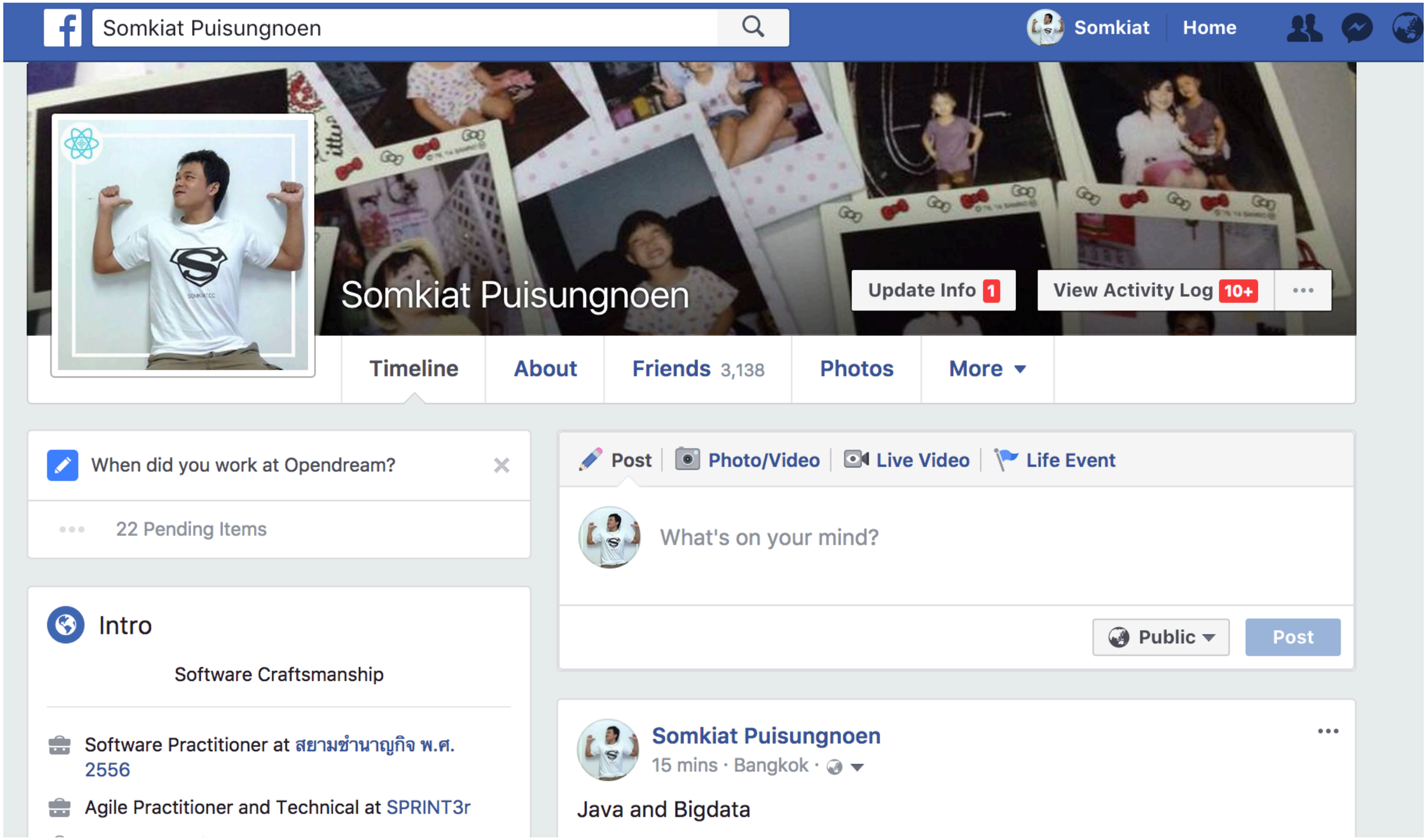
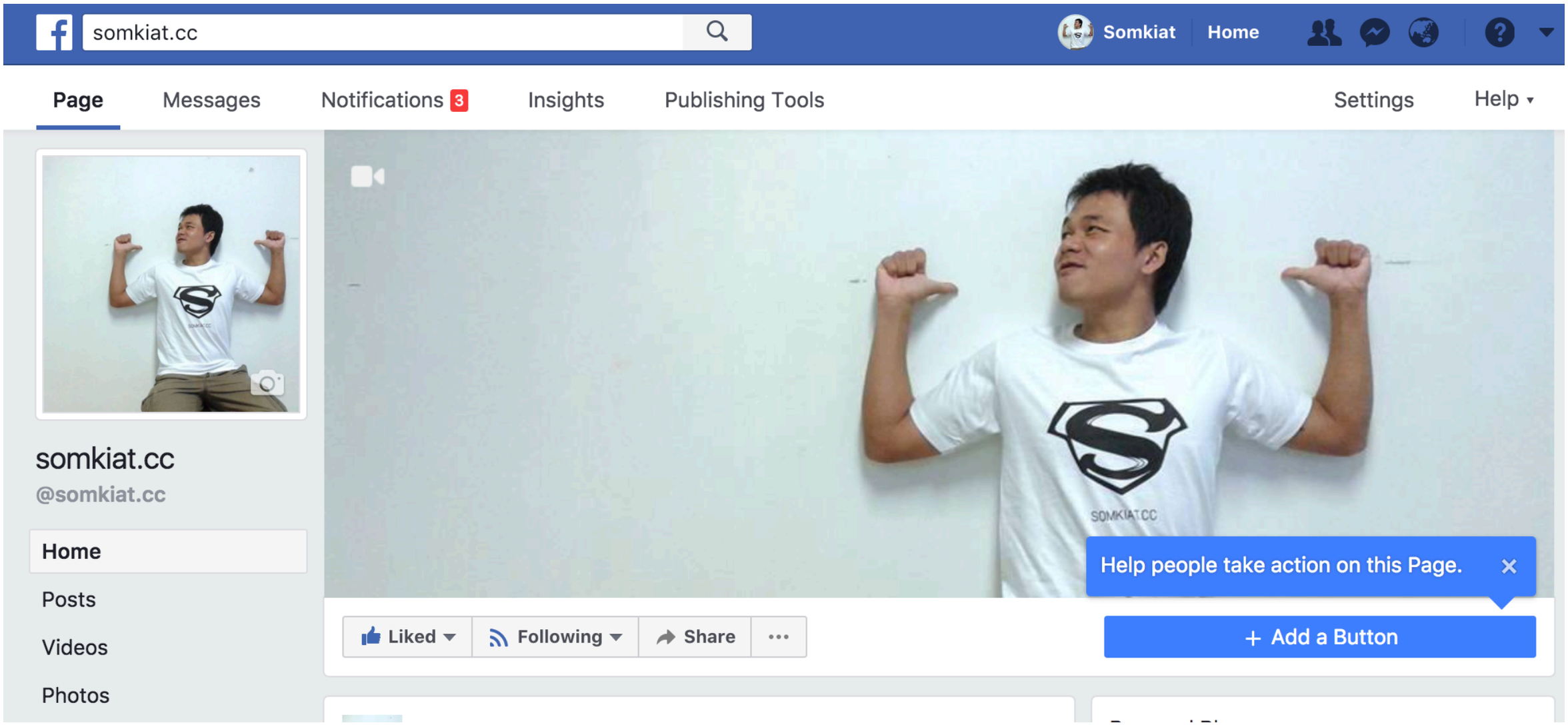
สยามชำนาญกิจ
SIAM CHAMNAN KIT

Kafka, Redis, ELK, Istio





Apache Kafka

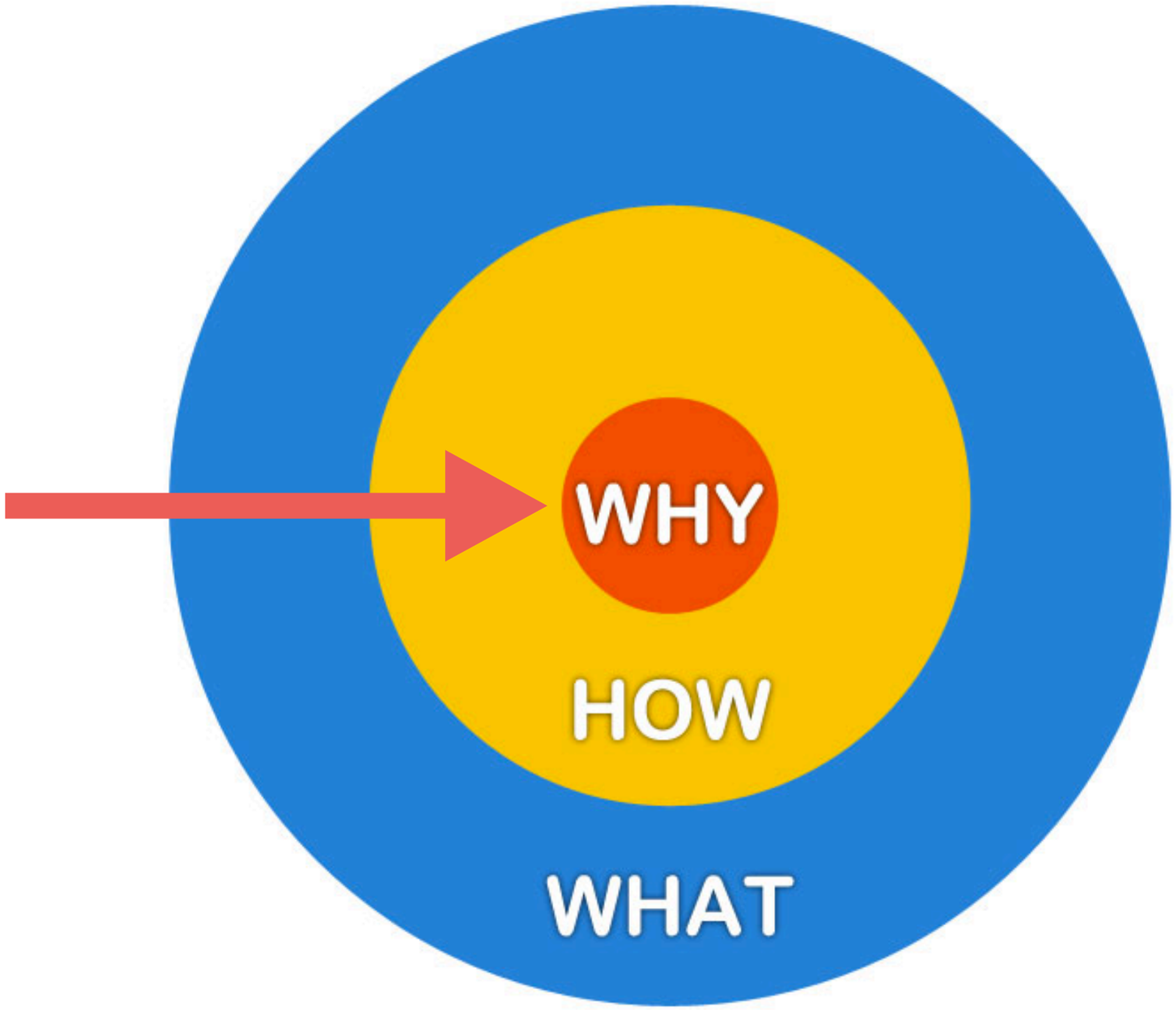
- Why Apache Kafka ?
- What is Apache Kafka ?
- Architecture
- Topologies and Tools
- Workshop

Redis

- Why Redis ?
- What is Redis ?
- NoSQL
- Architecture
- Redis command

ELK stack

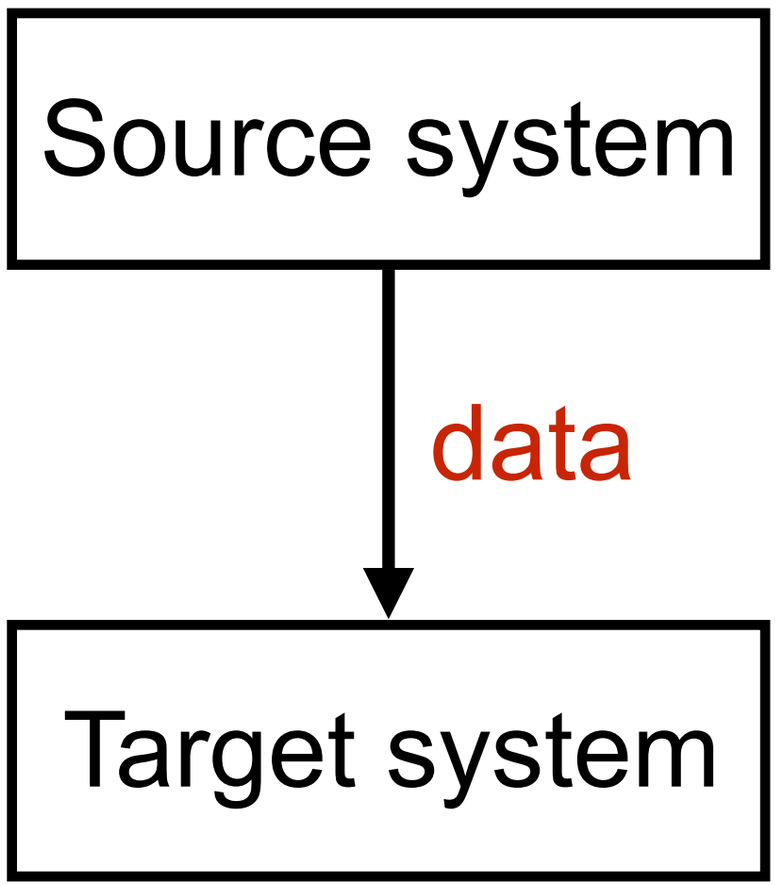
- ELK stack
- Elasticsearch as data store
- Logstash as data ingestion
- Kibana as data visualization
- How it work ?



Apache Kafka

Why

Starting with simple

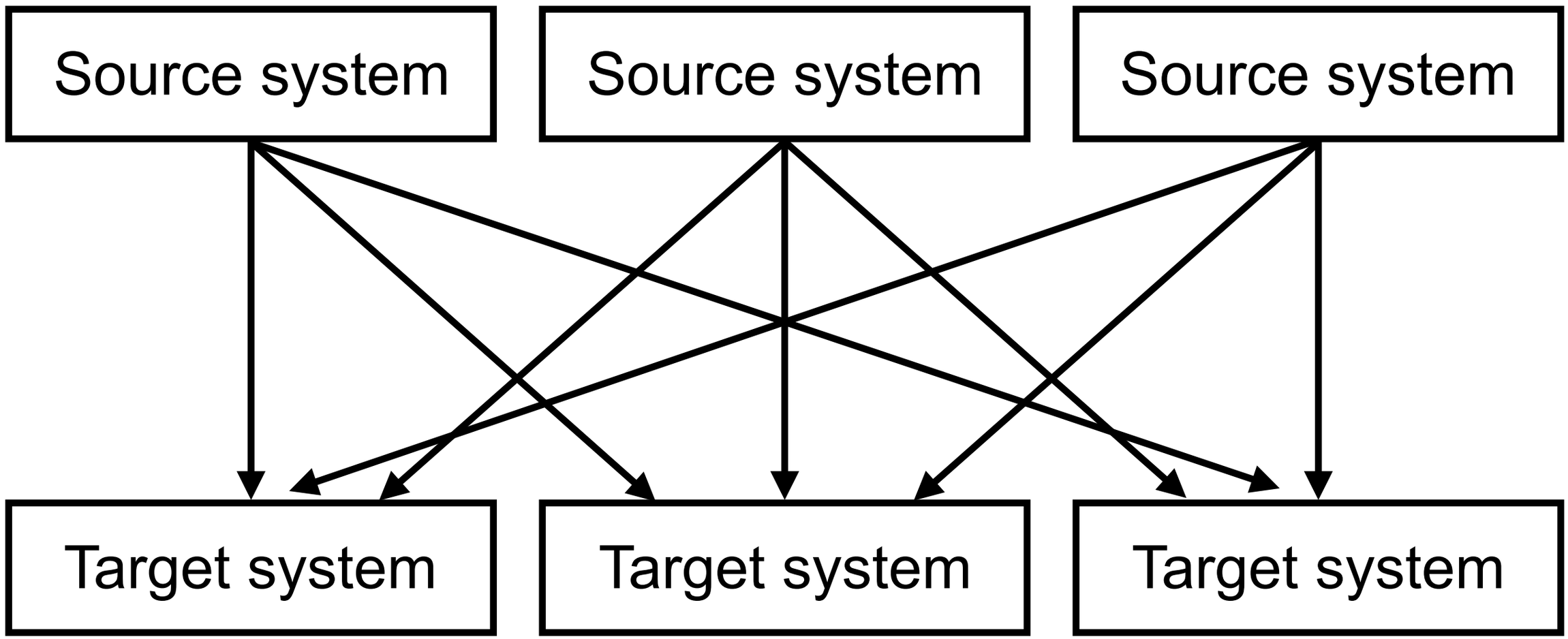


Why

More source systems
More target systems
More protocols
More data formats and schemas
More loads/traffics

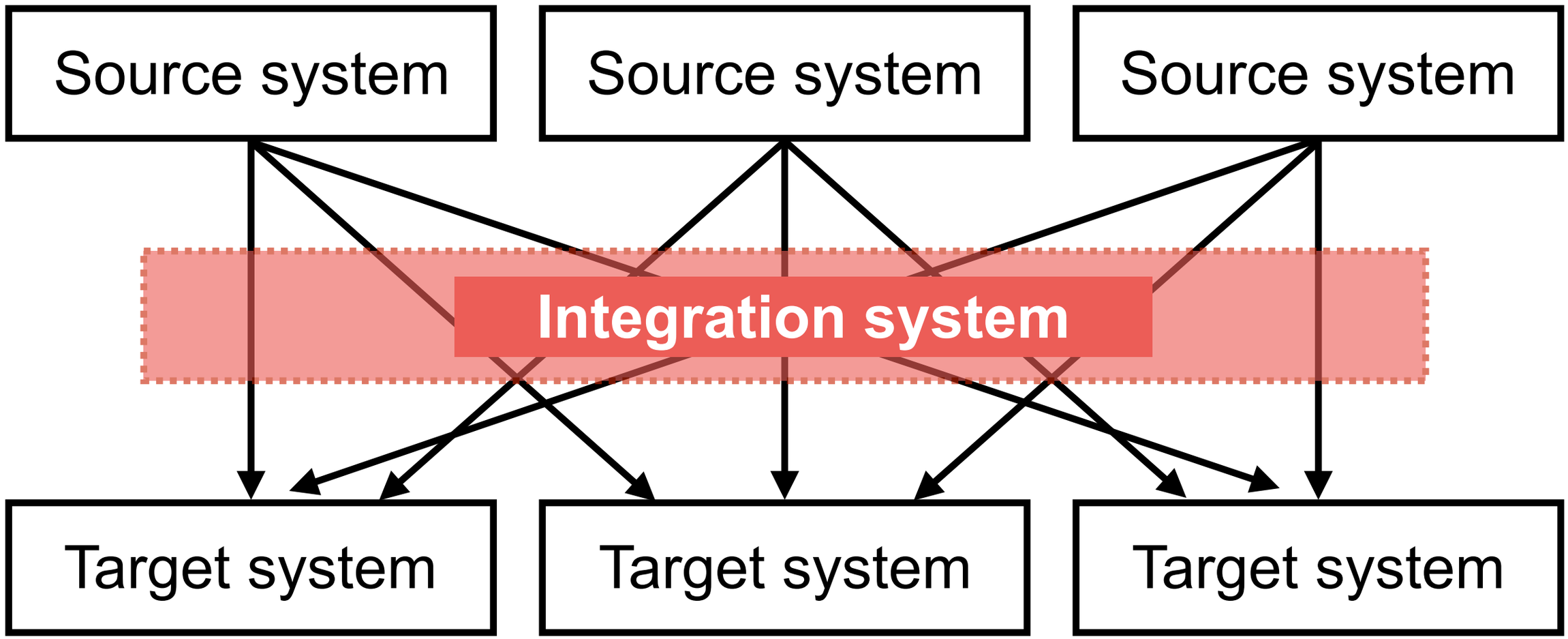
Why

Complex system !!

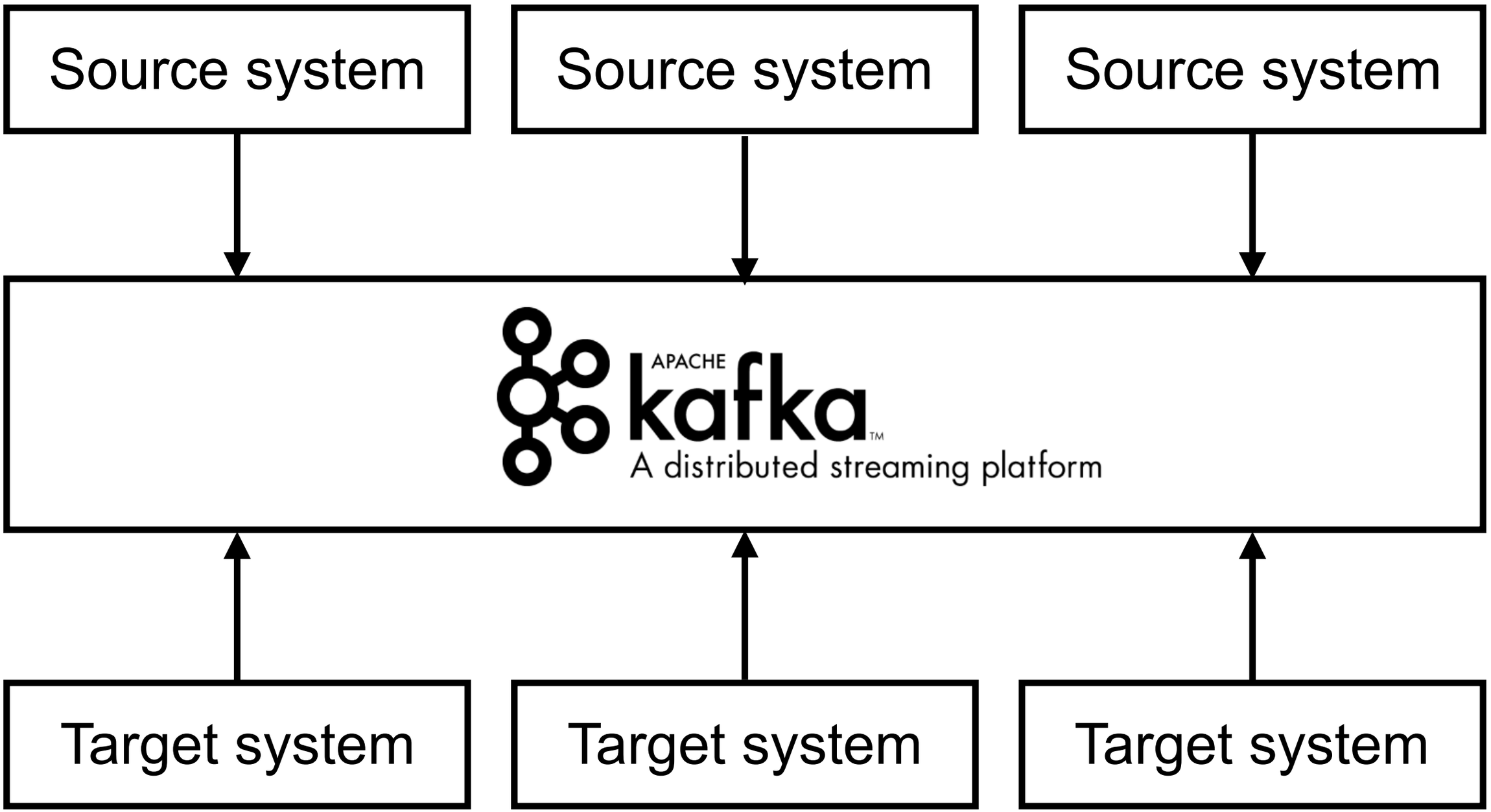


Why

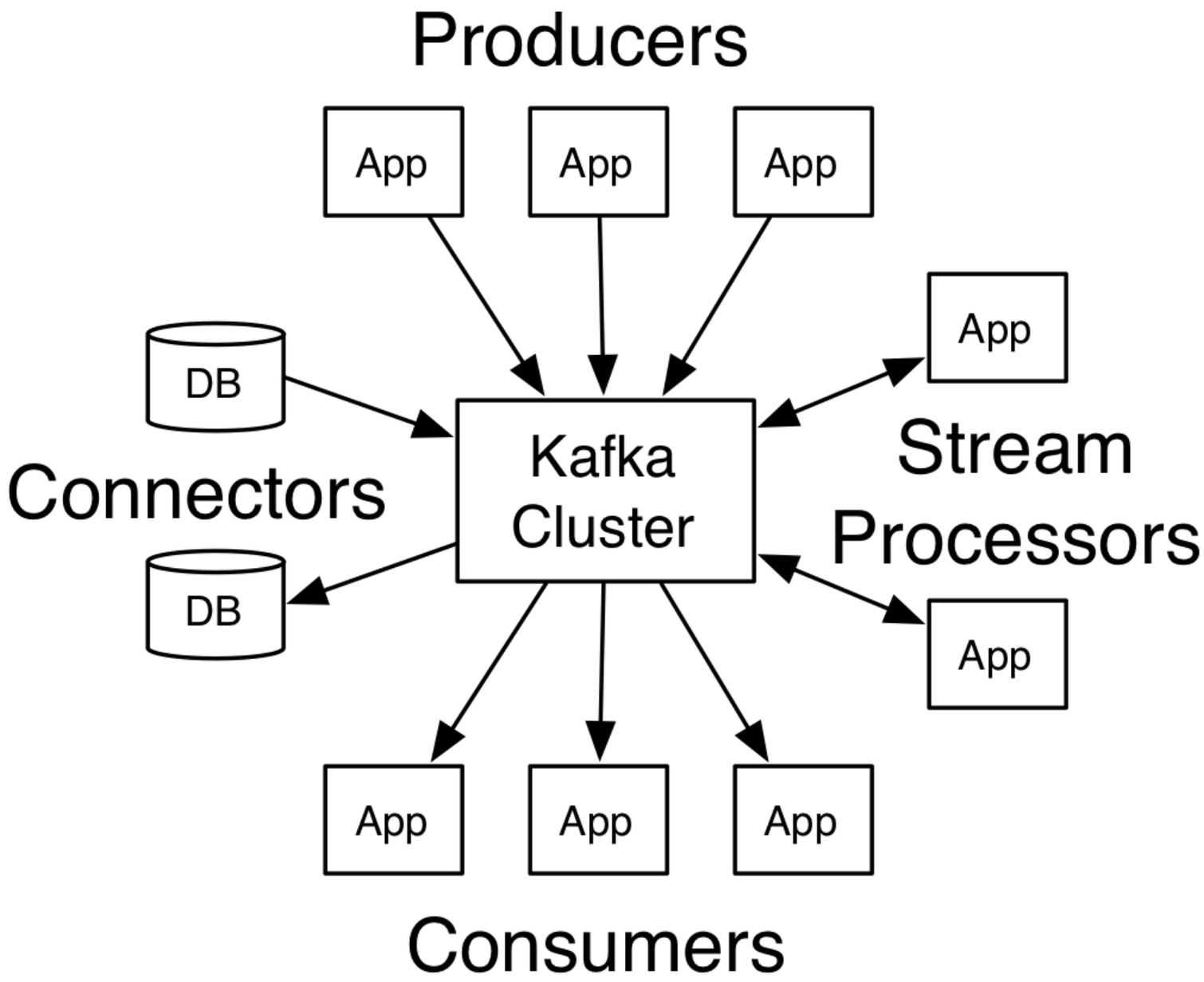
Need integration system



Apache Kafka



Apache Kafka



https://kafka.apache.org/intro.html

Why Apache Kafka ?

Created by LinkedIn
Open source project (maintain by Confluent)
Distributed system
Resilient architecture, fault tolerant
Horizontal scalability
High performance/ low latency

Used by

https://cwiki.apache.org/confluence/display/KAFKA/Powered+By

Use cases

Messaging system
Activity tracking
Gather metric from different locations
Gather application logs
Stream processing
Decoupling of system dependencies
Integration with others system/technologies

Kafka terminologies

Producers
Consumers
Topics
Partitions
Broker
Consumer groups
Cluster/Replicate
Offset

Learning paths

Part 1

- Kafka theory
- Starting Kafka
- Kafka CLI
- Kafka with Java

Part 2

- Configuration
- Producers
- Consumers
- Monitoring

Kafka theory

Topics, partitions and offsets

Topics

Stream of data

Similar to a table in database

You can have many topics as you want

A topic is identified by **name**

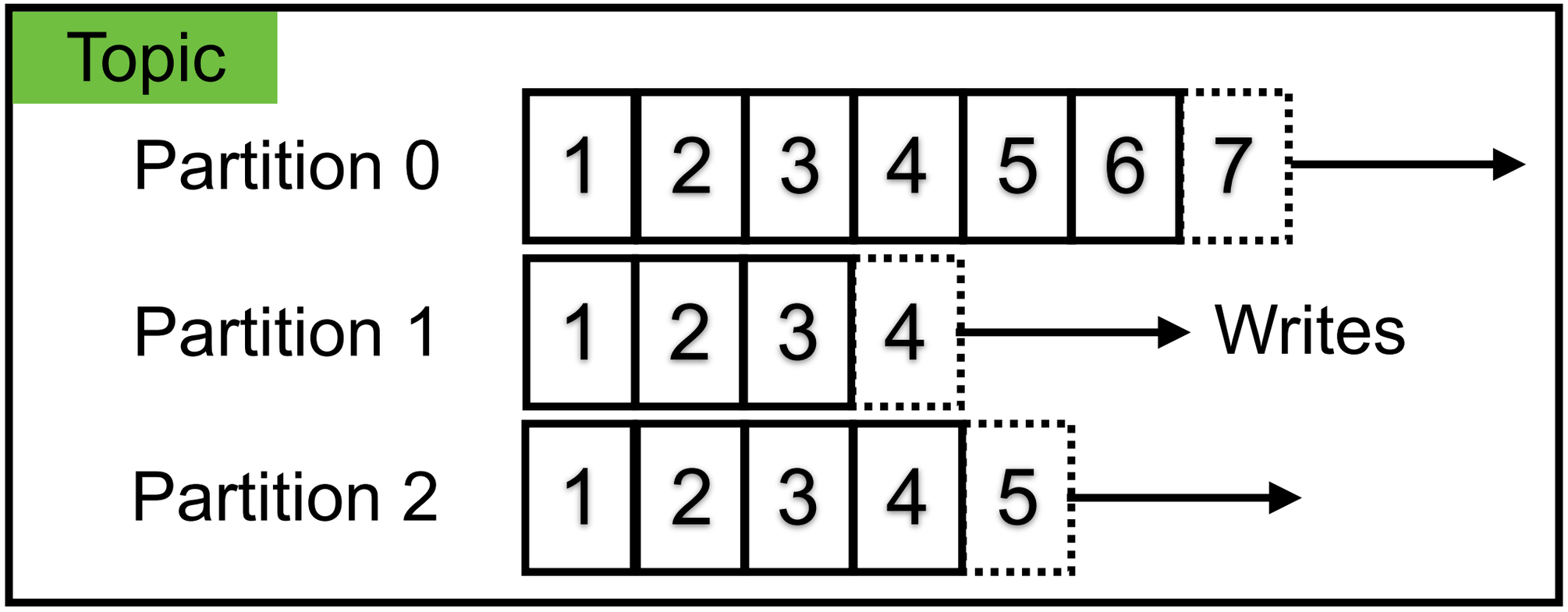
Topics, partitions and offsets

Partitions

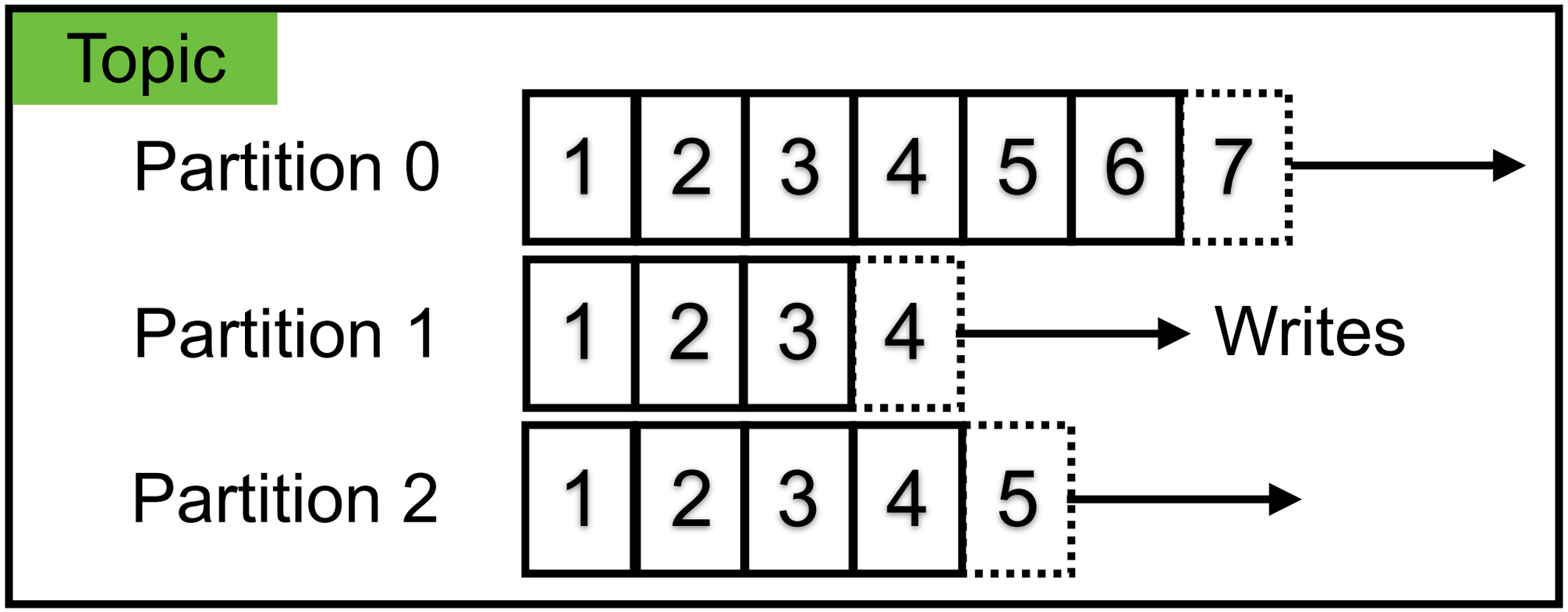
Topics are split in partitions

Each partition is **ordered**

Each message in partition get incremental id (**offset**)



Topics, partitions and offsets



Order is guaranteed only within partition

Data is keep in limited time (**Default = 1 week**)

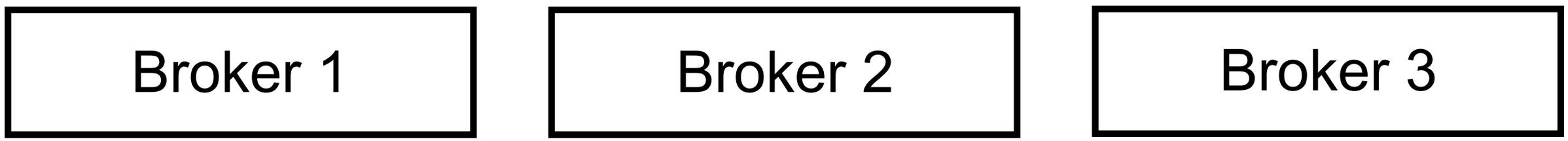
Data is **immutable** (can't be changed)

Data is assigned **randomly** to a partition

Brokers and topics

Brokers

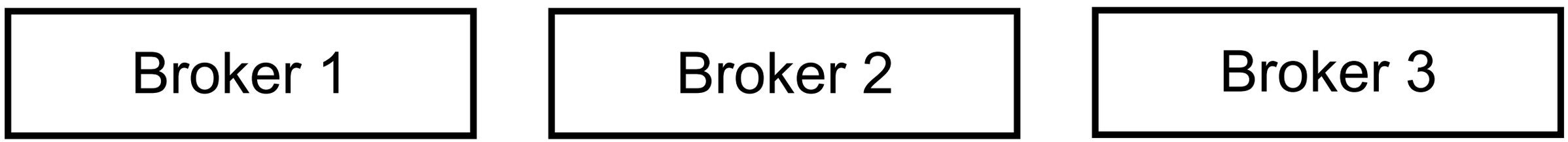
Kafka cluster is composed of multiple brokers (servers)
Each broker is identified by ID (integer)
Each broker contains certain topic partitions
After connecting any broker (bootstrap broker), you will connected to the entire cluster



Brokers and topics

Brokers

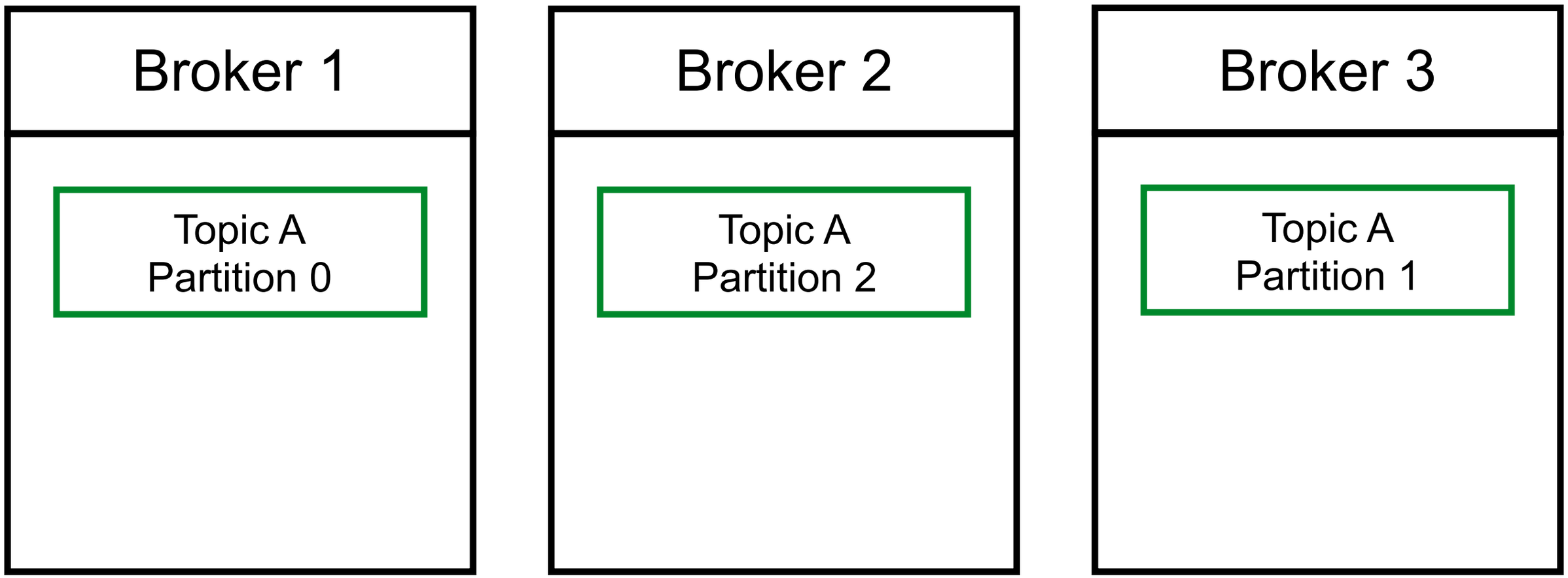
Good number to start id **3 brokers**



Brokers and topics

Example

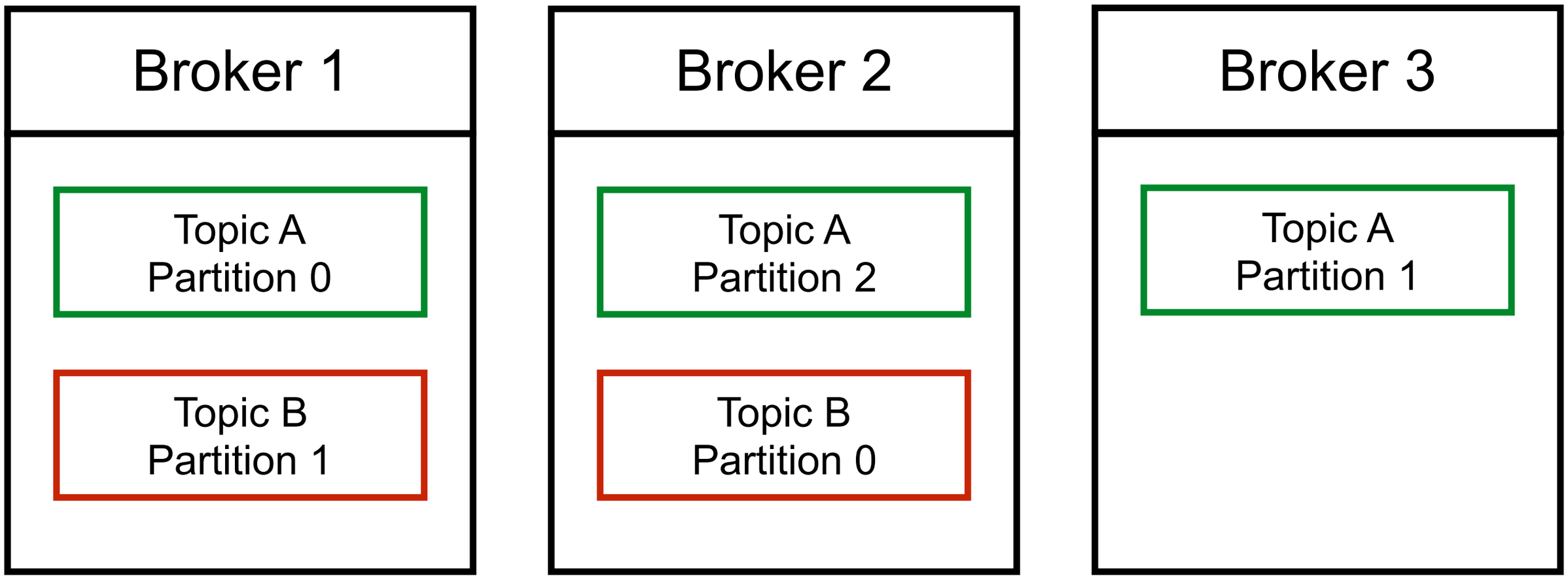
Topic A with 3 partitions



Brokers and topics

Example

Topic B with 2 partitions



Topic with replication factor

Topic should have a replica factor > 1 (2-3)

