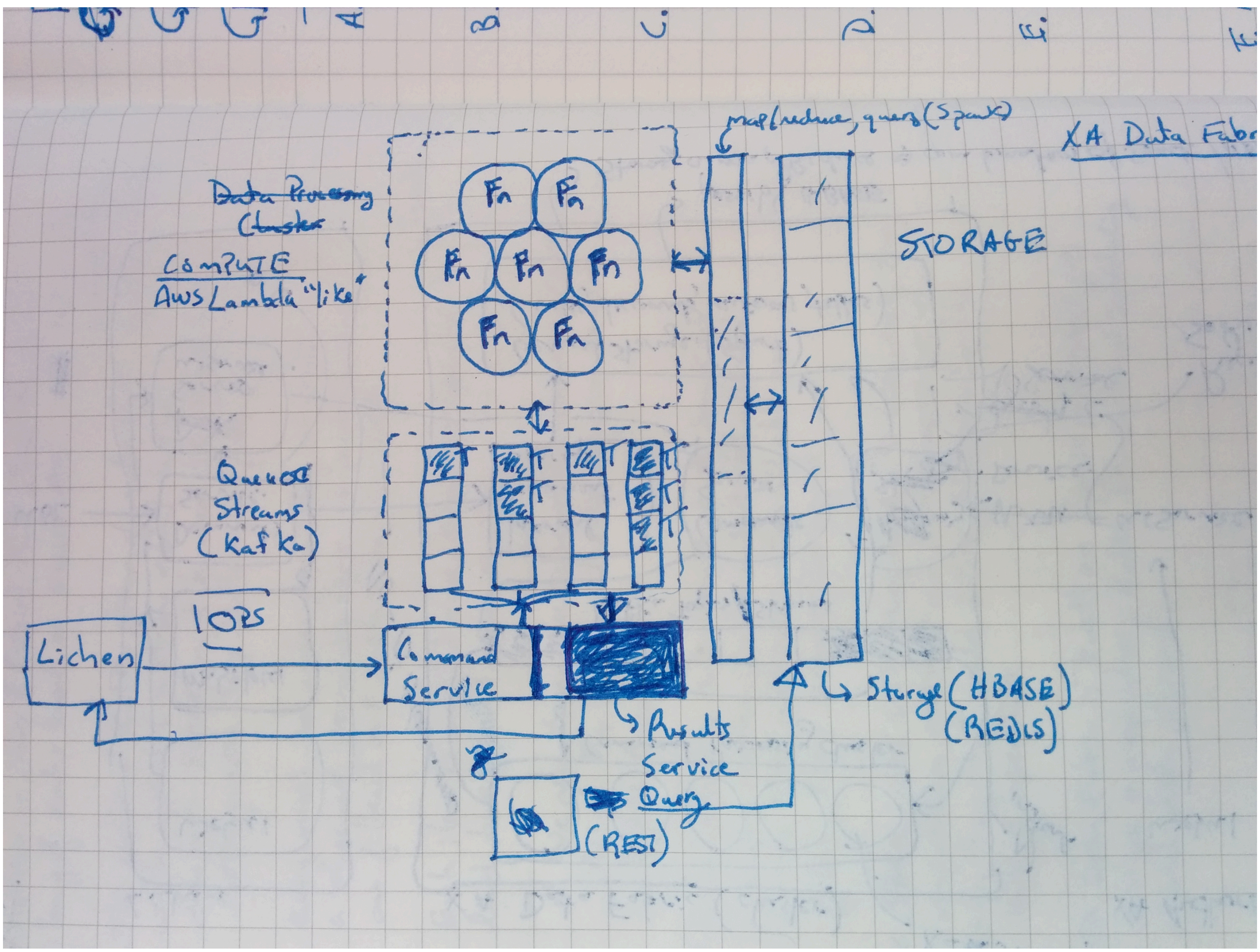
Summary

This document describes the fundamental architecture of the **XA Data Fabic** platform (XAF). It is the fundamental data processing system for XA, Lichen and related applications. It is a container-based, cloud-native system built on Apache Kafka and Spark. The computational model of the system is derived from message-based designs and CQRS, with inspiration from AWS Lambdas.

