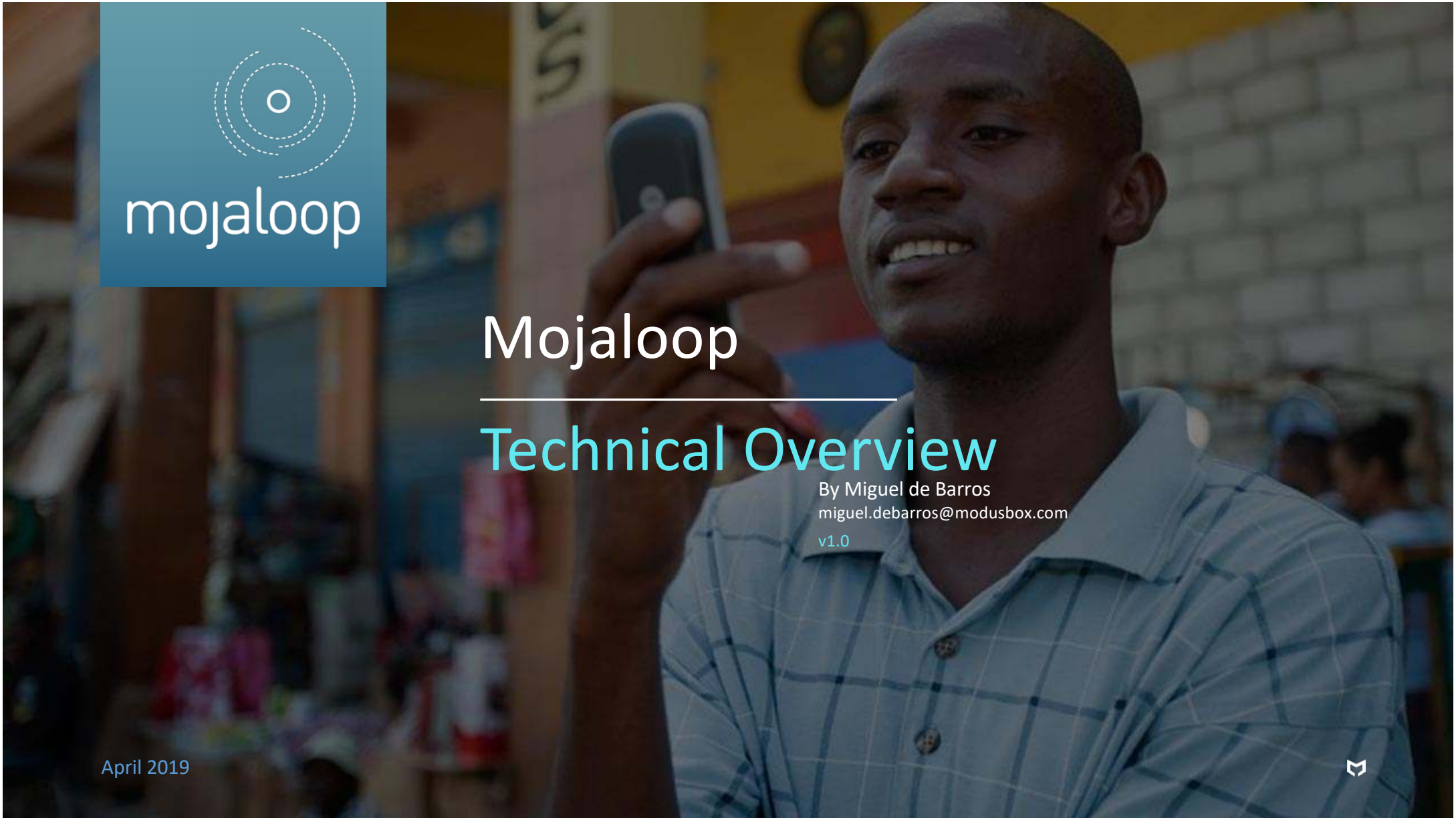


mojaloop

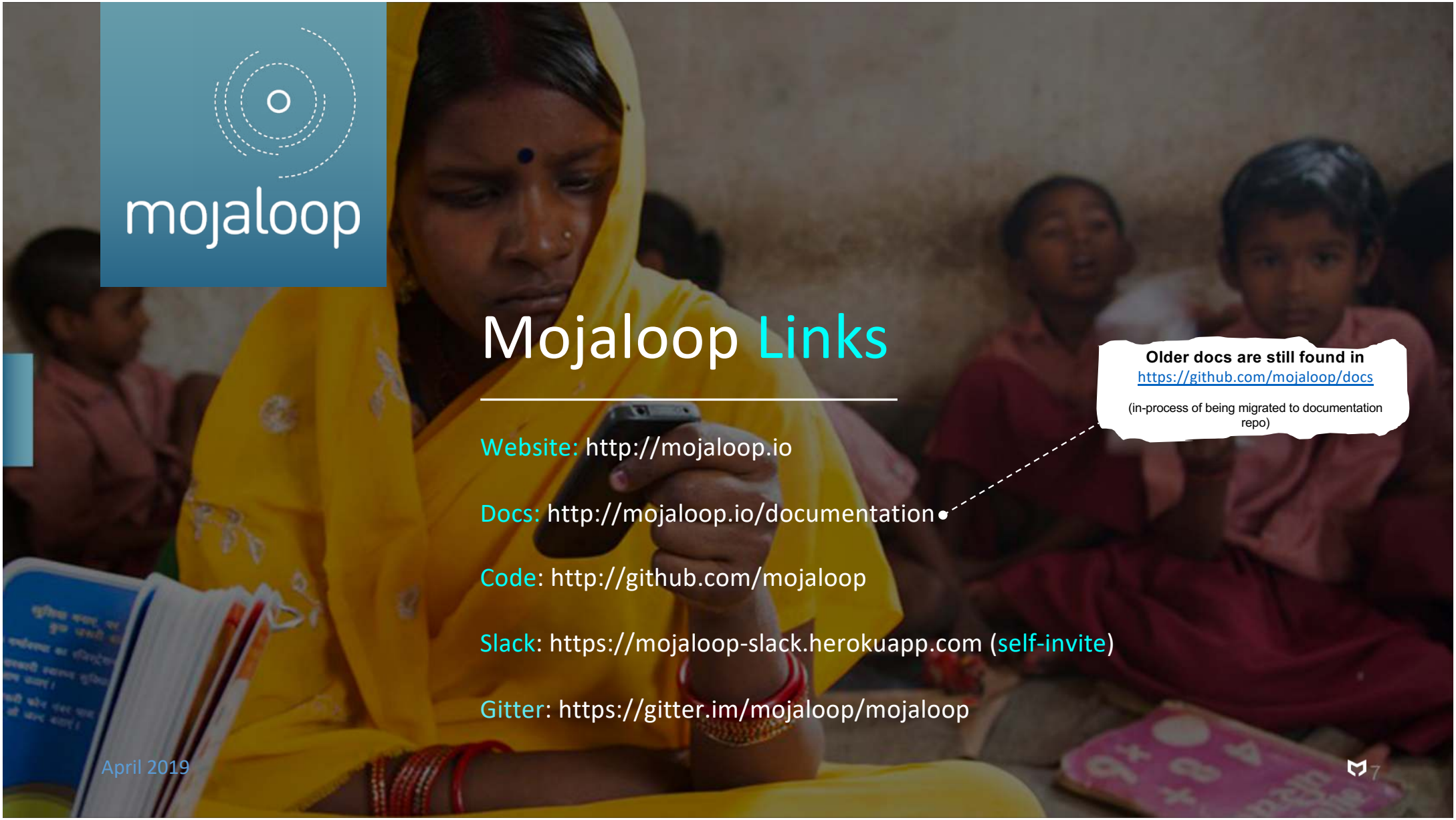
Mojaloop

Technical Overview

By Miguel de Barros
miguel.debarros@modusbox.com

v1.0

April 2019



mojaloop

Mojaloop Links

Website: http://mojaloop.io

Docs: http://mojaloop.io/documentation

Code: http://github.com/mojaloop

Slack: https://mojaloop-slack.herokuapp.com (self-invite)

Gitter: https://gitter.im/mojaloop/mojaloop

Older docs are still found in
https://github.com/mojaloop/docs

(in-process of being migrated to documentation repo)

Mojaloop

Technical Overview

1. What is Mojaloop?
