Deep Analysis of Redline Stealer: Leaked Credential with WCF

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Executive Summary

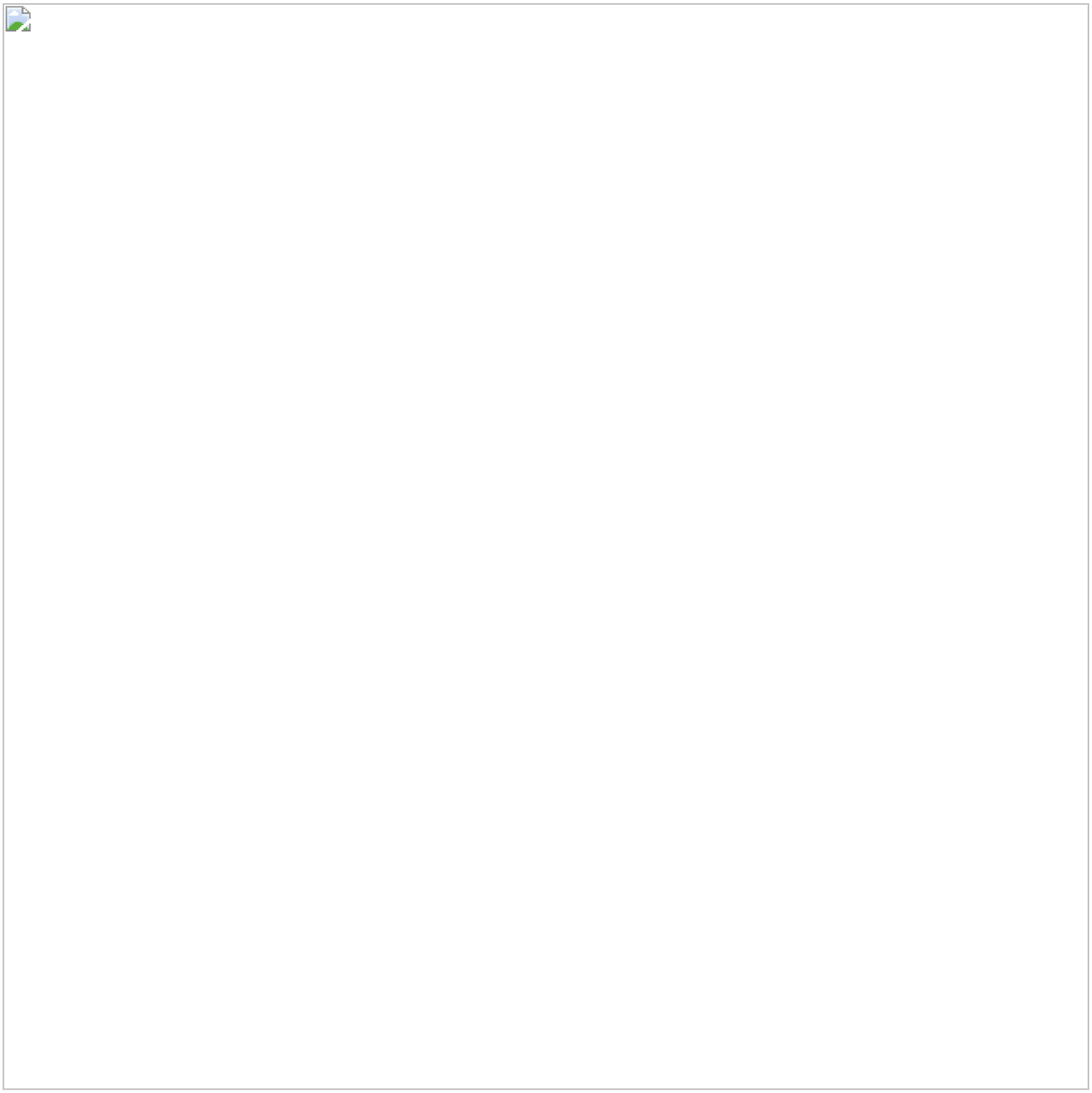
Redline Stealer, which is currently being distributed, has changed the C2 communication method and the way of delivering the collected information from the previous Redline Stealer, but the overall execution flow is the same.

Redline Stealer has hard-coded encoded data such as C2 Server IP and Unique ID, and the XOR Key required to decode this data. When Redline is executed, the value is extracted first. After that, the information is collected and leaked by referring to the configuration data received from the C2 server, and the collected information is composed of **Environment Details** and **Credential Details.** The collected information includes system information, browser credentials, crypto wallet information, FTP information, Telegram and Discord information, etc.

After collecting and leaking information, Redline Stealer also has the ability to download executable files and perform additional malicious actions.

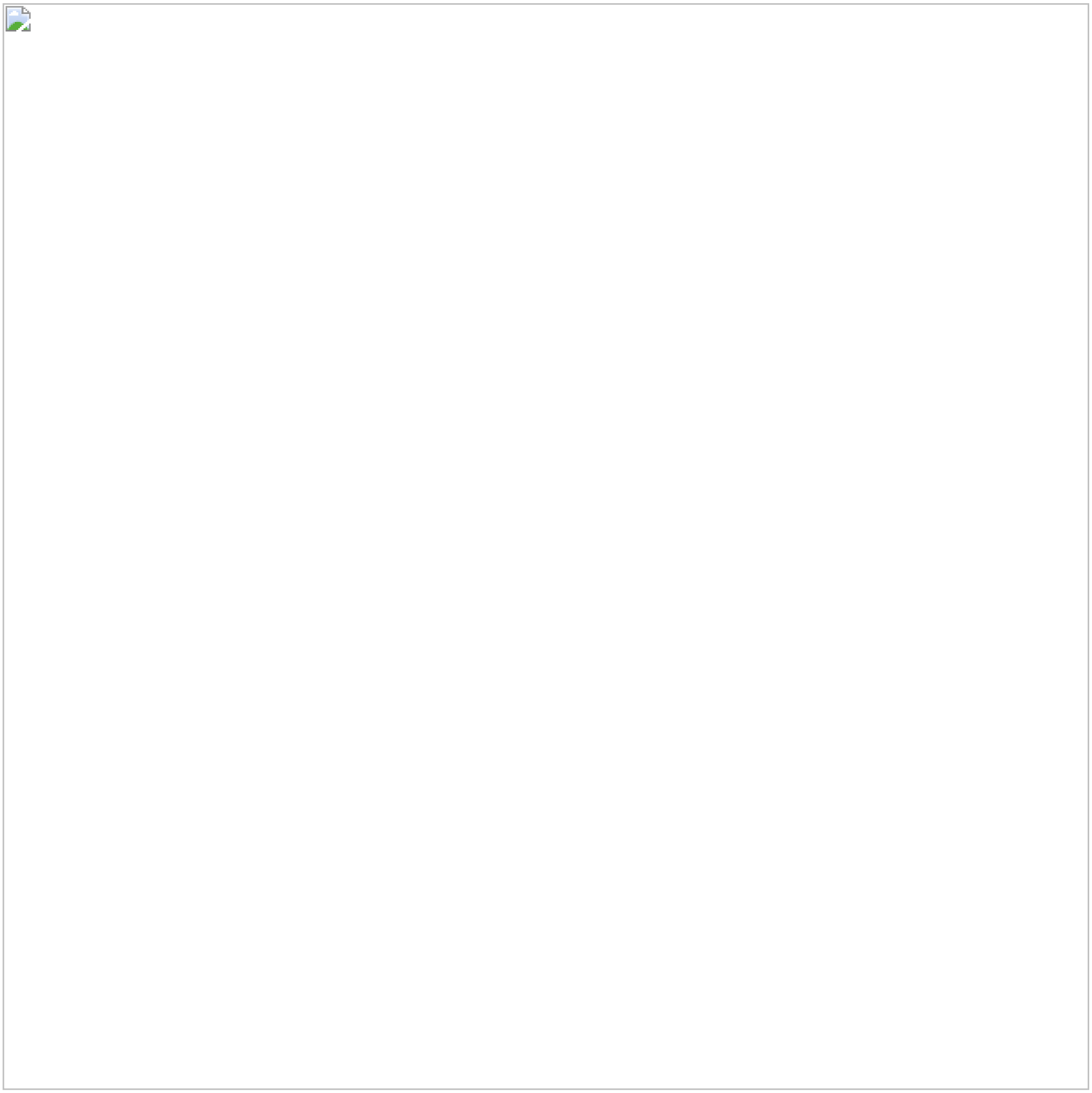
Introduction of Redline Stealer

Since its release in February 2020, Redline Stealer has been delivered through various channels. Redline Stealer is mostly distributed through Phishing Emails or malicious software disguised as installation files such as Telegram, Discord, and cracked software. However, recently, Phishing Link that downloads Chrome Extension containing Redline Stealer by abusing is utilized, or Python Script that runs Redline Stealer through FTP is being distributed.



Issues related to Redline Stealer

According to BleepingComputer released in October 2020, Redline Stealer was distributed through malicious links posted on YouTube Video Description related to free downloading of specific utility.



Redline via YouTube Video Description Link (Source:)

Redline Stealer in DDW

Redline Stealer first appeared in a Russian-based forum in February 2020. The user with the nickname “**REDGlade**” posted the promotion article and has been updating the version of Builder and Panel until at least January 2022. Redline Stealer is being rented for $100 per month and sold for $150 per month and $800 for a lifetime. Additional services, such as scanner and crypto subscription, appear differently depending on the cost.

The builder program of Redline Stealer is sold by the official seller on the DDW forum, but also by other users who sell the cracked version of Redline Stealer. In addition, some users sell only the collected Redline Stealer Logs.

