Banking Trojans Under Development

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Although banks themselves have taken measures to strengthen the security of their authentication processes, Banker Trojans, however, are still a popular tool for stealing user's financial details and draining bank accounts.

The Check Point Research team recently came across one such banking Trojan under development and already being distributed through the RIG Exploit Kit. Dubbed 'Karius', the Trojan aims to carry out web injects to add additional fields into a bank's legitimate login page and send the inputted information to the attacker.

While Karius is not yet in full infection mode, initial tests have already been made and our research below shows the evolution of how such malware takes place. Our analysis also shows how banking trojans such as Karius are put together and makes use of code from other well-known bankers such as Ramnit, Vawtrak and TrickBot.

Malware Analysis

Karius works in a rather traditional fashion to other banking malware and consists of three components:

- injector32\64.exe
- proxy32\64.dll
- mod32\64.dll

These components essentially work together to deploy webinjects in several browsers, thus intercepting the user's communication to the internet.

Normally, the content sought in the intercepted traffic would be a specific banking website that the victim has visited. This site would then be modified so as to trick the user to enter his credentials which are then sent to the attacker. However, it seems that this malware is still in a development and possibly in testing stages, which is why the webinjects don't yet target any financial institutions in particular.

The initial component that will be executed is **injector32.exe** (or injector64.exe, its equivalent for 64 bit systems). This component is responsible for several actions, namely:

Modifying several registry keys, for the purpose of disabling protection mechanisms in Internet Explorer.These include:

1. HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\3\2500 = DWORD:3
2. HKCU \Software\Microsoft\Internet Explorer\Main\TabProcGrowth = DWORD:0
3. HKCU \Software\Microsoft\Internet Explorer\Main\NoProtectedModeBanner = DWORD:1

- Copying itself to the startup directory with the name TEMP APPLICATION.lnk as a means of persistence, as well as creating a duplicate under the name %USERPROFILE%/music/temp.exe.
- Writing a batch script to disk which will delete the original file.
- Contacting the Command and Control (C&C) server for registering the bot using a message with the following json structure:

{"id": "<computer_name_hash><digital_product_id_hash>"

"action": "register"

"os": "<os_version>"

"lang": "<lang>"

"integrity": "None"

"admin": "admin"

“group”: “group”

