MANGO MESSENGER PROJECT

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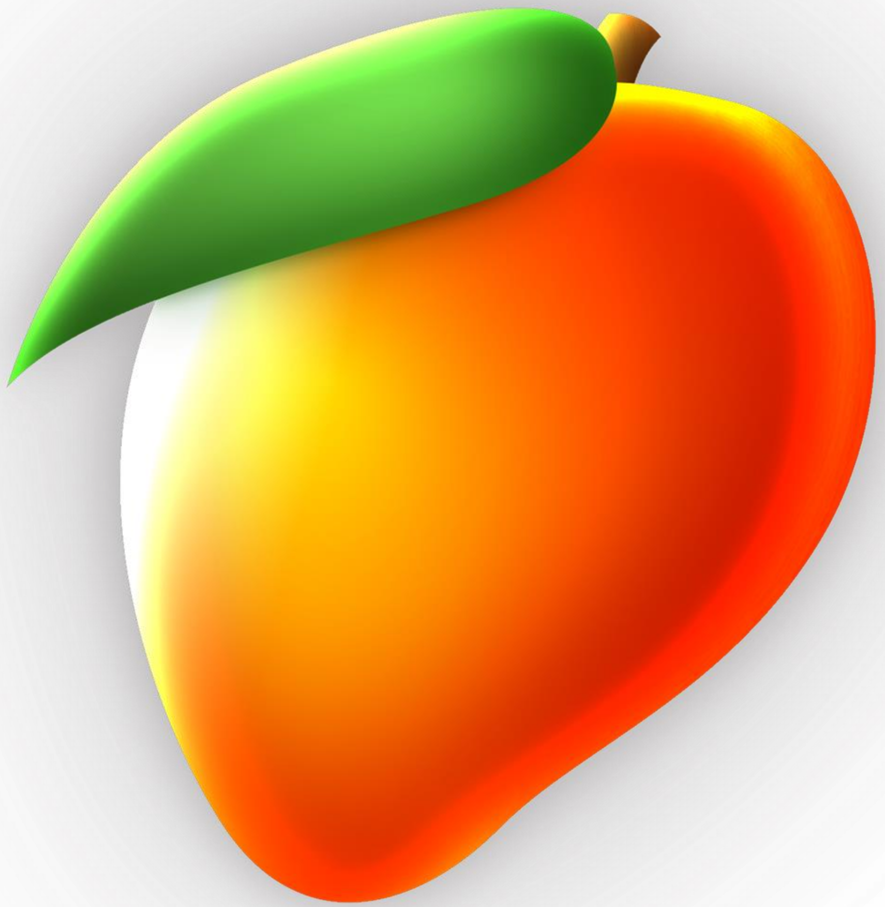

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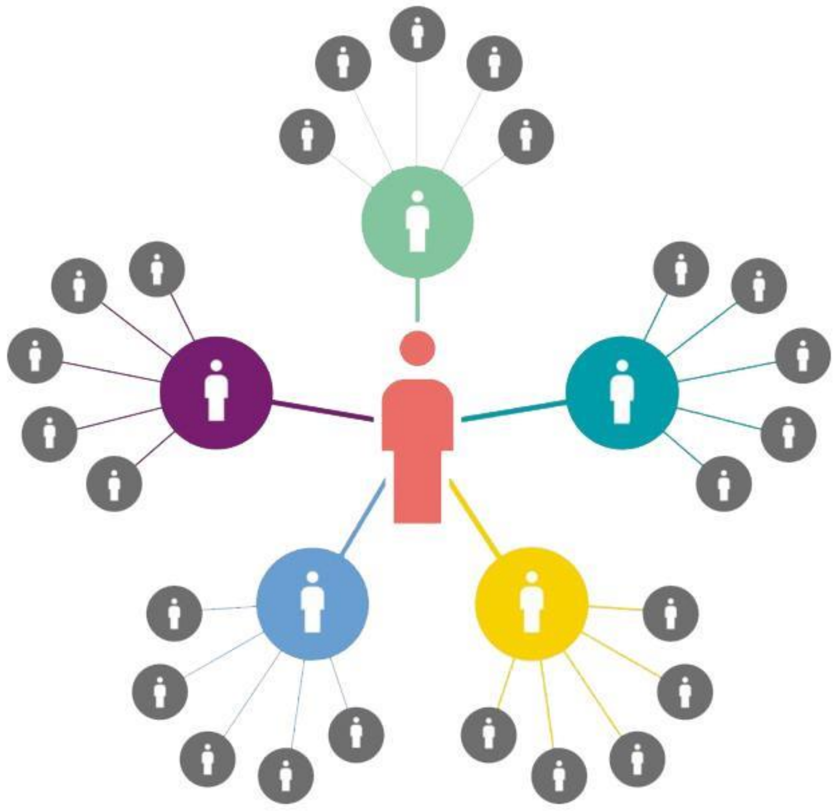

Unsurprisingly, messengers have become widely popular communication tools across the globe. Quick and convenient communication channel, some of which have originated via social networking sites, have developed into independent social platforms.

“Messaging is one of the few things that people do more than social networking.” — Mark Zuckerberg, 2014

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Our mission, vision and motto

Mission

"To create a safe and comfortable platform for communication and ability to share any feelings for people"

Vision

"To provide free and simple way of communication between people around the world."

Motto/Slogan

"Privacy and personal security come first."

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To be Mango

Mango Messenger is a free instant messaging service. It provides end-to-end encryption and focus on the speed and security of communication.

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MVP’s on the market

WhatsApp > 2.0 bil

Viber > 800 mil

WeChat > 1.2 bil

Tencent QQ > 591 mil

Messenger > 1.3 bil

Snapchat > 538 mil

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Our project proposes

Business Usage

Personal Usage

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Objectives

- To analyze the security and user privacy vulnerabilities of the IMS.
- To provide the system requirements.
- To propose web service (API's) architecture and authorization mechanism.
- To implement E2E encryption to the system.
- To implement Web service (API).
- To implement web, mobile and desktop clients.

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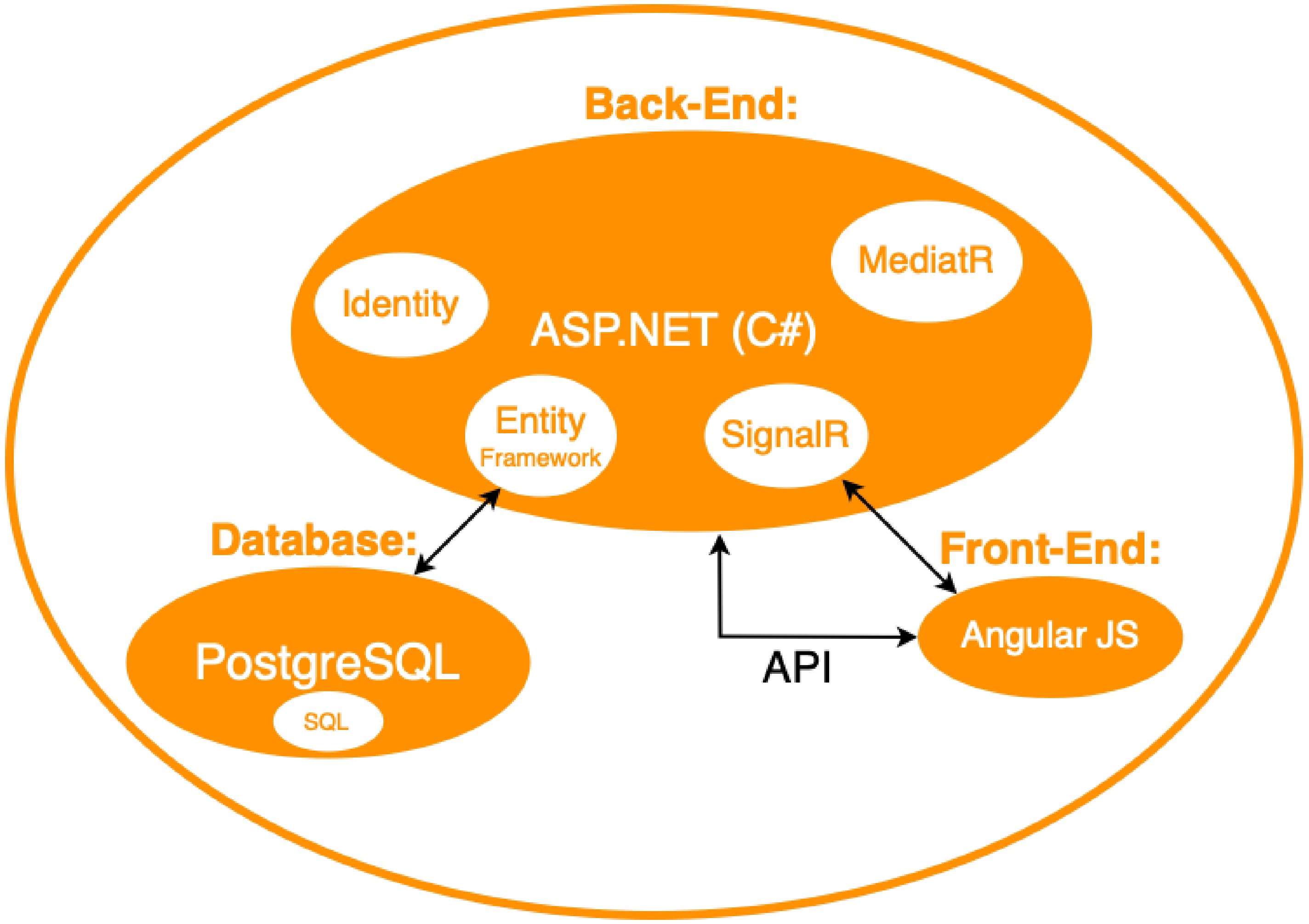
Project structure



