Service-to-service Communication Protocols.

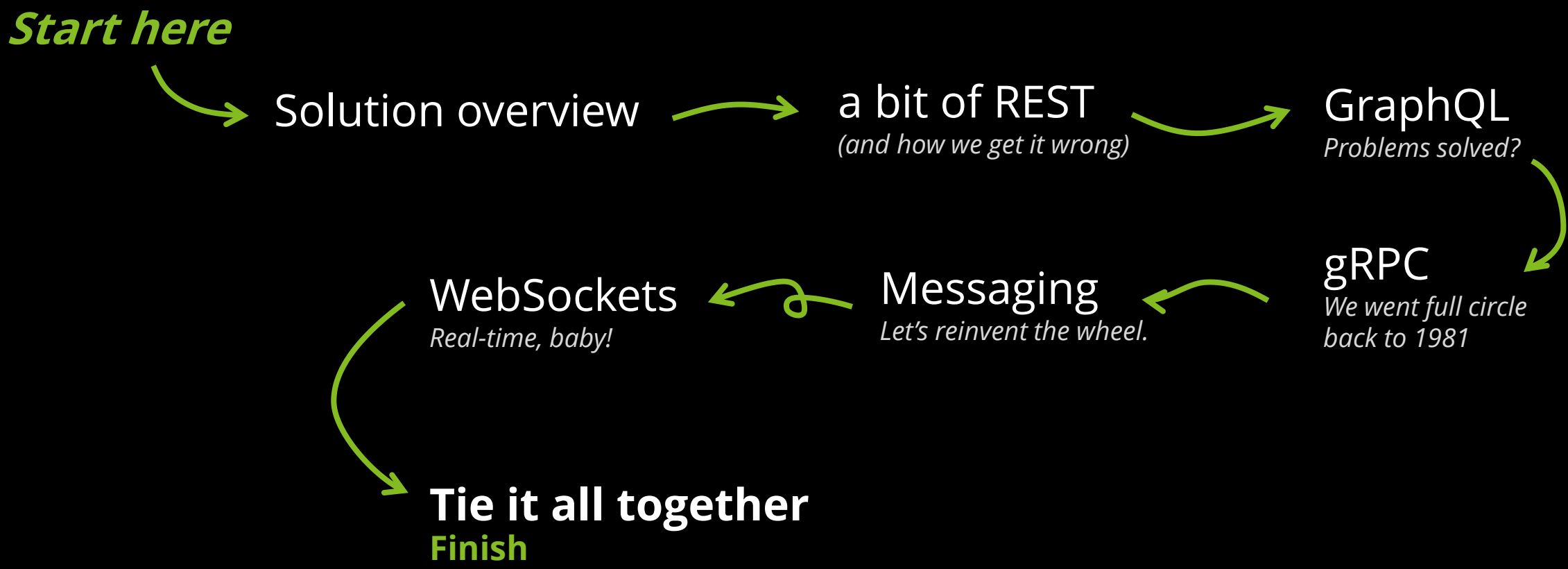
Nicklas Millard

Software Development Manager in Deloitte Consulting.

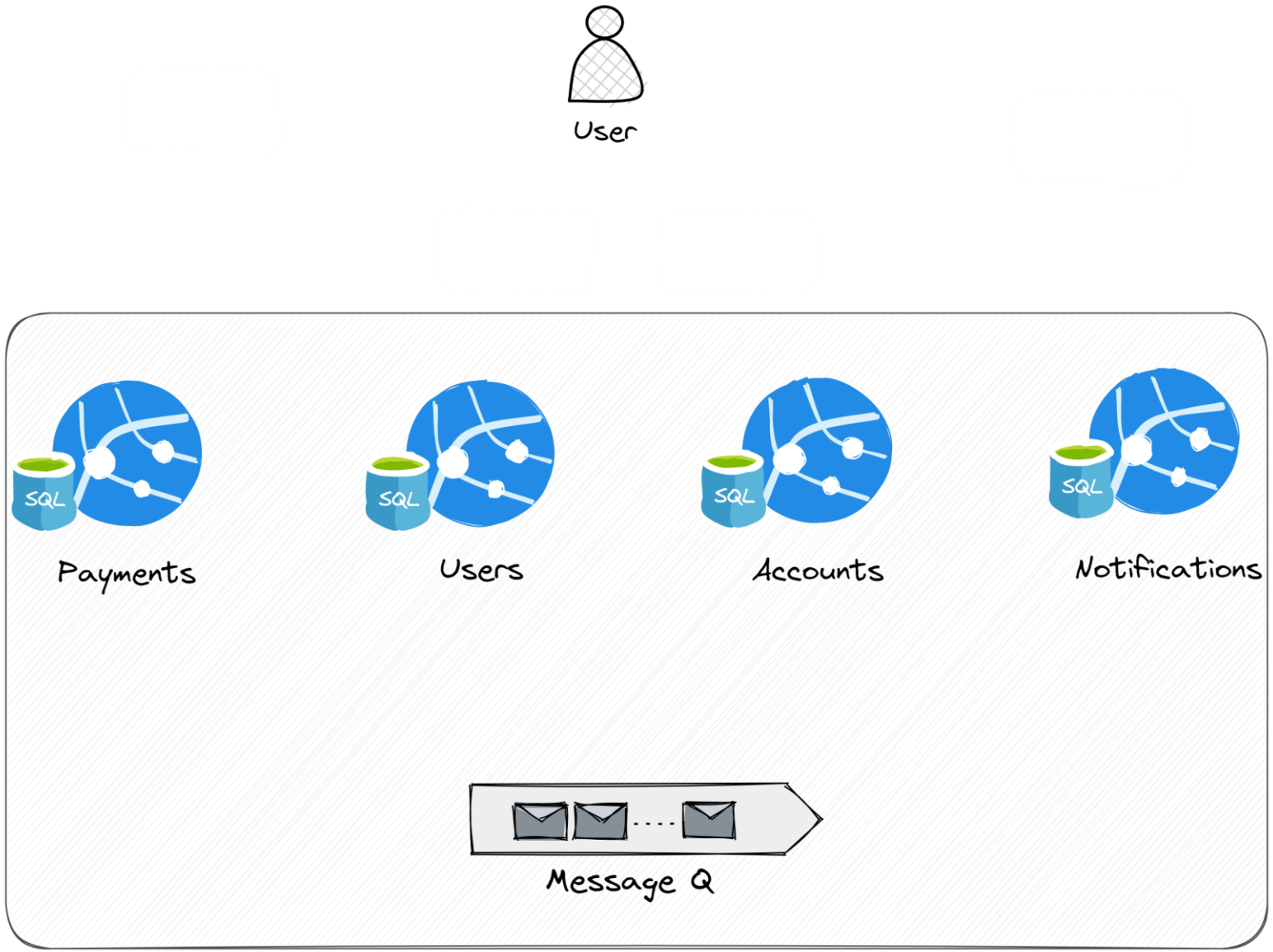
- Public and Private clients
- From solo developer to 20 person projects
- Done ~17 application development projects for 15 clients.
- FinTech industry experience

