
SBA
Research

COMET

Competence Centers for Excellent Technologies

Protect Your User Accounts Like It's 2019

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Bundesministerium Verkehr, Innovation und Technologie

Bundesministerium Digitalisierung und Wirtschaftsstandort

FFG Forschung wirkt.

wirtschaftsagentur wien Ein Fonds der Stadt Wien

FWF Der Wissenschaftsfonds.

netidee OPEN INNOVATIONS

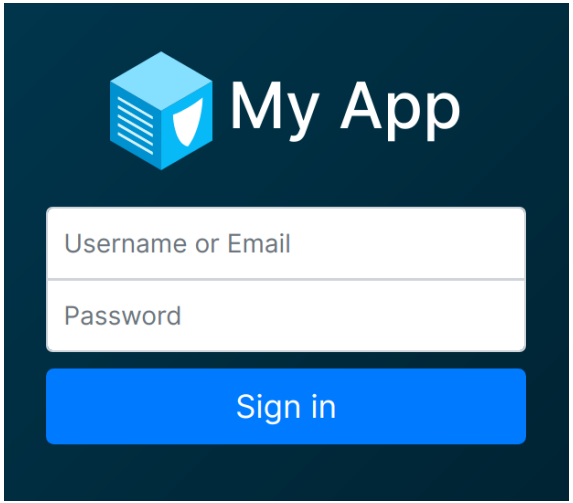
```
$ whoami
Thomas Konrad
$ id
uid=123(tom)
gid=0(SBA Research)
gid=1(Software Security)
gid=2(Penetration Testing)
gid=3(Software Development)
gid=4(Security Training)
```

Why Are We Here?

The starting point.

Some Assumptions

1. We're developing an **application** (web or mobile)
2. The application has **user accounts**
3. The processed data is at least somewhat **sensitive**
4. We have a **hard** time coming up with proper **account security solutions**



What Do We Want To Protect Against?

Motivations for account security measures

What do we strive for?

Image source: https://i2.wp.com/www.thesecurityawarenesscompany.com/wp-content/uploads/2015/05/CIAtriad-copy2.png?zoom=2.625&fit=2702%2C2448&ssl=1

A Basic Threat Model

Threat	Severity[1]	C/I/A	Countermeasures
Password guessing	**High**	C/I/-	?
Account lockout	**Medium**	-/-/A	?
Misuse of known passwords (public lists, other apps, ...)	**Medium**	C/I/-	?
Someone dumps the DB on the Internet	**Medium**	C/I/-	?
Enumerating valid user names	**Low**	C/-/-	?

[1] *The severity really depends on the classification of your data. Don't see them as absolute and unchangeable values.*

The Game Is On: Account Security Hammer Head

Image source: https://i.ytimg.com/vi/X4pSjBqbE0Y/maxresdefault.jpg

The C/I And The A

- In (account) security, these two are often **contradictory**
- Often, we have to find a **balance**
- **Password guessing** (C/I) vs. **account lockout** (A)

Thou Shalt Not Pass!

Protecting against credentials guessing attacks, a.k.a. “achieving the **C** and the **I**”

What Can We Do For The C And The A?

Gimme some ideas!

Image source: https://giphy.com/gifs/WilsonTennis-karen-khachanov-1o1iwQngXCF5guav2G

Password Policy

- NIST 800-63-3 Digital Identity Guidelines
- Major overhaul in June 2017

Password Policy

- **Current recommendations in a nutshell**
  - Nuke periodic changes 

  - Nuke complexity rules 

    - Only require a minimum length
  - **Screen passwords against compromised passwords**
  - Maximum length must be at least 64 cars 

  - Require MFA for high-privilege accounts

Image source: http://37wz5x2r8vbh3om46wmfhy71-wpengine.netdna-ssl.com/wp-content/uploads/2016/10/yeah-600px.png

