Unifying Banks & Blockchains @ Coinbase

History of Coinbase

Bitcoin

Europe

Bitcoin Microservice

2012 2013 2014 2015 2016 2017

US Buy & Sell

Exchange (GDAX)

Ethereum

2 Trading Platforms

coinbase

3 Digital Currencies

6 Fiat Currencies

USD

EUR

GBP

SGD

CAD

AUD

7 Traditional Payment Integrations

PayPal

US Domestic Wires

3-D Secure Cards

32 Countries

4 Microservices

Knox (Private keys)

Macbeth (Ethereum)

Wallace (Bitcoin)

Iron Bank (US Banking)

1 Monolithic Rails App

What is Bitcoin?

Bitcoin is both:

1) a scarce digital resource
2) a protocol for transferring the resource over the Internet

US Banking System	Bitcoin
Bank accounts	Cryptographic addresses
ACH/Wire	Peer-to-peer protocol
Interbank settlement	Public transaction ledger
Issued by US government	Fixed issuance
3 business days	~30 minutes
Chargebacks	Irreversible payments

Overview

- How ACH & Bitcoin work
- Unified payments architecture
- How our ACH & Bitcoin services work

Automated Clearing House (ACH)

Originating Depository Financial Institution

ACH Operator (Federal Reserve)

Receiving Depository Financial Institution

Originator

Receiver

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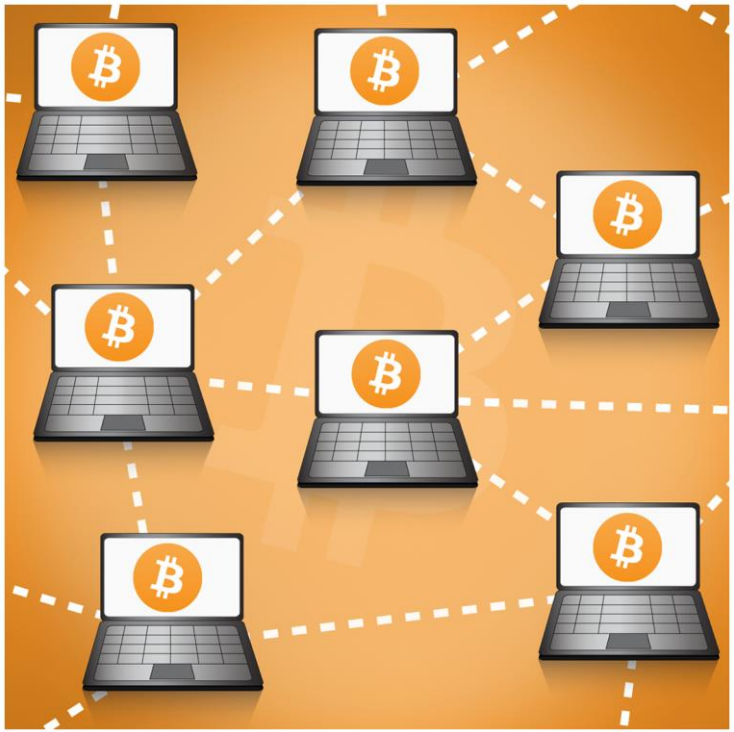
ACH Returns

- Payments are returned if insufficient funds, account closed, unauthorized debit, etc.
- RDFI has 24 hours to return for insufficient funds
- Receiver has 60 days to issue a chargeback
- “No news is good news”

How Bitcoin Works



Cryptography Review

Digital signature schemes:

- Gen() => (Public key, Private key)
- Sign(Private key, Data) => Signature
- Verify(Public key, Data, Signature) => {True, False}

Collision-resistant one-way functions

- Hash(Data) => Fixed length binary string

Bits of Coin

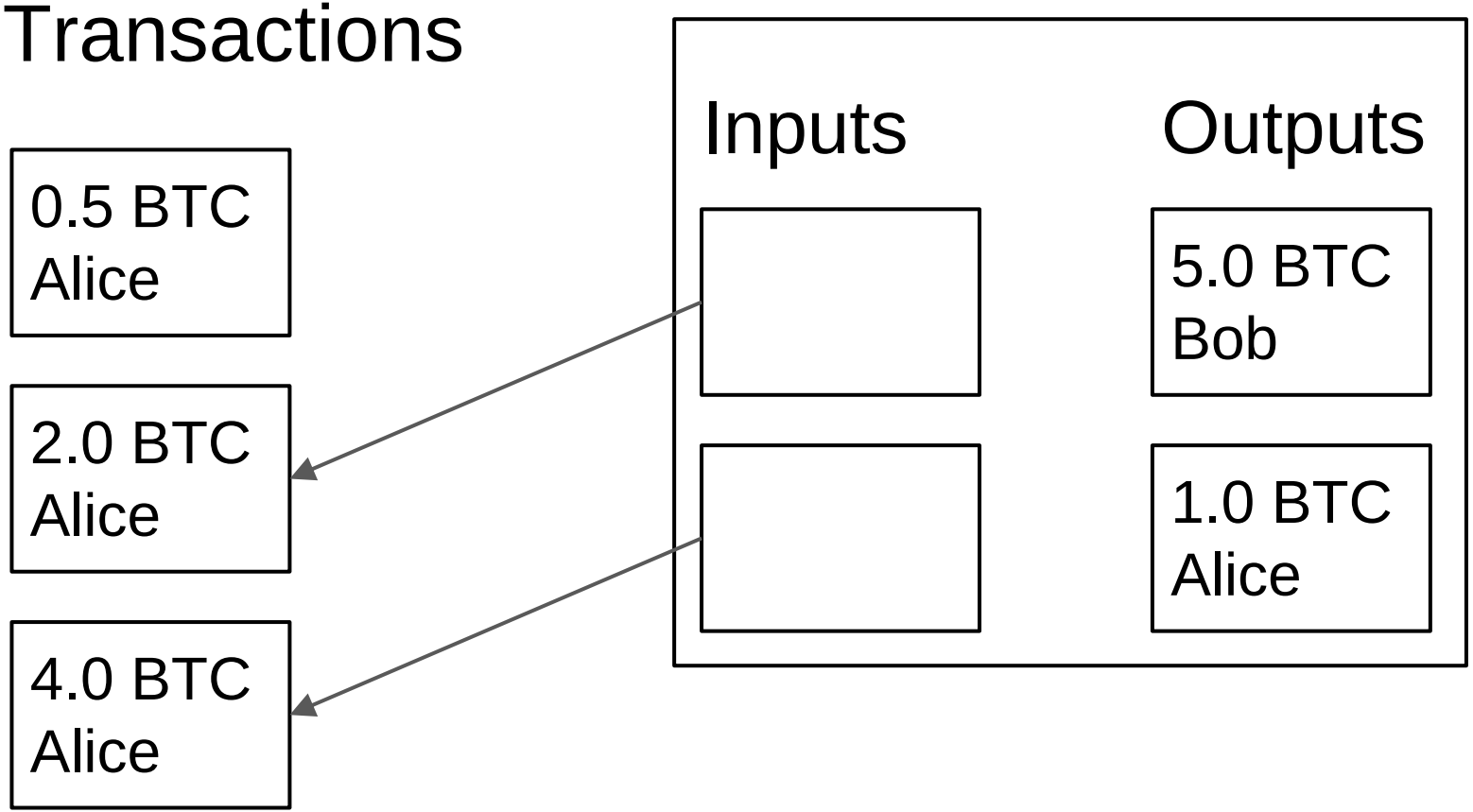
Transactions

0.5 BTC
Alice

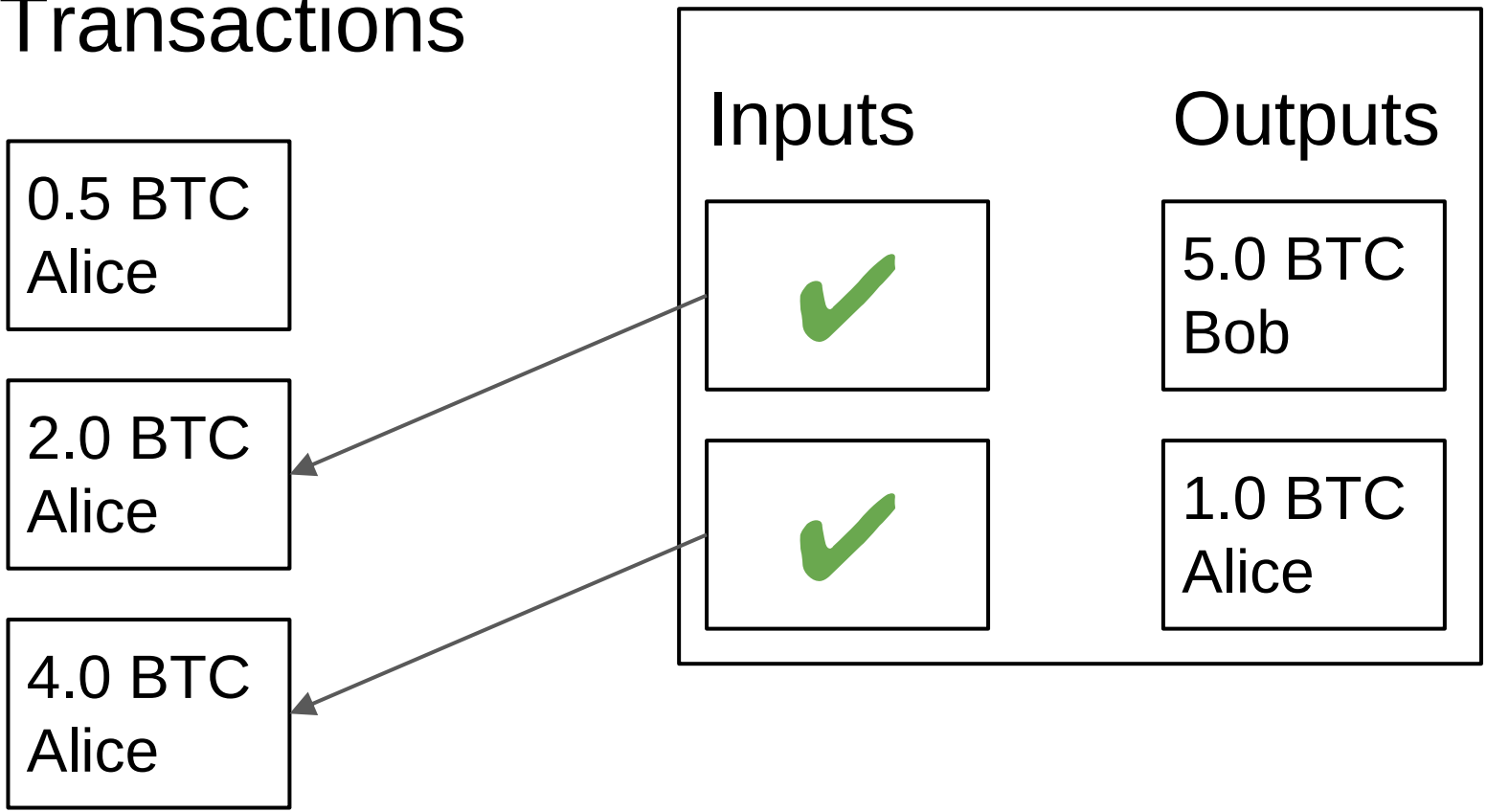
2.0 BTC
Alice

4.0 BTC
Alice

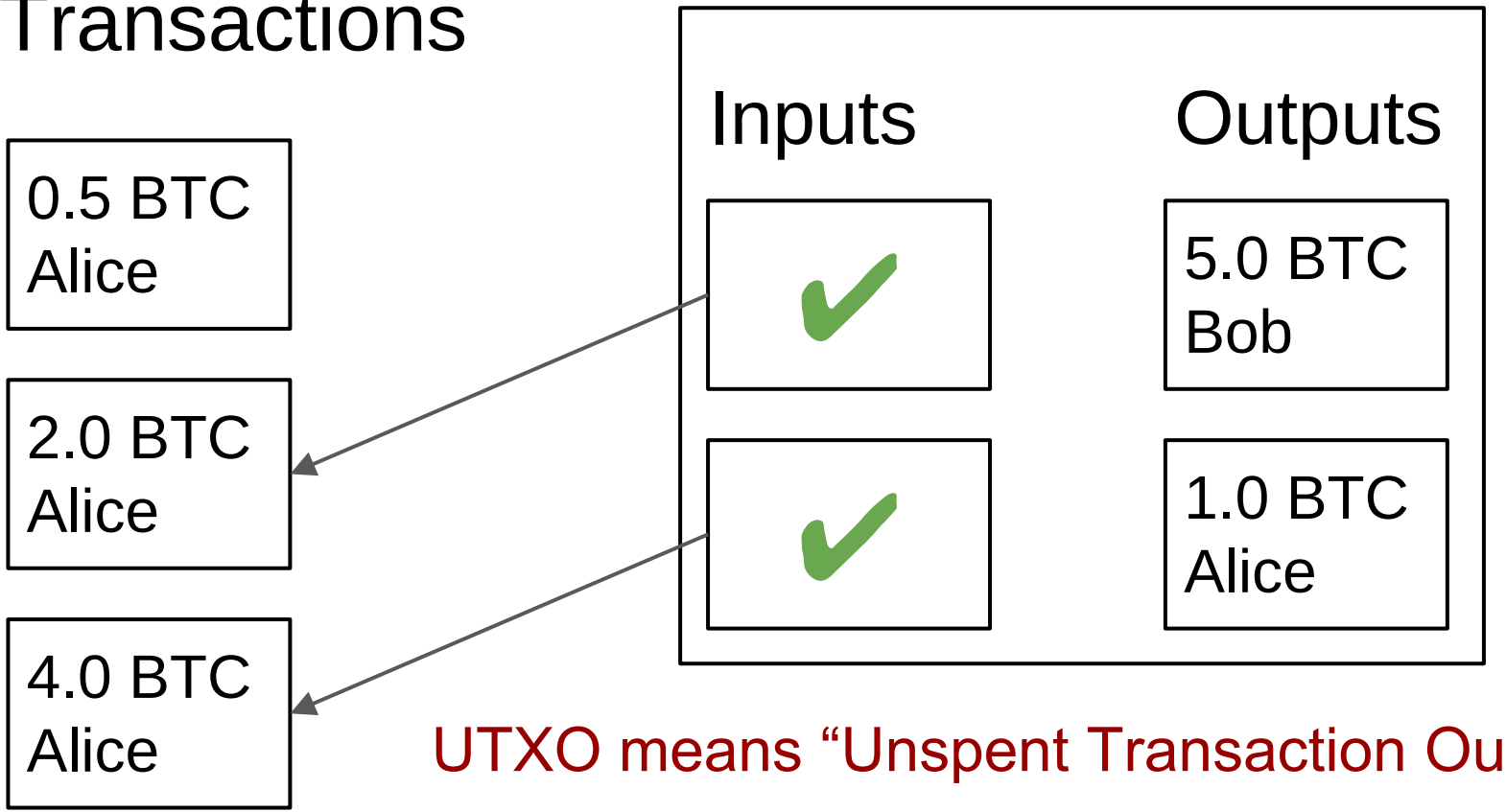
Transactions



Transactions



Transactions



UTXO means “Unspent Transaction Output”