Redline Stealer Promotion Article

Redline Stealer’s Pricing Policy

RENT ($100 / a month)

> 1 month of cryptor @spectrcrypt_bot (autocrypt + scanner)

LITE ($150 / a month)

- 1 month of crypt subscription

PRO ($200 / forever)

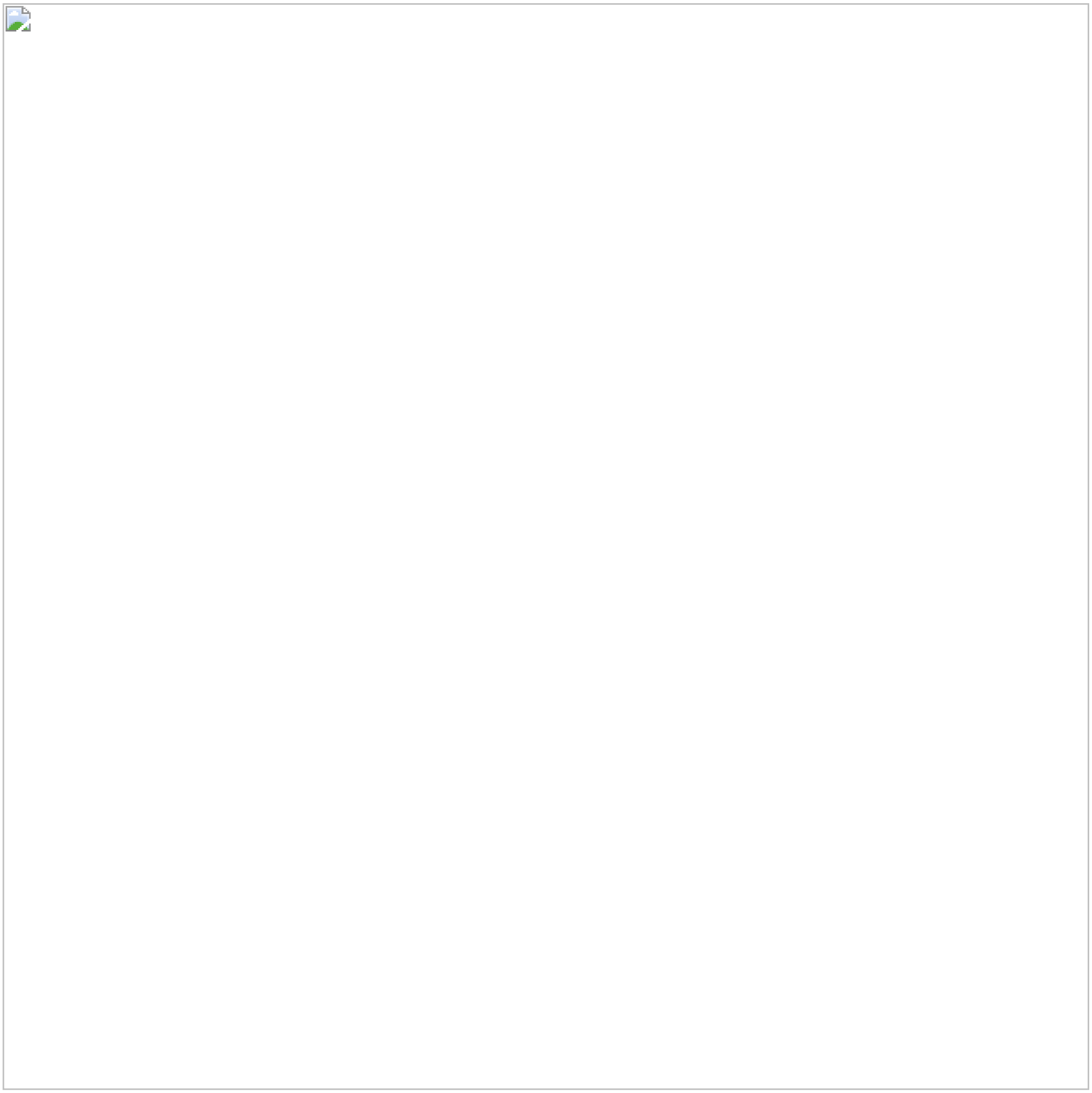
- 3 months of scanner subscription
- 3 months of cryptor @spectcrypt_bot

Channels operated by Redline Stealer Seller

Telegram channels operated by the Redline Stealer official seller are divided into 3 categories: **Official Page**, **Official Chat**, **and Buy Redline bot**. Announcement and updated information are posted on the Official Page channel, chat is freely available on the Official Chat channel, and Redline Stealer is sold on the Buy Redline bot.

Redline Stealer Telegram Channel

- @REDLINESTEALER — Official page
- @REDLINE_EN — Official Chat
- @REDLINESUPPORT_bot — Buy Redline bot

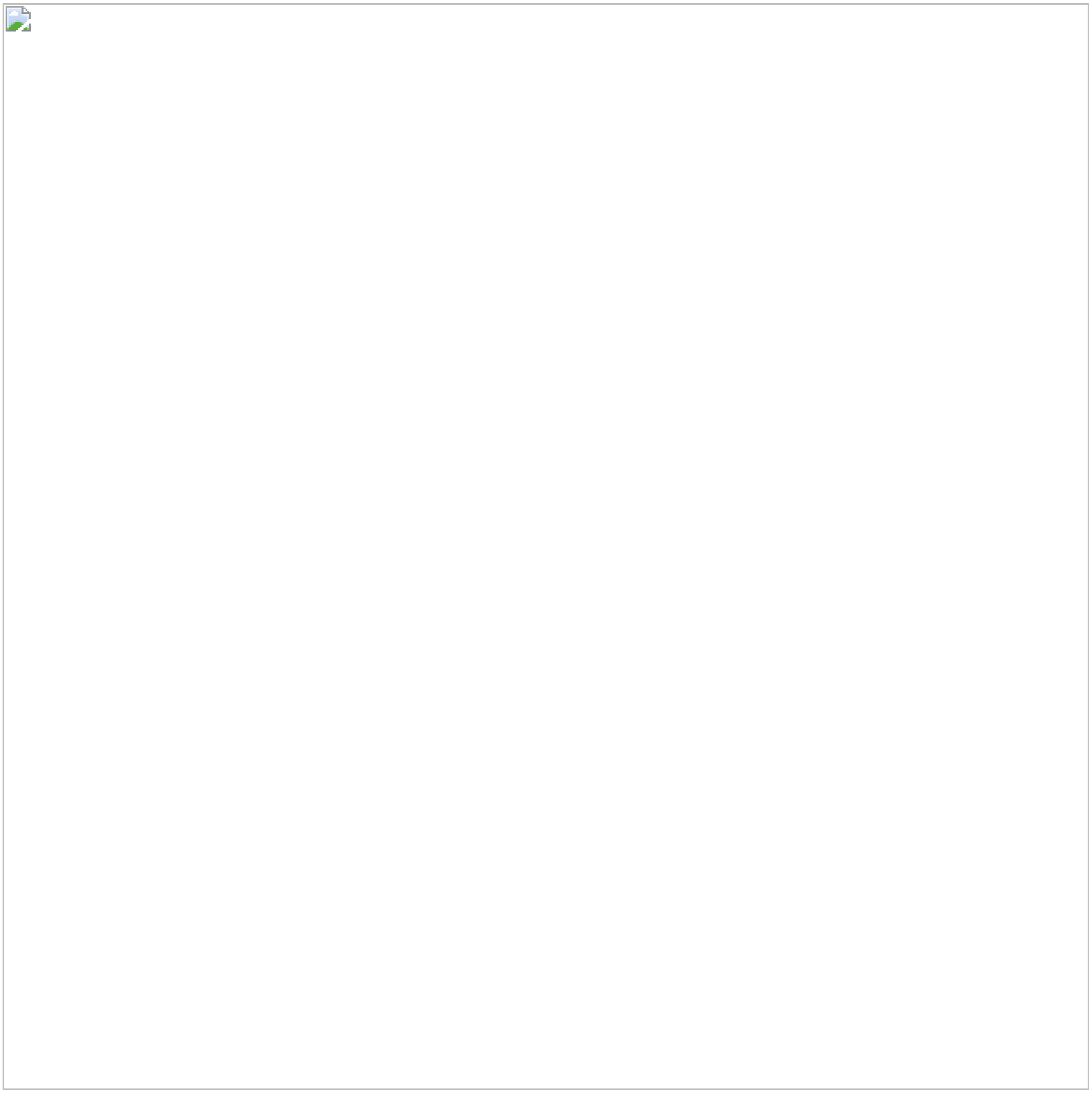


Redline Stealer Telegram Channel: Official Page

Cracked Redline Stealer & Log Seller

As Redline Stealer is an infostealer malware used by attackers a lot, there are several cracked versions, and other stealers derived from it. In addition, stealer logs collected through Redline Stealer are sold on the DDW forums, and they account for the largest portion of infostealer logs.

