Cuba Ransomware Analysis

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Due to the recent warning published by the FBI about Cuba ransomware (original FBI warning no longer available online for unknown reasons), from Lab52 we decided to publish some information about this ransomware family. Despite the fact that the ransomware has been named Cuba, there is no clear evidence linking the country to the implementation or perpetration of this type of attacks.

Nonetheless, the geopolitical analysis has revealed a few details of strategic interest. Firstly, the fact that most of the countries attacked, according to a McAfee report, correspond to those located in Latin America, North America and Europe. Of these, the most targeted were: Spain, Colombia and Germany. However, when looking at the possible link between the countries attacked and the sectors compromised, it has not been possible to identify a clear interest in the attack, since although Colombia is a US ally in Latin America and a NATO observer state, and Spain is a member of the European Union and NATO with a good geostrategic position, none of them stand out among the critical sectors that have been attacked.

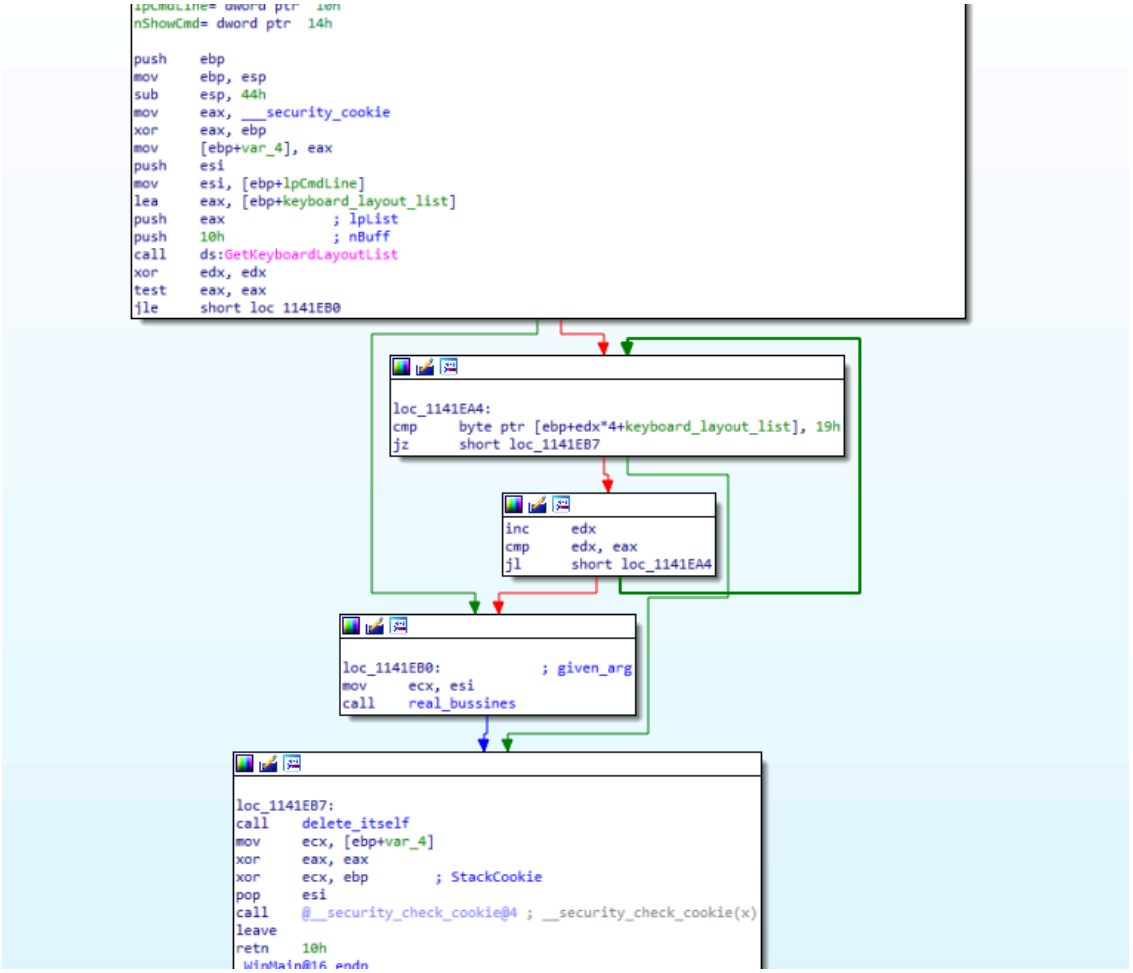
Secondly, it has also been observed that the profile of the countries attacked is common to apt groups that share certain ideological lines, which may be contrary to those of the countries that have been targeted. However, this has not yet allowed us to identify the link between this ransomware and any specific country or APT group.

For this post, we have analyzed a recent public sample, which has a compiler timestamp dated from August 23rd, 2021:

936119bc1811aeef01299a0150141787865a0dbe2667288f018ad24db5a7bc27

In this sample, we have observed some changes from the version described by McAfee in April 2021, which is the only and most recent published analysis about this ransomware family.