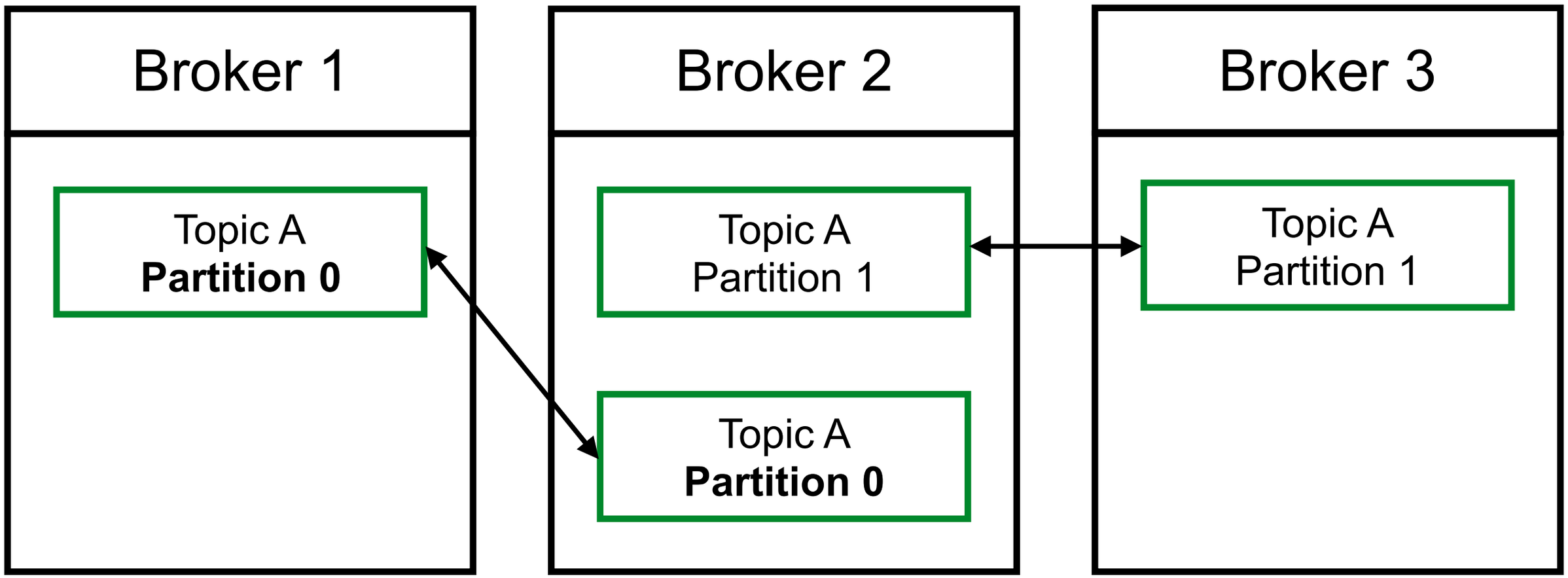
replica factor < no. of brokers

This way if a broker down, another broker can serve the data

Topic with replication factor

Example

Topic A with 2 partitions and replication factor = 2



Leader for a partition

At any time only **one Broker** can be leader for partition

Only leader partition can receive and serve data for a partition

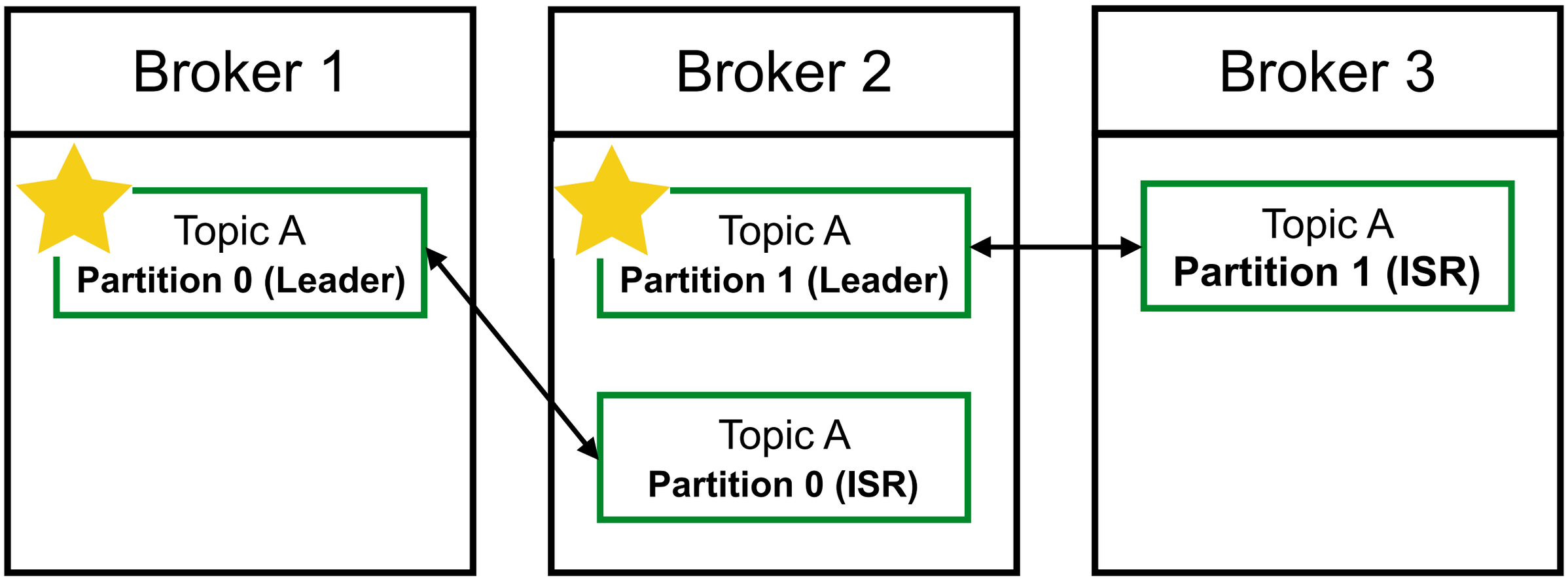
Other brokers will synchronize the data

Other partition called **in-sync replica (ISR)**

Leader for a partition

Example

Topic A with 2 partitions and replication factor = 2



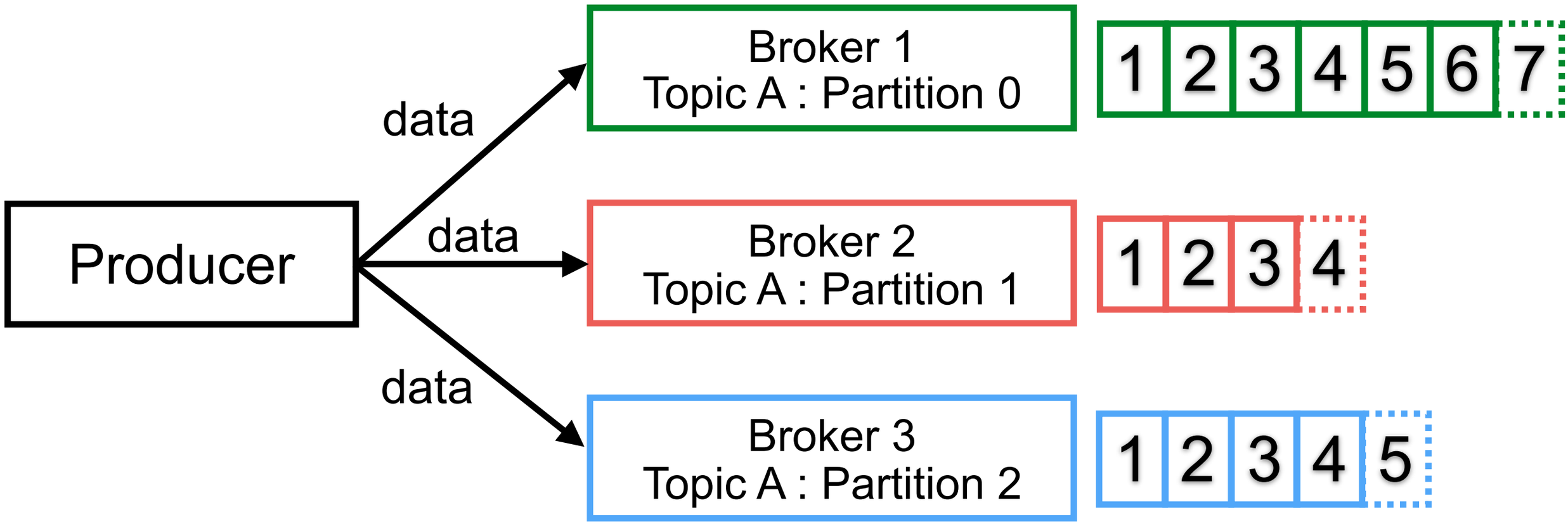
Producers

Producers write data to topics

Producers automatically know to broker and partition to write

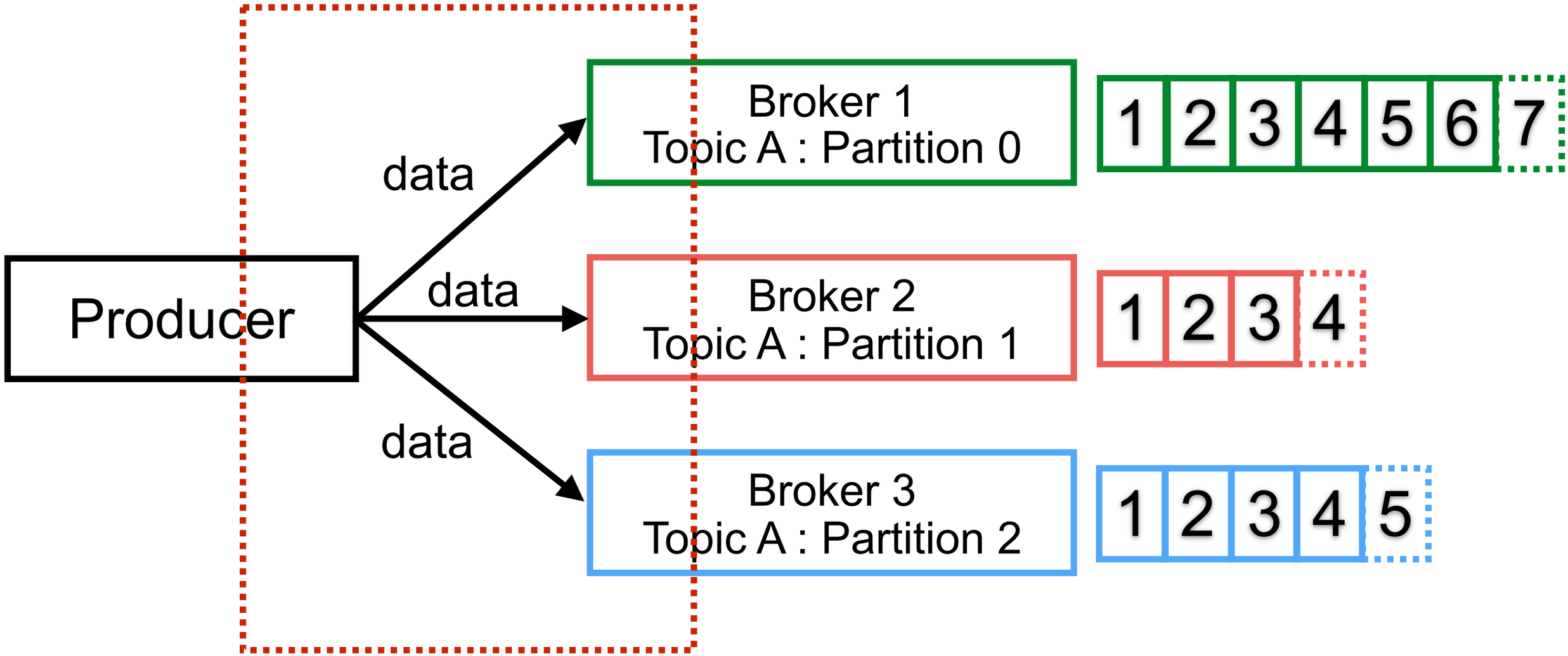
When broker failures, producers will automatically recover

Producers



*** The load is balance to many brokers (no. of partitions) ***

Producers issue to write data !!



Producers with acknowledgment

acks=0

Producer not wait for acknowledgment

Possible data loss

acks=1

Producer will wait for **leader** acknowledgment

Limited data loss

acks=all

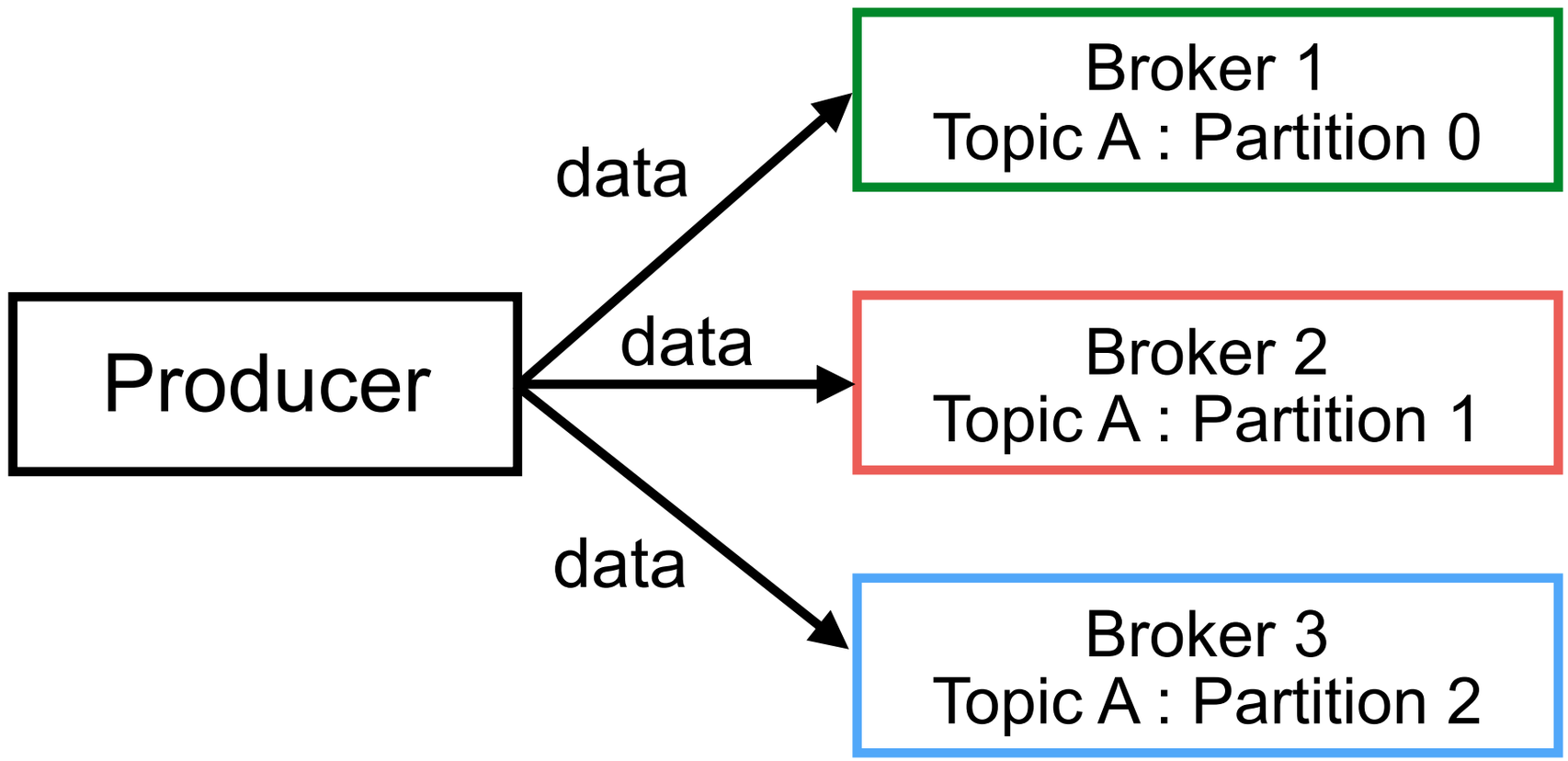
Producer will wait for **leader + ISR** acknowledgment

No data loss

Producers with message keys

Producers can choose to sent a **key** with data

Key = null, data is sent **round-robin**



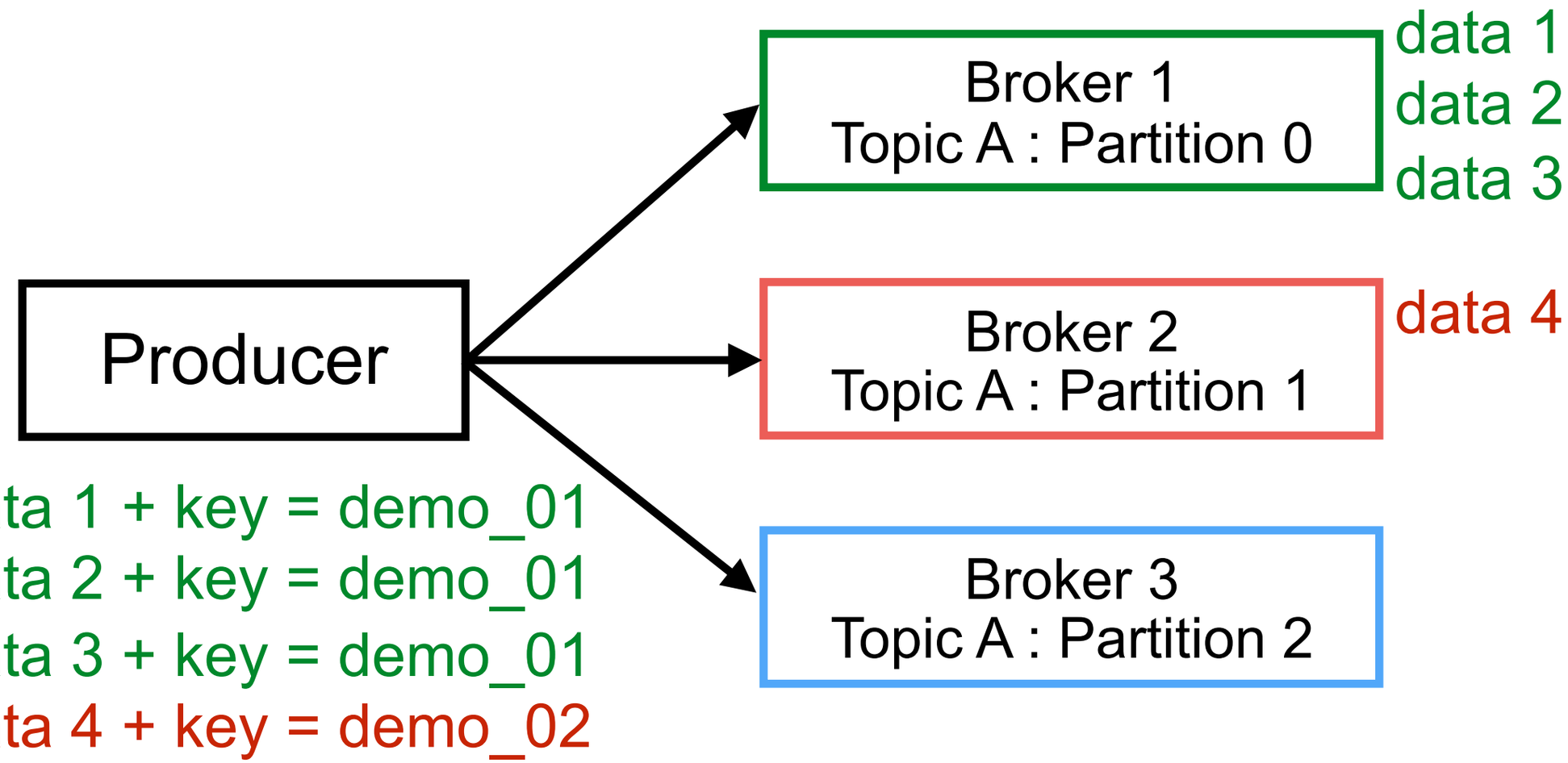
Producers with message keys

```
public int partition(String topic, Object key, byte[] keyBytes, Object value, byte[]
    if (keyBytes == null) {
        return stickyPartitionCache.partition(topic, cluster);
    }
    List<PartitionInfo> partitions = cluster.partitionsForTopic(topic);
    int numPartitions = partitions.size();
    // hash the keyBytes to choose a partition
    return Utils.toPositive(Utils.murmur2(keyBytes)) % numPartitions;
}
```

https://github.com/apache/kafka/blob/trunk/clients/src/main/java/org/apache/kafka/clients/producer/internals/DefaultPartitioner.java

Why use message keys ?

You need message ordering



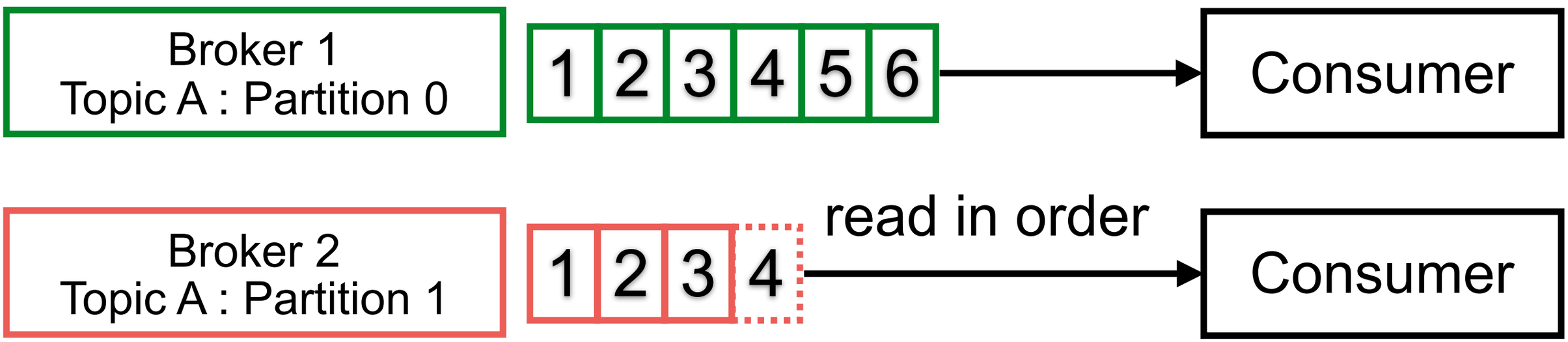
Consumers

Consumers read data from topic

Consumers know which broker to read from

Data will read in order **within each partition**

When broker failures, consumer know how to recover

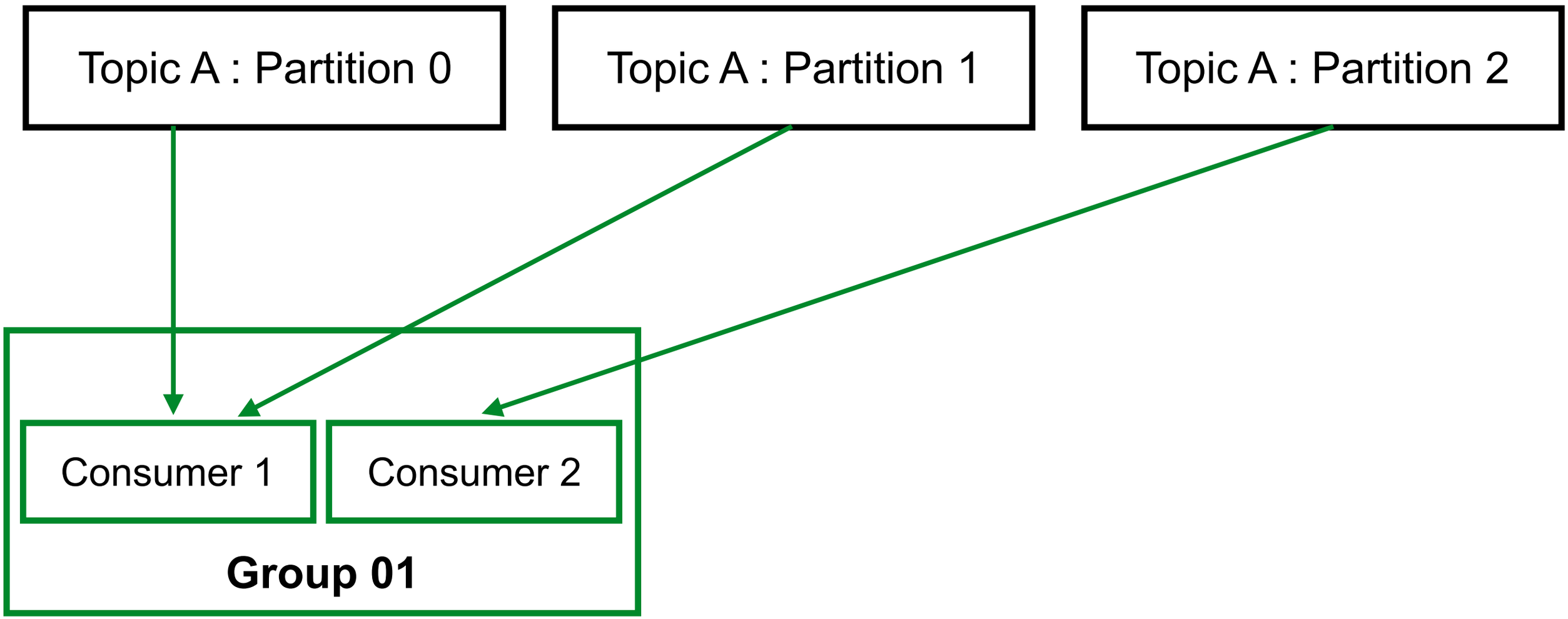


Consumer groups

Consumers read data in consumer groups

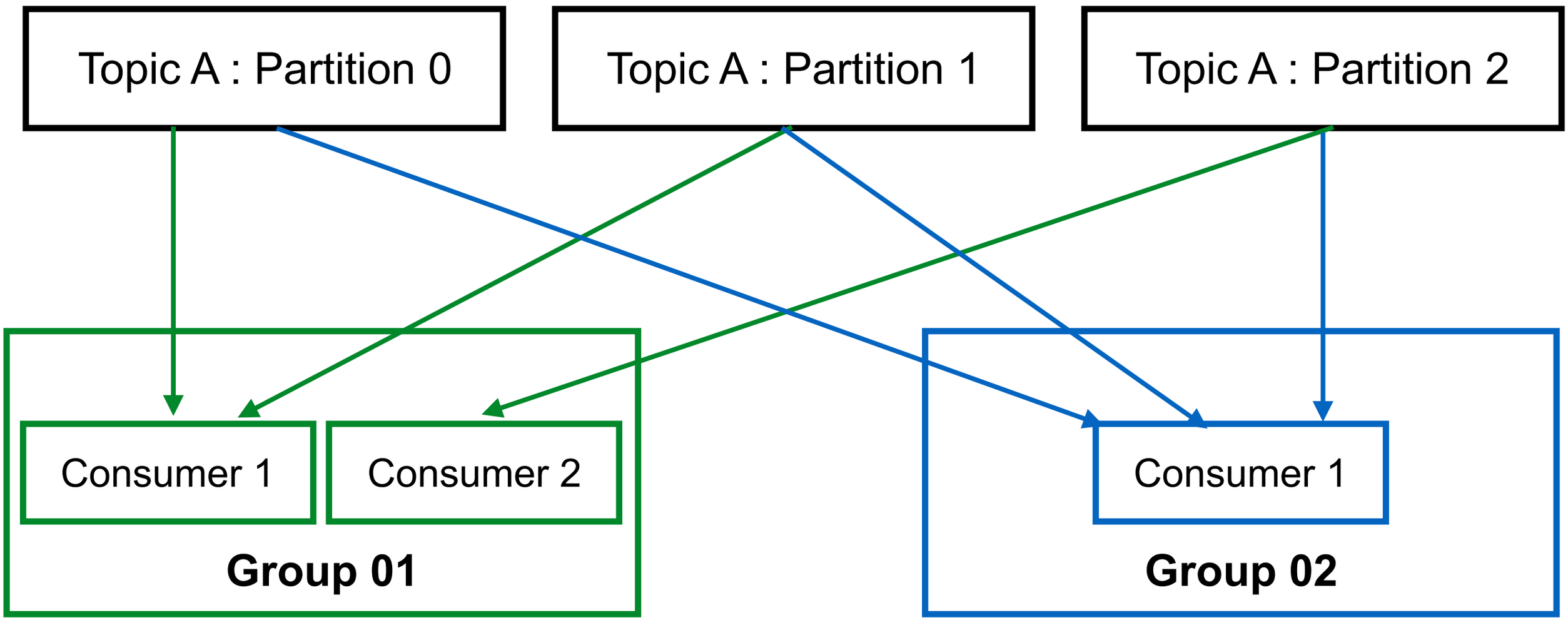
Each consumer in a group read from exclusive partitions

Consumer groups



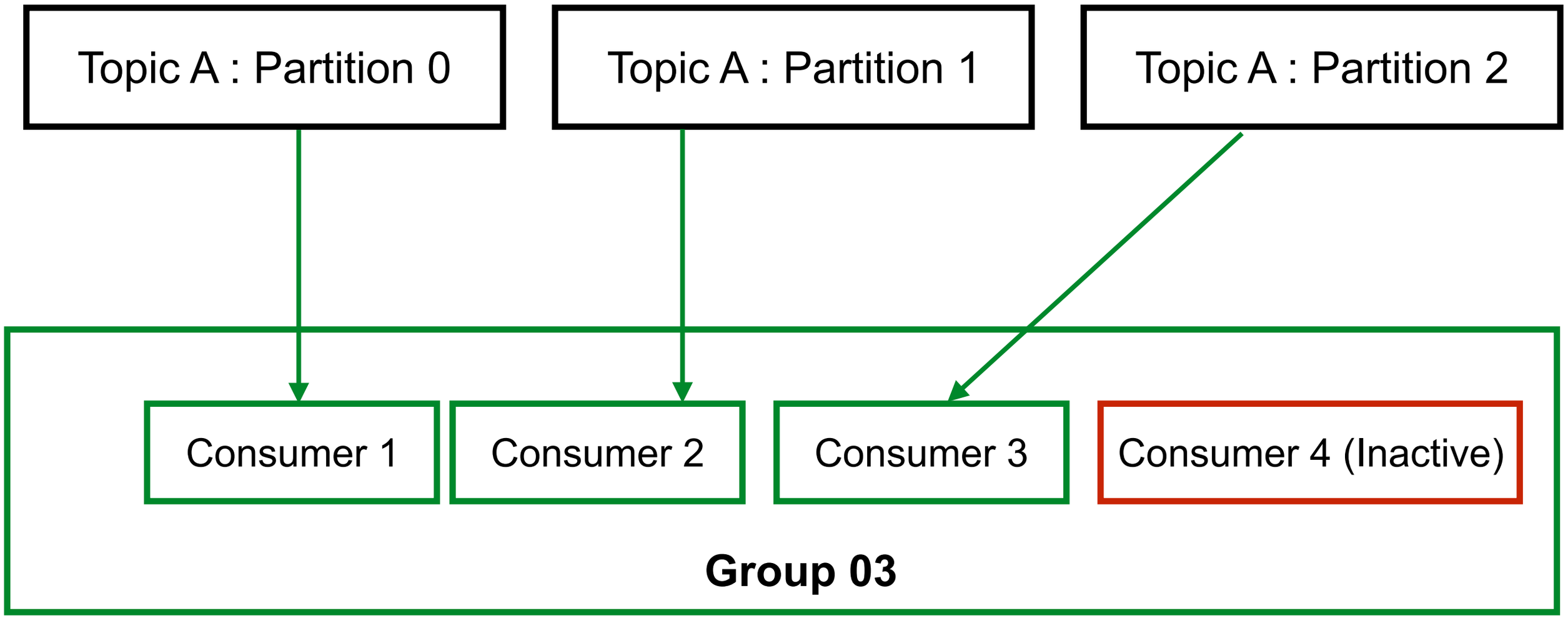
Consumer will automatically use a GroupCoordinator and ConsumerCoordinator to assign a consumer to a partition.

Consumer groups

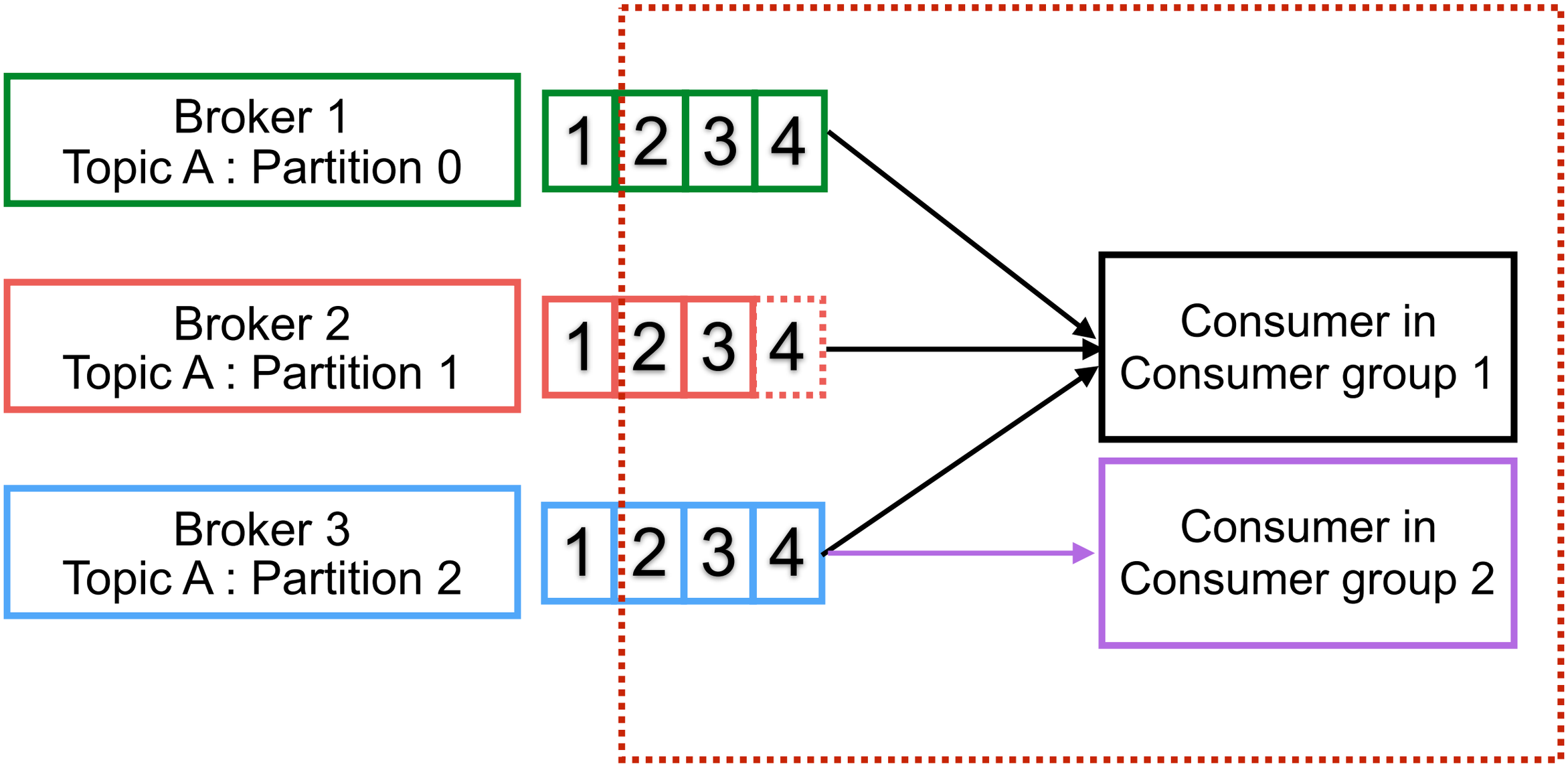


Consumers > partitions ?

Some consumers will inactive



Consumers offsets



Consumers offsets

Kafka store the offset at which a consumer group has been reading

The offsets committed live in topic named "**__consumer_offsets**"

When consumer in a group has processed data received from Kafka,
it should be **committing the offsets**

When to commit the offset ?

Delivery semantics for consumer

At most once
At lease once (preferred)
Exactly once

1. At most once

Offsets are committed as soon as the message is received

If processing go wrong, the message will be **loss**!!

2. At lease once

Offsets are committed after the message is processed

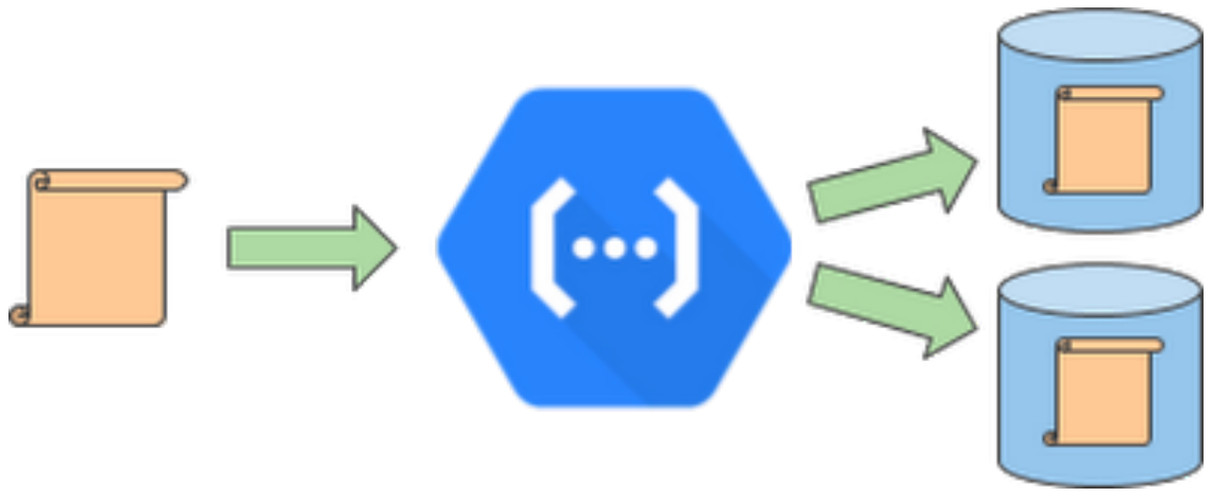
Messages are never lost but may be **redelivered**

If processing go wrong, the message will be **read again**

2. At lease once

Make sure your processing is **idempotent**

Processing again the message not impact to your system !!



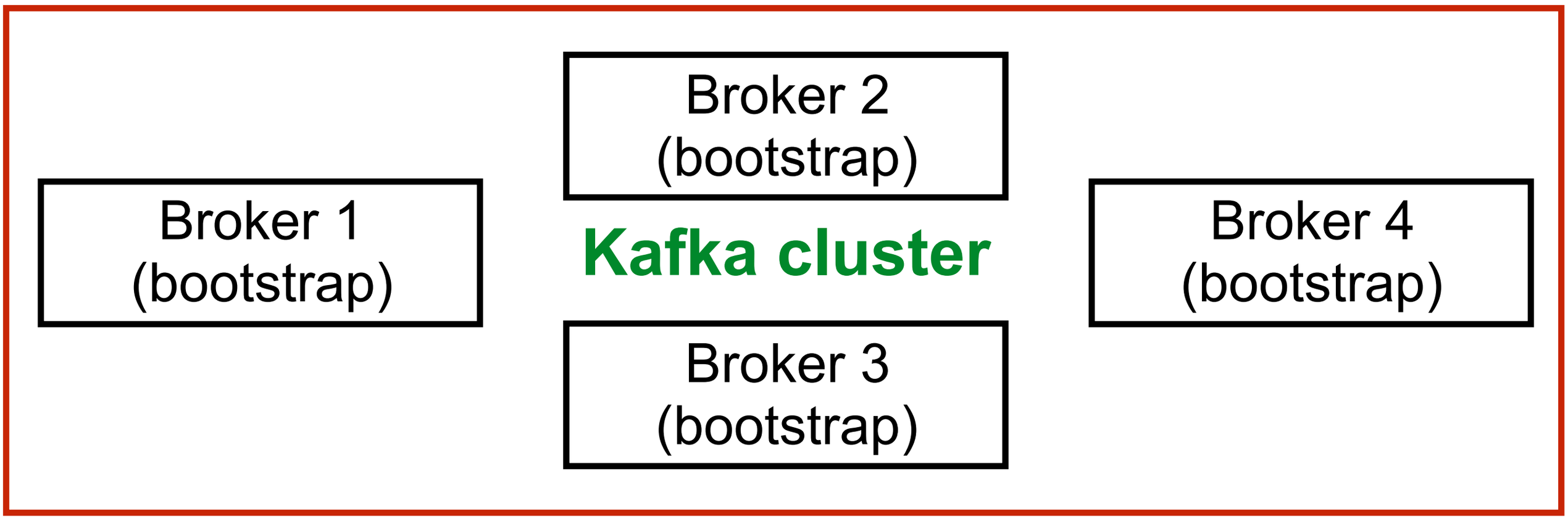
3. Exactly once

Each message id delivered once and only once
Can be achieved for Kafka (Workflow, Stream API)

Kafka broker discovery

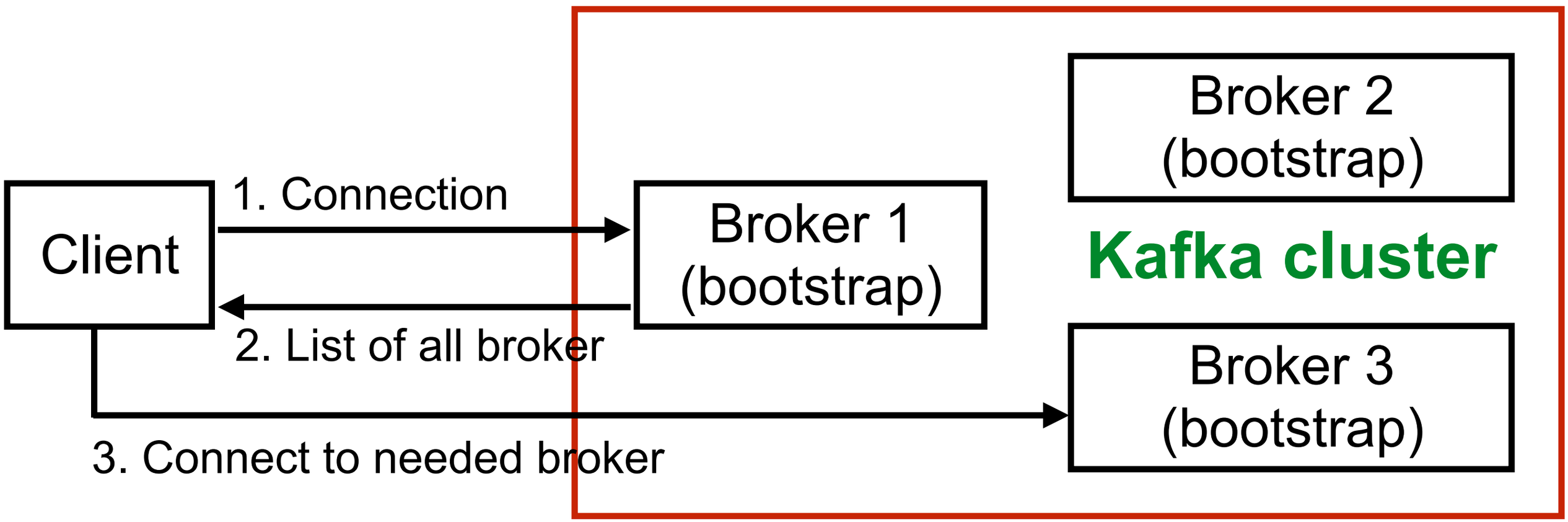
Every Kafka broker is called **“bootstrap server”**

You only need to connect to one broker, and you will connected to the entire cluster



Kafka broker discovery

Each broker knows about all brokers, topics and partitions (**metadata**)



Apache Zookeeper

Kafka can not work without Zookeeper !!

