MuddyWater Back with DarkBit

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By Sudeep April 21, 2023

Recently, we came across a tweet about DarkBit ransomware. An Iranian APT group, named MuddyWater, is reportedly behind the DarkBit ransomware. In this blog we will explore the ransomware's initial access method, the use of Cobalt Strike and the final ransomware payload.

Initial Access Method

The initial lure was delivered as an ISO file.

```
00008000  01 43 44 30 30 31 01 00 4C 49 4E 55 58 20 20 20  .CD001..LINUX
00008010  20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
00008020  20 20 20 20 20 20 20 20 48 52 2D 50 6F 6C 69 63          HR-Polic
00008030  79 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20  y
00008040  20 20 20 20 20 20 20 20 00 00 00 00 00 00 00 00           ........
00008050  66 03 00 00 00 00 03 66 00 00 00 00 00 00 00 00  f......f........
```

Figure 1 – ISOFile

The payload included a shortcut file (with a .doc extension) and a zip file.

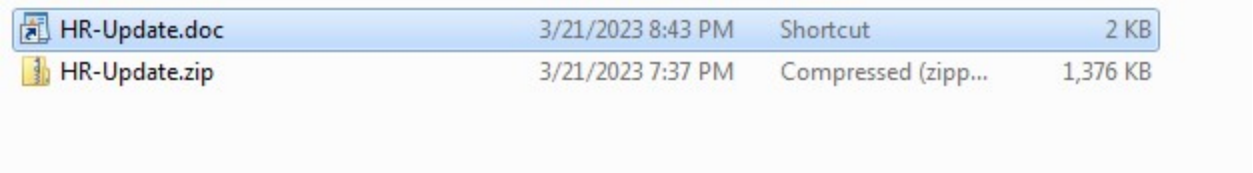


Figure 2 – Contents Inside ISO File

The shortcut was using PrintBrm.exe to unpack the HR-Update.zip and run it as shown below. PrintBrm.exe is a windows inbuilt command line tool.

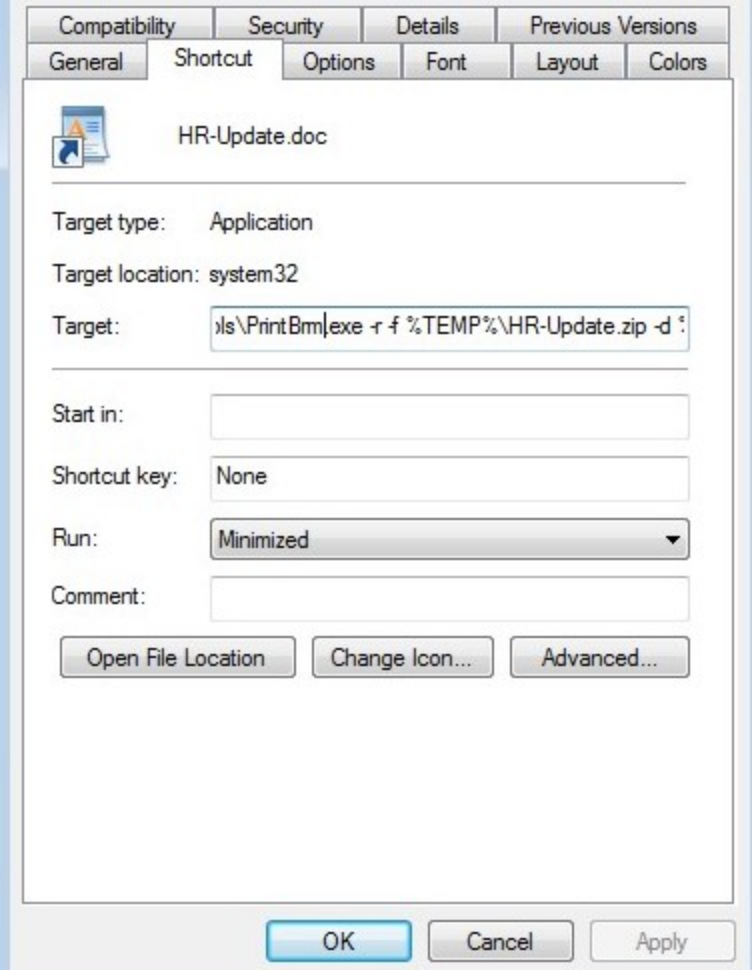


Figure 3 – Shortcut File

```
cmd.exe /c xcopy .\HR-Update.zip %TEMP% /h /y && PrintBrm.exe -r -f %TEMP%\HR-Update.zip -d %TEMP%\unzip & %TEMP%\unzip\HR-Update.exe
```

