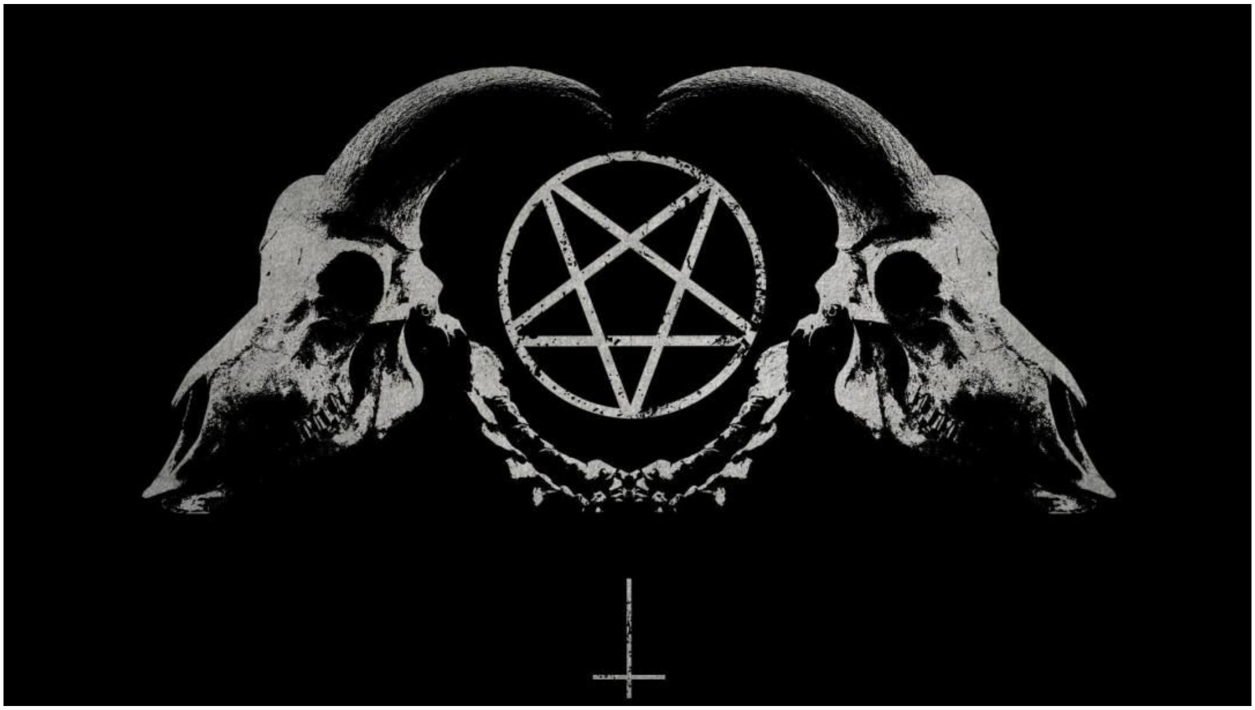
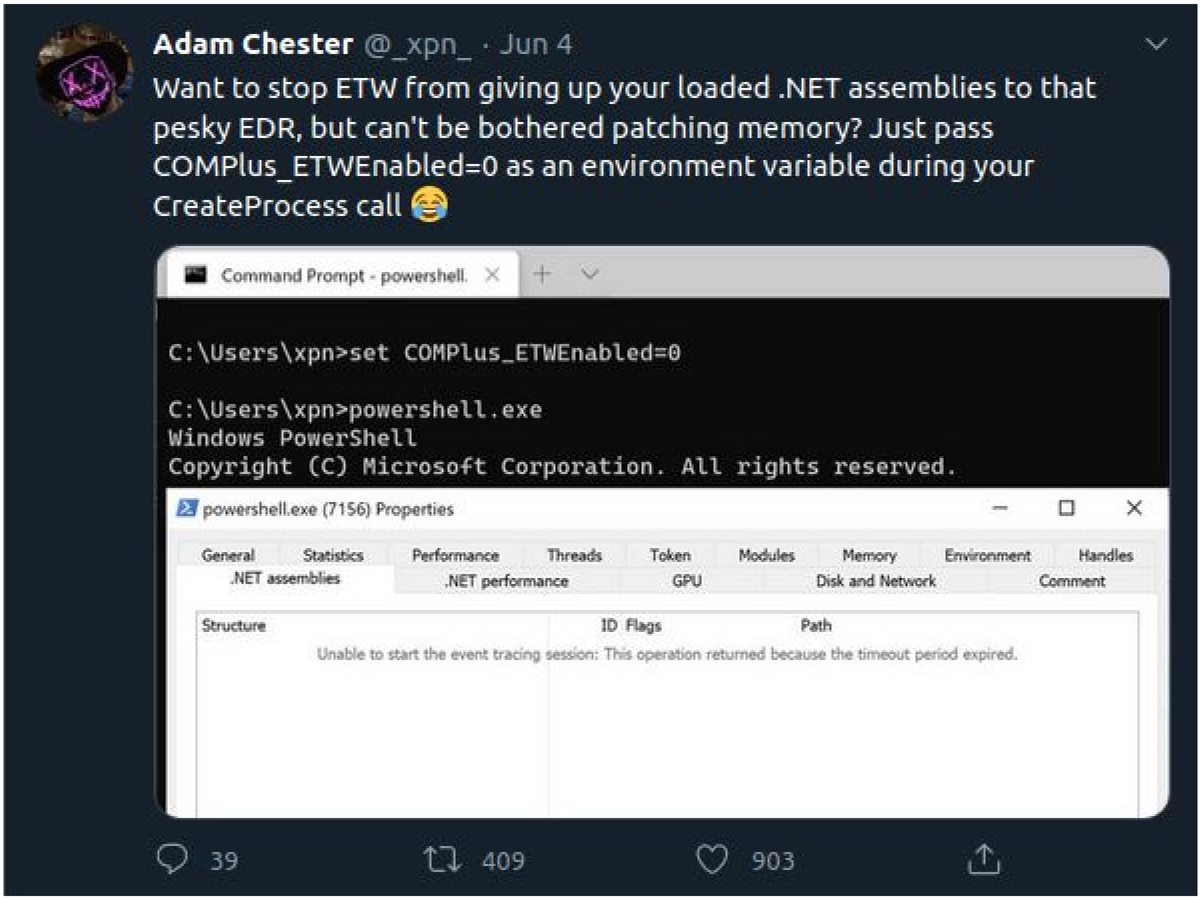
# Hiding your .NET - COMPlus_ETWEnabled

