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Feb 17, 2017

ChChes – Malware that Communicates with C&C Servers Using Cookie Headers

Since around October 2016, JPCERT/CC has been confirming emails that are sent to Japanese organisations with a ZIP file attachment containing executable files. The targeted emails, which impersonate existing persons, are sent from free email address services available in Japan. Also, the executable files' icons are disguised as Word documents. When the recipient executes the file, the machine is infected with malware called ChChes.

This blog article will introduce characteristics of ChChes, including its communication.

ZIP files attached to Targeted Emails

While some ZIP files attached to the targeted emails in this campaign contain executable files only, in some cases they also contain dummy Word documents. Below is the example of the latter case.

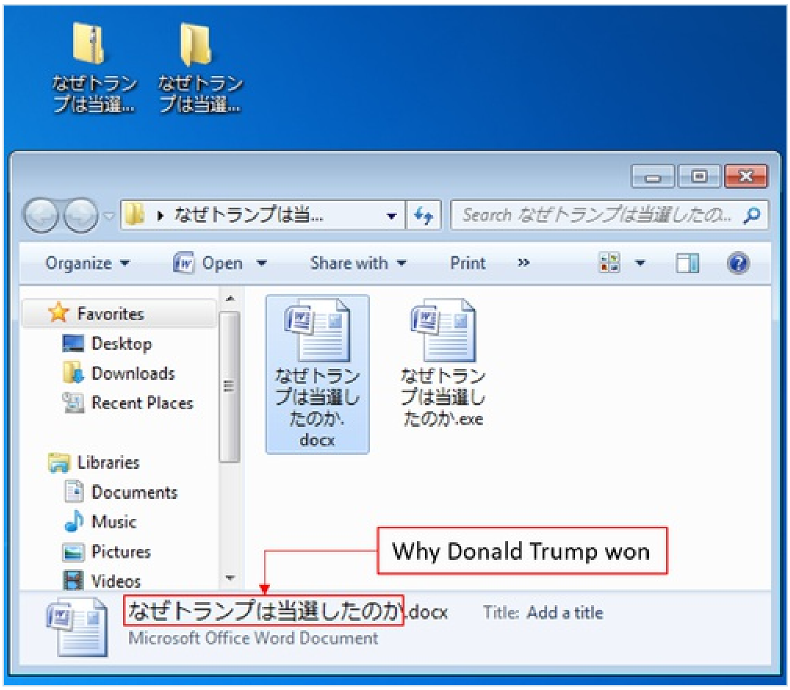

Figure 1: Example of an attached ZIP file

In the above example, two files with similar names are listed: a dummy Word document and an executable file whose icon is disguised as a Word document. By running this executable file, the machine will be infected with ChChes. JPCERT/CC has confirmed the executable files that have signatures of a specific code signing certificate. The dummy Word document is harmless, and its contents are existing online articles related to the file name "Why Donald Trump won". The details of the code signing certificate is described in Appendix A.

Communication of ChChes

ChChes is a type of malware that communicates with specific sites using HTTP to receive commands and modules. There are only few functions that ChChes can execute by itself. This means it expands its functions by receiving modules from C&C servers and loading them on the memory.

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The following is an example of HTTP GET request that ChChes sends. Sometimes, HEAD method is used instead of GET.

```
GET /X4iBJjp/MtD1xyoJMQ.htm HTTP/1.1
Cookie: uHa5=kXFGd3JqQHMfnMbi9mFZAJHCGja0ZLs%3D;KQ=yt%2Fe(omitted)
Accept: */*
Accept-Encoding: gzip, deflate
User-Agent: [user agent]
Host: [host name]
Connection: Keep-Alive
Cache-Control: no-cache
```

As you can see, the path for HTTP request takes*/[random string]*.htm, however, the value for the Cookie field is not random but encrypted strings corresponding to actual data used in the communication with C&C servers. The value can be decrypted using the below Python script.

```
data_list = cookie_data.split(';')
dec = []
for i in range(len(data_list)):
    tmp = data_list[i]
    pos = tmp.find("=")
    key = tmp[0:pos]
    val = tmp[pos:]
    md5 = hashlib.md5()
    md5.update(key)
    rc4key = md5.hexdigest()[8:24]
    rc4 = ARC4.new(rc4key)
    dec.append(rc4.decrypt(val.decode("base64"))[len(key):])
print("[*] decoded: " + "".join(dec))
```

The following is the flow of communication after the machine is infected.

