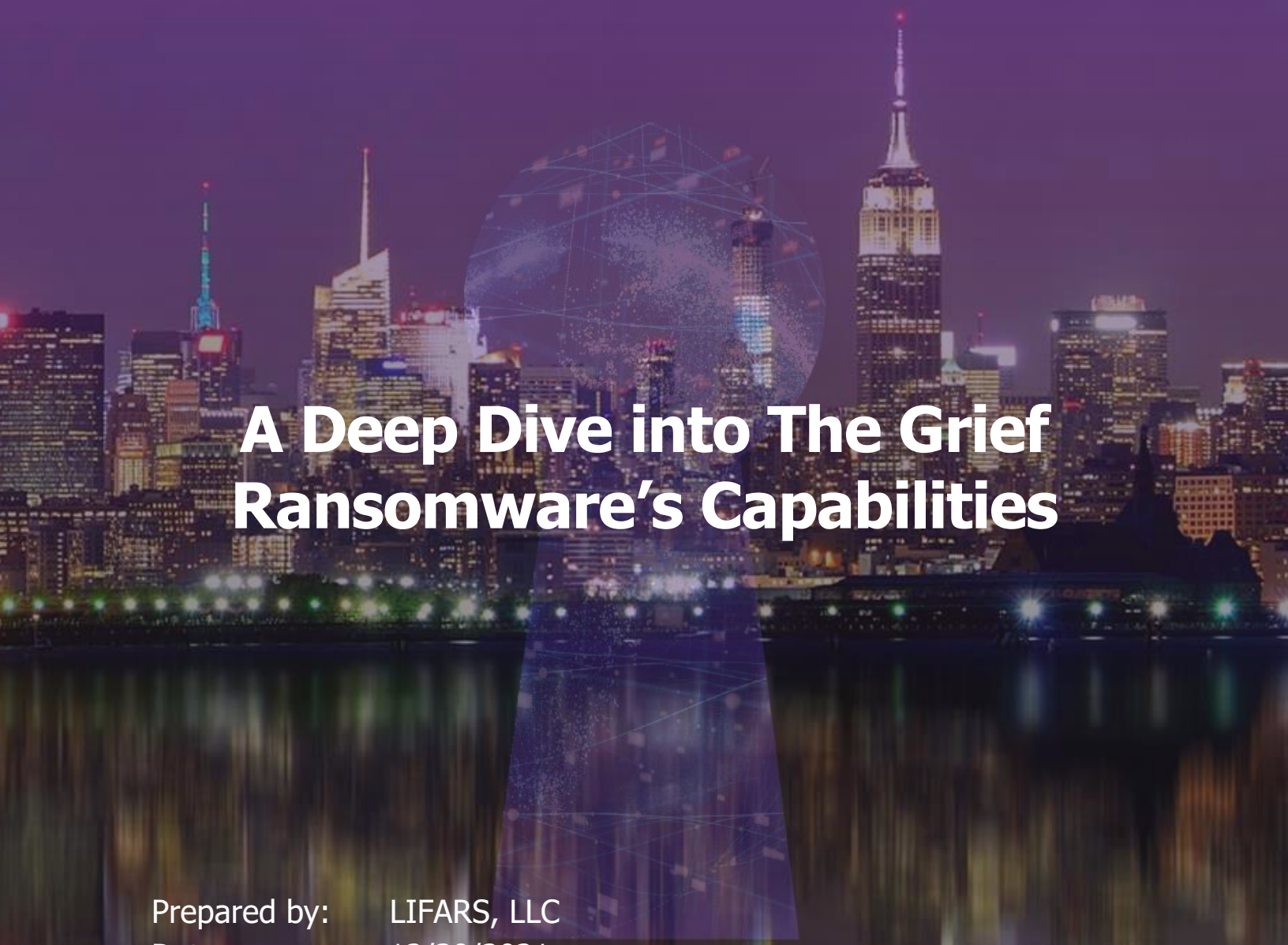
LIFARS
your digital world, **secured**



A Deep Dive into The Grief Ransomware's Capabilities

Prepared by: LIFARS, LLC
Date: 12/30/2021

EXECUTIVE SUMMARY

Grief ransomware is the successor of the DoppelPaymer ransomware, which emerged from the BitPaymer ransomware. Grief is deployed in an environment already compromised by Dridex and where the threat actor performed post-exploitation activities using Cobalt Strike. The ransomware is obfuscated and employs anti-analysis techniques that include API hashing, Vectored Exception Handling (VEH) manipulation, the Heaven's Gate technique, encrypt relevant data using RC4. Grief runs with specific parameters computed based on the victim's environment and crashes if no/incorrect parameters are provided (if you have been a victim of Grief ransomware, please contact us). The malware deletes all Volume Shadow Copies using vssadmin and Diskshadow and disables Microsoft Defender Antivirus. The encrypted files have the ".pay0rgrief" extension, and the malware imports an RSA public key that will be used to encrypt the generated AES file encryption keys.

LIFARS your digital world, secured

244 Fifth Avenue, Suite 2035, New York, NY 10001
LIFARS.com (212) 222-7061 info@lifars.com

ANALYSIS AND FINDINGS

SHA256: 2d1d08fce7156053c017825b722968b3117c9230412f4e7da5f89699ec9913cd

The DLL file is one of the most challenging malware samples we've even analyzed because of the multiple layers of obfuscation, API hashing, Vectored Exception Handling, and relevant strings decrypted at runtime using RC4. We will sequentially explain how we've overcome every obstacle and what challenges remain.

The binary has only one export function called "RoonlpvfdRoomvlof":

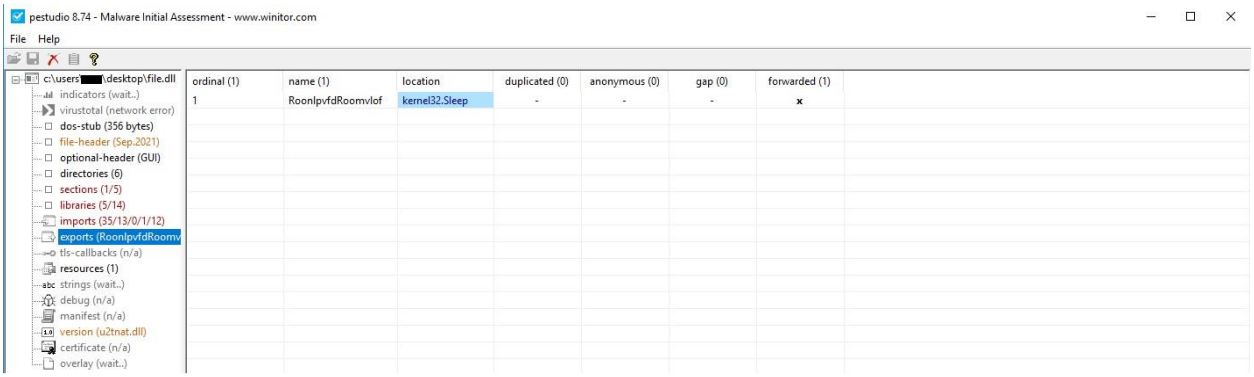


Figure 1

The malware retrieves the path of the executable file of the current process (which in our case is rundll32.exe) using the GetModuleFileNameW API:

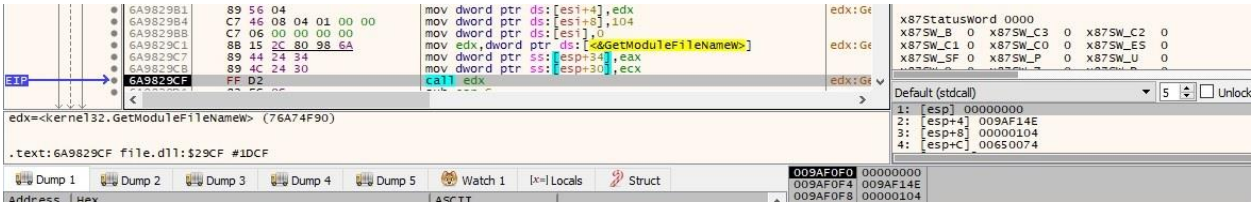


Figure 2

The process gets a module handle for a module called "self.exe":

Figure 3

VirtualAlloc is utilized to allocate memory in the address space of the current process (0x1000 = **MEM_COMMIT**, 0x4 = **PAGE_READWRITE**):

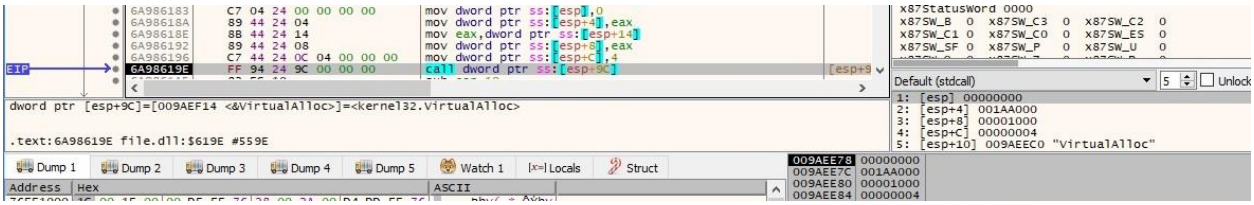


Figure 4

The binary writes a new executable to the newly created memory area and transfers the execution flow to a function inside it. The LoadLibraryA routine is used to load multiple DLLs into the address space of the process:

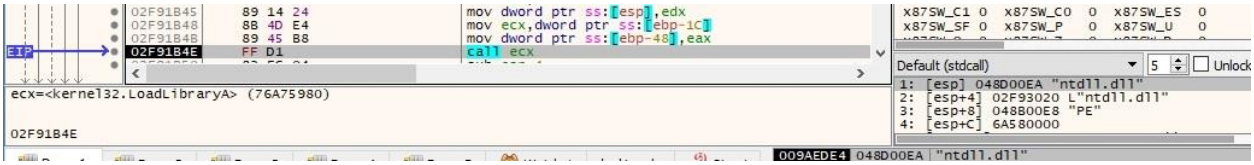


Figure 5

The GetProcAddress API is utilized to retrieve the address of export functions from multiple DLLs:

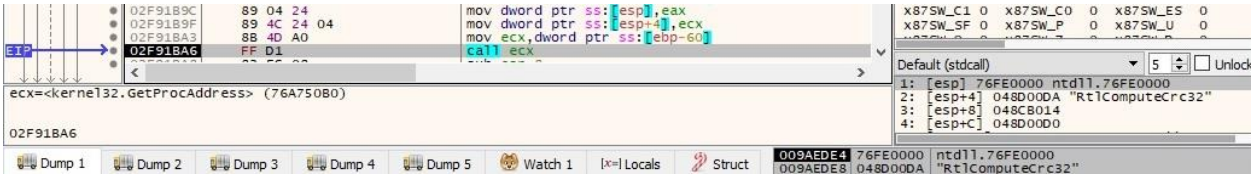


Figure 6

The process changes the protection of the memory area where the malicious DLL resides by calling the VirtualProtect routine (0x4 = **PAGE_READWRITE**):

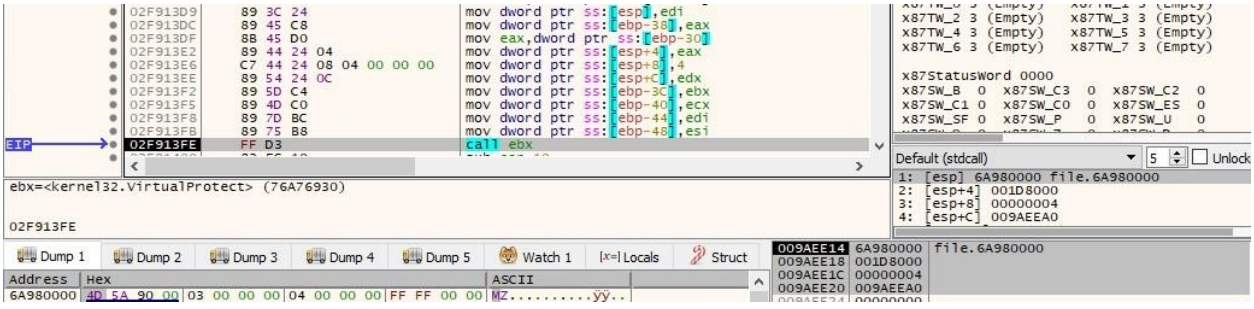


Figure 7

LIFARS
your digital world, secured
244 Fifth Avenue, Suite 2035, New York, NY 10001
LIFARS.com (212) 222-7061 info@lifars.com

The original DLL's code is modified, and a different DLL file appears in place of it. After the modifications are done, the memory protection is changed again (0x2 = **PAGE_READONLY**):

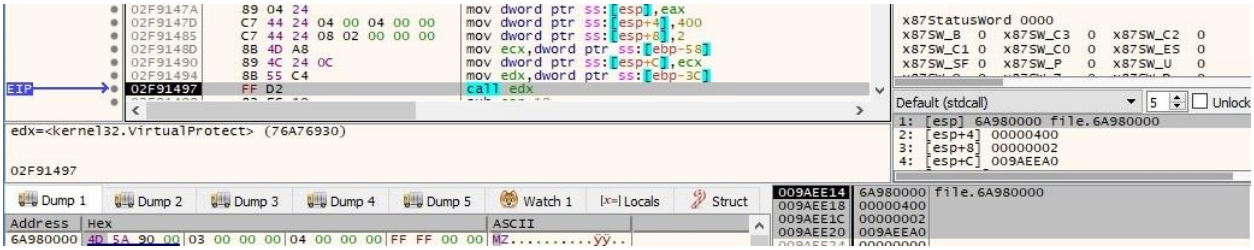


Figure 8

The binary disables the **DLL_THREAD_ATTACH** and **DLL_THREAD_DETACH** notifications for the newly created DLL:

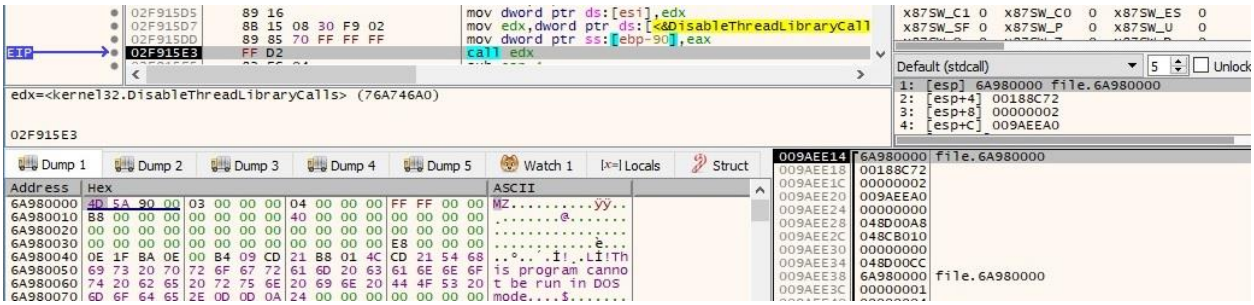


Figure 9

The final DLL represents the last stage of Grief ransomware. It has 5 export functions, however, only one is relevant in our analysis: DllRegisterServer. The other 4 exports jump in the middle of other functions, and we believe the threat actor didn't intend to use any of them:

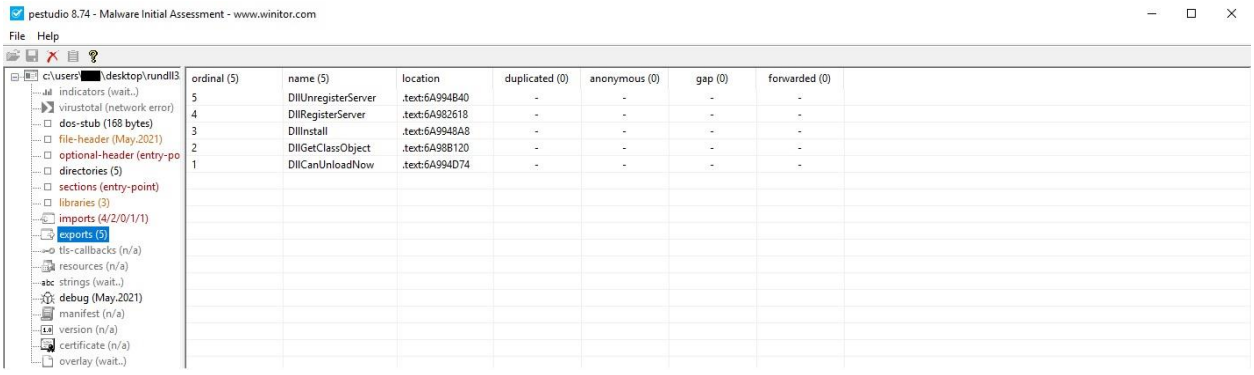


Figure 10

An important hint which suggests that the file is encrypted/obfuscated is the lack of imports: GetCommandLineW, lstrcpyW, CommandLineToArgvW, and RtlComputeCrc32. Grief, like its predecessor DoppelPaymer [1], is designed to run only with specific argument(s), otherwise it will crash. The ransomware extracts the arguments using the GetCommandLineW and CommandLineToArgvW APIs.