vx-underground collection //_xpn_



The process of disabling ETW is something that I first looked at back in March after trying to figure out just how some defenders were detecting in-memory Assembly loads (https://blog.xpnsec.com/hiding-your-dotnet-etw/). There have since been several other posts with clever and improved methods of bypassing this kind of detection from some awesome researchers including Cneeliz, BatSec and modexp. Each method relies on manipulating the ETW subsytem itself, from intercepting and manipulating calls to the usermode function EtwEventWrite or the kernel function NtTraceEvent, and even parsing and manipulating the ETW registration table to avoid any code patching.

It turns out however that there is also a further method of disabling ETW in .NET, strangely exposed by setting an environment variable of COMPlus_ETWEnabled=0:



Adam Chester @_xpn_ · Jun 4

Want to stop ETW from giving up your loaded .NET assemblies to that pesky EDR, but can't be bothered patching memory? Just pass COMPlus_ETWEnabled=0 as an environment variable during your CreateProcess call 😂

```
C:\Users\xpn>set COMPlus_ETWEnabled=0

C:\Users\xpn>powershell.exe
Windows PowerShell
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```

powershell.exe (7156) Properties

Unable to start the event tracing session: This operation returned because the timeout period expired.

Now since posting this method I have been asked quite a few questions, mostly focusing on how this particular setting was found as well as how it works. So in this short post I wanted to cover some of those details for anyone interested in peeking under the hood.

Before we begin to look at this however it is worth commenting on the fact that ETW was never meant to serve as a security control, which helps to explain some of the things shown in this post. Its primary purpose is as a debugging tool, but as attackers have evolved their payload execution techniques, it seems that some defenders turned to the power of ETW as a way of surfacing information on events like .NET Assembly loads. It is because of ETW's original purpose that we come across things like COMPlus_ETWEnabled which might seem like a toggle for security auditing... when in fact it's just a simple way to turn off some debugging functionality.