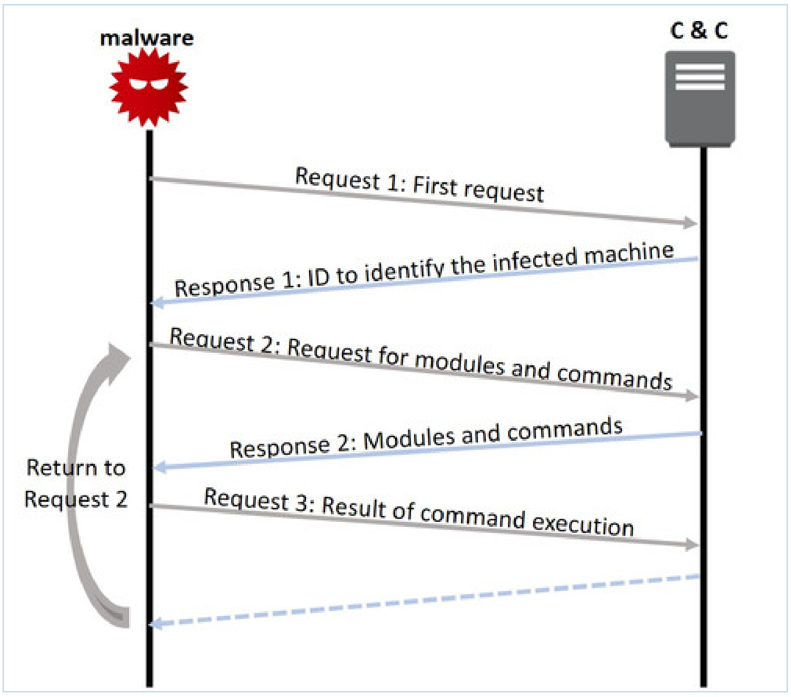
malware
C & C
Request 1: First request
Response 1: ID to identify the infected machine
Request 2: Request for modules and commands
Response 2: Modules and commands
Request 3: Result of command execution
Return to Request 2

Figure 2: Flow of communication

The First Request

The value in the Cookie field of the HTTP request that ChChes first sends (Request 1) contains encrypted data starting with ‘A’. The following is an example of data sent.

RSS feed

Contributor info

A R C H I

February 2017

January 2017

December 2016

November 2016

October 2016

August 2016

July 2016

June 2016

May 2016

April 2016

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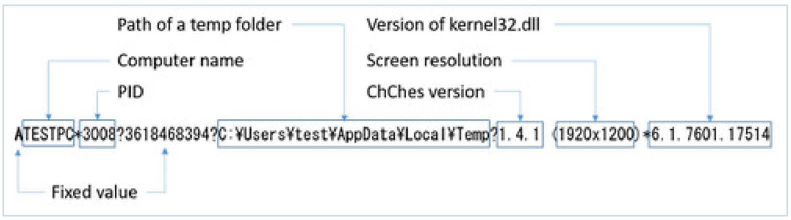
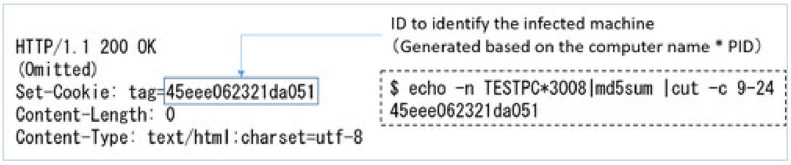


```
ATESTPC*3008?3618468394?C:¥Users¥test¥AppData¥Local¥Temp?1.4.1 (1920x1200)*6.1.7601.17514
```

Figure 3: Example of the first data sent

As indicated in Figure 3, the data which is sent contains information including computer name. The format of the encrypted data differs depending on ChChes's version. The details are specified in Appendix B.

As a response to Request 1, ChChes receives strings of an ID identifying the infected machine from C&C servers (Response 1). The ID is contained in the Set-Cookie field as shown below.