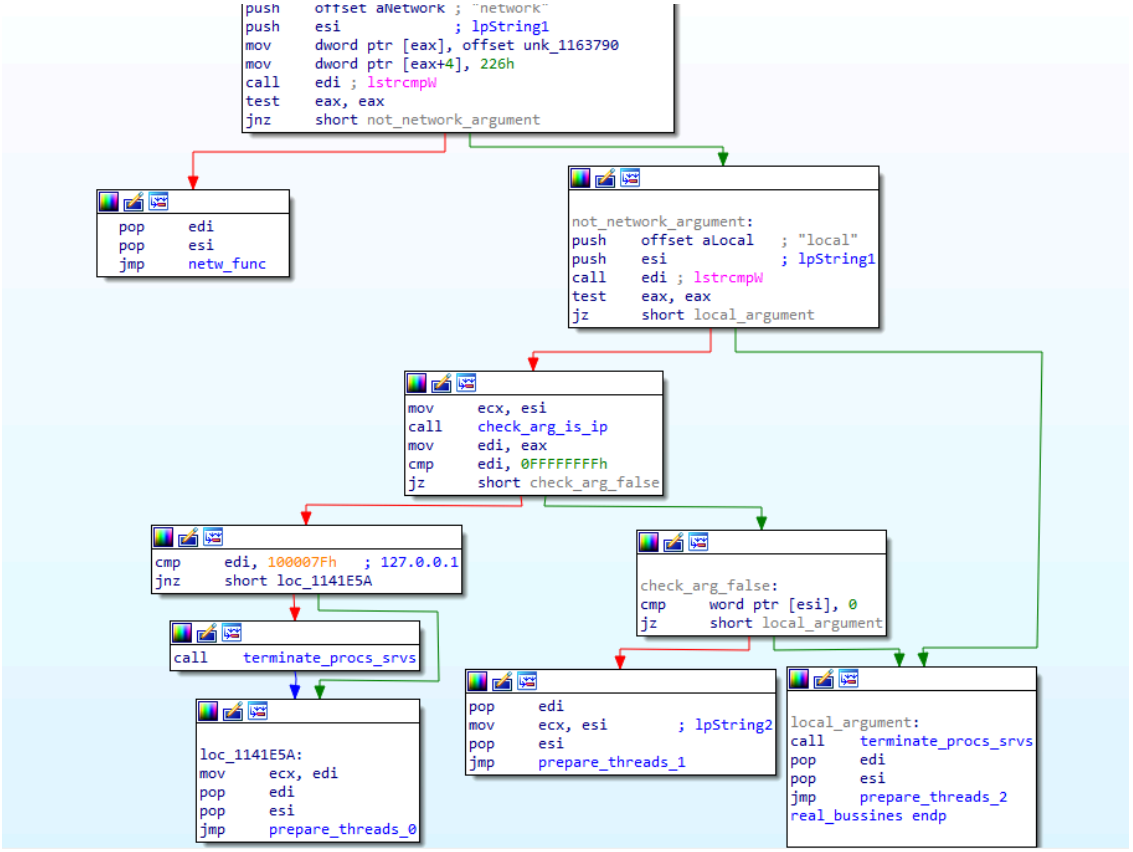
Firstly, the process retrieves the Input Locale identifiers (formerly called Keyboard Layout Handles) corresponding to the current set of input languages in the infected system. In case of finding the Russian language identifier (0x19) among the obtained list, the process terminates. Otherwise, it starts with its main activity.