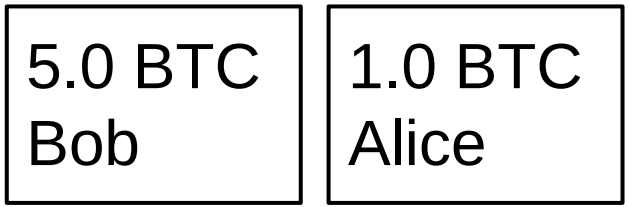
Public Ledger

Transaction #286

Public Ledger

Transaction #286

Transaction #287



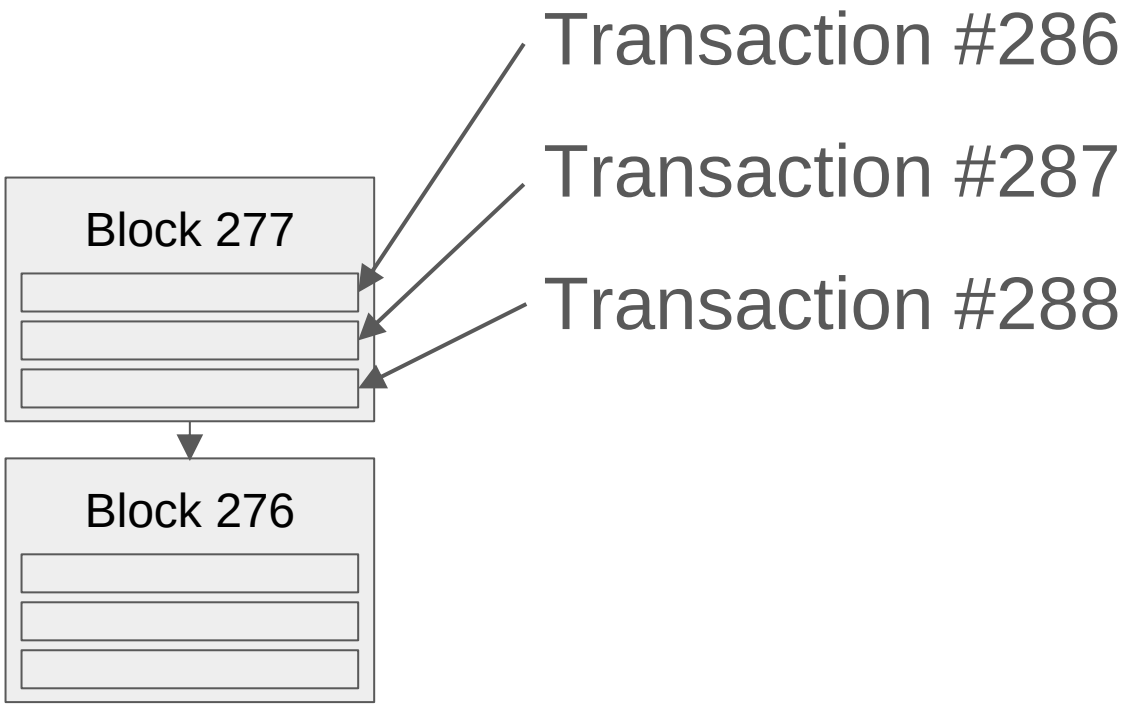
Public Ledger

Transaction #286

Transaction #287

Transaction #288

Blocks & Chains



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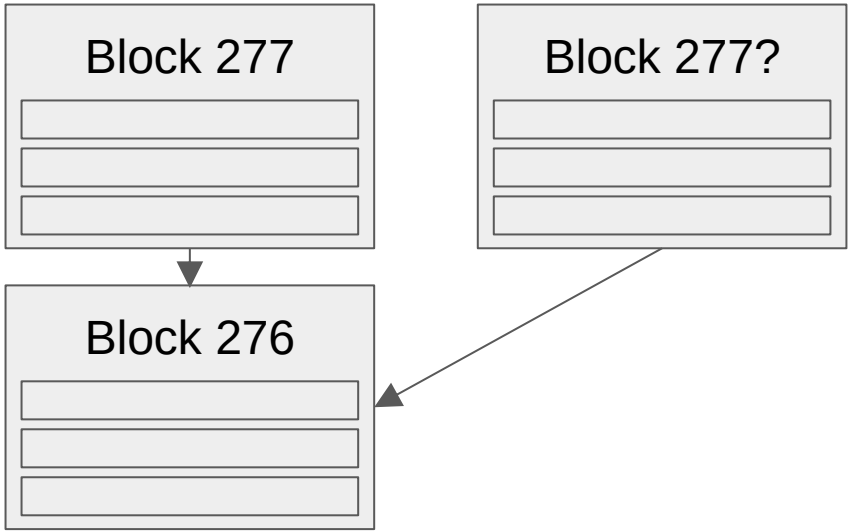

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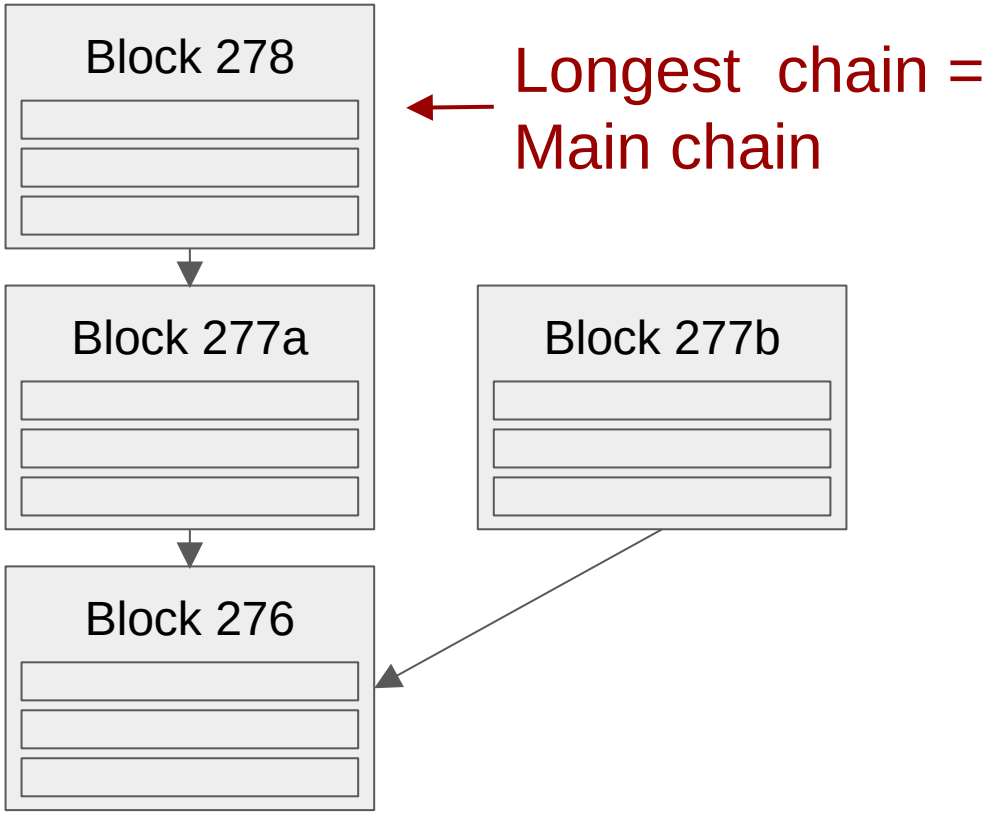

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History of Coinbase

Bitcoin

Europe

Bitcoin Microservice

2012

2013

2014

2015

2016

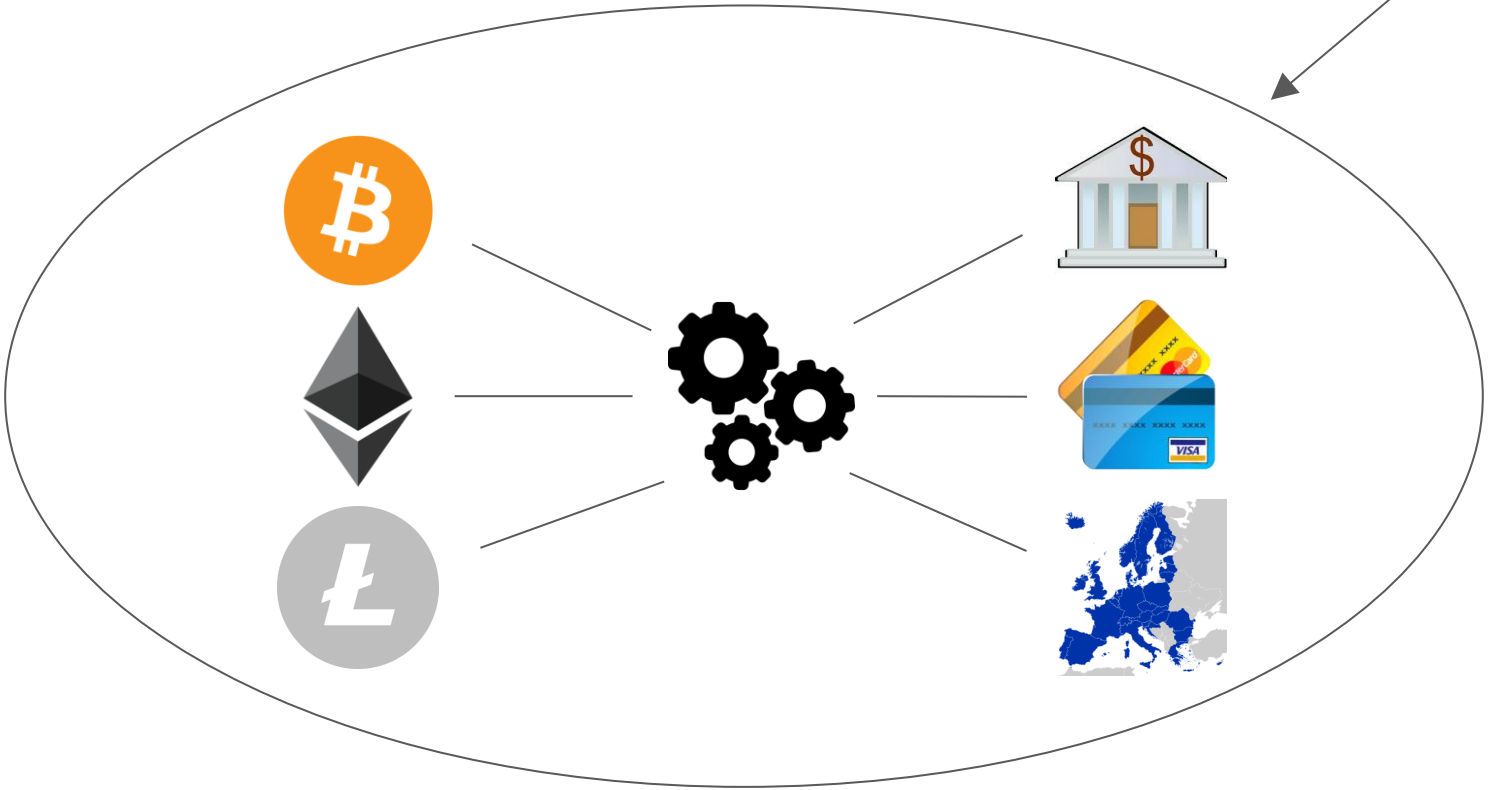
2017

US Buy & Sell

Exchange (GDAX)

Ethereum

A Not-So-Scalable Architecture

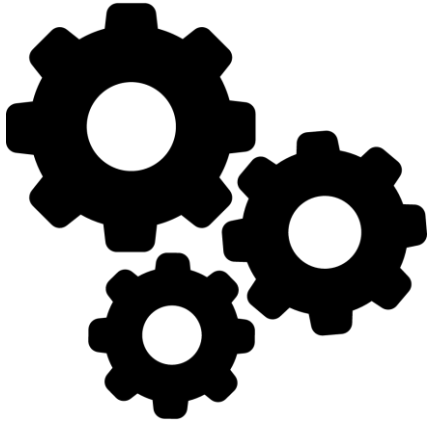


Core Transaction Processing

	Debit	**Credit**
Deposit	External account	Coinbase account
Withdrawal	Coinbase account	External account
Buy	Bank account	Coinbase crypto account
Sell	Coinbase crypto account	Bank account
Send	Coinbase account	Coinbase account

