

ELK Stack

Elasticsearch
Logstash
Beats
Kibana





Somkiat Puisungnoen

Somkiat Puisungnoen

Update Info 1 View Activity Log 10+ ...

Timeline About Friends 3,138 Photos More

When did you work at Opendream? X

... 22 Pending Items

Intro

Software Craftsmanship

Software Practitioner at สยามชัมนาณกิจ พ.ศ. 2556

Agile Practitioner and Technical at SPRINT3r

Post Photo/Video Live Video Life Event

What's on your mind?

Public Post

Somkiat Puisungnoen 15 mins · Bangkok · ⚙️

Java and Bigdata



Page

Messages

Notifications 3

Insights

Publishing Tools

Settings

Help ▾



somkiat.cc

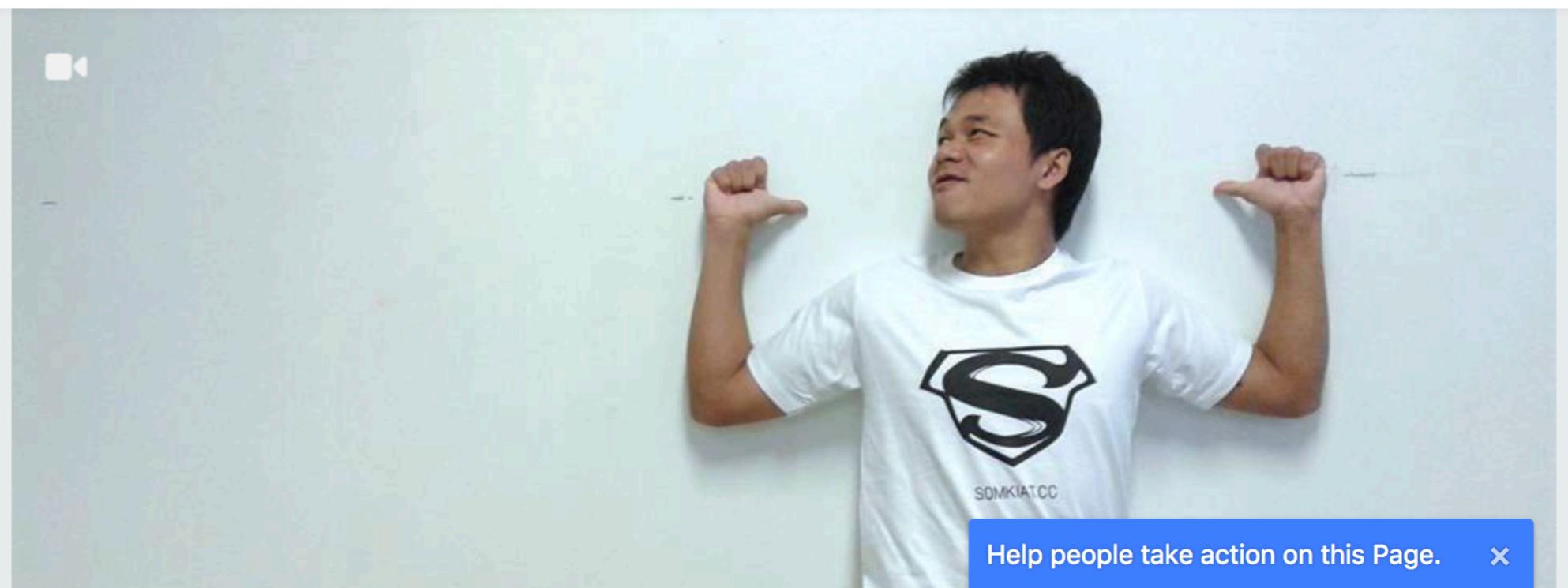
@somkiat.cc

Home

Posts

Videos

Photos



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https://github.com/up1/course_elk



Agenda

- ELK stack
- Introduction to Elasticsearch
- CRUD (Create, Read, Update, Delete)
- Search DSL (Domain Specific Language)
- Analyzer
- Mapping
- Aggregation



Agenda

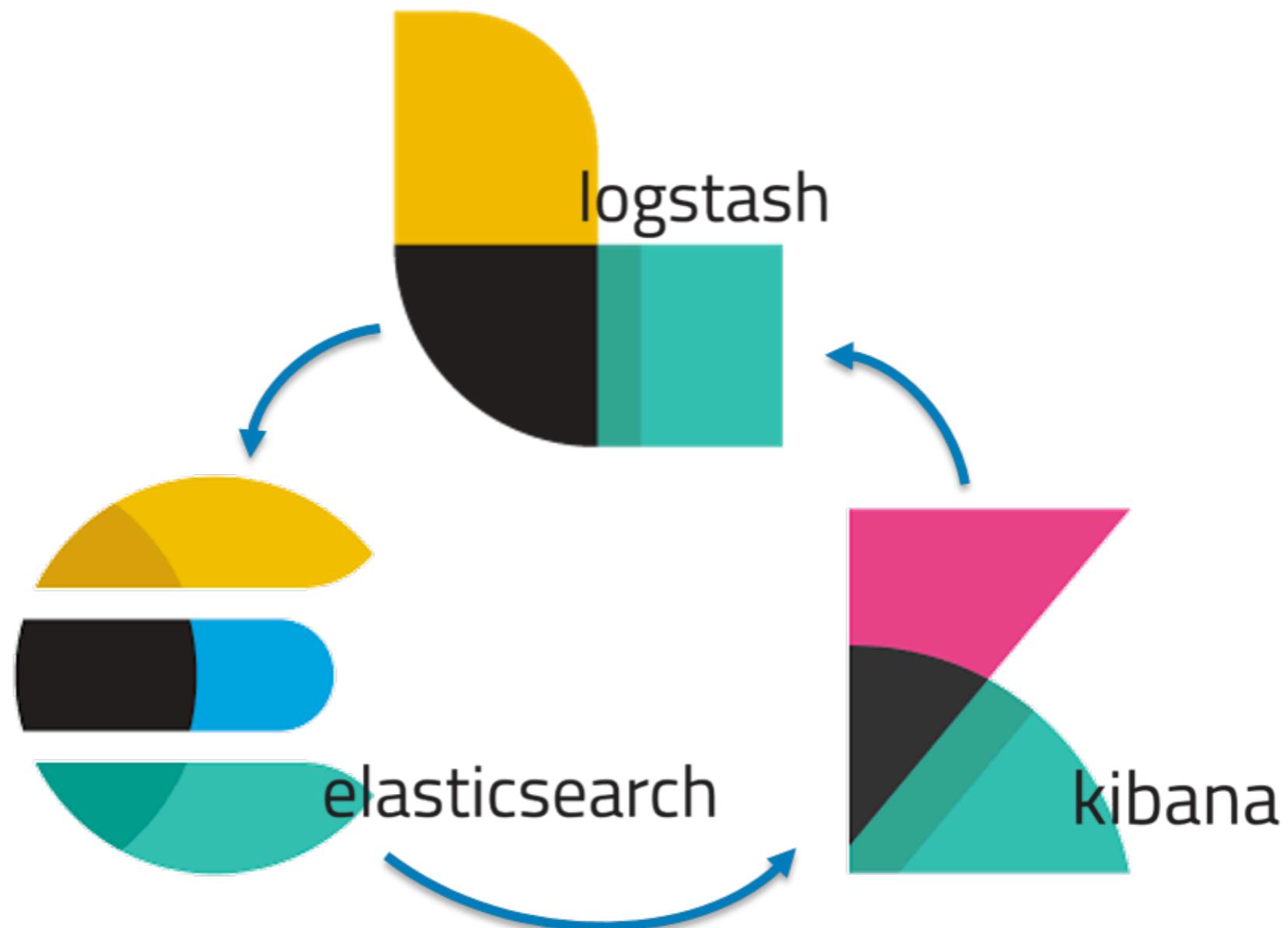
- Working with Kibana
- Useful features
 - Auto-suggestion
 - ngram algorithm
- Clustering management
- Design for scaling
- Working with Logstash
- Machine Learning with ELK



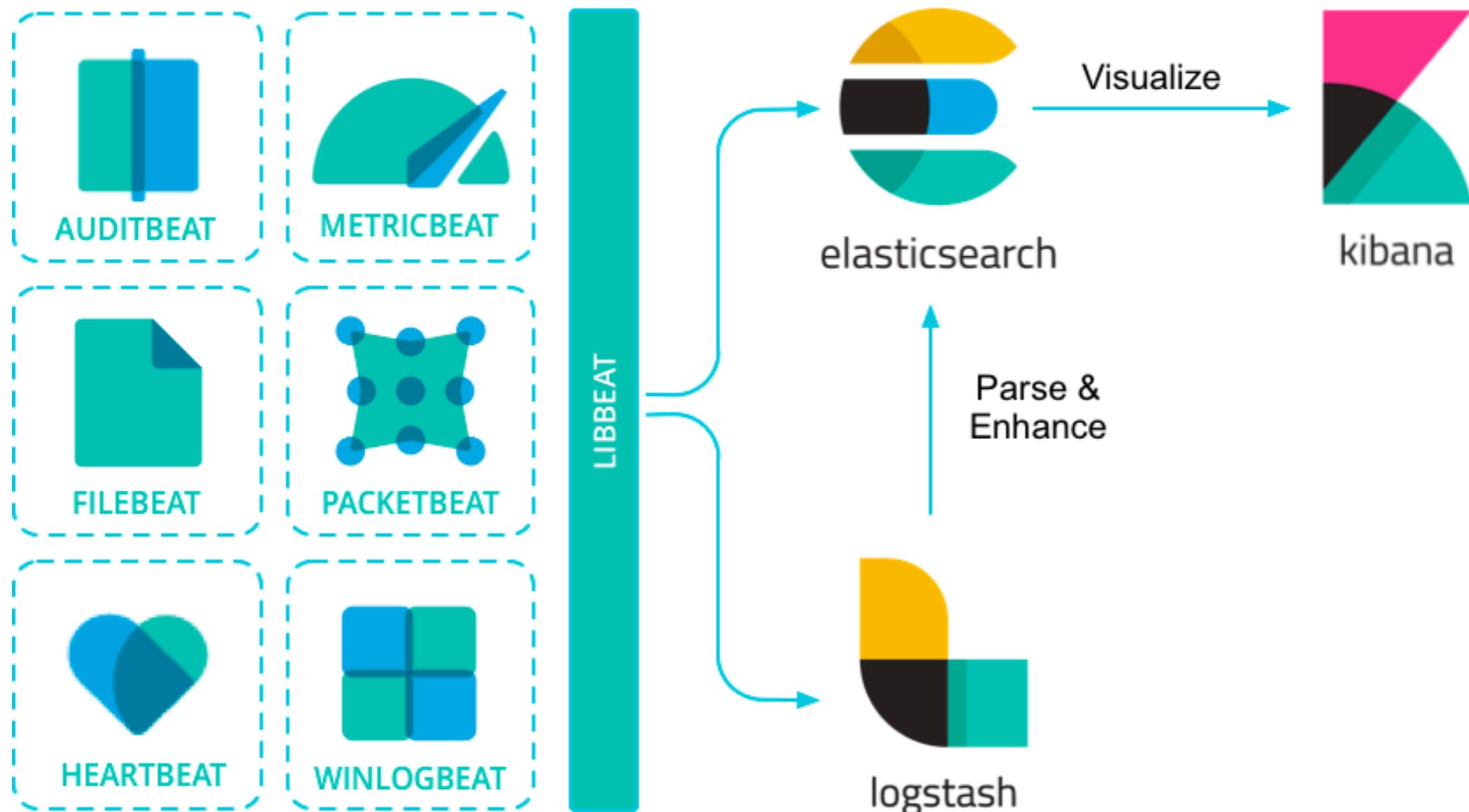
Agenda

- Working with Prometheus
- Working with Grafana
- Workshop





Beat



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



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Beat

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

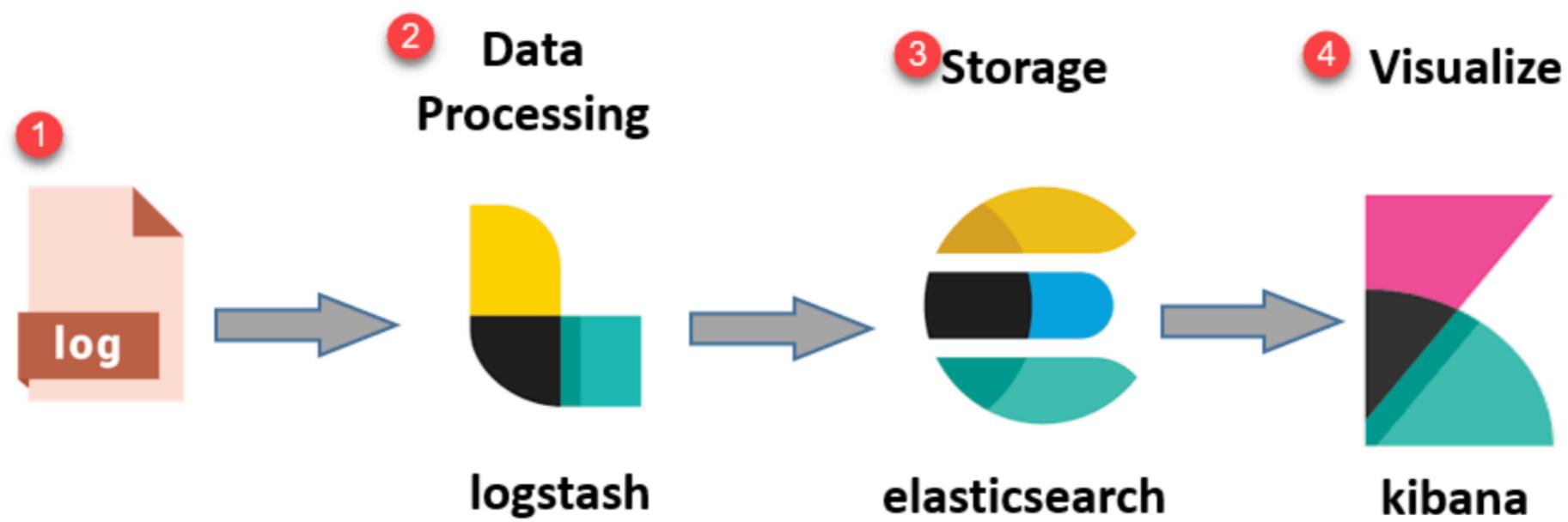
<https://www.elastic.co/guide/en/beats/libbeat/current/beats-reference.html>



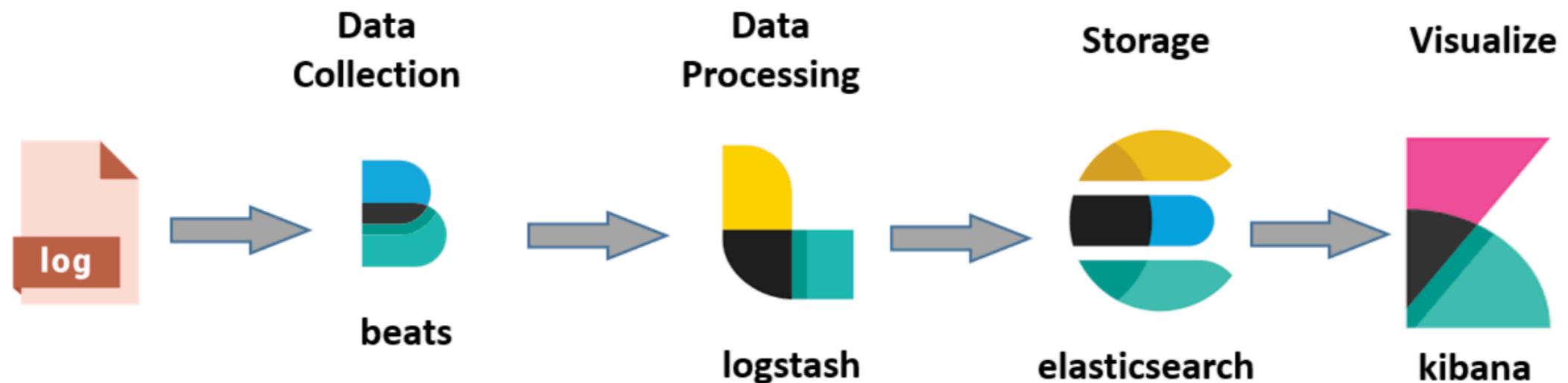
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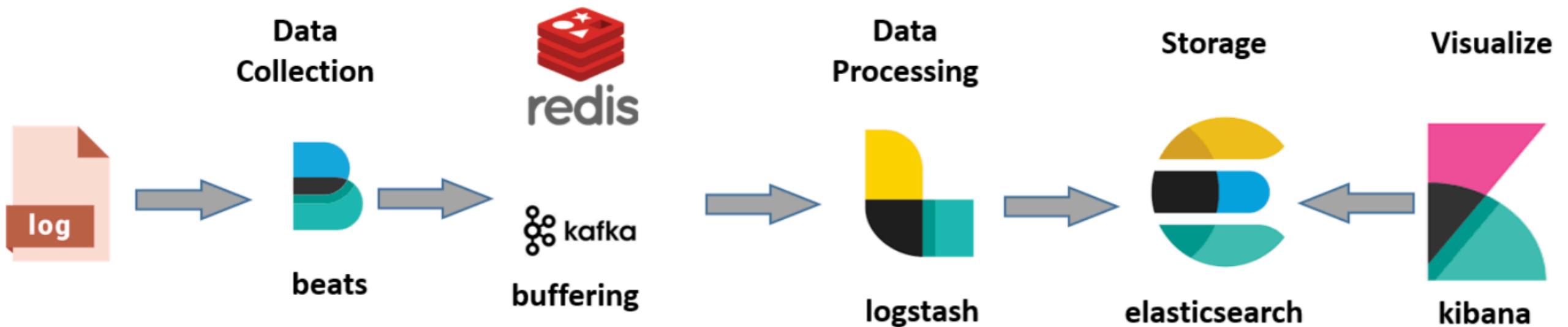
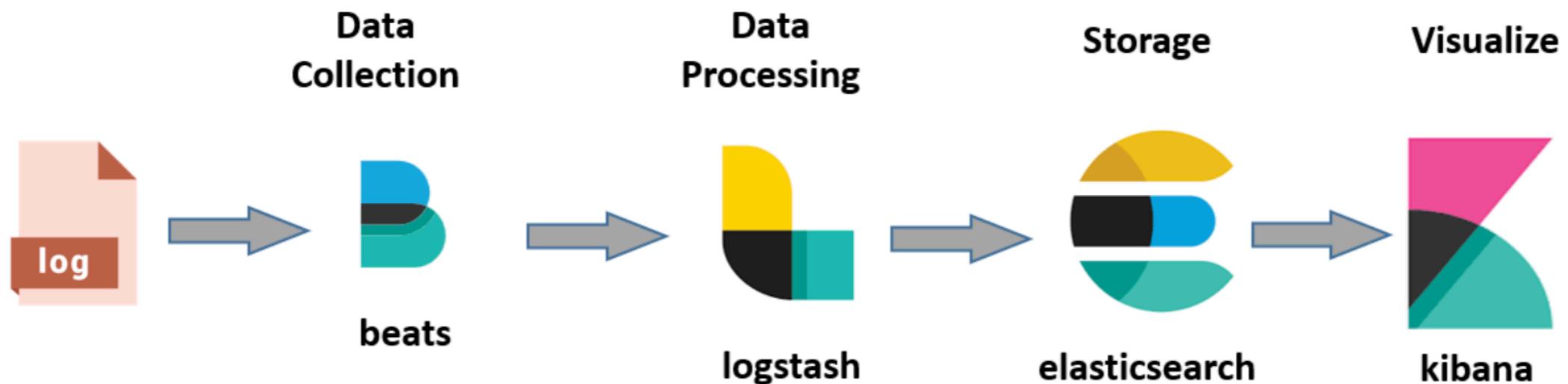
ELK



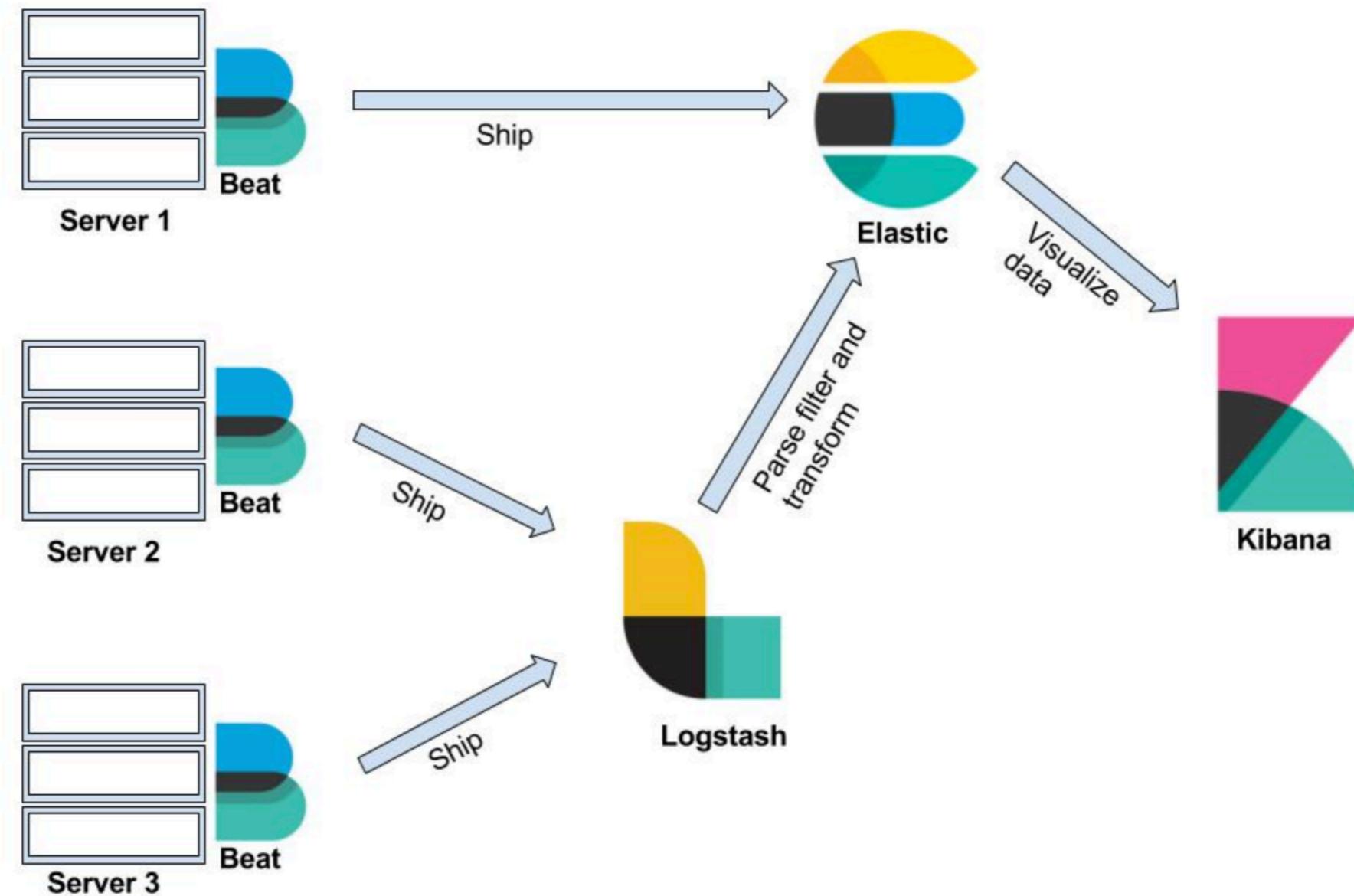
ELK + Beats



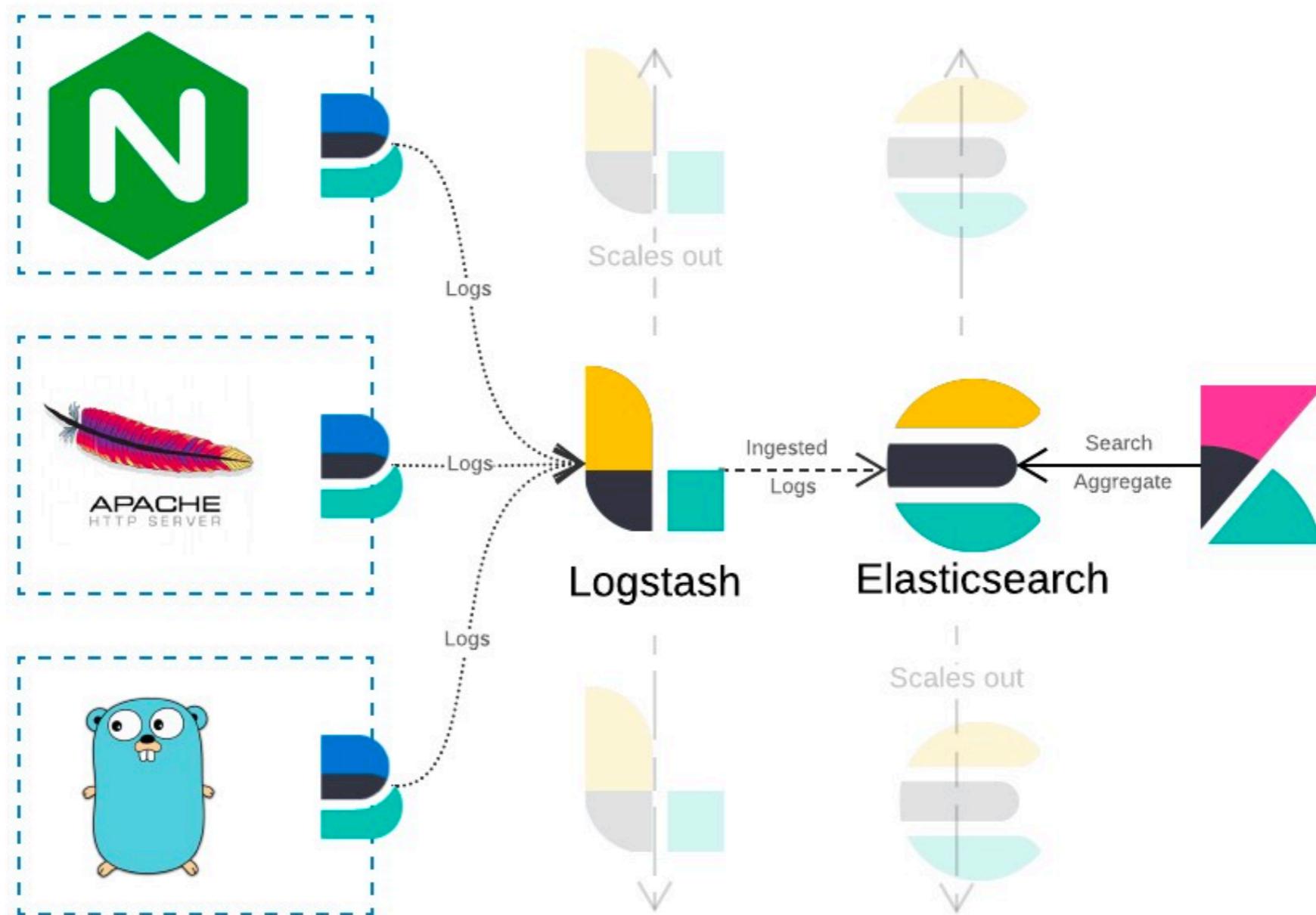
ELK + Beats



ELK + Beats



ELK + Beats



Elasticsearch

<https://www.elastic.co/elasticsearch/>



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Elasticsearch

Search
Analytic
Real-time
Distributed
Scalability



Distributed Search Engine

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



Distributed Search Engine



Compass



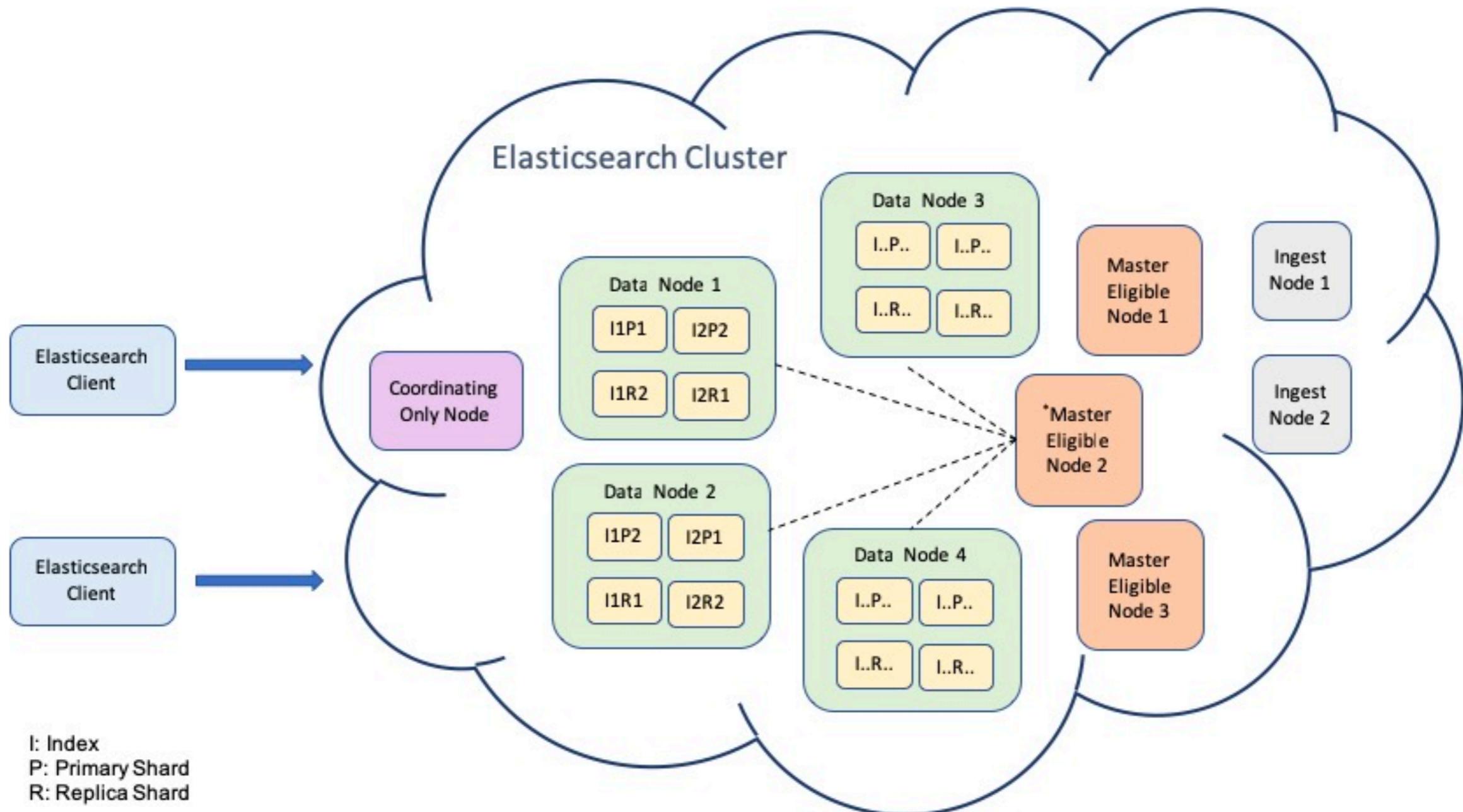
elasticsearch



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Elasticsearch Cluster



I: Index
P: Primary Shard
R: Replica Shard



Apache Lucene

The screenshot shows the official Apache Lucene website. At the top, there's a navigation bar with a search bar containing "Search with Apache So" and a dropdown menu "select provider". Below the search bar are three buttons: "CORE (JAVA)", "SOLR", and "PyLUCENE". The main header features the "Lucene" logo with a green feather graphic. Below the header, a large green banner reads "Ultra-fast Search Library and Server" and features the "Lucene" and "Solr" logos. A sub-section below the banner says "Apache Lucene and Solr set the standard for search and indexing performance". The main content area has a heading "Welcome to Apache Lucene". It lists what the project develops: open-source search software, including "Lucene Core", "Solr™", and "PyLucene". To the right of this text are two download buttons: a green one for "Apache Lucene 7.5.0" and an orange one for "Apache Solr 7.5.0". At the bottom right of this section is a link labeled "Projects".

Apache Lucene and Solr set the standard for search and indexing performance

Welcome to Apache Lucene

The Apache Lucene™ project develops open-source search software, including:

- [Lucene Core](#), our flagship sub-project, provides Java-based indexing and search technology, as well as spellchecking, hit highlighting and advanced analysis/tokenization capabilities.
- [Solr™](#) is a high performance search server built using Lucene Core, with XML/HTTP and JSON/Python/Ruby APIs, hit highlighting, faceted search, caching, replication, and a web admin interface.
- [PyLucene](#) is a Python port of the Core project.