}

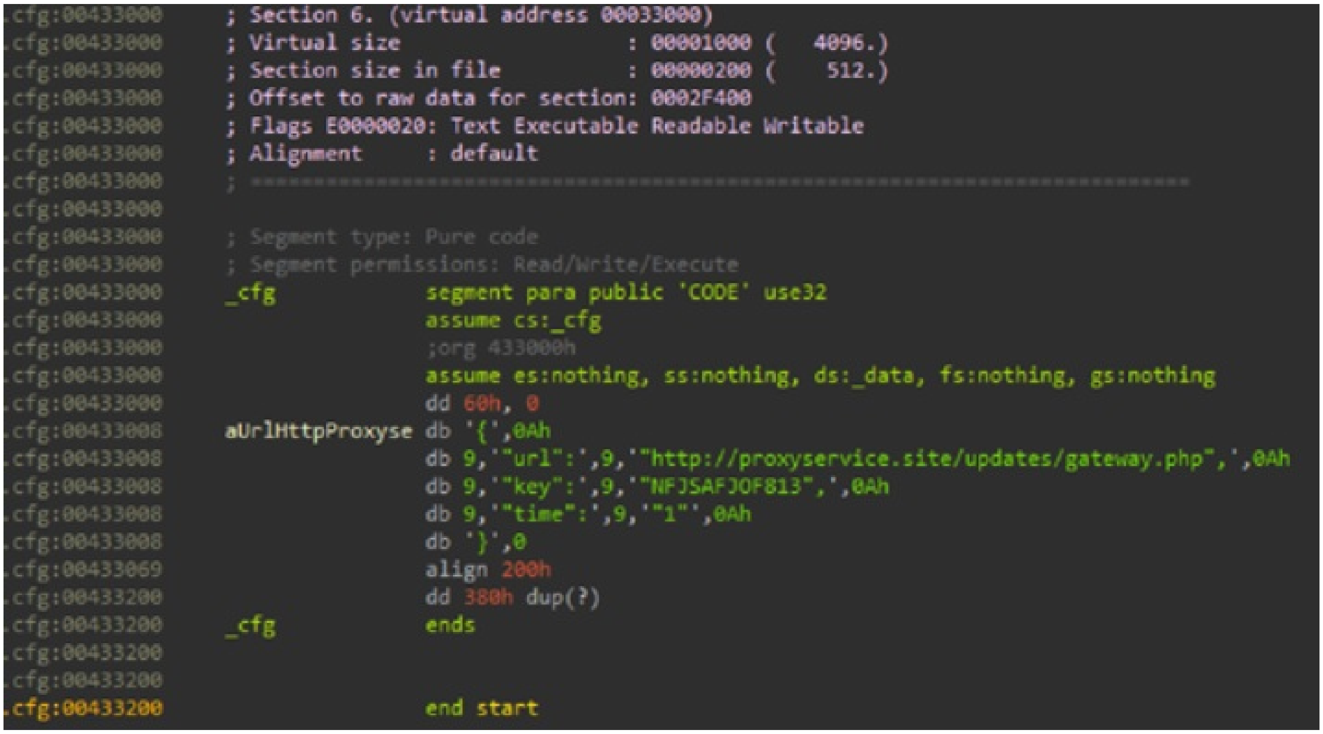
After contacting the C&C server, the malware would then send a message with a similar id and a “ping” action, which is then responded to by the server with one of two commands –

Update – sends a binary with a new version of the malware.

Config – issues a webinjects configuration payload, saved to a file named “temp.bin”.

All the traffic to the C&C server will then be encrypted with RC4 using a key hardcoded in a configuration struct that resides within the .cfg section of this module’s binary.

cfg section:



```
.cfg:00433000      ; Section 6. (virtual address 00033000)
.cfg:00433000      ; Virtual size                  : 00001000 (   4096.)
.cfg:00433000      ; Section size in file          : 00000200 (    512.)
.cfg:00433000      ; Offset to raw data for section: 0002F400
.cfg:00433000      ; Flags E0000020: Text Executable Readable Writable
.cfg:00433000      ; Alignment     : default
.cfg:00433000      ; ===========================================================================
.cfg:00433000
.cfg:00433000      ; Segment type: Pure code
.cfg:00433000      ; Segment permissions: Read/Write/Execute
.cfg:00433000      _cfg            segment para public 'CODE' use32
.cfg:00433000                      assume cs:_cfg
.cfg:00433000                      ;org 433000h
.cfg:00433000                      assume es:nothing, ss:nothing, ds:_data, fs:nothing, gs:nothing
.cfg:00433000                      dd 60h, 0
.cfg:00433008      aUrlHttpProxyse db '{',0Ah
.cfg:00433008                      db 9,'"url":',9,'"http://proxyservice.site/updates/gateway.php",',0Ah
.cfg:00433008                      db 9,'"key":',9,'"NFJSAFJOF813",',0Ah
.cfg:00433008                      db 9,'"time":',9,'"1"',0Ah
.cfg:00433008                      db '}',0
.cfg:00433069                      align 200h
.cfg:00433200                      dd 380h dup(?)
.cfg:00433200      _cfg            ends
.cfg:00433200
.cfg:00433200
.cfg:00433200                      end start
```

Figure 1: *The .cfg section of the configuration module’s library.*

– Creating the named pipe “\\.\pipe\form” in order to communicate with other modules, which in turn use it to forward stolen credentials to it. This data will then be sent to the C&C periodically (upon an interval predefined in the internal configuration section), using the following message format:

{“id”: “<computer_name_hash><digital_product_id_hash>”

