Mobile App Moolah: Profit taking with Mobile Malware

Jimmy Shah
Mobile Security Researcher
Contents

• Who we are
• Mobile malware
• Modern for-profit malware
• Examples
Who we are

- Mobile Antivirus Researchers
- My team and I specialize in mobile malware and threat analysis on existing (J2ME, SymbOS, WM, Apple iOS, Android) and upcoming mobile platforms.
- We work with a number of large mobile network operators.
Mobile Malware

In the Wild
Historical For-profit malware Trends
In the Wild

1200+ variants
Mobile Malware

In the Wild

Historical For-profit malware Trends
• What it does
  – First reported J2ME trojan (2006)
  – Pretends to access WAP web pages via SMS messages
  – Written using the MIDletPascal programming tool

• Profit?
  – In reality, it attempts to send SMS messages to Premium Rate SMS numbers
  – Eventually spawned a large number of J2ME malware/variants

"Carefully read following description of RedBrowser program
This program allows viewing WAP pages without GPRS connection. RedBrowser connects to SMS server of your operator (MTS, BEELINE, MEGAFON). Page is loaded by receiving coded SMS. First 5Mb (650 SMS) of traffic are provided free of charge in test mode. ATTENTION!!! Program RedBrowser works ONLY on above mentioned cellular operators."

description text (original text in Russian)
Mobile App Moolah: Profit taking with Mobile Malware

J2ME/Wesber.A

- What it does
  - No GUI, almost pure for-profit J2ME trojan
  - Program that disguises itself as an assistant program
  - It contains two jpg files within itself.

- Profit?
  - Sends SMS to premium rate number to purchase mobile phone games.
  - Presumably written to increase sales for the mobile site

Wesber installation prompt (Symbian OS, S60 UI)

Jpg files included but not displayed to user.
Mobile Malware

In the Wild
Historical For-profit malware
Trends
Trends – Mobile Malware Lifecycle
Modern for-profit malware

For-profit malware by geographical region

How they Profit

Detection/Analysis Evasion methods
For-profit malware by geographical region
Mobile App Moolah: Profit taking with Mobile Malware

For-profit malware by geographical region

100+ variants
Primarily J2ME w/ Android
SMS sending trojans

200+ variants
J2ME, Symbian, Android
SMS trojans, privacy stealing
Modern for-profit malware

For-profit malware by geographical region

How they Profit

Detection/Analysis Evasion methods
How they profit

• Production
  – Independent malware authors
  – Produce malware for sale
• Distribution
  – Forums, freeware sites, pirated software sites
How they profit

- **Where's the money?**
  - Premium Rate numbers
    - Ringtones, downloads, data services/newsfeeds
How they profit

• **Where's the money?**
  – Click Fraud, Black Hat SEO
    • Traffic generation, pay-per-click (PPC) ads
How they profit

• **Where's the money?**
  – Stealing, reselling PII
How they profit

- **Where's the money?**
  - SMS phishing, Injecting fake SMS
    - Download malware/adware, Drive traffic
How they profit

- **Where's the money?**
  - Stealing Accounts (Skype, QQ, SIM balances)
  - Using partner businesses to cash out
Modern for-profit malware

For-profit malware by geographical region
How they Profit
Detection/Analysis Evasion methods
Detection/Analysis Evasion methods

• Infection of/Injection into clean apps
  – J2ME
    • Chat/IM apps
    • Games
    • Adult entertainment
  – Symbian
    • Chat/IM apps
  – Android
    • Games
    • Chat/IM apps
Encryption

- Simple
  - Obfuscations
    - Hiding SMS numbers/message text within plaintext HTML files
      - Substitution cipher
        - Config file containing encrypted SMS numbers/message text

```
<link rel="stylesheet" type="text/css" href="/en/shared/core/2/css/css.ashx?sc=/en/us/site.config&amp;pt=cspMscomHomePage&amp;c=cspMscomSiteBrand;cspSearchComponent;cspMscomFeaturePanel;cspMscomMasterNavigation;[<SMS#:<MSG>]cspMscomNewsBand;cspVerticalRolloverTab;cspAdControl;cspMscomVerticalTab;cspSilverGate" />
</script>
<meta name="SearchTitle" content="Microsoft.com" scheme="" />
<meta name="Description" content="Get product information, support, and news from Microsoft." scheme="" />
<meta name="Title" content="Microsoft.c`
```
Encryption