2. History & Evolution
3. High-level Architecture
4. Component Architecture
5. Switch Functionality
6. Global foot-print & Roll-out

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What is Mojaloop?

- Open Loop System
- Real-time, Irrevocable, Push-only
- DFSP Governed, Same-day Settlements
- Shared investment in Fraud detection

Mojaloop

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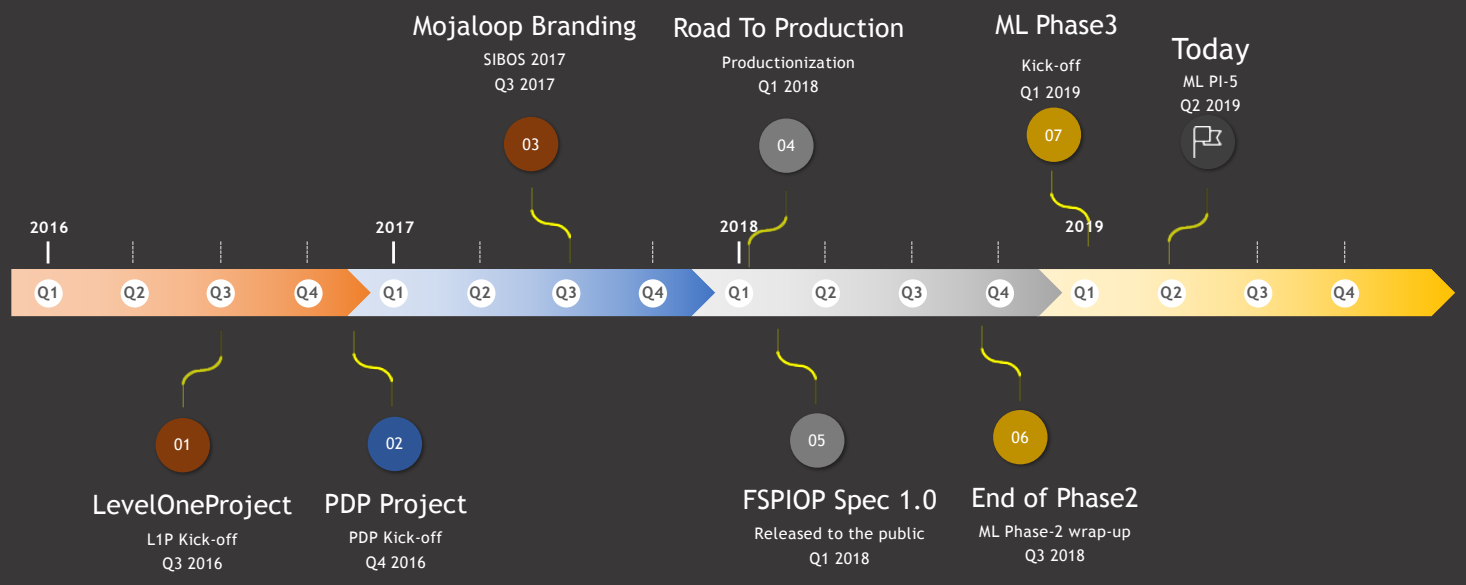
Mojaloop – History & Evolution



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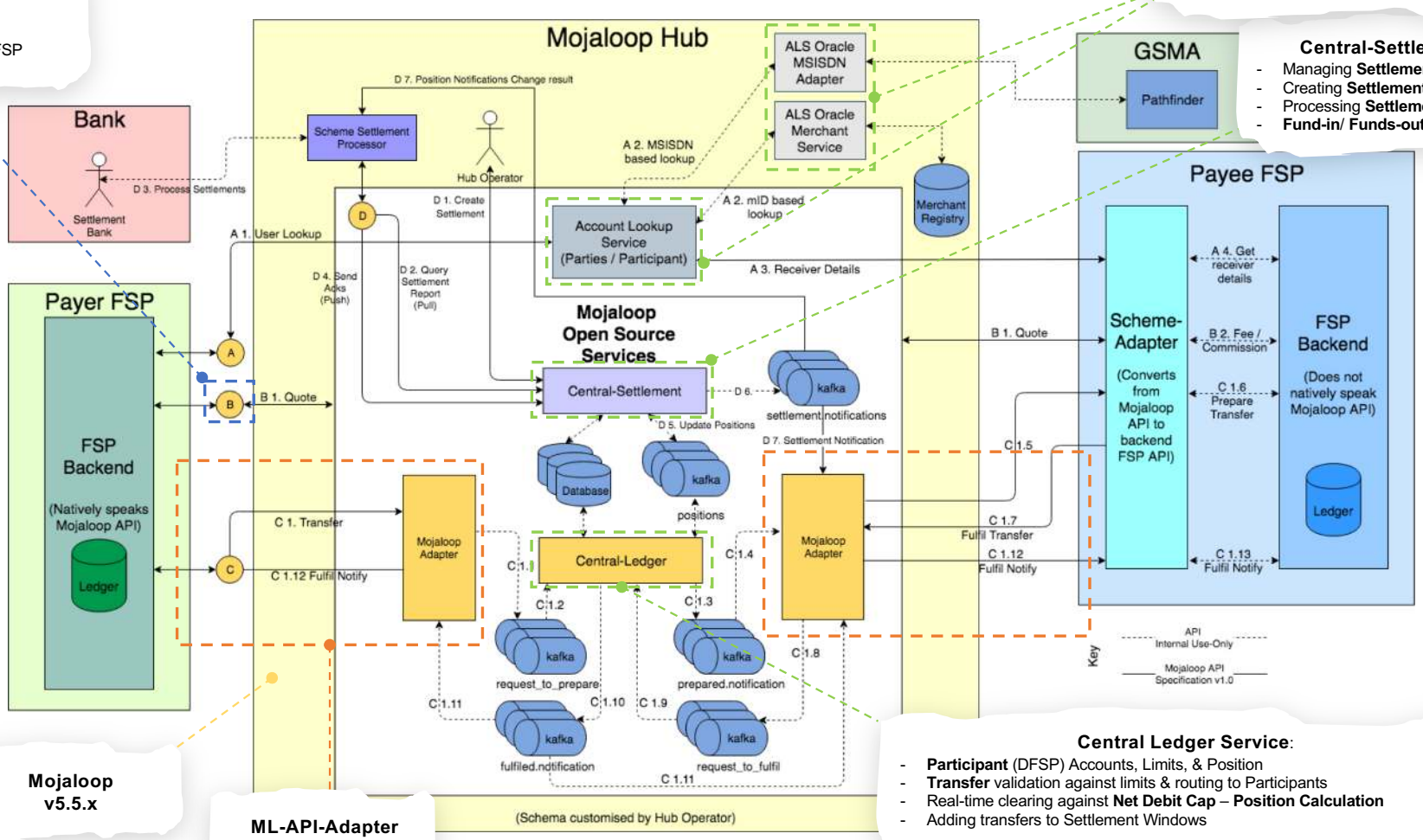
High-level Architecture – Current (PI5)

