Madrid
18-19.10.2013
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R. Luque & J. San Leandro

Grails vs XSS

Defending Grails against XSS attacks

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http://goo.gl/uVadCh

Plugins You can find out about all the publicly available Grails plugins.

<iframe width="9C

<iframe width="9C

FILTERS CLEAR FILTER

- All Plugins
- Featured
- Top Installed
- Popular
- Recently Updated
- Newest
- Supported by SpringSource
- Pending Plugins

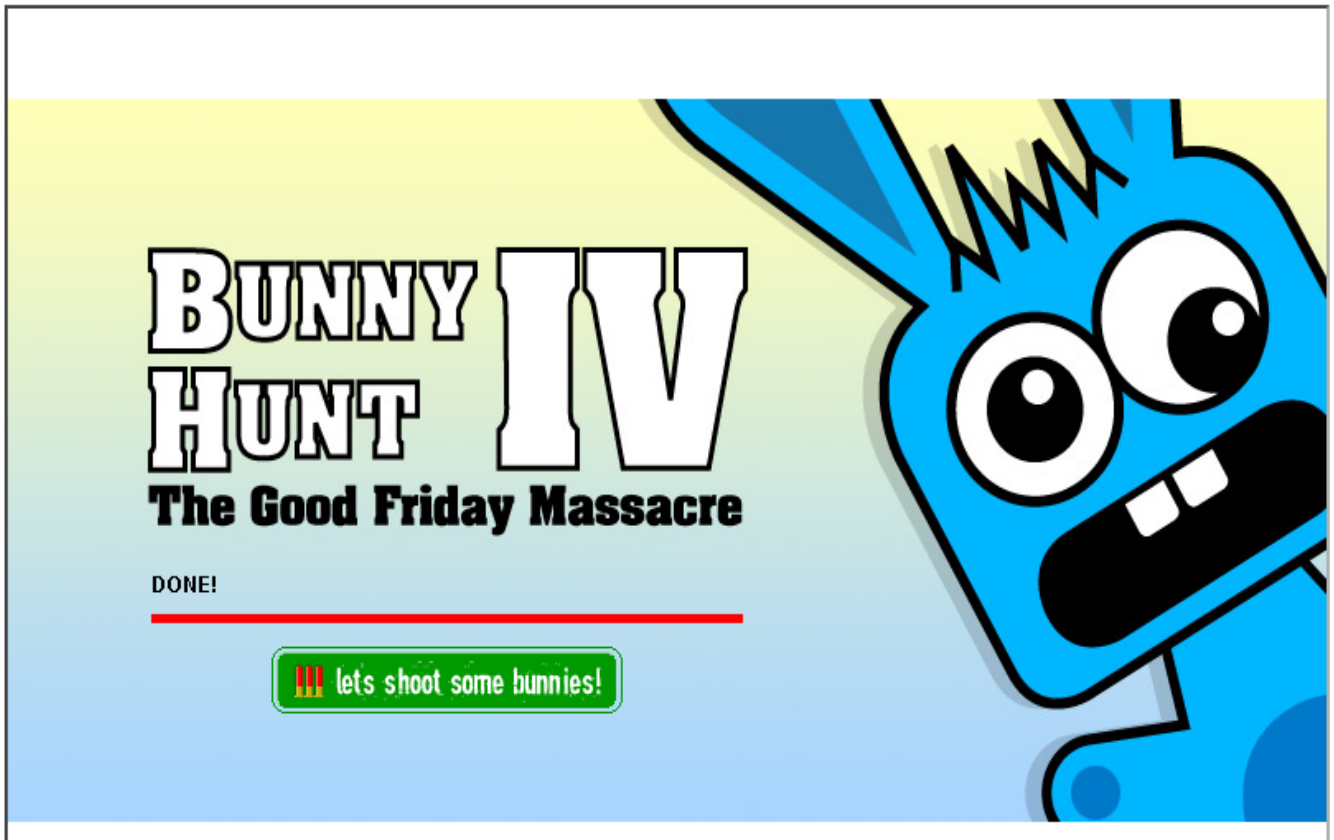
POPULAR TAGS

- Javascript
- Ajax
- Security
- Persistence
- Database

Nothing matched your query -

Oh no, Grails.org was PWN3D!!

Don't panic! This is a simple reflected XSS used as a proof of concept in our talk about Grails and XSS prevention.



XSS Intro

XSS concepts

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- What's a XSS
- XSS Types: Reflected, stored, DOM-based.
- Famous XSS attacks: Samy worm, MrBean defacement, ...

