Beyond the operators: The full Strimzi ecosystem for Kafka on Kubernetes

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- Open source software engineer
- Strimzi contributor

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Apache Kafka & Strimzi

The full Strimzi ecosystem

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A day in life of a Strimzi Kafka cluster on Kubernetes

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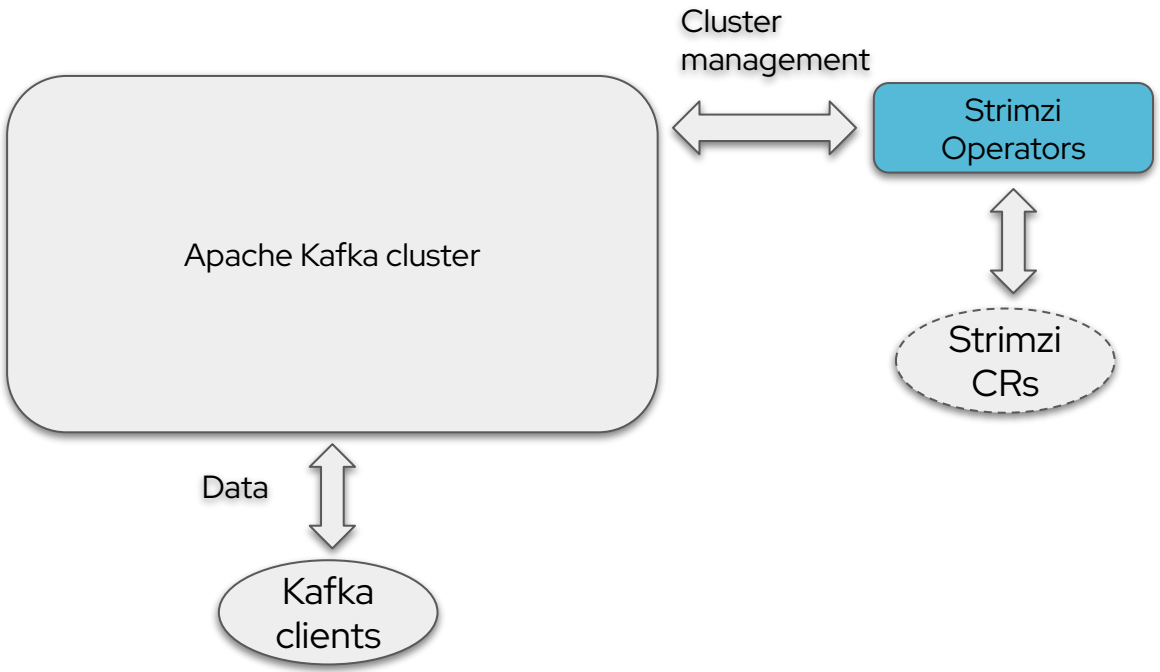
Operator, cluster and clients



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Getting Connected

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Getting Connected

- Problem:
  - Simplify native Kafka clients configuration to connect to the cluster
  - Developers want to use Kafka, but not all applications can speak Kafka's native protocol.
    - There are some mobile apps want REST/HTTP, and some MQTT based IoT devices
- Solution:
  - Access operator: smooth app binding, connection details as one Secret
  - HTTP bridge, to get a RESTful Kafka access via HTTP protocol
  - MQTT bridge, to get IoT devices can publish to Kafka via MQTT protocol

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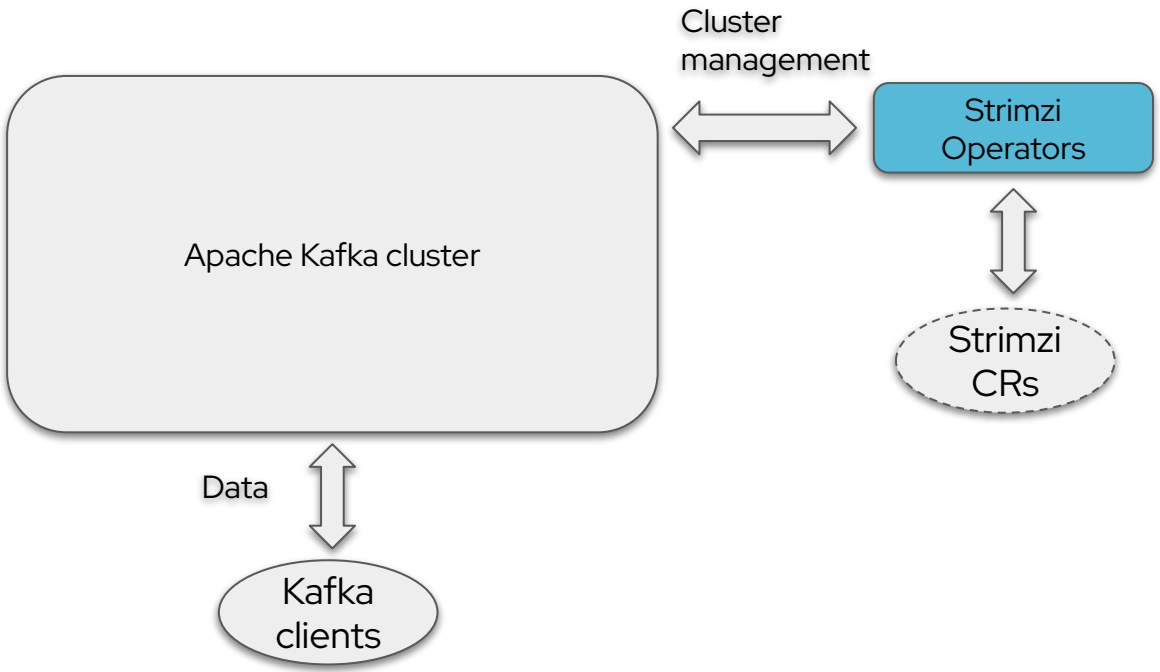
Cluster
management
Strimzi
Operators
Apache Kafka cluster
Strimzi
CRs
Data
Kafka
clients