## So what is this COMPlus_ prefix thing?

COMPlus_ prefixed settings provide developers with a number of configuration options which can be set at runtime with various levels of impact on the CLR, from loading alternative JITters, to tweaking performance and even dumping the IL of a method. Being provided via environment variables or registry values, many of these settings are undocumented, with one of the best resources for understanding each being the CoreCLR source, specifically clrconfigvalues.h.

Now if you take a quick look at this file you might notice that COMPlus_ETWEnabled isn't present. It actually turns out that this was removed from the CoreCLR in an earlier commit here on 31 May 2019.

As with many undocumented features, these settings provide some interesting functionality for us attackers. It's worth pointing out however that unsurprisingly these settings don't always follow the COMPlus_ prefix naming as we can see from this FullDisclosure post from 2007 which used a setting named COR_PROFILER to achieve a UAC bypass in MMC.exe.

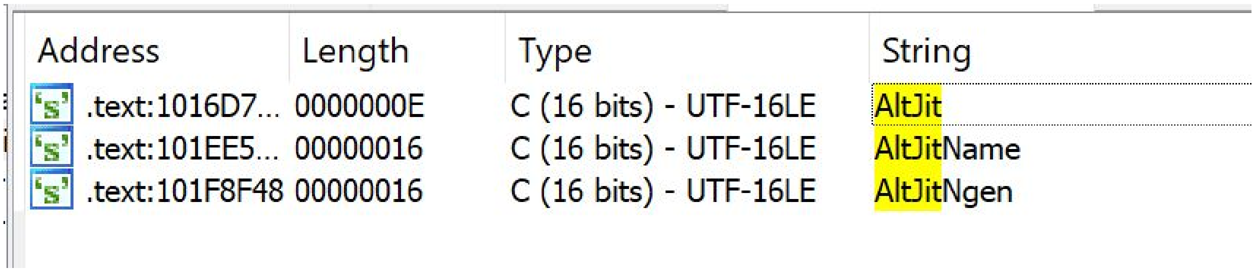
So now that we know just why these settings exist and how to list them, let's look at how this particular one was found.

## Finding COMPlus_ETWEnabled

Although there are a lot of settings shown in the CoreCLR source, many do not apply to the standard .NET Framework we're all familiar with.

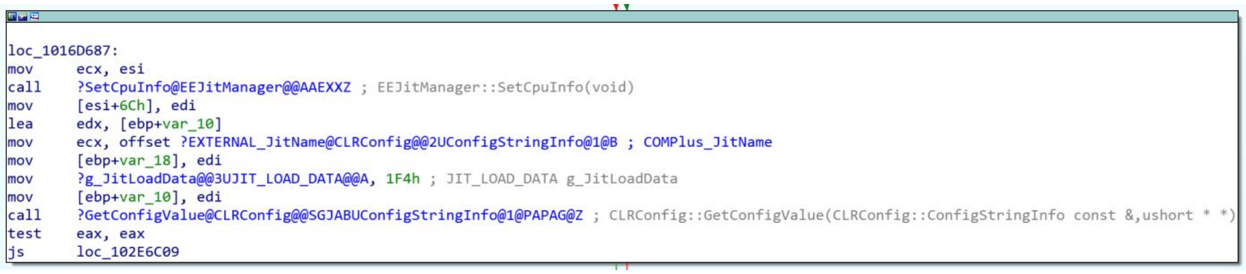
To determine which COMPlus_ settings apply to the .NET Framework, we can simply hunt within  clr.dll for any references, such as the COMPlus_AltJit setting documented in clrconfigvalues.h.

Removing the prefix and performing a simple string search in IDA is enough to give us an indication that AltJit is likely present within clr.dll:



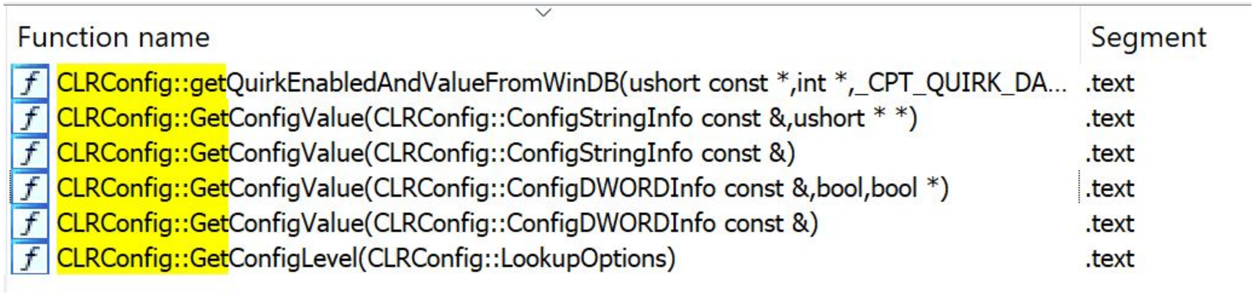
| Address | Length | Type | String |
|---|---|---|---|
| .text:1016D7... | 0000000E | C (16 bits) - UTF-16LE | AltJit |
| .text:101EE5... | 00000016 | C (16 bits) - UTF-16LE | AltJitName |
| .text:101F8F48 | 00000016 | C (16 bits) - UTF-16LE | AltJitNgen |

Following references to this string leads us to a method of CLRConfig::GetConfigValue which is passed our setting name as a parameter to retrieve the value:



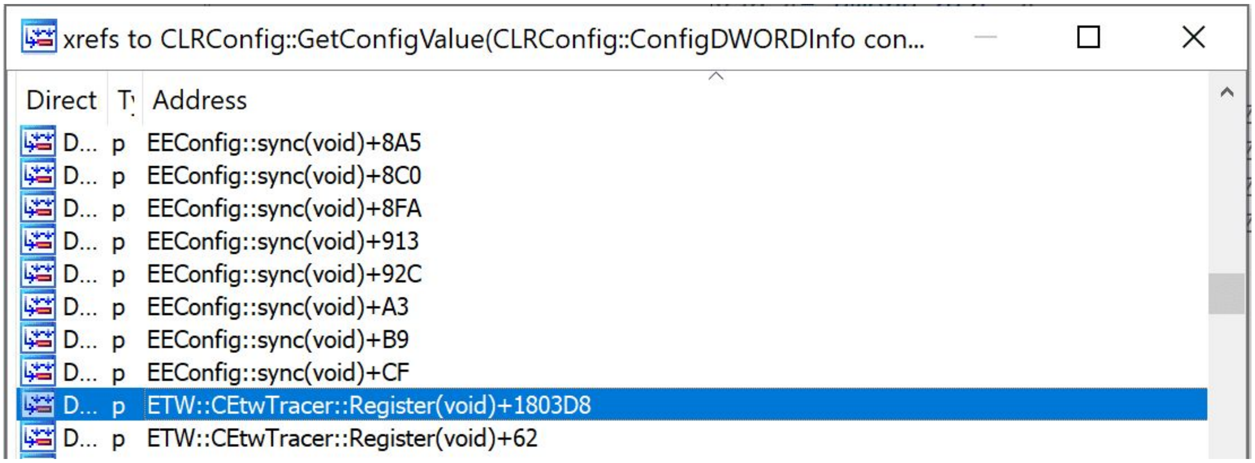
```
loc_1016D687:
mov     ecx, esi
call    ?SetCpuInfo@EEJitManager@@AAEXXZ ; EEJitManager::SetCpuInfo(void)
mov     [esi+6Ch], edi
lea     edx, [ebp+var_10]
mov     ecx, offset ?EXTERNAL_JitName@CLRConfig@@2UConfigStringInfo@1@B ; COMPlus_JitName
mov     [ebp+var_18], edi
mov     ?g_JitLoadData@@3UJIT_LOAD_DATA@@A, 1F4h ; JIT_LOAD_DATA g_JitLoadData
mov     [ebp+var_10], edi
call    ?GetConfigValue@CLRConfig@@SGJABUConfigStringInfo@1@PAPAG@Z ; CLRConfig::GetConfigValue(CLRConfig::ConfigStringInfo const &,ushort * *)
test    eax, eax
js      loc_102E6C09
```

Taking this and searching for overloads gives us several other methods which are also used to access similar configuration settings during runtime:



| Function name | Segment |
|---|---|
| CLRConfig::getQuirkEnabledAndValueFromWinDB(ushort const *,int *,_CPT_QUIRK_DA... | .text |
| CLRConfig::GetConfigValue(CLRConfig::ConfigStringInfo const &,ushort * *) | .text |
| CLRConfig::GetConfigValue(CLRConfig::ConfigStringInfo const &) | .text |
| CLRConfig::GetConfigValue(CLRConfig::ConfigDWORDInfo const &,bool,bool *) | .text |
| CLRConfig::GetConfigValue(CLRConfig::ConfigDWORDInfo const &) | .text |
| CLRConfig::GetConfigLevel(CLRConfig::LookupOptions) | .text |

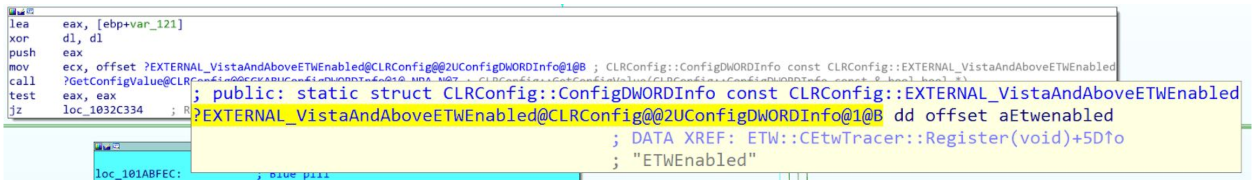
And as Microsoft provide the appropriate PDB file for the CLR, walking through each of these methods and taking a look at the Xrefs is enough to indicate which references are likely to be interesting, for example:



xrefs to CLRConfig::GetConfigValue(CLRConfig::ConfigDWORDInfo con...

