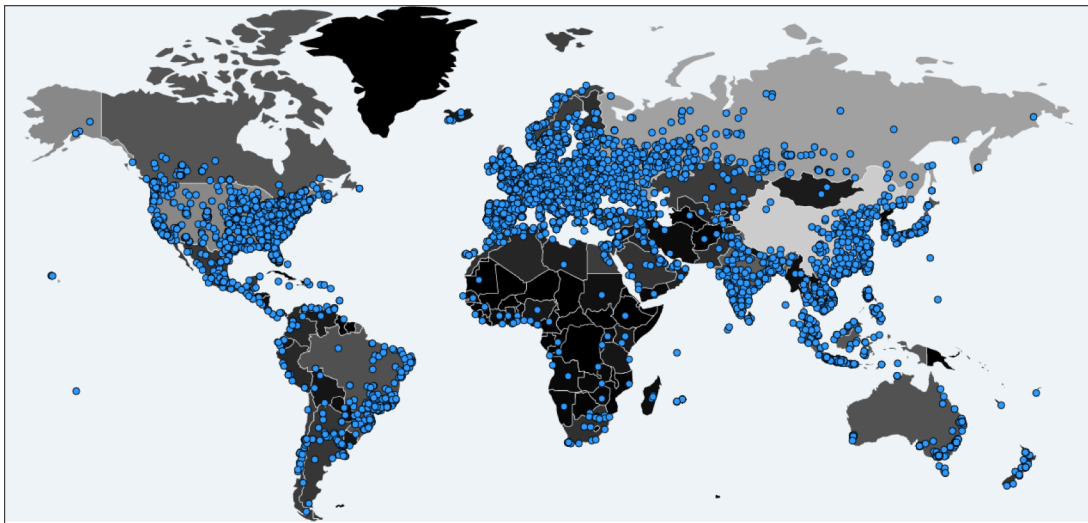


# WannaCry Ransomware Analysis Report

A major ransomware attack has affected many organizations across the world reportedly including the PetroChina(Gas Station) in the China, NHS(National Health Service) in the UK, FedEx in the US. The malware responsible for this attack is a ransomware variant known as 'WannaCry' (also known as 'WannaCrypt' or 'WannaCrypt0r'). A WannaCry ransomware finds vulnerable machines connected to the network, seeking for SMB remote code execution vulnerability targeting Windows XP and higher.

Once the Ransomware infection takes place, existing files such as documents, photos, music, videos, etc. in the system are encrypted and volume shadow copy(VSC) intending for file recovery is wiped out. Highly effective on taking files hostage, making the situation to pay Bitcoins for decryption keys.



Source, <https://intel.malwaretech.com/botnet/wcrypt/?t=24h&bid=all>

According to numerous open-source reports, a widespread ransomware campaign is affecting various organizations with reports of tens of thousands of infections in over 150 countries, including the United States, United Kingdom, Spain, Russia, Taiwan, France, Japan and Korea. The software can run in as many as 28 different languages. The latest version of this ransomware variant, known as WannaCry, WannaCryptor or WannaDecryptor, was discovered the evening of May 12, 2017, by an independent security researcher and has spread rapidly over several hours, with initial reports beginning around 4:00 AM EDT, May 12, 2017. Open-source reporting indicates a requested ransom of .1781 bitcoins, roughly \$300 U.S.

In South Korea, WannaCry Ransomware's arrival was confirmed for the first time in 2017-05-12 19:34:33 (GMT+9). WannaCry Ransomware's the first infection time was similar to foreign countries, or rather faster than the time spent on overseas media reports.

It is well known by now, the exploits have been made available on the Internet through the ShadowBrokers dump on April 14th, 2017 and already earlier patched by Microsoft on March 14th, 2017 as part of MS17-010. But the patch was not supported at that time such as Windows XP, Windows 8(VISTA) and Windows 2003 Server due to the product was the end of sale(EoS) that means no longer support any security update and patch anymore. It was one of a reason why the WannaCry ransomware infection rate was so fast and spread itself rapidly.