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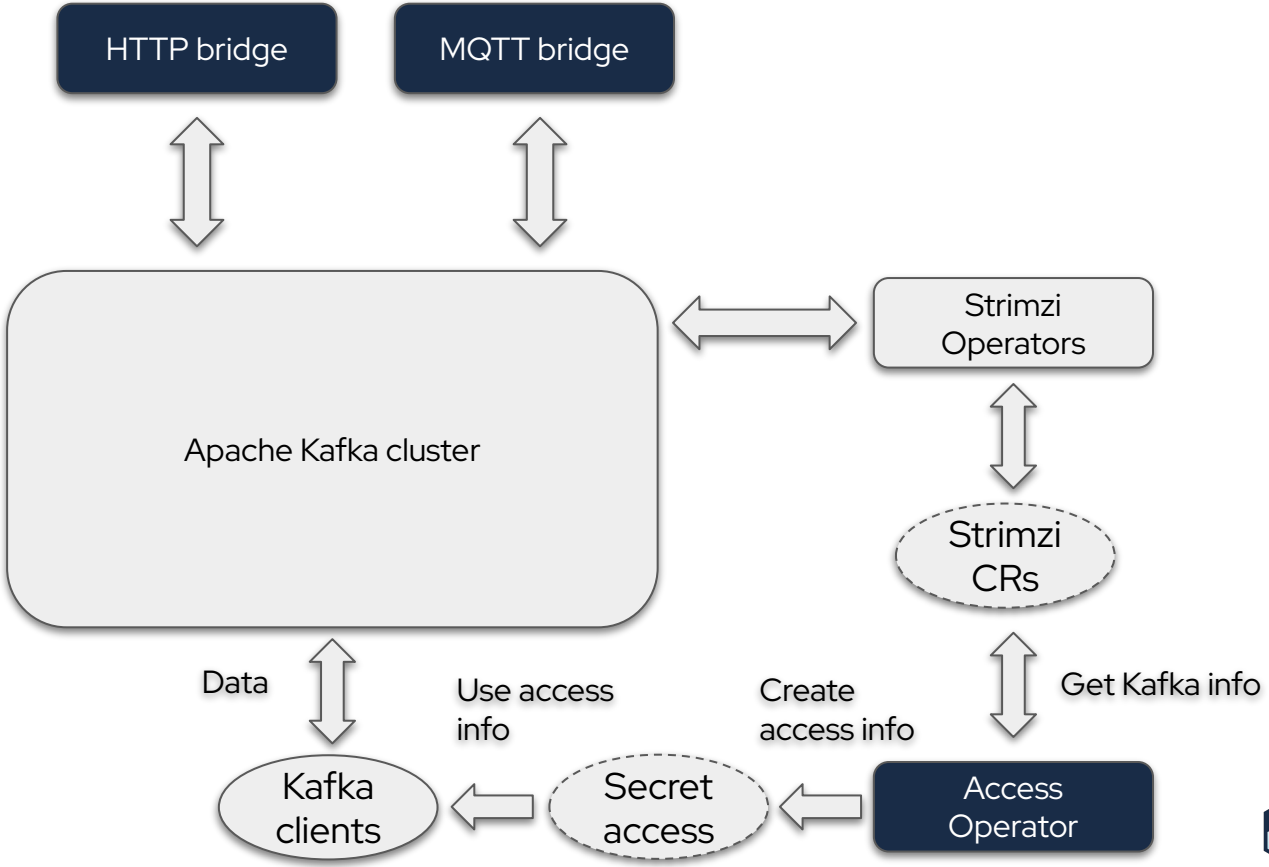
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Use access info
Create access info
Get Kafka info
Kafka clients
Secret access
Access Operator

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Access operator

- Simplifies sharing of Kafka cluster connection information
- Connection information is added/edited/deleted using a `KafkaAccess` resource specifying
  - Kafka cluster - name, namespace, listener (optional)
  - User (optional)
- Output is a secret containing the access data for applications to use
  - Contains cluster connection details and optional user credentials

HTTP bridge

- Provides a REST API interface to access an Apache Kafka cluster via HTTP
  - Endpoints for producing & consuming messages
  - Endpoint for administrative operations
- Support for
  - OpenTelemetry tracing, wiring together HTTP request/response with Kafka send/receive
  - Metrics exported in Prometheus format

MQTT bridge

- Exposes an MQTT 3.1.1 interface to access an Apache Kafka cluster
  - Supports producing messages to Kafka topics via MQTT
- Flexible topic mapping
  - Using mapping rules from an MQTT topic pattern (via regex) to a Kafka topic template
  - Possibility to use regex grouping to extract variables for template

```
{
   "mqttTopic": "building/(\\w+)/room/(\\d{1,4})/.*",
   "kafkaTopic": "building_$1",
   "kafkaKey": "room_$2"
}
```


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Securing & Governing Access

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Securing & Governing Access

- Problem:
  - Security and platform teams want to know who is accessing Kafka and how to authenticate them by using a token-based system
  - How to avoid issues as noisy neighbors
- Solution:
  - OAuth library, to provide token-based authentication
  - Kafka quotas plugin, to throttle client usage, protect cluster stability