The malware computes the CRC32 checksum of the last argument, adds 0x1EC6086B to the result, and finally adds the instruction pointer address to this final value (figure 11 is almost identical to the figure presented at [1] regarding the DoppelPaymer Control Flow Obfuscation). If no arguments/incorrect arguments are provided, the ransomware crashes. This action represents an anti-sandbox technique and a drawback for malware analysis (if you're not the victim, of course):

```
.text:6A982618 ; Exported entry   4. DllRegisterServer
.text:6A982618
.text:6A982618
.text:6A982618
.text:6A982618 public DllRegisterServer
.text:6A982618 DllRegisterServer proc near
.text:6A982618
.text:6A982618 arg_0= dword ptr  4
.text:6A982618 arg_4= byte ptr  8
.text:6A982618
.text:6A982618 lea     eax, [esp+arg_4]
.text:6A98261C push    offset aMicrosoft ; "Microsoft"
.text:6A982621 push    eax
.text:6A982622 call    ds:lstrcpyW
.text:6A982628 call    ds:GetCommandLineW
.text:6A98262E mov     edx, eax
.text:6A982630 lea     eax, [esp+0]
.text:6A982633 push    eax
.text:6A982634 push    edx
.text:6A982635 call    ds:CommandLineToArgvW
.text:6A98263B mov     ebx, eax
.text:6A98263D mov     eax, [esp+0]
.text:6A982640 mov     edx, 7FFFFFFFh
.text:6A982645 dec     eax
.text:6A982646 mov     [esp+0], eax
.text:6A982649 mov     ecx, [ebx+eax*4]
.text:6A98264C call    sub_6A98D300
.text:6A982651 mov     edx, [esp+0]
.text:6A982654 add     eax, eax
.text:6A982656 push    eax             ; Length
.text:6A982657 push    dword ptr [ebx+edx*4] ; Buffer
.text:6A98265A push    0               ; InitialCrc
.text:6A98265C call    ds:RtlComputeCrc32
.text:6A982662 add     eax, 1EC6086Bh
.text:6A982667 mov     [esp+arg_0], eax
.text:6A98266B call    sub_6A99A550
.text:6A982670 add     [esp+arg_0], eax
.text:6A982674 jmp     [esp+arg_0]
.text:6A982674 DllRegisterServer endp
.text:6A982674
```

Figure 11

LIFARS your digital world, secured
244 Fifth Avenue, Suite 2035, New York, NY 10001
LIFARS.com (212) 222-7061 info@lifars.com

We were able to find good insights even without the required arguments, based on the analysis of the most complex functions.

The first anti-analysis technique we present consists of inserting lots of "int 3" (0xCC) instructions in the code. This technique is like the one employed by Dridex and explained at [2]. An example of such instructions is shown in figure 12:

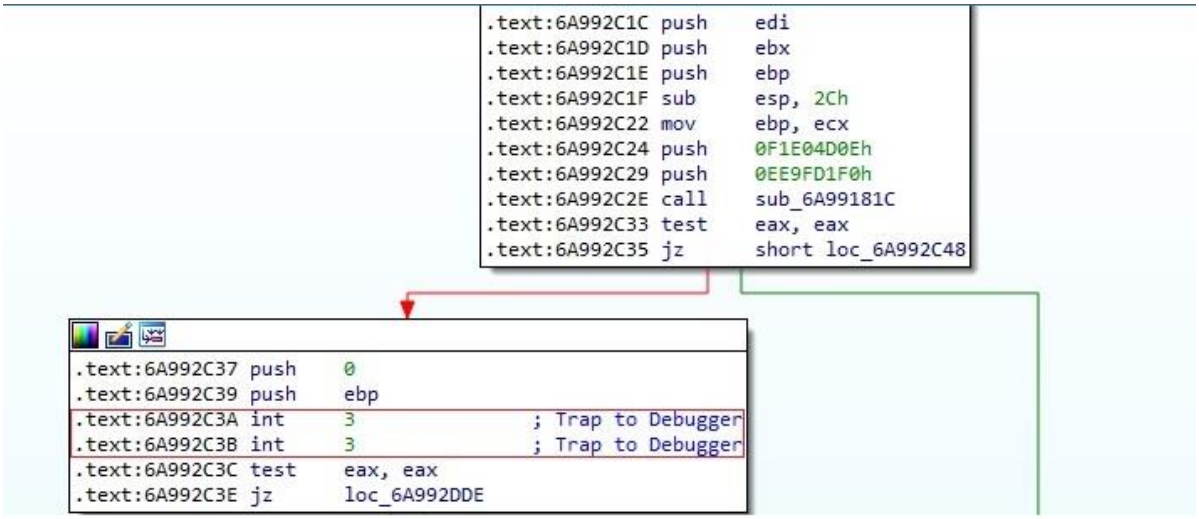


Figure 12

Grief registers a new customized Exception Handler by calling the RtlAddVectoredExceptionHandler API:

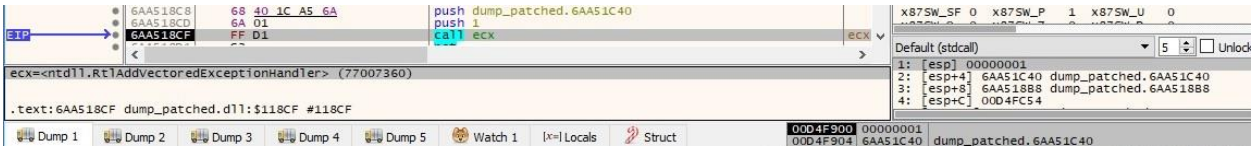


Figure 13

The exception handler displayed in figure 14 expects an exception code as an argument. Whether the exception code is 0xC0000005 (**ACCESS_VIOLATION**), 0xC00000FD (**STATUS_STACK_OVERFLOW**), and 0xC0000374 (Heap Corruption), the malware kills itself by calling the NtTerminateProcess API. If the exception code is 0x80000003 (**EXCEPTION_BREAKPOINT**), the function mimics the "call eax" instruction, which means that two "int 3" instructions can be interpreted as a "call eax" instruction. We've patched the binary by replacing the "0xCCCC" bytes with "0xFFD0".

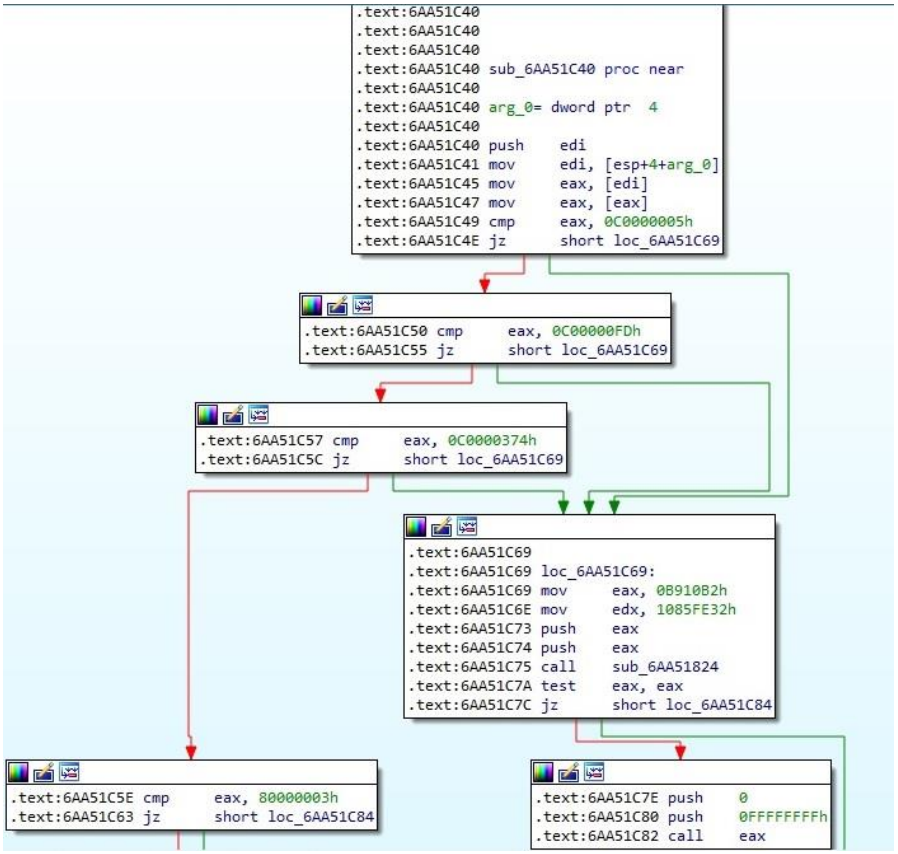


Figure 14

Grief implements API hashing in multiple functions. The first argument is the hashed DLL name, and the 2nd argument is the hashed API name:

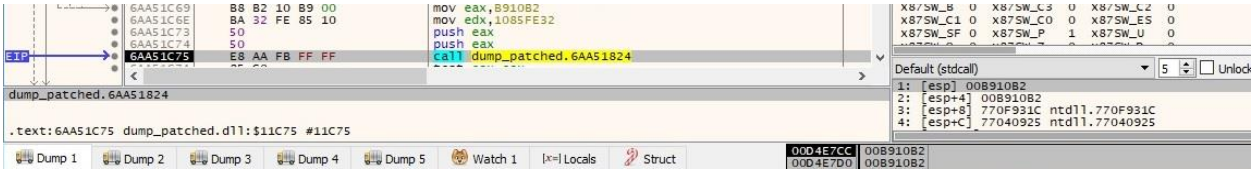


Figure 15

Figure 16

A snippet of one of the functions that parse the PEB (Process Environment Block) structure, performs XOR operations, and determines which APIs should be used, is shown below:

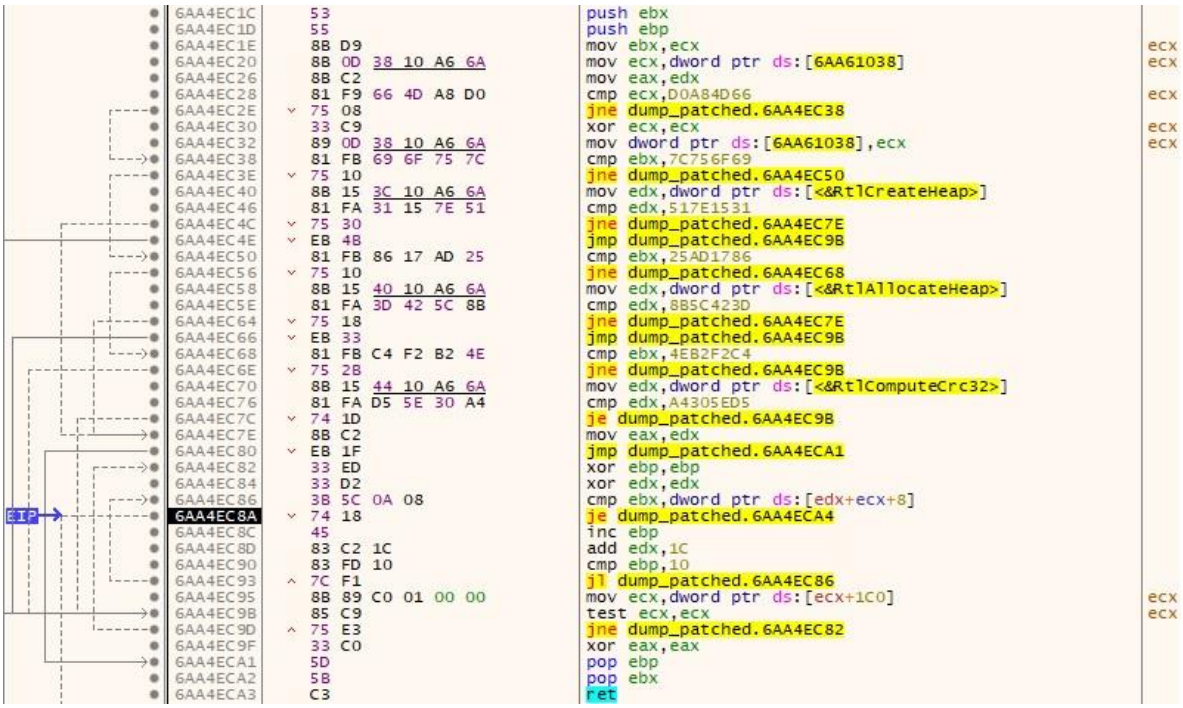


Figure 17

The result of the above operations, which is the address of an API, is stored in the EAX register. For example, figure 18 reveals an API that is used to kill the current process:

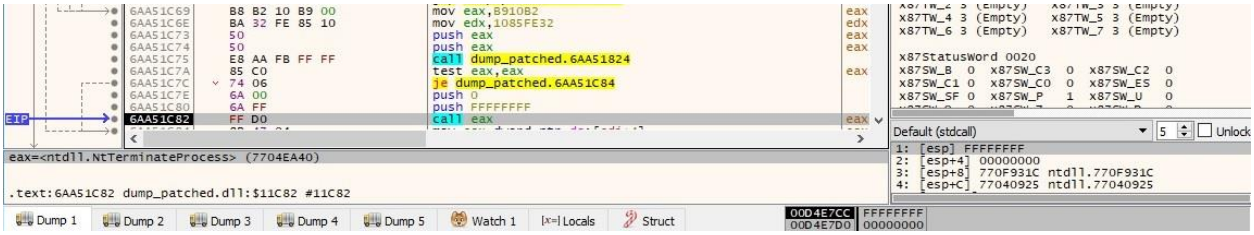


Figure 18

Capa [3] has been used to detect any encryption algorithms in our malicious DLL. It has identified the RC4 algorithm in sub_6A996248 based on the structure of the operations:

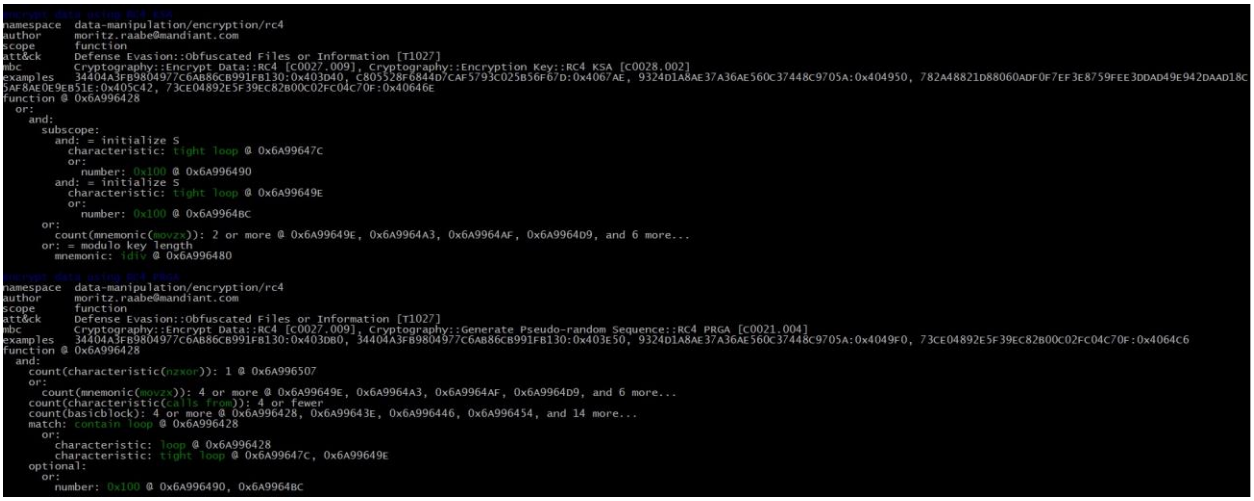


Figure 19

Figure 20

The CryptAcquireContextW routine is utilized to acquire a handle to a key container within a CSP (cryptographic service provider). The arguments are szProvider = "Microsoft Enhanced RSA and AES Cryptographic Provider", 0x18 = **PROV_RSA_AES**, and 0xF0000000 = **CRYPT_VERIFYCONTEXT**:

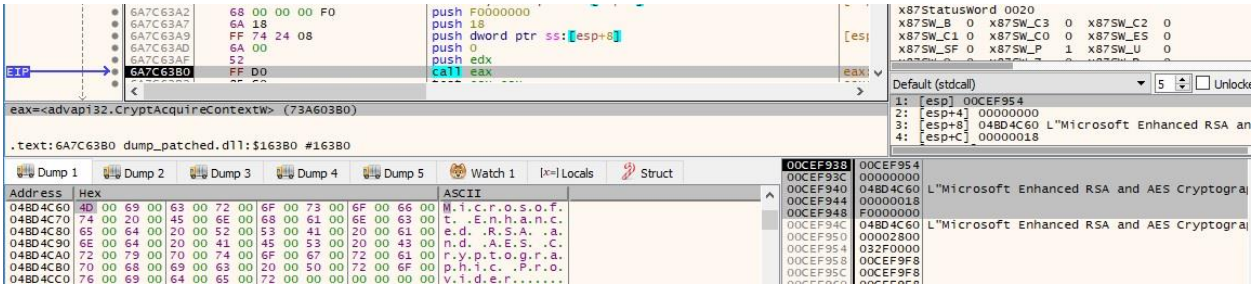


Figure 21

The function identified above is utilized to decrypt relevant strings using the RC4 algorithm. The RC4 key is changing frequently and has 48 bytes. We enumerate a list of decrypted strings and their explanations according to our analysis and the OSINT.