Password Policy: Tips By NIST

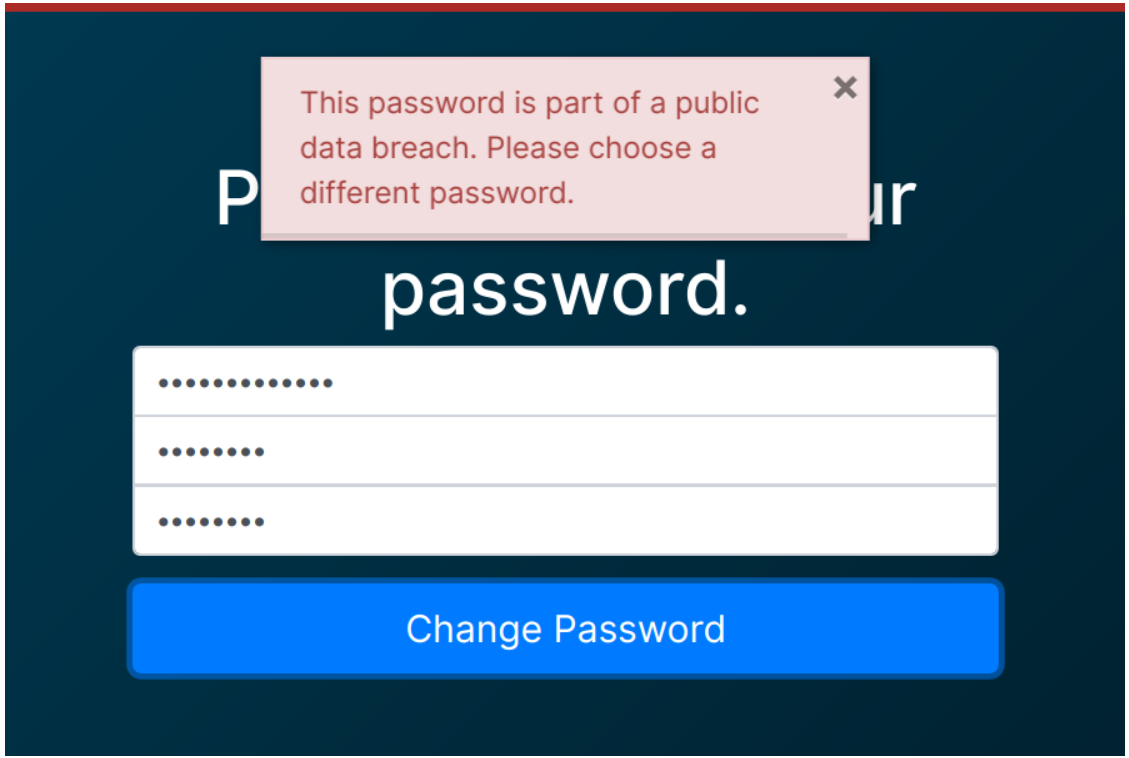
Password Policy: Screen Passwords

- Troy Hunt's Pwned Passwords API: https://haveibeenpwned.com/API/v2

```
GET https://api.pwnedpasswords.com/range/{first 5 hash chars}
```

```
0018A45C4D1DEF81644B54AB7F969B88D65:1
00D4F6E8FA6EECAD2A3AA415EEC418D38EC:2
011053FD0102E94D6AE2F8B83D76FAF94F6:1
012A7CA357541F0AC487871FEEC1891C49C:2
0136E006E24E7D152139815FB0FC6A50B15:2 ...
```

Password Policy: Screen Passwords



Use Proper Hashes

- Hash algorithms are designed to be **fast**
- If our DB gets breached, we wish they'd be **slow**
- **So how should we persist passwords?**
  - Use an algorithm that intentionally makes brute-force attacks slow
  - If you have the choice, use **Argon2**
  - **bcrypt** is ok, but has some pitfalls
  - **PBKDF2** is also ok

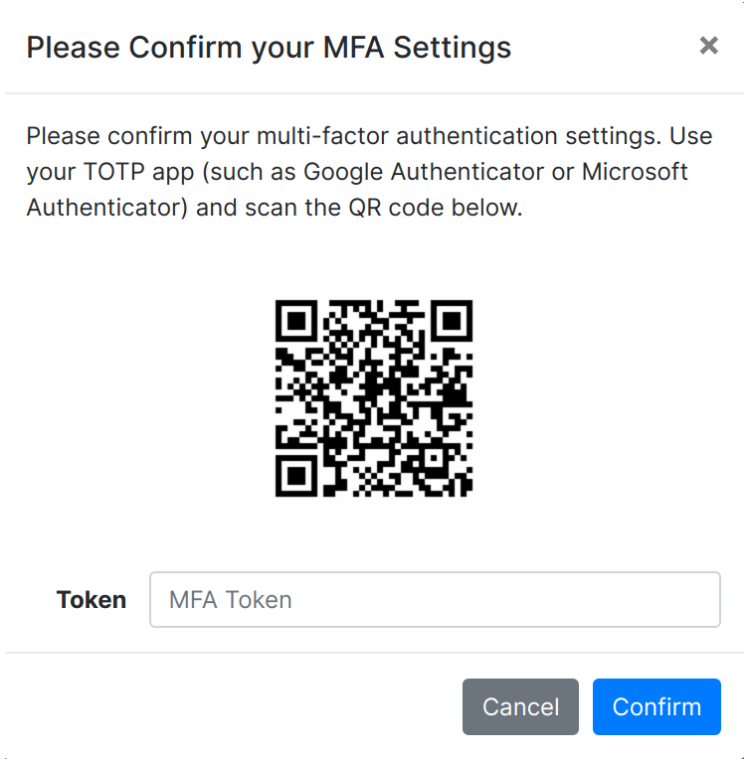
Lock Users After Too Many Failed Attempts

