WIP19 Espionage | New Chinese APT Targets IT Service Providers and Telcos With Signed Malware

sentinelone.com/labs/wip19-espionage-new-chinese-apt-targets-it-service-providers-and-telcos-with-signed-malware/

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Executive Summary

- A new threat cluster we track as WIP19 has been targeting telecommunications and IT service providers in the Middle East and Asia.
- We assess it is highly likely this activity is espionage-related and that WIP19 is a Chinese-speaking threat group.
- The threat cluster has some overlap with Operation Shadow Force but utilizes new malware and techniques.
- WIP19 utilizes a legitimate, stolen certificate to sign novel malware, including SQLMaggie, ScreenCap and a credential dumper.

Overview

SentinelLabs has been monitoring a threat cluster we track as WIP19, a group characterized by the usage of a legitimate, stolen digital certificate issued by a company called “DEEPSoft”. Based on our investigations, WIP19 has been targeting telecommunications and IT service providers in the Middle East and Asia.

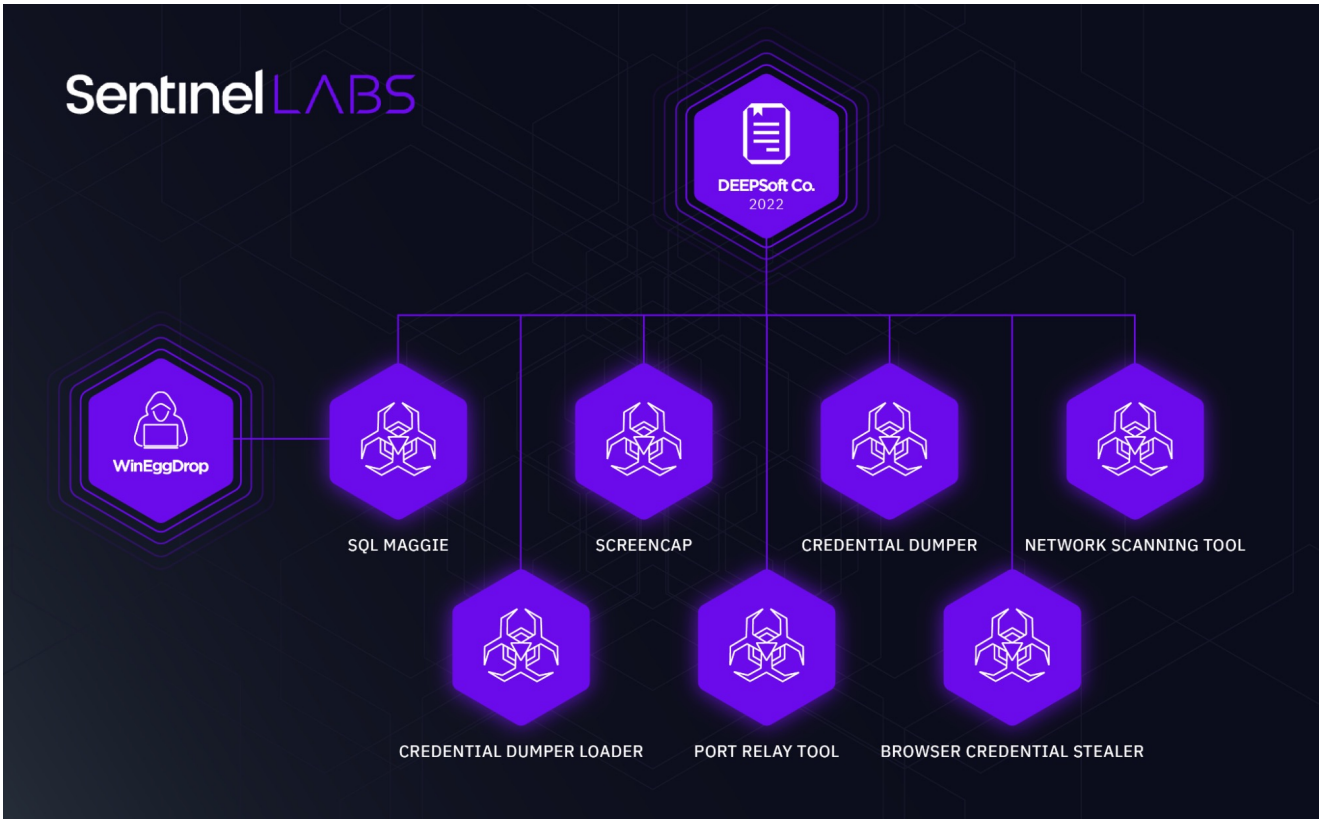
Throughout this activity, the threat actor abused the certificate to sign several malicious components. Almost all operations performed by the threat actor were completed in a “hands-on keyboard” fashion, during an interactive session with compromised machines. This meant the attacker gave up on a stable C2 channel in exchange for stealth.