XSS threats

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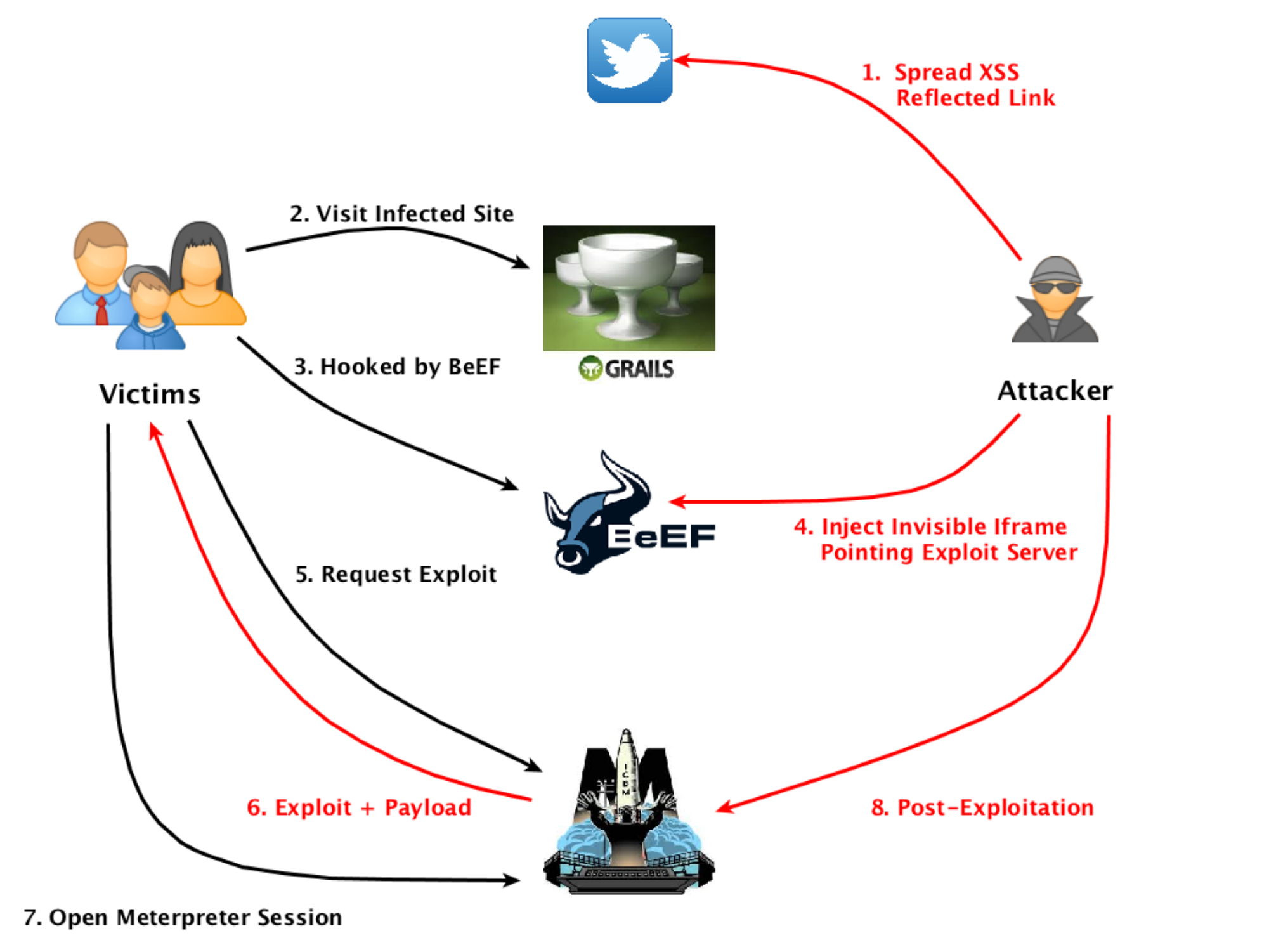
- Interface defacement
- Session hijacking
- Click hijacking
- Malware infection
- Your PC may be joined to the horde of zombies in a BotNet.

Following the white rabbit...

he white rab

Something more than a joke...


1. Spread XSS
Reflected Link
2. Visit Infected Site
3. Hooked by BeEF
Victims
GRAILS
Attacker
BeEF
4. Inject Invisible Iframe
Pointing Exploit Server
5. Request Exploit
6. Exploit + Payload
8. Post-Exploitation
7. Open Meterpreter Session

Responsibilities: Why is this still an issue?

Commercial software

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- XSS is not known for business stakeholders
- For most people, security means attacking your servers
- Developers don’t pay enough attention