ID to identify the infected machine
(Generated based on the computer name * PID)

```
HTTP/1.1 200 OK
(Omitted)
Set-Cookie: tag=45eee062321da051
Content-Length: 0
Content-Type: text/html:charset=utf-8
```

```
$ echo -n TESTPC*3008|md5sum |cut -c 9-24
45eee062321da051
```

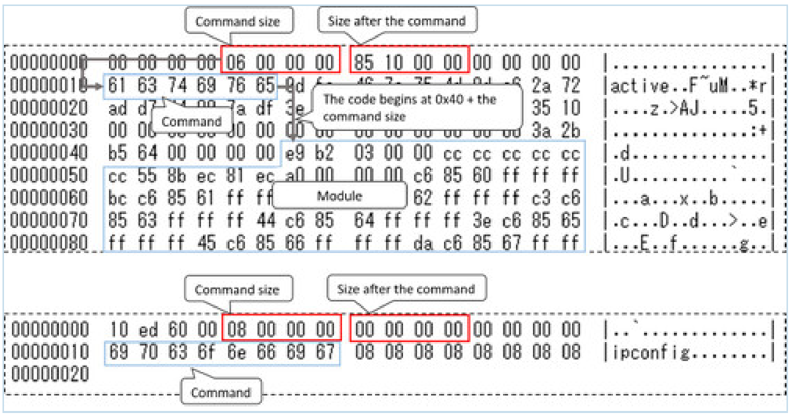
Figure 4: Example response to the first request

Request for Modules and Commands

Next, ChChes sends an HTTP request to receive modules and commands (Request 2). At this point, the following data starting with 'B' is encrypted and contained in the Cookie field.

```
B[ID to identify the infected machine]
```

As a response to Request 2, encrypted modules and commands (Response 2) are sent from C&C servers. The following shows an example of received modules and commands after decryption.



```
00000000  00 00 00 00 06 00 00 00  85 10 00 00 00 00 00 00  |................|
00000010  61 63 74 69 76 65 0d [illegible]            2a 72  |active..F~uM..*r|
00000020  ad d7 [illegible] 7a df 3e [illegible]      35 10  |....z.>AJ.....5.|
00000030  00 00 [illegible] 00 00 00 [illegible]      3a 2b  |..............:+|
00000040  b5 64 00 00 00 00 e9 b2  03 00 00 cc cc cc cc cc  |.d..............|
00000050  cc 55 8b ec 81 ec a0 00  00 00 c6 85 60 ff ff ff  |.U..........`...|
00000060  bc c6 85 61 ff ff [illegible]  62 ff ff ff c3 c6  |...a...x..b.....|
00000070  85 63 ff ff ff 44 c6 85  64 ff ff ff 3e c6 85 65  |.c...D..d...>..e|
00000080  ff ff ff 45 c6 85 66 ff  ff ff da c6 85 67 ff ff  |...E..f.......g..|
```

```
00000000  10 ed 60 00 08 00 00 00  00 00 00 00 00 00 00 00  |..`.............|
00000010  69 70 63 6f 6e 66 69 67  08 08 08 08 08 08 08 08  |ipconfig........|
00000020
```

Figure 5: Decrypted data of modules and commands received

Commands are sent either together with modules as a single data (as above), or by itself. Afterwards, execution results of the received command are sent to C&C servers, and it returns to the process to receive modules and commands. This way, by repeatedly receiving commands from C&C servers, the infected machines will be controlled remotely.

JPCERT/CC's research has confirmed modules with the following functions, which are thought to be the bot function of ChChes.

- Encrypt communication using AES
- Execute shell commands
- Upload files
- Download files
- Load and run DLLs
- View tasks of bot commands

Especially, it was confirmed that the module that encrypts the communication with AES is received in a relatively early stage after the infection. With this feature, communication with C&C servers after this point will be encrypted in AES on top of the existing encryption method.

Summary

ChChes is a relatively new kind of malware which has been seen since around October 2016. As this may be continually used for targeted attacks, JPCERT/CC will keep an eye on ChChes and attack activities using the malware.

The hash values of the samples demonstrated here are described in Appendix C. The malware's destination hosts that JPCERT/CC has confirmed are listed in Appendix D. We recommend that you check if your machines are communicating with such hosts.

Thanks for reading.