Transaction Processing Service

- Why is a payment made?
- Coordinates calls to payment services
- Ensures credits and debits balance out
- Buys, sells, deposits, withdrawals, sends

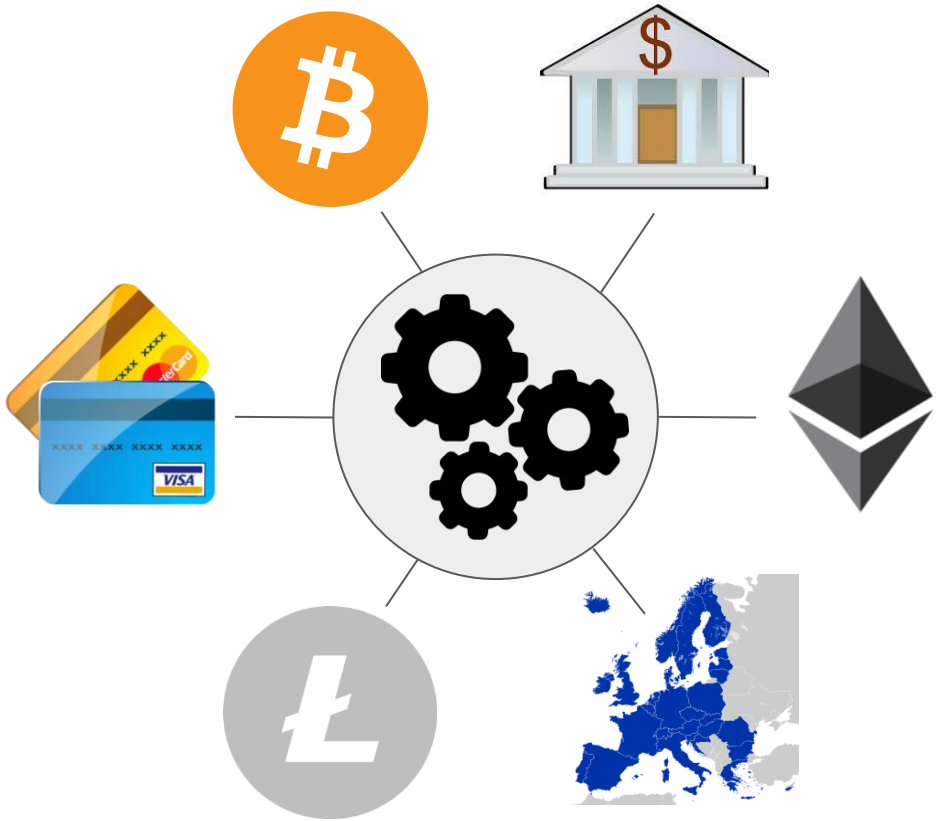


Payment Services

- How is a payment made?
- Can send and charge/receive money
- Encapsulates integration logic
- Implemented for both banks and blockchains




A Scalable Architecture

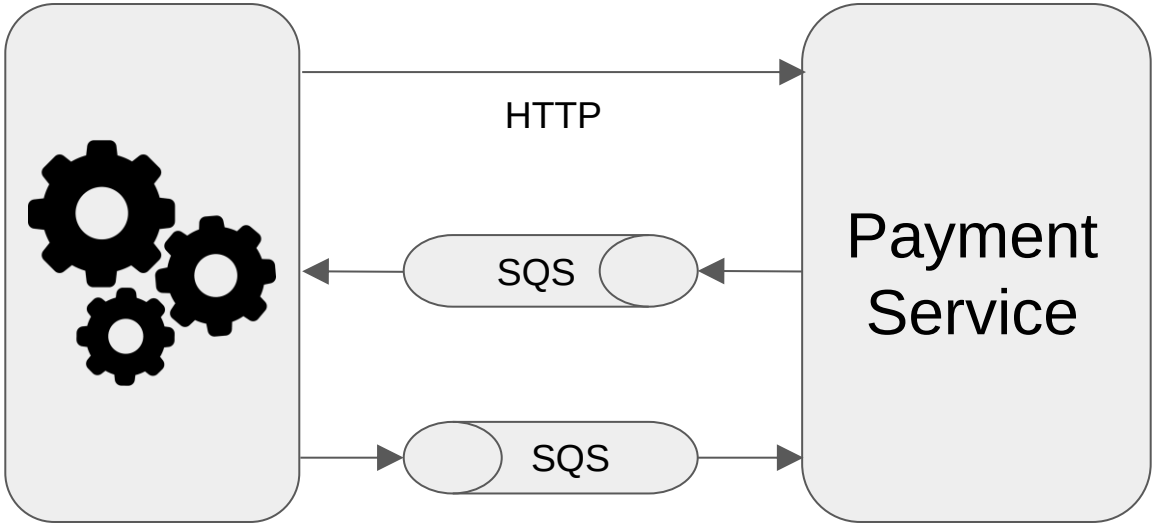


A Scalable Architecture

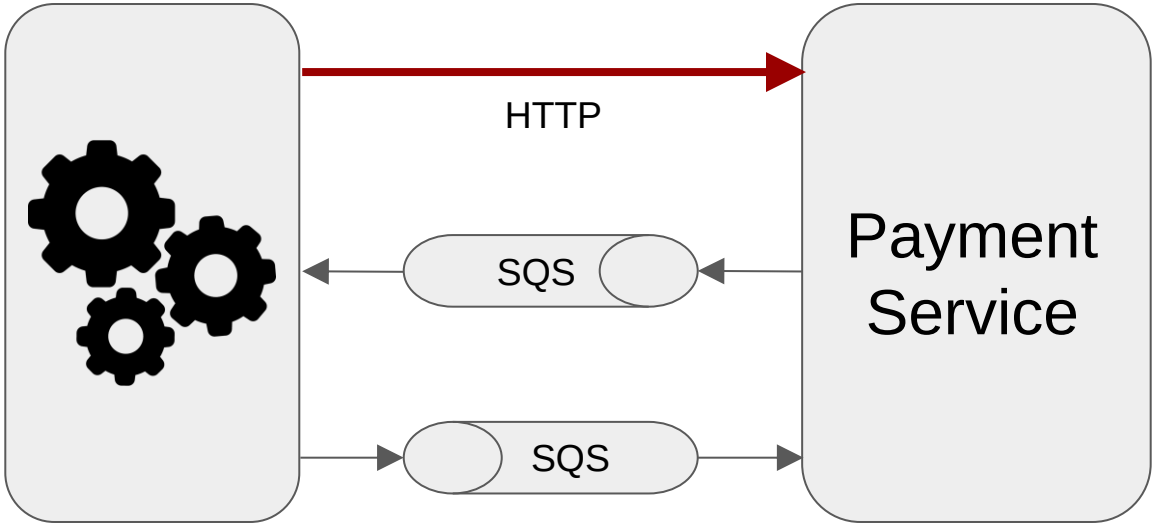
Universal Interface: Payment Structure


```
{
  "id": "21ee4091-ad9a-45b7-be49-6562ef19ea0e",
  "currency": "BTC",
  "amount": "-2.500000000",
  "fee": "0.000000000",
  "payment_method":
    "15pef9Cq8yd5a4b38DjKyKcT7R48VS4How",
  "account_id":
    "6ac6b0e1-8a2d-47d9-9f1e-bb3361b4f93e",
  "status": "completed"
}
```

Universal Interface: Microservice Protocol

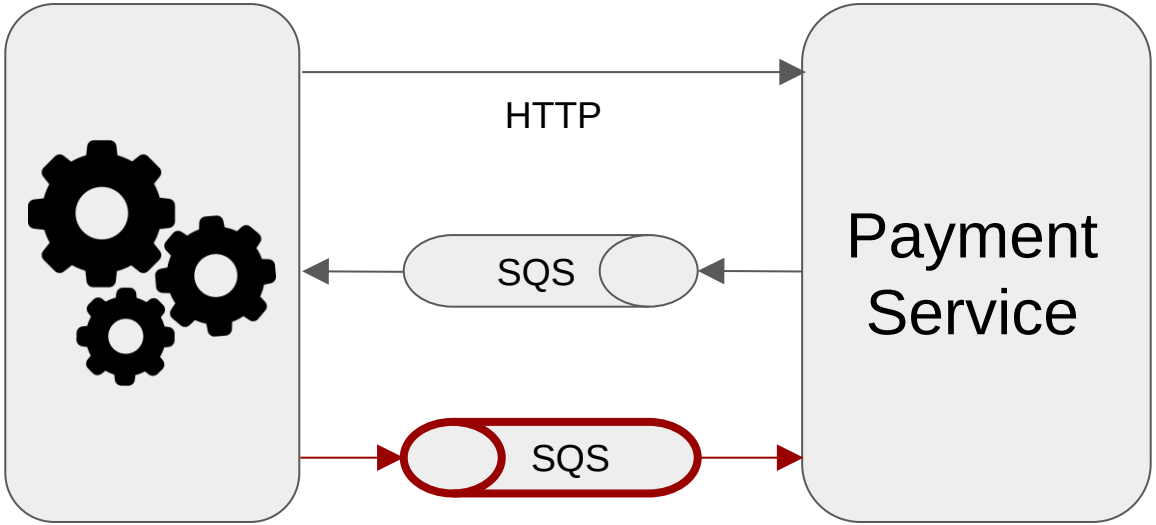


Universal Interface: Microservice Protocol



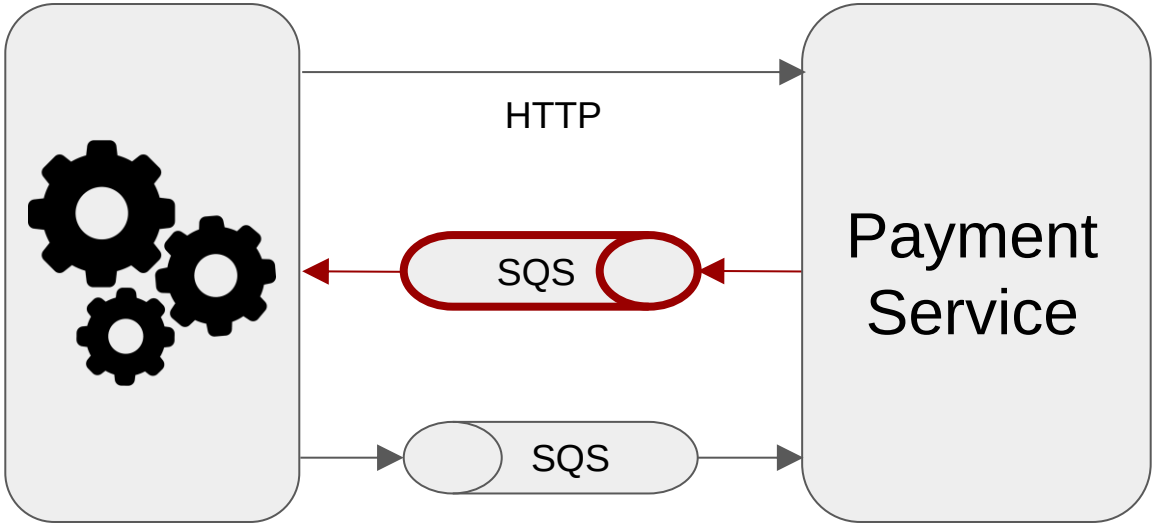
GET /payments/:id

Universal Interface: Microservice Protocol



create_payment(id, amount, currency, …)

Universal Interface: Microservice Protocol



payment_update(id)