The Windows SMB protocol is a very old Microsoft technology that has been around for nearly 30 years. The SMB protocol is a shared protocol used to share files with peripheral storage, memory devices and so on.


A variant of WannaCry 2.5 has been detected but, it has not even been detected by the fully signature updated anti-virus software (as of 16:00 on May 17). (In the picture below, only 3 of 61 the world's computer virus vaccines are detected as malicious code.)

SHA256: 925b3acaa3252bf4d660eab22856fff155f3106c2fee7567711cb34374b499f3

File name: WannaCry.exe

Detection ratio: 3 / 61

Analysis date: 2017-05-15 07:20:22 UTC ( 32 minutes ago )



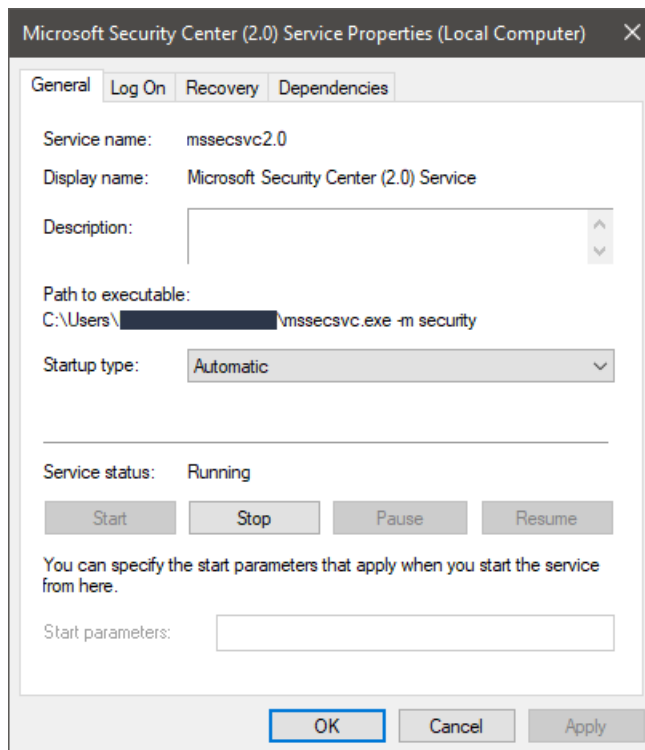
Antivirus	Result	Update
Baidu	Win32.Trojan.WisdomEyes.16070401.9500.9556	20170503
CrowdStrike Falcon (ML)	malicious_confidence_67% (D)	20170130
TrendMicro-HouseCall	Suspicious_GEN.F47V0514	20170515

Source : <https://www.virustotal.com/en/file/925b3acaa3252bf4d660eab22856fff155f3106c2fee7567711cb34374b499f3/analysis/>

Step by step breakdown of WannaCry Ransomware infection behavior is as below.

### Wannacry Attack step #1

The WannaCry creates a service named msseccsv2.0, and adds itself to automatic execution in startup, and is executes remotely through the exploit of SMB vulnerability.



### Wannacry AttAck step #2

By remotely gaining access over a victim's PC with system privileges without any user action, the attacker can spray this malware in the local network by having control over one system inside this network, and that infected system will spread the ransomware to all vulnerable Windows systems not patched for MS17-010.

### Wannacry Attack step #3

WannaCry ransomware is writing itself into a random character folder in the ProgramData folder(such as C:\ProgramData\Wtqdlfzbsctgohv917 or qarldlnupcv423) with the filename tasksche.exe or in the C:\Windows\ folder with the filename msseccsv.exe and tasksche.exe.

#### Wannacry Attack step #4

The list of files generated by WannaCry Ransomware attack is as follows.