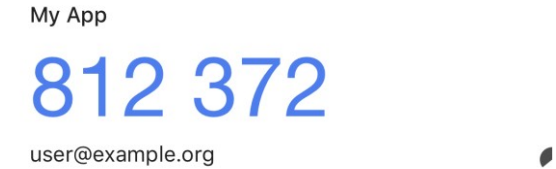
- **Soft lock** vs. **hard lock**
  - Soft == temporarily
  - Hard == permanently
  - **Have both implemented!**
- I'd generally recommend a **soft lock**
  - E.g., lock for 5 minutes after 5 wrong attempts
- But it really **depends on the C/I requirements**

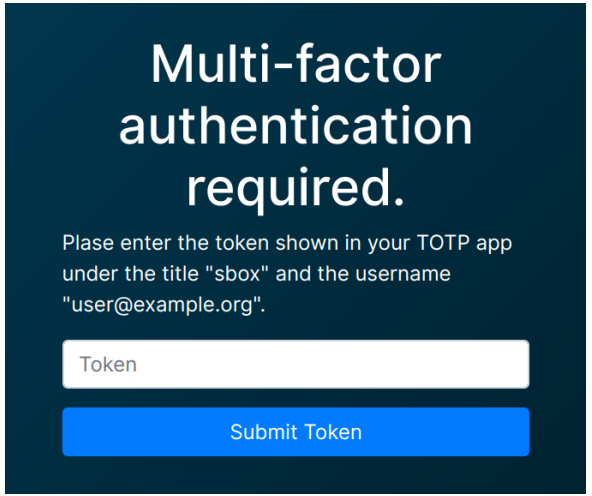
Multi-Factor Authentication

- Require not just user name and password, but also something else (optional, but mandatory for admins)
- Even if the credentials are breached, the attackers cannot log in
- **Some examples**
  - A one-time password sent via SMS
  - A TOTP app (e.g., Google Authenticator)
  - A hardware token
  - U2F