APACHE ZooKeeper™

https://zookeeper.apache.org/

Apache Zookeeper

Zookeeper **manages** brokers

Zookeeper help in performing **leading election** for partitions

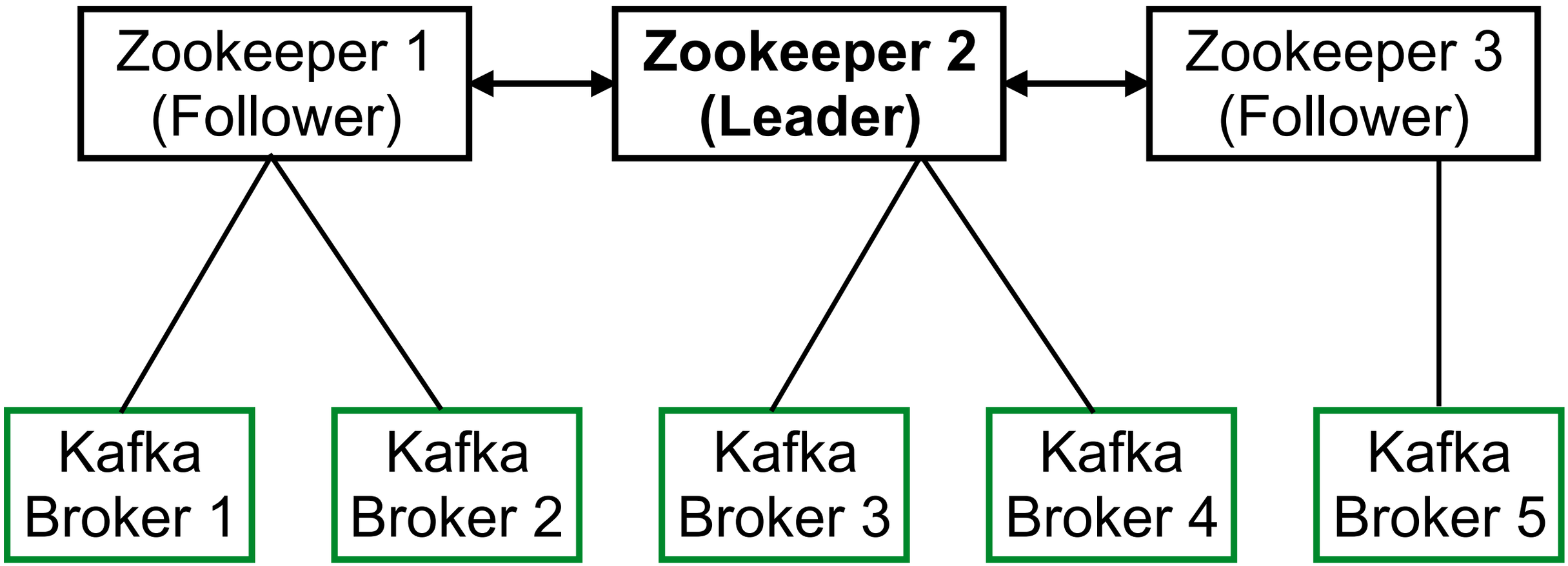
Zookeeper sends **notifications** to Kafka in case of changes (new topic, broker die)

Zookeeper by design operates with a odd number of servers (3, 5, 7)

Zookeeper architecture

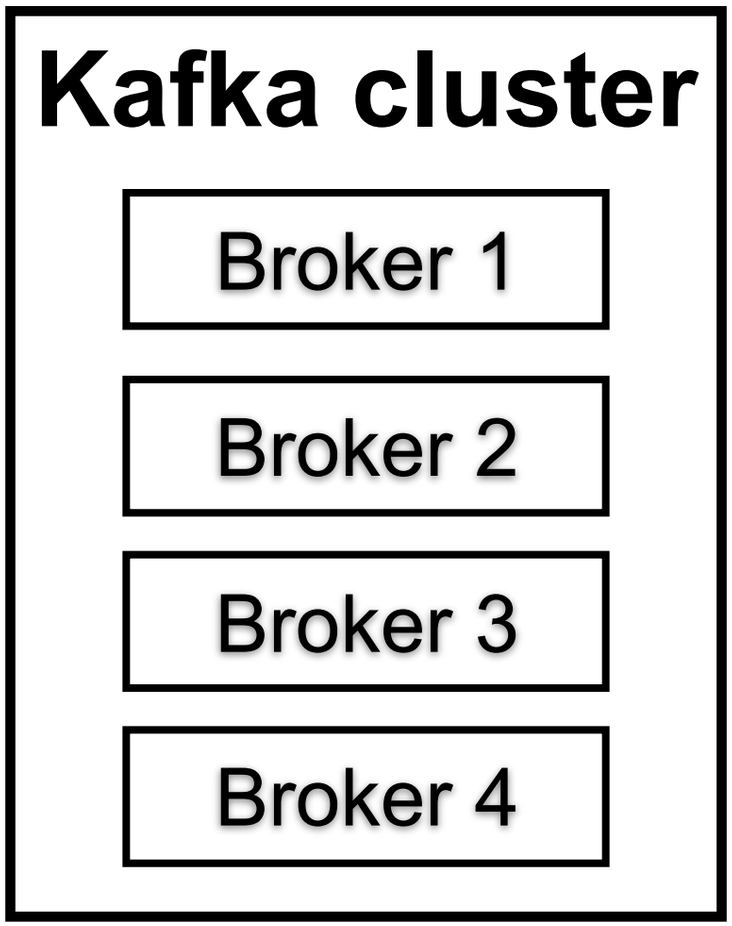
Leader for write
Follows for read

Zookeeper architecture



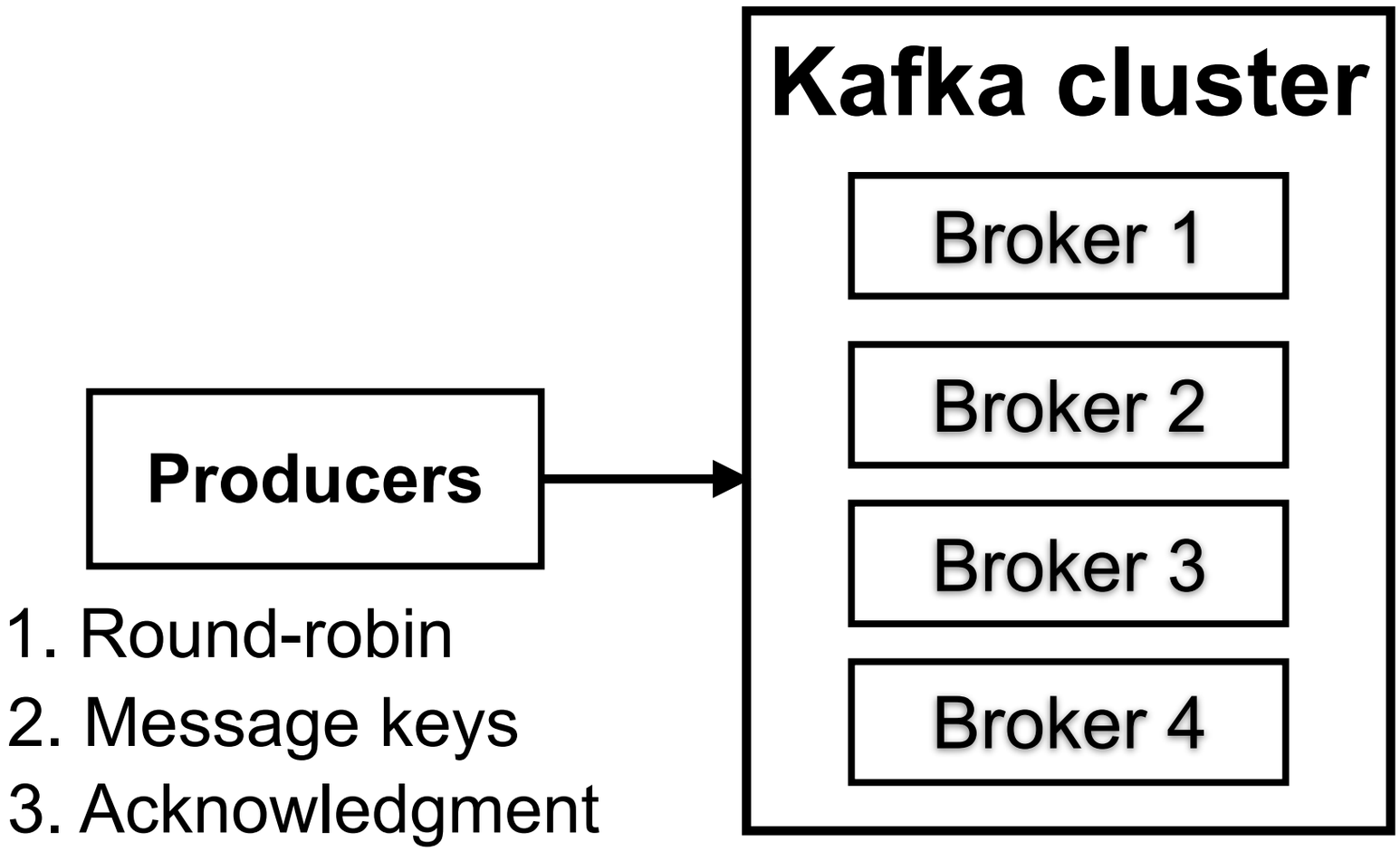
Summary of Kafka

Kafka concepts



1. Topics
2. Partition
3. Replication factor
4. Partition leader/ISR
5. Topic offset

Kafka concepts



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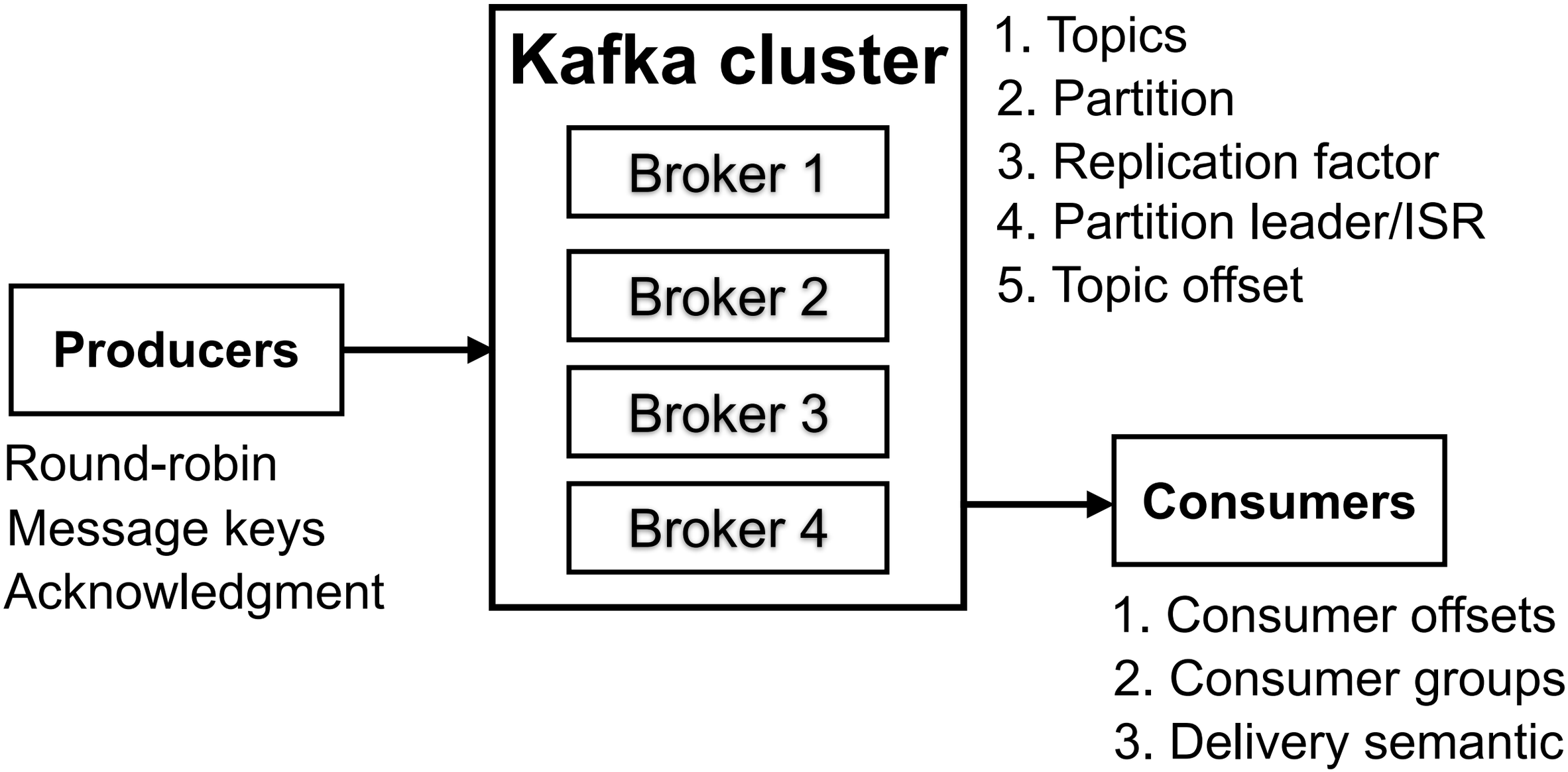
1. Round-robin
2. Message keys
3. Acknowledgment

Kafka concepts



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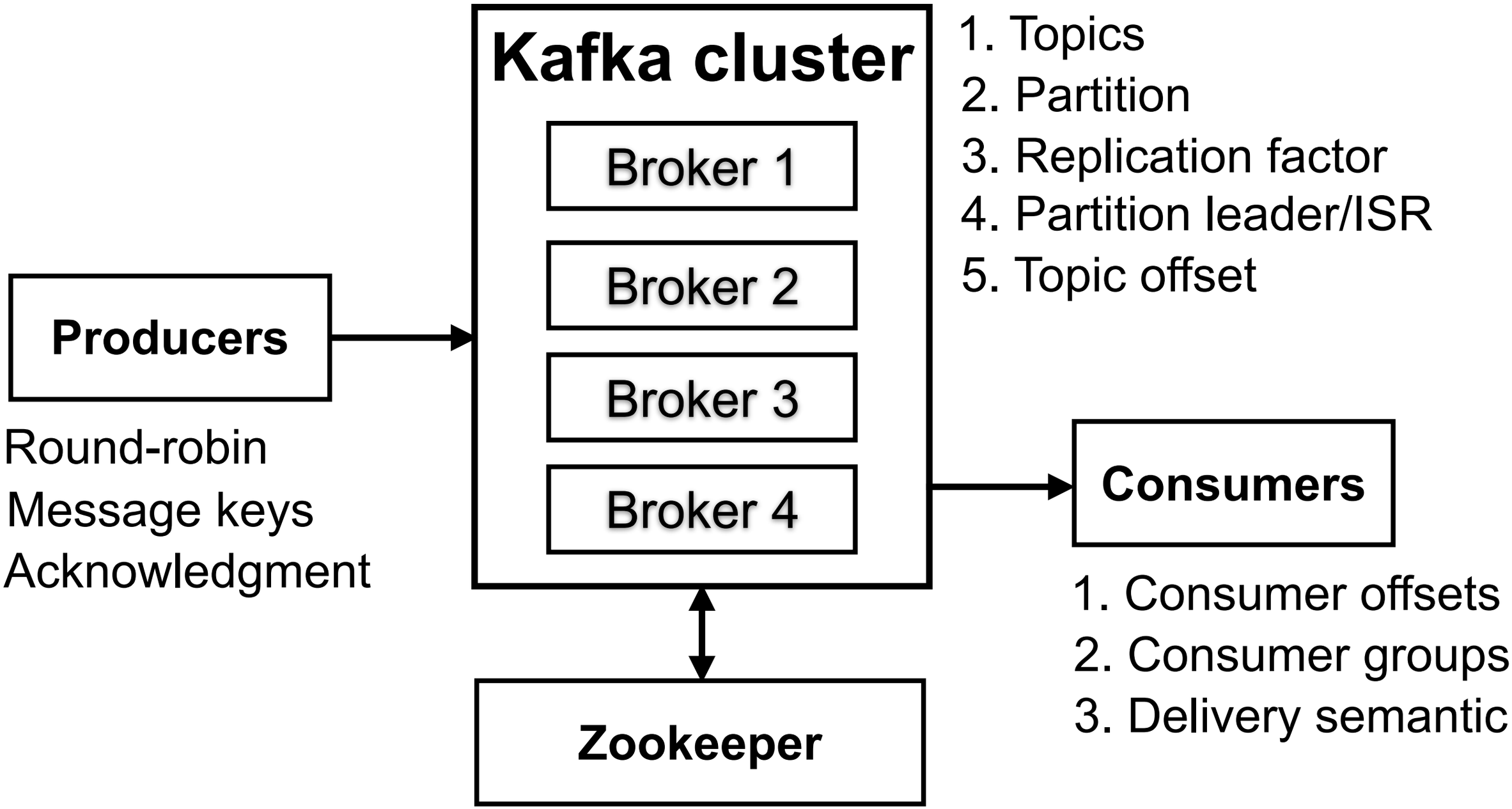
1. Consumer offsets
2. Consumer groups
3. Delivery semantic

Kafka concepts



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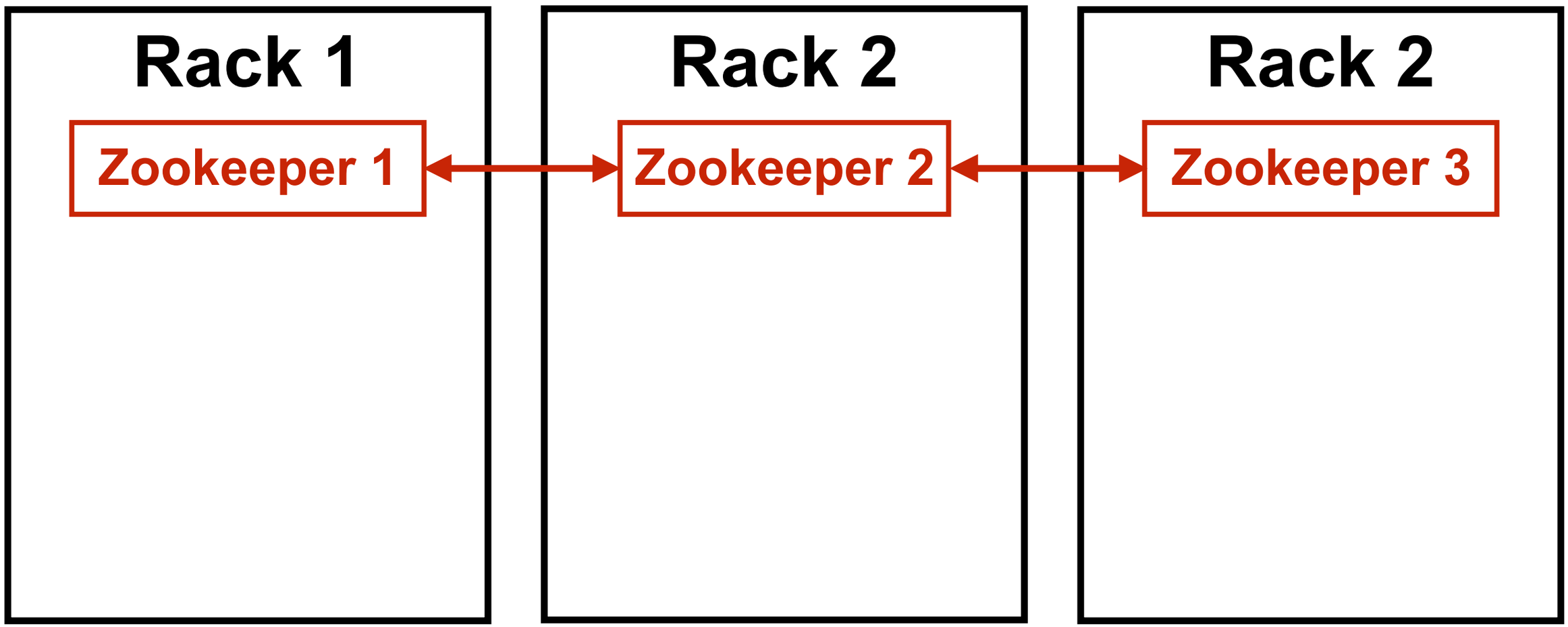
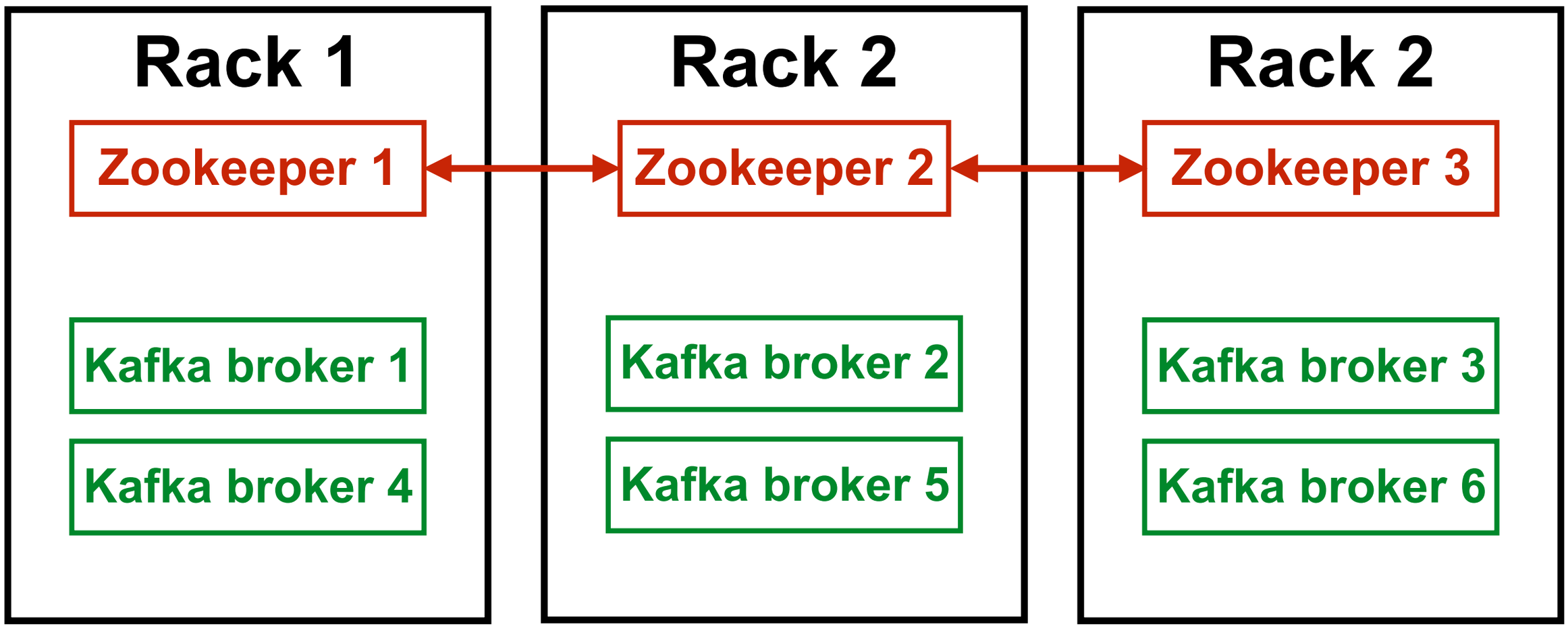
Kafka workshop

Monitoring Kafka

Kafka cluster



Kafka cluster



Kafka cluster

It’s not easy to setup a cluster

Need to isolate each Zookeeper and broker on separate servers

Need to implement a **Monitoring system**

Need skill of **operation** teams

Need a good **Kafka Admin**

Kafka monitoring

Tips #1

Please monitor Your Kafka !!

Monitoring ?

Broker health

Message delivery

Performance

Capacity

Kafka monitoring

Kafka exposes **metrics** through **JMX**
These metrics are very important for monitoring

Kafka monitoring

JConsole

JMX/Metrics integration

Burrow

Keep Kafka metrics ?

ELK stack
Prometheus
Confluent control center
Datadog
NewRelic
etc…

Important metrics

Under replicated partitions

of partitions are have problem with the **ISR**

May indicate a high load on the system

Request handlers

Utilization of threads for I/O, network

Utilization of Kafka broker

Important metrics

Request timing

How long it takes to reply to requests

Low is better, latency will improved

https://kafka.apache.org/documentation/#monitoring

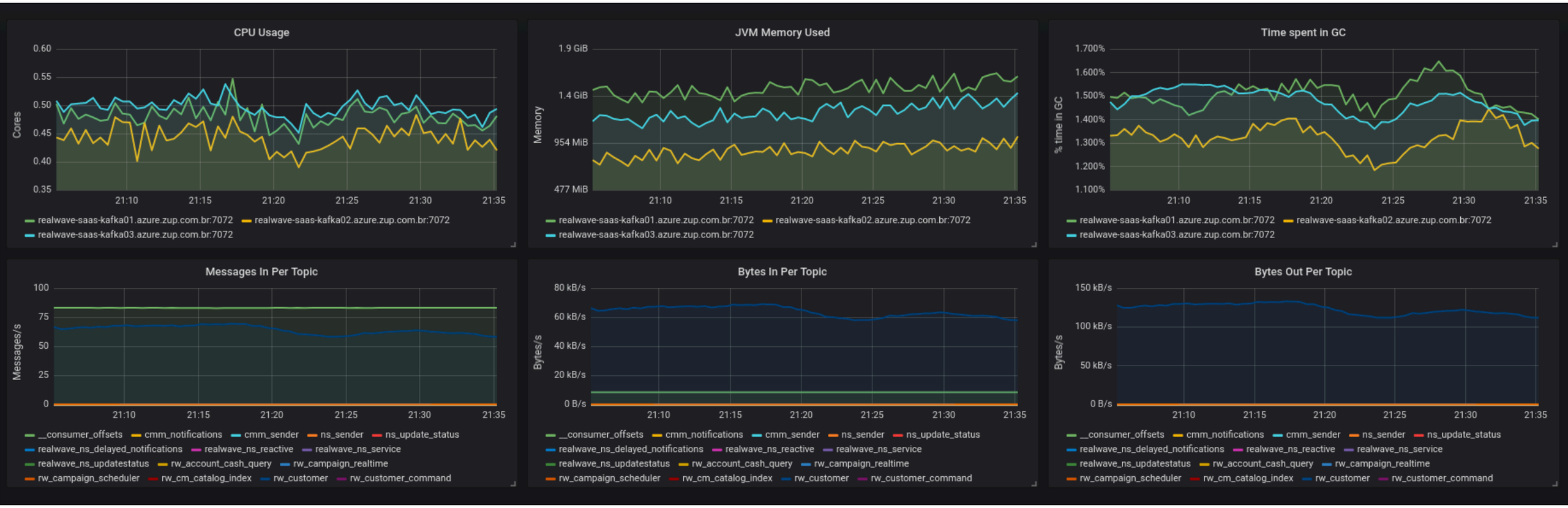
https://docs.confluent.io/current/kafka/monitoring.html

https://www.datadoghq.com/blog/monitoring-kafka-performance-metrics/

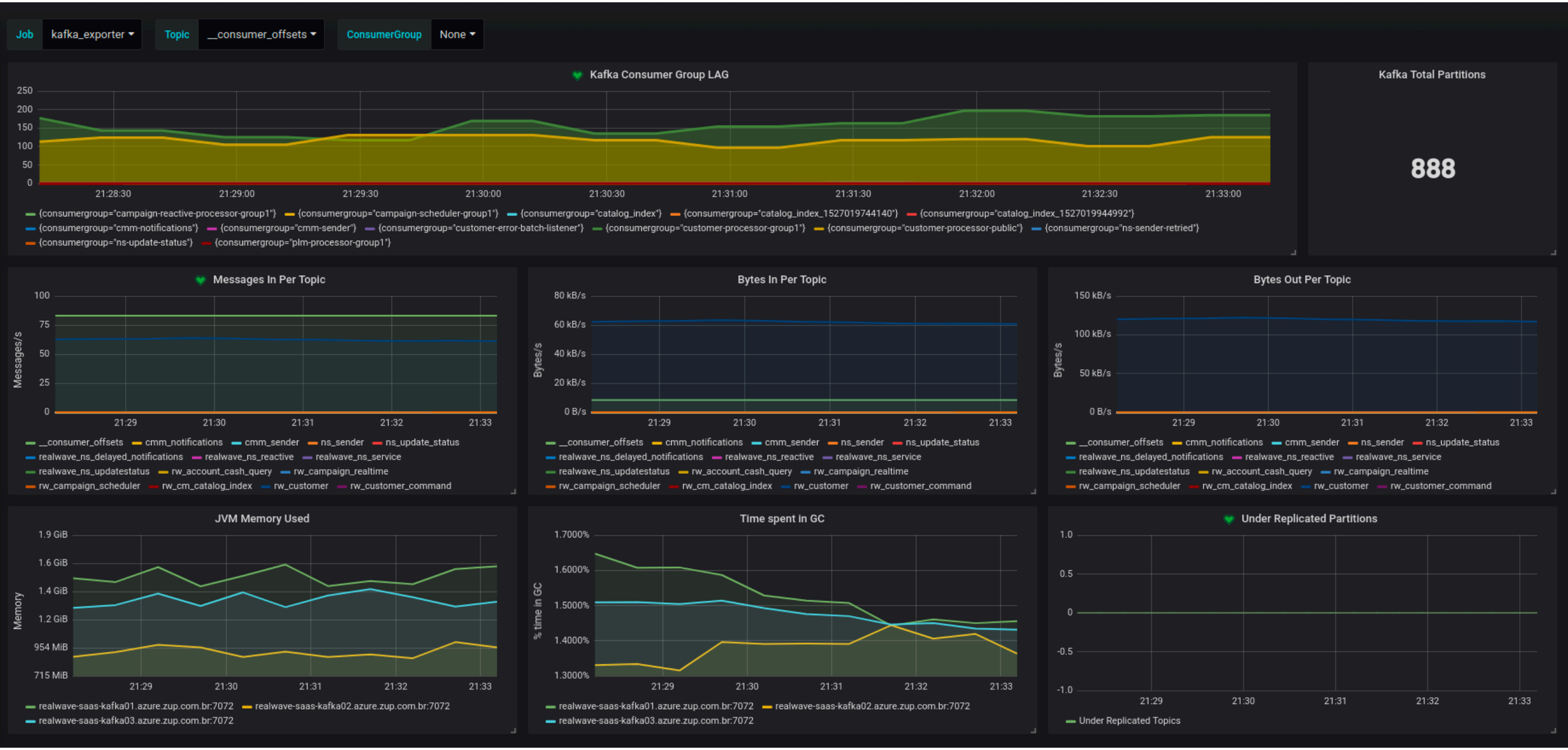
Tips #2

Have a dashboard that lets you know
“Everything is OK ?”
(in one look)

Dashboard



Dashboard



Tips #3

Don’t watch the dashboard
Alert on what is important

Only restart if you know why this will fix the issue !!

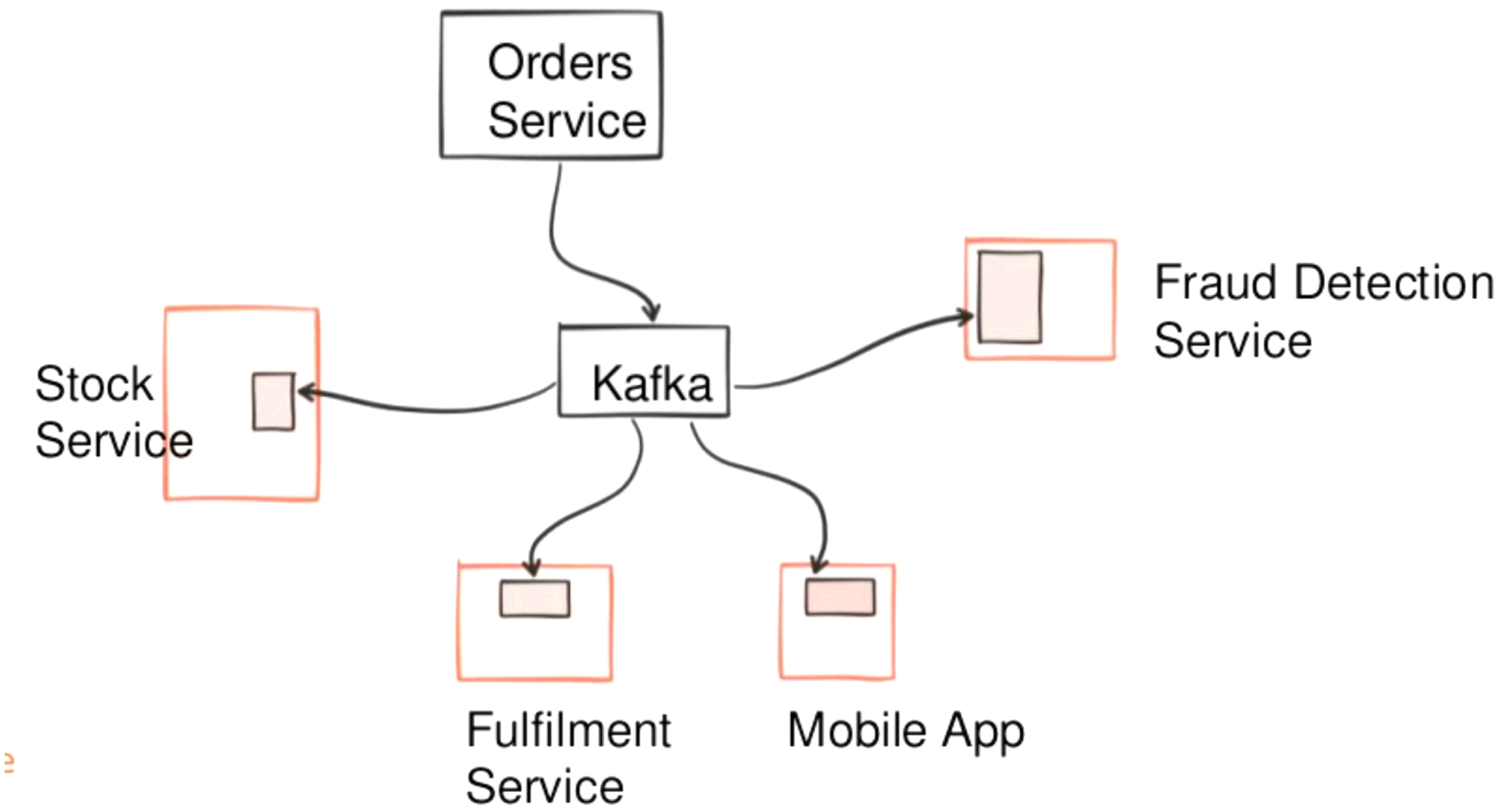
Capacity planning

CPU
Network and thread pool usages
Request latency
Network utilization
Disk utilization

Tips #4

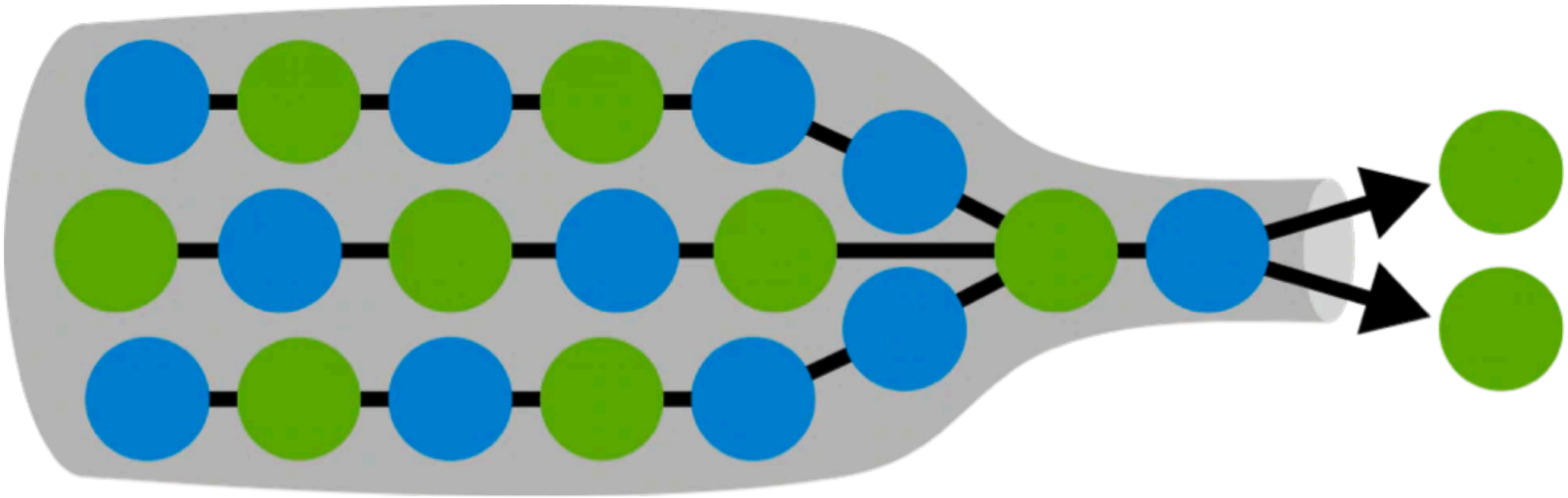
Monitoring brokers isn't enough

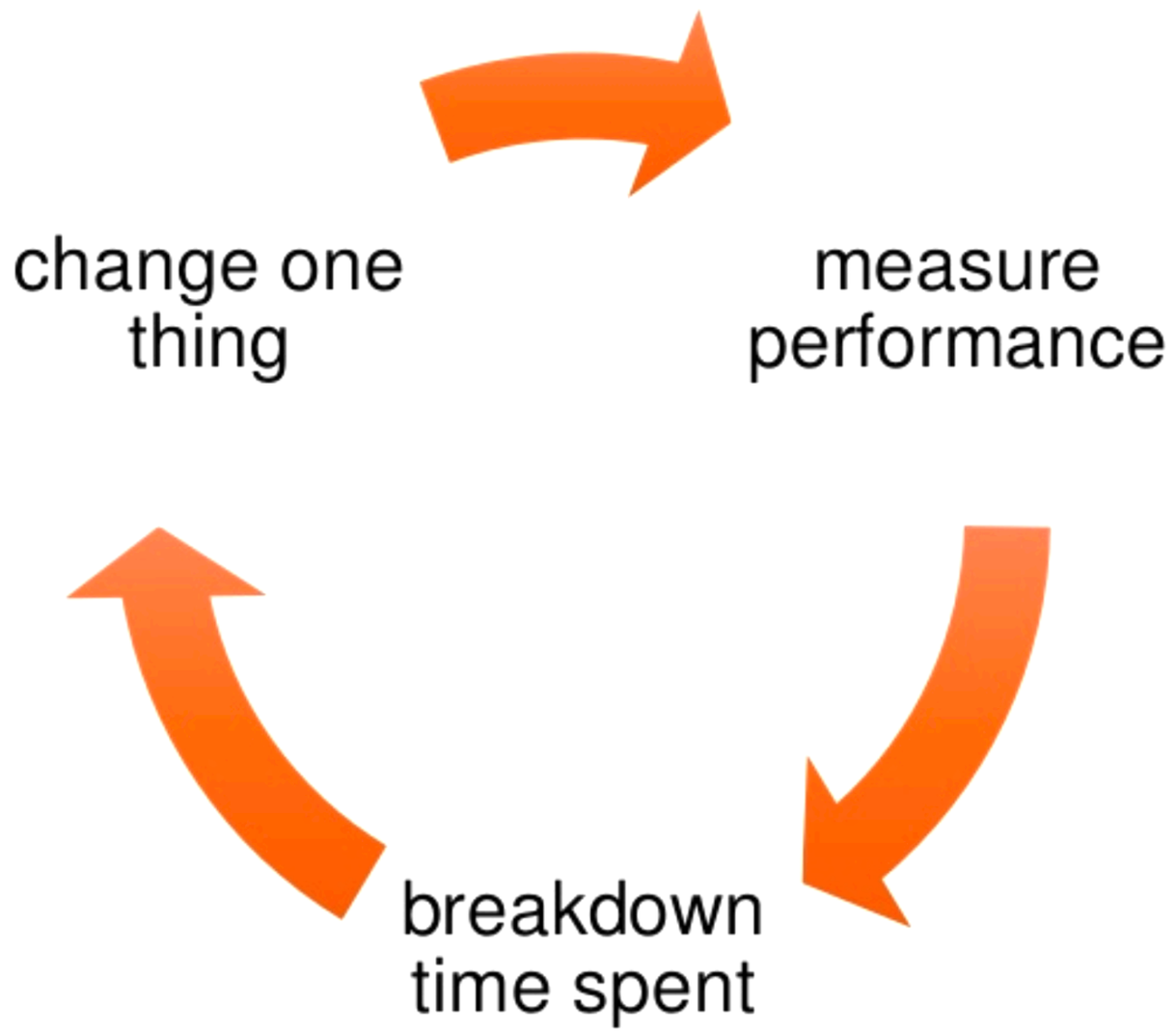
Need to monitor events



Tips #4

Tuning the bottlenecks





Life cycle of request

Client send request to broker
Network thread get request and put on queue
I/O thread/handler pick up request and process
(Read and write from/to disk)
Waiting for other brokers to ack messages
Put response on queue
Network thread send response to client

Kafka for operation

Kafka operations

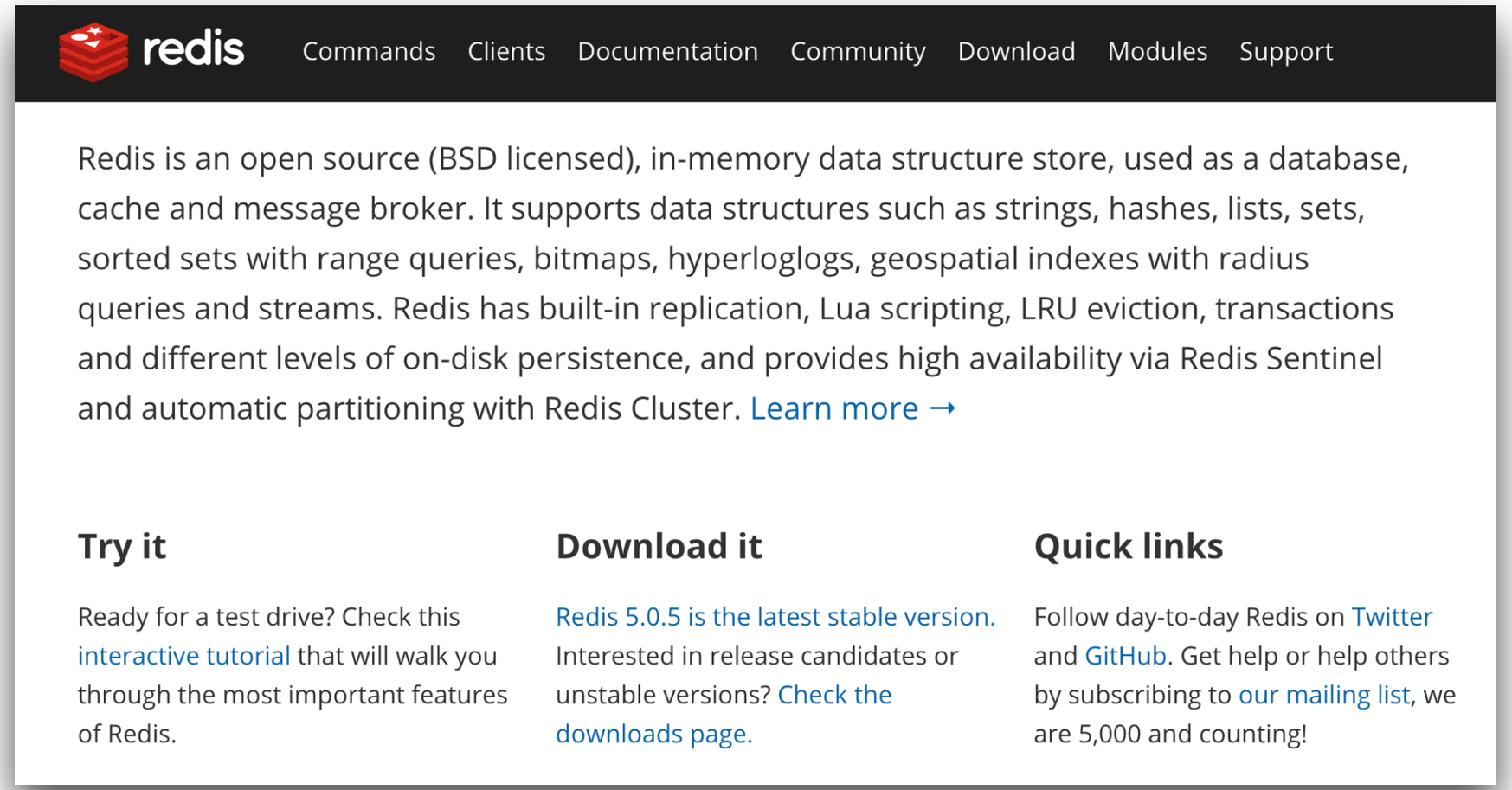
Rolling restart of brokers
Update configurations
Rebalancing partitions
Increase replication factor
Add/replace/remove a broker
Upgrade a Kafka cluster with zero downtime