```
Direct T  Address
D...   p  EEConfig::sync(void)+8A5
D...   p  EEConfig::sync(void)+8C0
D...   p  EEConfig::sync(void)+8FA
D...   p  EEConfig::sync(void)+913
D...   p  EEConfig::sync(void)+92C
D...   p  EEConfig::sync(void)+A3
D...   p  EEConfig::sync(void)+B9
D...   p  EEConfig::sync(void)+CF
D...   p  ETW::CEtwTracer::Register(void)+1803D8
D...   p  ETW::CEtwTracer::Register(void)+62
```

Finally, following the reference and looking at the arguments passed to CLRConfig::GetConfigValue is enough to give you the setting used:



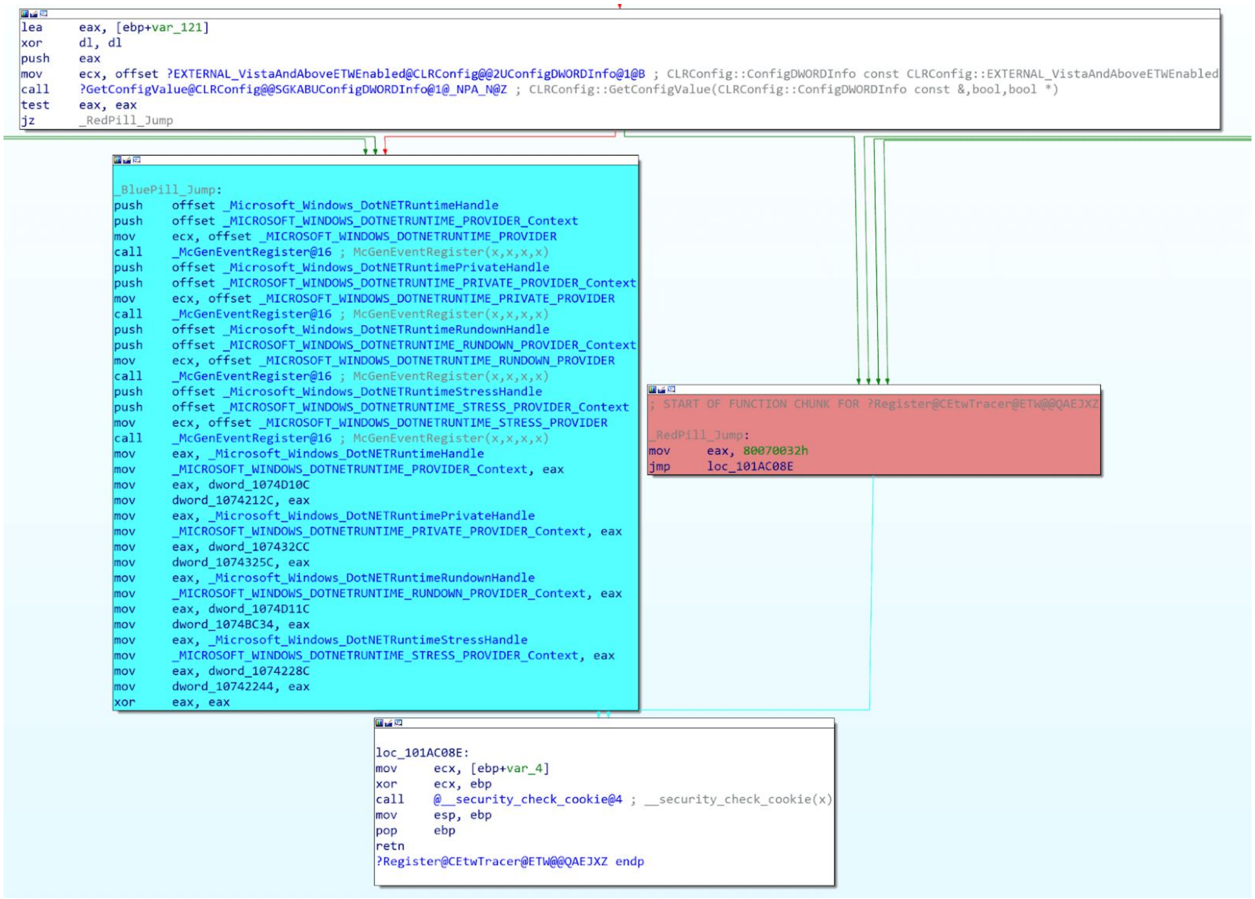
```
lea     eax, [ebp+var_121]
xor     dl, dl
push    eax
mov     ecx, offset ?EXTERNAL_VistaAndAboveETWEnabled@CLRConfig@@2UConfigDWORDInfo@1@B ; CLRConfig::ConfigDWORDInfo const CLRConfig::EXTERNAL_VistaAndAboveETWEnabled
call    ?GetConfigValue@CLR
test    eax, eax
jz      loc_1032C334    ; R