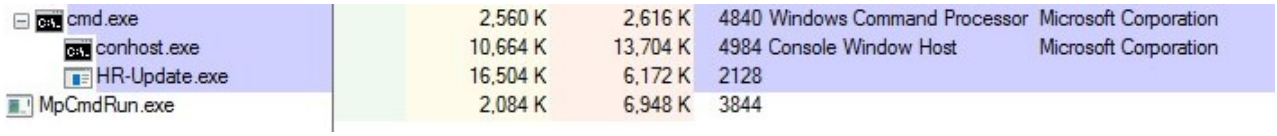


Figure 4 – HR-Update.exe Running

HR-Update.exe was a Cobalt Strike beacon. Cobalt Strike, a penetration testing tool, can also be used by attackers for gaining a foothold in the system. The final ransomware payload is downloaded with the help of Cobalt Strike.

At the time of writing the blog, we were unable to get the exact DarkBit ransomware payload. So we are using another available sample that belonged to the same campaign.

Analysis of Ransomware

This DarkBit ransomware sample is written in GoLang. It contains command line arguments.

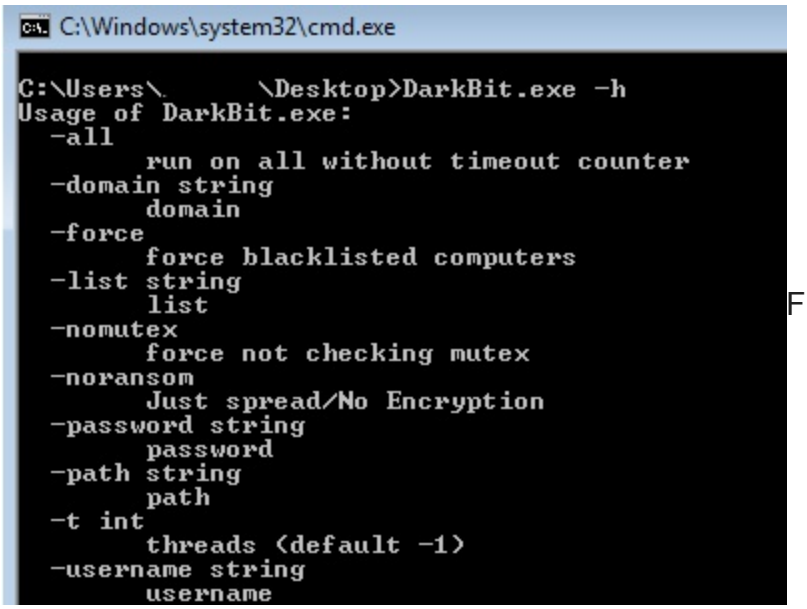


Figure 5 – Ransomware Features

It also contains an inbuilt configuration file as shown in Figure 6.

Figure 6 – InBuilt Config

Further analysis revealed that they had obfuscated some dll names like advapi32.dll and functions like SystemFunction036.