C:\ProgramData\W<Random>  
C:\ProgramData\W<Random>\Wmsg  
C:\ProgramData\W<Random>\WTaskData\WTor  
C:\ProgramData\W<Random>\W@Please\_Read\_Me@.txt  
C:\ProgramData\W<Random>\W@WanaDecryptor@.exe  
C:\ProgramData\W<Random>\W@WanaDecryptor@.exe.lnk  
C:\ProgramData\W<Random>\W00000000.eky  
C:\ProgramData\W<Random>\W00000000.pky  
C:\ProgramData\W<Random>\W00000000.res  
C:\ProgramData\W<Random>\Wb.wnry (Wallpaper File = @WanaDecryptor@.bmp)  
C:\ProgramData\W<Random>\Wc.wnry (C&C Server and Tor File Address)  
C:\ProgramData\W<Random>\Wf.wnry (Being encrypted files list)  
C:\ProgramData\W<Random>\Wr.wnry (Ransomware Purchasing Info File = @Please\_Read\_Me@.txt)  
C:\ProgramData\W<Random>\Ws.wnry (C:\ProgramData\W<Random>\WTaskData Related ZIP Compressed File)  
C:\ProgramData\W<Random>\Wt.wnry (Encryption/Decryption Related File)  
C:\ProgramData\W<Random>\Wtaskdl.exe  
C:\ProgramData\W<Random>\Wtasksche.exe (tqdlfzbsctgohv917 Service and Registered Startup Program)  
C:\ProgramData\W<Random>\Wtaskse.exe  
C:\ProgramData\W<Random>\Wu.wnry (@WanaDecryptor@.exe File)

#### Wannacry Attck step #5

After the file is created, the tasksche.exe file is executed to perform the file encryption operation, and the hidden attribute value will be set (attrib + h) for the encryption target file.

And then execute the following command for the purpose of obtaining authority to the inaccessible folder or file.

```
"icacls . /grant Everyone:F /T /C /Q"
```

Also, for the effective file encryption, execute the following command to terminate the specific process.

```
taskkill.exe /f /im mysqld.exe
```

```
taskkill.exe /f /im sqlwriter.exe
```

```
taskkill.exe /f /im sqlserver.exe
```

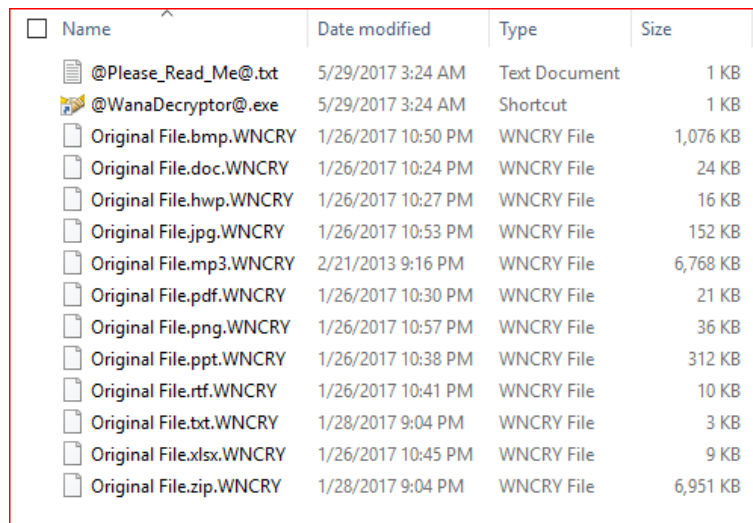
```
taskkill.exe /f /im MExchange*
```

```
taskkill.exe /f /im Microsoft.Exchange.*
```