loc_101ABFEC:               ; Blue pill
```

```
; public: static struct CLRConfig::ConfigDWORDInfo const CLRConfig::EXTERNAL_VistaAndAboveETWEnabled
?EXTERNAL_VistaAndAboveETWEnabled@CLRConfig@@2UConfigDWORDInfo@1@B dd offset aEtwenabled
                                        ; DATA XREF: ETW::CEtwTracer::Register(void)+5D↑o
                                        ; "ETWEnabled"
```

# What does COMPlus_ETWEnabled do exactly?

Now that we know that this setting exists in the .NET Framework, how does this disable event tracing? Well let's look at a CFG in IDA which should show you immediately why this works to disable ETW:



```
lea     eax, [ebp+var_121]
xor     dl, dl
push    eax
mov     ecx, offset ?EXTERNAL_VistaAndAboveETWEnabled@CLRConfig@@2UConfigDWORDInfo@1@B ; CLRConfig::ConfigDWORDInfo const CLRConfig::EXTERNAL_VistaAndAboveETWEnabled
call    ?GetConfigValue@CLRConfig@@SGKABUConfigDWORDInfo@1@_NPA_N@Z ; CLRConfig::GetConfigValue(CLRConfig::ConfigDWORDInfo const &,bool,bool *)
test    eax, eax
jz      _RedPill_Jump
```

```
_BluePill_Jump:
push    offset _Microsoft_Windows_DotNETRuntimeHandle
push    offset _MICROSOFT_WINDOWS_DOTNETRUNTIME_PROVIDER_Context
mov     ecx, offset _MICROSOFT_WINDOWS_DOTNETRUNTIME_PROVIDER
call    _McGenEventRegister@16 ; McGenEventRegister(x,x,x,x)
push    offset _Microsoft_Windows_DotNETRuntimePrivateHandle
push    offset _MICROSOFT_WINDOWS_DOTNETRUNTIME_PRIVATE_PROVIDER_Context
mov     ecx, offset _MICROSOFT_WINDOWS_DOTNETRUNTIME_PRIVATE_PROVIDER
call    _McGenEventRegister@16 ; McGenEventRegister(x,x,x,x)
push    offset _Microsoft_Windows_DotNETRuntimeRundownHandle
push    offset _MICROSOFT_WINDOWS_DOTNETRUNTIME_RUNDOWN_PROVIDER_Context
mov     ecx, offset _MICROSOFT_WINDOWS_DOTNETRUNTIME_RUNDOWN_PROVIDER
call    _McGenEventRegister@16 ; McGenEventRegister(x,x,x,x)
push    offset _Microsoft_Windows_DotNETRuntimeStressHandle
push    offset _MICROSOFT_WINDOWS_DOTNETRUNTIME_STRESS_PROVIDER_Context
mov     ecx, offset _MICROSOFT_WINDOWS_DOTNETRUNTIME_STRESS_PROVIDER
call    _McGenEventRegister@16 ; McGenEventRegister(x,x,x,x)
mov     eax, _Microsoft_Windows_DotNETRuntimeHandle
mov     _MICROSOFT_WINDOWS_DOTNETRUNTIME_PROVIDER_Context, eax
mov     eax, dword_1074D10C
mov     dword_1074212C, eax
mov     eax, _Microsoft_Windows_DotNETRuntimePrivateHandle
mov     _MICROSOFT_WINDOWS_DOTNETRUNTIME_PRIVATE_PROVIDER_Context, eax
mov     eax, dword_107432CC
mov     dword_1074325C, eax
mov     eax, _Microsoft_Windows_DotNETRuntimeRundownHandle
mov     _MICROSOFT_WINDOWS_DOTNETRUNTIME_RUNDOWN_PROVIDER_Context, eax
mov     eax, dword_1074D11C
mov     dword_1074BC34, eax
mov     eax, _Microsoft_Windows_DotNETRuntimeStressHandle
mov     _MICROSOFT_WINDOWS_DOTNETRUNTIME_STRESS_PROVIDER_Context, eax
mov     eax, dword_1074228C
mov     dword_10742244, eax
xor     eax, eax
```

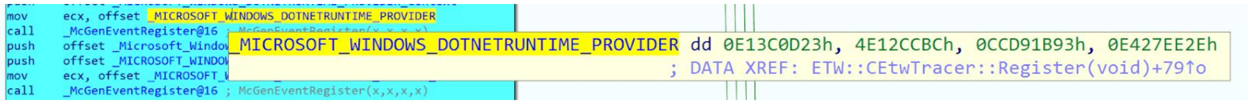
```
; START OF FUNCTION CHUNK FOR ?Register@CEtwTracer@ETW@@QAEJXZ