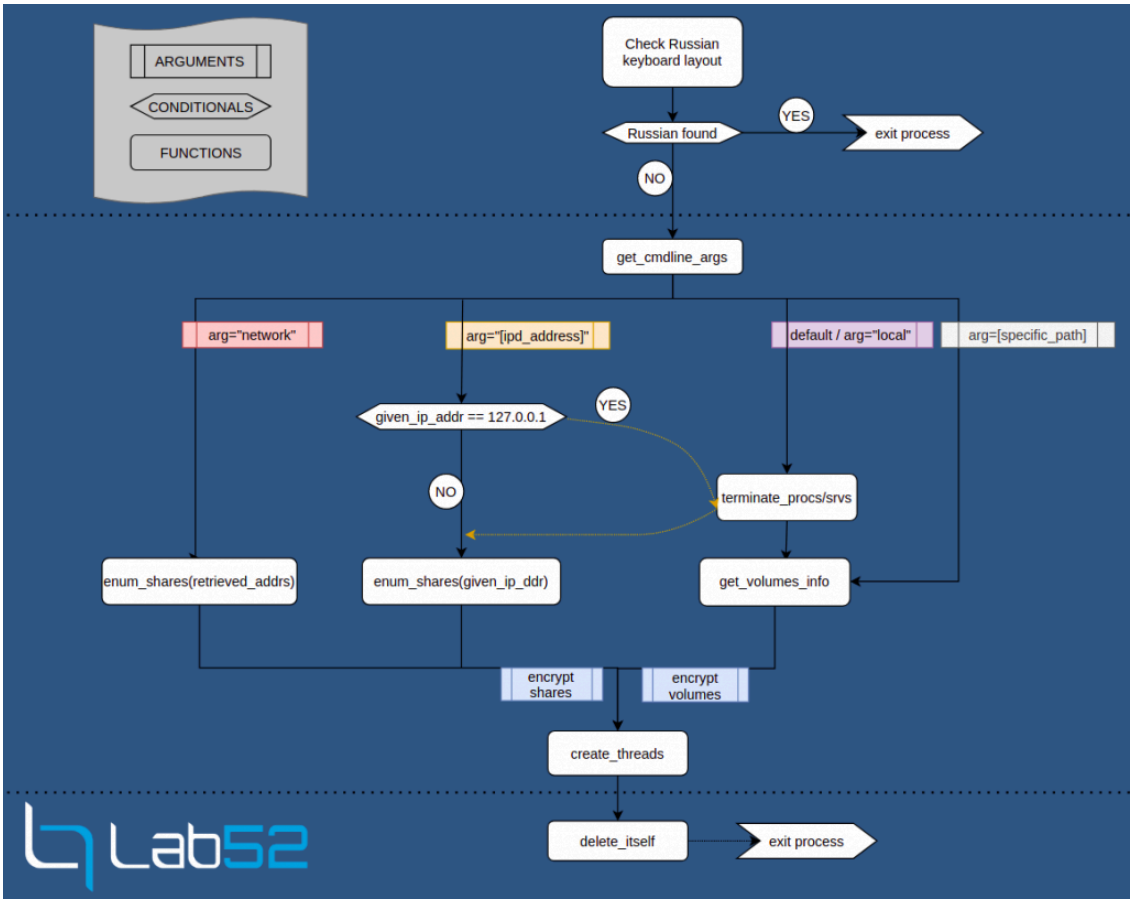
Main function of the Cuba Ransomware sample

Since the program accepts one argument, the main activity will start by parsing the given argument, looking for either “network”, some IP address, “local” or a specific path to encrypt. Thus, the usage of this sample by an operator would be as follows:

cuba.exe [network | [IP_addr] | local | [specific_path]]