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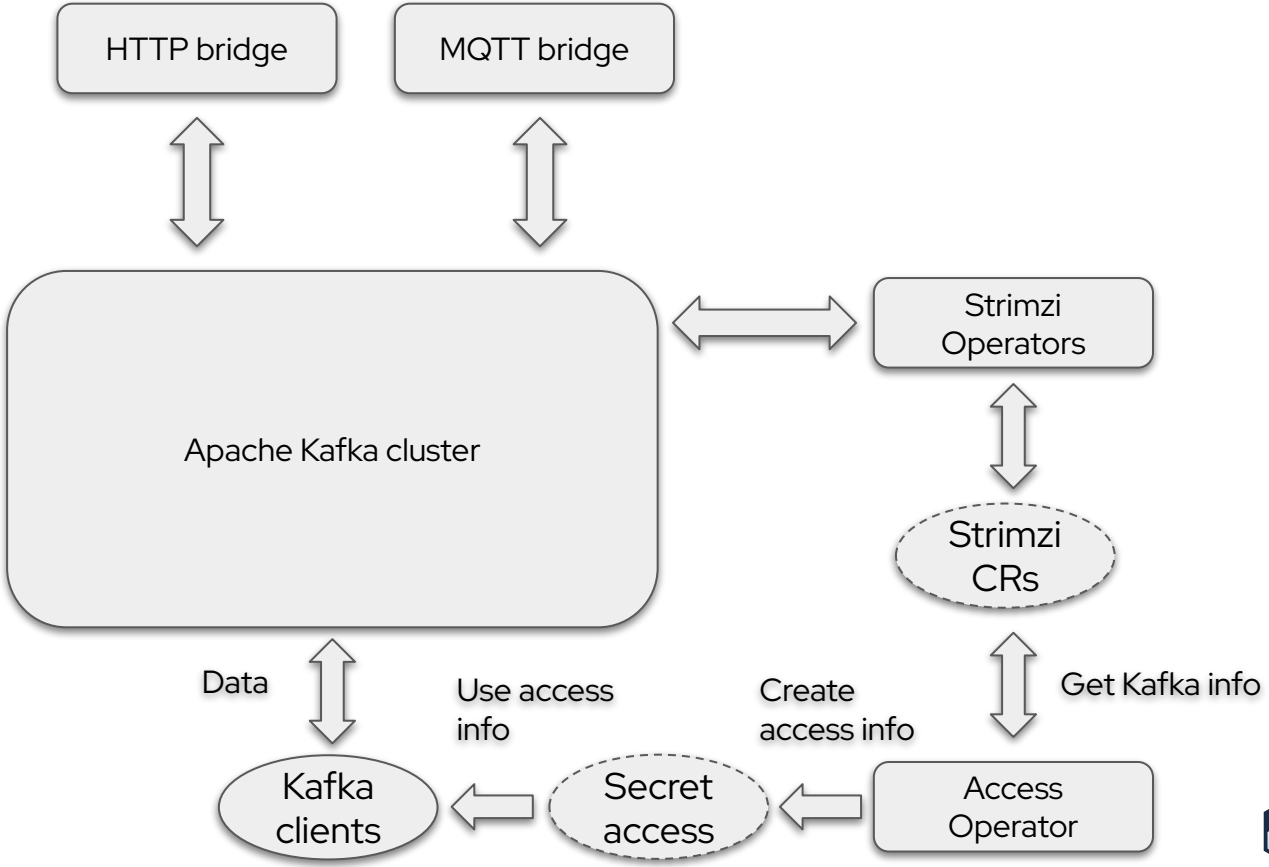
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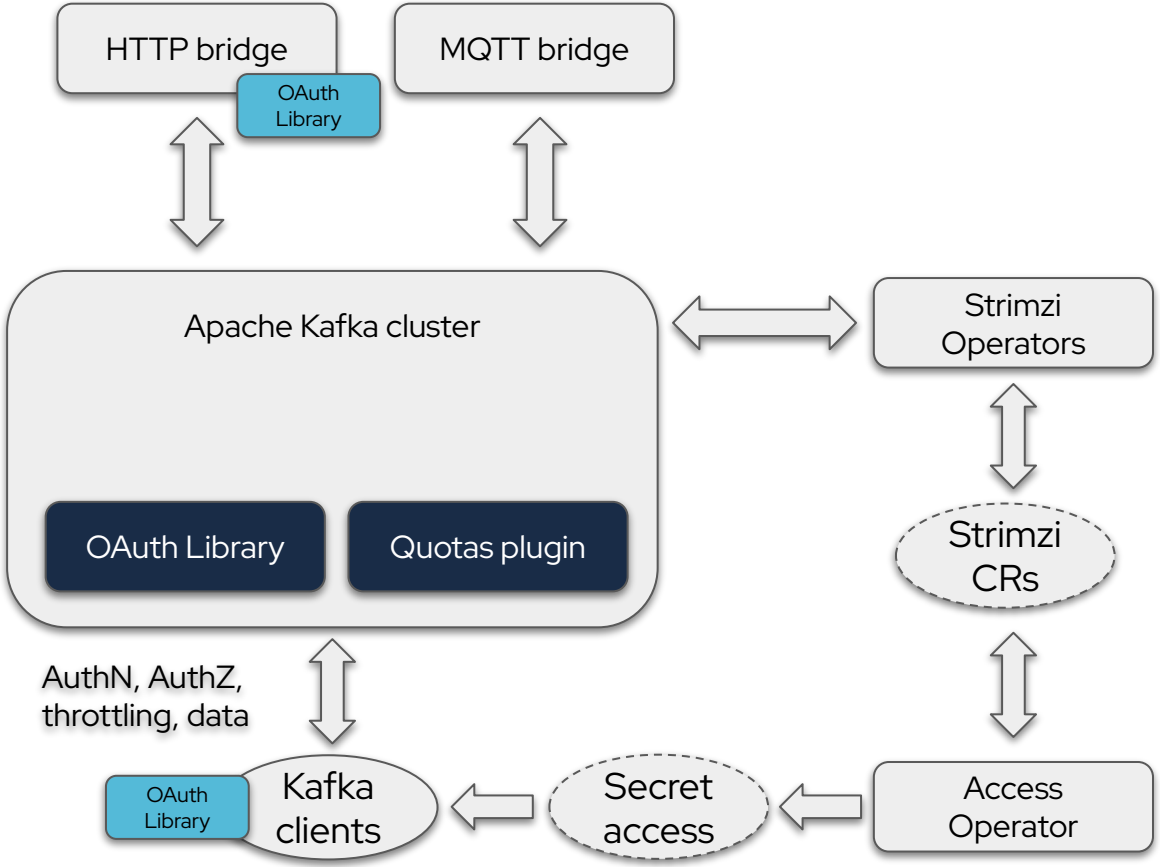
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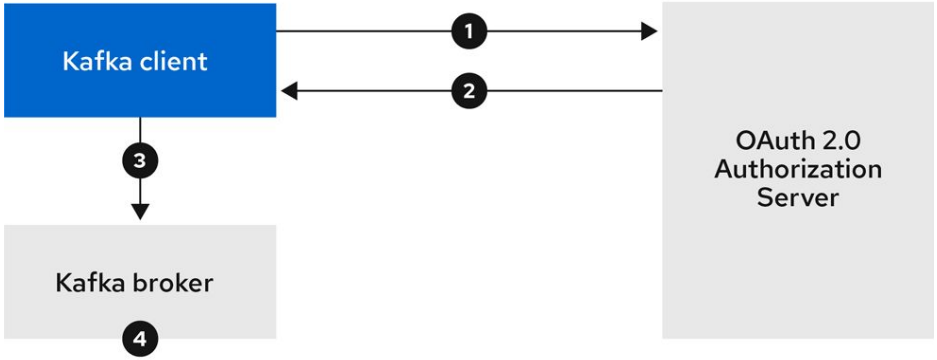
OAuth library