Do your homework

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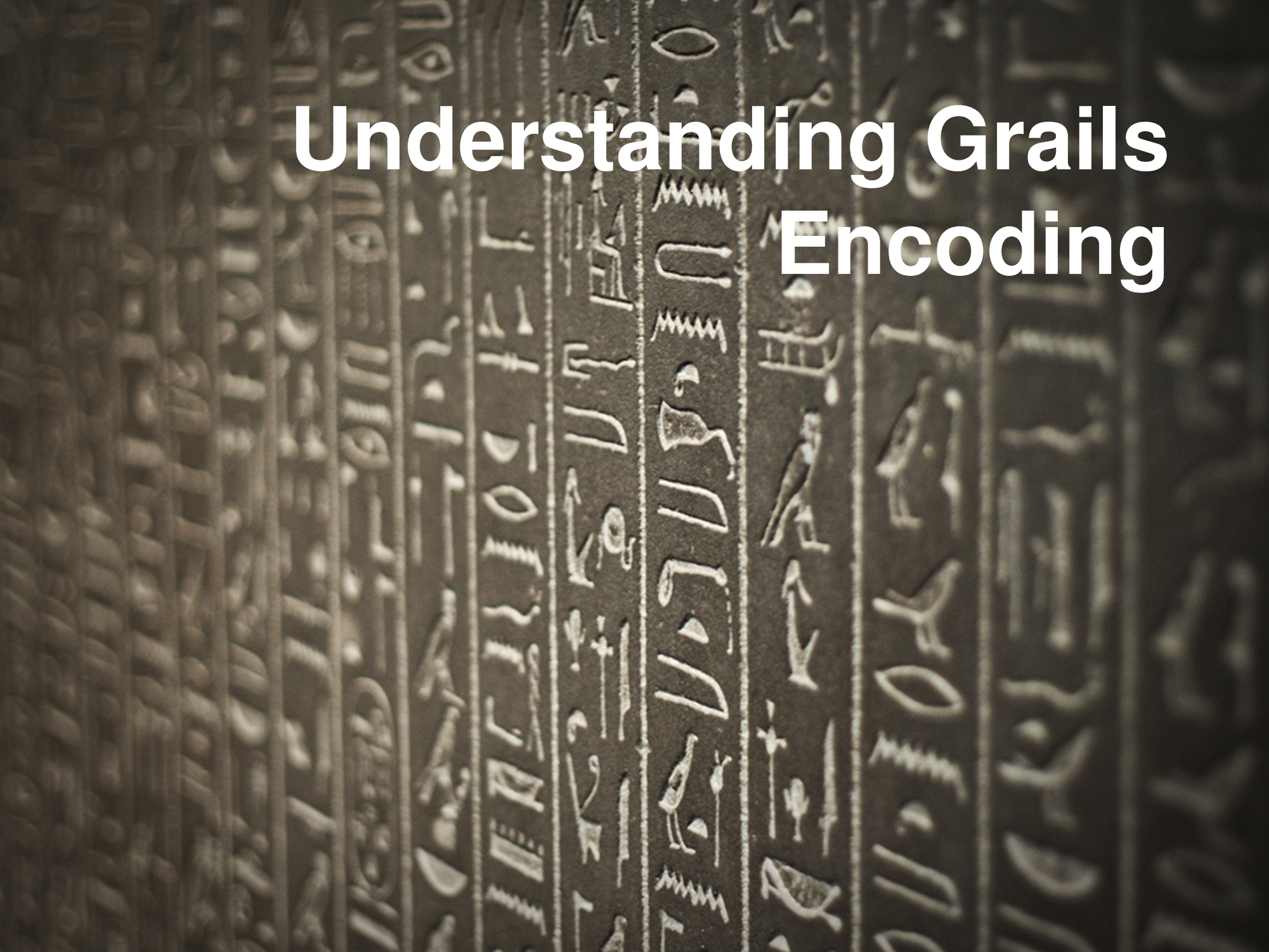
- Raise awareness
- Practice with security tools
- Promote defensive coding
- Improve monitoring



Understanding Grails Encoding

Grails Pre-2.3 Gotchas

#1: Built-in default codec

#1: Built-in default codec

```
grails.views.default.codec
```

#1: Built-in default codec *is none!*

```
grails.views.default.codec = ''none''
```

#1: Built-in default codec *is none!*

Problems

You have to escape explicitly every untrusted data:

```
encodeAsHTML()
encodeAsJavaScript()
encodeAsURL()
```

#1: Built-in default codec *is none!*

Problems

High likelihood of XSS vulnerabilities in production.

E.g. Grails.org website.

#1: Built-in default codec *is none!*

Problems

Double-encoding prevention over *Security by default*.

