DATA HIDING AND STEGANOGRAPHY REPORT 2012

JANUARY 2012

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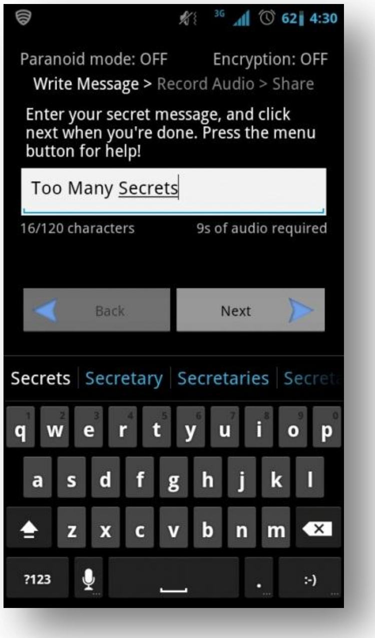
Background


Paranoid mode: OFF Encryption: OFF

Enter your secret message, and click next when you're done. Press the menu button for help!

Too Many Secrets

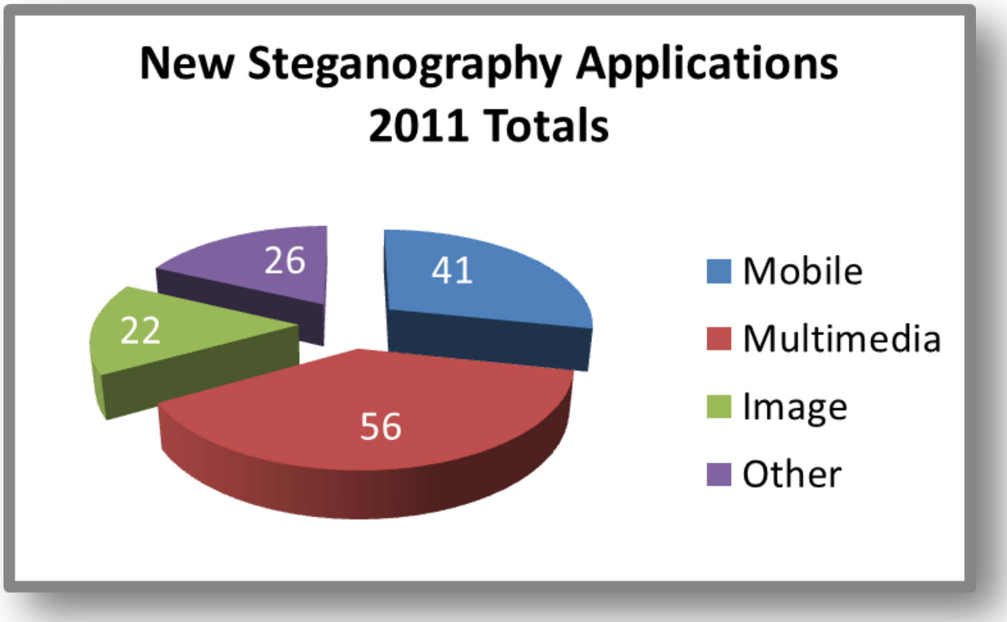
16/120 characters 9s of audio required

FIGURE 1 - STEGDROID

ANDROID STEGANOGRAPHY APPLICATION

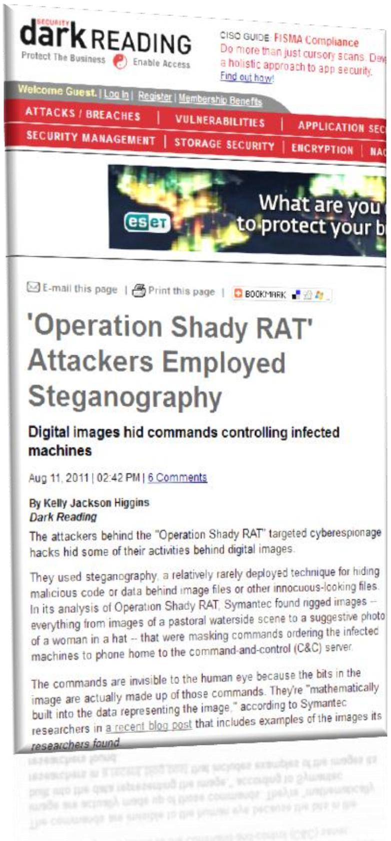
The development and application of new and innovative data hiding and steganography weapons by criminals and worse is clearly on the rise. We added over 140 new data hiding and steganography tools to our cyber weapons repository during 2011. In addition to the increase in the number of new applications, we observed a dramatic increase in the sophistication, depth and support for a wider array of computing platforms such as smart mobile devices.

2011 Quantitative Results



Threat Evolution

Advanced Persistent Threat (APT)



SECURITY
dark READING
Protect The Business
Enable Access
CISO GUIDE: FISMA Compliance
Do more than just cursory scans. Dev
a holistic approach to app security.
Find out how!
Welcome Guest. | Log In | Register | Membership Benefits
ATTACKS / BREACHES | VULNERABILITIES | APPLICATION SEC
SECURITY MANAGEMENT | STORAGE SECURITY | ENCRYPTION | NAC
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'Operation Shady RAT' Attackers Employed Steganography