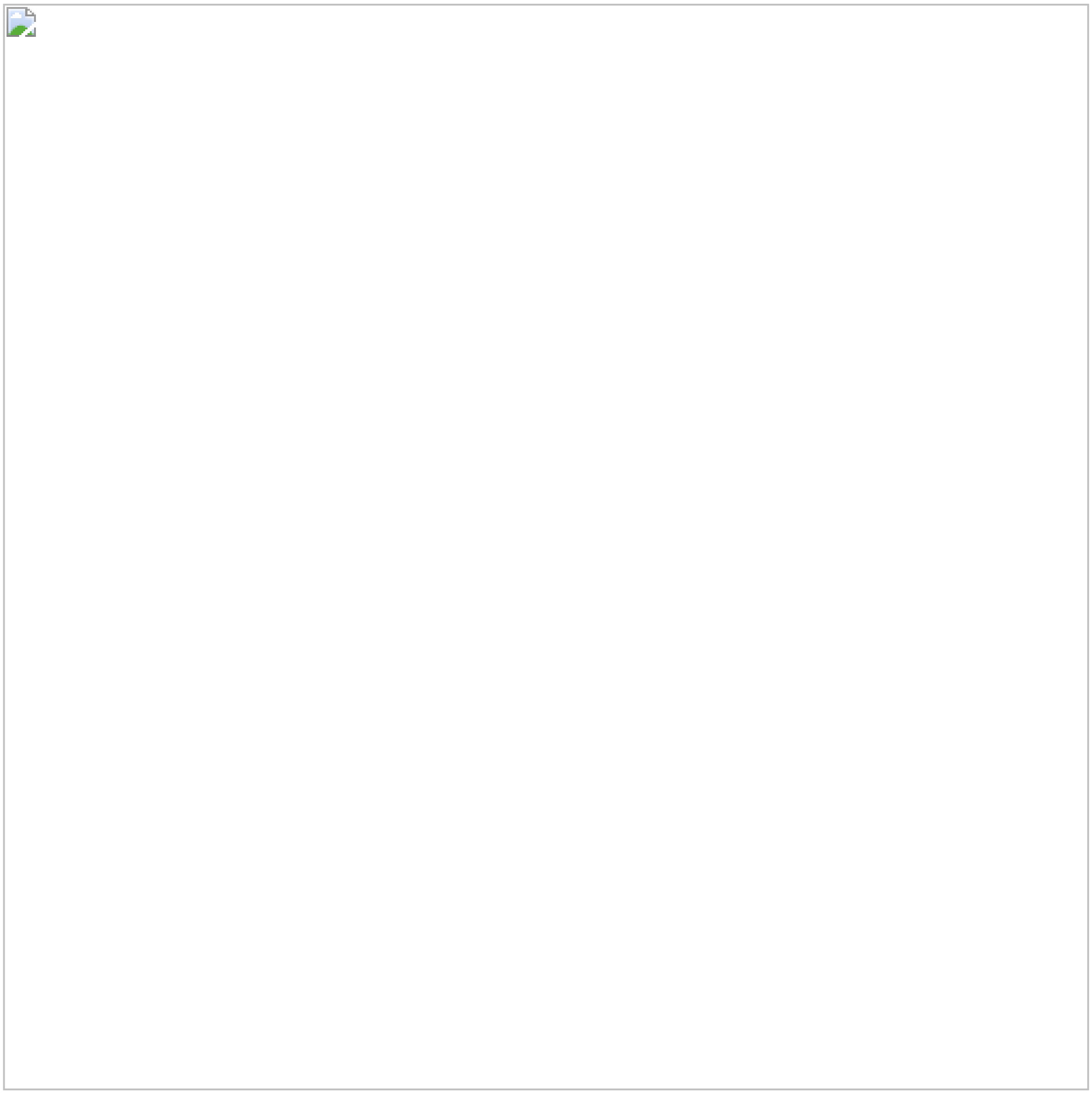
Cracked Redline Stealer Sales Post



Redline Stealer Log Sales Post

Redline Stealer Update Information

Redline Stealer Seller notifies update information on Telegram channel. As of January 2022, it has been updated to Builder v23, Panel v3.3.4. The main update information posted so far is shown in the table below.



Redline Stealer Major Update

Especially among the updates in May 2020 to June 2020, supporting ***.scr extension** and added **Browser Extension Wallet information** were also applied to issues related to NFT hacking that occurred in June 2021. At that time, most of the victims infected by Redline Stealer had *.scr extension. Also, the victims' stolen crypto wallets were leaked by Redline Stealer.

Malware analysis

Sample Information

- File Name: 9882_1643998124_6086.exe
- File Type: PE32 executable (GUI) Intel 80386 Mono/.Net assembly, for MS Windows
- Malware Type: Redline Stealer v22
- MD5: d81d3c919ed3b1aaa2dc8d5fbe9cf382
- SHA256: cd3f0808ae7fc8aa5554192ed5b0894779bf88a9c56a7c317ddc6a4d7c249e0e

Redline Stealer Execution Flow

1. The attachment in phishing mail contains cracked software with Redline Stealer.
2. When the cracked software is executed, Redline Stealer is also executed in the background.
3. Encoded data such as C2 Server IP and Unique ID are decoded along with the XOR key and used for C2 communication.
4. After finishing the decoding process, Redline Stealer requests configuration data from the C2 Server.

   Entity2: a structure that stores configuration data.

5. The C2 Server transmits configuration data to the infected PC.

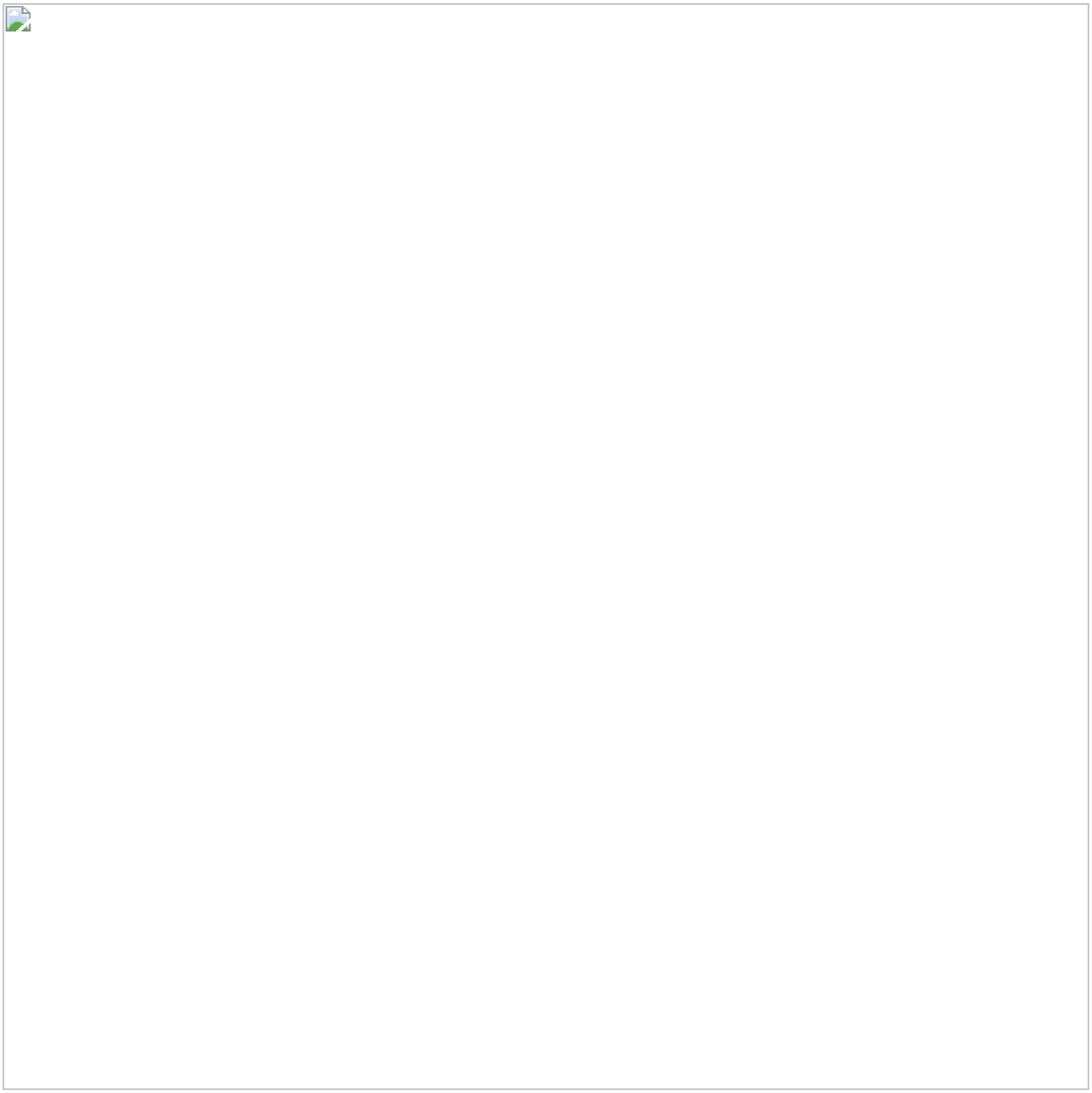
6. Information is collected from the infected PC referring to stored configuration data.

- Entity7: a structure that stores collected results. (Environment Details + Entity1)
- Entity1: a structure that stores Credential Details.

7. The information is leaked twice.

- Environment Details including infected PC information
- Credential Details including crypto wallet, accounts, and user data information