- OAuth2 authentication
  - Client side to get access token
  - Server side for token validation via OAuth2/OIDC endpoints (i.e. Keycloak)
- Flexible authentication options
  - Supports SASL/OAUTHBEARER and OAuth-over-PLAIN mechanisms
  - Multiple token validation strategies (JWKS, introspection endpoints)
- Token-Based Authorization using Keycloak (Authorization Services)

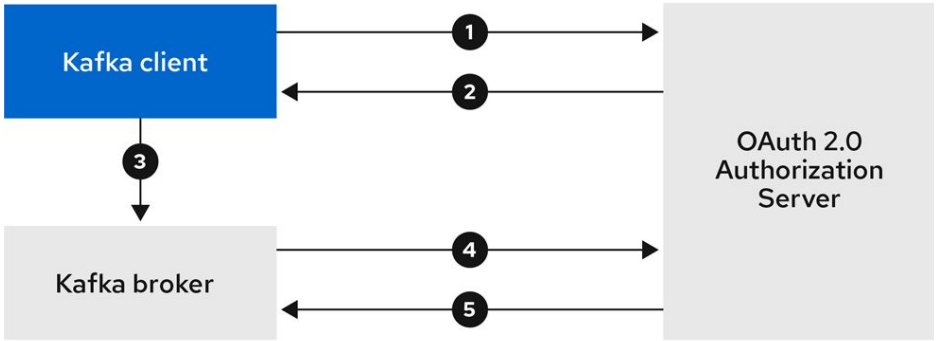
SASL/OAUTHBEARER

Fast local JWT token validation



Kafka 3.x & Strimzi OAuth

Delegate JWT and opaque token validation



Strimzi OAuth

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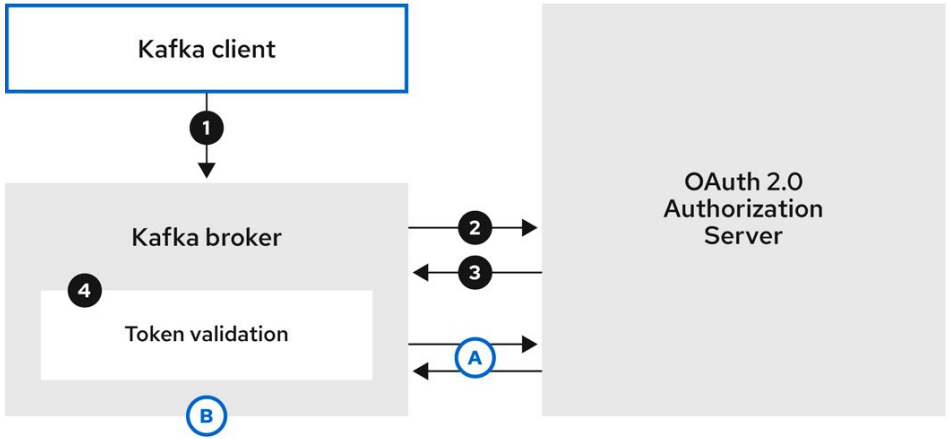
OAuth over PLAIN

Strimzi OAuth



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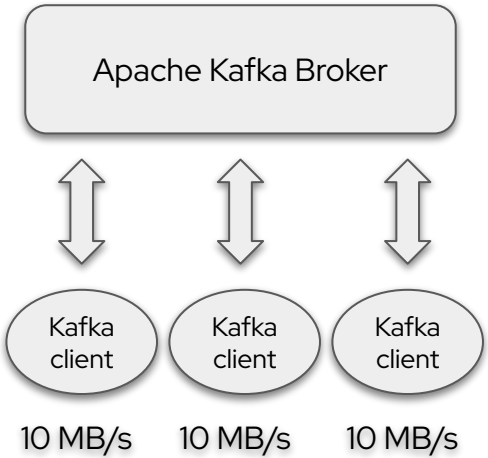
Kafka Quotas plugin

- Dynamic Cluster-Wide Quotas
  - Manages total bandwidth quotas per broker and independently of clients count
  - The quota distribution across clients is not static and automatically distributed
- Built-in Monitoring & Observability
  - Provides detailed metrics on quota levels, throttle factors, and cluster-wide volume/storage usage for operational visibility