Grief doesn't encrypt the files which contain the following strings in their name and also the files that have the following extensions:

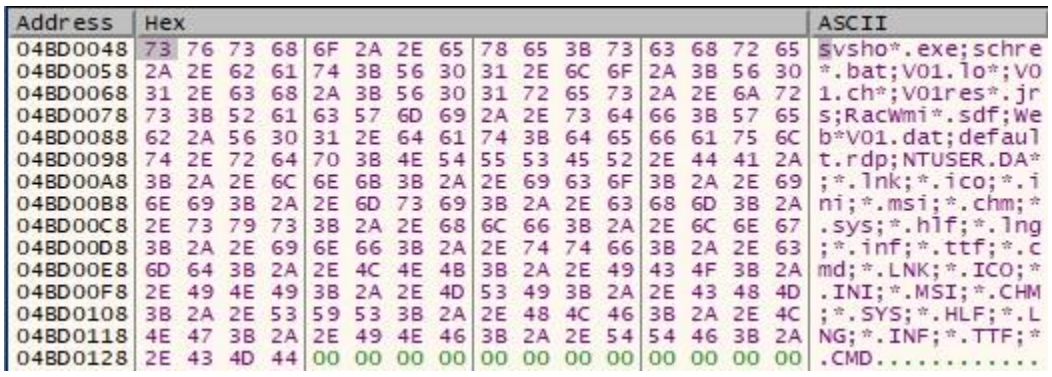


Figure 22

The ransomware doesn't encrypt the files that are located in the following directories:

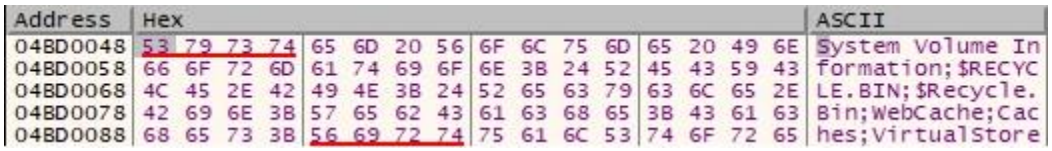
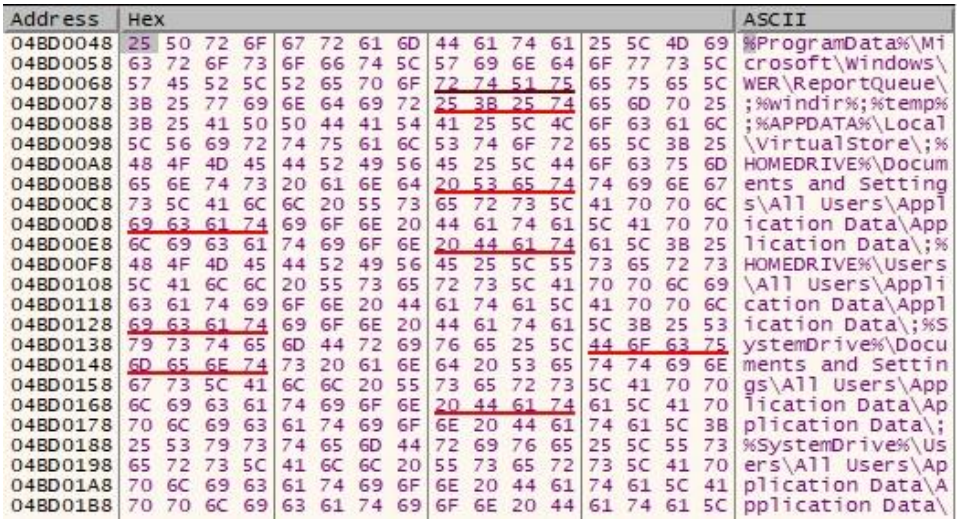


Figure 23

The malware also decrypts a list of environment-variable strings, which will be used as arguments for the ExpandEnvironmentStringsA function:

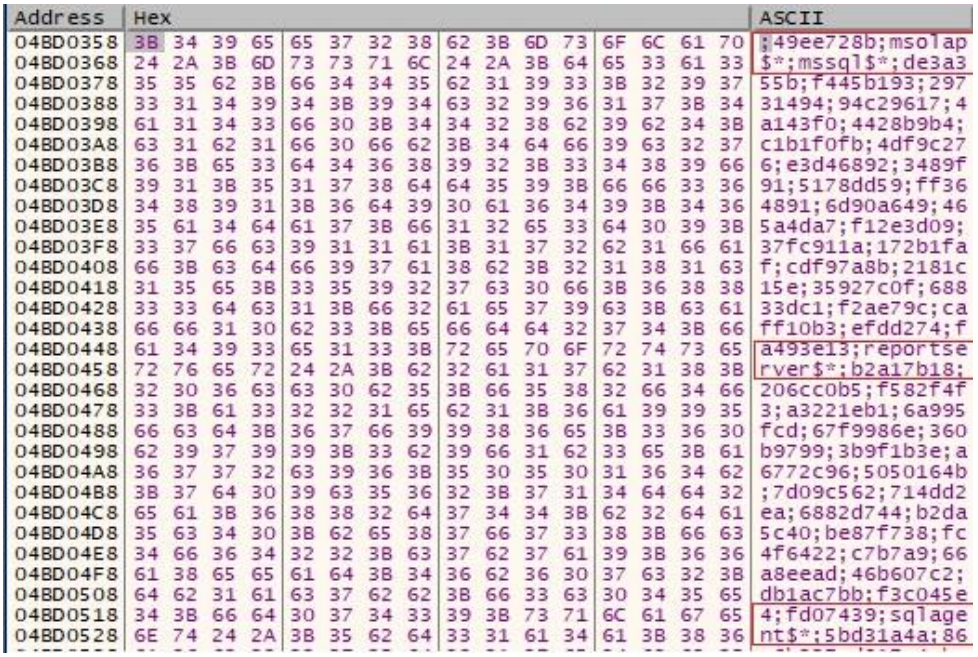
LIFARS your digital world, secured
244 Fifth Avenue, Suite 2035, New York, NY 10001
LIFARS.com (212) 222-7061 info@lifars.com



Address	Hex	ASCII
04BD0048	25 50 72 6F 67 72 61 6D 44 61 74 61 25 5C 4D 69	%ProgramData%\Mi
04BD0058	63 72 6F 73 6F 66 74 5C 57 69 6E 64 6F 77 73 5C	crosoft\Windows\
04BD0068	57 45 52 5C 52 65 70 6F 72 74 51 75 65 75 65 5C	WER\ReportQueue\
04BD0078	3B 25 77 69 6E 64 69 72 25 3B 25 74 65 6D 70 25	;%windir%;%temp%
04BD0088	3B 25 41 50 50 44 41 54 41 25 5C 4C 6F 63 61 6C	;%APPDATA%\Local
04BD0098	5C 56 69 72 74 75 61 6C 53 74 6F 72 65 5C 3B 25	\VirtualStore\;%
04BD00A8	48 4F 4D 45 44 52 49 56 45 25 5C 44 6F 63 75 6D	HOMEDRIVE%\Docum
04BD00B8	65 6E 74 73 20 61 6E 64 20 53 65 74 74 69 6E 67	ents and Setting
04BD00C8	73 5C 41 6C 6C 20 55 73 65 72 73 5C 41 70 70 6C	s\All Users\Appl
04BD00D8	69 63 61 74 69 6F 6E 20 44 61 74 61 5C 41 70 70	ication Data\App
04BD00E8	6C 69 63 61 74 69 6F 6E 20 44 61 74 61 5C 3B 25	lication Data\;%
04BD00F8	48 4F 4D 45 44 52 49 56 45 25 5C 55 73 65 72 73	HOMEDRIVE%\Users
04BD0108	5C 41 6C 6C 20 55 73 65 72 73 5C 41 70 70 6C 69	\All Users\Appli
04BD0118	63 61 74 69 6F 6E 20 44 61 74 61 5C 41 70 70 6C	cation Data\Appl
04BD0128	69 63 61 74 69 6F 6E 20 44 61 74 61 5C 3B 25 53	ication Data\;%S
04BD0138	79 73 74 65 6D 44 72 69 76 65 25 5C 44 6F 63 75	ystemDrive%\Docu
04BD0148	6D 65 6E 74 73 20 61 6E 64 20 53 65 74 74 69 6E	ments and Settin
04BD0158	67 73 5C 41 6C 6C 20 55 73 65 72 73 5C 41 70 70	gs\All Users\App
04BD0168	6C 69 63 61 74 69 6F 6E 20 44 61 74 61 5C 41 70	lication Data\Ap
04BD0178	70 6C 69 63 61 74 69 6F 6E 20 44 61 74 61 5C 3B	plication Data\;
04BD0188	25 53 79 73 74 65 6D 44 72 69 76 65 25 5C 55 73	%SystemDrive%\Us
04BD0198	65 72 73 5C 41 6C 6C 20 55 73 65 72 73 5C 41 70	ers\All Users\Ap
04BD01A8	70 6C 69 63 61 74 69 6F 6E 20 44 61 74 61 5C 41	plication Data\A
04BD01B8	70 70 6C 69 63 61 74 69 6F 6E 20 44 61 74 61 5C	pplication Data\

Figure 24

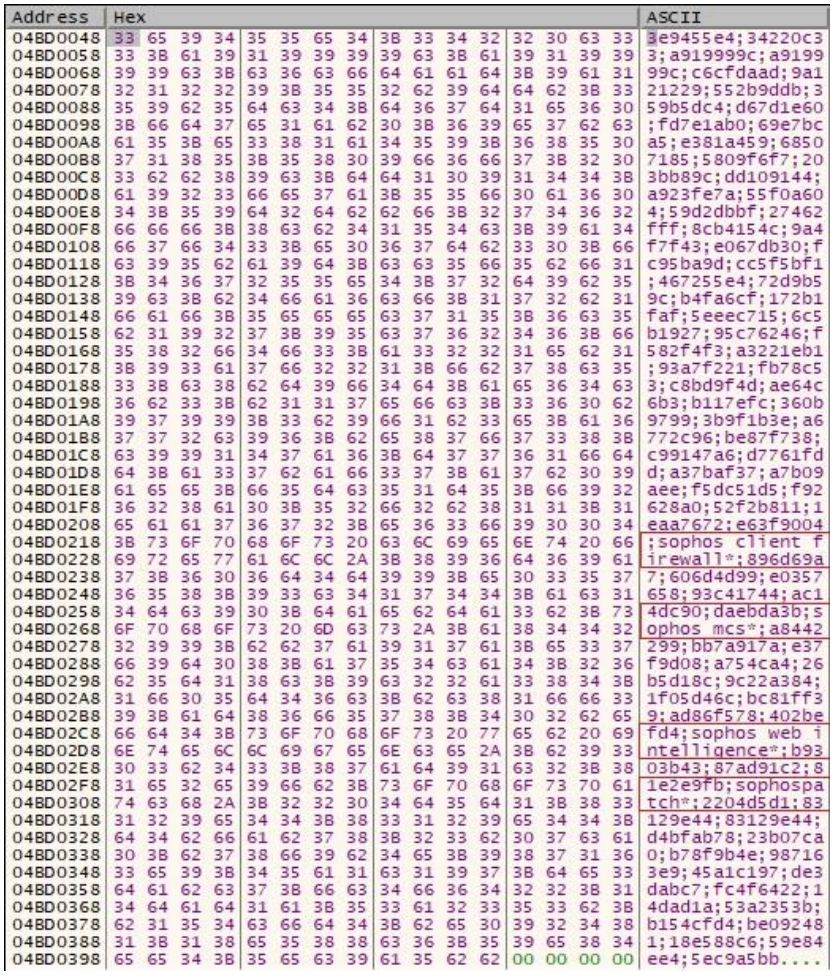
A list of services to be stopped is also decrypted using RC4 (see figure 25). These services might lock important files such as databases, and the ransomware wouldn't be able to encrypt them.



Address	Hex	ASCII
04BD0358	3B 34 39 65 65 37 32 38 62 3B 6D 73 6F 6C 61 70	;49ee728b;msolap
04BD0368	24 2A 3B 6D 73 73 71 6C 24 2A 3B 64 65 33 61 33	$*;mssql$*;de3a3
04BD0378	35 35 62 3B 66 34 34 35 62 31 39 33 3B 32 39 37	55b;f445b193;297
04BD0388	33 31 34 39 34 3B 39 34 63 32 39 36 31 37 3B 34	31494;94c29617;4
04BD0398	61 31 34 33 66 30 3B 34 34 32 38 62 39 62 34 3B	a143f0;4428b9b4;
04BD03A8	63 31 62 31 66 30 66 62 3B 34 64 66 39 63 32 37	c1b1f0fb;4df9c27
04BD03B8	36 3B 65 33 64 34 36 38 39 32 3B 33 34 38 39 66	6;e3d46892;3489f
04BD03C8	39 31 3B 35 31 37 38 64 64 35 39 3B 66 66 33 36	91;5178dd59;ff36
04BD03D8	34 38 39 31 3B 36 64 39 30 61 36 34 39 3B 34 36	4891;6d90a649;46
04BD03E8	35 61 34 64 61 37 3B 66 31 32 65 33 64 30 39 3B	5a4da7;f12e3d09;
04BD03F8	33 37 66 63 39 31 31 61 3B 31 37 32 62 31 66 61	37fc911a;172b1fa
04BD0408	66 3B 63 64 66 39 37 61 38 62 3B 32 31 38 31 63	f;cdf97a8b;2181c
04BD0418	31 35 65 3B 33 35 39 32 37 63 30 66 3B 36 38 38	15e;35927c0f;688
04BD0428	33 33 64 63 31 3B 66 32 61 65 37 39 63 3B 63 61	33dc1;f2ae79c;ca
04BD0438	66 66 31 30 62 33 3B 65 66 64 64 32 37 34 3B 66	ff10b3;efdd274;f
04BD0448	61 34 39 33 65 31 33 3B 72 65 70 6F 72 74 73 65	a493e13;reportse
04BD0458	72 76 65 72 24 2A 3B 62 32 61 31 37 62 31 38 3B	rver$*;b2a17b18;
04BD0468	32 30 36 63 63 30 62 35 3B 66 35 38 32 66 34 66	206cc0b5;f582f4f
04BD0478	33 3B 61 33 32 32 31 65 62 31 3B 36 61 39 39 35	3;a3221eb1;6a995
04BD0488	66 63 64 3B 36 37 66 39 39 38 36 65 3B 33 36 30	fcd;67f9986e;360
04BD0498	62 39 37 39 39 3B 33 62 39 66 31 62 33 65 3B 61	b9799;3b9f1b3e;a
04BD04A8	36 37 37 32 63 39 36 3B 35 30 35 30 31 36 34 62	6772c96;5050164b
04BD04B8	3B 37 64 30 39 63 35 36 32 3B 37 31 34 64 64 32	;7d09c562;714dd2
04BD04C8	65 61 3B 36 38 38 32 64 37 34 34 3B 62 32 64 61	ea;6882d744;b2da
04BD04D8	35 63 34 30 3B 62 65 38 37 66 37 33 38 3B 66 63	5c40;be87f738;fc
04BD04E8	34 66 36 34 32 32 3B 63 37 62 37 61 39 3B 36 36	4f6422;c7b7a9;66
04BD04F8	61 38 65 65 61 64 3B 34 36 62 36 30 37 63 32 3B	a8eead;46b607c2;
04BD0508	64 62 31 61 63 37 62 62 3B 66 33 63 30 34 35 65	db1ac7bb;f3c045e
04BD0518	34 3B 66 64 30 37 34 33 39 3B 73 71 6C 61 67 65	4;fd07439;sqlage
04BD0528	6E 74 24 2A 3B 35 62 64 33 31 61 34 61 3B 38 36	nt$*;5bd31a4a;86

Figure 25

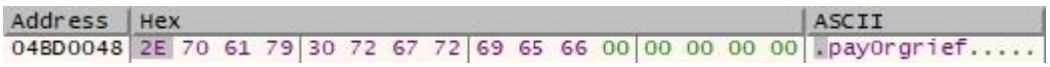
The binary also decrypts a list of Sophos services that will be stopped:



Address	Hex	ASCII
04BD0048	33 65 39 34 35 35 65 34 3B 33 34 32 32 30 63 33	3e9455e4;34220c3
04BD0058	33 3B 61 39 31 39 39 39 39 63 3B 61 39 31 39 39	3;a919999c;a9199
04BD0068	39 39 63 3B 63 36 63 66 64 61 61 64 3B 39 61 31	99c;c6cfdaad;9a1
04BD0078	32 31 32 32 39 3B 35 35 32 62 39 64 64 62 3B 33	21229;552b9ddb;3
04BD0088	35 39 62 35 64 63 34 3B 64 36 37 64 31 65 36 30	59b5dc4;d67d1e60
04BD0098	3B 66 64 37 65 31 61 62 30 3B 36 39 65 37 62 63	;fd7e1ab0;69e7bc
04BD00A8	61 35 3B 65 33 38 31 61 34 35 39 3B 36 38 35 30	a5;e381a459;6850
04BD00B8	37 31 38 35 3B 35 38 30 39 66 36 66 37 3B 32 30	7185;5809f6f7;20
04BD00C8	33 62 62 38 39 63 3B 64 64 31 30 39 31 34 34 3B	3bb89c;dd109144;
04BD00D8	61 39 32 33 66 65 37 61 3B 35 35 66 30 61 36 30	a923fe7a;55f0a60
04BD00E8	34 3B 35 39 64 32 64 62 62 66 3B 32 37 34 36 32	4;59d2dbbf;27462
04BD00F8	66 66 66 3B 38 63 62 34 31 35 34 63 3B 39 61 34	fff;8cb4154c;9a4
04BD0108	66 37 66 34 33 3B 65 30 36 37 64 62 33 30 3B 66	f7f43;e067db30;f
04BD0118	63 39 35 62 61 39 64 3B 63 63 35 66 35 62 66 31	c95ba9d;cc5f5bf1
04BD0128	3B 34 36 37 32 35 35 65 34 3B 37 32 64 39 62 35	;467255e4;72d9b5
04BD0138	39 63 3B 62 34 66 61 36 63 66 3B 31 37 32 62 31	9c;b4fa6cf;172b1
04BD0148	66 61 66 3B 35 65 65 65 63 37 31 35 3B 36 63 35	faf;5eeec715;6c5
04BD0158	62 31 39 32 37 3B 39 35 63 37 36 32 34 36 3B 66	b1927;95c76246;f
04BD0168	35 38 32 66 34 66 33 3B 61 33 32 32 31 65 62 31	582f4f3;a3221eb1
04BD0178	3B 39 33 61 37 66 32 32 31 3B 66 62 37 38 63 35	;93a7f221;fb78c5
04BD0188	33 3B 63 38 62 64 39 66 34 64 3B 61 65 36 34 63	3;c8bd9f4d;ae64c
04BD0198	36 62 33 3B 62 31 31 37 65 66 63 3B 33 36 30 62	6b3;b117efc;360b
04BD01A8	39 37 39 39 3B 33 62 39 66 31 62 33 65 3B 61 36	9799;3b9f1b3e;a6
04BD01B8	37 37 32 63 39 36 3B 62 65 38 37 66 37 33 38 3B	772c96;be87f738;
04BD01C8	63 39 39 31 34 37 61 36 3B 64 37 37 36 31 66 64	c99147a6;d7761fd
04BD01D8	64 3B 61 33 37 62 61 66 33 37 3B 61 37 62 30 39	d;a37baf37;a7b09
04BD01E8	61 65 65 3B 66 35 64 63 35 31 64 35 3B 66 39 32	aee;f5dc51d5;f92
04BD01F8	36 32 38 61 30 3B 35 32 66 32 62 38 31 31 3B 31	628a0;52f2b811;1
04BD0208	65 61 61 37 36 37 32 3B 65 36 33 66 39 30 30 34	eaa7672;e63f9004
04BD0218	3B 73 6F 70 68 6F 73 20 63 6C 69 65 6E 74 20 66	;sophos client f
04BD0228	69 72 65 77 61 6C 6C 2A 3B 38 39 36 64 36 39 61	irewall*;896d69a
04BD0238	37 3B 36 30 36 64 34 64 39 39 3B 65 30 33 35 37	7;606d4d99;e0357
04BD0248	36 35 38 3B 39 33 63 34 31 37 34 34 3B 61 63 31	658;93c41744;ac1
04BD0258	34 64 63 39 30 3B 64 61 65 62 64 61 33 62 3B 73	4dc90;daebda3b;s
04BD0268	6F 70 68 6F 73 20 6D 63 73 2A 3B 61 38 34 34 32	ophos mcs*;a8442
04BD0278	32 39 39 3B 62 62 37 61 39 31 37 61 3B 65 33 37	299;bb7a917a;e37
04BD0288	66 39 64 30 38 3B 61 37 35 34 63 61 34 3B 32 36	f9d08;a754ca4;26
04BD0298	62 35 64 31 38 63 3B 39 63 32 32 61 33 38 34 3B	b5d18c;9c22a384;
04BD02A8	31 66 30 35 64 34 36 63 3B 62 63 38 31 66 66 33	1f05d46c;bc81ff3
04BD02B8	39 3B 61 64 38 36 66 35 37 38 3B 34 30 32 62 65	9;ad86f578;402be
04BD02C8	66 64 34 3B 73 6F 70 68 6F 73 20 77 65 62 20 69	fd4;sophos web i
04BD02D8	6E 74 65 6C 6C 69 67 65 6E 63 65 2A 3B 62 39 33	ntelligence*;b93
04BD02E8	30 33 62 34 33 3B 38 37 61 64 39 31 63 32 3B 38	03b43;87ad91c2;8
04BD02F8	31 65 32 65 39 66 62 3B 73 6F 70 68 6F 73 70 61	1e2e9fb;sophospa
04BD0308	74 63 68 2A 3B 32 32 30 34 64 35 64 31 3B 38 33	tch*;2204d5d1;83
04BD0318	31 32 39 65 34 34 3B 38 33 31 32 39 65 34 34 3B	129e44;83129e44;
04BD0328	64 34 62 66 61 62 37 38 3B 32 33 62 30 37 63 61	d4bfab78;23b07ca
04BD0338	30 3B 62 37 38 66 39 62 34 65 3B 39 38 37 31 36	0;b78f9b4e;98716
04BD0348	33 65 39 3B 34 35 61 31 63 31 39 37 3B 64 65 33	3e9;45a1c197;de3
04BD0358	64 61 62 63 37 3B 66 63 34 66 36 34 32 32 3B 31	dabc7;fc4f6422;1
04BD0368	34 64 61 64 31 61 3B 35 33 61 32 33 35 33 62 3B	4dad1a;53a2353b;
04BD0378	62 31 35 34 63 66 64 34 3B 62 65 30 39 32 34 38	b154cfd4;be09248
04BD0388	31 3B 31 38 65 35 38 38 63 36 3B 35 39 65 38 34	1;18e588c6;59e84
04BD0398	65 65 34 3B 35 65 63 39 61 35 62 62 00 00 00 00	ee4;5ec9a5bb....

Figure 26

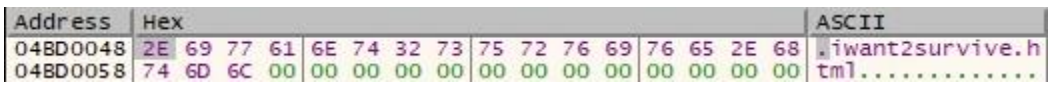
Grief appends the following extension to the file name of the encrypted files:



Address	Hex	ASCII
04BD0048	2E 70 61 79 30 72 67 72 69 65 66 00 00 00 00 00	.pay0rgrief.....

Figure 27

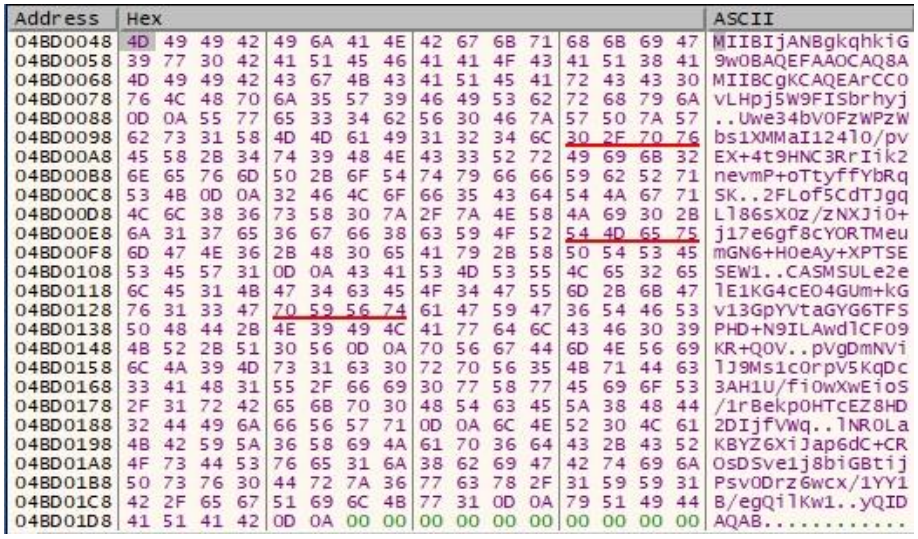
The ransom note file name is also decrypted using RC4:



Address	Hex	ASCII
04BD0048	2E 69 77 61 6E 74 32 73 75 72 76 69 76 65 2E 68	.iwant2survive.h
04BD0058	74 6D 6C 00 00 00 00 00 00 00 00 00 00 00 00 00	tml.............

Figure 28

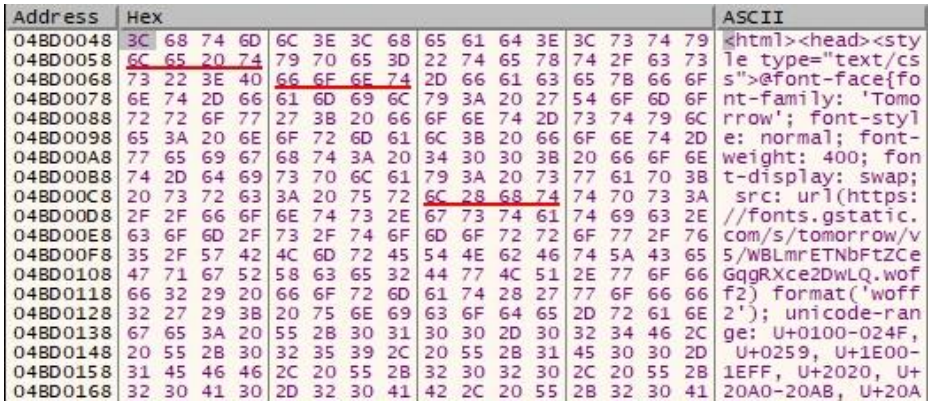
An RSA public key that is Base64-encoded is decrypted by the process:



Address	Hex																ASCII
04BD0048	4D	49	49	42	49	6A	41	4E	42	67	6B	71	68	6B	69	47	MIIBIjANBgkqhkiG
04BD0058	39	77	30	42	41	51	45	46	41	41	4F	43	41	51	38	41	9w0BAQEFAAOCAQ8A
04BD0068	4D	49	49	42	43	67	4B	43	41	51	45	41	72	43	43	30	MIIBCgKCAQEArCC0
04BD0078	76	4C	48	70	6A	35	57	39	46	49	53	62	72	68	79	6A	vLHpj5W9FISbrhyj
04BD0088	0D	0A	55	77	65	33	34	62	56	30	46	7A	57	50	7A	57	..Uwe34bV0FzWPzW
04BD0098	62	73	31	58	4D	4D	61	49	31	32	34	6C	30	2F	70	76	bs1XMMaI124l0/pv
04BD00A8	45	58	2B	34	74	39	48	4E	43	33	52	72	49	69	6B	32	EX+4t9HNC3RrIik2
04BD00B8	6E	65	76	6D	50	2B	6F	54	74	79	66	66	59	62	52	71	nevmP+oTtyffYbRq
04BD00C8	53	4B	0D	0A	32	46	4C	6F	66	35	43	64	54	4A	67	71	SK..2FLof5CdTJgq
04BD00D8	4C	6C	38	36	73	58	30	7A	2F	7A	4E	58	4A	69	30	2B	Ll86sX0z/zNXJi0+
04BD00E8	6A	31	37	65	36	67	66	38	63	59	4F	52	54	4D	65	75	j17e6gf8cYORTMeu
04BD00F8	6D	47	4E	36	2B	48	30	65	41	79	2B	58	50	54	53	45	mGN6+H0eAy+XPTSE
04BD0108	53	45	57	31	0D	0A	43	41	53	4D	53	55	4C	65	32	65	SEW1..CASMSULe2e
04BD0118	6C	45	31	4B	47	34	63	45	4F	34	47	55	6D	2B	6B	47	lE1KG4cEO4GUm+kG
04BD0128	76	31	33	47	70	59	56	74	61	47	59	47	36	54	46	53	v13GpYVtaGYG6TFS
04BD0138	50	48	44	2B	4E	39	49	4C	41	77	64	6C	43	46	30	39	PHD+N9ILAwdlCF09
04BD0148	4B	52	2B	51	30	56	0D	0A	70	56	67	44	6D	4E	56	69	KR+Q0V..pVgDmNVi
04BD0158	6C	4A	39	4D	73	31	63	30	72	70	56	35	4B	71	44	63	lJ9Ms1c0rpV5KqDc
04BD0168	33	41	48	31	55	2F	66	69	30	77	58	77	45	69	6F	53	3AH1U/fi0wXwEioS
04BD0178	2F	31	72	42	65	6B	70	30	48	54	63	45	5A	38	48	44	/1rBekp0HTcEZ8HD
04BD0188	32	44	49	6A	66	56	57	71	0D	0A	6C	4E	52	30	4C	61	2DIjfVWq..lNR0La
04BD0198	4B	42	59	5A	36	58	69	4A	61	70	36	64	43	2B	43	52	KBYZ6XiJap6dC+CR
04BD01A8	4F	73	44	53	76	65	31	6A	38	62	69	47	42	74	69	6A	OsDSve1j8biGBtij
04BD01B8	50	73	76	30	44	72	7A	36	77	63	78	2F	31	59	59	31	Psv0Drz6wcx/1YY1
04BD01C8	42	2F	65	67	51	69	6C	4B	77	31	0D	0A	79	51	49	44	B/egQilKw1..yQID
04BD01D8	41	51	41	42	0D	0A	00	00	00	00	00	00	00	00	00	00	AQAB..........

Figure 29

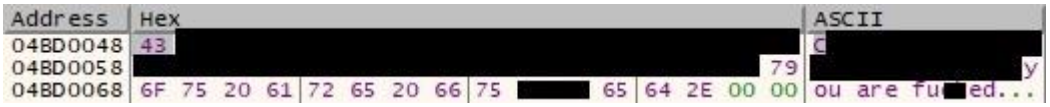
The content of the ransom note is also revealed:



Address	Hex																ASCII
04BD0048	3C	68	74	6D	6C	3E	3C	68	65	61	64	3E	3C	73	74	79	<html><head><sty
04BD0058	6C	65	20	74	79	70	65	3D	22	74	65	78	74	2F	63	73	le type="text/cs
04BD0068	73	22	3E	40	66	6F	6E	74	2D	66	61	63	65	7B	66	6F	s">@font-face{fo
04BD0078	6E	74	2D	66	61	6D	69	6C	79	3A	20	27	54	6F	6D	6F	nt-family: 'Tomo
04BD0088	72	72	6F	77	27	3B	20	66	6F	6E	74	2D	73	74	79	6C	rrow'; font-styl
04BD0098	65	3A	20	6E	6F	72	6D	61	6C	3B	20	66	6F	6E	74	2D	e: normal; font-
04BD00A8	77	65	69	67	68	74	3A	20	34	30	30	3B	20	66	6F	6E	weight: 400; fon
04BD00B8	74	2D	64	69	73	70	6C	61	79	3A	20	73	77	61	70	3B	t-display: swap;
04BD00C8	20	73	72	63	3A	20	75	72	6C	28	68	74	74	70	73	3A	src: url(https:
04BD00D8	2F	2F	66	6F	6E	74	73	2E	67	73	74	61	74	69	63	2E	//fonts.gstatic.
04BD00E8	63	6F	6D	2F	73	2F	74	6F	6D	6F	72	72	6F	77	2F	76	com/s/tomorrow/v
04BD00F8	35	2F	57	42	4C	6D	72	45	54	4E	62	46	74	5A	43	65	5/WBLmrETNbFtZCe
04BD0108	47	71	67	52	58	63	65	32	44	77	4C	51	2E	77	6F	66	GqgRXce2DwLQ.wof
04BD0118	66	32	29	20	66	6F	72	6D	61	74	28	27	77	6F	66	66	f2) format('woff
04BD0128	32	27	29	3B	20	75	6E	69	63	6F	64	65	2D	72	61	6E	2'); unicode-ran
04BD0138	67	65	3A	20	55	2B	30	31	30	30	2D	30	32	34	46	2C	ge: U+0100-024F,
04BD0148	20	55	2B	30	32	35	39	2C	20	55	2B	31	45	30	30	2D	U+0259, U+1E00-
04BD0158	31	45	46	46	2C	20	55	2B	32	30	32	30	2C	20	55	2B	1EFF, U+2020, U+
04BD0168	32	30	41	30	2D	32	30	41	42	2C	20	55	2B	32	30	41	20A0-20AB, U+20A

Figure 30

The LegalNoticeCaption and LegalNoticeText registry values will be modified to contain the client's name, a password, and the Dark web link that needs to be accessed in order to communicate with the threat actor. We've redacted the company name, however, we've confirmed that it was listed on the Grief's page:



Address	Hex																ASCII
04BD0048	43	[redacted]															C[redacted]
04BD0058	[redacted]															79	[redacted]y
04BD0068	6F	75	20	61	72	65	20	66	75	[redacted]			65	64	2E	00	00	ou are fu[redacted]ed...