8. Collected information is converted into XML format and transmitted to the C2 Server through SOAP Message.



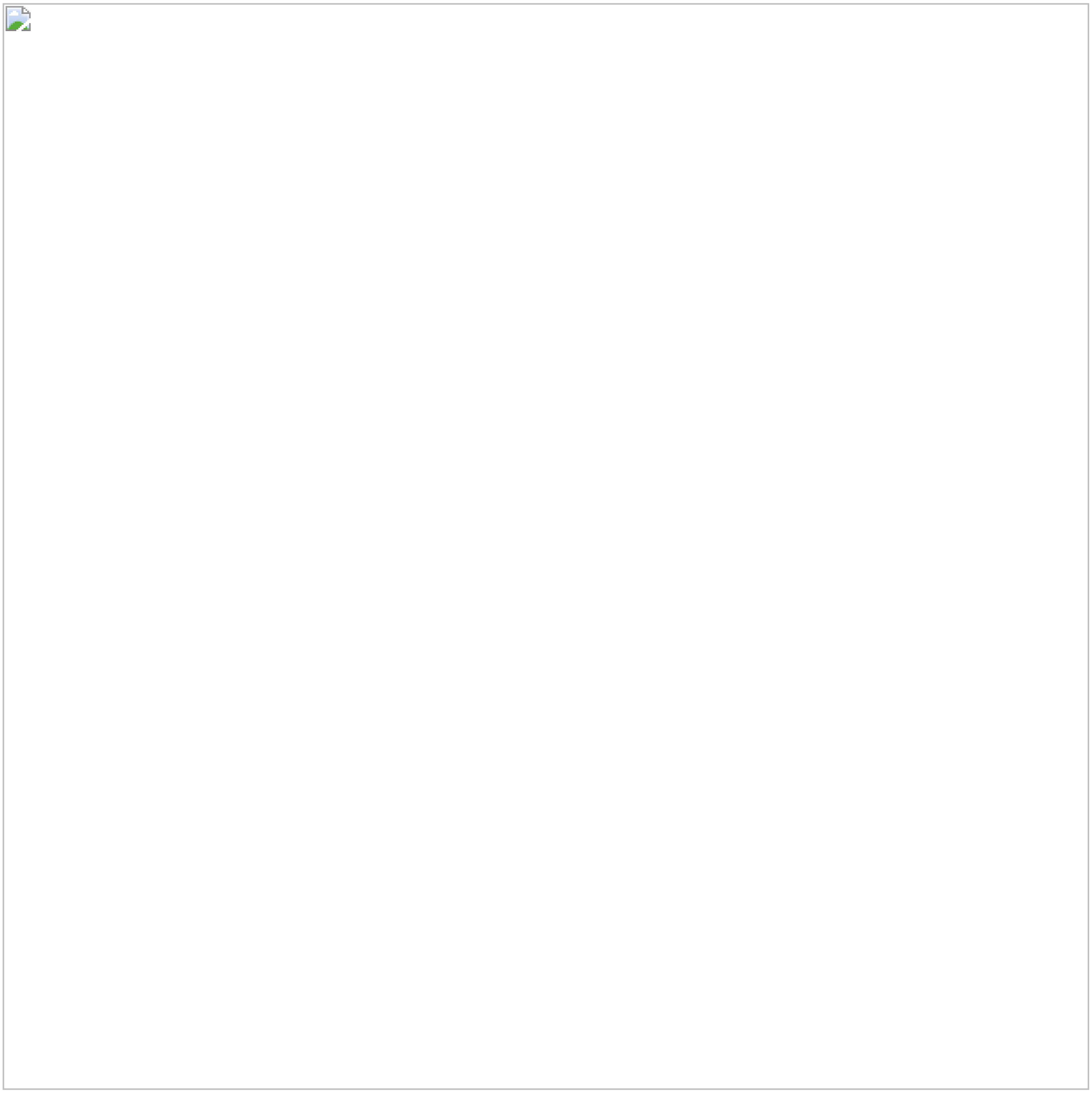
Redline Stealer Execution Flow

Configuration of C2 Communication

Redline Stealer with WCF

The framework Redline Stealer uses for C2 communication is WCF(Windows Communication Foundation). WCF is a system that allows endpoints to exchange messages and communicate across multiple computers connected to the network.

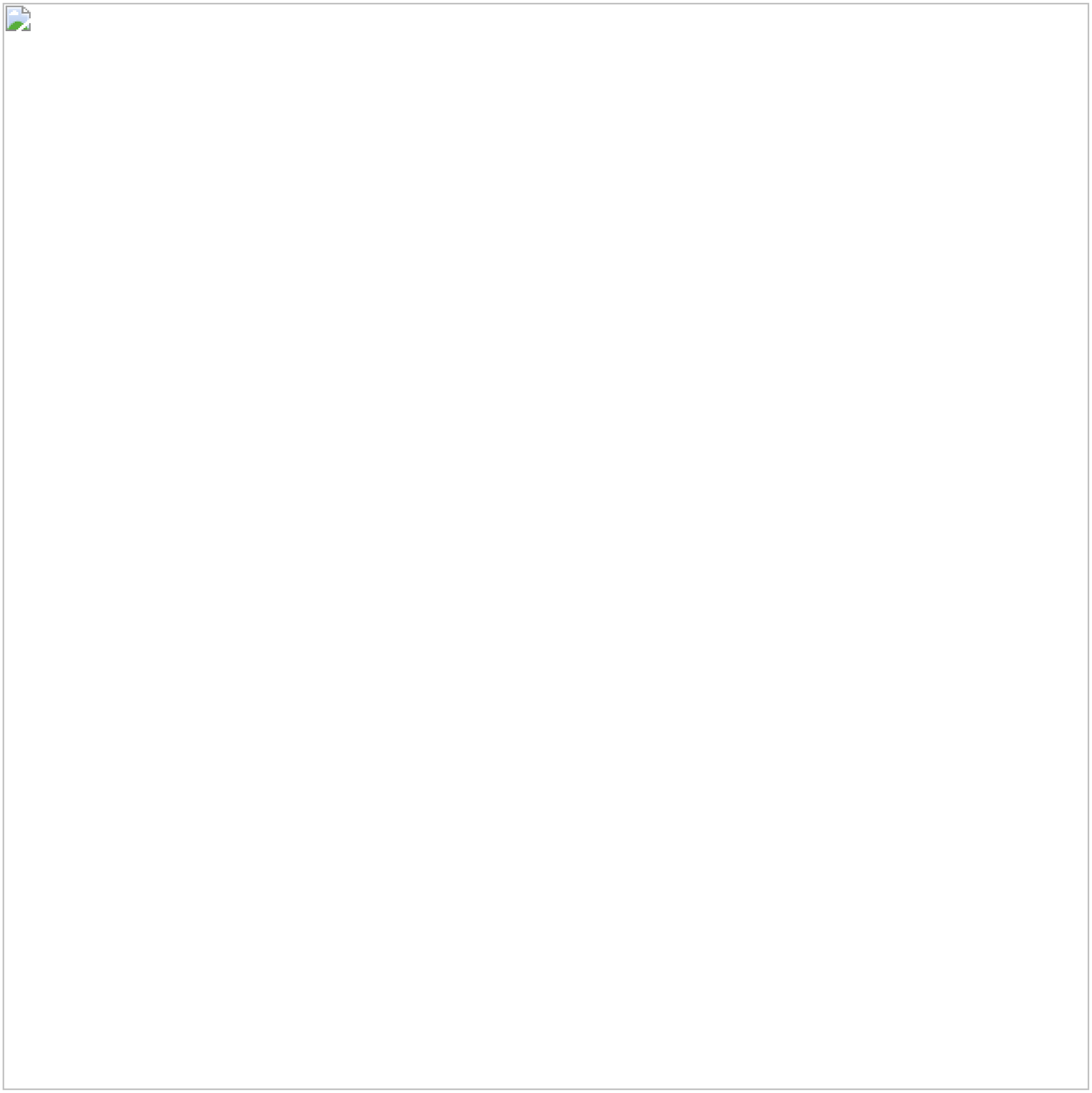
At least one endpoint must be configured to use WCF. When configuring the endpoint, three elements are required: **Address**, **Binding**,and **Contract**. ‘Address’ is the address providing the service, ‘Binding’ is the information related to the communication protocol used to access the service, and ‘Contract’ defines the service interface. The WCF Client can call the service defined as Service Contract, and when a specific method is called, a method of the same name implemented in the server is called. [ServiceContract] keyword, a service interface, is used to define the contract, [DataContract] keyword is used to define a data structure to be transmitted, and [OperationContract] keyword is used to define the function of the service.



WCF Communication

The previous Redline Stealer used BasicHTTPBinding() for communication. However, from Redline Stealer v22 updated in August 2020, the communication protocol was changed to NetTcpBinding(). NetTcpBinding() has a performance advantage compared to BasicHTTPBinding() because SOAP messages are binary encoded and delivered.

Redline Stealer collects information by specifying a Service Contract named **Entity** and defines 24 Operation Contracts and 17 Data Contracts. When a method defined as Operation Contract is called from an infected PC to the C2 Server, a method of the same name implemented on the C2 Server is called. At this time, ‘*Entity7 result’* is delivered to the C2 Server.



WCF Service Call/Response

Decoding C2 Server and Unique ID

In Redline Stealer, the encoded C2 Server address and Unique ID are hard-coded. Therefore, when the malware is executed, they are decoded and used for C2 communication.

Hardcoded data

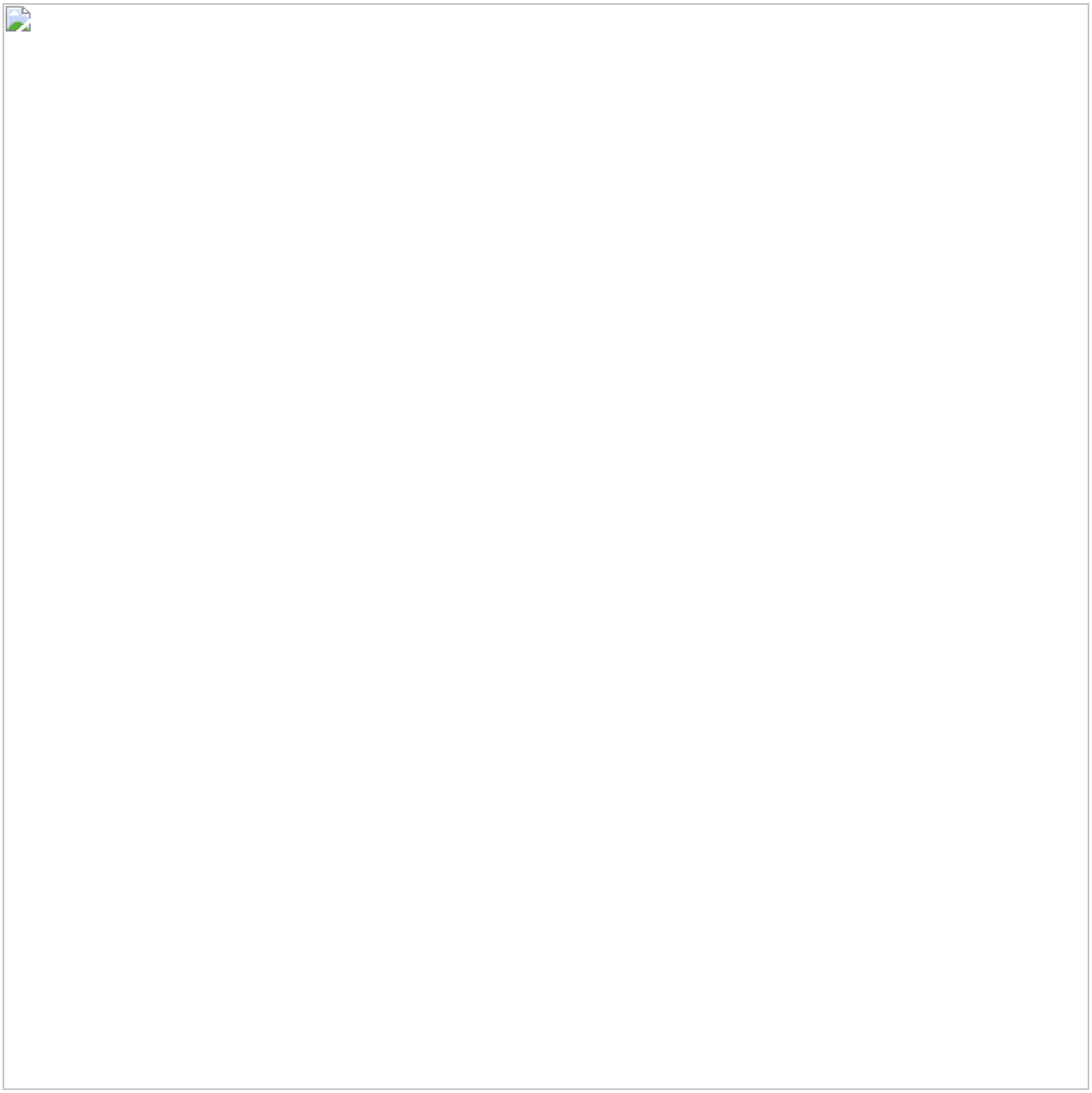
> C2 Server address: Dw0oGCQnJh4tByxCDjRVWScZLlUvOTwJDDZcUA
> Unique ID: DyMgXCcJKlcvBwJB
> Message: “”
> Version: 1

Decoding Process

> FromBase64 → XOR → FromBase64
> XOR Key: Agamis

Decoding Result

> C2 Server address: **62.182.159.86:65531**Unique ID: **405794696**Message: “”
> Version: 1



Decoding Method: Read()

Communication Method

As mentioned, Redline Stealer uses WCF for C2 communication.