Multi-Factor Authentication: TOTP



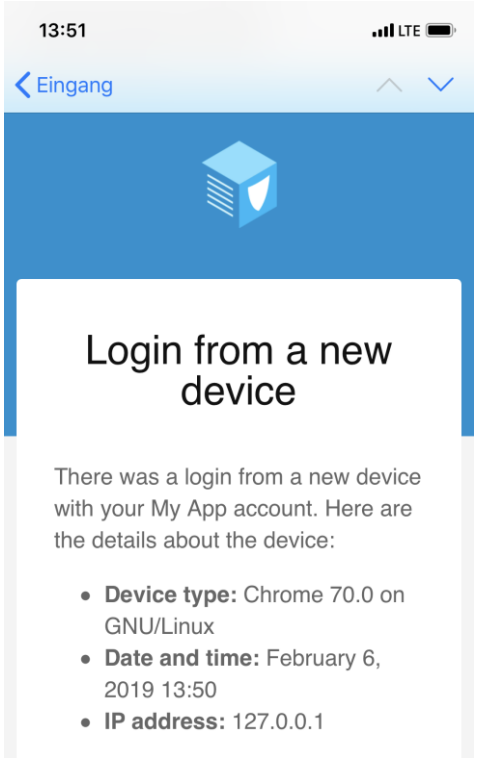




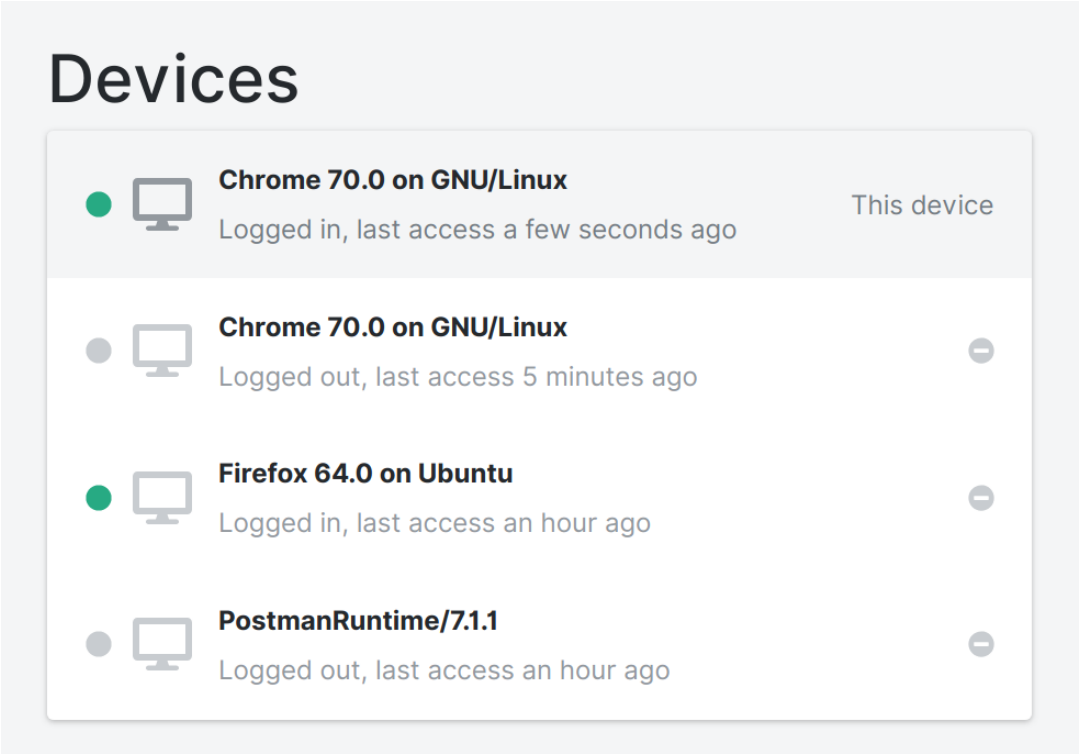
Transparency

- Even if we do all we can, there might still be malicious activity
- **If fishy things happen, we at least want …**
  - … the user to know it.
  - … have the ability to react on it.

Transparency: Notifications



Transparency: Device List



Transparency: How Do We Track Devices?

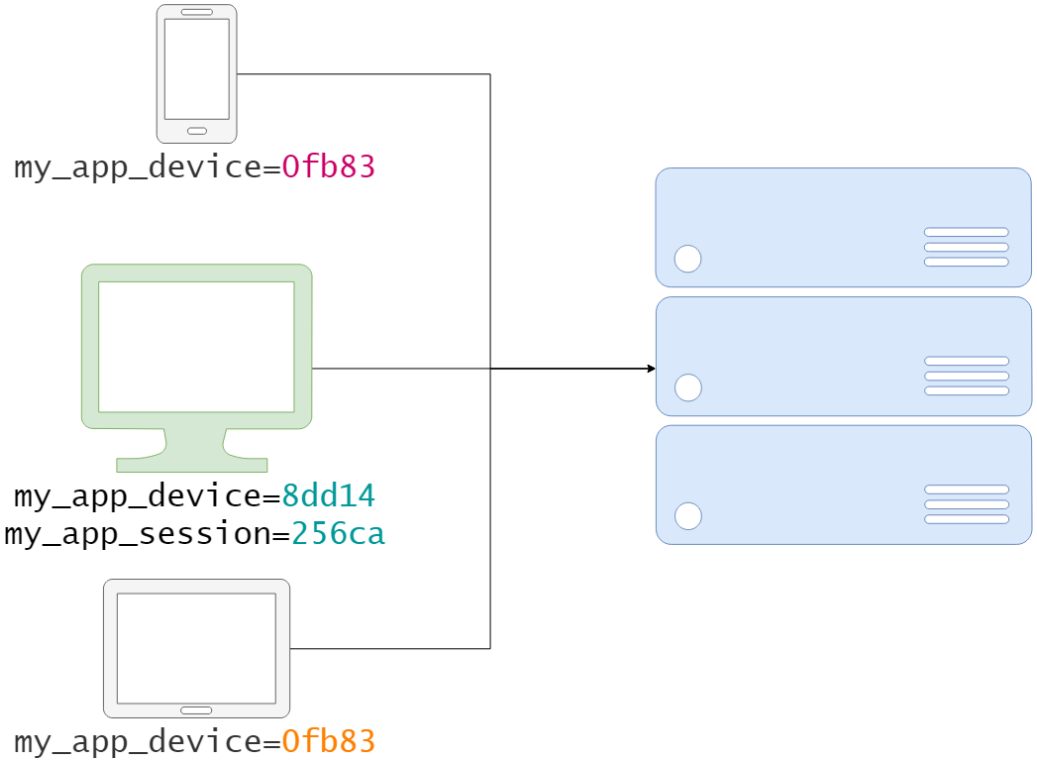
- With **Device Tokens** (Device Cookies)!