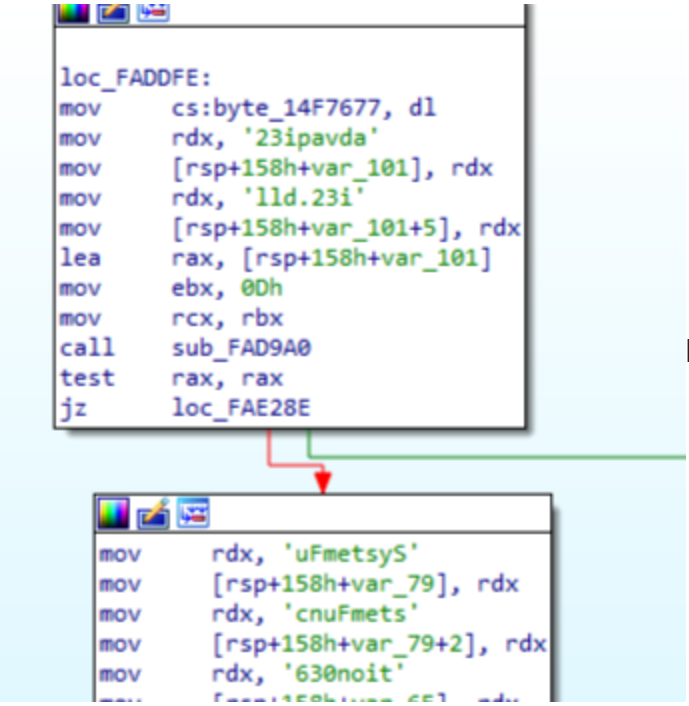
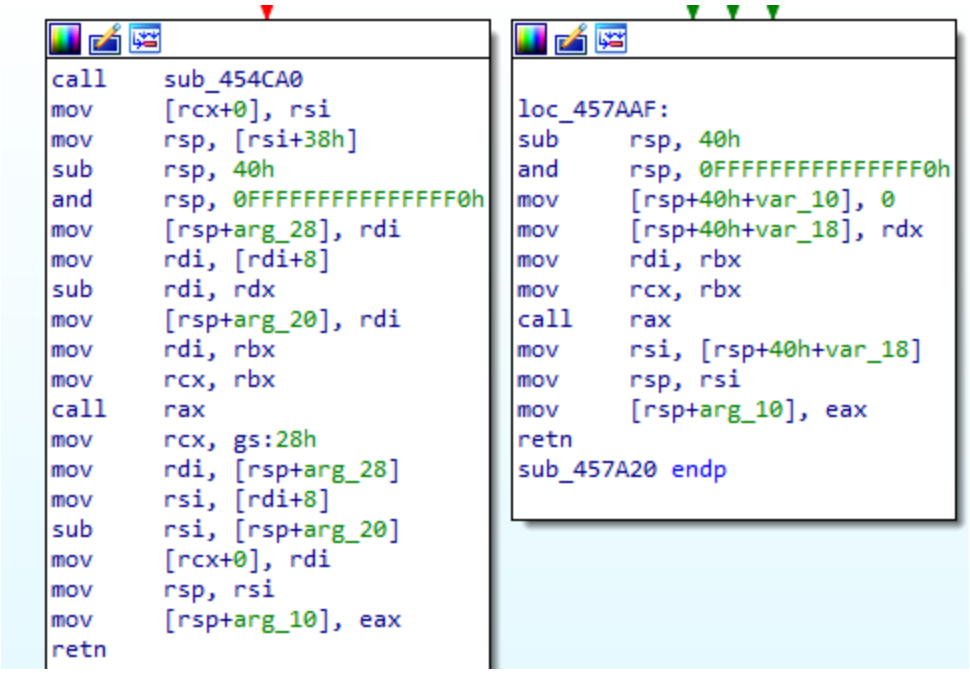


Figure 7- Obfuscation

Its dynamically resolving API at this address. Malware authors tend to dynamically resolve API to avoid static detections.



```
call    sub_454CA0
mov     [rcx+0], rsi
mov     rsp, [rsi+38h]
sub     rsp, 40h
and     rsp, 0FFFFFFFFFFFFFFF0h
mov     [rsp+arg_28], rdi
mov     rdi, [rdi+8]
sub     rdi, rdx
mov     [rsp+arg_20], rdi
mov     rdi, rbx
mov     rcx, rbx
call    rax
mov     rcx, gs:28h
mov     rdi, [rsp+arg_28]
mov     rsi, [rdi+8]
sub     rsi, [rsp+arg_20]
mov     [rcx+0], rdi
mov     rsp, rsi
mov     [rsp+arg_10], eax
retn
```

```
loc_457AAF:
sub     rsp, 40h
and     rsp, 0FFFFFFFFFFFFFFF0h
mov     [rsp+40h+var_10], 0
mov     [rsp+40h+var_18], rdx
mov     rdi, rbx
mov     rcx, rbx
call    rax
mov     rsi, [rsp+40h+var_18]
mov     rsp, rsi
mov     [rsp+arg_10], eax
retn
sub_457A20 endp
```

Figure 8 – Dynamically Resolving API

CreateMutexW API is being used to check if an instance of the malware is already running. As can be seen in Figure 5 previously, they are also using multithreading.

As the customary prelude to file encryption, they are using vssadmin.exe to delete all the shadow copies.