Account Lookup Service:
- Resolve **Participant** (DFSP) Routing
- Resolve **Party** (Customer) details via DFSP
- **Validation** of routing/ownership
- Rails/Routing to schema specific **Oracle registries**

Interop-Switch
(Legacy component)
- Rails/Routing for Quote to DFSP
- Initiate Quote

Central-Settlement Service:
- Managing **Settlement Windows**
- Creating **Settlement reports**
- Processing **Settlement Acks**
- **Fund-in/ Funds-out**



Mojaloop v5.5.x

ML-API-Adapter
(Mojaloop Spec API)

Central Ledger Service:
- **Participant** (DFSP) Accounts, Limits, & Position
- **Transfer** validation against limits & routing to Participants
- Real-time clearing against **Net Debit Cap** – **Position Calculation**
- Adding transfers to Settlement Windows

Mojaloop

Technical Overview

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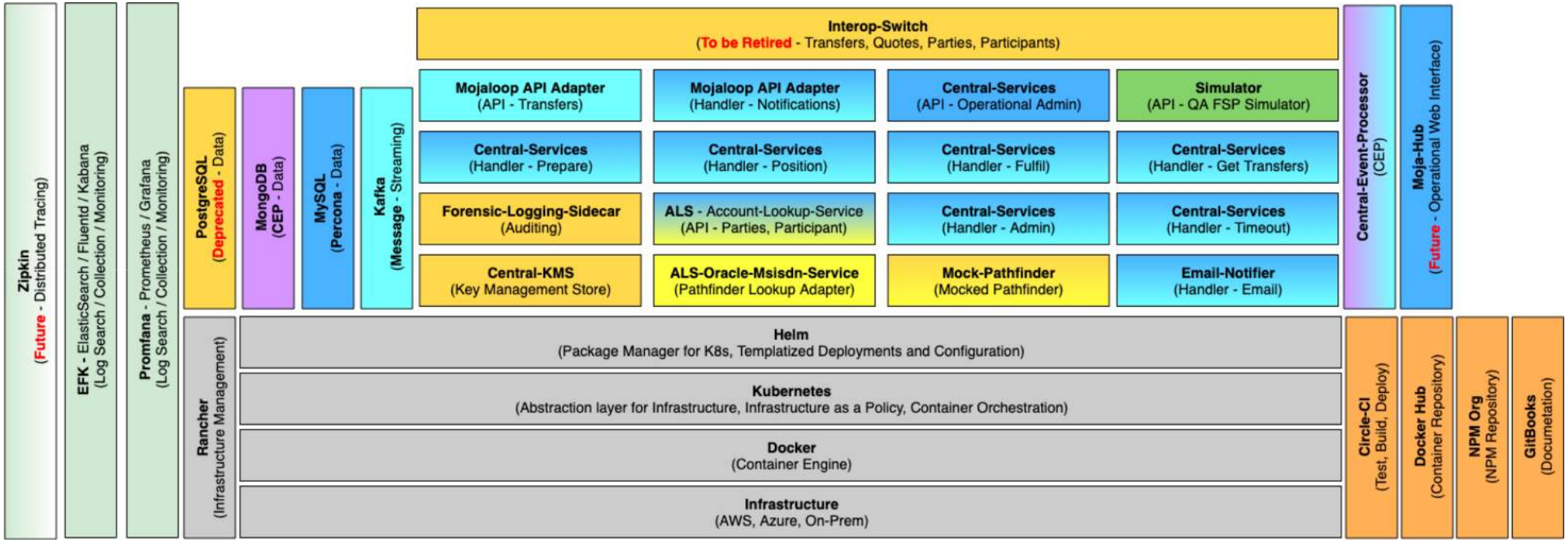
Component Architecture – Current (PI5)



Deployment Architecture – Helm Overview

Ref: http://helm.sh

What is Helm?

Open Source Package Manager for Kubernetes through the use of Charts.

Charts help you define, install and upgrade releases for Kubernetes deployment via templates and configuration.

Why Helm?

Manage Complexity

Charts describe even the most complex apps; provide repeatable application installation, and serve as a single point of authority.

Easy Updates

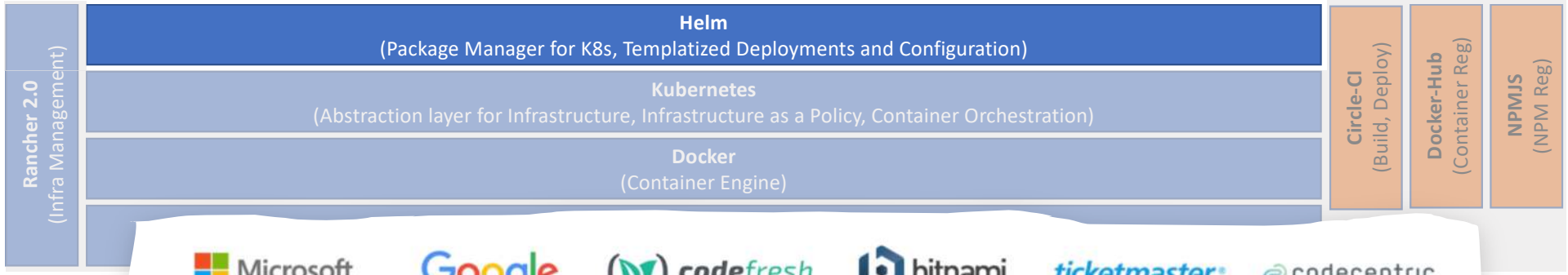
Take the pain out of updates with in-place upgrades and custom hooks.

