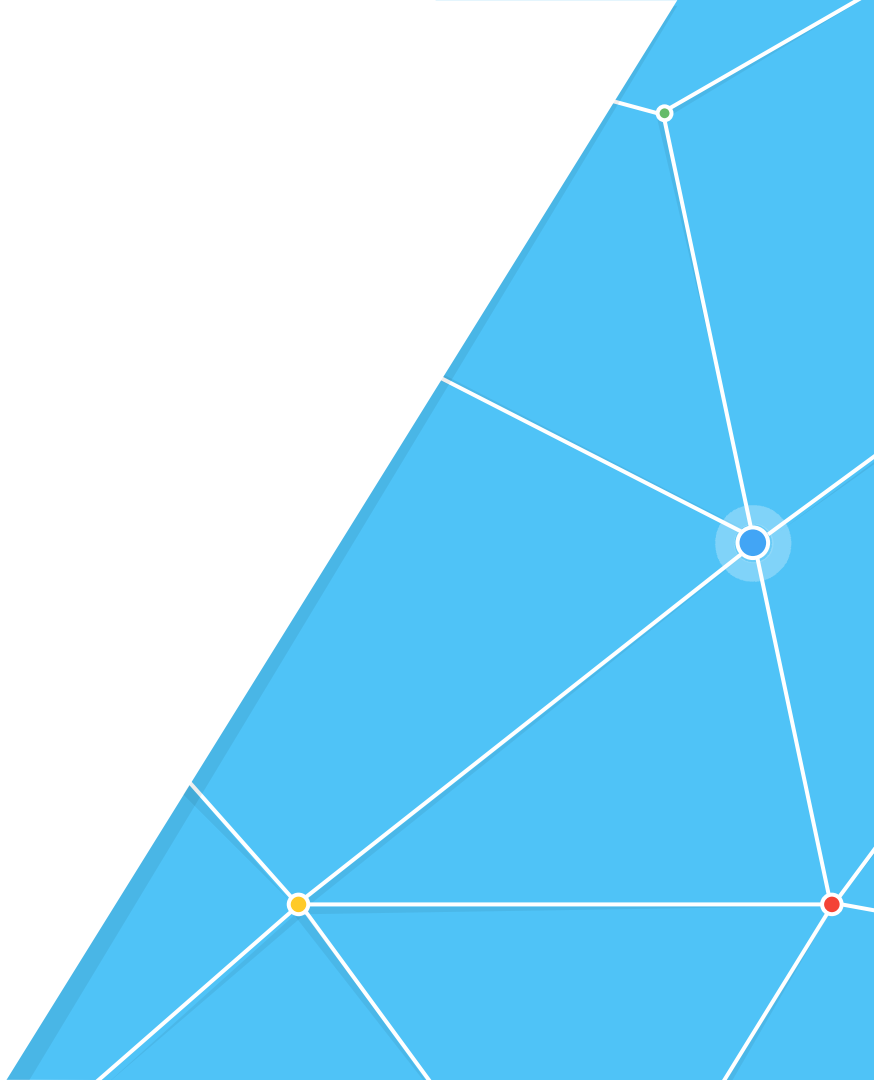
Research at Google

The Anatomy of Account-Takeover

Grzegorz Milka (grzegorzmilka@google.com)