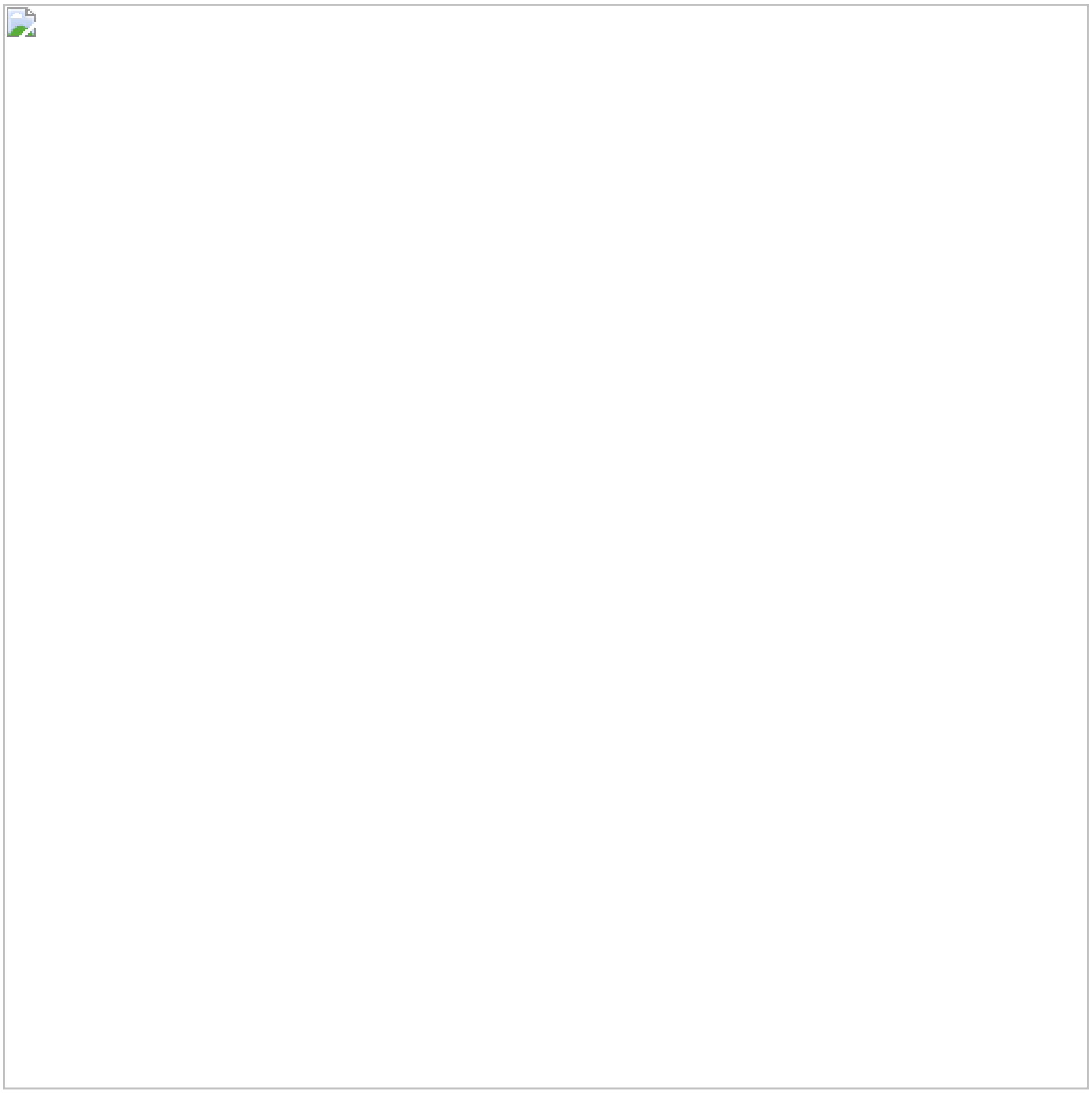
Endpoint Configuration: Address & Binding

> Address: net.tcp//62.182.159.86:65531/
> Binding: NetTcpBinding()

Endpoint Configuration: Contract

Redline Stealer has a Service Contract named **Entity**, 17 Data Contracts that define the structure to store information, and 24 Operation Contracts that define the functionality of the service. Among them, the description of the Data Contract storing information is shown in the table below.

(*Functional descriptions for each Operation Contract are described in Appendix.)



Data Contract List

Try to connect

After configuring the endpoint, Redline Stealer tries to connect with the C2 Server and receives the response. Redline Stealer periodically checks whether it maintains a connection with the C2 Server during execution.

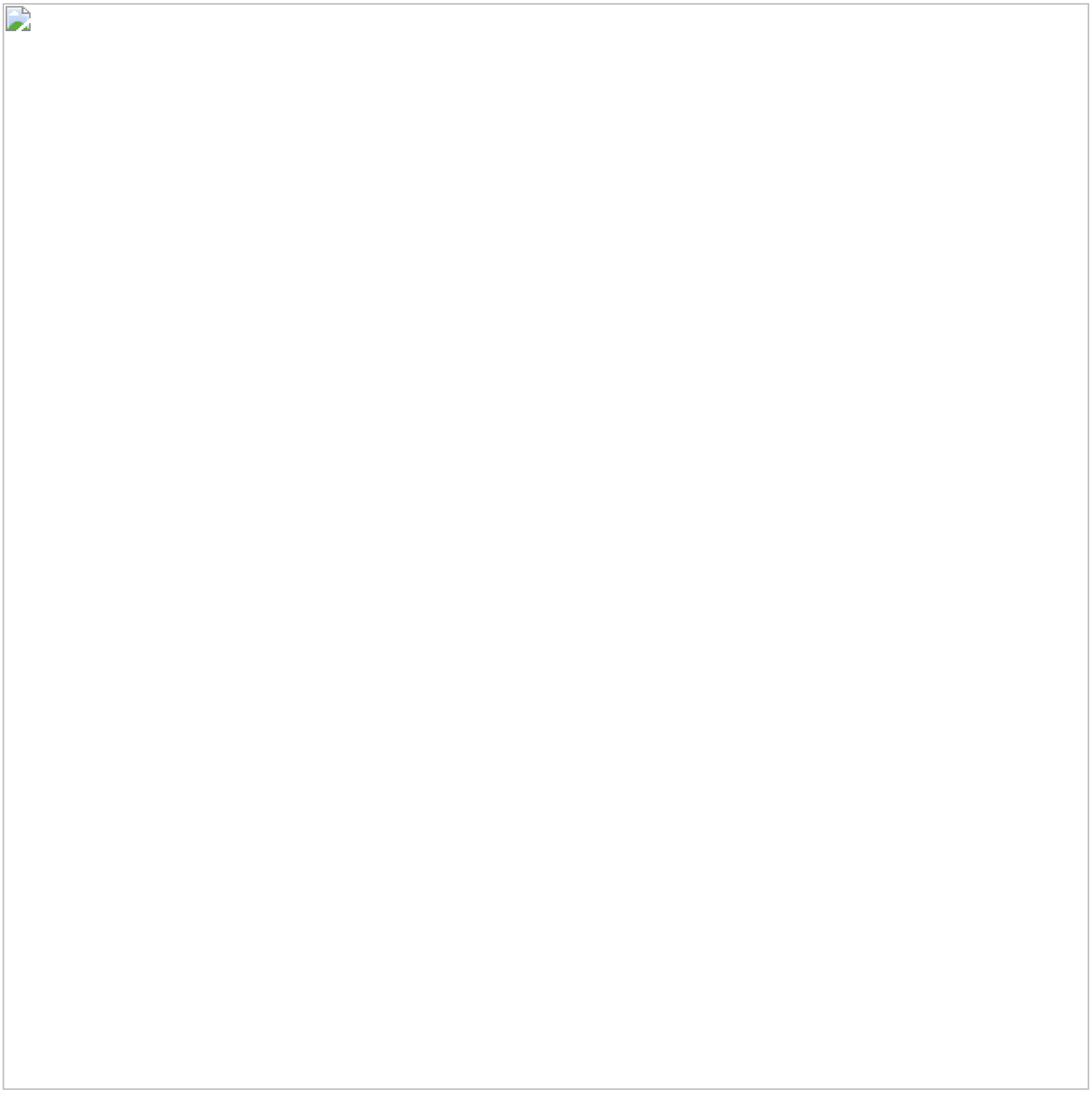
Configuration Data Request/Receive

Request configuration data

The Redline Stealer requests configuration data that specifies what information to collect, and includes the paths and keywords required to collect browser and local file information, and the name of crypto wallets to be explored.

Response configuration data

The configuration data is stored in **Entity2** and used to collect information to be leaked. The configuration data consists of **Flag** indicating whether each item is collected and **Setting** indicating paths and keywords for collecting files.