#1: Built-in default codec *is none!*

Solution

Change default codec to HTML:

```
grails.views.default.codec = ''html''
```

#2: Inconsistent behaviour

Apply codec

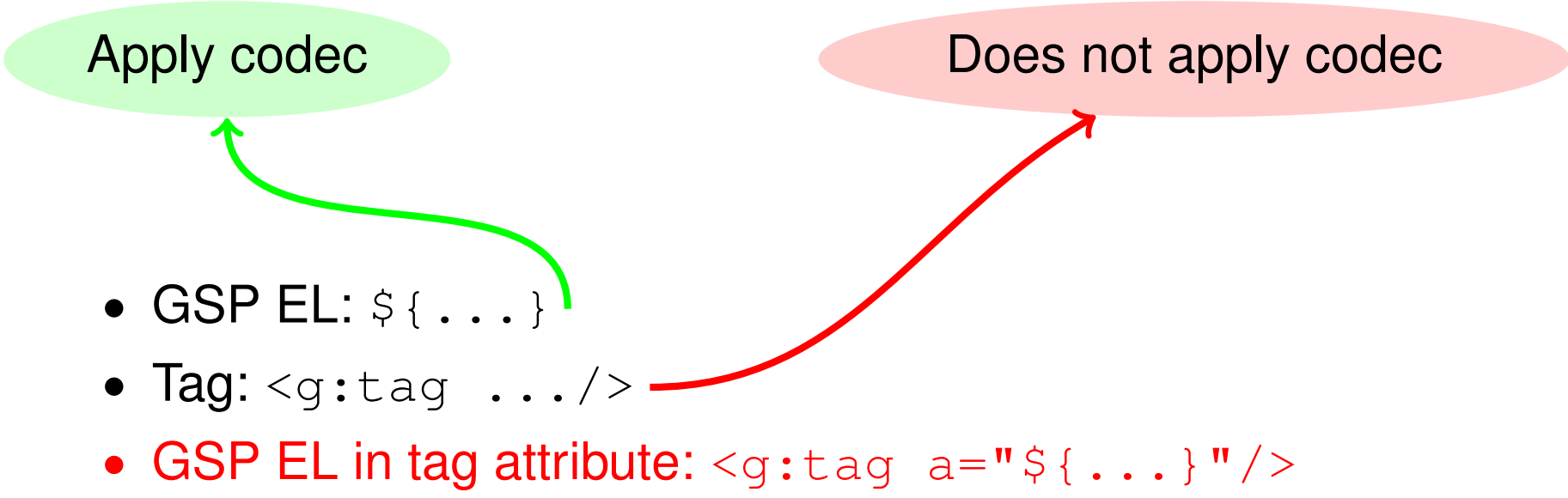
Does not apply codec

- GSP EL: `${...}`

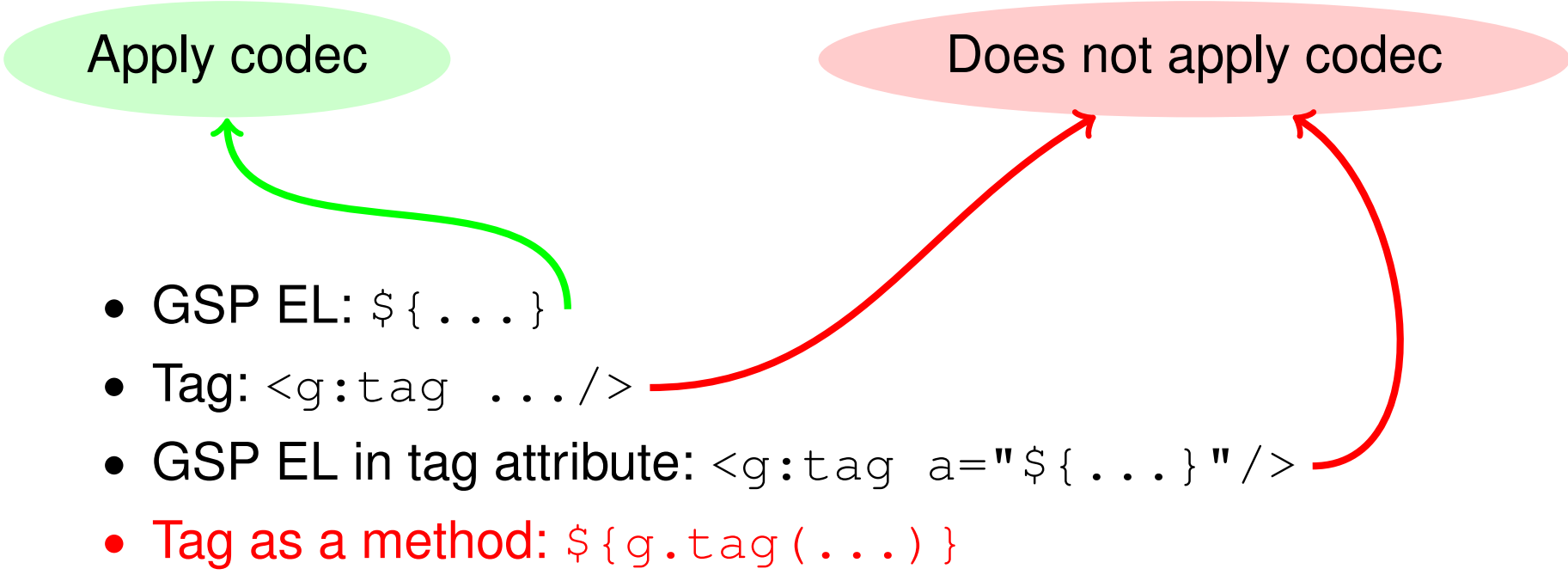
#2: Inconsistent behaviour

- GSP EL: `${...}`
- Tag: `<g:tag .../>`