Name	Value
my_app_device	9d5f235ee236ab90dcb884d001…
my_app_session	pcippce933n26mrs2bqvp5fdr0

Detour: Device Tokens

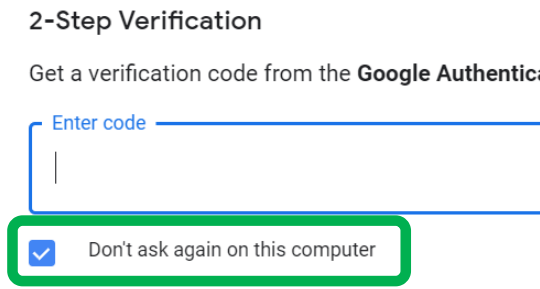
- **Device Tokens in a nutshell**
  - Catch *successful* login events
  - If this is a new device
    - Issue a Device Token
    - Send a notification (as you saw before)
  - The cookie (token) must be long-running
  - Connect the new session to it
  - Store source IP, user agent, first access, last access

Detour: Device Tokens

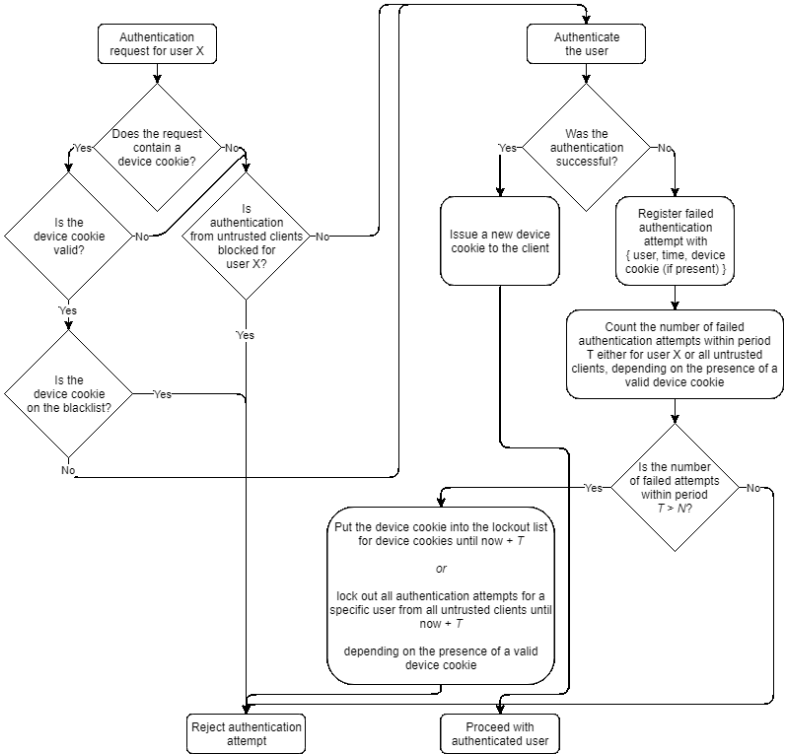


Detour: Device Tokens

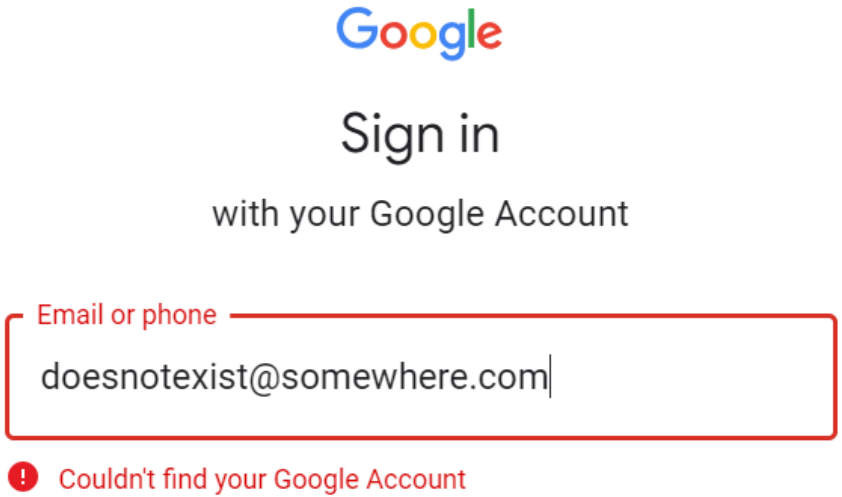
- **Device Tokens enable us to do tons of good things**
  - List devices (transparency, remember?)
  - Notifications upon a login from a new device (transparency, remember?)
  - Remember MFA for specific devices
  - Remember previously logged-in users
  - Slow down password guessing (you'll see later)
  - …
- **They are very helpful for good account security!**