Supported by:

Docker

Git

Heroku

Web-service architecture

Implementing the instant messenger system, we consider applying a well- known N-tier Monolithic Architecture [Bucchiarone et al., 2018], which provides a time-proven model that allows software developers to create flexible and reusable applications.

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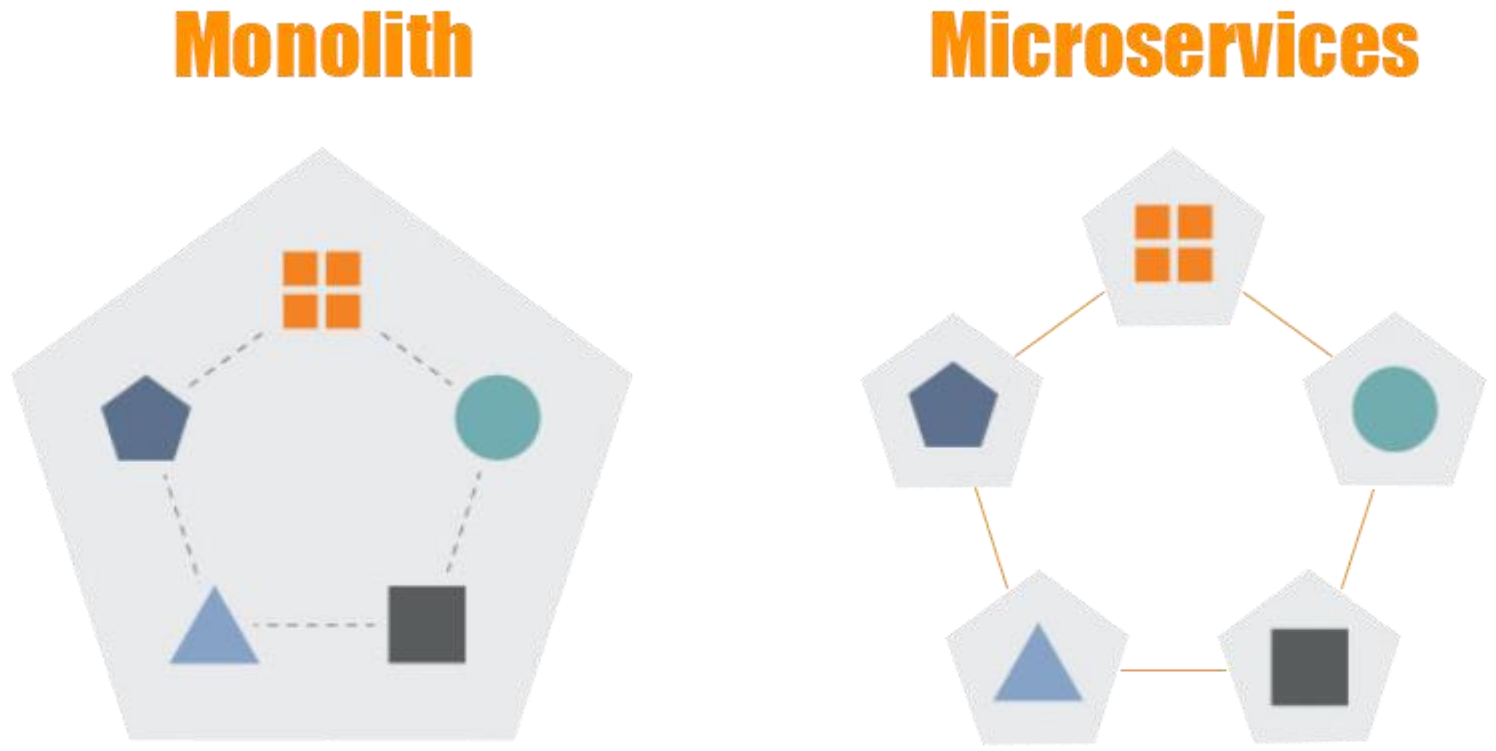
Which architecture to choose?



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Which architecture to choose?

"You shouldn't start a new project with microservices, even if you're sure your application will be big enough to make it worthwhile."

Martin Fowler [Fowler, 2015b]

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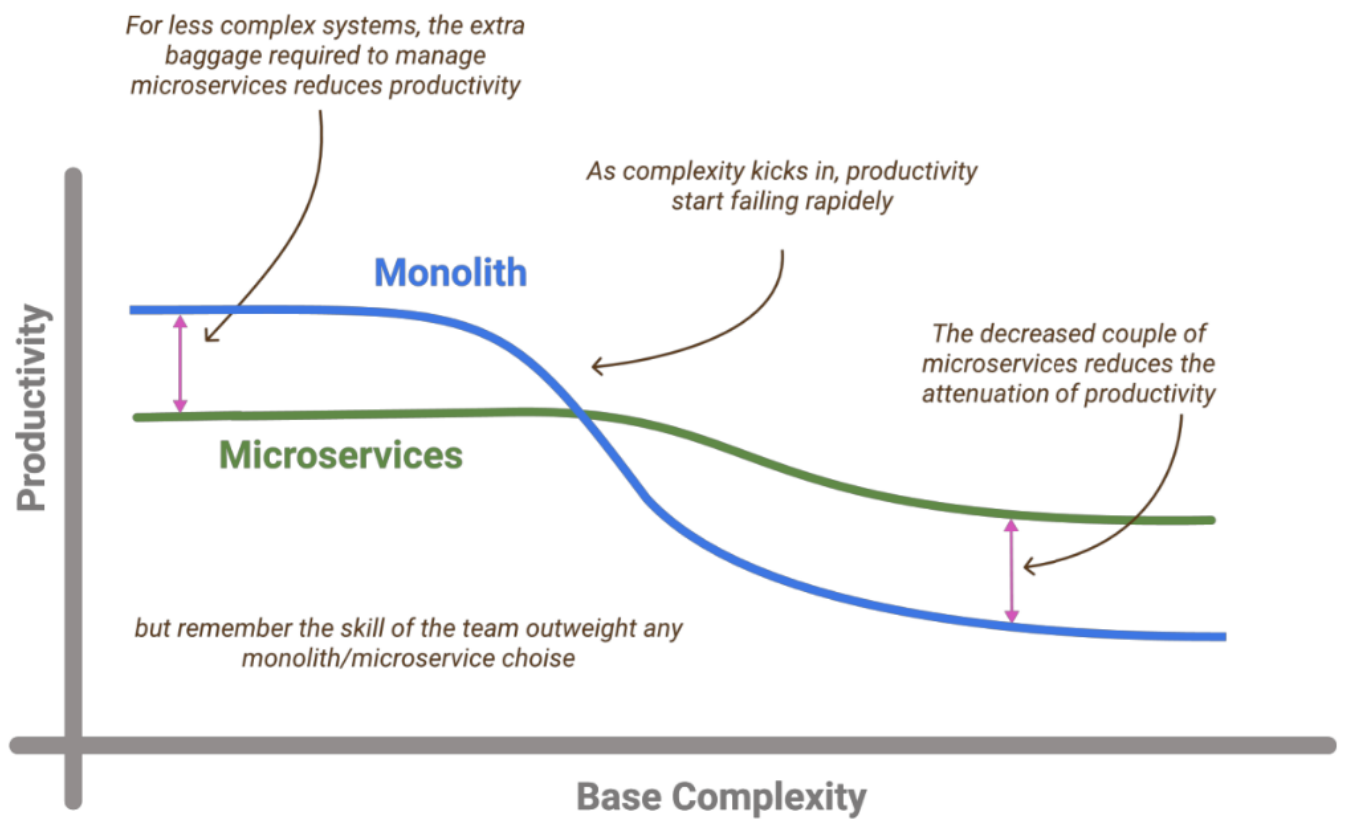
Monolith vs Microservices