Our analysis of the backdoors utilized, in conjunction with pivoting on the certificate, suggest portions of the components used by WIP19 were authored by WinEggDrop, a well-known Chinese-speaking malware author who has created tools for a variety of groups and has been active since 2014.

The use of WinEggDrop-authored malware, stolen certificates and correlating TTPs indicate possible links to Operation Shadow Force, as reported by TrendMicro and AhnLab. As the toolset itself appears to be shared among several actors, it is unclear whether this is a new iteration of operation “Shadow Force” or simply a different actor utilizing similar TTPs. The activity we observed, however, represents a more mature actor, utilizing new malware and techniques.

We linked an implant dubbed “SQLMaggie”, recently described by DCSO CyTec, to this set of activity. SQLMaggie appears to be actively maintained and provides insights into the development timeline with hardcoded version names. In addition, we identified a number of other pieces of malware utilized by this threat actor.

This report focuses on detailing the set of activity we track as WIP19 and provides further context around the usage of these new tools.



Relationship between the malware, certificates, and creators

Abusing Valid Digital Certificates

WIP19 has been observed signing malware with a valid digital certificate issued for DEEPSoft Co., Ltd., a Korean company specializing in messaging solutions. The threat actor used the certificate to sign several malware components, some of which were tailor-made for specific targets. We assess that it is highly likely the certificate was stolen, as it was also used to sign legitimate software used by DEEPSoft in the past.

Signature Verification

Signed file, valid signature

File Version Information

Date signed 2022-05-24 05:26:00 UTC

Signers

– DEEPSoft Co., Ltd.

Name	DEEPSoft Co., Ltd.
Status	Valid
Issuer	DigiCert SHA2 Assured ID Code Signing CA
Valid From	12:00 AM 01/08/2021
Valid To	11:59 PM 01/11/2023
Valid Usage	Code Signing
Algorithm	sha256RSA
Thumbprint	68FF94B5C77481CC3AB10A05F3C926711C9C5F93
Serial Number	02 10 36 B9 E8 0D 16 EA 7F 8C F0 E9 06 2B 34 55

+ DigiCert SHA2 Assured ID Code Signing CA

+ DigiCert

DEEPSoft digital certificate

Activity involving toolsets authored by WingEggDrop and signed with both legitimate and fake certificates has been previously reported on by AhnLab. It's commonly understood that malware created by WinEggDrop is shared among several threat clusters, making it possible that these associated toolsets could also be in use by the WIP19 threat actor.

Dumper Analysis

Like many components utilized by WIP19, all their credential harvesting tools – consisting mainly of password dumpers – were signed using the DEEPSoft certificate. The main dumper used by the threat actor utilized open source projects to load an SSP to LSASS and then dump the process.

WIP19's password dumper consists of two components, one used as a loader, and the other as a dumper. On many of the instances observed, the dumper was executed using WMIEXEC.