Digital images hid commands controlling infected machines

Aug 11, 2011 | 02:42 PM | 6 Comments

By Kelly Jackson Higgins
Dark Reading

The attackers behind the "Operation Shady RAT" targeted cyberespionage hacks hid some of their activities behind digital images.

They used steganography, a relatively rarely deployed technique for hiding malicious code or data behind image files or other innocuous-looking files. In its analysis of Operation Shady RAT, Symantec found rigged images -- everything from images of a pastoral waterside scene to a suggestive photo of a woman in a hat -- that were masking commands ordering the infected machines to phone home to the command-and-control (C&C) server.

The commands are invisible to the human eye because the bits in the image are actually made up of those commands. They're "mathematically built into the data representing the image," according to Symantec researchers in a recent blog post that includes examples of the images its researchers found.

FIGURE 2- JACKSON, KELLY, DARK READING HTTP://DARKREADING.EU/ADVANCED-THREATS/167901091/SECURITY/ATTACKS-BREACHES/231400084/OPERATION-SHADY-RAT-ATTACKERS-EMPLOYED-STEGANOGRAPHY.HTML

We recognize that data hiding and steganography are beginning to play an important role in the command, control and communication between deployed threats and their operators. Our ability, as we move forward, to detect and mitigate such threats is paramount.