[DOWNLOAD](#)

Apache Lucene 7.5.0

[DOWNLOAD](#)

Apache Solr 7.5.0

[Projects](#)

<http://lucene.apache.org/>



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Document based

JSON (JavaScript Object Notation)

Dynamic Schema (Schema-less)

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>



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Ranking from DB Engine (2018)

350 systems in ranking, June 2019

Rank			DBMS	Database Model	Score		
Jun 2019	May 2019	Jun 2018			Jun 2019	May 2019	Jun 2018
1.	1.	1.	Oracle	Relational, Multi-model	1299.21	+13.67	-12.04
2.	2.	2.	MySQL	Relational, Multi-model	1223.63	+4.67	-10.06
3.	3.	3.	Microsoft SQL Server	Relational, Multi-model	1087.76	+15.57	+0.03
4.	4.	4.	PostgreSQL	Relational, Multi-model	476.62	-2.27	+65.95
5.	5.	5.	MongoDB	Document	403.90	-4.17	+60.12
6.	6.	6.	IBM Db2	Relational, Multi-model	172.20	-2.24	-13.44
7.	7.	8.	Elasticsearch	Search engine, Multi-model	148.82	+0.20	+17.78
8.	8.	7.	Redis	Key-value, Multi-model	146.13	-2.28	+9.83
9.	9.	9.	Microsoft Access	Relational	141.01	-2.77	+10.02
10.	10.	10.	Cassandra	Wide column	125.18	-0.54	+5.97

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



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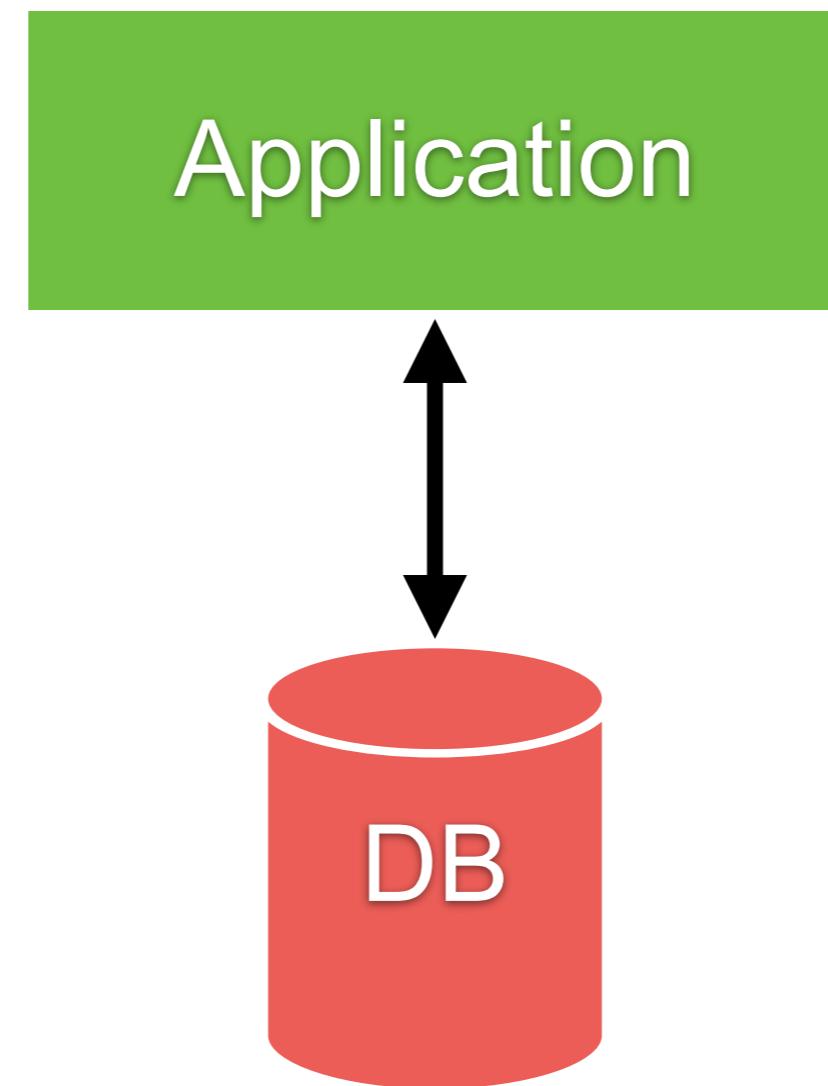
Use cases

Security/log analytics
Marketing
Operations
Searching data



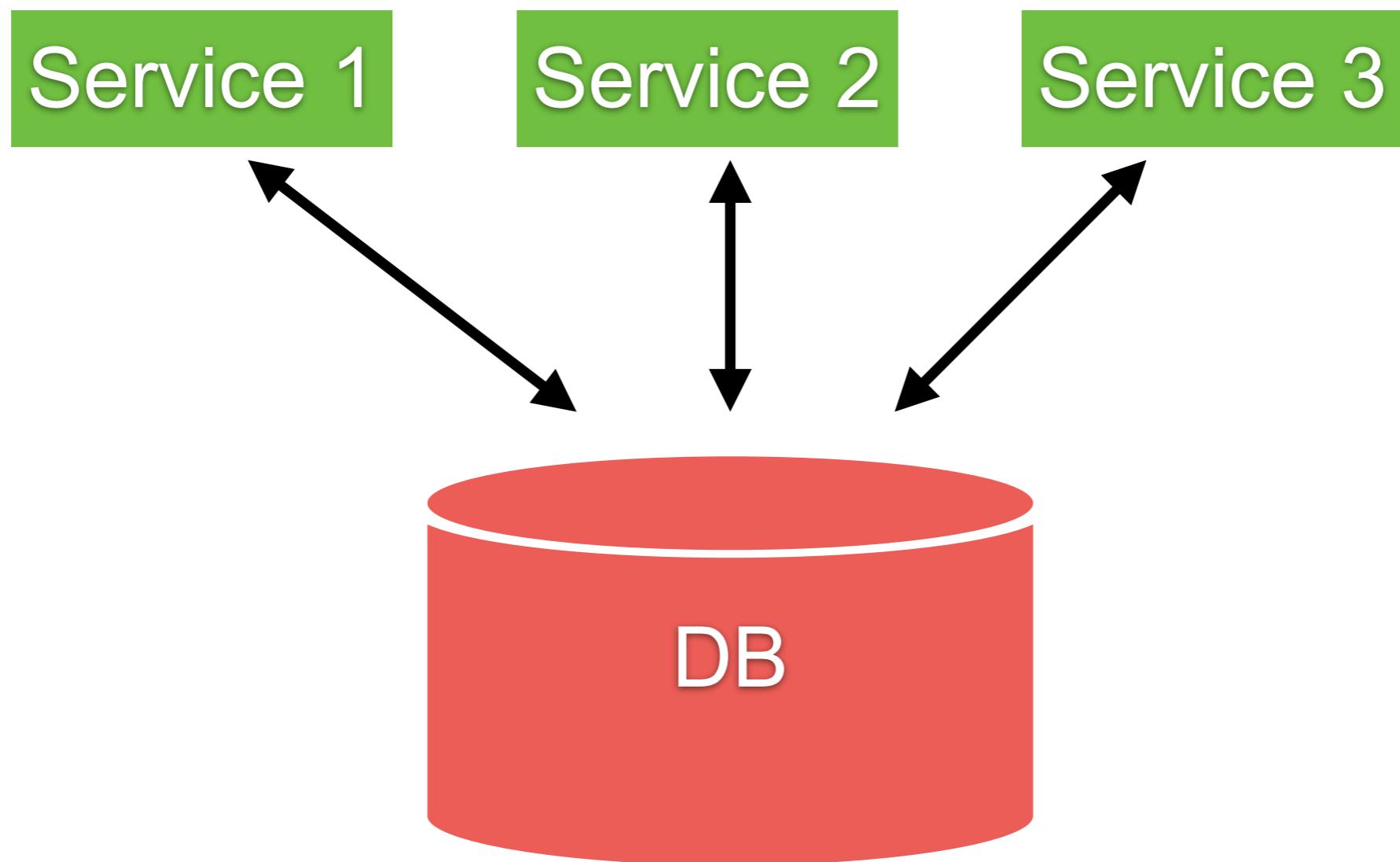
Problem ?

Single/Centralize database



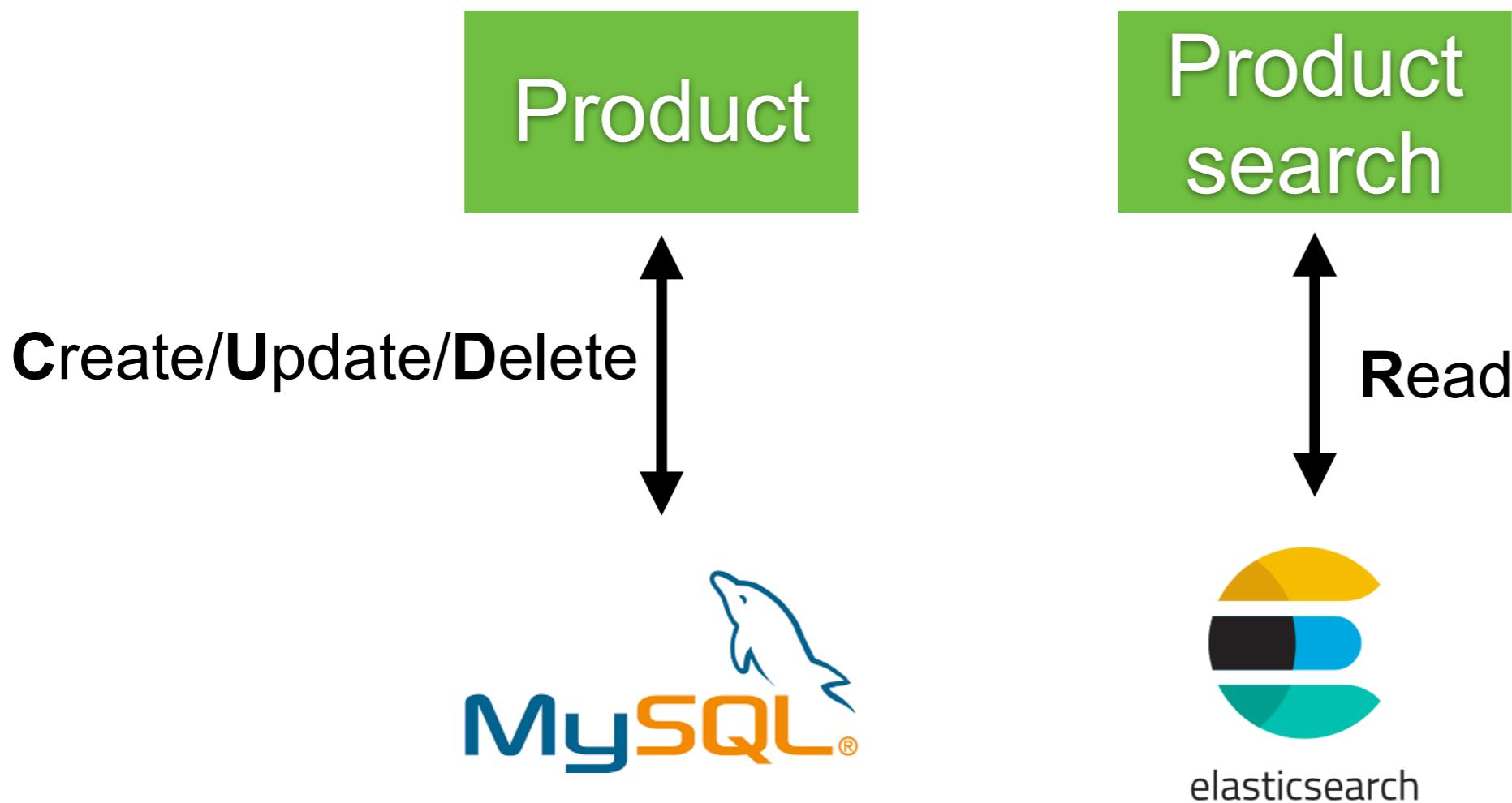
Problem ?

Single/Centralize database



Separate data for read and write

For example MySQL to write, Elasticsearch to search



Let's start



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Installation

Elasticsearch
Kibana



Install Elasticsearch



Elasticsearch

Required Java 8
JDK and Open JDK
Need \$JAVA_HOME



JAVA_HOME

\$echo %JAVA_HOME% //For Windows

\$echo \$JAVA_HOME // for Linux/Mac



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
transport] [0g8-71W] publish_address {127.0.0.1:9200},
```



Configuration files

`elasticsearch.yml`

`jvm.options`

`log4j2.properties`

Default : `$ES_HOME/config`

Custom config path : `$ES_PATH_CONF`



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>



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X-Pack ?

Elastic Stack Extension
Security
Monitoring
Alerting
Reporting
Machine Learning



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Licence

	FREE OPEN SOURCE	BASIC	GOLD	PLATINUM
Elasticsearch	Download		Request Info	Request Info
✓ Scalability & Resiliency	✓	✓	✓	✓
✓ Query & Analytics	✓	✓	✓	✓
✓ Data Enrichment	✓	✓	✓	✓
✓ Management & Tooling	✓	✓	✓	✓
✓ Security			✓	✓
✓ Alerting			✓	✓
✓ Machine Learning				✓
Kibana				
✓ Explore & Visualize	✓	✓	✓	✓
✓ Stack Management & Tooling	✓	✓	✓	✓
✓ Stack Monitoring		✓	✓	✓

<https://www.elastic.co/subscriptions>



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Hello Elasticsearch

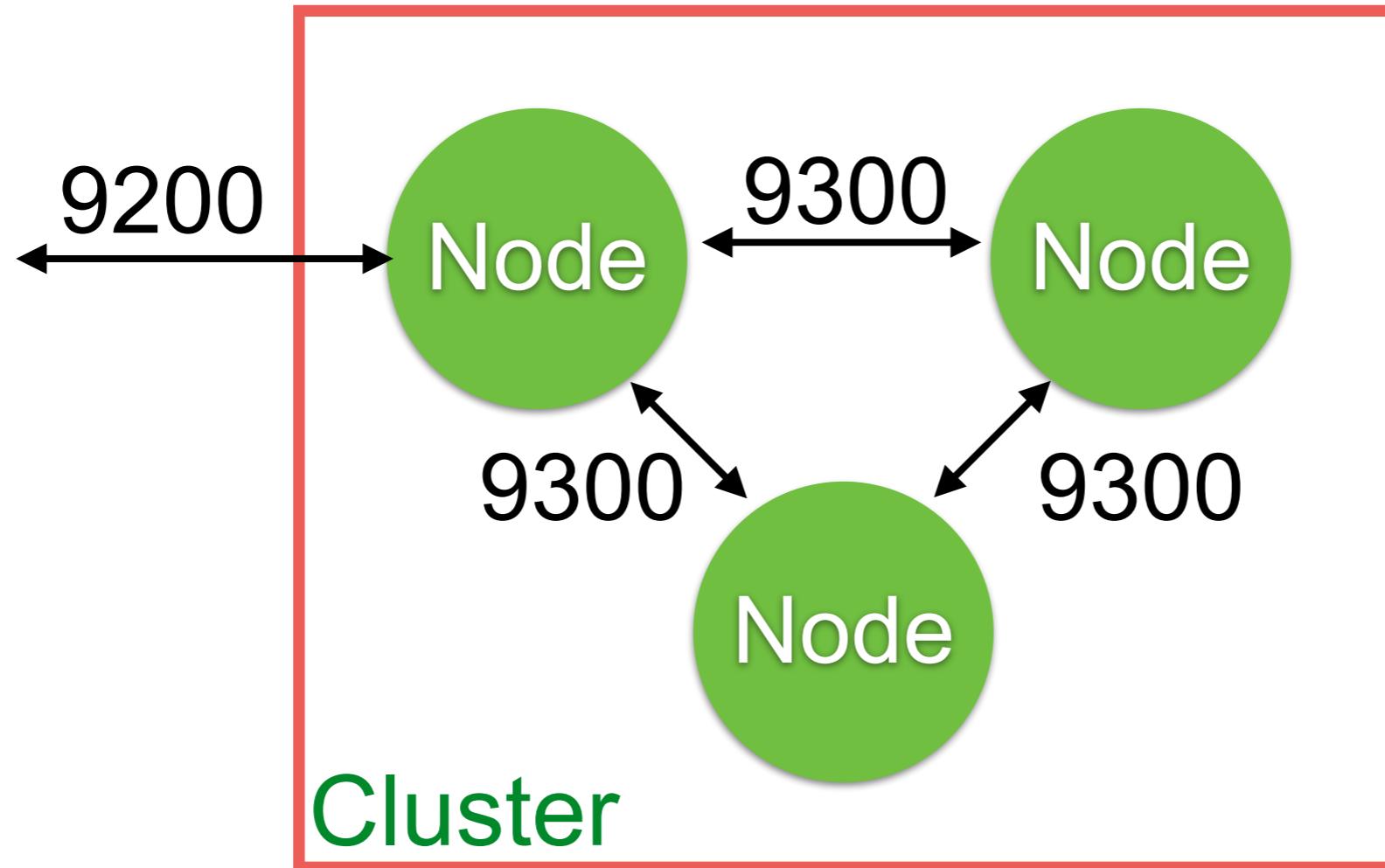
<http://localhost:9200/>

```
{  
  "name": "Somkiats-MacBook-Pro",  
  "cluster_name": "elasticsearch",  
  "cluster_uuid": "AmWXLi6DRFOWuZbZEi9FCw",  
  "version": {  
    "number": "7.14.0",  
    "build_flavor": "default",  
    "build_type": "tar",  
    "build_hash": "dd5a0a2acaa2045ff9624f3729fc8a6f40835aa1",  
    "build_date": "2021-07-29T20:49:32.864135063Z",  
    "build_snapshot": false,  
    "lucene_version": "8.9.0",  
    "minimum_wire_compatibility_version": "6.8.0",  
    "minimum_index_compatibility_version": "6.0.0-beta1"  
  },  
  "tagline": "You Know, for Search"  
}
```



Ports of Elasticsearch

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



Name of node and cluster

```
{  
  name: "Somkiats-MacBook-Pro",  
  cluster_name: "elasticsearch",  
  cluster_uuid: "gglAIg0NRHyn4AefFR61aw",  
  - version: {  
      number: "7.1.1",  
      build_flavor: "default",  
      build_type: "tar",  
      build_hash: "7a013de",  
      build_date: "2019-05-23T14:04:00.380842Z",  
      build_snapshot: false,  
      lucene_version: "8.0.0",  
      minimum_wire_compatibility_version: "6.8.0",  
      minimum_index_compatibility_version: "6.0.0-beta1"  
    },  
  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>



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Try to change and restart !!!



```
{  
  name: "Somkiats-MacBook-Pro",  
  cluster_name: "elasticsearch",  
  cluster_uuid: "gglAIg0NRHyn4AefFR61aw",  
  - version: {  
      number: "7.1.1",  
      build_flavor: "default",  
      build_type: "tar",  
      build_hash: "7a013de",  
      build_date: "2019-05-23T14:04:00.380842Z",  
      build_snapshot: false,  
      lucene_version: "8.0.0",  
      minimum_wire_compatibility_version: "6.8.0",  
      minimum_index_compatibility_version: "6.0.0-beta1"  
    },  
  tagline: "You Know, for Search"  
}
```



Compatibility of DSL and Index



```
{  
  name: "Somkiats-MacBook-Pro",  
  cluster_name: "elasticsearch",  
  cluster_uuid: "gglAIg0NRHyn4AefFR61aw",  
  - version: {  
      number: "7.1.1",  
      build_flavor: "default",  
      build_type: "tar",  
      build_hash: "7a013de",  
      build_date: "2019-05-23T14:04:00.380842Z",  
      build_snapshot: false,  
      lucene_version: "8.0.0",  
      minimum_wire_compatibility_version: "6.8.0",  
      minimum_index_compatibility_version: "6.0.0-beta1"  
    },  
  tagline: "You Know, for Search"  
}
```

DSL version

Index version



```
{  
  name: "Somkiats-MacBook-Pro",  
  cluster_name: "elasticsearch",  
  cluster_uuid: "gglAIg0NRHyn4AefFR61aw",  
  - version: {  
      number: "7.1.1",  
      build_flavor: "default",  
      build_type: "tar",  
      build_hash: "7a013de",  
      build_date: "2019-05-23T14:04:00.380842Z",  
      build_snapshot: false,  
      lucene_version: "8.0.0",  
      minimum_wire_compatibility_version: "6.8.0",  
      minimum_index_compatibility_version: "6.0.0-beta1"  
    },  
  tagline: "You Know, for Search"  
}
```

Index version



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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>



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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



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Kibana

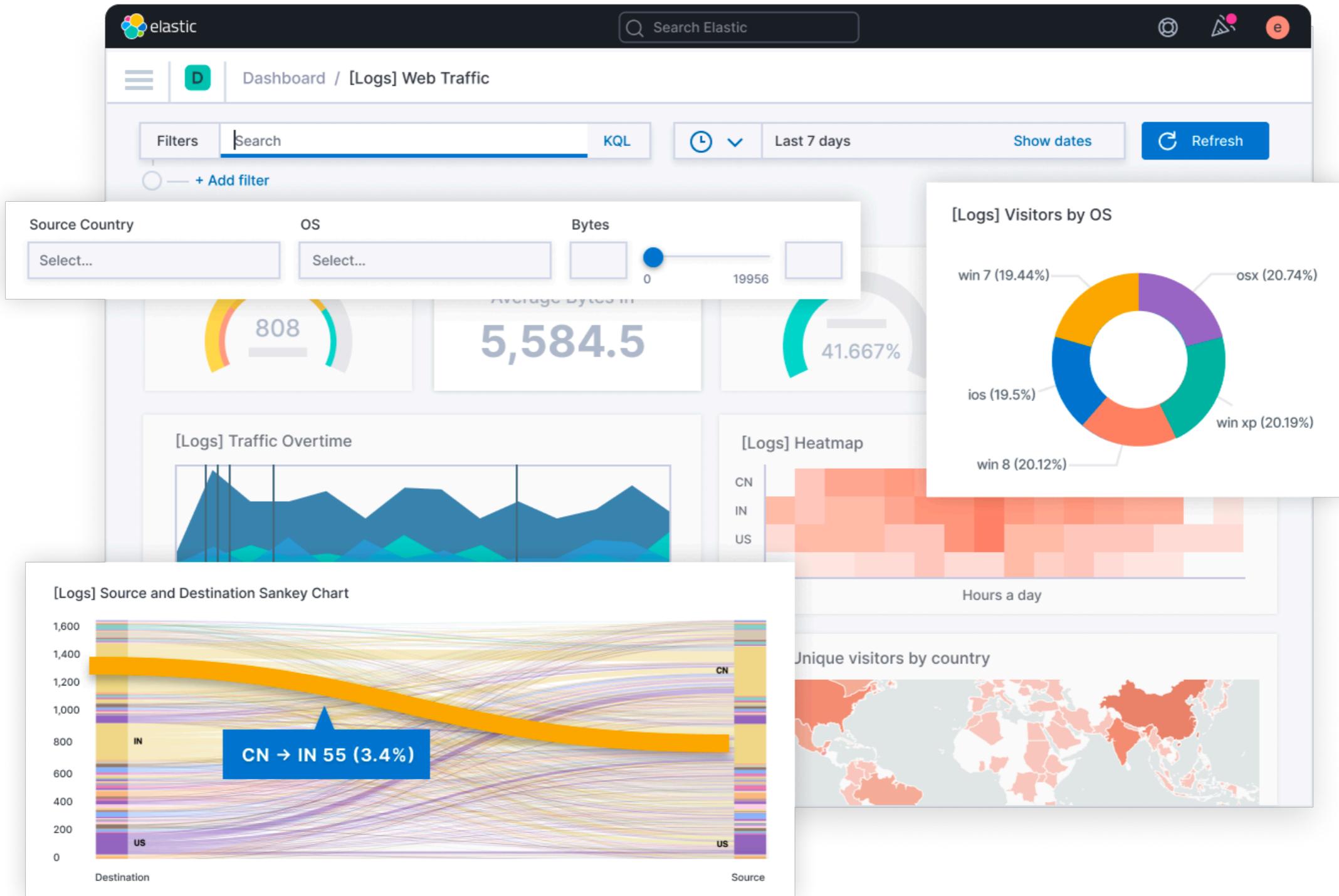
<https://www.elastic.co/kibana/>



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Kibana



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 - Ready

[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/>

The image shows the Kibana landing page. On the left is a vertical sidebar with icons for Kibana, APM, Metrics, Security, Visualize, Discover, and Admin. The main content area has two main sections: "Add Data to Kibana" and "Visualize and Explore Data".

Add Data to Kibana:

- APM:** APM automatically collects in-depth performance metrics and errors from inside your applications. [Add APM](#)
- Logging:** Ingest logs from popular data sources and easily visualize in preconfigured dashboards. [Add log data](#)
- Metrics:** Collect metrics from the operating system and services running on your servers. [Add metric data](#)
- Security analytics:** Centralize security events for interactive investigation in ready-to-go visualizations. [Add security events](#)

Data already in Elasticsearch? [Set up index patterns](#)

Visualize and Explore Data:

- Dashboard:** Display and share a collection of visualizations and saved searches.
- Timelion:** Use an expression language to analyze time series data.
- Discover:** Interactively explore your data by querying and filtering raw documents.
- Visualize:** Create visualizations and aggregate data stores in your

Manage and Administer the Elastic Stack:

- Console:** Skip cURL and use this JSON interface to work with your data directly.
- Index Patterns:** Manage the index patterns that help retrieve your data from Elasticsearch.
- Saved Objects:** Import, export, and manage your saved searches,



ELK Stack

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Using Dev Tools

The screenshot shows the Kibana interface with a sidebar on the left and a main content area on the right.

Left Sidebar:

- Kibana logo
- Discover
- Visualize
- Dashboard
- Timelion
- APM
- Dev Tools** (highlighted with a red box)
- Monitoring
- Management

Main Content Area:

Dev Tools

Welcome to Console

Quick intro to the UI

The Console UI is split into two panes: an editor pane (left) and a response pane (right). Use the editor to type requests and submit them in the response pane on the right side.

Console understands requests in a compact format, similar to cURL:

```
1 # index a doc
2 PUT index/type/1
3 {
4   "body": "here"
5 }
6
7 # and get it ...
8 GET index/type/1
```

While typing a request, Console will make suggestions which you can then accept by hitting Enter/Tab. These suggestions are made based on types.

A few quick tips, while I have your attention

- Submit requests to ES using the green triangle button.
- Use the wrench menu for other useful things.
- You can paste requests in cURL format and they will be translated to the Console syntax.
- You can resize the editor and output panes by dragging the separator between them.
- Study the keyboard shortcuts under the Help button. Good stuff in there!

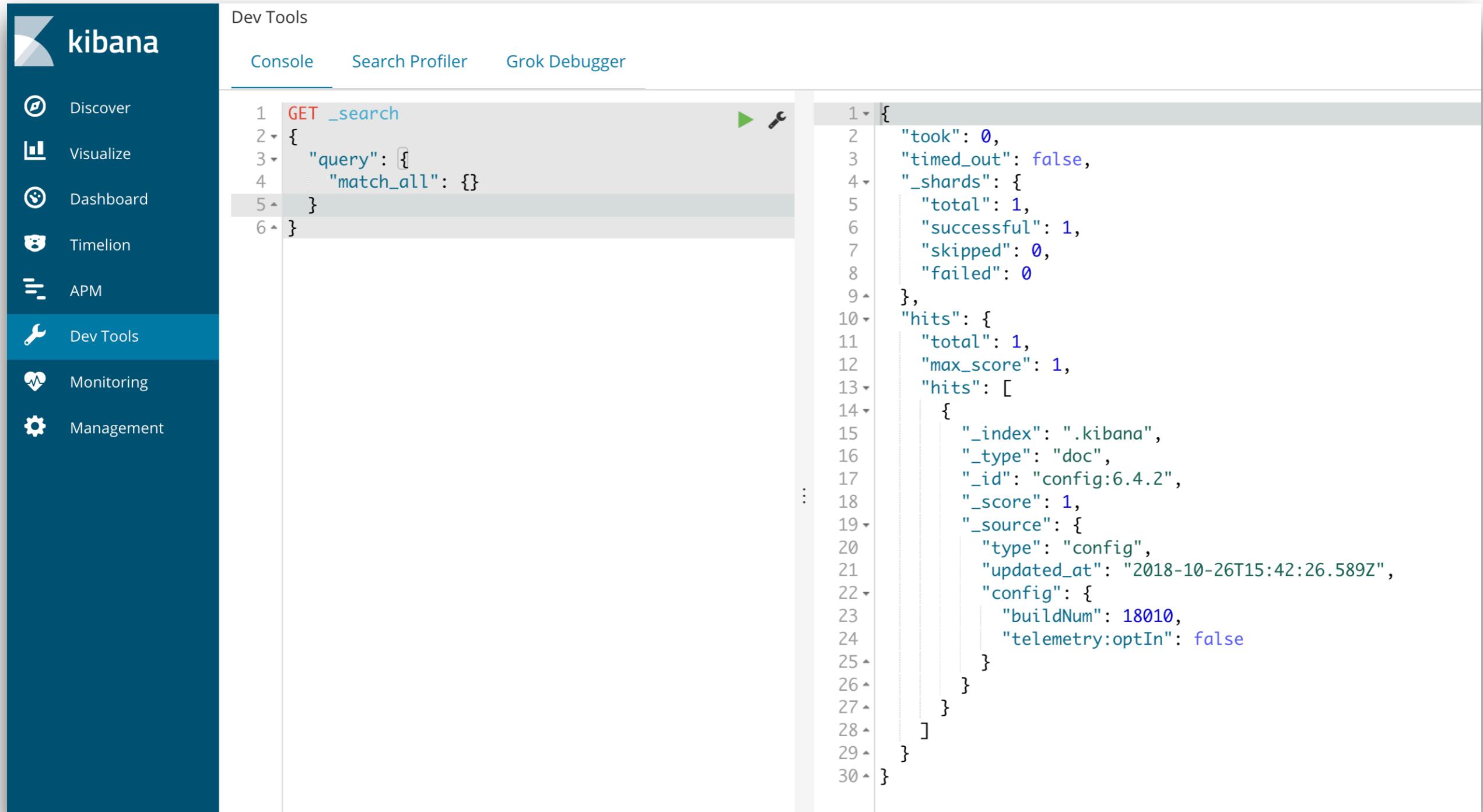
[Get to work](#)



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Ready to start



The screenshot shows the Kibana Dev Tools interface. On the left is a sidebar with icons for Discover, Visualize, Dashboard, Timelion, APM, Dev Tools (which is selected), Monitoring, and Management. The main area is titled "Dev Tools" and contains three tabs: Console, Search Profiler, and Grok Debugger. The "Console" tab is active, displaying a code editor with a GET _search request and its JSON response. The request is:

```
1 GET _search
2 {
3   "query": {
4     "match_all": {}
5   }
6 }
```

The response is:

```
1 {
2   "took": 0,
3   "timed_out": false,
4   "_shards": {
5     "total": 1,
6     "successful": 1,
7     "skipped": 0,
8     "failed": 0
9   },
10  "hits": {
11    "total": 1,
12    "max_score": 1,
13    "hits": [
14      {
15        "_index": ".kibana",
16        "_type": "doc",
17        "_id": "config:6.4.2",
18        "_score": 1,
19        "_source": {
20          "type": "config",
21          "updated_at": "2018-10-26T15:42:26.589Z",
22          "config": {
23            "buildNum": 18010,
24            "telemetry:optIn": false
25          }
26        }
27      }
28    ]
29  }
30 }
```