Loader Analysis

The dumper loader component is a signed EXE file, internally dubbed `ssp_rpc_loader`, as indicated from the PDB path embedded within the file. As the name suggests, the loader uses RPC to load a malicious DLL file as an SSP (Security Support Provider), given as an argument. The loader appears to be taken from an open source project available on GitHub.

```
D:\source\dump_lsass-main\ssp_rpc_loader\x64\Release\ssp_rpc_loader.pdb
```

SSP Analysis

The actual SSP loaded is NanoDump, which is loaded into LSASS and creates a minidump of the process. Loading NanoDump as an SSP is a built-in function embedded within NanoDump. This is done utilizing the MiniDumpWriteDump API. The dump will be created in the following path:

```
C:\\windows\\temp\\1.bin
```

Much like the loader, the threat actor did not bother to remove the PDB path for the DLL dumper.

```
D:\source\dump_lsass-main\dll1\x64\release\dll1.pdb
```

Combining both components, a full execution of the dumper will look like this:

```
C:\attacker\loader.exe c:\attacker\ssp.dll
```

Keylogger & Screen Recording (ScreenCap)

Loading Mechanism

WIP19 has been observed utilizing a less-common (although documented) DLL search order hijacking of `explorer.exe` to load a keylogging and screen recording component internally named `ScreenCapDll_x64`.

```
:0 ;
:0 word_1800148E0  dw 0, 1, 2                ; DATA XREF: .rd
:6 aScreencapdllX6 db 'ScreenCapDll_x64.dll',0
:6                                           ; DATA XREF: .rd
:B aDllregisterser db 'DllRegisterServer',0
:B                                           ; DATA XREF: .rd
0D aStart          db 'Start',0              ; DATA XREF: .rd
L3 aI              db 'i',0                  ; DATA XREF: .rd
L5                 align 800h
L5  rdata          ends
```

The keylogging and screen recording components

The threat actor dropped the malicious, signed DLL, in the path `c:\windows\linkinfo.dll`. Dropping the file in this specific path triggers the loading of the DLL into `explorer.exe` the next time it is executed. The threat actor may manually kill and restart the `explorer.exe` process to initiate the screen recording and keylogging functionality.

The ScreenCap malware performs checks involving the victim's machine name, indicating it is specially crafted for each deployment. This does not prevent the actor from re-signing each of the payloads with the DEEPSoft certificate, proving the actors have direct access to the stolen certificate.

After verifying it is executed on the correct machine, the ScreenCap malware drops a RAR CLI binary in one of the following paths, according to the target's operating system:

```
C:\Documents and Settings\All Users\Application Data\dwmgr.exe
C:\Users\Public\AppData\MsTemp\dwmgr.exe
```

```
lstrcpyA(byte_180017FB0, &Buffer);
lstrcatA(CurrentDirectory, &Buffer);
v1 = sub_180001680();
if ( v1 == 1 )
{
  lstrcatA(&Buffer, "Documents and Settings\\All Users");
  CreateDirectoryA(&Buffer, 0i64);
  lstrcatA(&Buffer, "\\Application Data");
  CreateDirectoryA(&Buffer, 0i64);
  lstrcatA(&Buffer, "\\MsTemp");
  CreateDirectoryA(&Buffer, 0i64);
  lstrcatA(byte_180017FB0, "Documents and Settings\\All Users\\Application Data\\dwmgr.exe");
  v2 = "Documents and Settings\\All Users\\Application Data";
}
else
{
  if ( v1 != 2 )
    return 0i64;
  lstrcatA(&Buffer, "Users\\Public");
  CreateDirectoryA(&Buffer, 0i64);
  lstrcatA(&Buffer, "\\AppData");
  CreateDirectoryA(&Buffer, 0i64);
  lstrcatA(&Buffer, "\\MsTemp");
  CreateDirectoryA(&Buffer, 0i64);
  lstrcatA(byte_180017FB0, "Users\\Public\\AppData\\MsTemp\\dwmgr.exe");
  v2 = "Users\\Public\\AppData\\MsTemp";
}
lstrcatA(CurrentDirectory, v2);
if ( (unsigned int)sub_18000E4BC(byte_180017FB0, 0i64) )
```