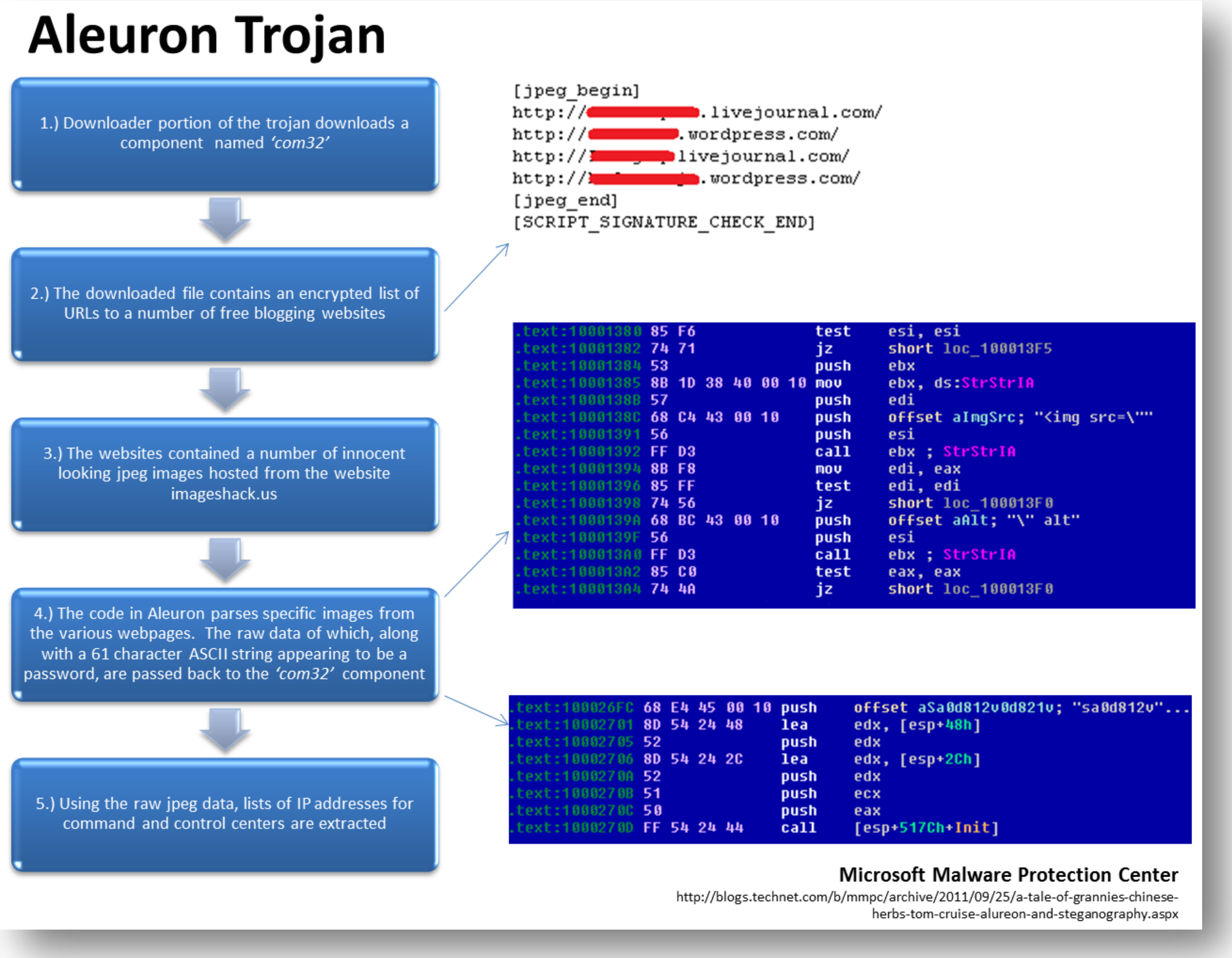
Let's take a look at a couple of these threats and their impact.

Operation Shady Rat:

Operation Shady RAT was a well planned and executed advanced persistent threat (APT) that has been ongoing for at least 5 years. The attack impacted over 70 organizations including corporation, government agencies, and non-profits in as many as 14 countries. The targeted organizations were infiltrated by the malicious code as most malware is deployed today, but the goal was to keep the breach hidden and slowly exfiltrate information from the infected locations. This was facilitated through the use of innocuous digital images that contained command and control instructions and additional malware components. This use of steganography has been long proposed and now proven to be a viable element of sophisticated attacks (whether considered APT or not).

Alureon

According to sources at Microsoft and others, the Alureon Trojan is part of a new genre of malware categorized as data stealing. What makes Alureon interesting is the use of data hidden in jpeg files that were distributed across the internet at innocuous locations. The trojan would reach out to those images via the web, and decode the hidden contents. The images contain information that is interpreted by the trojanized *com32 software,* allowing Alureon to obtain a list of trusted command and control servers in order to continue and expand operations.