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Elasticsearch architecture



Basic concepts

Cluster

Node

Shard

Replica

Gateway

Index

Document

Type

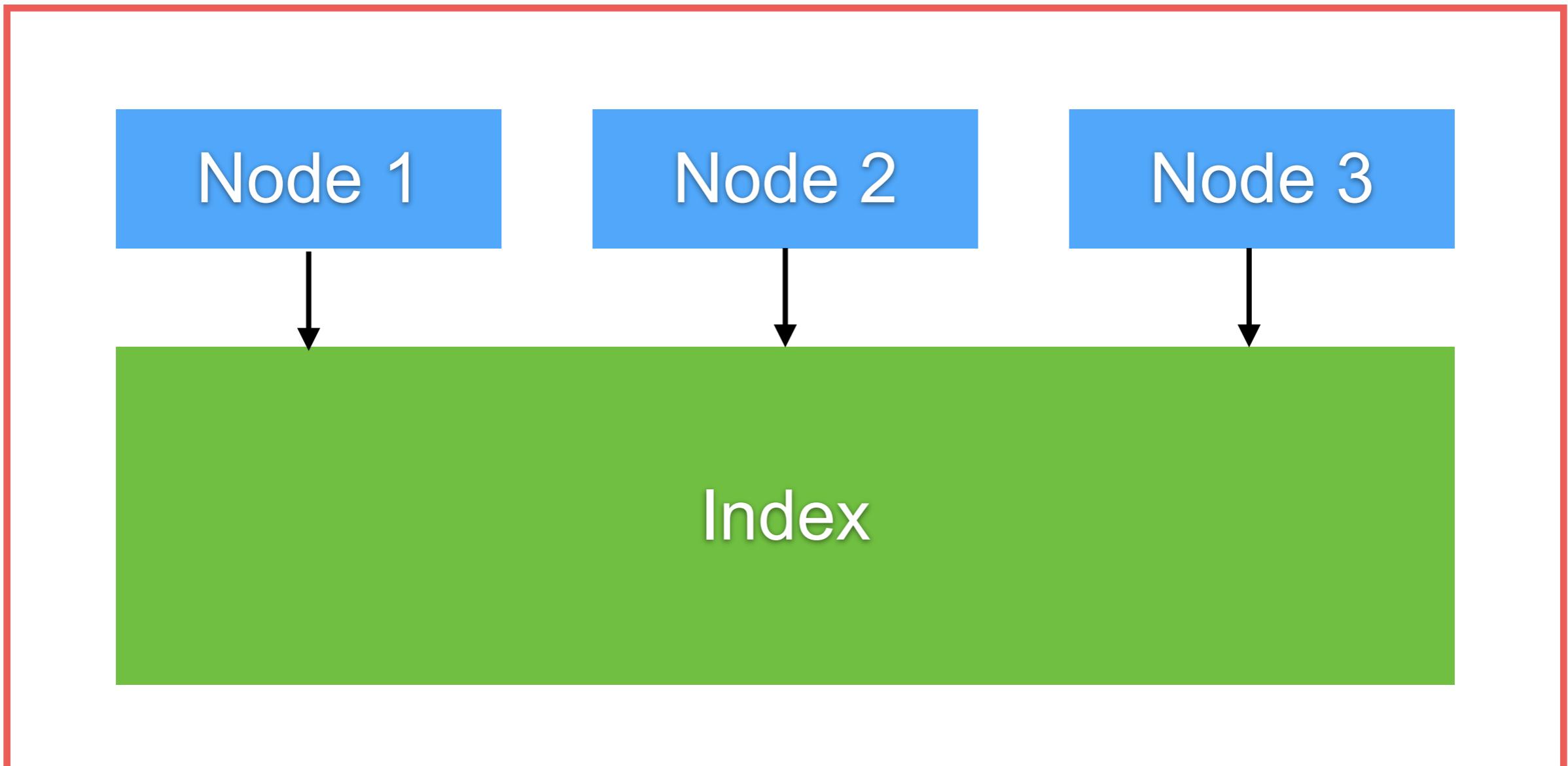
Mapping



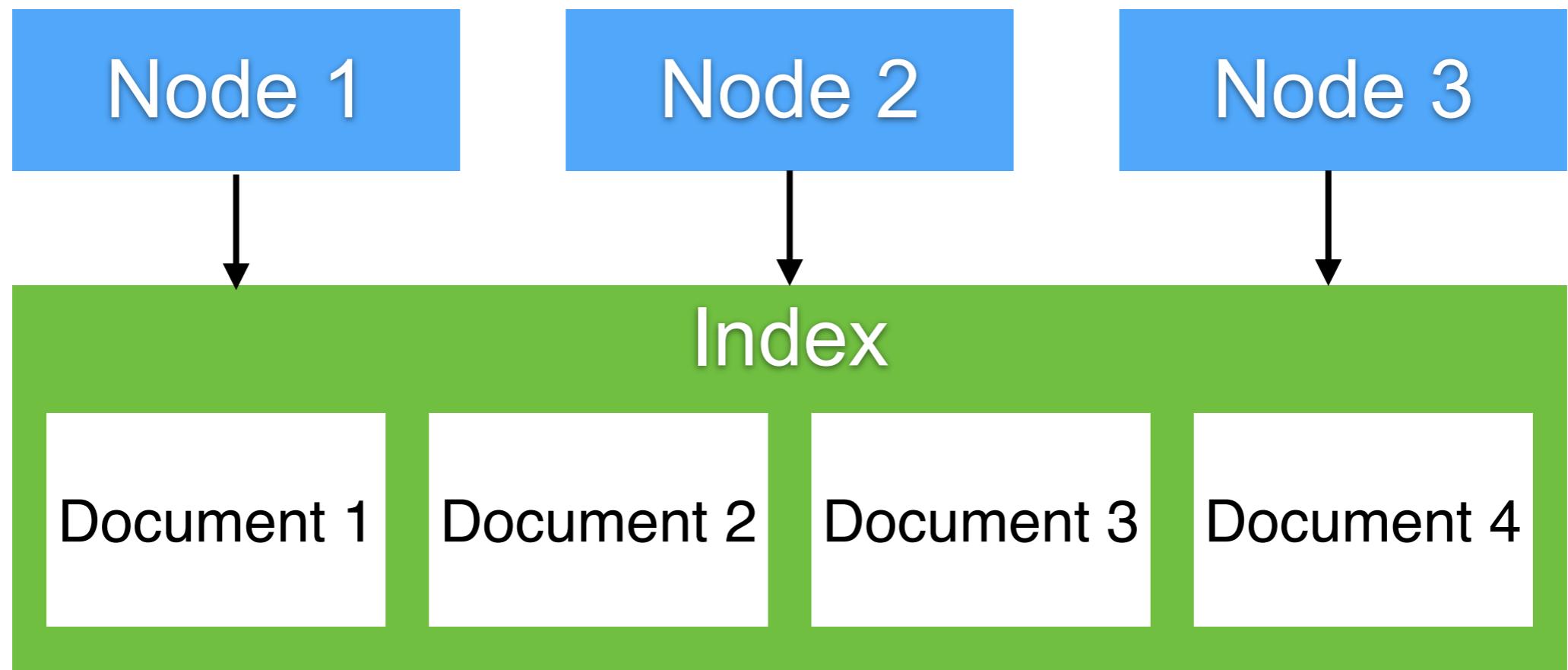
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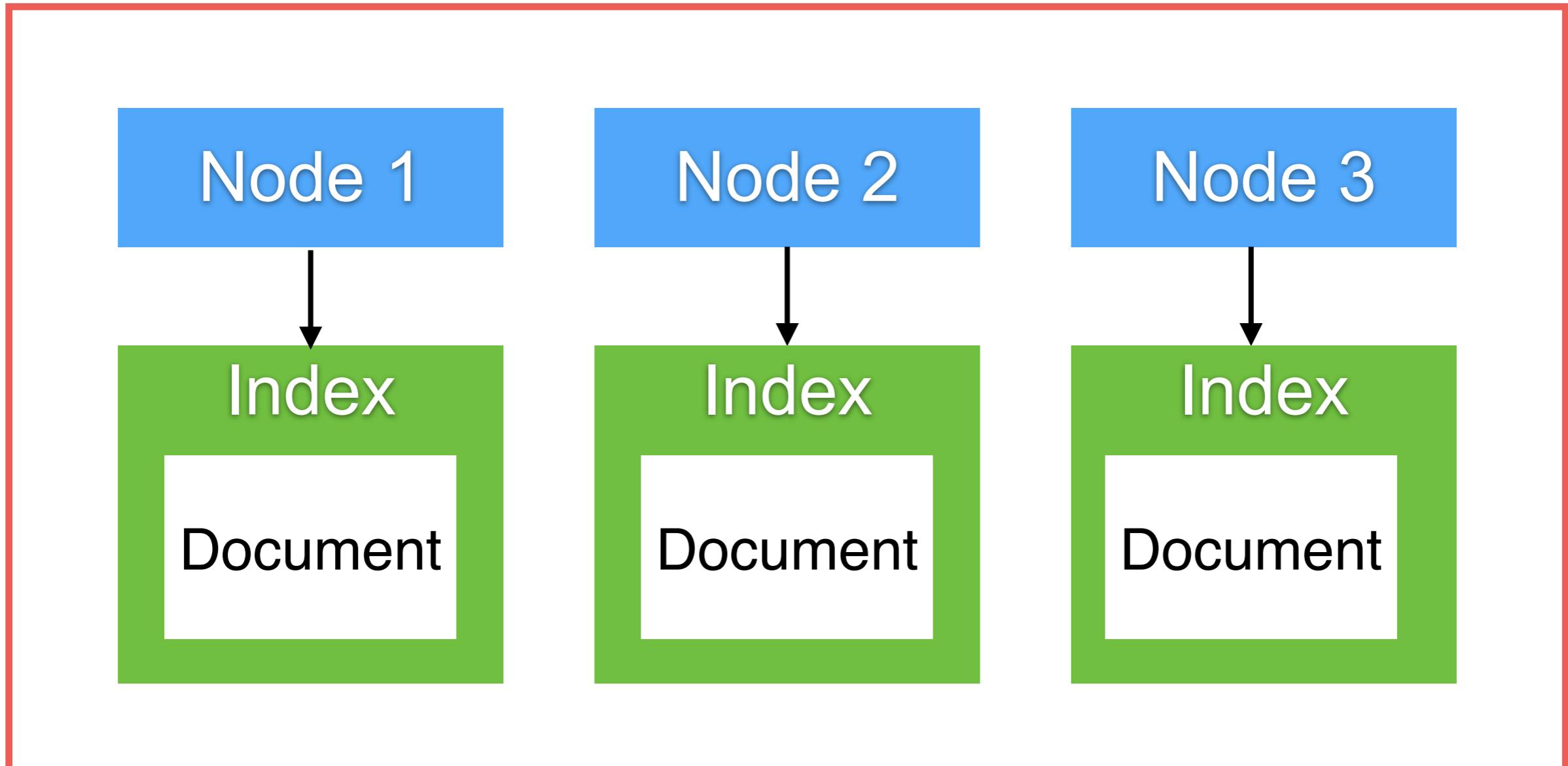
Cluster



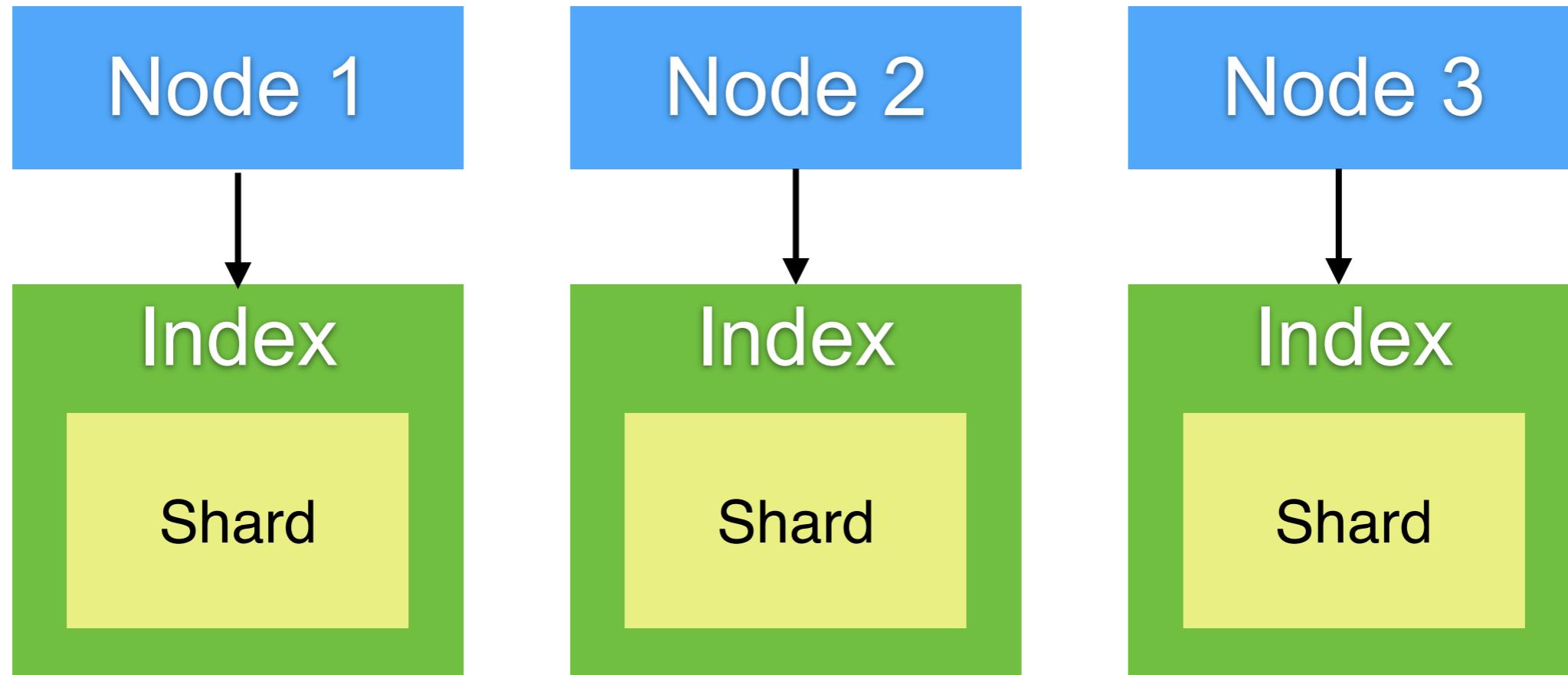
Documents !!



Distributed database



Design for scale (Shard)



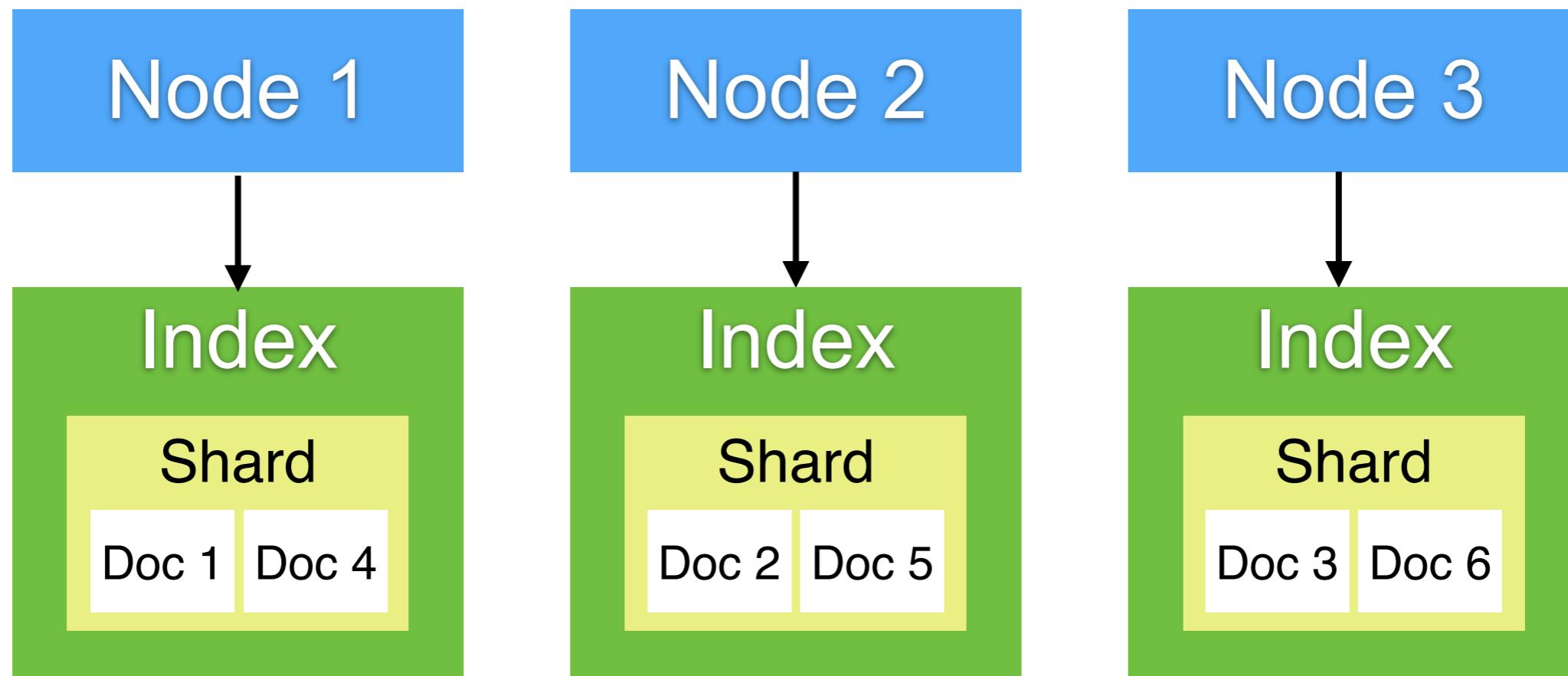
Index is split into shards

Each shard may be on a different node in cluster

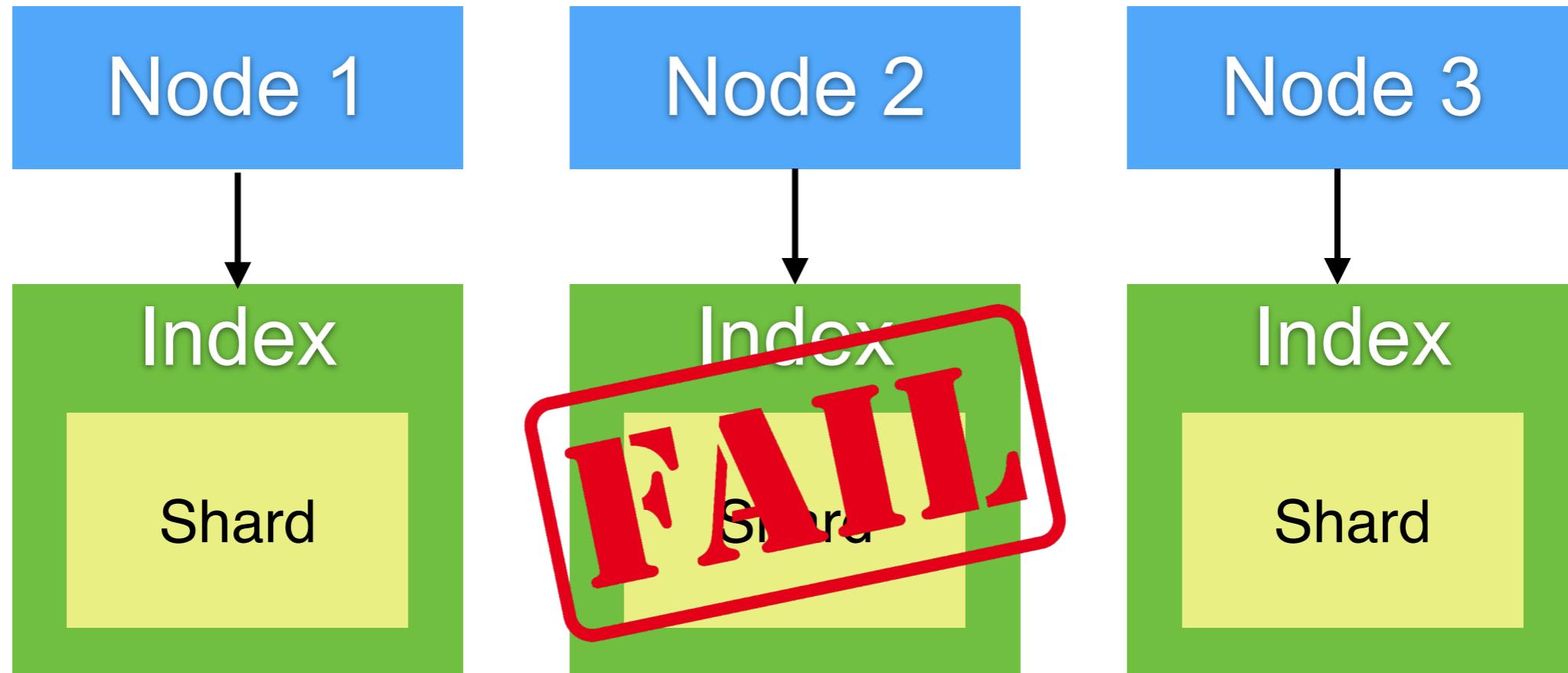
Every shard is a self-contained *Lucene index*



Documents are hashed



Design for fail (Replica)



Replica = copy of shards

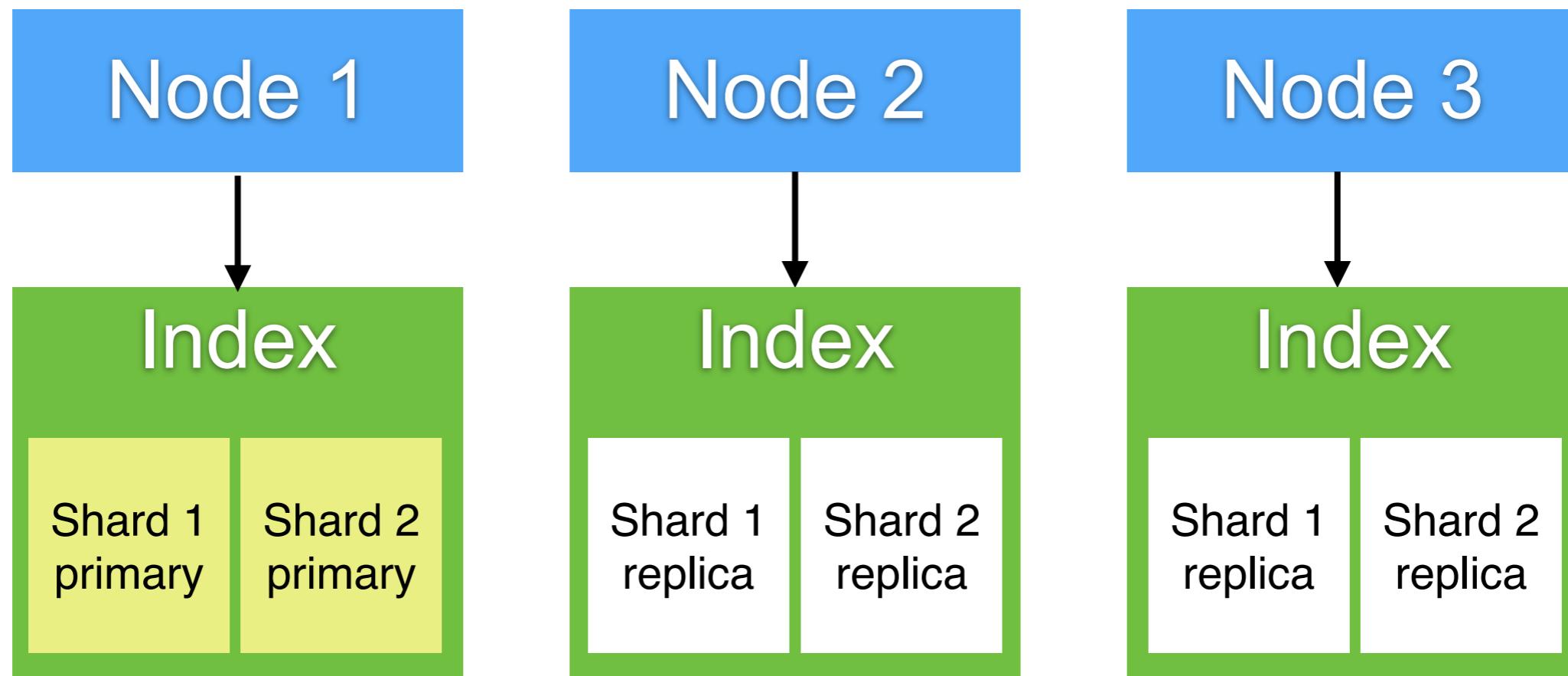
1 replica = 1 Primary + 1 Replica

2 replicas = 1 Primary + 2 Replicas

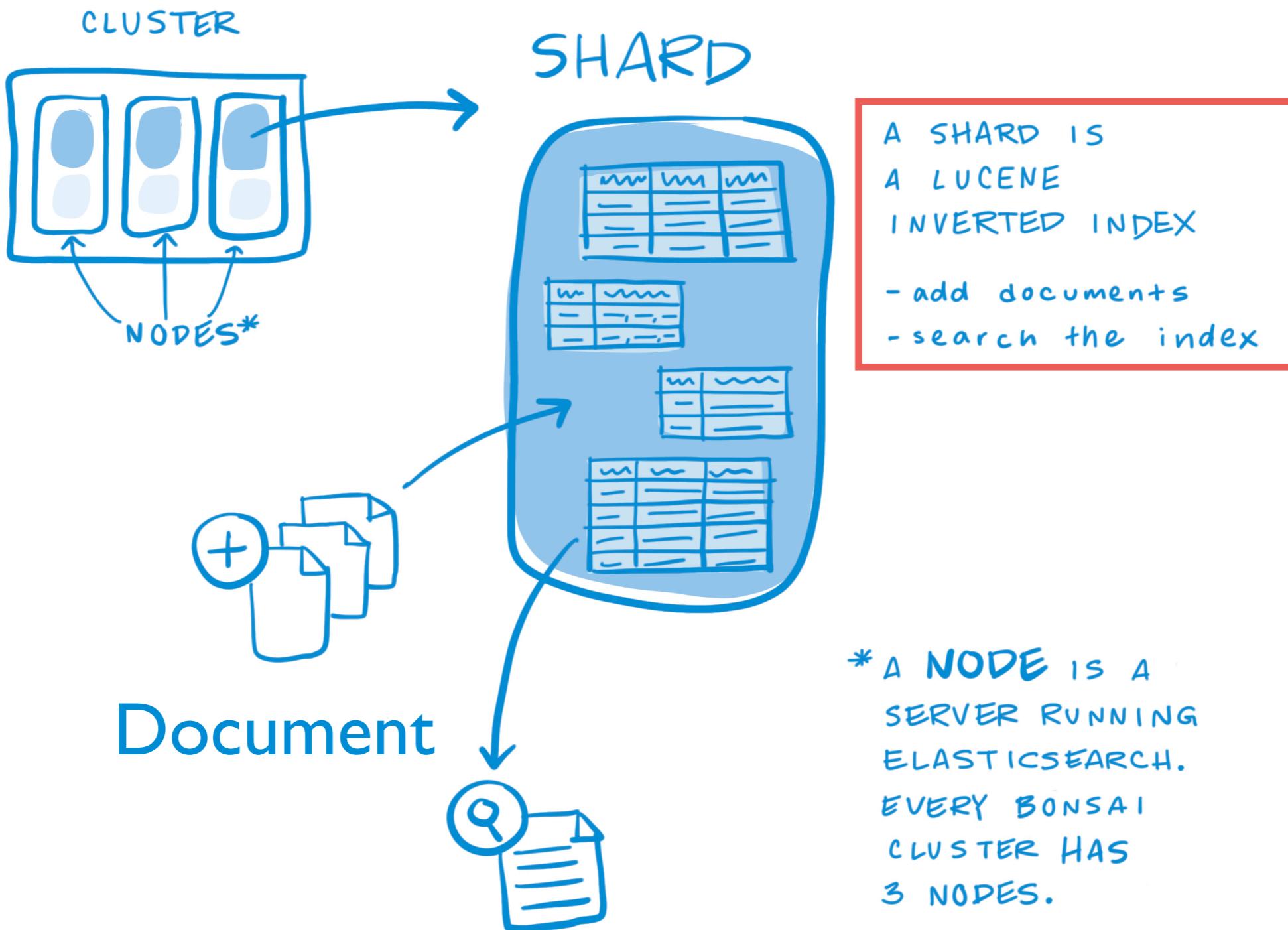
3 replicas = 1 Primary + 3 Replicas



Replica = 2



Basic concepts

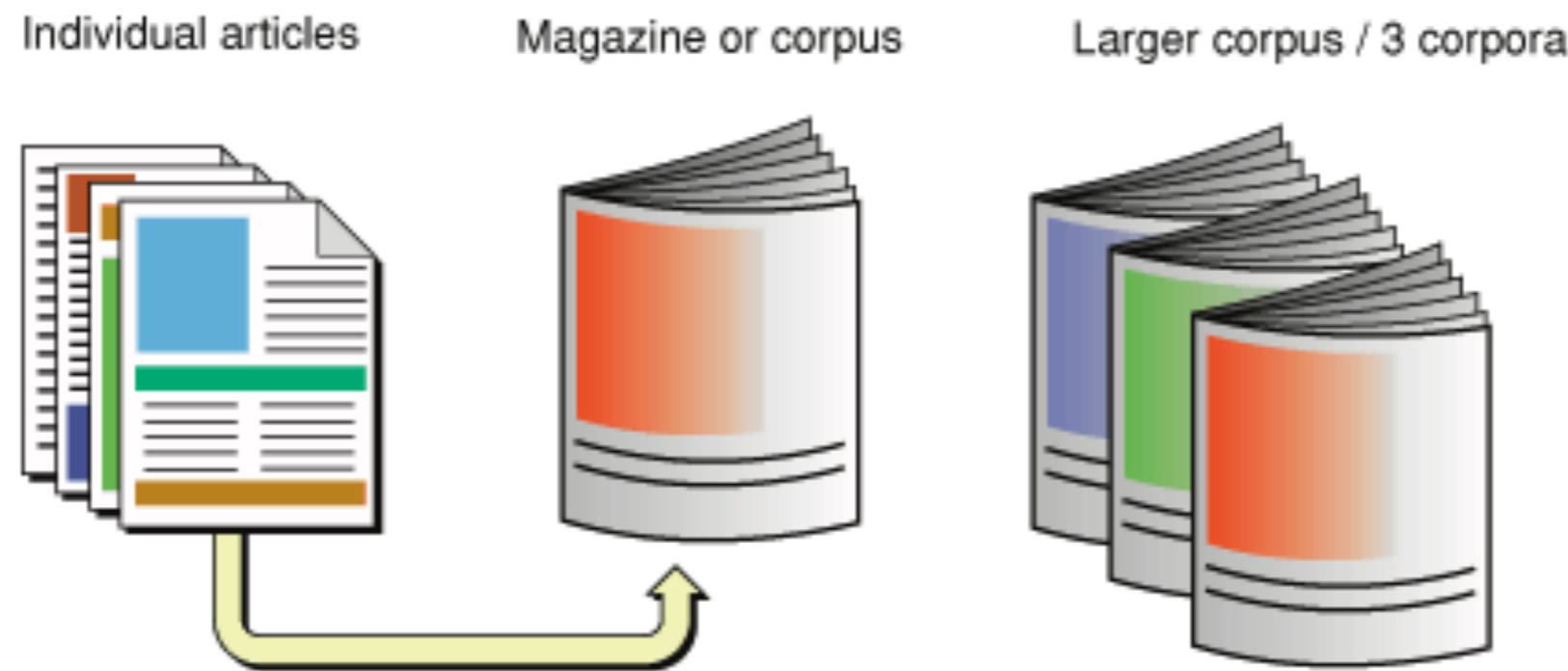


Inverted Index



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

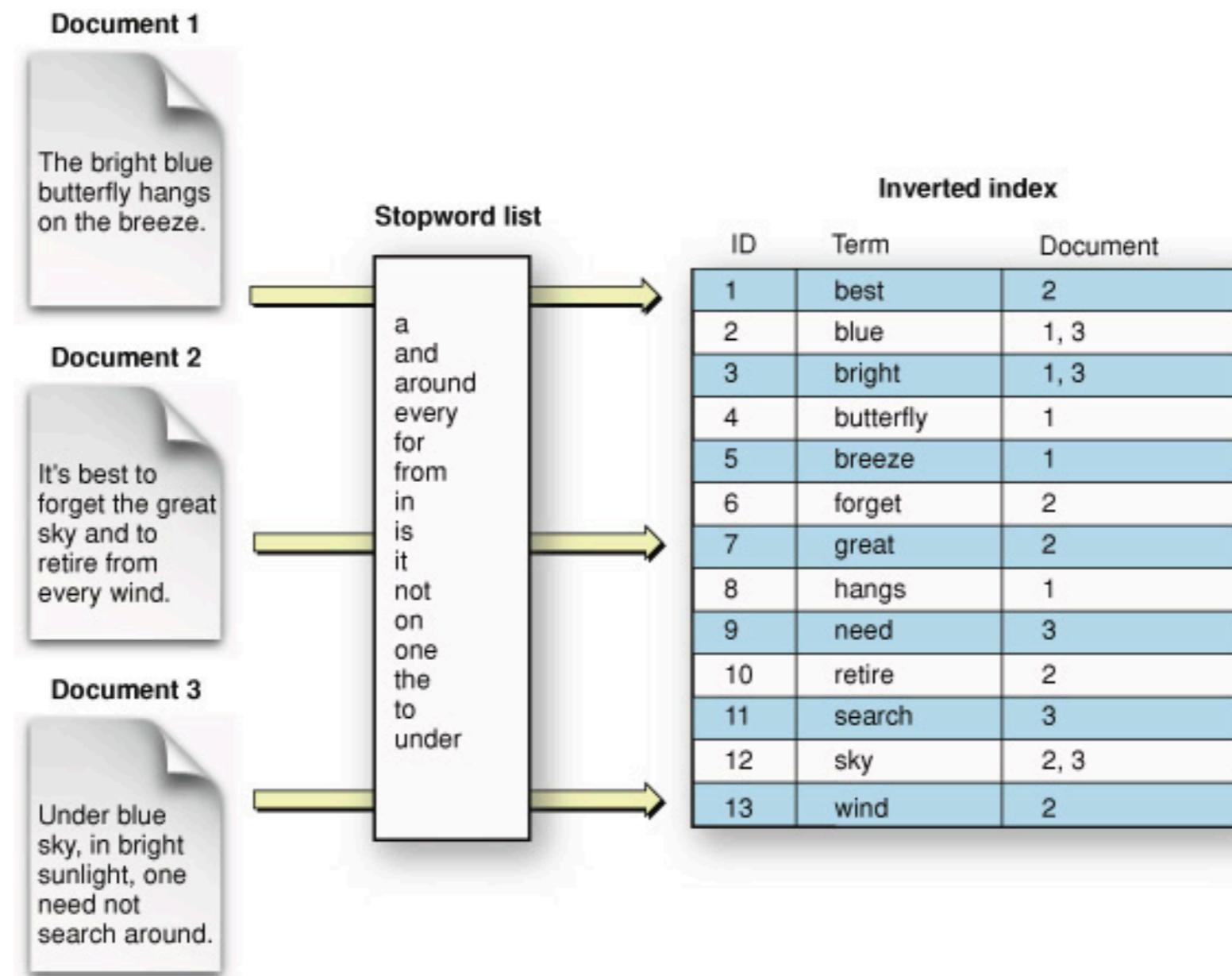


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Inverted Index

Try to construct index



Apache Lucene

Elasticsearch

Apache Lucene

JVM

<https://lucene.apache.org/>



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Basic concept

Apache Lucene writes all the information to a structure called “**Inverted Index**”



Basic concept

Document
Field
Term
Token



Example

Document no.	Data
1	Elasticsearch Server
2	Mastering Elasticsearch Second Edition
3	Apache Solr Cookbook Third Edition



Token

Token	Document no.
Elasticsearch	1
Elasticsearch	2
Server	1
Mastering	2
Second	2
Edition	2
Edition	3
Apache	3
Solr	3
Cookbook	3
Third	3



Term

Token	Count	Document no.
elasticsearch	2	1,2
server	1	1
mastering	1	2
second	1	2
edition	2	2,3
apache	1	3
solr	1	3
cookbook	1	3
third	1	3



Lucene inverted index

Token	Count	Document no.
elasticsearch	2	1,2
server	1	1
mastering	1	2
second	1	2
edition	2	2,3
apache	1	3
solr	1	3
cookbook	1	3
third	1	3



Lucene inverted index

Write-once and read-many-times structure

Called “**Segment**”

Can't be delete (just marked to deleted)



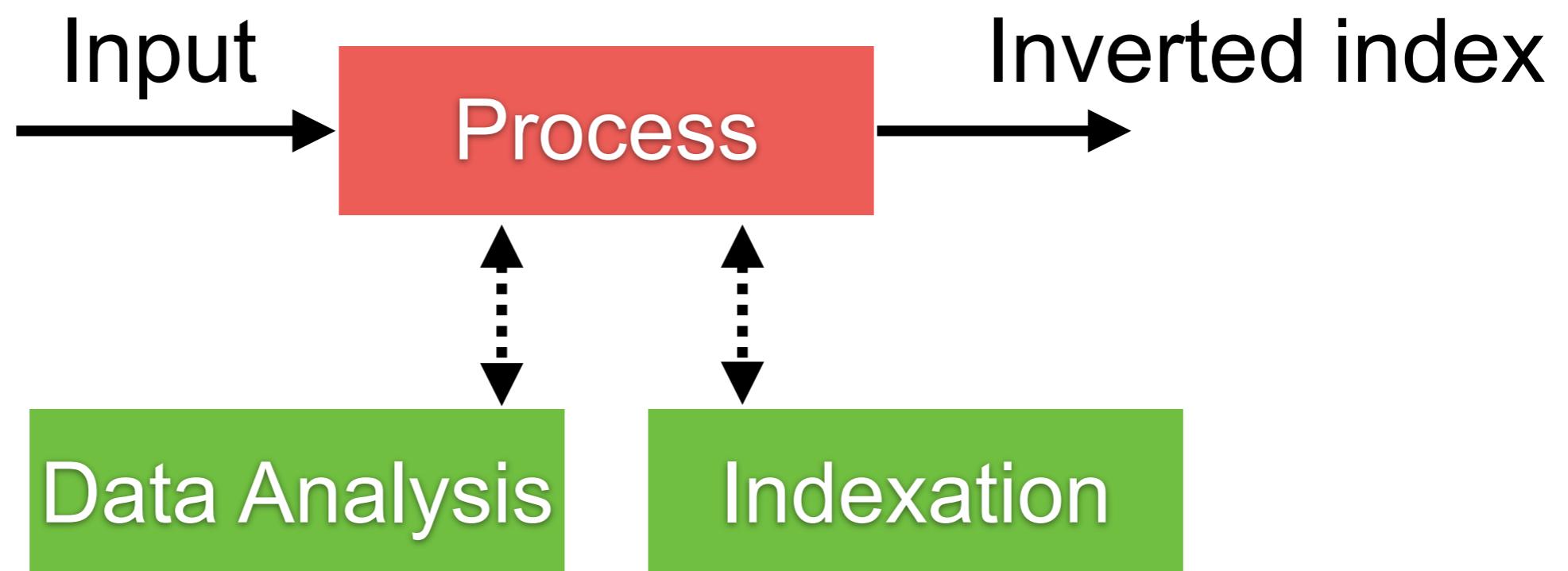
Input data analysis

Write-once and read-many-times structure

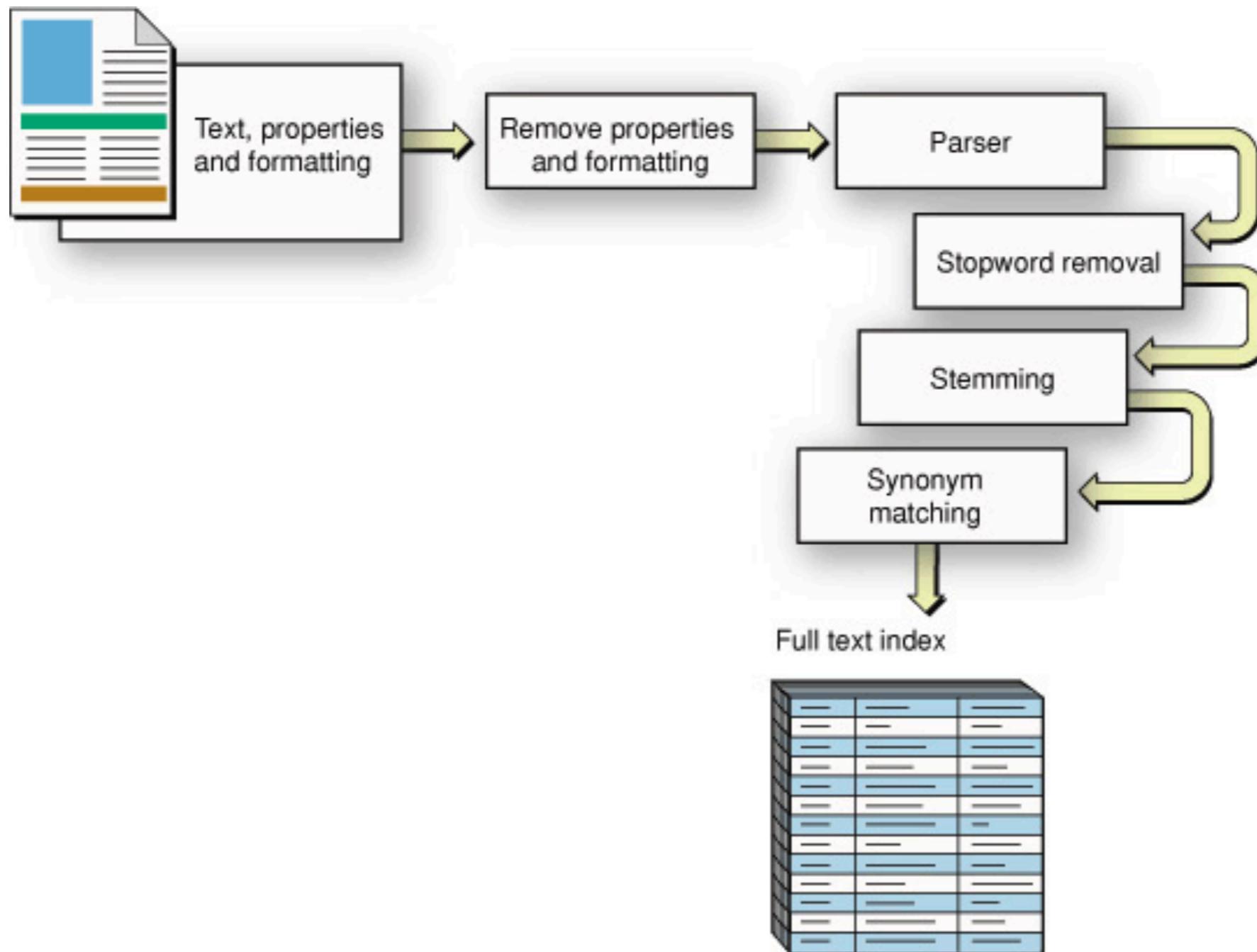


Input data analysis

Write-once and read-many-times structure



Process ?