Roadmap

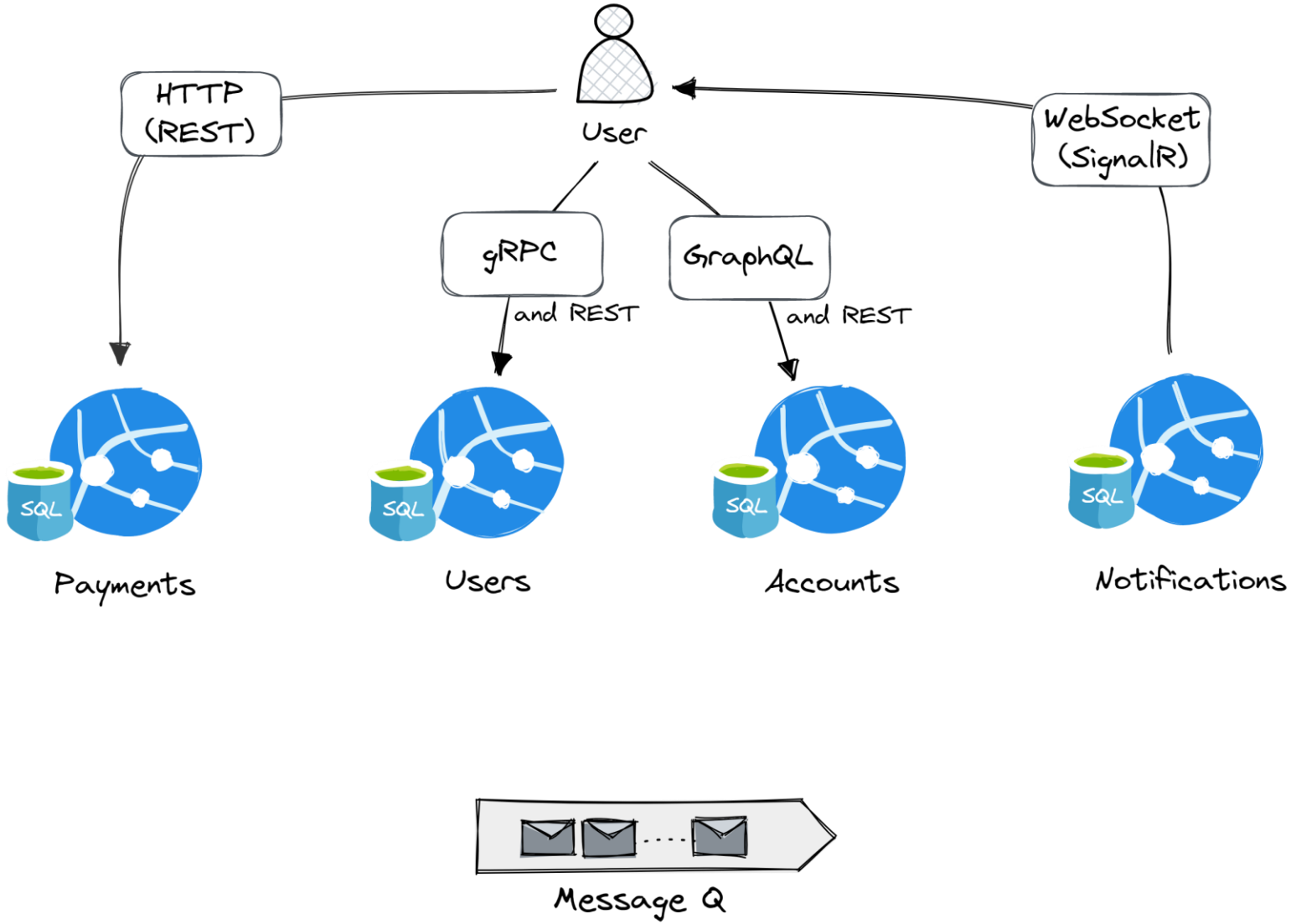
There’s a lot to unpack.