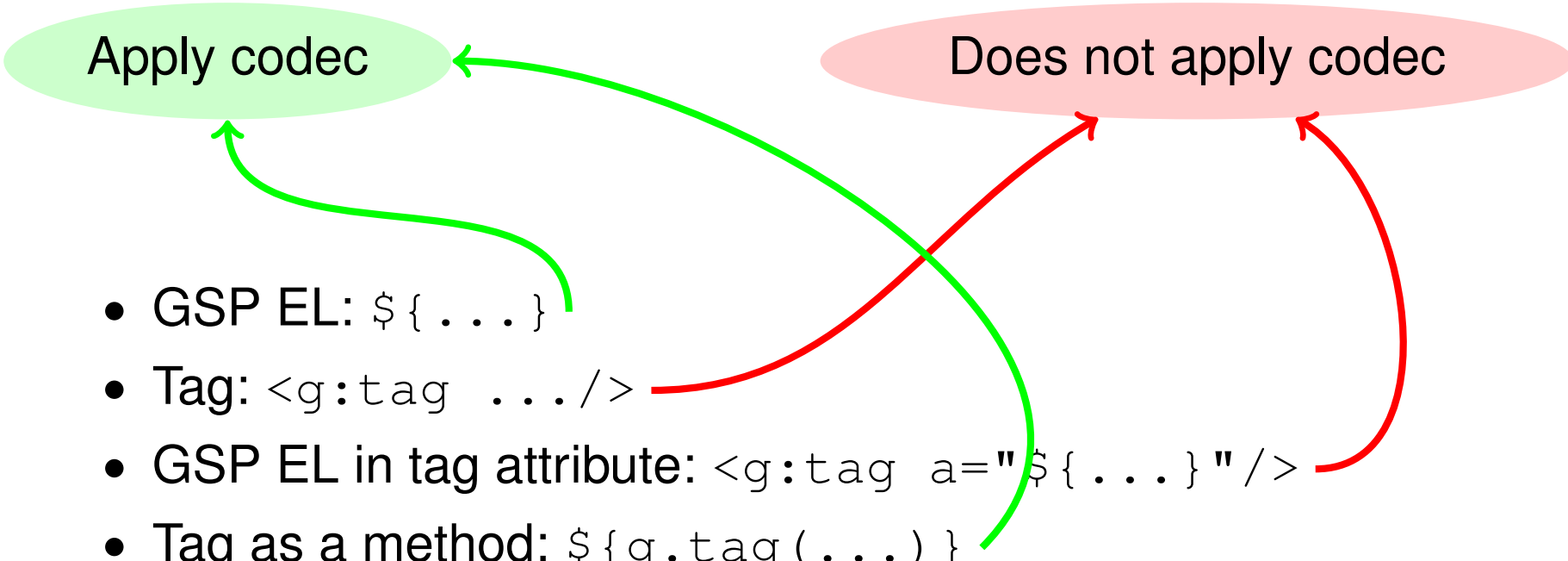
#2: Inconsistent behaviour



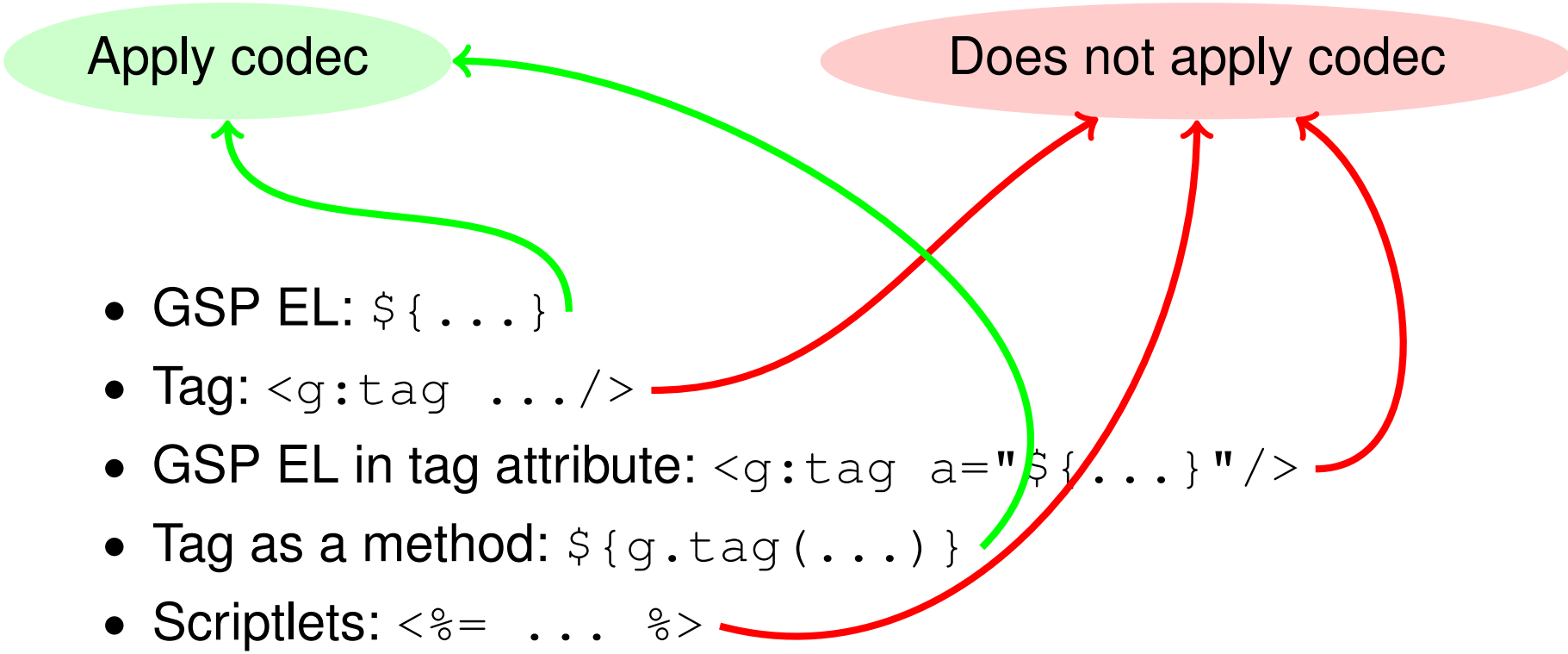
#2: Inconsistent behaviour



#2: Inconsistent behaviour



#2: Inconsistent behaviour



#3: Tag output is not escaped

Problems

Review the tags you use to make sure they encode their output or have options for this (e.g. `encodeAs` attribute).