“action”: “report”

“url”: “<url_of_stolen_credentials>”

“browser”: “UNK”

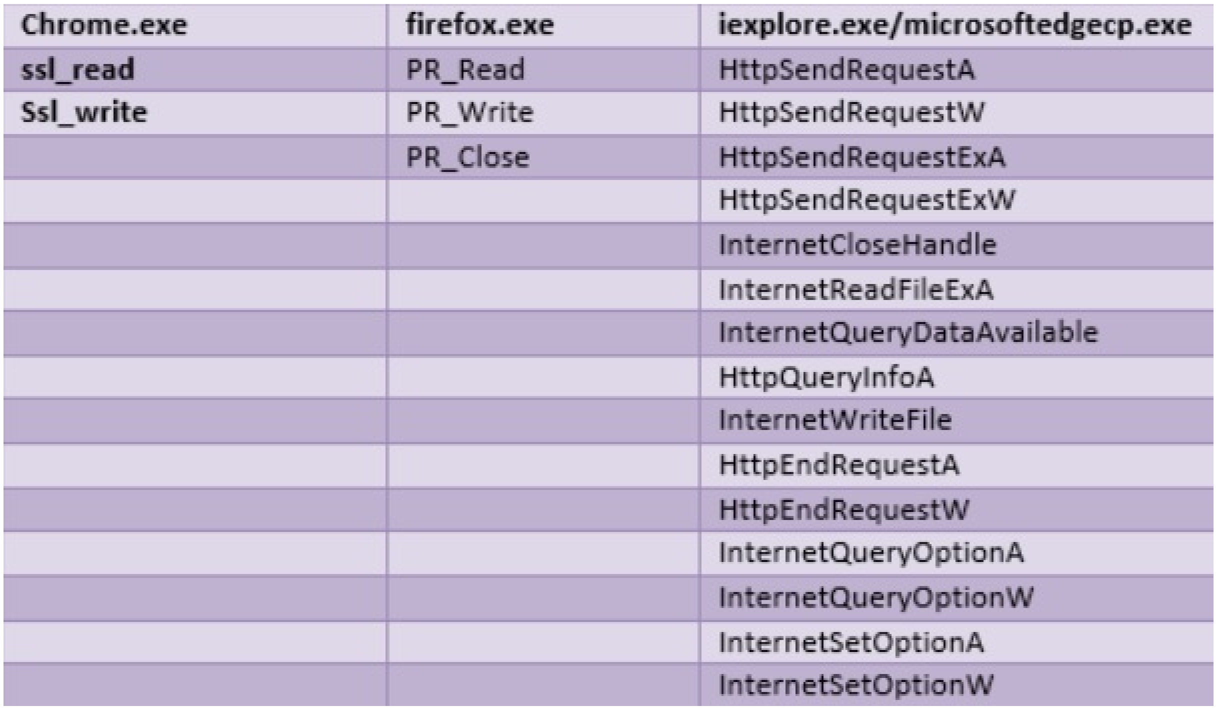
“Data”: “<data_of_stolen_credentials>”

}

– Decompressing the subsequent components (proxy32.dll and proxy64.dll) using aPLib and injecting the one corresponding to the system’s architecture to the “explorer.exe” process.

The dll component injected to “explorer.exe” is used to hook the CreateProcessInternalW API function, which is invoked upon initiation of processes under Explorer. The hook function, in this case, will look for one of several browsers and would inject it with yet another decompressed DLL named mod32.dll (or mod64.dll for 64 bit systems). These browsers include: Internet Explorer, Chrome, Firefox and Edge.

This final DLL payload, which will execute in the context of one or more of the aforementioned browsers, is the component that will implement the webinjects mechanism by applying some hooks, as done by many other banking malwares. The hooked functions can be found below.