Simple Sharing

Charts are easy to version, share, and host on public or private servers.

Rollbacks

Use `helm rollback` to roll back to an older version of a release with ease.



Microsoft Google codefresh bitnami ticketmaster codecentric

Deployment Architecture – Kubernetes Overview

What is Kubernetes?
Open-source system for automating deployment, scaling, and management of containerized applications.

kubernetes

Why Kubernetes?

Deploy your applications quickly and predictably
- Infrastructure as a Policy
- Abstraction of Infrastructure (Cloud, On-Prem)

Scale your applications on the fly
- Policy rule based scaling
- Limit hardware & resources by scaling horizontally up/down

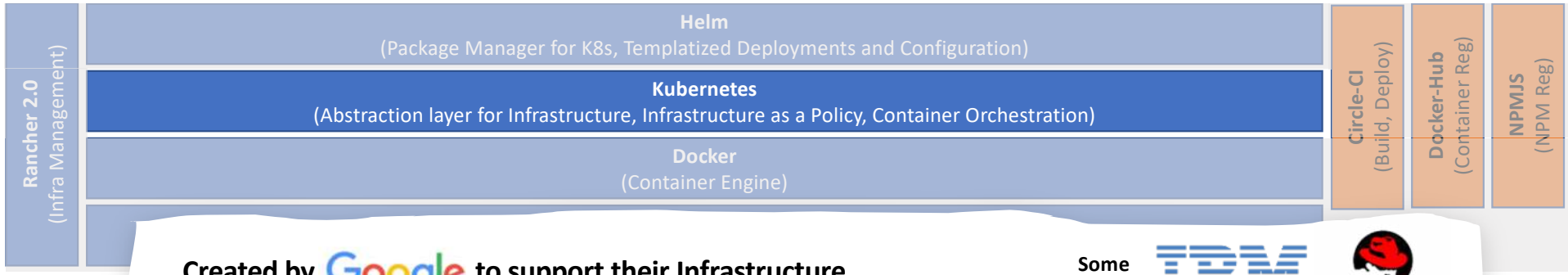
Roll out new features seamlessly
- Rolling updates

Discoverability
- Dynamic service resolution via DNS

Durability
- Self-healing
- Auto-[placement, restart, replication, scaling] based on Policies
- Load Balancing

Security
- Isolation through Containers, Network and Namespaces

Operations
- App config & secrets stored in distributed key-value store (etcd)
- Monitoring of containers



Created by Google to support their Infrastructure.

Some contributors: IBM redhat

Deployment Architecture – Rancher Overview

Ref: http://rancher.com

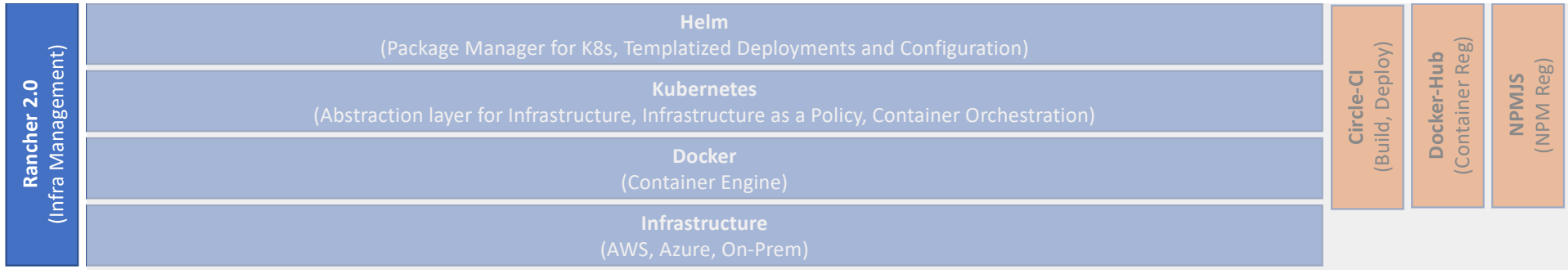
What is Rancher?

Rancher is an enterprise management plane for Kubernetes.

"**Every distro. Every cluster. Every cloud.**" ~ rancher.com

Why Rancher?

- Kubernetes Management
- Container Management
- *Access Management (RBAC)
- *Helm Repository Management
- Multi-environment Management (multi k8s clusters, On-prem, Azure, Google, AWS, etc)
- Multi-Provider provisioning (On-prem, Azure, Google, AWS, vSphere)
- Easily scale up/down Kubernetes clusters



Deployment Architecture – Ops Monitoring Overview

Zipkin (**Future** - Distributed Tracing)

EFK - ElasticSearch / Fluentd / Kabana (Log Search / Collection / Monitoring)

Promfana - Prometheus / Grafana (Real-time Metric Collection / Monitoring)

Ref: *http://prometheus.io*, *http://Grafana.com*

What is Metric Instrumentation?

Real-time operational visibility for:

- Performance
- Health
- Alerts

What is Promfana?

Prometheus

Leading open-source instrumentation solution for monitoring

Grafana

The open platform for beautiful analytics and monitoring

Why Promfana?

- Metric Instrumentation for Mojaloop
- Low overhead on nodejs (histograms + pull metric end-point)
- **Real-time metric visualization** for **Performance** and **Health monitoring** of the Mojaloop Stack

Dimensional data

Prometheus implements a highly dimensional data model. Time series are identified by a metric name and a set of key-value pairs.

Powerful queries

PromQL allows slicing and dicing of collected time series data in order to generate ad-hoc graphs, tables, and alerts.

Great visualization

Prometheus has multiple modes for visualizing data: a built-in expression browser, Grafana integration, and a console template language.

Efficient storage

Prometheus stores time series in memory and on local disk in an efficient custom format. Scaling is achieved by functional sharding and federation.

Simple operation

Each server is independent for reliability, relying only on local storage. Written in Go, all binaries are statically linked and easy to deploy.

Precise alerting

Alerts are defined based on Prometheus's flexible PromQL and maintain dimensional information. An alertmanager handles notifications and silencing.

