Apache Fineract CN

an open source tool in the fight against poverty

Software can make the world
a better place.

-Myrle Krantz
Director, The Apache Software Foundation
Vice President Emeritus, Apache Fineract

Agenda

- Introduction (Fineract CN, Apache)
- Requirements (functional and non-functional)
- Architecture (patterns, services)

…break

- Customization (configuration, collaboration, extension, access)

...setup

- Internal architecture (services)

...creating your own service

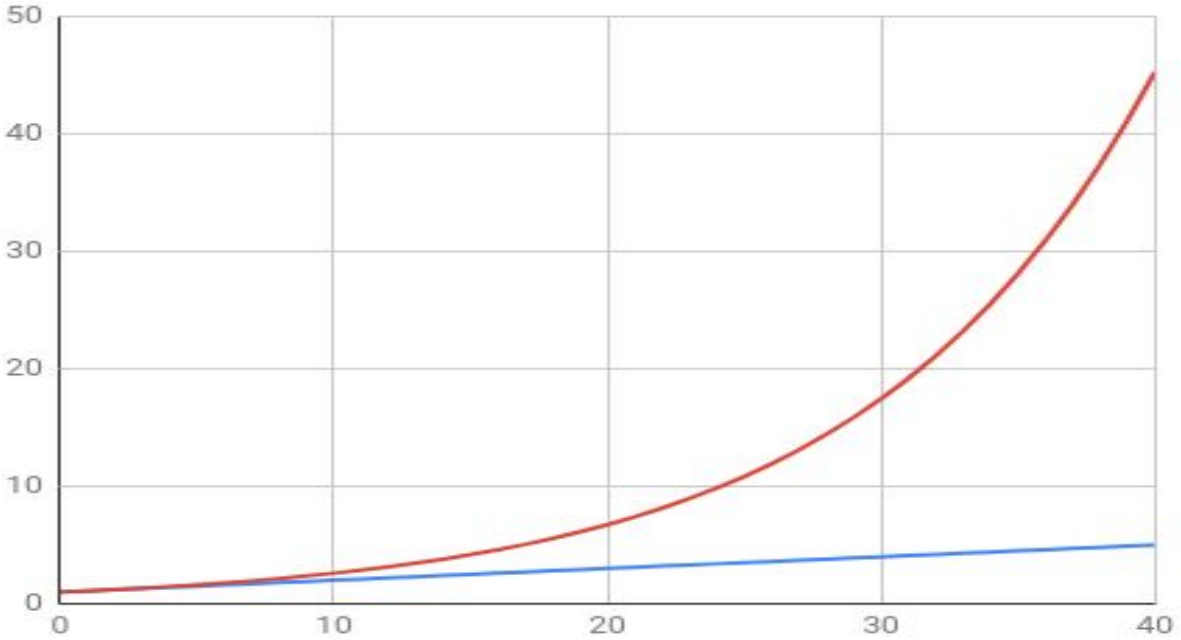
(+ Q&A for each general topic)

Introduction

Apache Fineract

Why fintech?

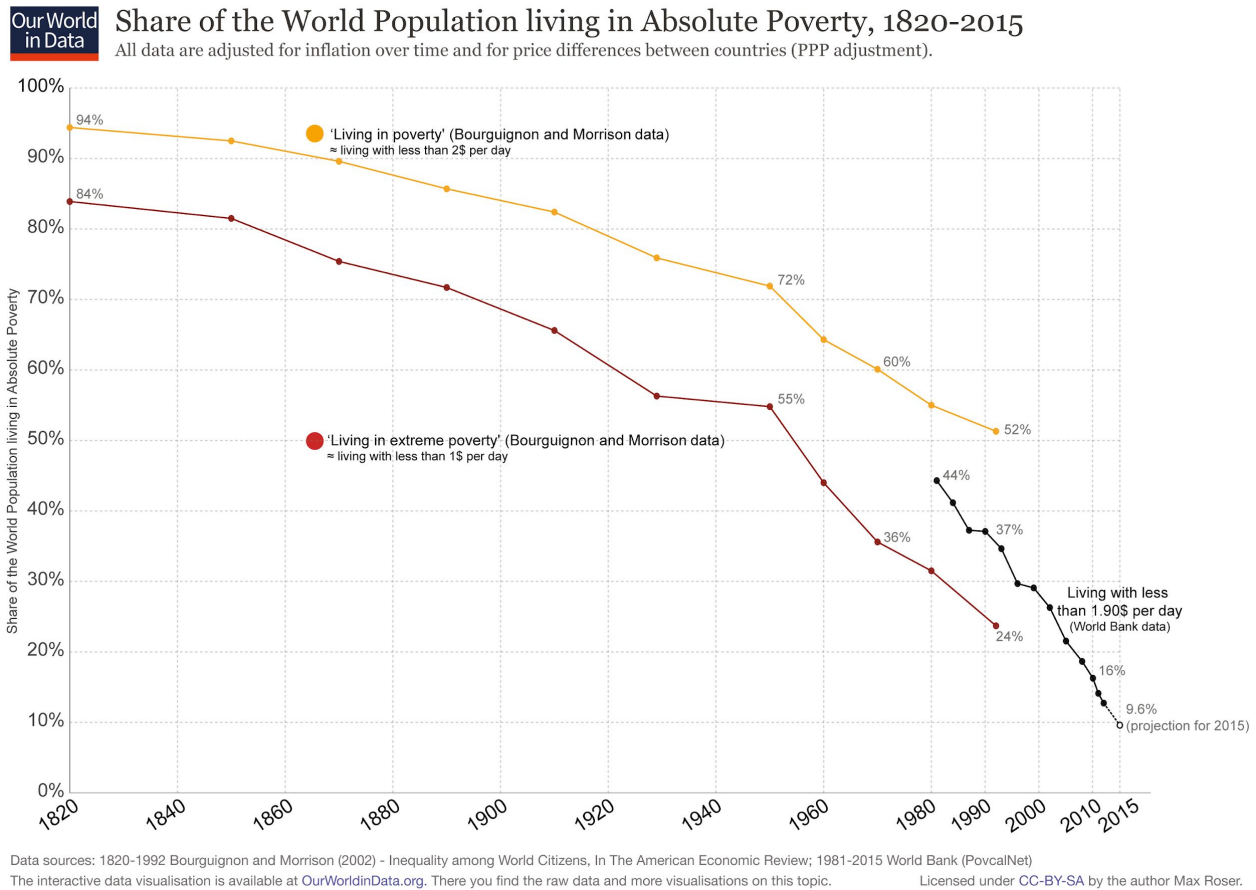
Interest compounding is magic...



$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

$O(2^n)$

...in the real world...



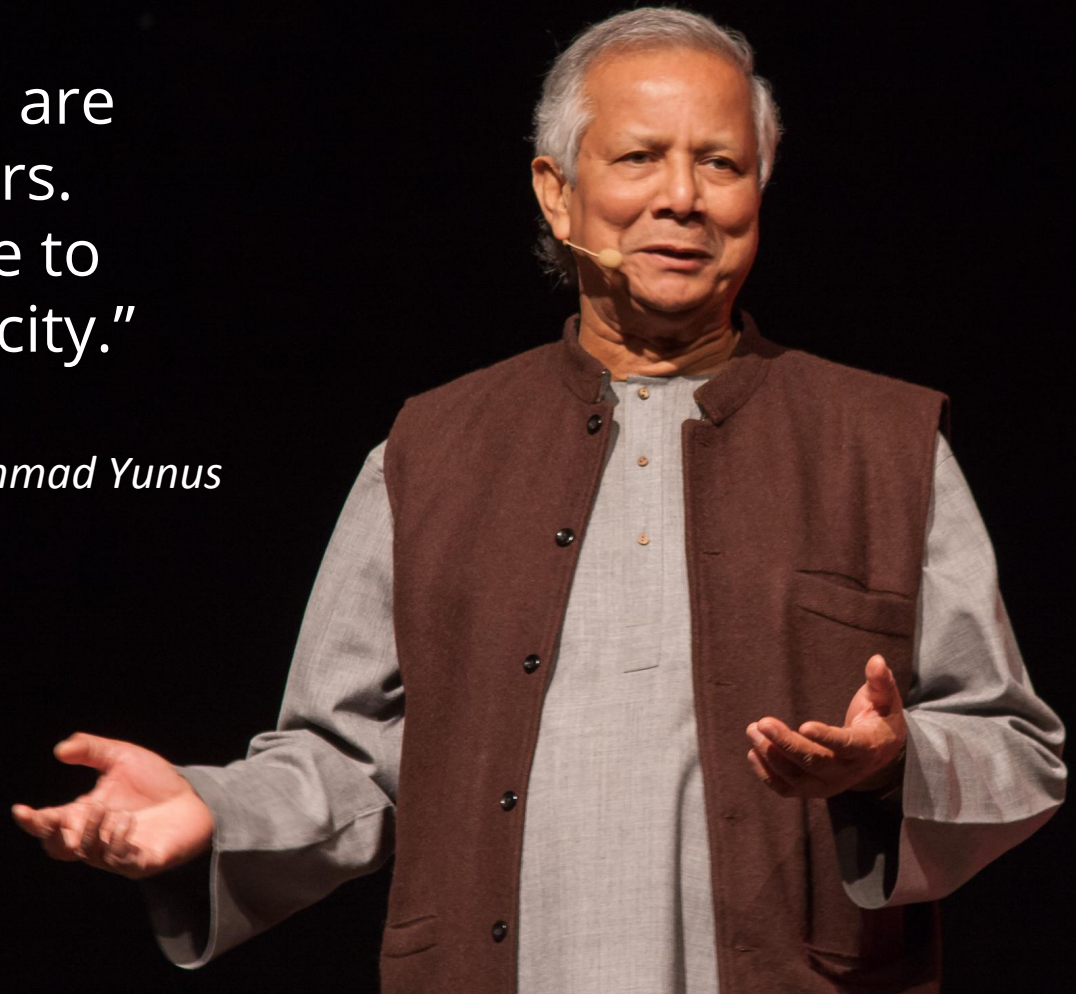
Data sources: 1820-1992 Bourguignon and Morrison (2002) - Inequality among World Citizens, In The American Economic Review; 1981-2015 World Bank (PovcalNet)

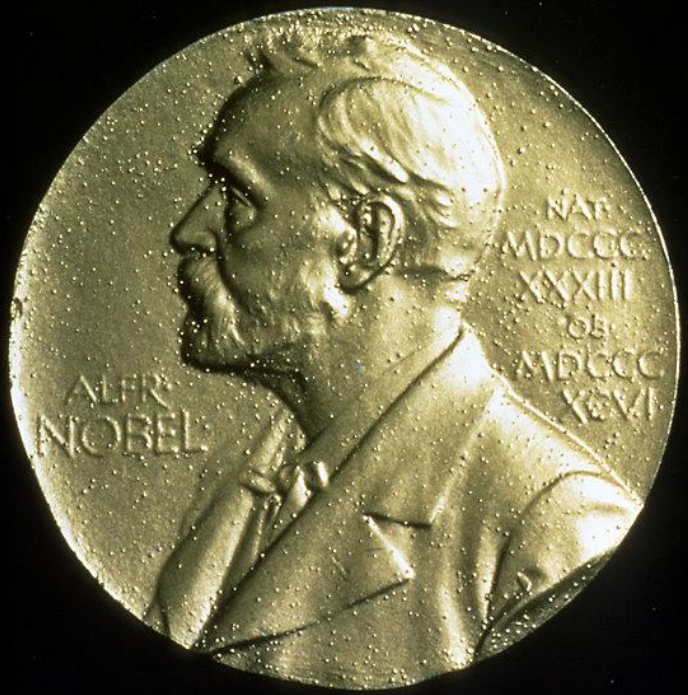
The interactive data visualisation is available at OurWorldinData.org. There you find the raw data and more visualisations on this topic.

What is microfinance?

“All human beings are born entrepreneurs. Some get a chance to unleash that capacity.”

-Muhammad Yunus



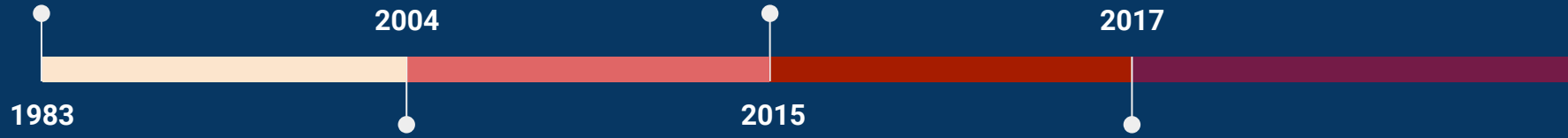

ALFR
NOBEL
NAT
MDCCC
XXXIII
OB
MDCCC
XCVI

Where do banks get their infrastructure?


Mifos

The Apache Software Foundation

Apache Fineract CN



Grameen Bank founded

The Grameen Bank was founded to provide financial services to the very poor in Bangladesh.

First Mifos started

The Grameen Foundation funded by Paul Maritz began developing an open source software to support micro-lending.

Mifos donated Fineract to Apache

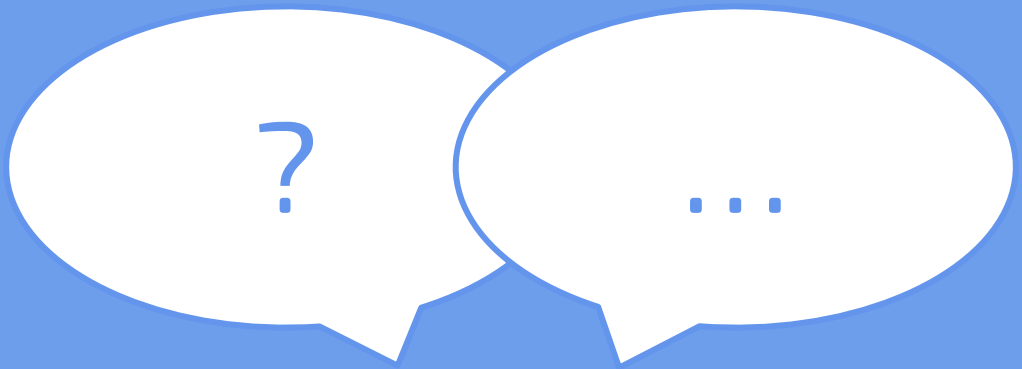
The Mifos Initiative donated the Mifos backend to a new project at the Apache Software Foundation.

Mifos donated Fineract CN

Fineract CN is a cloud native rearchitecture of the Fineract backend.

History of the software

Questions?

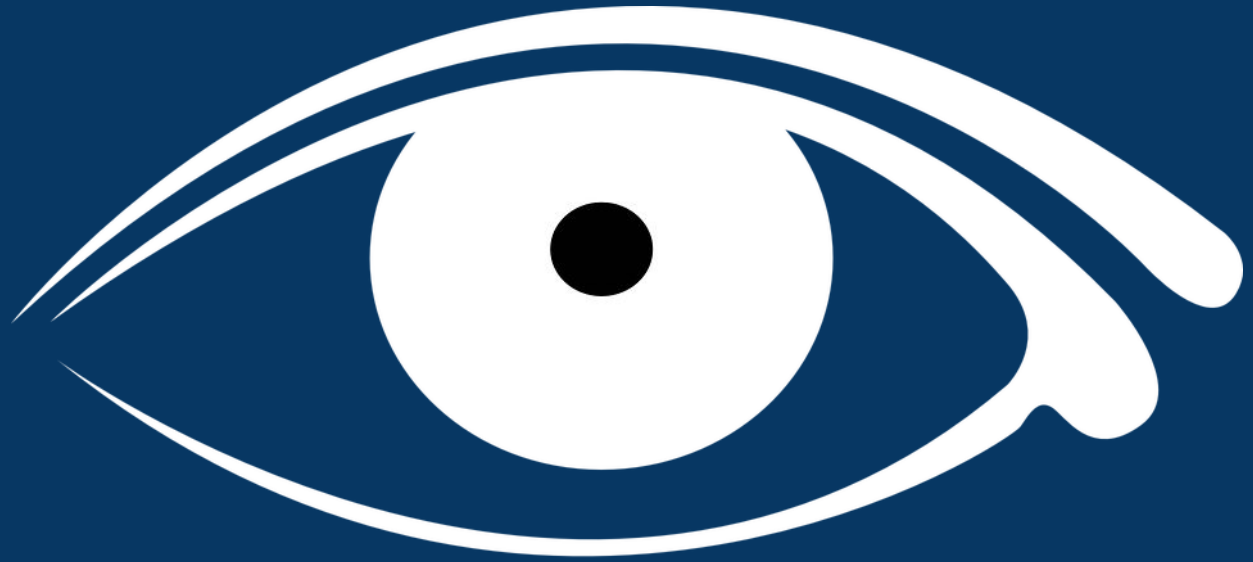


Introduction
Apache

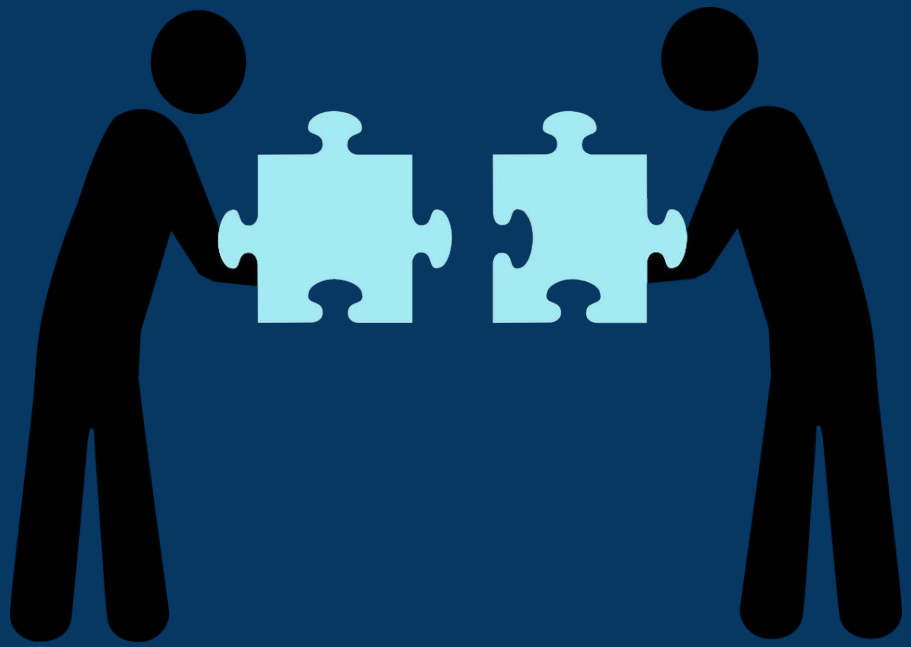
The Apache Software Foundation

Open Source at Apache

Transparent



Collaborative

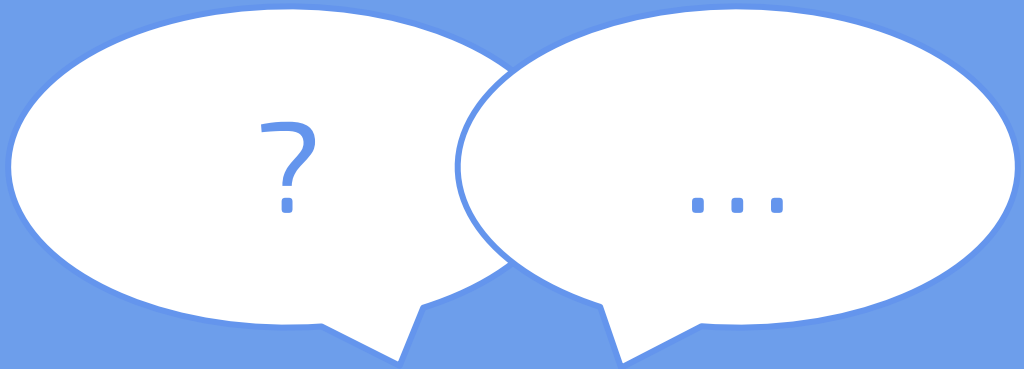


Meritocratic

Charitable

Pragmatic

Questions?