#3: Tag output is not escaped

Problems

Review the tags from plugins you use.

#3: Tag output is not escaped

Problems

Review the tags you invoke as methods in Controllers.

#3: Tag output is not escaped

Problems

Don’t trust Grails core tags, they have inconsistent behaviour. E.g:

```
<g:fieldValue /> // HTML-encoded
<g:message />    // NO HTML-encoded
```

#3: Tag output is not escaped

Solutions

If tag implementation doesn't encode, add it explicitly or invoke it as a method inside a GSP expression:

```
<g:message ... encodeAs=''HTML''/>
${g.message(...)}
g.message(...).encodeAsHTML()
```

#4: g:message doesn't escape arguments

Problems

With default codec set to HTML the following XSS attack vector works:

```
<g:message code='welcome' args='[params.user]'/>

where:
   welcome = Hi {0}!
   params.user = <script>alert('pwnd')</script>
```

#4: g:message doesn't escape arguments

Solutions

Upgrade to a Grails version with the issue (GRAILS-7170) fixed:

2.0.5, 2.1.5, 2.2.2, 2.3-M1

#4: g:message doesn't escape arguments

Solutions

Escape explicitly or invoke the tag inside a GSP expression:

```
<g:message code='welcome' args='[params.user]'
    encodeAs='HTML'/>

${g.message(code:'welcome', args:[params.user])}
```

#5: One codec is not enough

You MUST use the escape syntax for the context of the HTML document you're putting untrusted data into:

- HTML
- JavaScript
- URL
- CSS

#5: One codec is not enough

HTML entity encoding doesn't work if you're using untrusted data inside a <script>, or an event handler attribute like onmouseover, or inside CSS, or in a URL.

#5: One codec is not enough

Problems

You can override the default codec for a page, but not to switch the codec for each context:

```
<%@page defaultCodec='CODEC' %>
```

#5: One codec is not enough

Problems

How to manage GSPs with mixed encoding requirements?

#5: One codec is not enough

Solutions

Turn off default codec for that page and use `encodeAsJavaScript()` and `encodeAsHTML()` explicitly everywhere.

#5: One codec is not enough

Solutions

Extract the JavaScript fragment to a GSP tag encoding as JavaScript.

Grails 2.3 Encoding Enhancements

#1: New configuration more *secure by default*

#1: New configuration more security by default

```
grails {
  views {
    gsp {
      encoding = 'UTF-8'
      htmlcodec = 'xml' // use xml escaping instead of HTML4
      codecs {
        expression = 'html' // escapes values inside ${}
        scriptlet = 'html' // escapes output from scriptlets in GSPs
        taglib = 'none' // escapes output from taglibs
        staticparts = 'none' // escapes output from static templates
      }
    }
    // escapes all not-encoded output at final stage of outputting
    filteringCodecForContentType {
      //'text/html' = 'html'
    }
  }
}
```

#2: Finer-grained control of codecs

Control the codecs used per plugin:

```
pluginName.grails.views.gsp.codecs.expression = 'CODEC'
```

#2: Finer-grained control of codecs

Control the codecs used per page:

```
<%@ expressionCodec='CODEC' %>
```

#2: Finer-grained control of codecs

Control the default codec used by a tag library:

```
static defaultEncodeAs = 'HTML'
```

Or on a per tag basis:

```
static encodeAsForTags = [tagName: 'HTML']
```

#2: Finer-grained control of codecs

Add support for an optional `encodeAs` attribute to all tags automatically:

```
<my:tag arg='foo.bar' encodeAs='JavaScript'/>
```

#3: Context-sensitive encoding switching

Tag `withCodec('CODEC', Closure)` to switch the current default codec, pushing and popping a default codec stack.

```
out.println '<script type=''text/javascript''>'
withCodec(``JavaScript'') {
    out << body()
}
out.println()
out.println '</script>'
```

#3: Context-sensitive encoding switching

Core tags like `<g:javascript/>` and `<r:script/>` automatically set an appropriate codec.

#4: Raw output

When you do not wish to encode a value, you can use the `raw()` method.

```
${raw(book.title)}
```

It's available in GSPs, controllers and tag libraries.

#5: Default encoding for all output

You can configure Grails to encode all output at the end of a response.

#5: Default encoding for all output

```
grails {
  views {
    gsp {
      codecs {
        expression = 'html' // escapes values inside ${}
        scriptlet = 'html' // escapes output from scriptlets in GSPs
        taglib = 'none' // escapes output from taglibs
        staticparts = 'raw' // escapes output from static templates
      }
    }
    // escapes all not-encoded output at final stage of outputting
    filteringCodecForContentType {
      'text/html' = 'html'
    }
  }
}
```

Don’t Trust Plugins

Plugins are part of your app

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- Grails plugins are not security audited
- Grails plugins are part of your application's attack surface
- Review plugins to make sure they encode, and if they don't you should JIRA the authors immediately, and fork and patch to fix your app quickly.