Aleuron Trojan

1.) Downloader portion of the trojan downloads a component named *'com32'*

2.) The downloaded file contains an encrypted list of URLs to a number of free blogging websites

3.) The websites contained a number of innocent looking jpeg images hosted from the website imageshack.us

4.) The code in Aleuron parses specific images from the various webpages. The raw data of which, along with a 61 character ASCII string appearing to be a password, are passed back to the *'com32'* component

5.) Using the raw jpeg data, lists of IP addresses for command and control centers are extracted

```
[jpeg_begin]
http://[redacted].livejournal.com/
http://[redacted].wordpress.com/
http://[redacted]livejournal.com/
http://[redacted].wordpress.com/
[jpeg_end]
[SCRIPT_SIGNATURE_CHECK_END]
```

```
.text:10001380 85 F6             test    esi, esi
.text:10001382 74 71             jz      short loc_100013F5
.text:10001384 53                push    ebx
.text:10001385 8B 1D 38 40 00 10 mov     ebx, ds:StrStrIA
.text:1000138B 57                push    edi
.text:1000138C 68 C4 43 00 10    push    offset aImgSrc; "<img src=\""
.text:10001391 56                push    esi
.text:10001392 FF D3             call    ebx ; StrStrIA
.text:10001394 8B F8             mov     edi, eax
.text:10001396 85 FF             test    edi, edi
.text:10001398 74 56             jz      short loc_100013F0
.text:1000139A 68 BC 43 00 10    push    offset aAlt; "\" alt"
.text:1000139F 56                push    esi
.text:100013A0 FF D3             call    ebx ; StrStrIA
.text:100013A2 85 C0             test    eax, eax
.text:100013A4 74 4A             jz      short loc_100013F0
```

```
.text:100026FC 68 E4 45 00 10 push    offset aSa0d812v0d821v; "sa0d812v"...
.text:10002701 8D 54 24 48    lea     edx, [esp+48h]
.text:10002705 52             push    edx
.text:10002706 8D 54 24 2C    lea     edx, [esp+2Ch]
.text:1000270A 52             push    edx
.text:1000270B 51             push    ecx
.text:1000270C 50             push    eax
.text:1000270D FF 54 24 44    call    [esp+517Ch+Init]
```

Microsoft Malware Protection Center
http://blogs.technet.com/b/mmpc/archive/2011/09/25/a-tale-of-grannies-chinese-herbs-tom-cruise-alureon-and-steganography.aspx

FIGURE 3 - ALUREON TROJAN CONOPS

Smart Mobile Platforms

As the explosion of smart mobile devices continues to expand along with the applications available for Android, iPhone and Windows Mobile, new data hiding applications have emerged. The table below itemizes just some of the new steganography offerings now available on smart mobile platforms. There are a couple of surprises and innovative techniques. On the other hand, as we expected, some of the methods are very simple and not stealthy, while others provide a window into the innovation we are likely to see continue.

APP Name	Author	Platform	Basics	File Format
StegSec	Raffaele De Lorenzo	iPhone	Simple text hiding. Information is hidden in the comment field of the jpeg header.	.jpg
iStego	Antonio Calatrava	iPhone	Allows you to hide text or an image into a cover image. The hidden data is stored in the IDAT image data using LSB methods.	.png
Spy Pix	JuicyBitsSoftware	iPhone	Hides a secret inside a selected cover image. Interesting approach that required a special detection approach to uncover.	.png
Concealment	David Berroa	iPhone	Hides an image inside an image by appending an additional IEND marker to the .png.	.png
Pixogram	UnderWare LLC	iPhone	Hides text within a selected cover image. Text data is compressed, encrypted and embedded in the last	.png