Many client libraries

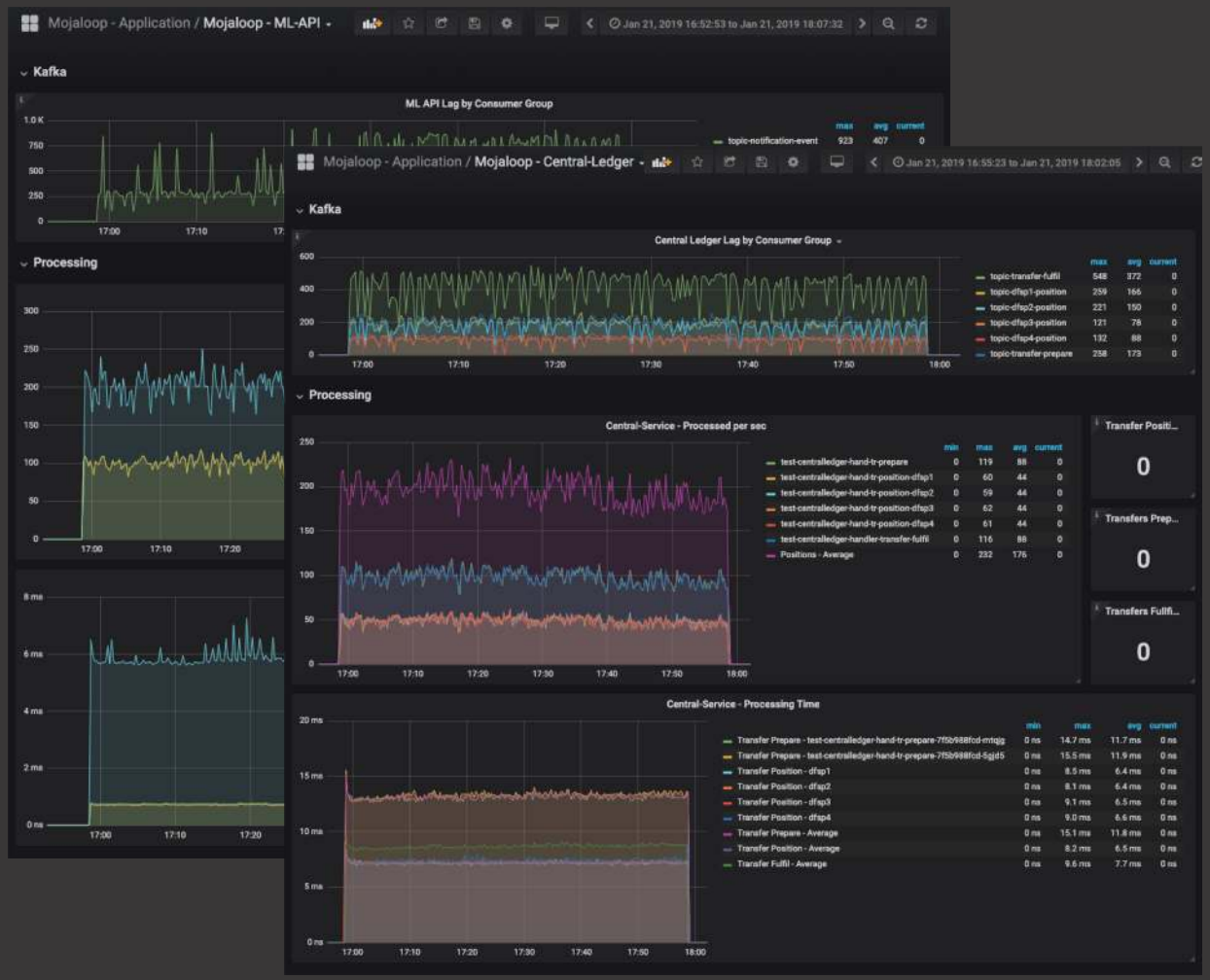
Client libraries allow easy instrumentation of services. Over ten languages are supported already and custom libraries are easy to implement.

Many integrations

Existing exporters allow bridging of third-party data into Prometheus. Examples: system statistics, as well as Docker, HAProxy, StatsD, and JMX metrics.

CoreOS docker DigitalOcean SOUNDCLOUD PERCONA ERICSSON weaveworks

Deployment Architecture – Ops Monitoring Dashboards



Documentation

http://mojaloop.io/helm/monitoring/

Mojaloop Application

- ML-API-Adapter -- nodejs + application
- Central-Ledger -- nodejs + application
- Simulators -- nodejs + application

Data Store

- MySQL Overview
- PXC Galera Overview
- PXC Galera Graphs

Messaging

- Kafka Cluster Overview
- Kafka Topic Overview

Kubernetes

- Clusters
- Deployments

Deployment Architecture – Ops Logging Overview

Zipkin (Future - Distributed Tracing)

EFK - ElasticSearch / Fluentd / Kabana (Log Search / Collection / Monitoring)

Promfana - Prometheus / Grafana (Real-time Metric Collection / Monitoring)

Ref: http://prometheus.io, http://Grafana.com

What is EFK (aka ELK)?

elasticsearch

Elasticsearch is a distributed, RESTful search and analytics engine.

fluentd

Open source data collector for unified logging layer, with ingestions into Elasticsearch.

kibana

Kibana lets you visualize your Elasticsearch data and navigate the Elastic Stack.

Why EFK?

- Central location and storage of all Mojaloop log files
- Management of log data (persistence, long-term storage, etc)
- Management of alert/events based on log data
- Log files are indexed and searchable
- Assist with tracing & trouble shooting Mojaloop's distributed micro-service logs

Why E-F-K and not E-L-K?

- Fluentd is used instead of Logstash due to its support & seemless integration for Kubernetes (k8s).
- K8s Pods/Containers are easily collected by Fluentd and ingested into ElasticSearch using the underlying K8s logging architecture.

Sprint Rabobank AIRBUS ebay vimeo Fermilab

Deployment Architecture – CircleCI Overview

circleci

What is CircleCI? Cloud based Continuous Integration & Deployment Platform

Ref: http://circleci.com

VCS Integration
CircleCI integrates with GitHub, GitHub Enterprise, and Bitbucket. Every time you commit code, CircleCI creates a build.

Automated Testing
CircleCI automatically tests your build in a clean container or virtual machine.

Automated Deployment
Passing builds are deployed to various environments so your product goes to market faster.

Notifications
Your team is notified if a build fails so issues can be fixed quickly.

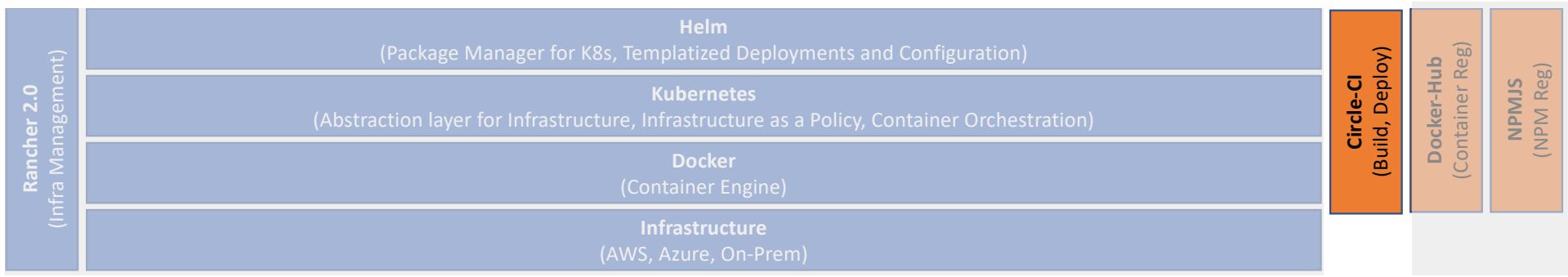
Why CircleCI?