After that, WannaCry will encrypt the files on the hard disks, external hard drives and even also USB devices with the following extensions

```
.123, .3dm, .3ds, .3g2, .3gp, .602, .accdb, .aes, .ARC, .asc, .asf, .asm, .asp, .avi, .backup, .bak, .bat, .bmp, .brd, .b22, .cgm, .class, .cmd, .cpp, .crt, .csr, .csv, .dbf, .dch, .der, .dif, .dip, .djuv, .doc, .docb, .docm, .docx, .dot, .dotm, .dotx, .dwg, .edb, .eml, .fla, .flv, .frm, .gif, .gpg, .hwp, .ibd, .iso, .jar, .java, .jpeg, .jpg, .jsp, .key, .lay, .lay6, .ldf, .m3u, .m4u, .max, .mdb, .mdf, .mid, .mkv, .mml, .mov, .mp3, .mp4, .mpeg, .mpg, .msg, .myd, .myi, .nef, .odb, .odg, .odp, .ods, .odt, .onetoc2, .ost, .otg, .otp, .ots, .ott, .p12, .PAQ, .pas, .pdf, .pem, .pfx, .php, .png, .pot, .potm, .potx, .ppam, .pps, .ppsm, .ppsx, .ppt, .pptm, .pptx, .ps1, .psd, .pst, .rar, .raw, .rtf, .sch, .sldm, .sldx, .slk, .sln, .snt, .sql, .sqlite3, .sqlitedb, .stc, .std, .sti, .stw, .suo, .svg, .swf, .sxc, .sxd, .sxi, .xsm, .sxw, .tar, .tbk, .tgz, .tif, .tiff, .txt, .uop, .uot, .vbs, .vcd, .vdi, .vmdk, .vmx, .vob, .vsd, .vsdx, .wav, .wb2, .wk1, .wks, .wma, .wmv, .xlc, .xlm, .xls, .xlsb, .xlsm, .xlsx, .xlt, .xltm, .xlb, .xlw, .zip
```

After encrypting in WNCRYT format, finally being encrypted file name will be changed to "<original file name>.<original file extension>.<WNCRY>".



Name	Date modified	Type	Size
@Please_Read_Me@.txt	5/29/2017 3:24 AM	Text Document	1 KB
@WanaDecryptor@.exe	5/29/2017 3:24 AM	Shortcut	1 KB
Original File.bmp.WNCRY	1/26/2017 10:50 PM	WNCRY File	1,076 KB
Original File.doc.WNCRY	1/26/2017 10:24 PM	WNCRY File	24 KB
Original File.hwp.WNCRY	1/26/2017 10:27 PM	WNCRY File	16 KB
Original File.jpg.WNCRY	1/26/2017 10:53 PM	WNCRY File	152 KB
Original File.mp3.WNCRY	2/21/2013 9:16 PM	WNCRY File	6,768 KB
Original File.pdf.WNCRY	1/26/2017 10:30 PM	WNCRY File	21 KB
Original File.png.WNCRY	1/26/2017 10:57 PM	WNCRY File	36 KB
Original File.ppt.WNCRY	1/26/2017 10:38 PM	WNCRY File	312 KB
Original File.rtf.WNCRY	1/26/2017 10:41 PM	WNCRY File	10 KB
Original File.txt.WNCRY	1/28/2017 9:04 PM	WNCRY File	3 KB
Original File.xlsx.WNCRY	1/26/2017 10:45 PM	WNCRY File	9 KB
Original File.zip.WNCRY	1/28/2017 9:04 PM	WNCRY File	6,951 KB

In the file encryption process, the original file is not deleted until the encryption of the whole disk is completed. When the file encryption is completed, the original file is changed to "<number> WNCRYT" in the temporary folder "C: \ Windows \ Temp", so that it cannot be recovered.

## Wannacry attack step #6

After finish the encrypting the files, execute the following command through the execution of the “@WanaDecryptor@.Exe” file, then delete volume shadow copies and change boot recovery options to prevent recovery to a state before encryption..

