W10B1   source = WinEventLog:Microsoft-Windows-WMI-Activity/Operational   sourcetype = WinEventLog:Microsoft-Windows-WMI-Activity/Operational
```

2. Second, becase I am running Powershell v5, Script Block Auditing is enabled by default, hence, the malicious script was also captured:



```
>  02/03/2018    03/02/2018 03:07:46 AM
   03:07:46.000  LogName=Microsoft-Windows-PowerShell/Operational
                 SourceName=Microsoft-Windows-PowerShell
                 EventCode=4104
                 EventType=3
                 Type=Warning
                 ComputerName=W10B1
                 User=NOT_TRANSLATED
                 Sid=S-1-5-21-2876542525-3899777576-1000537697-1001
                 SidType=0
                 TaskCategory=Execute a Remote Command
                 OpCode=On create calls
                 RecordNumber=189
                 Keywords=None
                 Message=Creating Scriptblock text (3 of 3):
                 at uses a custom WMI class for storage.
                 .EXAMPLE
                 PS C:\>Add-TemplateLurker -EventName Lurker -Registry
                 This command will create a WMI event that uses the registry for storage.
                 .EXAMPLE
                 PS C:\>Add-TemplateLurker -EventName Lurker -WMI -NamespaceName root\cimv2\KeeThief -ExposeNamespace
                 This command will create a WMI event that uses a custom WMI class for storage at 'root\cimv2\KeeThief'.
                 will be readable remotely by 'Everyone'
                 #>

                     Param (

                         [Parameter(ParameterSetName = 'WMI')]
                         [String]
                         $ClassName = 'WindowsUpdate',

                         [Parameter(Mandatory = $True, ParameterSetName = 'Registry')]
                         [Parameter(Mandatory = $True, ParameterSetName = 'WMI')]
                         [String]
                         $EventName,
```

3. We also notice via another Event Id 5860 that some application with the Process Id 2024 issued a query to the WMI provider:



```
02/03/2018    03/02/2018 02:27:55 AM
02:27:55.000  LogName=Microsoft-Windows-WMI-Activity/Operational
              SourceName=Microsoft-Windows-WMI-Activity
              EventCode=5860
              EventType=0
              Type=Information
              ComputerName=W10B1
              User=NOT_TRANSLATED
              Sid=S-1-5-18
              SidType=0
              TaskCategory=The operation completed successfully.
              OpCode=Info
              RecordNumber=106
              Keywords=None
              Message=Namespace = ROOT\Subscription; NotificationQuery = SELECT * FROM __InstanceOperationEvent WITHIN 5WHERE TargetInstance ISA '__EventConsumer' OR Targe
              tInstance ISA '__EventFilter' OR TargetInstance ISA '__FilterToConsumerBinding'; UserName = NT AUTHORITY\SYSTEM; ClientProcessID = 2024, ClientMachine = W10B
              1; PossibleCause = Temporary
```

Who is this guy?

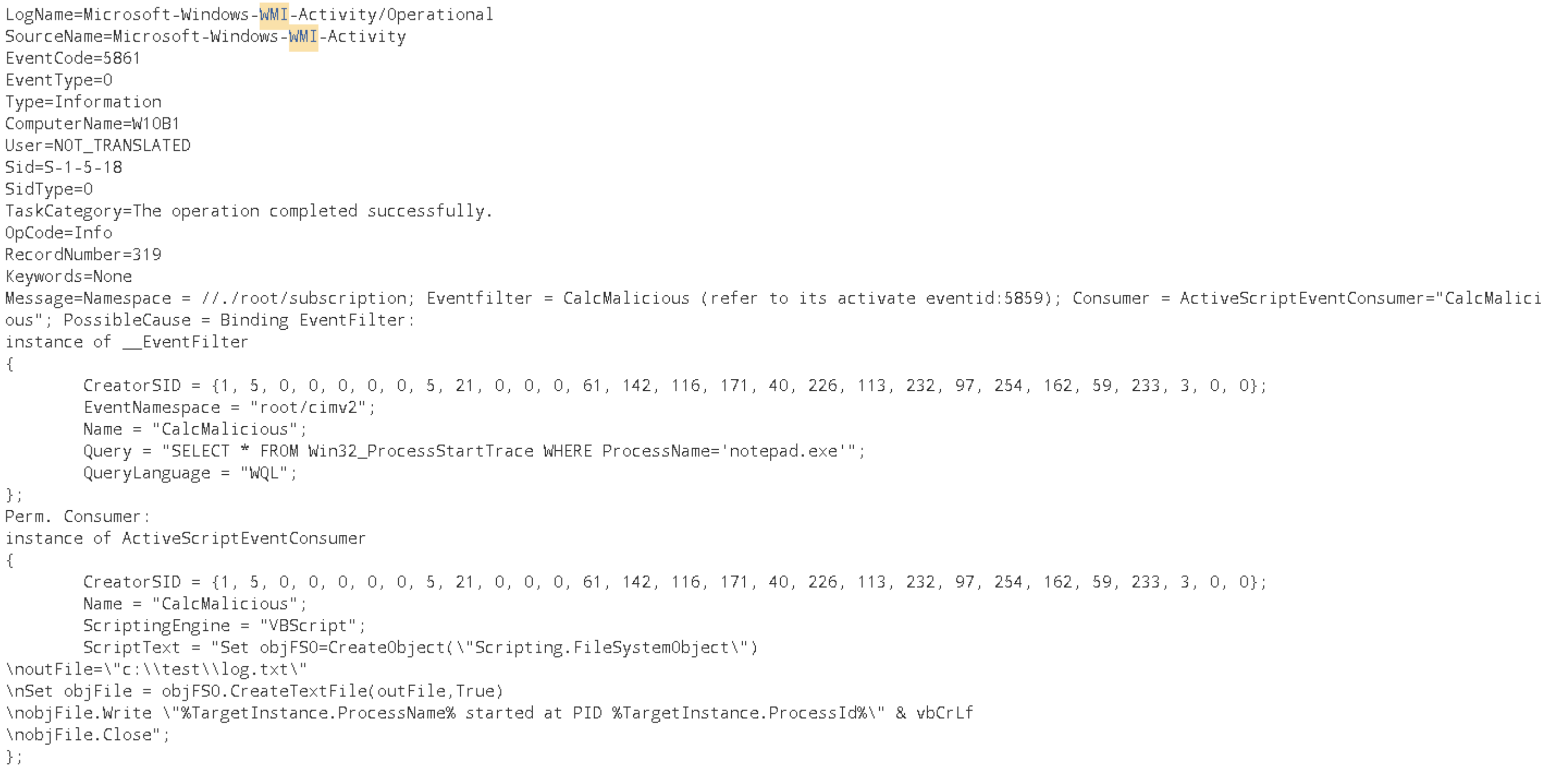
```
PS C:\WINDOWS\system32> Get-Process -Id 2024

Handles  NPM(K)    PM(K)      WS(K)     CPU(s)     Id  SI ProcessName
-------  ------    -----      -----     ------     --  -- -----------
    425      20    22676      21804     174.56   2024   0 Sysmon64
```

> **Note:** TL;DR. Well it seems that the new capability added by Sysmon to monitor WMI Events (SYSMON EVENT ID 19 & 20 & 21 : WMI EVENT MONITORING [WmiEvent]) is nothing else but a few queries issued to the WMI service which are then reported back to their own log space (Sysmon/Operational). Essentially sysmon is *registering itself here as a subscriber for intrinsic events*. This pretty much means Sysmon is duplicating on effort here, since Windows already comes with native events to detect WMI operations. It doesn't mean though that this feature is plain redundant, since our logging architecture could be

> The only problem we noticed here is that, for Timer-based WMI Events, **sysmon wasn't generating any logs**. So *you need to monitor Windows Event Id 5859/5861 if you want to catch those.*

What would happen if we create a script event consumer?

```
$script = @'
Set objFSO=CreateObject("Scripting.FileSystemObject")
outFile="c:\test\log.txt"
Set objFile = objFSO.CreateTextFile(outFile,True)
objFile.Write "%TargetInstance.ProcessName% started at PID %TargetInstance.ProcessId%" & vbCrLf
objFile.Close
'@

Register-MaliciousWmiEvent -EventName CalcMalicious -PermanentScript $script -Trigger ProcessStart -ProcessN
ame notepad.exe -ScriptingEngine VBScript
```