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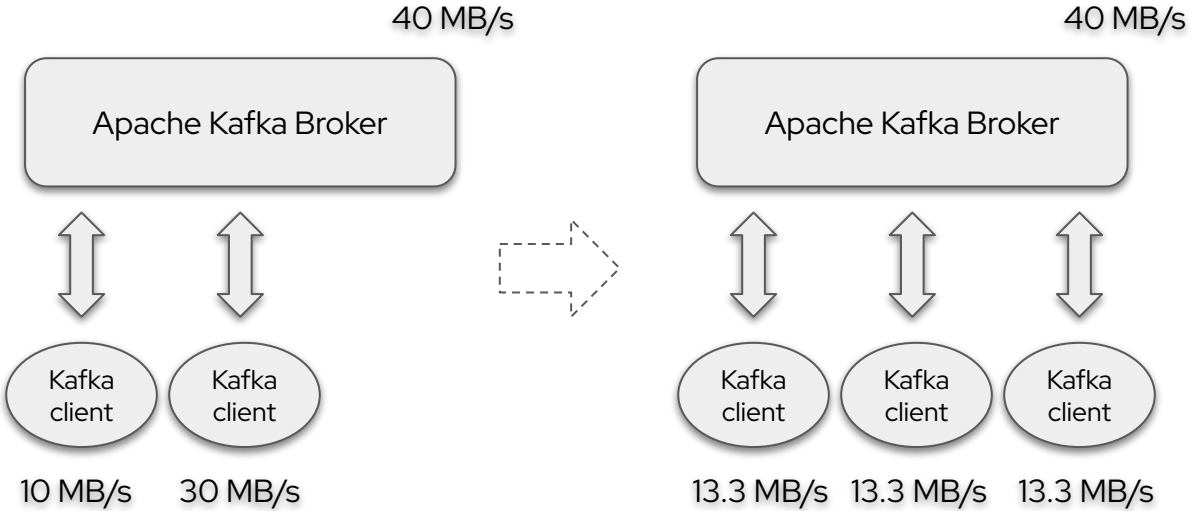

Strimzi Quotas

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Operations & Reliability

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Operations & Reliability

- Problem:
  - The ops team schedules maintenance with draining nodes, configuration changes and so on.
- Solution:
  - Drain cleaner, to safely cordon and eviction of nodes running Kafka brokers
  - Kubernetes Config Provider for advanced Kafka configuration from Secrets/ConfigMaps