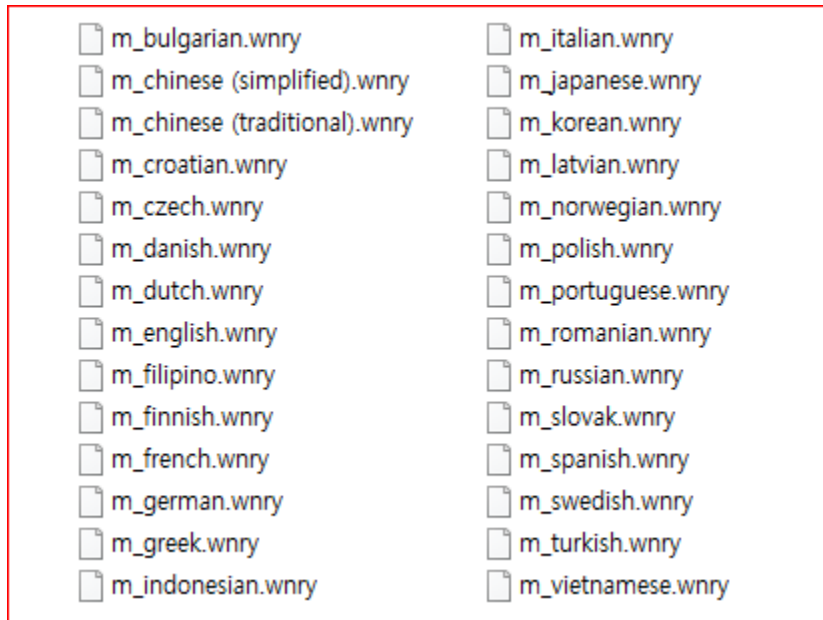
```
cmd.exe /c vssadmin delete shadows /all /quiet & wmic shadowcopy delete & bcdedit /set {default} bootstatuspolicy ignoreallfailures & bcdedit /set {default} recoveryenabled no & wbadm delete catalog -quiet
```

Tor related file will be created in "C: \ProgramData \ <Random> \ TaskData \ Tor" folder for communication with C2 via Tor protocol

Name	Date modified	Type	Size
libeay32.dll	12/31/1999 11:00 ...	Application extension	3,123 KB
libevent_core-2-0-5.dll	12/31/1999 11:00 ...	Application extension	408 KB
libevent_extra-2-0-5.dll	12/31/1999 11:00 ...	Application extension	402 KB
libevent-2-0-5.dll	12/31/1999 11:00 ...	Application extension	703 KB
libgcc_s_sjlj-1.dll	12/31/1999 11:00 ...	Application extension	511 KB
libssp-0.dll	12/31/1999 11:00 ...	Application extension	91 KB
ssleay32.dll	12/31/1999 11:00 ...	Application extension	695 KB
taskhsvc.exe	12/31/1999 11:00 ...	Application	3,026 KB
tor.exe	12/31/1999 11:00 ...	Application	3,026 KB
zlib1.dll	12/31/1999 11:00 ...	Application extension	105 KB

## Wannacry attack step #7

The WannaCry Ransomware message window created at the last step generates messages for 28 languages, including Korean, depending on the language of the infected operating system.



For the purpose of Q&A, @ Please\_Read\_Me @.txt is created, and the desktop background and information messages are changed to @ WanaDecryptor @. Bmp file.





When every encryption activity finishes, the message window appears with the message "Wana Decrypt0r 2.0", If you don't pay the money in time, increase money for decryption or impossible to decrypted any files.

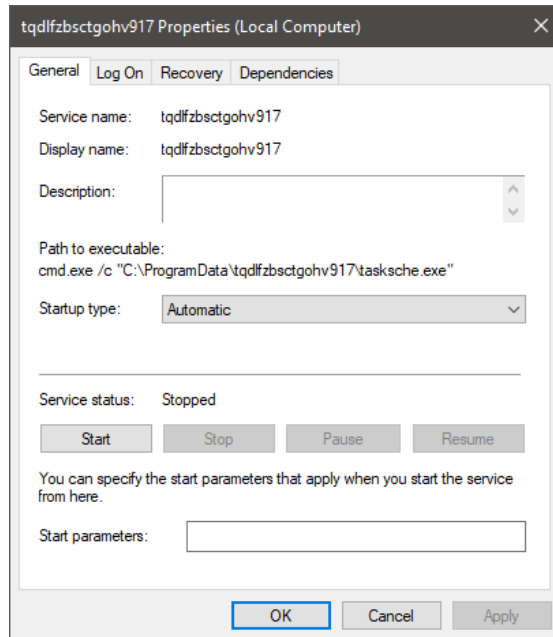




## Wannacry attack step #8

Especially, WannaCry ransomware will be executed with already registered window registry key and this activity will be executed automatically whenever your system boots up.