Quiz

When did Fineract become a top-level project at Apache? ***April 2017***

What does open source enable you to do with Apache Fineract?

examine the code, change the code

Requirements

Functional

- Accounting (accounts, ledgers, journal entries, transactions, balances)
- Organization (headquarters, branches, employees)
- Customer (name, address, profession, identification)
- Product (deposit and loan product configuration, case management)
- Teller (cash tracking)
- Reporting
- ...

Non-functional

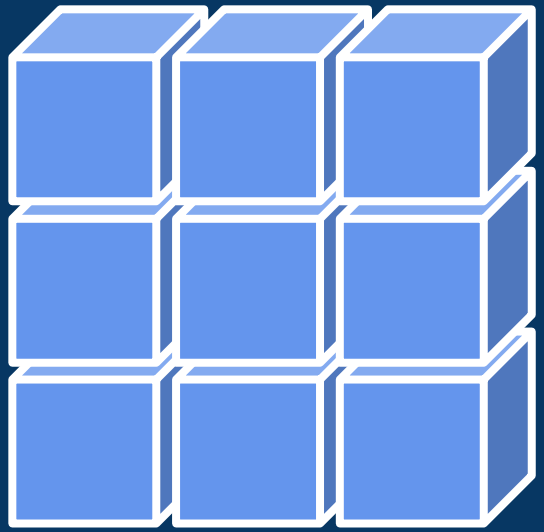
- Dependability (availability, reliability, safety, integrity and maintainability)
- Auditability
- Multi-tenancy
- Agility (debuggability, extensibility, portability, scalability, securability, testability and understandability)
- Sustainability (energy efficiency, creator efficiency, user efficiency, open source, open API)
- Extensibility
- ...

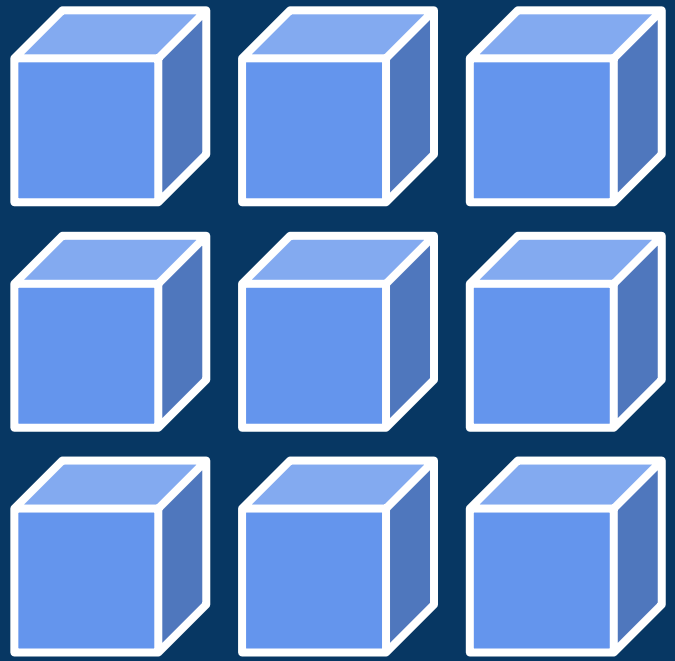
Architecture

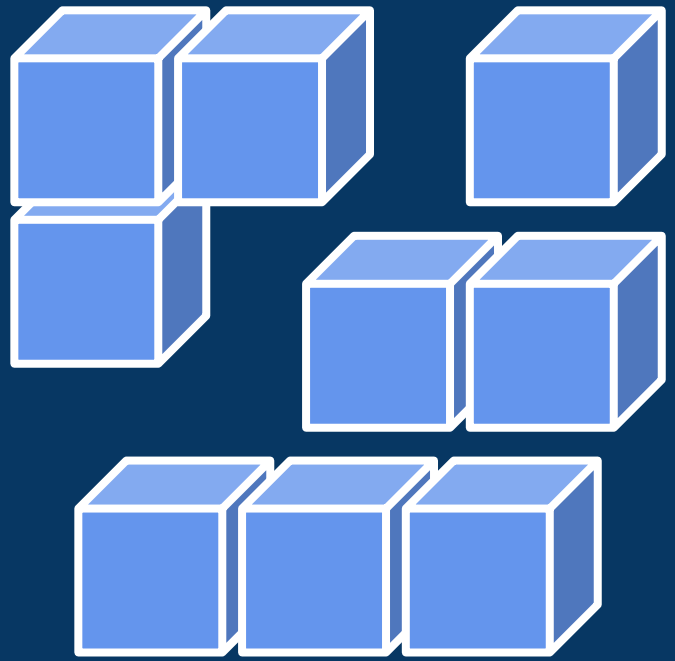
Patterns

Domain Driven Design


Az







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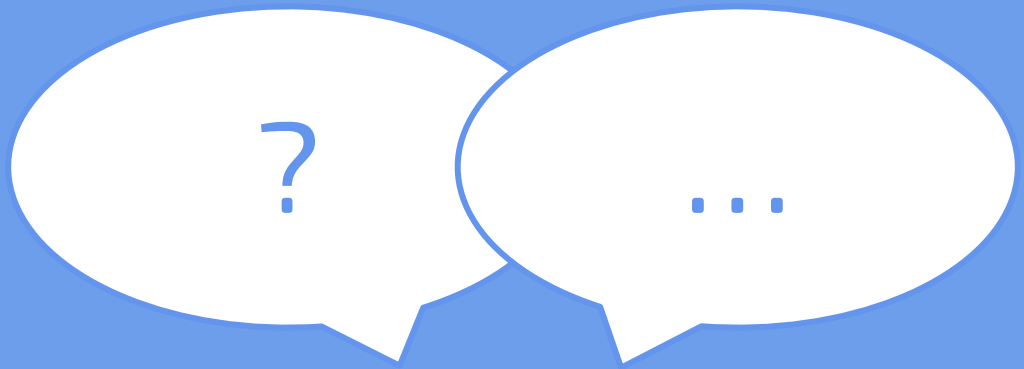
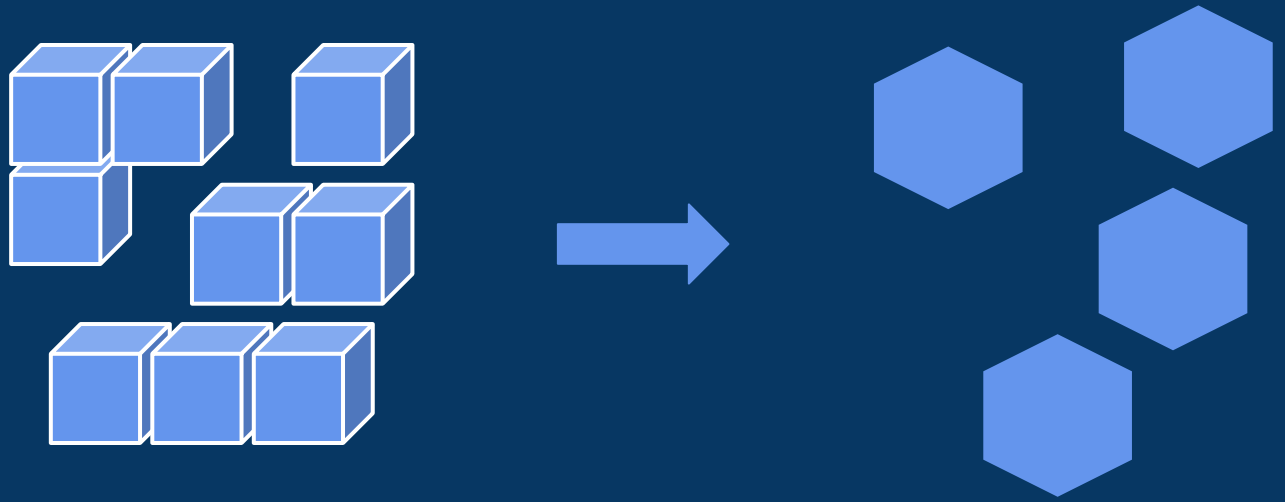
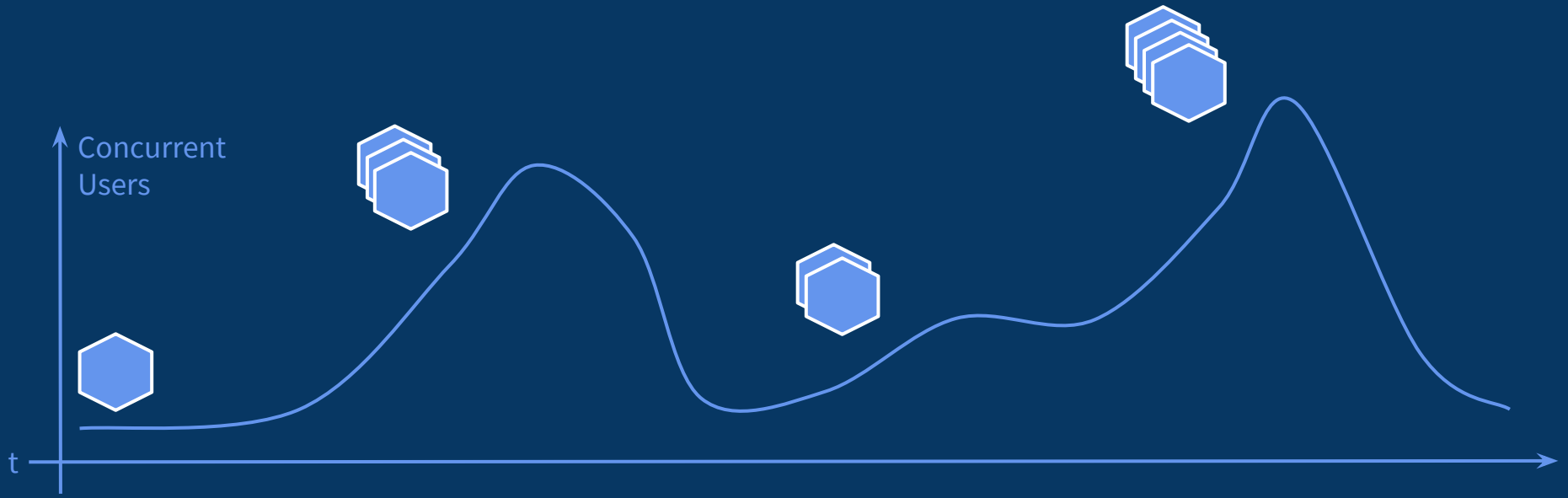


