Too Big to Fail

Breaking WordPress Core

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What is WordPress?

- A CMS/blogging platform
- **The most popular in the world**
    - ~60% market share
- **One of the most secure Web Apps in the world**
    - No SQLI/LFI/RCE for the past **4 years**
        - *Plenty of plugin vulnerabilities, though*

What Did We Find In WordPress?

- A **Privilege Escalation attack**
  - **Any subscriber can become an author**
- An **SQL Injection**
  - **Compromising the database**
- A **Persistent XSS**
  - **Executing arbitrary JS on all privileged users**

- **Basically, complete compromise of both the server and the clients**

- *For the full, detailed, white paper, please see:*
  - *http://blog.checkpoint.com/tag/wordpress/*

How WordPress Works

- Any user can access the admin panel
  - But using a capabilities system, not every admin page

	Subscriber	Administrator
read_page	✓	✓
read_post	✓	✓
edit_posts	✗	✓
install_themes	✗	✓
edit_plugins	✗	✓

Exploiting The Un-Exploitable

- We assume we are subscribers at the site
  - The lowest role possible
  - We can only read public posts and pages
    - *Can't even comment*

- We need more capabilities!

Exploiting The Un-Exploitable

- How does WordPress check our capabilities?

```
if(current_user_can('edit_posts')) // Can we edit posts?
```

```
if(current_user_can('edit_post', 1)) // Can we edit post ID 1?
```

- Each role has specific permissions
- ‘*current_user_can()*’ maps a requested capability into the appropriate role permission
  - And returns true/false based on our permissions

- **But how?**

Exploiting The Un-Exploitable

- Let’s look on the “*edit_post*” capability check
  - *Responsible for checking if the user can edit a specific post*

```
case 'edit_post': // Edit Post/Page
case 'edit_page':
        $post = get_post( $args[0] ); // Get the post

        // If the post doesn't exist, no capabilities needed
        if ( empty( $post ) )
                break;
```

- If the post ID doesn’t exist => no permissions needed!

Exploiting The Un-Exploitable

- We can access code that checks capabilities for a post ID, but doesn’t check it exists
- But we want to be able to edit a post that **does exist**!

- How can we do that?

The Need For Speed

- Using the capabilities bug, we could access the post editing code

```
function edit_post( $post_data = null ) {
    if ( empty($post_data) )
        $post_data = &$_POST;

    $post_ID = (int) $post_data['post_ID']; // Get the post ID
    $post = get_post( $post_ID ); // Get the post
    …
    $success = wp_update_post( $post_data ); // Update the post
in the DB
}
```

The Need For Speed

- But before the DB update occurres, a post ID validation check takes place

```
function wp_update_post($postarr = array(), $wp_error = false){
    // First, get all of the original fields.
    $post = get_post($postarr['ID'], ARRAY_A);

    if ( is_null( $post ) ) {
        if ( $wp_error )
            return new WP_Error('invalid_post', 'Invalid post');
        return 0;
    }
    ...
}
```

The Need For Speed

- **We’re stuck :(**

- We need an **INVALID** post ID for ‘*edit_post()*’
- But a **VALID** post ID for ‘*wp_update_post()*’

- Wait…
- **What if we could create the post between these function calls?**

The Need For Speed

- WordPress doesn’t allow subscribers to **create a post**

- In fact, when we try to do so it **blocks** our access by calling ‘*wp_dashboard_quick_press()*’:

```
switch($action) {
case 'post-quickdraft-save':
    if ( ! current_user_can( 'edit_posts' ) )
        $error_msg = "You don’t have access to add new posts.";

    // If there’s an error (no token, no capabilities)
    if ( $error_msg )
        return wp_dashboard_quick_press( $error_msg );
```

The Need For Speed

- But what does *‘wp_dashboard_quick_press()’* do?

- It creates a post.

```
function wp_dashboard_quick_press( $error_msg = false ) {
       ...
       $post = get_default_post_to_edit( 'post' , true);
       ...
}
```

The Need For Speed

- Now we can create a post
  - **But how do we create it exactly at the right time?**
- **We will delay the script**
  - By executing a lot of DB queries