HKEY\_LOCAL\_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run  
 - "C:\ProgramData\<Random>\tasksche.exe"



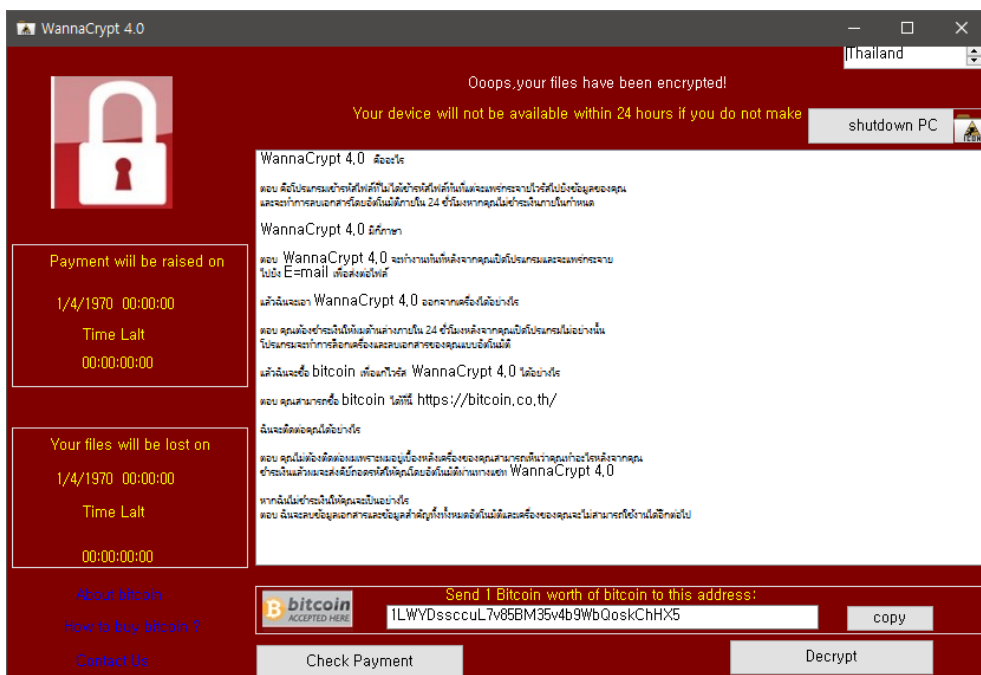
## Wannacry attack step #9

A more serious problem is that WannaCry Ransomware has the ability to spread itself through various internal and external IP scans via port 445 on infected devices

No.	Time	Source	Destination	Protocol	Length	Info
98	101.851970		93.188.59.6	TCP	66	50883 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
99	101.866592		140.146.154.86	TCP	66	50885 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
100	101.866672		112.42.2.150	TCP	66	50884 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
104	101.928557		207.237.6.178	TCP	66	50887 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
105	101.928622		87.13.237.34	TCP	66	50886 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
106	101.928662		120.96.33.116	TCP	66	50888 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
107	101.928794		162.6.185.238	TCP	66	50889 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
108	101.928820		183.167.197.15	TCP	66	50890 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
116	102.147119		36.246.144.65	TCP	66	50892 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
119	102.537247		220.203.188.6	TCP	66	50893 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
122	102.631934		106.21.148.128	TCP	66	50894 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
123	102.632127		14.188.203.205	TCP	66	50895 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
124	102.632198		42.131.218.51	TCP	66	50896 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
125	102.632490		177.215.120.81	TCP	66	50898 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
126	102.632541		153.53.230.54	TCP	66	50900 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
127	102.632605		36.242.192.142	TCP	66	50897 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
128	102.632741		76.59.197.202	TCP	66	50899 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
129	102.632813		205.152.80.201	TCP	66	50901 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
130	102.632897		119.190.168.155	TCP	66	50902 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
131	102.633095		103.164.179.168	TCP	66	50903 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
132	102.633162		159.139.28.233	TCP	66	50904 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1

The disk spaces of the infected device may be overloaded and the capacity may be reduced. Therefore, you should take action to remove malicious files and take steps to prevent them from being re-executed the ransomware.