Architecture

The architecture is arrayed in three layers: Storage, Compute and Operations.



Storage

The foundation of the architecture is built from Apache Spark on top of Apache HBASE. This yields a solid, distributed storage system accessed via a distributed map/reduce system. All XA data (rules, tables, documents etc) are retained in this layer. Services and Functions (detailed later) will access data from the HBASE cluster via the map/reduce component (Spark). Direct access to *some data* that is *operational* in nature may be provided by direct access to the storage (rather than map/reduce) if map/reduce proves to be too cumbersome for potentially simple data access (for example, retrieving a list of rules for display in a UI).

By design, the Storage Layer will be deployed and managed *independantly* of the other Layers in the architecture. This will allow the critical core functionality provided by the Compute Layer to operate at arms length of this Layer. With this separation in place, the core functionality can be improved incrementally and deployed against different Storage Layers that do not retain sensitive financial information from day-to-day operations. This will facilitate testing and improve development to deployment turn-around time.

Compute

This layer is built on two primitive concepts: Tasks and Functions.

Functions are arrayed in a cluster of containers (Docker) that provide **very simple* micro-services that are inspired by AWS Lambdas. Functions represent single operations from the Rule Expressions (Xalgo 2.0) or inbound handlers of Tasks. They are designed to be purely functional (the same inputs yield the same outputs in subsequent invocations). Since they are implemented as contained micro-services, Functions can be started and stopped automatically by the clustering system to meet the demands of scale. Functions receive their input and place their output on Task queues.

Tasks represent solitary compute requests for the Function cluster (discover rules for a document, lookup data from a table, etc). They are scheduled using topics and streams provided by Apache Kafka. The Operations layer has access to Tasks in order to enqueue requests for computation and to listen for results of those requests.

Operations

This layer provides the public API access to the Task layer in order to schedule computations, to receive results and to query for information from the system.

All requests for the system enter via the Command Service as Commands. These Commands are *pseudo-transactional* in that **no** results appear until all internal elements of the Command are satisfied. Examples of Commands: submitting a document for processing, adding or updating a Rule, etc.

External applications may register to receive events related to processing or results via the Events Service via a Web Socket.

Any external application that needs information about the system may perform a synchronous Query via the Query Service. This might include meta-data like lists of rules or the results of a computation. This service will also allow for the registration of Stored Queries that will yield matching data via the Events Service when new data arrives in the Storage Layer.

Deployment

This section is still a work in progress. All aspects have been considered, but some further investigation of Apache Mesos is required to solidify the technology that will support it.

Currently, it is expected that the Fabric will be deployed using Docker containers managed with Docker Compose / Kubernetes using Rancher 2.0 as the management system. It will be deployed in three independant *compositions* representing the three layers described earlier in this document. This compositions will run on independant cloud infrastructures in order to correctly manage the different scaling requirements of each (Compute is on-demand, but Storage and Operations are generally scaled on initial deployment).

Example Lichen Usage

This section describes how the classic Lichen rule processing request would be handled by the Fabric.

1. A document (this is an *internal* processable document derived from the UBL document that Lichen received) would be delivered to the Fabric via the Commands Service. This would enqueue a Task in the Compute layer.

2. A Function would be instantiated (or reused if already live and idle) to process the Task from (1). Using Spark map/reduce, an ordered stream of relevant Rules would be generated and combined with the document to create a new stream of Tasks.

3. Functions would be triggered from the Task stream generated in (2), each would process a single Rule application across the associated document. This would generate a stream of rules and items from the document that would produce a new stream of Tasks.

4. As in (3), Functions would be triggered to handle each rule and item combination. This effectively applies the Rule to an atomic item in the document. Out of this application, a stream of result Tasks would be created.

5. A Function would be triggered from the item result stream to reassemble the document based on the

results from (4). Spark map/reduce would be used to perform this reassembly, storing the resulting revision in the permanent storge. Ultimately, a results Task would be queued.

6. The Events Service would signal the listening Lichen application based on the results Task using the Web Socket connection.