Chrome.exe	firefox.exe	iexplore.exe/microsoftedgecp.exe
ssl_read	PR_Read	HttpSendRequestA
Ssl_write	PR_Write	HttpSendRequestW
	PR_Close	HttpSendRequestExA
		HttpSendRequestExW
		InternetCloseHandle
		InternetReadFileExA
		InternetQueryDataAvailable
		HttpQueryInfoA
		InternetWriteFile
		HttpEndRequestA
		HttpEndRequestW
		InternetQueryOptionA
		InternetQueryOptionW
		InternetSetOptionA
		InternetSetOptionW

Figure 2: *Table of hooked functions per browser.*

As mentioned previously, the webinjects reside within the “temp.bin” file, and have the following format:

host: <url_of_host>

path: <path_in_url>

data:

inject: <data_to_inject>

before: <what is before the injected data>

after: <what is after the injected data>

The credentials stolen by applying the webinjects will then be sent using the named pipe to the injector component, and subsequently forwarded to the C&C.

A figure that illustrates all aforementioned actions can be seen below:

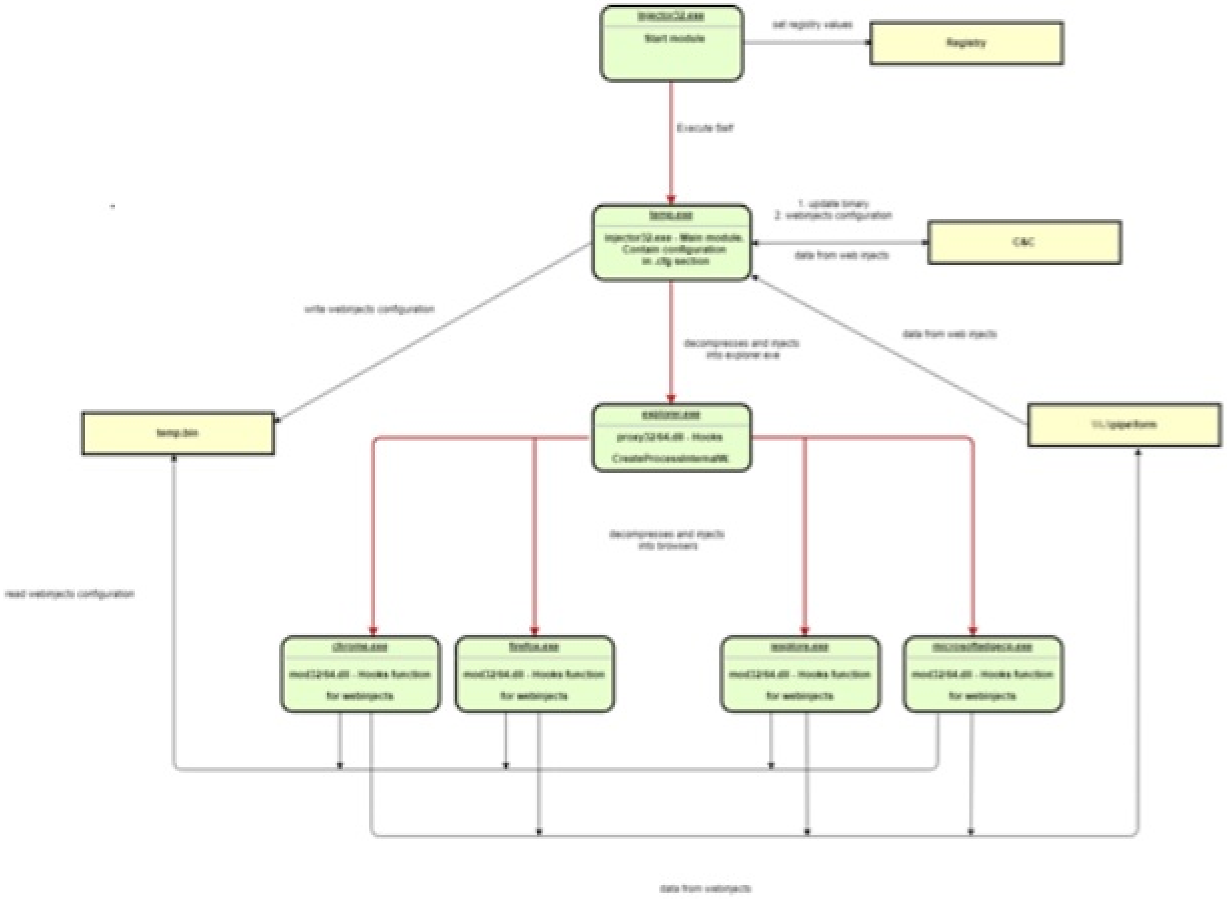

injector32.exe
Start module
set registry values
Registry
Execute Self
temp.exe
injector32.exe - Main module. Contain configuration in .cfg section
1. update binary
2. webinjects configuration
C&C
data from web injects
write webinjects configuration
decompresses and injects into explorer.exe
data from web injects
temp.bin
explorer.exe
proxy3264.dll - Hooks CreateProcessInternalW
\\.\pipe\form
decompresses and injects into browsers
read webinjects configuration
chrome.exe
mod3264.dll - Hooks function for webinjects
firefox.exe
mod3264.dll - Hooks function for webinjects
iexplore.exe
mod3264.dll - Hooks function for webinjects
microsoftedgecp.exe
mod3264.dll - Hooks function for webinjects
data from webinjects

Figure 3: *Diagram of Karius' processes.*

Similarity to Known Banking Trojans

As seen in the previous section, the malware's internal workings are quite standard for the Banking Trojans. What's more interesting, though, is the fact that major parts of the malware are heavily based on well-known bankers that can be found in the wild. For instance, the usage of aPLib compression to store both 32 and 64 bit modules one after the other in the file was used previously in Vawtrak.

Also, in one of the malware’s inspected samples we were able to track hardcoded webinjects, which to our surprise were used previously by Ramnit.

Webinjects similarity:

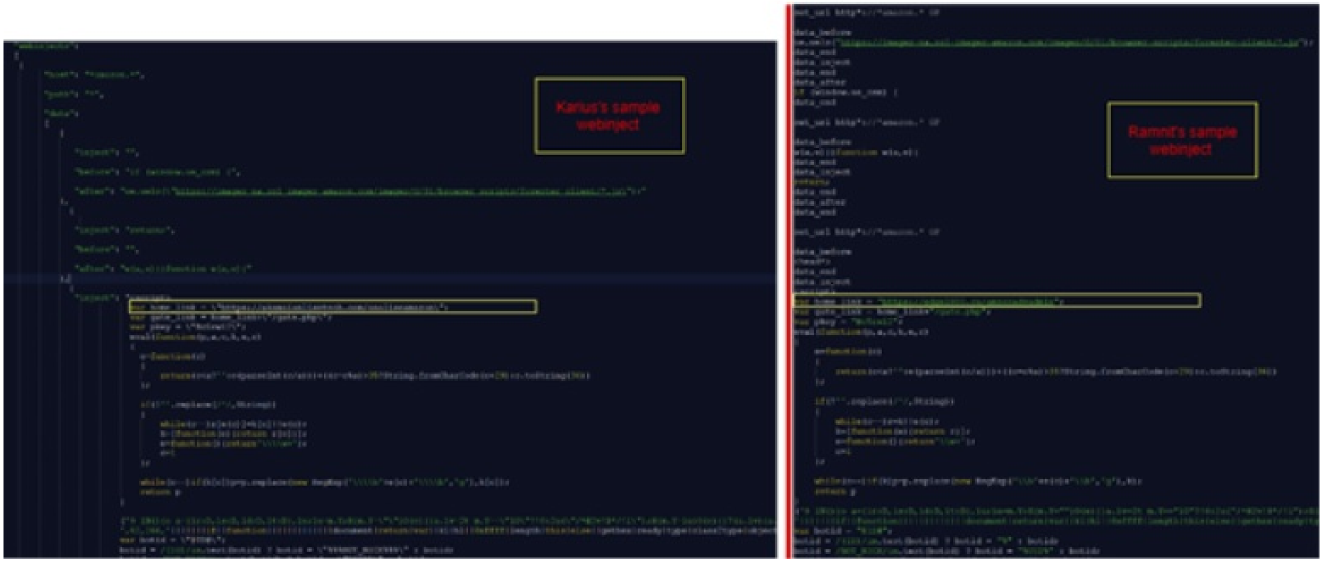


Figure 4: *Comparison of code used in Karius and Ramnit’s webinjects.*

But probably the most significant resemblance we were able to spot is to the widely distributed TrickBot banker. In particular, we saw a very high similarity in binary code between the two malwares. The functionalities of injection and hooking methods showed very similar code elements.

It might be not so surprising for the injection functionality, since both used the reflective loading injection method, which has an online open source implementation, found here.

However, it is not clear whether the inline hooking implementation was taken from any particular known source code.

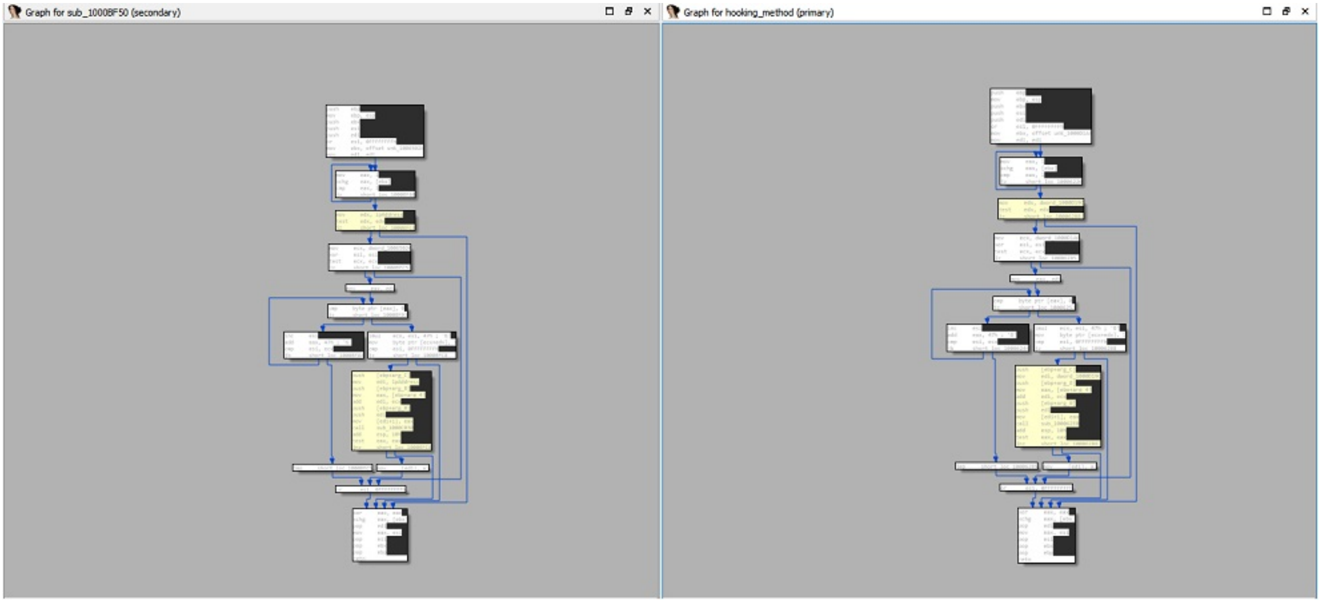

Graph for sub_1000BF50 (secondary)
Graph for hooking_method (primary)