Online accounts are valuable targets

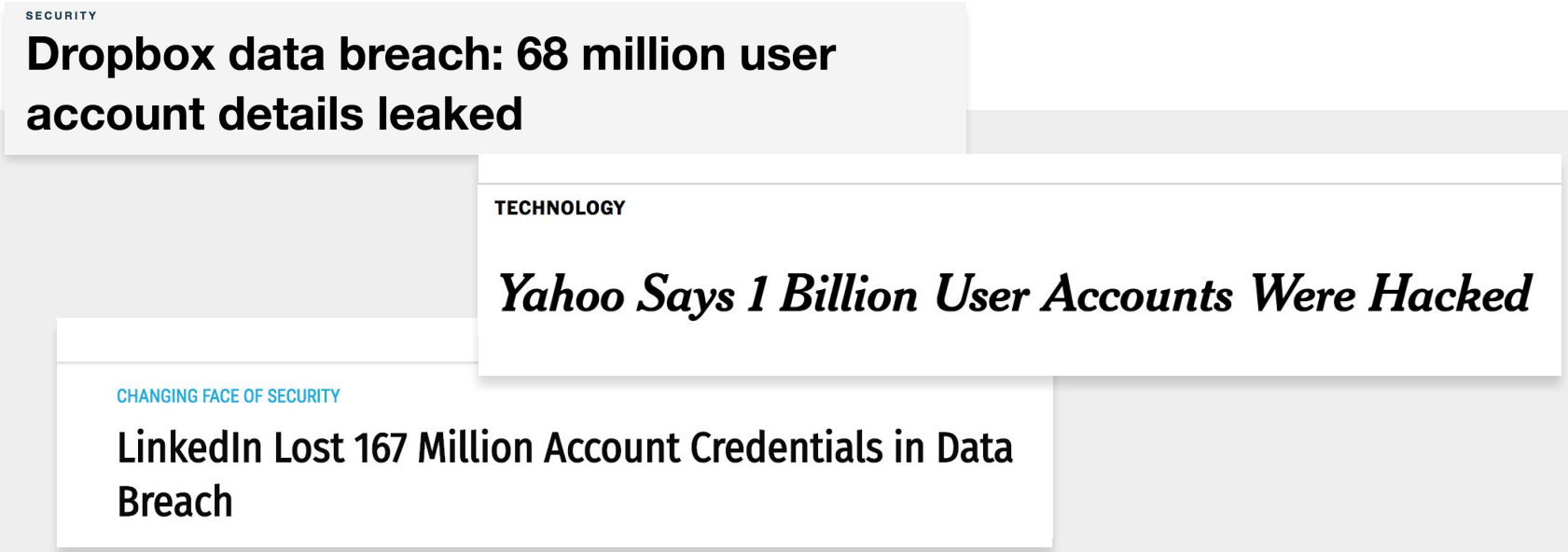
Financial data

Personal data

Contacts

Identity
(impersonation)

Data breaches are always there



And so are targeted hijacks

https://techcrunch.com/2017/08/23/i-was-hacked/

We want to protect **all users,**
and today we discuss
passwords.

Key takeaway

Modern password authentication requires a **risk-aware, defense-in-depth** system.