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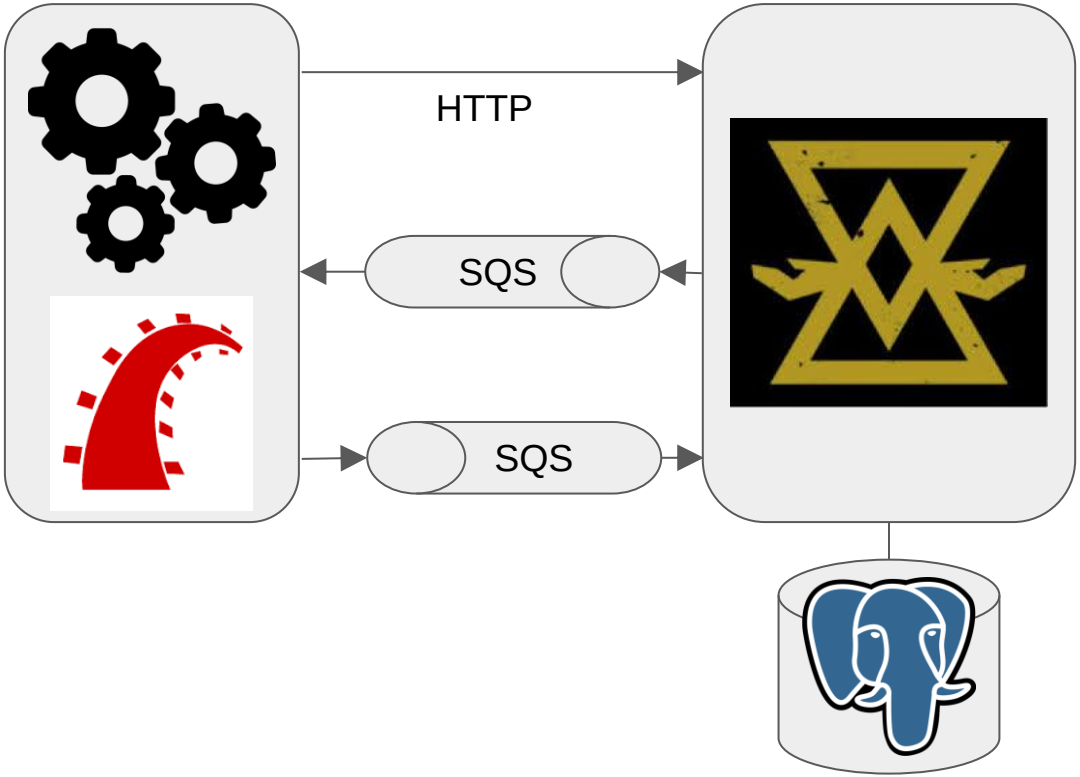
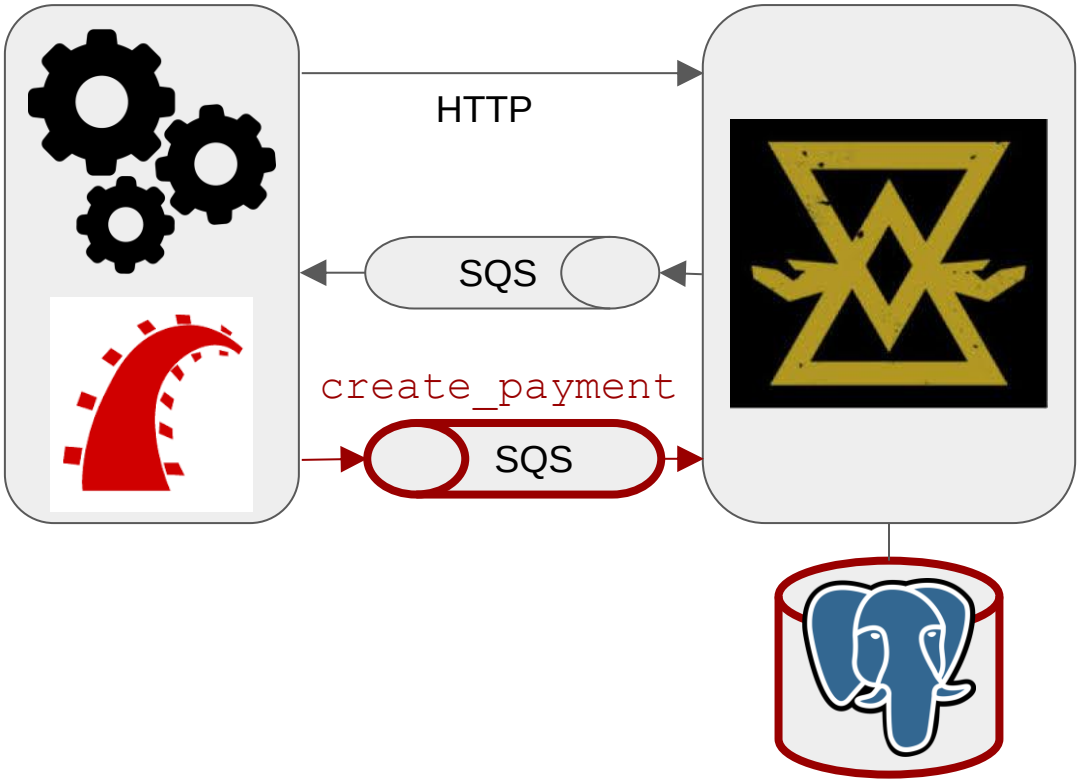
Iron Bank



ODFI

Iron Bank



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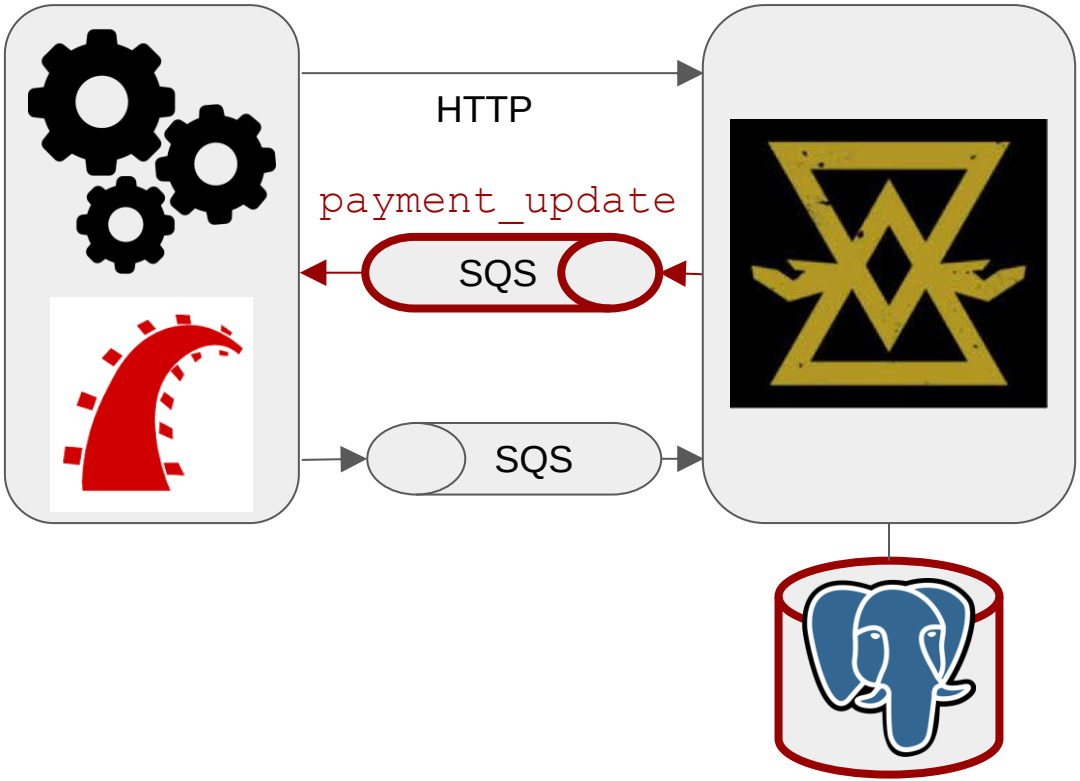

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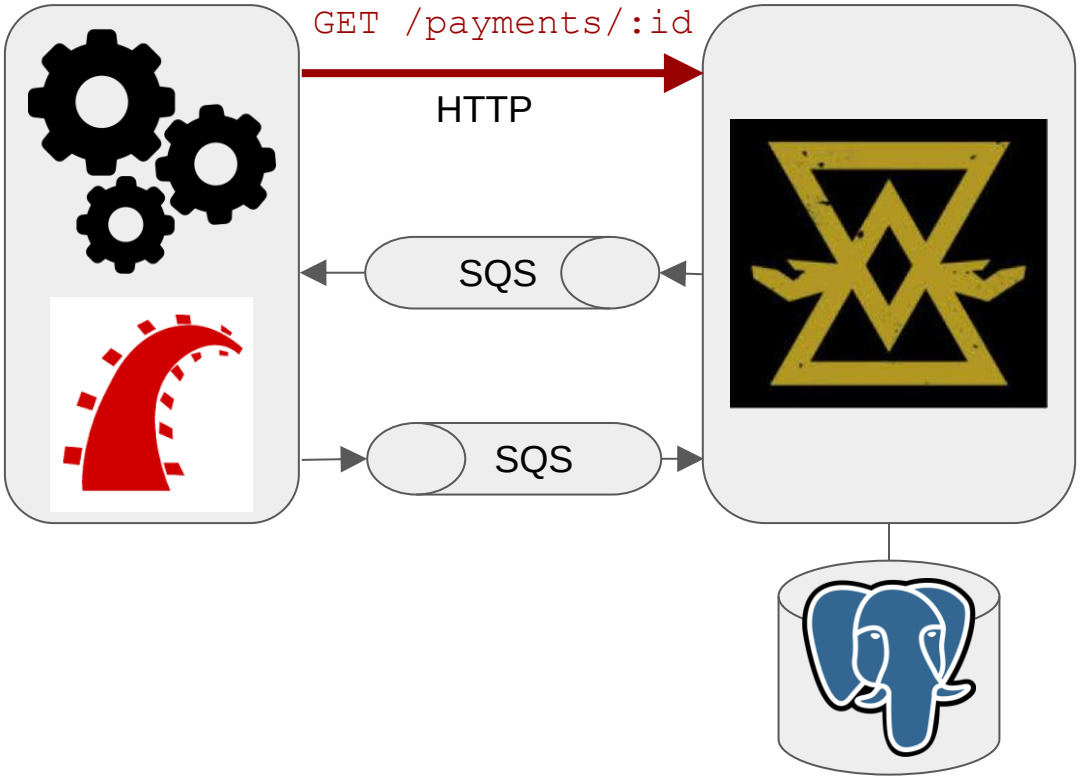

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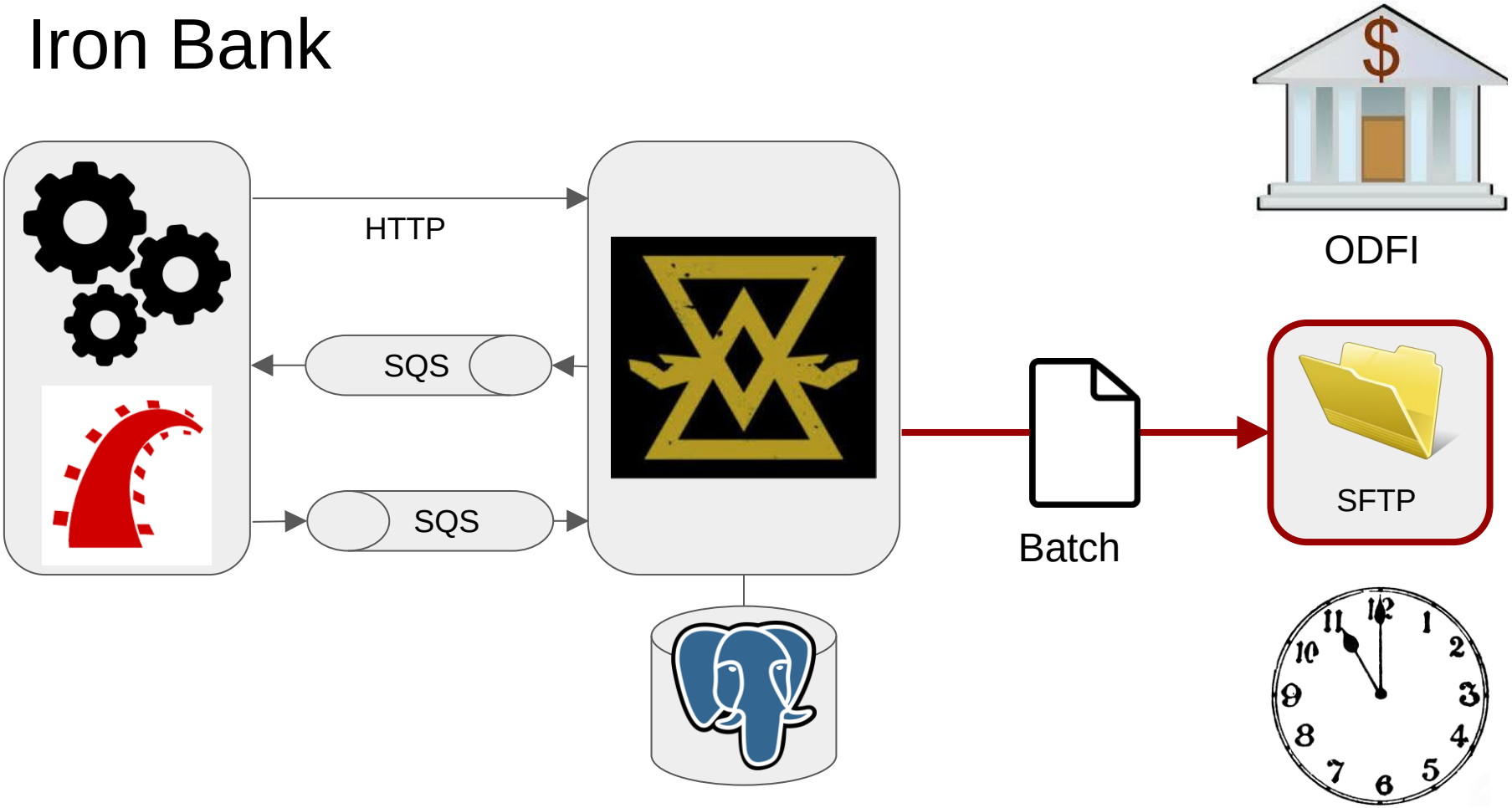

