Angry Cow
Malware Analysis Report

SikoMode
Self-Deleting Data Exfiltration Malware

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Preamble to Report

This document is a sample report completed as a final project for a course from TCM Security (https://academy.scm-sec.com), titled “Practical Malware Analysis and Triage”, developed, and presented by Matt Kiely.

The course was a well prepared and presented entry level course. That being said, it was a realistic artfully contrived scenario with a very functional well controlled, ”malicious” file.

As an educational exercise, there were 13 challenge questions requiring answers in the content of this report. In a spirit of full disclosure there are two that I did not personally find the answers to but included in this report for completeness. 1. The Encryption Algorithm of RC4 – while I found evidence of encryption I did not determine what the method was on my own. 2. Mention of, or the significance of the ”Houdini” signature.

This was a thoroughly enjoyable practical exercise that left me feeling just a little bit more prepared to move forward with my education in this are.

Respectfully Submitted,
Larry Schlack
Aka. The Angry Cow

Executive Summary

Hash Values

Md5	B9497FFB7E9C6F49823B95851EC874E3
Sha1	6C8F50040545D8CD9AF4B51564DE654266E592E3
Sha256	3ACA2A08CF296F1845D6171958EF0FFD1C8BDFC3E48BDD34A605CB1F7468213E

File type	64 bit executable	Written in the NIM programming language

SikoMode *(named after the password in password.txt file)* is a self-deleting data exfiltration malware package. SikoMode can target specific location(s) on a compromised machine and is self-deleting when its task(s) are completed. The most likely method of delivery to the compromised machine is by targeted phishing.

Symptoms of attack may be noticed in reduced system performance because of continuous data exfiltration. Another indicator is the presence of a file named ‘password.txt’ located at C:\Users\Public\password.txt.

YARA signature rules are attached in Appendix A. Hashes submitted to VirusTotal have yielded the following sample results.

Virus Total	13 of 64 found malicious (sample ID's)
Kaspersky	Backdoor.Win32.PMax.auos
Fortinet	Malicious_Behavior.SB
Alibaba	Backdoor:Win32/Meterpreter.09eb9990

High-Level Technical Summary

SikoMode consists of a single executable delivered to the compromised machine via a fishing link. According to the Incident Response Team it was located at C:\Users|Public\. The initial task was connecting to the call back URL of hxxp://update.ec12-4-109-278-3-ubuntu20-04.local. The second task was to contact the exfiltration URL of hxxp://cdn.altimiter.local/ This connection was kept alive by a repeating request at 1 second intervals.