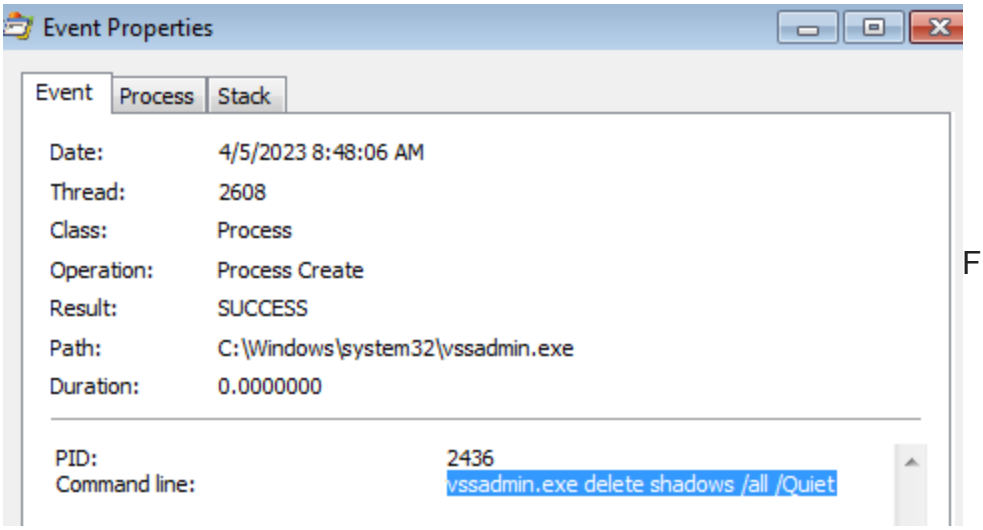


Figure 9 – Delete Shadow all

Here they are using SystemFunction036 (documented in MSDN as RtlGenRandom) to generate a random key as shown in Figure 10.

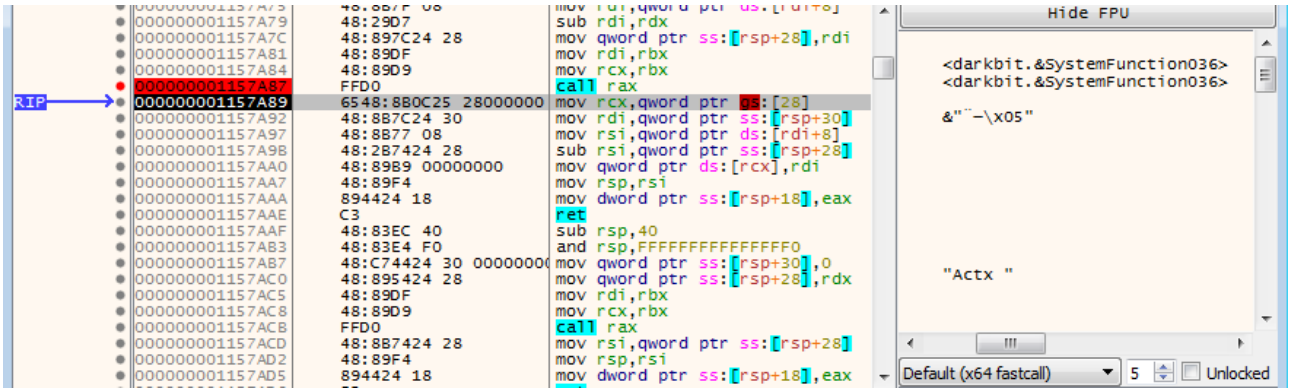


Figure 10 – SystemFunction036

SystemFunction036 is accessed multiple times in the code with varying buffer sizes passed to it.