Collected information

Way to collect and store information

The information collected from the infected PC is stored in **Entity7**. Entity7 includes Environment Details and Entity1, and Entity1 separately stores Credential Details information. Each item in Entity1 uses the structure of Entity3~Entity5, Entity8~Entity12, and Entity14 to store related information. At this time, Entity1 may or may not be used depending on Redline Stealer’s information leakage mode.

A structure of Entity7

Way to leak information

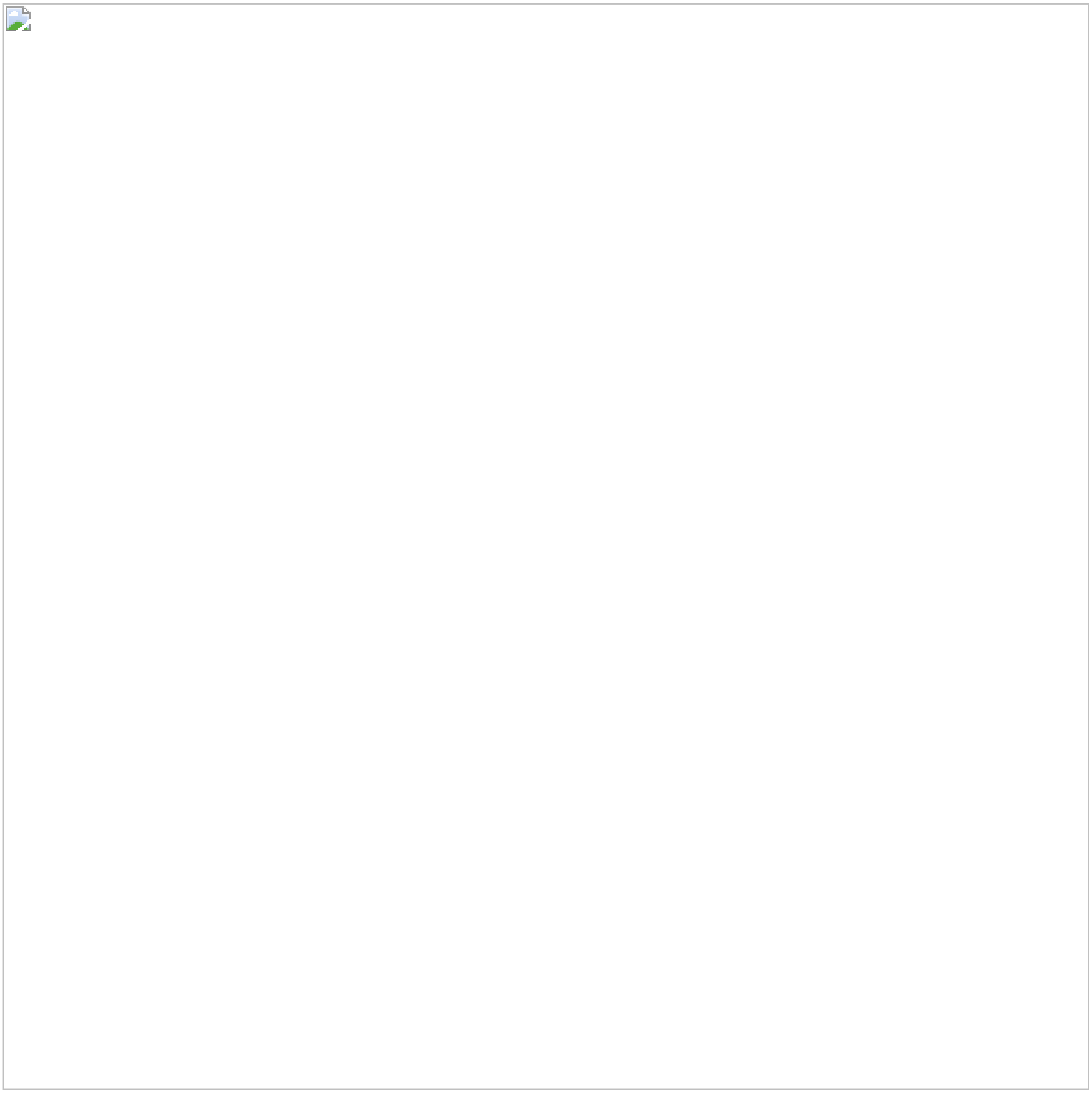
Redline Stealer defines **two ways** to leak information.

(Default)

The “Send Log by Parts” is a method of collecting information from the infected PC and then partially leaking it. That is, the collected ‘Environment Details’ are first leaked to the C2 Server by putting it in Entity7. In this case, each item of Entity1 is stored empty. After that, ‘Credential Details’ are collected, but not stored in Entity1 and immediately leaked after being collected by the item.

Send Log by Parts Flow

This method stores all the collected information in Entity7 and leaks it. First, ‘Environment Details’ are collected and stored in Entity7. Credential Details are then collected and stored in Entity1. If Environment Details and Entity1 are filled in Entity7, it is leaked to the C2 Server.



Send Log by Full-Flow

The biggest difference between the two methods is whether Entity1 is used or not. Environment Details and Entity1 collected from the infected PC are stored in Entity7, while Entity1 stores Credential Details. In the “Send Log by Full” method, Entity1 is used to leak information at once, but in the “Send Log by Parts” method, Entity1 is not used and each item of Credential Details is leaked as soon as it is collected.

What method Redline Stealer uses can be checked through the “Version” value among hard-coded data. If the version is 1, “Send Log by Parts” method is used, and in other cases, “**Send Log by Full**” method is used. In the case of the sample, since the version is set to 1, the “Send

Log by Parts” method can be seen, which partially leaks the collected information to be used. Therefore, among the collected information, Credential Details is collected for each item and then leaked immediately.

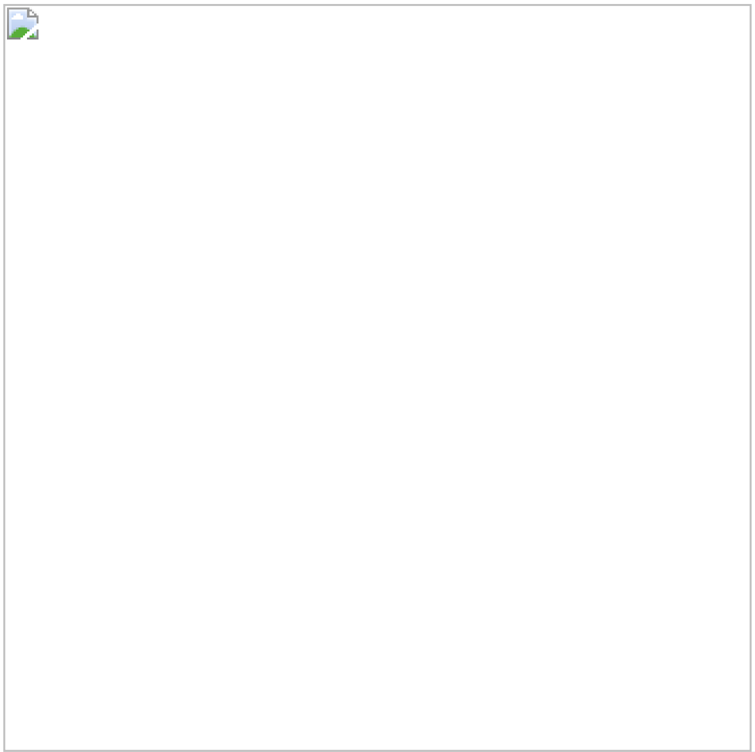
Collect Environment Details

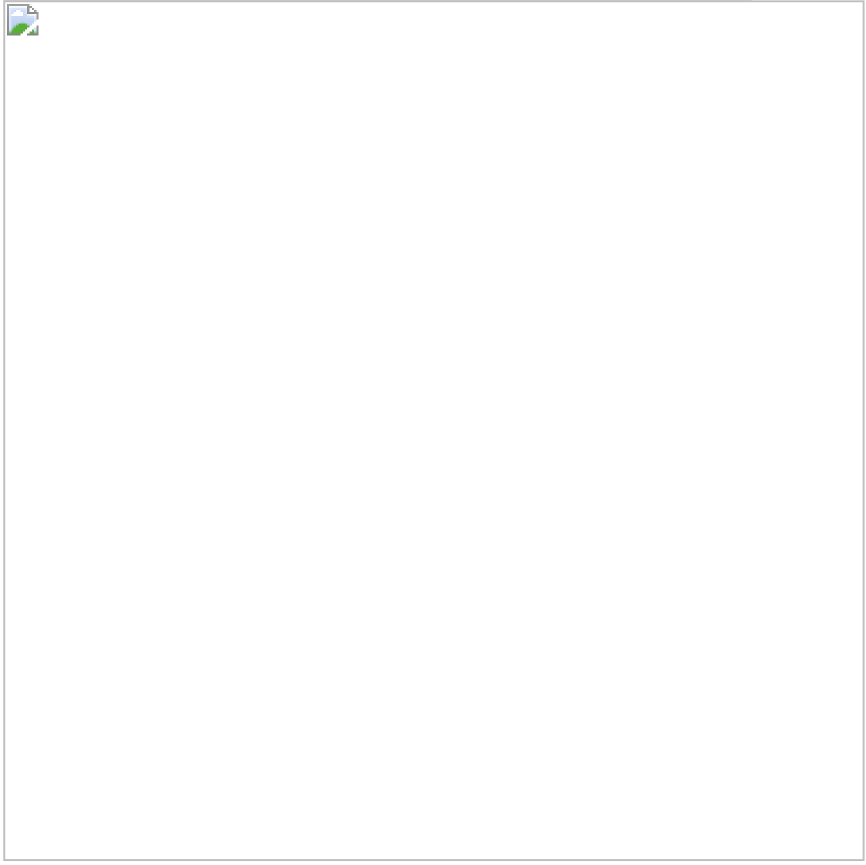
Device information of the infected PC is collected and stored in Entity7.

Entity7 includes hardware information, Unique ID, machine name, OS information, available languages, monitor information, IPv4, the malware file location, Redline Stealer infection history, and monitor screenshots where each item of Credential Details (Entity1) excluding monitor screenshots is stored empty.