REST Microservices




Concurrent
Users
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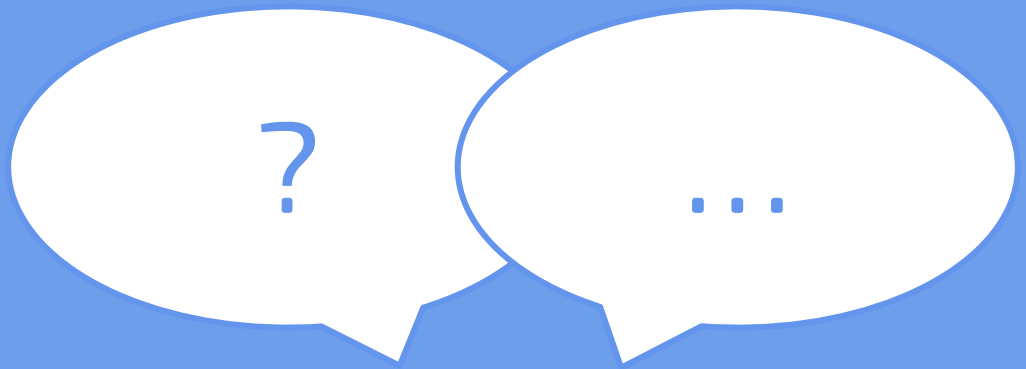
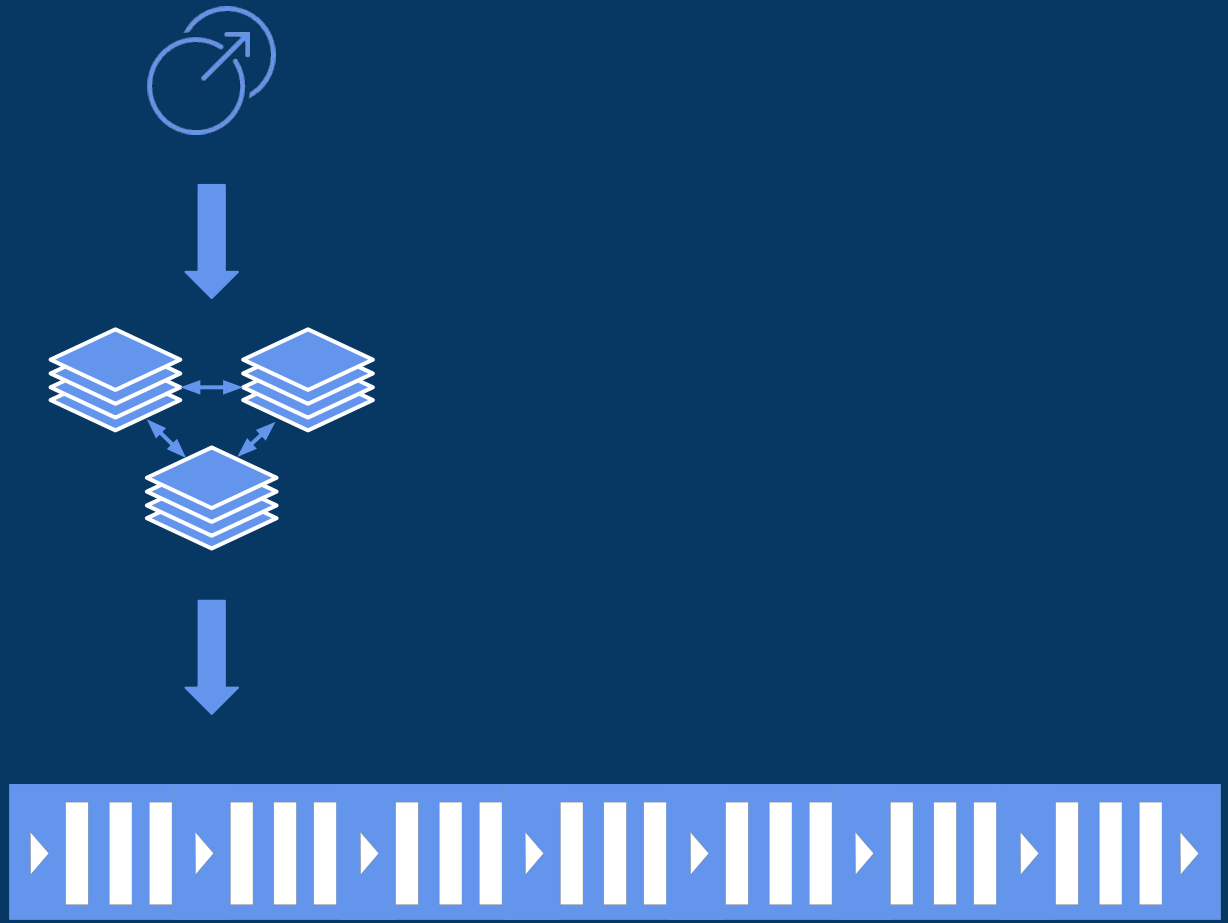
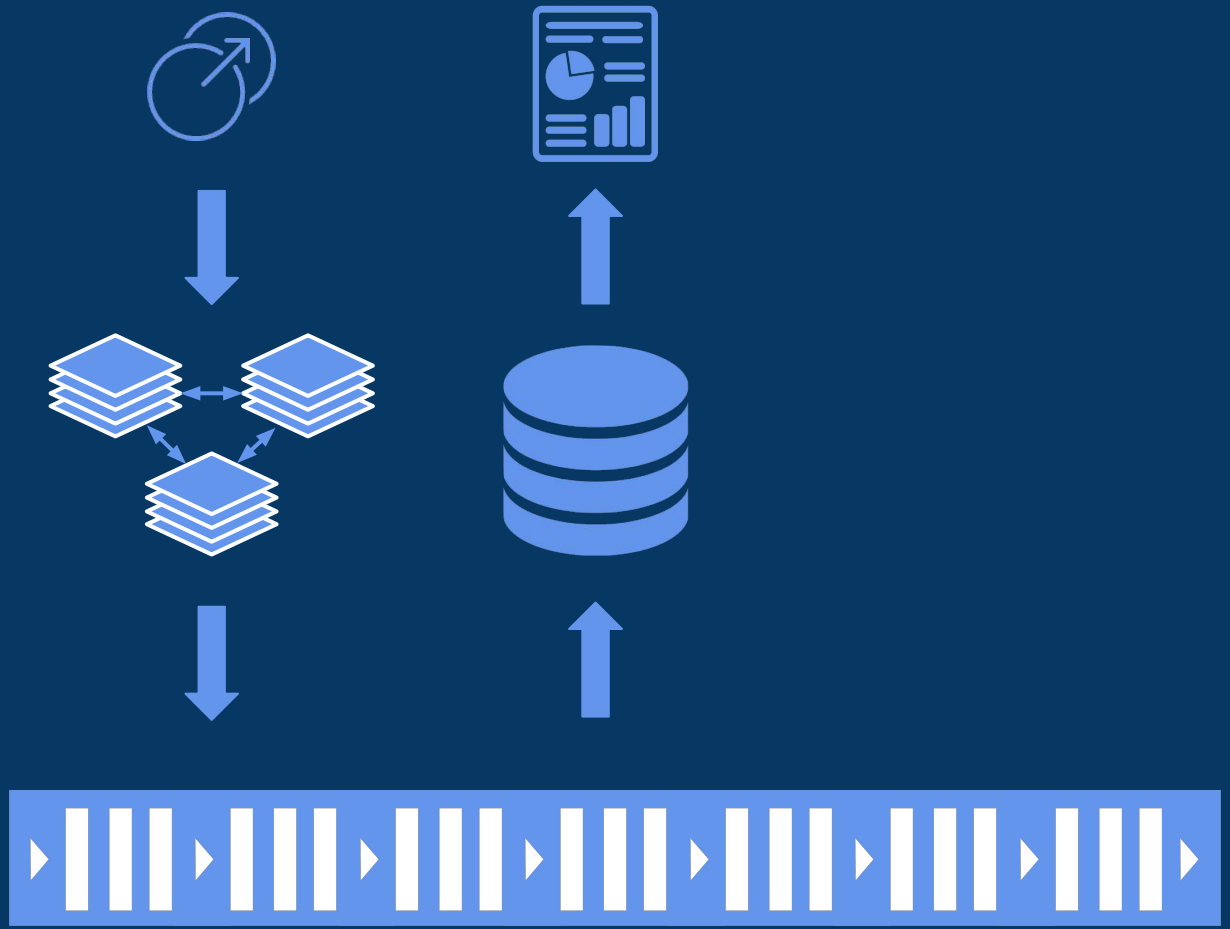
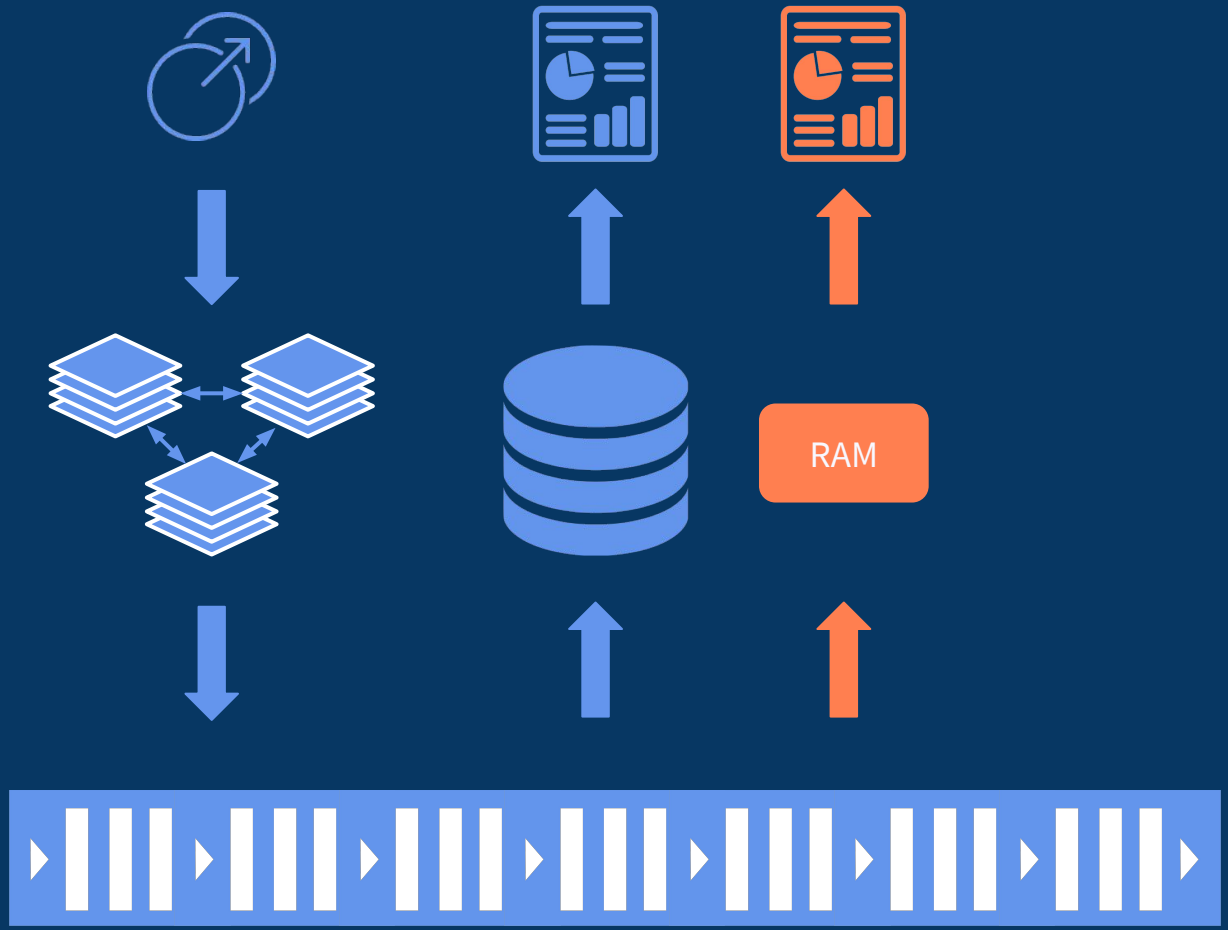
Questions?

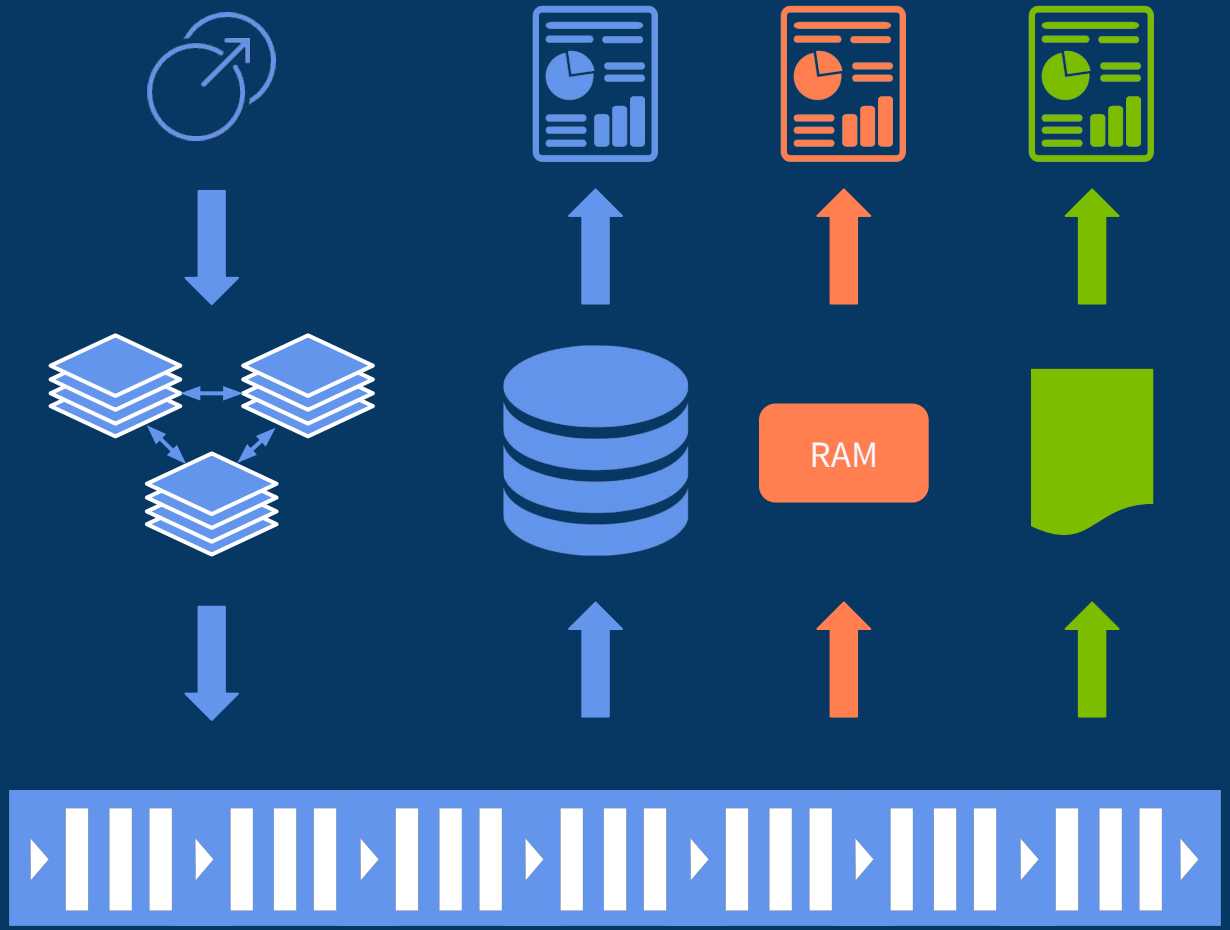


Event Sourcing

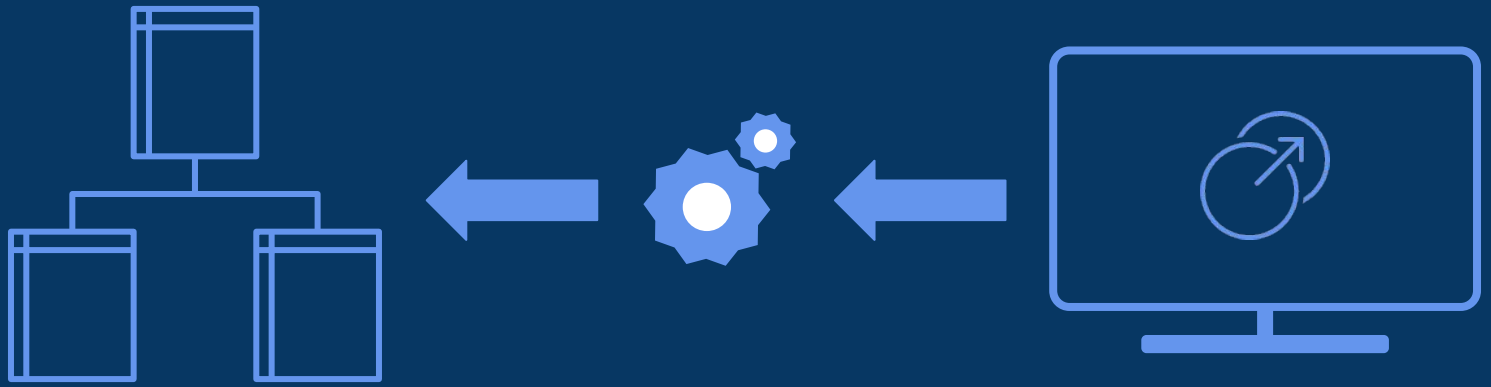


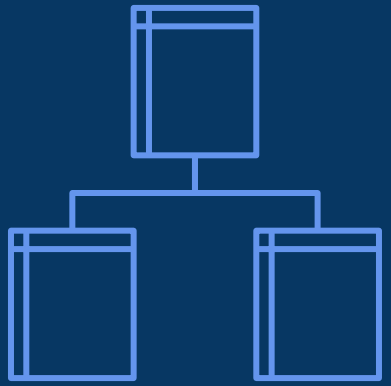


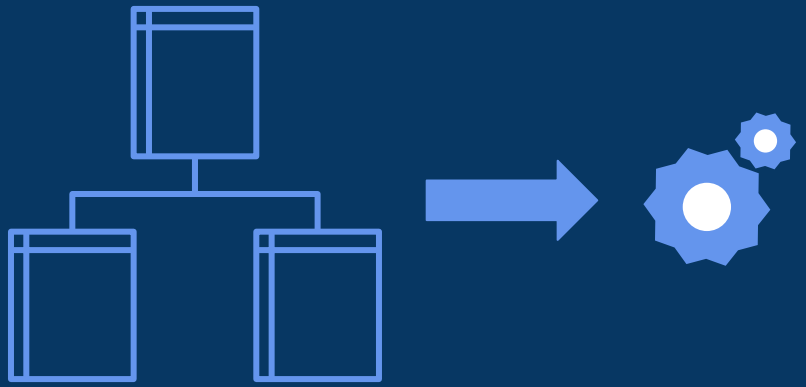

RAM

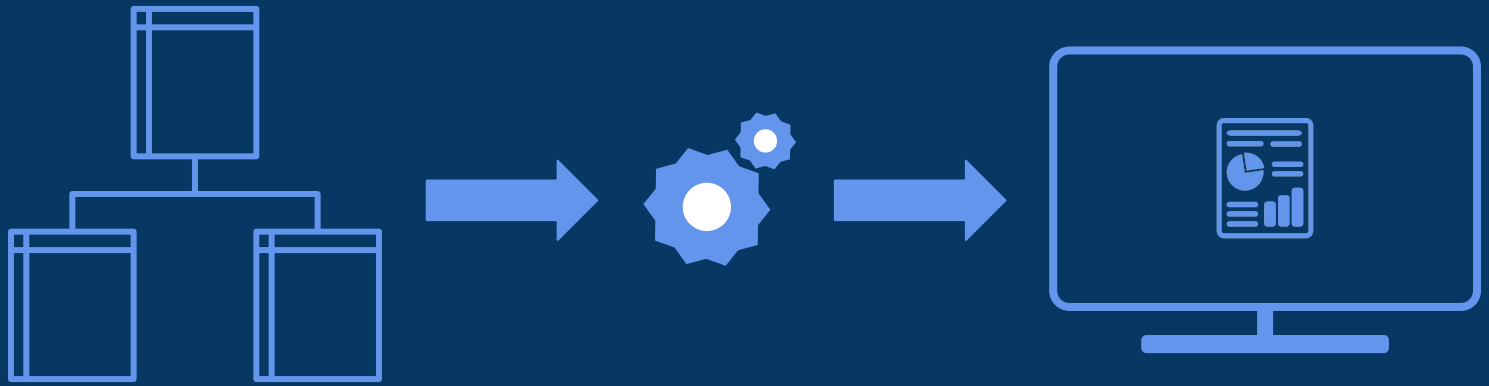

RAM

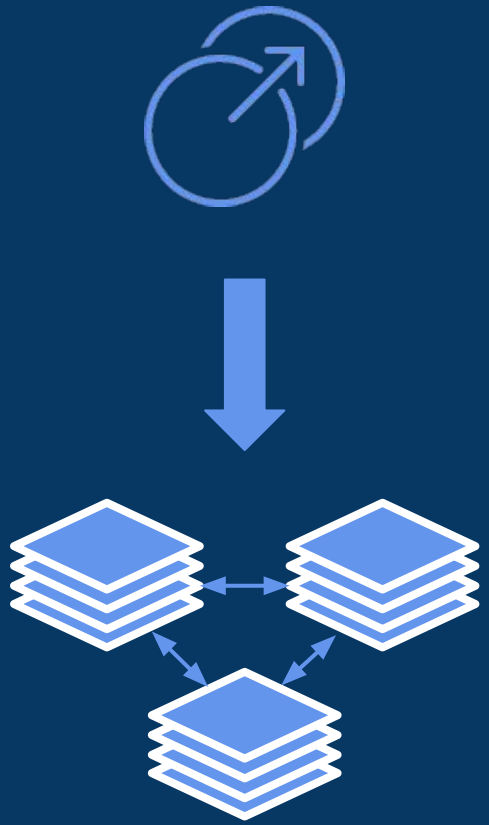
Command Query Responsibility Segregation (CQRS)