- Complex
  - Symmetric cipher
    - DES

byte abyte1[] = k.b;
DESKeySpec deskeyspec = new DESKeySpec(abyte1);
javax.crypto.SecretKey secretkey = SecretKeyFactory.getInstance("DES").generateSecret(deskeyspec);
Cipher cipher = Cipher.getInstance("DES");
b = cipher;
cipher.init(2, secretkey);

- Used by Android/Geinimi to encrypt URL queries and C&C commands
- Used by Android/DrddreamLite
  - to encrypt/decrypt config file
    - URLs, next connect time
  - to encrypt/decrypt C&C commands
  - to decrypt root exploits
Reduce security/bypass protection

• Disable Software installation controls
  – WinCE/InfoJack.A turns off the unsigned application prompt, allowing it to perform silent installations

<table>
<thead>
<tr>
<th>Key</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HKEY_LOCAL_MACHINE\Security\Policies\Policies\0000101a</td>
<td>0 = Enable Unsigned Application Prompt</td>
</tr>
<tr>
<td></td>
<td>1 = Disable Prompt</td>
</tr>
</tbody>
</table>

• Root vulnerabilities
  – Exploits are used legitimately by users to allow modifying or reflashing new OS versions
  – Android/DrdDream utilizes 2 root exploits to gain a foothold on android devices
  – Android/DrddreamLite uses very similar, 1 identical, root exploits

• Jailbreaking
  – Not In the Wild, used only in PoCs
    • e.g. Eric Monti's modified jailbreak at Toorcon 2010
Examples of for-profit malware

J2ME
Symbian
Android
Other
What it Does

- Pretends to be a variety of legitimate apps
  - anonymous SMS sender
  - pornographic app
  - free SMS sender

- Profit?
  - Instead of the user's message it sends to a Premium Rate number
  - Country specific SMS messages are sent
    - Russia (5 SMS)
    - Ukraine (4 SMS)
    - Kazakhstan (4 SMS)
• **What it Does**
  - Pretends to be a mobile client for the VKontakte social network
  - A phishing app, it emails the victim's account details to the attacker

- ![Screen shot of a VKontakte app]

• **Profit?**
  - Attackers collect VKontakte user accounts
    - Use trust relationships to spread malware/adware/spyware
    - Resell accounts
    - Blackmail users

<table>
<thead>
<tr>
<th>To:</th>
<th>ololoe2010yandex.ru</th>
</tr>
</thead>
<tbody>
<tr>
<td>From:</td>
<td>bork_rulsmail.ru</td>
</tr>
<tr>
<td>Subject:</td>
<td>&lt;username&gt;:&lt;password&gt;</td>
</tr>
<tr>
<td>Message:</td>
<td>&lt;username&gt;:&lt;password&gt;</td>
</tr>
</tbody>
</table>
Examples of for-profit malware

<table>
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<th>J2ME</th>
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<td>Symbian</td>
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<tr>
<td>Android</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>
• **What it Does**
  – Distributed as part of a larger collection of malware, SymbOS/MultiDropper.CR
  – Deletes incoming and outgoing SMS messages

• **Profit?**
  – Displays a warning message and attempts to extort money from the user
  – Money is to be transferred as the QQ coin virtual currency

Warning: Your mobile phone has been infected, please prepare a mobile phone recharge card of 50 Yuan RMB, and contact QQ<account removed>, or your phone will be paralyzed!!
• **What it Does**
  – Python script designed to run under the S60 Python interpreter
  – Pretends to be a Python client for ICQ
• **Profit?**
  – Sends SMS to premium rate number
    ```python
    appswitch.switch_to_fg(u'Phone')#
    try:messaging.sms_send('<XXXX>',u'FILES <XXX>')#
    except:pass#
    ```
  – Deletes messages received from the same premium rate number
    ```python
    new=sms.sms_messages()#
    if len(new)!=0:#
       keypress.simulate_key(63555,63555)# ← Right button
        for id in new:#
            if sms.address(id)==u'<XXXX>':#
                sms.delete(id)#
    ```
• **What it does**
  – Adds bookmarks for a smartphone related forum
  – Launches a browser to view the forum

• **Profit?**
  – Generate traffic to the smartphone forum
    • Auto-runs an app that creates the bookmarks