			IDAT chunk.	
PrivateTIP	ADJ-soft	iPhone	Hides text with a cover image. Hidden text can be encrypted. Ultimately stored in the JPEG scan data.	.jpg
Hide it In	Jorge Blasco Alis	iPhone	Program crashes on iPad.	
CoverText	J & R Technologies, Rabah Rahil	iPhone	Hides text inside cover image. Data is hidden JPEG header comment field.	.jpg
InvisiLetter	Samurai-apps	iPhone	Allows you to draw (with finger or stylus) a message or drawing on an image. The data is embedded in IDAT chunks by modifying the LSB values.	.png
Secret Letter	ivanaLum	Android 2.1+	Hides Text into images, accepts images from camera or gallery, and utilizes a password to encrypt message.	.png
Da Vinci Secret Image	RadJab	Android 2.1+	Hides text into images.Accepts an image from gallery. Allows for an optional password and selecting different sizes for the image	.png
My Secret	Tipspedia Ro	Android 1.6+	Hides text into images. Selects an image from the gallery. Only supports png/jpg and requires an SD Card to run the app	.jpg/.png
Stega	Danny Thuering	Android 2.1+	Hides text into images, accepts images from the	.jpg

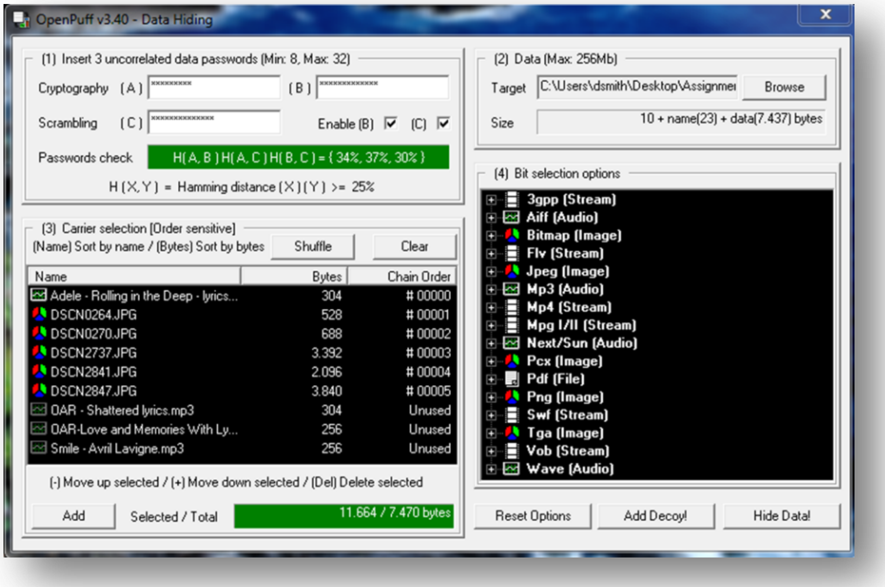
			gallery/camera, supports .png/.jpg, and embeds messages in comment field of JPEG header	
StegDroid	Tom Medley	Android 2.1+	Hides text into audio.Accepts both recorded audio and direct microphone input	.ogg
MobiStego	Pasquale Paola	Android 2.0+	Hides text into images by using LSB embedding within the IDAT Chunks.	.png

In 2011 we saw many of these new threats evolve and allow for covert communication using image and multimedia file interchange. As this first wave of apps advances, we expect to see improvements in usability and improvements in the core algorithms. However, several of the algorithms, above, that hide small amounts of text into large images or multimedia carriers provide a viable means of covert communications due to the difficulty in detecting statistical variations with such tiny payload to carrier file ratios.

Multimedia Steganography

With the benefits we all experience from the increased exchange and streaming of multimedia, there is also a downside. These same streams and multimedia files offer the opportunity to hide and exchange much larger amounts of information. A couple of notable offerings in this category include OpenPuff and MSU Stego.