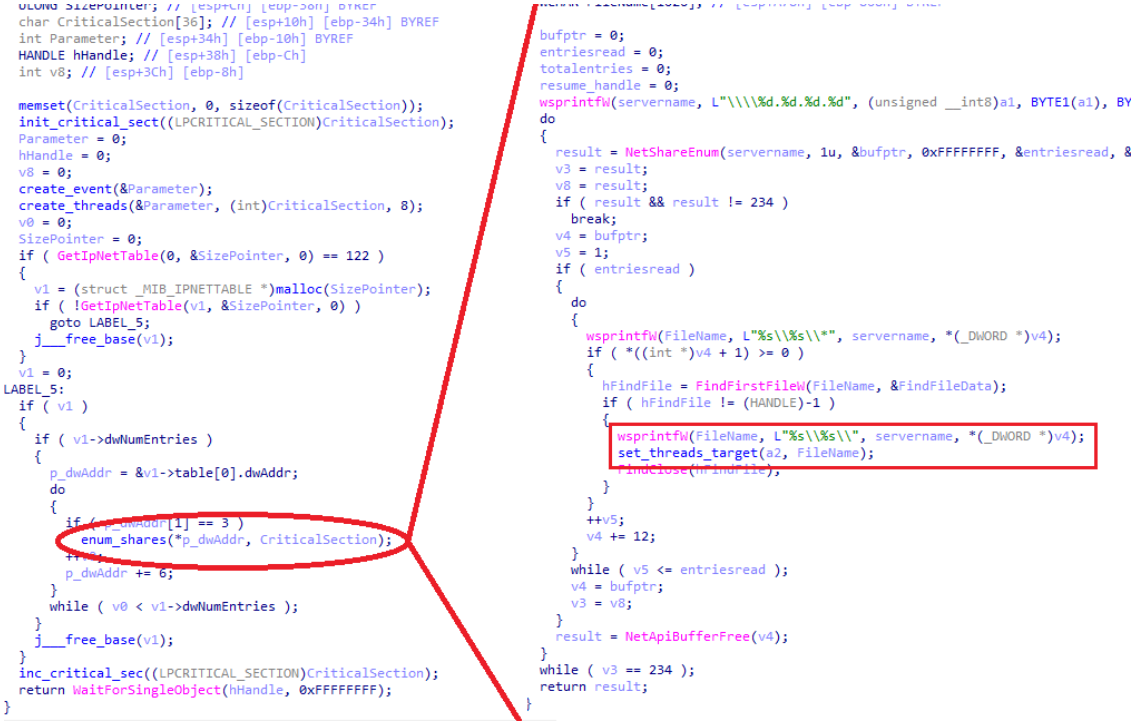


Principal function of Cuba Ransomware



Flow diagram of the Cuba Ransomware sample

According to this, we could distinguish between two network modes and two local modes. The network mode triggered by the “network” argument will call the windows API GetIPNetTable in order to obtain the ARP table and call NetShareEnum using each IP as the serverName parameter for this second API call. In the case of specifying an IP address, it will just enumerate the shares of that specific address.



```
char CriticalSection[36]; // [esp+10h] [ebp-34h] BYREF
int Parameter; // [esp+34h] [ebp-10h] BYREF
HANDLE hHandle; // [esp+38h] [ebp-Ch]
int v8; // [esp+3Ch] [ebp-8h]

memset(CriticalSection, 0, sizeof(CriticalSection));
init_critical_sect((LPCRITICAL_SECTION)CriticalSection);
Parameter = 0;
hHandle = 0;
v8 = 0;
create_event(&Parameter);
create_threads(&Parameter, (int)CriticalSection, 8);
v0 = 0;
SizePointer = 0;
if ( GetIpNetTable(0, &SizePointer, 0) == 122 )
{
  v1 = (struct _MIB_IPNETTABLE *)malloc(SizePointer);
  if ( !GetIpNetTable(v1, &SizePointer, 0) )
    goto LABEL_5;
  j___free_base(v1);
}
v1 = 0;
LABEL_5:
if ( v1 )
{
  if ( v1->dwNumEntries )
  {
    p_dwAddr = &v1->table[0].dwAddr;
    do
    {
      if ( p_dwAddr[1] == 3 )
        enum_shares(*p_dwAddr, CriticalSection);
      ++v0;
      p_dwAddr += 6;
    }
    while ( v0 < v1->dwNumEntries );
  }
  j___free_base(v1);
}
inc_critical_sec((LPCRITICAL_SECTION)CriticalSection);
return WaitForSingleObject(hHandle, 0xFFFFFFFF);
}
```

```
bufptr = 0;
entriesread = 0;
totalentries = 0;
resume_handle = 0;
wsprintfW(servername, L"\\\\%d.%d.%d.%d", (unsigned __int8)a1, BYTE1(a1), BY
do
{
  result = NetShareEnum(servername, 1u, &bufptr, 0xFFFFFFFF, &entriesread, &
  v3 = result;
  v8 = result;
  if ( result && result != 234 )
    break;
  v4 = bufptr;
  v5 = 1;
  if ( entriesread )
  {
    do
    {
      wsprintfW(FileName, L"%s\\%s\\*", servername, *(_DWORD *)v4);
      if ( *((int *)v4 + 1) >= 0 )
      {
        hFindFile = FindFirstFileW(FileName, &FindFileData);
        if ( hFindFile != (HANDLE)-1 )
        {
          wsprintfW(FileName, L"%s\\%s\\", servername, *(_DWORD *)v4);
          set_threads_target(a2, FileName);
          FindClose(hFindFile);
        }
      }
      ++v5;
      v4 += 12;
    }
    while ( v5 <= entriesread );
    v4 = bufptr;
    v3 = v8;
  }
  result = NetApiBufferFree(v4);
}
while ( v3 == 234 );
return result;
}
```

Pseudocode of the “network” argument function calls

The default (no argument given) or “local” argument mode will enumerate the volumes by their Device IDs in the system. If a path is specified as the argument, the ransomware will only encrypt that specified path.