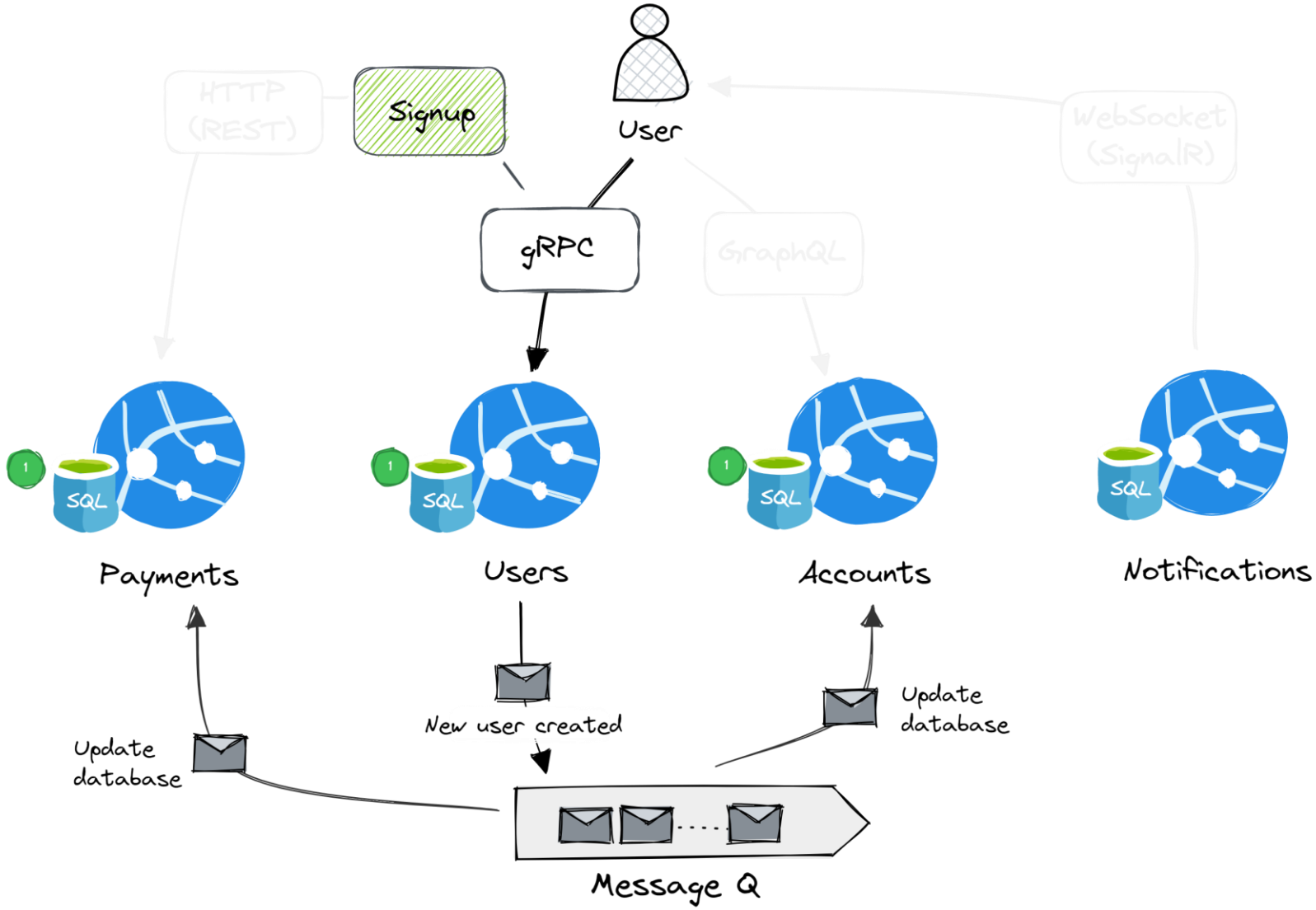
Our demo banking app solution architecture.



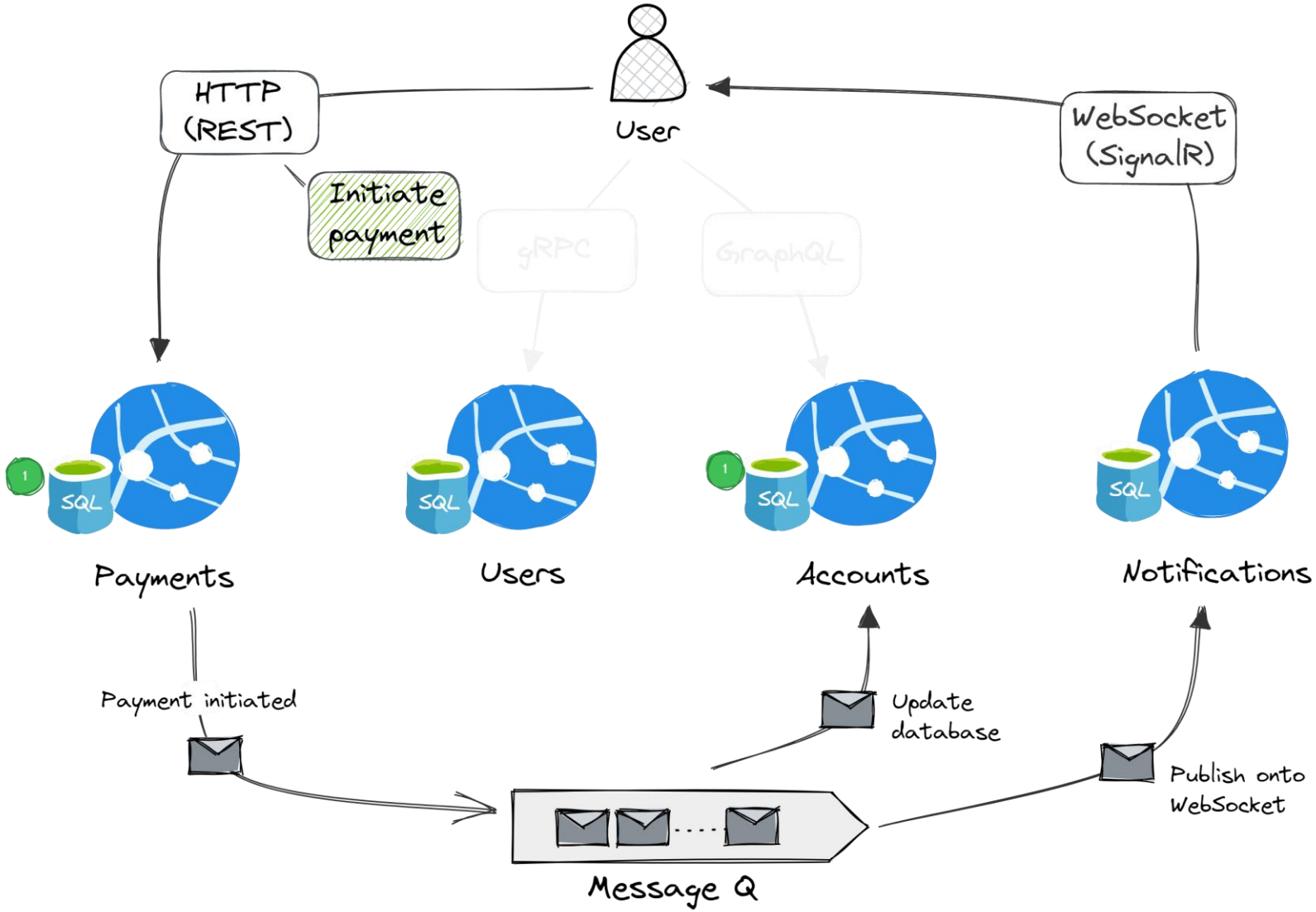
Our demo banking app solution architecture.