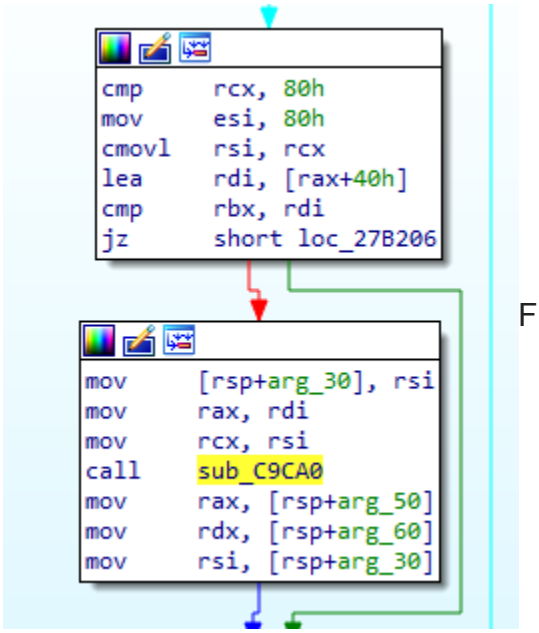


Figure 11 – Call To Dynamically Resolve API and Then SystemFunction036

Here we can see that the buffer size of 80 is made available for SystemFunction036.

```
mov     rsi, [rdx+38h]
mov     rax, [rsp+50h+arg_20]
mov     rbx, [rsp+50h+arg_28]
mov     rcx, [rsp+50h+arg_30]
mov     rdi, [rsp+50h+arg_38]
call    rsi
mov     rdx, [rsp+50h+arg_18]
mov     rsi, [rdx+38h]
mov     rax, [rsp+50h+arg_20]
mov     rbx, [rsp+50h+var_10]
mov     ecx, 4
mov     rdi, rcx
call    rsi
mov     rdx, [rsp+50h+arg_18]
mov     rsi, [rdx+30h]
mov     rax, [rsp+50h+arg_20]
mov     rbx, [rsp+50h+var_18]
xor     ecx, ecx
mov     rdi, [rsp+50h+var_20]
call    rsi
mov     [rsp+50h+var_18], rax
mov     [rsp+50h+var_28], rbx
mov     [rsp+50h+var_20], rcx
mov     rdx, [rsp+50h+arg_18]
```

Figure 12 – Encrypting Key

Later-on, the key used for encrypting the files is itself encrypted and attached to the encrypted files.

```
loc_BDAB2E:
mov     rbp, rsp
mov     rax, [rsi]
bswap   rax
mov     [rbp+0], rax
mov     rdx, 428A2F98D728AE22h
add     r15, rax
mov     rax, r12
add     r15, rdx
mov     rcx, r12
ror     rax, 0Eh
mov     rdx, r12
ror     rcx, 12h
xor     rax, rcx
mov     rcx, r12
ror     rdx, 29h
and     rcx, r13
xor     rdx, rax
mov     rax, r12
not     rax
add     r15, rdx
and     rax, r14
xor     rax, rcx
```

Figure 13 – EncryptionAlgorithm

From Figure 13, we can see that It's encrypting. It is likely using AES to encrypt the files, as strings related to the same functions can be found elsewhere in this same sample.

FindFirstFileW, FindNextFileW are used to iterate through the file system, to find the appropriate file and then encrypt it.

At that point it was observed that its writing file in chunks and not as a whole. For doing the same it's using SetFilePointerEx API to move the file pointer to a specific address.

Figure 14 – SetFilePointerEx

It's then using the WriteFile API.

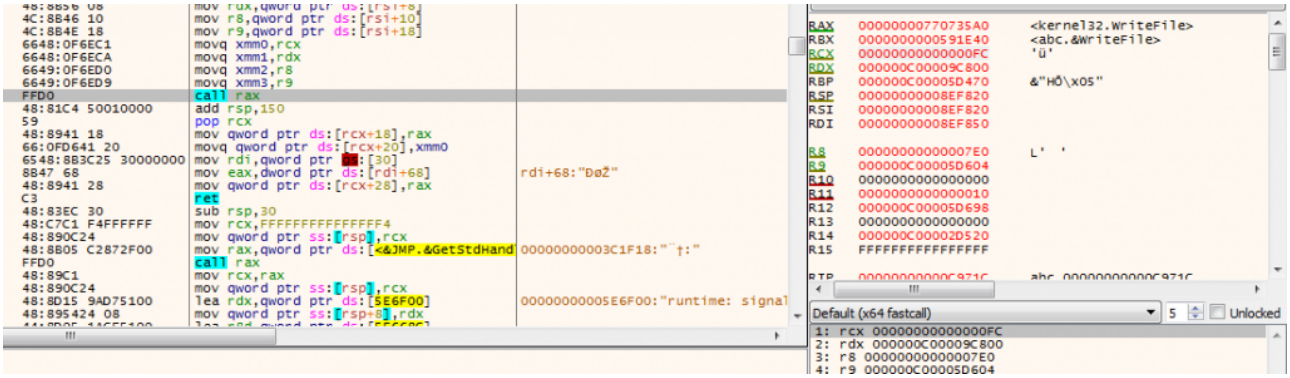


Figure 15 – WriteFile

All these functions are called one after another, till all the files are encrypted.