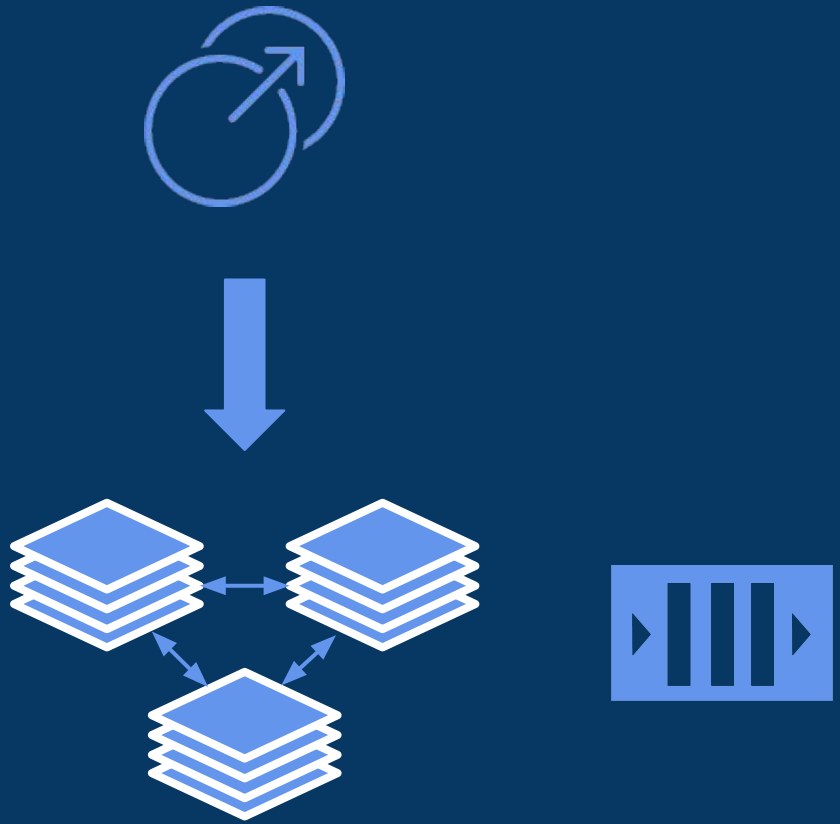


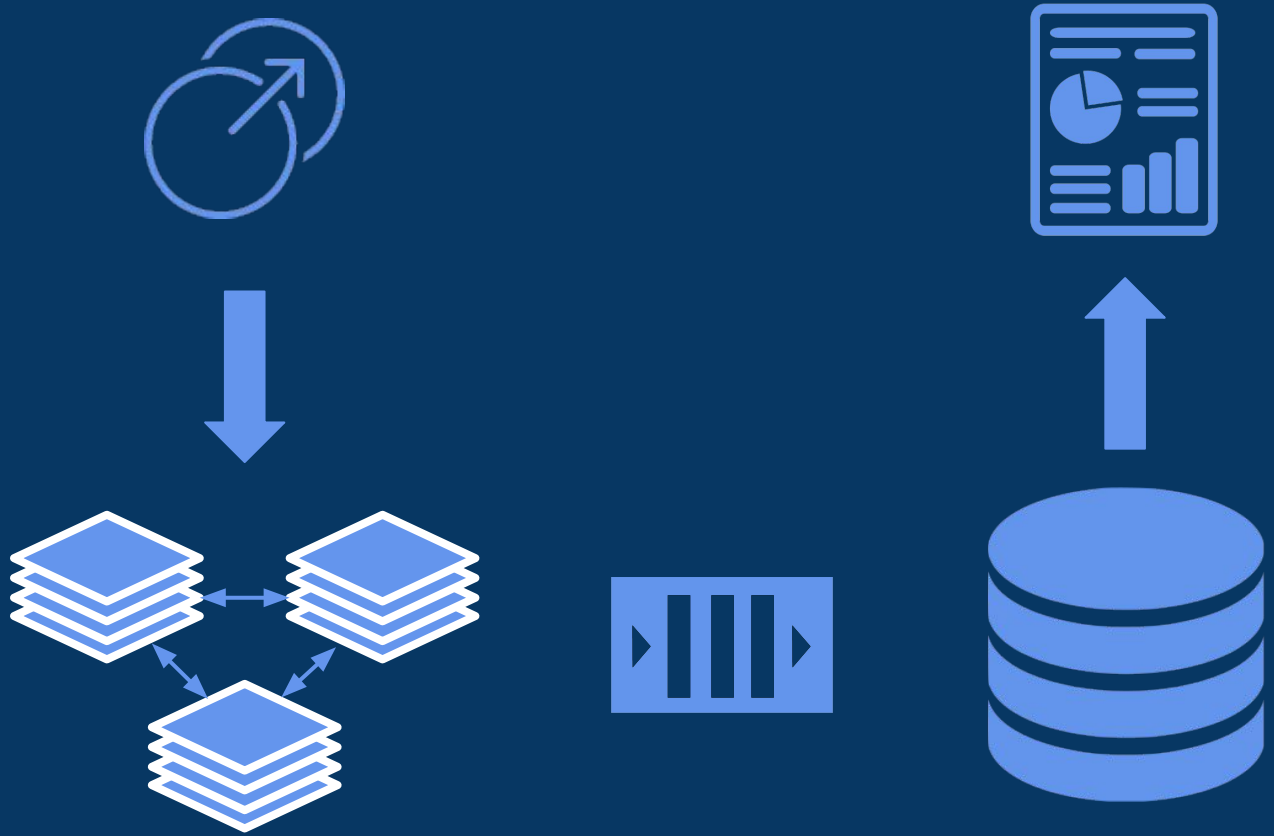


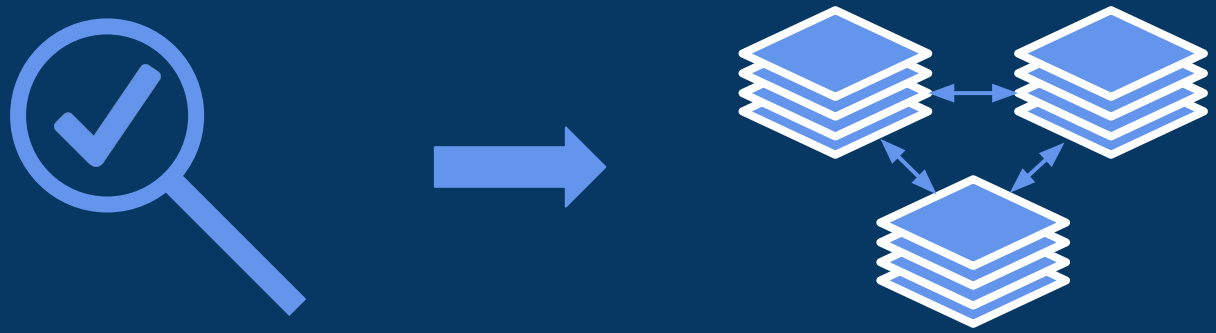




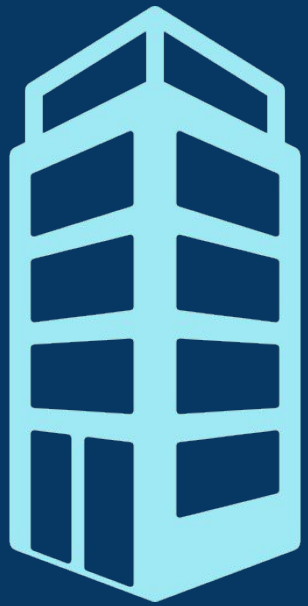








Multitenancy



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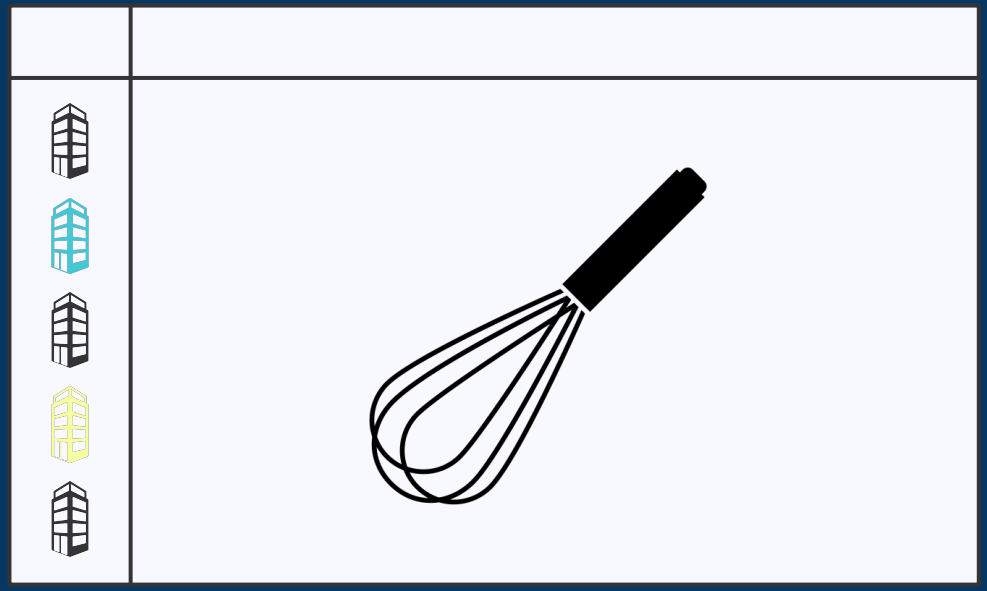
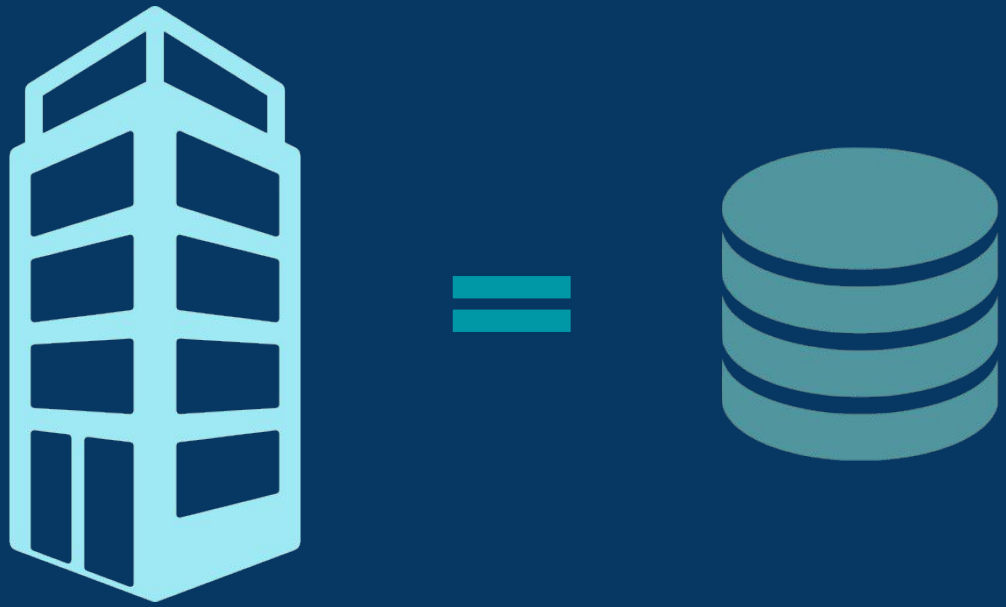
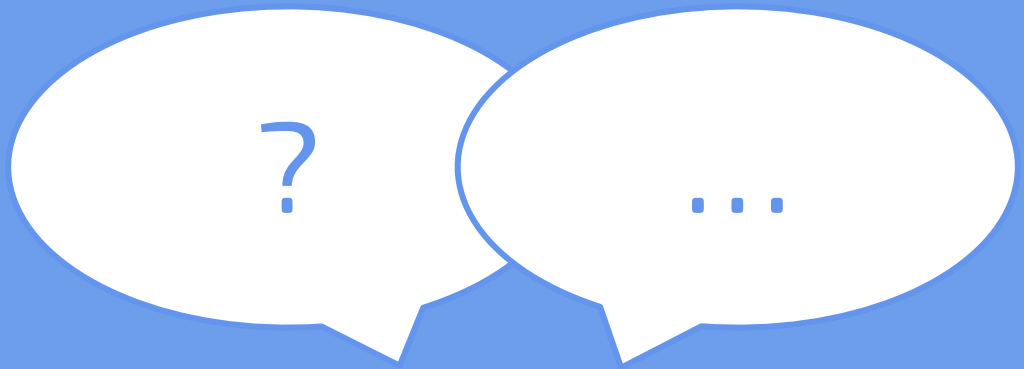




Questions?