Kafka workshop

Redis

Redis

In-memory data structure store
Using for database cache and message broker

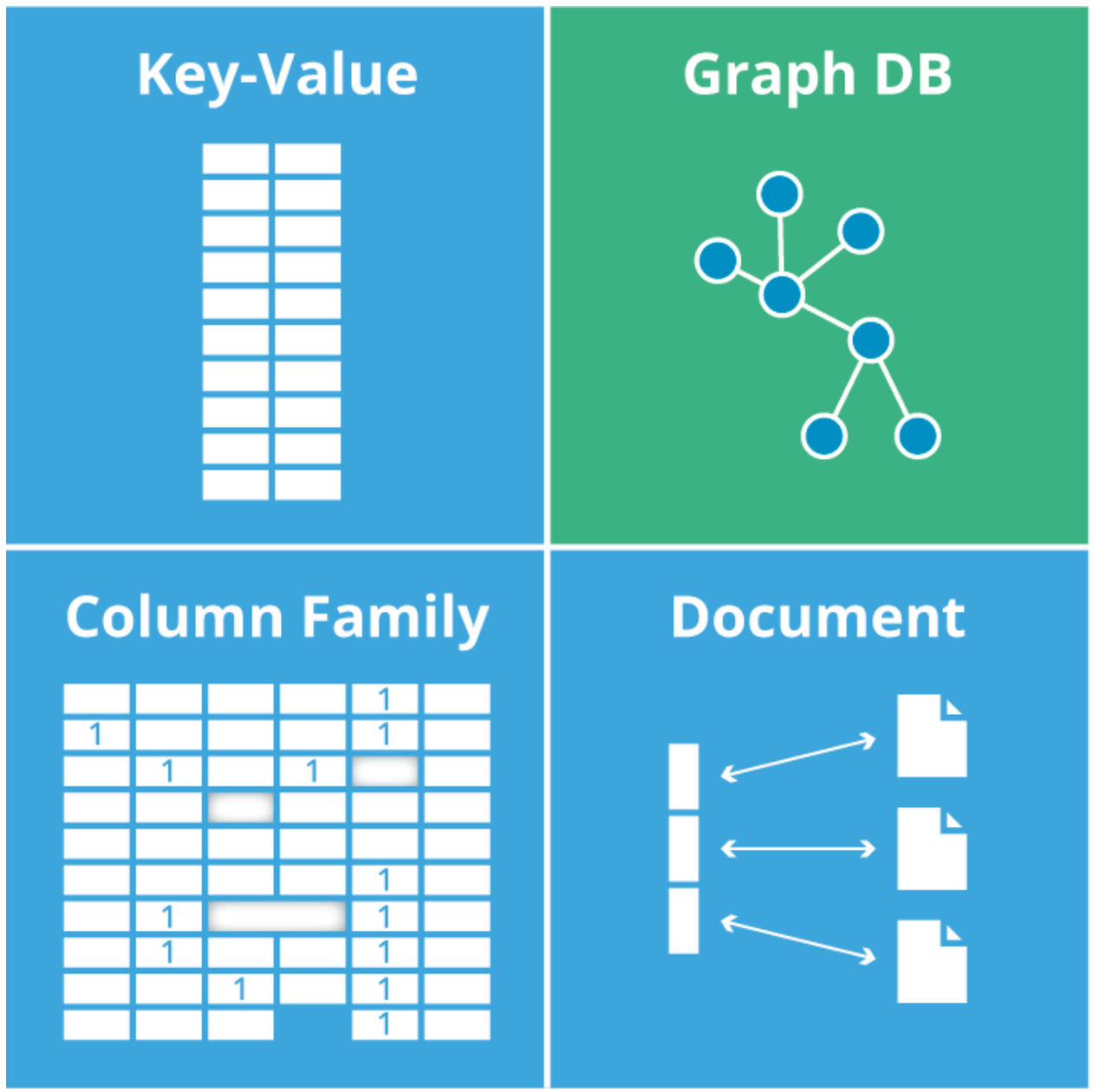


https://redis.io/

Learning path

Install and connect to Redis
Data storage and retrieval
Basic Redis data structures
Redis pub/sub functionality

NoSQL



Database ranking

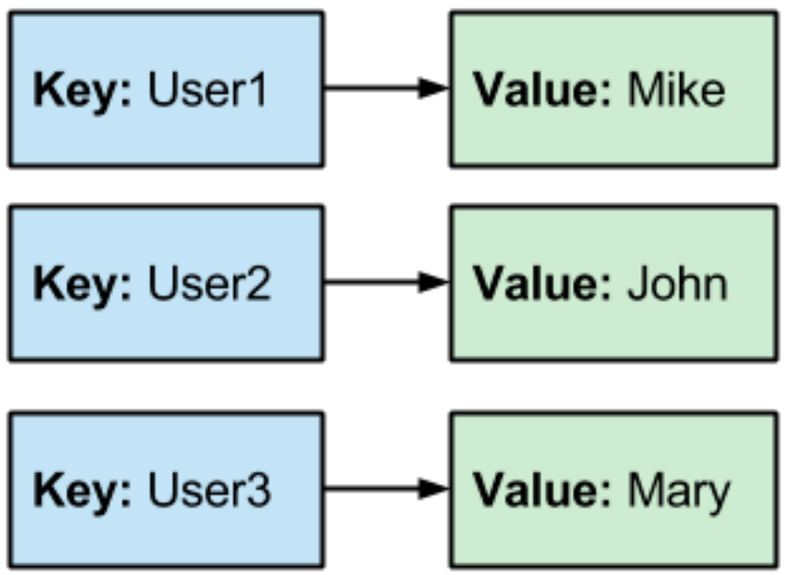
351 systems in ranking, August 2019

Rank Aug 2019	Rank Jul 2019	Rank Aug 2018	DBMS	Database Model	Score Aug 2019	Score Jul 2019	Score Aug 2018
1.	1.	1.	Oracle	Relational, Multi-model	1339.48	+18.22	+27.45
2.	2.	2.	MySQL	Relational, Multi-model	1253.68	+24.16	+46.87
3.	3.	3.	Microsoft SQL Server	Relational, Multi-model	1093.18	+2.35	+20.53
4.	4.	4.	PostgreSQL	Relational, Multi-model	481.33	-1.94	+63.83
5.	5.	5.	MongoDB	Document	404.57	-5.36	+53.59
6.	6.	6.	IBM Db2	Relational, Multi-model	172.95	-1.19	-8.89
7.	7.	↑ 8.	Elasticsearch	Search engine, Multi-model	149.08	+0.27	+10.97
8.	8.	↓ 7.	Redis	Key-value, Multi-model	144.08	-0.18	+5.51
9.	9.	9.	Microsoft Access	Relational	135.33	-1.98	+6.24
10.	10.	10.	Cassandra	Wide column	125.21	-1.80	+5.63

https://db-engines.com/en/ranking

What is Redis ?

In-memory key-value store
Focus on performance and simplicity
All data keep in memory



What is Redis ?

REmote **DI**ctionary **S**erver

Data structure server

String, list, set, hash, sorted set

No index

No query language

Networking

Local or distributed access
Replication
Clustering

Durability options

Memory only
Snapshot (RDB)
Append-only file (AOF)
Master-slave replication

Use cases

Caching data
Session storage
Queue
Notifications
Leaderboards

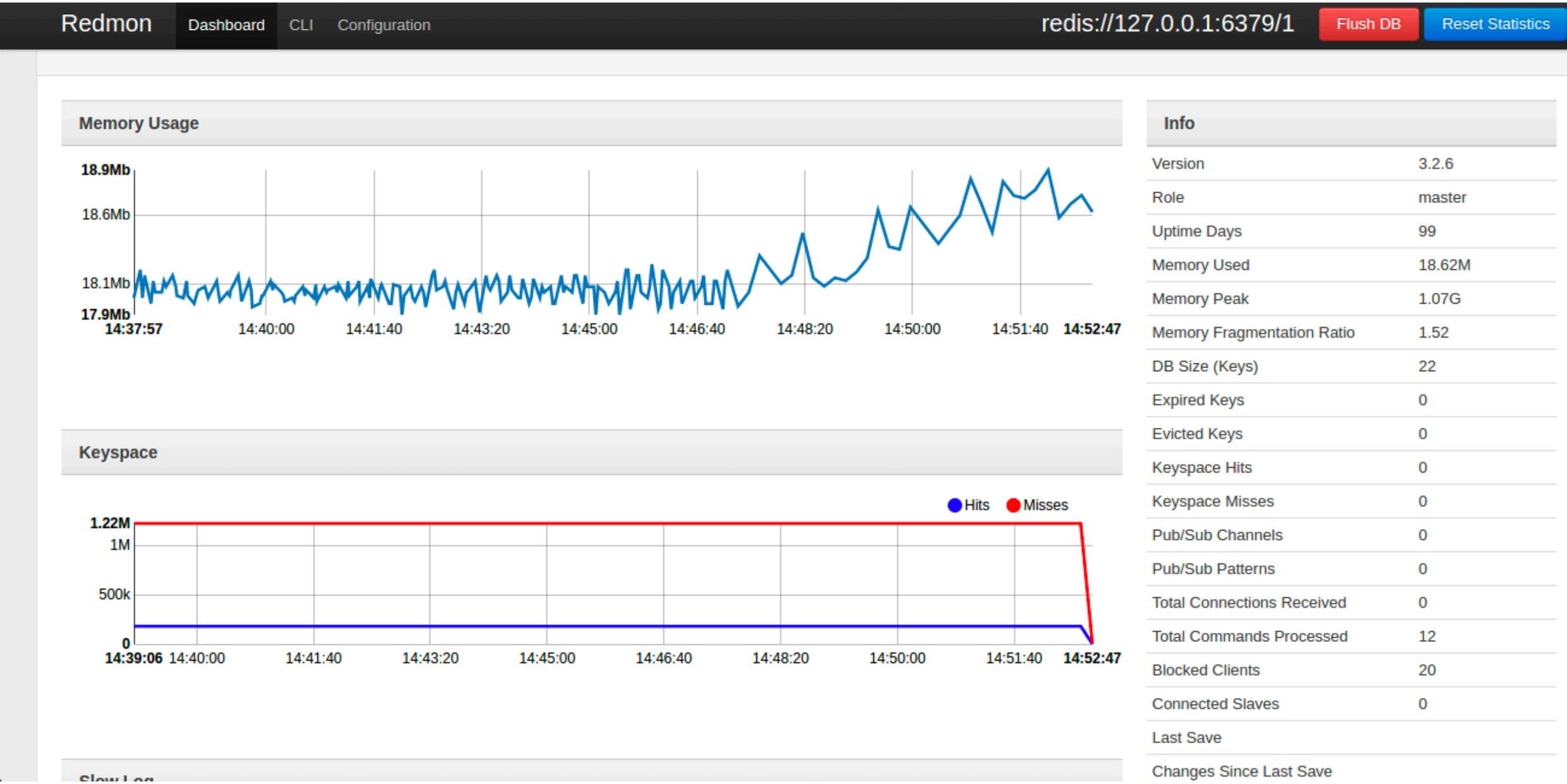
Redis workshop

Monitoring Redis

Redis-cli info
Redis-cli monitor

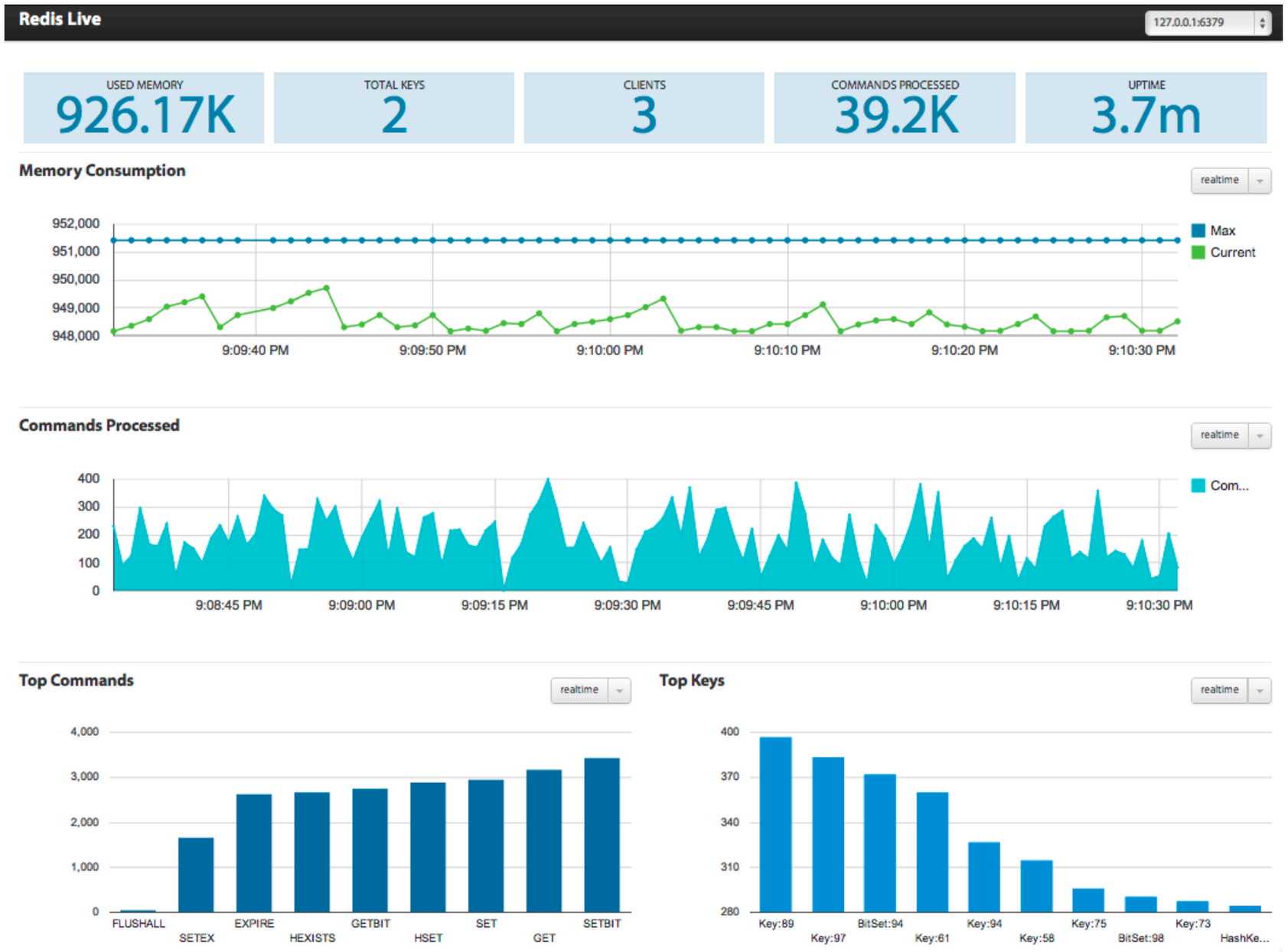
```
127.0.0.1:6379> info commandstats
# Commandstats
cmdstat_get:calls=797,usec=4041,usec_per_call=5.07
cmdstat_append:calls=797,usec=4480,usec_per_call=5.62
cmdstat_expire:calls=797,usec=5471,usec_per_call=6.86
cmdstat_auth:calls=147,usec=288,usec_per_call=1.96
cmdstat_info:calls=46,usec=902,usec_per_call=19.61
cmdstat_config:calls=2,usec=130,usec_per_call=65.00
cmdstat_eval:calls=796,usec=36950,usec_per_call=46.42
cmdstat_command:calls=796,usec=8578,usec_per_call=10.78
```

Redmon



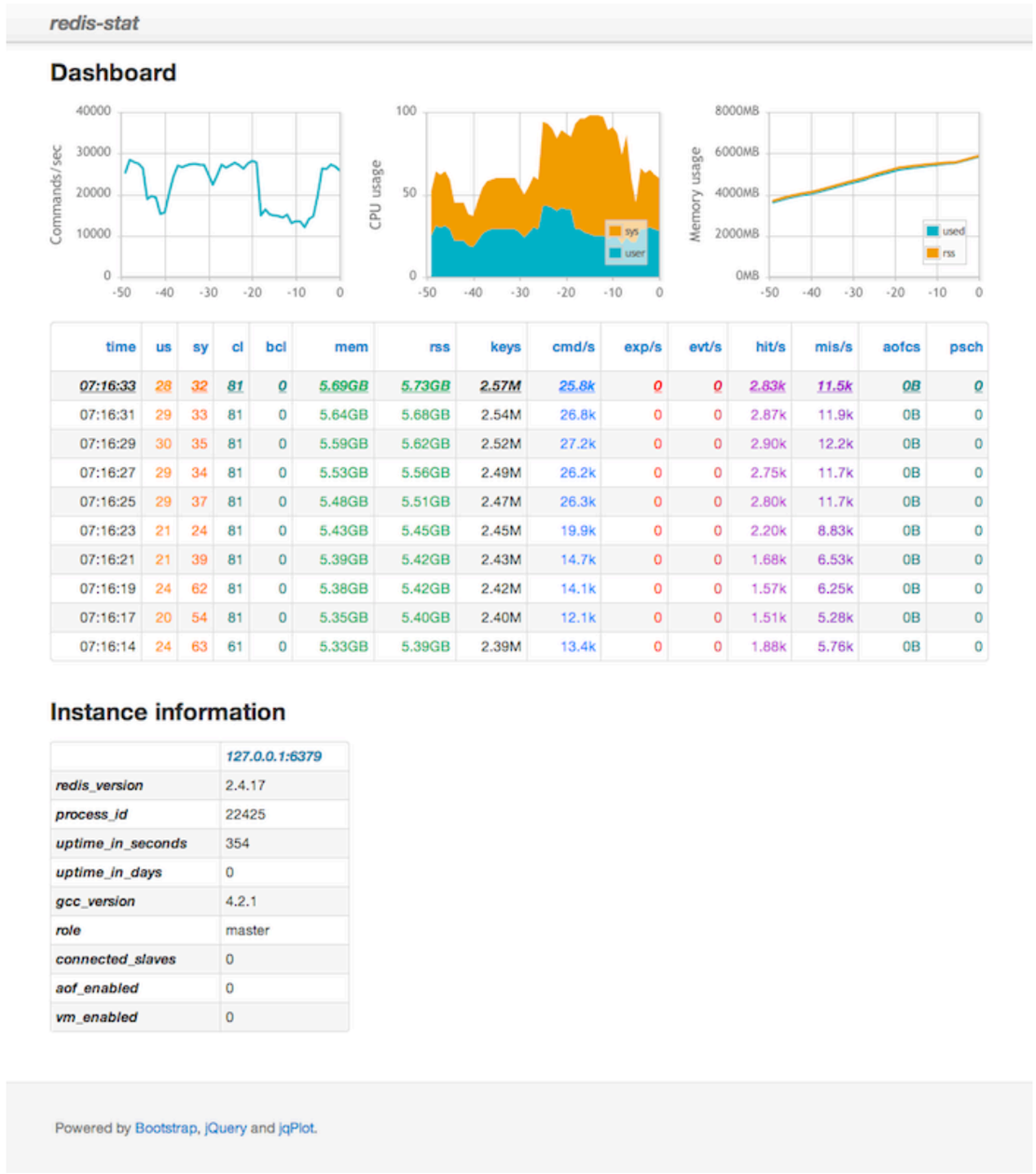
https://github.com/steelThread/redmon

Redis Live



https://github.com/nkrode/RedisLive

Redis-stat

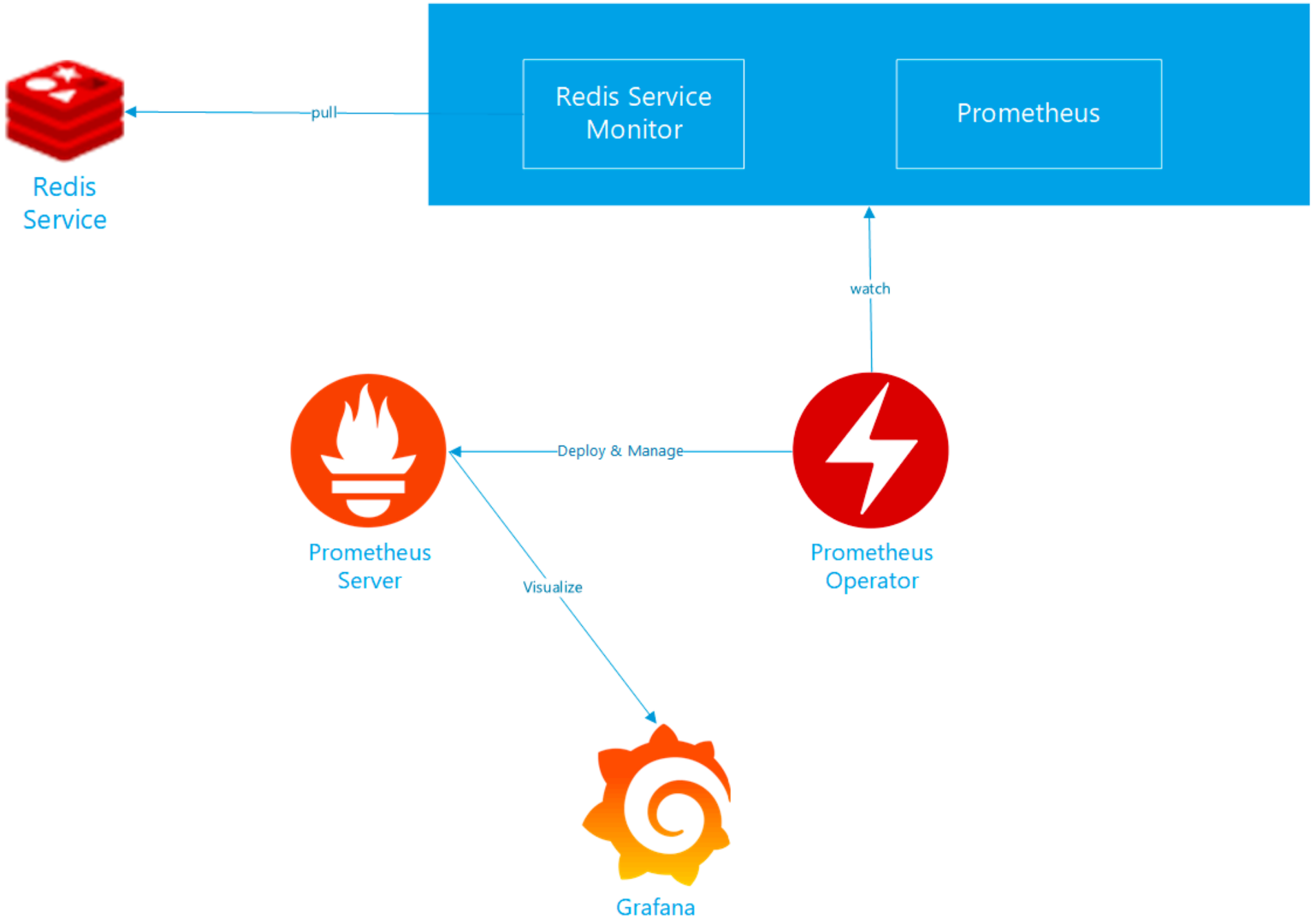


time	us	sy	cl	bcl	mem	rss	keys	cmd/s	exp/s	evt/s	hit/s	mis/s	aofcs	psch
07:16:33	28	32	81	0	5.69GB	5.73GB	2.57M	25.8k	0	0	2.83k	11.5k	0B	0
07:16:31	29	33	81	0	5.64GB	5.68GB	2.54M	26.8k	0	0	2.87k	11.9k	0B	0
07:16:29	30	35	81	0	5.59GB	5.62GB	2.52M	27.2k	0	0	2.90k	12.2k	0B	0
07:16:27	29	34	81	0	5.53GB	5.56GB	2.49M	26.2k	0	0	2.75k	11.7k	0B	0
07:16:25	29	37	81	0	5.48GB	5.51GB	2.47M	26.3k	0	0	2.80k	11.7k	0B	0
07:16:23	21	24	81	0	5.43GB	5.45GB	2.45M	19.9k	0	0	2.20k	8.83k	0B	0
07:16:21	21	39	81	0	5.39GB	5.42GB	2.43M	14.7k	0	0	1.68k	6.53k	0B	0
07:16:19	24	62	81	0	5.38GB	5.42GB	2.42M	14.1k	0	0	1.57k	6.25k	0B	0
07:16:17	20	54	81	0	5.35GB	5.40GB	2.40M	12.1k	0	0	1.51k	5.28k	0B	0
07:16:14	24	63	61	0	5.33GB	5.39GB	2.39M	13.4k	0	0	1.88k	5.76k	0B	0

	127.0.0.1:6379
redis_version	2.4.17
process_id	22425
uptime_in_seconds	354
uptime_in_days	0
gcc_version	4.2.1
role	master
connected_slaves	0
aof_enabled	0
vm_enabled	0

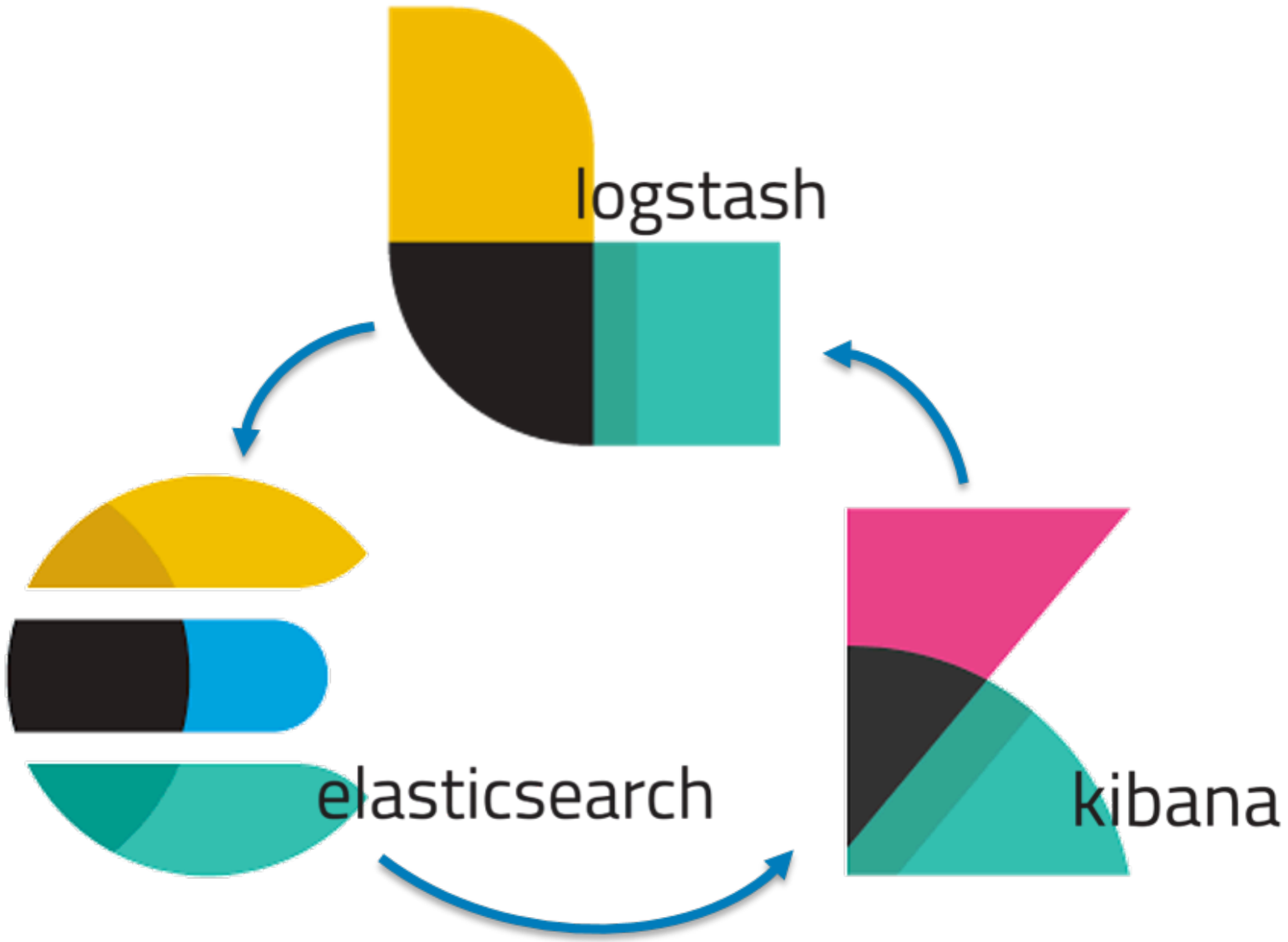
https://github.com/junegunn/redis-stat

Workshop Redis Monitoring

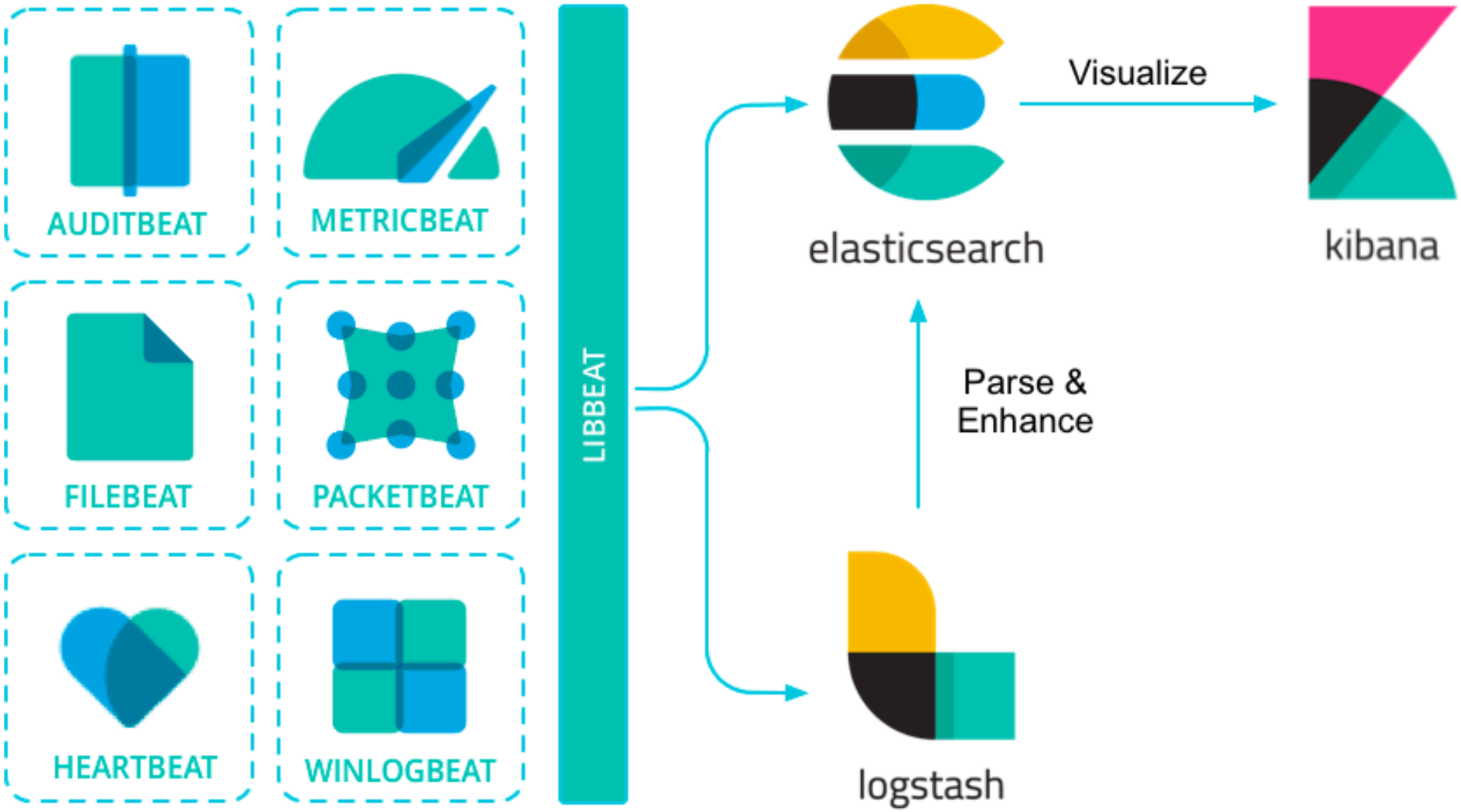


Workshop Redis Monitoring

ELK stack



Beat

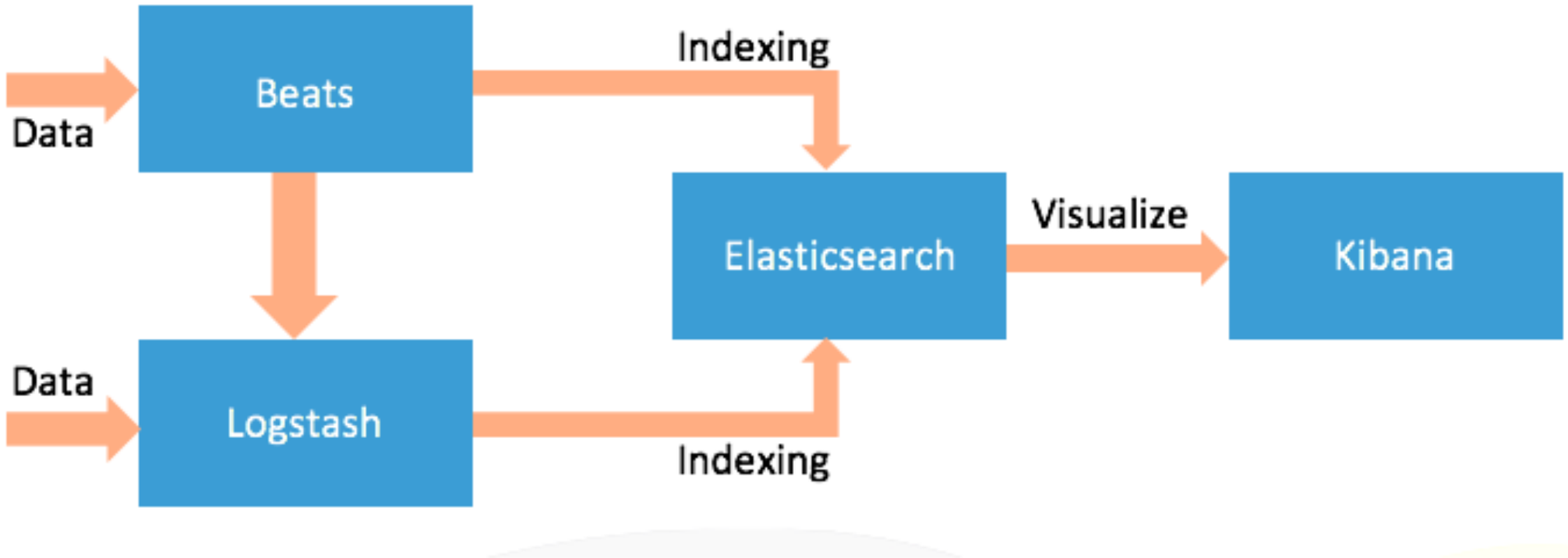


https://www.elastic.co/guide/en/beats/libbeat/current/index.html

Beat

Purpose	Library
Audit data	Auditbeat
Log files	Filebeat
Cloud data	Functionbeat
Availability	Heartbeat
Metrics	Metricbeat
Network traffic	Packetbeat
Windows event logs	Winlogbeat

ELK stack



Elasticsearch ?

Elasticsearch

Search

Analytic

Real-time

Distributed

Distributed Search Engine

Open Source
Document-based
Based on Apache Lucene
JSON over HTTP

Document based

JSON (JavaScript Object Notation)
Dynamic Schema
Some relationship (nested, parent/child)

StackOverflow Question


```
{
  "items": [
    {
      "owner": {
        "reputation": 13,
        "user_id": 9796344,
        "user_type": "registered",
        "profile_image": "",
        "display_name": "Cherry",
        "link": "https://stackoverflow.com/users/9796344/cherry"
      },
      "score": 0,
      "last_activity_date": 1528986761,
      "creation_date": 1528986761,
      "post_type": "question",
      "post_id": 50859951,
      "link": "https://stackoverflow.com/q/50859951"
    }
  ],
  "has_more": false,
  "quota_max": 10000,
  "quota_remaining": 9986
}
```


https://api.stackexchange.com/docs/posts-by-ids

Database ranking

351 systems in ranking, August 2019

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9.	9.	9.	Microsoft Access	Relational	135.33	-1.98	+6.24
10.	10.	10.	Cassandra	Wide column	125.21	-1.80	+5.63

https://db-engines.com/en/ranking

Installation

Elasticsearch
Kibana

Elasticsearch

Required Java 8
JDK 1.8.0_131+
Need $JAVA_HOME

Start Elasticsearch

$./bin/elasticsearch

```
[0g8-71W] loaded module [reindex]
[0g8-71W] loaded module [repository-url]
[0g8-71W] loaded module [transport-netty4]
[0g8-71W] loaded module [tribe]
[0g8-71W] no plugins loaded
[0g8-71W] using discovery type [zen]
initialized
[0g8-71W] starting ...
[0g8-71W] publish_address {127.0.0.1:9300},
[0g8-71W] recovered [0] indices into cluster_state
ansport] [0g8-71W] publish_address {127.0.0.1:9200},
```

Default of Memory

1 GB !!! (Java need more memory)

```
    ] [DW5j42N] JVM arguments [-Xms1g, -Xmx1g, -
ction=75, -XX:+UseCMSInitiatingOccupancyOnly, -XX
Dfile.encoding=UTF-8, -Djna.nosys=true, -XX:-Omit
.netty.noKeySetOptimization=true, -Dio.netty.recy
led=false, -Dlog4j2.disable.jmx=true, -Djava.io.t
T/elasticsearch.G4kbTLZn, -XX:+HeapDumpOnOutOfMem
s_err_pid%p.log, -Xlog:gc*,gc+age=trace,safepoint
ize=64m, -Djava.locale.providers=COMPAT, -XX:UseA
```

Config of JVM

$ES_HOME/config/jvm.options

```
# Xms represents the initial size of total heap space
# Xmx represents the maximum size of total heap space

-Xms1g
-Xmx1g
```

Default plugins

```
[o.e.p.PluginsService     ] [DW5j42N] loaded module [aggs-matrix-stats]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [analysis-common]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [ingest-common]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [lang-expression]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [lang-mustache]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [lang-painless]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [mapper-extras]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [parent-join]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [percolator]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [rank-eval]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [reindex]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [repository-url]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [transport-netty4]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [tribe]
```

Install X-Pack by default

```
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-core]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-deprecation]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-graph]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-logstash]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-ml]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-monitoring]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-rollup]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-security]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-sql]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-upgrade]
[o.e.p.PluginsService     ] [DW5j42N] loaded module [x-pack-watcher]
[o.e.p.PluginsService     ] [DW5j42N] no plugins loaded
```

https://www.elastic.co/guide/en/elasticsearch/reference/current/installing-xpack-es.html

X-Pack ?

Elastic Stack Extension
Security
Monitoring
Alerting
Reporting
Machine Learning

Hello Elasticsearch

http://localhost:**9200**/


```
{
  "name": "DW5j42N",
  "cluster_name": "elasticsearch",
  "cluster_uuid": "boIZeF6MSHyxZ2owIG66rg",
  "version": {
    "number": "6.4.2",
    "build_flavor": "default",
    "build_type": "tar",
    "build_hash": "04711c2",
    "build_date": "2018-09-26T13:34:09.098244Z",
    "build_snapshot": false,
    "lucene_version": "7.4.0",
    "minimum_wire_compatibility_version": "5.6.0",
    "minimum_index_compatibility_version": "5.0.0"
  },
  "tagline": "You Know, for Search"
}
```


```
{
    name: "19f9aJW",
    cluster_name: "elasticsearch",
    cluster_uuid: "jGPzn4phQOWck81uuGDUNQ",
  - version: {
        number: "6.5.4",
        build_flavor: "default",
        build_type: "tar",
        build_hash: "d2ef93d",
        build_date: "2018-12-17T21:17:40.758843Z",
        build_snapshot: false,
        lucene_version: "7.5.0",
        minimum_wire_compatibility_version: "5.6.0",
        minimum_index_compatibility_version: "5.0.0"
    },
    tagline: "You Know, for Search"
}
```


Name of node and cluster


```
{
  name: "19f9aJW",
  cluster_name: "elasticsearch",
  cluster_uuid: "jGPzn4phQOWck81uuGDUNQ",
- version: {
      number: "6.5.4",
      build_flavor: "default",
      build_type: "tar",
      build_hash: "d2ef93d",
      build_date: "2018-12-17T21:17:40.758843Z",
      build_snapshot: false,
      lucene_version: "7.5.0",
      minimum_wire_compatibility_version: "5.6.0",
      minimum_index_compatibility_version: "5.0.0"
  },
  tagline: "You Know, for Search"
}
```


Name of node and cluster

$ES_HOME/config/elasticsearch.yml

```
# ---------------------------------- Cluster -----------------------------
#
# Use a descriptive name for your cluster:
#
cluster.name: my-application
#
# ------------------------------------ Node ------------------------------
#
# Use a descriptive name for the node:
#
node.name: node-1
#
# Add custom attributes to the node:
#
#node.attr.rack: r1
#
```

Change in Elasticsearch 7.x

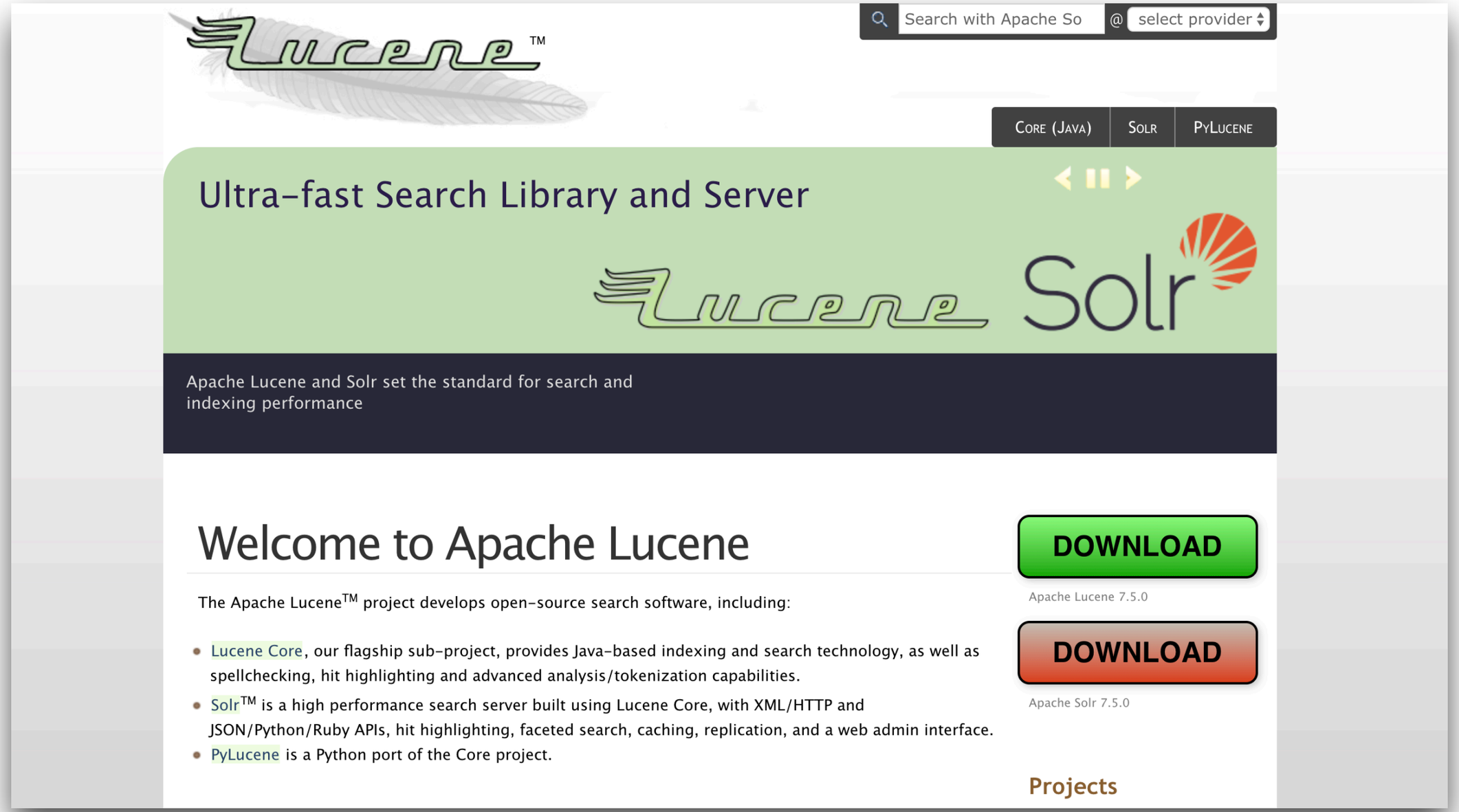
Default name = Hostname

https://www.elastic.co/guide/en/elasticsearch/reference/master/breaking-changes-7.0.html

Try to change and restart !!!