<table>
<thead>
<tr>
<th>Bookmark title</th>
<th>Translation</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;removed&gt; 网 - 手机软件第一站</td>
<td>&lt;removed&gt; Network - the first leg of mobile phone software</td>
<td>http://&lt;removed&gt;.com/?id=&lt;removed&gt;</td>
</tr>
<tr>
<td>智能手机大社区</td>
<td>Smart phone community</td>
<td>http://&lt;removed&gt;.com/?id=&lt;removed&gt;</td>
</tr>
<tr>
<td>手机主题免费下载</td>
<td>Free downloading mobile phone themes</td>
<td>http://&lt;removed&gt;com/?id=&lt;removed&gt;</td>
</tr>
<tr>
<td>手机游戏免费下载</td>
<td>Free downloading mobile phone games</td>
<td>http://&lt;removed&gt;/?id=&lt;removed&gt;</td>
</tr>
</tbody>
</table>

• A second app attempts to download files from the mobile phone forum

http://<removed>.com:8118/client/symbian/S60v2active.txt
http://<removed>.com:8118/client/symbian/BackgroundUpdata.ini
http://<removed>.com:8118/client/symbian/S60v2StartUpdata.ini
SymbOS/InSpirit.A

• **What it does**
  
  – Pretends to be “91 calls show”
    
    • With the “System acceleration patch”
  
  – Injects a phishing message into the Inbox
  
  – Text message is spoofed from a Chinese Bank

• **Profit?**
  
  – Text message directs victim to a mobile banking phishing site
    
    • “Dear customer, <Bank> reminds you: your account password is entered wrongly for 5 times today. To avoid your fund loss, please login http://<removed>.com for account protection immediately.”
Examples of for-profit malware

J2ME
Symbian
Android
Other
• What it does
  – Malicious code inserted into legitimate apps/games
    • Most likely inserted manually rather than by a file infector
  – Additional permissions requested
    • Reading/writing SMS, read/write contacts, access GPS, make phone calls, install shortcuts, etc.
• **What it does**
  - Encryption
    - backdoor commands, C&C URL queries
    ```java
    byte abyte1[] = k.b;
    DESKeySpec deskeyspec = new DESKeySpec(abyte1);
    javax.crypto.SecretKey secretkey = SecretKeyFactory.getInstance("DES").generateSecret(deskeyspec);
    Cipher cipher = Cipher.getInstance("DES");
    b = cipher;
    cipher.init(2, secretkey);
    ```
  - Listens on 5432 for handshake, “hi, are you online?”
    - Responds with “yes, I’m online!”
    - Falls back to ports 4501 or 6543
  - Attempts to connect to local backdoor
    - Port 8791

```plaintext
| cts.Monke 1001 | 10033  | 32u | CHR | 10.62 |
| cts.Monke 1001 | 10033  | 34u | CHR | 10.62 |
| cts.Monke 1001 | 10033  | 35u | CHR | 10.62 |
| cts.Monke 1001 | 10033  | 36u | CHR | 10.62 |
| cts.Monke 1001 | 10033  | 37u | CHR | 10.62 |
| cts.Monke 1001 | 10033  | 38u | sock | 0.4 |
| cts.Monke 1001 | 10033  | 39u | CHR | 10.62 |
```

TCP 5432 (LISTEN)
• **Profit?**
  - Backdoor commands
    - Forwarding SMS to C&C server
    - Installing additional software
      - malware/spyware
    - Forwarding contacts
      - New targets
  - Traffic generation
    - Loading URLs
• **What it does**
  - Malicious code inserted into legitimate app
  - Requests many additional permissions
  - Sends IMEI, IMSI, and ICCID to C&C server
  - Adds bookmarks for a smartphone related forum

• **Profit?**
  - Generate traffic to the smartphone forum
  - Send SMS messages
    - Useful for signing up for Premium Rate Services
  - Installing additional software
    - malware/spyware
  - Forwarding contacts
    - New targets
  - Traffic generation
    - Loading URLs
• **What it does**
  - Malicious code inserted into legitimate app
  - Requests many additional permissions

• **Profit?**
  - Send SMS messages
    - Useful for signing up for Premium Rate Services
  - Deletes messages from signed up services
    - No way to know you're subscribed
• **What it does**
  – Appears to be a system application
  – Sends IMEI and phone number to C&C server
  – Attempts to kill certain security applications