_RedPill_Jump:
mov     eax, 80070032h
jmp     loc_101AC08E
```

```
loc_101AC08E:
mov     ecx, [ebp+var_4]
xor     ecx, ebp
call    @__security_check_cookie@4 ; __security_check_cookie(x)
mov     esp, ebp
pop     ebp
retn
?Register@CEtwTracer@ETW@@QAEJXZ endp
```

Here we can clearly see the 2 code paths which depend on the COMPlus_ETWEnabled value returned from CLRConfig::GetConfigValue. If this setting exists and returns a 0 value, the CLR will jump past the block of ETW registrations shown in blue, where _McGenEventRegister is simply a wrapper around the EventRegister API call.

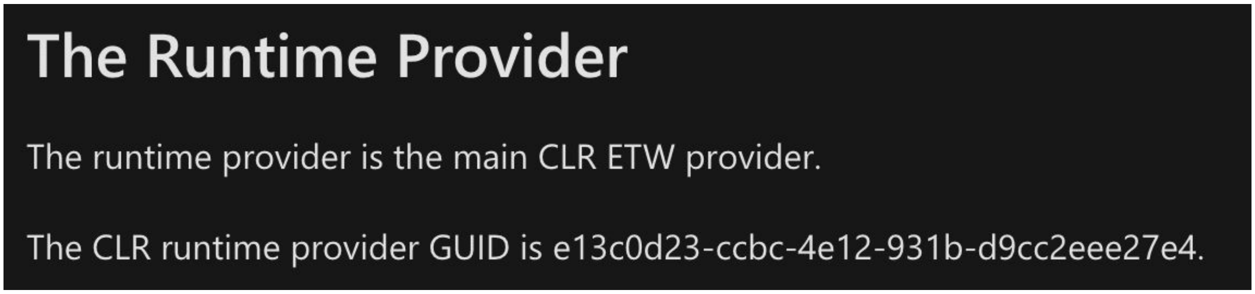
Digging further by taking one of these provider GUID's, we see something familiar:



```
mov     ecx, offset _MICROSOFT_WINDOWS_DOTNETRUNTIME_PROVIDER
call    _McGenEventRegister@16
push    offset _Microsoft_Windo
push    offset _MICROSOFT_WINDO
mov     ecx, offset _MICROSOFT_
call    _McGenEventRegister@16 ; McGenEventRegister(x,x,x,x)