CRUD with Elasticsearch

02-crud/book_document.json



CRUD with Elasticsearch

Create document

Read document

Update document

Delete document



Compare with RDBMS

Database

Table

Row

Column

Index

Type*

Document

Field

* Only 1 type per index



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

PUT **/store/book/1**

Index name

Type name

Document ID



1 Type per Index

Removal of mapping types



IMPORTANT

Indices created in Elasticsearch 6.0.0 or later may only contain a single [mapping type](#). Indices created in 5.x with multiple mapping types will continue to function as before in Elasticsearch 6.x. Mapping types will be completely removed in Elasticsearch 7.0.0.

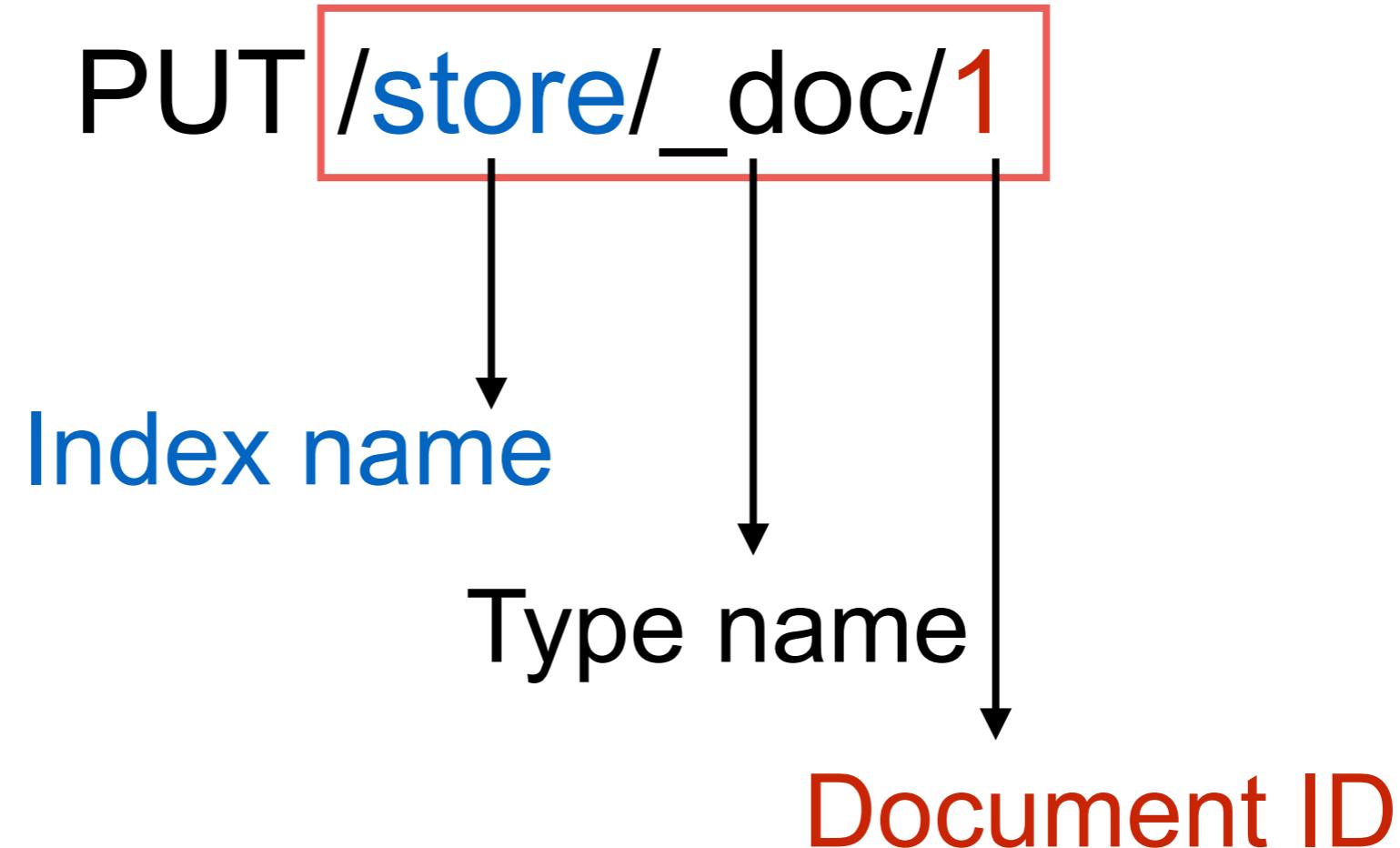
<https://www.elastic.co/guide/en/elasticsearch/reference/6.5/removal-of-types.html>



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Create document (1 type)



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": {  
    "index": "store1",  
    "status": "CREATED",  
    "shards": 1,  
    "primary": true  
  }  
}
```



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/_doc/123

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



Update partial document

POST /store/_update/123

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



Delete document

DELETE /store/_doc/1

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

*Not delete document !!
Marked deleted only*



Delete index (delete from disk)

DELETE /store



More features

Update by query

Delete by query

Partial update document



Routing

<https://www.elastic.co/guide/en/elasticsearch/reference/current/mapping-routing-field.html#>

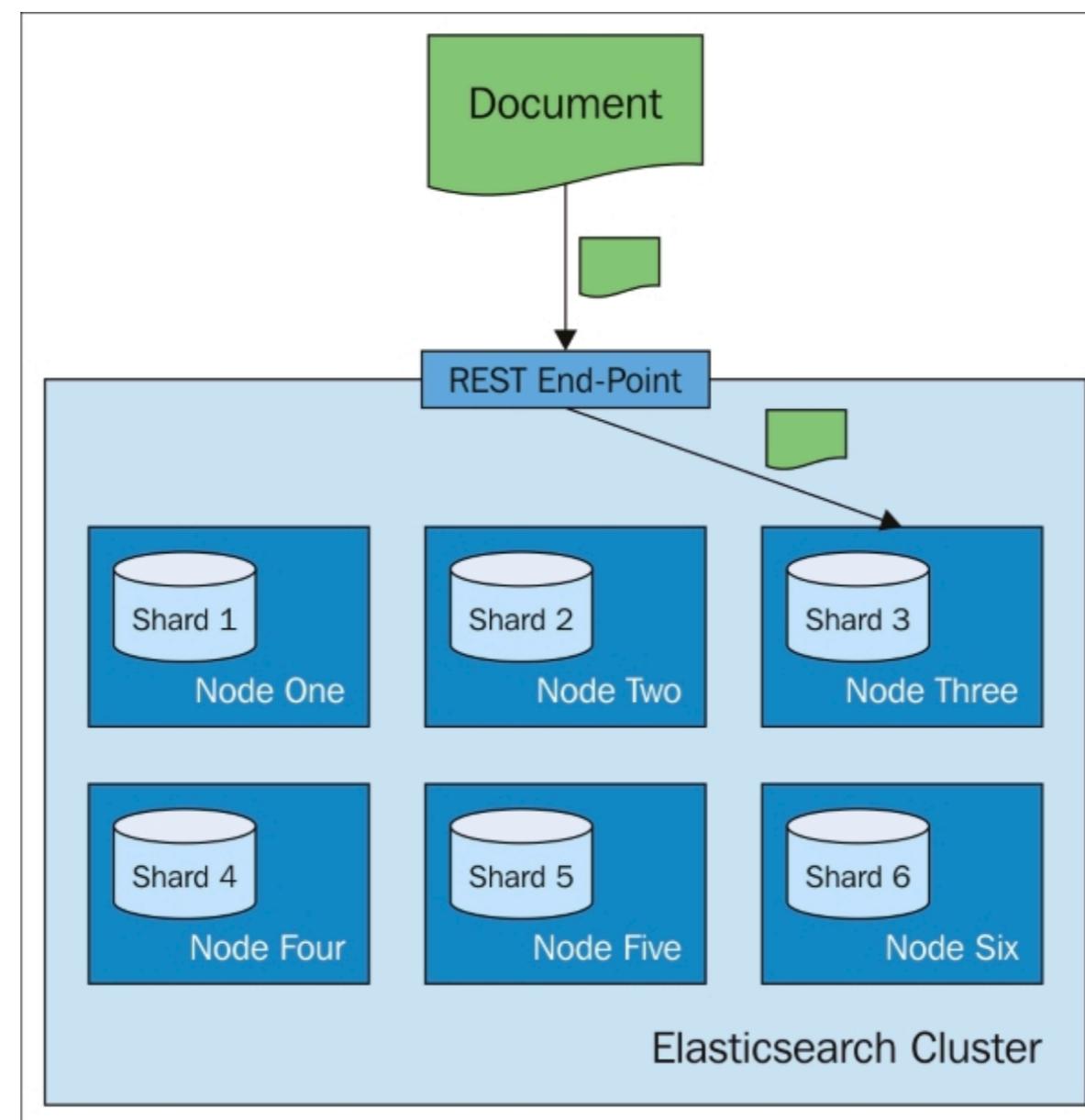


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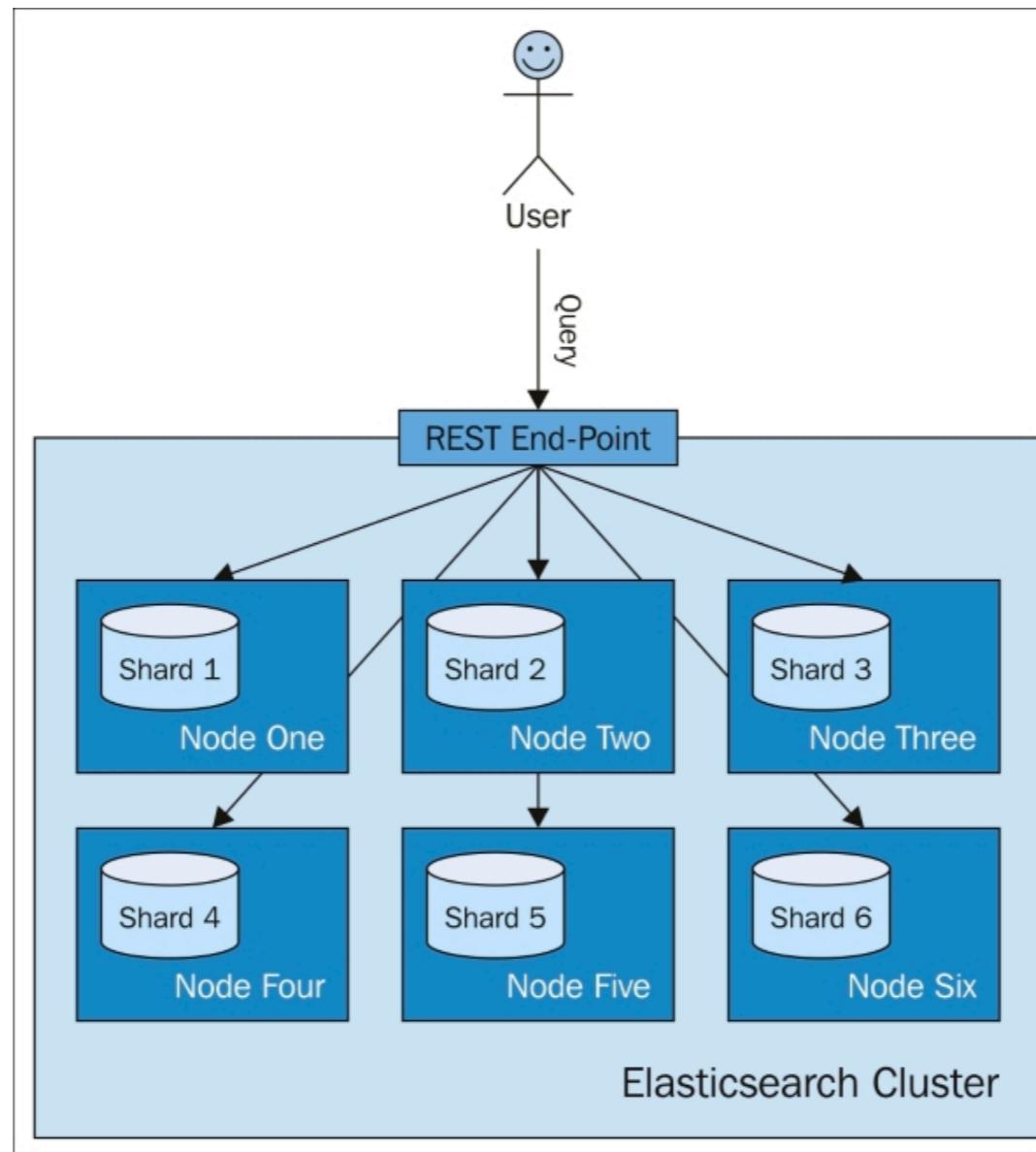
Default indexing

ES calculate the hash value of the doc id



Default searching/query

Query all the shards to get data
(depend on search type)



Custom routing

Routing field
Routing to index partition



Routing field

```
shard_num =  
hash(_routing) % num_primary_shards
```



Routing to index partition

```
shard_num  
=  
(hash(_routing) + hash(_id)) % routing_partition_size)  
%
```

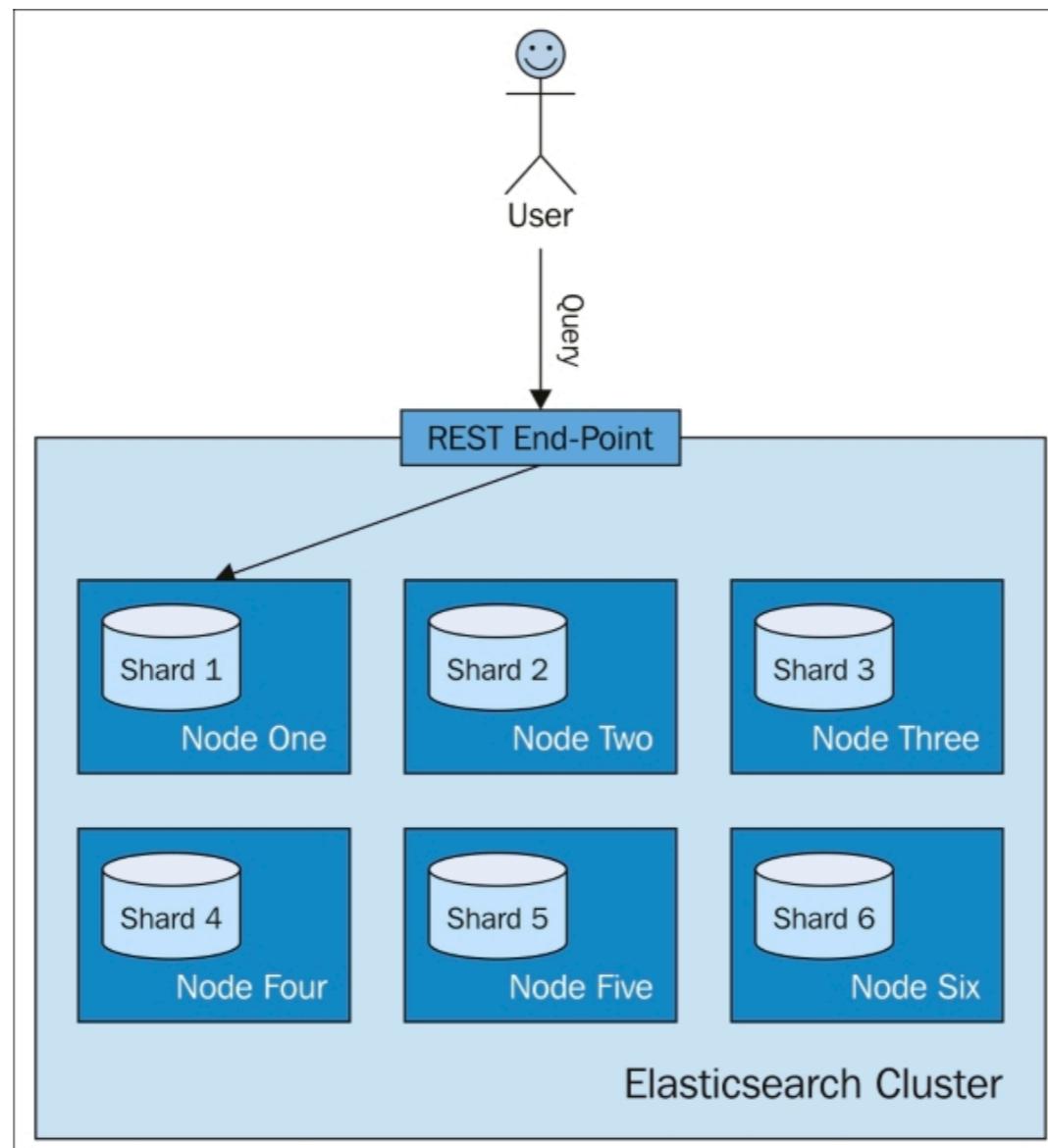
num_primary_shards

routing_partition_size = 1 (default)



Custom routing

ES will send our query to a single shard



Bulk API

03-bulk/book_bulk.json

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



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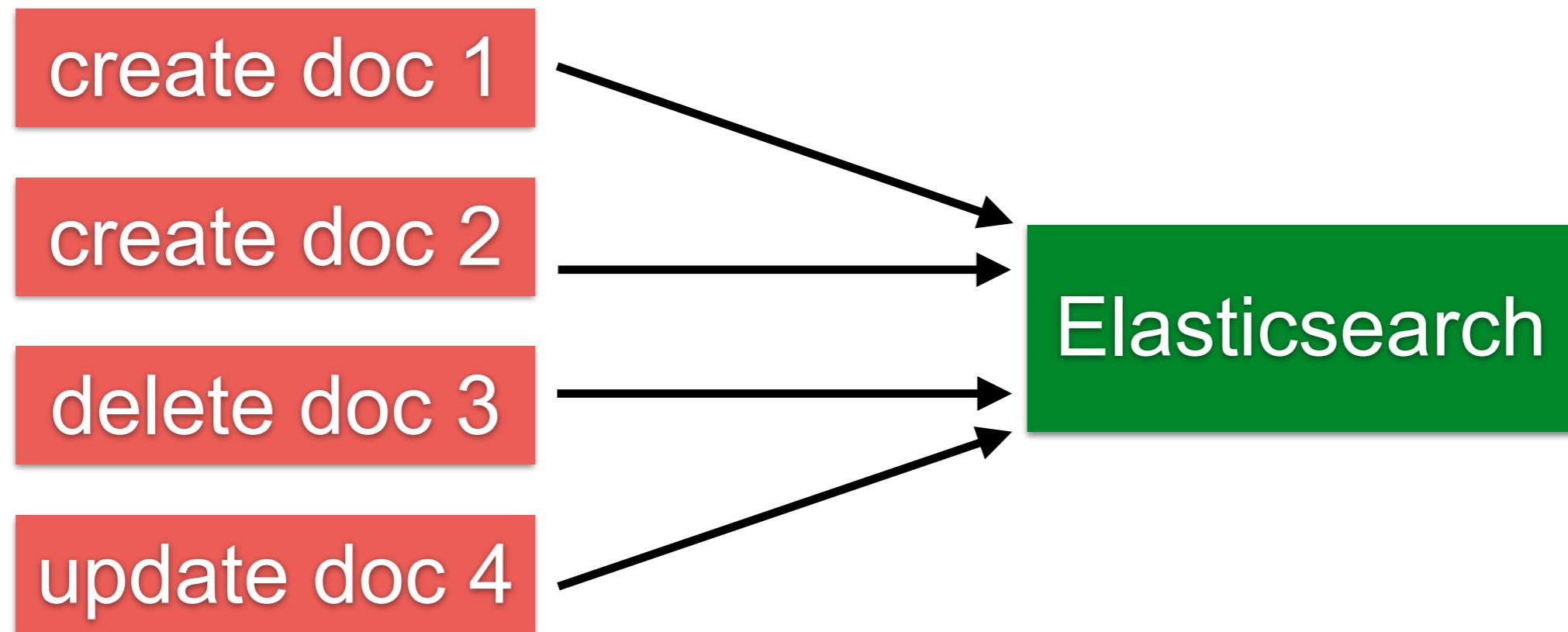
Bulk API

Perform many index/delete operation in single API call

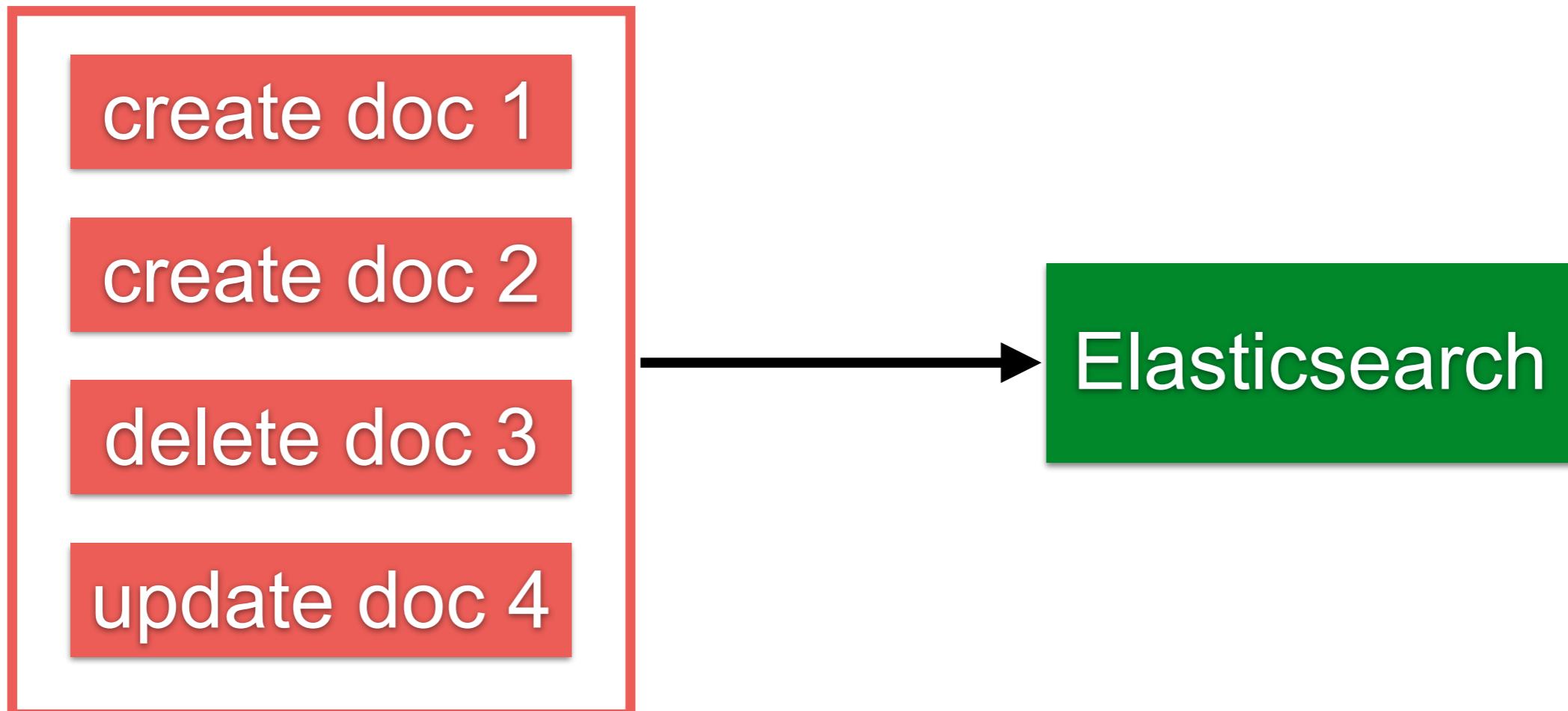
Increase indexing speed



Without Bulk API



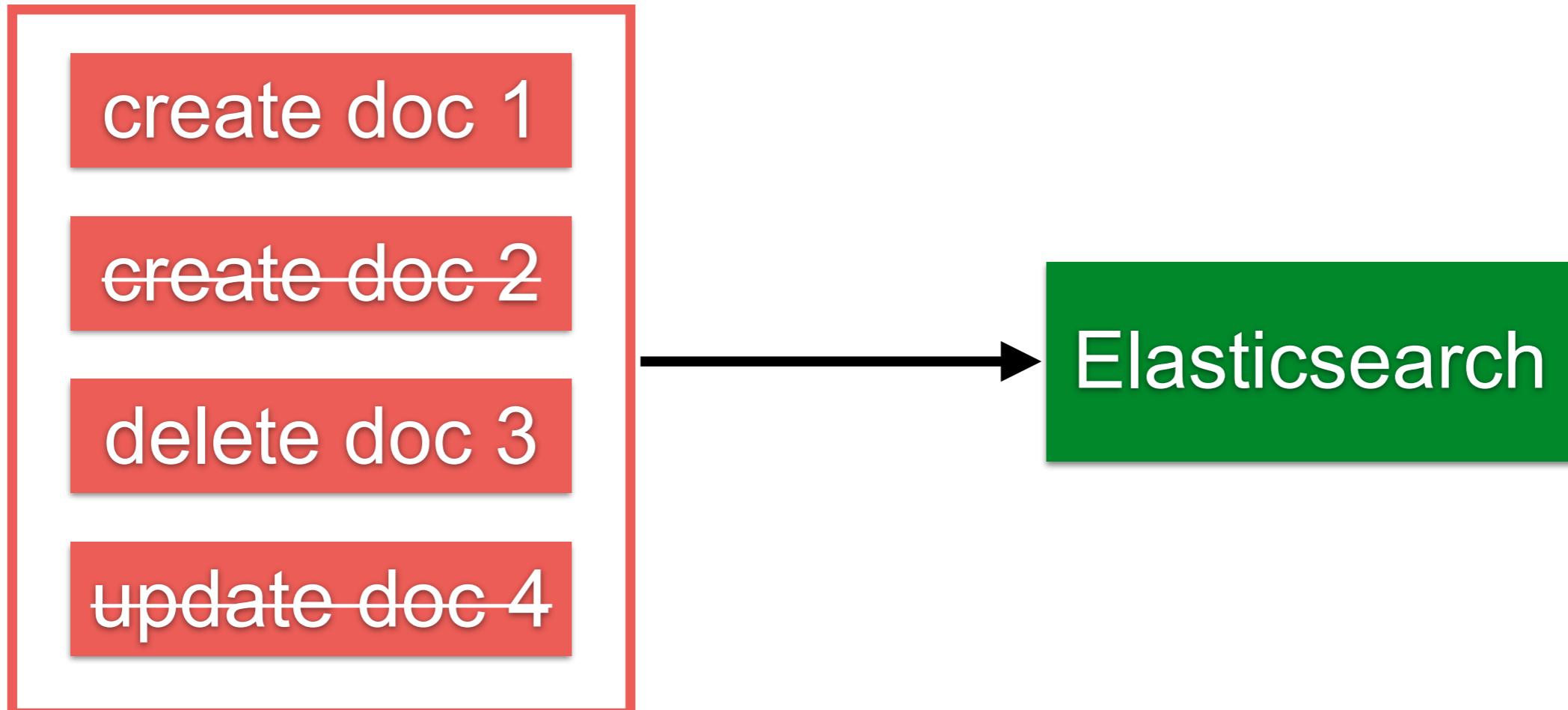
With Bulk API



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



Searching / Query

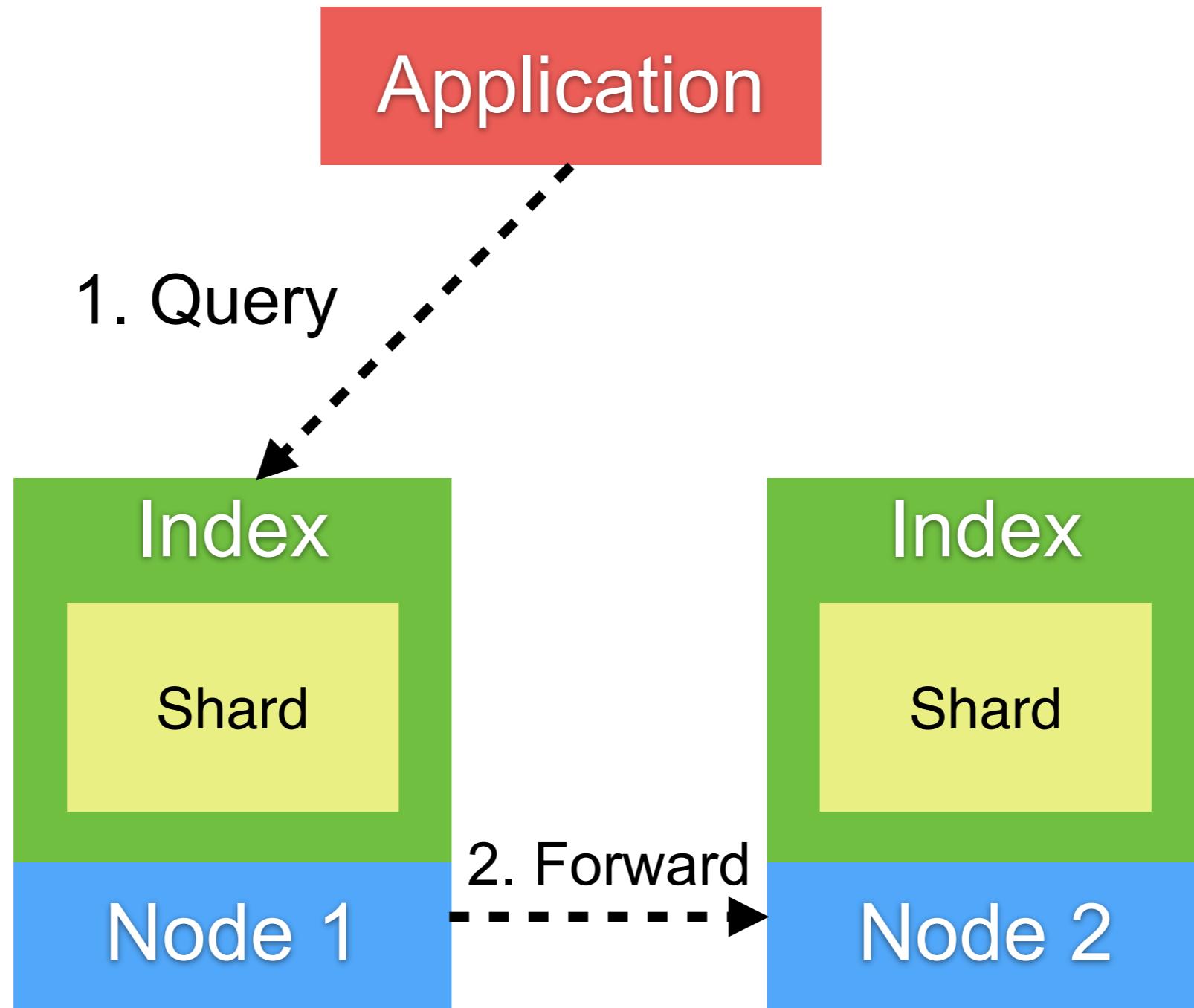


Searching

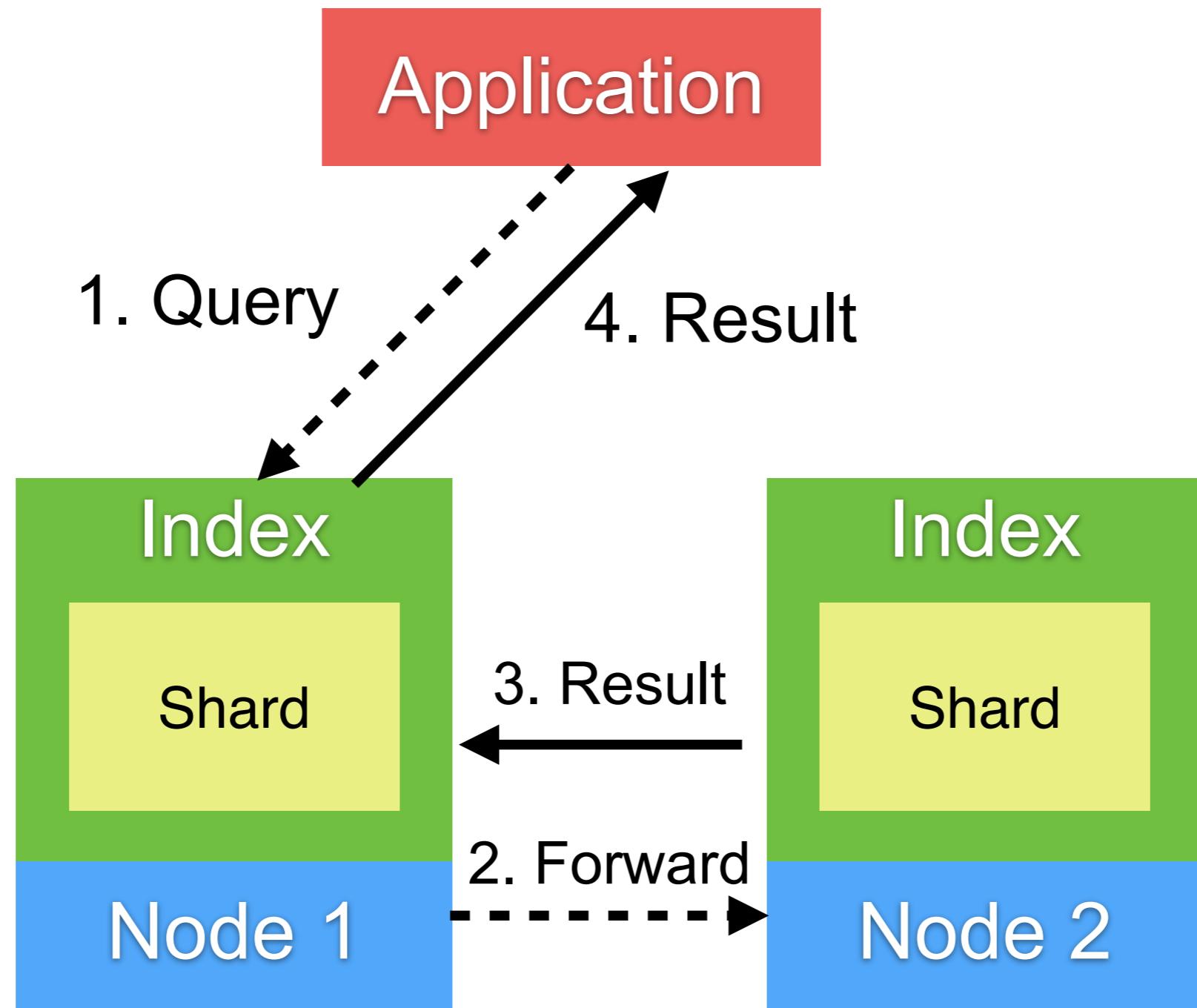
Scattering phase
Gathering phase



Scattering phase



Gathering phase



Query DSL

04-search/book_search.json



Query DSL

Domain Specific Language for query data
Flexible query language
Based on JSON format

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



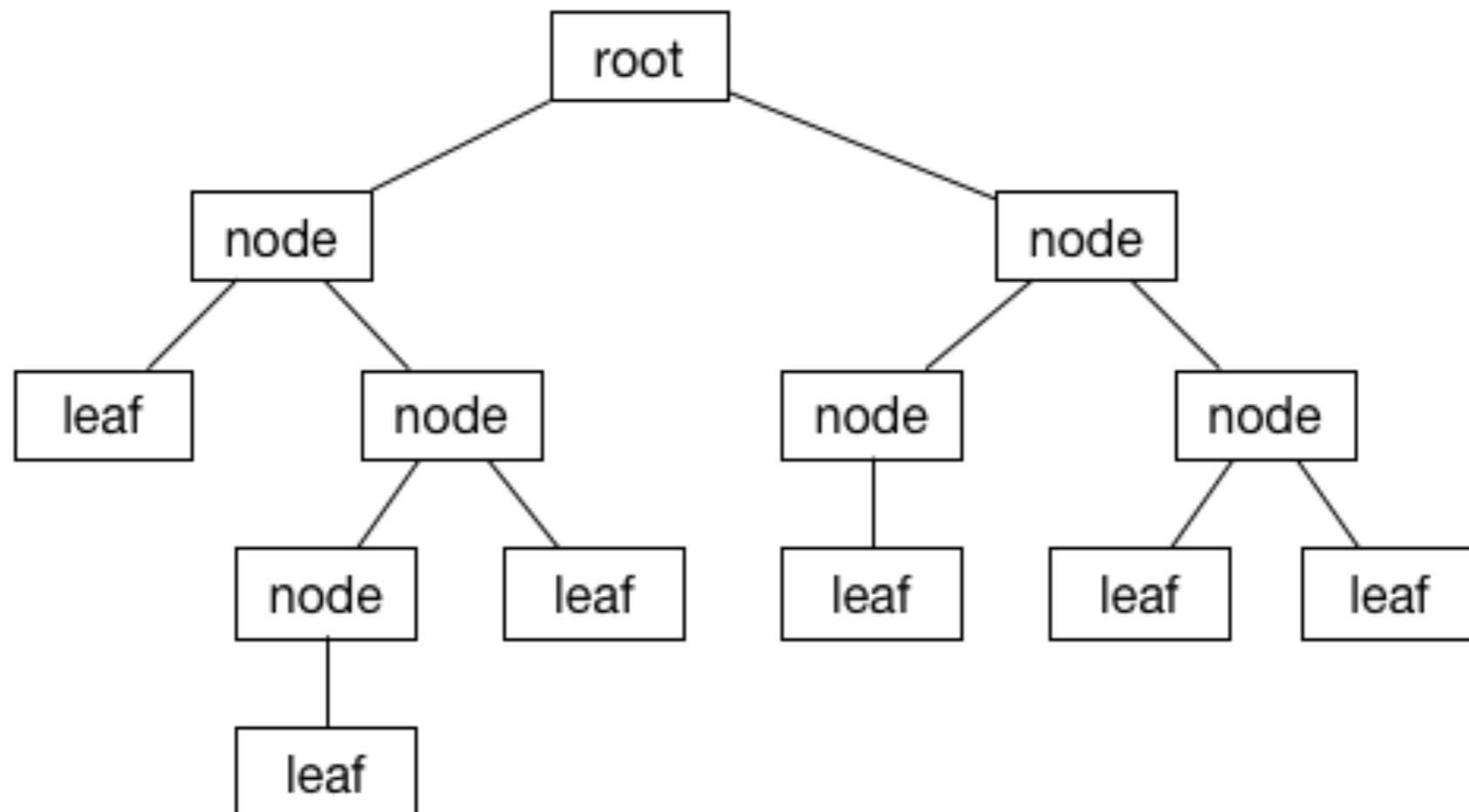
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123

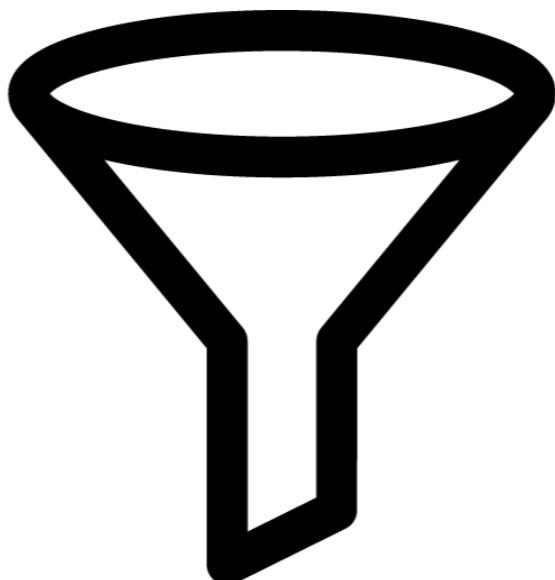
Query DSL

1. Leaf query clause
2. Compound query clause



Query DSL

Query (unstructured data)
Filter (structured data)



Query



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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": [{}]  
    }  
  }  
}
```