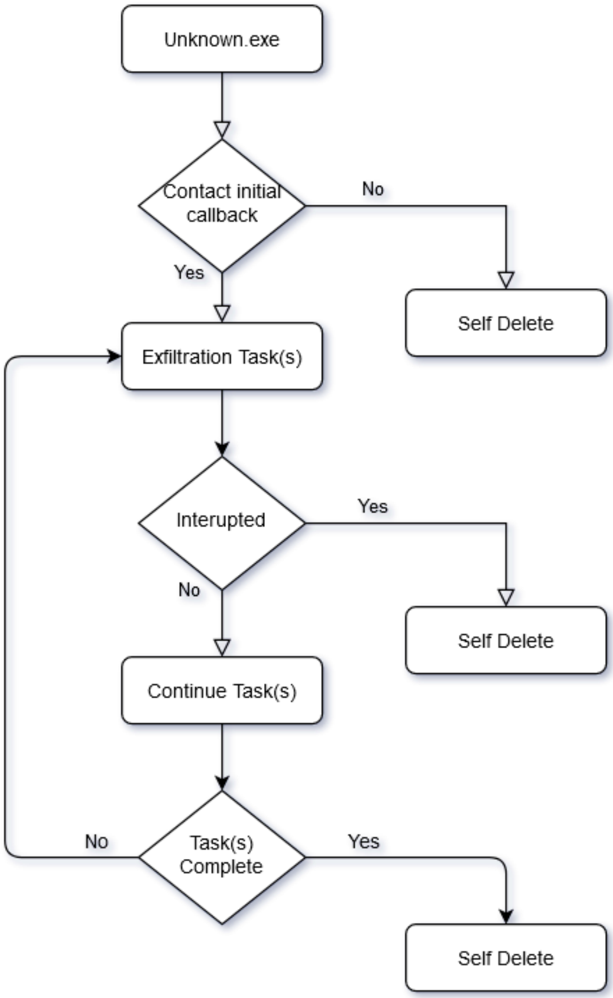


Figure 1. Simplified execution flow

Malware Composition

SikoMode malware consists of a single file unknown.exe with the following characteristics.

File type	64 bit exe, Exfil data encrypted with RC4	Written in NIM

Hash Values

Md5	B9497FFB7E9C6F49823B95851EC874E3
Sha1	6C8F50040545D8CD9AF4B51564DE654266E592E3
Sha256	3ACA2A08CF296F1845D6171958EF0FFD1C8BDFC3E48BDD34A605CB1F7468213E

Virus Total	13 of 64 found malicious (sample ID's)
Kaspersky	Backdoor.Win32.PMax.auos
Fortinet	Malicious_Behavior.SB
Alibaba	Backdoor:Win32/Meterpreter.09eb9990

SikoMode also writes a file named password to the file system located at: C:\users\public\password.txt containing the encryption key value of “SikoMode”.

There are three circumstances where the malware will self-delete as shown in figure1 above.

1. If the initial callback address is not contacted
2. If at any time communication is interrupted during the exfiltration process
3. Once the data exfiltration is completed

Basic Static Analysis

{Screenshots and description about basic static artifacts and methods}

During the basic static analysis portion there was very little observed that provided indications of the function of this program. Finding some sort of string information is more typical than not with malware products. Later analysis was able to reveal strings that help identify that the malware was written in the Nim programming language, The fact that these strings were not found earlier attests to some level of potential sophistication of the malware author(s). The strings were only visible for us at runtime while working in X64dbg, and Cutter. There were a few interesting strings available from PE Studio seen in Figure 2 below.

12,0x0001A480	InternetOpen	19,0x00020FC6	GetCurrentProcessId
15,0x0001A48E	InternetOpenUrl	18,0x00020FDC	GetCurrentThreadId
19,0x0001A49F	InternetCloseHandle	19,0x000210AE	RtlAddFunctionTable
25,0x0001A85E	QueryPerformanceFrequency	22,0x000210D8	,RtlLookupFunctionEntry
		16,0x0002112C	TerminateProcess
11,0x0001A0CC	getaddrinfo	14,0x00021188	VirtualProtect
0x0001A0D8	freeaddrinfo	6,0x00021356	getenv
13,0x0001A0ED	FindFirstFile		

Figure 2 Sample Strings from PE Studio

Basic Dynamic Analysis

{Screenshots and description about basic dynamic artifacts and methods}

It was during the basic dynamic analysis that we were able to begin determining what we might have utilizing iNetSim and WireShark

INetSim Log Information

Our first DNS request is to time.windows.com,
Second is to update.ec12-4-109-278-3-ubuntu20-04.local
Third (below) is to cdn.altimiter.local