Password theft ecosystem

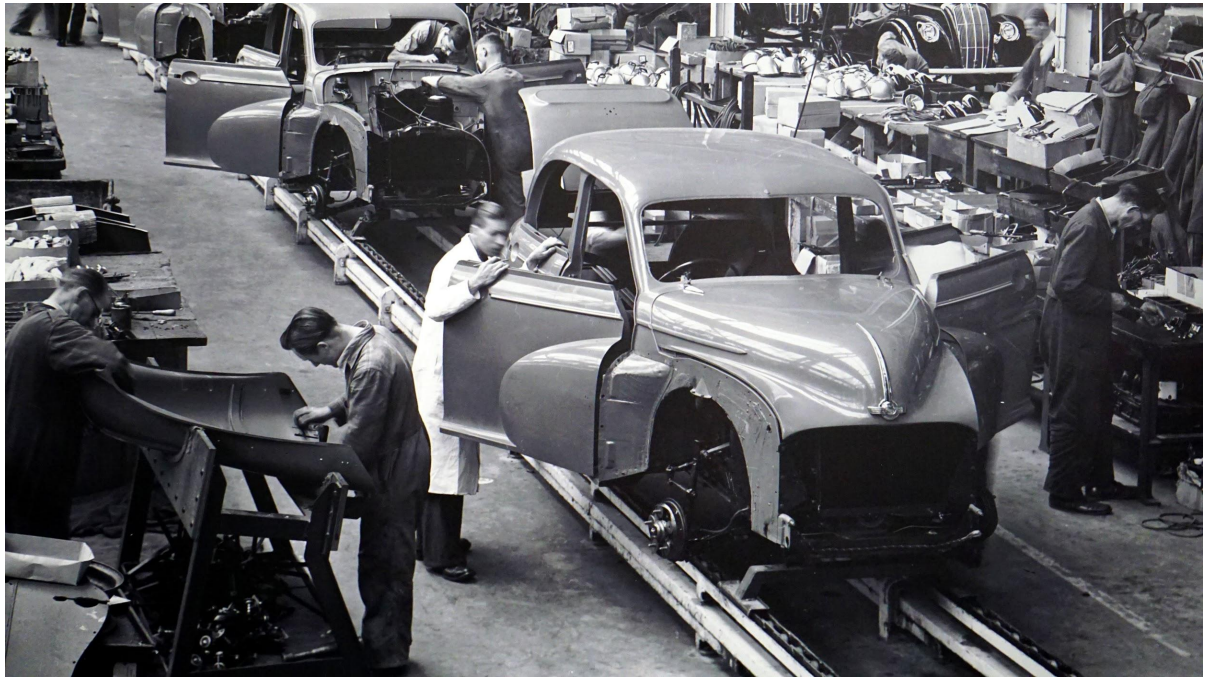
The three avenues of password theft

Data breach

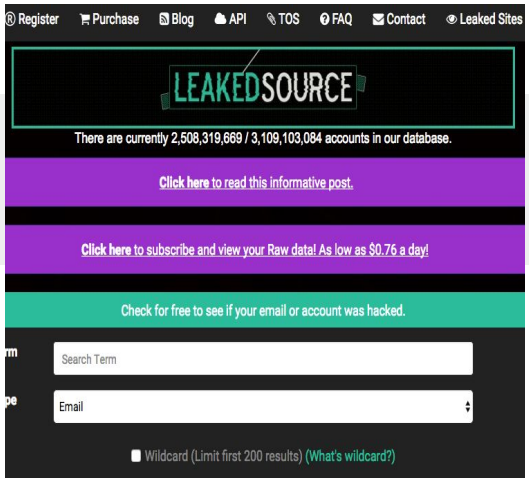
Malware (Keyloggers)

Phishing

Commoditization of abuse

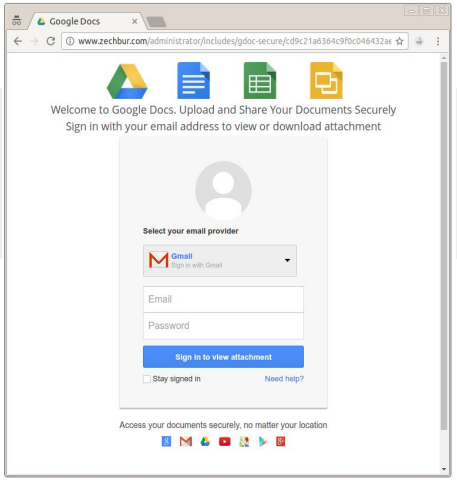


The wares on sale



Data breach market

Keyloggers



Phishing kits

Markets can be tracked

In 2016, we have collected over **4000** data breach dumps with over **3.3B** credentials.

Users reuse passwords

12%-43%*

reuse rate

*”Data breaches, phishing, or malware?”