Relation between system complexity and architectures. Source: [Fowler, 2015a].

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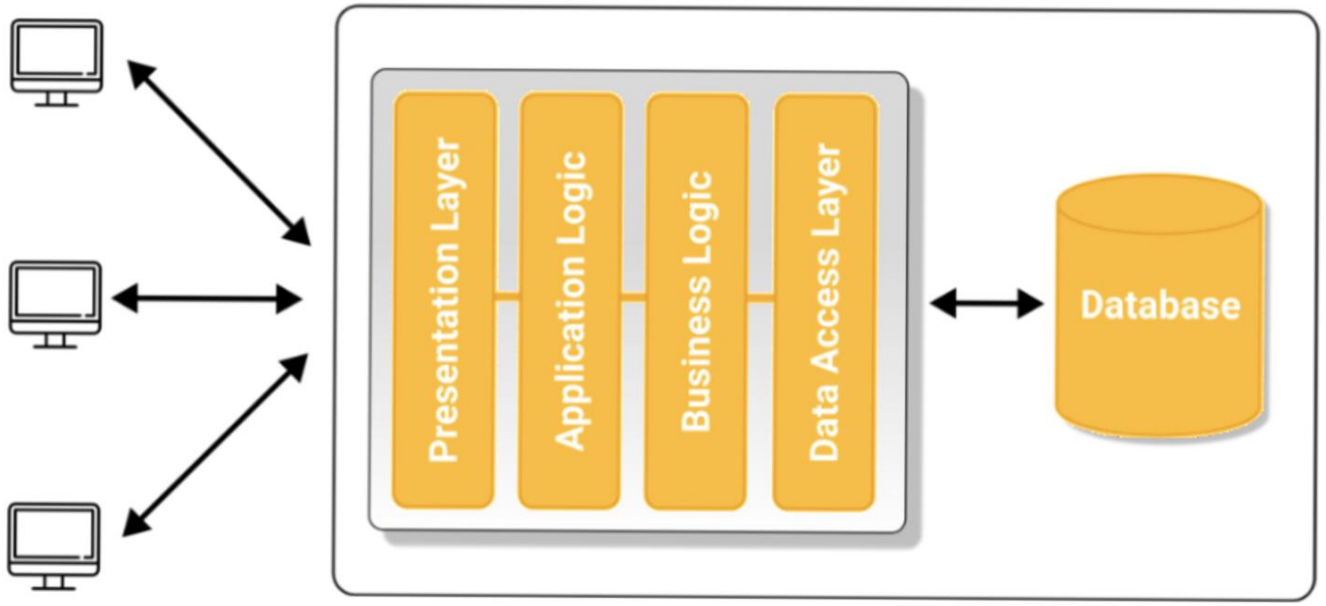
Monolith concept diagram



Monolith concept diagram. Source: [Mango Messenger Figma, 2021].

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Monolithic architecture: Pros and Cons

PROS:

- *Simplicity*
- *Performance*
- *Easier development*
- *Easier debugging and testing*

CONS:

- *Tight Coupling*
- *Understanding*
- *Reliability to errors*
- *Updates*
- *Technology stack*

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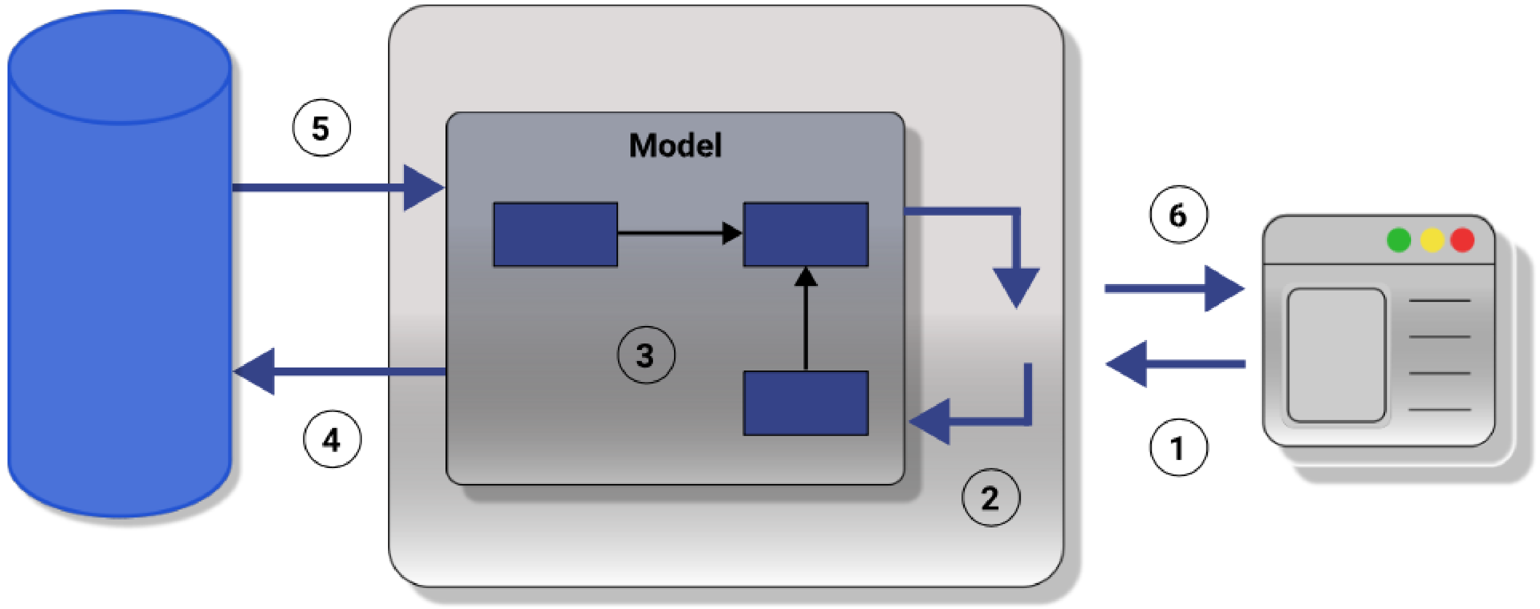
Service entity concept diagram



Service entity concept diagram. Source: [Fowler, 2011].