Sign-up using gRPC



Initiate a payment with HTTP

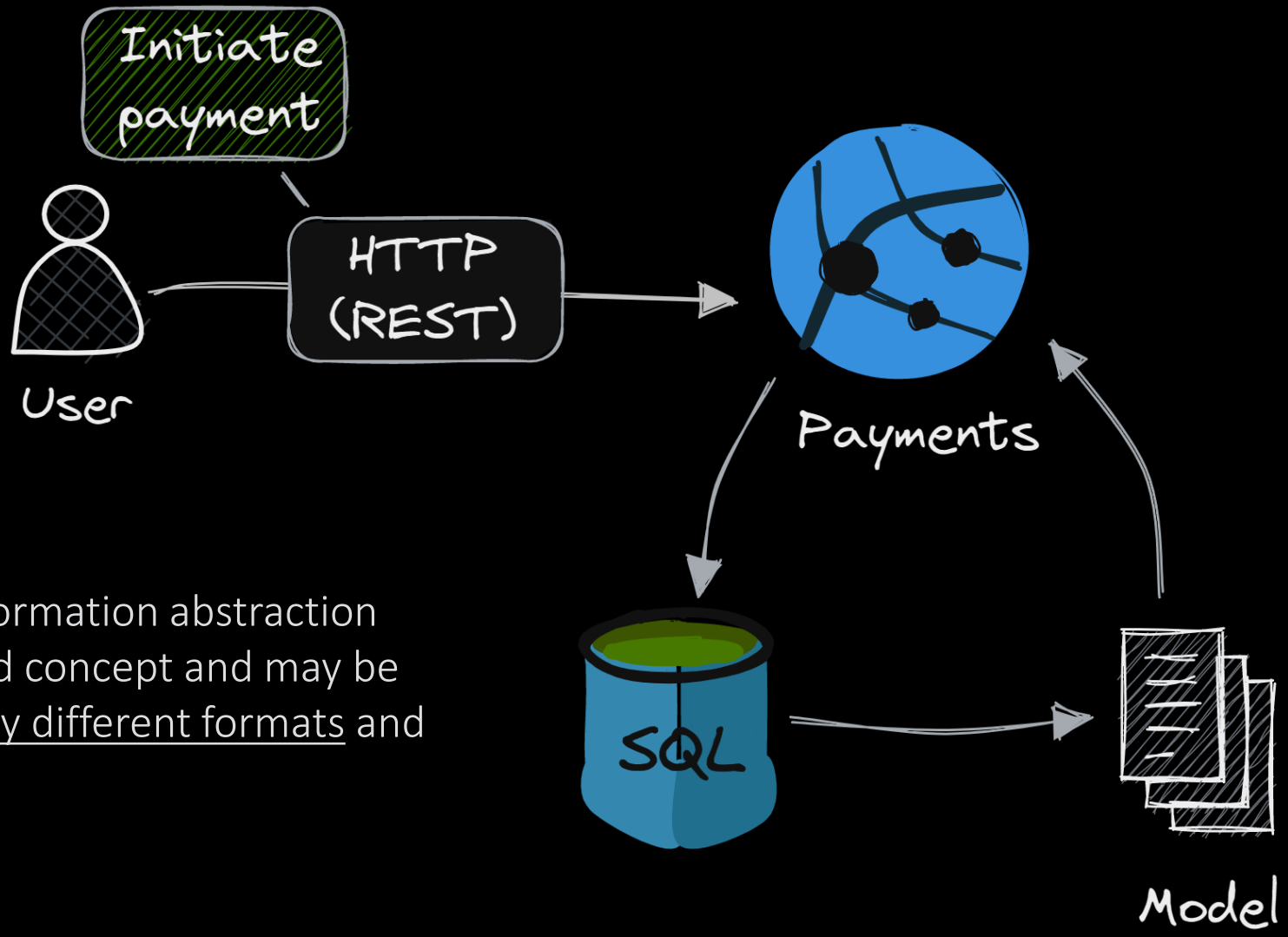


Why should you care?

REST*(ful). Everywhere.*

aka. JSON over HTTP **(... nowhere)**

How REST APIs are (typically) made.