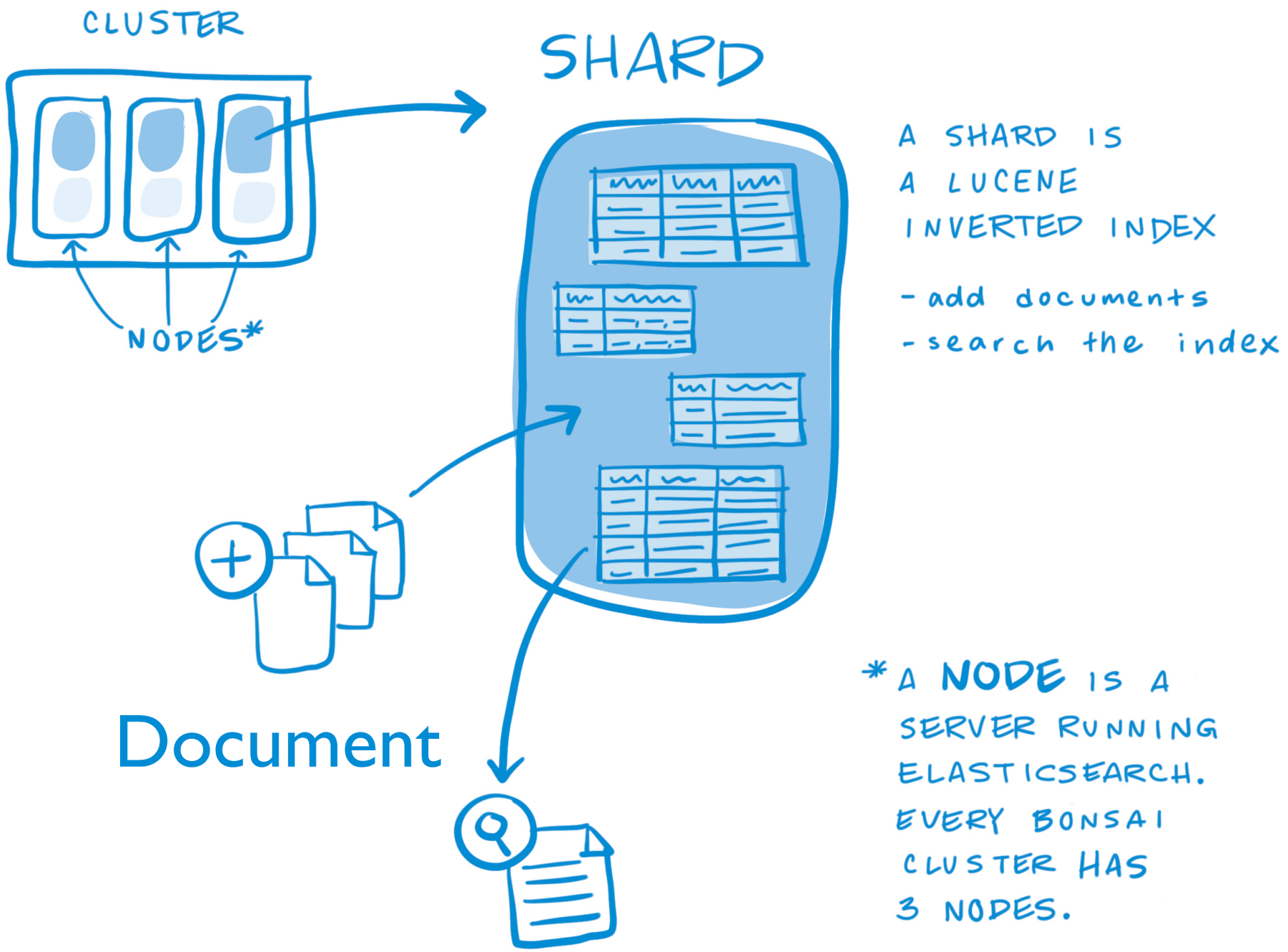
```
{
    name: "19f9aJW",
    cluster_name: "elasticsearch",
    cluster_uuid: "jGPzn4phQOWck81uuGDUNQ",
  - version: {
        number: "6.5.4",
        build_flavor: "default",
        build_type: "tar",
        build_hash: "d2ef93d",
        build_date: "2018-12-17T21:17:40.758843Z",
        build_snapshot: false,
        lucene_version: "7.5.0",
        minimum_wire_compatibility_version: "5.6.0",
        minimum_index_compatibility_version: "5.0.0"
    },
    tagline: "You Know, for Search"
}
```

Apache Lucene

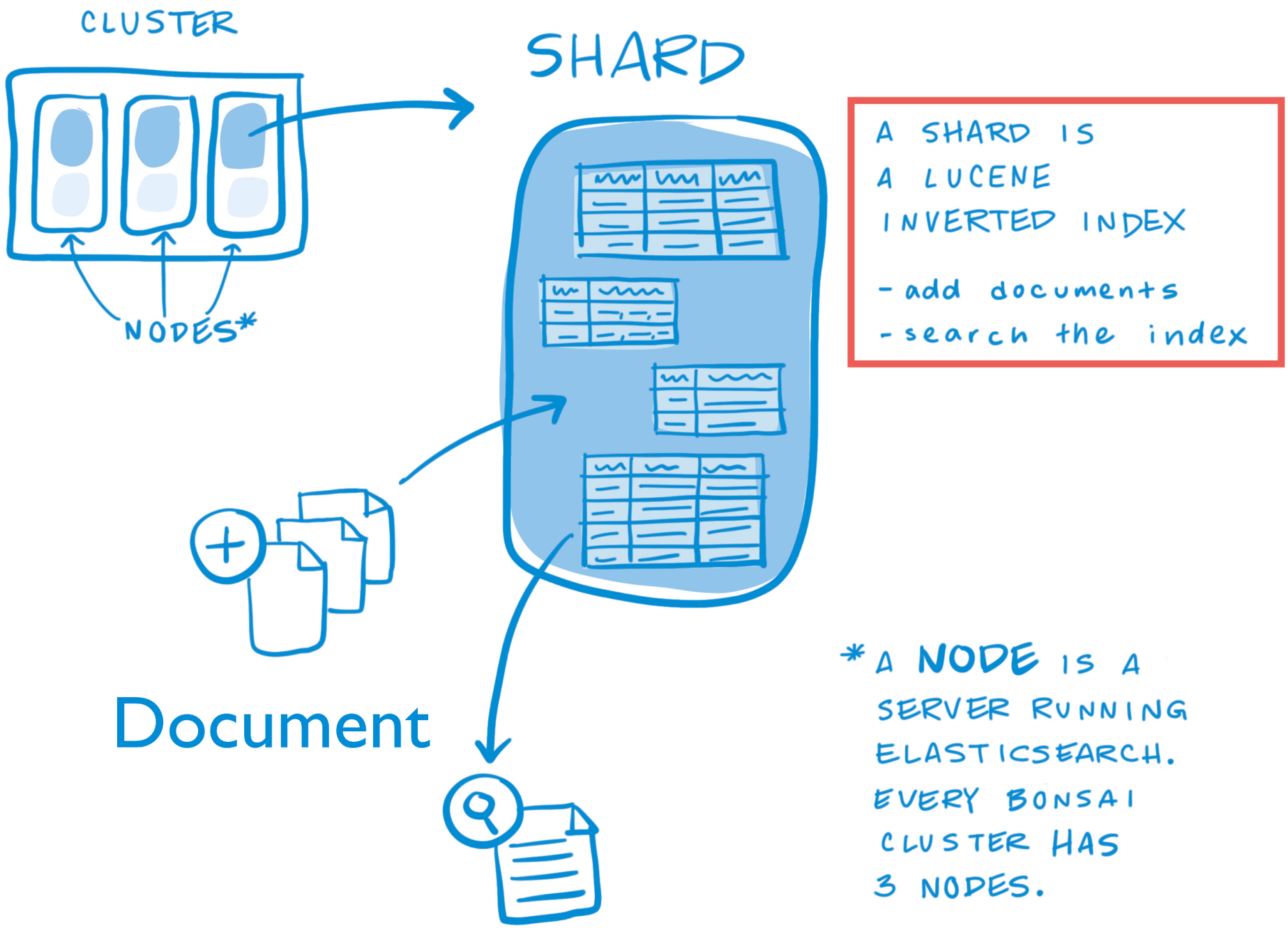


http://lucene.apache.org/

Basic concepts

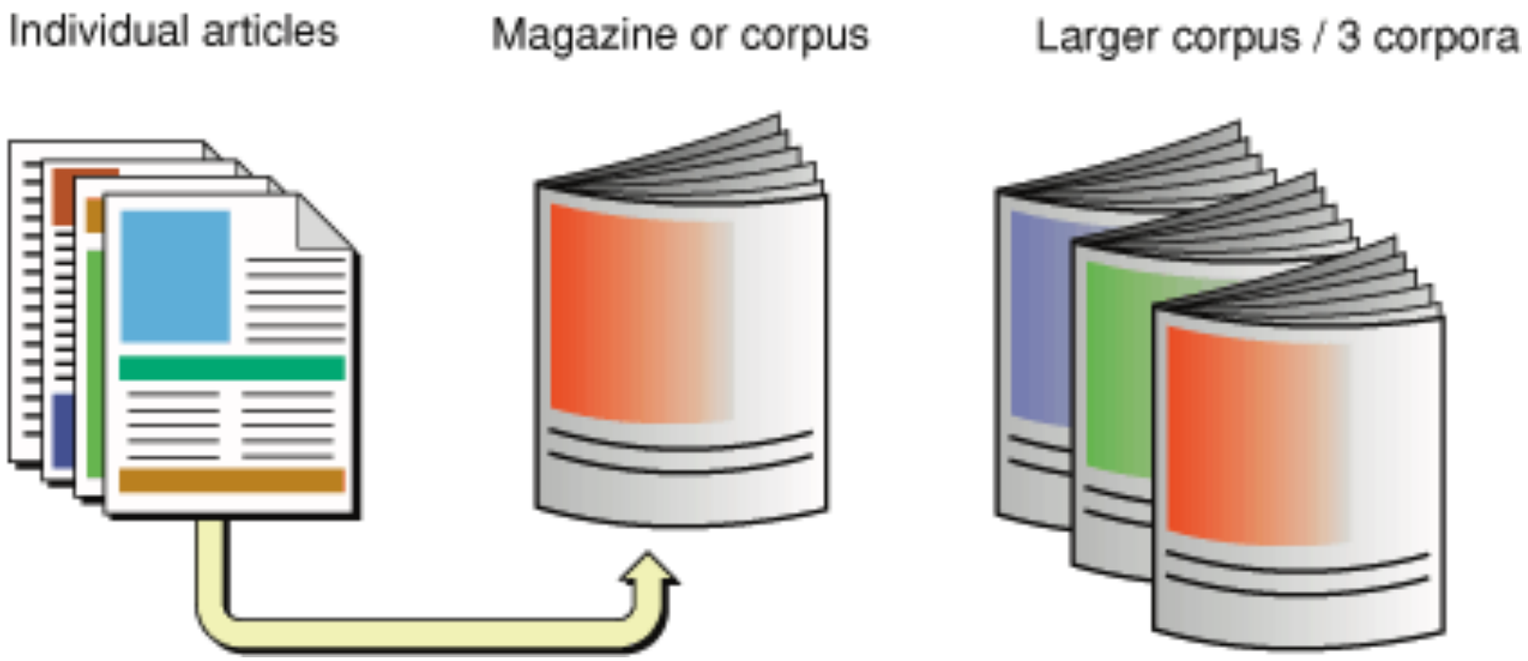


Basic concepts



Inverted Index

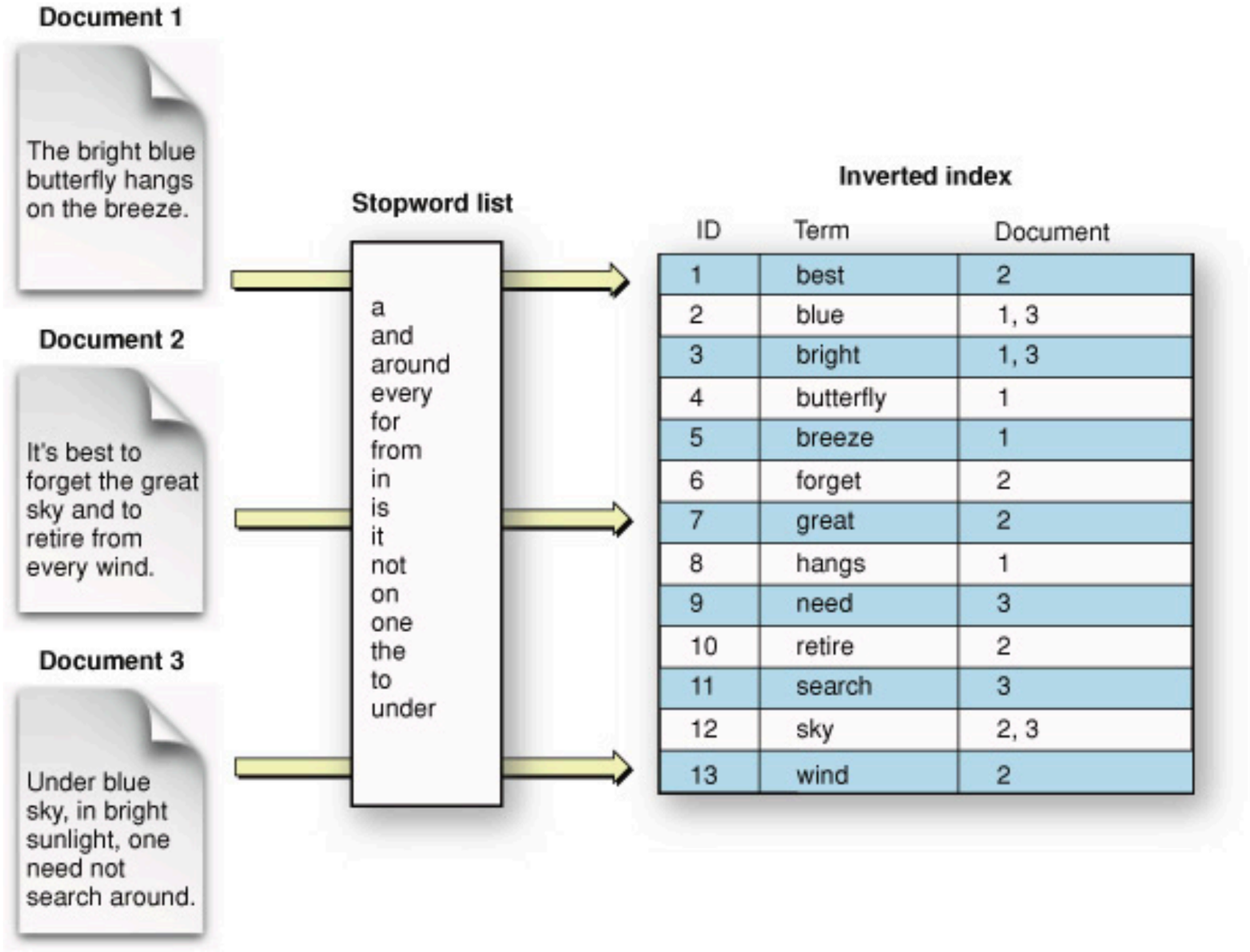
Corpus is a collection of documents



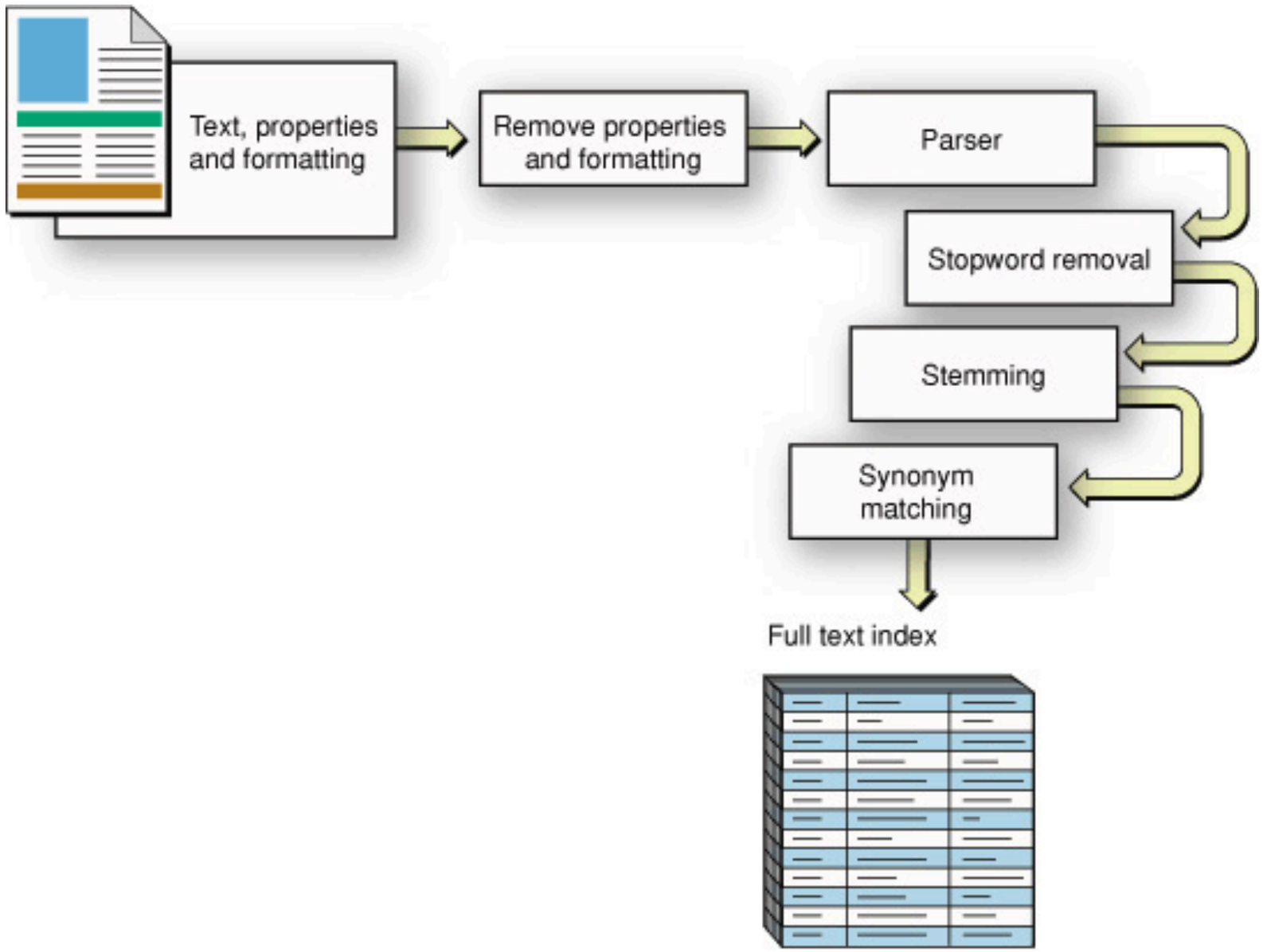
https://developer.apple.com/library/archive/documentation/UserExperience/Conceptual/SearchKitConcepts/searchKit_basics/searchKit_basics.html#//apple_ref/doc/uid/TP40002843-TPXREF101

Inverted Index

Try to construct index



Text extraction



```
{
    name: "19f9aJW",
    cluster_name: "elasticsearch",
    cluster_uuid: "jGPzn4phQOWck81uuGDUNQ",
  - version: {
        number: "6.5.4",
        build_flavor: "default",
        build_type: "tar",
        build_hash: "d2ef93d",
        build_date: "2018-12-17T21:17:40.758843Z",
        build_snapshot: false,
        lucene_version: "7.5.0",
        minimum_wire_compatibility_version: "5.6.0",
        minimum_index_compatibility_version: "5.0.0"
    },
    tagline: "You Know, for Search"
}
```

DSL version

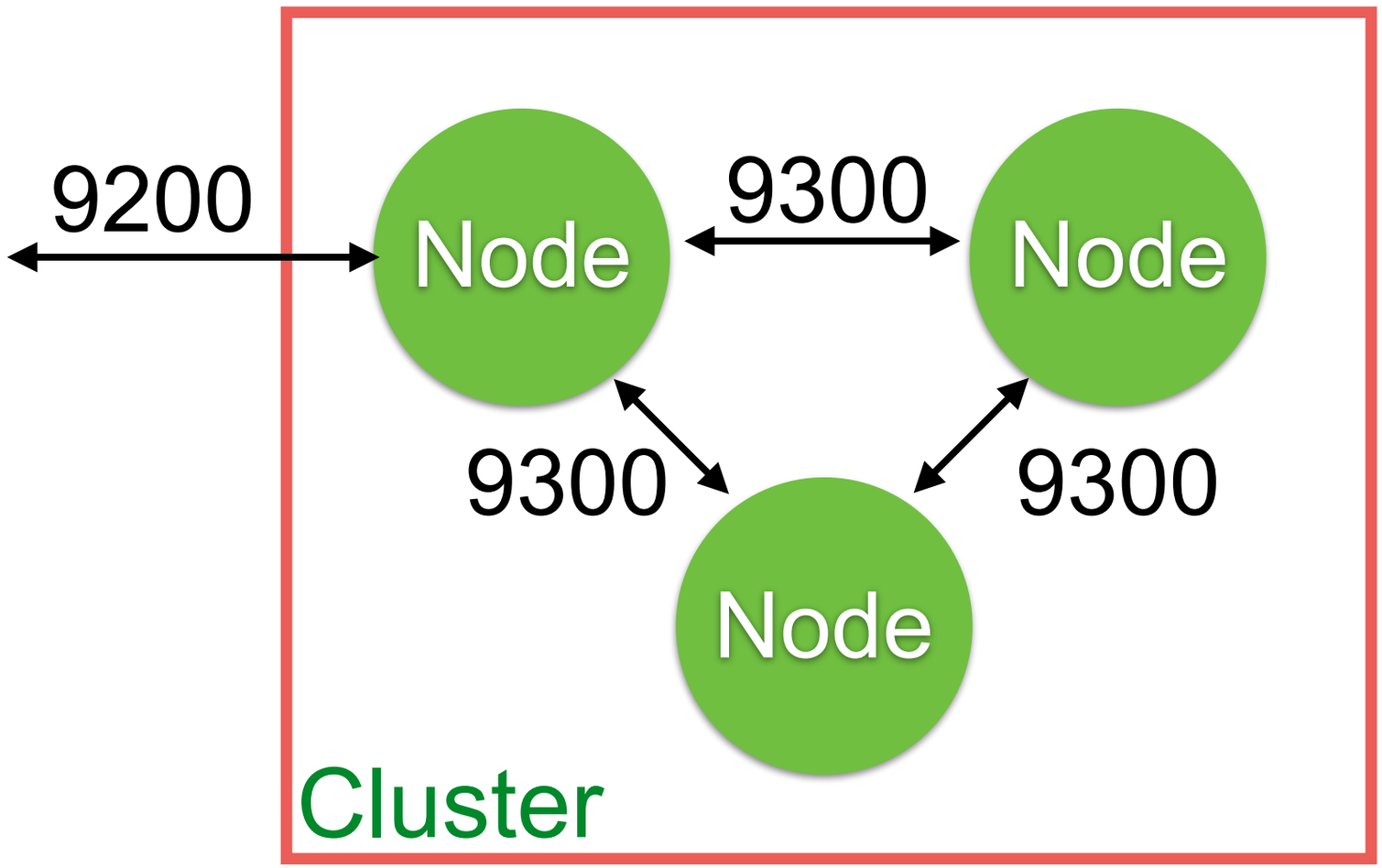
Index version

```
{
    name: "19f9aJW",
    cluster_name: "elasticsearch",
    cluster_uuid: "jGPzn4phQOWck81uuGDUNQ",
  - version: {
        number: "6.5.4",
        build_flavor: "default",
        build_type: "tar",
        build_hash: "d2ef93d",
        build_date: "2018-12-17T21:17:40.758843Z",
        build_snapshot: false,
        lucene_version: "7.5.0",
        minimum_wire_compatibility_version: "5.6.0",
        minimum_index_compatibility_version: "5.0.0"
    },
    tagline: "You Know, for Search"
}
```

Index version

Ports of Elasticsearch

RESTful API with JSON Over HTTP (9200)
Java API (9300)



Health of cluster

http://localhost:9200/_cluster/health


```
{
  "cluster_name": "elasticsearch",
  "status": "green",
  "timed_out": false,
  "number_of_nodes": 1,
  "number_of_data_nodes": 1,
  "active_primary_shards": 0,
  "active_shards": 0,
  "relocating_shards": 0,
  "initializing_shards": 0,
  "unassigned_shards": 0,
  "delayed_unassigned_shards": 0,
  "number_of_pending_tasks": 0,
  "number_of_in_flight_fetch": 0,
  "task_max_waiting_in_queue_millis": 0,
  "active_shards_percent_as_number": 100.0
}
```


Health of cluster

Status	Meaning
Green	All shards are allocated
Yellow	Primary shard is allocated, but replicas are not
Red	Shard not allocated in the cluster

cat APIs

http://localhost:9200/_cat

```
=^.^=
/_cat/allocation
/_cat/shards
/_cat/shards/{index}
/_cat/master
/_cat/nodes
/_cat/tasks
/_cat/indices
/_cat/indices/{index}
/_cat/segments
/_cat/segments/{index}
/_cat/count
/_cat/count/{index}
/_cat/recovery
/_cat/recovery/{index}
/_cat/health
/_cat/pending_tasks
/_cat/aliases
/_cat/aliases/{alias}
```

https://www.elastic.co/guide/en/elasticsearch/reference/current/cat.html

cat APIs

http://localhost:9200/_cat/nodes?v

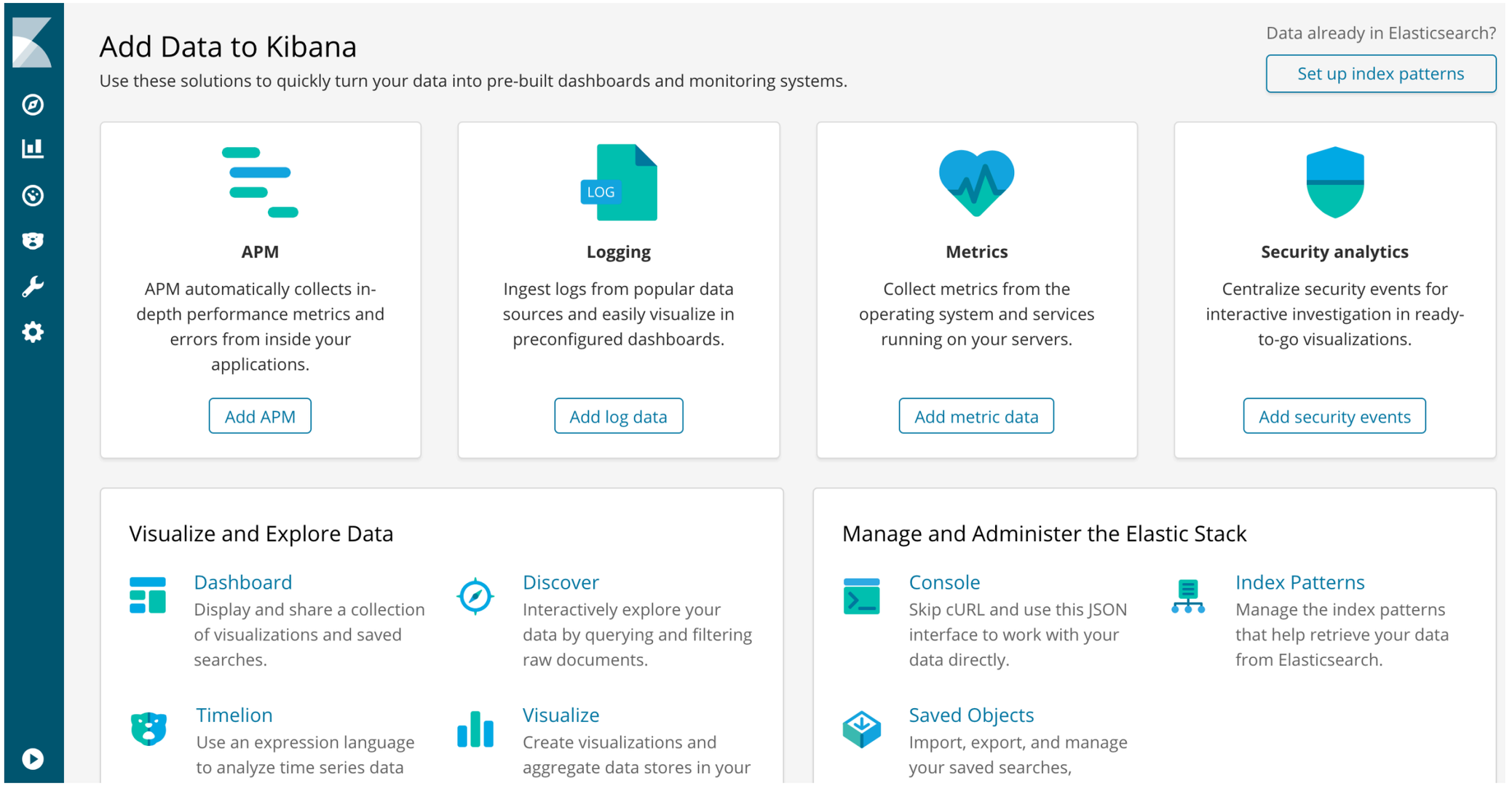
```
ip        heap.percent ram.percent cpu load_1m load_5m load_15m node.role master name
127.0.0.1           20         100   7    1.98                  mdi       *      DW5j42N
```

Start Kibana

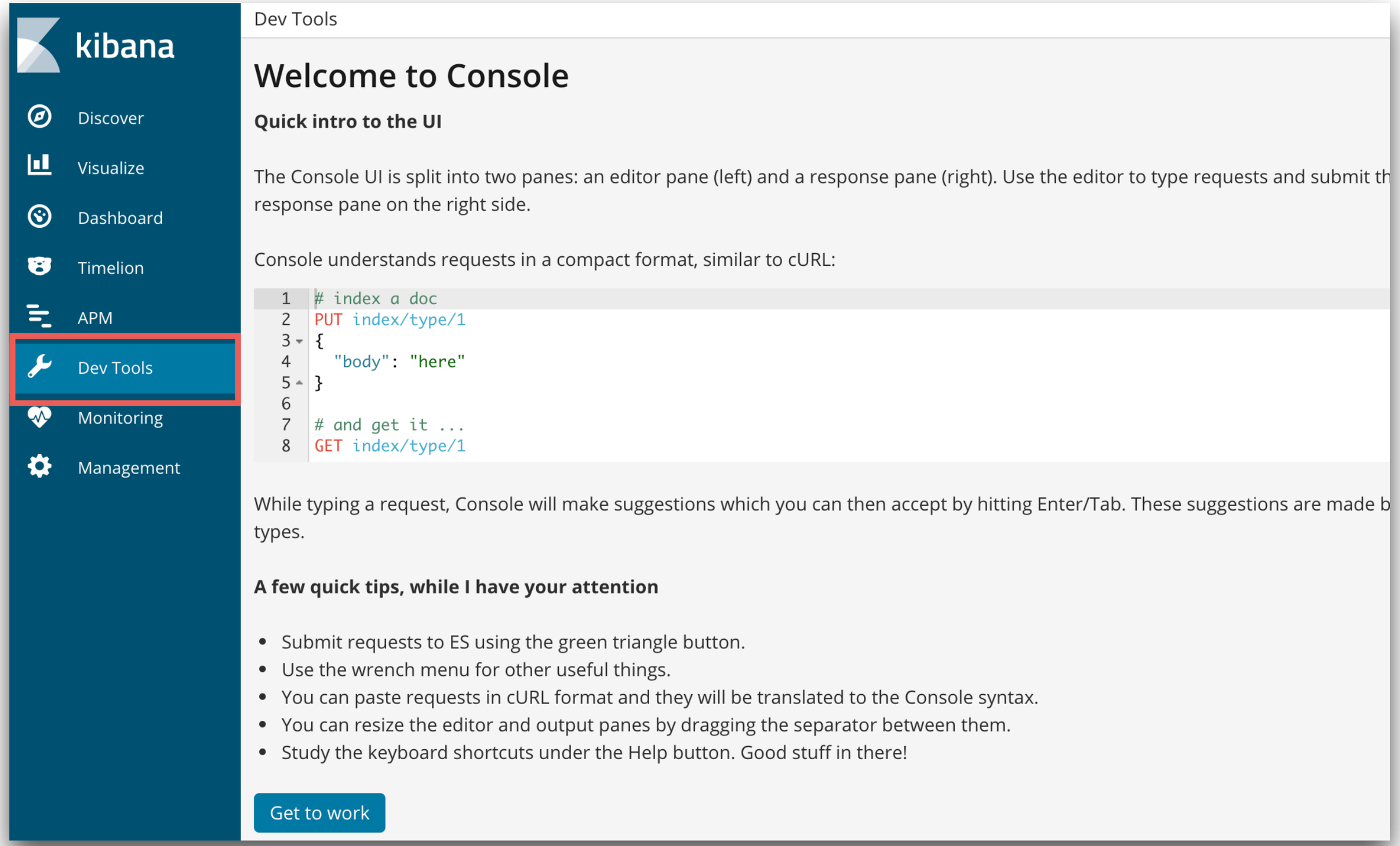
```
[status][plugin:xpack_main@6.4.2] Status changed from yellow to green - Ready
[status][plugin:searchprofiler@6.4.2] Status changed from yellow to green - Ready
[status][plugin:ml@6.4.2] Status changed from yellow to green - Ready
[status][plugin:tilemap@6.4.2] Status changed from yellow to green - Ready
[status][plugin:watcher@6.4.2] Status changed from yellow to green - Ready
[status][plugin:index_management@6.4.2] Status changed from yellow to green - Rea

[status][plugin:graph@6.4.2] Status changed from yellow to green - Ready
[status][plugin:grokdebugger@6.4.2] Status changed from yellow to green - Ready
[status][plugin:logstash@6.4.2] Status changed from yellow to green - Ready
[status][plugin:reporting@6.4.2] Status changed from yellow to green - Ready
[kibana-monitoring][monitoring-ui] Starting monitoring stats collection
[status][plugin:security@6.4.2] Status changed from yellow to green - Ready
[license][xpack] Imported license information from Elasticsearch for the [monitor
tatus: active
[listening][server][http] Server running at http://localhost:5601
```

Hello Kibana

http://localhost:**5601**/



Using Dev Tools



Ready to start

kibana

Discover
Visualize
Dashboard
Timelion
APM
Dev Tools
Monitoring
Management

Dev Tools

Console | Search Profiler | Grok Debugger

```
GET _search
{
  "query": {
    "match_all": {}
  }
}
```

```
{
  "took": 0,
  "timed_out": false,
  "_shards": {
    "total": 1,
    "successful": 1,
    "skipped": 0,
    "failed": 0
  },
  "hits": {
    "total": 1,
    "max_score": 1,
    "hits": [
      {
        "_index": ".kibana",
        "_type": "doc",
        "_id": "config:6.4.2",
        "_score": 1,
        "_source": {
          "type": "config",
          "updated_at": "2018-10-26T15:42:26.589Z",
          "config": {
            "buildNum": 18010,
            "telemetry:optIn": false
          }
        }
      }
    ]
  }
}
```

CRUD with Elasticsearch

02-crud/book_document.json

CRUD with Elasticsearch

Create document

Read document

Update document

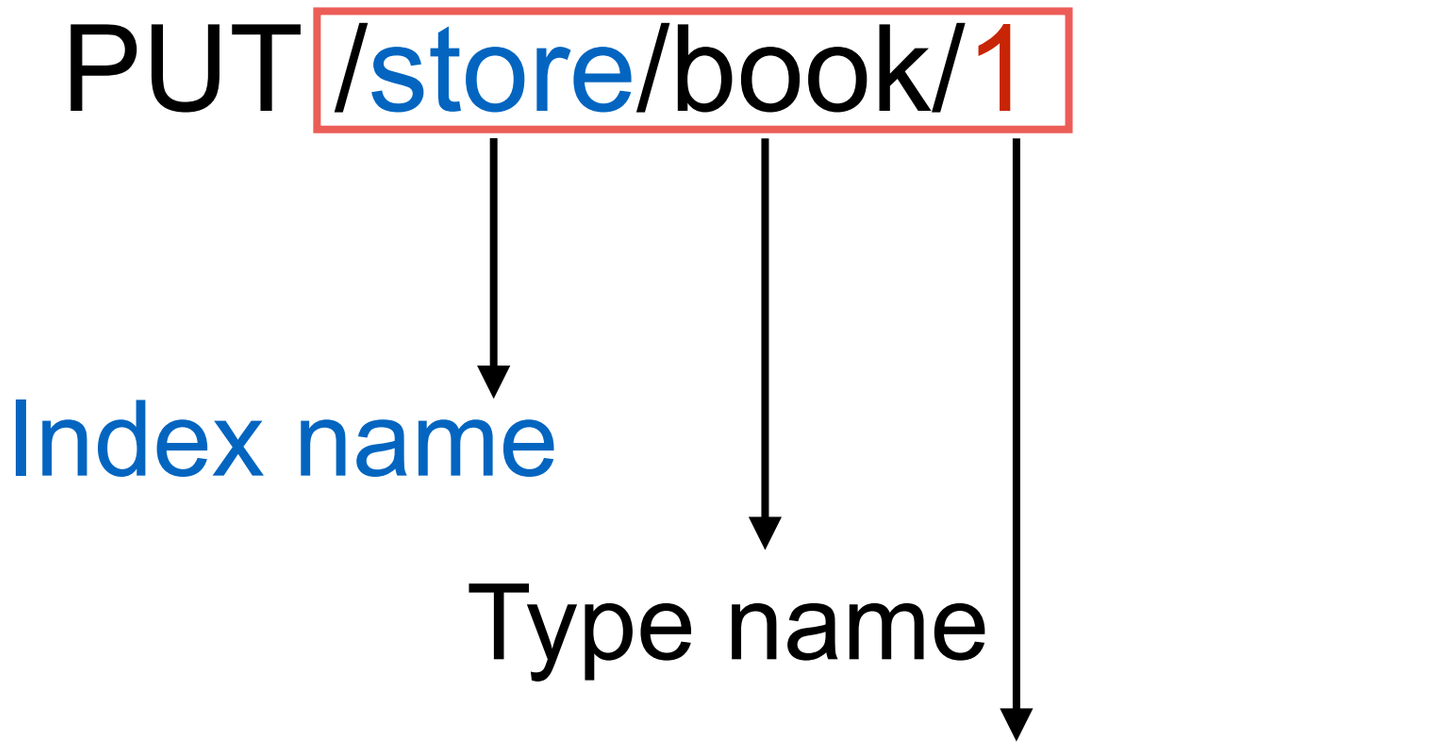
Delete document

Create a document

PUT /store/book/1

```
{
  "title": "Elasticsearch: The Definitive Guide",
  "author_name": [
    "Clinton Gormley",
    "Zachary Tong"
  ],
  "tag": [
    "search",
    "computer"
  ],
  "isbn-13": "978-1449358549",
  "isbn-10": "1449358543",
  "price": 44.3,
  "page": 724,
}
```

Create document



Compare with RDBMS

Database	Table	Row	Column
Index	Type*	Document	Field

** Only 1 type per index*

Change in Elasticsearch 7.x

of shard of index change from 5 to 1

```
#! Deprecation: the default number of shards will change
  from [5] to [1] in 7.0.0; if you wish to continue using
  the default of [5] shards, you must manage this on the
  create index request or with an index template
{
"_index": "store1",
"_type": "book",
"_id": "2",
"_version": 1,
"result": "created",
"_shards": {
```

Read document

GET /store/book/1


```
{
  "_index": "store",
  "_type": "book",
  "_id": "1",
  "_version": 1,
  "found": true,
  "_source": {
    "title": "Elasticsearch: The Definitive Guide",
    "author_name": [
      "Clinton Gormley",
      "Zachary Tong"
    ],
    "tag": [
      "search",
      "computer"
    ]
  }
```


Information of document

Update document

Whole document
Partial document

Update whole document

PUT /store/book/123

```
{
  "title": "Update",
  "author_name": [
    "user1",
    "user2"
  ],
  "tag": [
    "update",
    "book"
  ]
}
```

Update partial document

POST /store/book/123/_update

```
{
  "doc": {
    "title": "partial update",
    "tag": [
      "test",
      "computer"
    ],
    "views": 0
  }
}
```