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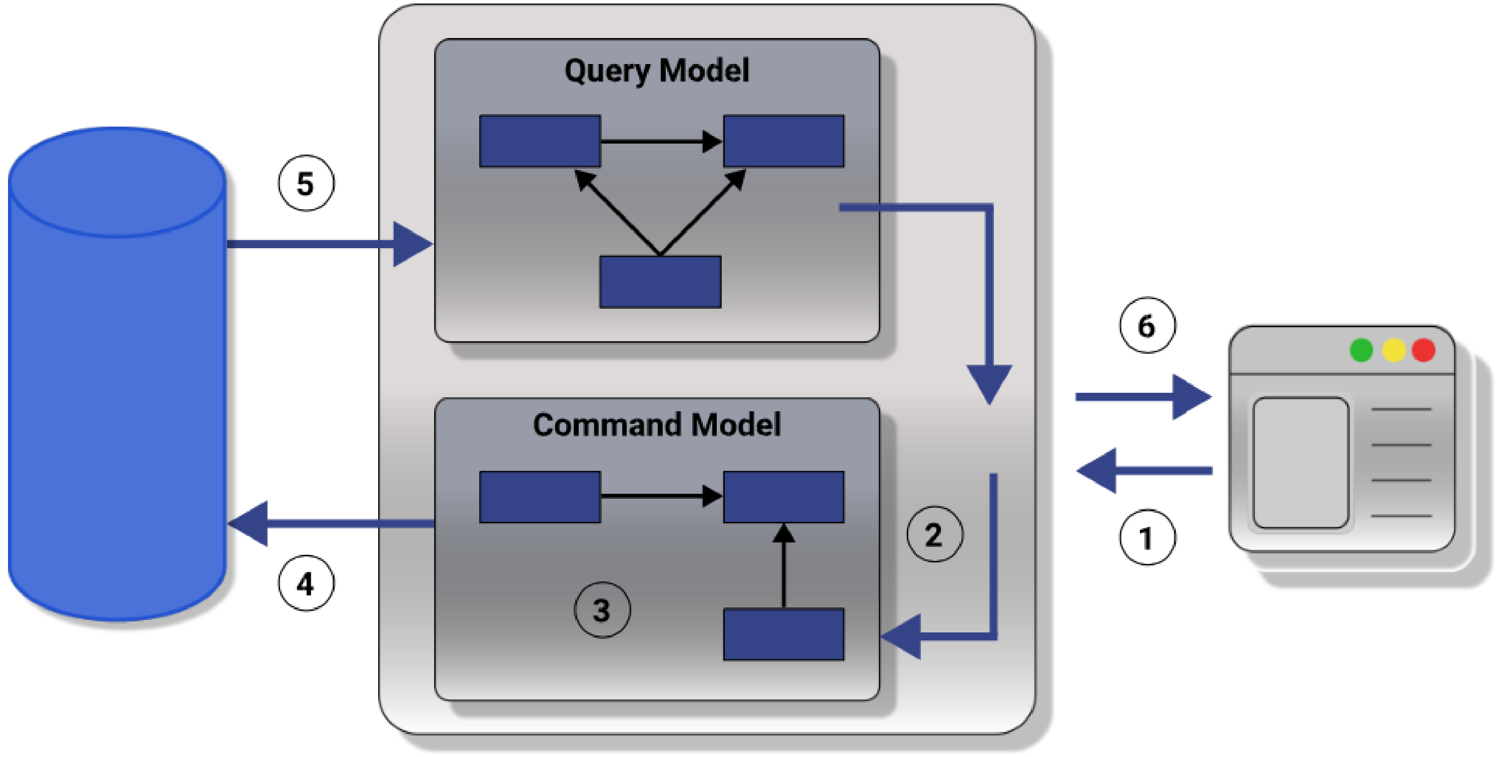
CQRS Concept Diagram



CQRS concept diagram. Source: [Fowler, 2011].

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Authorization

A JSON Web Token, or **JWT** is a standardized, in some cases signed and encrypted, data packaging format that is used to securely transfer information between two parties.

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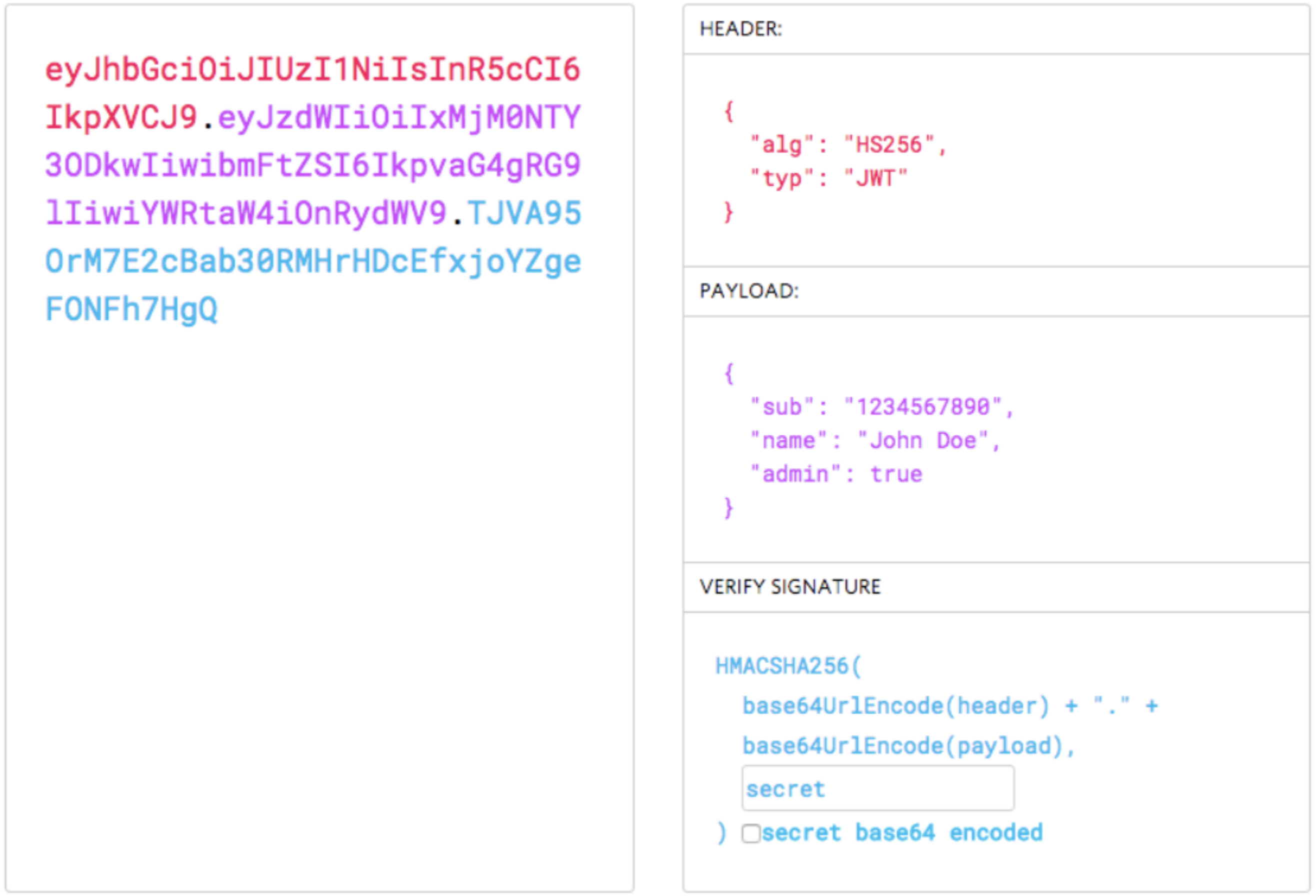
JWT Token



```
eyJhbGciOiJIUzI1NiIsInR5cCI6
IkpXVCJ9.eyJzdWIiOiIxMjM0NTY
3ODkwIiwibmFtZSI6IkpvaG4gRG9
lIiwiYWRtaW4iOnRydWV9.TJVA95
OrM7E2cBab30RMHrHDcEfxjoYZge
FONFh7HgQ
```

HEADER:

```
{
  "alg": "HS256",
  "typ": "JWT"
}
```

PAYLOAD:

```
{
  "sub": "1234567890",
  "name": "John Doe",
  "admin": true
}
```

VERIFY SIGNATURE

```
HMACSHA256(
  base64UrlEncode(header) + "." +
  base64UrlEncode(payload),
  secret
) ☐secret base64 encoded
```

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Recommendation for JWT usage

- JWT should have a short lifetime, since it cannot be revoked.

  However, extremely short lifetimes of the tokens would affect the overall performance of the system.

  Therefore, we consider access token lifetime to be 5 minutes and refresh token to be 7 days.

- JWT should be used in a single time, e.g. JWT per request.

  For each request client preliminarily checks access token lifetime.