OpenPuff



OpenPuff v3.40 - Data Hiding

(1) Insert 3 uncorrelated data passwords (Min: 8, Max: 32)

Cryptography (A) ********* (B) *************

Scrambling (C) ************** Enable (B) ☑ (C) ☑

Passwords check H(A, B) H(A, C) H(B, C) = { 34%, 37%, 30% }

H (X, Y) = Hamming distance (X) (Y) >= 25%

(2) Data (Max: 256Mb)

Target C:\Users\dsmith\Desktop\Assignmer

Size 10 + name(23) + data(7.437) bytes

(3) Carrier selection [Order sensitive]

(Name) Sort by name / (Bytes) Sort by bytes

Name	Bytes	Chain Order
Adele - Rolling in the Deep - lyrics...	304	# 00000
DSCN0264.JPG	528	# 00001
DSCN0270.JPG	688	# 00002
DSCN2737.JPG	3.392	# 00003
DSCN2841.JPG	2.096	# 00004
DSCN2847.JPG	3.840	# 00005
OAR - Shattered lyrics.mp3	304	Unused
OAR-Love and Memories With Ly...	256	Unused
Smile - Avril Lavigne.mp3	256	Unused

(-) Move up selected / (+) Move down selected / (Del) Delete selected

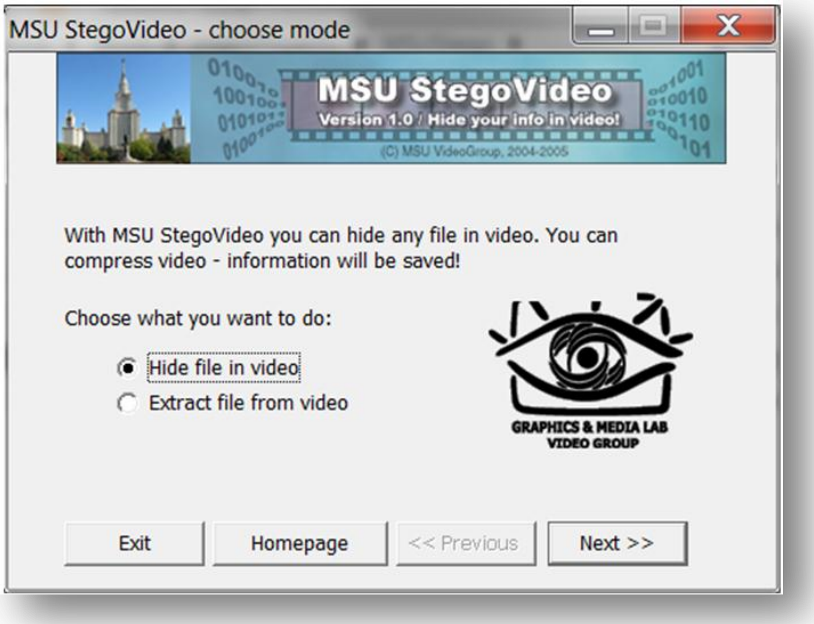
Selected / Total 11.664 / 7.470 bytes

(4) Bit selection options

- 3gpp (Stream)
- Aiff (Audio)
- Bitmap (Image)
- Flv (Stream)
- Jpeg (Image)
- Mp3 (Audio)
- Mp4 (Stream)
- Mpg I/II (Stream)
- Next/Sun (Audio)
- Pcx (Image)
- Pdf (File)
- Png (Image)
- Swf (Stream)
- Tga (Image)
- Vob (Stream)
- Wave (Audio)

OpenPuff Steganography is a free tool for the Windows Operating Systems. OpenPuff is semi-open source in that the encryption algorithm is open source, but the rest of the program is proprietary. The way OpenPuff works is that the data to be hidden is split up and then hidden inside many carrier files using a variety of embedding methods. The program allows users to hide data in a plethora of carrier types ranging from image, audio, and video files. Before the data is hidden, it is encrypted, whitened, then encoded (whitening is a decorrelation method). The advantage of hiding encrypted data into carrier files using stego is that not only are you hiding data, but you are hiding the fact that you have hidden data. This makes it much easier to pass data back and forth without arousing suspicion. In short, the use of steganography and cryptography together protects both the hidden data as well as the people using the files to communicate. A notable feature of OpenPuff is the decoy file. If someone finds your file and demands the password from you, you can give a decoy password that will allow you to successfully extract a file that would not include incriminating data.