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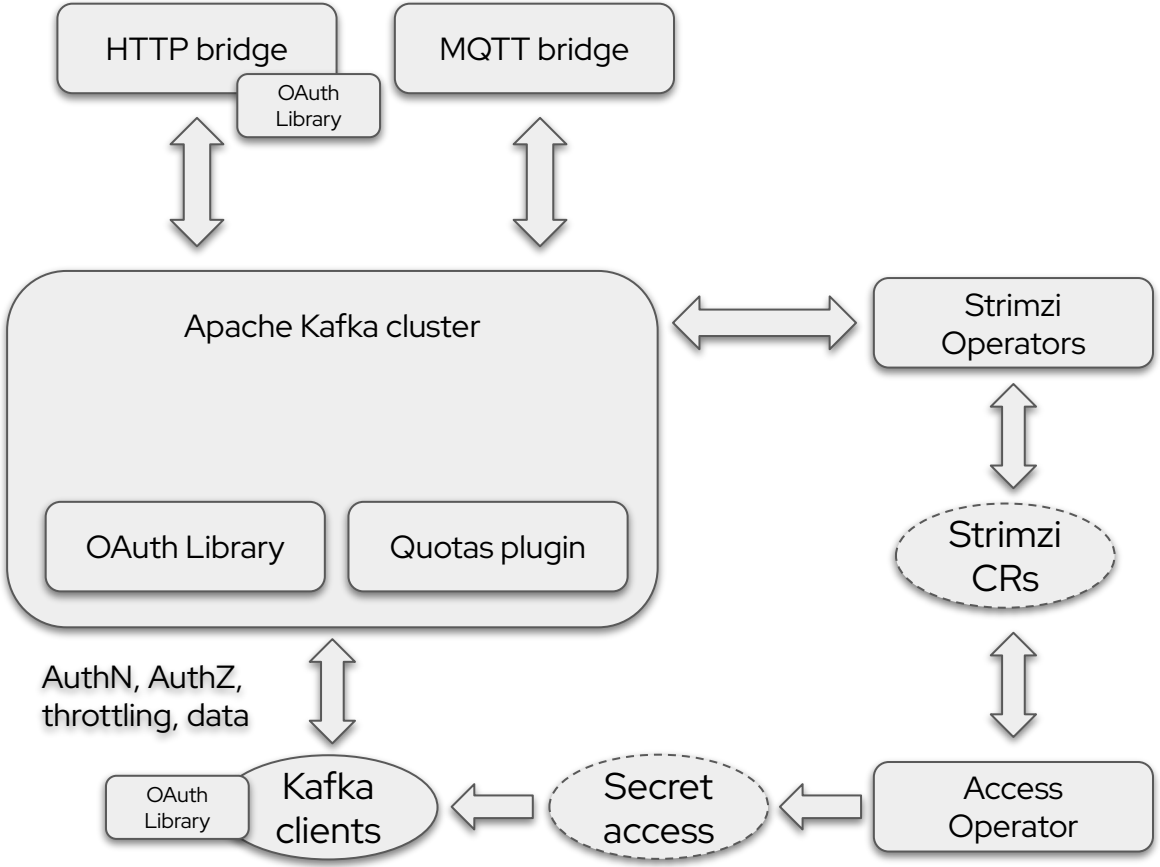
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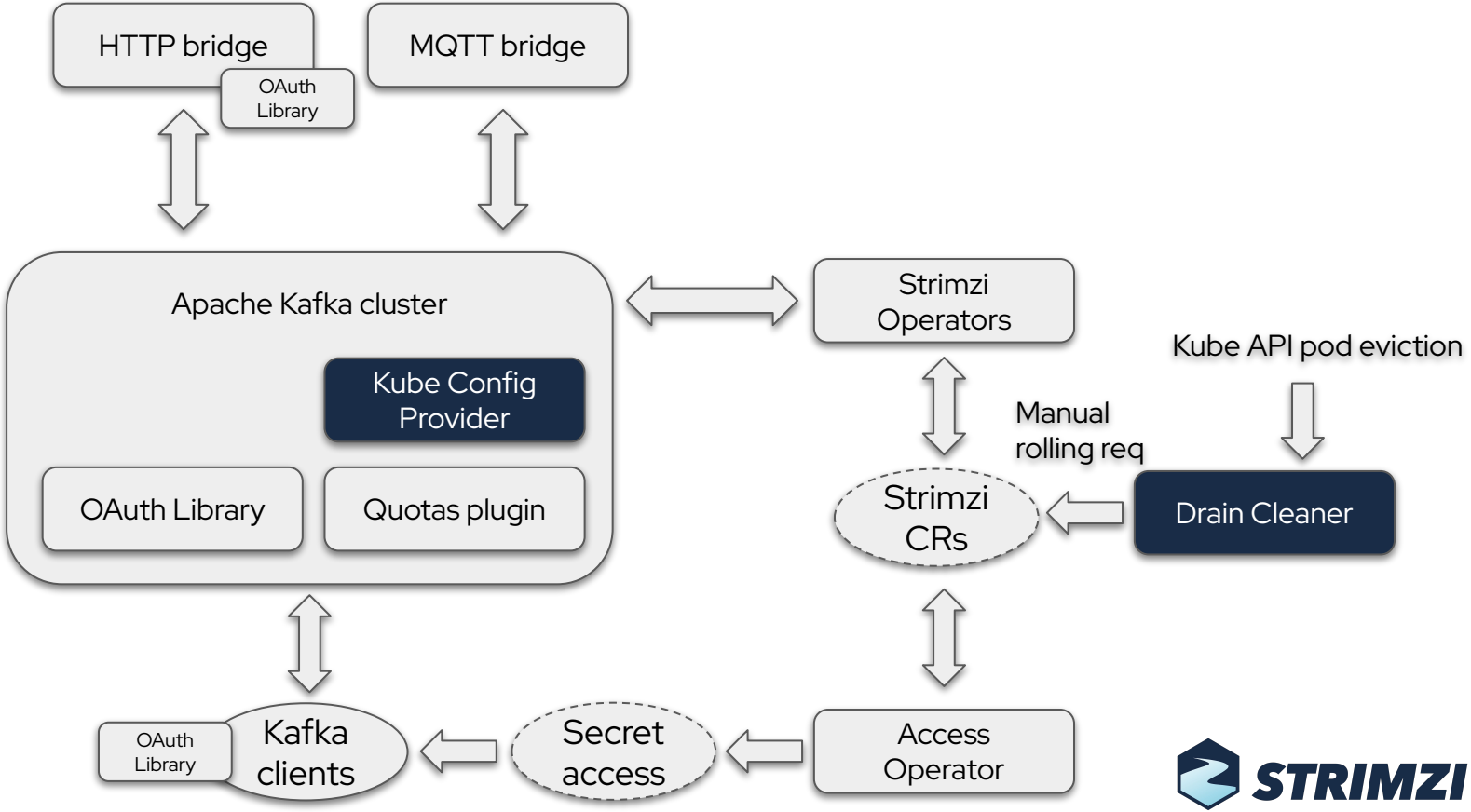
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Drain cleaner

- Safe Kubernetes Node Maintenance
  - Ensures Kafka cluster availability during node draining by preventing under-replication and managing controlled pod migration
- Intelligent Admission Control
  - Uses Kubernetes webhooks to deny automatic pod eviction, allowing Strimzi operator to orchestrate safe pod movement instead of default Kubernetes behavior

Kubernetes Config Provider

- Native Kubernetes Configuration Integration
  - Enables Kafka components to dynamically load configuration from Kubernetes Secrets and ConfigMaps without manual file management (via providers)
- Enhanced Security Management
  - Centralizes sensitive data (certificates, JAAS configs, credentials) in Kubernetes native resources with proper RBAC controls and encryption
- Dynamic Configuration Updates
  - Allows runtime configuration changes without service restarts

Observability & Testing

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Observability & Testing

- Problem:
  - The SRE team wants to know what's actually happening in the cluster
  - Strimzi developers and contributors want to test new features or bug fixes without the need for a real Kafka cluster
- Solution:
  - Strimzi metrics reporter, to export Kafka metrics in Prometheus format natively
  - Test containers, to provide programmatic model to spin up Kafka cluster in containers