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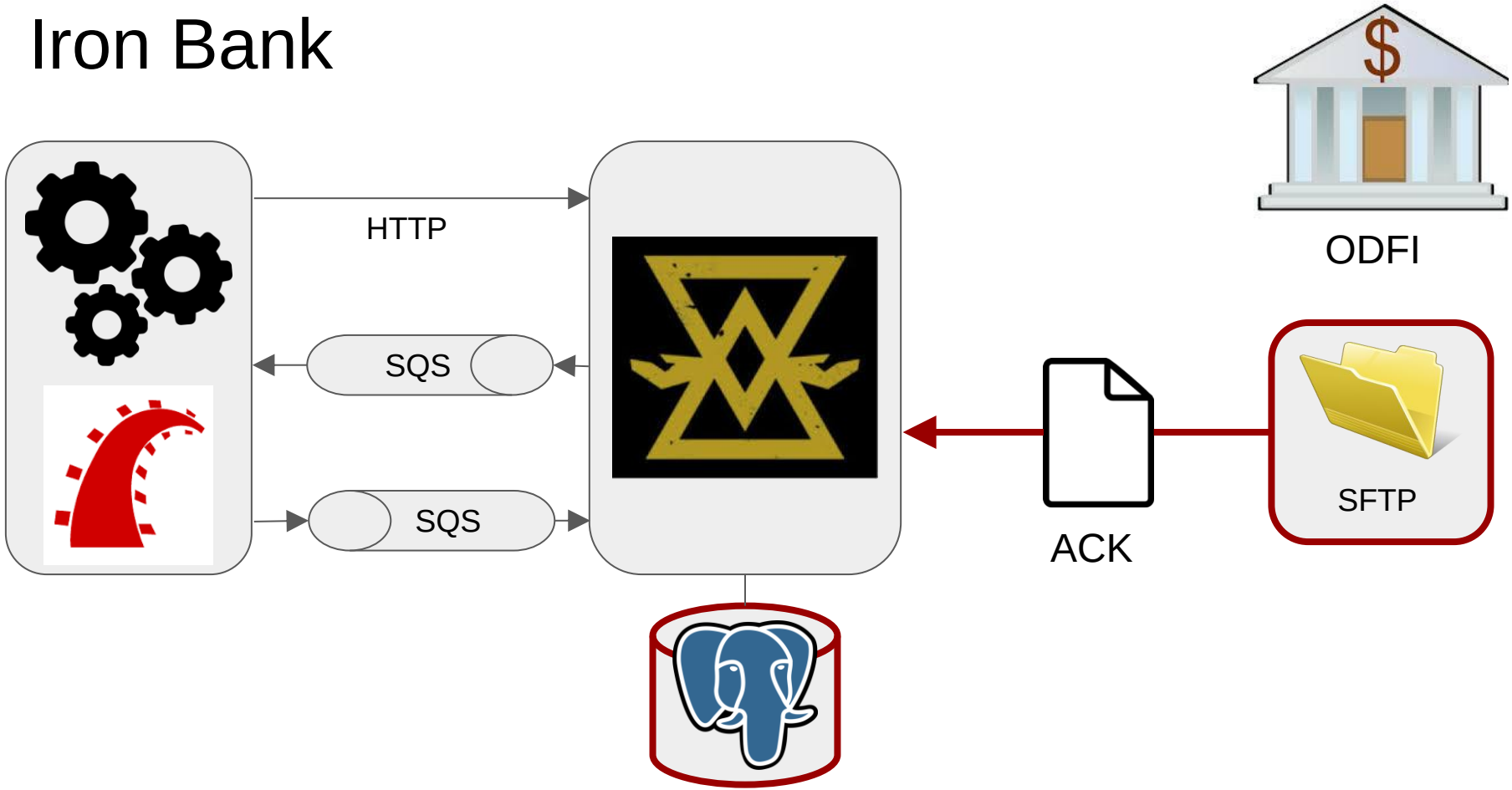

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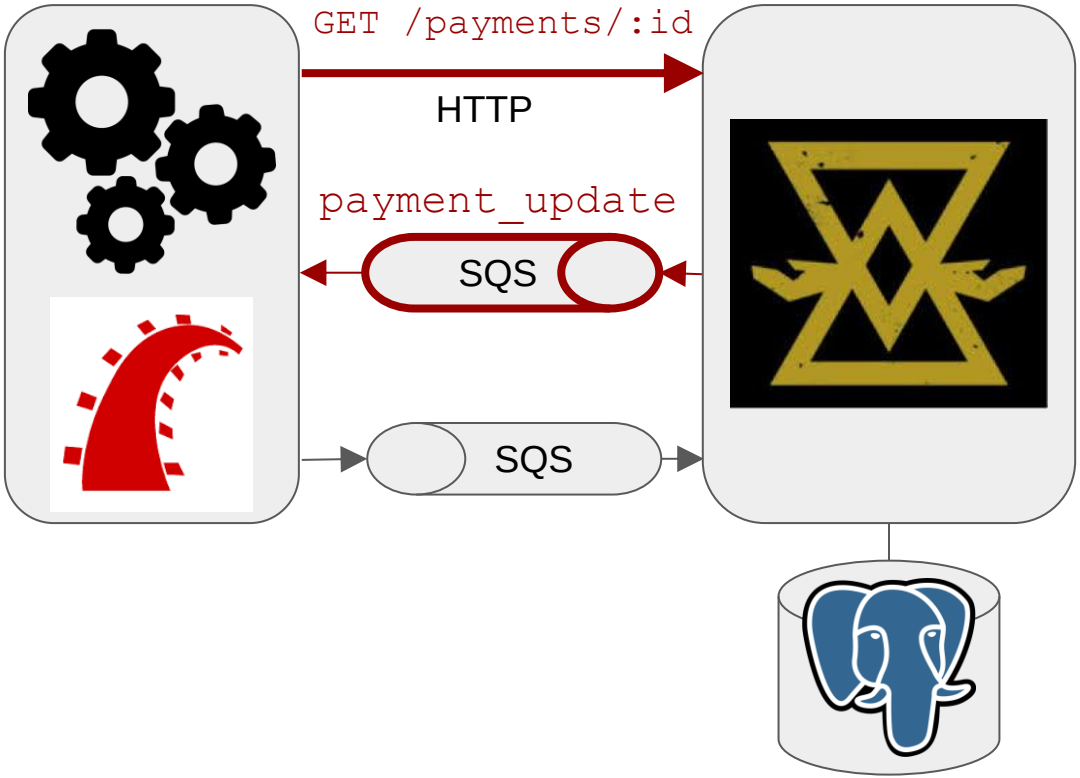

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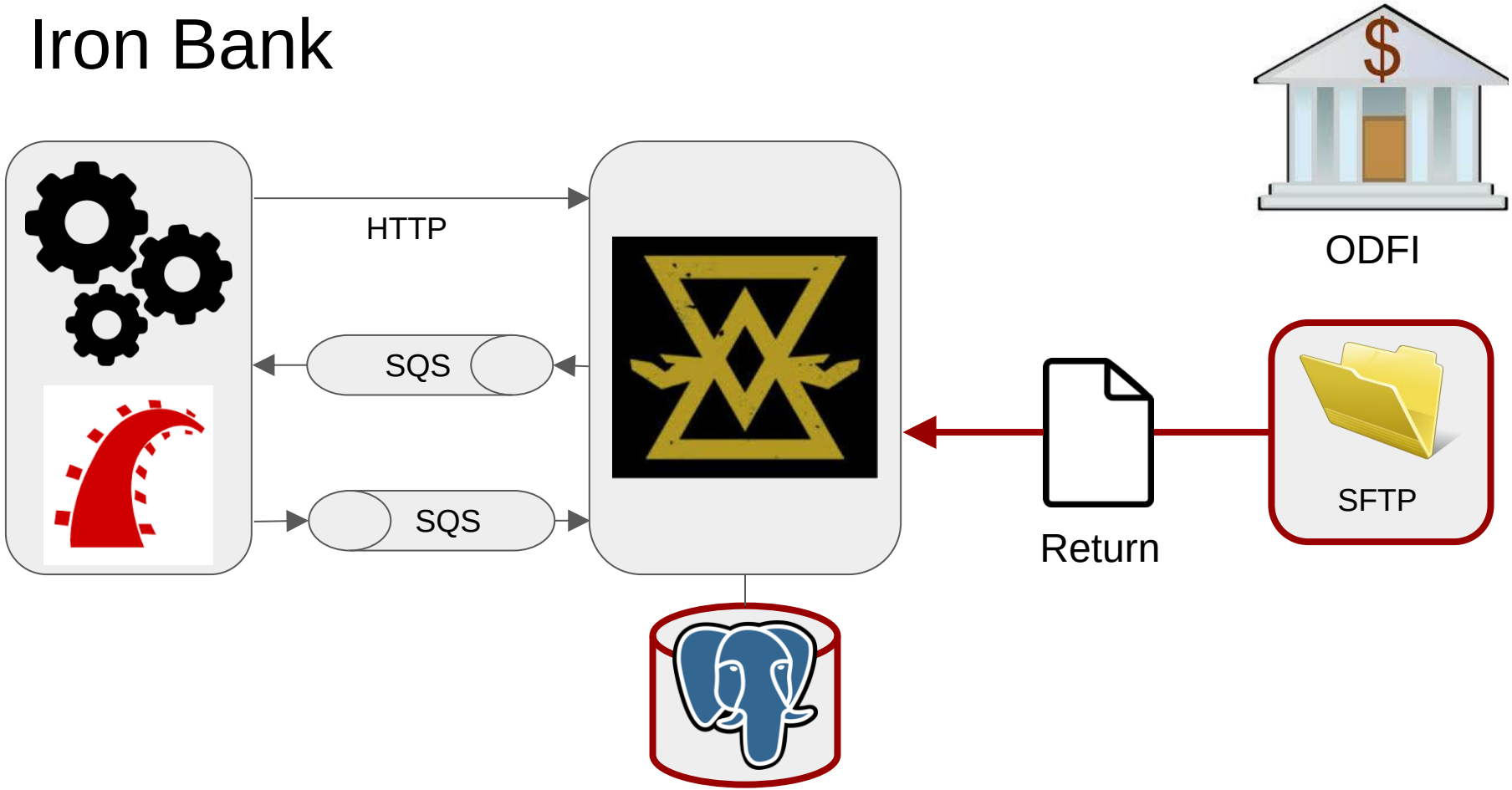

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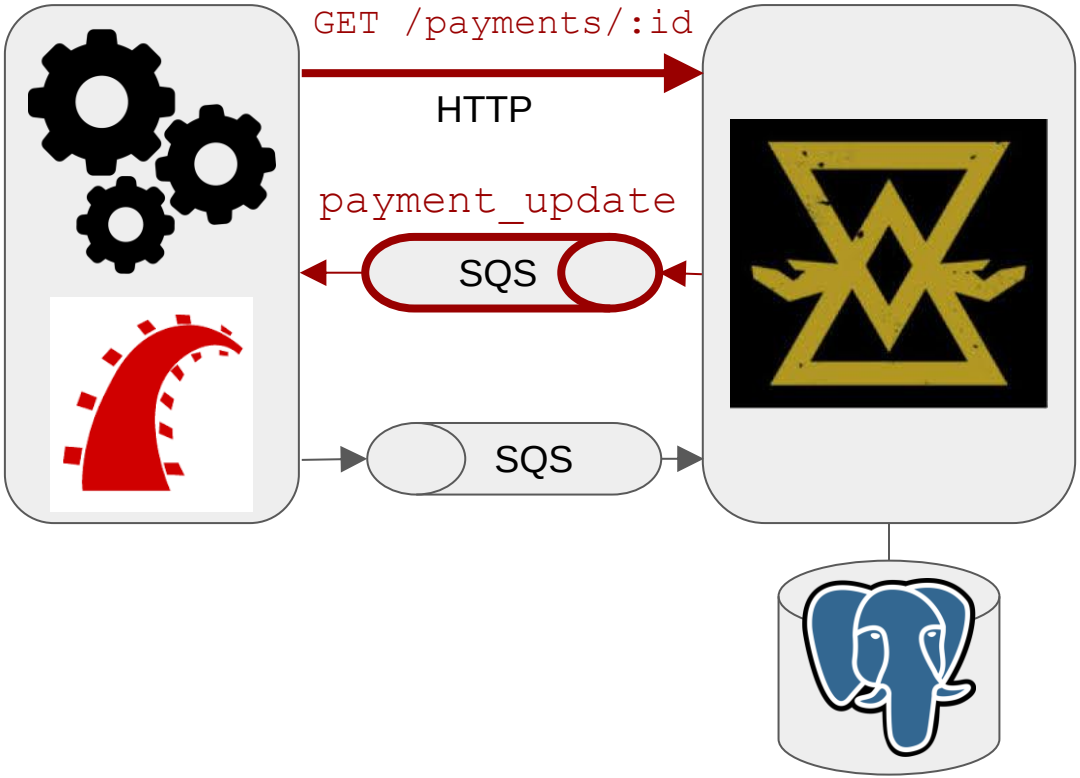
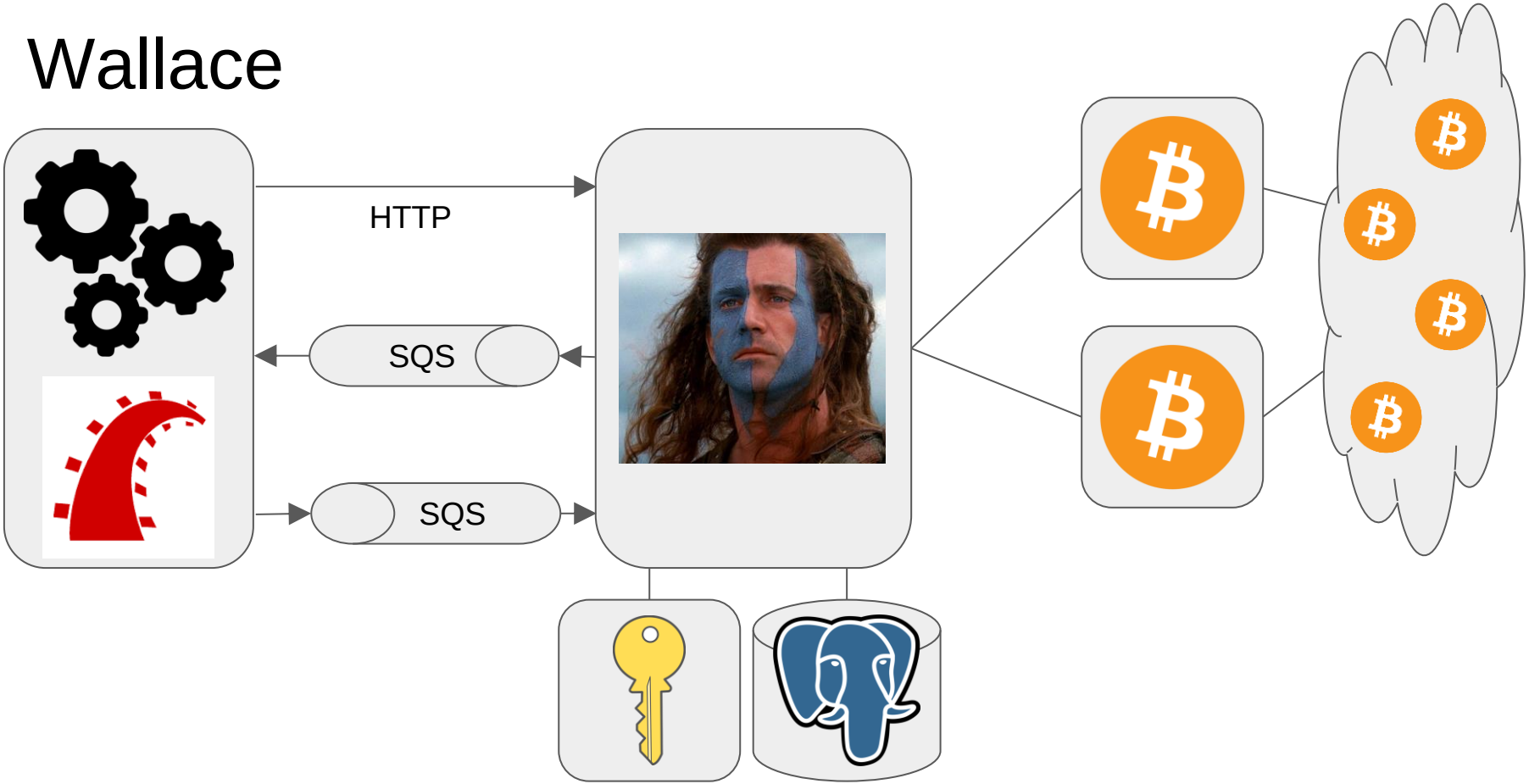