MSUStego


MSU StegoVideo - choose mode
MSU StegoVideo
Version 1.0 / Hide your info in video!
(C) MSU VideoGroup, 2004-2005
GRAPHICS & MEDIA LAB
VIDEO GROUP
Exit
Homepage
<< Previous
Next >>

With MSU StegoVideo you can hide any file in video. You can compress video - information will be saved!

Choose what you want to do:

● Hide file in video
○ Extract file from video

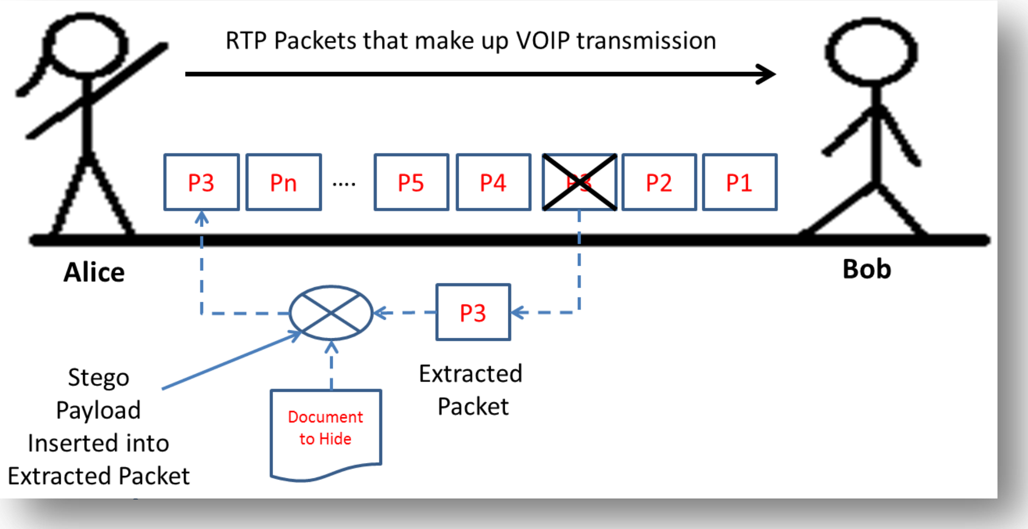
MSU StegoVideo is a free non-open source steganography program available from Moscow State University in Russia. Its key features are an ability to hide text-based data efficiently into a video sequence with very low distortion, and an ability to extract that data with a small amount of errors. This program also allows you to protect the data being hidden into the image using a passcode. MSU StegoVideo is unique in the fact that it is the only known product that can hide data in the actual frames of the video versus simply adding data to redundant parts of the video file.

Though the algorithm that MSU StegoVideo uses is not yet known, there are some things that we do know about it. For one, MSU StegoVideo stores information into the video by modifying the video frame by frame. This is done by decomposing each frame into bit planes and modifying the lower (least significant) planes. Modifications in these lower planes, in most cases, have no visual effect on the frame. We also know that the method that MSU StegoVideo uses to prevent data loss is redundant storage of the data throughout the video. It stores all data at least twice in the video; however, the level of redundancy can be chosen by the user. Overall, MSU StegoVideo could be considered dangerous because without some in-depth analysis of a video file, the fact that data was hidden inside of it would be completely indistinguishable.

Streaming Methods

As we briefly discussed above, it is possible to insert hidden information within data streams not only within multimedia or digital image carriers. One of the methods that continues to evolve, and is an ongoing research project, involves the use of StegoSIP and Lost Audio Packet Steganography. The diagram below depicts the use of this process. The steps involved are pretty straight-forward and demonstrates the weakness that exists today in most network protocols.