  If access token it expired, client sends request for updating a pair of access-refresh tokens.

  For more confidence, we can update tokens a few seconds earlier.

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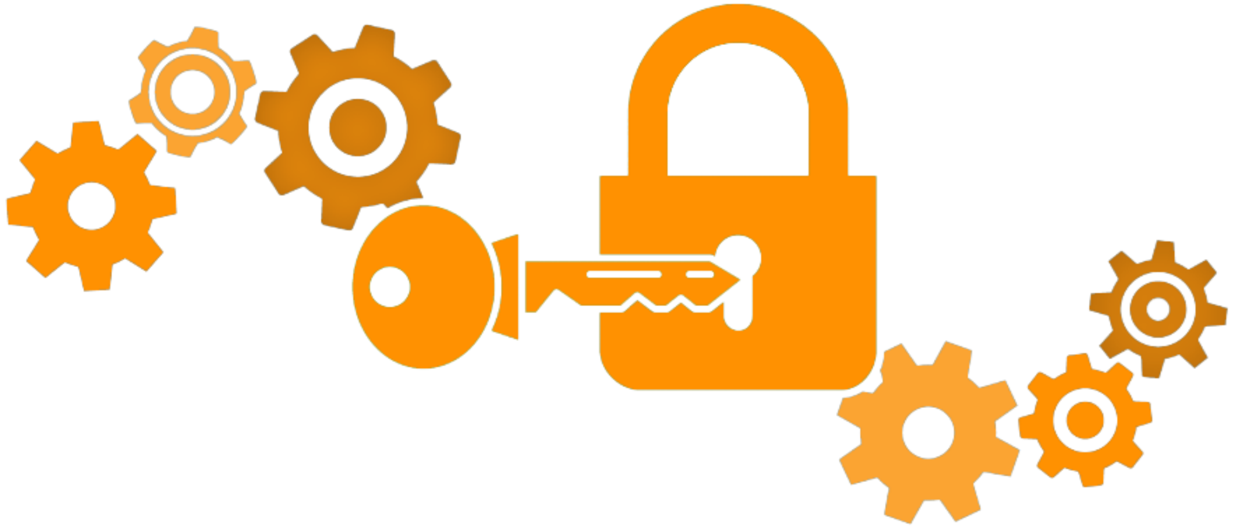
Encryption

Encryption – is a conversion of the original representation of the information, known as plaintext, into an alternative form known as ciphertext. The inverse operation is called Decryption.

Encryption may be both symmetric or asymmetric.



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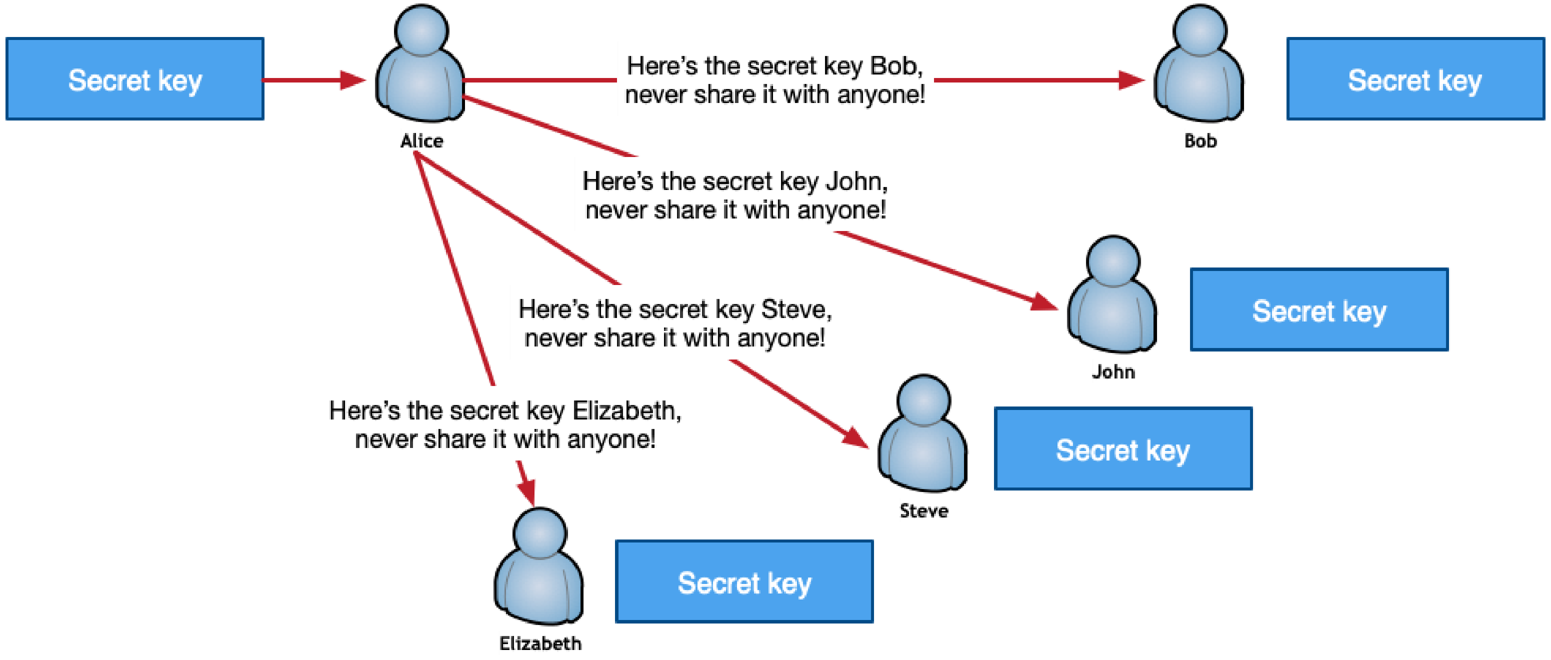
Symmetric cryptography

Symmetric encryption – is a type of encryption where only one secret key is used to both encrypt and decrypt electronic information.


Secret key
Alice
Here's the secret key Bob, never share it with anyone!
Bob
Secret key
Here's the secret key John, never share it with anyone!
John
Secret key
Here's the secret key Steve, never share it with anyone!
Steve
Secret key
Here's the secret key Elizabeth, never share it with anyone!
Elizabeth
Secret key

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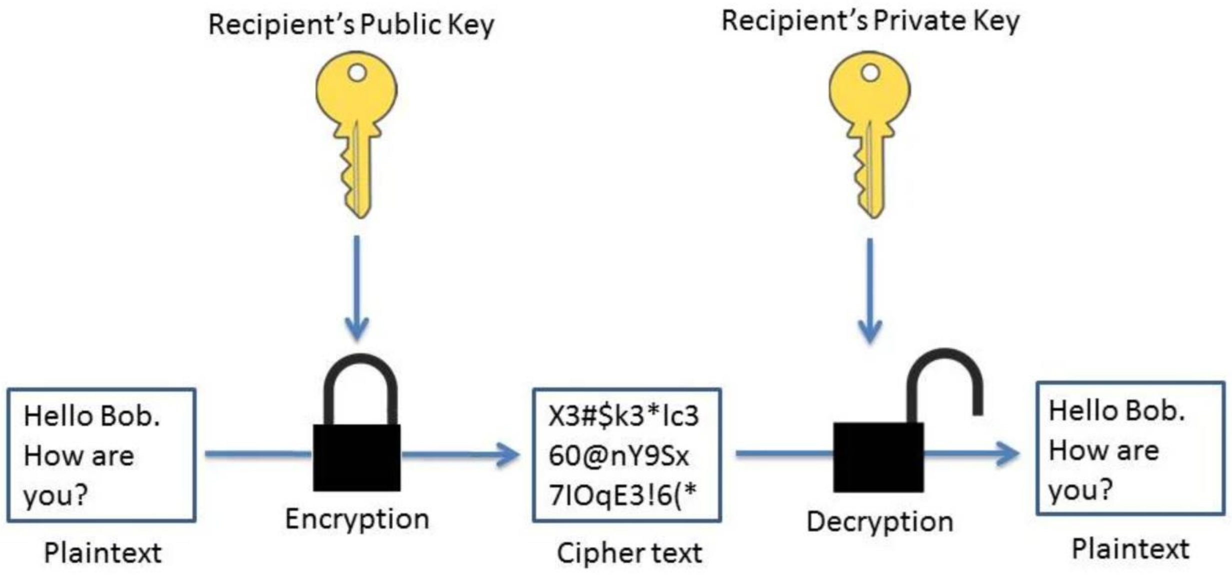
Asymmetric cryptography

Asymmetric encryption – is an encryption such that a message is encrypted using public key, and decrypted using private key.