Detour: Device Tokens



User Enumeration



User Enumeration

Google

Create your Google Account

First name: Somebody

Last name: Somewhere

Username: thomas.konrad@gmail.com

That username is taken. Try another.

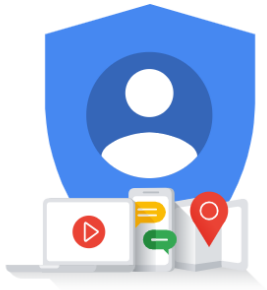
Available:

somewheres758 somewheresomebody677
somebodysomewhere05

Use my current email address instead

Password: ••••••••••••••••••

Confirm: ••••••••••••••••••



One account. All of Google working for you.

User Enumeration

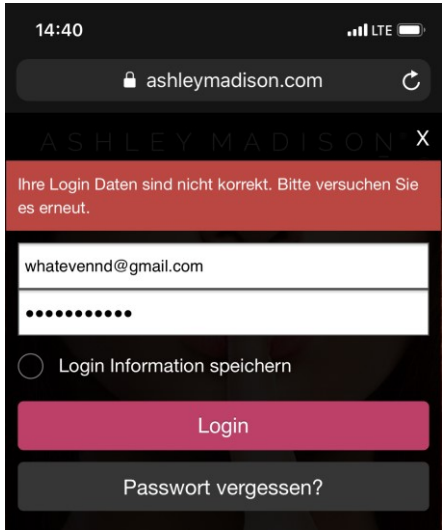
- ***Actually* protecting against user enumeration is *really hard***
  - Login form?
  - Login form after a user lockout?
  - Registration form?
  - Password reset?
  - Timing differences?
  - Other services that use the same user DB?
  - …

User Enumeration

- **It's mostly about error messages with really bad usability**
  - "Username and/or password wrong."
  - "Invalid credentials. Note that you might get locked out after too many failed login attempts."
  - "Password reset request received. If that account exists, you should have gotten an email with further instructions."

User Enumeration

- Again, this depends on the **sensitivity of the fact that somebody is registered**.
- Think "Ashley Madison vs. The Recipe Collection"
- **Sometimes, it is ok to accept the risk of user enumeration**



What Can We Do For The C And The I?

1. Use a good password policy
2. User proper hashes
3. Lock out users (hard lock vs. soft lock)
4. Multi-factor authentication (MFA)
5. Transparency (device lists, notifications)
6. Protect against user enumeration (?)

Thou Shalt Not Lock!

Keeping attackers from systematically locking out users, a.k.a. “achieving the **A**”

Preventing User Lockout

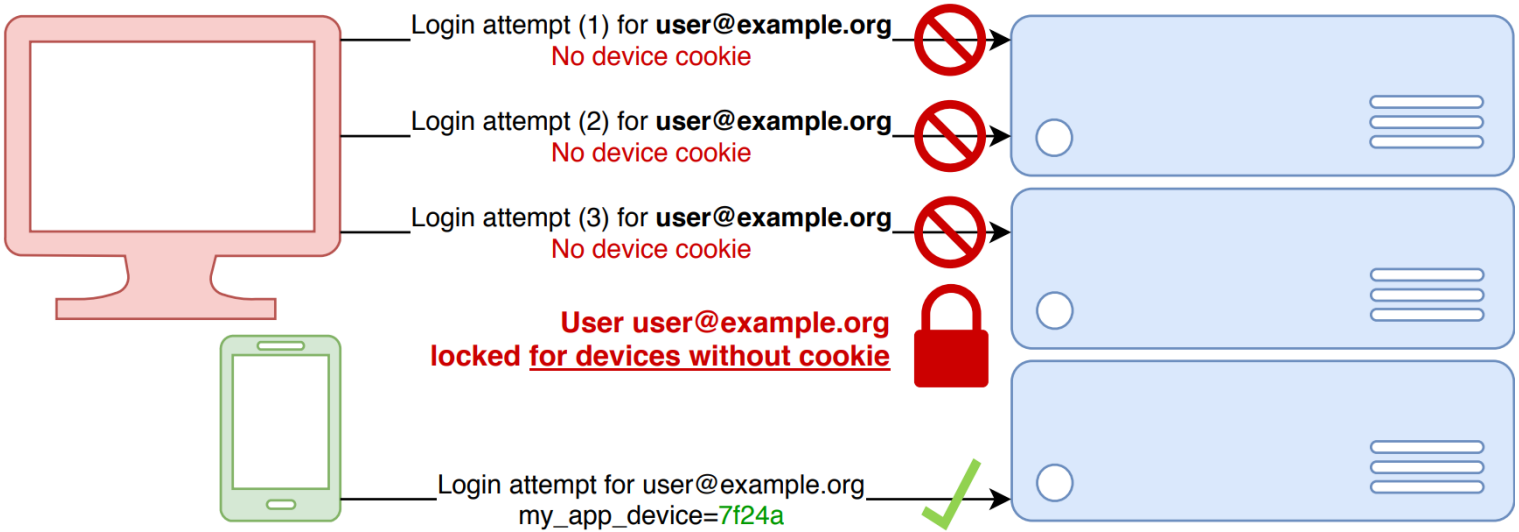
- **This is the harder part!**
- Remember the Hammer Head?