After encrypting the file, the key is stored at the end of the file.

```
Offset    0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   Ascii
00002D90  09 2A 92 7D B4 AE BD 9D D9 77 B7 40 86 E8 0F FD  .*´}´®½ Ùw·@▌è¤ý
00002DA0  63 27 A7 0D 21 89 E6 6F DB F9 A9 20 49 50 B6 C9  c'§.!▌æoÛù©.IP¶É
00002DB0  E9 3E 0C 2B 24 8F 0E AB C7 59 FE CF 1A EB 7B 2A  é>▌+$ ♫«ÇYþÏ→ë{*
00002DC0  B2 2F 93 73 6B 11 15 8A CD 7D 5B 0E 68 20 A5 4A  ²/▌sk◄┴▌Í}[♫h.¥J
00002DD0  8E CF C4 37 97 B9 3B D8 CE A4 39 11 24 1D 11 36  ▌ÏÄ7▌¹;ØÎ¤9◄$ ◄6
00002DE0  D2 BF 98 76 DA C5 6A 2C 04 51 90 53 F2 A1 DA 15  Ò¿▌vÚÅj,┘Q Sò¡Ú┴
00002DF0  A6 66 19 60 36 25 08 25 28 9A A8 64 FD B2 02 20  ¦f├`6%□%(▌¨dý²┐.
00002E00  82 2F E9 33 2E 28 B5 E8 52 FD A4 D1 BD 69 21 FC  ▌/é3.(µèRý¤Ñ½i!ü
00002E10  C2 F5 A7 B7 0C 10 15 63 66 5F 7C 82 85 41 B9 8E  Âõ§·▌┼┴cf_|▌▌A¹▌
00002E20  F0 B8 69 66 E8 B7 16 26 4F 8D E5 85 41 98 44 91  ð¸ifè·┬&O å▌A▌D´
00002E30  44 41 52 4B 42 49 54 5F 45 4E 43 52 59 50 54 45  DARKBIT_ENCRYPTE
00002E40  44 5F 46 49 4C 45 53 7C 06 9C 02 5E AC 87 C8 F8  D_FILES|├▌╖^¬▌Èø
00002E50  35 4B FA 53 CF 23 11 CB 7B 6A 2D 76 4A E2 43 2F  5KúSÏ#◄Ë{j-vJâC/
00002E60  EE B6 29 D0 E4 93 D2 7D DE 2F BB D4 52 64 F8 24  î¶)Ðä▌Ò}Þ/»ÔRdø$
00002E70  DA 4E A4 76 42 DD 5E 88 F4 40 67 21 53 6E 36 F2  ÚN¤vBÝ^▌ô@g!Sn6ò
00002E80  06 33 2C B2 D1 3B D4 BE D5 B3 F8 57 6A DA BF D9  ─3,²Ñ;Ô¾Õ³øWjÚ¿Ù
00002E90  C1 4A F6 73 E6 D0 61 D7 44 41 52 4B 42 49 54 A4  ÁJösæÐa×DARKBIT¤
00002EA0  8B A4 9A D4 C1 F2 C1 C3 6D 0C 91 5D 85 EE E3 D0  ▌¤▌ÔÁòÁÃm▌´]▌îãÐ
00002EB0  B0 DE 31 19 36 0E 64 36 80 E1 1C 24 3C EC 41 9B  °Þ1↓├6♫d6▌á $<ìA▌
00002EC0  95 2A 16 C5 CE 7B BD 21 95 33 63 B2 94 E5 3E F2  ▌*┼ÅÎ{½!▌3c²▌å>ò
00002ED0  BE 9D 99 B4 FB 16 09 11 1A 69 13 1C C9 E0 BE 3F  ¾ ▌´û┼.◄┼i‼ Éà¾?
00002EE0  68 76 3F 52 38 E5 54 1A 8E 4E E1 FB 82 C5 59 E1  hv?R8åT→▌Náû▌ÅYá
00002EF0  42 82 4A FA B8 66 2A C9 08 DC D1 D0 0D 27 08 C3  B▌Jú¸f*É□ÜÑÐ.'□Ã
00002F00  5C 50 A5 55 B6 79 AE 15 3D 4E C5 F6 33 F4 28 CC  \P¥U¶y®┴=NÅö3ô(Ì
00002F10  E8 B8 D7 C0 E9 92 14 0E DF F8 B1 D7 B4 58 EE 87  è¸×Àé´¶♫ßø±×´Xî▌
00002F20  0A 83 61 9E 2C 97 B0 9B 65 7E 01 74 D2 AD 1A 1C  .▌a▌,▌°▌e~┤ tÒ┼
00002F30  78 07 85 A0 A1 9B F6 46 94 48 EF 96 8F 3E 92 82  x•▌ ¡▌öF▌Hï▌ >´▌
00002F40  F8 35 5E 35 24 71 65 FC 75 3D B6 CC 3D 80 E2 8D  ø5^5$qeüu=¶Ì=▌â
00002F50  12 1A BA 56 56 D2 05 D5 57 A7 43 DF CF BB FA A6  ↕├ºVVÒ|ÕWSCßÏ»ú¦
00002F60  C9 70 D6 4D A7 F9 D5 3C 56 64 CE C1 FA 5A 13 E9  ÉpÖM§ùÕ<VdÎÁúZ‼é
00002F70  68 DE 12 F9 37 22 03 5A F0 FD 8A 4D 02 0C 4C DC  hÞ↕ù7"┘ZðýM┤ ▌LÜ
00002F80  E2 3F C0 C3 2A A6 CF 30 E1 45 C6 90 5E 57 AE 09  â?ÀÃ*¦Ï0áEÆ ^W®.
00002F90  EC 42 E9 6B EB 1B 18 07 5B 00 86 1B 5A F5 ED     ìBékë┼↑•[.▌┼Zõí
```