_all field is disabled (ES 6.0+)

_all field



WARNING

Deprecated in 6.0.0.

`_all` may no longer be enabled for indices created in 6.0+, use a custom field and the mapping `copy_to` parameter

Space issue
Analyzer issue
Highlighting issue

<https://www.elastic.co/guide/en/elasticsearch/reference/6.5/mapping-all-field.html>



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Query

amazon

All ▾ elasticsearch 

Departments ▾ Your Amazon.com Today's Deals Gift Cards Sell

New to Amazon? EN Hello. Sign In Account Lists Orders Cart

Sort by Featured

1-16 of 119 results for "elasticsearch"

Filter

Books
Computers & Technology
Data Processing
Web Development & Design
Online Internet Searching
Databases & Big Data
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Refine by

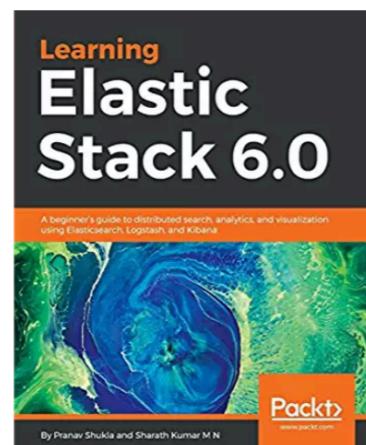
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Book Format

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Paging

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1 2 3 ... 8

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Aggregation API

05-aggregation/book_aggregation.json

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



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```
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/_search

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



Count by category

GET /store/_search

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

Aggregation name



Count by category

```
GET /store/_search
{
  "aggs": {
    "all_book_title": {
      "terms": { Aggregation type
        "field": "category.keyword"
      }
    }
  }
}
```



Result of aggregation

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

Search result



Result of aggregation

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



Show only aggregation result

GET /store/_search

```
{  
  "size": 0, Set search result size = 0  
  "aggs": {  
    "all_book_title": {  
      "terms": {  
        "field": "category.keyword"  
      }  
    }  
  }  
}
```



Range of price

GET /store/_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/_search

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



Workshop aggregation with car

05-aggregation/car.json



Try by yourself

Best seller by color

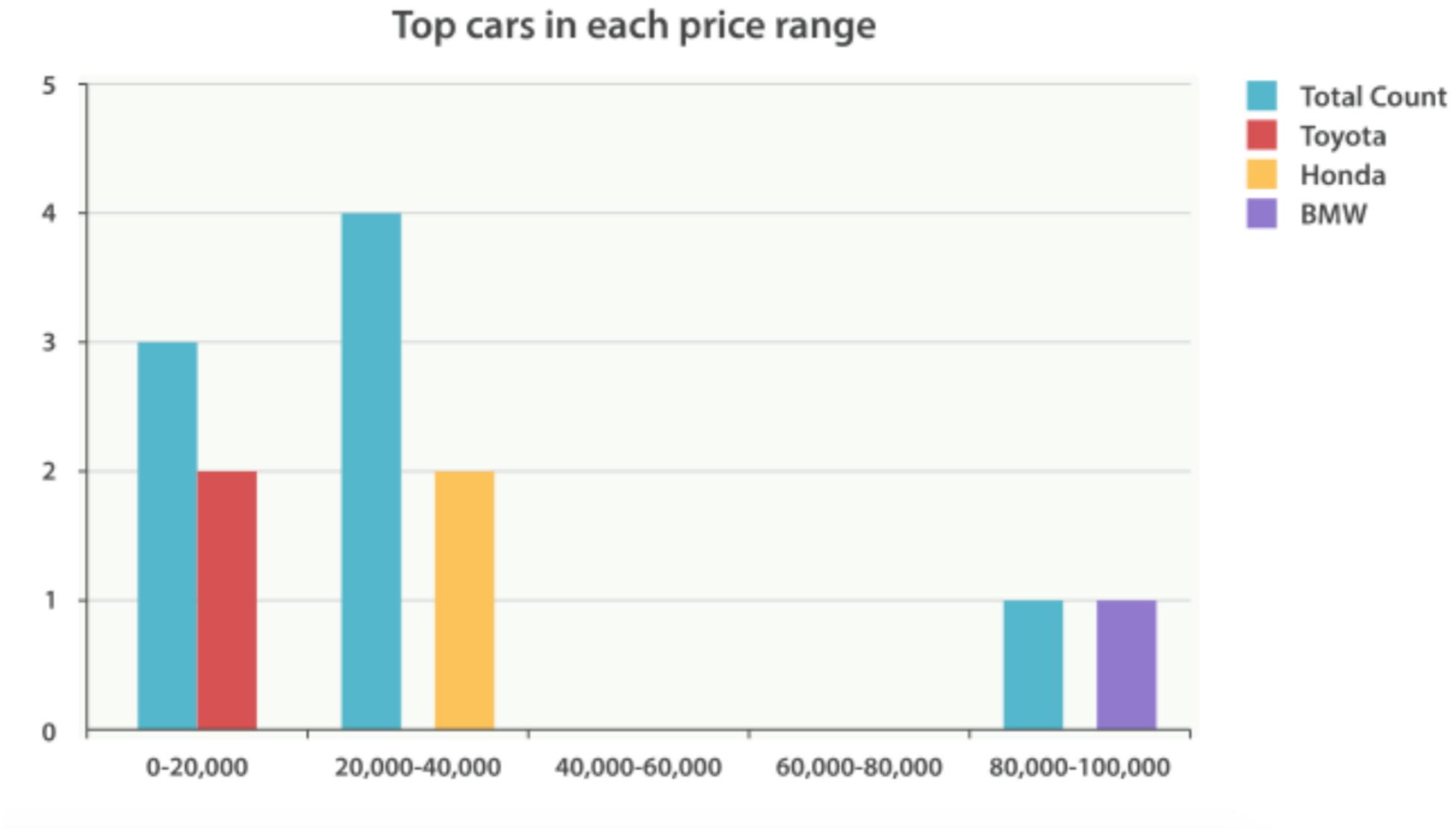
Statistic of best seller by color

Detail of car in each color

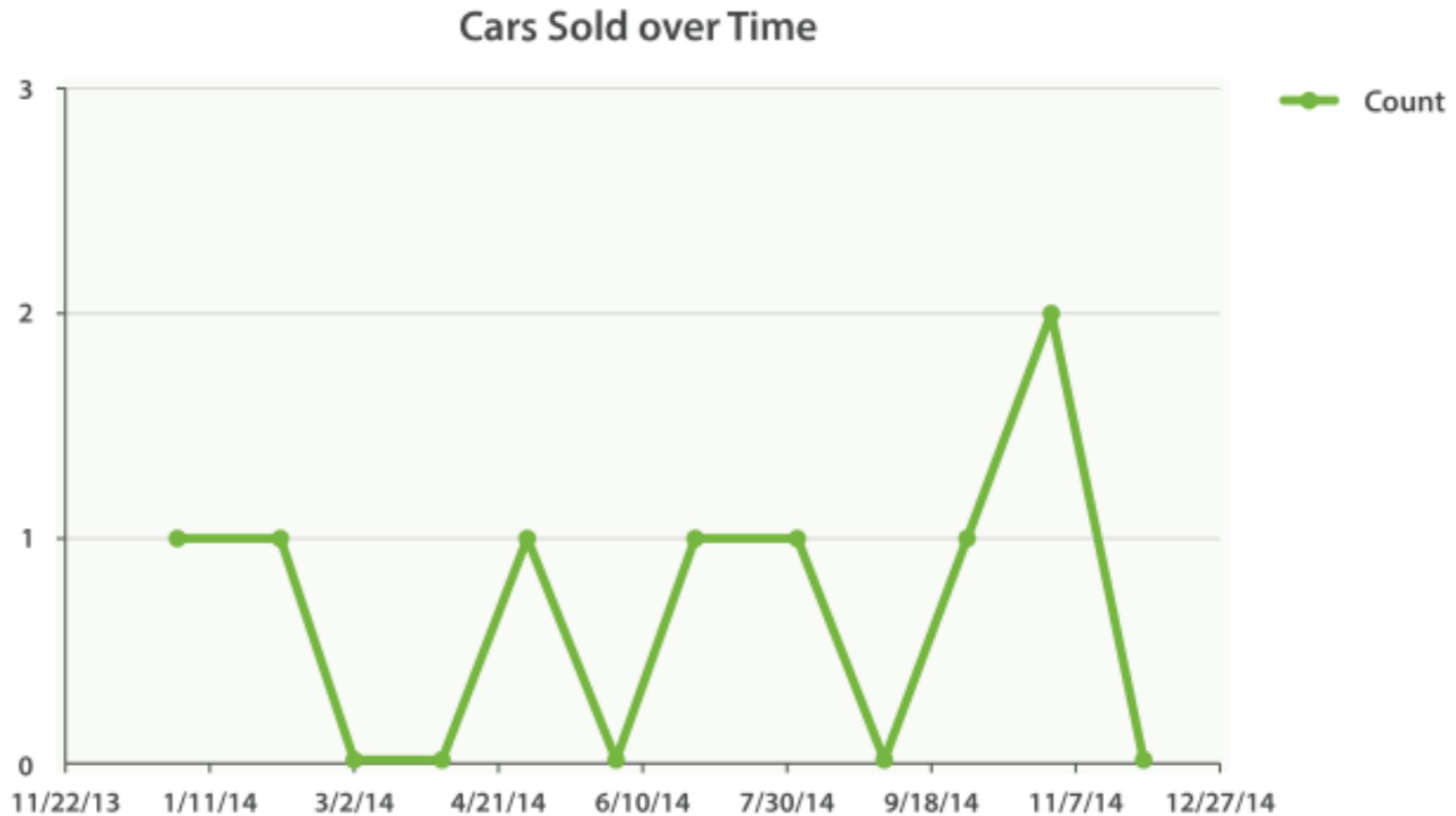
Min/max of price by make



Top cars in each price range ?



Cars sold over Time ?



Mapping

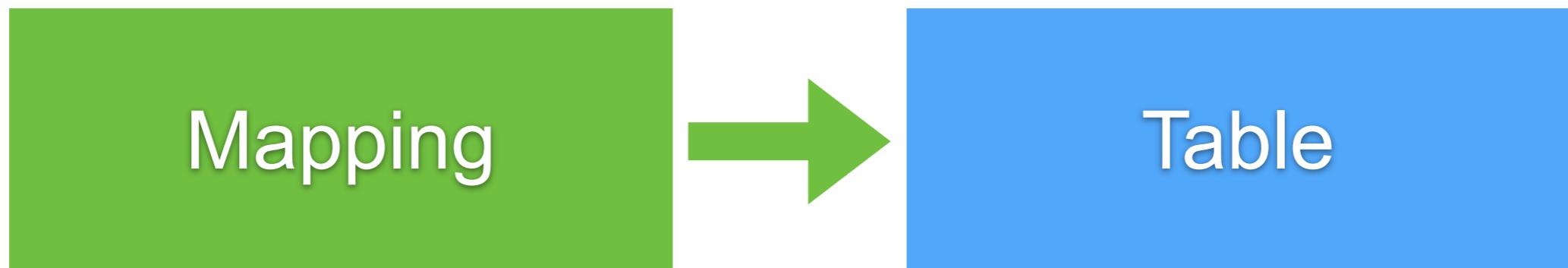
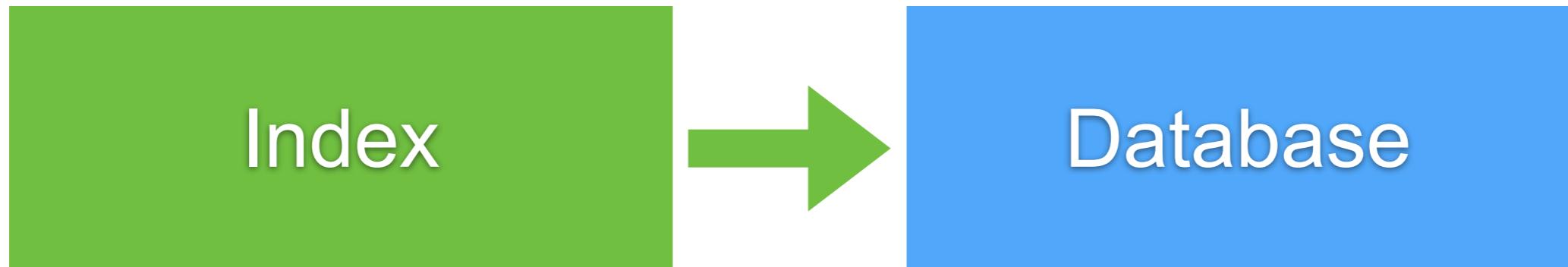
<https://www.elastic.co/guide/en/elasticsearch/reference/current/mapping.html>



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Explicit Mapping



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

Core

Complex

Geo

Specialized



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>



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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>



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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/Explicit mapping

Fields and mapping types not need to defined before being used



Mapping

Explicit mapping

Quick data insertion

Manual mapping

Better search Results

Increased performance

Concerned of the field types



Custom Mapping in ES 7

Don't specify the type name !!

```
PUT project/_mapping
{
  "properties": {
    "user_id": {
      "type": "keyword"
    },
    "image_name": {
      "type": "keyword"
    }
  }
}
```



Analyzer

07-analyzer

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

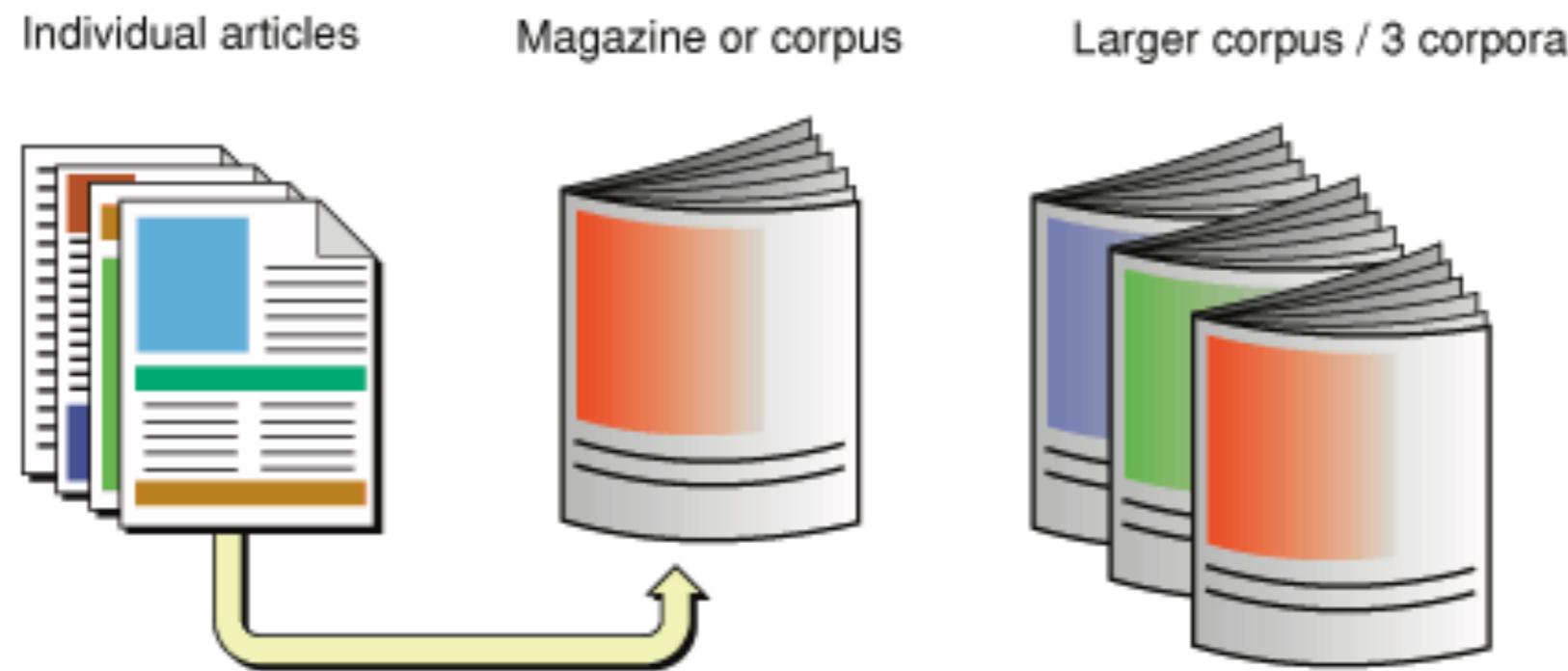


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Inverted Index

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

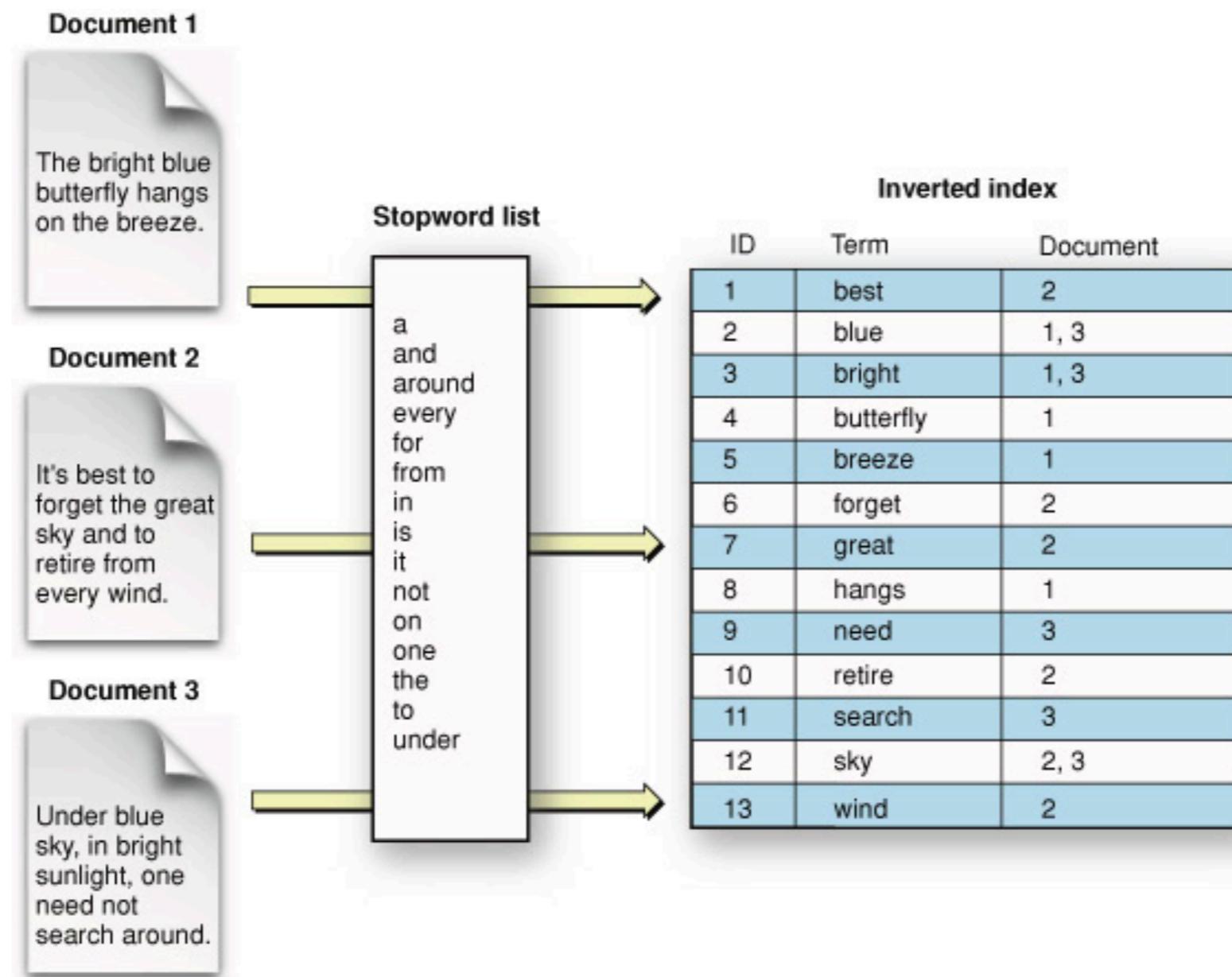


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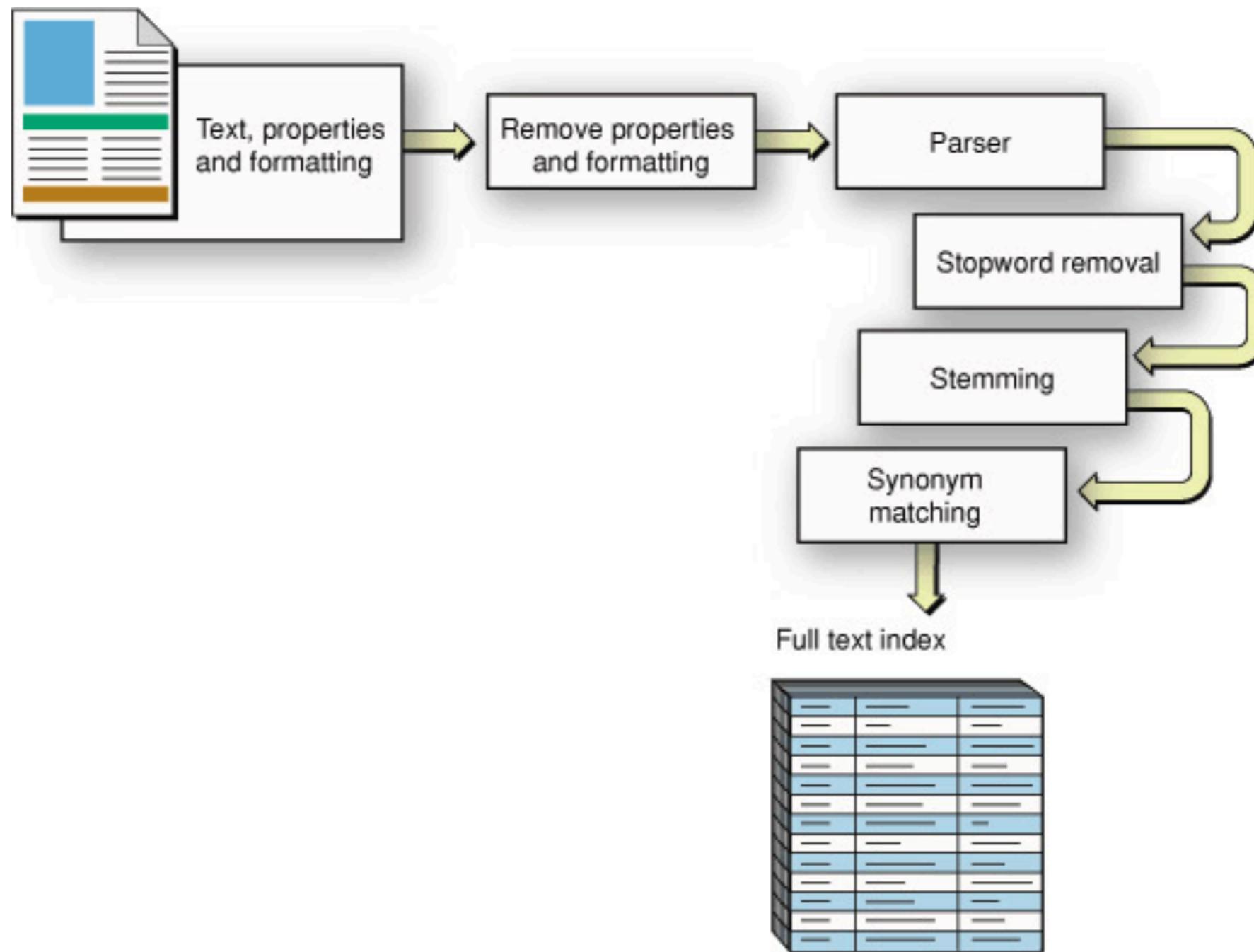
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Inverted Index

Try to construct index



Text extraction



Analyzer in ES

Analyzer
Tokenizer
Filter



Testing analyzer !!

Very important



Testing analyzer !!

```
POST _analyze
{
  "analyzer": "whitespace",
  "text":      "The quick brown fox."
}
```



Default analyzer !!

```
POST _analyze
{
  "text": "The quick brown fox."
}
```



Thai analyzer !!

```
POST _analyze
{
  "analyzer": "thai",
  "text":      "สวัสดีประเทศไทย"
}
```



Tokenizer and filter

```
POST _analyze
{
  "tokenizer": "standard",
  "filter": [ "lowercase", "asciifolding" ],
  "text":      "Is this déjà vu?"
}
```



Analyze by index

```
POST my_index/_analyze
{
  "analyzer": "your_analyzer",
  "text":      "your text"
}
```



Analyze by field

```
POST my_index/_analyze
{
  "field": "my_text",
  "text": "your text"
}
```



Working with Suggester

<https://www.elastic.co/guide/en/elasticsearch/reference/current/search-suggesters.html>



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Suggesters in ES

Term
Phrase
Completion
Context



Basic knowledge

N-gram tokenizer
Edge-ngram tokenizer

<https://www.elastic.co/guide/en/elasticsearch/reference/7.1/analysis-ngram-tokenizer.html>



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N-Gram

Terms as a sequence of n words

search

Unigram	s,e,a,r,c,h
Bigram	se, ea, ar,rc, ch
Trigram	sea, ear, arc, rch
4-gram	sear, earc, arch
5-gram	searc, earch



Workshop

ngram/ngram.json



More tools



Elasticsearch Head

The screenshot shows the ElasticSearch Head extension interface. At the top, there's a navigation bar with tabs for OVERVIEW, REVIEWS, SUPPORT, and RELATED. The OVERVIEW tab is active. Below the navigation bar, there's a cluster overview grid. The grid contains several nodes, each represented by a row of four boxes. The first two boxes show the number of primary and replica shards respectively. The third box shows the status of the shard (green for healthy, yellow for warning, red for error). The fourth box shows the shard ID. A context menu is open over the third box of the 'cu_msg' shard in the 'Rick' node, with options like Refresh, Flush, Gateway Snapshot, Test Analyser, Close, and Delete... highlighted. To the right of the grid, there's a detailed view of the 'cu_msg' shard for the 'Rick' node, showing its configuration in JSON format:

```
{ "name": "Leon", "transport_address": "inet[/192.168.7.8:9302]", "attributes": [], "http_address": "inet[/192.168.7.8:9202]", "os": { "refresh_interval": 5000, "cpu": [ { "vendor": "Intel", "model": "Macmini4,1", "mhz": 2400, "total_cores": 2, "total_sockets": 1, "cores_per_socket": 2, "cache_size": "3kb", "cache_size_in_bytes": 3072 } ] } }
```

On the right side of the interface, there's a sidebar with the title 'ElasticSearch Head'. It includes a 'Compatible with your device' badge, a 'Website' link, a 'Report Abuse' link, and additional information about the extension: Version 0.1.3, Updated December 4, 2017, Size 434KiB, and Language English (United States).

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



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Elasticsearch Dump



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



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Make Logs

Simple generator used to push fake HTTP traffic logs into elasticsearch

npm install -g @elastic/makelogs

<https://github.com/elastic/makelogs>



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Geo Location

08-geo-location/sample_geo.json



Geo Location Type

Geo-point
Geo-shape



Geo-point

Must pre-define in mapping of index

```
PUT /my_map
{
  "mappings": {
    "city": {
      "properties": {
        "name": {
          "type": "text"
        },
        "location": {
          "type": "geo_point"
        }
      }
    }
  }
}
```



Geo-point Format

Geo-point as object

Geo-point as string

Geo-point as array

Geo-point as geohash

<https://www.elastic.co/guide/en/elasticsearch/reference/current/geo-point.html>



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Geo-point Format

Type	Format
Object	lat = lon =
String	lat, lon
Array	[lon, lat] ** GeoJSON **

<https://en.wikipedia.org/wiki/GeoJSON>



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Geohash converter

Geohash Converter

Simple and fast conversion from geohash to latitude/longitude and from latitude/longitude to geohash.