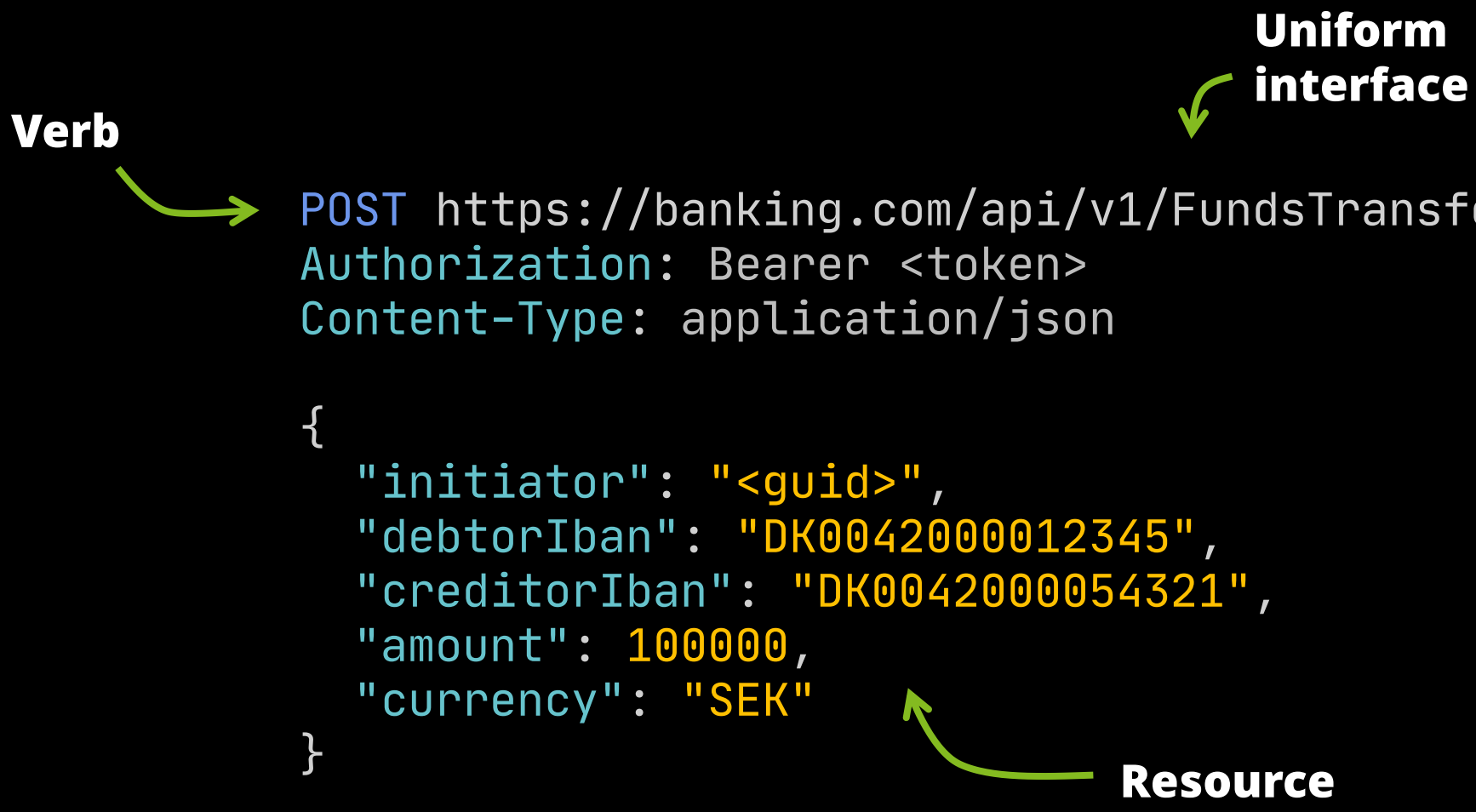
A resource is an information abstraction that covers a named concept and may be represented in many different formats and shapes.

Typical looking REST call.

```
POST https://banking.com/api/v1/FundsTransfer
Authorization: Bearer <token>
Content-Type: application/json

{
  "initiator": "<guid>",
  "debtorIban": "DK0042000012345",
  "creditorIban": "DK0042000054321",
  "amount": 100000,
  "currency": "SEK"
}
```

Typical looking REST call.



1-1 Anti pattern

```
{
  "initiator": "<guid>"
  "debtorIban": "DK0042000012345",
  "creditorIban": "DK0042000054321",
  "amount": 100000,
  "currency": "SEK"
}
```

Id	DebtorIban	CreditorIban	Amount	Currency	UserId
guid	DK4200213	DK0035131	10.000	DKK	guid

Glorified CRUD

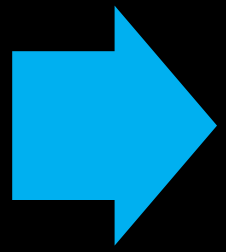
When a web developer marries a Database developer.