Users reuse passwords

17%*

reuse rate

* internal estimate

Number of valid Google passwords found in data breaches:

67 Million

Volume of credentials stolen in 2016*

Data breaches

>3.3B

Keyloggers

>1M

Phishing

>12M

*all services, lower bound

Hijacking likelihood*

Compared to a general active account, how much more likely it is that you will be a victim of hijacking if we know:

You were in a breach

Had a keylogger

Were phished

*lower bound

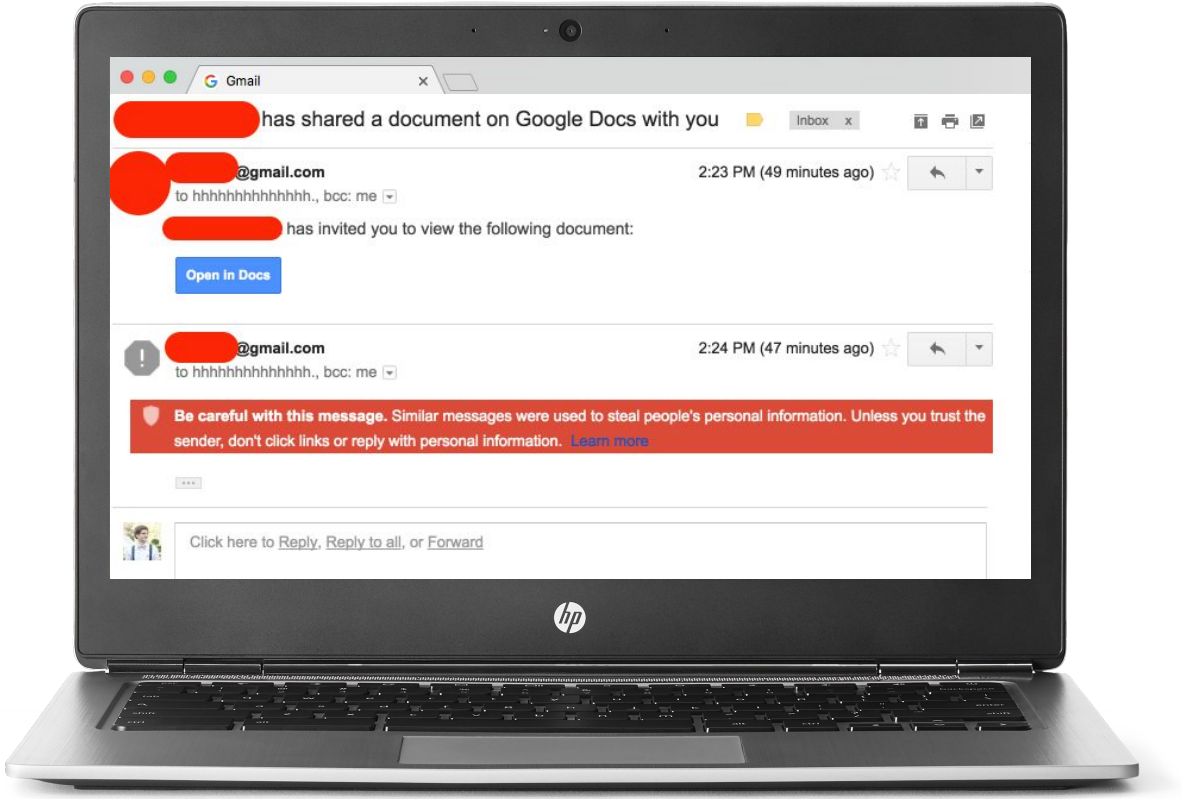
Prevention

Sign-in risk detection

Challenges

Key takeaway

Modern password authentication requires a risk-aware, **defense-in-depth** system.


Gmail
has shared a document on Google Docs with you
Inbox x
@gmail.com
2:23 PM (49 minutes ago)
to hhhhhhhhhhhhh., bcc: me
has invited you to view the following document:
Open in Docs
@gmail.com
2:24 PM (47 minutes ago)
to hhhhhhhhhhhhh., bcc: me
Be careful with this message. Similar messages were used to steal people's personal information. Unless you trust the sender, don't click links or reply with personal information. Learn more
Click here to Reply, Reply to all, or Forward

Safe Browsing

Deceptive site ahead

Attackers on [redacted] may trick you into doing something dangerous like installing software or revealing your personal information (for example, passwords, phone numbers, or credit cards). Learn more

☑ Automatically send some system information and page content to Google to help detect dangerous apps and sites. Privacy policy

DETAILS

Back to safety

We notify compromised users and ask them to change their password.