GeoHash

Lat, Lng

Precision

<http://geohash.co/>



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Geo-point query

Geo-bounding-box

Geo-distance

Geo-polygon

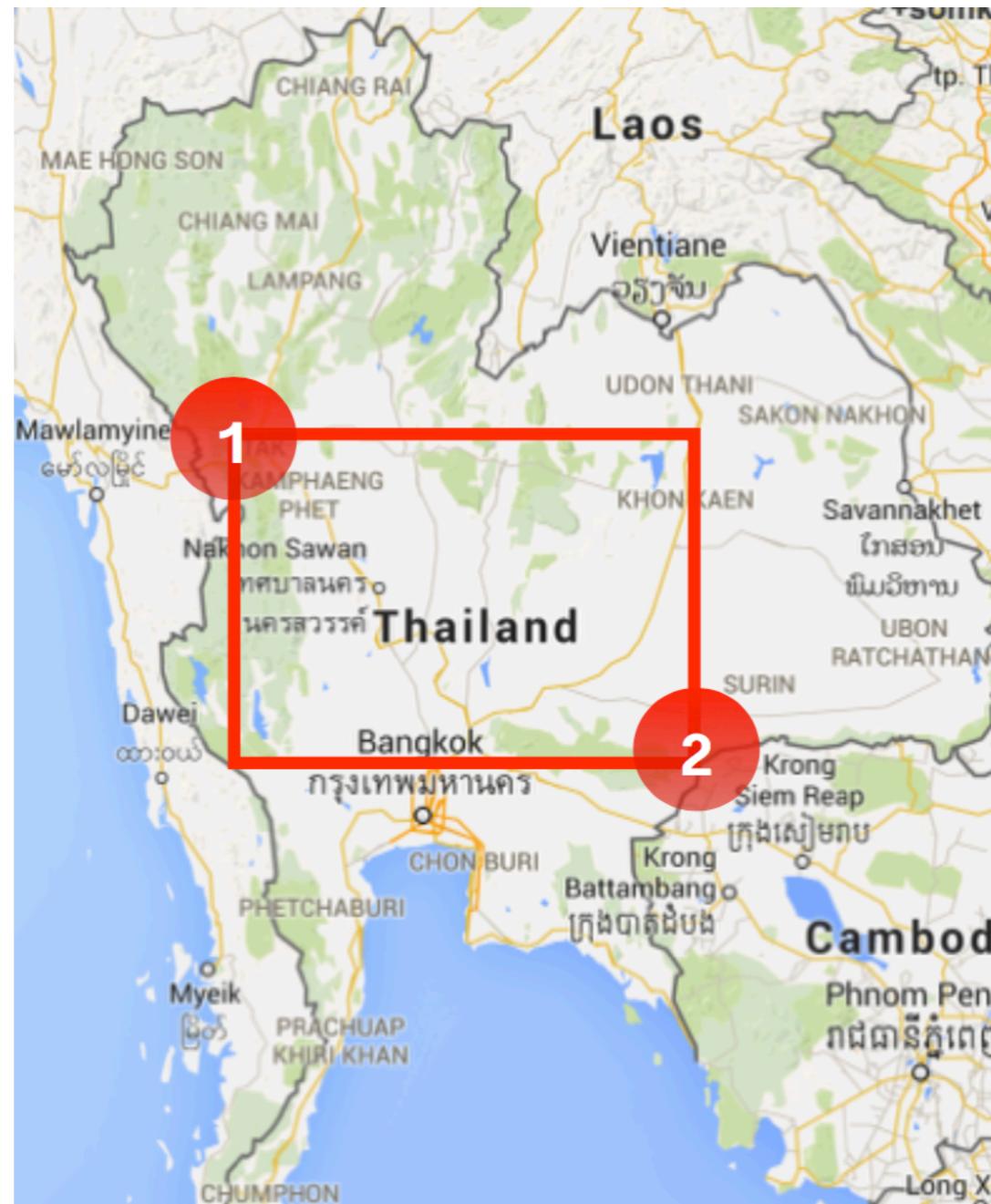
<https://www.elastic.co/guide/en/elasticsearch/reference/current/geo-queries.html>



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Bounding Box



<https://www.elastic.co/guide/en/elasticsearch/reference/current/query-dsl-geo-bounding-box-query.html>



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Geo Distance



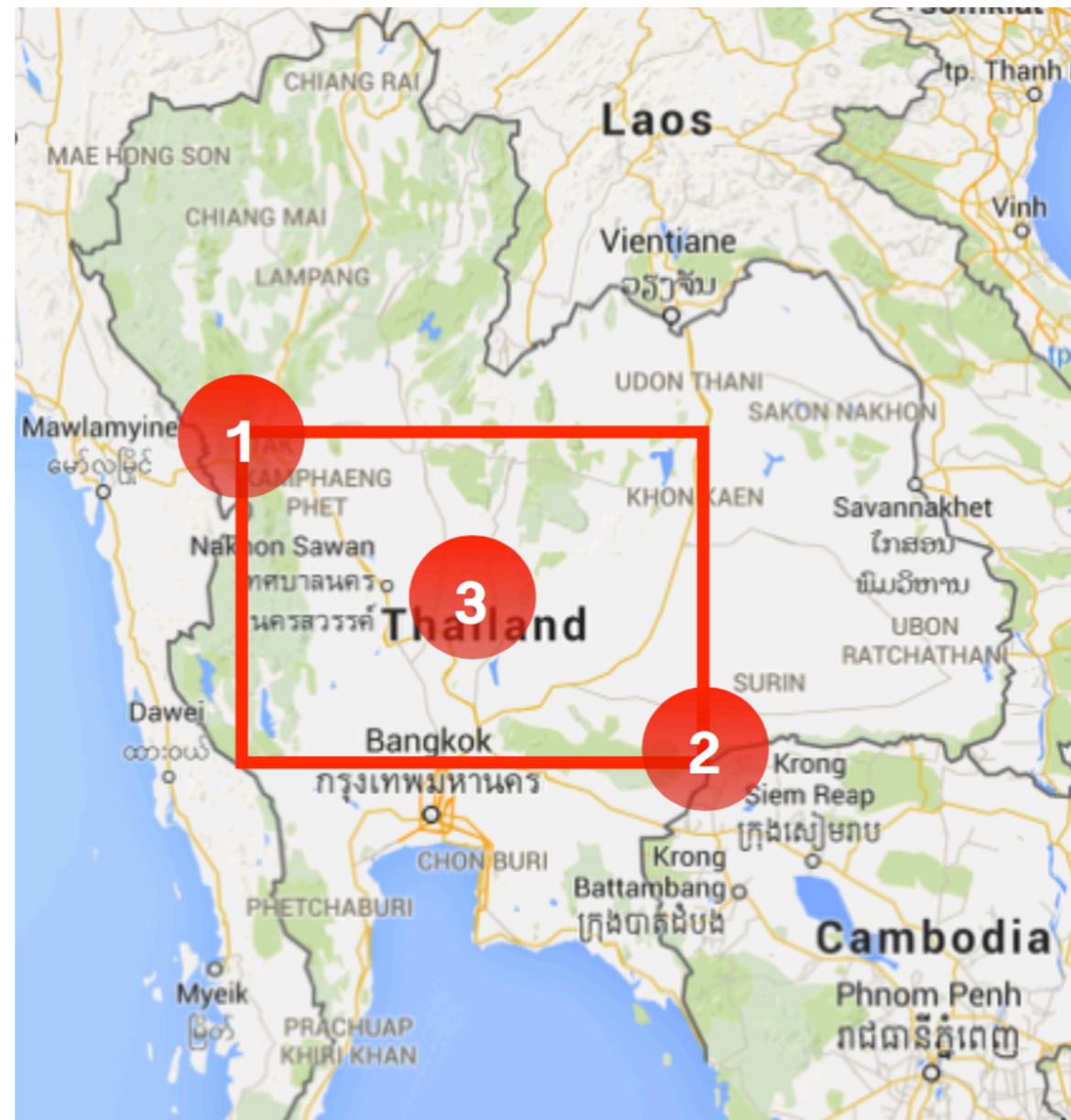
<https://www.elastic.co/guide/en/elasticsearch/reference/current/query-dsl-geo-distance-query.html>



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Try to ordering result



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>



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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>



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Profile API

GET /my_map/_search

```
{  
  "profile": true,  
  "query": {  
    "bool": {
```



Working with Data

<https://www.elastic.co/guide/en/kibana/current/tutorial-load-dataset.html>



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Working with Data

\$elasticsearch-plugin install **ingest-geoip**

<https://www.elastic.co/guide/en/elasticsearch/plugins/current/ingest-geoip.html>



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GeolP with Elasticsearch

geoip/instruction.json



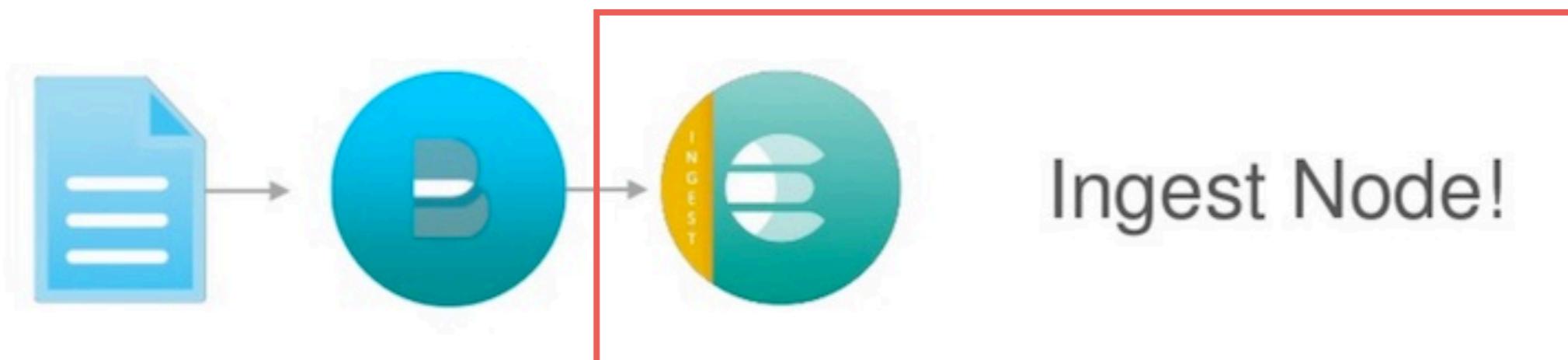
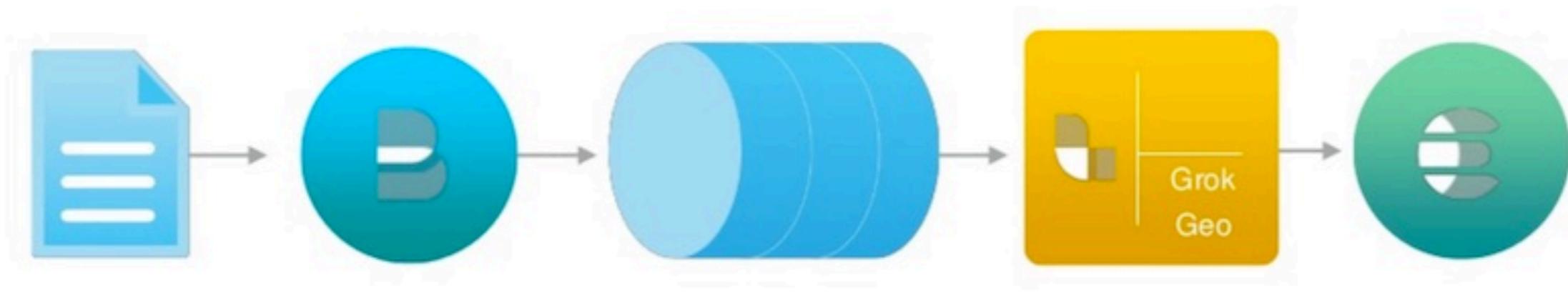
Sample Data

```
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T09:03:25.877Z","ip":"185.124.182.12"},  
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T12:28:25.013Z","ip":"79.1.14.87","e"},  
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T17:44:34.357Z","ip":"178.209.1.7"},  
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T13:04:18.120Z","ip":"118.140.92.127"},  
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T11:37:40.653Z","ip":"235.154.34.221"},  
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T08:46:07.025Z","ip":"228.216.38.41"}
```



Working with Ingest

Pre-process document before actual indexing



<https://www.elastic.co/guide/en/elasticsearch/reference/current/ingest.html>



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Install plugin

```
$elasticsearch-plugin install ingest-geoip
```

<https://www.elastic.co/guide/en/elasticsearch/plugins/current/ingest-geoip.html>



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Alias Index

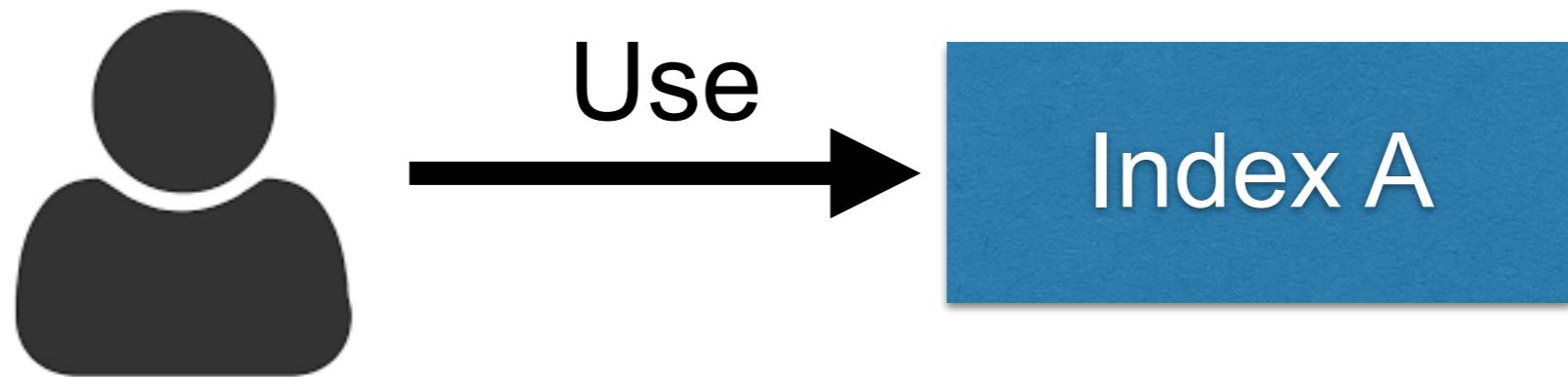


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Common usage



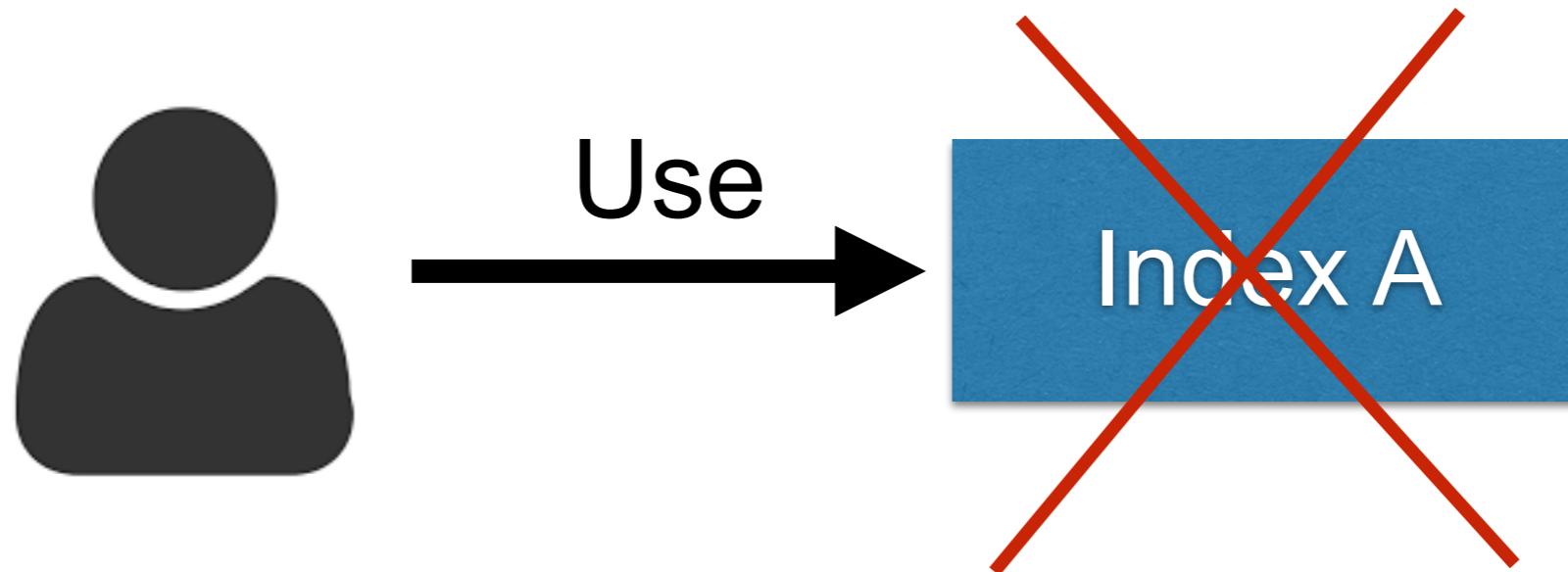
<https://www.elastic.co/guide/en/elasticsearch/reference/current/indices-aliases.html>



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Problem ?



<https://www.elastic.co/guide/en/elasticsearch/reference/current/indices-aliases.html>



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Using Alias Index



<https://www.elastic.co/guide/en/elasticsearch/reference/current/indices-aliases.html>



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Using Alias Index



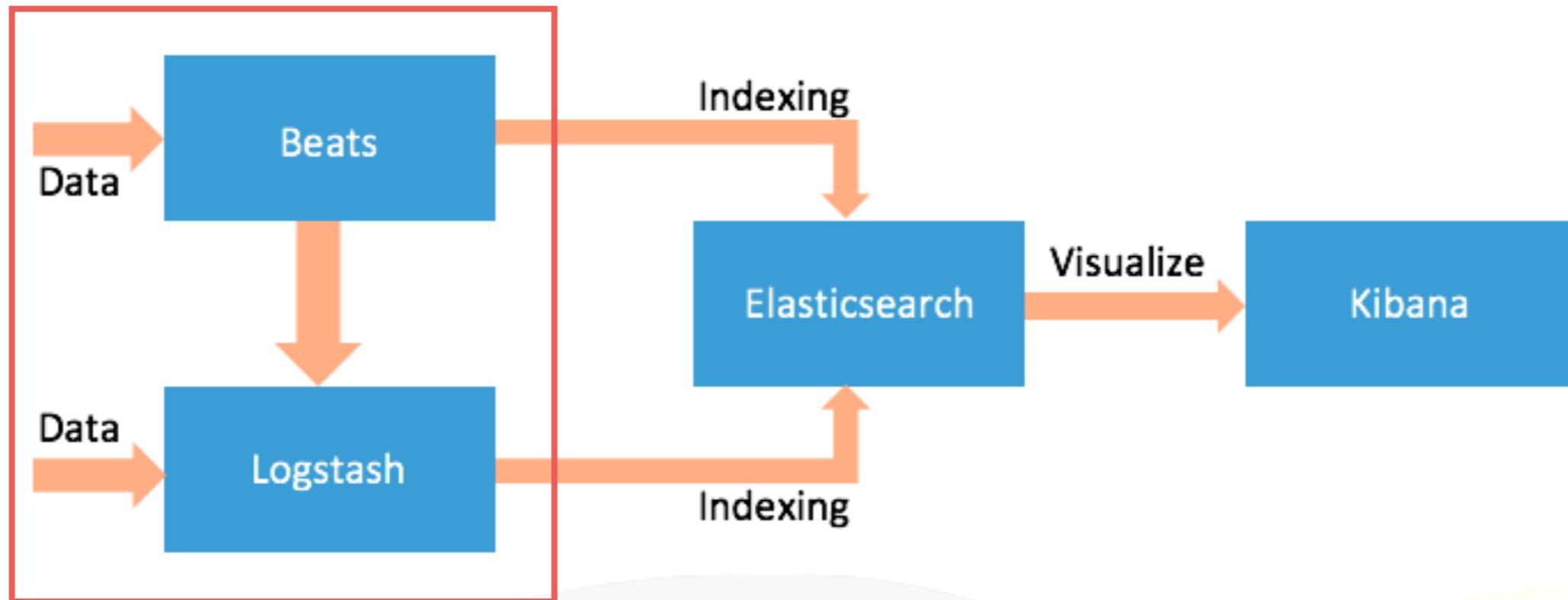
<https://www.elastic.co/guide/en/elasticsearch/reference/current/indices-aliases.html>



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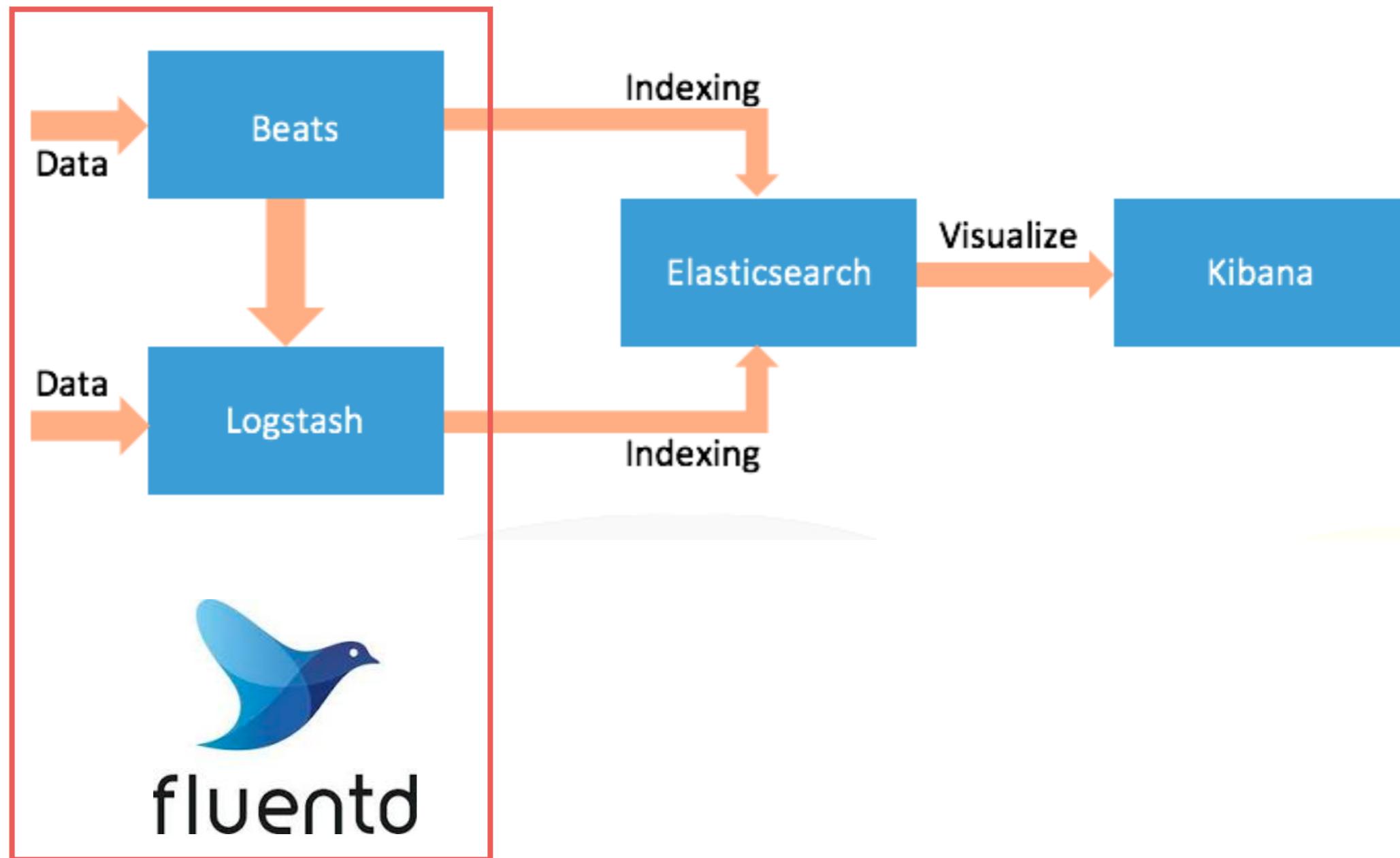
ELK stack



fluentd



EFK stack



Working with Logstash

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



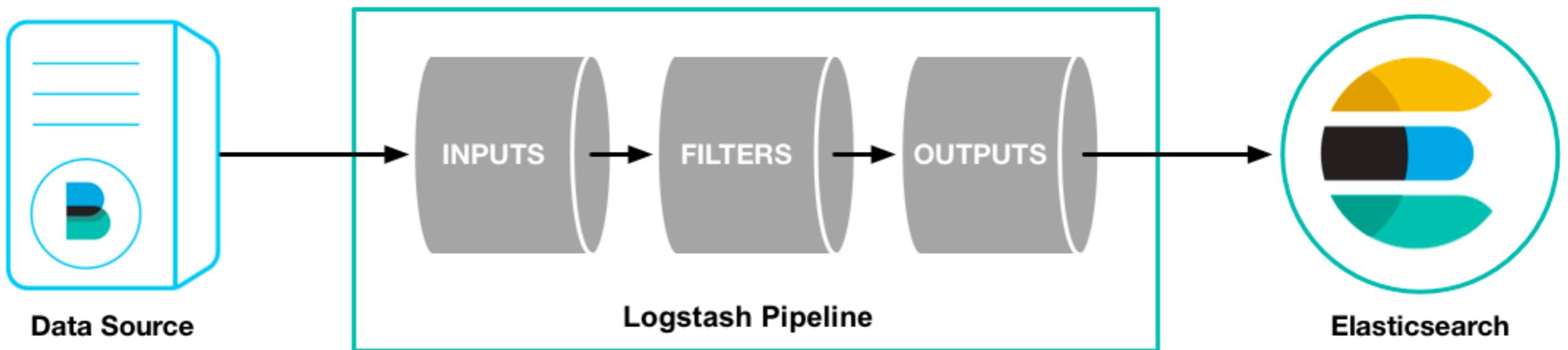
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Logstash



Logstash



Example



Standard Input

Standard Output



sample.conf

```
input {  
    stdin{  
}  
  
output {  
    stdout {  
        codec => rubydebug  
    }  
}
```



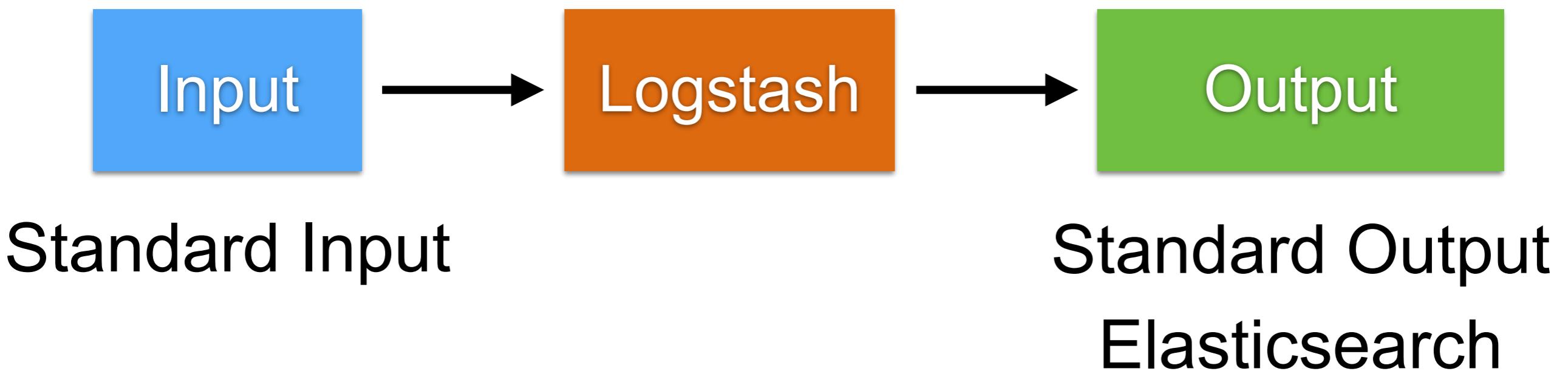
Example

\$logstash -f sample.conf

```
hello world
{
    "message" => "hello world",
    "@timestamp" => 2019-06-20T06:01:30.048Z,
    "@version" => "1",
    "host" => "Somkiats-MacBook-Pro"
}
```



Change output to ES



<https://www.elastic.co/guide/en/logstash/current/plugins-outputs-elasticsearch.html>



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sample.conf

```
input {  
    stdin{  
}  
  
output {  
    stdout {  
        codec => rubydebug  
}  
  
    elasticsearch {  
}  
}
```



Working with Filter



<https://www.elastic.co/guide/en/logstash/current/filter-plugins.html>



sample.conf

```
input {
    stdin{}
}

filter {
    grok {
        match => { "message" => "%{WORD:firstname} %
{WORD:lastname}" }
    }
}

output {
    stdout {
        codec => rubydebug
    }
}
```



Workshop



File system

Standard Output
Elasticsearch

`workshop/logstash-beat-fluentd/demo.conf`



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try.conf

```
input {  
    stdin{}  
}  
  
output {  
    stdout {  
        codec => rubydebug  
    }  
  
    elasticsearch {  
    }  
}
```



Design your input first !!