https://giphy.com/gifs/cuteness-Hnv3oVMOkmHiE

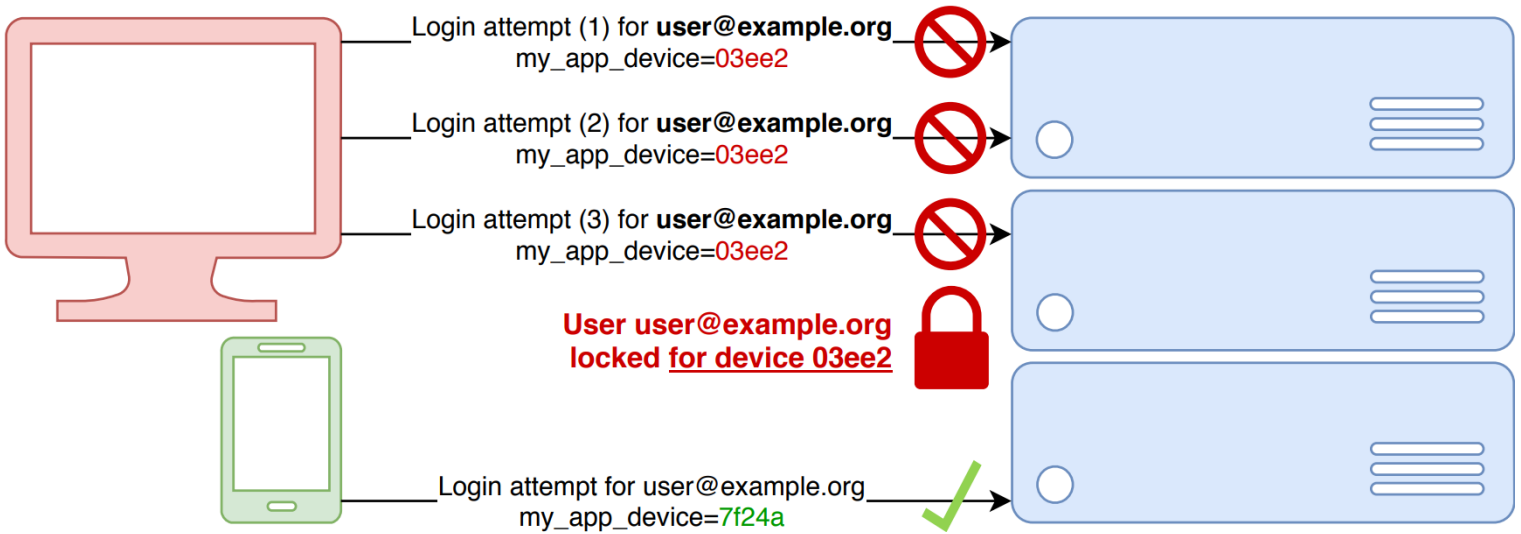
Preventing User Lockout: A Question Of Trust

Image source: https://www.supermarketguru.com/site/assets/files/6521/bakerycounter.jpg

Preventing User Lockout: A Question Of Trust



Preventing User Lockout: A Question Of Trust



Preventing User Lockout: The Pareto Principle

- You can **save most users** from being **locked out**
- But not 100 %!
- A note for apps with **public registration forms**
  - An attacker could register and issue themselves new device token via a script
  - Therefore: Count failed login attempts also for users and hard-lock them in case they’re attacking

Let's Update the Threat Model

What do all the countermeasures mean to our model?