```
LogName=Microsoft-Windows-WMI-Activity/Operational
SourceName=Microsoft-Windows-WMI-Activity
EventCode=5861
EventType=0
Type=Information
ComputerName=W10B1
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
TaskCategory=The operation completed successfully.
OpCode=Info
RecordNumber=319
Keywords=None
Message=Namespace = //./root/subscription; Eventfilter = CalcMalicious (refer to its activate eventid:5859); Consumer = ActiveScriptEventConsumer="CalcMalici
ous"; PossibleCause = Binding EventFilter:
instance of __EventFilter
{
        CreatorSID = {1, 5, 0, 0, 0, 0, 0, 5, 21, 0, 0, 0, 61, 142, 116, 171, 40, 226, 113, 232, 97, 254, 162, 59, 233, 3, 0, 0};
        EventNamespace = "root/cimv2";
        Name = "CalcMalicious";
        Query = "SELECT * FROM Win32_ProcessStartTrace WHERE ProcessName='notepad.exe'";
        QueryLanguage = "WQL";
};
Perm. Consumer:
instance of ActiveScriptEventConsumer
{
        CreatorSID = {1, 5, 0, 0, 0, 0, 0, 5, 21, 0, 0, 0, 61, 142, 116, 171, 40, 226, 113, 232, 97, 254, 162, 59, 233, 3, 0, 0};
        Name = "CalcMalicious";
        ScriptingEngine = "VBScript";
        ScriptText = "Set objFSO=CreateObject(\"Scripting.FileSystemObject\")
\noutFile=\"c:\\test\\log.txt\"
\nSet objFile = objFSO.CreateTextFile(outFile,True)
\nobjFile.Write \"%TargetInstance.ProcessName% started at PID %TargetInstance.ProcessId%\" & vbCrLf
\nobjFile.Close";
};
```

As we can observe, this pretty handy Windows Event Id **5861** provides all the information pertaining to the FilterToConsumerBinding, the EventConsumer and EventFilter

We also observe Windows Event Id **5859** showing the EventFilter which is effectively registered in the NotificationQueue:

```
LogName=Microsoft-Windows-WMI-Activity/Operational
SourceName=Microsoft-Windows-WMI-Activity
EventCode=5859
EventType=0
Type=Information
ComputerName=W10B1
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
TaskCategory=The operation completed successfully.
OpCode=Info
RecordNumber=321
Keywords=None
Message=Namespace = //./root/CIMV2; NotificationQuery = SELECT * FROM Win32_ProcessStartTrace WHERE ProcessN
```

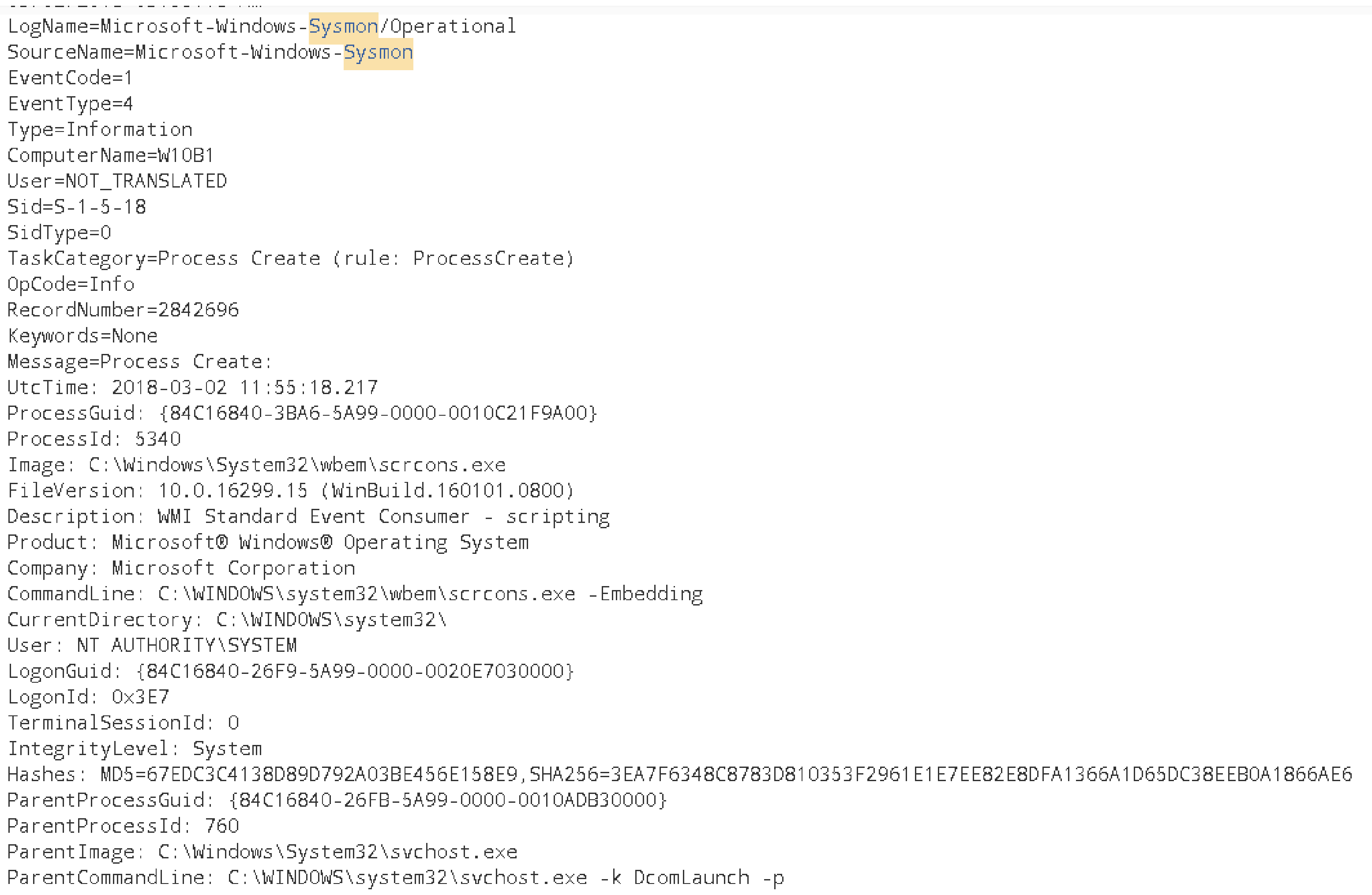
And one other small but important piece o ion is the presence of Event Id **5857** which is telling us who the provider is (an executable) whose task is to carry out the actions determined in the EventConsumer class:

```
LogName=Microsoft-Windows-WMI-Activity/Operational
SourceName=Microsoft-Windows-WMI-Activity
EventCode=5857
EventType=0
Type=Information
ComputerName=W10B1
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
TaskCategory=The operation completed successfully.
OpCode=Info
RecordNumber=322
Keywords=None
Message=ActiveScriptEventConsumer provider started with result code 0x0. HostProcess = wmiprvse.exe; Process
ID = 972; ProviderPath = %SystemRoot%\system32\wbem\scrcons.exe
```

Let’s commit that to memory for a second: **%SystemRoot%\system32\wbem\scrcons.exe**. What the event is telling us is the executable in charge of running our script. Riding the Google brave horses I was able to obtain good answers from the Internet Elders: https://msdn.microsoft.com/en-us/library/aa940177(v=winembedded.5).aspx Here it says that these are the handlers for common event consumers:

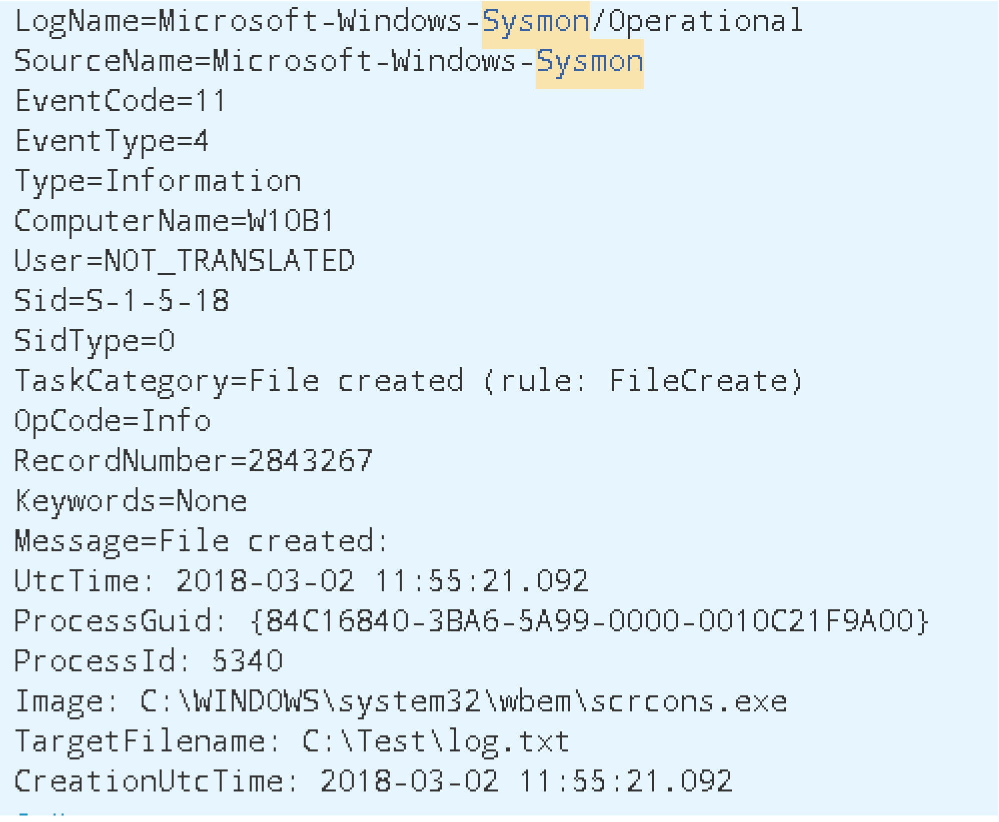
```
    Scrcons.exe. ActiveScriptEventConsumer
    Smtpcons.dll. SMTPEventConsumer
    Wbemcons.dll. CommandLineEventConsumer, NTEventLogEventConsumer, LogFileEventConsumer
```

So essentially, even if you are **NOT** monitoring for either **Sysmon Events 19, 20 & 21** or Windows native Events in the **WMI/Operational** space Ids **5857, 5859, 5860 & 5861**, you can **still** detect the presence of potentially malicious WMI persistence by leveraging the event consumer handlers listed above. Let’s ask Sysmon for *Scrcons.exe*