1. StegoSIP is launched on both Alice and Bob's computer and listens for activity.
2. Next a Voice over IP session is initiated between Alice and Bob and a standard voice conversation ensues.
3. The Lost Audio Packet Stego method is then employed. This method delays selected RTP packets from delivery. The VOIP program on the receiving end automatically compensates for the delayed or missing packet and voice communication continues normally.
4. The delayed packets are then modified by embedding the hidden data in the desired payload of theses delayed packets.
5. The delayed packet with the hidden content is reinserted into the data stream.
6. The excessively delayed packet is detected and then intercepted by StegoSIP and the hidden content is decoded. The packet is allowed to continue on as normal to the VOIP program, but due to the delay in the delivery the VOIP program ignores the packet as it was already previously compensated for.


RTP Packets that make up VOIP transmission
P3
Pn
....
P5
P4
P3
P2
P1
Alice
Bob
P3
Stego Payload Inserted into Extracted Packet
Document to Hide
Extracted Packet

V
O

IP DATASTREAM STEGANOGRAPHY

To avoid the risk of detection, the user employing the lost audio packet method must randomly select packets and ensure that the frequency of the process is such that it creates a low level observable.

Hybrid Methods

One of the newest Data Hiding weapons is a technology that combines the power of TrueCrypt® (one of the best known and easiest to use encryption programs) with a steganography twist. This latest advancement hides a TrueCrypt container inside an existing MP4 or QuickTime multimedia file.

CNN - Operation Shady RAT
MichaelSias
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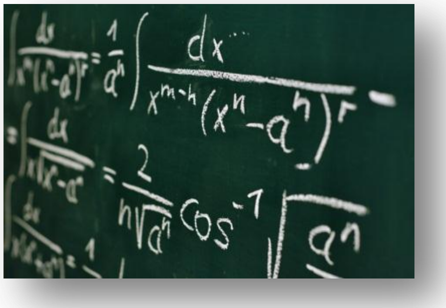
DEVELOPING STORY
THE SITUATION ROOM
MASSIVE HACK ATTACK HITS U.S., U.N.
Dozens of govts., organizations, firms targeted
International online child pornography ring busted
CNN
DOW
0:03 / 3:21
CC
360p
Like
Add to
Share
63 views

TCStego is a straight-forward python script that works with both QuickTime and MP4 multimedia containers.

The tcsteg.py application combines an existing MP4 or QuickTime multimedia file with a TrueCrypt file container in such a manner that the resulting file operates as both a standard multimedia file and as a mountable TrueCrypt volume.

With the rapid increase in movie files exchanged over the Internet (YouTube, etc.), a huge haystack in which to hide or exchange covert information exists right now, and the size of this haystack is predicted to increase exponentially over the next decade. Clearly this provides a new method for pedophiles to exchange their content through innocuous sharing of benign looking digital media, and criminals or worse to continually exchange large amounts of clandestine information.

Mitigation Strategies



Over the past decade we have developed a comprehensive set of mitigation strategies and technologies to assist government, law enforcement and commercial entities deal with the escalating data hiding and steganography threat.

1. Awareness and Training
2. Detection, mitigation and blocking of unauthorized Data Hiding and Steganography Programs
3. Discovery of images, multimedia files and datastreams that have been utilized as a carrier of hidden content
4. Recovery of hidden information once carriers have been detected
5. Data Leak Protection
6. Nondestructive jamming of images, multimedia files and network protocols to prevent leakage of sensitive data

If you would like more information regarding our product, training or services offerings please feel free to contact us.

Future Predictions

New data hiding and steganography methods are likely to lock down our networks and end points by employing network intrusion prevention solutions, content filters, application firewalls, data leak prevention solutions and host intrusion prevention capabilities, criminals, malicious insiders and worse will continue to exploit weaknesses in protocols, images, multimedia and general data structures. These exploits will provide mechanisms to conceal and exfiltrate data and provide a viable means to command and control the deployed malicious code.

Without significant and immediate measures to uncover, mitigate or otherwise disrupt these operations we risk further attacks and continued loss of intellectual property or state secrets.