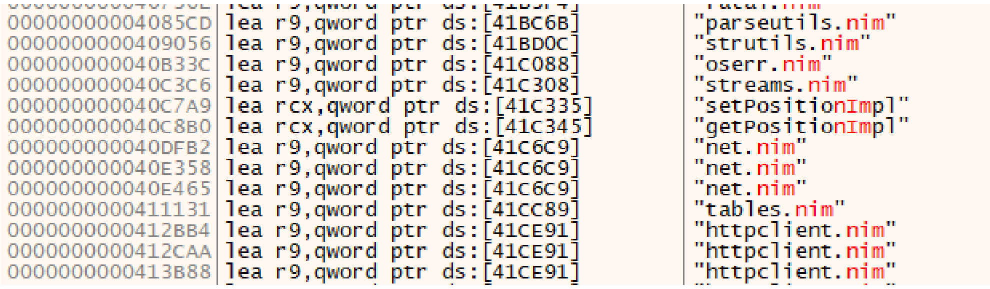
```
2022-02-17 19:12:08  DNS connection, type: A, class: IN, requested name: time.windows.com

2022-02-17 19:14:46  DNS connection, type: A, class: IN, requested name: update.ec12-4-109-278-3-ubuntu20-04.local

2022-02-17 19:14:46  HTTP connection, method: GET, URL: hxxp://update.ec12-4-109-278-3-ubuntu20-04.local/, file name: /var/lib/inetsim/http/fakefiles/sample.html

2022-02-17 19:14:47  DNS connection, type: A, class: IN, requested name: cdn.altimiter.local

2022-02-17 19:14:47  HTTP connection, method: GET, URL: hxxp://cdn.altimiter.local/feed?post=A8E437E8F0367592569A2870BBDD382A1DFBB01A15FC23999D7788C33502AD9256E481B402BDC6BC25167B6478F204C49A9BADD68C4AC2A617437ECCBBA9, file name: /var/lib/inetsim/http/fakefiles/sample.html

2022-02-17 19:14:48  HTTP connection, method: GET, URL: hxxp://cdn.altimiter.local/feed?post=B69A1CF6853645A440A0337BA0FB38291DE0B01A07FC129199658DDD4C1286BE45FEA8851D9BC6BC34220A6466D404C49A988BD6895AF291136076CCAFA9, file name: /var/lib/inetsim/http/fakefiles/sample.html

2022-02-17 19:14:49  HTTP connection, method: GET, URL: hxxp://cdn.altimiter.local/feed?post=B69C1CF58536758272963755A8FB34291DEBB01907FC28919D7789E440128EBE45FDA88C199BC6BC08240E5C72D40CC49A9B8BC2895AC6B7666571CEBBA9, file name: /var/lib/inetsim/http/fakefiles/sample.html
```

This process above repeated once per second This appears to be the exfiltration taking place as it is continuously repeating with a different string attached each time. This was an indication of data exfiltration as they were each individually distinct.

Advanced Analysis

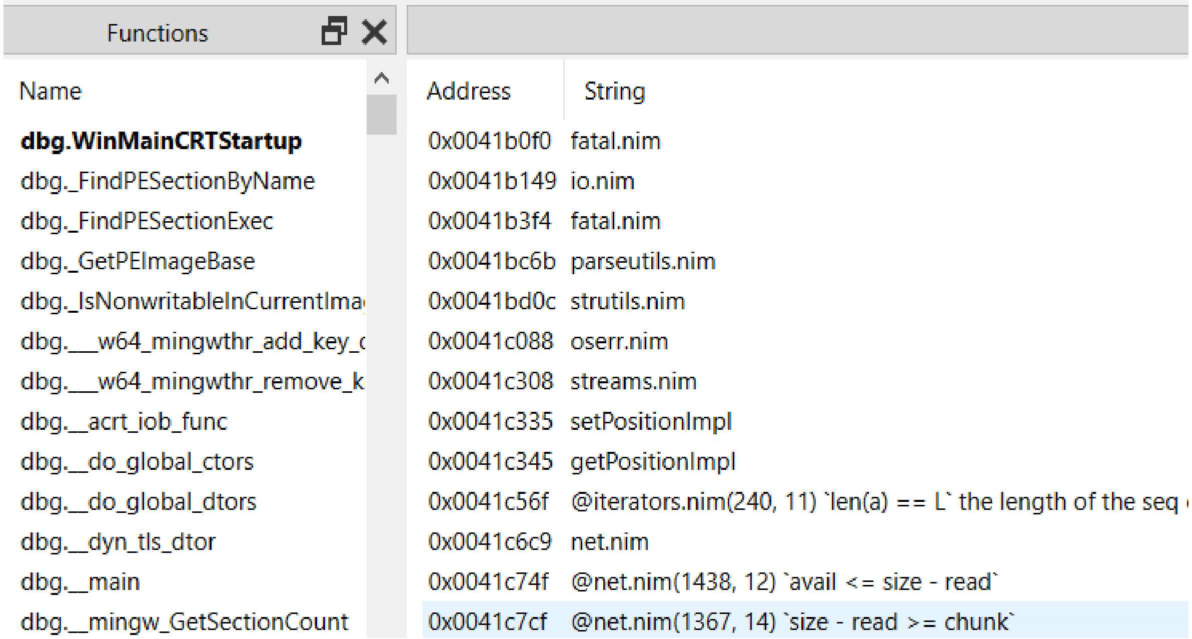
{Screenshots and description about findings during advanced analysis}