Figure 5: *The Hooking_Method function.*

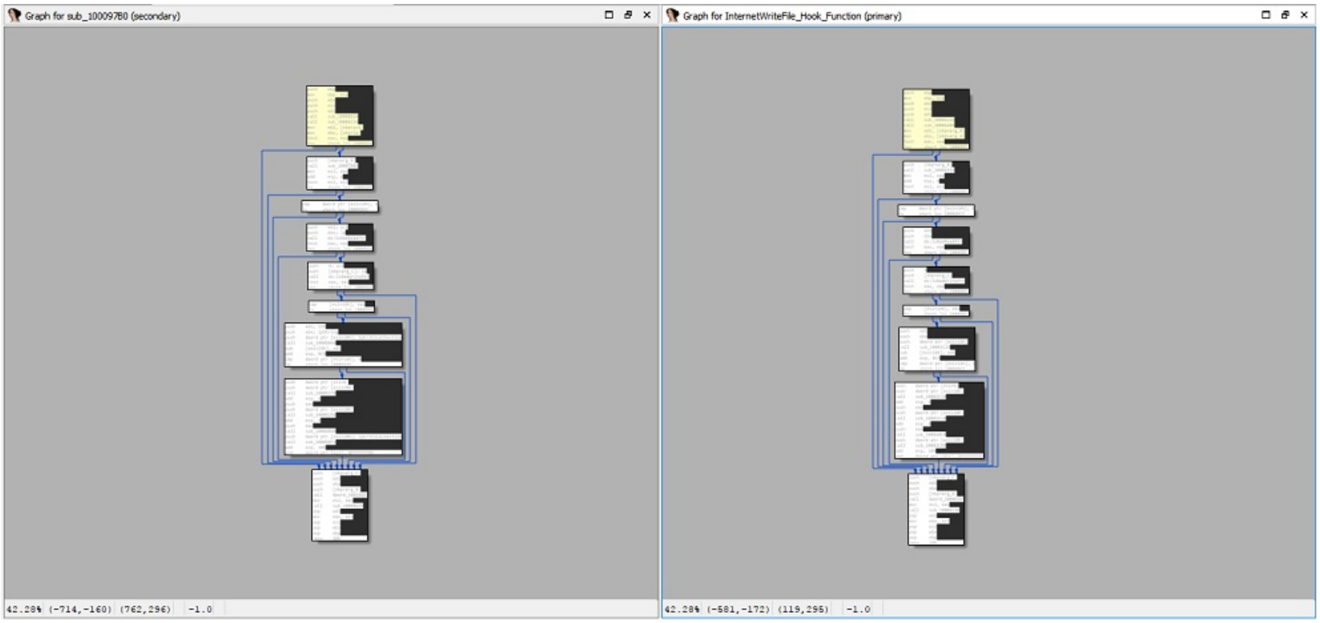

Graph for sub_100097B0 (secondary)
Graph for InternetWriteFile_Hook_Function (primary)
42.28% (-714,-160) (762,296) -1.0
42.28% (-581,-172) (119,295) -1.0

Figure 6: *The InternetWriteFile_Hook_Function.*

It’s interesting to note that in one of the similar hooking functions observed in Karius, we could spot a call to the OutputDebugString function, which contains a string that hints on the function’s name. This may suggest that the author of Karius was in possession of the source code used to implement the hooking mechanism of TrickBot, and added this line for debugging purposes. It also hints that this malware is still undergoing some development and that more versions of it are yet to be released.