Delete document

DELETE /store/book/1


```
{
  "_index": "store",
  "_type": "book",
  "_id": "1",
  "_version": 2,
  "result": "deleted",
  "_shards": {
    "total": 2,
    "successful": 1,
    "failed": 0
  },
  "_seq_no": 1,
  "_primary_term": 1
}
```


More features

Update by query
Delete by query
Partial update document

Bulk API

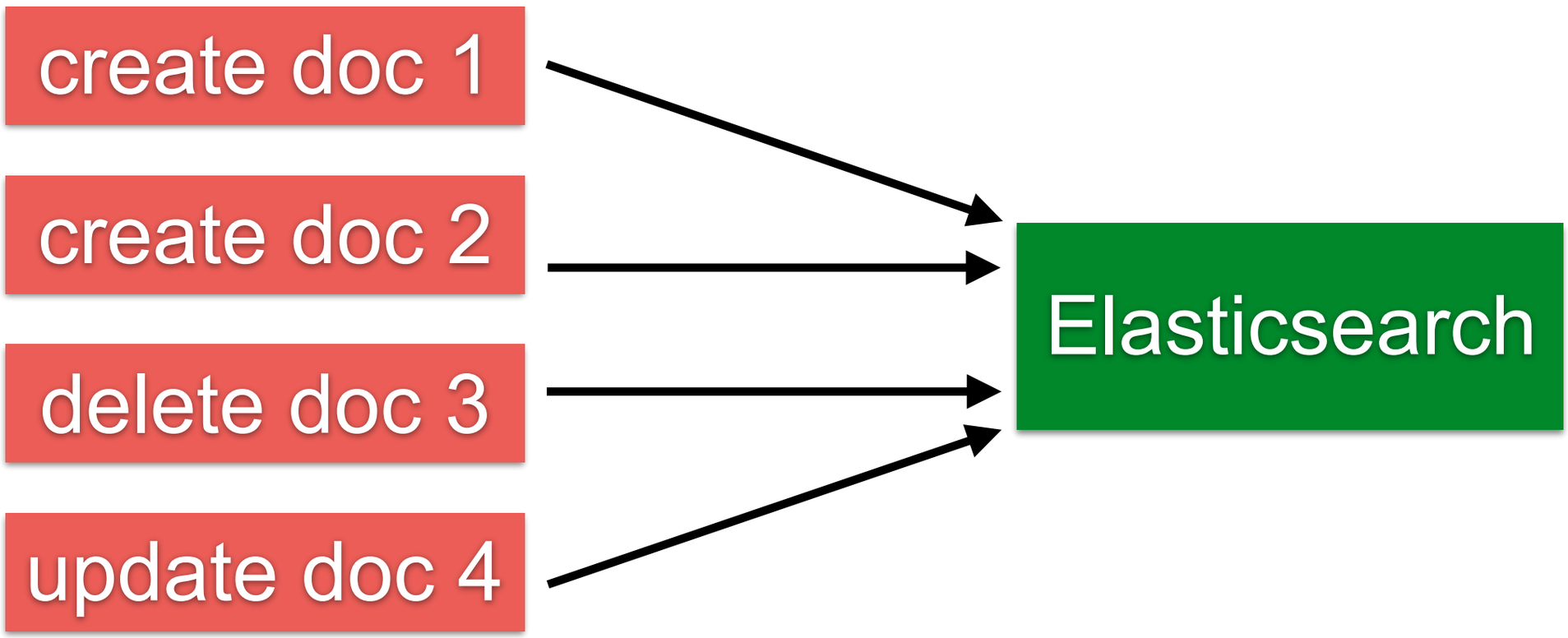
https://www.elastic.co/guide/en/elasticsearch/reference/current/docs-bulk.html

Bulk API

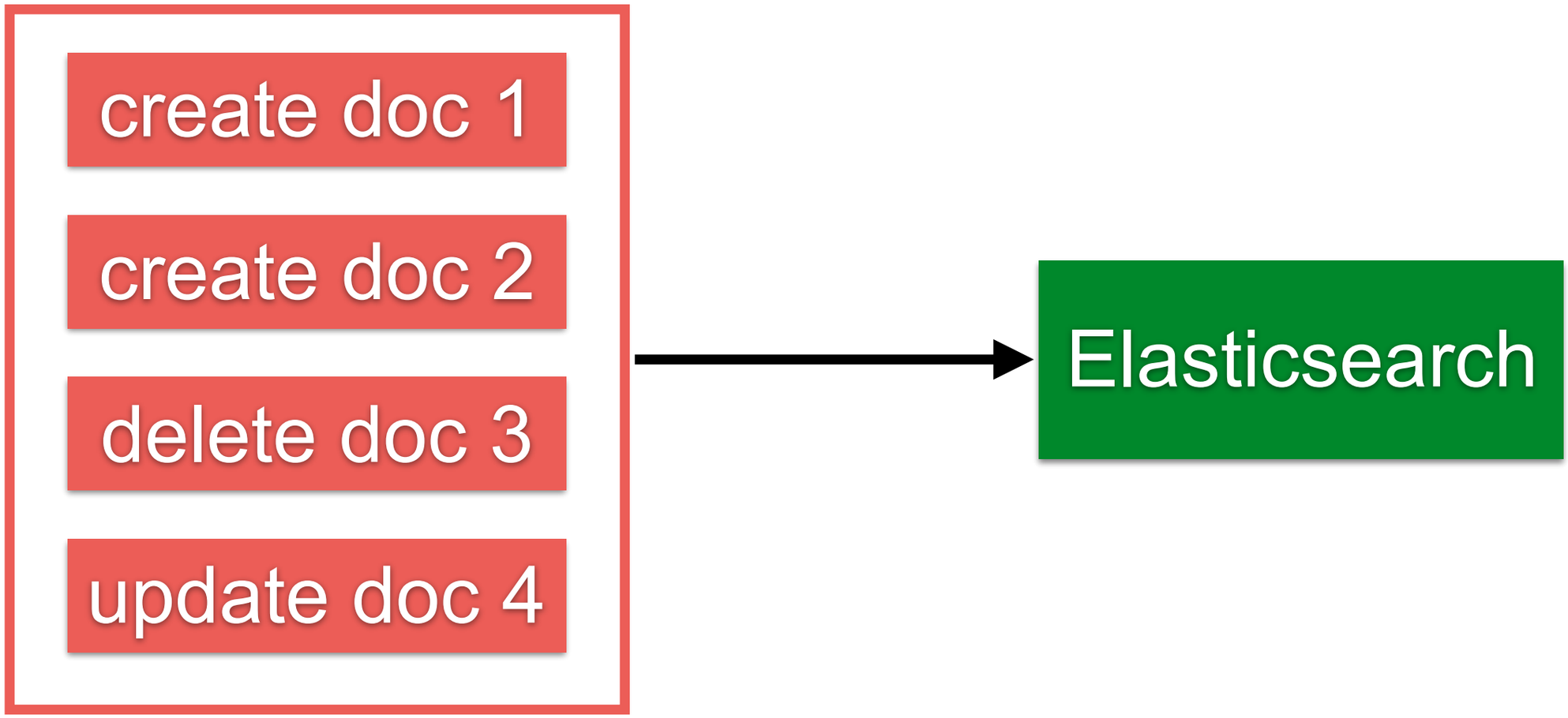
Perform many index/delete operation in single API call

Increase indexing speed

Without Bulk API

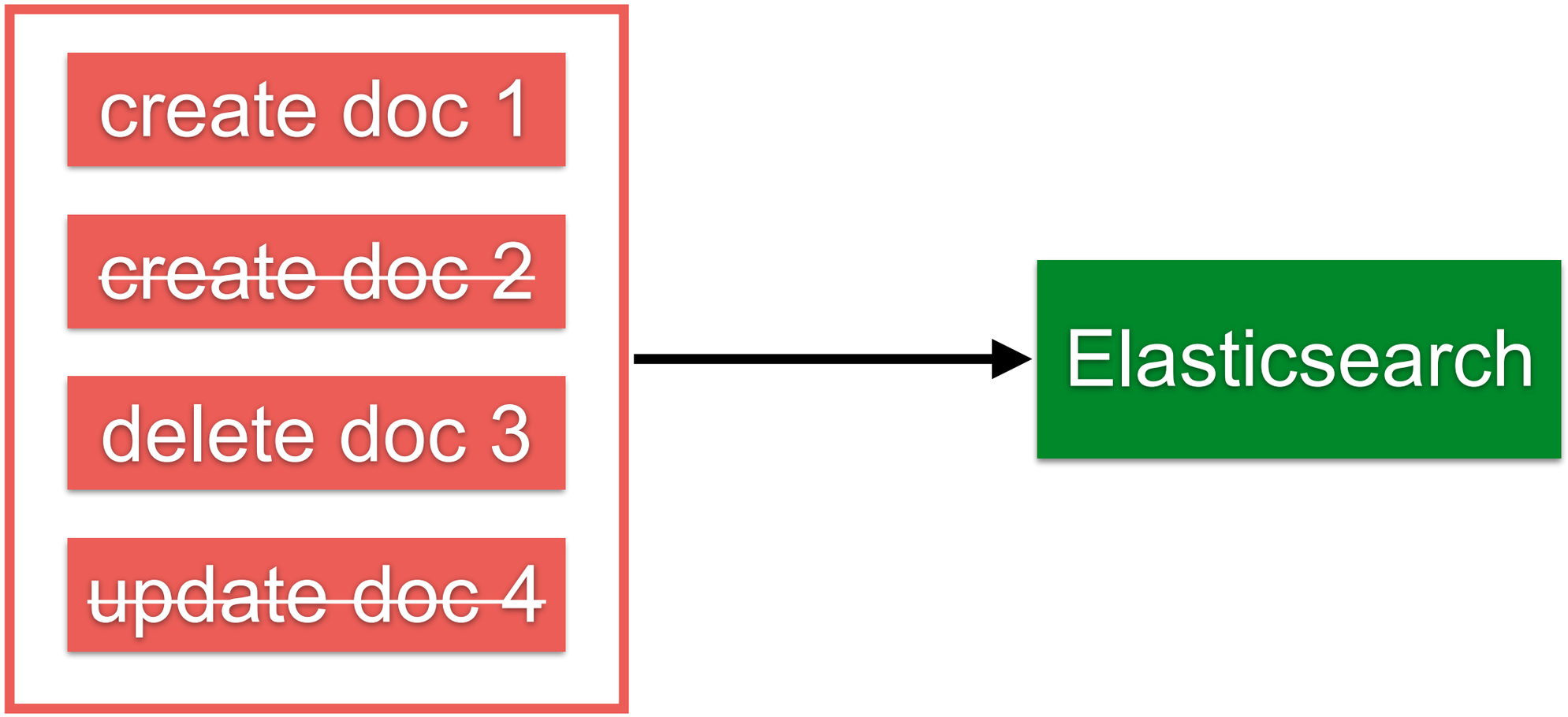


With Bulk API



Store in memory 5-15 MB

No transaction in bulk api



Create a document

POST /store/book/**_bulk**

```
{"create":{"_id":"1001"}}
{"title":"new book 1000","description":"my new book"}
```

Response from Bulk API


```
{
  "took": 89,
  "errors": false,
  "items": [
    {
      "create": {
        "_index": "store",
        "_type": "book",
        "_id": "1001",
        "_version": 1,
        "result": "created",
        "_shards": {
          "total": 2,
          "successful": 1,
          "failed": 0
        },
        "_seq_no": 0,
        "_primary_term": 1,
        "status": 201
```


Time in milliseconds

HTTP Status 201 = Created

Query DSL

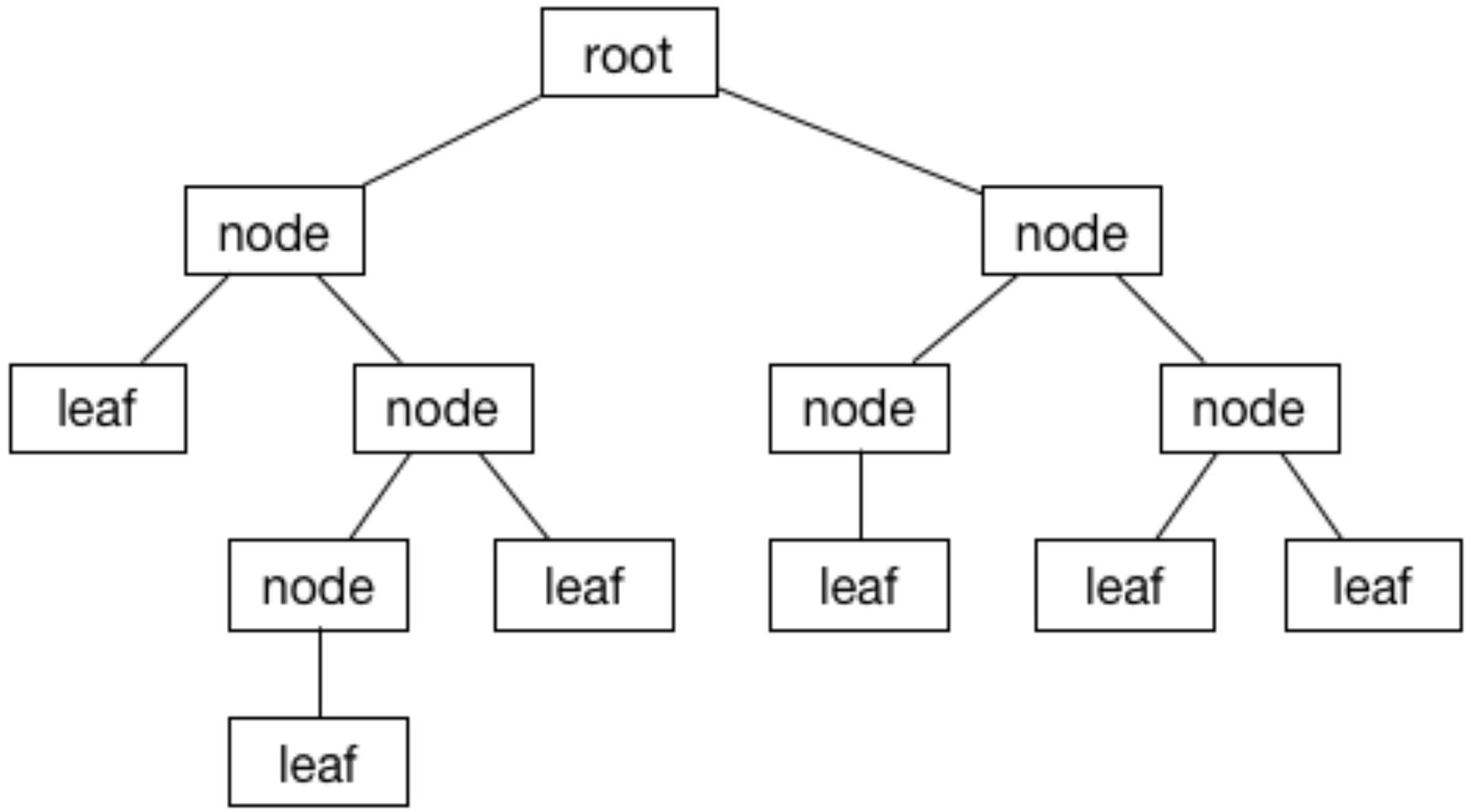
Query DSL

Domain **S**pecific **L**anguage for query data
Flexible query language
Based on JSON format

https://www.elastic.co/guide/en/elasticsearch/reference/current/query-dsl.html

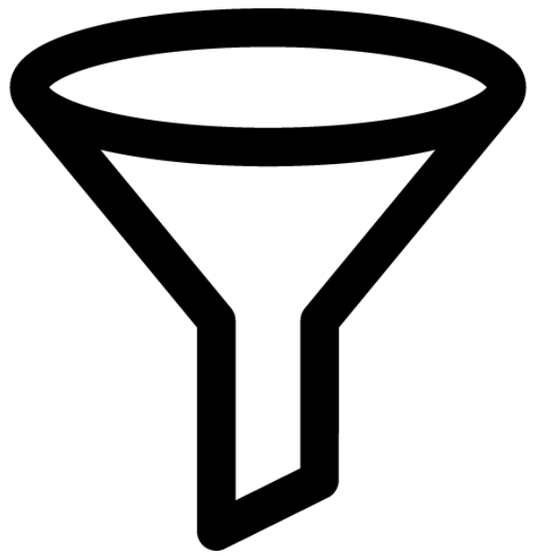
Query DSL

1. Leaf query clause
2. Compound query clause



Query DSL

Query (unstructured data)
Filter (structured data)



Query

Query DSL

Query	Filter
Relevance	Boolean, yes/no
Full text search	Exact values
Not cached	Cached
Slower	Faster

***Filter first**, then query remaining documents*

Query DSL

Full text query
Term level query
Compound query
Joining query
Geo query
Specialized query
Span query

Leaf query clause

GET /store/book/_search

```
{
    "query": {
      "match_all": {}
    }
}
```

Compound query clause

GET /store/book/_search

```
{
   "query": {
      "bool": {
         "must": [{}],
         "should": [{}],
         "must_not": [{}]
      }
   }
}
```

Use case

amazon

All | elasticsearch

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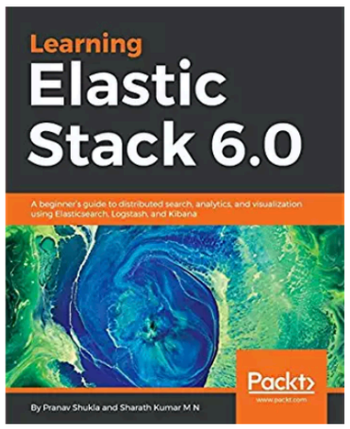

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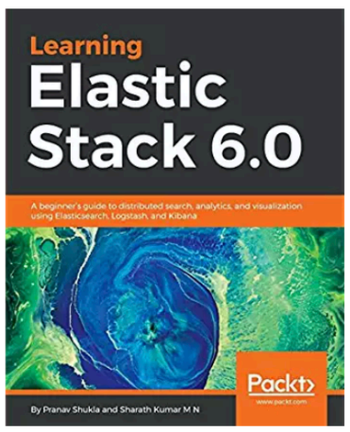

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Aggregation API

https://www.elastic.co/guide/en/elasticsearch/reference/current/search-aggregations.html

```
SELECT count(1), sum(price)
FROM some_table
GROUP BY some_column
```

Aggregation Types

Bucketing

Metric

Matrix

Pipeline

Structure

```
"aggregations" : {
    "<aggregation_name>" : {
        "<aggregation_type>" : {
            <aggregation_body>
        }
        [,"meta" : {  [<meta_data_body>] } ]?
        [,"aggregations" : { [<sub_aggregation>]+ } ]?
    }
    [,"<aggregation_name_2>" : { ... } ]*
}
```

Count by category

GET /store/book/_search

```
{
 "aggs": {
    "all_book_title": {
      "terms": {
        "field": "category.keyword"
      }
    }
  }
}
```

Count by category

GET /store/book/_search

```
{
 "aggs": {
     "all_book_title": {
        "terms": {
          "field": "category.keyword"
        }
     }
  }
}
```

Aggregation name

Count by category

GET /store/book/_search

```
{
 "aggs": {
    "all_book_title": {
     "terms": {
        "field": "category.keyword"
            }
        }
    }
}
```

Aggregation type

Result of aggregation

Search result


```
{
  "hits": {
    "total": 5,
    "max_score": 1,
    "hits": [
      {
        "_source": {
          "title": "The Logstash Book"
        }
      },
      {
        "_source": {
          "title": "Elasticsearch Server: Second Edition"
        }
      }
    ]
  }}
```


Result of aggregation

```
"aggregations": {
  "all_book_title": {
    "doc_count_error_upper_bound": 0,
    "sum_other_doc_count": 0,
    "buckets": [
      {
        "key": "Computer & Technology",
        "doc_count": 5
      },
      {
        "key": "Online Searching",
        "doc_count": 3
      },
      {
        "key": "Java Programming",
        "doc_count": 2
      }
]
```

Aggregation result

Show only aggregation result

GET /store/book/_search

```
{
  "size": 0,
  "aggs": {
    "all_book_title": {
      "terms": {
        "field": "category.keyword"
      }
    }
  }
}
```

Set search result size = 0

Range of price

GET /store/book/_search

```
{
  "size": 0,
  "aggs": {
    "price_range": {
      "range": {
        "field": "price",
        "ranges": [
          { "from": 0,"to": 10 },
          { "from": 11,"to": 20 },
          { "from": 21,"to": 50 }
        ]
      }
    }
  }
}
```

Result of aggregation

```
"buckets": [
    {
      "key": "0.0-10.0",
      "from": 0,
      "to": 10,
      "doc_count": 1
    },
    {
      "key": "11.0-20.0",
      "from": 11,
      "to": 20,
      "doc_count": 0
    },
    {
      "key": "21.0-50.0",
      "from": 21,
      "to": 50,
      "doc_count": 3
    }
```

Range of price and ordering

GET /store/book/_search

```
{
  "size": 0,
  "aggs": {
    "price_range": {
      "range": {
        "field": "price",
        "ranges": [
          { "from": 0,"to": 10 },
          { "from": 11,"to": 20 },
          { "from": 21,"to": 50 }
        ]
      }
    }
  }
}
```

Mapping

https://www.elastic.co/guide/en/elasticsearch/reference/current/mapping.html

Mapping type

Meta-fields
Field or properties

Meta-field

Metadata of document
_index, _type, _id, _source

Field or properties

List of fields or properties of document

Mapping/Schema of document

GET /store/_mapping/book

```
"mappings": {
      "book": {
        "properties": {
          "author_name": {
            "type": "text",
        "fields": {
          "keyword": {
            "type": "keyword",
            "ignore_above": 256
          }
        }
      }
}
```

Mapping/Schema of document

GET /store/_mapping/book

```
"mappings": {
      "book": {
          "page": {
            "type": "long"
          },
          "price": {
            "type": "float"
          },
          "published_date": {
            "type": "date"
          }
      }
  }
}
```

Field Datatypes

text	date
keyword	ip
long	boolean
double	completion
geo_point	geo_shape
array	object
nested	binary

https://www.elastic.co/guide/en/elasticsearch/reference/current/mapping-types.html

Field Datatypes

text	date
keyword	ip
long	boolean
double	completion
geo_point	geo_shape
array	**object**
nested	binary

https://www.elastic.co/guide/en/elasticsearch/reference/current/mapping-types.html

Array

No data type **array** in Elasticsearch

[“name”, “title”]	array of string
[1, 2, 3]	array of integer
[{“name”: “up1”, “age”: 30}]	array of object

Mapping configuration

Maximum number of fields = 1,000

Maximum depth of fields = 20

Maximum depth of nested fields = 50

Dynamic mapping

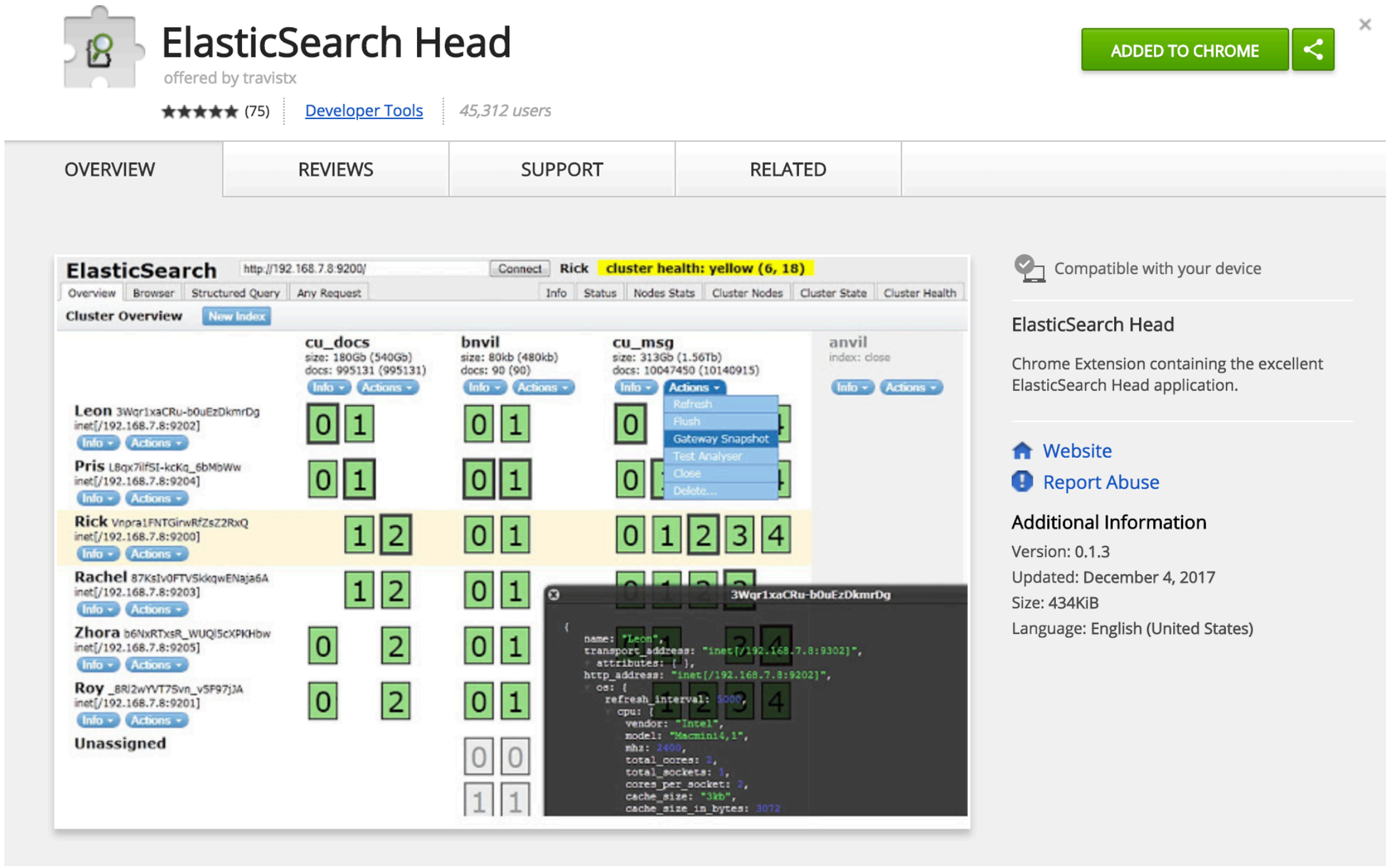
Fields and mapping types not need to defined before being used

Analyzer

https://www.elastic.co/guide/en/elasticsearch/reference/current/analysis.html

More tools

Elasticsearch Head



https://github.com/mobz/elasticsearch-head

Elasticsearch Dump

https://github.com/taskrabbit/elasticsearch-dump

Kibana

Explain and Profiling your query

2 ways

Explain API

Profile API

Explain API

```
GET /my_map/_search
{
  "explain": true,
  "query": {
    "bool": {
```

https://www.elastic.co/guide/en/elasticsearch/reference/6.3/search-explain.html

Profile API

Debugging tool

Add overhead to search execution

Output is verbose and depend on internal operation

https://www.elastic.co/guide/en/elasticsearch/reference/6.3/search-profile.html

Profile API

```
GET /my_map/_search
{
  "profile": true,
  "query": {
    "bool": {
```

Working with Logstash

https://www.elastic.co/guide/en/logstash/current/index.html

Logstash

Input

Filter

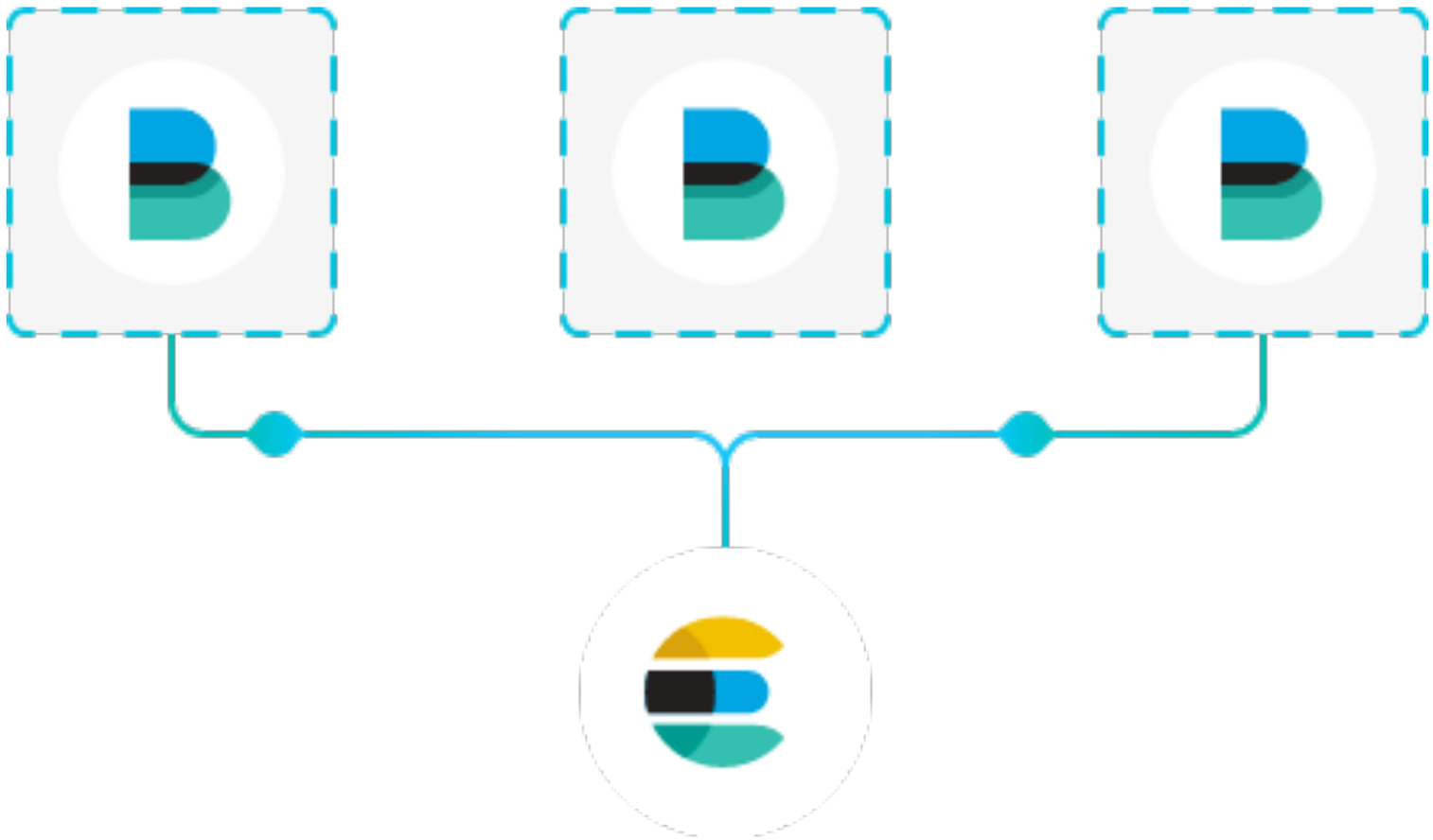
Output

Design your input first !!

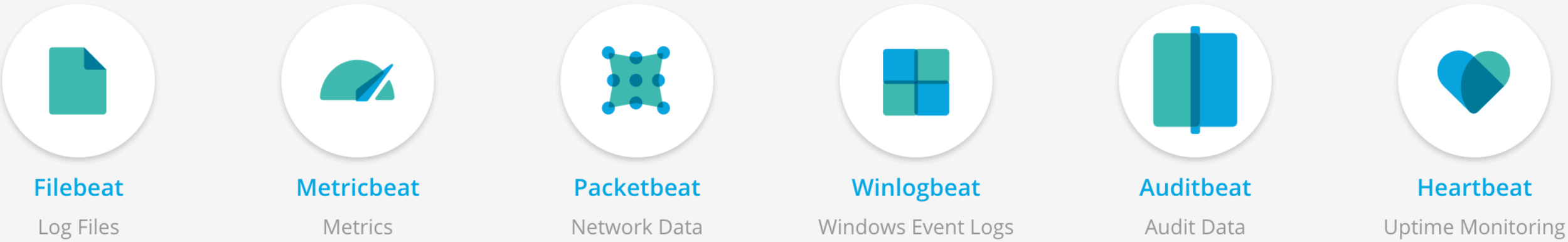
Use beats is better

https://www.elastic.co/products/beats

Beat



Beat

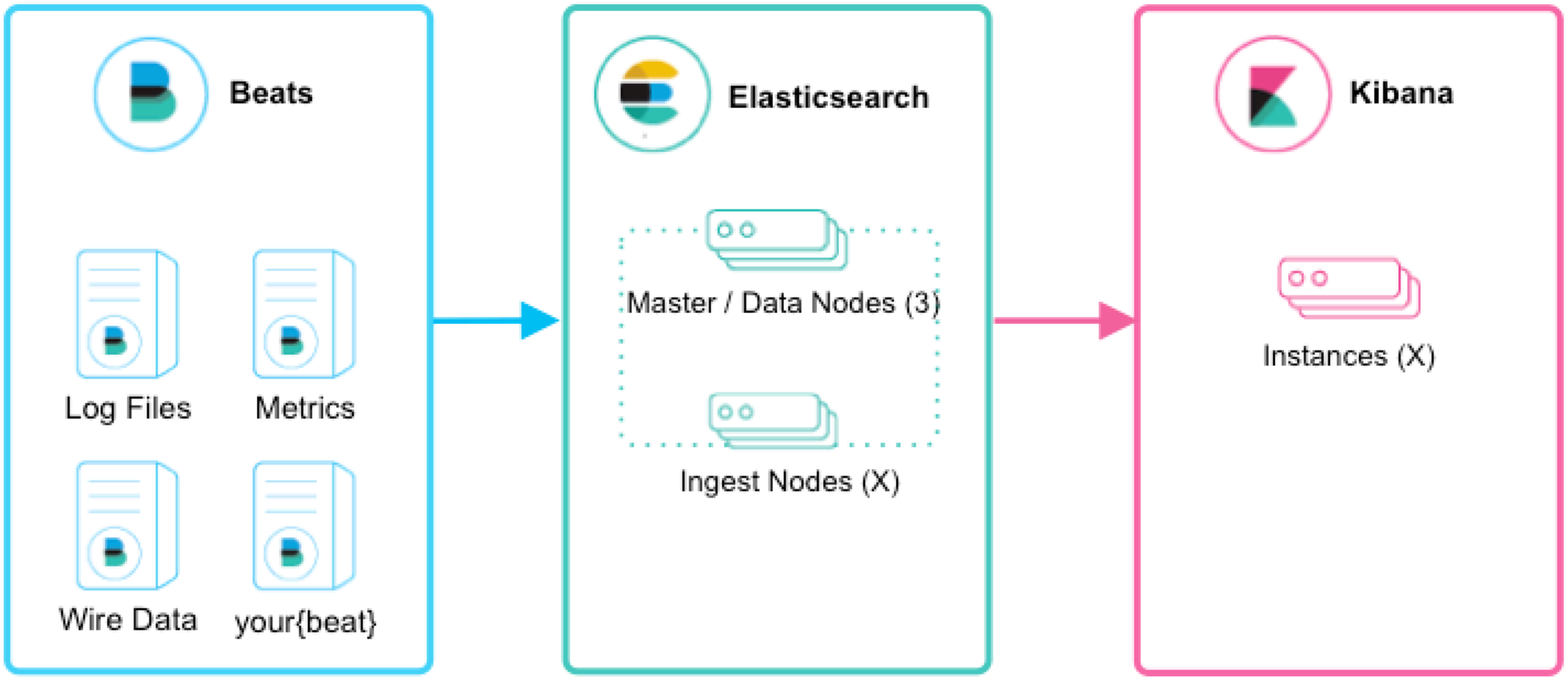


Example

$filebeat -e -c **beat.yml** -d "publish"

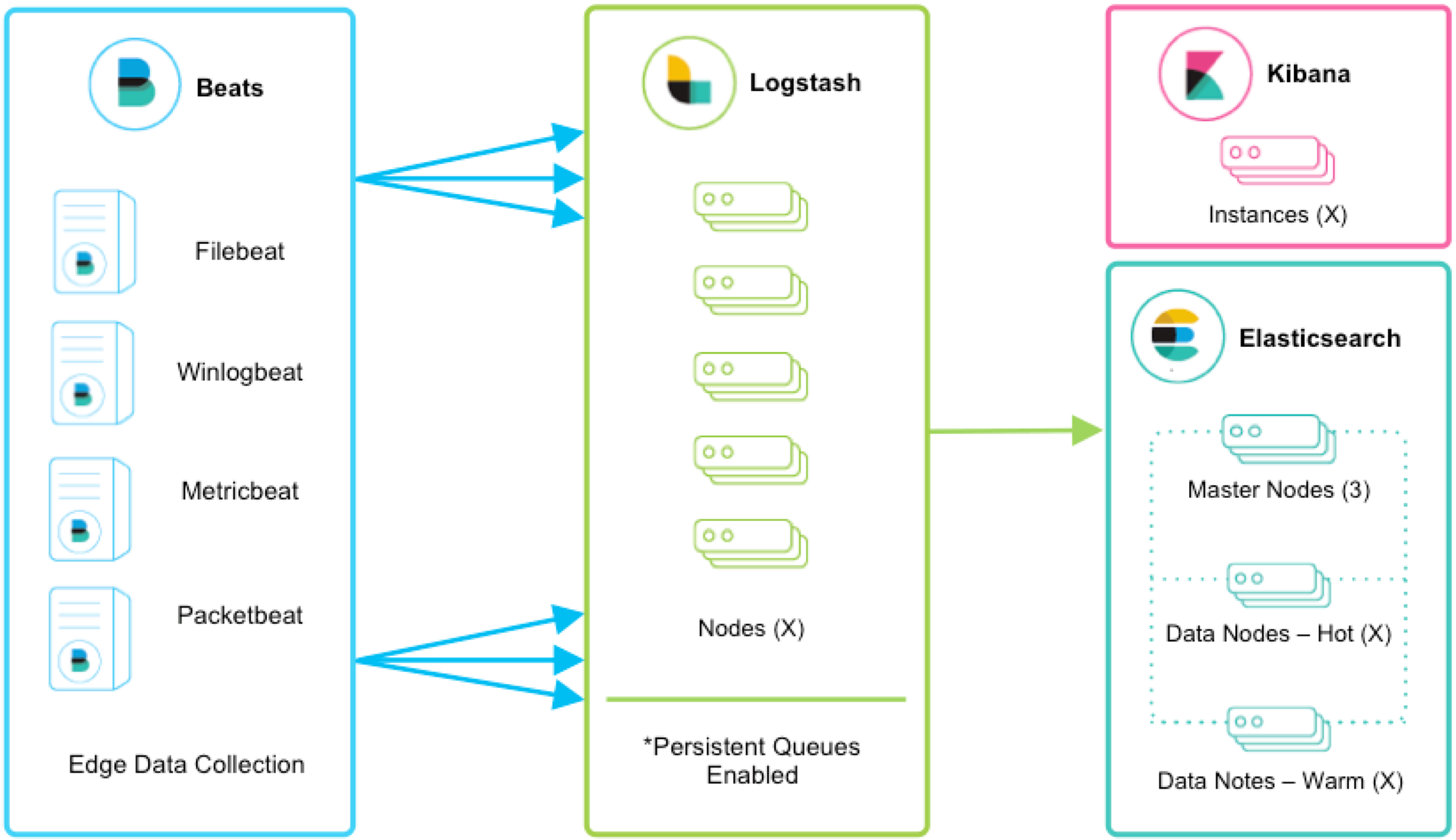
https://www.elastic.co/guide/en/beats/filebeat/current/index.html

Beat and Logstash



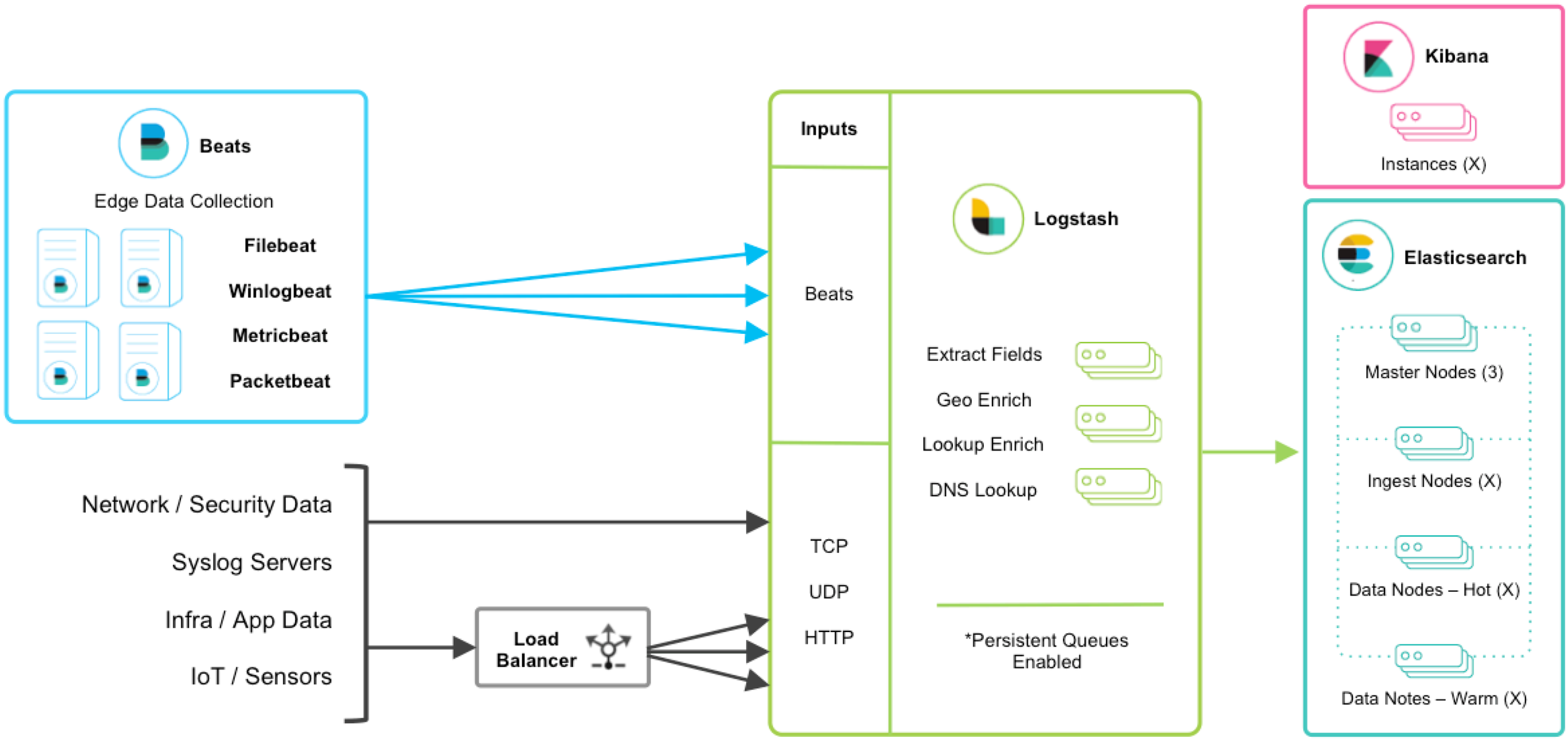
https://www.elastic.co/guide/en/logstash/current/deploying-and-scaling.html