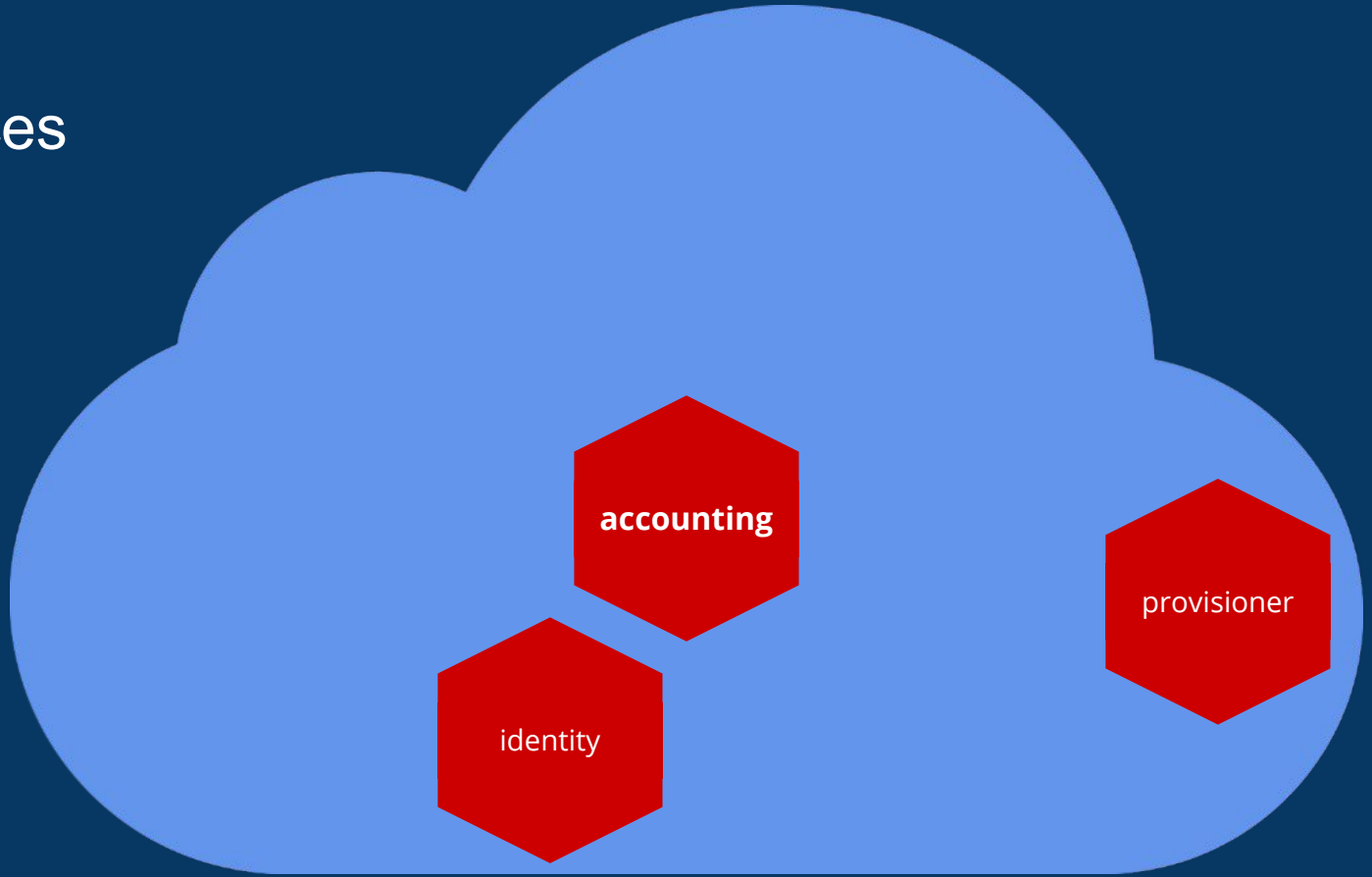
Architecture

Services

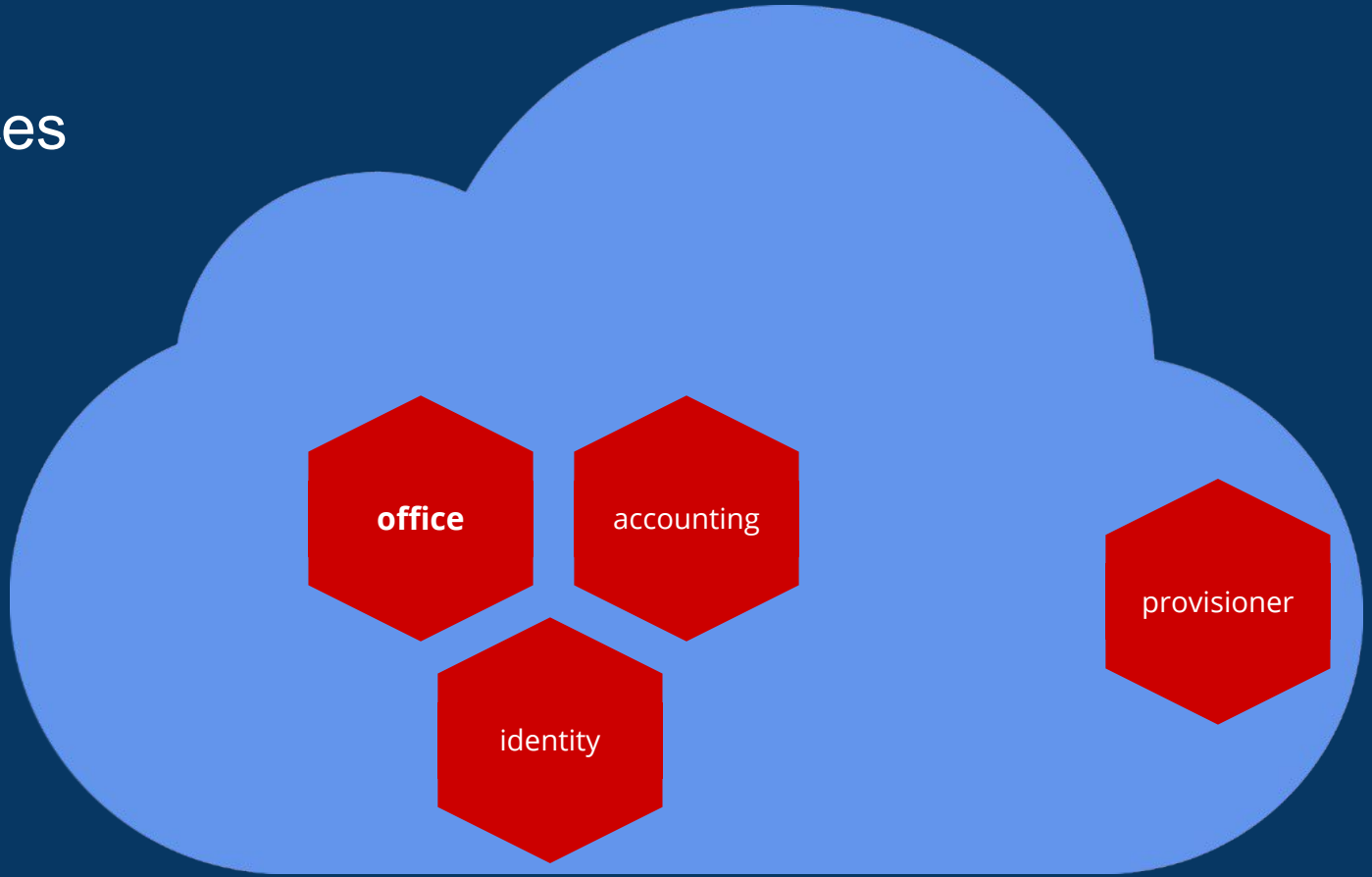
Services

Services

Services

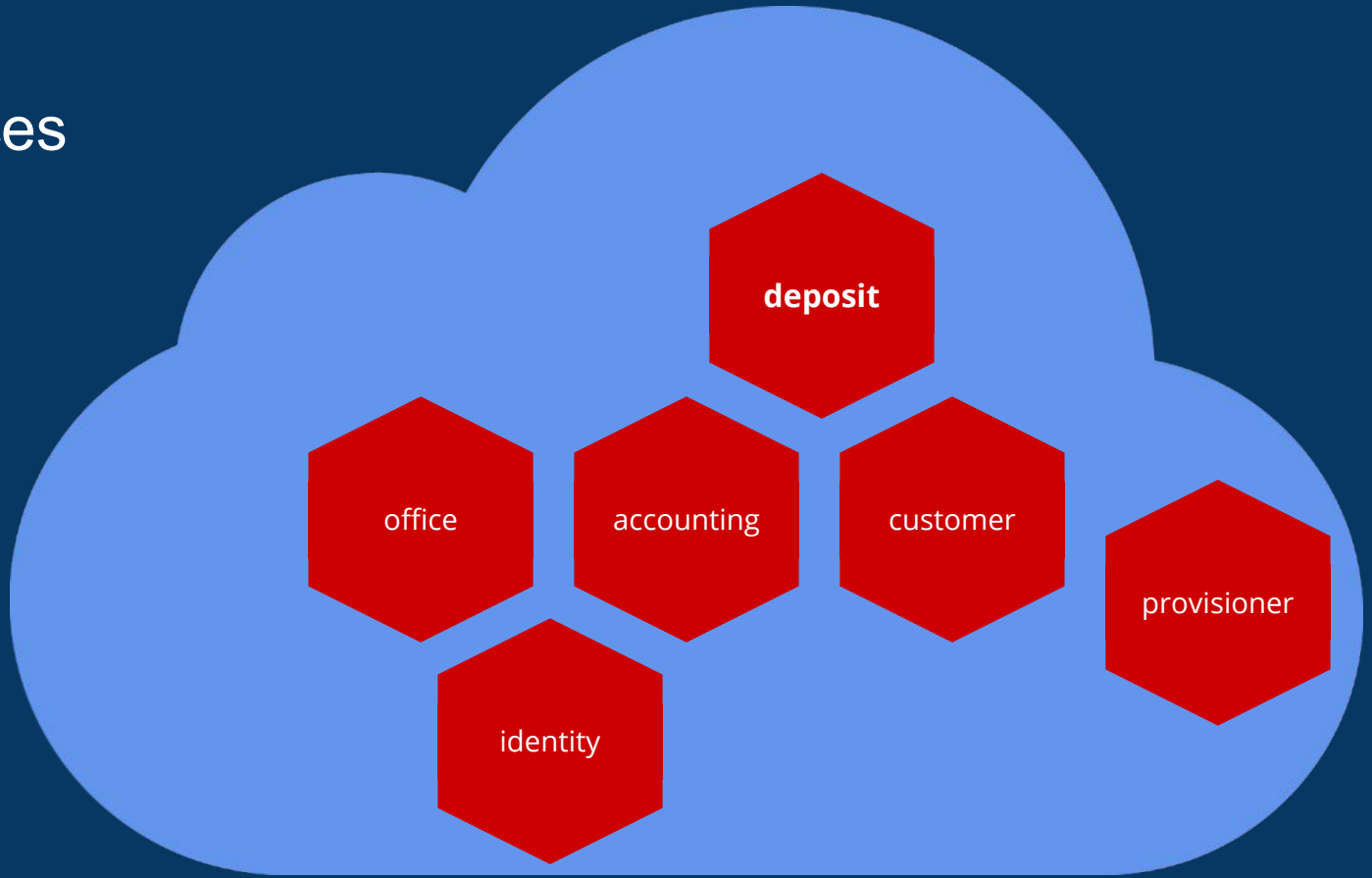


Services

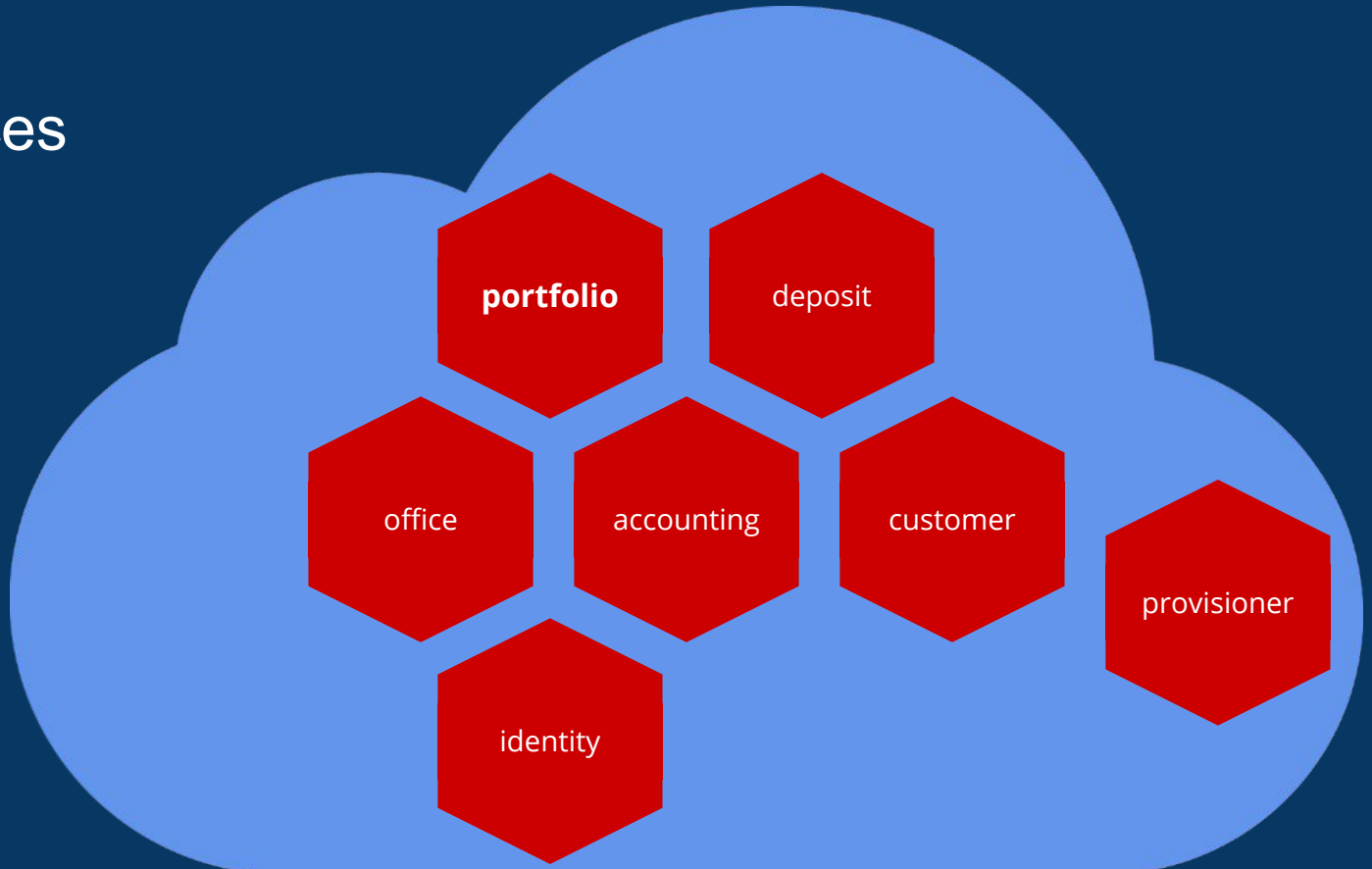


Services

Services


deposit
office
accounting
customer
provisioner
identity

Services


portfolio
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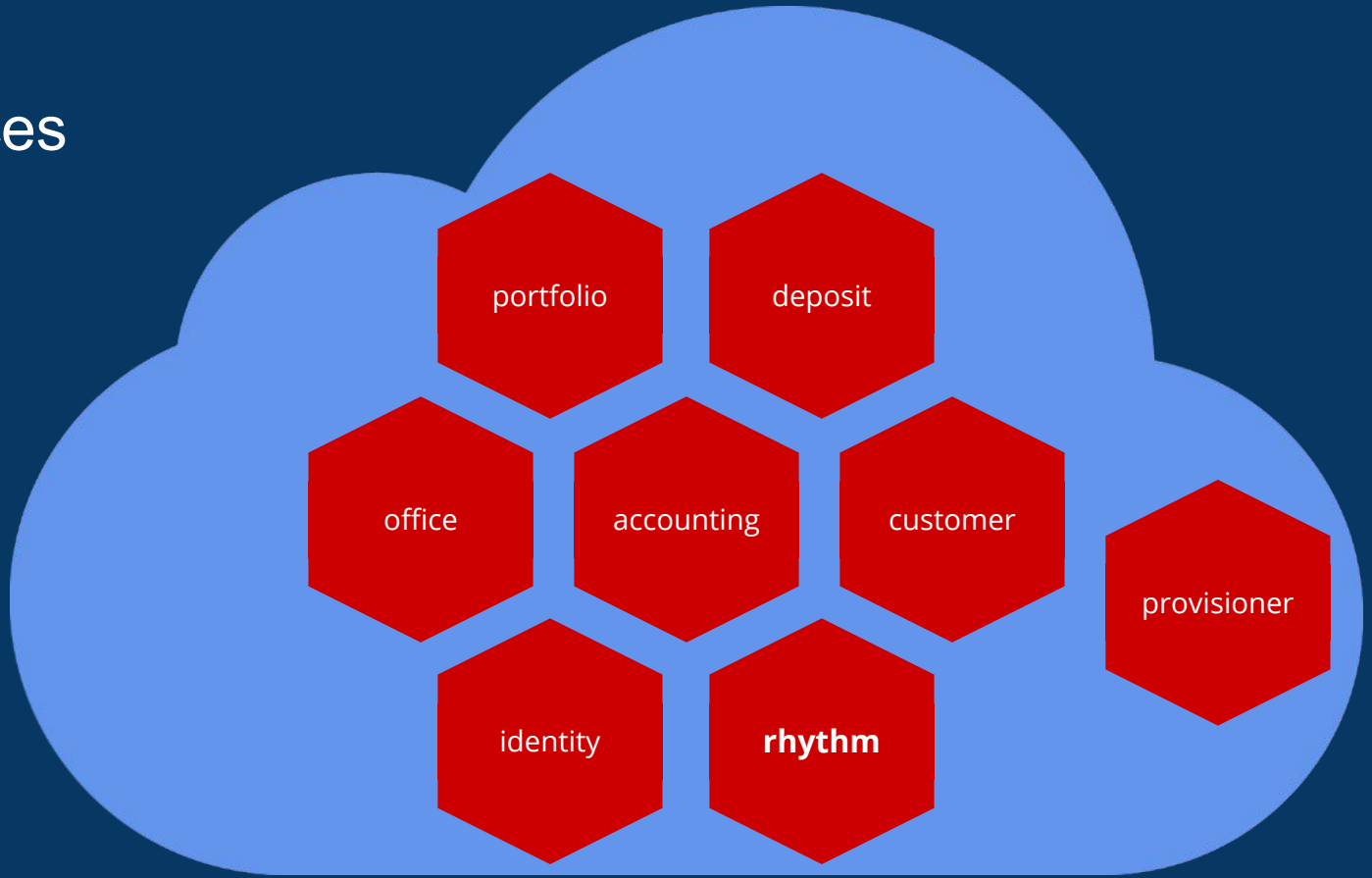
identity

Services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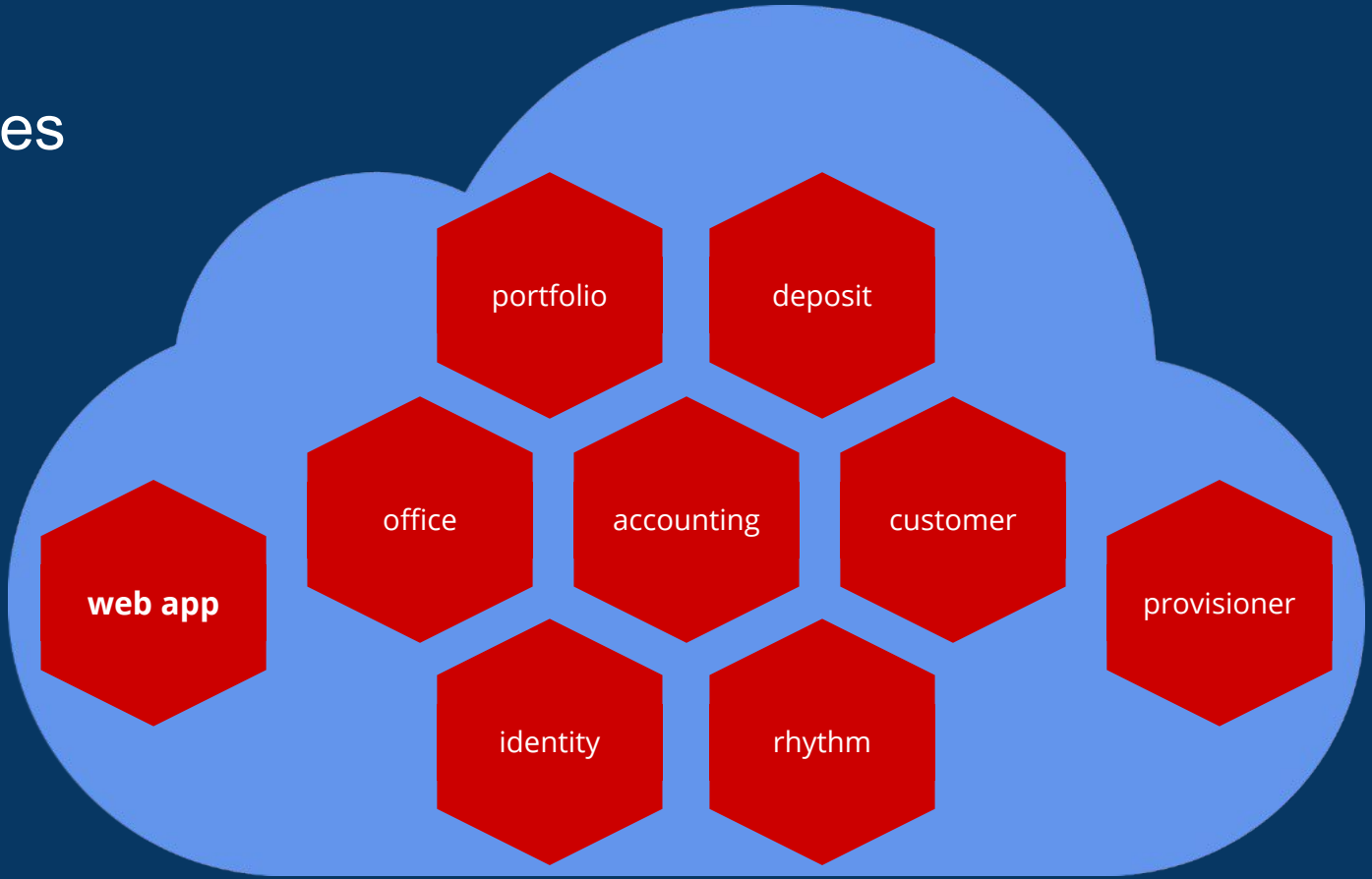
rhythm

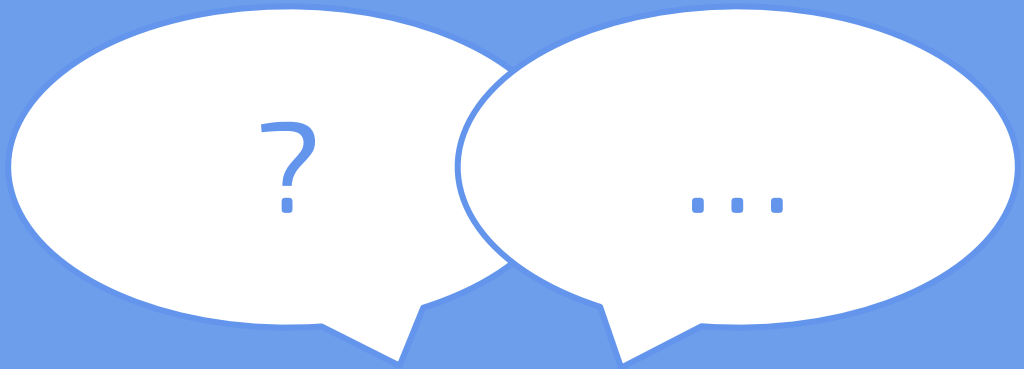
Services


portfolio
deposit
office
accounting
customer
web app
provisioner
identity
rhythm

Also...