RAR executable drop file path

Keylogging

The keylogging functionality mainly focuses on the user's browser. The malware detects the user's browser and logs all keystrokes to `.ax` files stored in its current working directory. By default, it will keylog Internet Explorer activity, but it also supports keylogging of other popular browsers including Chrome and Opera.

```
v4 = check_OS_version();
if ( v4 == 1 )                                  // win7
{
  v5 = "Documents and Settings\\All Users\\Application Data";
LABEL_19:
  lstrcatA(String1, v5);
  snprintf(
    Src,
    0x104ui64,
    "%s\\%s_%04d%02d%02d.ax",
    String1,
    NameBuffer,
    SystemTime.wYear,
    SystemTime.wMonth,
    SystemTime.wDay);
  goto LABEL_20;
}
if ( v4 == 2 )                                  // win8 and above
{
  v5 = "Users\\Public\\AppData\\MsTemp";
  goto LABEL_19;
}
```

```
  v10 = (HWND)lParam;
LABEL_13:
  if ( (unsigned int)SendMessageA(v10, 0xEu, 0i64, 0i64) <= 0x7FF
    && (unsigned int)SendMessageA(v10, 0xDu, 0x800ui64, (LPARAM)v27) )
  {
    snprintf(Buffer, 0x1000ui64, "[URL] %s\r\n", v27);
    sub_1800024E0(Buffer);
    return 1i64;
  }
  return 0i64;
}
if ( strstr(&String, "Google Chrome") )
{
  v12 = "Chrome_OmniboxView";
}
else
{
  if ( !strstr(&String, "Opera") )
    return 0i64;
  v12 = "ViewsTextfieldEdit";
}
v10 = FindWindowExA(v1, 0i64, v12, 0i64);
if ( v10 )
  goto LABEL_13;
return 0i64;
}
```

Keylogger drop file path and the browser it targets

Screen Recording

A relatively unique TTP observed in this activity is the recording of the user's screen. Much like keylogging, this helps the actor harvest credentials and access sensitive information. The malware will record the screen for 1,296,000 milliseconds at a time, 30 times, and store the output as `.avi` files in its current working directory.

```
Options.lpParms = 0i64;
*(_QWORD *)&Options.cbParms = 0i64;
strcpy((char *)plpOptions, "vidsmsvc");
plpOptions->dwQuality = a1;
plpOptions->dwBytesPerSecond = 0;
plpOptions->dwFlags = 12;
plpOptions->lpFormat = 0i64;
plpOptions->cbFormat = 0;
plpOptions->dwInterleaveEvery = 0;
if ( !AVIMakeCompressedStream(&ppsCompressed, ppavi, &Options, 0i64) )
{
  if ( AVIStreamSetFormat(ppsCompressed, 0, v12, *v12 + 4 * v12[8]) )
    return 0xFFFFFFFFi64;
  MemHandle(v12);
  timeGetTime();
  recored_counter = 0;
  v16 = 0;
  total_count = 1000 * total_time / (unsigned int)(1000 / a2);// 1296000
  do                                            // record for 30 times
  {
    ++recored_counter;
    ++v16;
    ++v13;
    handler = (unsigned int *)load_gdi32_API(0, 0, v50, cy);
    AVIStreamWrite(ppsCompressed, v13, 1, (char *)&handler[handler[8]] + *handler, handler[5], 0, 0i64, 0i64);
    MemHandle(handler);
    hFile = CreateFileA(FileName, 0, 7u, 0i64, 3u, 0x80u, 0i64);
```

Using Windows Multimedia (vfw.h) to record the user's screen

During our analysis of the ScreenCap malware, we identified a number of samples that contained hardcoded victim IDs. This indicates that some of the intrusions are well researched and highly targeted.

```
                                        ; DATA XREF: .data:off_180015190↓o
                align 8
aBbbbbbbbbbbbbb db 'bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb',0
                                        ; DATA XREF: .data:off_180015188↓o
                align 20h
                db 'DESKTOP-[redacted]',0  ; DATA XREF: .data:Src↓o
                db    0
                db    0
```