Asymmetric encryption uses computationally hard problems with a secret (private), and shared (public) key.

Asymmetric encryption is based on the concept of the one-way functions.



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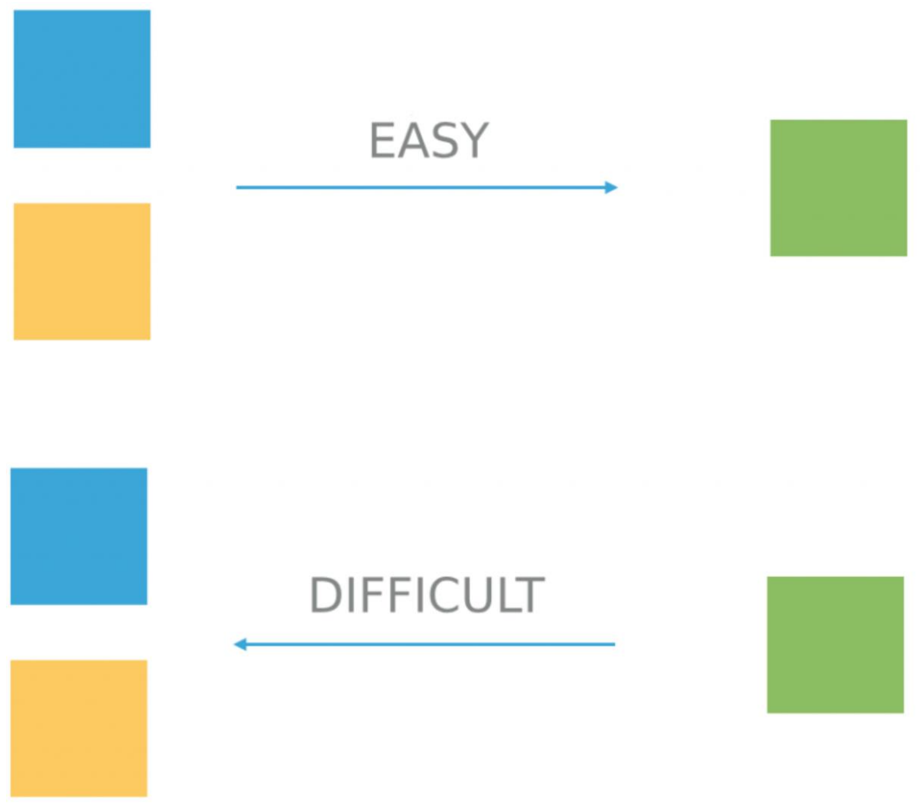
One-way functions

One-way function – is a function that is easy to compute on every input, but hard to invert given the image of a random input.



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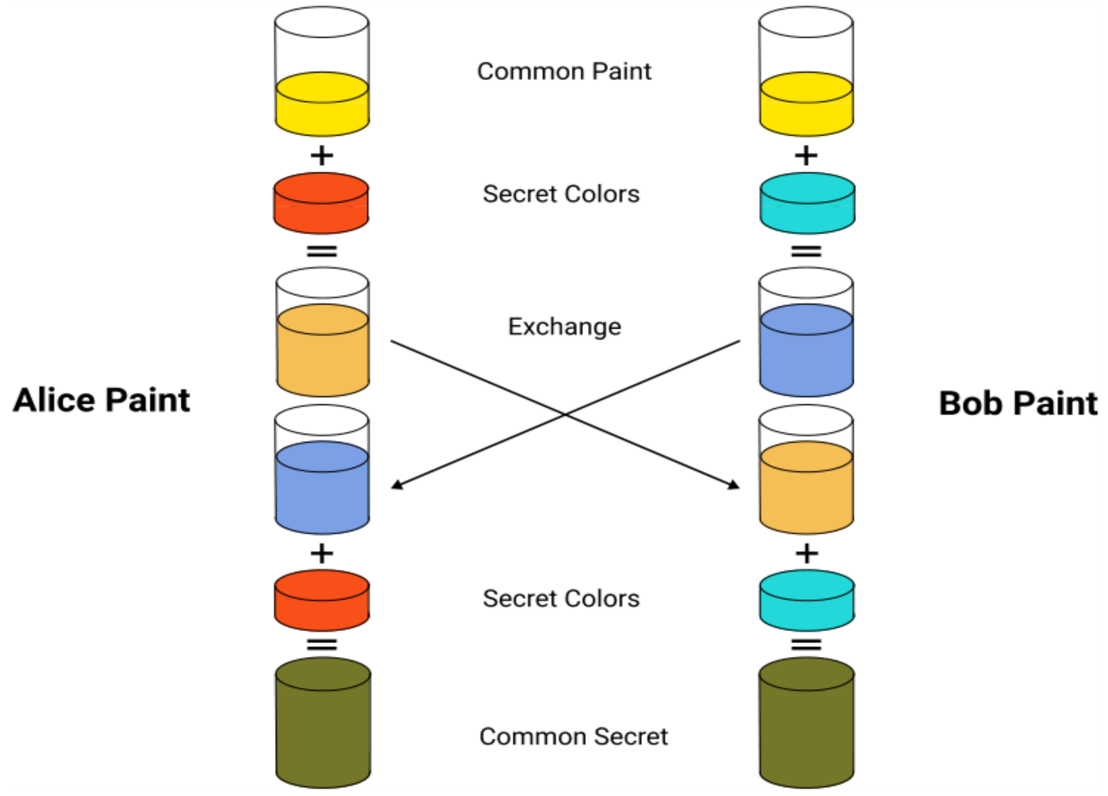
DH Key Exchange

Diffie-Hellman key exchange – is a method of securely exchanging cryptographic keys over a public channel. Diffie-Hellman is based on the on the one-way function A = G^a mod P.



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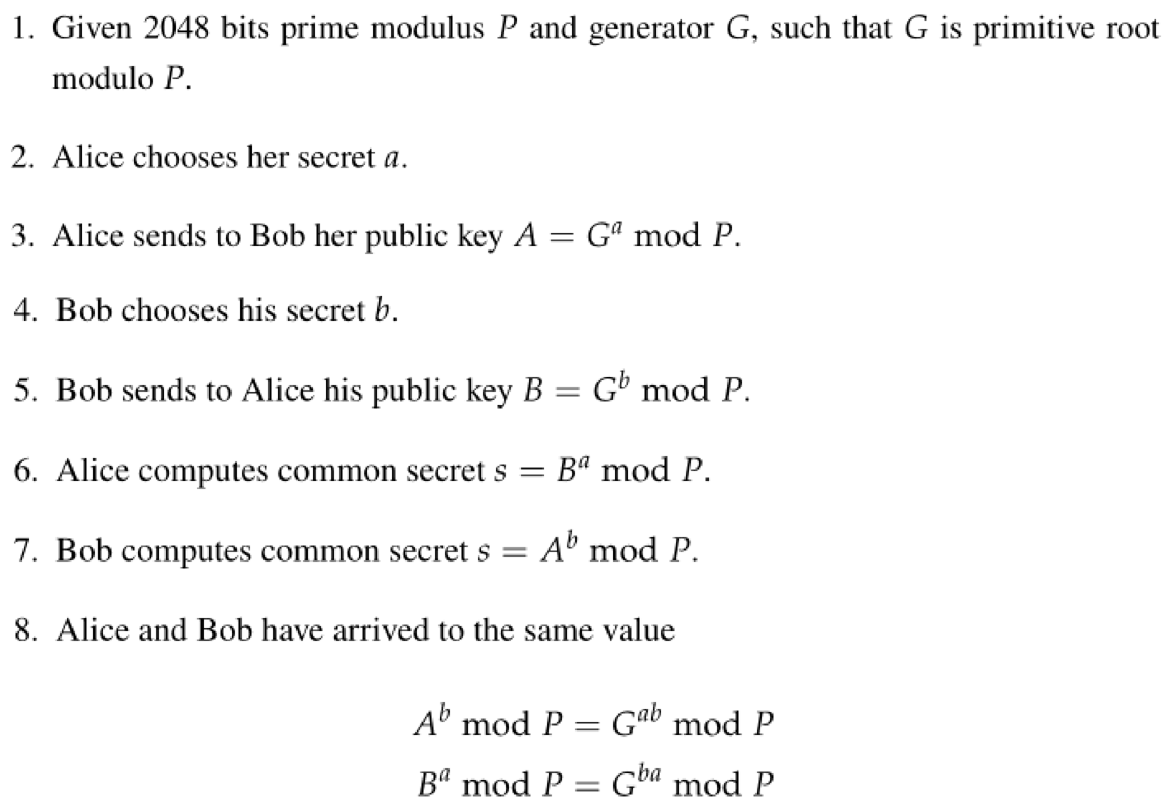
Math behind the DH