Scaling



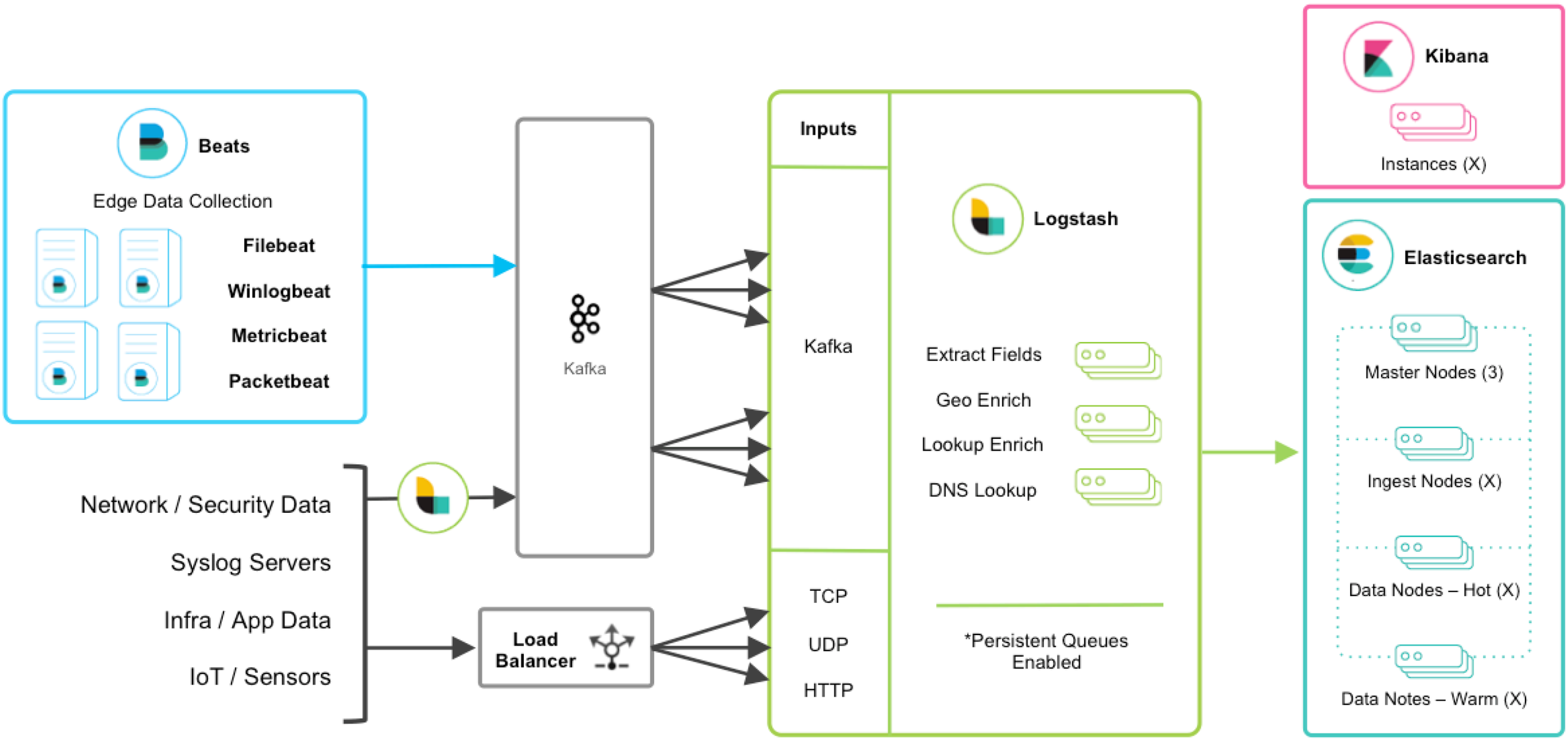
https://www.elastic.co/guide/en/logstash/current/deploying-and-scaling.html

More data sources



https://www.elastic.co/guide/en/logstash/current/deploying-and-scaling.html

Use messaging Queue



https://www.elastic.co/blog/logstash-persistent-queue

Design for Failure

09-cluster

Elasticsearch Nodes

Node Type	Description
Master	Control the cluster
Data	Keep/store data
HTTP/Query	Run your query
Coordinating	Smart Load Balancer
Ingest	Pre-processing documents before indexing

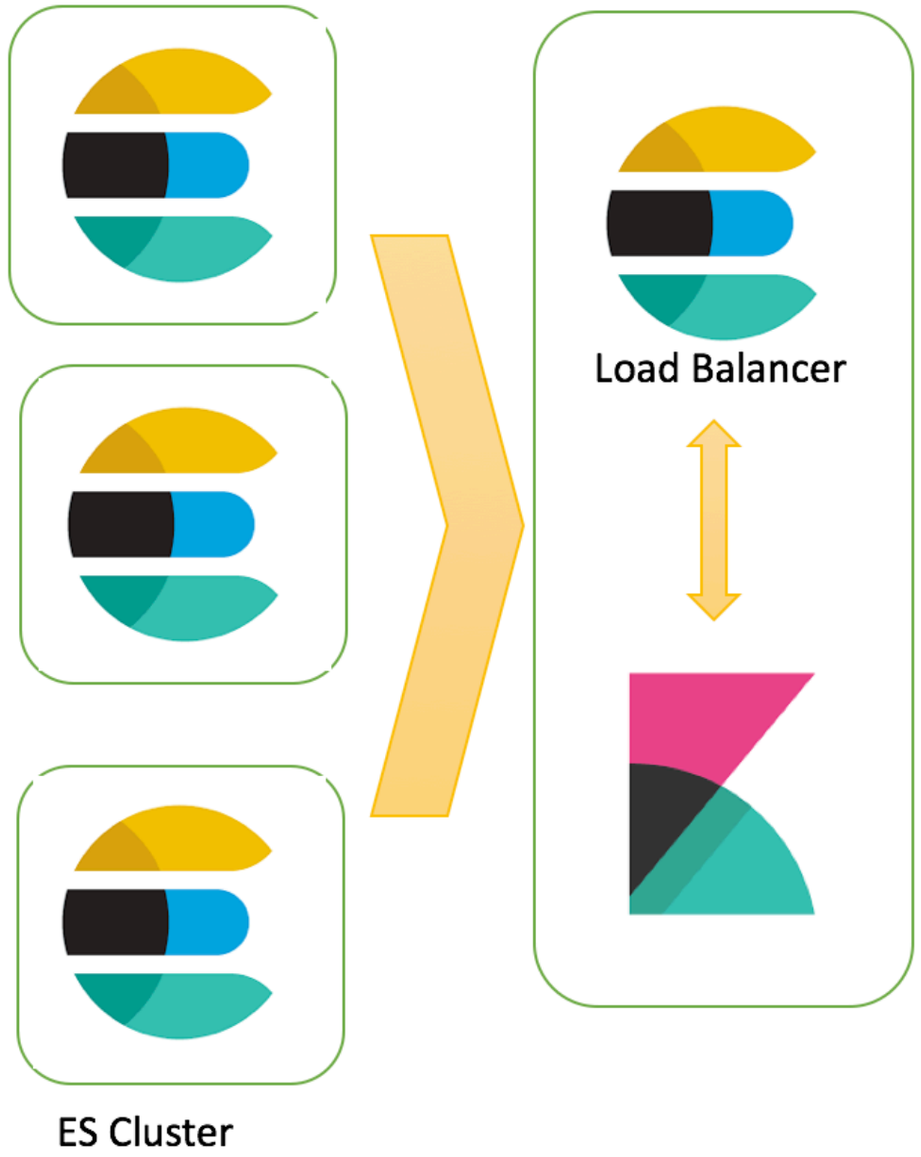
https://www.elastic.co/guide/en/elasticsearch/reference/current/modules-node.html

Elasticsearch Nodes

Not Secure | 35.240.161.188:9200/_cat/nodes?v&h=ip,name,node.role,master,heap.percent,ram.percent

```
ip          name        node.role master heap.percent ram.percent
10.148.0.2 master       m           *             17           33
10.148.0.4 query        -           -             10           63
10.148.0.5 coordinator  -           -              9           78
10.148.0.3 data         d           -             13           63
```

Elasticsearch Nodes



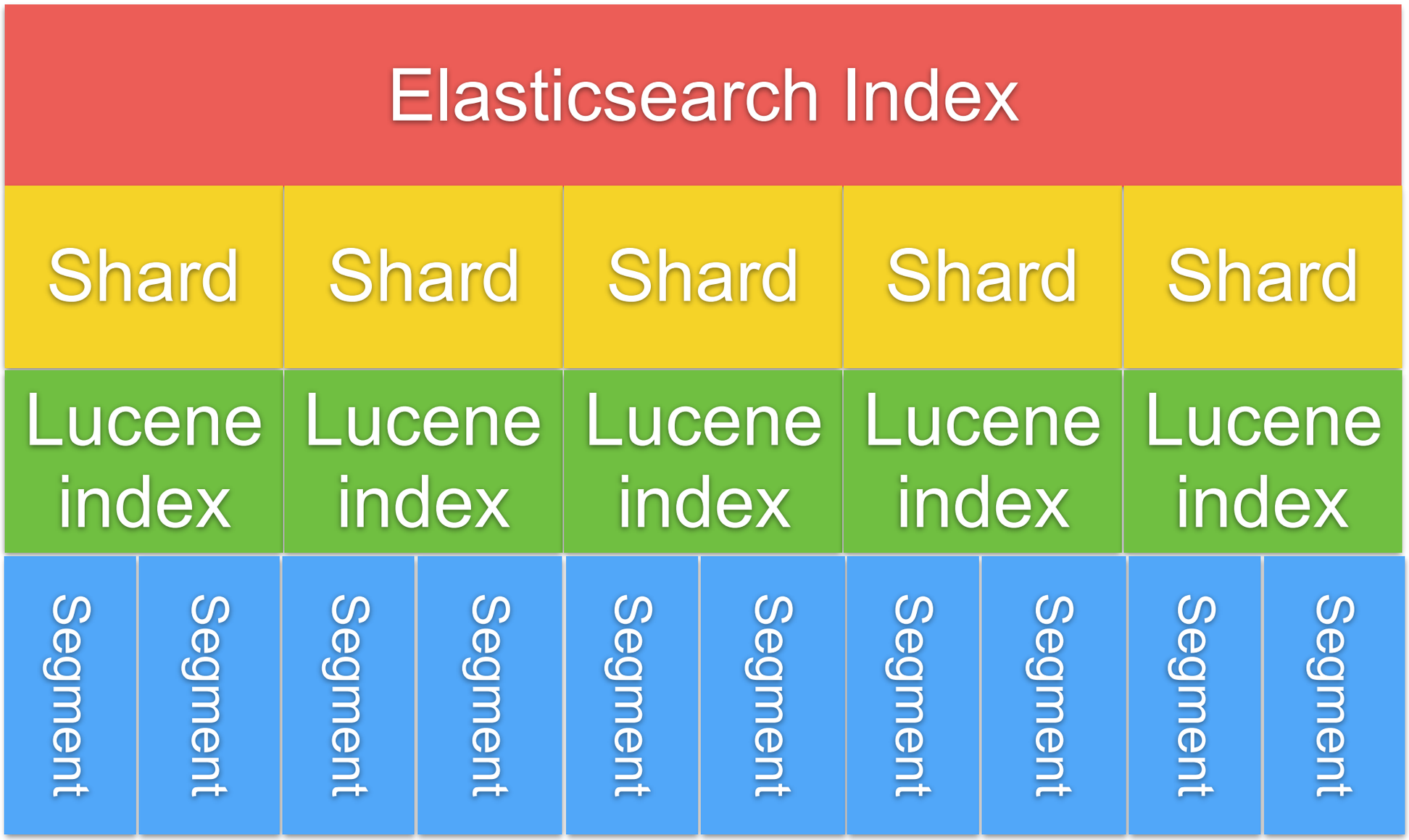
https://www.elastic.co/guide/en/kibana/current/production.html#load-balancing

Elasticsearch Nodes

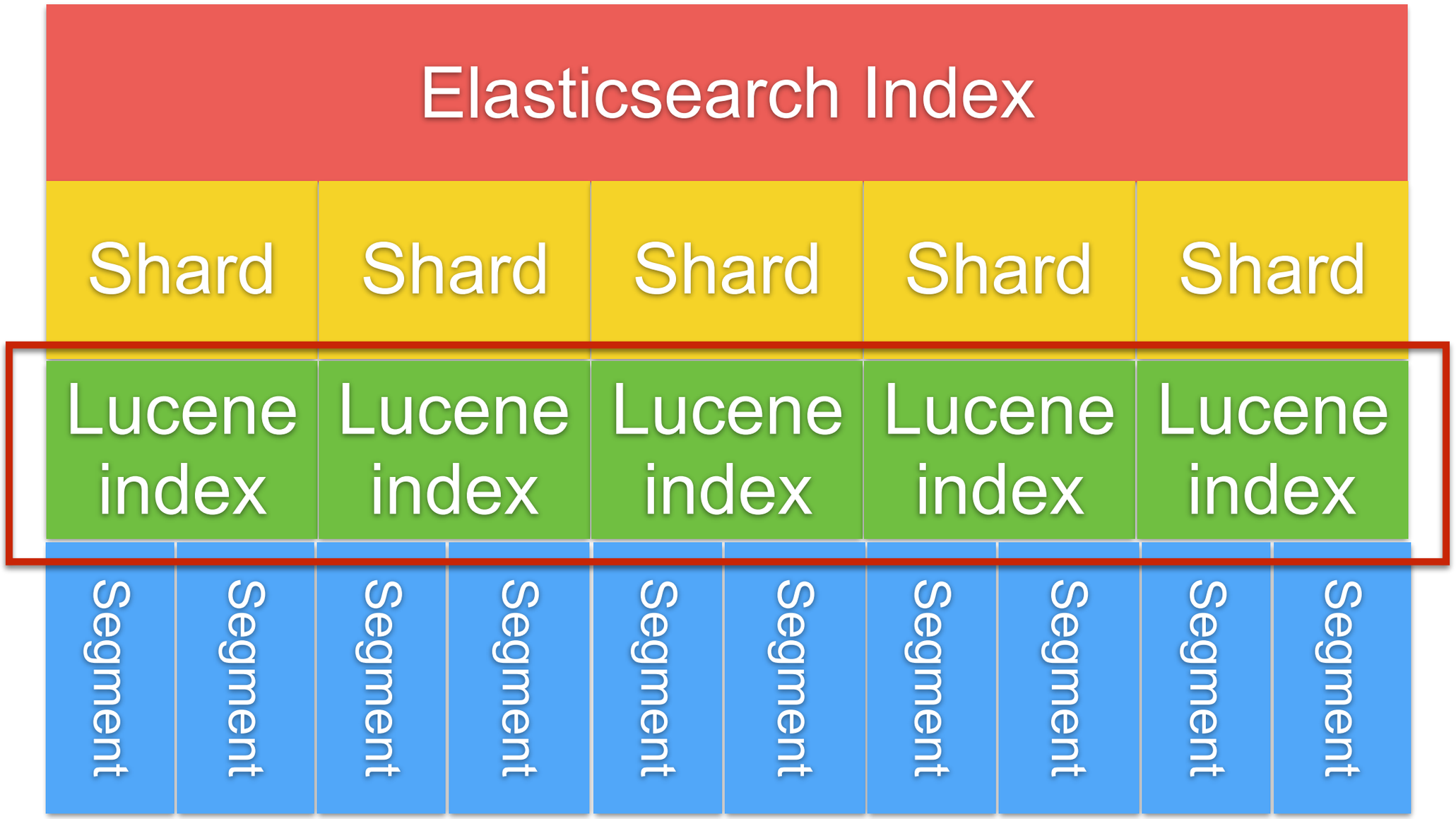
Apache Lucene

http://lucene.apache.org/

Apache Lucene

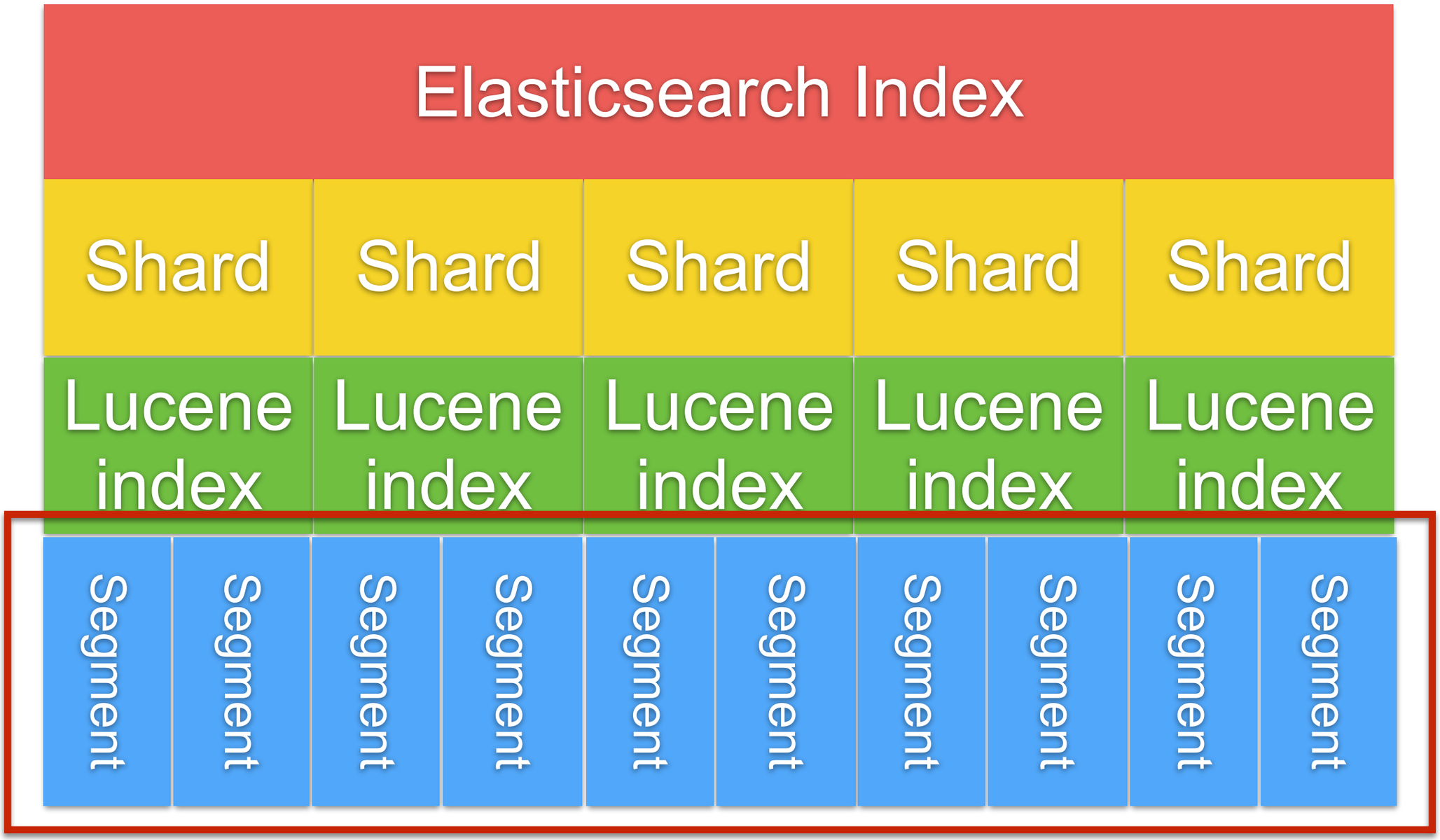


Apache Lucene



Max # of document of Lucene index = 2,147,483,519

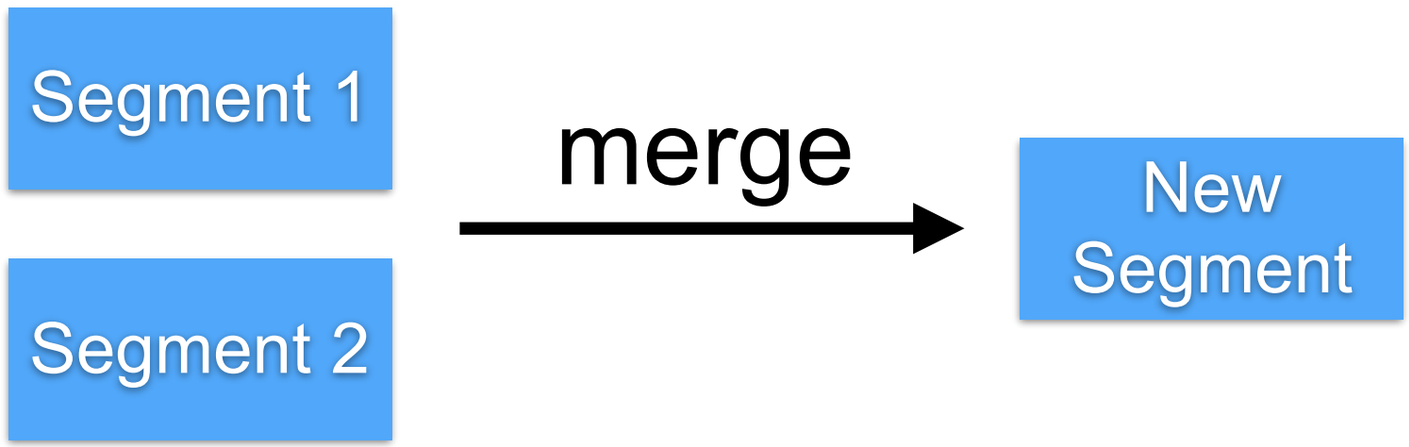
Apache Lucene



Segments are immutable

Segment

More shards, more segments
Documents are never delete !!
Lucene segment **merge** use more CPU/IO
Segments are immutable



Hardware

Hardware

CPU

Memory

Network

Storage

Memory

Enable bootstrap.memorylock
Disable all swap files
Change ES_HEAP_SIZE (default 1G)

https://www.elastic.co/guide/en/elasticsearch/reference/current/setup-configuration-memory.html

Design your index

Design your index

Sharding
Replication

Sharding

Elasticsearch divides the data in **logical** parts

# of sharding is define when index created

How many shard ?

Need to know your size of data

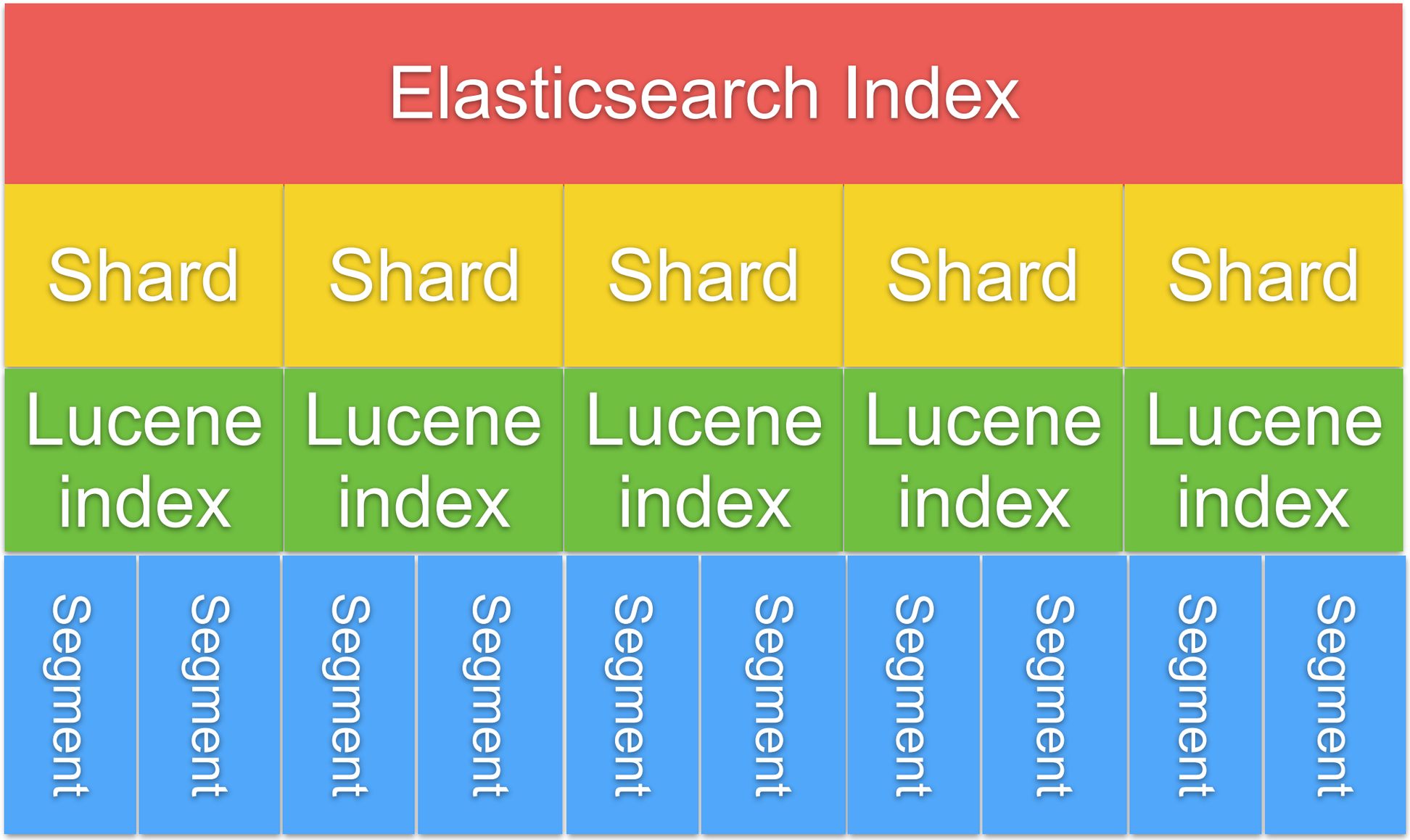
Data Size	# of shard
< 3M	1
>3M <5M	2
>5M	(# of document / 5M) + 1

Sharding

Small shards on multiple nodes make the cluster recovery faster

Small shards on a lot of nodes solve memory mgt problem when query on large data

More shard, more Segment !!



Need to config file descriptor

https://www.elastic.co/guide/en/elasticsearch/reference/current/system-config.html

Don’t create more shard than you need !!

Replication

Prevent data loss

Default = 1

```
# nodes = [(primary + # replication) /2 ] + 1
```

Problems with scaling

CPU consumption
Load average
Request rate
Search latency

Slow log

```
PUT /myindex/_settings
{
    "index.search.slowlog.threshold.query.warn: 1s",
    "index.search.slowlog.threshold.query.info: 500ms",
    "index.search.slowlog.threshold.query.debug: 1500ms",
    "index.search.slowlog.threshold.query.trace: 300ms",
    "index.search.slowlog.threshold.fetch.warn: 500ms",
    "index.search.slowlog.threshold.fetch.info: 400ms",
    "index.search.slowlog.threshold.fetch.debug: 300ms",
    "index.search.slowlog.threshold.fetch.trace: 200ms"
}
```

If can’t optimize then add more resources or rewrite

https://www.elastic.co/guide/en/elasticsearch/reference/current/index-modules-slowlog.html

Indexing Data

Indexing data

Must be define data schema for your need
Default mapping == more cost (Memory/Disk)
Default for data is “text” + “keyword”
Understand analyzer and tokenizer
Use auto generated IDs if possible

Indexing data

Prefer bulk indexing

Change refresh interval

Time based index for log data

https://www.elastic.co/guide/en/elasticsearch/reference/current/indices-update-settings.html

For Large data

Increase refresh interval
Decrease replica number

```
PUT /logstash-2015.05.20/_settings
{
    "index" : {
        "refresh_interval" : "-1",
        "number_of_replicas" : 0
    }
}
```

https://www.elastic.co/guide/en/elasticsearch/reference/current/indices-update-settings.html

Query Data

Query data

Use filters as much as possible

Use scan and scroll for dumping large data

Node query cache

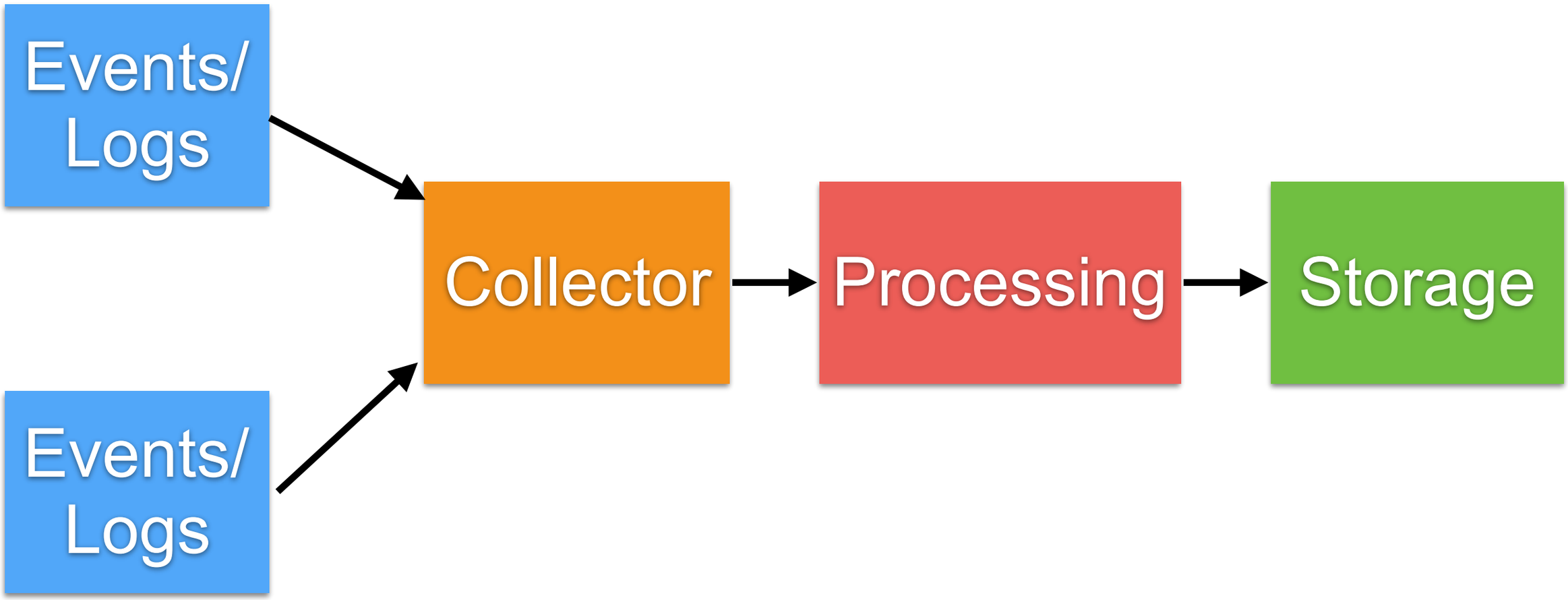
Shard query cache

Retrieve only necessary fields

https://www.elastic.co/guide/en/elasticsearch/reference/current/query-cache.html

Use cases

Event or Logging from Servers



Event or Logging from Servers

Data Collection	Data Aggregation & Processing	Indexing & storage	Analysis & visualization

Event or Logging from Servers

RabbitMQ

NGINX

Data Collection

Buffering

Data Aggregation & Processing

Indexing & storage

Analysis & visualization

Istio

Microservices

Distributed system

Distributed system

Deployment
Resiliency
Networking
Security

Distributed system

Deployment
Resiliency
Networking
Security

kubernetes

Services have to deal with

Client-side load balancing
Fault tolerance (timeout/retry)
Observability
Monitoring and tracing
Circuit breaking

Popular tools/library

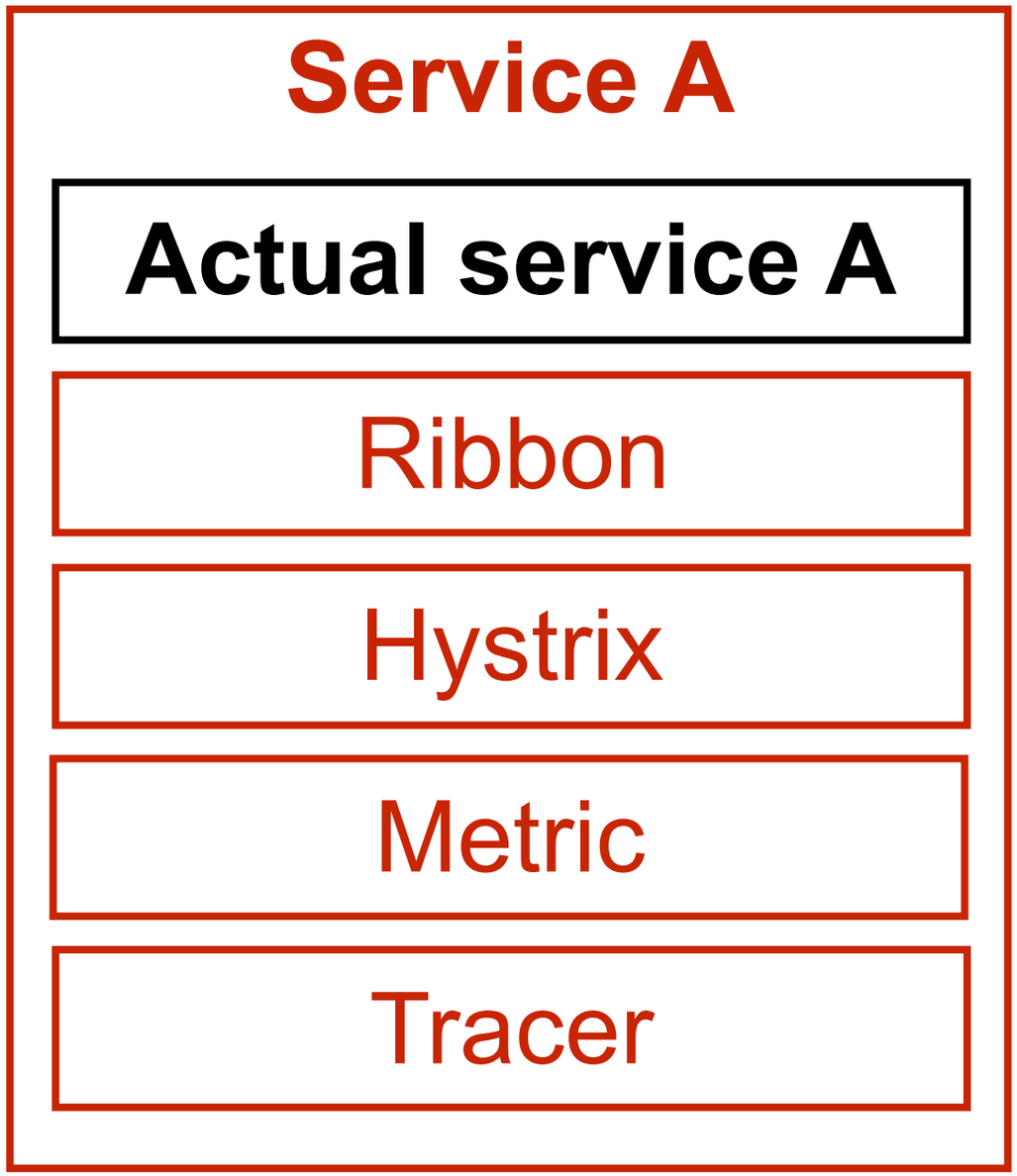
Client-side load balancing = **Ribbon**

Service registry = **Eureka**

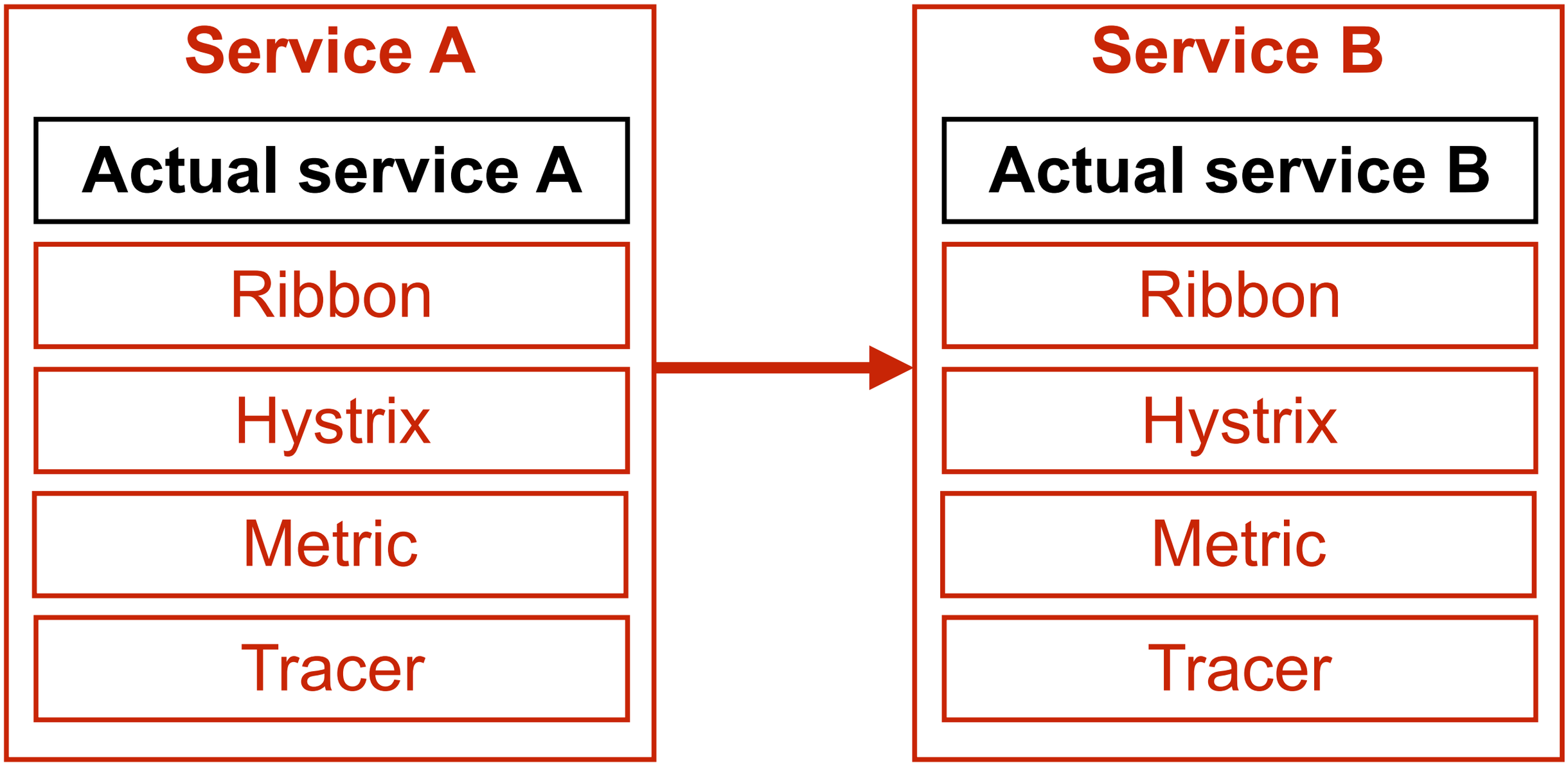
Circuit breaking = **Hystrix**

Distributed tracing = **Zipkin**

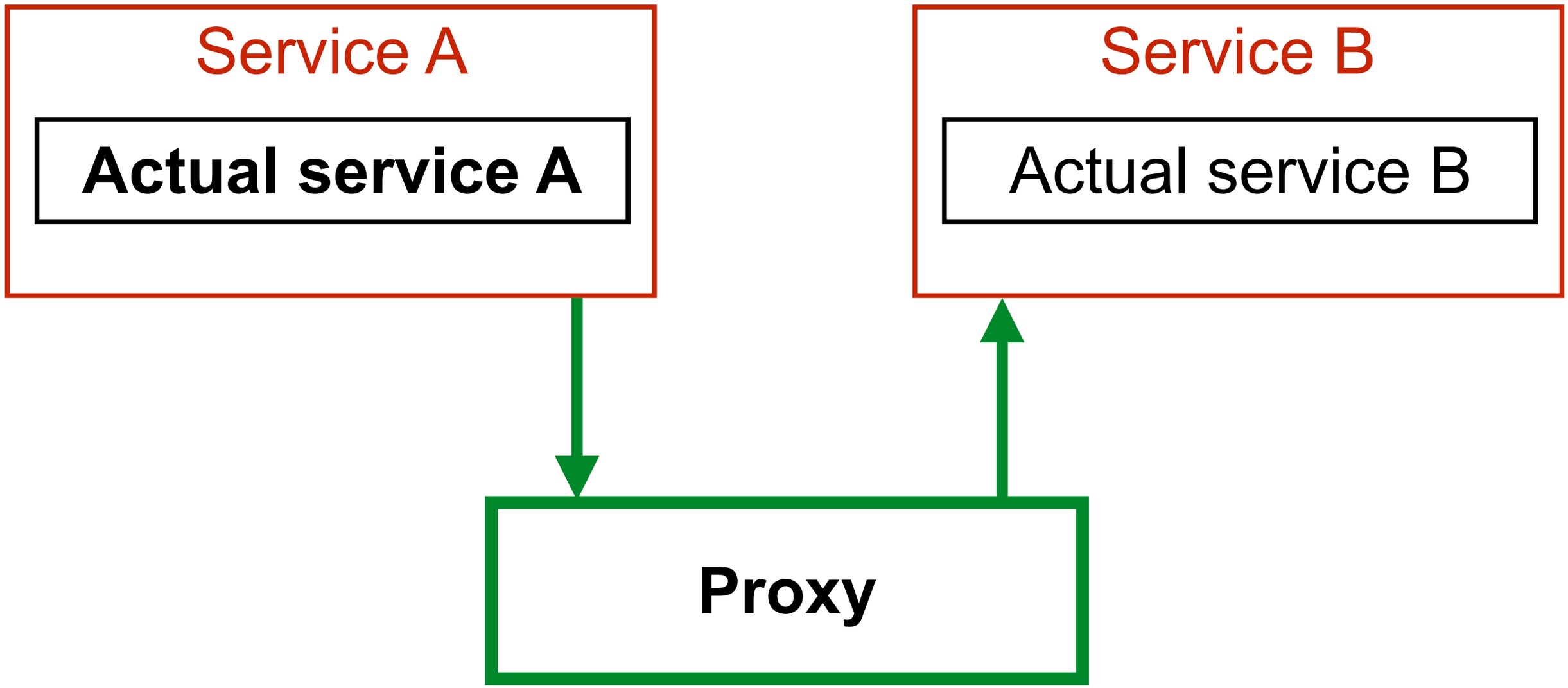
Microservice ?