Prevention

Sign-in risk detection

Challenges

Password-only authentication is risky.

Adoption of additional security is low

<10%

2FA

Of active
Google accounts

~12%

Password managers*

Of Americans
*Pew Research Center

Sign-in risk detection

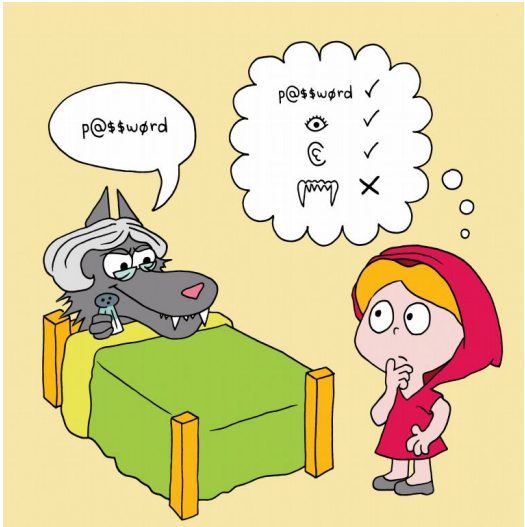


Image courtesy of Dr Frank Stajano, "Passwords and the Evolution of Imperfect Authentication"

Dimensionality of risk

How surprised we are to see you login like that?

Unusual location, device, time

How suspicious does the login look?

- Similarity to known hijacking patterns
- Is user at risk?

Hijackers adapt.

Geocloaking

```
$message .= "---------------+ Begin +-------------\n";
$message .= "Email    : ".$_POST['Email']."\n";
$message .= "Password : ".$_POST['Passwd']."\n";
$message .= "---------+ IP Address & Date +---------\n";
$message .= "IP Address: ".$ip."\n";
$message .= "Country: ".$country."\n";
$message .= "Date: ".$adddate."\n";
```

~83%

phishing kits

In the end, we don't look at user's location for many users.

Prevention

Sign-in risk detection

Challenges

Dynamic 2FA:
Ask for additional verification

When the sign-in is risky

That is solvable by the user

Key takeaway

Modern password authentication requires a **risk-aware,** defense-in-depth system.

2 things that can go wrong

Hijacker gets in

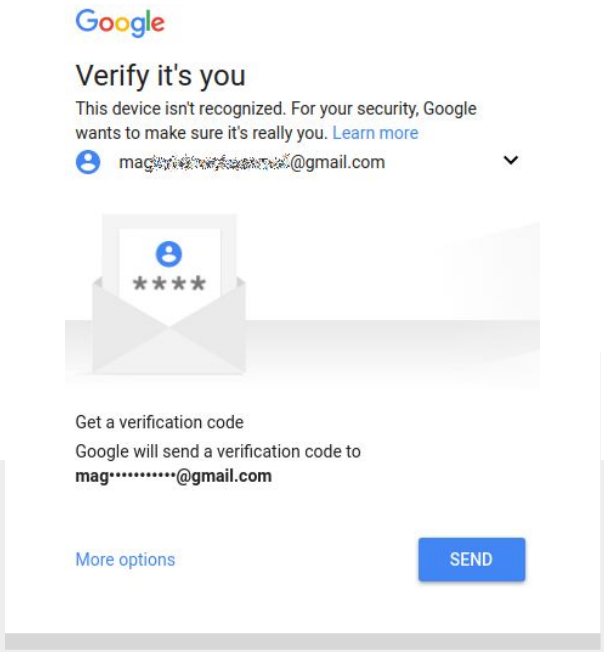
"The burglar" by Eastlake Times (https://goo.gl/yh4zyB), CC BY 2.0

"Try 'Open underscore sesame.'"