```
LogName=Microsoft-Windows-Sysmon/Operational
SourceName=Microsoft-Windows-Sysmon
EventCode=1
EventType=4
Type=Information
ComputerName=W10B1
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
TaskCategory=Process Create (rule: ProcessCreate)
OpCode=Info
RecordNumber=2842696
Keywords=None
Message=Process Create:
UtcTime: 2018-03-02 11:55:18.217
ProcessGuid: {84C16840-3BA6-5A99-0000-0010C21F9A00}
ProcessId: 5340
Image: C:\Windows\System32\wbem\scrcons.exe
FileVersion: 10.0.16299.15 (WinBuild.160101.0800)
Description: WMI Standard Event Consumer - scripting
Product: Microsoft® Windows® Operating System
Company: Microsoft Corporation
CommandLine: C:\WINDOWS\system32\wbem\scrcons.exe -Embedding
CurrentDirectory: C:\WINDOWS\system32\
User: NT AUTHORITY\SYSTEM
LogonGuid: {84C16840-26F9-5A99-0000-0020E7030000}
LogonId: 0x3E7
TerminalSessionId: 0
IntegrityLevel: System
Hashes: MD5=67EDC3C4138D89D792A03BE456E158E9,SHA256=3EA7F6348C8783D810353F2961E1E7EE82E8DFA1366A1D65DC38EEB0A1866AE6
ParentProcessGuid: {84C16840-26FB-5A99-0000-0010ADB30000}
ParentProcessId: 760
ParentImage: C:\Windows\System32\svchost.exe
ParentCommandLine: C:\WINDOWS\system32\svchost.exe -k DcomLaunch -p
```

scrcons.exe returns a Sysmon Event Id 11 (File created) event where our little friend created a file.



```
LogName=Microsoft-Windows-Sysmon/Operational
SourceName=Microsoft-Windows-Sysmon
EventCode=11
EventType=4
Type=Information
ComputerName=W10B1
User=NOT_TRANSLATED
Sid=S-1-5-18
SidType=0
TaskCategory=File created (rule: FileCreate)
OpCode=Info
RecordNumber=2843267
Keywords=None
Message=File created:
UtcTime: 2018-03-02 11:55:21.092
ProcessGuid: {84C16840-3BA6-5A99-0000-0010C21F9A00}
ProcessId: 5340
Image: C:\WINDOWS\system32\wbem\scrcons.exe
TargetFilename: C:\Test\log.txt
CreationUtcTime: 2018-03-02 11:55:21.092
```

If we were expecting to see this file, written to disk by wscript.exe we will be disappointed

— —

This time though, Sysmon seems to have noticed that a malicious event subscription was created and here we have it:

```
Get-WinEvent -FilterHashtable @{logname="Microsoft-Windows-Sysmon/Operational";id=20} | Select-Object -Expan
dProperty Message

WmiEventConsumer activity detected:
EventType: WmiConsumerEvent
UtcTime: 2018-03-02 14:17:53.442
Operation: Created
User: W10B1\Artanis
Name:  "CalcMalicious"
Type: Script
Destination:  "Set objFSO=CreateObject(\"Scripting.FileSystemObject\")\noutFile=\"c:\\test\\log.txt\"\nSet o
bjFile = objFSO.Cre
ateTextFile(outFile,True)\nobjFile.Write \"%TargetInstance.ProcessName% started at PID %TargetInstance.Proce
ssId%\" & vbCrLf\no
bjFile.Close"
```

If you are using Sysmon events to monitor for WMI event subscriptions, you only need to capture the results of **Event Id 19** as it will display the *event consumer* which is were the juicy information is that allows us to discriminate benign from malicious.

What happens if we instead create a CommandLine Event Subscription instead of a Script based one? The command would look like this with PowerLurk:

```
Register-MaliciousWmiEvent -EventName LogCalc1 -PermanentCommand “cmd.exe /c msg Artanis This is Persistenc
e!” -Trigger ProcessStart -ProcessName calculator.exe
```

module by *WmiPrvse.exe* is **extremely rare**, so pay attention to those if you are not monitoring WMI/Operational native Windows events.

I will leave it as an exercise to the reader to investigate which events are generated by creating a CommandLine Event Consumer.

What about DFIR?

It happens to be the case that any permanent event subscription gets written to a WMI database file called OBJECTS.DATA that can be located here:

- C:\Windows\System32\wbem\Repository\OBJECTS.DATA
- C:\Windows\System32\wbem\Repository\FS\OBJECTS.DATA

It turns out that the information pertaining WMI event subscriptions can be located there in plain text. The file has a binary format and its structure, AFAIK, is undocumented. However, there are a few out there that were brave enough to come up with some cool python scripts that make use of `The Sword of RegEx The Great and Meticulous` that allow for parsing of these files, namely:

- https://github.com/darkquasar/WMI_Persistence (developed by me)
- https://github.com/davidpany/WMI_Forensics (David Pany script)
- https://github.com/fireeye/flare-wmi (a few scripts by FireEye analysts)

So even if you are (*well… luckily after reading this post "were"*) not collecting any WMI telemetry data in your environment, you can still go out there and hunt for these threats by collecting all the **OBJECTS.DATA** files in your hosts. The scripts listed above allow for easy parsing of a folder full of these files so the heavy lifting will be on the *collecting* side of things ;)

Detection Logics & Lessons Learned

You may think that WMI fileless persistence and malware execution mechanisms are a very low risk threat thus spending business cycles into creating a detection for this drops way down the list of priorities. It is, however, **an extremely easy to detect tactic** and if your priority list is not packed with threat scenarios like this one then you are not putting together a proper list!

> We all know looking at detailed TTPs is a tedious process, but only by adopting a systemic approach you will be able to extend your detection & prevention surface. It's an ants work, mixed with that of a dragon
>
> — —

So, to summarize

Sysmon Event Id 11 (File Write) where "Image" is "C:\WINDOWS\system32\wbem\scrcons.exe".	files written by the script event consumer handler	Environments with Sysmon monitoring
Sysmon Event Id 1 where "ParentImage" is C:\Windows\System32\svchost.exe AND Image is "C:\WINDOWS\system32\wbem\scrcons.exe". Alternatively Windows Security Log Event ID 4688 (Process Created) can also be monitored.	Instances of an Active Script Event Consumer WMI Persistence	When you are not monitoring Windows native WMI/Operational events OR,when a malicious actor disabled native windows event logging and you have another technology in place (for example EDR)
Sysmon Event Id 7 where "Image" is C:\Windows\System32\wbem\WmiPrvSE.exe AND "ImageLoaded" contains "wbemcons.dll".	Instances of an Active CommandLine Event Consumer Persistence	When you are not monitoring Windows native WMI/Operational events,OR,when a malicious actor disabled native windows event logging and you,have another technology in place (for example EDR)
Windows Event Id 5859 in WMI-Activity/Operational	Suspicious Event Consumers	Environments with no Sysmon monitoring using solely native Windows Events OR for Intrinsic Timer Events (Sysmon doesn't catch those!)
Windows Event Id 5861 in WMI-Activity/Operational	Suspicious Event Filters	Environments with no Sysmon monitoring using solely native Windows Events OR for Intrinsic Timer

Hopefully in my next post I will resume the Mimikatz one and then I will jump into Meterpreter detections ;)

Changes to your Sysmon Config

We will add a tag for the new event that has a pretty tight condition: it will only collect WMI events when they are created. This way, the FP ratio is reduced to a minimum, but as a trade off you need to be really paying attention and treat Alarms pertaining to these events as critical *always*.