CREATE
POST

READ
GET

UPDATE
PUT

DELETE

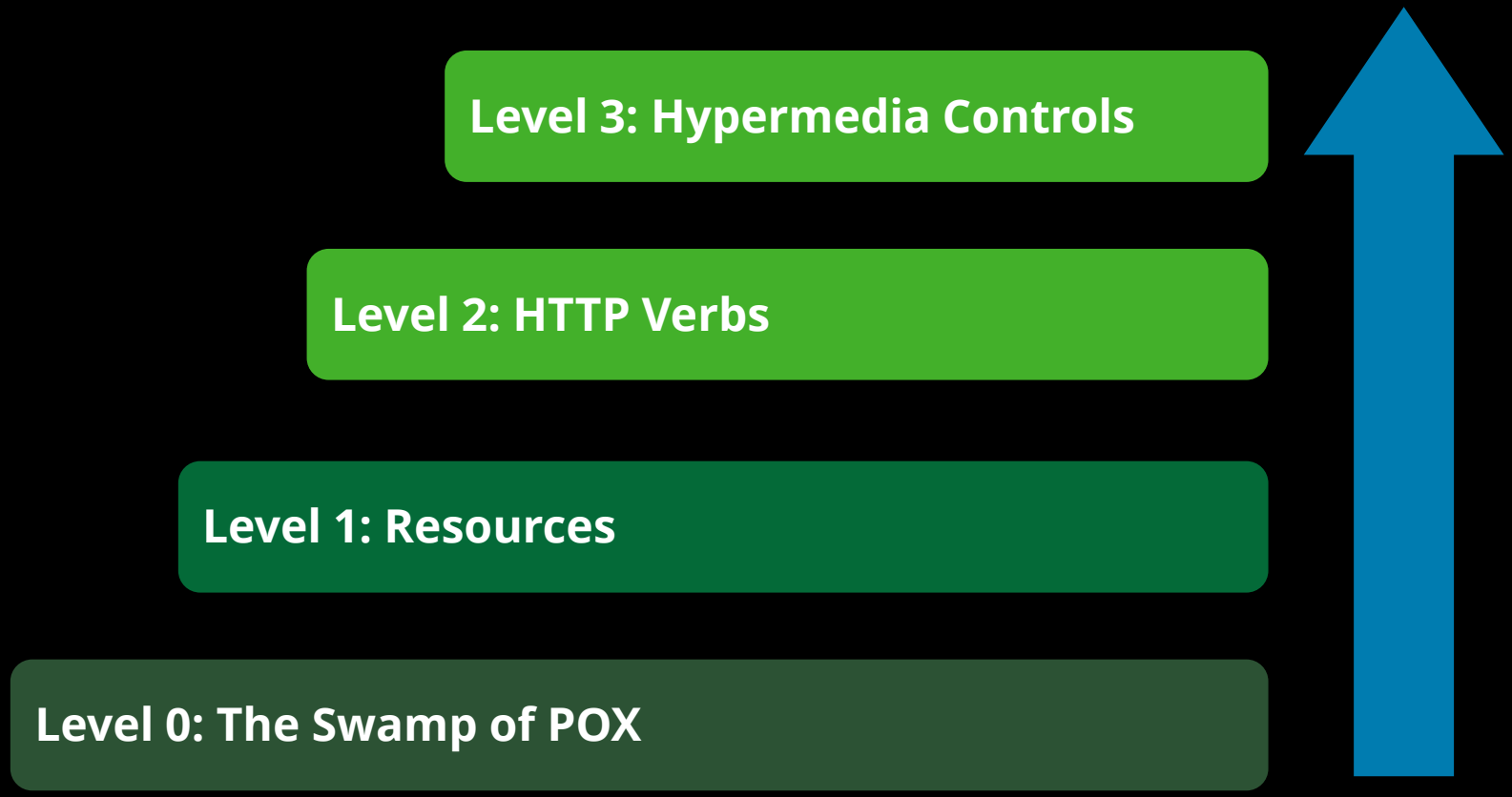


CRUD API

GET	api/v1/accounts
GET	api/v1/accounts/{id}
POST	api/v1/accounts
PUT	api/v1/accounts
DELETE	api/v1/accounts

Maturity model

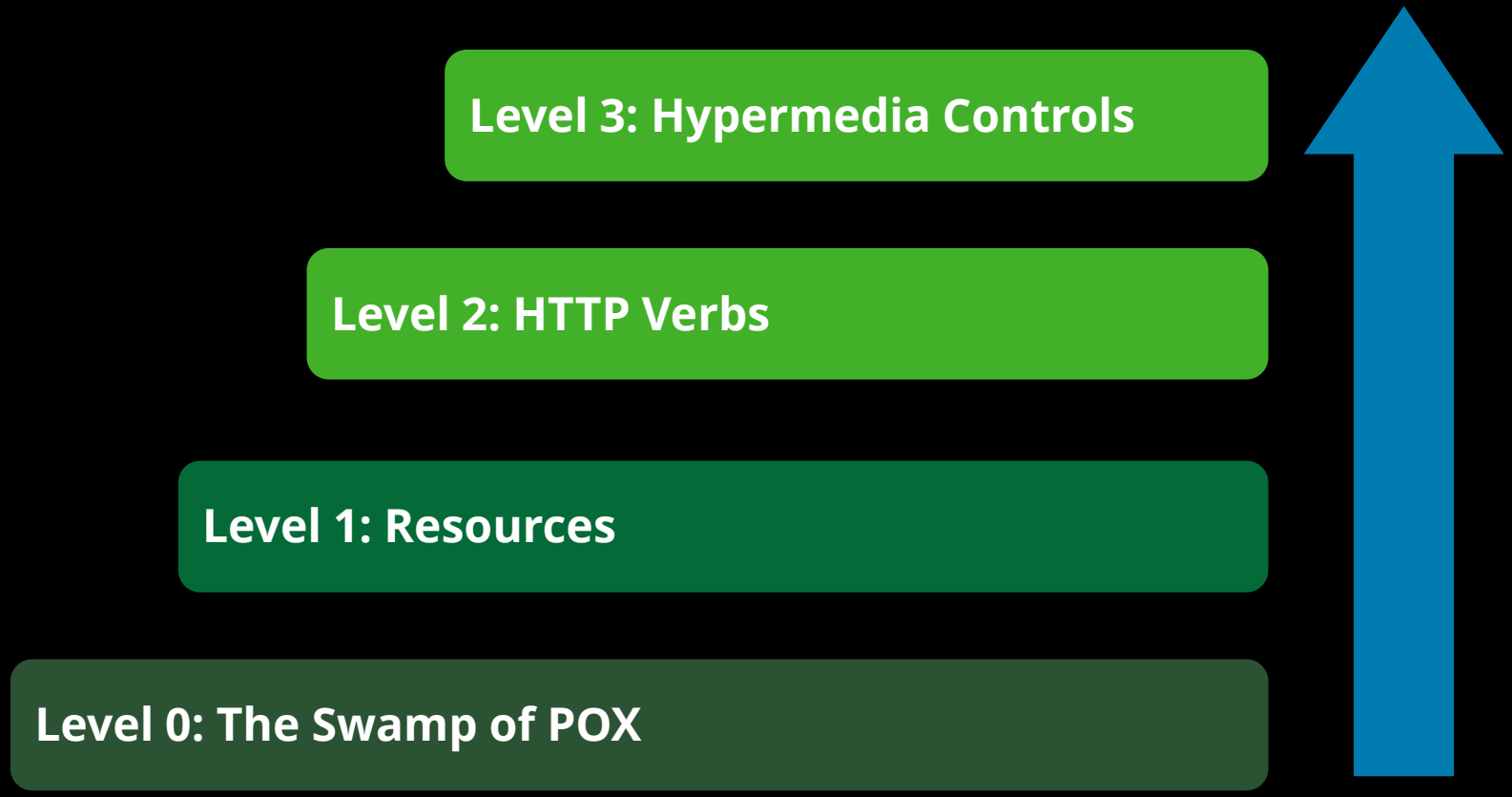
(Richardson REST maturity model)



Maturity model

(Richardson REST maturity model)

***This* is REST.**
Nothing else.



REST is hard to get right.
Today REST mostly means JSON over HTTP.

HATEOAS

Hypermedia as the Engine of Application State

```
POST https://banking.com/api/v1/FundsTransfer
Authorization: Bearer <token>
Content-Type: application/json

{
  "initiator": "<guid>",
  "debtorIban": "DK0042000012345",
  "creditorIban": "DK0042000054321",
  "amount": 100000,
  "currency": "SEK"
}
```

```
HTTP/1.1 201 Created
Content-Type: application/json; charset=utf-8
Location: https://banking.com/api/v1/FundsTransfer/transfer-id-guid
Transfer-Encoding: chunked

{
  "fundsTransferId": "transfer-id-guid",
}
```

```
HTTP/1.1 201 Created
Content-Type: application/json; charset=utf-8
Location: https://banking.com/api/v1/FundsTransfer/transfer-id-guid
Transfer-Encoding: chunked

{
  "fundsTransferId": "transfer-id-guid",
  "_links": [
    {
      ”name": ”Details",
      "href": "https://banking.com/api/v1/FundsTransfer/transfer-id-guid",
      "method": "GET",
      "description": "See funds transfer details"
    },
    {
      ”name": ”InitiatePayment",
      "href": "https://banking.com/api/v1/FundsTransfer",
      "method": "POST",
      "description": "Initiate a new transfer of funds"
    }
  ]
}
```

```
HTTP/1.1 201 Created
Content-Type: application/json; charset=utf-8
Location: https://banking.com/api/v1/FundsTransfer/transfer-id-guid
Transfer-Encoding: chunked

{
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    }
  ]
}
```