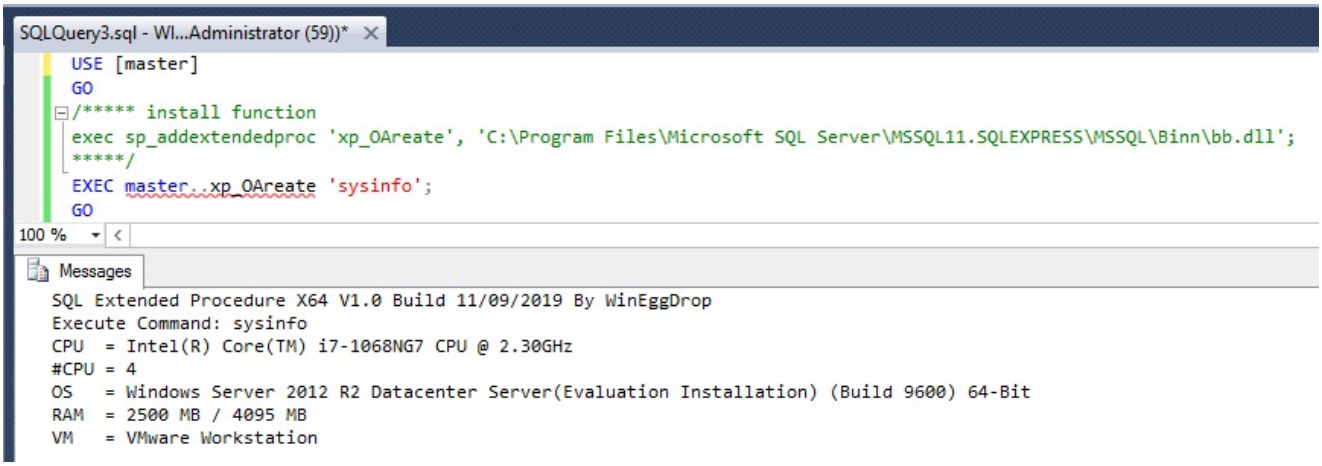
Hardcoded victim host identity number “DESKTOP-xxxxxxx

ExtendedProcedure SQL (SQLMaggie)

Whilst we did not observe the initial infection vector in this intrusion, the SQLmaggie malware dropped on victim networks targets Windows systems and has to be executed in an MSSQL server. This provided us a foundation from which to investigate further.

We found that SQLMaggie masquerades as a legitimate DLL containing extended stored procedure functions for an MSSQL Server. The executed methodology uses the `sp_addextendedproc` function to register an external DLL in a MSSQL server. After registering the DLL into the MSSQL server, the threat actor is able to fully control the server machine and use this backdoor to conduct reconnaissance in the internal network. For instance:

```
sp_addextendedproc 'malicious', 'c:\Program Files\Microsoft SQL
Server\MSSQL13.0.MSSQLSERVER\MSSQL\Binn\malicious.dll';
```



Reproduced SQLMaggie backdoor command

Our analysis showed that this backdoor was authored by WinEggDrop.

From the timestamp of the sample, we can confirm the first version of this backdoor variant was developed in or before 2019. Available commands in each version vary according to the target environment. Unlike some of the other components which can be found on public, open-source repositories, neither the source code nor the executable for SQLMaggie appear to be publicly available. This suggests that the tool is either sold or used privately, or is in exclusive use by WinEggDrop.

```
StackCookie = qword_1000B070;
print(a1, "SQL Extended Procedure X64 V1.0 Build 11/09/2019 By WinEggDrop");
if ( (unsigned int)opends60_40(a1) != 1 )
{
  print(a1, "Parameter Count Error");
  return 1i64;
}
v2 = (const void *)opends60_25(a1, 1i64);
if ( !v2 )
{
  print(a1, "Parameter NULL");
  return 1i64;
}
```

The author's purported signature in SQLMaggie

Below we detail SQLMaggie backdoor commands and capabilities. The following commands appear in all versions of SQLMaggie.

Command	Description
SysInfo	Show system information and detected is it in the VM or not
FileAccess	Modify file permissions
ls	List DIR
Exec	Create process
RShell	Reverse Shell
Type	Open file and print the strings inside
Download	Download files

Additionally, the following commands appear variously in different versions of SQLMaggie coded for specific targets.