ODFI

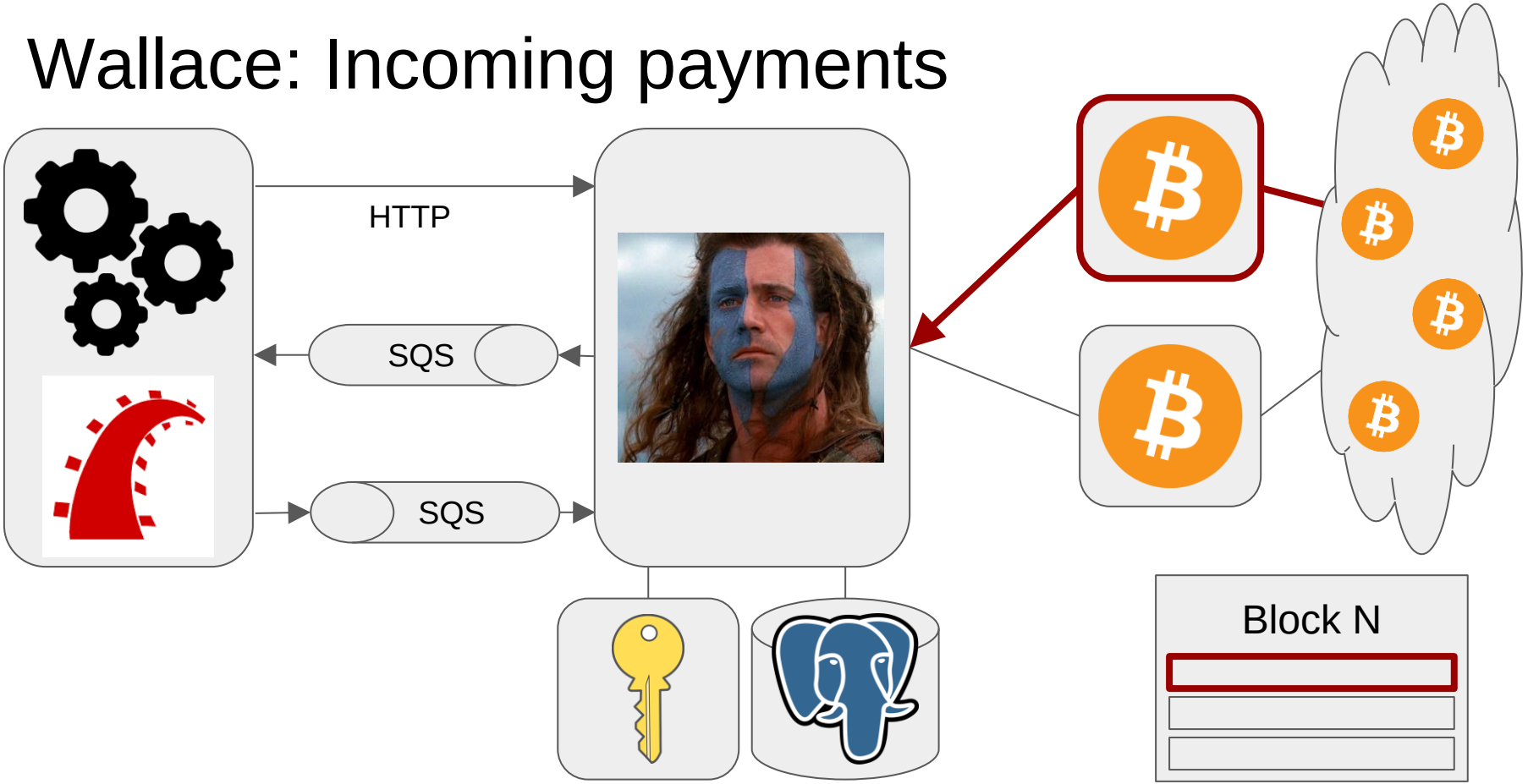
Iron Bank Details

- Multiple banks
- Quantity and volume limits per bank
- Web scrapers as alternative to FTP

Wallace



Wallace: Incoming payments



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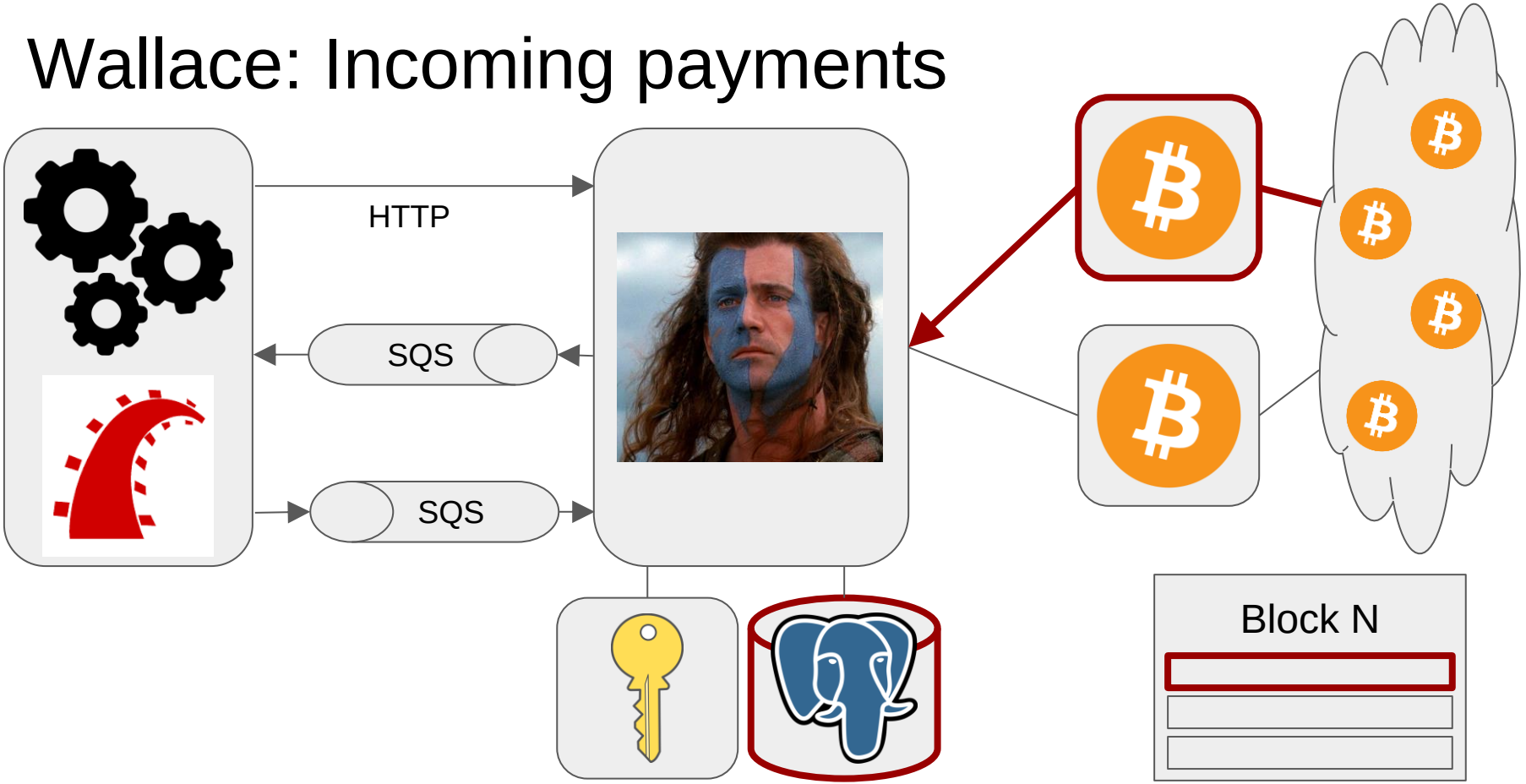

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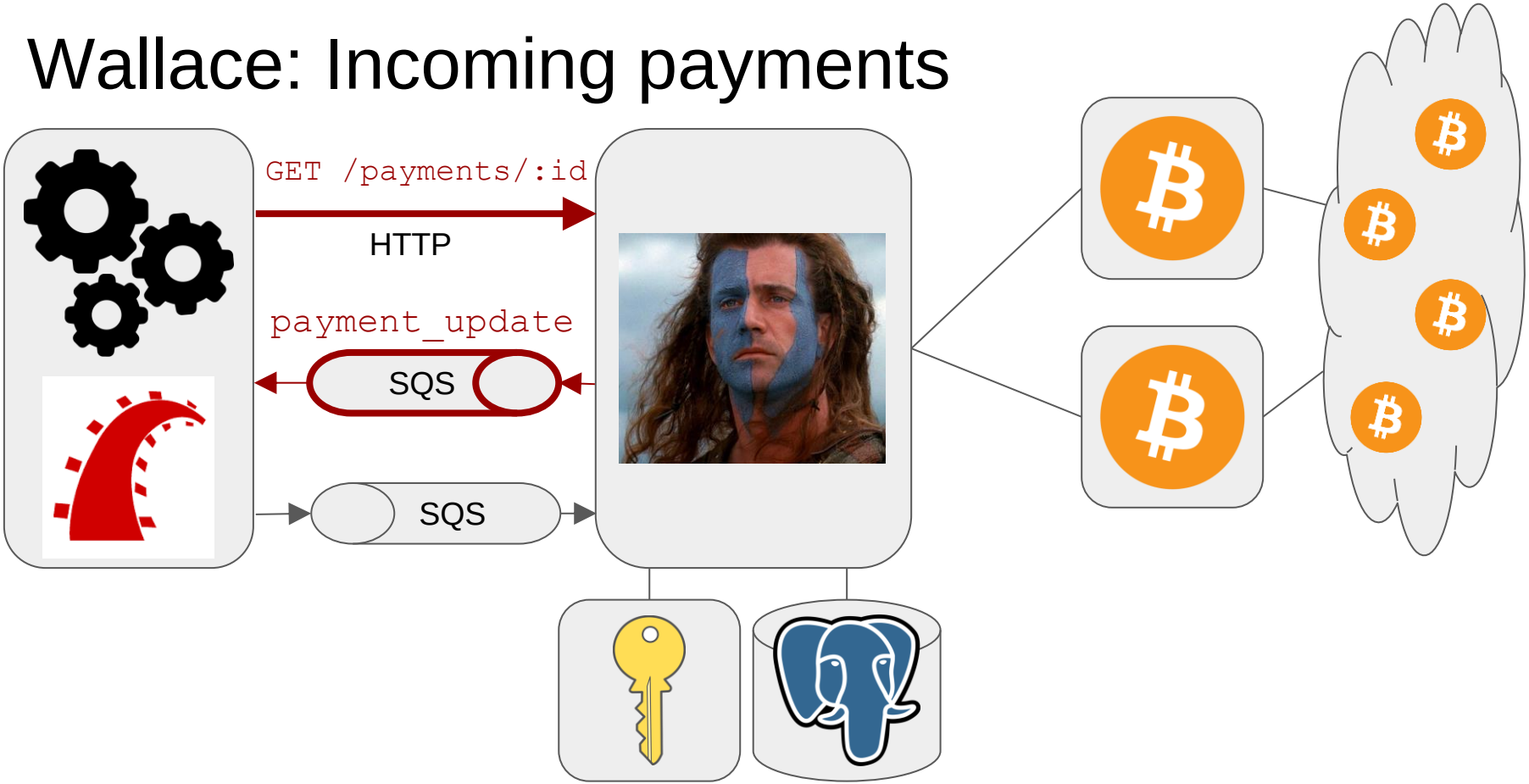