WannaCry Ransomware, which is currently active, is mostly version 2.0, but among the malicious codes collected overseas, 2.5 or 4.0 new version being developed for attack is confirmed as below image. So, With unknown vulnerabilities and various spreading methods, the WannaCry Ransomware variant is expected to continue to be attacked in the future.



**Ref. 1. [IOC / Kill Switch] Current time on 16:00 May, 15th, 2017 [1]**

www[.]iuqerfsodp9ifjaposdfjhgosurijfaewrwegwea.com

www[.]ifferfsodp9ifjaposdfjhgosurijfaewrwegwea.com

**Ref. 2. [IOC / C2 Domain & IP] Current time on 16:00 May, 15th, 2017 [2]**

57g7spgrzlojinas.onion

76jdd2ir2embyv47.onion

cwwnhwhlz52maq7.onion

gx7ekbenv2riucmf.onion

sqjolphimrr7jqw6.onion

xxlvbrloxvriy2c5.onion

1.rvb87.org

astra4925.startdedicated.de

belegost.csail.mit.edu

belegost.seul.org

blogs.a01x.de

cloud.cfotr.com

cryptochess.rvb87.org

cyberdnesys.org

dannenbergtorauth.de

ehlo.4711.se

ftp.rvb87.org

imap.rvb87.org

ip93.ip-94-23-173.eu

joostrijneveld.nl

kerksanders.nl

kili.joostrijneveld.nl

lfbn-1-14687-209.w2-3.abo.wanadoo.fr

maatuska.4711.se

marliesrijneveld.nl

mysql.rvb87.org

ns1.epow0.org

off-scan-21-12-2014-mvd.ditchyourip.com

poop.rvb87.org

ppcseed.ns.7server.net

ramonj.nl  
rvb87.org  
seed1.fair-coin.org  
static.148.176.243.136.clients.your-server.de  
stigmatle.no  
testnet3.btcseed.kronolabs.com  
testnet-seed.bitcoin.petertodd.org  
testnet-seed.bitcoin.schildbach.de  
tor.epow0.org  
tor-exit.stigmatle.no  
www.rvb87.org  
2.3.69.209:9001  
50.7.151.47:443  
50.7.161.218:9001  
62.138.7.231:9001  
83.162.202.182:9001  
94.23.173.93:443  
128.31.0.39:9101  
136.243.176.148:443  
146.0.32.144:9001  
163.172.153.12:9001  
163.172.185.132:443  
163.172.35.247:443  
171.25.193.9:80  
178.62.173.203:9001  
185.97.32.18:9001  
188.166.23.127:443  
193.23.244.244:443  
213.61.66.116:9003  
217.172.190.251:443  
188.166.23[.]127:443  
193.23[.]244[.]244:443  
2.3.69[.]209:9001  
146.0.32[.]144:9001  
50.7.161[.]218:9001  
217.79.179[.]77  
128.31.0[.]39

213.61.66[.]116  
212.47.232[.]237  
81.30.158[.]223  
79.172.193[.]32  
89.45.235[.]21  
38.229.72[.]16  
188.138.33[.]220