A Basic Threat Model

Threat	Severity[1]	C/I/A	Countermeasures
Password guessing	**High**	C/I/-	(Temporary) user lockout, password policy, MFA, transparency (device lists and notifications, with Device Tokens)
Account lockout	**Medium**	-/-/A	Selective lockout (with Device Tokens)
Misuse of known passwords (public lists, other apps, ...)	**Medium**	C/I/-	MFA
Someone dumps the DB on the Internet	**Medium**	C/I/-	Proper hashes (Argon2)
Enumerating valid user names	**Low**	C/-/-	(Generic error messages, constant timing on all requests containing the user name)

[1] *The severity really depends on the classification of your data. Don't see them as absolute and unchangeable values.*

Advanced Countermeasures

Where to go from here

Advanced Countermeasures

- Geo IP blocking
- Heuristics
- Conditional CAPTCHA
- Conditional MFA
- …
- **A lot more can be cone, but think about taking this as a starting point!**

Account Security For End Users

How to minimize the risk of a data breach for yourself

Account Security For End Users

1. Use a password manager (not the browsers')
2. Don't re-use passwords
3. Turn on MFA where possible
4. Register on https://haveibeenpwned.com

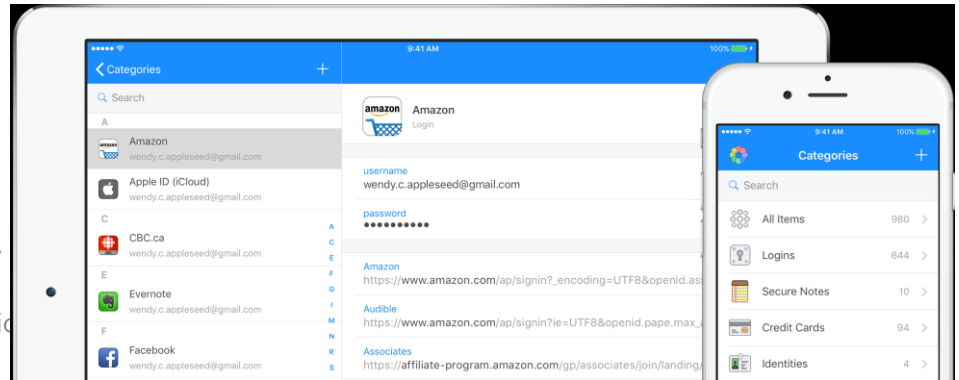


Image source: https://i.1password.com/media/ios-hero.png

Summing Up

Things to do for better account security

Summary

1. Define the **CIA requirements** for your data!
2. Do *your* **Threat Model**
3. Implement **Device Tokens**
4. Protect the **C/I** (password policy, proper hashes, lock users, (optional) MFA, transparency)
5. Protect the **A** (selective lock-out with Device Trokens)

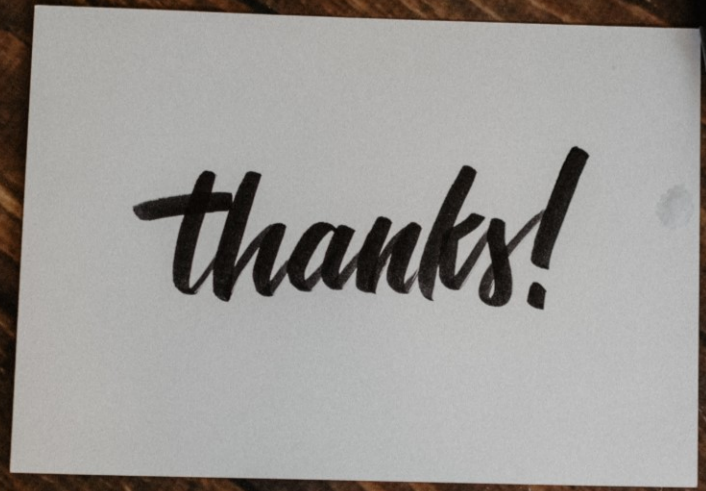


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Photo by Kelly Sikkema on Unsplash

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- Thank you all for being here!
- **Save The Date: 24 to 27 Feb 2020**
- **Let's build a community!**
  - Security Meetup by SBA Research (meetup.com)
  - Twitter: @sec4dev
- Please spread the world!


Thanks!
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