```
<!--SYSMON EVENT ID 19,20,21 : WMIEvent-->
<WmiEvent onmatch="include">
        <Operation condition="is">Created</Operation>
</WmiEvent>
```

Some references

- Malware using WMI Persistence: WMIGhost / Actors: APT29POSHSPY
- Yeap, cryptominers WMI'ing the sh!@# out of Browsers
- This dude man! mattifestation
- List of modules involved in each WMI event https://msdn.microsoft.com/en-us/library/aa940177(v=winembedded.5).aspx
- https://msdn.microsoft.com/en-us/library/aa392282(v=vs.85).aspx This explains how to create an NTEventLogEventConsumer class and how to setup one of its properties (insertionstrings) to a string. It also does this via MOF and compiling the MOF. The MOF then is embedded in OBJECTS.DATA. WMIPers is not parsing the "_EventConsumer" for these events very well, must look into that. The interesting thing though is that you could store anything in those "strings", why not a payload?
- https://msdn.microsoft.com/en-us/library/aa393016(v=vs.85).aspx Ability to register EventConsumers and EventFilters can be restricted by setting the EventAccess attribute of the EventFilter instance.

arrivederci my friends, wine and fettuccine awaits!

EventCode 400 sample contents

```
09/19/2017 11:44:22 PM
LogName=Windows PowerShell
SourceName=PowerShell
EventCode=400
EventType=4
Type=Information
ComputerName=W10B1
TaskCategory=Engine Lifecycle
OpCode=Info
RecordNumber=56
Keywords=Classic
Message=Engine state is changed from None to Available.

Details:
        NewEngineState=Available
        PreviousEngineState=None
        HostId=9ebd19fb-d695-44ec-a9b1-51d48db8b1
        HostApplication=powershell.exe -NoP -C iex ([Text.Encoding]::Unicode.GetString([Convert]::FromBase64
String((Get-ItemProperty -Path HKLM:\SOFTWARE\PayloadKey -Name PayloadValue).PayloadValue)))
        EngineVersion=5.1.14393.206
        RunspaceId=0a4191f5-9ee9-417b-9ebe-fbb73aa20b37
        PipelineId=
        CommandName=
        CommandType=
        ScriptName=
        CommandPath=
        CommandLine=
```

EventCode 403 sample contents

```
09/19/2017 11:44:23 PM
LogName=Windows PowerShell
SourceName=PowerShell
EventCode=403
EventType=4
Type=Information
ComputerName=W10B1
TaskCategory=Engine Lifecycle
OpCode=Info
RecordNumber=57
Keywords=Classic
Message=Engine state is changed from Available to Stopped.

Details:
        NewEngineState=Stopped
        PreviousEngineState=Available

        SequenceNumber=15

        HostName=ConsoleHost
        HostVersion=5.1.14393.206
        HostId=9ebd19fb-d695-44ec-a9b1-51d48db8b1ef
        HostApplication=powershell.exe -NoP -C iex ([Text.Encoding]::Unicode.GetString([Convert]::FromBase64
String((Get-ItemProperty -Path HKLM:\SOFTWARE\PayloadKey -Name PayloadValue).PayloadValue)))
        EngineVersion=5.1.14393.206
        RunspaceId=0a4191f5-9ee9-417b-9ebe-fbb73aa20b37
        PipelineId=
        CommandName=
        CommandType=
        ScriptName=
        CommandPath=
        CommandLine=
```

[1] EventCode 400 sample contents: ↩

[2] EventCode 403 sample contents: ↩

Tags: threat hunting, hunting, wmi, windows management instrumentation, backdoor, persistene, siem, ioc, splunk, elk, darkquasar, volatility

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