- teller
- payroll
- cheques
- group
- reporting

Questions?



Quiz

What programming pattern is used to make data changes asynchronously? ***CQRS***

What kind of interface does Apache Fineract CN have? ***REST***

What major REST microservices is Apache Fineract CN composed of?

provisioner, identity, rhythm, accounting, customer, office, portfolio, deposit, web-app, ..

Requirements
(revisited)

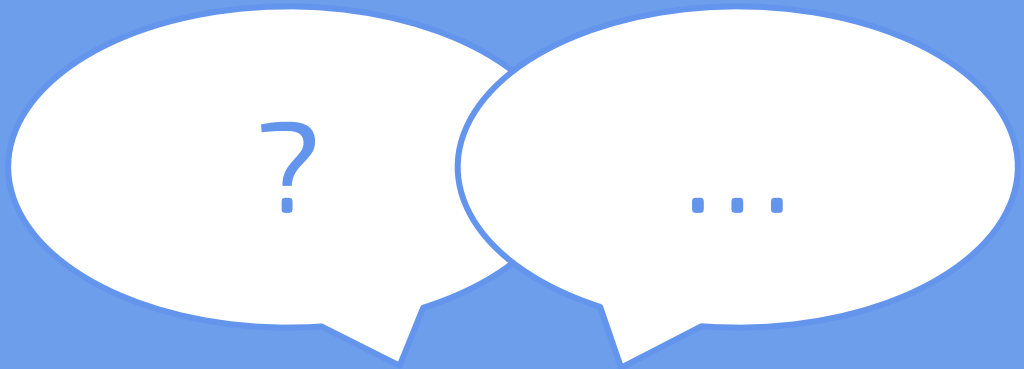
Functional

- Accounting (accounts, ledgers, journal entries, transactions, balances)
- Organization (headquarters, branches, employees)
- Customer (name, address, profession, identification)
- Product (deposit and loan product configuration, case management)
- Teller (cash tracking)
- Reporting
- ...

Non-functional

- Dependability (availability, reliability, safety, integrity and maintainability)
- Auditability
- Multi-tenancy
- Agility (debuggability, extensibility, portability, scalability, securability, testability and understandability)
- Sustainability (energy efficiency, creator efficiency, user efficiency, open source, open API)
- Extensibility
- ...

Questions?



Customization

Configure

Use case

A bank wishes to create an individual loan product for customers who are purchasing tools for their businesses.

Expertise Required

Using a web UI

Loan Demo


portfolio
deposit
office
accounting
customer
web app
provisioner
identity
rhythm

Roles

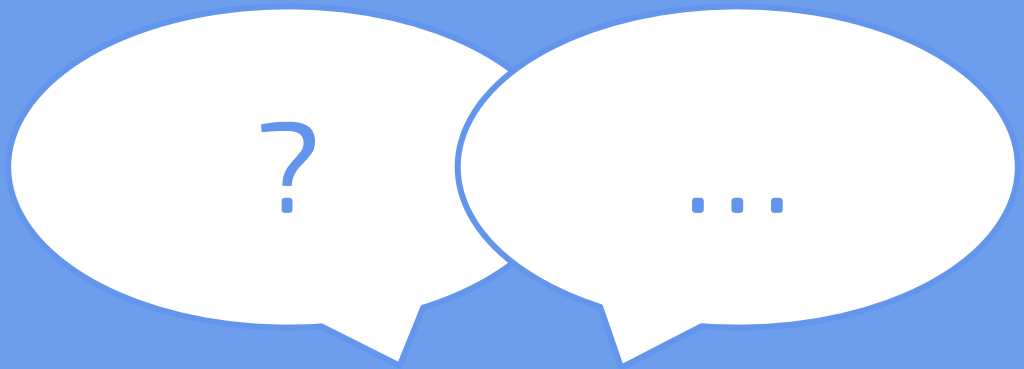
You

- Create the loan product you want
- Create loans based on it

Apache Fineract community

- Program the Fineract CN front- and backend

Questions?



Collaborate

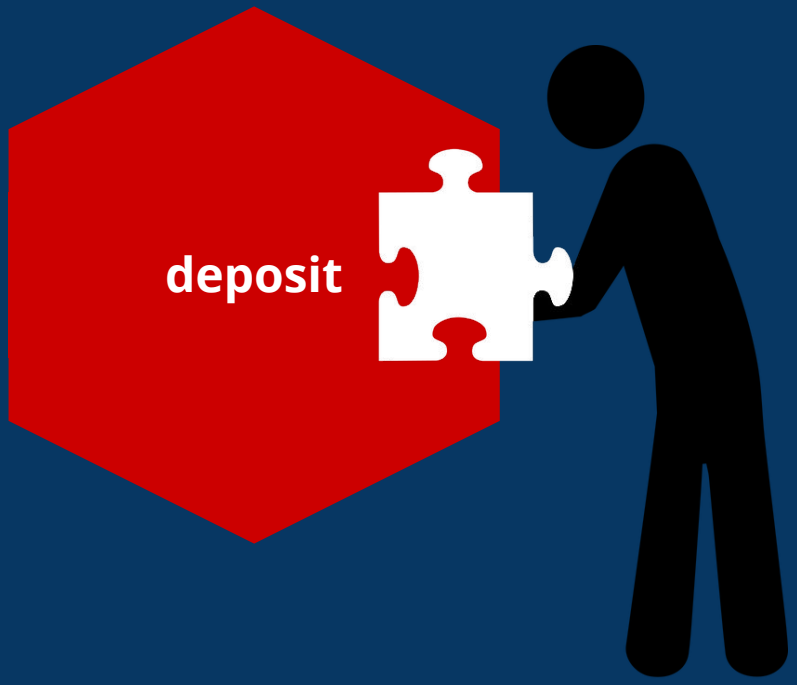
Use case

A bank wishes to offer a savings product, for which customers can win prizes.

Expertise Required

Programming in an existing codebase.

Collaborate



Roles

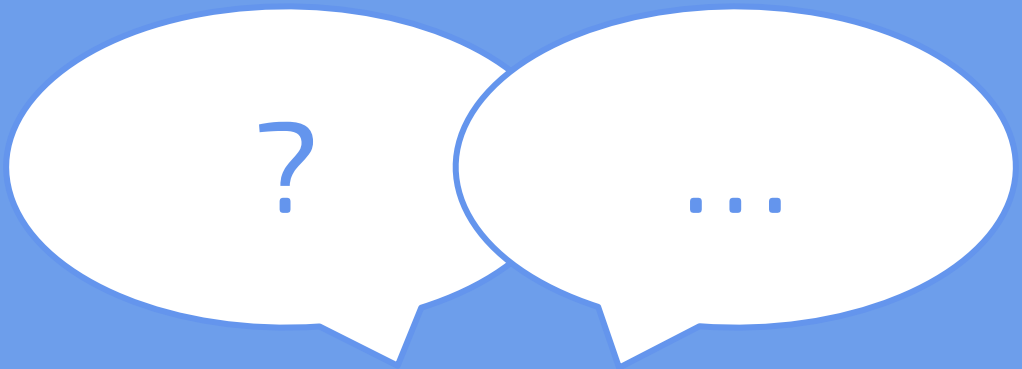
You

- Submit a pull request via github

Apache Fineract community

- Review and merge your pull request
- Create a release

Questions?



Extend

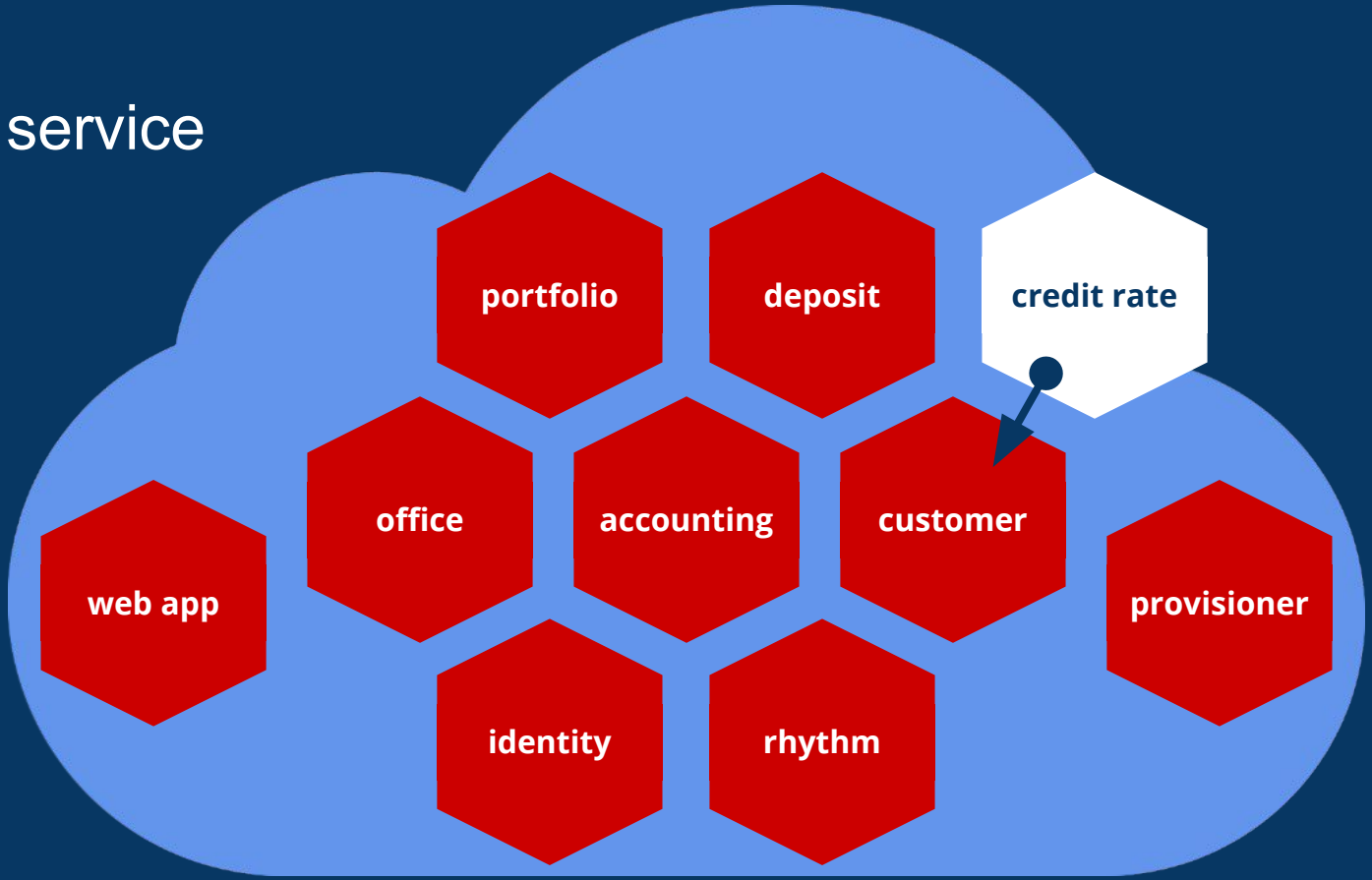
Use case

A bank wishes to request information from a national credit-ratings agency for new customers.

Expertise Required

Programming and maintaining a product

Add a service



Roles

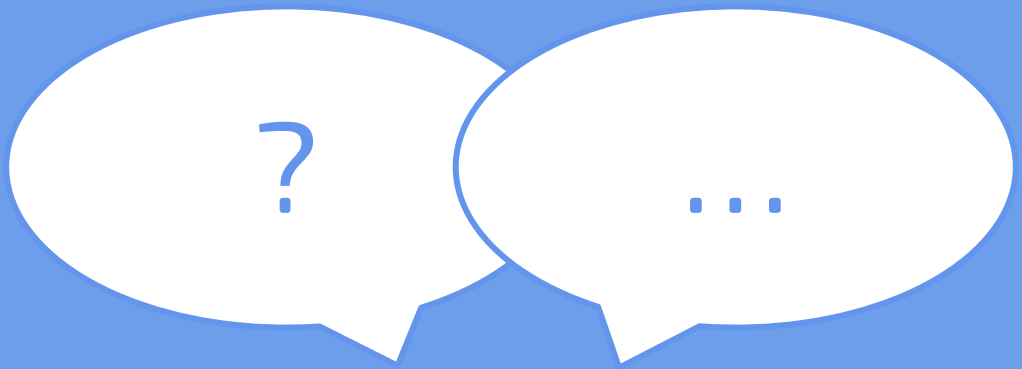
You

- Create and deploy a (possibly proprietary) service

Apache Fineract community

- Program the Fineract CN front- and backend

Questions?



Access

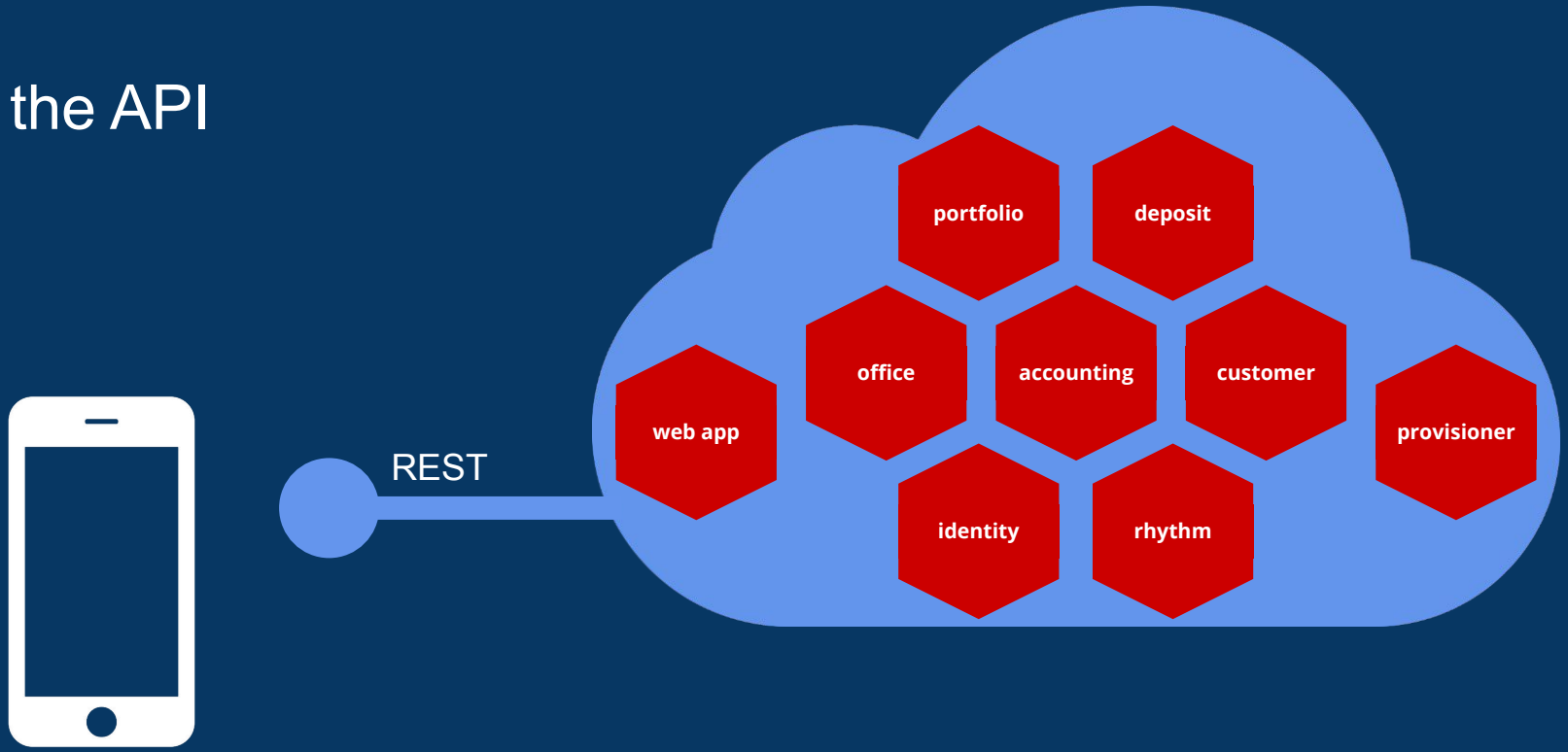
Use case

A bank wishes to create a customized mobile application for employees to allow them to manage their own contact information and view their payroll data.

Expertise Required

Programming, maintaining, and deploying a product

Use the API


portfolio
deposit
office
accounting
customer
web app
provisioner
identity
rhythm
REST

Roles

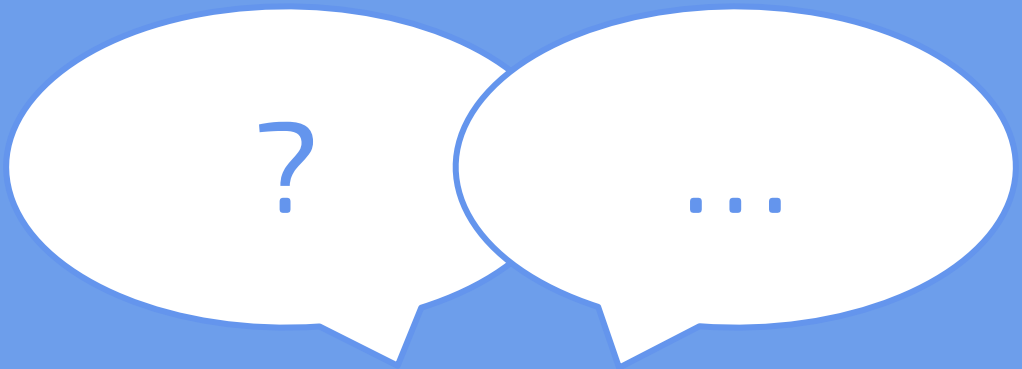
You

- Create an app
- Deploy the app

Apache Fineract community

- Program the Fineract CN backend

Questions?