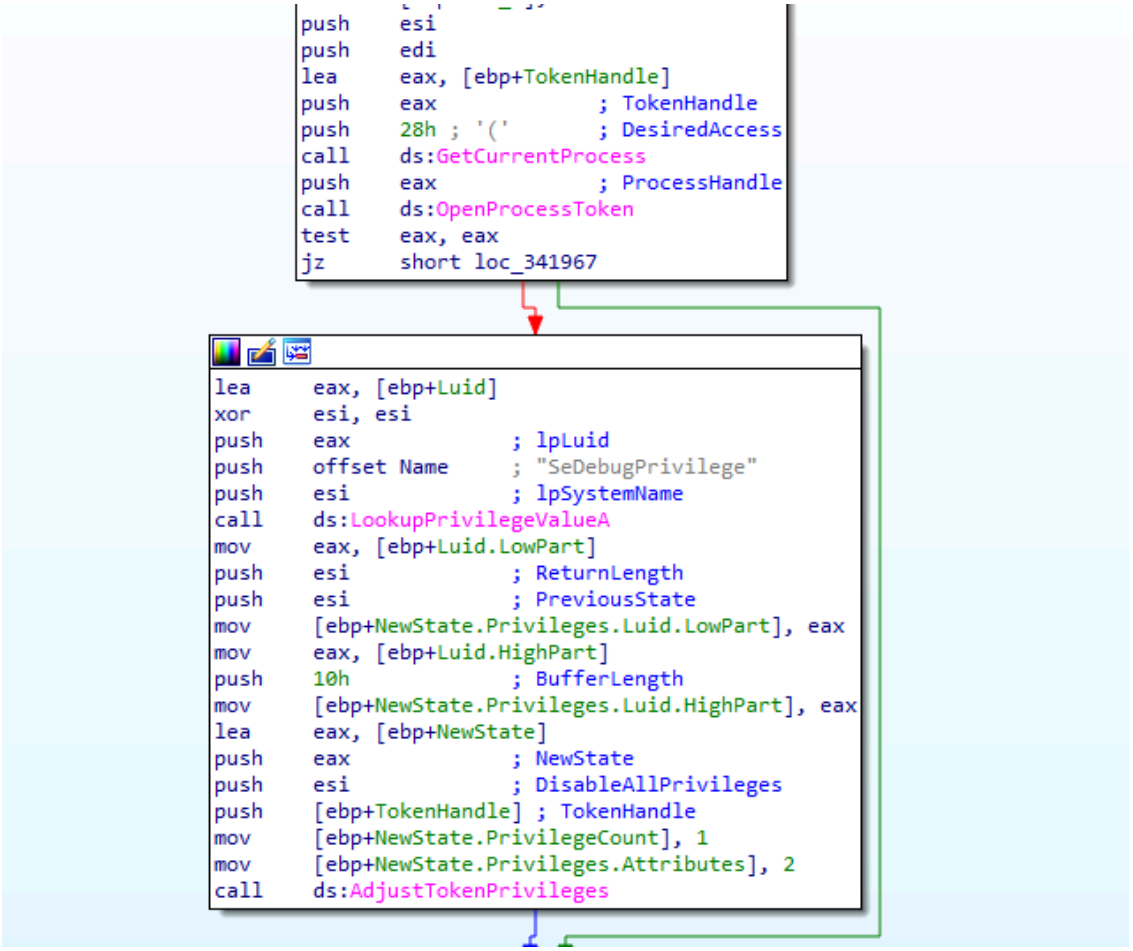
```
HANDLE hFindVolume; // [esp+8h] [ebp-81Ch]
int v8; // [esp+10h] [ebp-814h]
ULARGE_INTEGER TotalNumberOfBytes; // [esp+14h] [ebp-810h] BYREF
DWORD cchReturnLength; // [esp+1Ch] [ebp-808h] BYREF
WCHAR szVolumeName[1024]; // [esp+20h] [ebp-804h] BYREF

v1 = lpszVolumePathNames;
v2 = 0;
hFindVolume = FindFirstVolumeW(szVolumeName, 0x400u);
if ( hFindVolume == (HANDLE)-1 )
  return 0;
v4 = 0;
v8 = 0;
do
{
  lstrcpyW(v1 + 1024, szVolumeName);
  cchReturnLength = 1024;
  if ( GetVolumePathNamesForVolumeNameW(szVolumeName, v1, 0x400u, &cchReturnLength) )
  {
    v5 = (ULARGE_INTEGER *)((char *)lpszVolumePathNames + v4);
  }
  else
  {
    *v1 = 0;
    v5 = (ULARGE_INTEGER *)v1;
  }
  if ( GetDiskFreeSpaceExW(szVolumeName, 0, &TotalNumberOfBytes, 0) )
    v5[512] = TotalNumberOfBytes;
  v4 = v8 + 4104;
  v1 += 2052;
  v8 += 4104;
  ++v2;
}
while ( FindNextVolumeW(hFindVolume, szVolumeName, 0x400u) );
return v2;
}
```

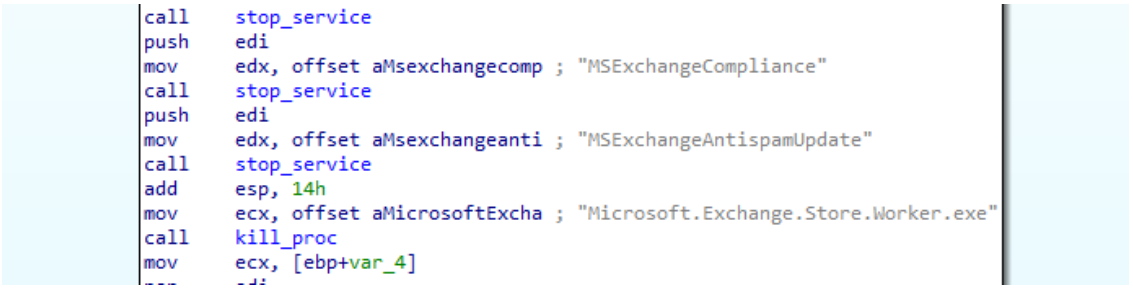
Pseudocode of the default “local” mode

Depending on the case there will be between 2 and 4 threads encrypting the information, which will be created by the same function, for which a different target will be given also depending on the initial argument.