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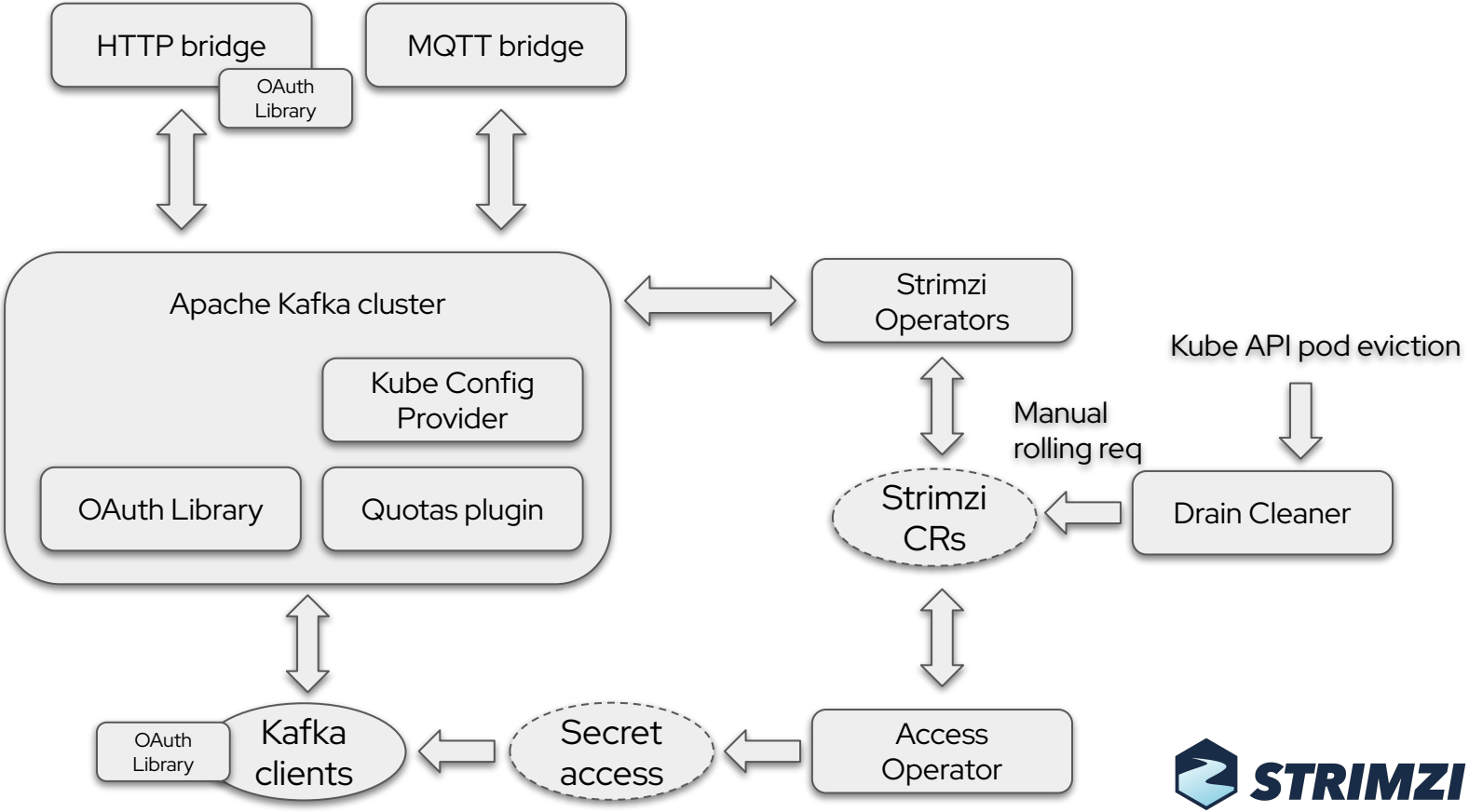
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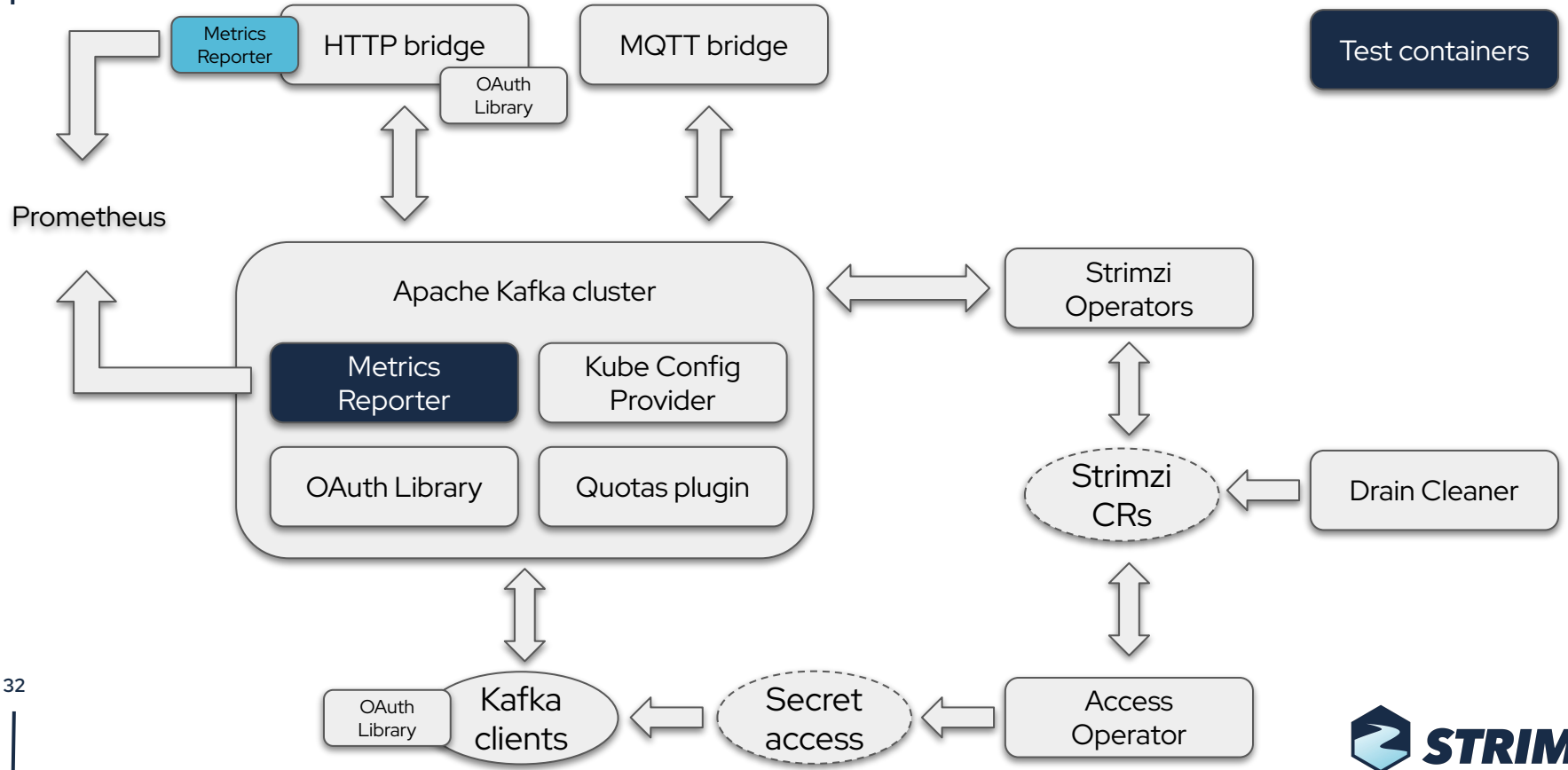
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Strimzi metrics reporter