Workflows for Job Orchestration
Orchestrate customizable job execution (such as build, test, deploy), giving complete control over your development process.

Language-Agnostic Support
Supports any language that builds on Linux or macOS, including C++, Javascript, .NET, PHP, Python, and Ruby.

First-Class Docker Support
Run any image from Docker's public/private registry or other common registries. Build Docker images, access Docker layer caching, Compose.

Powerful Caching
Speed up builds with expanded caching options, including images, source code, dependencies, and custom caches. Full control over cache save and restore points for optimal performance.



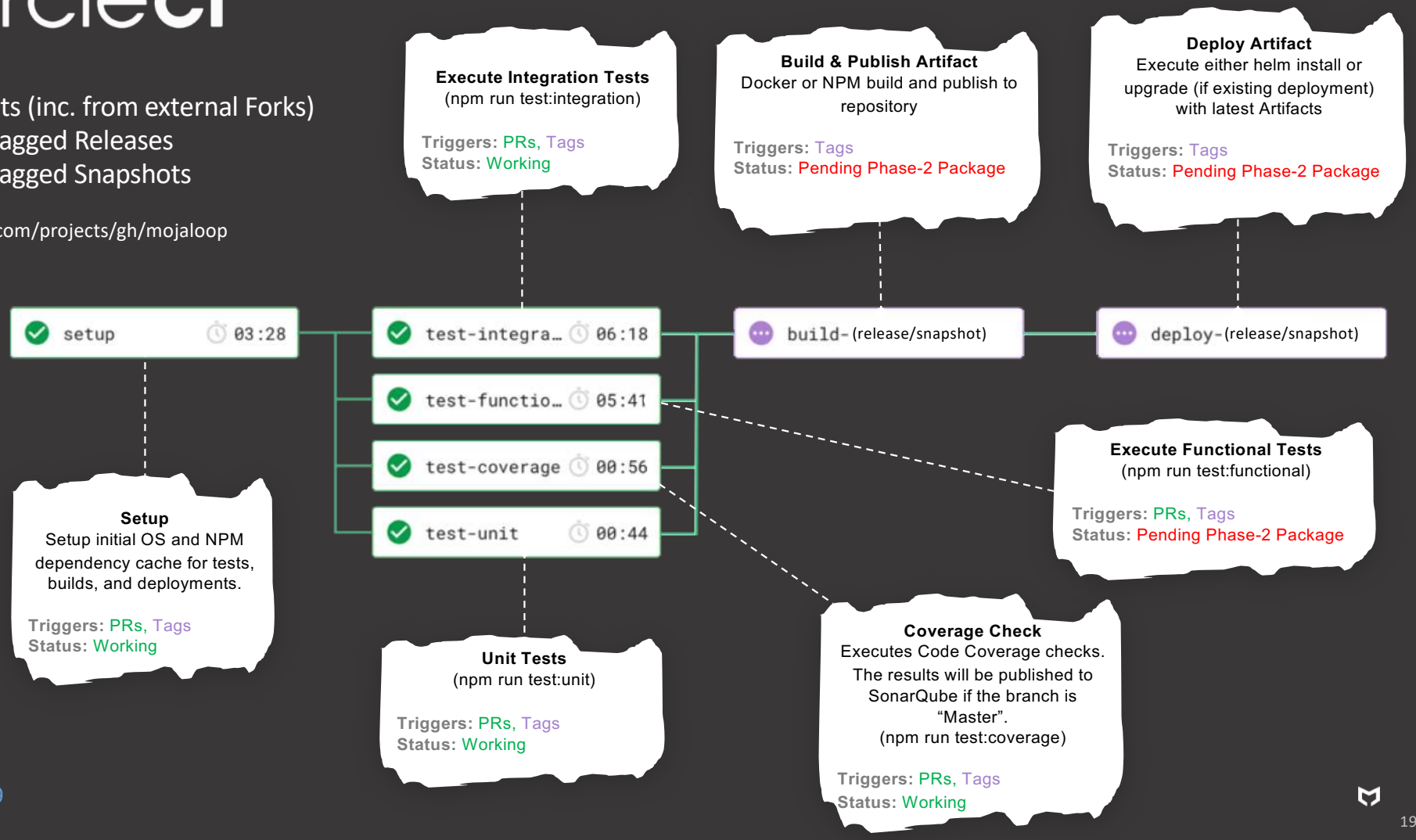
** Forrester names CircleCI a leader (https://www2.circleci.com/circleci-forrester-wave-leader-2017.html)*

Deployment Architecture – CI/CD Pipeline

circleci

Triggers:
[●] Pull-Requests (inc. from external Forks)
[●] Publishing tagged Releases
[●] Publishing tagged Snapshots

Ref: https://circleci.com/projects/gh/mojaloop



Documentation – GitBooks Overview

GitBook

Ref: http://gitbook.com
Ref: https://en.wikipedia.org/wiki/Markdown

What is Gitbooks?

An open-source open documentation framework where teams can document everything from products, to APIs and internal knowledge-bases based on open-standards with community driven plugins.

Why Gitbooks?

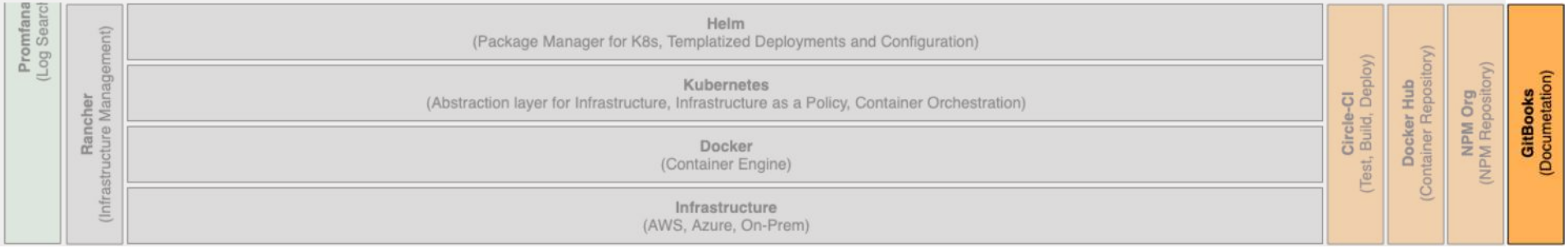
Markdown
Lightweight markup language with plain text formatting syntax supporting standard HTML, and CSS.

Plugins
Community plugins for generating content (e.g. plantuml, openapi/swagger docs), providing integration to Github, Slack, etc and themes (e.g. ToCs, Navigation, etc)

Imbed Generated Content
Embed generated sequence diagrams, openapi/swagger docs, etc.

Cli
Gitbook-cli to build static-content, with support for local testing. Also supports auto-build sense when changes are made locally when testing.

Search
Find what you are looking for.