Use beats is better

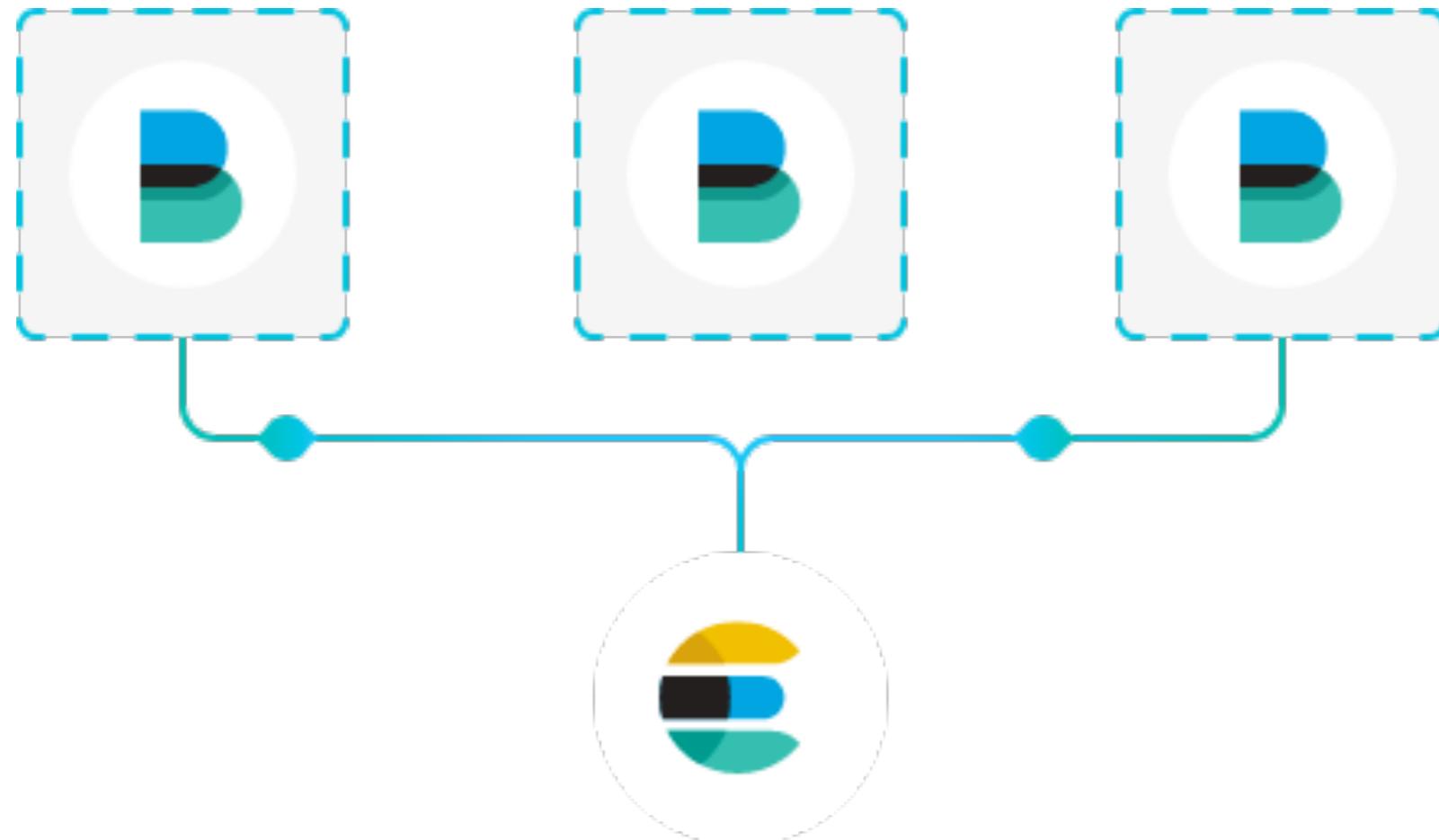
<https://www.elastic.co/products/beats>



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Beat



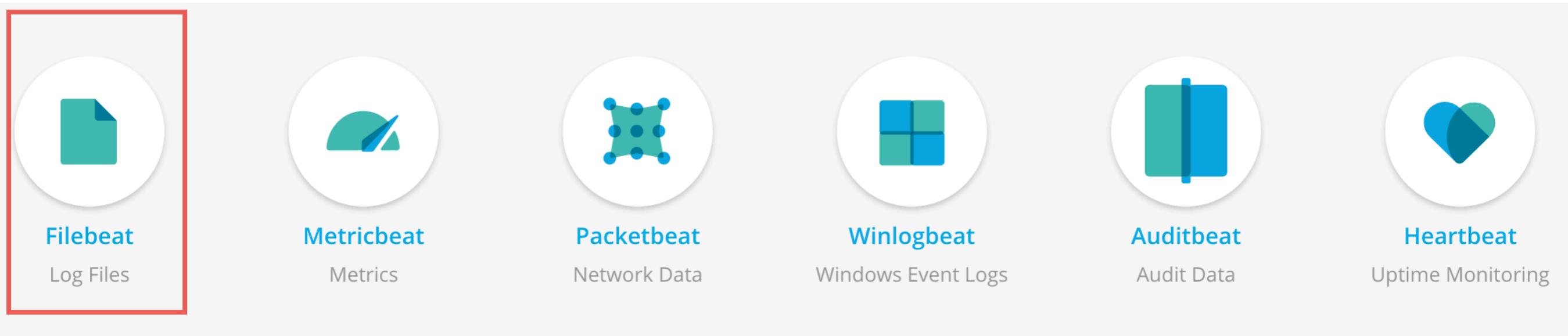
<https://www.elastic.co/guide/en/beats/filebeat/current/index.html>



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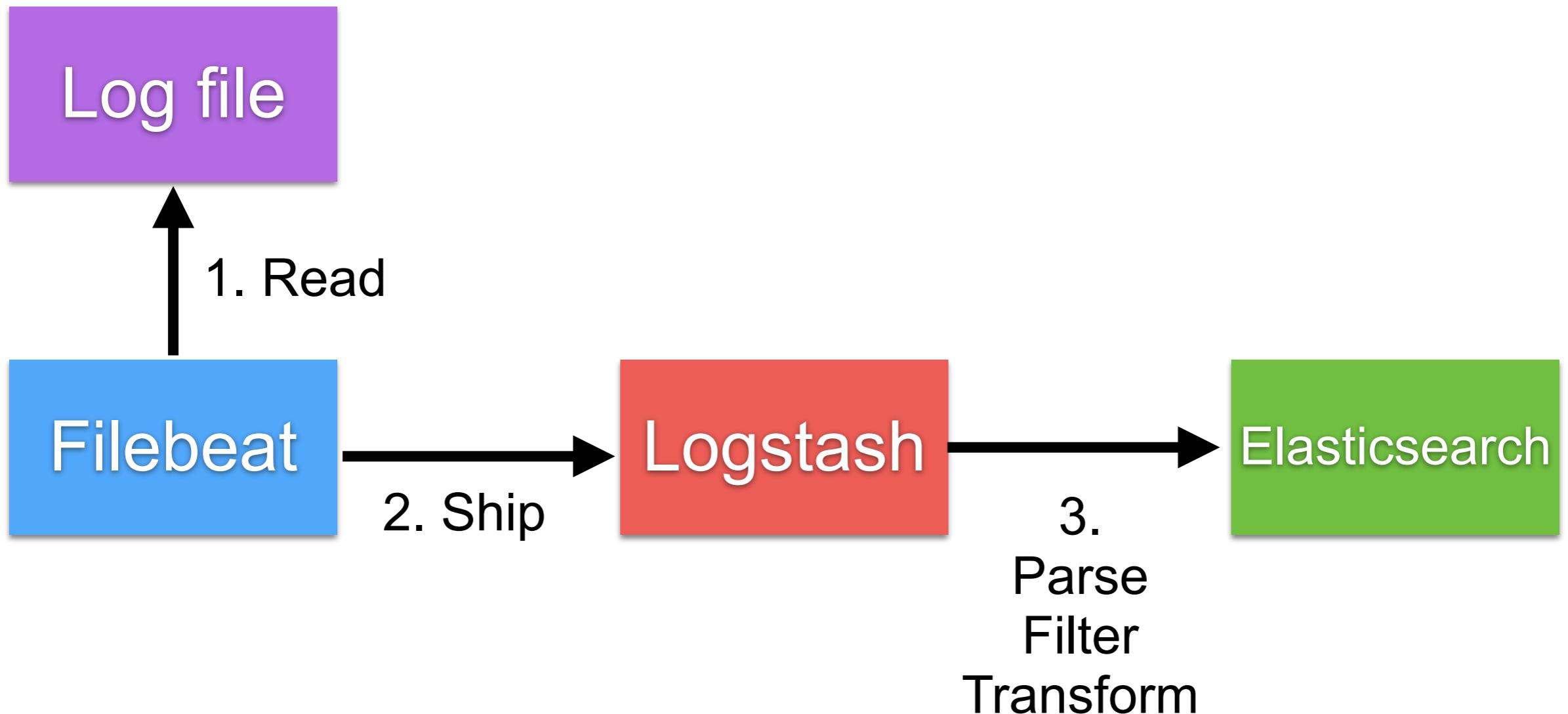
Beat



ELK Stack

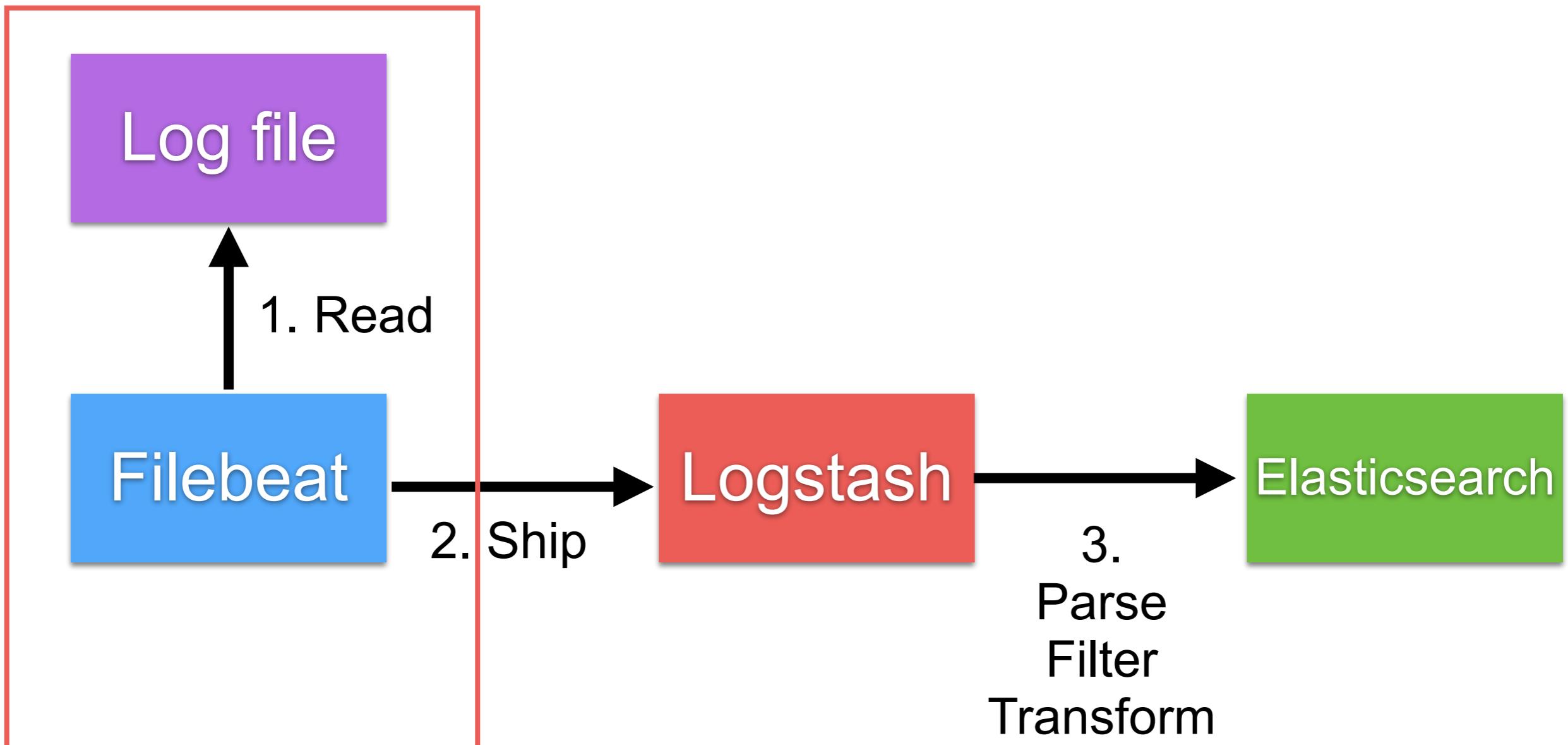
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Example of filebeat



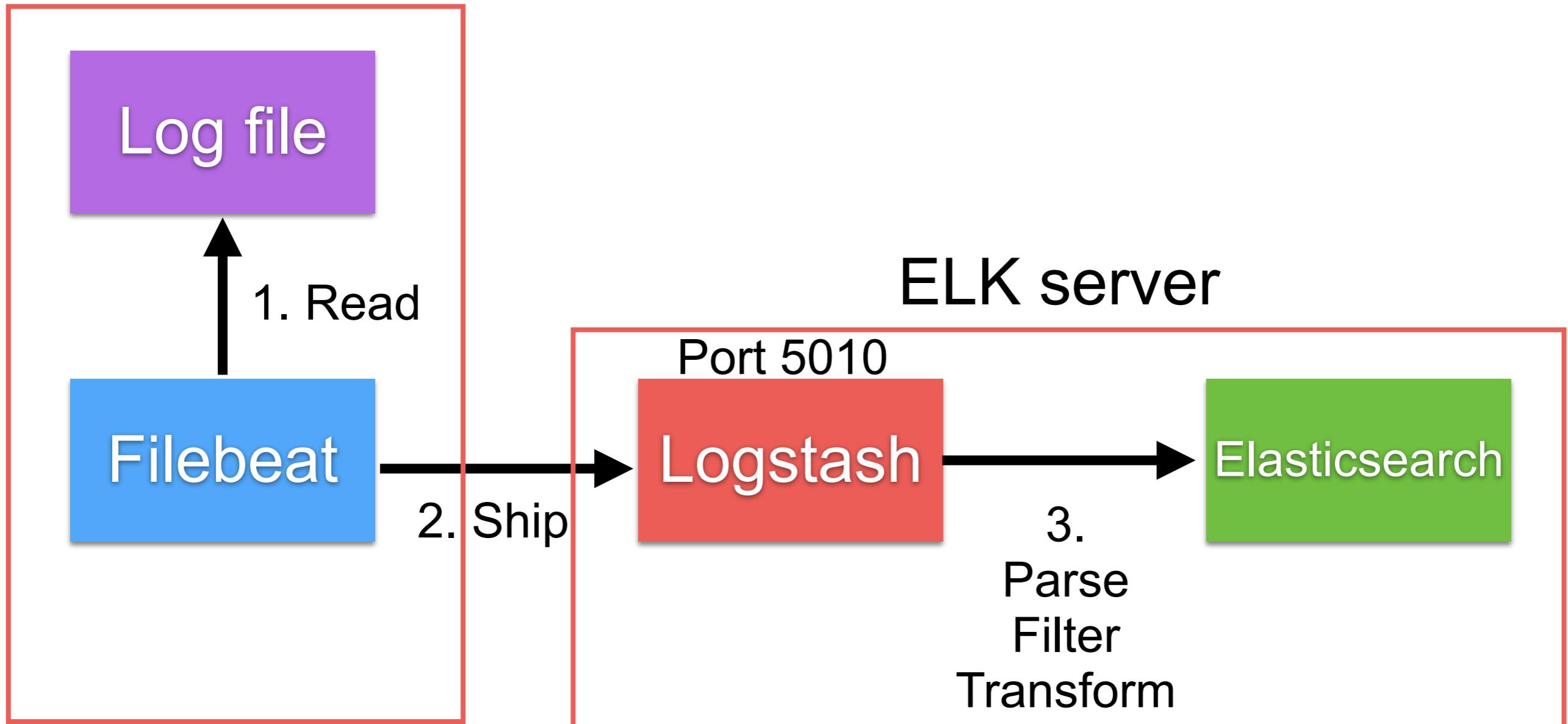
Example of filebeat

Server A

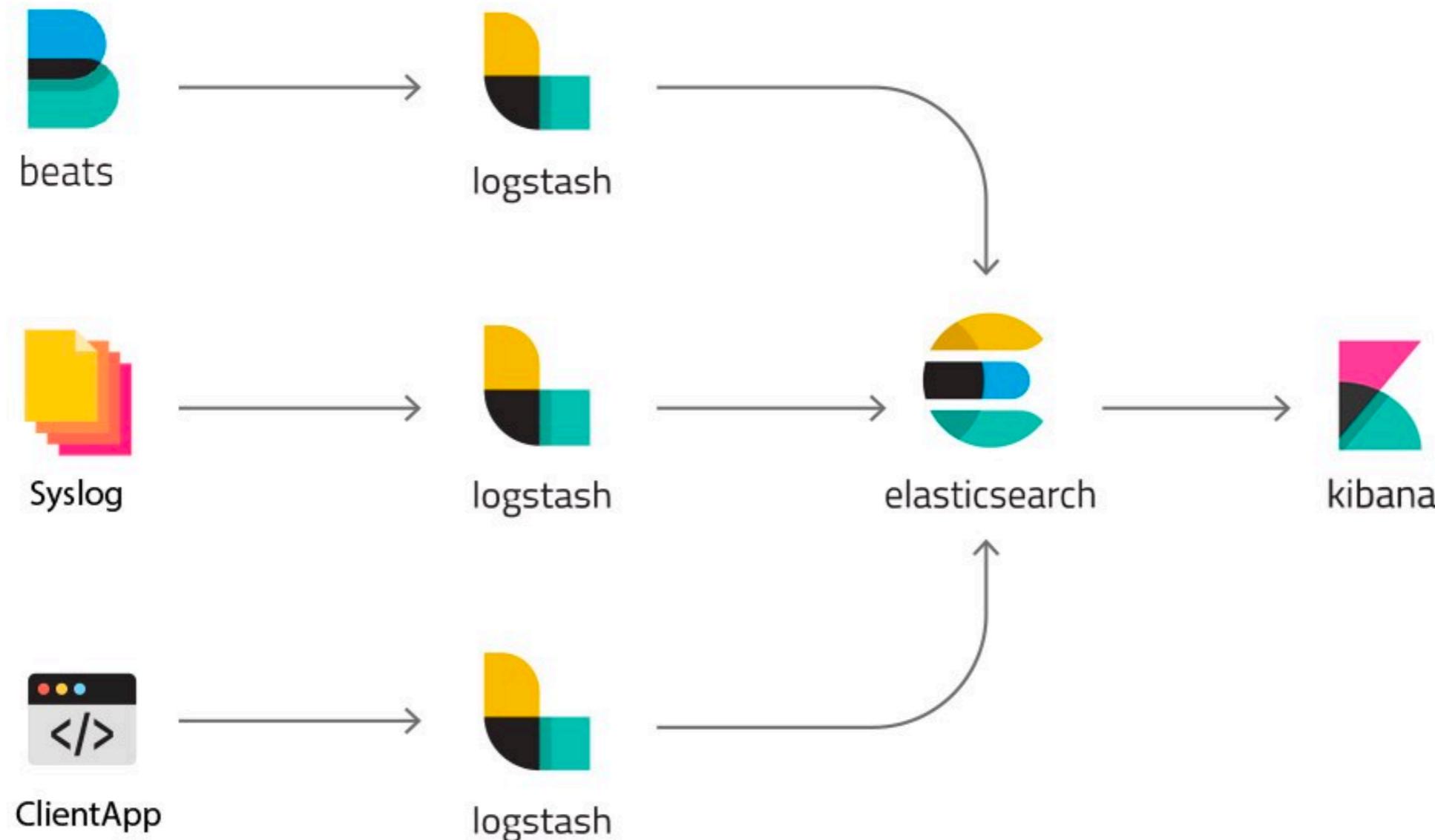


Example of filebeat

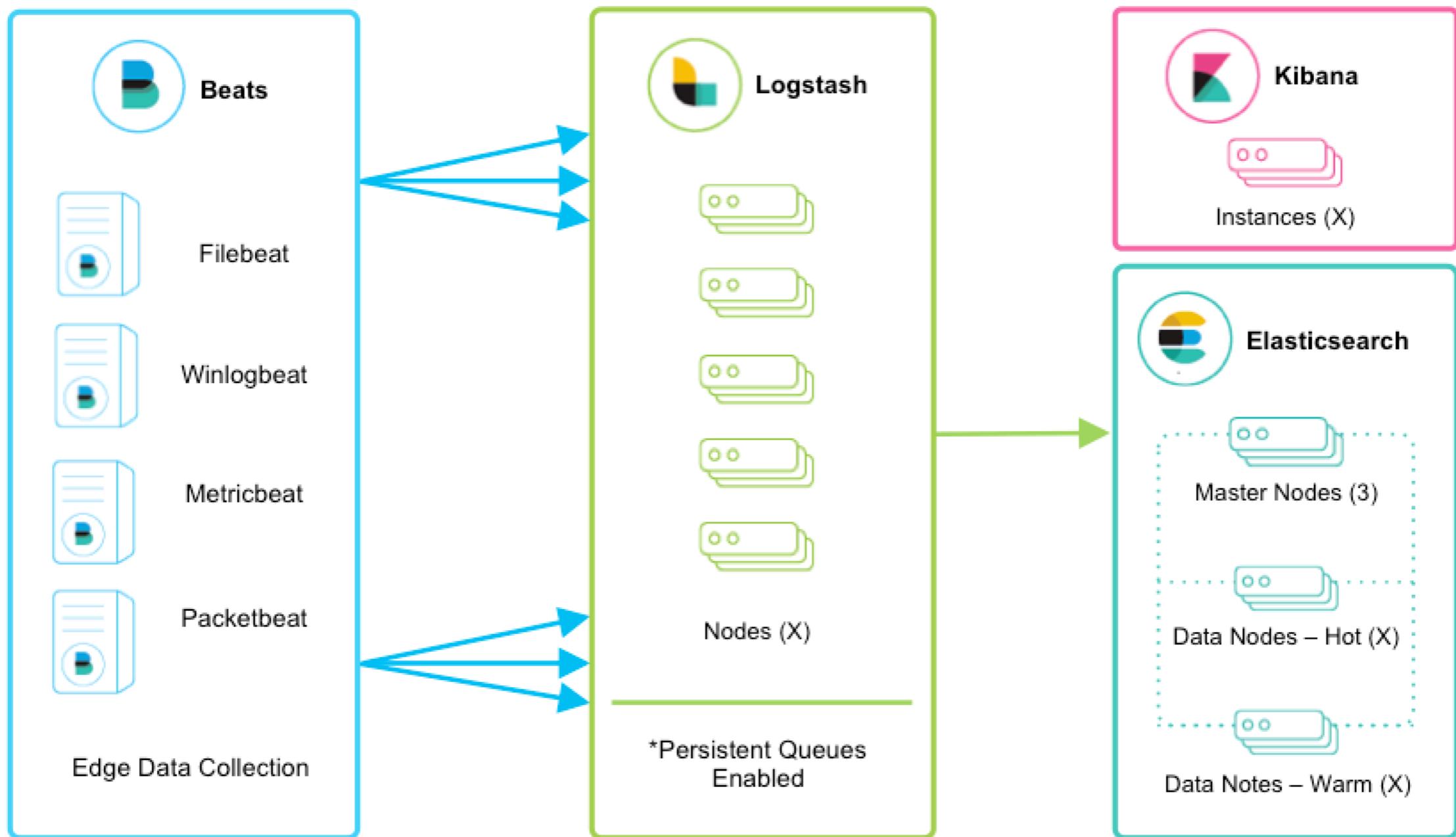
Server A



Beat and Logstash



Scaling



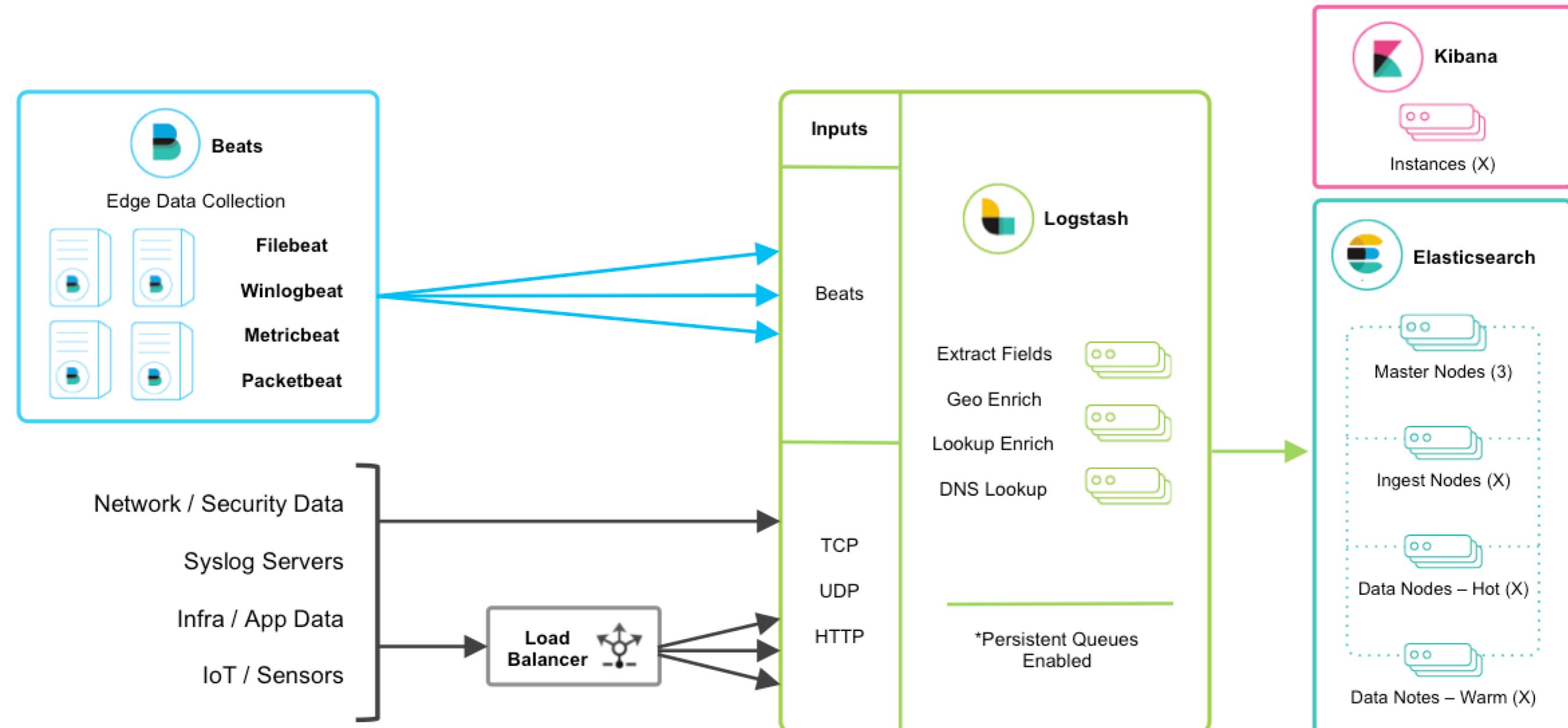
<https://www.elastic.co/guide/en/logstash/current/deploying-and-scaling.html>



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More data sources



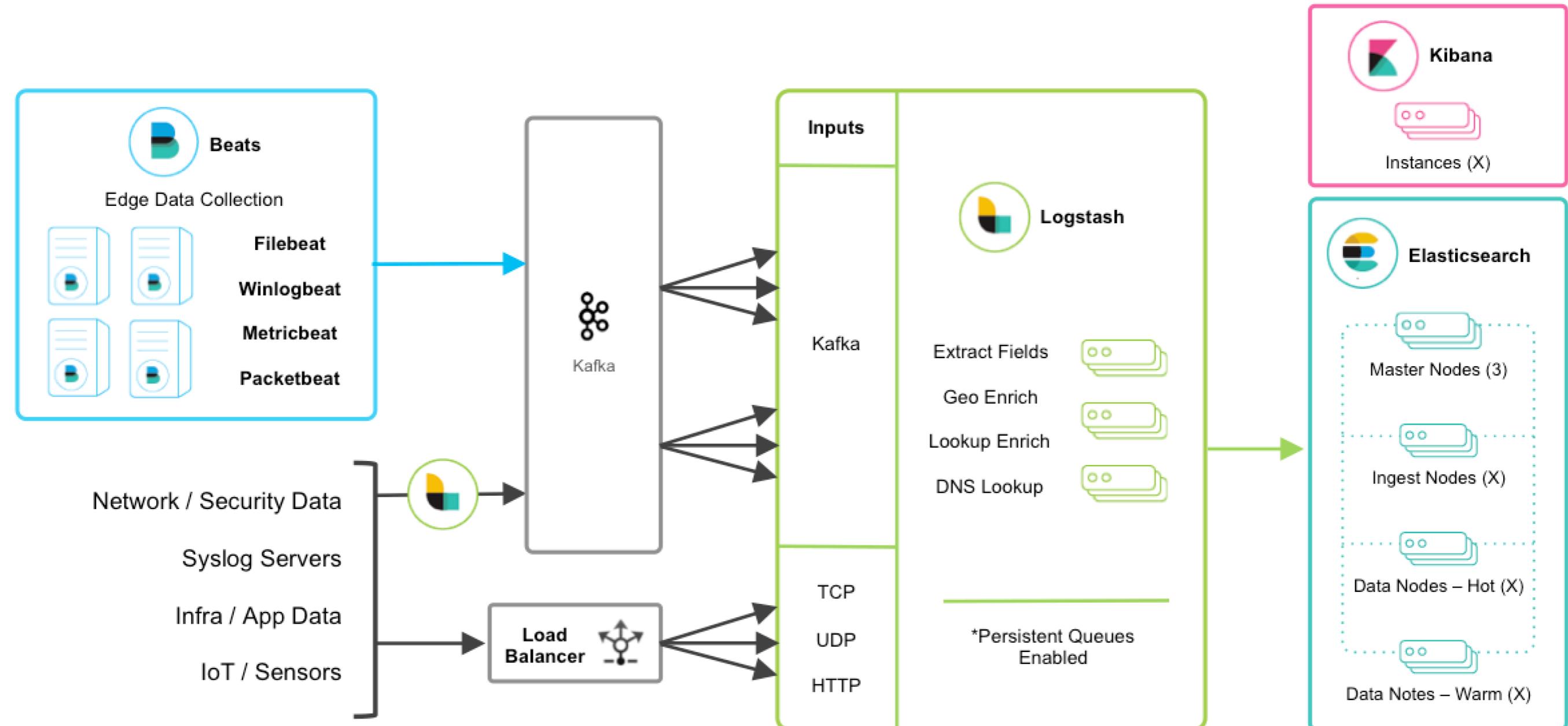
<https://www.elastic.co/guide/en/logstash/current/deploying-and-scaling.html>



ELK Stack

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Use messaging Queue



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

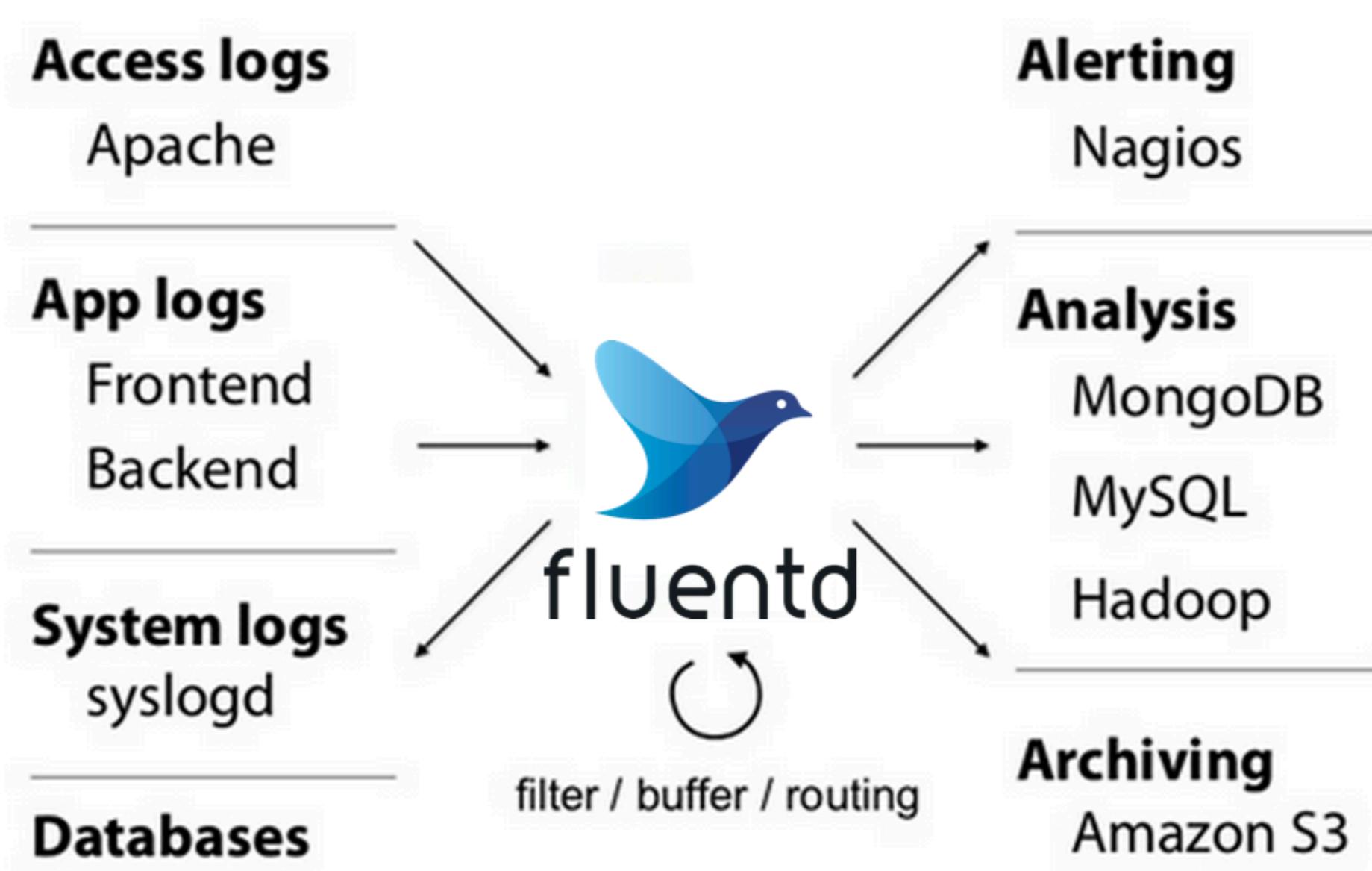


Working with Fluentd

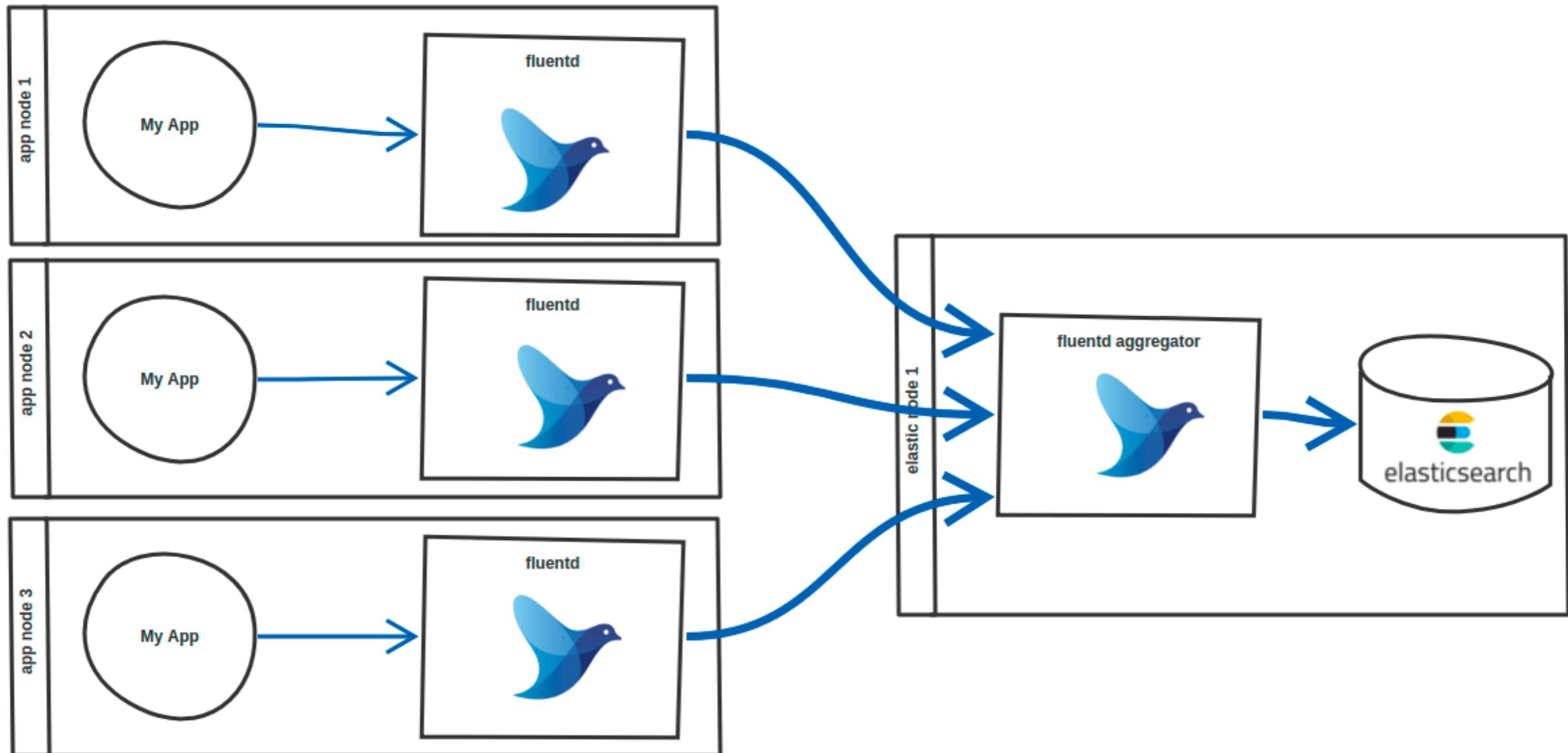
<https://www.fluentd.org/>



Fluentd

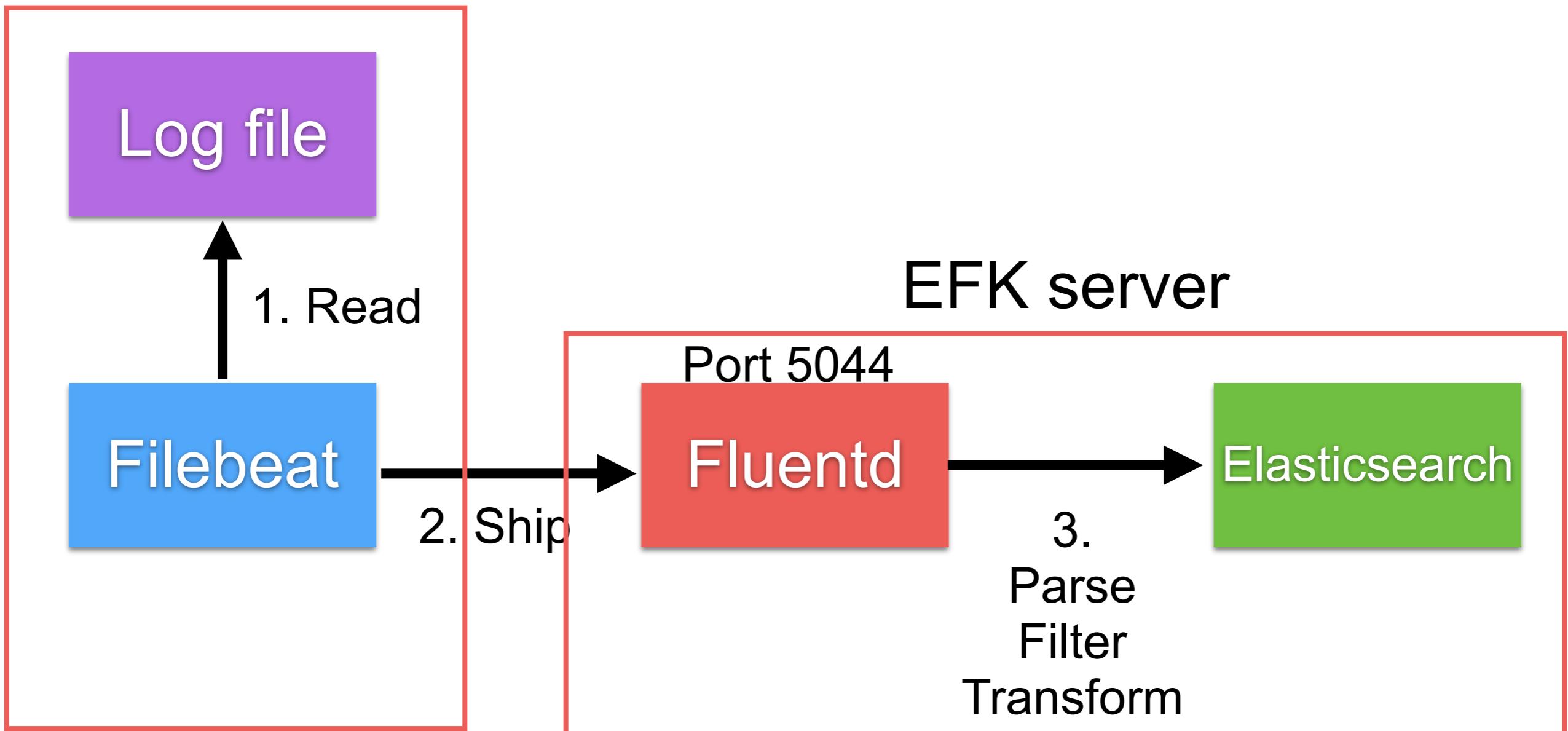


EFK stack



Example of fluentd

Server A



Fluentd regex editor

Fluentular fluentd v1.5.2

a Fluentd regular expression editor

</> Regular Expression

“ Test String

⌚ Custom Time Format (See also ruby document; [strftime](#))