Diffie-Hellman key exchange – is a method of securely exchanging cryptographic keys over a public channel. Diffie-Hellman is based on the on the one-way function A = G^a mod P.



1. Given 2048 bits prime modulus P and generator G, such that G is primitive root modulo P.
2. Alice chooses her secret a.
3. Alice sends to Bob her public key $A = G^a \bmod P$.
4. Bob chooses his secret b.
5. Bob sends to Alice his public key $B = G^b \bmod P$.
6. Alice computes common secret $s = B^a \bmod P$.
7. Bob computes common secret $s = A^b \bmod P$.
8. Alice and Bob have arrived to the same value

$$A^b \bmod P = G^{ab} \bmod P$$
$$B^a \bmod P = G^{ba} \bmod P$$

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End-to-end encryption

End-to-end encryption – is an asymmetric encryption such that the only communicating parties are able to decrypt the data.

End-to-end encryption may be implemented using

- **Asymmetric encryption algorithm (ex. RSA)**
- **Asymmetric common secret exchange + symmetric encryption (ex. DH + AES)**

In Mango Messenger E2E encryption is implemented via ECDH + AES256 symmetric encryption.

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Choose public constants properly

In DH key exchange, it is important to properly choose public constants.

It is recommended

- Modulus **P** to be **P = 2Q + 1** such that **2048** bits safe-prime because **Q** is also prime
- Generator **G** such that **G** is primitive root modulo **P**
- For elliptic curve cryptography it is enough to use **512** bit prime as **P**

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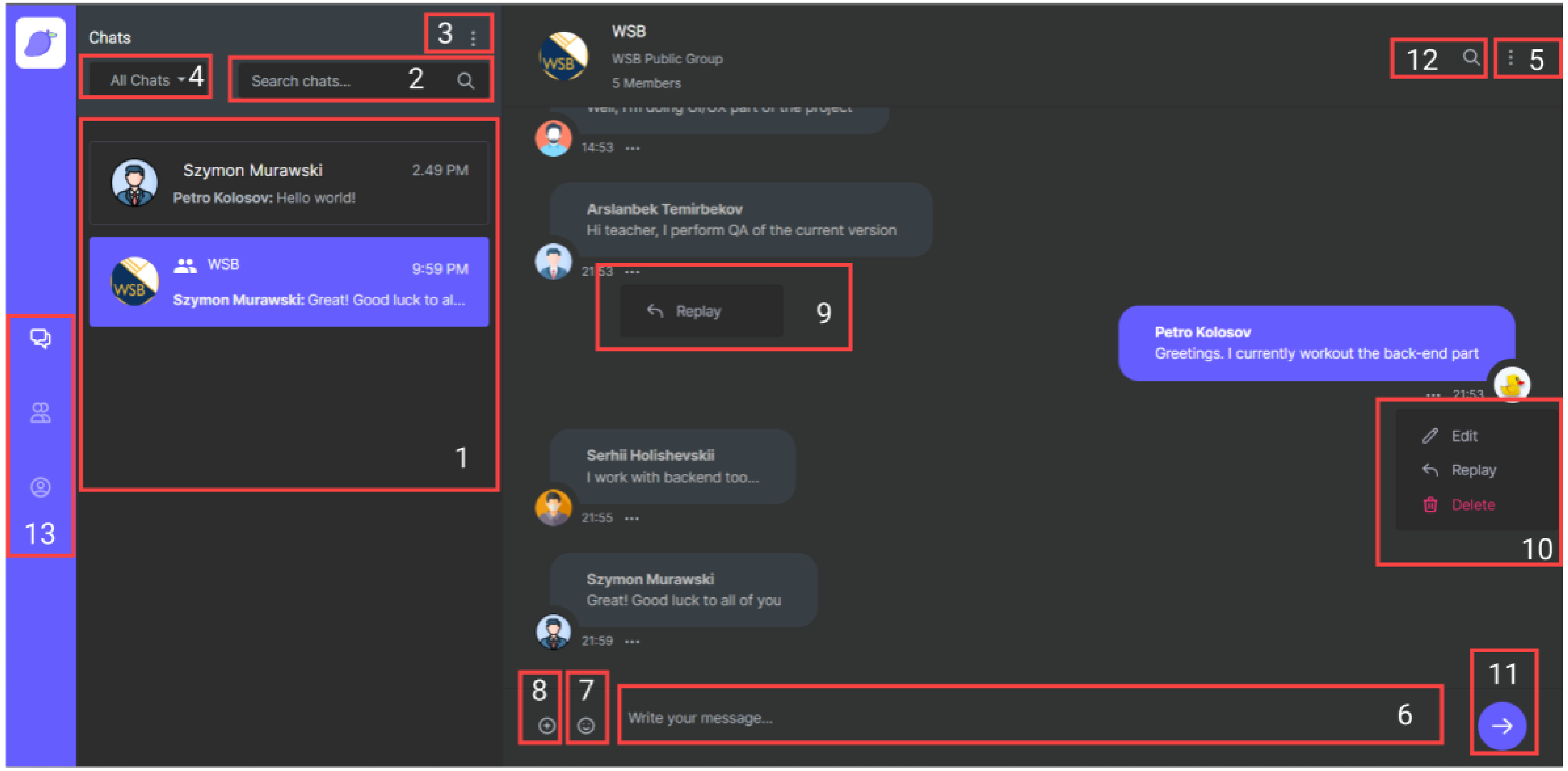
Project outcomes



Szymon Murawski 2.49 PM
Petro Kolosov: Hello world!

WSB 9:59 PM
Szymon Murawski: Great! Good luck to al...

Well, I'm doing UI/UX part of the project
14:53

Arslanbek Temirbekov
Hi teacher, I perform QA of the current version
21:53

Petro Kolosov
Greetings. I currently workout the back-end part
21:53

Serhii Holishevskii
I work with backend too...
21:55

Szymon Murawski
Great! Good luck to all of you
21:59

1. Chatlist
2. Chat Searching
3. Creating Groups
4. Filtering Chats
5. Leaving or Sharing the Chat
6. Entering the Text
7. Adding Emoji
8. Adding Attachments
9. Replying to the Messages
10. Edit or Delete Messages
11. Send Message
12. Message Search
13. Navigation to the Main Page