HttpSendRequestA_Hook_Function

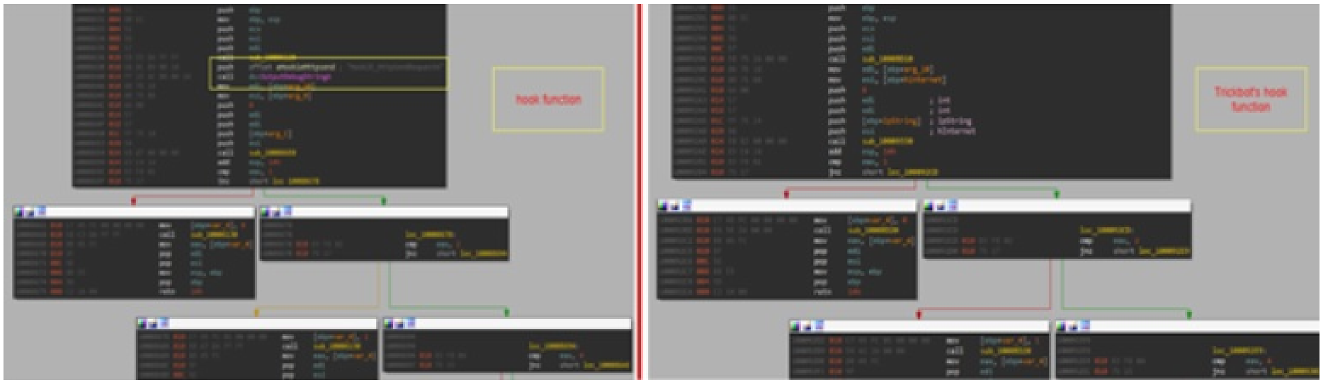
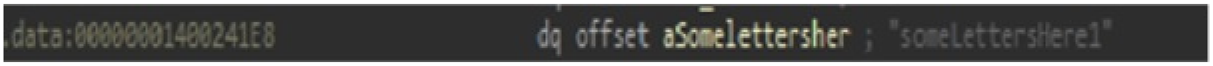


Figure 7: *The HttpSendRequestA_Hook function.*

An Evolving Malware

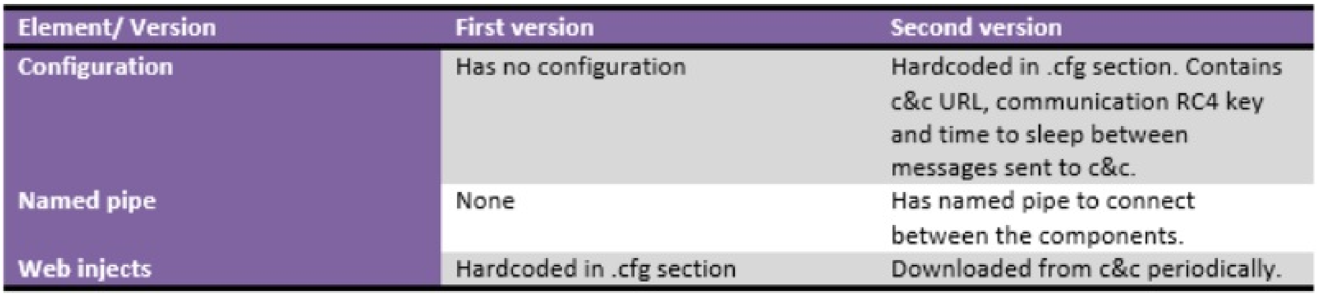
Throughout the research of this malware, we observed two main versions which outline a certain evolution in its development. The first version seemed to be very buggy, and possibly used only for testing purposes, while the second, while more functional, is still not fully complete. This can be seen in the presence of various “placeholder” strings such as the one below:



```
.data:00000001400241E8                dq offset aSomelettersher ; "someLettersHere1"
```

Figure 8: *An incomplete “placeholder” string.*

The major changes between the two versions are outlined in the following table:



Element/ Version	First version	Second version
Configuration	Has no configuration	Hardcoded in .cfg section. Contains c&c URL, communication RC4 key and time to sleep between messages sent to c&c.
Named pipe	None	Has named pipe to connect between the components.
Web injects	Hardcoded in .cfg section	Downloaded from c&c periodically.

Figure 9: *Table of development changes between the two versions of the malware.*

IOCs:

Md5 hashes:

728911a915d9ec3b6defa430d24bc0d5

857430b8c9dc78ce4eabbe57cb3ae134

Domains:

https://proxyservice.site/updates/gateway.php