E.g. Javamelody vulnerability

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- CVE-2013-4378 vulnerability reported.
- Allows **blind XSS** attack via `X-Forwarded-For` header spoofing.
- The attack target is the admin's browser.
- Fixed in the last release (1.47).
- You should upgrade ASAP.

Demo: Javamelody XSSed

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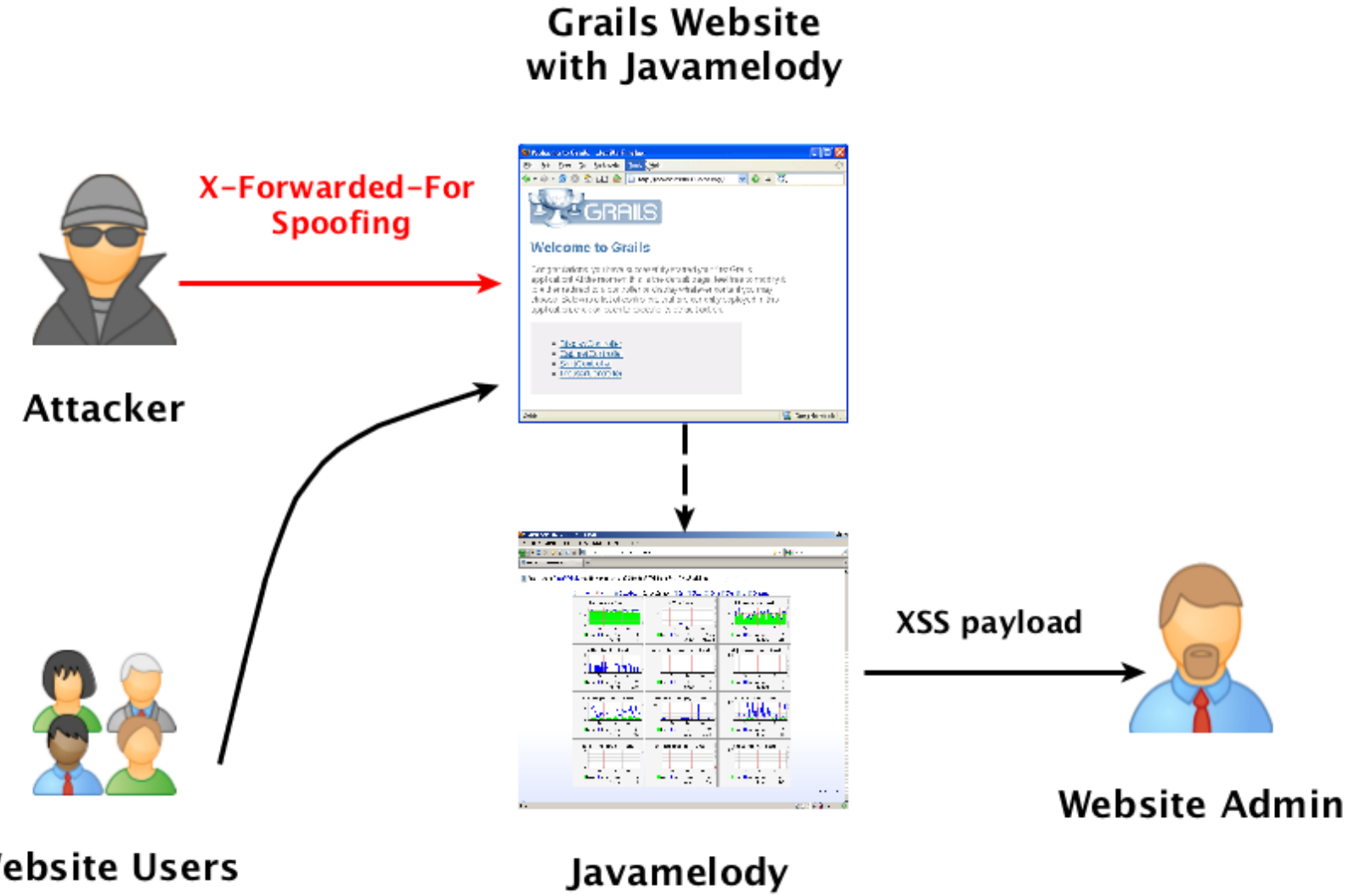

Solutions: What options do we have?