Figure 31

LIFARS your digital world, secured
244 Fifth Avenue, Suite 2035, New York, NY 10001
LIFARS.com (212) 222-7061 info@lifars.com

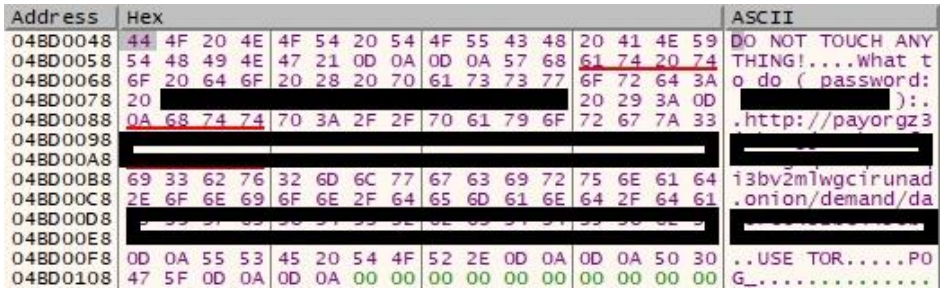


Figure 32

The process also decrypts the Windows Defender Registry Key and the DisableAntiSpyware registry key, which will be utilized to turn off Microsoft Defender Antivirus:

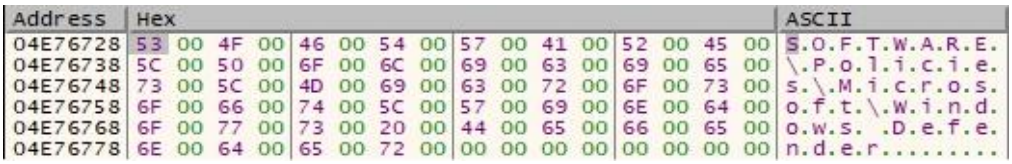


Figure 33

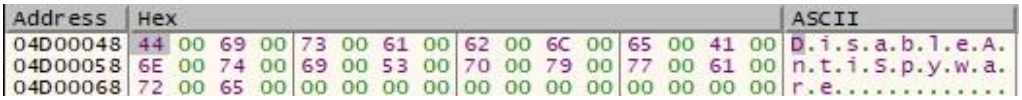


Figure 34

A list of commands that will be used to delete the Volume Shadow Copies is decrypted by the ransomware:

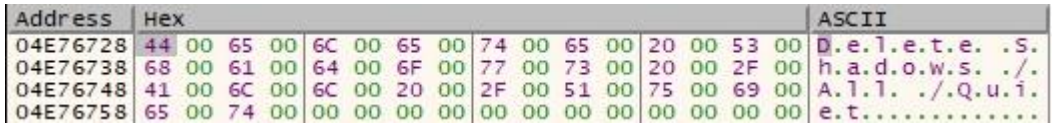


Figure 35

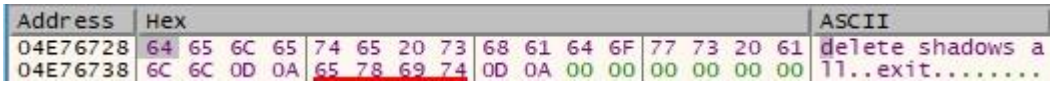


Figure 36

Grief decrypts even more data using RC4, however, we've included the other less relevant strings in the appendix for completeness.

The ransom note called ".iwant2survive.html" is displayed in figure 37:

Figure 37

ExpandEnvironmentStringsA is utilized to expand an environment-variable string and replace it with the value defined for the current user:

Figure 38

The malicious process extracts the NetBIOS name of the local computer via a function call to GetComputerNameW:

Figure 39

The binary acquires a handle to a key container within a CSP (cryptographic service provider) using the CryptAcquireContextW API (0x18 = **PROV_RSA_AES**, 0xF0000000 = **CRYPT_VERIFYCONTEXT**):

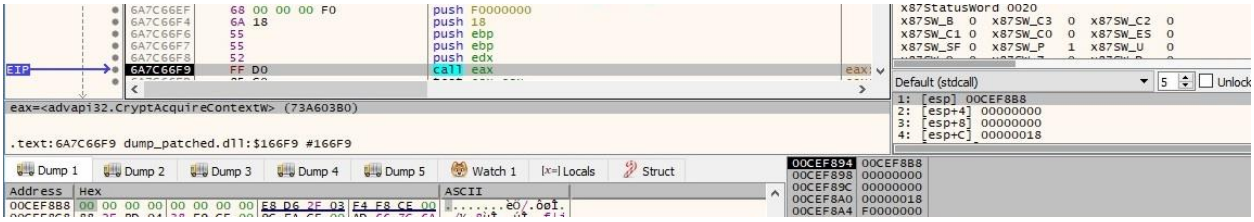


Figure 40

The CryptCreateHash function is used to create a handle to a CSP hash object (0x8003 = **CALG_MD5**):

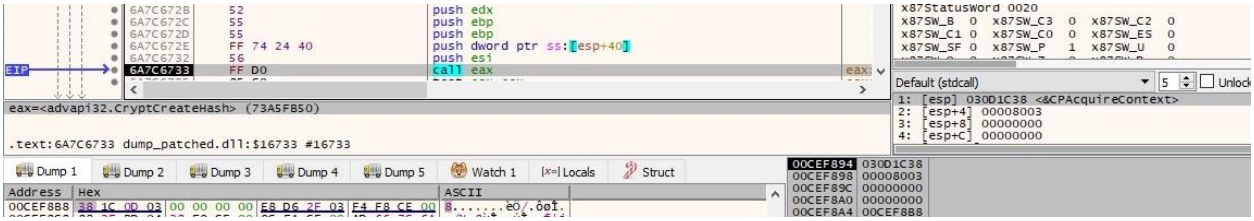


Figure 41

The binary computes the MD5 hash of the computer name by calling the CryptHashData routine:

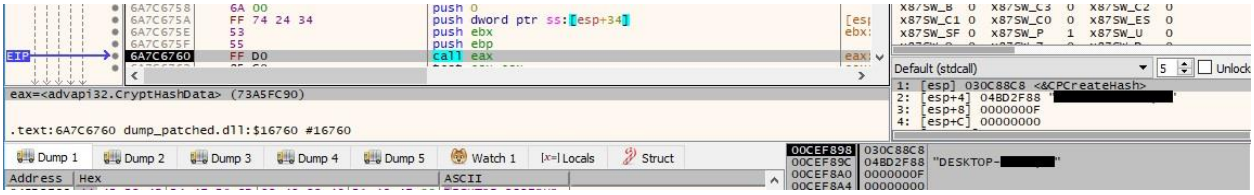


Figure 42

The hash size (16 bytes) is extracted by calling the CryptGetHashParam API (0x4 = **HP_HASHSIZE**):

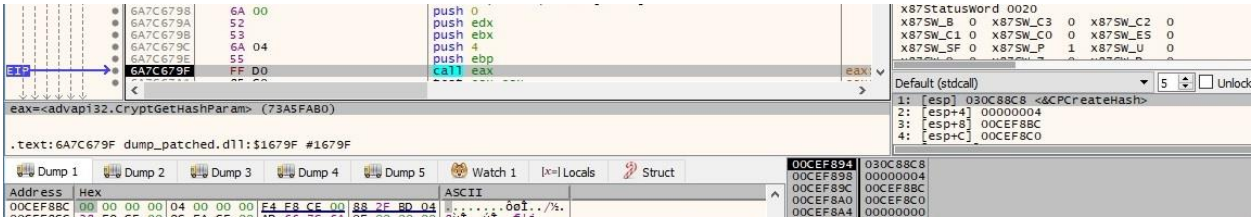


Figure 43

The hash value is retrieved using the same API (0x2 = **HP_HASHVAL**):

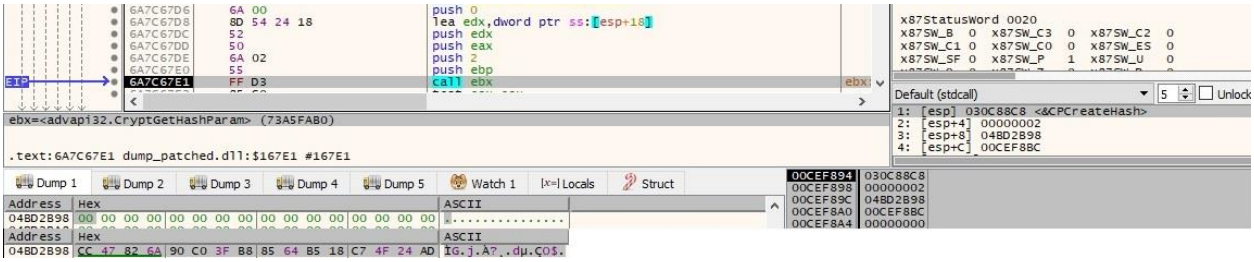


Figure 44

From our analysis and the OSINT, one of the parameters that Grief is supposed to run with is "-<First 6 chars from the hash value>". Based on this observation, the parameter changes from one host to another.

The binary retrieves the command line string for the current process:

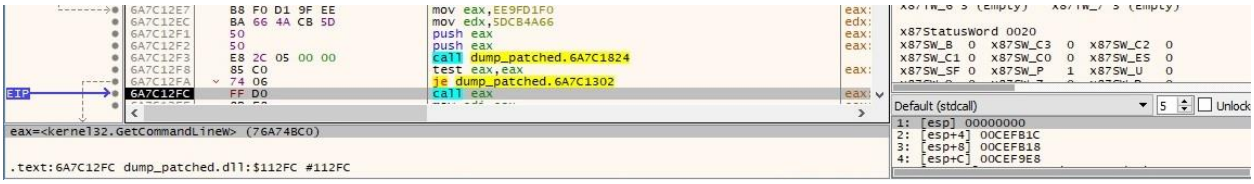


Figure 45

CommandLineToArgvW is utilized to parse the command line string and return an array of pointers to the cmd line arguments:

Figure 46

The malicious process retrieves the path of the executable of the current process via a function call to GetModuleFileNameW:

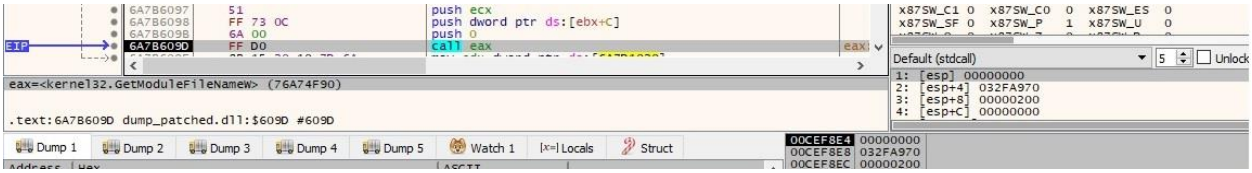


Figure 47

The ransomware also computes the MD5 hash of the string "1<Computer Name extracted earlier>":

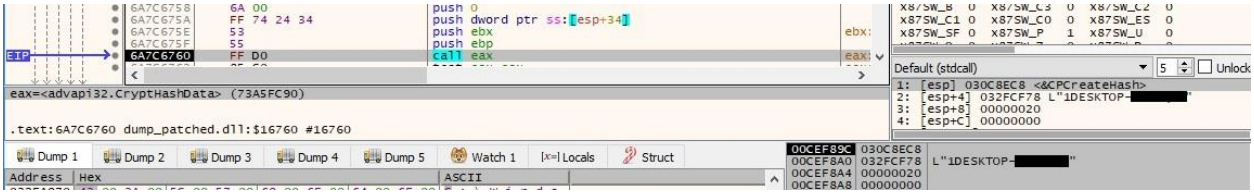


Figure 48

The file creates an event object using the NtCreateEvent routine (0x1F0003 = **EVENT_ALL_ACCESS**):

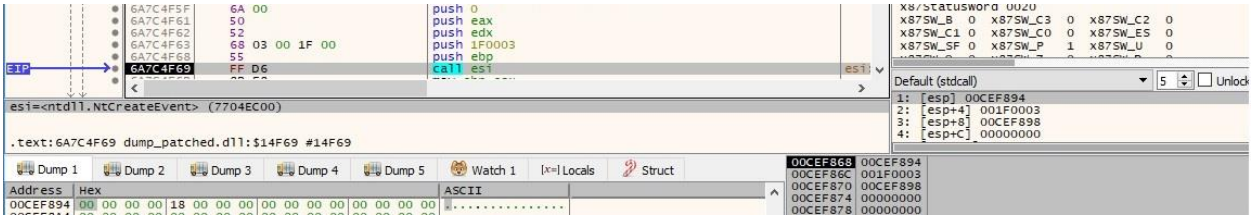


Figure 49

The process creates a mutant object by calling the NtCreateMutant function (0x1F0001 = **MUTEX_ALL_ACCESS**):

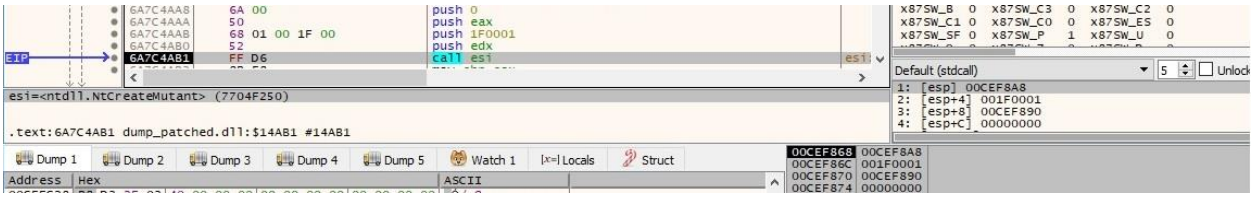


Figure 50

The malware decodes the Base64-encoded RSA public key using the CryptStringToBinaryA function (0x1 = **CRYPT_STRING_BASE64**):

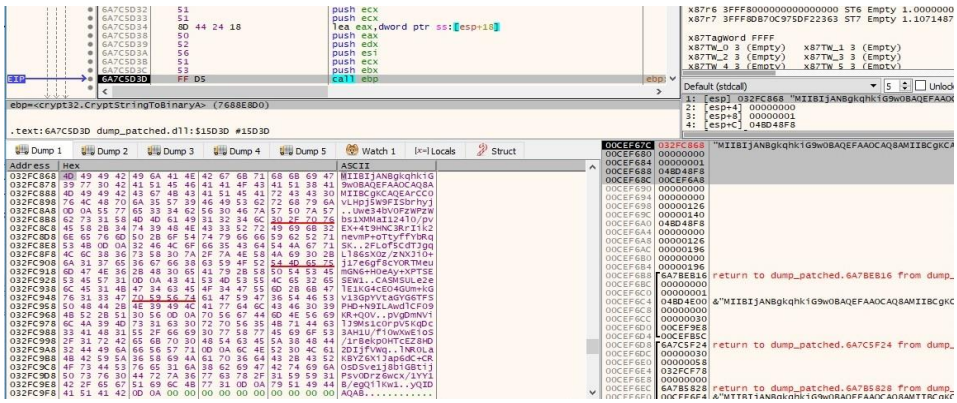
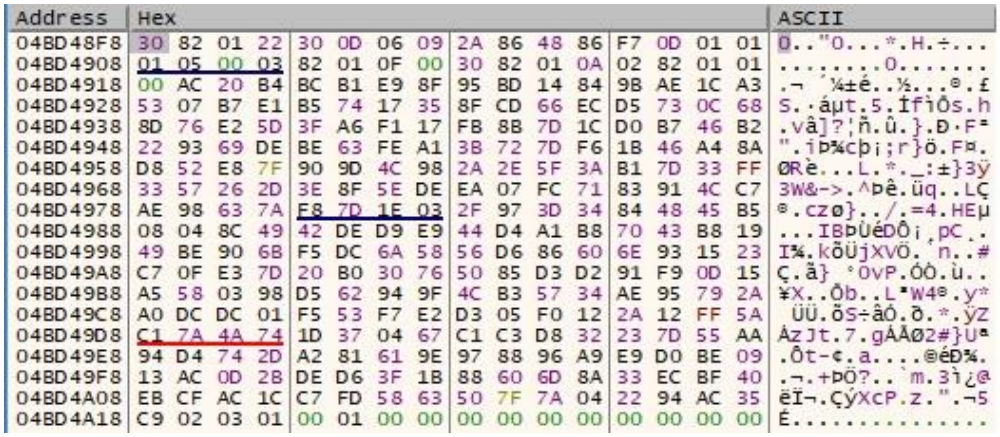


Figure 51



Address	Hex	ASCII
04BD48F8	30 82 01 22 30 0D 06 09 2A 86 48 86 F7 0D 01 01	0.."0...*.H.÷...
04BD4908	01 05 00 03 82 01 0F 00 30 82 01 0A 02 82 01 01	........0.......
04BD4918	00 AC 20 B4 BC B1 E9 8F 95 BD 14 84 9B AE 1C A3	.¬ ´¼±é..½...®.£
04BD4928	53 07 B7 E1 B5 74 17 35 8F CD 66 EC D5 73 0C 68	S.·áµt.5.ÍfìÕs.h
04BD4938	8D 76 E2 5D 3F A6 F1 17 FB 8B 7D 1C D0 B7 46 B2	.vâ]?¦ñ.û.}.Ð·F²
04BD4948	22 93 69 DE BE 63 FE A1 3B 72 7D F6 1B 46 A4 8A	".iÞ¾cþ¡;r}ö.F¤.
04BD4958	D8 52 E8 7F 90 9D 4C 98 2A 2E 5F 3A B1 7D 33 FF	ØRè...L.*._:±}3ÿ
04BD4968	33 57 26 2D 3E 8F 5E DE EA 07 FC 71 83 91 4C C7	3W&->.^Þê.üq..LÇ
04BD4978	AE 98 63 7A F8 7D 1E 03 2F 97 3D 34 84 48 45 B5	®.czø}../.=4.HEµ
04BD4988	08 04 8C 49 42 DE D9 E9 44 D4 A1 B8 70 43 B8 19	...IBÞÙéDÔ¡¸pC¸.
04BD4998	49 BE 90 6B F5 DC 6A 58 56 D6 86 60 6E 93 15 23	I¾.kõÜjXVÖ.`n..#
04BD49A8	C7 0F E3 7D 20 B0 30 76 50 85 D3 D2 91 F9 0D 15	Ç.ã} °0vP.ÓÒ.ù..
04BD49B8	A5 58 03 98 D5 62 94 9F 4C B3 57 34 AE 95 79 2A	¥X..Õb..L³W4®.y*
04BD49C8	A0 DC DC 01 F5 53 F7 E2 D3 05 F0 12 2A 12 FF 5A	ÜÜ.õS÷âÓ.ð.*.ÿZ
04BD49D8	C1 7A 4A 74 1D 37 04 67 C1 C3 D8 32 23 7D 55 AA	ÁzJt.7.gÁÃØ2#}Uª
04BD49E8	94 D4 74 2D A2 81 61 9E 97 88 96 A9 E9 D0 BE 09	.Ôt-¢.a....©éÐ¾.
04BD49F8	13 AC 0D 2B DE D6 3F 1B 88 60 6D 8A 33 EC BF 40	.¬.+ÞÖ?..`m.3ì¿@
04BD4A08	EB CF AC 1C C7 FD 58 63 50 7F 7A 04 22 94 AC 35	ëÏ¬.ÇýXcP.z.".¬5
04BD4A18	C9 02 03 01 00 01 00 00 00 00 00 00 00 00 00 00	É...............