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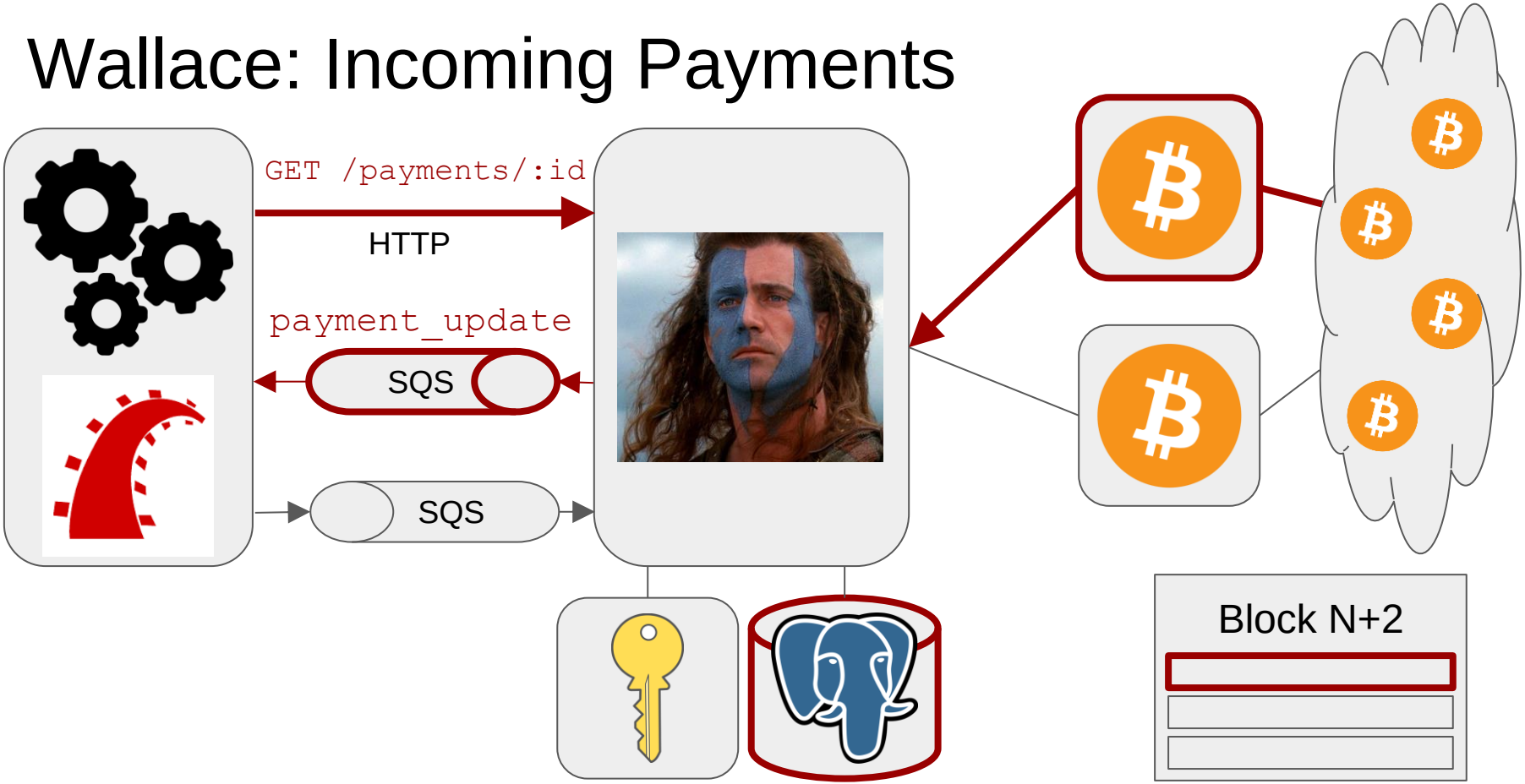
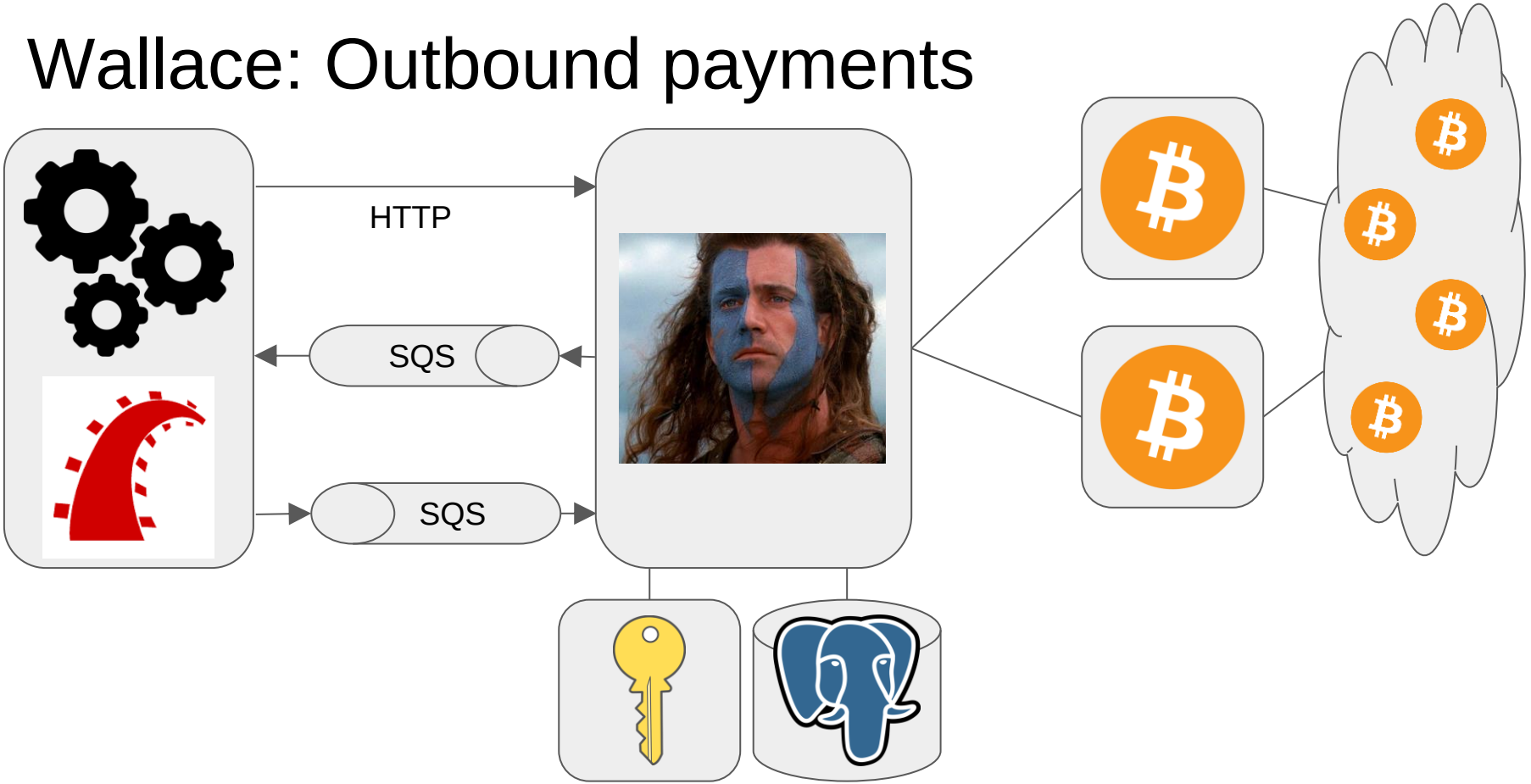


Wallace: Outbound payments



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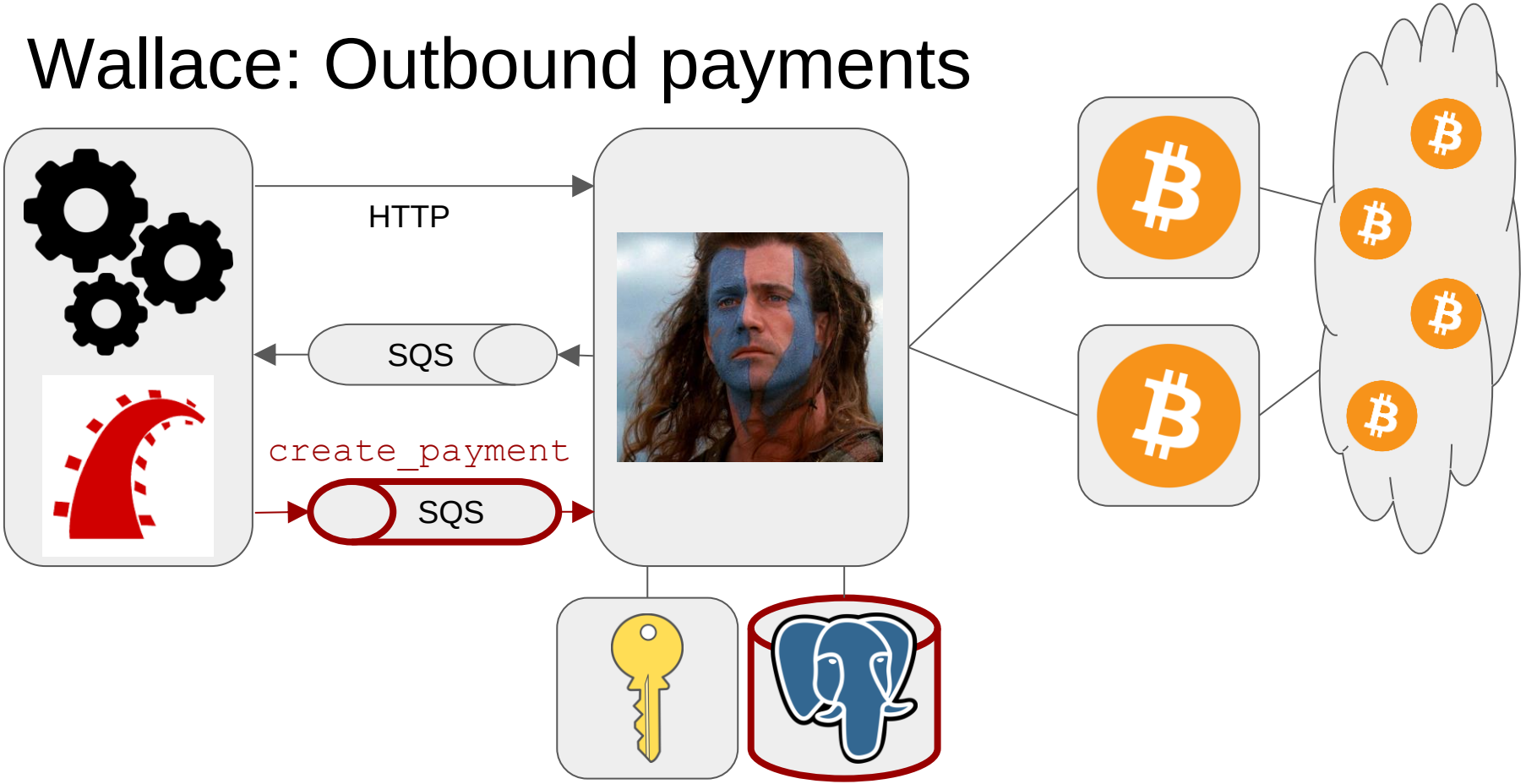

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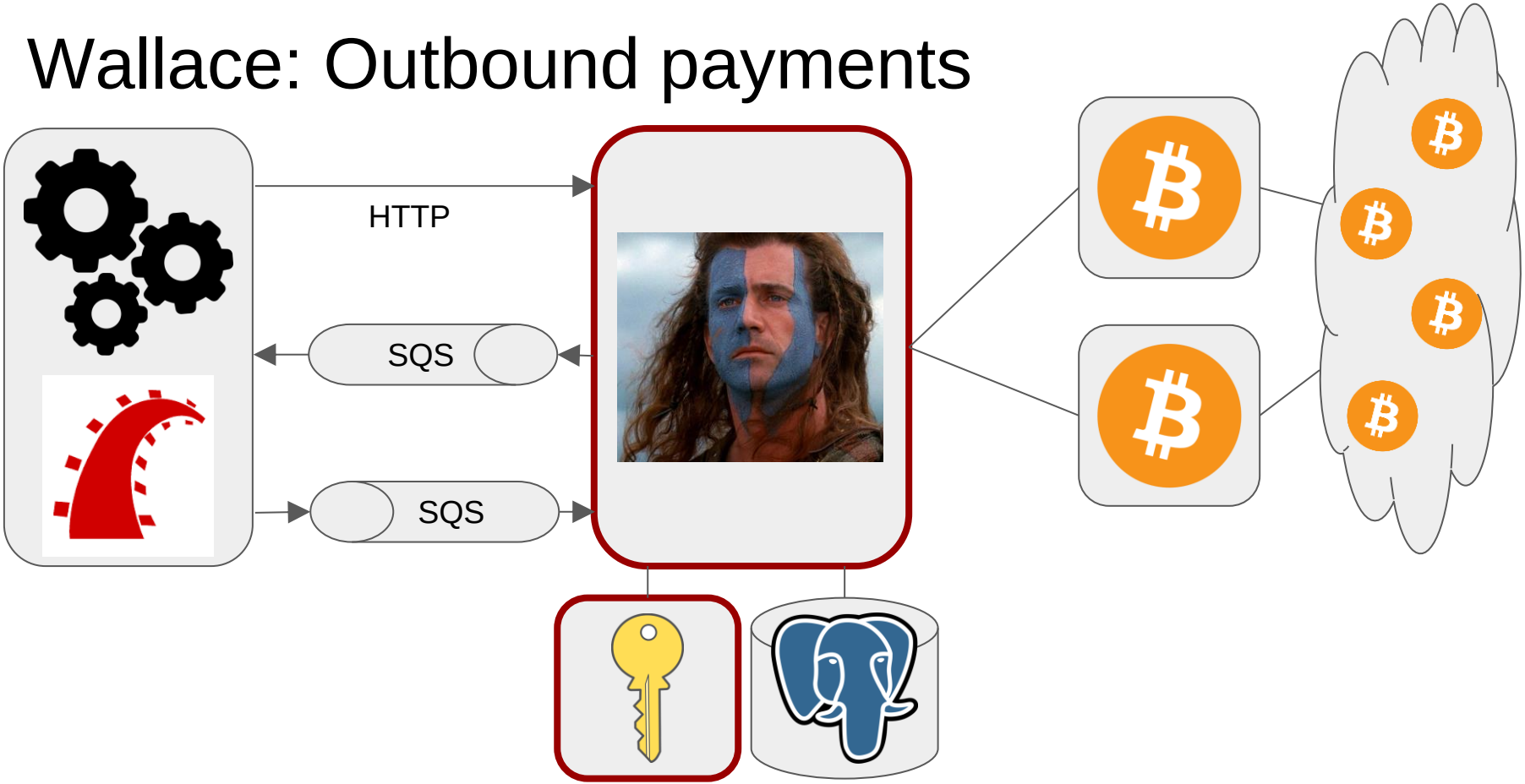