Before starting the encryption there are two different cases where the binary will first terminate some harcoded processes or services. As shown in the elaborated flow diagram, this will happen only if no argument or “local” is given, or if the specified IP address is 127.0.0.1.



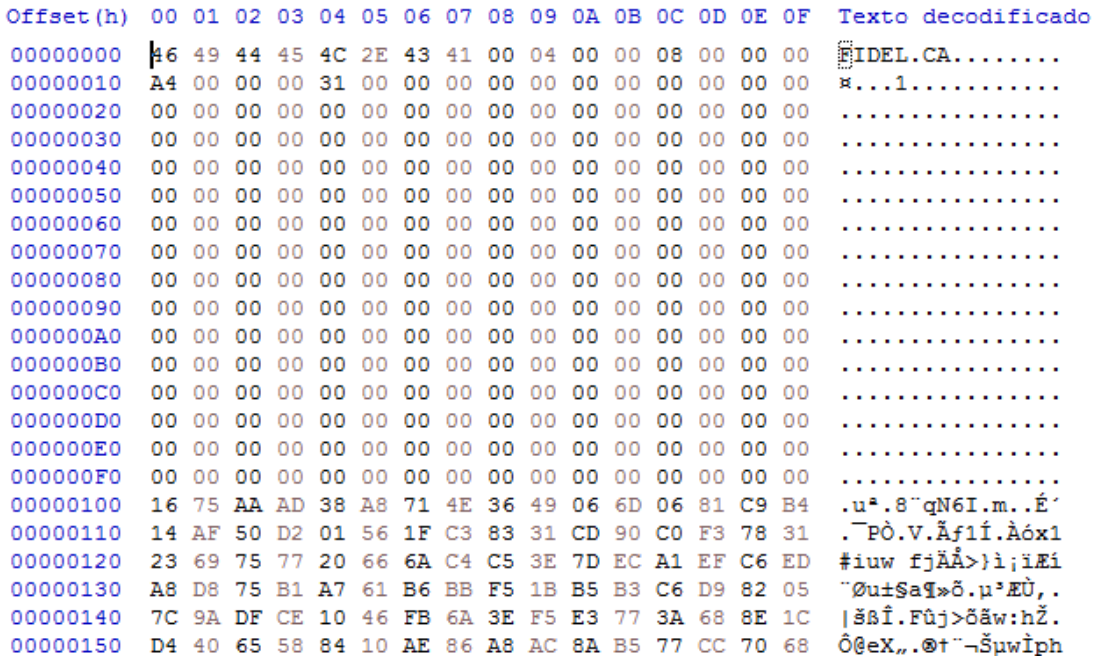
Elevation of privileges prior to termination of processes



Hardcoded services and processes names to terminate, along with the function calls to do so

Just like the previous versions, this sample will use SeDebugPrivilege in order to obtain the necessary rights to terminate processes and services, in this sample they only added one new process to terminate: the Store Worker Process (Microsoft.Exchange.Store.Worker.exe), responsible for executing RPC operations for mailboxes on a database.

Unlike the majority of ransomware families, two different instances of the same process could be executed at the same time, which could cause interferences between each other. However, to avoid double cyphering, the RANSOMWARE still adds to the encrypted file a 240 bytes header, with nothing but the string “FIDEL.CA” and four extra values in the consecutive words. Before encypting a file, the presence of this “file signature” will be checked.



Offset(h)	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	Texto decodificado
00000000	46	49	44	45	4C	2E	43	41	00	04	00	00	08	00	00	00	FIDEL.CA.....
00000010	A4	00	00	00	31	00	00	00	00	00	00	00	00	00	00	00	¤...1.....
00000020	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000030	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000040	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000080	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000100	16	75	AA	AD	38	A8	71	4E	36	49	06	6D	06	81	C9	B4	.uª.8¨qN6I.m..É´
00000110	14	AF	50	D2	01	56	1F	C3	83	31	CD	90	C0	F3	78	31	.¯PÒ.V.Ãƒ1Í.Àóx1
00000120	23	69	75	77	20	66	6A	C4	C5	3E	7D	EC	A1	EF	C6	ED	#iuw fjÄÅ>}ì¡ïÆí
00000130	A8	D8	75	B1	A7	61	B6	BB	F5	1B	B5	B3	C6	D9	82	05	¨Øu±§a¶»õ.µ³ÆÙ‚.
00000140	7C	9A	DF	CE	10	46	FB	6A	3E	F5	E3	77	3A	68	8E	1C	|šßÎ.Fûj>õãw:hŽ.
00000150	D4	40	65	58	84	10	AE	86	A8	AC	8A	B5	77	CC	70	68	Ô@eX„.®†¨¬Šµwìph

Encrypted file header

```
if ( !(unsigned __int8)switch_unk(&v15, &v14) )
  return 0;
v20 = v5 | v4;
setFilePointer_call(v5, v5, 0);
v6 = 1024;
if ( !(unsigned __int8)readFile_call((LPVOID)*this, 0x400u, (int)&nNumberOfBytesToWrite)
  || *(_DWORD *)*this == 'EDIF' && *(_DWORD *)(*this + 4) == 'AC.L' )
{
  return 0;
}
setFilePointer_call(v7, v7, 2u);
if ( !(unsigned __int8)writeFile_call((LPCVOID)*this, 0x400u, v8) )
  return 0;
```

Encryption header check

In the version analyzed by McAfee, they found that their sample could take a different list of arguments such as /min, /max, /dm, /net, or /scan. However, the sample we analyzed only accepts one of the arguments described above. This means that for this version THERE IS NO POSSIBILITY THAT the ransomware operator CAN specify a maximum or minimunm file size to encrypt. Though, large files will only get encrypted their first MB for EVERY 9MB.