Leak Environment Details

Environment Details stored in *Entity7 result* prepares to access service via Id6() method. Thereafter, the collected information is leaked by calling the defined [OperationContract] Id4() method. Upon receiving the leaked information, the C2 Server sends a response to the infected PC, which is stored and delivered in Entity13. The response type can be divided into Unknown(Entity13.Id1), Success(Entity13.Id2), RepeatPart(Entity13.Id3), NotFound(Entity13.Id4)

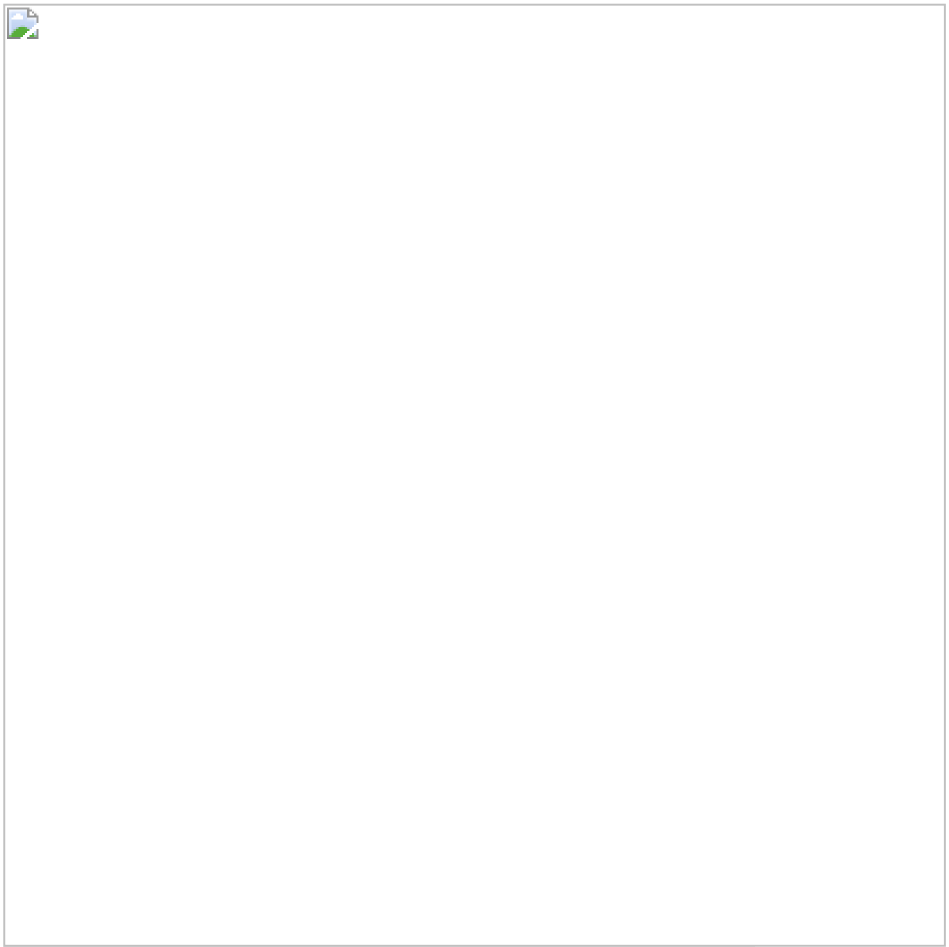


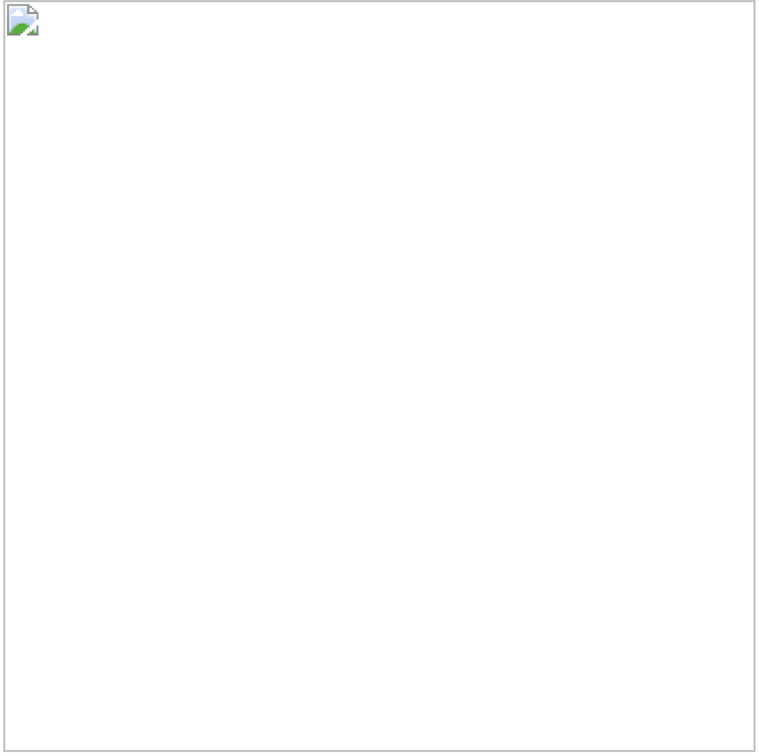


Preparing to leak information (Left) / Leaked information after accessing service (Right)

Collect & Leak Credential Details

‘Credential Details’ are leaked whenever one item is collected. The information leakage process is the same as ‘Environment Details’ leakage process, but there is a difference in the information delivered to the C2 Server. Each item of Credential Details is leaked by calling the matched [OperationContract] Id#() method. When the C2 Server receives information, it sends a response to the infected PC, which is the same type of response it receives when Environment Details is leaked.





Preparing to leak information (Left) / Leaked information after accessing service (Right)

Result: Collected Information

Targets collected by Redline Stealer are largely divided into infection device information, installation information, crypto wallet information, account information, User Data information, and local file information. In the case of crypto wallet information, in addition to the crypto wallet list specified in configuration data, the installed Browser Extension Wallet list is checked to collect related information. The table summarizing the collected information by type is as follows.

Summarizing of collected information by type

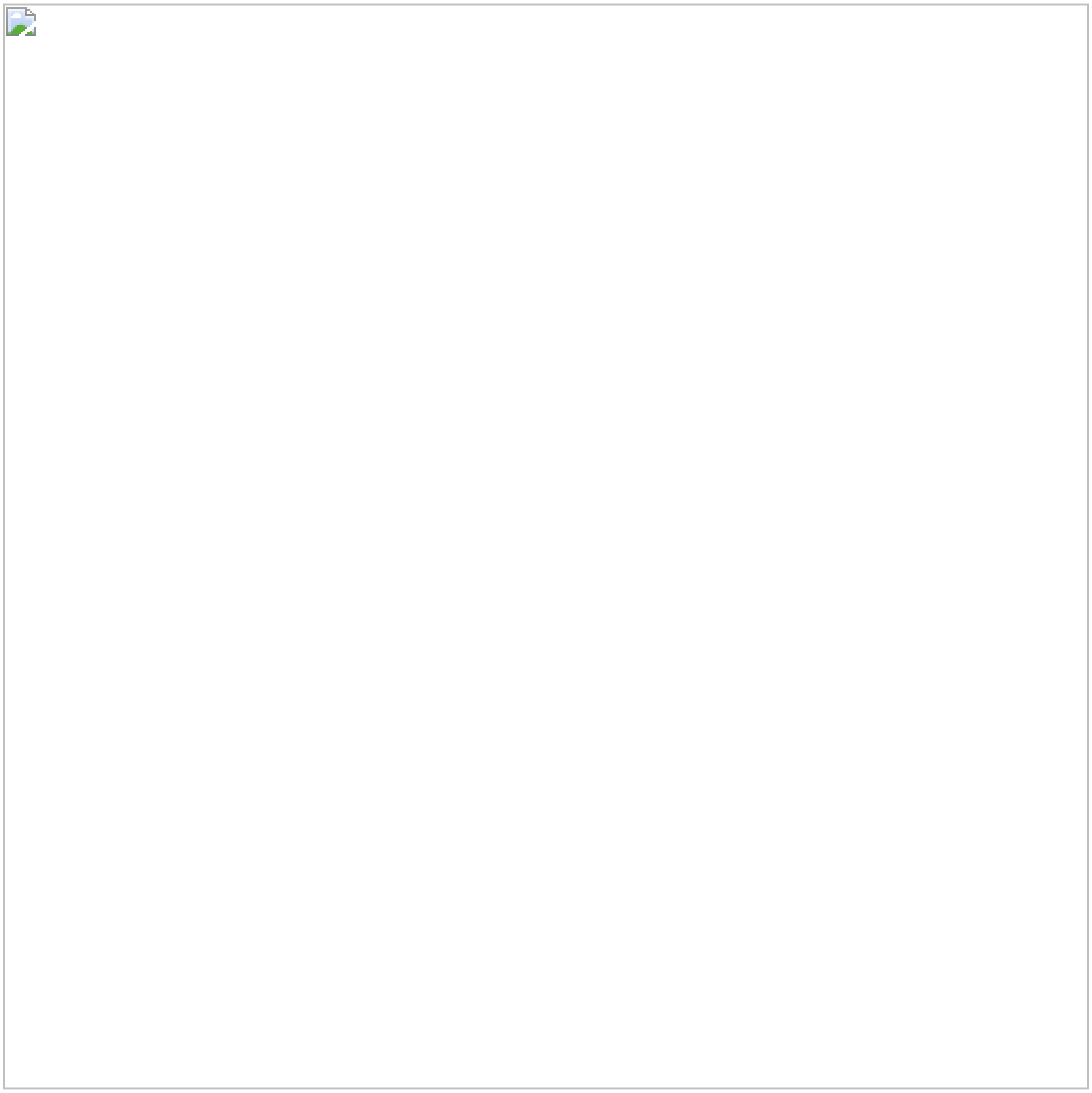
Conclusion

- Redline Stealer is one of the most popular infostealers along with Vidar, Raccoon, and Ficker.
- Logs stolen through Redline Stealer are the most traded logs on DDW Forums.

- Redline Stealer has been updating versions until recently, and continuous analysis is needed in that the structure of Redline Stealer is gradually changing according to major updates.