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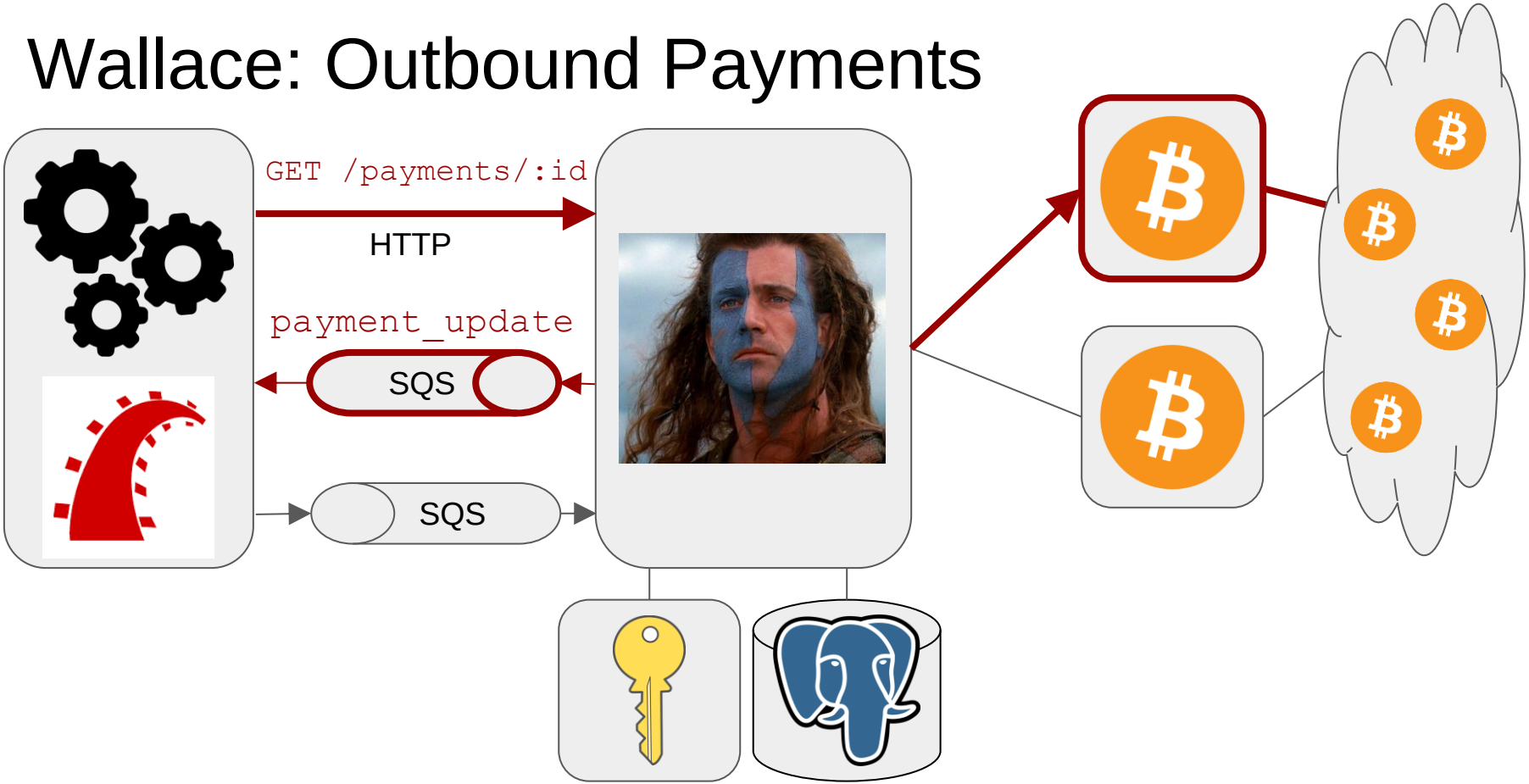

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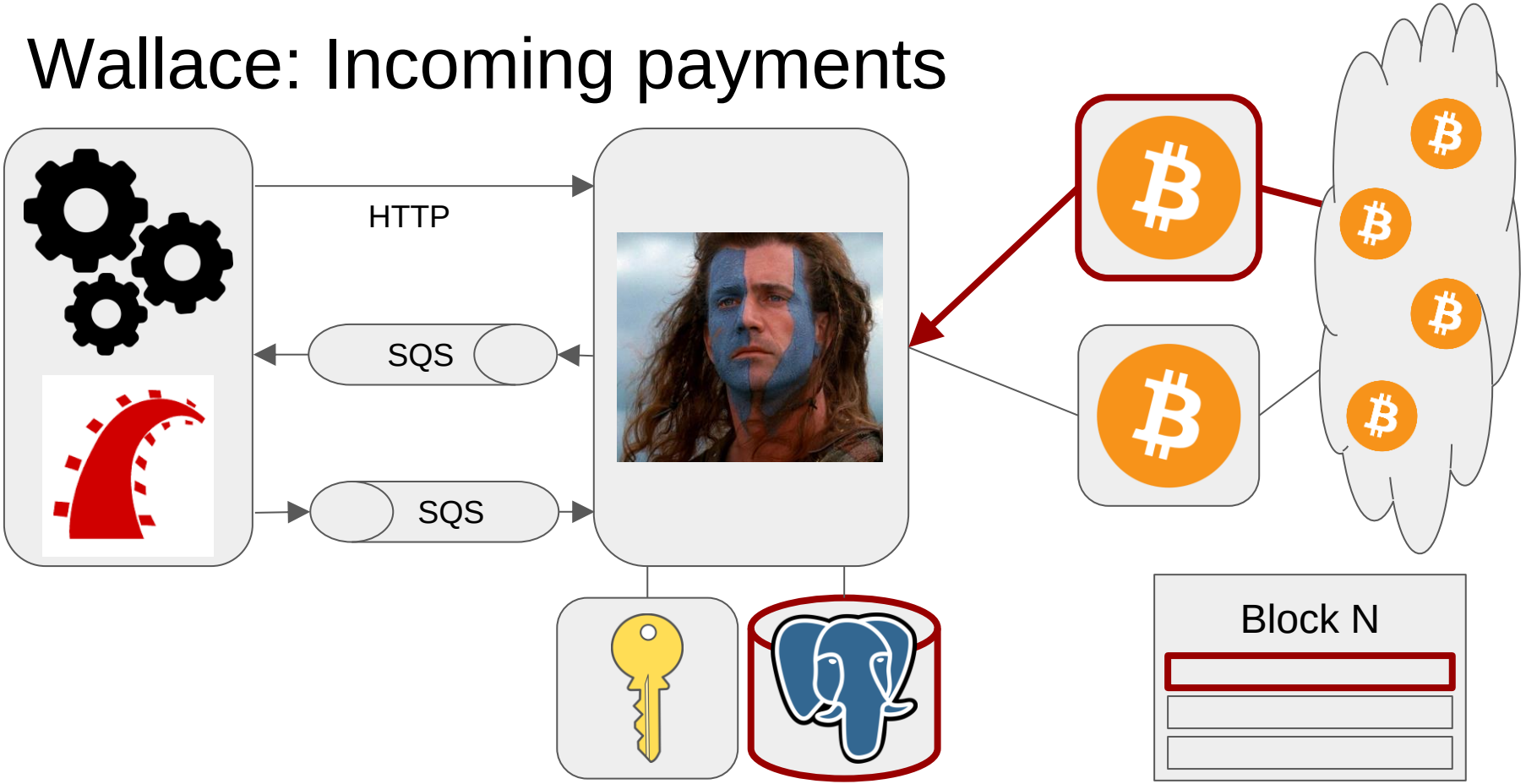

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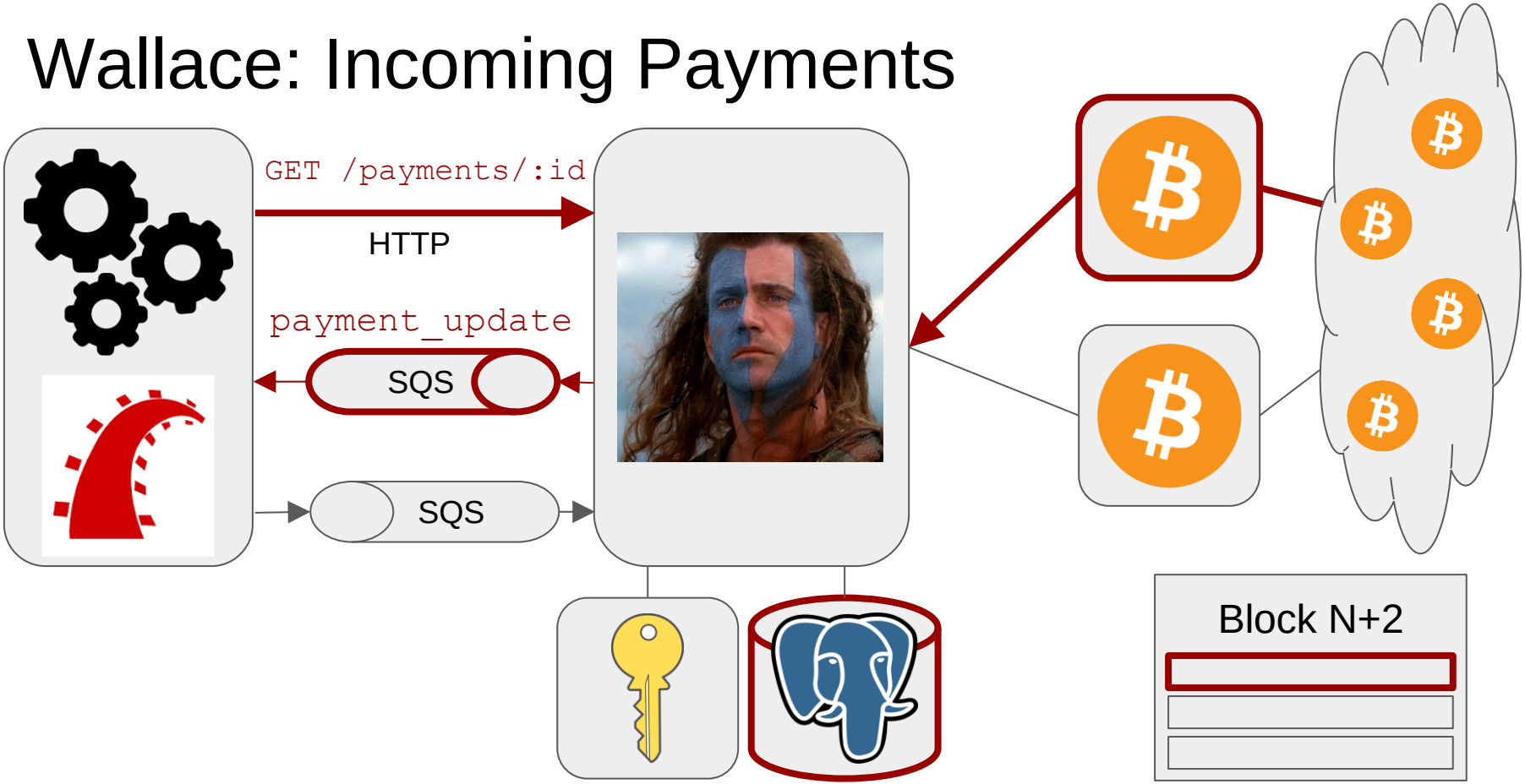

Wallace Details

- Transaction generation/UTXO selection
- Maintains separate pool of online & offline funds

Recap

- How blockchain integrations differ from banking integrations
- Evolution of Coinbase payments towards a unified architecture
- Polymorphic service interface using an abstraction of payments

Ongoing & Future Work

- Rearchitecture of existing integrations around new abstraction
- Migration of internal accounting to a microservice
- Dedicated microservice for core transaction processing

We would love your help :-)

Thanks for listening!

mailto:jimpo@coinbase.com