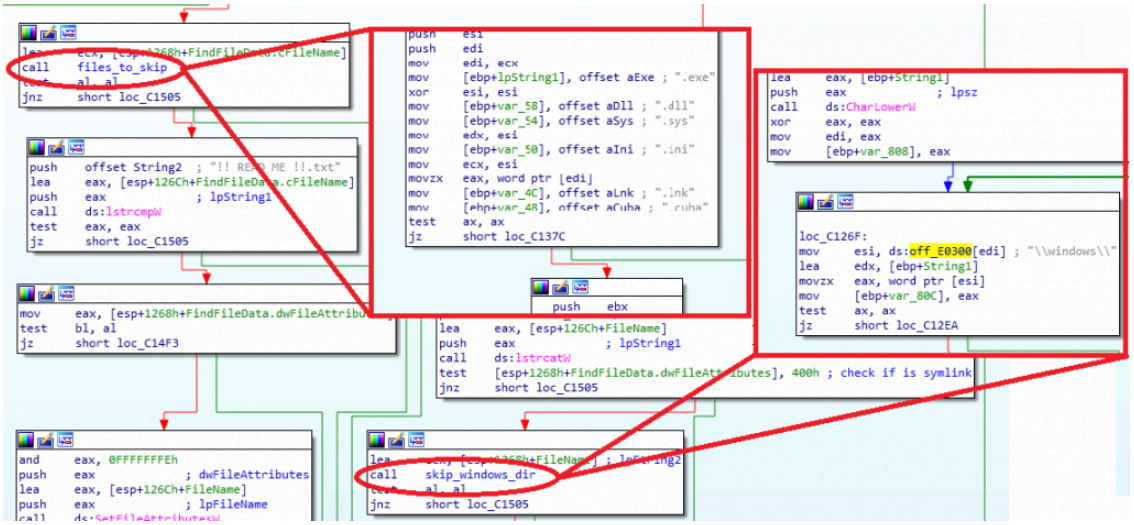
Offset(h)	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	Texto decodificado
00100390	D7	17	52	BA	9E	C0	1D	E1	4B	77	9E	65	A9	9E	01	A6	×.R°žÀ.áKwže©ž.¦
001003A0	1E	9B	56	14	28	2B	F0	AC	A0	D1	9A	7C	72	60	47	83	.›V.(+ð¬ Ñš|r`Gƒ
001003B0	27	54	EF	40	06	FC	3E	7E	DB	28	9E	64	8B	05	F6	EF	'Ti@.ü>~Û(žd‹.öi
001003C0	3E	00	1D	0C	22	8C	C2	44	EC	9A	55	8E	D5	5C	BA	70	>..."ŒÂDìšUŽÕ\°p
001003D0	A2	BE	B8	1E	25	77	08	9A	D5	CD	53	F8	5A	31	33	D7	¢¾¸.%w.šÕÍSøZ13×
001003E0	32	BD	B4	41	81	DF	08	6B	27	34	62	75	DA	60	3D	5F	2½´A.ß.k'4buÚ`=_
001003F0	36	82	FA	EF	46	D7	62	03	05	52	95	18	09	61	B0	84	6.úïF×b..R•..a°„
00100400	65	73	74	20	54	45	53	54	20	74	65	73	74	20	54	45	est TEST test TE
00100410	53	54	20	74	65	73	74	20	54	45	53	54	20	74	65	73	ST test TEST tes
00100420	74	20	54	45	53	54	20	74	65	73	74	20	54	45	53	54	t TEST test TEST
00100430	20	74	65	73	74	20	54	45	53	54	20	74	65	73	74	20	test TEST test
00100440	54	45	53	54	20	74	65	73	74	20	54	45	53	54	20	74	TEST test TEST t
00100450	65	73	74	20	54	45	53	54	20	74	65	73	74	20	54	45	est TEST test TE
00100460	53	54	20	74	65	73	74	20	54	45	53	54	20	74	65	73	ST test TEST tes
00100470	74	20	54	45	53	54	20	74	65	73	74	20	54	45	53	54	t TEST test TEST
00100480	20	74	65	73	74	20	54	45	53	54	20	74	65	73	74	20	test TEST test
00100490	54	45	53	54	20	74	65	73	74	20	54	45	53	54	20	74	TEST test TEST t