Appendix

Description of each Operation Contract function.



Chromium-based Browser List

```
Battle.net, Chromium, Chrome, Opera Software, ChromePlus, Iridium, 7Star, CentBrowser,
Chedot, Vivaldi, Kometa, Elements Browser, Epic Privacy Browse, uCozMedia, Sleipnir5,
Citrio, Coowon, liebao, QIP, Orbitum, Comodo Dragon, Amigo, Torch, Yandex, 360Browser,
Maxthon3, K-Melon, Sputnik, Nichrome, CocCoc, Uran, Chromodo, Mail.Ru, BraveSoftware,
Edge, VIDIA GeForce Experience, Steam, CryptoTab Browser
```

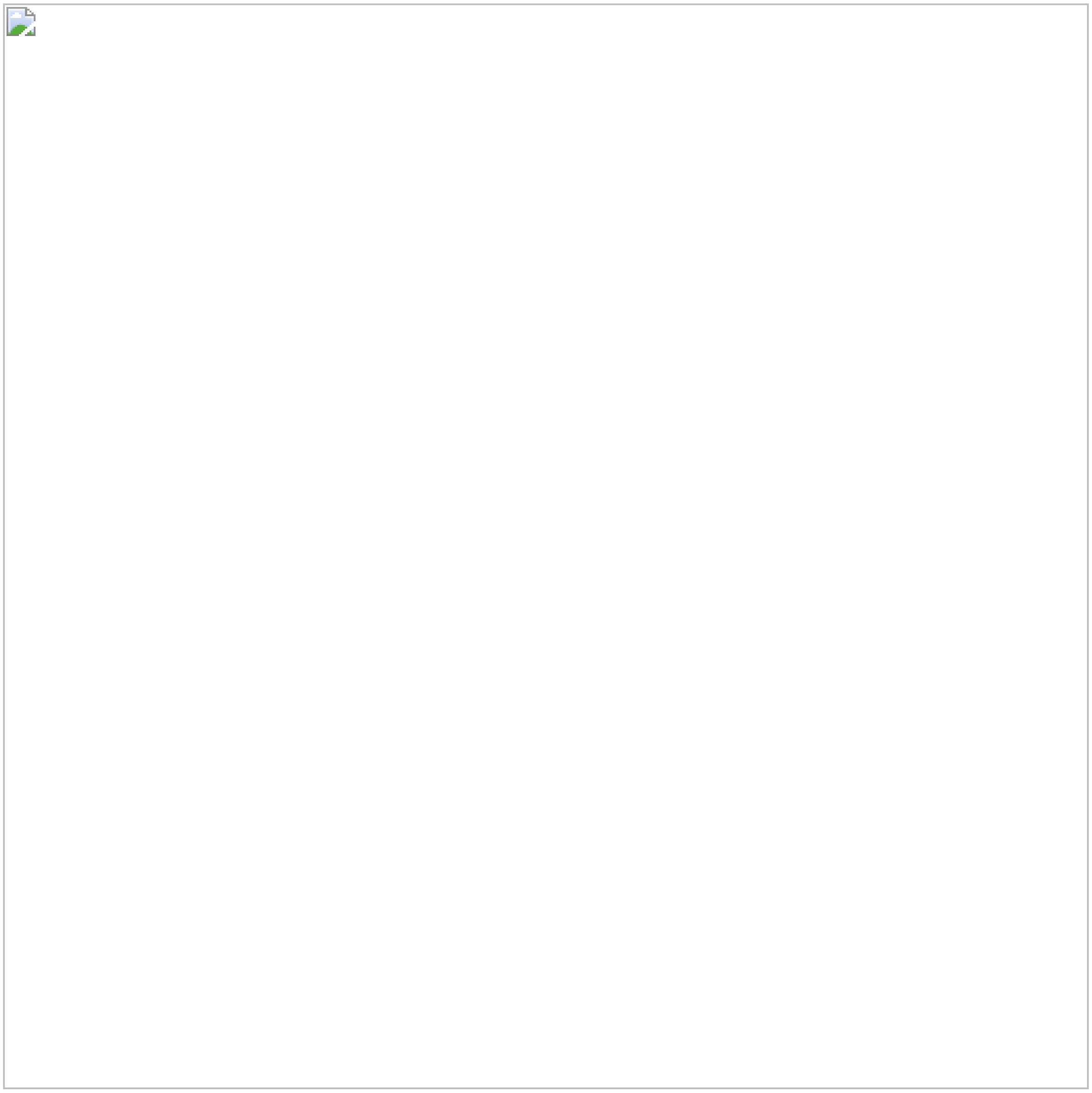
Gecko-based Browser List

```
Firefox, Waterfox, K-Meleon, Thunderbird, Comodo, Cyberfox, BlackHaw, Pale Moon
```

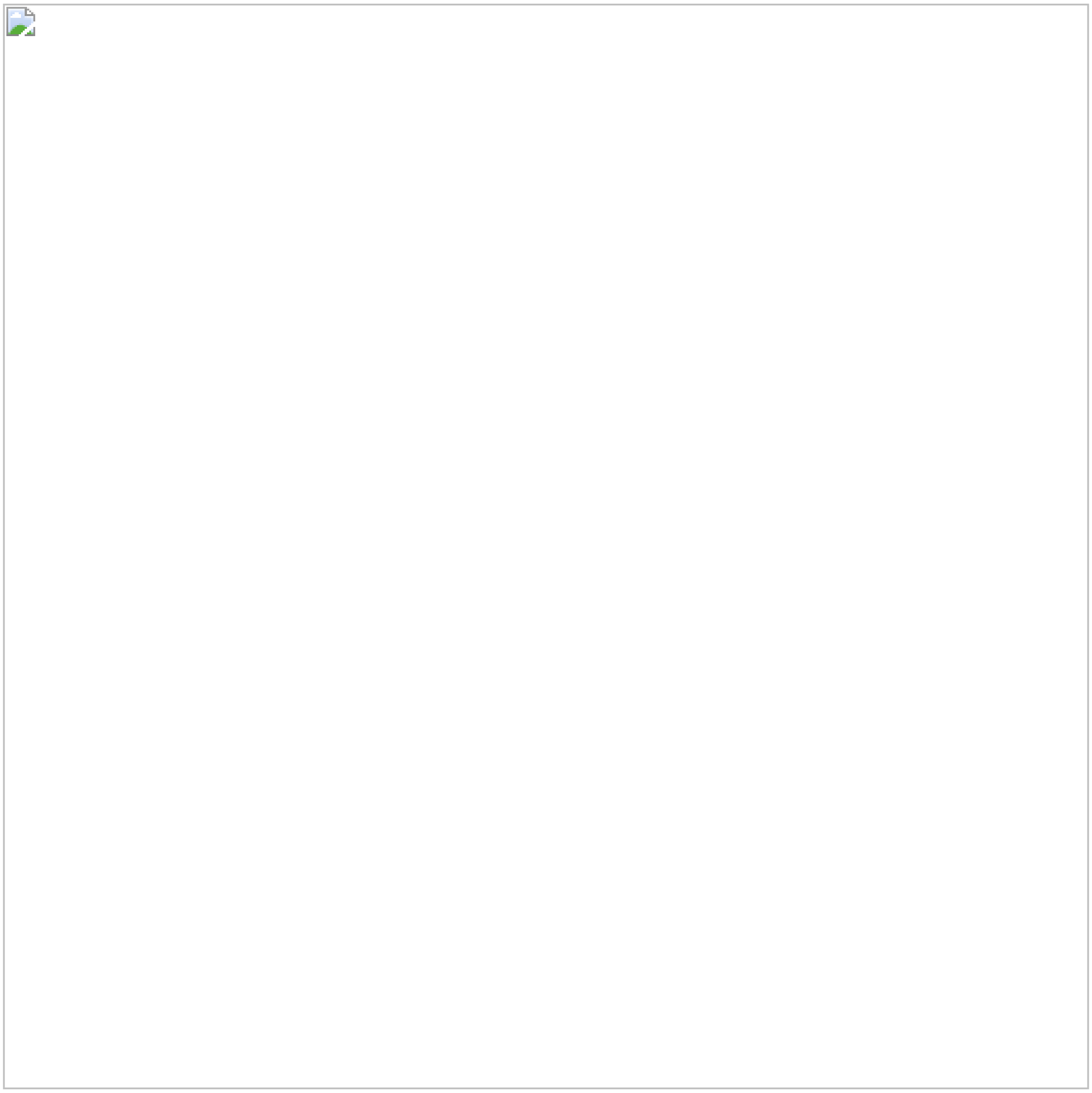
Browser Extension Wallet List

```
YoroiWallet, Tronlink, NiftyWallet, MetaMask, Coinbase, BinanceChain, BraveWallet,
GuardaWallet,  EqualWallet, JaxxxLiberty, BitAppWalllet, iWallet, AtomicWallet, Wombat,
AtomicWallet, MexCx, GuildWallet, SaturnWallet, RoninWallet, TerraStation,
HarmonyWallet, Coin98Wallet, TonCrystal, KardiaChain, Phantom, Oxygen, PaliWallet,
BoltX, LiqualityWallet, XdefiWallet, NamiWallet, MaiarDeFiWallet, Authentiator
```

Methods collecting Environment Details



Methods collecting Credential Details



Redline Stealer IoCs

- d81d3c919ed3b1aaa2dc8d5fbe9cf382 | cd3f0808ae7fc8aa5554192ed5b0894779bf88a9c56a7c317ddc6a4d7c249e0e
- af90600728c9d3d1270dd4da39a0f9e5 | 38a5b96fd07f03041f6eff913b85fc621fa314e1de87326accb00ee218c37756
- d6e630749bdd4f16c37ca15886fc6bdc | 020fbe48b4da34a90d3422f211aa0338681a7cb9e99292b2b9d738a354ed97de
- ce70574f6c90835076d9b195e90cd275 | c6d48514031cc6e83445b95f9ed4e975f2cdcebc2e9cc1914605058ff7af7764
- 10adb0969eb2b385d6bb8ad8e91bb0c4 | 9ac01cc861cfe9e340c66a5cd527ab8a7e3de345b851ebcf07a7ca08eeee2f88