• **Profit?**
  – Signs up for Premium Rate Services
  – Deletes messages from signed up services
    • No way to know you're subscribed
• **What it does**
  – Pretends to be an MMS app
  – Sends IMEI and phone number to C&C server
  – Attempts to delete software

• **Profit?**
  – Send SMS messages
    - Useful for signing up for Premium Rate Services
• **What it does**
  - Malicious code inserted into legitimate app
  - Installs backdoor to listen for commands
  - Sends IMEI, OS type, Device type, etc. to C&C server
  - Uses two root exploits to install a non-GUI version of the malware

• **Profit?**
  - Installing additional software
    - malware/spyware
  - Traffic generation
    - Loading URLs

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**Android/DroidKungfu**

- Malicious code inserted into legitimate app
- Installs backdoor to listen for commands
- Sends IMEI, OS type, Device type, etc. to C&C server
- Uses two root exploits to install a non-GUI version of the malware

- Installing additional software
  - malware/spyware
- Traffic generation
  - Loading URLs
• **What it does**
  - Malicious code inserted into legitimate IM app
  - Installs backdoor to listen for commands
  - Sends IMEI, IMSI, SIM serial number, etc. to C&C server

• **Profit?**
  - Send SMS messages
    • Useful for signing up for Premium Rate Services
  - Traffic generation
    • Adding Bookmarks
• **What it does**
  - Trojan pretending to be angry birds update
    • Similar to Oberheide's Twilight preview app
  - Alter/delete browser history
  - Downloads additional APK and loads the code

• **Profit?**
  - Add/delete bookmarks
  - Add/delete shortcuts
  - Display messages
    • phishing
• **What it does**
  - Trojan pretending to be a legitimate app
  - Kills security software

• **Profit?**
  - Send SMS messages
  • Useful for signing up for Premium Rate Services
• **What it does**
  – Malicious code inserted into legitimate app
  – Installs backdoor to listen for commands
  – Sends IMEI, IMSI, GPS coords. to C&C server

• **Profit?**
  – Signs up for Premium Rate Services
  – Deletes messages from signed up services
    • No way to know you're subscribed
  – Installing additional software
    • malware/spyware
• **What it does**
  - Malicious code inserted into legitimate game
  - Installs backdoor to listen for commands

• **Profit?**
  - Forwards SMS messages
    • Useful for intercepting mTANs
  - Send SMS messages
    • Useful for signing up for Premium Rate Services
  - Installing additional software
    • malware/spyware
• **What it does**
  - Malicious code inserted into legitimate app

• **Profit?**
  - Signs up for Premium Rate Services
  - Deletes messages from signed up services
    • No way to know you're subscribed
Examples of for-profit malware

J2ME
Symbian
Android
Other
• What it does
  – Set of PoC Android apps
    • Soundcomber
      – Records phone calls
      – Identifies relevant portions of IVR
      – Processes audio for credit card numbers
  
• Deliverer
  – Receives extracted information from Soundcomber
  – Transmits credit card number to attacker
• **Profit?**
  - Eavesdrops on voice calls
    - Intercept credit card/account numbers
  - Collects DTMF (touch tones)
    - Intercept credit card/account numbers

References
References

- J2ME/RedBrowser.A
  - http://vil.nai.com/vil/content/v_138726.htm
- J2ME/Wesber.A
  - http://vil.nai.com/vil/content/v_140595.htm
- J2ME/SMSFree.A
  - http://vil.nai.com/vil/content/v_145420.htm
- J2ME/Vkonpass.A
  - http://vil.nai.com/vil/content/v_268520.htm
- SymbOS/Kiazha.A
  - http://vil.nai.com/vil/content/v_144207.htm
- Android/Geinimi.A
  - http://vil.nai.com/vil/content/v_342726.htm
- Android/Jmsonez.A
  - http://vil.nai.com/vil/content/v_501748.htm
- Android/Tcent.A
  - http://vil.nai.com/vil/content/v_501599.htm
- Android/Cruisewin.A
  - http://vil.nai.com/vil/content/v_501639.htm
References

- Android/DroidKungFu.A
- Android/PJApp.A
- Android/Toplank.A
- Android/BaseBridge.A
- Android/J.SMSHider.A
- Android/GoldDream.A
- Android/HippoSMS.A
References


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