User is locked out

Choose the challenge that minimizes damage

Secondary e-mail verification

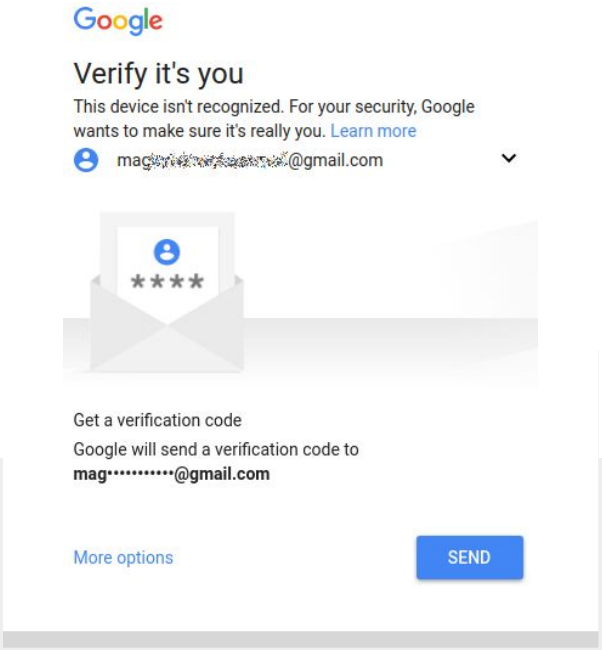


10%

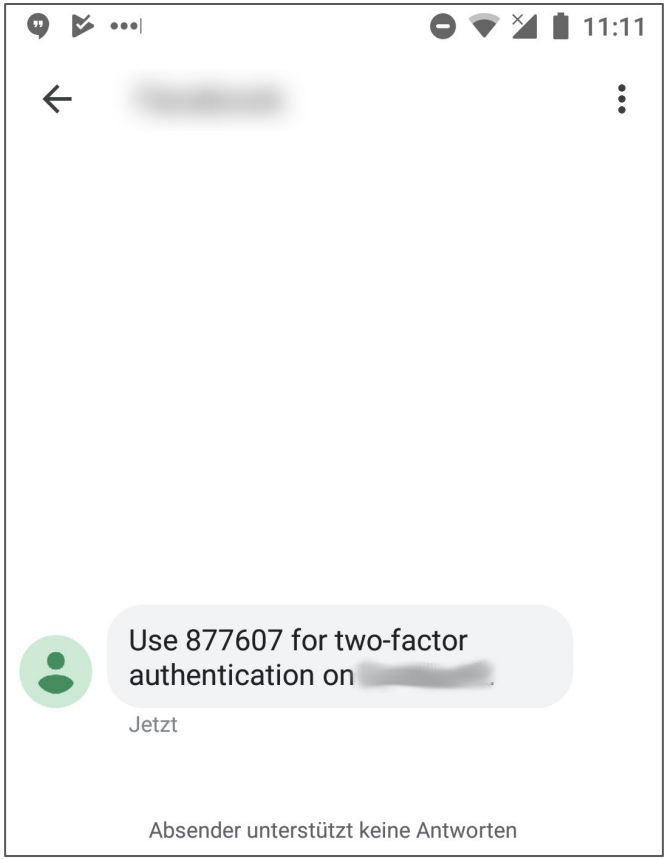
Of users

have problems passing this challenge

Secondary e-mail verification



Vulnerable to password reuse



SMS code

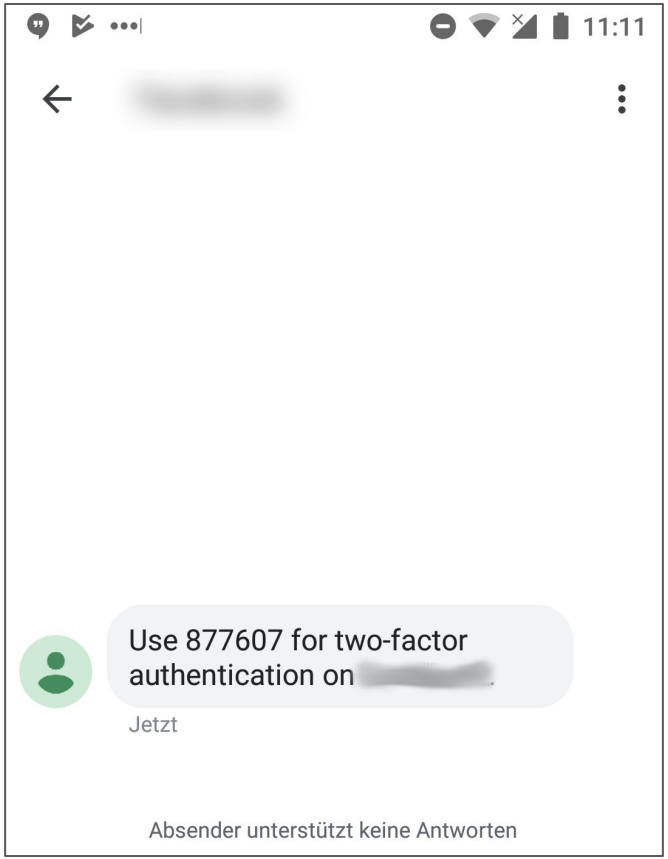