Command	Description
StopSocks5	Stop Socks5 tunnel stopped
StartHook	Start WinSock socket hook
StopHook	Stop Winsock socket Hook
ResetClientData	Attacker input information
ViewClientData	Show client data, attacker input information
TS	Checking regkey about TermService and its port
ListIP	Get host name, IP

CheckPath	Get data path
StartSocks5	Create Socks5 tunnel
SetClient	Set client data, include hook winsock and allow ip, port
InstallTS	Install TermService
DelFile	Delete file
SetFile	Set file attributes
GetUser	Using ROOT\\CIMV2 to get host account
GetModule	Print out the execute module file path
ScanStatus	Scan the victim's environment machines
StopScan	Terminate all scan threads
GetAdmin	Get domain admin account
SqlCheck	Check SQL server is running and list username & password
SqlScan	Create a thread to scan for SQL server
Exploit Run	Use exploit to execute process
Exploit AddUser	Use exploit to add user
Exploit Clone	Use exploit to clone user
Exploit TS	Use exploit to install TermService on a machine
StartHook	Hook WinSock socket and show client data, attacker input information
Port	Check if port is open
WriteAll	MSSQLServer Write permission
AccessAll	MSSQLServer Access permission

Attribution Analysis

We assess it is highly likely this activity is espionage-related and that WIP19 is a Chinese-speaking threat group. The Work-In-Progress (WIPxx) designation is used for unattributed clusters of activity. A WIP may represent activity that fits under the umbrella of an existing – but thus far unknown – actor or ultimately represent the activity of a new threat actor.

The intrusions we have observed involved precision targeting and were low in volume. Specific user machines were hardcoded as identifiers in the malware deployed, and the malware was not widely proliferated. Further, the targeting of telecommunications and IT service providers in the Middle East and Asia suggest the motive behind this activity is espionage-related. Communications providers are frequent targets of espionage activity due to the kinds and amount of sensitive data they hold.

The overlap with Operation Shadow Force through a possible common developer in WinEggDrop, and the fact their tooling has been observed in other Chinese espionage-related activity, supports the assessment that this activity is likely being carried out by a thus far unidentified Chinese-speaking threat group. The hardcoding of machine identifiers and the usage of malware to log keystrokes and screenshot specific user machines, suggests that WIP19 is after very specific information.

Conclusion

WIP19 is an example of the greater breadth of Chinese espionage activity experienced in critical infrastructure industries. The existence of reliable quartermasters and common developers enables a landscape of hard-to-identify threat groups that are using similar tooling, making threat clusters difficult to distinguish from the defenders point of view. We hope this report helps move the needle forward in the effort to continue identifying threat groups engaged in spying on industries critical to society.

SentinelLabs continues to track this activity to provide further insight into their evolution and future activity.

Indicators of Compromise

SQLMaggie SHA1	Real File Name
4AABB34B447758A2C676D8AD49338C9E0F74A330	sqlmaggieAntivirus_32.dll
5796068CFD79FBA65394114BA0EDC8CC93EAE151	sqlmaggieVS2008new_64.dll
13BA1CFD66197B69A0519686C23BDEF17955C52E	sqlmaggieVS2008new_32.dll
CA25FCBA11B3B42D9E637132B5753C9B708BE6F0	sqlmaggieVS2008new_64.dll
26cbd3588b10cabc7c63492c82808104829e9ac0	sqlmaggieAntiVirus_64.dll
5e0291928e29db46386fd0bd85f269e967758897	sqlmaggieVS2008new_64.dll
96099015981559237a52a7d50a07143870728fd0	sqlmaggieAntiVirus_64.dll
7eb6e7d4e5bd5a34c602879cad0a26b35a3ca4fb	sqlmaggieVS2008new_32.dll