Mojaloop

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Current (PI5) Switch Functionality – Mojaloop Specification

Mojaloop v1.0 – API Specification

Transfers
[●] POST - Prepare
[●] PUT - Response
[●] **PUT – Error**
[●] Outgoing
[●] **Incoming**
[●] **GET - Query**

Parties
[●] **GET - Request**
[●] **PUT - Response**
[●] **PUT - Error**

Quotes
[●] POST - Request
[●] PUT - Response
[●] PUT - Error
[o] GET - Query

Participants
[●] **POST - Create**
[●] **PUT - Response**
[●] **POST - Bulk Create**
[●] **PUT - Error**
[●] **DEL - Delete**

Transactions
[o] PUT - Response
[o] GET - Query

TransactionRequests
[o] POST - Request
[o] PUT - Response
[o] PUT - Error
[o] GET - Query

Authorizations
[o] GET - Request
[o] PUT - Response
[o] PUT - Error

BulkTransfers
[o] POST - Request
[o] PUT - Response
[o] PUT - Error
[o] GET - Query

BulkQuotes
[o] POST - Request
[o] PUT - Response
[o] PUT - Error
[o] GET - Query

● Interim:
- subId not supported currently
- no validations applied to "update" operations
- full design for Participants POST – Create is pending

Key
[●] Fully implemented
[●] Legacy Code
[●] Partially implemented
[●] Not implemented
[o] Out of Scope for PI5

Current (PI5) Switch Functionality – Operations (1 of 2)

Operational – Use Cases

Participants

[●] Manage Participants
- [●] Create Initial Value
- [●] Query
- [●] Update

[●] Manage Participant Limits
- [●] Create Initial Value
- [●] Query
- [●] Update

[●] Manage Callback URLs
- [●] Create Initial Value
- [●] Query
- [●] Update

Settlements

[●] Open, close Settlement Windows
[●] Query Settlement Windows
[●] Query Settlement Report
[●] Create/Trigger Settlement with Windows
[●] Process successful Settlement Acknowledgements
[●] Reconcile Positions based on successful Settlements
[●] Process failed Settlement Acknowledgements

Positions

[●] Query Positions

[●] Manage Positions
- [●] Create Initial Value
- [●] Query
- [●] Update

Oracles

[●] Manage Oracles
- [●] Create
- [●] Query
- [●] Update
- [●] Delete

Key
[●] Fully implemented
[●] Legacy Code
[●] Partially implemented
[●] Not implemented
[○] Out of Scope

Current (PI5) Switch Functionality – Operations (2 of 2)

Central Services – API Specification

Participants
[●] POST - Create
[●] GET - Query
[●] PUT - Update

Participants Limits
[●] POST - Set initial Position
[●] Manage Limits
  [●] POST - Set Limits
  [●] PUT - Update Limits
  [●] GET - Query Limits

Positions
[●] GET - Query by FSP

Participants Callback
[●] POST - Set Callback URIs
[●] PUT - Update Callback URIs
[●] GET - Query Callback URIs

Central Settlements – API Specification

Settlement Windows
[●] POST - Open new window, and close previous
[●] GET - Query

Settlements
[●] POST – Create/trigger new Settlement with associated Windows
[●] PUT - Receive Acknowledgments from Settlement Providers
  [●] Process successful Settlement acknowledgements
  [●] Reconcile Positions based on successful Settlements
[●] GET – Query

Key
[●] Fully implemented
[●] Legacy Code
[●] Partially implemented
[●] Not implemented
[o] Out of Scope

Mojaloop Hackathon

Technical Overview

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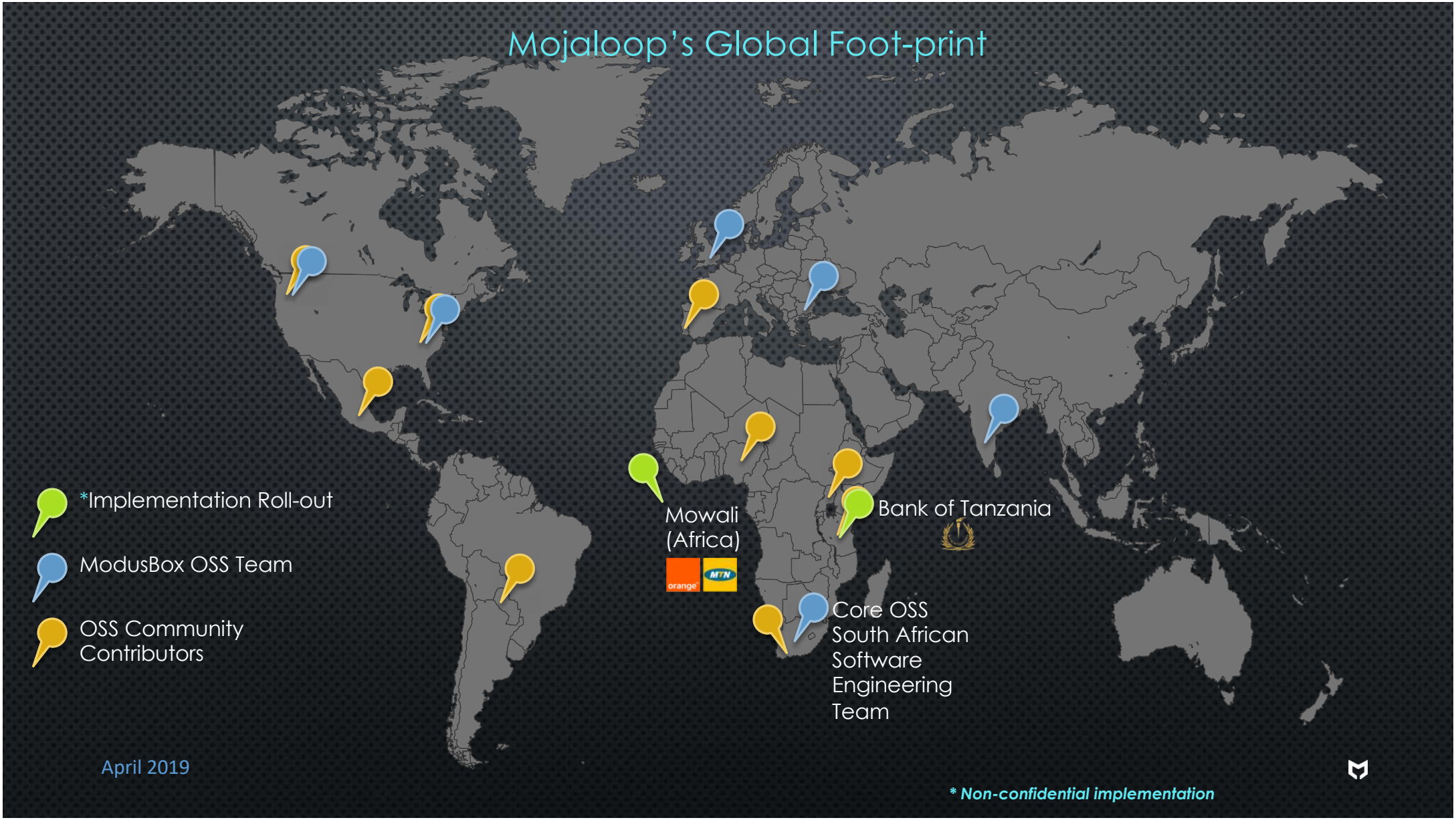
Mojaloop's Global Foot-print



mojaloop

Mojaloop Appendix

April 2019

Sequence Diagrams: Overview

1. Overview of Sequence Diagrams
2. High level Design for :
    a. Prepares, Positions, Fulfils, Rejections, Timeouts
    b. Operations: Settlements, Positions, Limits, callback URLs, etc.
3. List of Sequence Diagrams
4. Location: https://github.com/mojaloop/docs/tree/develop/CentralServices/seq_diagrams