Figure 52

Grief decodes a structure of the **X509_PUBLIC_KEY_INFO** type by calling the CryptDecodeObject API (0x10001 = **PKCS_7_ASN_ENCODING** | **X509_ASN_ENCODING**, 0x8 = **X509_PUBLIC_KEY_INFO**):

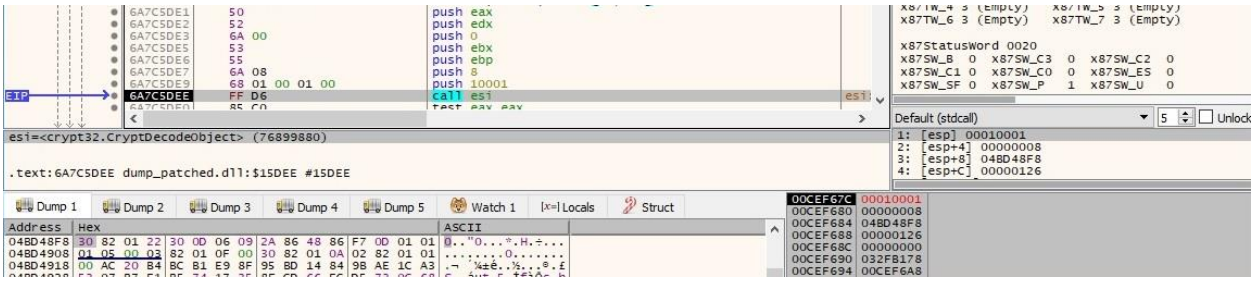


Figure 53

Address	Hex	ASCII
032FB178	90 B1 2F 03 02 00 00 00 A8 B1 2F 03 0E 01 00 00	.±/..... ¨±/.....
032FB188	B0 B1 2F 03 00 00 00 00 31 2E 32 2E 38 34 30 2E	°±/.....1.2.840.
032FB198	31 31 33 35 34 39 2E 31 2E 31 2E 31 00 00 00 00	113549.1.1.1....
032FB1A8	05 00 00 00 00 00 00 00 30 82 01 0A 02 82 01 01	........0.......
032FB1B8	00 AC 20 B4 BC B1 E9 8F 95 BD 14 84 9B AE 1C A3	.¬ ´¼±é..½...®.£
032FB1C8	53 07 B7 E1 B5 74 17 35 8F CD 66 EC D5 73 0C 68	S.·áµt.5.ÍfìÕs.h
032FB1D8	8D 76 E2 5D 3F A6 F1 17 FB 8B 7D 1C D0 B7 46 B2	.vâ]?¦ñ.û.}.Ð·F²
032FB1E8	22 93 69 DE BE 63 FE A1 3B 72 7D F6 1B 46 A4 8A	".iÞ¾cþ¡;r}ö.F¤.
032FB1F8	D8 52 E8 7F 90 9D 4C 98 2A 2E 5F 3A B1 7D 33 FF	ØRè...L.*._:±}3ÿ
032FB208	33 57 26 2D 3E 8F 5E DE EA 07 FC 71 83 91 4C C7	3W&->.^Þê.üq..LÇ
032FB218	AE 98 63 7A F8 7D 1E 03 2F 97 3D 34 84 48 45 B5	®.czø}../.=4.HEµ
032FB228	08 04 8C 49 42 DE D9 E9 44 D4 A1 B8 70 43 B8 19	...IBÞÙéDÔ¡¸pC¸.
032FB238	49 BE 90 6B F5 DC 6A 58 56 D6 86 60 6E 93 15 23	I¾.kõÜjXVÖ.`n..#
032FB248	C7 0F E3 7D 20 B0 30 76 50 85 D3 D2 91 F9 0D 15	Ç.ã} °0vP.ÓÒ.ù..
032FB258	A5 58 03 98 D5 62 94 9F 4C B3 57 34 AE 95 79 2A	¥X..Õb..L³W4®.y*
032FB268	A0 DC DC 01 F5 53 F7 E2 D3 05 F0 12 2A 12 FF 5A	ÜÜ.õS÷âÓ.ð.*.ÿZ
032FB278	C1 7A 4A 74 1D 37 04 67 C1 C3 D8 32 23 7D 55 AA	ÁzJt.7.gÁÃØ2#}Uª
032FB288	94 D4 74 2D A2 81 61 9E 97 88 96 A9 E9 D0 BE 09	.Ôt-¢.a....©éÐ¾.
032FB298	13 AC 0D 2B DE D6 3F 1B 88 60 6D 8A 33 EC BF 40	.¬.+ÞÖ?..`m.3ì¿@
032FB2A8	EB CF AC 1C C7 FD 58 63 50 7F 7A 04 22 94 AC 35	ëÏ¬.ÇýXcP.z.".¬5
032FB2B8	C9 02 03 01 00 01 00 00 00 00 00 00 00 00 00 00	É...............

Figure 54

CryptImportPublicKeyInfo is utilized to convert and import the RSA public key information into the provider (0x10001 = **PKCS_7_ASN_ENCODING** | **X509_ASN_ENCODING**):

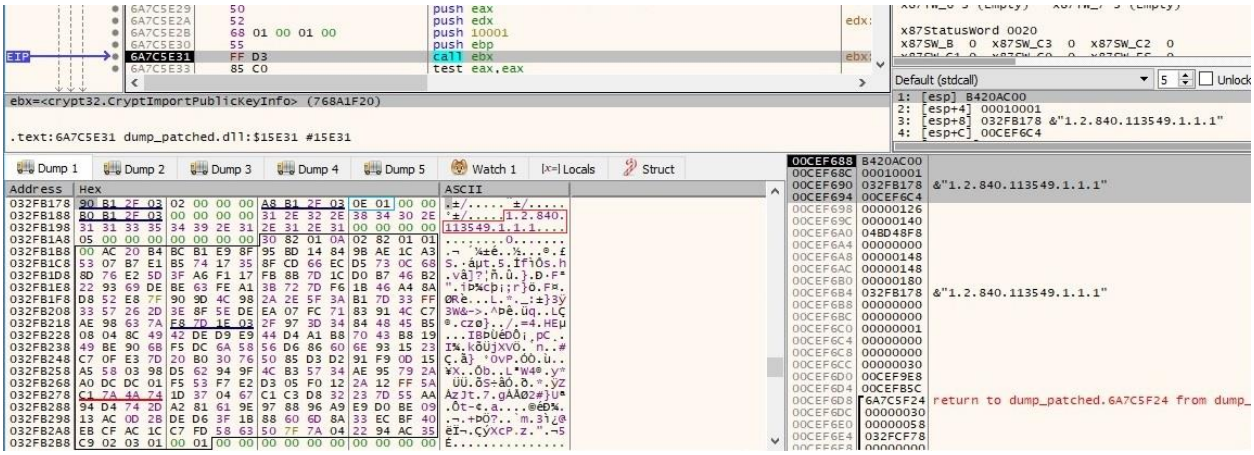
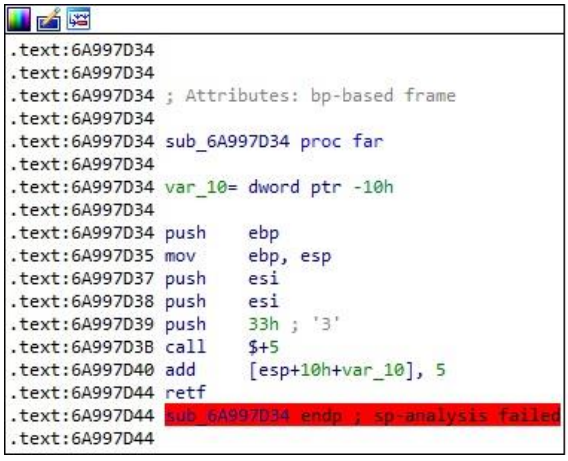


Figure 55

The RSA public key is in the ASN.1 format, and a great explanation of this format is presented at [4]. The public key is used to encrypt the generated AES file encryption keys. We were not able to reach the point where the malware encrypts the files due to the lack of the initial parameters.

Grief also implements the Heaven's Gate technique, which is fully described at [5]. Shortly, the process running as a 32-bit binary switches to the 64-bit environment and executes some instructions there. As we can see in figure 56, the binary pushes 0x33 (the segment selector) on the stack and calls the next line. The retf instruction is a "far return" and specifies the address where the execution returns and the segment. The code that starts after the retf instruction should be interpreted as 64-bit and debugged accordingly (for example, using WinDbg because x64dbg or the IDA Pro debugger can't be used to perform the switch).



```
.text:6A997D34
.text:6A997D34
.text:6A997D34 ; Attributes: bp-based frame
.text:6A997D34
.text:6A997D34 sub_6A997D34 proc far
.text:6A997D34
.text:6A997D34 var_10= dword ptr -10h
.text:6A997D34
.text:6A997D34 push    ebp
.text:6A997D35 mov     ebp, esp
.text:6A997D37 push    esi
.text:6A997D38 push    esi
.text:6A997D39 push    33h ; '3'
.text:6A997D3B call    $+5
.text:6A997D40 add     [esp+10h+var_10], 5
.text:6A997D44 retf
.text:6A997D44 sub_6A997D34 endp ; sp-analysis failed
.text:6A997D44
```

Figure 56

Deletion of Volume Shadow Copies using vssadmin and Diskshadow. Disable Microsoft Defender Antivirus

The ransomware initializes the COM library for use by the calling thread using the CoInitializeEx API (0x2 = **COINIT_APARTMENTTHREADED**):

Figure 57

The binary calls the CoCreateInstance function in order to create a Group Policy Object with the CLSID {EA502722-A23D-11D1-A7D3-0000F87571E3} (0x1 = **CLSCTX_INPROC_SERVER**):

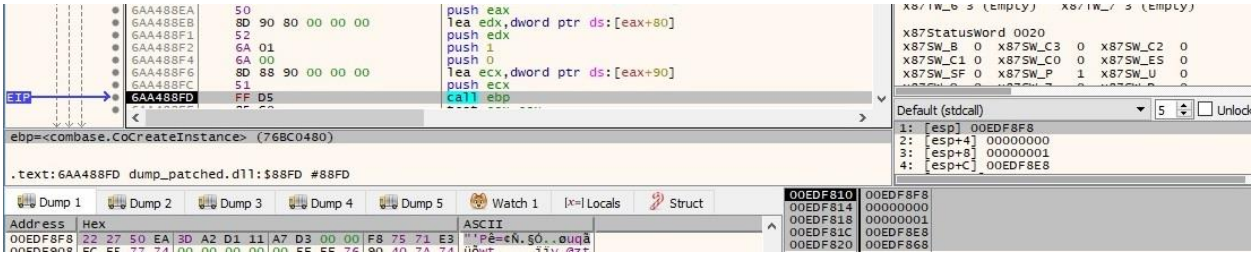


Figure 58

The OpenLocalMachineGPO method is used to open the default GPO for the computer and load the registry information (0x1 = **GPO_OPEN_LOAD_REGISTRY**):

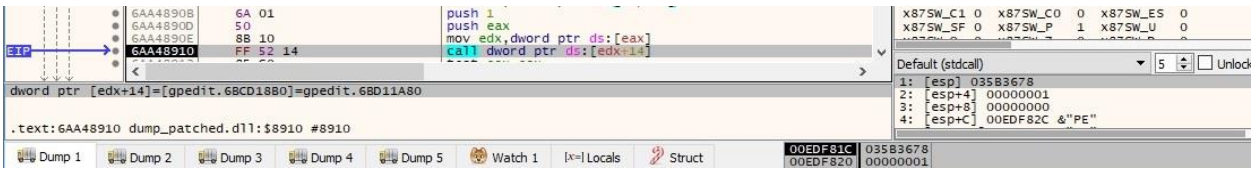


Figure 59

GetRegistryKey is utilized to retrieve a handle to the root of the registry key for the computer section (0x2 = **GPO_SECTION_MACHINE**):

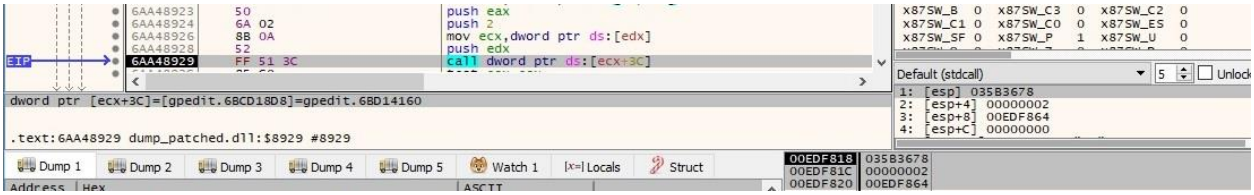


Figure 60

The malicious binary opens the "SOFTWARE\Policies\Microsoft\Windows Defender" registry key (0x3 = **KEY_QUERY_VALUE** | **KEY_SET_VALUE**):

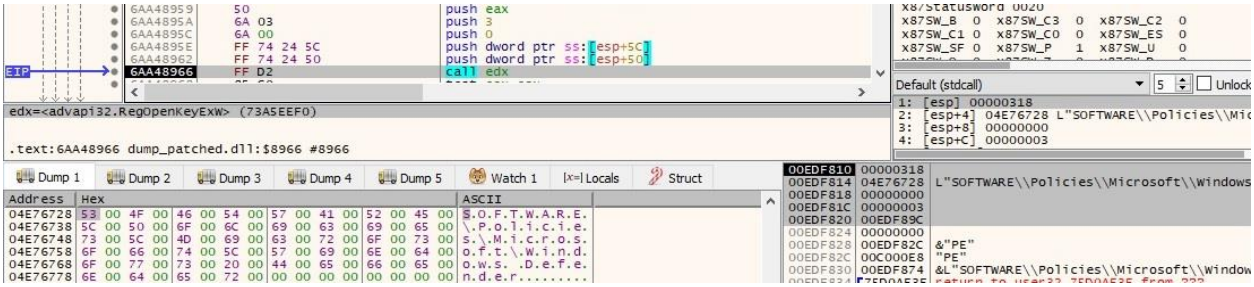


Figure 61

The process turns off Microsoft Defender, as well as 3rd-party antivirus software and apps by setting the "DisableAntiSpyware" registry value to 1:

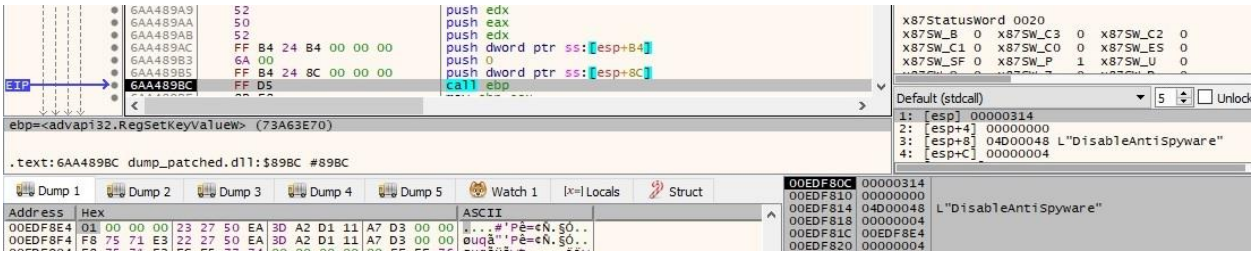


Figure 62

Figure 63

The Save method is used to save the specified registry policy settings to disk and update the revision number. The parameter called pGuidExtension is set to the GUID {35378eac-683f-11d2-a89a-00c04fbbcfa2} and pGuid is set to {3D271CFC-2BC6-4AC2-B633-3BDFF5BDAB2A}:

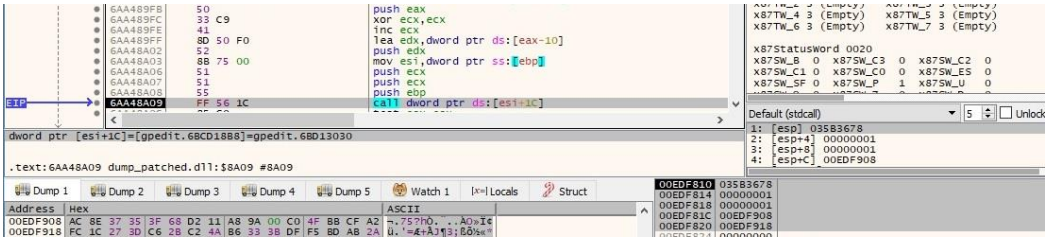


Figure 64

The GPO object created earlier is deleted using the Delete method:

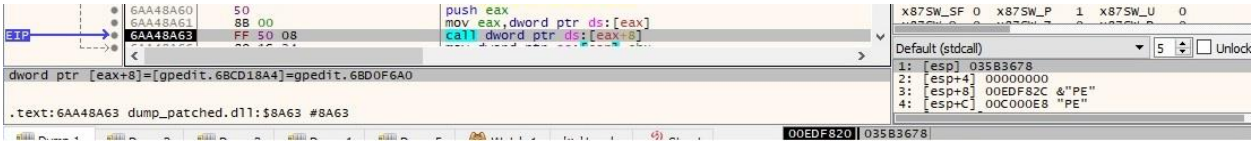


Figure 65

Grief enumerates the executable files located in the System32 directory using the FindFirstFileExW routine (0x1 = **FindExInfoBasic**, 0x2 = **FIND_FIRST_EX_LARGE_FETCH**):