End of first Megabyte from encryption file

Offset(h)	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	Texto decodificado
01200350	74	20	54	45	53	54	20	74	65	73	74	20	54	45	53	54	t TEST test TEST
01200360	20	74	65	73	74	20	54	45	53	54	20	74	65	73	74	20	test TEST test
01200370	54	45	53	54	20	74	65	73	74	20	54	45	53	54	20	74	TEST test TEST t
01200380	65	73	74	20	54	45	53	54	20	74	65	73	74	20	54	45	est TEST test TE
01200390	53	54	20	74	65	73	74	20	54	45	53	54	20	74	65	73	ST test TEST tes
012003A0	74	20	54	45	53	54	20	74	65	73	74	20	54	45	53	54	t TEST test TEST
012003B0	20	74	65	73	74	20	54	45	53	54	20	74	65	73	74	20	test TEST test
012003C0	54	45	53	54	20	74	65	73	74	20	54	45	53	54	20	74	TEST test TEST t
012003D0	65	73	74	20	54	45	53	54	20	74	65	73	74	20	54	45	est TEST test TE
012003E0	53	54	20	74	65	73	74	20	54	45	53	54	20	74	65	73	ST test TEST tes
012003F0	74	20	54	45	53	54	20	74	65	73	74	20	54	45	53	54	t TEST test TEST
01200400	04	BF	B9	47	3D	65	BF	1F	CE	C9	45	6D	93	92	C0	70	.¿¹G=e¿.ÎÉEm"'Àp
01200410	D7	FE	DC	76	84	1B	04	72	6F	4F	39	A4	9C	E2	1B	92	×þÜv„..roO9¤œâ.'
01200420	33	DA	93	07	73	F7	88	2E	71	41	A3	68	8B	87	E6	66	3Ú".s÷ˆ.qA£h‹‡æf
01200430	86	52	A7	32	B0	12	FC	BC	58	CC	9D	AA	14	A0	FA	49	†R§2°.ü¼XÌ.ª. úI
01200440	19	54	9A	C9	AD	E2	F1	DA	E5	B4	38	B1	8F	2B	96	63	.TšÉ.âñÚå´8±.+–c
01200450	EA	9F	A5	55	CE	57	DE	66	3D	A8	2B	80	C4	7B	4A	4F	êŸ¥UÎWÞf=¨+€Ä{JO
01200460	C6	8A	25	FB	04	FD	0B	2C	60	9D	70	F3	95	30	0C	33	ÆŠ%û.ý.,`.pó•0.3
01200470	BC	CF	42	C3	84	36	4E	61	10	46	B2	F8	6B	E4	1B	13	¼ÏBÃ„6Na.F²økä..
01200480	99	56	71	1C	A8	A3	DD	54	EB	66	1A	B6	C7	E2	AB	3D	™Vq.¨£ÝTëf.¶Câ«=

Beginning of 9th Megabyte of encrypted file

Most likely in order to avoid system failures, the ransomware will not encrypt files with extensions .exe, .dll, .sys, .ini, .lnk, .cuba, and it will ignore paths containing “\windows\”.



Cypher function checking files and routes to skip, with snippets of the called functions

Once the threads have finished the cyphering task, the function to delete itself from disk will be called, INDEPENDENTLY FROM the argument provided, unlike the McAfee sample, where they affirmed that this function would be called when giving the “/dm” argument. For this, the sample will call the Windows API CreateProcessW with “\\system32\\cmd.exe” as the ApplicationName and ” /c \del [exe_path] >> NULL ” as command line arguments.

The complete list of stopped processes and services is shown in the following tables:

MySQL	MSExchangePOP3BE
MySQL80	MSExchangePop3
SQLSERVERAGENT	MSExchangeNotificationsBroker
MSSQLSERVER	MSExchangeMailboxReplication
SQLWriter	MSExchangeMailboxAssistants
SQLTELEMETRY	MSExchangeIS
MSDTC	MSExchangeIMAP4BE
SQLBrowser	MSExchangeImap4
vmcompute	MSExchangeHMRecovery
vmms	MSExchangeHM
MSExchangeUMCR	MSExchangeFrontEndTransport
MSExchangeUM	MSExchangeFastSearch
MSExchangeTransportLogSearch	MSExchangeEdgeSync

MSExchangeTransport	MSExchangeDiagnostics
MSExchangeThrottling	MSExchangeDelivery
MSExchangeSubmission	MSExchangeDagMgmt
MSExchangeServiceHost	MSExchangeCompliance
MSExchangeRPC	MSExchangeAntispamUpdate
MSExchangeRepl	

Stopped services

sqlagent.exe	sqlbrowser.exe
sqlservr.exe	vmwp.exe
sqlwriter.exe	outlook.exe
sqlceip.exe	vmsp.exe
msdtc.exe	Microsoft.Exchange.Store.Worker.exe

Tertminated processes