https://www.front.mangomessenger.company

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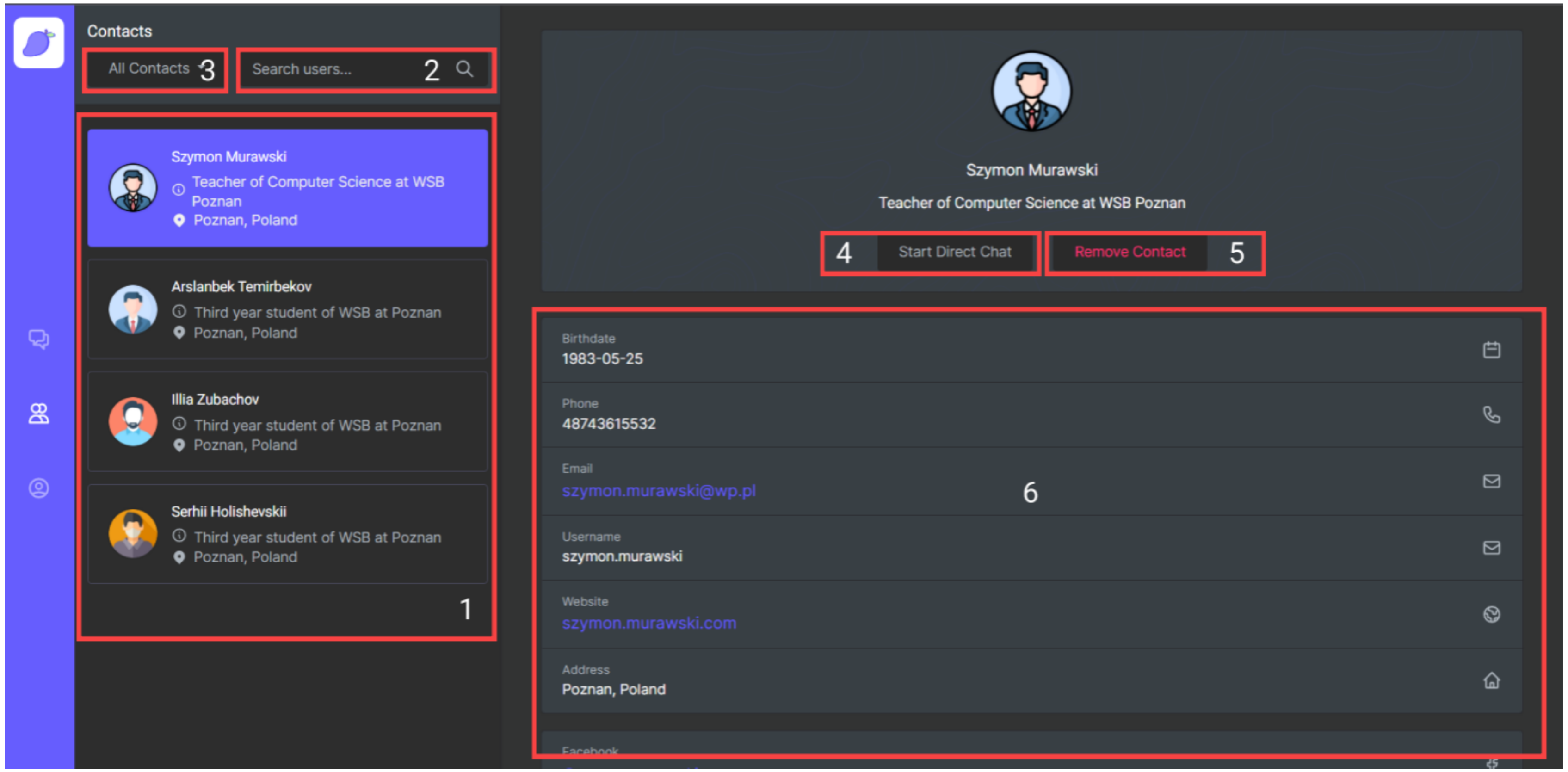
Project outcomes



Birthdate	1983-05-25
Phone	48743615532
Email	szymon.murawski@wp.pl
Username	szymon.murawski
Website	szymon.murawski.com
Address	Poznan, Poland

1. User's Contact List
2. Searching Users
3. Filtering Contacts
4. Start a Chat
5. Delete User from Contacts
6. Specified User Info

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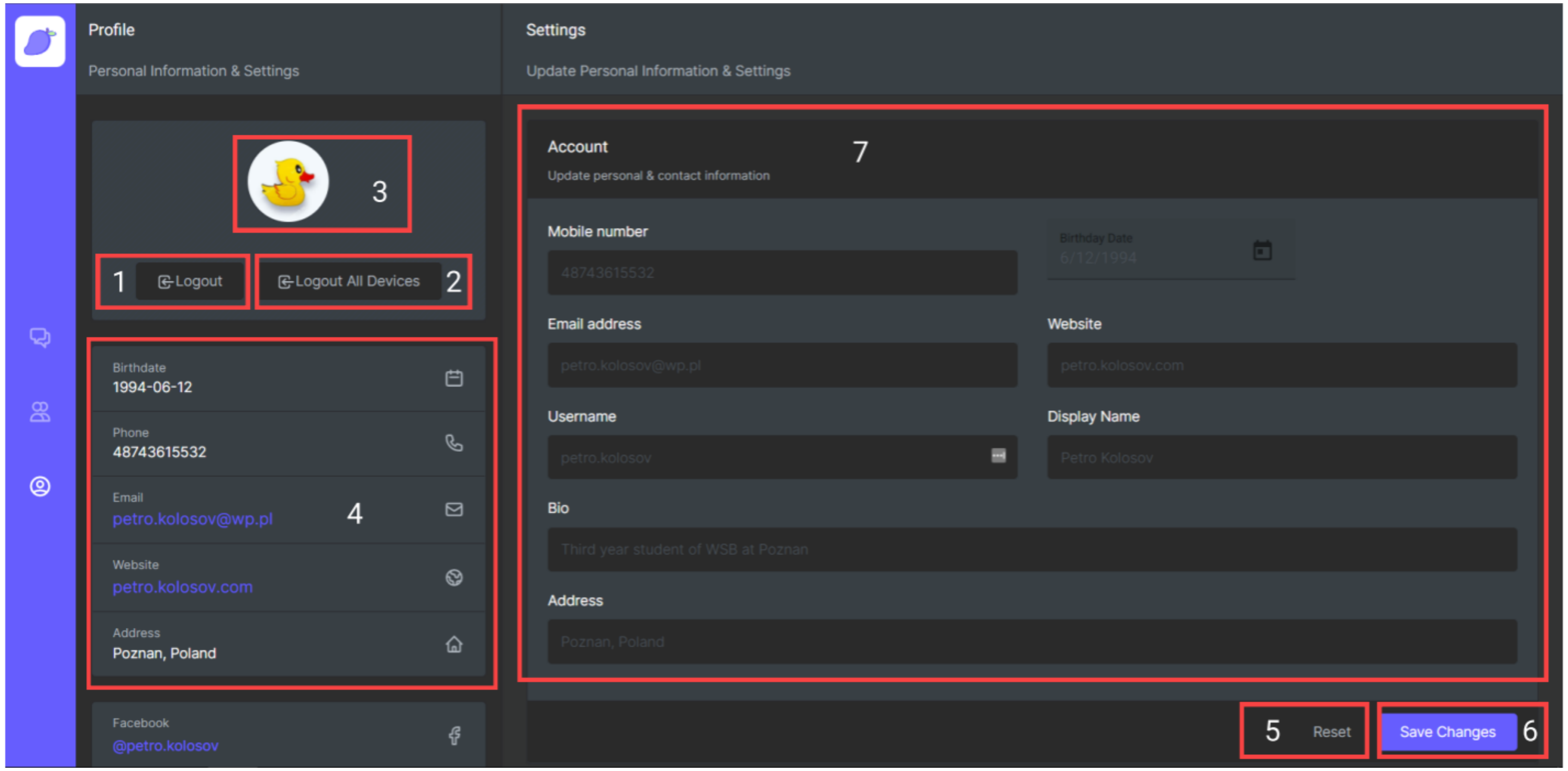
Project outcomes



Profile

Personal Information & Settings

Logout

Logout All Devices

Birthdate
1994-06-12

Phone
48743615532

Email
petro.kolosov@wp.pl

Website
petro.kolosov.com

Address
Poznan, Poland

Facebook
@petro.kolosov

Settings

Update Personal Information & Settings

Account

Update personal & contact information

Mobile number: 48743615532	Birthday Date: 6/12/1994
Email address: petro.kolosov@wp.pl	Website: petro.kolosov.com
Username: petro.kolosov	Display Name: Petro Kolosov

Bio: Third year student of WSB at Poznan

Address: Poznan, Poland

Reset

Save Changes

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1. Log Out from current Device
2. Log Out from All Devices
3. User's Profile image
4. User's Information
5. Reset Updated Data
6. Save Updated Data
7. Panel for Changing Personal Data

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