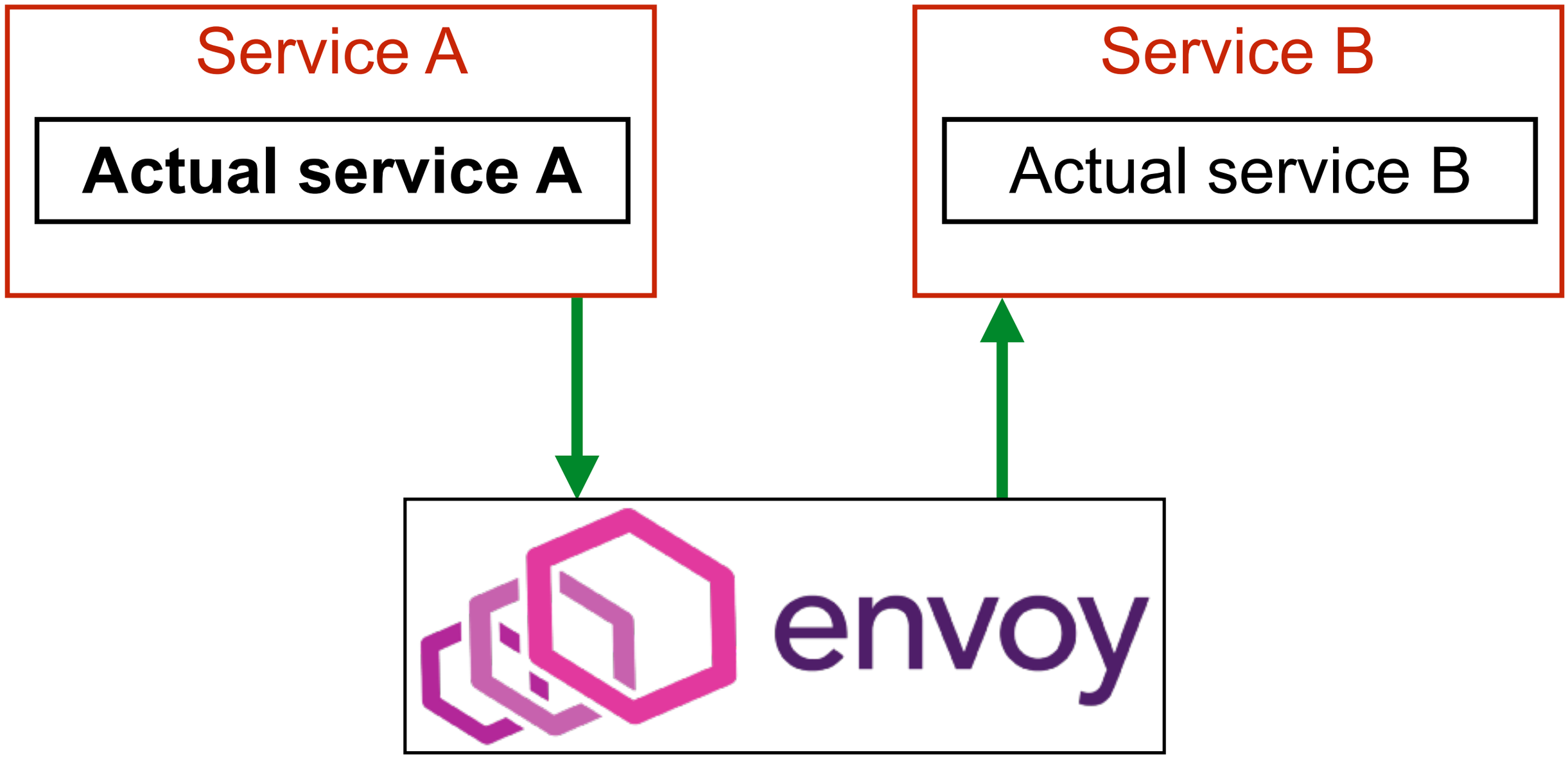
Microservice ?



Moving common functionality !!



Moving common functionality !!



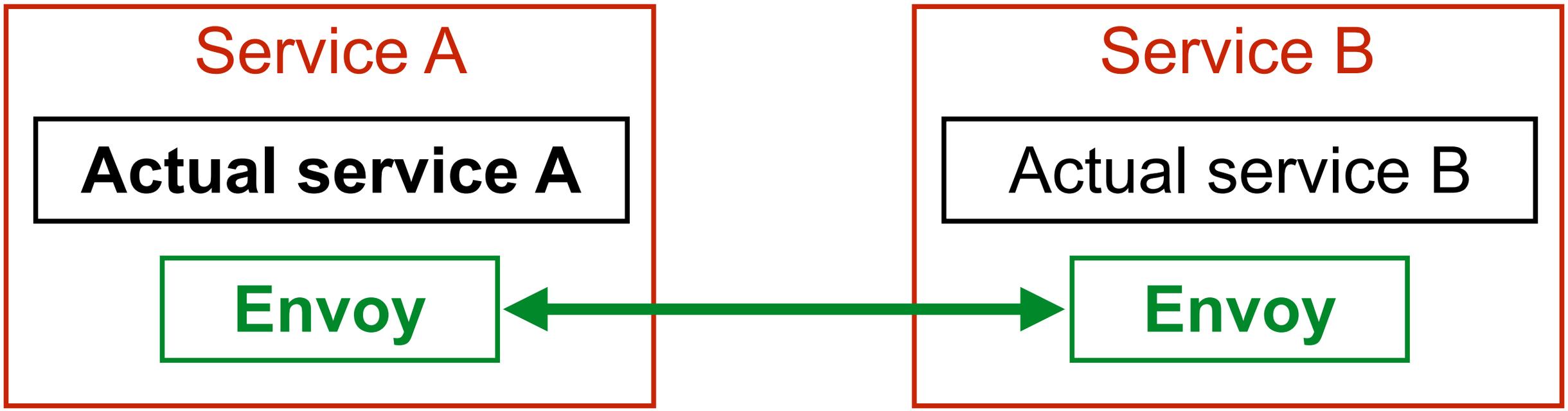
https://www.envoyproxy.io/

What is Envoy ?

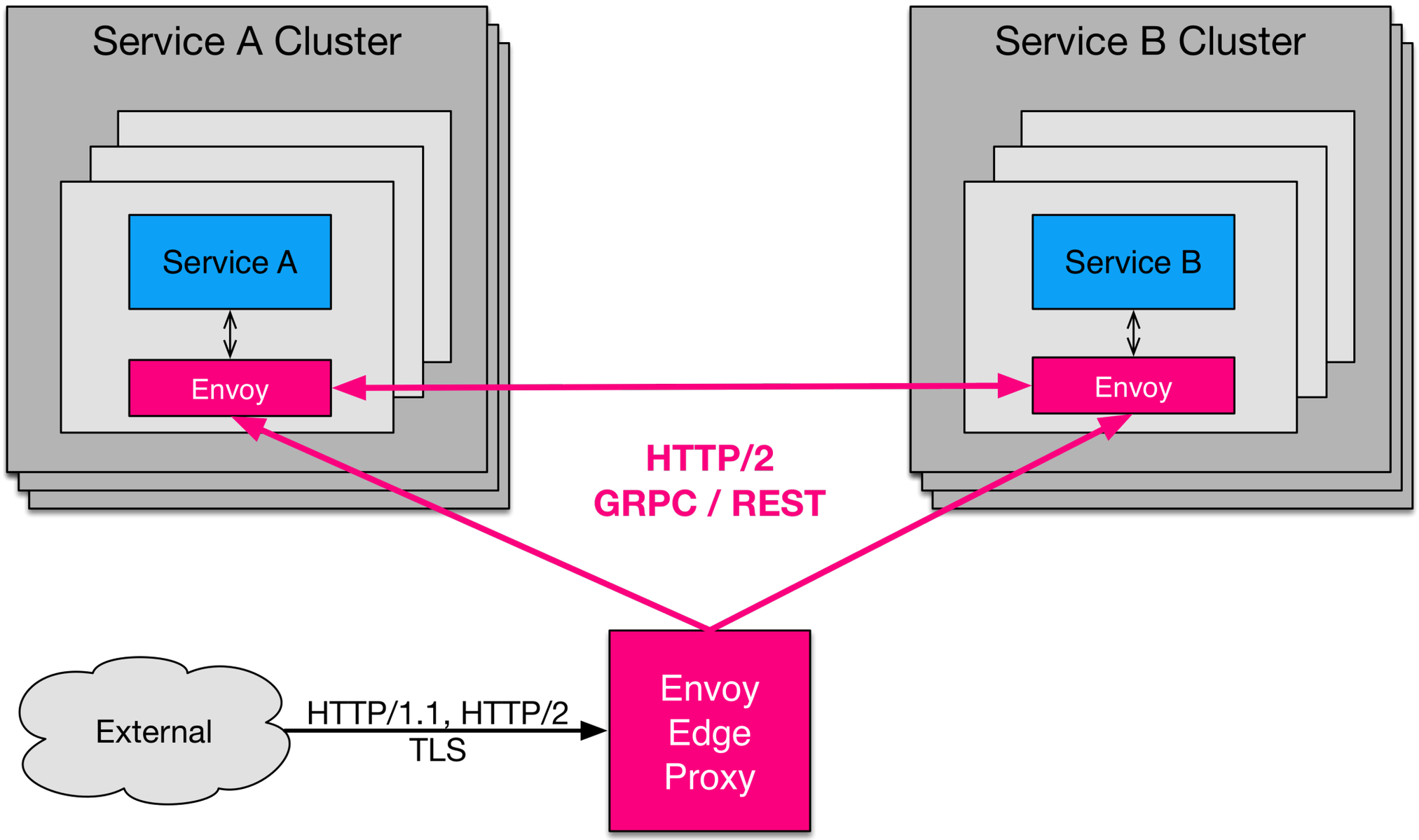
Service proxy
Developed by Lyft
Written in C++, non-blocking, highly parallel
HTTP 2, including gRPC
Service discovery/registry and health check
Advance load balancing
Stat, metrics and tracing

Deployment with Kubernetes

Using sidecar model



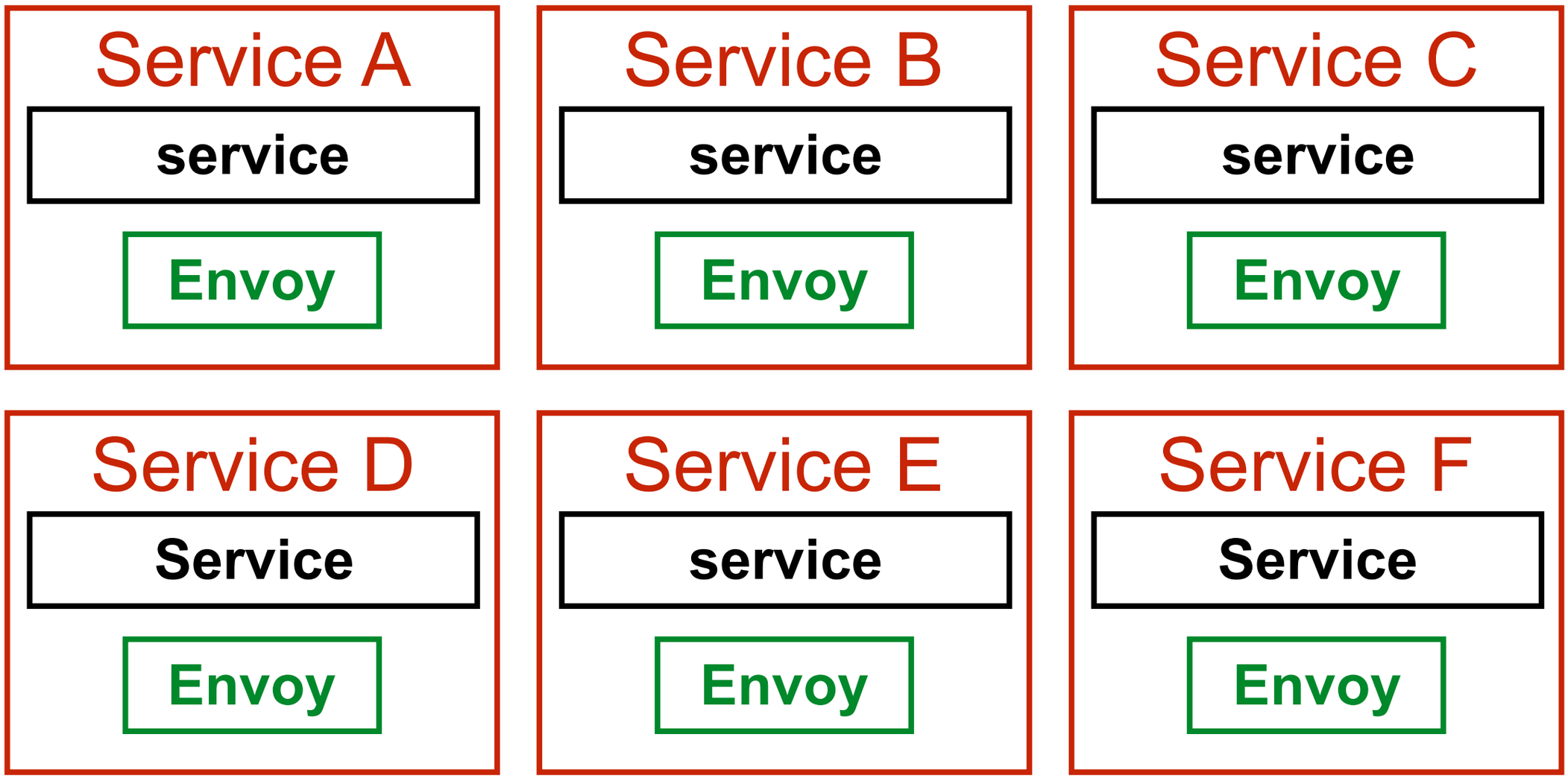
Envoy



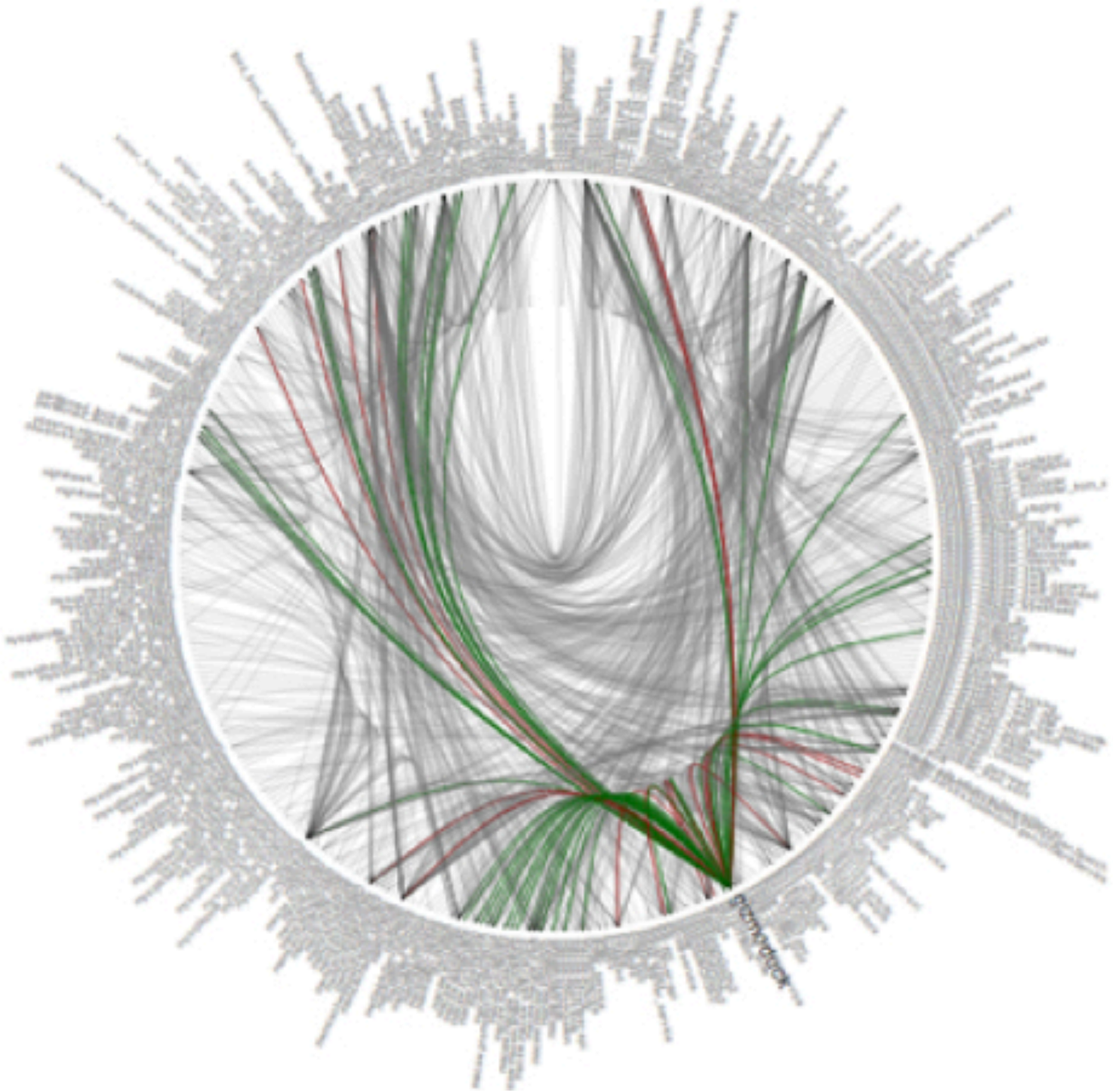
https://www.envoyproxy.io/

More services !!

Configure can be verbose and error prone !!

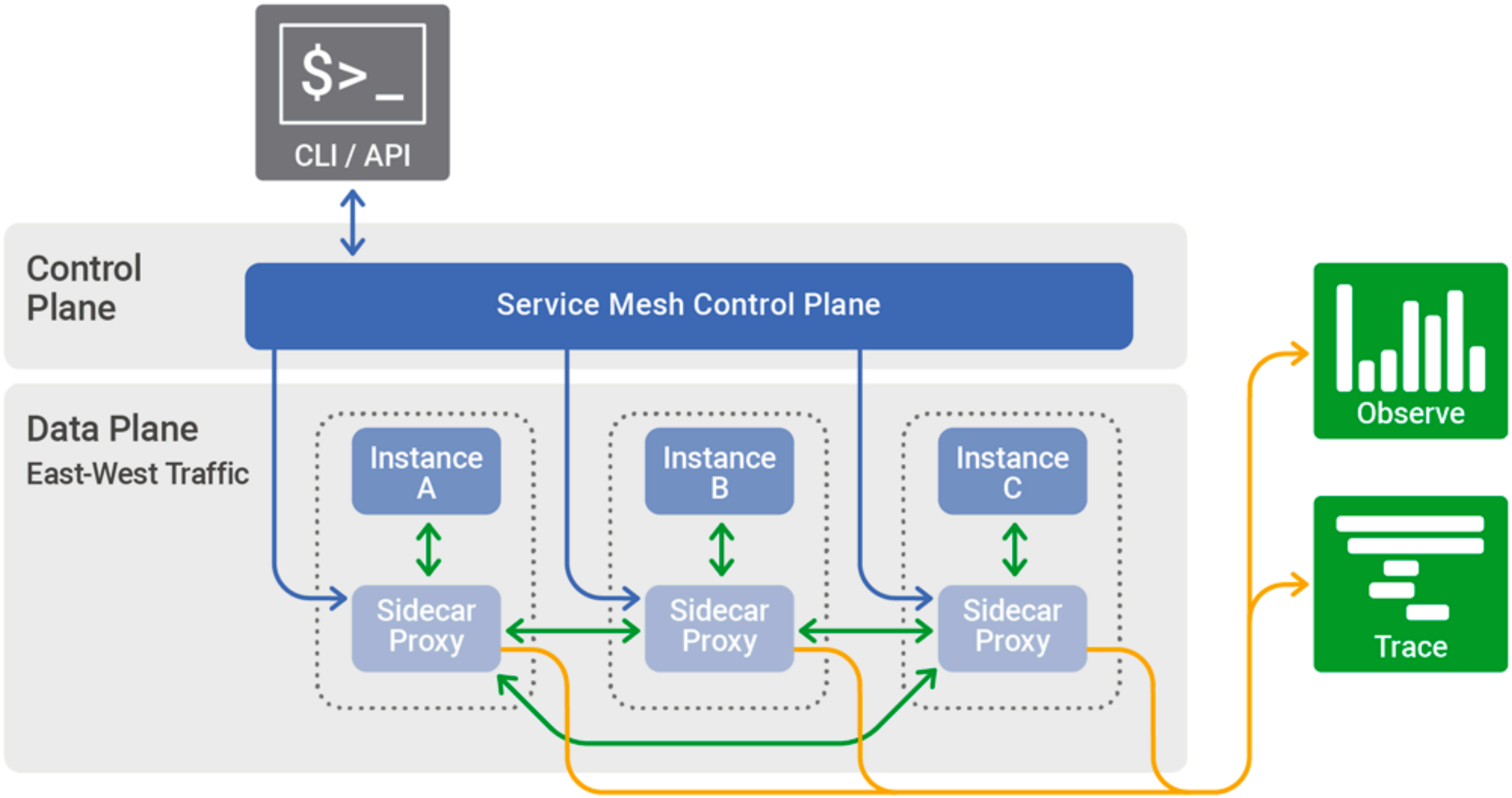


Service mesh



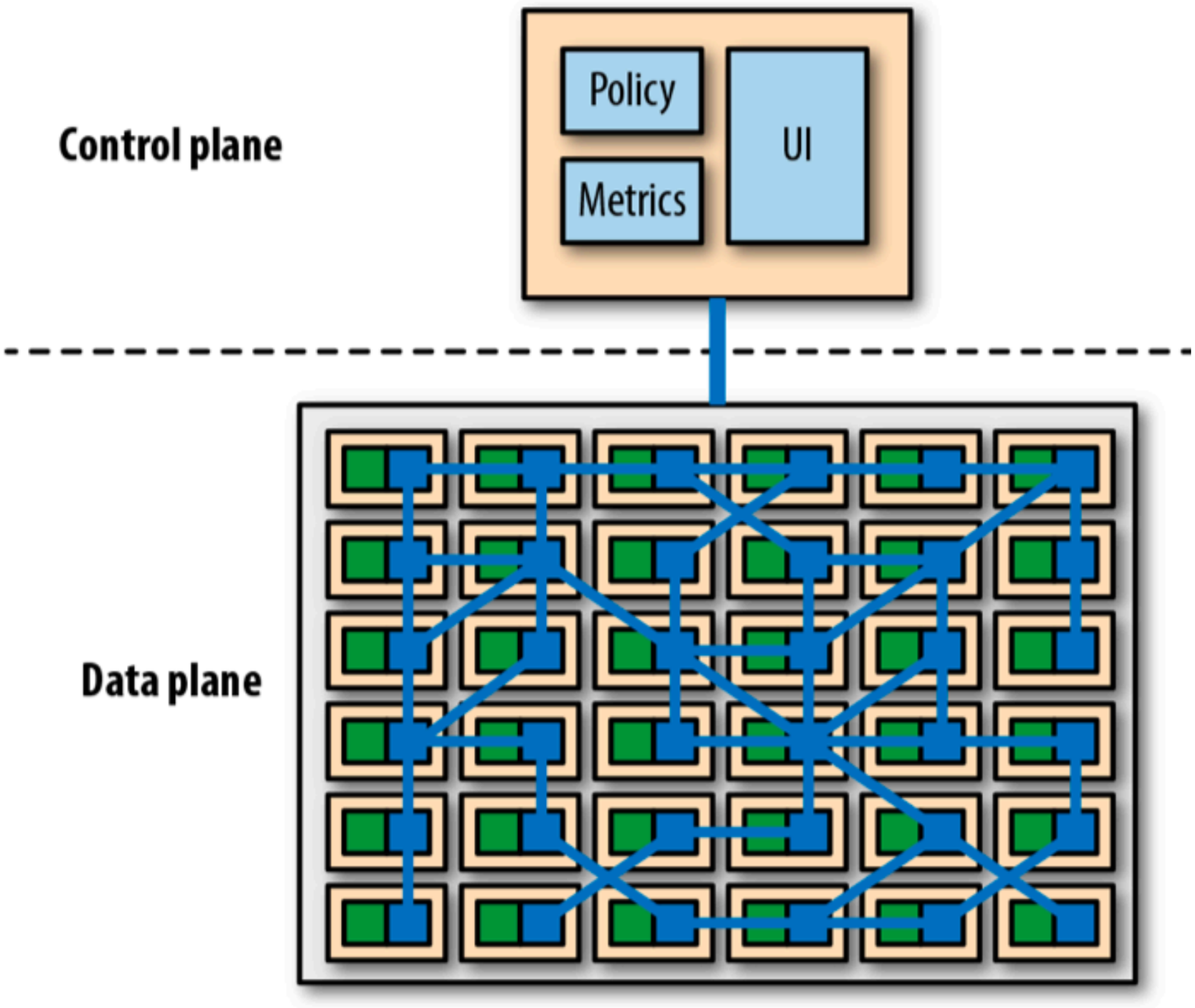
We need control plane

Control plane



https://www.nginx.com/blog/what-is-a-service-mesh/

Control and data plane

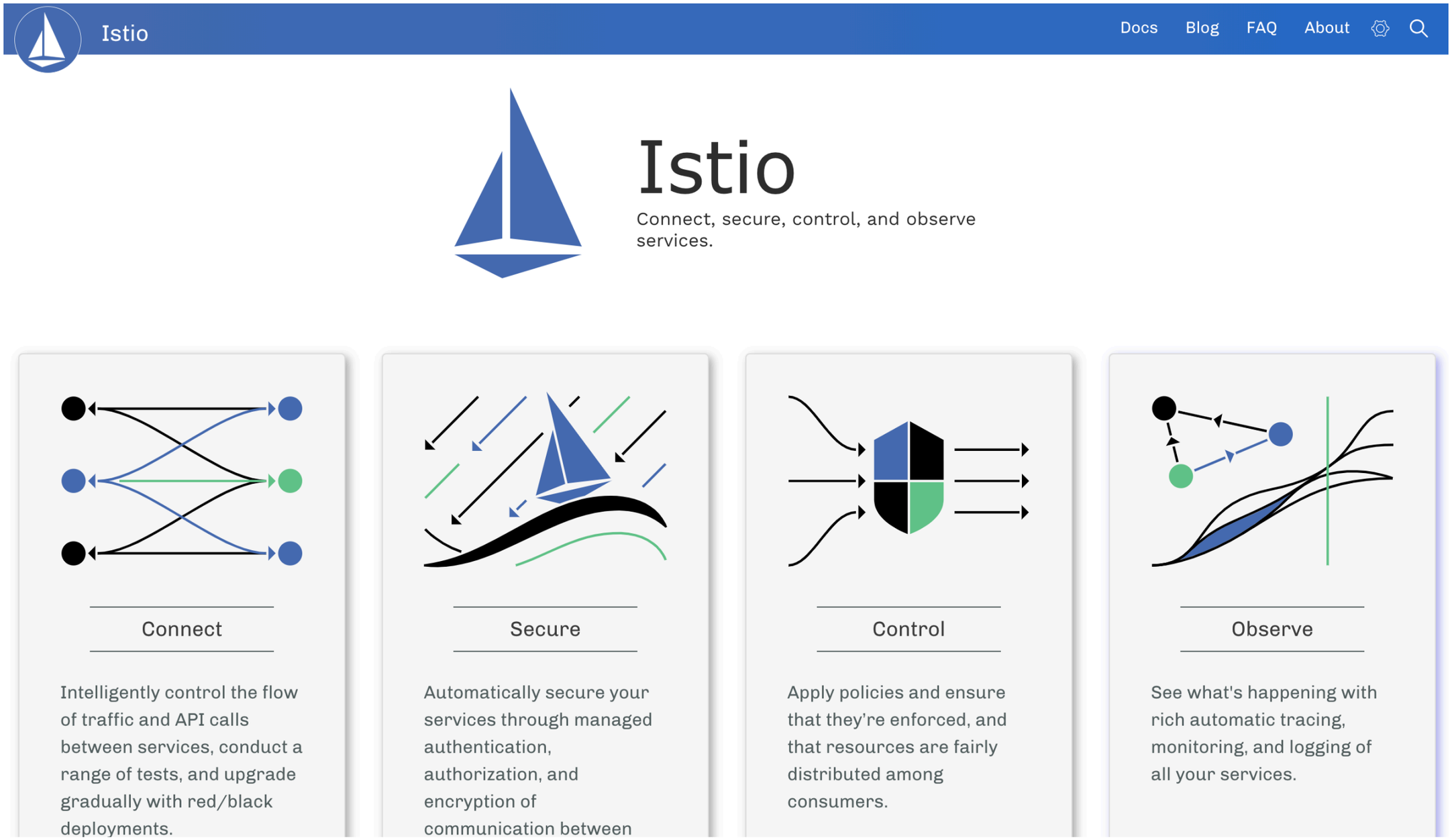


Istio

linkerd

OPENCONTRAIL

Welcome to Istio

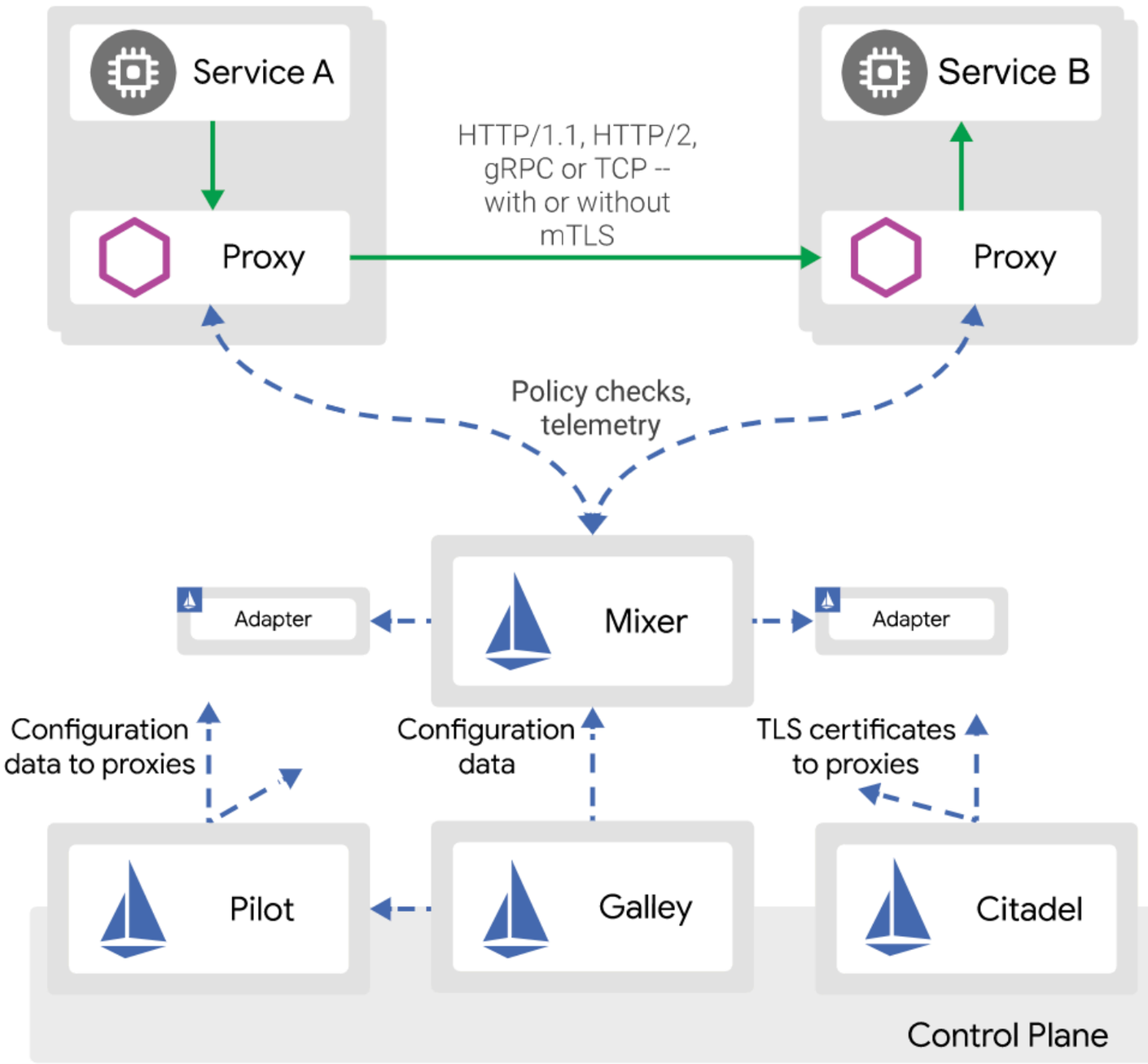


https://istio.io/

Welcome to Istio

Control plane for service mesh
Abstracts Envoys concepts and configurations
Easy to operate (kubectl and istioctl)
HTTP 2, including gRPC
Service discovery/registry and health check
Advance load balancing
Stat, metrics and tracing

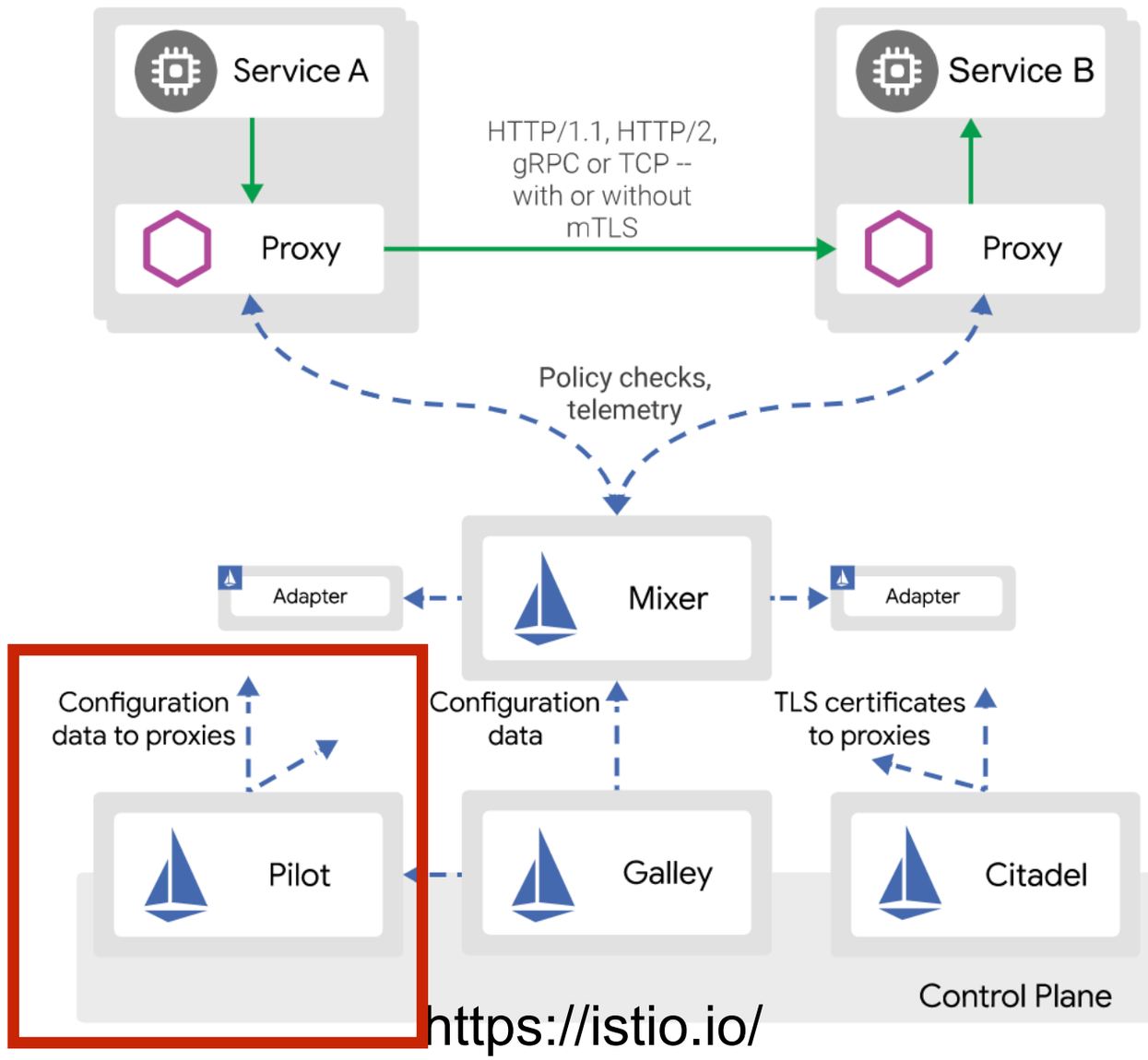
Istio Architecture



https://istio.io/

Pilot

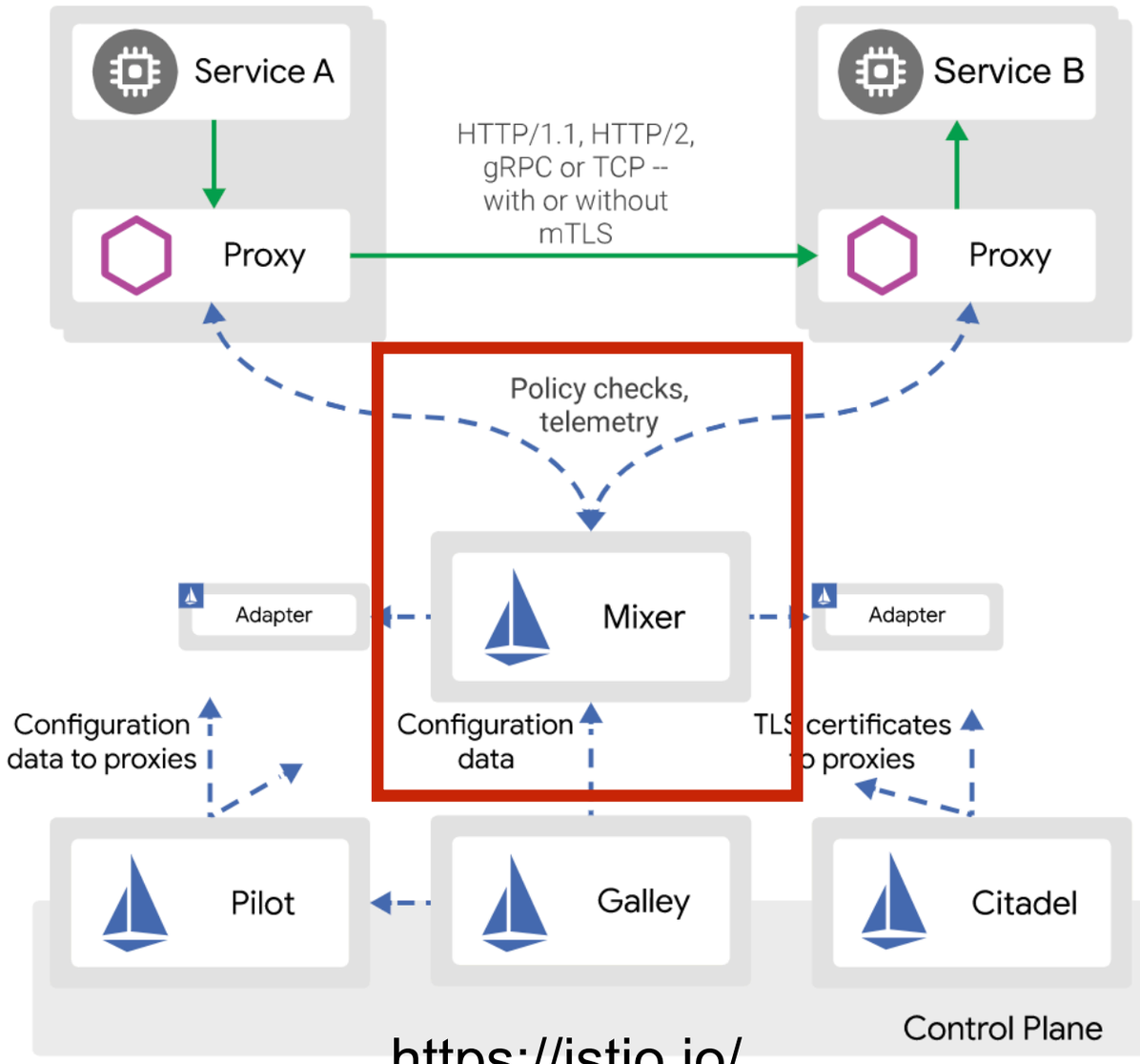
Traffic control (route rules and policies)
Resiliency (circuit breaker, timeout and retry)



https://istio.io/

Mixer

API management
Telemetry, tracing and integration with others

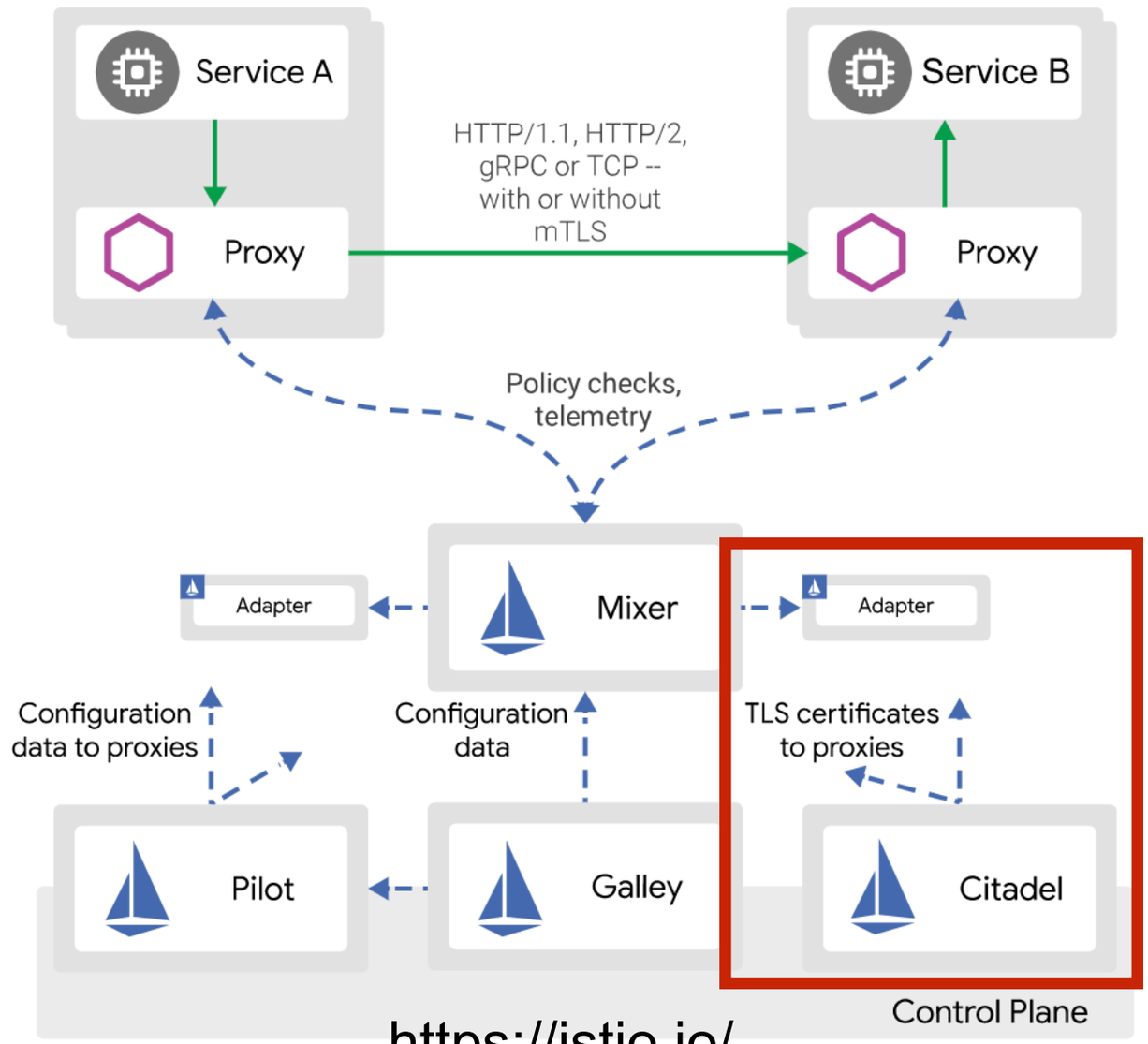


https://istio.io/

Citadel

Enforce mTSL between services

Along with mixer and pilot allows authorization & audit



https://istio.io/

Istio workshop

kubernetes

ISTIO