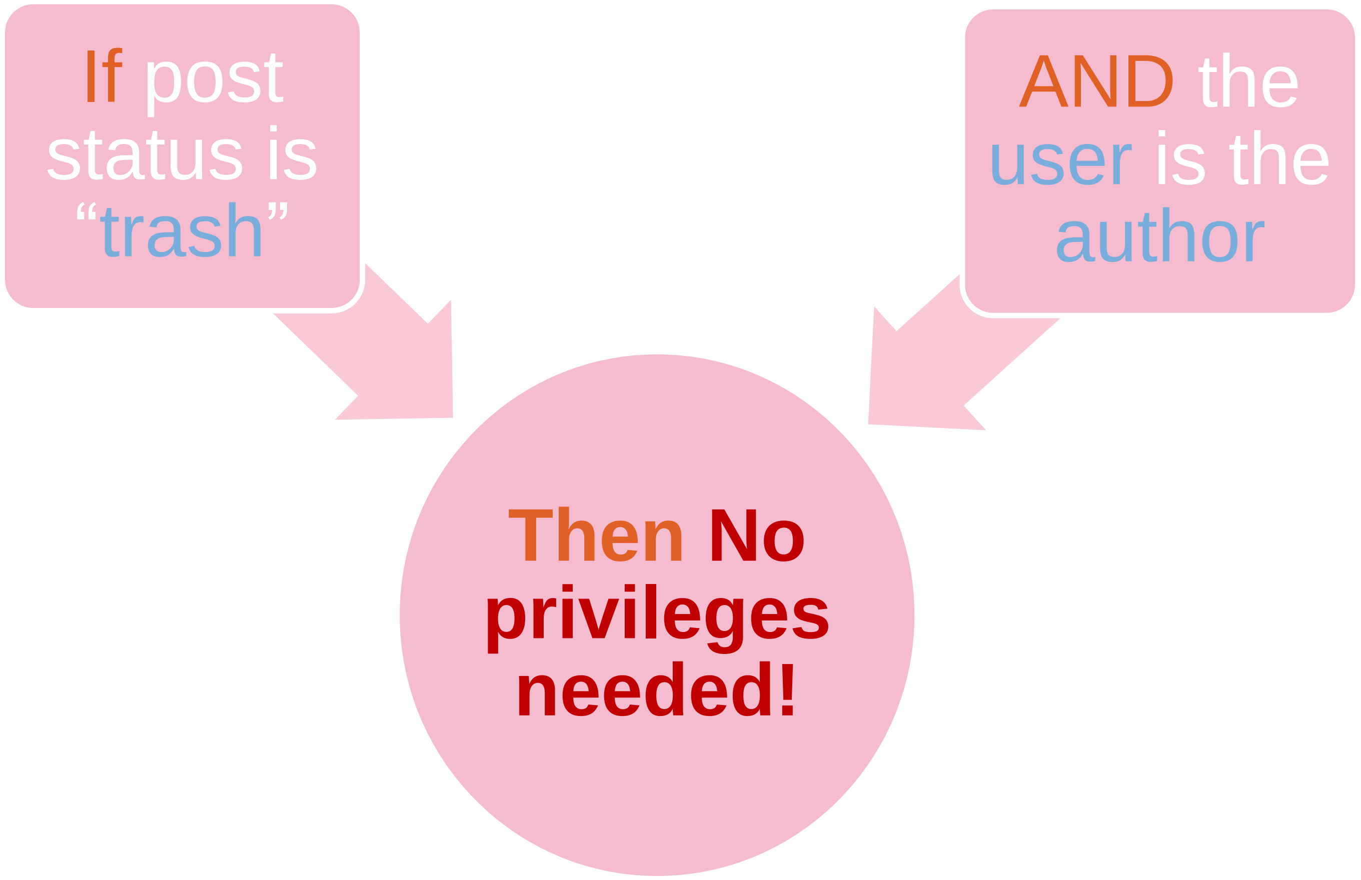
```
foreach ((array) $post_data['tax_input'] as $taxonomy => $terms) {
    // Make sure the terms variable is an array
    $terms = explode(',', trim( $terms, " \n\t\r\0\x0B," ) );

    // Fetch the required terms from the DB
    foreach ( $terms as $term ) {
        $_term = get_terms( $term ) );
    }
}
```

The Need For Speed

- Using the race condition, we were able to **edit a real post**
  1. We send an “edit post” request for an invalid post ID
     - With our large taxonomy array
  2. While the script executes, we send a “create post” request, which creates that post
  3. When the taxonomy queries are done, the post already exists in the DB
     - Allowing us to update it as we wish

I’m an Author!

- **We can now edit the post data**
  - We change its status to “trash”


If post status is “trash”
AND the user is the author
Then No privileges needed!

I’m an Author!

- What now?
  - Editing posts doesn’t compromise anyone

- **We need to leverage this new attack surface**

All Your Shortcodes Are Belong To Us

- **WordPress validates the post content for XSS**
  1. It uses KSES for HTML validating
  2. Then, it expands shortcodes and validates them too
  3. The resulting HTML is displayed as is

- **Wait…**
  - WordPress FIRST validates the HTML
  - THEN it expands shortcodes, which adds **more HTML**

- **Let’s dig into that behavior**

All Your Shortcodes Are Belong To Us

- Regular link HTML:

```
<a href="http://4chan.org/b/" title='OK'></a>
```

- Regular shortcode:

```
[gallery ids="729,732,731,720" order='DESC']
```

- KSES **only** validates the link HTML
- Shortcodes **only** validate the shortcode HTML
- **2 different mechanisms**
  - Validating the same thing
    - In different context!