During the advanced analysis of unknown.exe we were able to determine the most likely language the malware was written in. While other tools identified this as written in C, later indication were of Nim. See figures 3 and 4,



```
00000000004085CD lea r9,qword ptr ds:[41BC6B]       "parseutils.nim"
0000000000409056 lea r9,qword ptr ds:[41BD0C]       "strutils.nim"
000000000040B33C lea r9,qword ptr ds:[41C088]       "oserr.nim"
000000000040C3C6 lea r9,qword ptr ds:[41C308]       "streams.nim"
000000000040C7A9 lea rcx,qword ptr ds:[41C335]      "setPositionImpl"
000000000040C8B0 lea rcx,qword ptr ds:[41C345]      "getPositionImpl"
000000000040DFB2 lea r9,qword ptr ds:[41C6C9]       "net.nim"
000000000040E358 lea r9,qword ptr ds:[41C6C9]       "net.nim"
000000000040E465 lea r9,qword ptr ds:[41C6C9]       "net.nim"
0000000000411131 lea r9,qword ptr ds:[41CC89]       "tables.nim"
0000000000412BB4 lea r9,qword ptr ds:[41CE91]       "httpclient.nim"
0000000000412CAA lea r9,qword ptr ds:[41CE91]       "httpclient.nim"
0000000000413B88 lea r9,qword ptr ds:[41CE91]       "httpclient.nim"
```

Figure 3   Strings from X64dbg (partial) Referencing NIM



Name
dbg.WinMainCRTStartup
dbg._FindPESectionByName
dbg._FindPESectionExec
dbg._GetPEImageBase
dbg._IsNonwritableInCurrentIma
dbg.__w64_mingwthr_add_key_c
dbg.__w64_mingwthr_remove_k
dbg.__acrt_iob_func
dbg.__do_global_ctors
dbg.__do_global_dtors
dbg.__dyn_tls_dtor
dbg.__main
dbg.__mingw_GetSectionCount

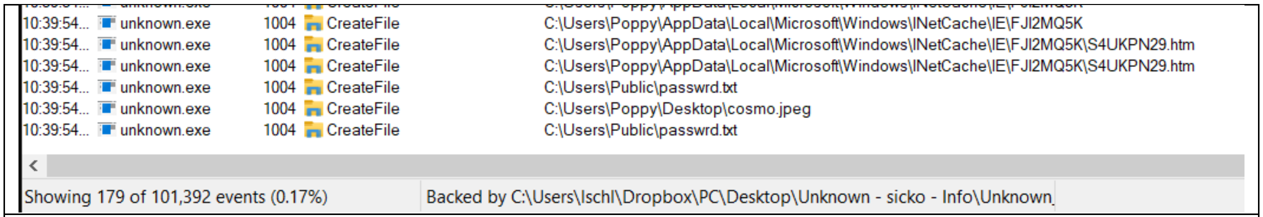
Address	String
0x0041b0f0	fatal.nim
0x0041b149	io.nim
0x0041b3f4	fatal.nim
0x0041bc6b	parseutils.nim
0x0041bd0c	strutils.nim
0x0041c088	oserr.nim
0x0041c308	streams.nim
0x0041c335	setPositionImpl
0x0041c345	getPositionImpl
0x0041c56f	@iterators.nim(240, 11) `len(a) == L` the length of the seq
0x0041c6c9	net.nim
0x0041c74f	@net.nim(1438, 12) `avail <= size - read`
0x0041c7cf	@net.nim(1367, 14) `size - read >= chunk`