Vulnerable to phishing...

18% of observed phishing kits collect phone data.

... and other methods

There are multiple ways to get the SMS code besides phishing.

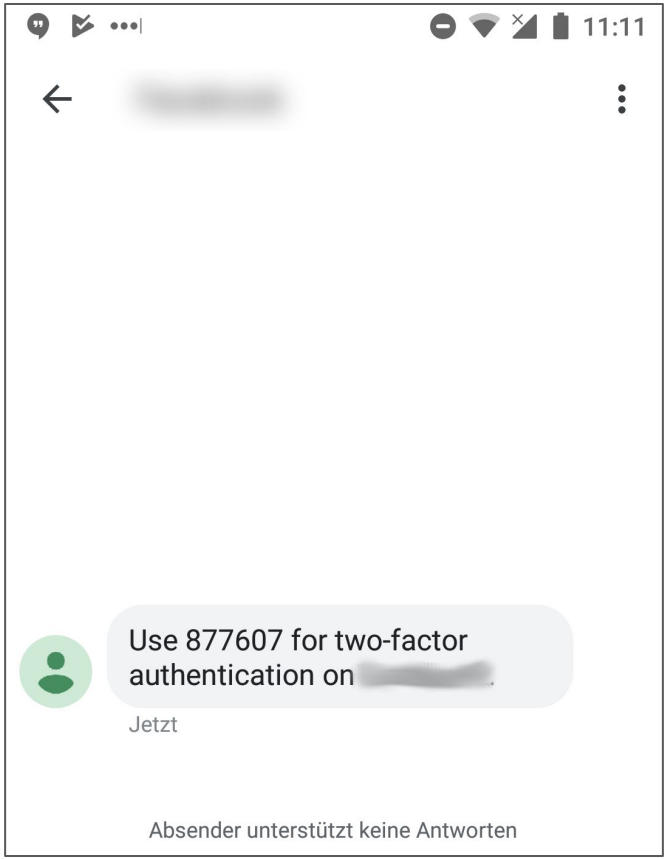
https://techcrunch.com/2017/08/23/i-was-hacked/



SMS code

Most successful hijackings of high-value 2FA-accounts involve breaking the SMS code.