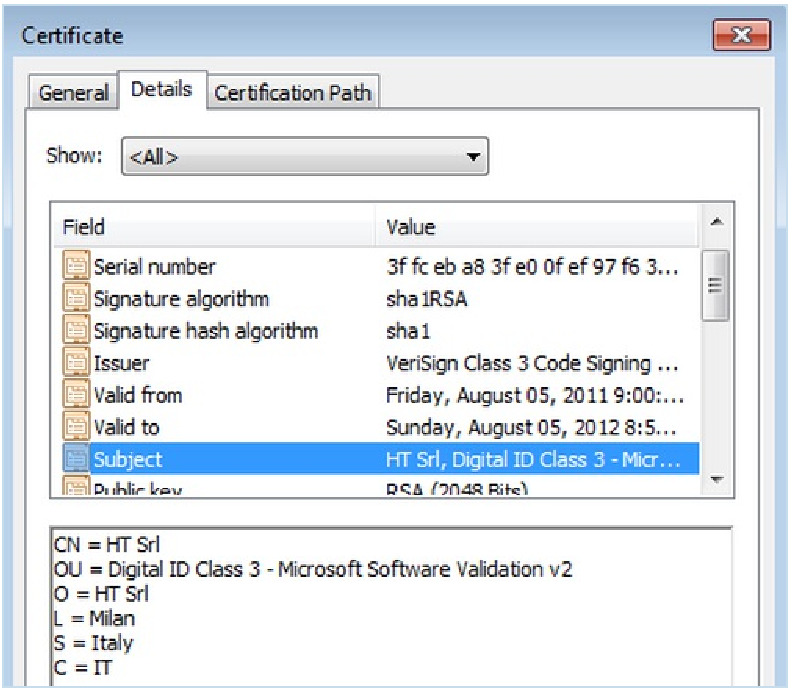
- Yu Nakamura

(Translated by Yukako Uchida)

Appendix A: Code signing certificate

The code signing certificate attached to some samples are the following:

```
$ openssl x509 -inform der -text -in mal.cer
Certificate:
    Data:
        Version: 3 (0x2)
        Serial Number:
            3f:fc:eb:a8:3f:e0:0f:ef:97:f6:3c:d9:2e:77:eb:b9
    Signature Algorithm: sha1WithRSAEncryption
        Issuer: C=US, O=VeriSign, Inc., OU=VeriSign Trust Network, OU=Terms of use at
https://www.verisign.com/rpa (c)10, CN=VeriSign Class 3 Code Signing 2010 CA
        Validity
            Not Before: Aug  5 00:00:00 2011 GMT
            Not After : Aug  4 23:59:59 2012 GMT
        Subject: C=IT, ST=Italy, L=Milan, O=HT Srl, OU=Digital ID Class 3 - Microsoft Software
Validation v2, CN=HT Srl
        Subject Public Key Info:
(Omitted)
```



Field	Value
Serial number	3f fc eb a8 3f e0 0f ef 97 f6 3...
Signature algorithm	sha1RSA
Signature hash algorithm	sha1
Issuer	VeriSign Class 3 Code Signing ...
Valid from	Friday, August 05, 2011 9:00:...
Valid to	Sunday, August 05, 2012 8:5...
Subject	HT Srl, Digital ID Class 3 - Micr...
Public key	RSA (2048 Bits)

```
CN = HT Srl
OU = Digital ID Class 3 - Microsoft Software Validation v2
O = HT Srl
L = Milan
S = Italy
C = IT
```

Figure 6: Code signing certificate

Figure 6: Code signing certificate

Appendix B: ChChes version

The graph below shows the relation between the version numbers of the ChChes samples that JPCERT/CC has confirmed and the compile times obtained from their PE headers.

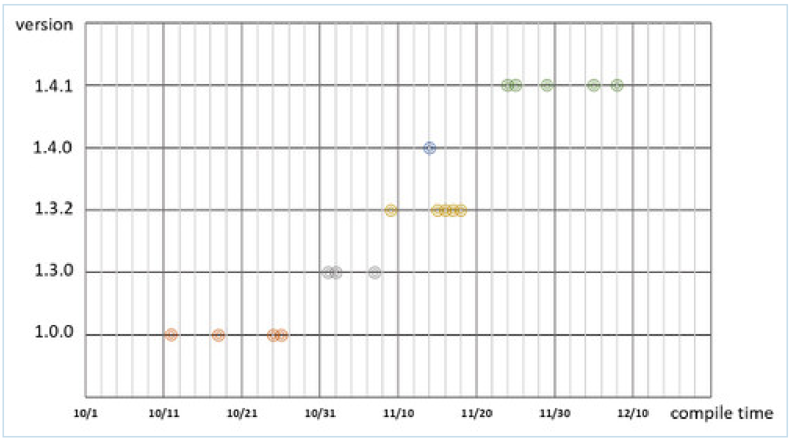


Figure 7: Compile time for each ChChes version

The lists below describe encrypted data contained in the first HTTP request and explanation of the values for each ChChes version.