Figure 4   Strings from Cutter (partial) referencing NIM

Advanced Analysis (Cont.)

{Screenshots and description about advanced artifacts and methods}

ProcMon was helpful in confirming the existence of encryption and locating the key.



```
10:39:54...  unknown.exe    1004  CreateFile    C:\Users\Poppy\AppData\Local\Microsoft\Windows\INetCache\IE\FJI2MQ5K
10:39:54...  unknown.exe    1004  CreateFile    C:\Users\Poppy\AppData\Local\Microsoft\Windows\INetCache\IE\FJI2MQ5K\S4UKPN29.htm
10:39:54...  unknown.exe    1004  CreateFile    C:\Users\Poppy\AppData\Local\Microsoft\Windows\INetCache\IE\FJI2MQ5K\S4UKPN29.htm
10:39:54...  unknown.exe    1004  CreateFile    C:\Users\Public\passwrd.txt
10:39:54...  unknown.exe    1004  CreateFile    C:\Users\Poppy\Desktop\cosmo.jpeg
10:39:54...  unknown.exe    1004  CreateFile    C:\Users\Public\passwrd.txt

Showing 179 of 101,392 events (0.17%)    Backed by C:\Users\Ischl\Dropbox\PC\Desktop\Unknown - sicko - Info\Unknown_
```

Processes from ProcMon showing possible encryption key and target

```
bcryptprimitives.dll    0x7ffd02d40000    0x83000    C:\Windows\System32\bcryptprimitives.dll
Microsoft Corporation    10.0.19041.1202 (WinBuild.160101.0800)    12/8/2012 10:40:38 PM

bcrypt.dll    0x7ffd02dd0000    0x27000    C:\Windows\System32\bcrypt.dll
Microsoft Corporation    10.0.19041.1 (WinBuild.160101.0800)    5/26/2020 5:18:52 AM
```

Additional references to encryption methodOperation: CreateFile from Thread 1068 (last CreateFile item in screenshot above), C:\Users\Public\passwrd.txt