**Ref. 3. [IOC / MD5] Current time on 16:00 May, 15th, 2017 [3]**

d724d8cc6420f06e8a48752f0da11c66  
24f32da258b8c42c71abfb7577fb35a8  
84c82835a5d21bbcf75a61706d8ab549  
db349b97c37d22f5ea1d1841e3c89eb4  
f107a717f76f4f910ae9cb4dc5290594  
7f7ccaa16fb15eb1c7399d422f8363e8  
800446ec5d8b6041f6b08693d8aa1d53  
fefe6b30d0819f1a1775e14730a10e0e  
f97d2e6f8d820dbd3b66f21137de4f09  
7e6b6da7c61fcb66f3f30166871def5b  
5bef35496fcbdbe841c82f4d1ab8b7c2  
638f9235d038a0a001d5ea7f5c5dc4ae  
86721e64ffbd69aa6944b9672bcabb6d  
d6114ba5f10ad67a4131ab72531f02da  
80a2af99fd990567869e9cf4039edf73  
f0d9ffefa20cdadf5b47b96b7f8d1f60  
3c6375f586a49fc12a4de9328174f0c1  
4362e287ca45a4862b7fe9ecaf46e985  
509c41ec97bb81b0567b059aa2f50fe8  
7a2726bb6e6a79fb1d092b7f2b688af0  
007a71c83b7e5e7dee8cca4cb13e86c1  
31dab68b11824153b4c975399df0354f  
54a116ff80df6e6031059fc3036464df  
3175e4ba26e1e75e52935009a526002c  
246c2781b88f58bc6b0da24ec71dd028  
bdda04ebcc92840a64946fc222edc563  
93bec8b34a4894c34c54cca5039c089

82fd8635ff349f2f0d8d42c27d18bc7  
46d140a0eb13582852b5f778bb20cf0e  
f9992dfb56a9c6c20eb727e6a26b0172  
c39ed6f52aaa31ae0301c591802da24b  
c61256583c6569ac13a136bfd440ca09  
bec0b7aff4b107edd5b9276721137651  
b7f7ad4970506e8547e0f493c80ba441  
2b4e8612d9f8cddf520a8b2e42779ffa  
05a00c320754934782ec5dec1d5c0476  
9503af3b691e22149817edb246ea7791  
f9cee5e75b7f1298aece9145ea80a1d2  
32f5d4bb6e967ac8c15950322b69975b  
7c742d6cc135784323395ecc7d526bf6  
b8a7b71bfbde9901d20ab179e4dead58  
84a912cc30e697c4aab6978fb2fceb7c  
835fff032c51075c0c27946f6ebd64a3  
3e0020fc529b1c2a061016dd2469ba96  
ff81d72a277ff5a3d2e5a4777eb28b7b  
eb7009df4951e18ccbe4f035985b635c  
57aaa19f66b1eab6bea9891213ae9cf1  
08bab082019257268a3726ae75463f47  
92cc807fa1ff0936ef7bcd59c76b123b  
82fc5885862b097be5ec9ec2176e30f1  
13d702666bb8eadcd60d0c3940c39228  
947d69c0531504ee3f7821574ea405a7  
c3e7343ae0de8f6c6a907ba06925fe19  
0156edf6d8d35def2bf71f4d91a7dd22  
38089fd3b6f1faa54cfe974fd1e29f0a  
52ba0c7470f214486da9a6c7a710afa0  
1fd3d102d83758e8317df2380821e807  
7d31adca26c6c830f6ea78ed68de166b  
df535dcb74ab9e2ba0a63b3519eee2bb  
2822abbaff89f989a4377b3c54067540  
57b5c96abfd7ab5f33d9e3c20067687a  
8ff9c908dea430ce349cc922cee3b7dc  
8424e87370e83d18d1239f43238b318b  
efa8cda6aa188ef8564c94a58b75639f

4b27c04d8c3befc0b534c1e41933245d  
b0badc4ce72ce584ef0855249dbb0d98  
a155e4564f9ec62d44bf3ea2351fd6ce  
0fb1ce09b168987ce7f47bcd82fa034d  
bb54f7f62e845ce054d1b3234ea52b22  
b33c6822e68a5a1a666579681fdc5429  
c39f774f7b4257f0ec3a7329063fc39c  
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**Ref. 4. [IOC /SHA256] Current time on 16:00 May, 15th, 2017 현재[4]**

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## Ref. 5. [IOC / File Extensions] Current time on 16:00 May, 15th, 2017

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5. <https://docs.google.com/spreadsheets/d/1XNCCiiwplfW8y0mzTUdLLVzoW6x64hkHJ29hcQW5deQ/pubhtml#> - Gathered and merged information on many and various systems and media source
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