All Your Shortcodes Are Belong To Us

- **Let’s combine the two mechanisms!**

- This shortcode text:

```
[caption width='1' caption='TEST']
```

- Will result in this HTML:

```
<figcaption class="wp-caption-
text">TEST</figcaption>
```

All Your Shortcodes Are Belong To Us

- **Let’s combine the two mechanisms!**

- This shortcode text:

```
[caption width='1' caption='<a href="''">]
```

- Will result in this HTML:

```
<figcaption class="wp-caption-text"><a href="
</figcaption>
```

All Your Shortcodes Are Belong To Us

- **Let’s combine the two mechanisms!**

- This shortcode + HTML text:

```
[caption width='1' caption='<a href="''">]</a><a
href=" onClick='alert(1)'">
```

- Will result in this HTML:

```
<figcaption class="wp-caption-text"><a href="
</figcaption></a><a href=" onClick='alert(1)'"></a>
```

- **Bingo!**
- Persistent XSS on the site’s front page

Delete Me If You Can

- Now we can **compromise** the clients
- But we want to **break** the **server** too

- **We need a server side vulnerability!**

Delete Me If You Can

- **We can add comments to our post**
  - We can edit them
  - We can delete them
  - We can restore them
  - We can **approve** them

- Approving a comment means changing the "comment_approve" DB field
  - We can set that field to whatever we want

Delete Me If You Can

- When we delete a post, its comments are deleted too
  - Actually, their “comment_approve” value is changed

- When we restore a post, its comments are restored too
  - Actually, their “comment_approve” value is restored

- **But how does WordPress know which values to restore?**

Delete Me If You Can

- When we delete a post, its comments approve value is stored in the post metadata
- When we restore a post, its comments approve value is assigned using that metadata

Delete Me If You Can

- Than, this code happens:

```
function wp_untrash_post_comments( $post_id ) {
    // Get the previous comments status from the post meta
    $statuses = get_post_meta($post_id,'trash_meta_comments_status');

    // Set the comments status to what is was prior to the trashing
    foreach ( $statuses as $status => $comments ) {
        // Update the comments status
        $wpdb->query( "UPDATE $wpdb->comments SET comment_approved = 
'$status' WHERE comment_ID IN ('" . $comments . "')" );
    }
}
```

- **We control the status**
- **We control the SQL ;)**

PWNGE Sum Up

- We used a race condition to cause a **privilege escalation**
- We used 2 faulty HTML validators to cause **an XSS**
- We used a broken restore mechanism to cause **an SQL Injection**

- **So long WordPress security**
  - **You will be missed <3**

Who uses WordPress?

- **Sony** / Best Buy / Ford
- **BBC** / The NYT / The Wall Street Journal
- **US Army** / NASA / Sweden

- **70 million more websites!**

WordPress’s Significance

- **Huge client reach**
  - 30% more visitors than Amazon!
- **It stores sensitive data**
  - Passwords, emails, address
  - Some plugins support credit card storage!

- **All in all, WordPress handles 126 Million unique visitors per month**

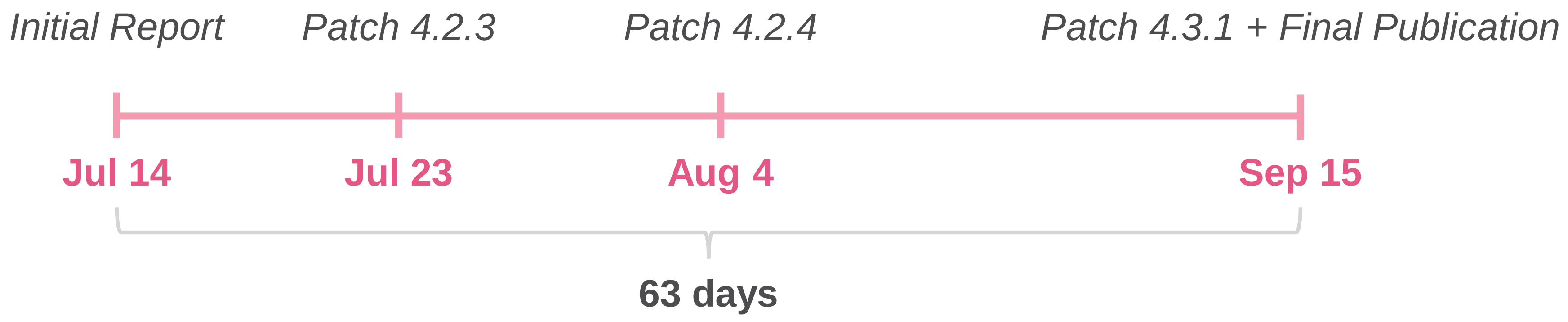
Have you reported it?

- **Yes.**
- We reported to WordPress's security contact
  - Provided a full technical description including suggested fixes

- The vulnerabilities were assigned 4 CVEs
  - CVE-2015-5623 – Subscriber Privilege Escalation
  - CVE-2015-2213 – SQL Injection
  - CVE-2015-5714 – Shortcode XSS
  - CVE-2015-5715 – Post Publish Privilege Escalation

Have they fixed it?

- **Yes.**
- WordPress fixed the issues using 3 patches
  - Approximately 2 months from disclosure to final fix



Summary

- Even if it’s responsible for 126M users a month
- Even if governments use it
- Even if it’s **THE** Web Platform

- **It seems no code is secure**

Thanks!