Figure 16 – Ransomware key

The encrypted files are given '.darkbit' extension and also a ransom note is dropped in the respective folders.

```
Dear Colleagues,
We're sorry to inform you that we've had to hack [redacted] network completely and transfer "all" data to our secure servers.
So, keep calm, take a breath and think about an apartheid regime that causes troubles here and there.
They should pay for their lies and crimes, their names and shames. They should pay for occupation, war crimes against humanity,
killing the people (not only Palestinians' bodies, but also Israelis' souls) and destroying the future and all dreams we had.
They should pay for firing high-skilled experts.

Anyway, there is nothing for you (as an individual) to be worried.
That's the task of the administration to follow up our instruction for recovering the network.
But, you can contact us via TOX messenger if you want to recover your files personally. (TOX ID: AB33BC51AFAC64D98226826E70B483593C81CB22E6A3B504F7A75348C38C86

Our instruction for the administration:
All your files are encrypted using AES-256 military grade algorithm. So,
    1. Don't try to recover data, because the encrypted files are unrecoverable unless you have the key.
    Any try for recovering data without the key (using third-party applications/companies) causes PERMANENT damage. Take it serious.
    2. You have to trust us. This is our business (after firing from high-tech companies) and the reputation is all we have.
    3. All you need to do is following up the payment procedure and then you will receive decrypting key using for returning all of your files and VMs.
    4. Payment method:
        Enter the link below
            http://iw6v2p3cruy7tqfup3yl4dgt4pfibfa3ai4zgnu5df2q3hus3lm7c7ad.onion/support
        Enter the ID below and pay the bill (80 BTC)
            dabda-bt2as4dfa-294jfajks-qti9-bm3xu2
You will receive decrypting key after the payment.

Notice that you just have 48 hours. After the deadline, a 30% penalty will be added to the price.
We put data for sale after 5 days.
Take it serious and don't listen to probable advices of a stupid government.

Good Luck!
"DarkBit"
```

Figure 17 – Ransomware Note

Figure 18 – Tweet on DarkBit

MuddyWaters uses different types of attacks for initial access like phishing email campaigns, using tools like MimiKatz to break into the system, etc. In this case, MuddyWaters made use of Cobalt Strike to get initial access into the system. From the ransomware note, we figured out that it was a politically motivated attack.

We at K7 Labs provide detection for DarkBit ransomware and all the latest threats. Users are advised to use a reliable security product such as “K7 Total Security” and keep it up-to-date to safeguard their devices.

Indicators of Compromise (IOCs)

File Name	Hash	Detection Name
DarkBit.exe	9880FAE6551D1E9EE921F39751A6F3C0	Trojan (0058e3dd1)
hr-update.iso	1219A8880DEBDD10D081195E27A2A016	Trojan (0001140e1)

References

https://attack.mitre.org/groups/G0069/