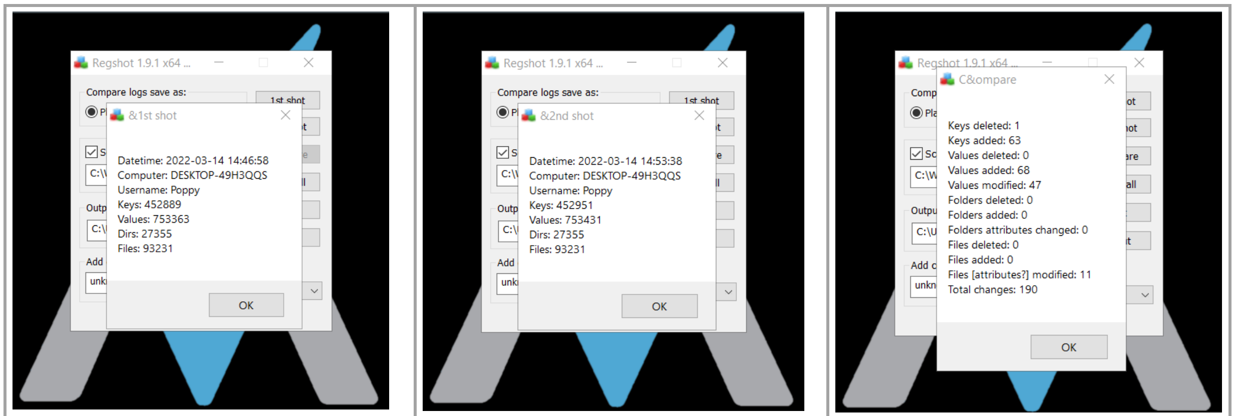
Figure 5   Additional References

Indicators of Compromise

Domain or URL's	hxxp://update.ec12-4-109-278-3-ubuntu20-04.local hxxp://cdn.altimiter.local	
Hashs	Md5	B9497FFB7E9C6F49823B95851EC874E3
	Sha1	6C8F50040545D8CD9AF4B51564DE654266E592E3
	Sha256	3ACA2A08CF296F1845D6171958EF0FFD1C8BDFC3E48BDD34A605CB1F7468213E
Files	C:\Users\Public\unknown.exe C:\Users\Public\passwrd.txt	

Host-based Indicators

{Description of host-based indicators}



```
Datetime: 2022-03-14 14:46:58
Computer: DESKTOP-49H3QQS
Username: Poppy
Keys: 452889
Values: 753363
Dirs: 27355
Files: 93231
```

```
Datetime: 2022-03-14 14:53:38
Computer: DESKTOP-49H3QQS
Username: Poppy
Keys: 452951
Values: 753431
Dirs: 27355
Files: 93231
```

```
Keys deleted: 1
Keys added: 63
Values deleted: 0
Values added: 68
Values modified: 47
Folders deleted: 0
Folders added: 0
Folders attributes changed: 0
Files deleted: 0
Files added: 0
Files [attributes?] modified: 11
Total changes: 190
```

Figure 6 Regshot Results

Keys Deleted	1
Keys Added	63
Values Added	68
Values Modified	47
Files/(Attrib) Modified	11

RegShot Compare Results

Sample Values Added
HKU\S-1-5-21-4083756768-584771330-1588837462-1001\SOFTWARE\Microsoft\Windows\CurrentVersion\Explorer\SessionInfo\1\ApplicationViewManagement\W32:000000000020030C\VirtualDesktop: 10 00 00 00 30 30 44 56 22 1A 67 40 BA 3F 0A 44 AE 37 A5 45 5E 46 58 AA
HKU\S-1-5-21-4083756768-584771330-1588837462-1001\SOFTWARE\Classes\Local Settings\Software\Microsoft\Windows\Shell\Bags\55\Shell\SniffedFolderType: "Generic"
HKU\S-1-5-21-4083756768-584771330-1588837462-1001_Classes\Local Settings\Software\Microsoft\Windows\Shell\Bags\55\ComDlg\{5C4F28B5-F869-4E84-8E60-F11DB97C5CC7}\GroupByDirection: 0x00000001
HKU\S-1-5-21-4083756768-584771330-1588837462-1001_Classes\Local Settings\Software\Microsoft\Windows\Shell\Bags\55\Shell\SniffedFolderType: "Generic"

Rules & Signatures

A full set of YARA rules is included in Appendix A.

Appendices

A. Yara Rules

```
rule SikoModeTest {

    meta:
        last_updated = "20220315"
        author = "The Angry Cow"
        description = "A rule to find SikoMode malware"

    strings:
        // Fill out identifying strings and other criteria
        $string1 = "SikoMode" ascii
        $string2 = "nim"
        $PE_magic_byte = "MZ"

    condition:
        // Fill out the conditions that must be met to identify the binary
        $PE_magic_byte at 0 and
        ($string1 and $string2)
}
```

B. Callback URLs

Domain	Port
hxxps:// update.ec12-4-109-278-3-ubuntu20-04.local	80
hxxps:// cdn.altimiter.local/fees? Post=(any string)	80