“[…] if the engine of application state is not being driven by hypertext, then it cannot be RESTful and cannot be a REST API. Period.
– Roy T. Fielding

Versioning

Version 1?

```
GET https://banking.com/api/v1/accounts
```

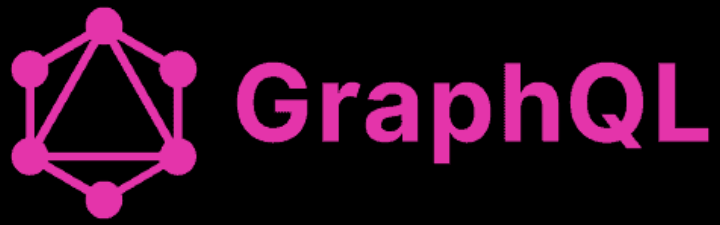
Version 2?

```
GET https://banking.com/api/v2/accounts
```

```
GET https://banking.com/api/accounts
Accept: application/vnd.accounts-complete+json
```

Use Content Negotiation

DEMO




```
query GetAllAccounts {
  allAccounts {
    iban,
    bookings {
      amount,
      currencyCode,
      debitCredit
    }
  }
}
```

POST

Query
Mutation

GET

Playground

The client dictates what's returned. Not the service.

```
### Get complete accounts representation

GET https://banking.com/api/Accounts
Accept: application/vnd.accounts-complete+json
```

```
query GetAllAccounts {
 allAccounts {
   userInfo: {
     id
     name: username # Rename
   },
   iban,
   bookings {
    amount,
    currencyCode,
    debitCredit
   }
 }
}
```

```
mutation openNewAccount {
  createAccount(account: {
    # Input
     currency: "DKK"
     iban: "DK4200874321"
     number: 874321
     ownerId: “<owner-id>"
  }) {
    # What we want returned
    iban
  }
}
```

Demo

GraphQL Playground

Is GraphQL an end to API versioning?

Not really.

Removing fields is still a breaking change.

Caching can be difficult.

Is it 1981 again?

```
syntax = "proto3";

option csharp_namespace = "Users.GrpcServer";

package usersgrpc;

service UsersService {
  rpc AuthenticateUser (AuthenticationRequest)
    returns (AuthenticationReply);

  rpc CreateUser (CreateUserRequest)
    returns (UserCreatedReply);

  rpc GetUser (GetUserRequest)
    returns (UserReply);
}

message AuthenticationRequest {
  string username = 1;
  string password = 2;
}

message AuthenticationReply {
  bool isAuthenticated = 1;
  optional string token = 2;
}

message CreateUserRequest {
  string username = 1;
  string password = 2;
}

message UserCreatedReply {
  oneof response {
    string userId = 1;
    CreationError error = 2;
  }
}

message CreationError {
  string message = 1;
}
```

Proto Description

```
syntax = "proto3";

option csharp_namespace = "Users.GrpcServer";

package usersgrpc;

service UsersService {
  rpc AuthenticateUser (AuthenticationRequest)
    returns (AuthenticationReply);

  rpc CreateUser (CreateUserRequest)
    returns (UserCreatedReply);

  rpc GetUser (GetUserRequest)
    returns (UserReply);
}

message AuthenticationRequest {
  string username = 1;
  string password = 2;
}

message AuthenticationReply {
  bool isAuthenticated = 1;
  optional string token = 2;
}

message CreateUserRequest {
```

Contract


syntax = "proto3";
option csharp_namespace = "Users.GrpcServer";
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returns (AuthenticationReply);
rpc CreateUser (CreateUserRequest)
returns (UserCreatedReply);
rpc GetUser (GetUserRequest)
returns (UserReply);
}
message AuthenticationRequest {
string username = 1;
string password = 2;
}
message AuthenticationReply {
bool isAuthenticated = 1;
optional string token = 2;
}
gRPC Server
gRPC Client
Stub
Stub
1
Protobuf Request
01101000 01100101 ...
2
Protobuf Response

Demo

Calling an gRPC method

Surprises.

Data modeling

Null handling - proto

```
message UserInfo {
  string userId = 1;
  optional string username = 2;
}

message UserReply {
  optional UserInfo user = 1;
}
```

Return value

```
return new UserReply
{
    User = new UserInfo
    {
        UserId = user.Id.ToString(),
        Username = null
    }
};
```

Tooling gotchas

(Hard to debug)