Think like an attacker

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- According to your grails version
- Find unescaped values
- Use fuzzers
- Read and understand Samy code
- Review OWASP XSS cheatsheets

Be aware

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- Review your Grails app to double-check how all dynamic content gets escaped
- Monitor for suspicious traffic
- Spread the knowledge
- Review available security plugins for Grails

Automated security tests

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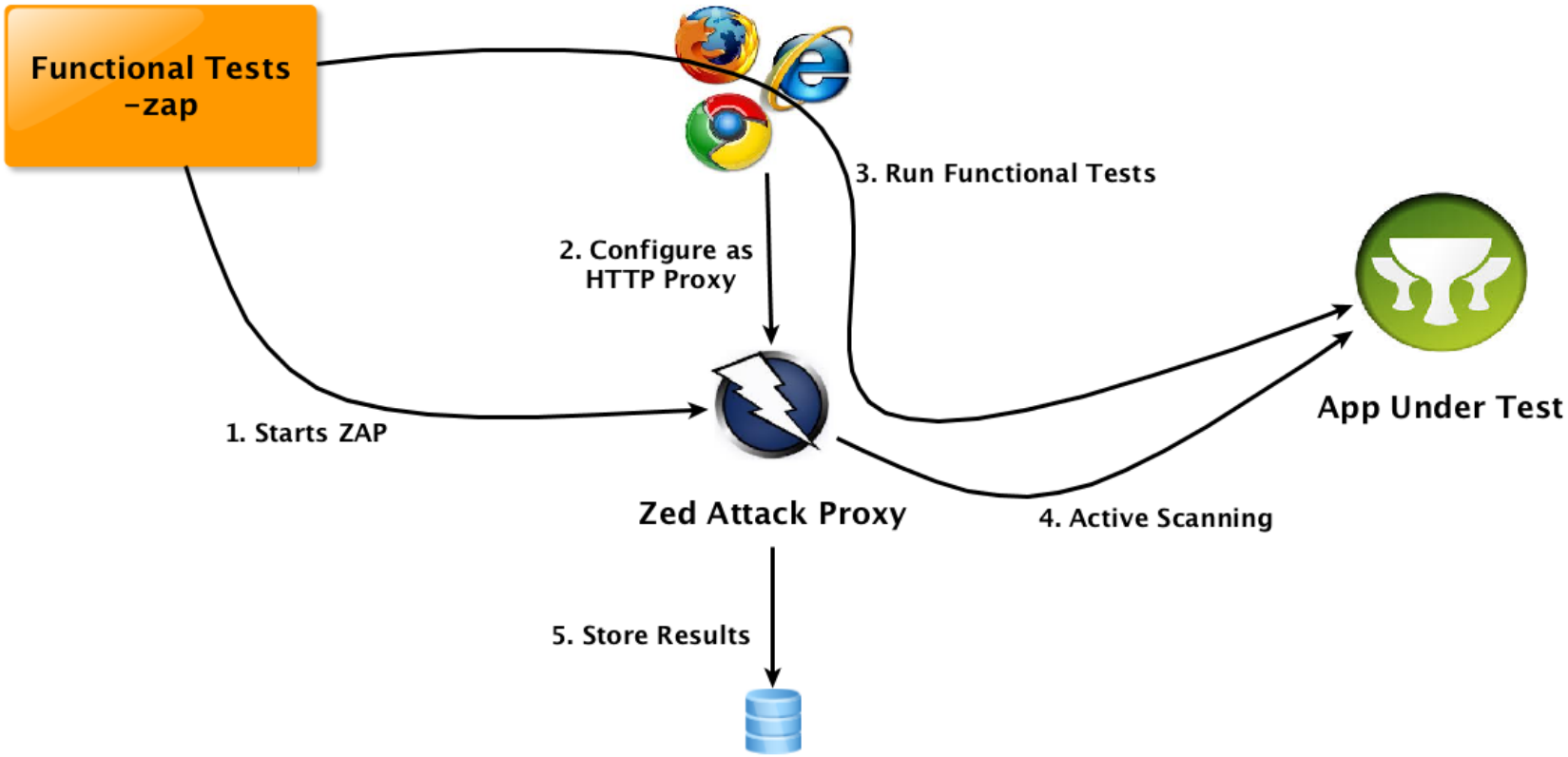
- **ZAP Security Tests plugin** for Grails.



Application firewalls

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- Enable common, safe rules

Application firewalls

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- Enable common, safe rules
- Log unexpected traffic

Application firewalls

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- Enable common, safe rules
- Log unexpected traffic
- Don’t fool yourself

- CSP: Content Security Policy
- Adds headers to disable default behavior
  - inline Javascript
  - dynamic code evaluation
- Still a Candidate Recommendation of W3C

Conclusions: Grails can defeat XSS

Grails

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- Is able to defend our application from XSS attacks

Grails

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- Is able to defend our application from XSS attacks
- But we need to pay attention to the details

Grails

R. Luque & J. San Leandro

- Is able to defend our application from XSS attacks
- But we need to pay attention to the details
- Upgrade to 2.3 ASAP

Grails

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- Is able to defend our application from XSS attacks
- But we need to pay attention to the details
- Upgrade to 2.3 ASAP
- Pay attention to XSS

XSS

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- Is much more dangerous than defacement jokes

XSS

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- Is much more dangerous than defacement jokes
- The browsers are the actual target

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- Is much more dangerous than defacement jokes
- The browsers are the actual target
- Difficult to monitor

XSS

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- Is much more dangerous than defacement jokes
- The browsers are the actual target
- Difficult to monitor
- Unconfortable counter-measures in the browser: NoScript, Request Policy

Wake up

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- Write secure applications by default

Wake up

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- Write secure applications by default
- Get yourself used with Metasploit, Burp, ZAP

Wake up

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- Write secure applications by default
- Get yourself used with Metasploit, Burp, ZAP
- Spread the word both horizontally and vertically

Picture credits

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