Phase-2: Sequence Diagrams - 1

Topic	Sequence Diagram Name	Filename
Events	• 9.1.0. Event Handler Placeholder	• seq-event-9.1.0.svg
Fulfil	• 2.1.0. DFSP2 sends a Fulfil Success Transfer request • 2.1.1. Fulfil Handler Consume (Success) • 2.2.1. Fulfil Handler Consume (Reject) • 2.2.0. DFSP2 sends a Fulfil Reject Transfer request	• seq-fulfil-2.1.0.svg • seq-fulfil-2.1.1.svg • seq-reject-2.2.1.svg • seq-reject-2.2.0.svg
Notification	• 1.1.4.a. Send notification to Participant (Payer/Payee) (single message) • 1.1.4.b. Send notification to Participant (Payer/Payee) (batch messages) • 5.1.1. Notification Handler for Rejections	• seq-prepare-1.1.4.a.svg • seq-prepare-1.1.4.b.svg • seq-notification-reject-5.1.1.svg
Participant	• 1.0.0 Get Participant Limit Details • 2.06 Design an API to manage NET DEBIT CAP #330 • 3.1.0 Add Participant Callback Details • 3.1.0 Get Participant Callback Details • 4.1.0 Get Participant Position Details	• seq-get-participant-limit-1.1.0.svg • seq-manage-participant-limit-1.1.0.svg • seq-callback-add-3.1.0.svg • seq-callback-3.1.0.svg • seq-participants-positions-query-4.1.0.svg

Phase-2: Sequence Diagrams - 2

Topic	Sequence Diagram Name	Filename
Position	• 1.0.0 Create initial position and limits for participant • 1.1.2.a. Position Handler Consume (single message) • 1.1.2.b. Position Handler Consume (batch messages) • 1.3.0 Position Handler Consume (single message) • 1.3.1 Prepare Position Handler Consume • 1.3.2 Fulfil Position Handler Consume • 1.3.3 Abort Position Handler Consume • 2.2.2. Position Handler Consume (Reject) • 4.2.0 Get Positions of all Participants • uc Position Handler	• seq-participant-limits-1.0.0.svg • seq-prepare-1.1.2.a.svg • seq-prepare-1.1.2.b.svg • seq-position-1.3.0.svg • seq-position-1.3.1-prepare.svg • seq-position-1.3.2-fulfil.svg • seq-position-1.3.3-abort.svg • seq-reject-2.2.2.svg • seq-participants-positions-query-all-4.2.0.svg • use-case-position-handler.svg
Prepare	• 1.1.0. DFSP1 sends a Prepare Transfer request to DFSP2 • 1.1.1.a. Prepare Handler Consume (single message) • 1.1.1.b. Prepare Handler Consume (batch messages)	• seq-prepare-1.1.0.svg • seq-prepare-1.1.1.a.svg • seq-prepare-1.1.1.b.svg

Phase-2: Sequence Diagrams - 3

Topic	Sequence Diagram Name	Filename
Transfer	• 1.1.3.a. Transfer Handler Consume (single message) • 1.1.3.b. Transfer Handler Consume (batch messages) • 2.1.3. Transfer Handler Consume (Success) • 2.2.3. Transfer Handler Consume (Reject) • 2.3.0. Transfer Timeout • 2.3.1. Timeout Handler Consume • 2.3.3. Transfer Handler Consume (Timeout)	• seq-prepare-1.1.3.a.svg • seq-prepare-1.1.3.b.svg • seq-fulfil-2.1.3.svg • seq-reject-2.2.3.svg • seq-timeout-2.3.0.svg • seq-timeout-2.3.1.svg • seq-timeout-2.3.3.svg
Settlement	• 6.1.1. Request Settlement Window By Id (getSettlementWindowById) • 6.1.2. Close Settlement Window (closeSettlementWindow) • 6.1.3. Get Settlement Windows By Parameters (getSettlementWindowsByParams) • 6.2.1. Trigger Settlement Event (createSettlement) • 6.2.2. Query Settlements by Parameters • 6.2.3. Get Settlement By Settlement, Participant and Account (getSettlementBySettlementParticipantAccount) • 6.2.4. Get Settlement By Id (getSettlementById) • 6.2.5. Acknowledgement of Settlement Transfer (updateSettlementById)	• seq-setwindow-6.1.1.svg • seq-setwindow-6.1.2.svg • seq-setwindow-6.1.3.svg • seq-settlement-6.2.1.svg • seq-settlement-6.2.2.svg • seq-settlement-6.2.3.svg • seq-settlement-6.2.4.svg • seq-settlement-6.2.5.svg

API First Approach

Key
[●] Implemented using API First Approach
[●] Not implemented – To be re-factored in future

Background

Legacy Mojaloop API components were implemented using a Code First approach (even if a contract existed).

What is API First Approach?

An Interface Contract is defined up-front, which is then used to generate Base-code which includes validations, routes, documentation, etc.

Benefits?

- Faster implementation time as Base-code is auto-magically created for developers, only requiring logic to be implemented.
- QA Improvement
  - Validations are done auto-magically adhering to contract
  - Routes adhere to contract
  - Documentation adheres to contract

Mojaloop & Operational APIs

[●] Mojaloop-API-Adapter
[●] Central-Ledger
[●] Central-Settlements

Example:
https://github.com/mojaloop/central-settlement

Tools used

Hapi-openapi

- API schema validation.
- Routes based on the OpenAPI document.
- API documentation route.
- Input validation.
- Ref: https://github.com/krakenjs/hapi-openapi

Database Design

Database Design Objectives

1. Align the data model to support to the Mojaloop specification
2. Design for efficiency and reduce locking
3. Data integrity maintained through a idempotency pattern

How was this achieved?

1. Redesign scheme to reflect the Mojaloop API and support the state transitions.
2. Inserts are used instead of updates to ensure reduced locking, and increased speed of data "updates"
3. Inserts are used to ensure an idempotent pattern for data "updates" is maintained. The result being that all "updates" have a history.
4. Support for batch processing of DFSP position, maintain repeatable and deterministic outcomes of rule processing and "running balance" for positions.