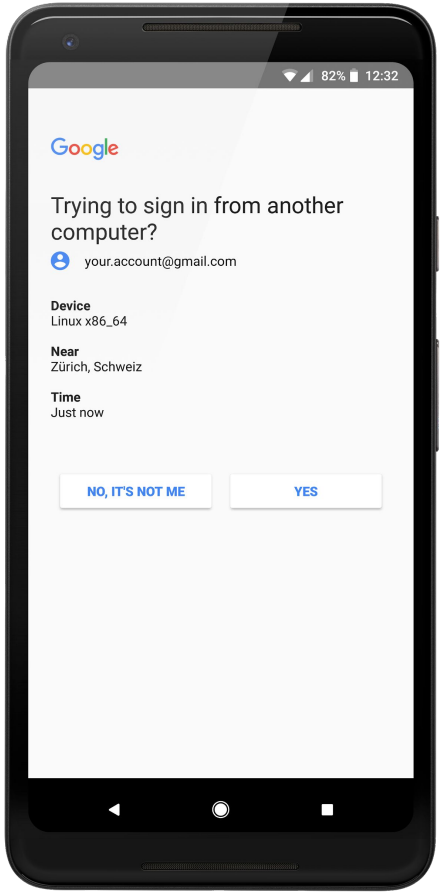
SMS code interception happens in targeted attacks as well as in opportunistic ones.



SMS code

"by January 2016, [the number of phone hijackings] had increased to **2,658**."

Lorrie Cranor, FTC Chief Technologist



Google Prompt

Nothing stops the user from just clicking “Yes”

More flexible

We can present more data and use additional signals for risk-analysis

In-session detection

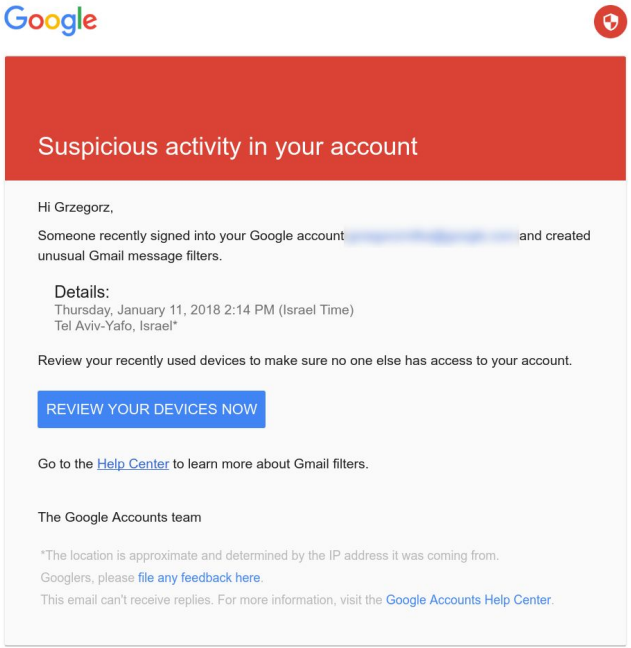
Hijacking monetization

Theft of personal data

Viral-phishing and scams

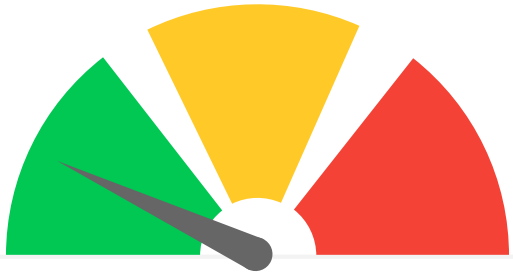
Spamming and product abuse

Bringing the user into the loop



Finding the hijacker in-session

```
20:54:24 | LOGIN (new)          |
20:55:51 | MAIL_DELETE          | 1 (new device notifn.)
```



Finding the hijacker in-session

```
20:54:24 | LOGIN (new)        |
20:55:51 | MAIL_DELETE        | 1 (new device notifn.)
21:01:30 | EXPORT_CONTACTS    |
```

Finding the hijacker in-session

```
20:54:24 | LOGIN (new)        |
20:55:51 | MAIL_DELETE        | 1 (new device notifn.)
21:01:30 | EXPORT_CONTACTS    |
21:06:45 | MAIL_SEND          | with phishing links
21:07:50 | MAIL_FILTER        | “hacked”->Trash
21:08:07 | LOGOUT             |
```

Key takeaway

Modern password authentication requires a **risk-aware, defense-in-depth** system.