Table 1: Sending format of each version

Version	Format
1.0.0	A<a>*<b>?3618468394?<c>?<d>*<f>
1.2.2	A<a>*<b>?3618468394?<c>?<d>*<f>
1.3.0	A<a>*<b>?3618468394?<c>?<d>*<f>
1.3.2	A<a>*<b>?3618468394?<c>?<d>*<g>
1.4.0	A<a>*<b>?3618468394?<c>?<d>*<g>
1.4.1	A<a>*<b>?3618468394?<c>?<d> (<e>)*<g>
1.6.4	A<a>*<b>*<h>?3618468394?<c>?<d> (<e>)*<g>

Table 2: Description of <a> to <h>

Letter	Data	Size	Details
<a>	Computer name	Variable	Capital alphanumeric characters
<b>	Process ID	Variable	Capital alphanumeric characters
<c>	Path of a temp folder	Variable	%TEMP% value
<d>	Malware version	Variable	e.g. 1.4.1
<e>	Screen resolution	Variable	e.g. 1024x768
<f>	explorer.exe version	Variable	e.g. 6.1.7601.17567
<g>	kernel32.dll version	Variable	e.g. 6.1.7601.17514
<h>	Part of MD5 value of SID	16 bytes	e.g. 0345cb0454ab14d7

Appendix C: SHA-256 Hash value of the samples

ChChes

- 5961861d2b9f50d05055814e6bfd1c6291b30719f8a4d02d4cf80c2e87753fa1
- ae6b45a92384f6e43672e617c53a44225e2944d66c1ffb074694526386074145
- 2c71eb5c781daa43047fa6e3d85d51a061aa1dfa41feb338e0d4139a6dfd6910
- 19aa5019f3c00211182b2a80dd9675721dac7cfb31d174436d3b8ec9f97d898b
- 316e89d866d5c710530c2103f183d86c31e9a90d55e2ebc2dda94f112f3bdb6d
- efa0b414a831cbf724d1c67808b7483dec22a981ae670947793d114048f88057
- e90064884190b14a6621c18d1f9719a37b9e5f98506e28ff0636438e3282098b
- 9a6692690c03ec33c758cb5648be1ed886ff039e6b72f1c43b23fbd9c342ce8c
- bc2f07066c624663b0a6f71cb965009d4d9b480213de51809cdc454ca55f1a91
- e6ecb146f469d243945ad8a5451ba1129c5b190f7d50c64580dbad4b8246f88e
- e88f5bf4be37e0dc90ba1a06a2d47faaeea9047fec07c17c2a76f9f7ab98acf0
- d26dae0d8e5c23ec35e8b9cf126cded45b8096fc07560ad1c06585357921eeed
- 2965c1b6ab9d1601752cb4aa26d64a444b0a535b1a190a70d5ce935be3f91699
- 312dc69dd6ea16842d6e58cd7fd98ba4d28eefeb4fd4c4d198fac4eee76f93c3
- 4ff6a97d06e2e843755be8697f3324be36e1ebeb280bb45724962ce4b6710297
- 45d804f35266b26bf63e3d616715fc593931e33aa07feba5ad6875609692efa2
- cb0c8681a407a76f8c0fd2512197aafad8120aa62e5c871c29d1fd2a102bc628
- 75ef6ea0265d2629c920a6a1c0d1dd91d3c0eda86445c7d67ebb9b30e35a2a9f
- 471b7edbd3b344d3e9f18fe61535de6077ea9fd8aa694221529a2ff86b06e856
- ae0dd5df608f581bbc075a88c48eedeb7ac566ff750e0a1baa7718379941db86
- 646f837a9a5efbbdde474411bb48977bff37abfefaa4d04f9fb2a05a23c6d543
- 3d5e3648653d74e2274bb531d1724a03c2c9941fdf14b8881143f0e34fe50f03
- 9fbd69da93fbe0e8f57df3161db0b932d01b6593da86222fabef2be31899156d
- 723983883fc336cb575875e4e3ff0f19bcf05a2250a44fb7c2395e564ad35d48
- f45b183ef9404166173185b75f2f49f26b2e44b8b81c7caf6b1fc430f373b50b

Appendix D: List of communication destination

- area.wthelpdesk.com
- dick.ccfchrist.com
- kawasaki.cloud-maste.com
- kawasaki.unhamj.com
- sakai.unhamj.com
- scorpion.poulsenv.com
- trout.belowto.com
- zebra.wthelpdesk.com
- hamiltion.catholicmmb.com
- gavin.ccfchrist.com

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