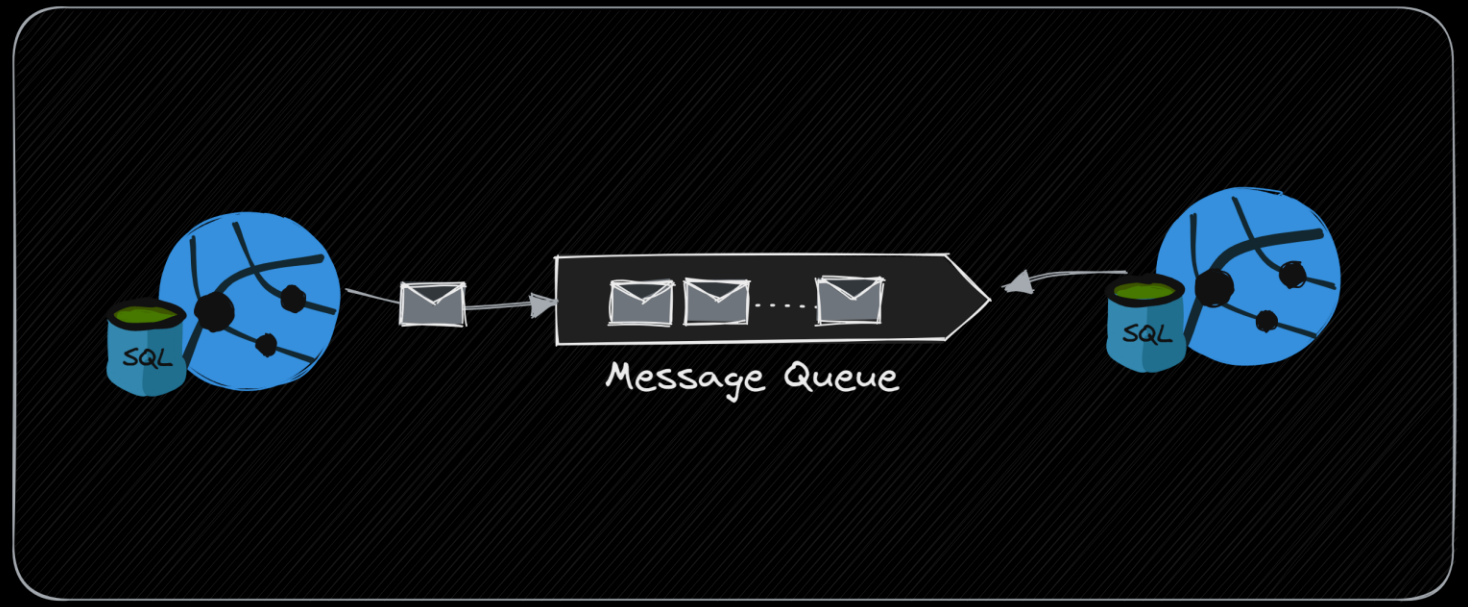
Out-of-sync
Proto descriptions

Messaging

Solution Architects’ dream.
Developers’ nightmare.

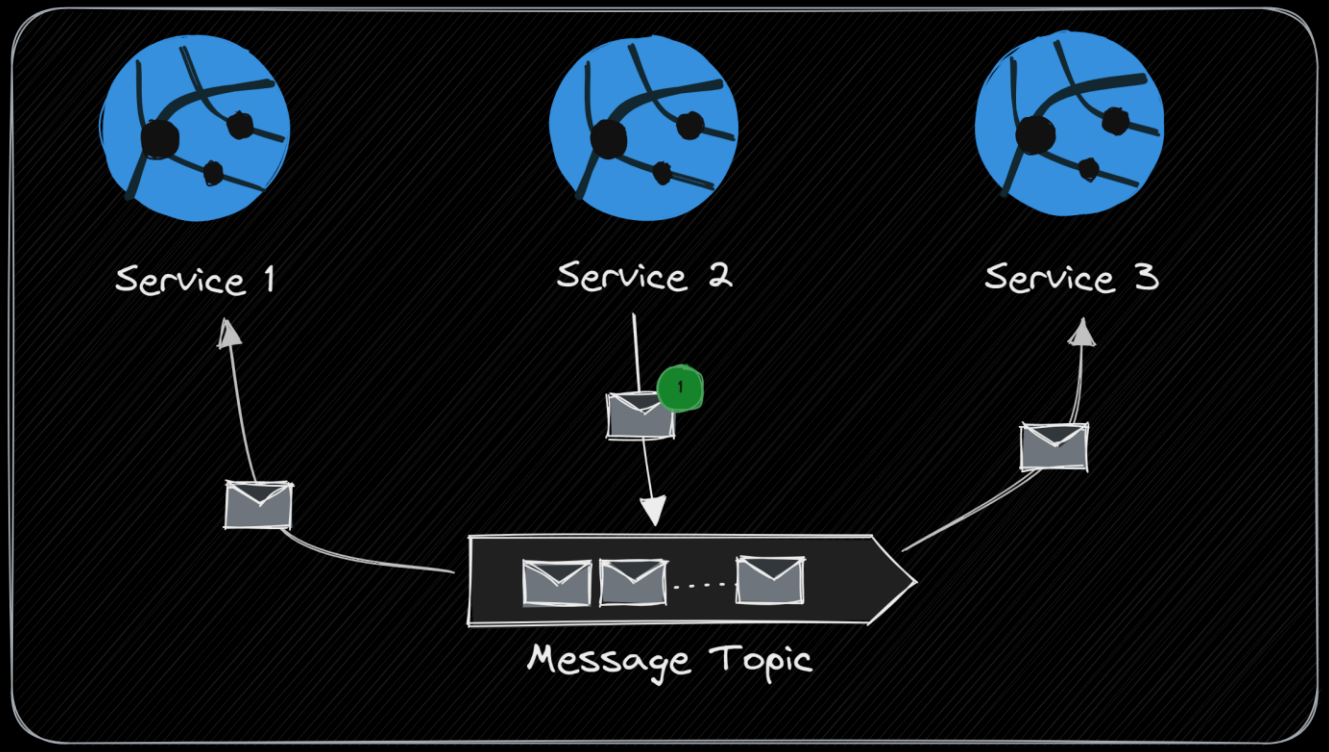
Core messaging concepts

Point-to-point



Core messaging concepts

Publisher/Subscriber



Typical event data

```
{
  "CorrelationId": "5ac3fe27-e3ee-47af-89b1-00c5765b38b1",
  "BeneficiaryIban": "DK4200987654",
  "OriginatingIban": "DK4200123456",
  "Amount": 100000,
  "Currency": "SEK"
}
```

Cloud Event

Our data

```
{
    "id": "78869fd3-a17c-4bb7-9a46-574be4564a01",
    "source": "payments-api/funds-initiated",
    "type": "payments.fundstransfer.initiated",
    "data": {
        "BeneficiaryIban": "DK4200987654",
        "OriginatingIban": "DK4200123456",
        "Amount": 100000,
        "Currency": "SEK"
    },
    "time": "2023-01-10T21:44:18.1689474+00:00",
    "specversion": "1.0"
}
```

cloudevents.io

Message formats

AMQP, MQTT, Avro?

AMQP

AMQP 0-9-1

Exchange **Binding** **Routing key**

Exchange type

Fanout
Direct
Topic
Headers

Queue

AMQP 1-0

Queue **Topic** **Subscription**

Demo

Publish and subscribing to messages

Lessons learnt

Use a shared library

(... but only to publish and subscribe)

Distributed message objects

Results in unintended, painful updates

Demo

Tying it all together.

Thank you!

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Reach out at nimillard@deloitte.dk