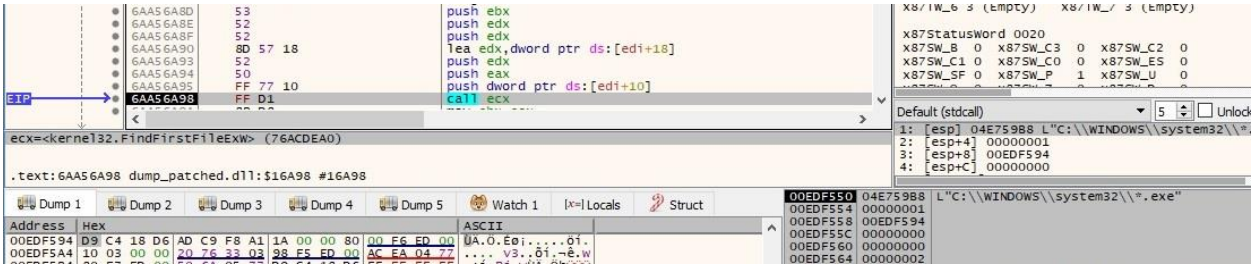


Figure 66

The process computes a "hash" (4-byte value) of each executable name using a custom function:

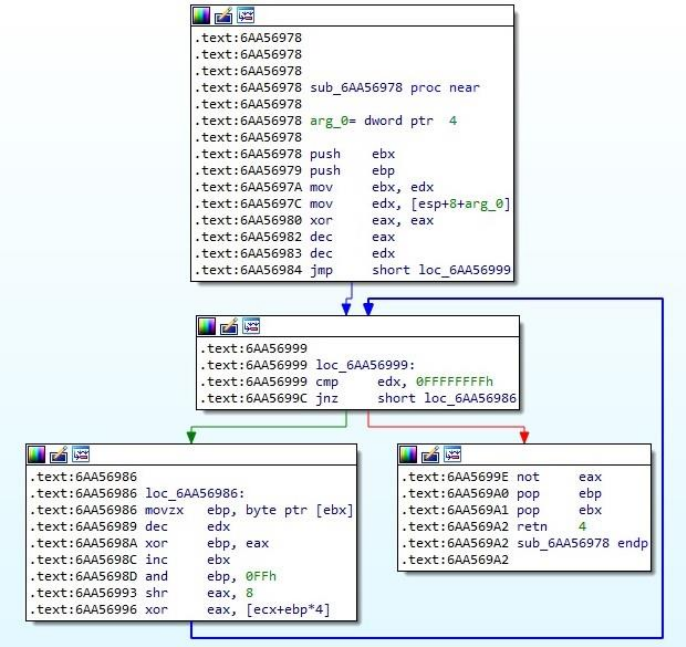


Figure 67

The hash value is XOR-ed with 0x84794EF2, and then compared with 0x668B9032 (hard-coded value). Whether the two values aren't equal, the malware continues the enumeration by calling the FindNextFileW API:

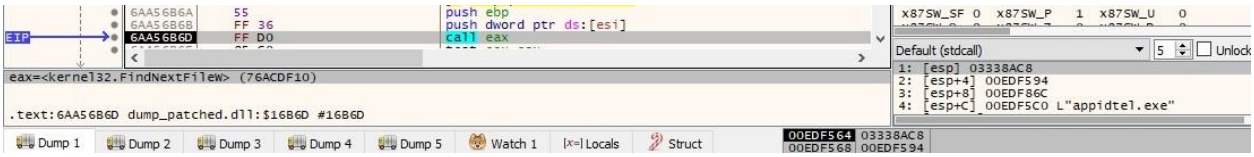


Figure 68

The binary is looking for vssadmin.exe. It disables file system redirection for the current thread using Wow64DisableWow64FsRedirection:

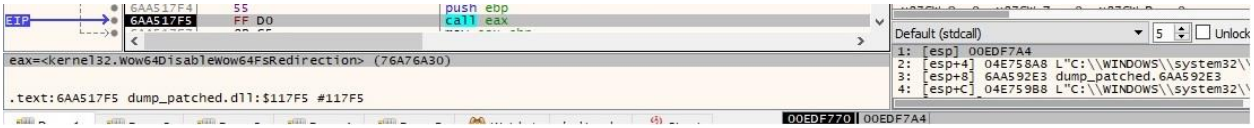


Figure 69

The ransomware deletes all Volume Shadow Copies using vssadmin (0x08000000 = **CREATE_NO_WINDOW**):

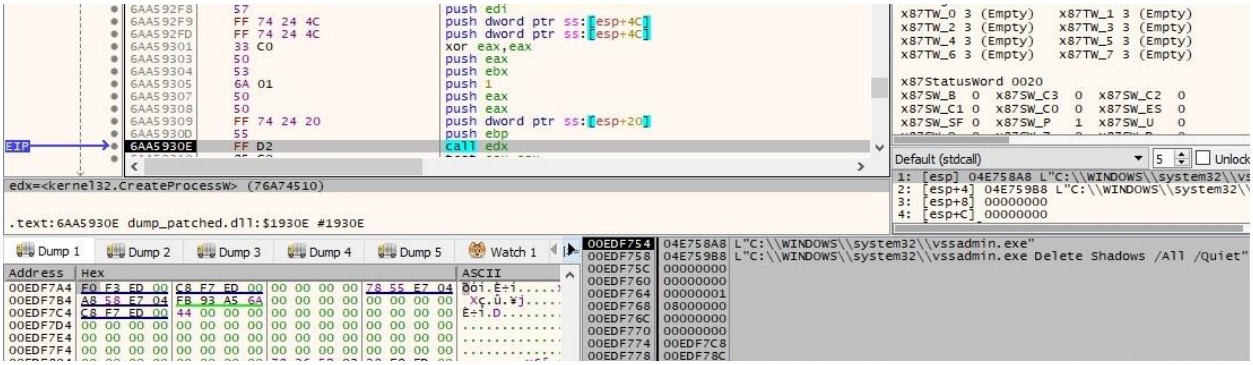


Figure 70

The process restores file system redirection for the current thread via a function call to Wow64RevertWow64FsRedirection:

Figure 71

The process of enumerating the executable files from the System32 folder is repeated one more time, and the XOR-ed result is compared with 0x96164682 (hard-coded value). Based on our analysis, the targeted file is Diskshadow.exe.

CryptGenRandom is utilized to generate 4 random bytes 3 times:

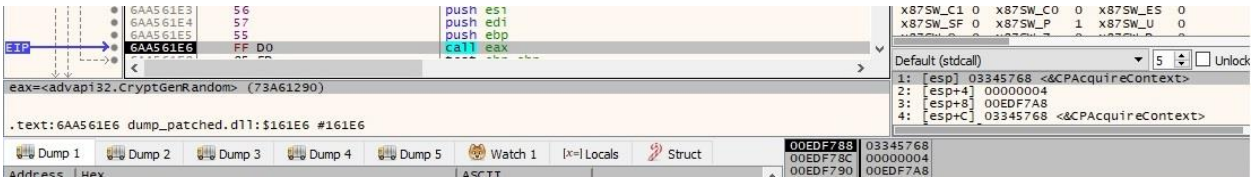


Figure 72

The binary creates an empty temporary file with a prefix string generated based on the random bytes:

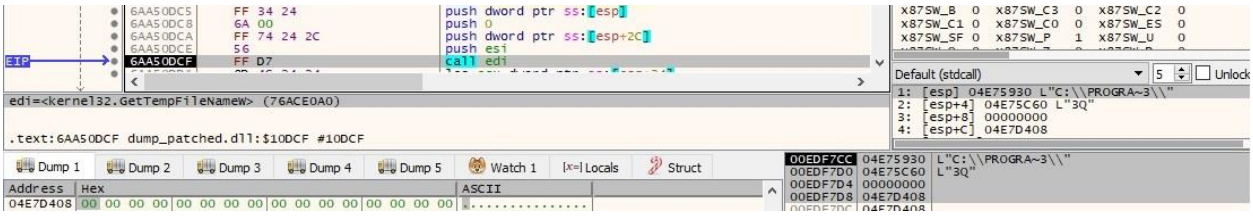


Figure 73

The malware retrieves the short path form of the specified path by calling the GetShortPathNameW routine:

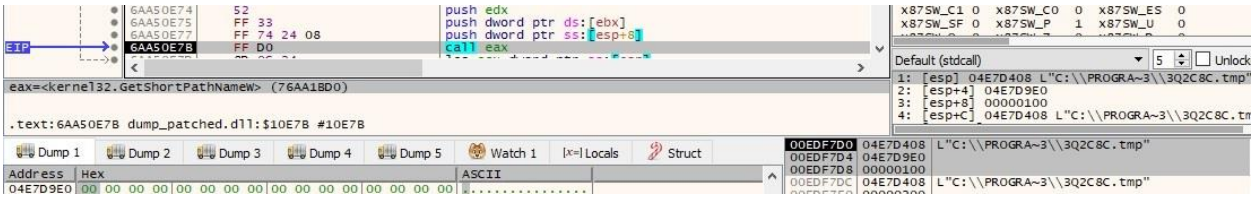


Figure 74

Grief ransomware opens the newly created file using CreateFileW (0xC0000000 = **GENERIC_READ** | **GENERIC_WRITE**, 0x5 = **TRUNCATE_EXISTING**, 0x80 = **FILE_ATTRIBUTE_NORMAL**):

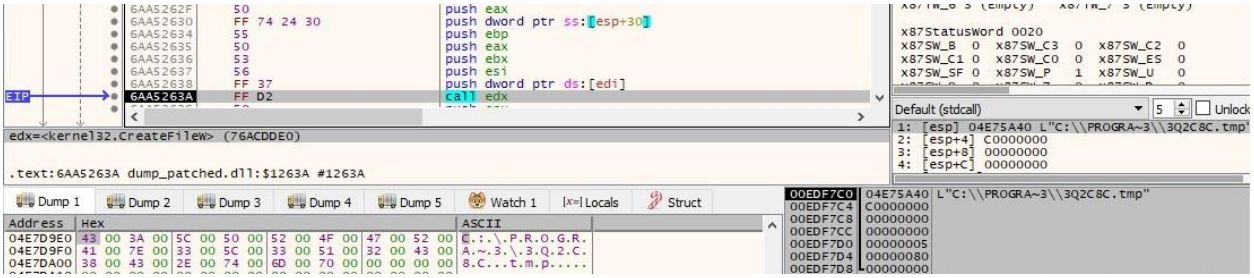


Figure 75

The malware calls the SetFileTime function in order to prevent file operations using the file handle from modifying the last access time and the last write time (dwLowDateTime and dwHighDateTime are set to 0xFFFFFFFF):

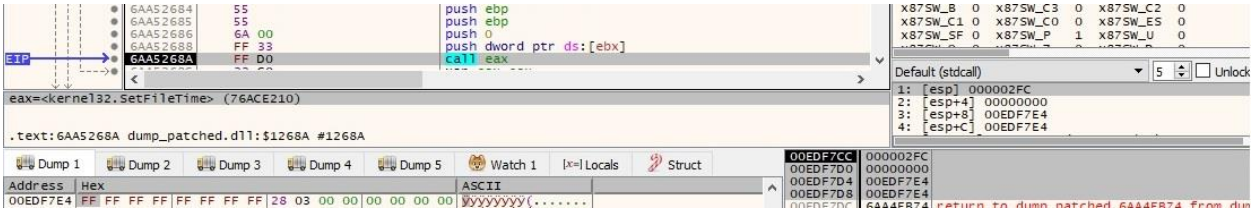


Figure 76

The file is populated with the following content:

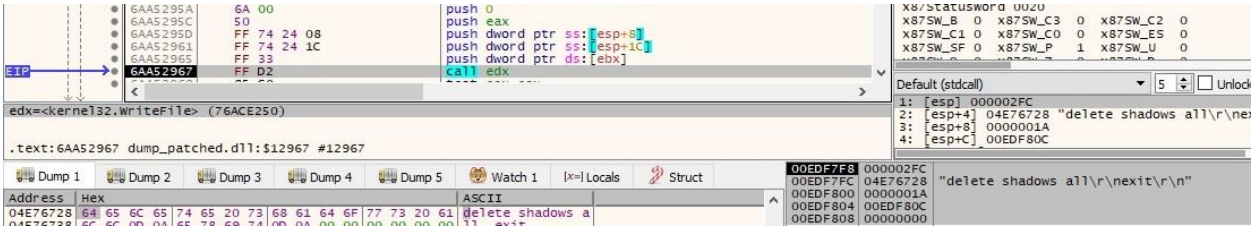


Figure 77

The ransomware deletes all Volume Shadow Copies by creating a Diskshadow process and then running the "delete shadows all" command:

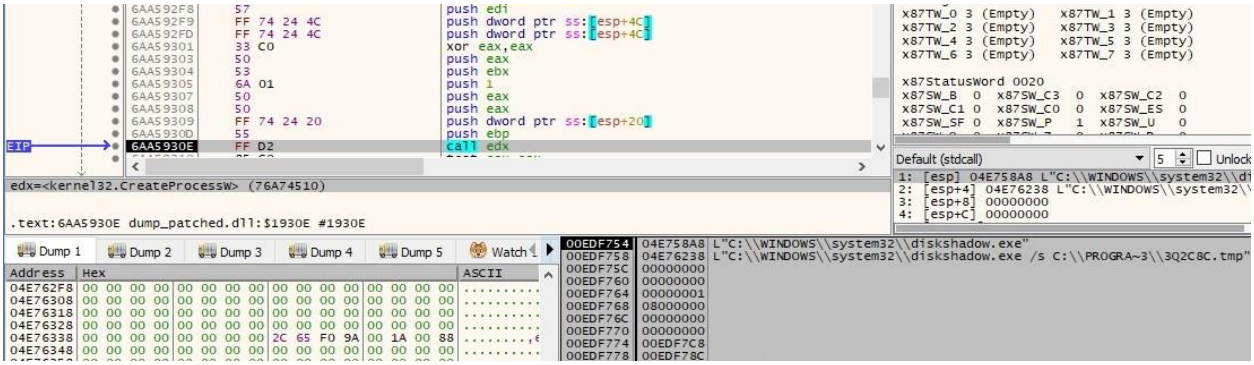


Figure 78

The malicious file retrieves the share names available on the local computer using the NetShareEnum API:

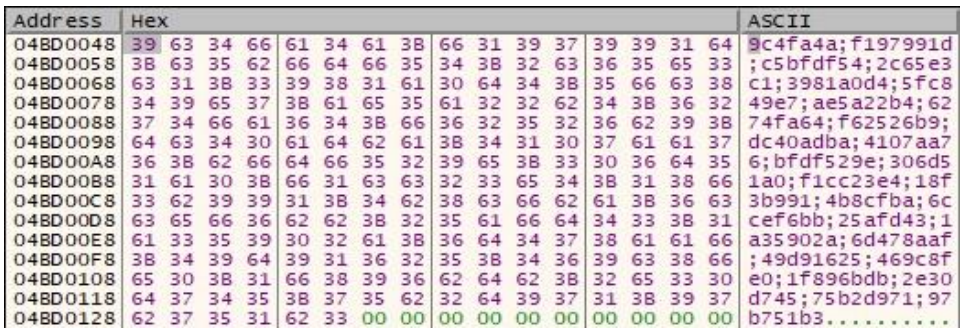
Figure 79

REFERENCES

1. https://www.crowdstrike.com/blog/doppelpaymer-ransomware-and-dridex-2/
2. https://cyber-anubis.github.io/malware%20analysis/dridex/
3. https://github.com/mandiant/capa
4. https://stackoverflow.com/questions/18039401/how-can-i-transform-between-the-two-styles-of-public-key-format-one-begin-rsa
5. https://blog.malwarebytes.com/threat-analysis/2018/01/a-coin-miner-with-a-heavens-gate/

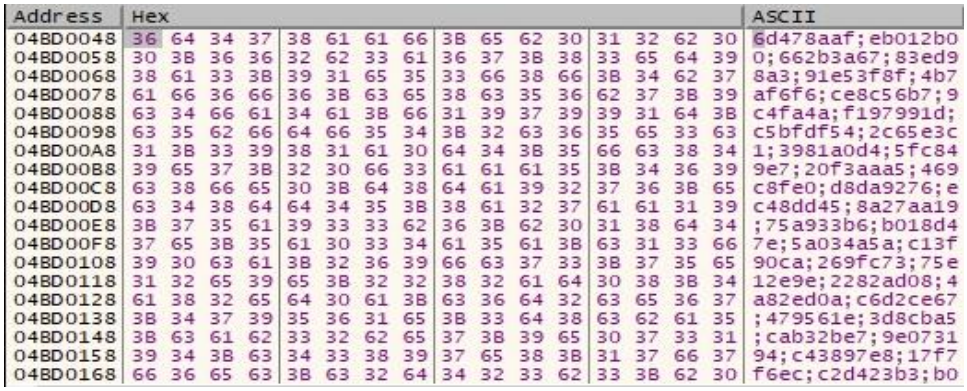
APPENDIX

The other strings decrypted using the RC4 algorithm are shown in the following pictures:



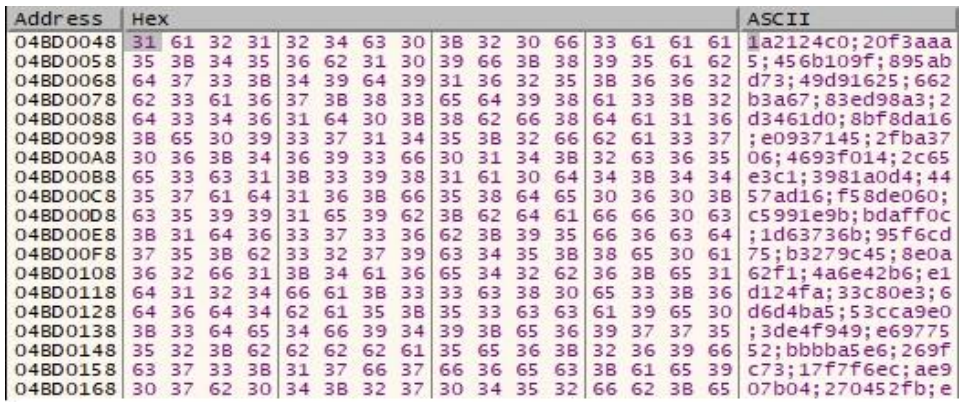
Address	Hex																ASCII
04BD0048	39	63	34	66	61	34	61	3B	66	31	39	37	39	39	31	64	9c4fa4a;f197991d
04BD0058	3B	63	35	62	66	64	66	35	34	3B	32	63	36	35	65	33	;c5bfdf54;2c65e3
04BD0068	63	31	3B	33	39	38	31	61	30	64	34	3B	35	66	63	38	c1;3981a0d4;5fc8
04BD0078	34	39	65	37	3B	61	65	35	61	32	32	62	34	3B	36	32	49e7;ae5a22b4;62
04BD0088	37	34	66	61	36	34	3B	66	36	32	35	32	36	62	39	3B	74fa64;f62526b9;
04BD0098	64	63	34	30	61	64	62	61	3B	34	31	30	37	61	61	37	dc40adba;4107aa7
04BD00A8	36	3B	62	66	64	66	35	32	39	65	3B	33	30	36	64	35	6;bfdf529e;306d5
04BD00B8	31	61	30	3B	66	31	63	63	32	33	65	34	3B	31	38	66	1a0;f1cc23e4;18f
04BD00C8	33	62	39	39	31	3B	34	62	38	63	66	62	61	3B	36	63	3b991;4b8cfba;6c
04BD00D8	63	65	66	36	62	62	3B	32	35	61	66	64	34	33	3B	31	cef6bb;25afd43;1
04BD00E8	61	33	35	39	30	32	61	3B	36	64	34	37	38	61	61	66	a35902a;6d478aaf
04BD00F8	3B	34	39	64	39	31	36	32	35	3B	34	36	39	63	38	66	;49d91625;469c8f
04BD0108	65	30	3B	31	66	38	39	36	62	64	62	3B	32	65	33	30	e0;1f896bdb;2e30
04BD0118	64	37	34	35	3B	37	35	62	32	64	39	37	31	3B	39	37	d745;75b2d971;97
04BD0128	62	37	35	31	62	33	00	00	00	00	00	00	00	00	00	00	b751b3..........

Figure 80



Address	Hex																ASCII
04BD0048	36	64	34	37	38	61	61	66	3B	65	62	30	31	32	62	30	6d478aaf;eb012b0
04BD0058	30	3B	36	36	32	62	33	61	36	37	3B	38	33	65	64	39	0;662b3a67;83ed9
04BD0068	38	61	33	3B	39	31	65	35	33	66	38	66	3B	34	62	37	8a3;91e53f8f;4b7
04BD0078	61	66	36	66	36	3B	63	65	38	63	35	36	62	37	3B	39	af6f6;ce8c56b7;9
04BD0088	63	34	66	61	34	61	3B	66	31	39	37	39	39	31	64	3B	c4fa4a;f197991d;
04BD0098	63	35	62	66	64	66	35	34	3B	32	63	36	35	65	33	63	c5bfdf54;2c65e3c
04BD00A8	31	3B	33	39	38	31	61	30	64	34	3B	35	66	63	38	34	1;3981a0d4;5fc84
04BD00B8	39	65	37	3B	32	30	66	33	61	61	61	35	3B	34	36	39	9e7;20f3aaa5;469
04BD00C8	63	38	66	65	30	3B	64	38	64	61	39	32	37	36	3B	65	c8fe0;d8da9276;e
04BD00D8	63	34	38	64	64	34	35	3B	38	61	32	37	61	61	31	39	c48dd45;8a27aa19
04BD00E8	3B	37	35	61	39	33	33	62	36	3B	62	30	31	38	64	34	;75a933b6;b018d4
04BD00F8	37	65	3B	35	61	30	33	34	61	35	61	3B	63	31	33	66	7e;5a034a5a;c13f
04BD0108	39	30	63	61	3B	32	36	39	66	63	37	33	3B	37	35	65	90ca;269fc73;75e
04BD0118	31	32	65	39	65	3B	32	32	38	32	61	64	30	38	3B	34	12e9e;2282ad08;4
04BD0128	61	38	32	65	64	30	61	3B	63	36	64	32	63	65	36	37	a82ed0a;c6d2ce67
04BD0138	3B	34	37	39	35	36	31	65	3B	33	64	38	63	62	61	35	;479561e;3d8cba5
04BD0148	3B	63	61	62	33	32	62	65	37	3B	39	65	30	37	33	31	;cab32be7;9e0731
04BD0158	39	34	3B	63	34	33	38	39	37	65	38	3B	31	37	66	37	94;c43897e8;17f7
04BD0168	66	36	65	63	3B	63	32	64	34	32	33	62	33	3B	62	30	f6ec;c2d423b3;b0

Figure 81



Address	Hex																ASCII
04BD0048	31	61	32	31	32	34	63	30	3B	32	30	66	33	61	61	61	1a2124c0;20f3aaa
04BD0058	35	3B	34	35	36	62	31	30	39	66	3B	38	39	35	61	62	5;456b109f;895ab
04BD0068	64	37	33	3B	34	39	64	39	31	36	32	35	3B	36	36	32	d73;49d91625;662
04BD0078	62	33	61	36	37	3B	38	33	65	64	39	38	61	33	3B	32	b3a67;83ed98a3;2
04BD0088	64	33	34	36	31	64	30	3B	38	62	66	38	64	61	31	36	d3461d0;8bf8da16
04BD0098	3B	65	30	39	33	37	31	34	35	3B	32	66	62	61	33	37	;e0937145;2fba37
04BD00A8	30	36	3B	34	36	39	33	66	30	31	34	3B	32	63	36	35	06;4693f014;2c65
04BD00B8	65	33	63	31	3B	33	39	38	31	61	30	64	34	3B	34	34	e3c1;3981a0d4;44
04BD00C8	35	37	61	64	31	36	3B	66	35	38	64	65	30	36	30	3B	57ad16;f58de060;
04BD00D8	63	35	39	39	31	65	39	62	3B	62	64	61	66	66	30	63	c5991e9b;bdaff0c
04BD00E8	3B	31	64	36	33	37	33	36	62	3B	39	35	66	36	63	64	;1d63736b;95f6cd
04BD00F8	37	35	3B	62	33	32	37	39	63	34	35	3B	38	65	30	61	75;b3279c45;8e0a
04BD0108	36	32	66	31	3B	34	61	36	65	34	32	62	36	3B	65	31	62f1;4a6e42b6;e1
04BD0118	64	31	32	34	66	61	3B	33	33	63	38	30	65	33	3B	36	d124fa;33c80e3;6
04BD0128	64	36	64	34	62	61	35	3B	35	33	63	63	61	39	65	30	d6d4ba5;53cca9e0
04BD0138	3B	33	64	65	34	66	39	34	39	3B	65	36	39	37	37	35	;3de4f949;e69775
04BD0148	35	32	3B	62	62	62	62	61	35	65	36	3B	32	36	39	66	52;bbbba5e6;269f
04BD0158	63	37	33	3B	31	37	66	37	66	36	65	63	3B	61	65	39	c73;17f7f6ec;ae9
04BD0168	30	37	62	30	34	3B	32	37	30	34	35	32	66	62	3B	65	07b04;270452fb;e

Figure 82

LIFARS
your digital world, secured
244 Fifth Avenue, Suite 2035, New York, NY 10001
LIFARS.com (212) 222-7061 info@lifars.com

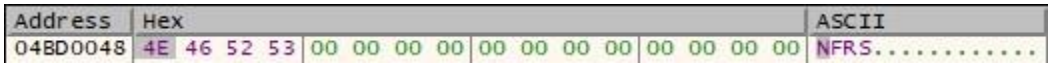


Figure 83

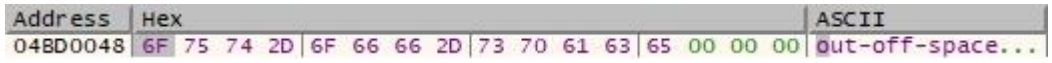


Figure 84

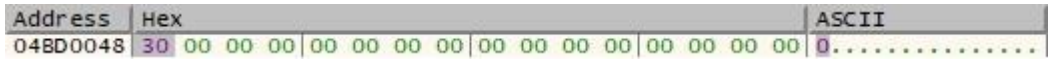


Figure 85

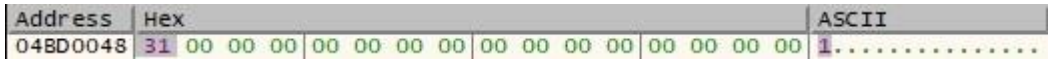


Figure 86

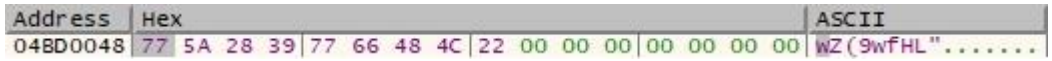


Figure 87

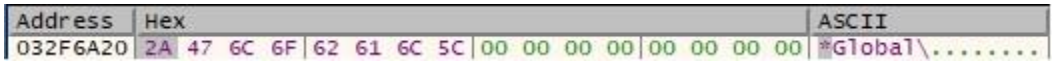


Figure 88

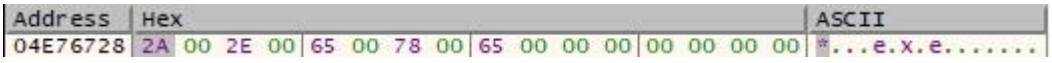


Figure 89

List of files and file's extensions to be skipped:

- svsho*.exe;schre*.bat;V01.lo*;V01.ch*;V01res*.jrs;RacWmi*.sdf;Web*V01.dat;default.rdp;NTUSER.DA*;*.lnk;*.ico;*.ini;*.msi;*.chm;*.sys;*.hlf;*.lng;*.inf;*.ttf;*.cmd;*.LNK;*.ICO;*.INI;*.MSI;*.CHM;*.SYS;*.HLF;*.LNG;*.INF;*.TTF;*.CMD

List of directories to be skipped:

- System Volume Information;$RECYCLE.BIN;$Recycle.Bin;WebCache;Caches;VirtualStore

List of environment-variable strings:

- %ProgramData%\\Microsoft\\Windows\\WER\\ReportQueue\\;%windir%;%temp%;%APPDATA%\\Local\\VirtualStore\\;%HOMEDRIVE%\\Documents and Settings\\All Users\\Application Data\\Application Data\\;%HOMEDRIVE%\\Users\\All Users\\Application Data\\Application Data\\;%SystemDrive%\\Documents and Settings\\All Users\\Application Data\\Application Data\\;%SystemDrive%\\Users\\All Users\\Application Data\\Application Data\\

List of services to be stopped:

- msolap$*;mssql$*;sqlagent$*;reportserver$*
- sophos client firewall*;sophos mcs*;sophos web intelligence*;sophospatch*

Extension of encrypted files:

- .pay0rgrief

Grief's Dark web site and the impacted client:

- "CROMOLOGY SERVICES ... ZOLPAN, you are fu**ed." (Redacted)
- "DO NOT TOUCH ANYTHING!\r\n\r\nWhat to do (password: oN*********):\r\nhttp[:]//payorgz3j6hs2gj66nk6omfw65atgmqwzxqbbxnqi3bv2mlwgcirunad[.]onion/demand/da597c8432bc4458b9475627fd55eded\r\n\r\nUSE TOR.\r\n\r\nP0G_\r\n\r\n" (Redacted)

LIFARS your digital world, secured
244 Fifth Avenue, Suite 2035, New York, NY 10001
LIFARS.com (212) 222-7061 info@lifars.com

API hashing table

A169D93E	ExitProcess	7408F6CF	RegDeleteValueA
B7303F40	GetCurrentDirectoryW	CB74E56B	RegSetValueExA
F1E04D0E	CreateDirectoryW	3440E30C	RegQueryValueExA
14134842	CreateThread	3FA0503A	RegSetValueExW
D8FC22B5	CreateProcessW	C094565D	RegQueryValueExW
C4B669CF	CreateFileMappingW	8D388F19	RegEnumValueA
1D4786C2	QueryDosDeviceW	2D504FC7	RegCloseKey
2CE276DD	MapViewOfFile	B1978170	RegOpenKeyExW
BD63F85D	UnmapViewOfFile	49A2BC02	RegEnumKeyW
589C7CD4	GetFileType	2478983B	RegCreateKeyExW
2596A7DB	CreateFileW	2C39743C	CryptReleaseContext
D7509C5D	GetVolumeNameForVolumeMountPointW	826FDC1D	CryptGetHashParam
8EB1B560	DeviceIoControl	429ACFE2	CryptHashData
22C3F66E	ExpandEnvironmentStringsA	5B40E61E	CryptCreateHash
78120C03	GetModuleFileNameW	D8EFD506	CryptAcquireContextW
ECED49A4	FileTimeToSystemTime	8E1D8F12	CryptDestroyHash
BC8CDE49	SystemTimeToFileTime	53F5694D	CryptGenRandom
A88A7EA6	GetShortPathNameW	D4E43A30	CryptEncrypt
F5656839	GetLogicalDrives	DE78F152	CryptExportKey
86089CF3	GetDriveTypeW	6F75B3F1	CryptGenKey
D9DE4146	SetThreadPriority	69836B71	CryptDestroyKey
E66CC345	GetDiskFreeSpaceExW	8A2AACA0	SetSecurityInfo
65C66CA1	SetFileAttributesW	7EBEE13C	GetSecurityDescriptorSacl
AE320B72	MoveFileW	7F0B03AE	ConvertStringSecurityDescriptorToSecurityDescriptorW
F68850CB	MultiByteToWideChar	8B6FA607	ControlService
1EF9AB7B	WideCharToMultiByte	3373DF6A	OpenServiceW
AF2A8DE9	GetVersionExW	2EE029FE	StartServiceCtrlDispatcherW
F246E304	GetSystemInfo	F40C812D	CloseServiceHandle
BA71B979	LocalFree	F66A15F1	OpenSCManagerW
AA297AF9	IsWow64Process	9675A67D	ChangeServiceConfigW
C0ED06A6	GetSystemWow64DirectoryW	5CDDF47	StartServiceW
F61D52F9	GetSystemDirectoryW	3F1483A7	QueryServiceConfigW
459F8107	GetEnvironmentStringsW	42132256	QueryServiceStatus
9224D8AB	GetTempFileNameW	26652D0D	EnumServicesStatusExW
8F5E891D	GetWindowsDirectoryW	E8C5D221	SetServiceStatus
CA2E3F55	GetComputerNameW	518E8878	RegisterServiceCtrlHandlerW
5DCB4A66	GetCommandLineW	29DBE130	GetUserNameW
D5D107B9	IsBadReadPtr	787BAFBC	GetSidSubAuthority
5321A741	GetThreadId	F2EC9F3E	GetSidSubAuthorityCount
1F442F52	GetProcessId	922CE64F	GetTokenInformation
99CD5D11	GetCurrentProcessId	7DBF48E7	OpenProcessToken
72A2E993	SearchPathW	B514674F	FreeSid
4FCE620F	Wow64DisableWow64FsRedirection	9C01B84F	ConvertSidToStringSidA
84A5D7E5	Wow64RevertWow64FsRedirection	D46EE9FF	EqualSid
569C7845	GetLastError	434A3624	AllocateAndInitializeSid
A5F904F1	SetFileTime	967918CF	RegSetKeyValueW
6BBEA486	SetFilePointer	62DE91AE	CreateProcessAsUserW
23820F97	GetFileSize	65E4543B	NetUserEnum
8D254D22	ReadFile	0BCF31C0	NetUserSetInfo
489018E0	WriteFile	53FF883	NetShareEnum
7E44617A	FlushFileBuffers	4266BEEF	NetApiBufferFree
A160FFA8	SetEndOfFile	F5EE9951	NetShareDel
BBD6B3B8	GetFileTime	A633633A	CryptStringToBinaryA
2236F20A	GetFileAttributesExW	C380FA58	CryptDecodeObject
4348FE4D	RemoveDirectoryW	2F9F0714	CryptImportPublicKeyInfo
E1369068	DeleteFileW	DD2C7E1F	WTSEnumerateSessionsW
3E4FB2EF	GetHandleInformation	7809AAC1	WTSQueryUserToken
784487EE	QueryFullProcessImageNameW	71A22286	WTSFreeMemory
7D5DB015	GetProcessTimes	0B910B2	ZwClose
98B31D0F	GetExitCodeProcess	4D62C13	RtlExitUserThread
9F5CDB	LocalSize	8631D459	GetClassNameW
565B4A16	GetSystemTime		
5C52B868	FindClose		
7380D608	FindFirstFileExW		
58AD2EB	FindNextFileW		
5982AEC6	SetLastError		
BBB8F37F	LoadLibraryA		
5E116D7D	FreeLibrary		
4D05510D	GetProcAddress		