fe2e7c663913e0744822d1469be0c3655d24178d	sqlmaggieAntivirus_32.dll
b15bae6a8379a951582fc7767fa8490722af6762	sqlmaggieAntiVirus_64.dll
c81de9a27f7e8890d30bd9f7ec0f705029b74170	sql_epX64_MD.dll
829df7b229220c56eedc5660e8f0e7f366fa271f	sqlmaggieAntivirus_32.dll
d02fce5d87ea1fe9fabe7ac52cae2439e8215121	sqlmaggieAntivirus_32.dll
1c6d0e8920af9139a8a9fe3d60b15cf01fb85461	sqlmaggieAntiVirus_64.dll
2cad0328863cb09a6b27414d5158075d69bfb387	sqlmaggieAntiVirus_64.dll
26c0722a1d16641d85b97594deea2a65399daef7	sqlbackupAntiVirus_64.dll
17ff9fc9ee72baaf8d66ef9b3ab6411c47384968	sqlmaggieAntiVirus_64.dll
5be50453f6e941c5c1dd20e0ba53e9abb6d00b68	sqlmaggieVS2008new_32.dll
56d326dfe7dcb1ce7cae2cb4c13819510fc9945c	sqlmaggieAntiVirus_64.dll
253e702ff8201eec6fdf9630a39f5a8c28b132ed	xp_OAreateX64.dll
b91ab391a4e26e4ff0717cd989ad5ce7f6af235c	xp_OAreateX64.dll
4d2eb6e03be068f364e8e3f3c9645e03e1052e66	xp_OAreate.dll
b91ab391a4e26e4ff0717cd989ad5ce7f6af235c	xp_OAreateX64.dll
4d2eb6e03be068f364e8e3f3c9645e03e1052e66	xp_OAreate.dll
8941d889cb199a234d99c90ce78a96411b6dedb6	sqlmaggieAntivirus_32.dll
5aa9a9299865b0cb81fcad5f42424d79c67c403b	sqlmaggieVS2008new_64.dll
5182e0a5f075317171ad0e01e52d32937ec2fa01	sqlmaggieVS2008new_64.dll
bfccf57e173b8233d35928956022bae85fc5d722	sqlmaggieAntiVirus_64.dll
18d3ac848955295381f769b923a86871e01bfa1c	sqlmaggieVS2008new_64.dll
2bf1b6163af5685824c2d7ecda4f3f65f3ca4723	sqlmaggieAntiVirus_64.dll
9577a2c15494edc2f7f4a59ecfb3ee90dd1df9d7	sqlmaggieAntiVirus_64.dll
32e96ef4754c8f357e2366078387750e7f6add43	sqlmaggieAntiVirus_64.dll
11678237dfccc88f257acca2b66b578713deaca8	sqlmaggieVS2008new_64.dll
327bedce44160ebccc7d465c673d3464e23292b9	sqlmaggieVS2008new_32.dll

7d58e51aee7da91dc93025854712cee47ed03101	sqldoorVS2005_64.dll
4a6cf3d5b005e97ef6f2be09f8ab19c2755cae39	sqlmaggieAntiVirus_64.dll
f37d9ce547894ab5449e5632188a3a3bb9e91fed	sqlbackupAntiVirus_64.dll
a347aaf152d8ddcd299d86d7839d4ffa369ef2ef	sqlmaggieVS2008new_32.dll
f2c64108cb670e82908e5f41c58f1aab97ee7786	sqlmaggieVS2008new_64.dll
a34bda87bd253eda794462c20074baed19e1c01c	sqlmaggieAntiVirus_64.dll
df1a7c13a3ec612a10819353ba0d34348a404bc8	sqlmaggieAntiVirus_64.dll
b3249b6f05eeeb2cf5f74931aa990fbc92027b54	sqlmaggieAntiVirus_64.dll
d3eeb9db89f0b21dc945f5410be9a9532e0c951e	sqlmaggieAntiVirus_64.dll

ScreenCap SHA1	**Real File Name**
c6cb7ec82ee55ccb56a4cc8b91c64e9b4f4e14da	ScreenCapDll_x64.dll
19f2a546a76458dda6eab6e2fae07d0942759b84	ScreenCapDll_x64.dll
693e4ed784279bc47a013dc56f87cbd103e1db2e	x
ad72aa442ff2c357b48ae8b4f8ba9b04b63c698b	ScreenCapDll.dll

Hacking Tool SHA1	**Description**
da876cd6e3528f95aafb158713d3b21db5fc780b	Browser credential stealer
1121324a15e6714e4313dfa18c8b03a6da381ba1	Credential dumper loader
9bedb5810536879fae95c70a918eb90ac628953e	Network scanning tool
539d87139de6d5136b6d45dbc33a1aae69926eee	Credential dumper
afe25455804a7afb7639cb4e356cb089105be82d	Port relay tool
37cca724227a8e77671ecde3d295f5b98531705b	Credential dumper loader
2eeb46d538c486f8591a78a65dde250b0bf62f89	Windows domain tool