Code Architecture

Overview

Service Internals

- Writing data
- Querying data
- Permissions
- Tenants
- Testing

Code Architecture

Writing Data

Writing data

- API
- Command Handlers
- Persistence
- Logging
- Notifications

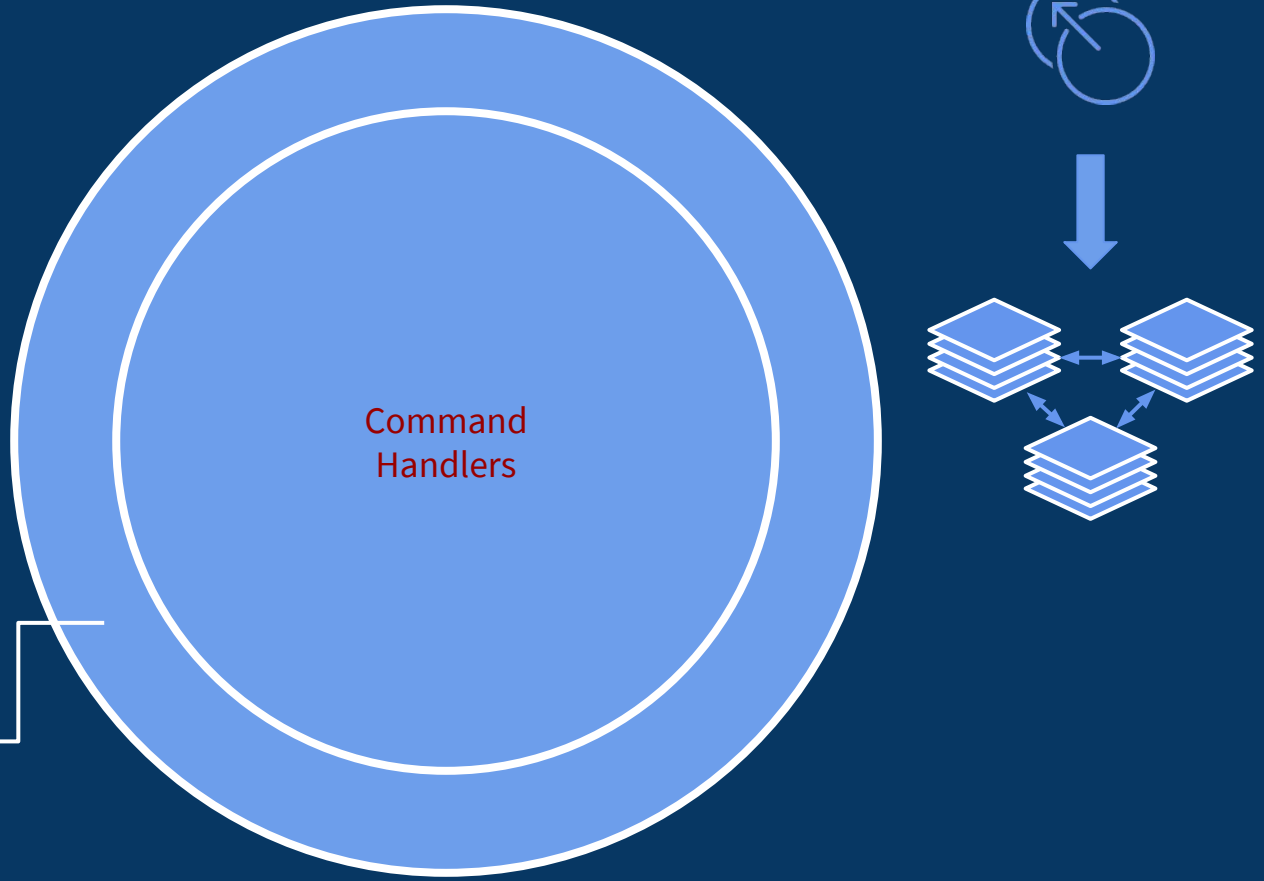
(core libraries: api, async, command)

API

API - Feign Interface

```
@FeignClient(value = "portfolio-v1", path = "/portfolio/v1")
public interface PortfolioManager {
  @RequestMapping(
    value = "/products/{productidentifier}/cases/",
    method = RequestMethod.POST,
    produces = MediaType.APPLICATION_JSON_VALUE,
    consumes = MediaType.APPLICATION_JSON_VALUE)
  void createCase(
    @PathVariable("productidentifier") String productIdentifier,
    Case caseInstance);
}
```

Command Handlers

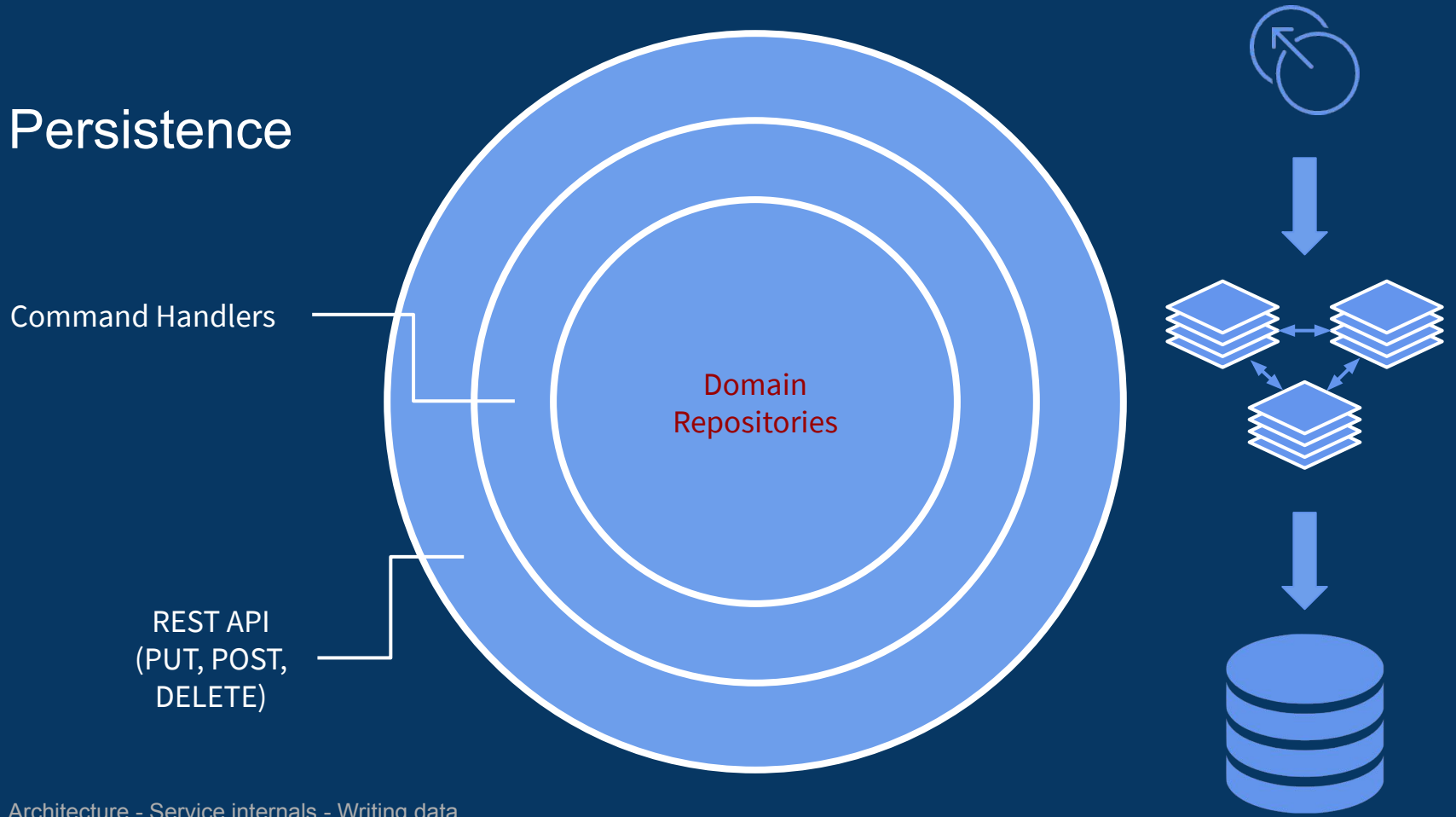


Command Handlers

```
@RequestMapping(method = RequestMethod.POST)
public @ResponseBody ResponseEntity<Void> createCase(
    @PathVariable("productidentifier") String productIdentifier,
    @RequestBody @Valid Case instance) {
  //...parameter validation

  this.commandGateway.process(new CreateCaseCommand(instance));
  return new ResponseEntity<>(HttpStatus.ACCEPTED);
}
```

Persistence



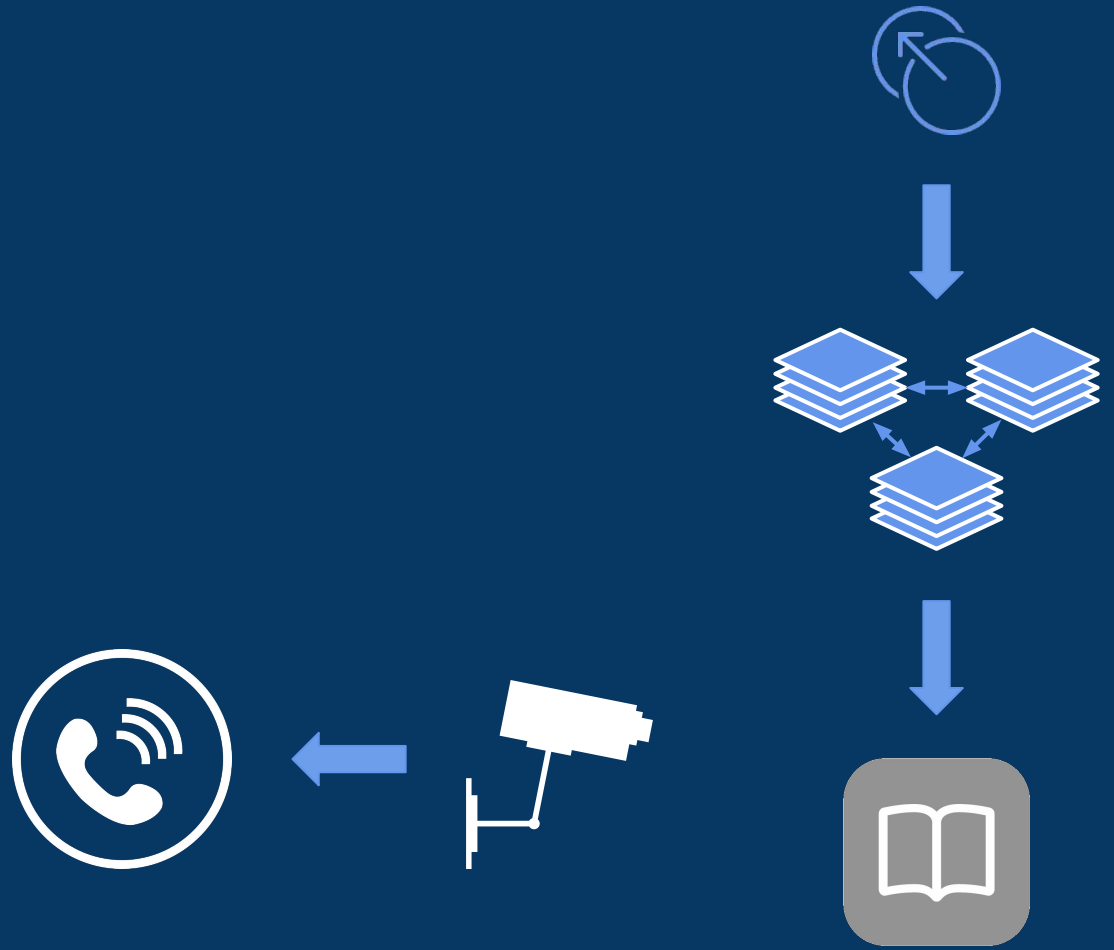
Persistence

```
@CommandHandler(logStart = INFO, logFinish = INFO)
@EventEmitter(
      selectorName = "action", selectorValue = "post-case")
public CaseEvent process(CreateCaseCommand createCaseCommand) {
  //...parameter validation
  //...map domain object to jpa object.

  this.caseRepository.save(...);
  return new CaseEvent(productIdentifier, caseIdentifier);
}
```

Logging

- Sent before handler called
- Sent after handler completes



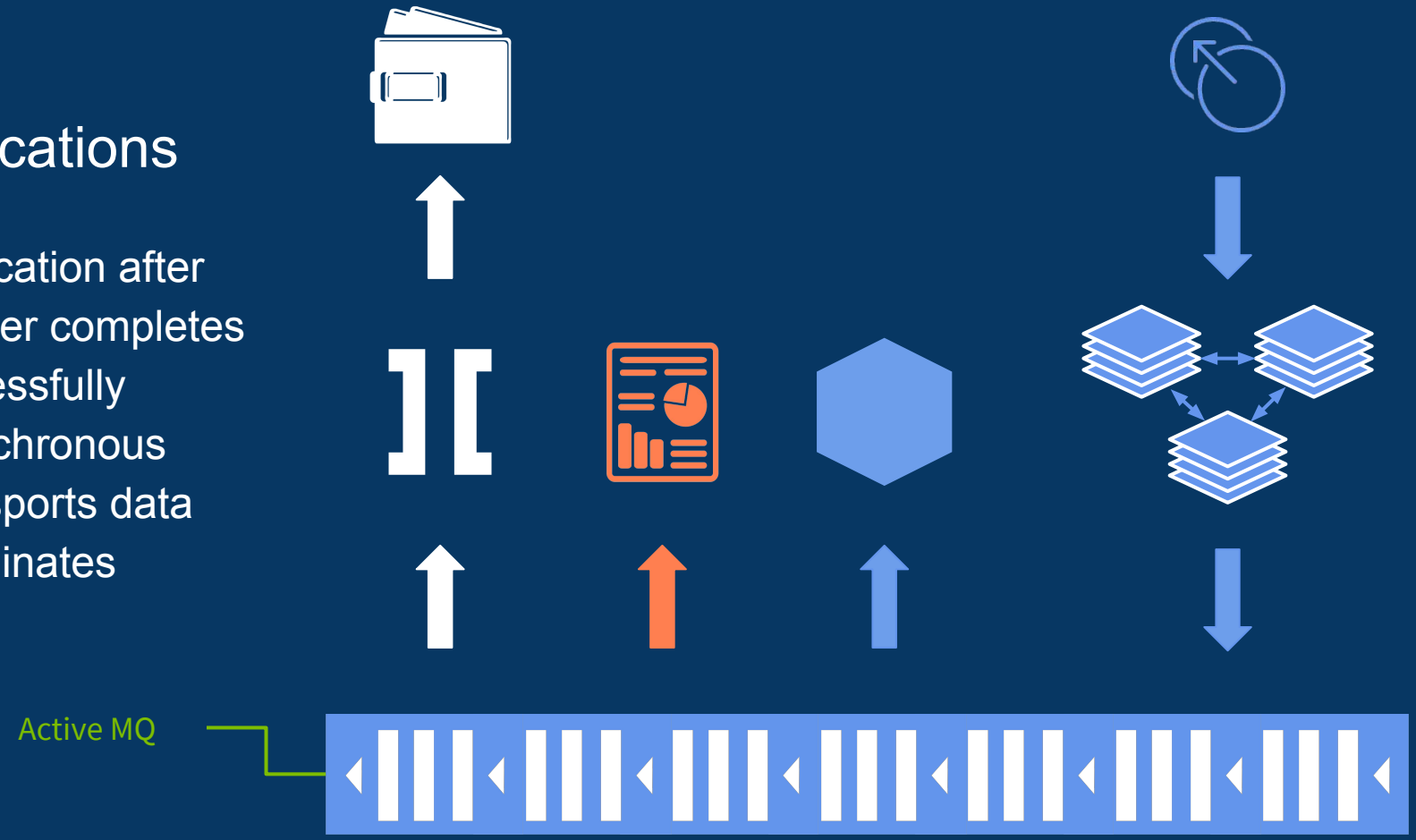
Logging

```
@CommandHandler(logStart = INFO, logFinish = INFO)
@EventEmitter(
      selectorName = "action", selectorValue = "post-case")
public CaseEvent process(CreateCaseCommand createCaseCommand) {
  //...parameter validation
  //...map domain object to jpa object.

  this.caseRepository.save(...);
  return new CaseEvent(productIdentifier, caseIdentifier);
}
```

Notifications

- Notification after handler completes successfully
- Asynchronous
- Transports data coordinates



Notifications - Emit

```
@CommandHandler(logStart = INFO, logFinish = INFO)
@EventEmitter(
      selectorName = "action", selectorValue = "post-case")
public CaseEvent process(CreateCaseCommand createCaseCommand) {
  //...parameter validation
  //...map domain object to jpa object.

  this.caseRepository.save(...);
  return new CaseEvent(productIdentifier, caseIdentifier);
}
```

Notifications - Receive

```
@JmsListener(
    subscription = "portfolio-v1",
    destination = "portfolio-v1",
    selector = "action = 'post-case'")
public void onCreateCase(
    @Header("X-Tenant-Identifier") String tenant,
    String payload) {
  CaseEvent caseEvent
      = this.gson.fromJson(payload, CaseEvent.class);

  //...application specific logic
}
```