_MICROSOFT_WINDOWS_DOTNETRUNTIME_PROVIDER dd 0E13C0D23h, 4E12CCBCh, 0CCD91B93h, 0E427EE2Eh
                                          ; DATA XREF: ETW::CEtwTracer::Register(void)+79↑o
```

This is of course referencing the GUID {e13c0d23-ccbc-4e12-931b-d9cc2eee27e4} which we used in our previous post when unhooking ETW and is documented by Microsoft as the CLR ETW provider:



## The Runtime Provider

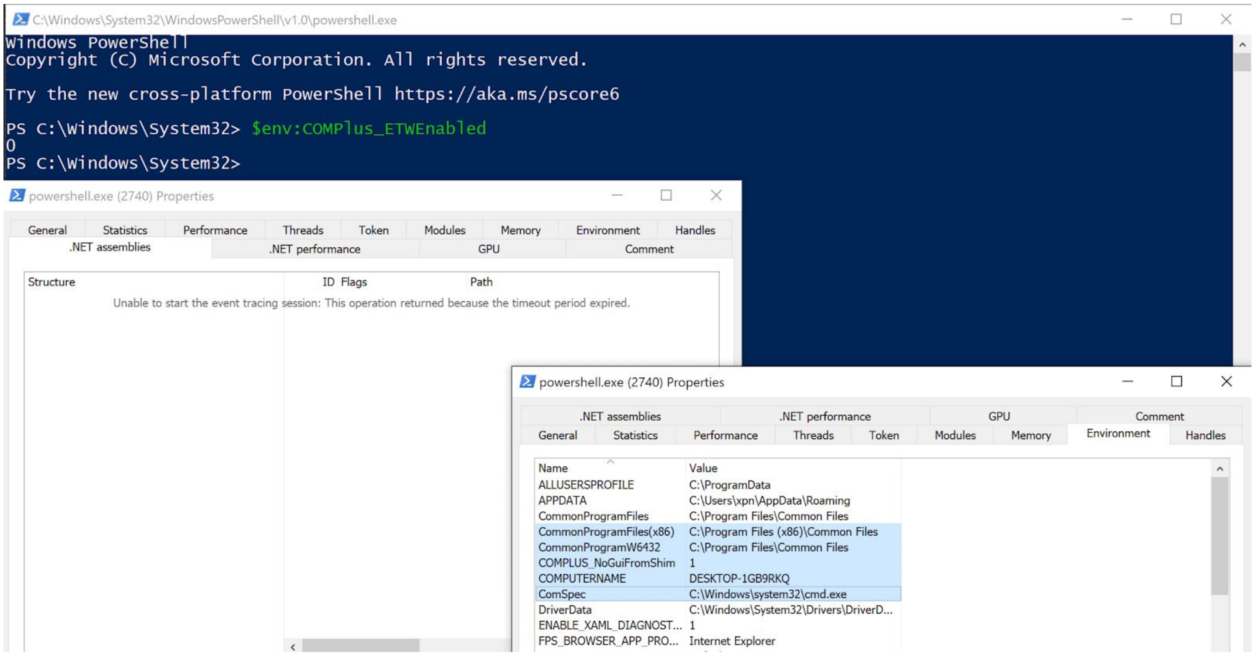
The runtime provider is the main CLR ETW provider.

The CLR runtime provider GUID is e13c0d23-ccbc-4e12-931b-d9cc2eee27e4.

So hopefully this sheds some light on this strange but cool setting... Essentially, toggling it just forces the CLR to skip past the point of registering to the .NET ETW providers which is required to surface events.

Now for defending against this, I'll defer to Roberto Rodriguez's awesome set of notes which detail a number of detections and mitigations which can be used to detect and protect an environment... check them out here.

**Update 07/06/2020 -** I have created a quick environment variable spoofing POC which uses a similar practice to Argument Spoofing to mask environment variables passed to a process on launch. This can be found here and is designed to hide the COMPlus_ETWEnabled=0 variable from CreateProcess:



```
Windows PowerShell
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Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Windows\System32> $env:COMPlus_ETWEnabled
0
PS C:\Windows\System32>
```

Unable to start the event tracing session: This operation returned because the timeout period expired.

| Name | Value |
|---|---|
| ALLUSERSPROFILE | C:\ProgramData |
| APPDATA | C:\Users\xpn\AppData\Roaming |
| CommonProgramFiles | C:\Program Files\Common Files |
| CommonProgramFiles(x86) | C:\Program Files (x86)\Common Files |
| CommonProgramW6432 | C:\Program Files\Common Files |
| COMPLUS_NoGuiFromShim | 1 |
| COMPUTERNAME | DESKTOP-1GB9RKQ |
| ComSpec | C:\Windows\system32\cmd.exe |
| DriverData | C:\Windows\System32\Drivers\DriverD... |
| ENABLE_XAML_DIAGNOST... | 1 |
| FPS_BROWSER_APP_PRO... | Internet Explorer |