- Prometheus-native reporter
  - Exposes metrics for all Kafka components (brokers/controllers, clients, Connect, Streams, and MirrorMaker)
  - No “translation” from JMX
- Flexible Metrics Filtering
  - Supports configurable allowlists with regex patterns for selective metric collection

Strimzi test container

- Containers-based Kafka Testing Framework
  - Provides containerized Apache Kafka instances for rapid unit and integration testing, built on the Testcontainers framework
- Flexible Cluster Configurations
  - Supports both single-node and multi-node (`StrimziKafkaCluster`) setups with KRaft mode (dedicated or mixed nodes) and configurable Kafka versions
- Kafka Connect support
  - Standing Connect clusters by using `StrimziConnectCluster`

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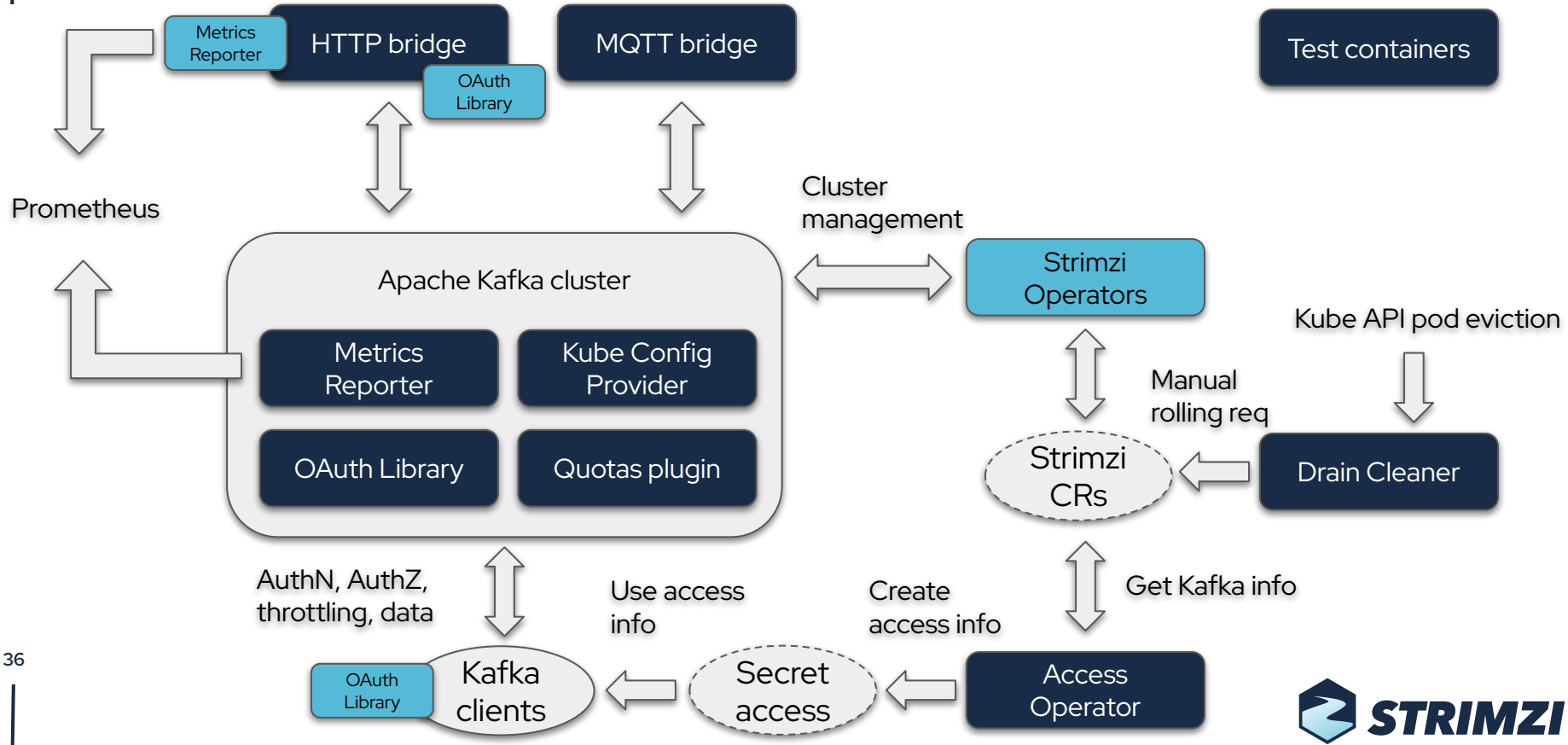

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https://strimzi.io/join-us/

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Thank you


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