Code Architecture

Querying Data

Querying data

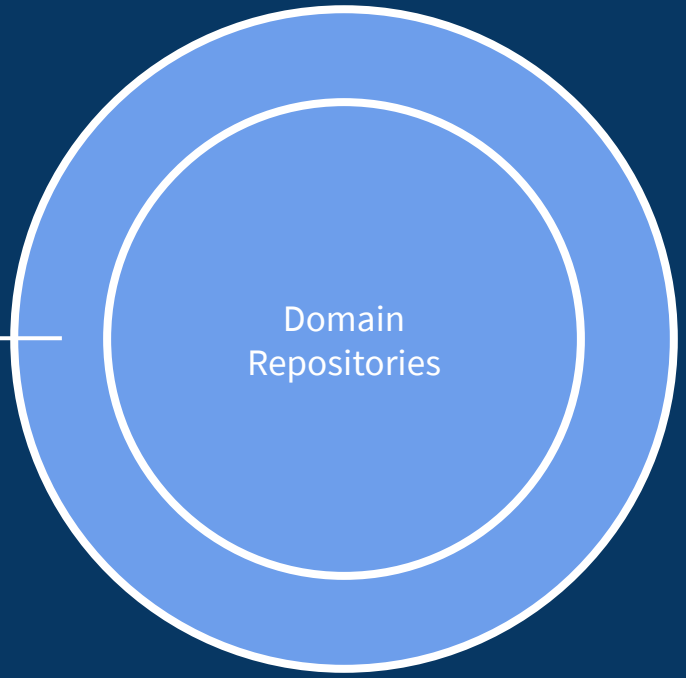
- Persistence
- Mapping
- API

(core libraries: mariadb, data-jpa, api)

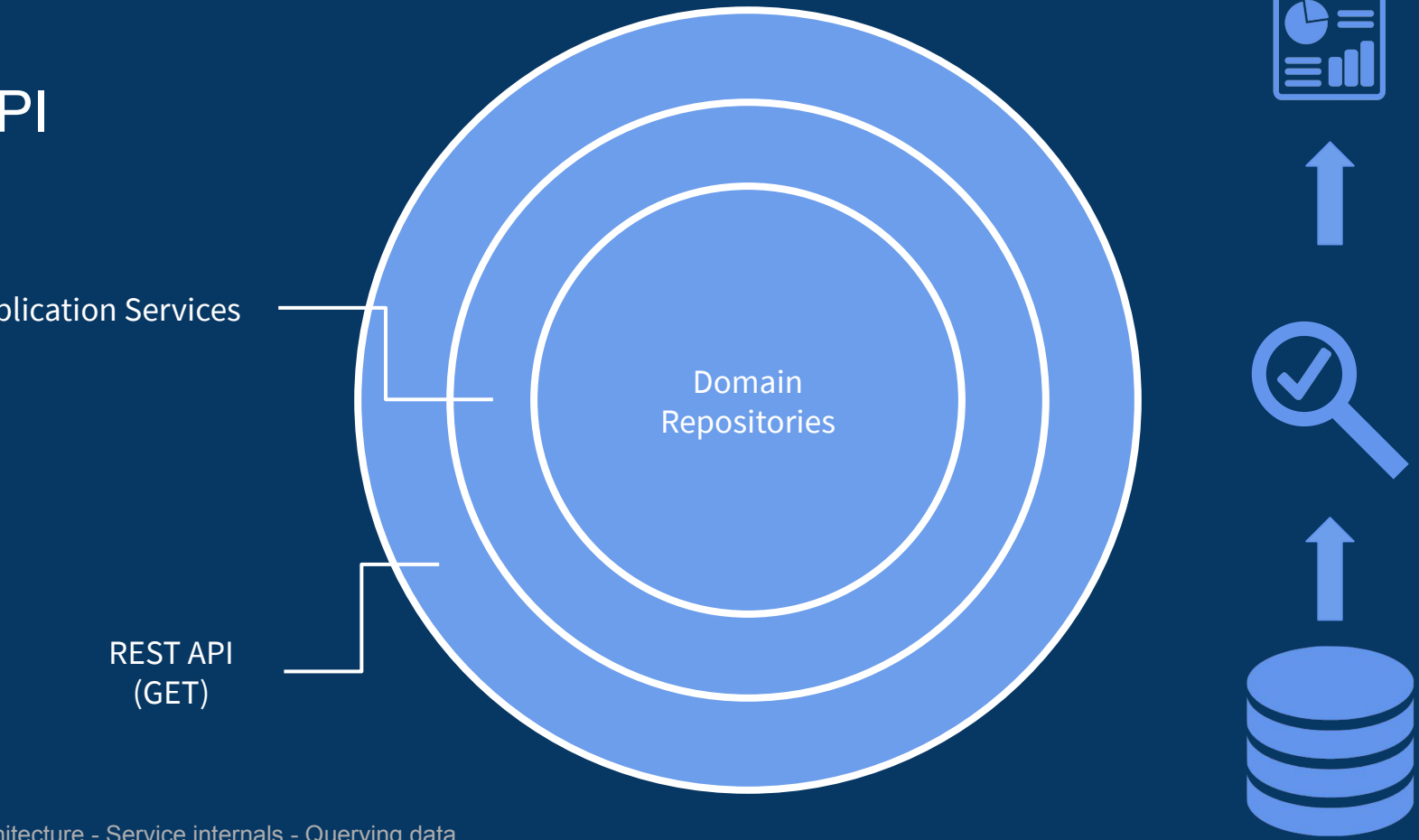
Persistence

Mapping

Application Services



API



Code Architecture

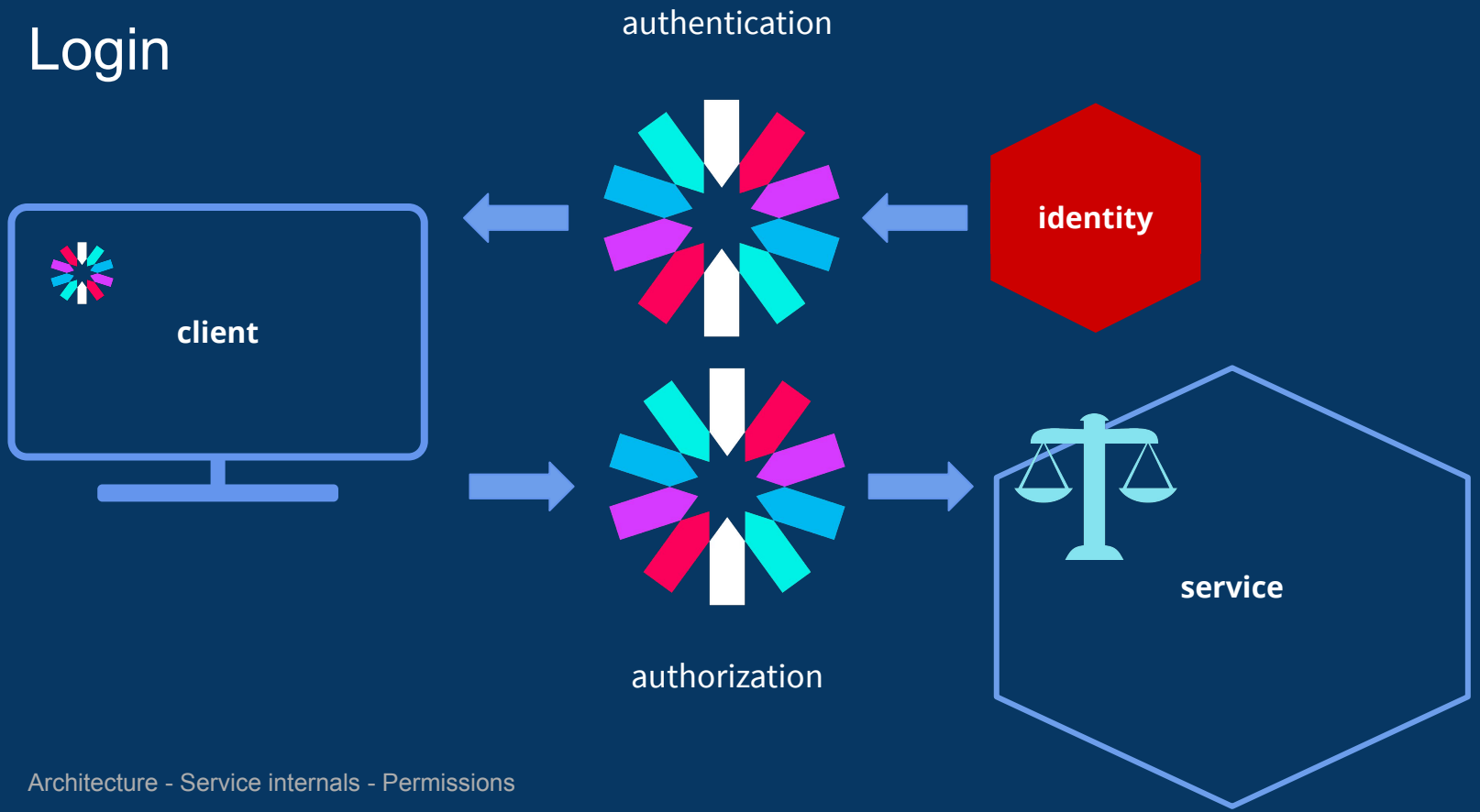
Permissions

Permissions

- Login
- Permission definition
- Token types

(core libraries: anubis, anubis-test, permitted-feign-client)

Login



Permission Definition

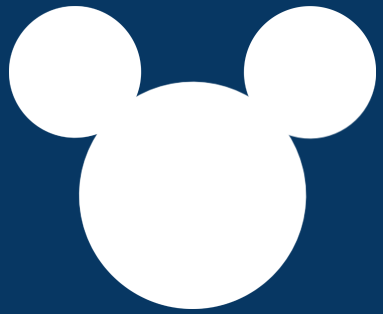
```
@Permittable(value = AcceptedTokenType.TENANT,
    groupId = PermittableGroupIds.CASE_MANAGEMENT)
@RequestMapping(method = RequestMethod.POST)
public @ResponseBody ResponseEntity<Void> createCase(
    @PathVariable("productidentifier") String productIdentifier,
    @RequestBody @Valid Case instance) {
  //...
}
```

Token Types

SYSTEM

TENANT (user)

GUEST



Code Architecture

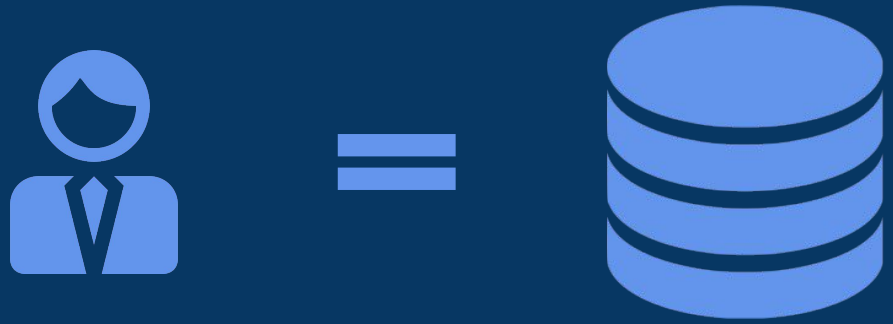
Multi-tenancy

Tenants

- Provisioning
- Thread context
- Request header

(core libraries: lang, cassandra, mariadb)

Provisioning



Tenant
Montego Bay Co-op

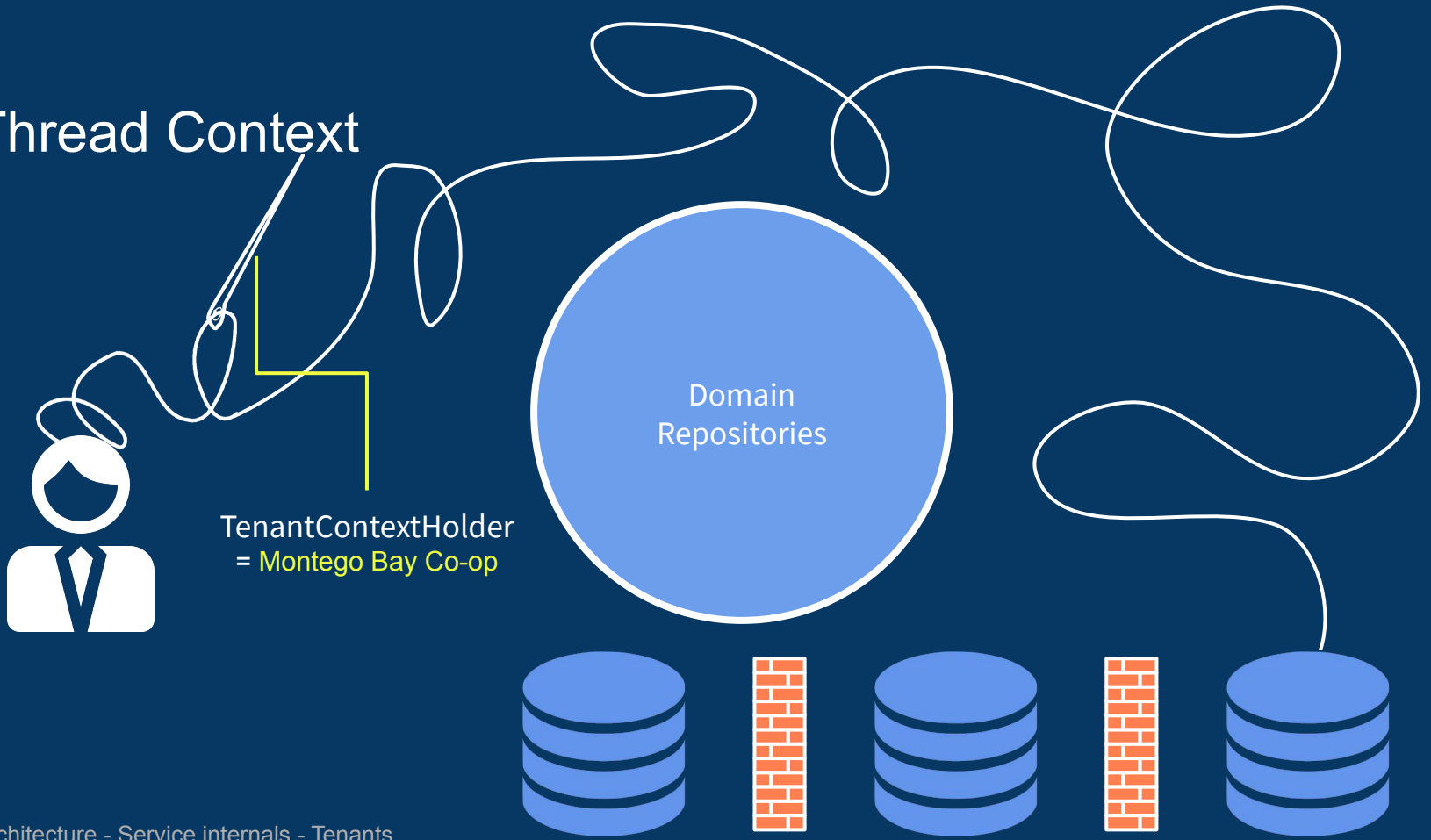
Provisioning

Database
Swiss Bank

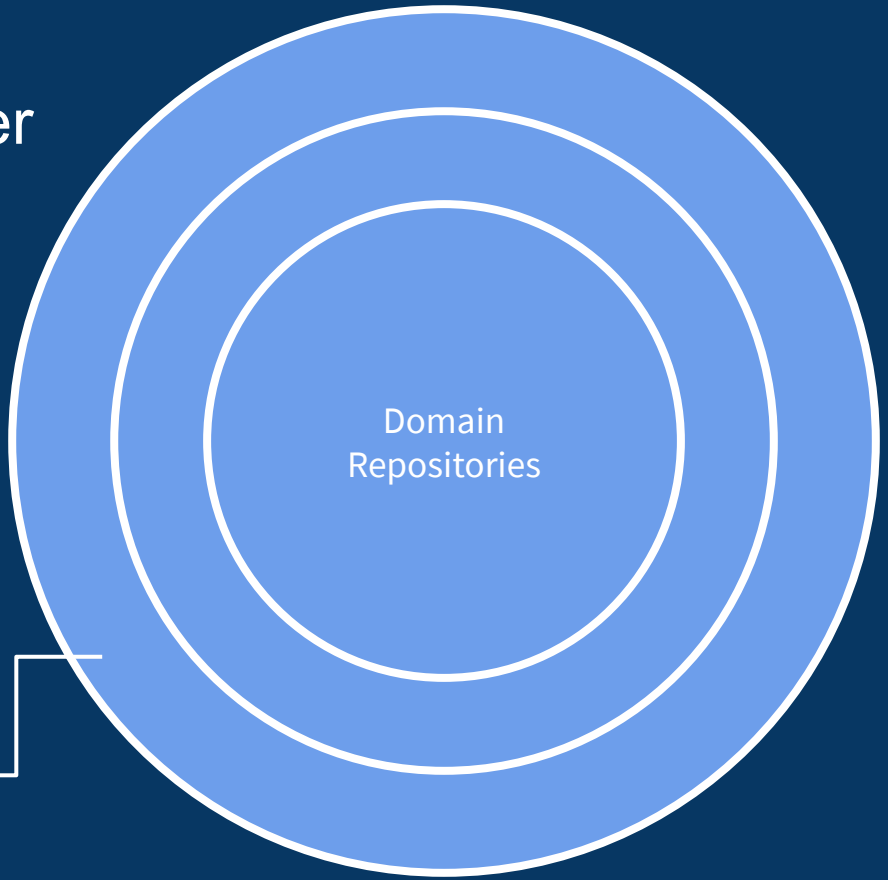
Database
Deutsche Bank

Database
Montego Bay Co-op

Thread Context



Request Header



REST header:
X-Tenant-Identifier =
“Montego Bay Co-op”

Code Architecture

Quality Assurance

Quality Assurance

- Testing code quality (findbugs, code reviews)
- Testing domain object validation (unit tests)
- Testing specific logic (unit tests)
- Testing a service (component tests)
- Testing service interactions (integration tests)

(core libraries: test, anubis-test, service-starter)

@myrleKrantz
@apachefineract

Sources:

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- https://en.wikipedia.org/wiki/Muhammad_Yunus
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- Nobel Prize photo: http://www.freestockphotos.biz/stockphoto/17280
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- https://www.soprabanking.com/en

JWT Bearer Tokens

Tools

- Spring
- MariaDB/PostgreSQL
- Cassandra
- ActiveMQ
- AngularJS
- Eureka
- Feign
- JWT
- Junit + Mockito