Parse

Example (Apache)

Regular expression:

```
^(?<host>[ ^ ]*) [ ^ ]* (?<user>[ ^ ]*) \[ (?:<time>[^\\ ]*)\] " (?<method>\\S+)(?: +(?<path>[ ^ ]*) +\\S*)?" (?<code>[ ^ ]*) (?<size>[ ^ ]*)(?: "(?<referer>[ ^\\ ]*)" "?<agent>[ ^\\ ]*")? $
```

Time Format:

```
%d/%b/%Y:%H:%M:%S %z
```

<http://fluentular.herokuapp.com/>

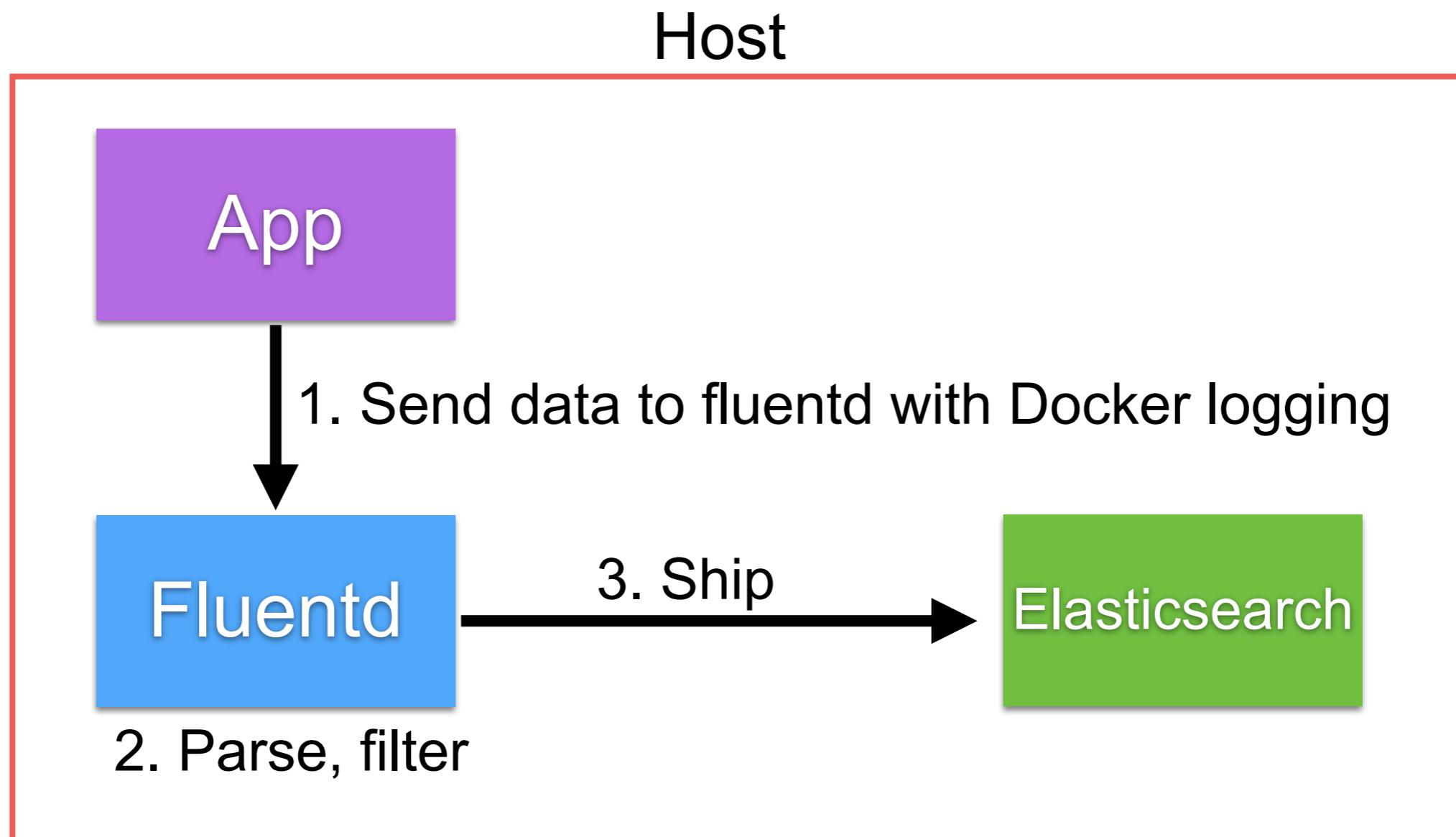


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Fluentd with Docker

Using docker-compose



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
Machine Learning	Required subscription !!

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



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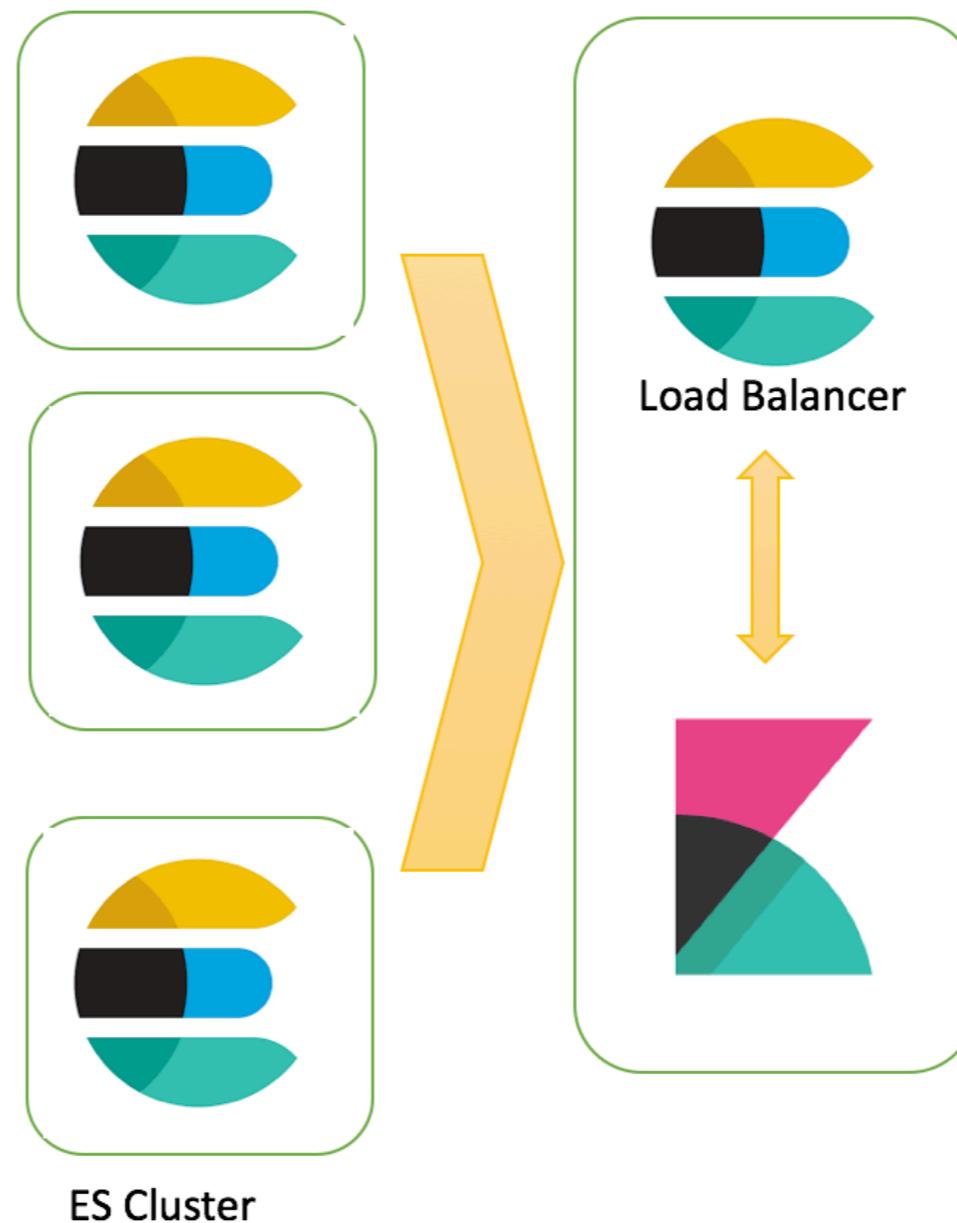
Elasticsearch Nodes

← → ⌂ ⓘ 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>



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Elasticsearch Nodes

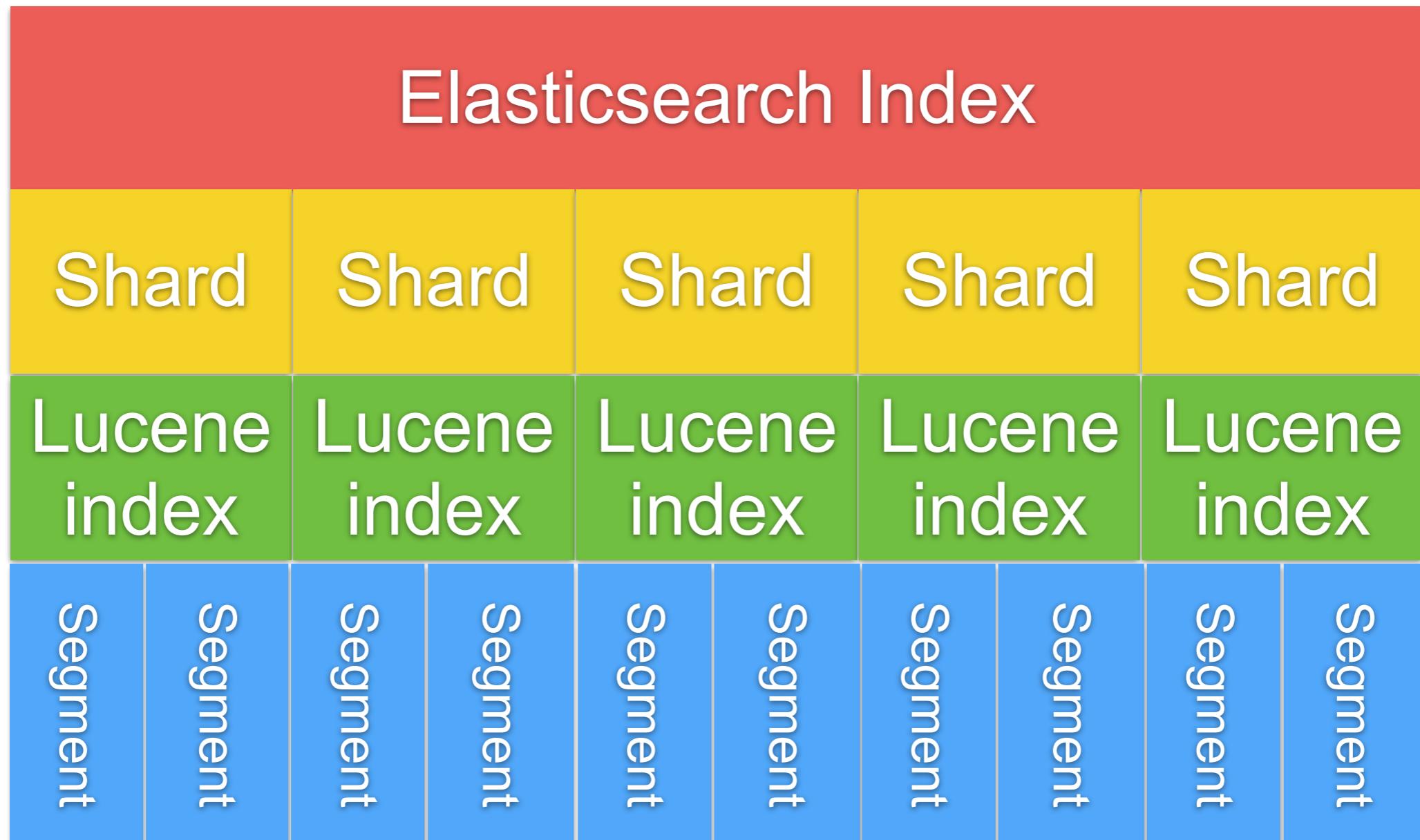


Apache Lucene

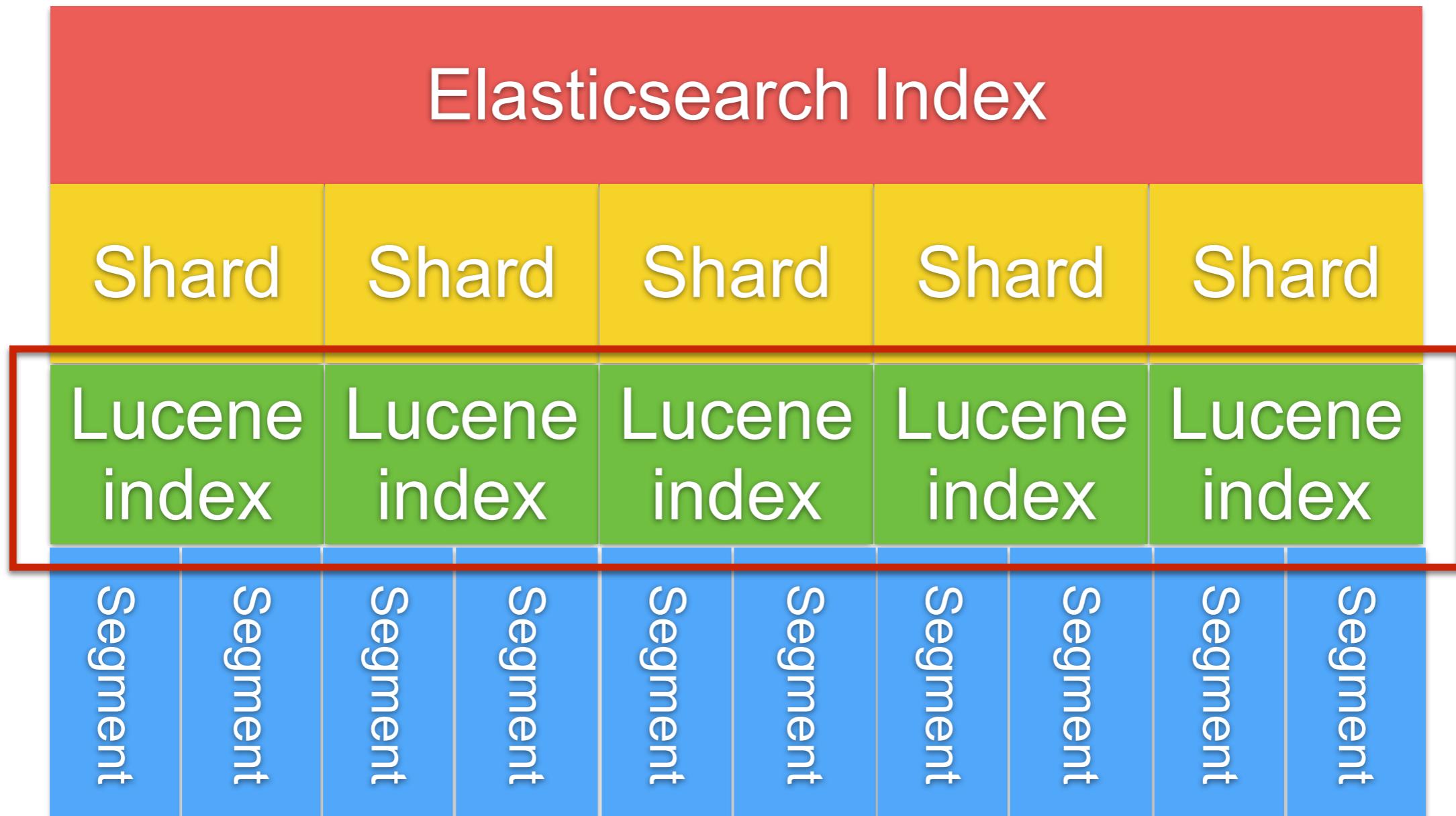
<http://lucene.apache.org/>



Apache Lucene



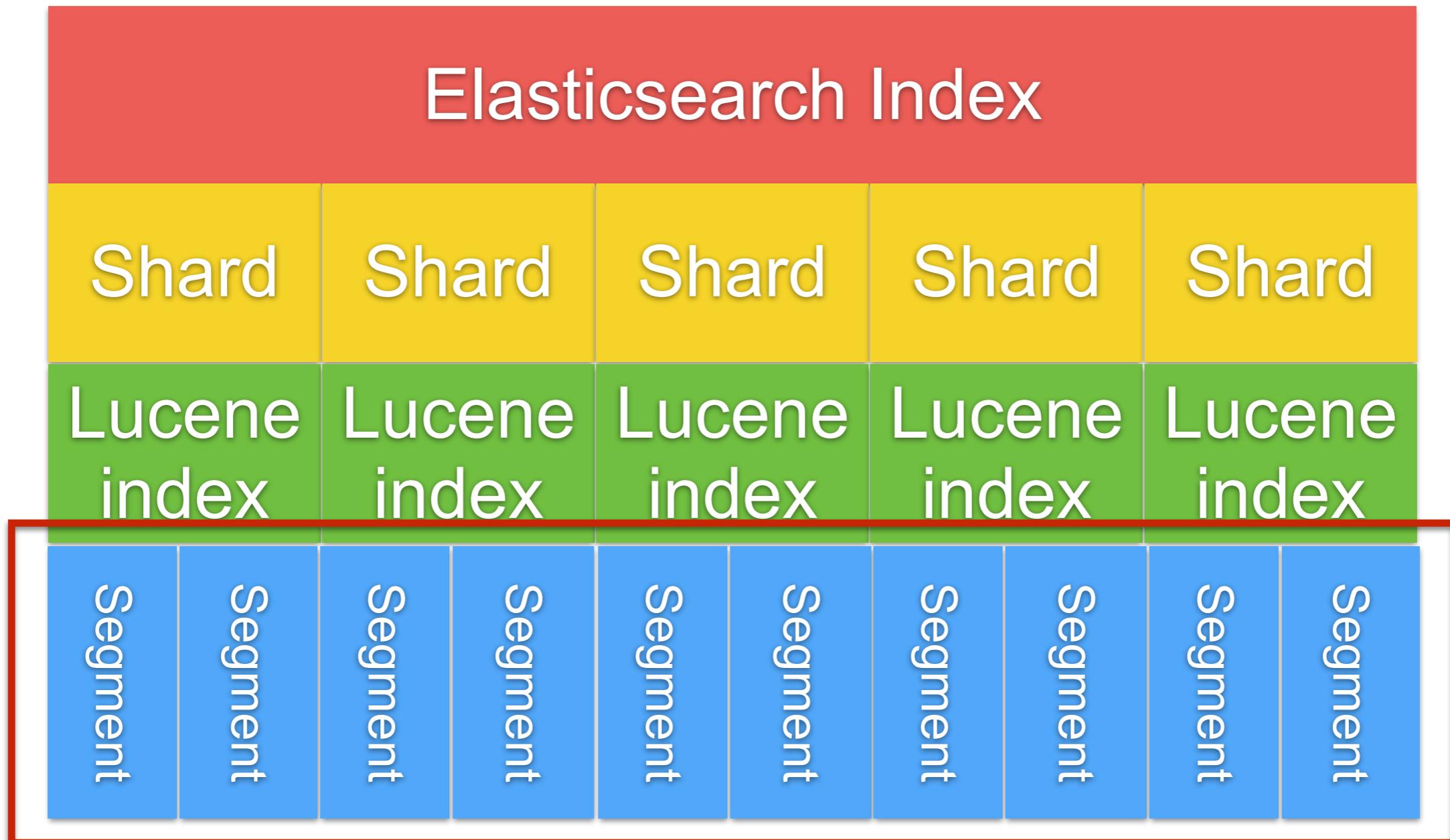
Apache Lucene



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



Apache Lucene



Segments are immutable

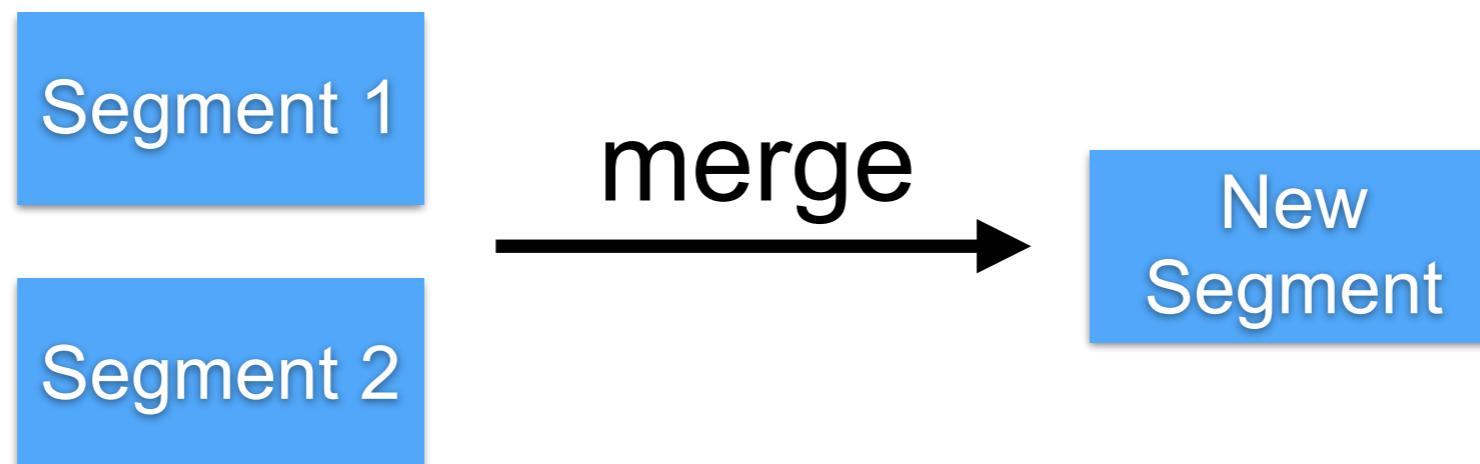


Segment

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>



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Design your index



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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 !!

Elasticsearch Index				
Shard	Shard	Shard	Shard	Shard
Lucene index	Lucene index	Lucene index	Lucene index	Lucene index
Segment	Segment	Segment	Segment	Segment

Need to config file descriptor

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



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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>



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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>



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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>



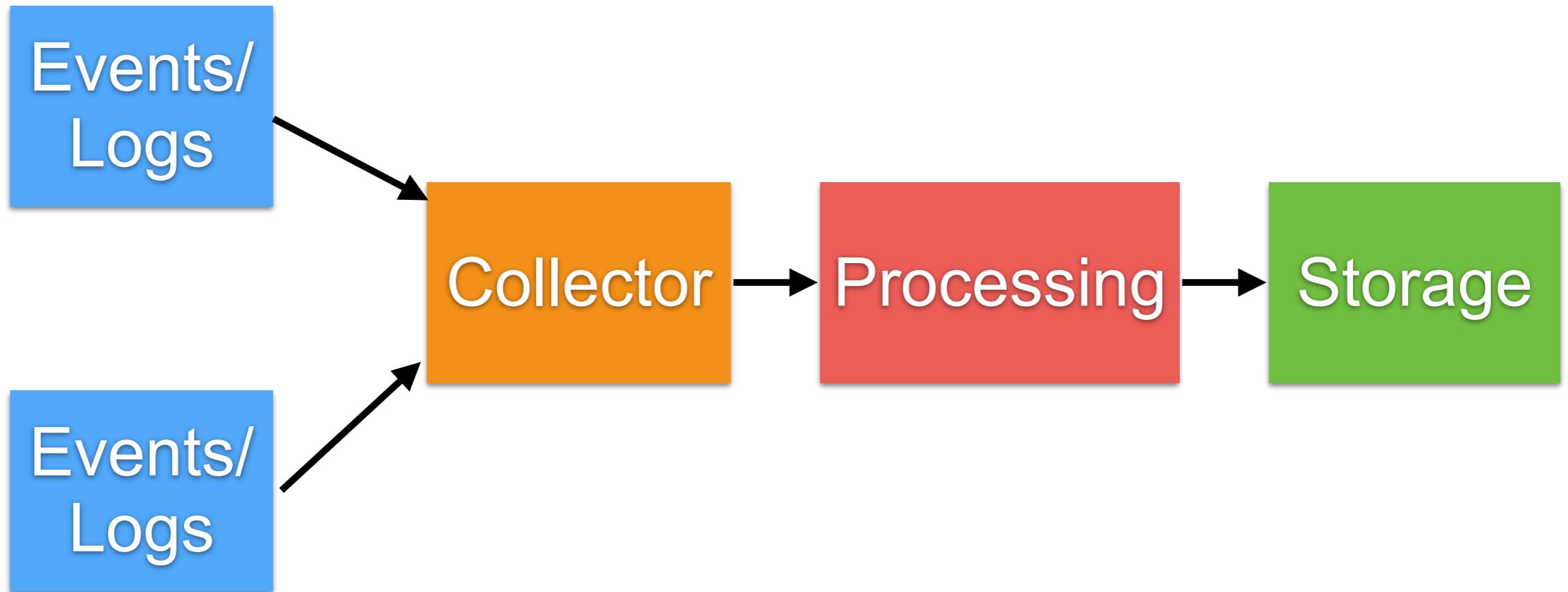
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Use cases



Event or Logging from Servers



Event or Logging from Servers



Data
Collection

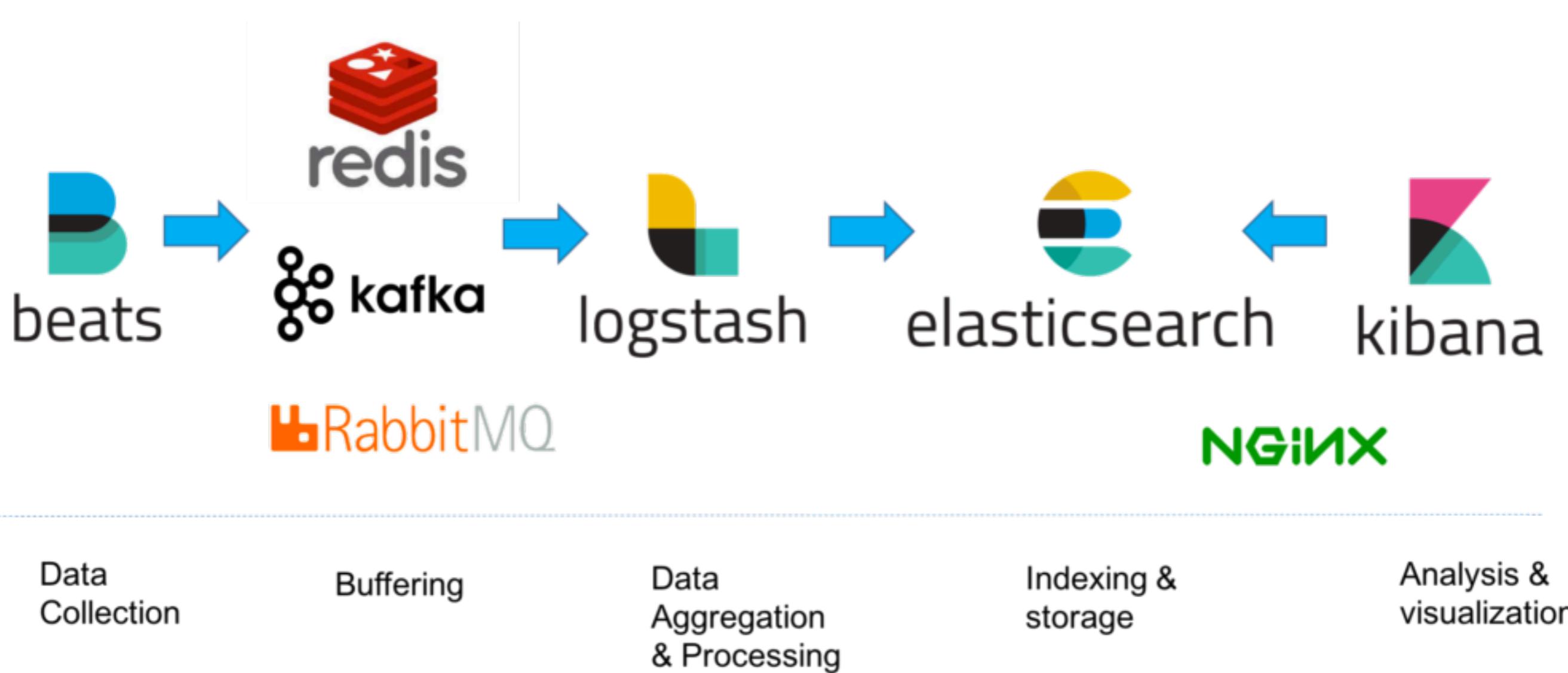
Data
Aggregation
& Processing

Indexing &
storage

Analysis &
visualization



Event or Logging from Servers



Monitoring



Collect data from ?

Elasticsearch nodes

Logstash nodes

Kibana instances

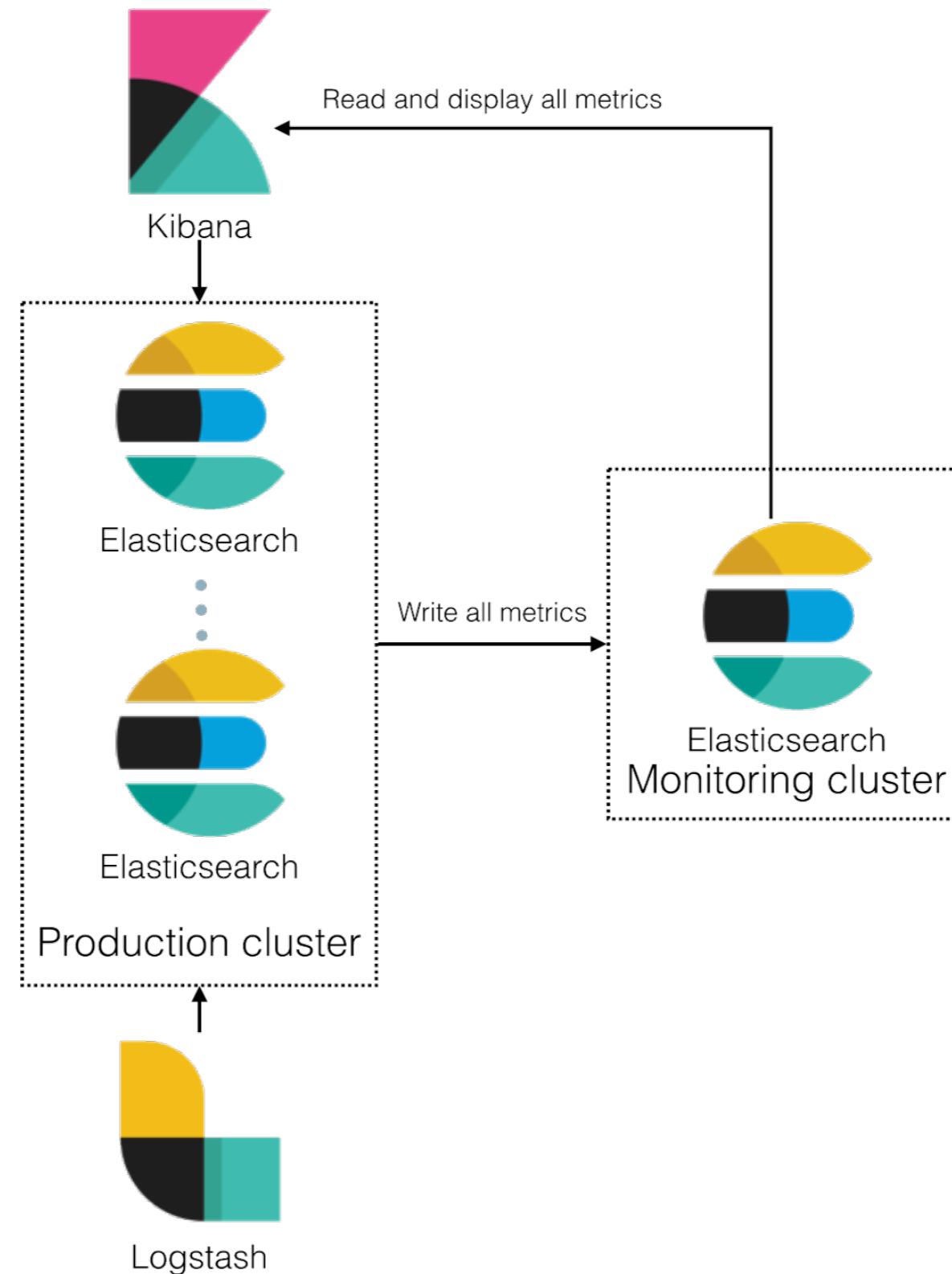
<https://www.elastic.co/guide/en/elasticsearch-stack-overview/6.5/xpack-monitoring.html>



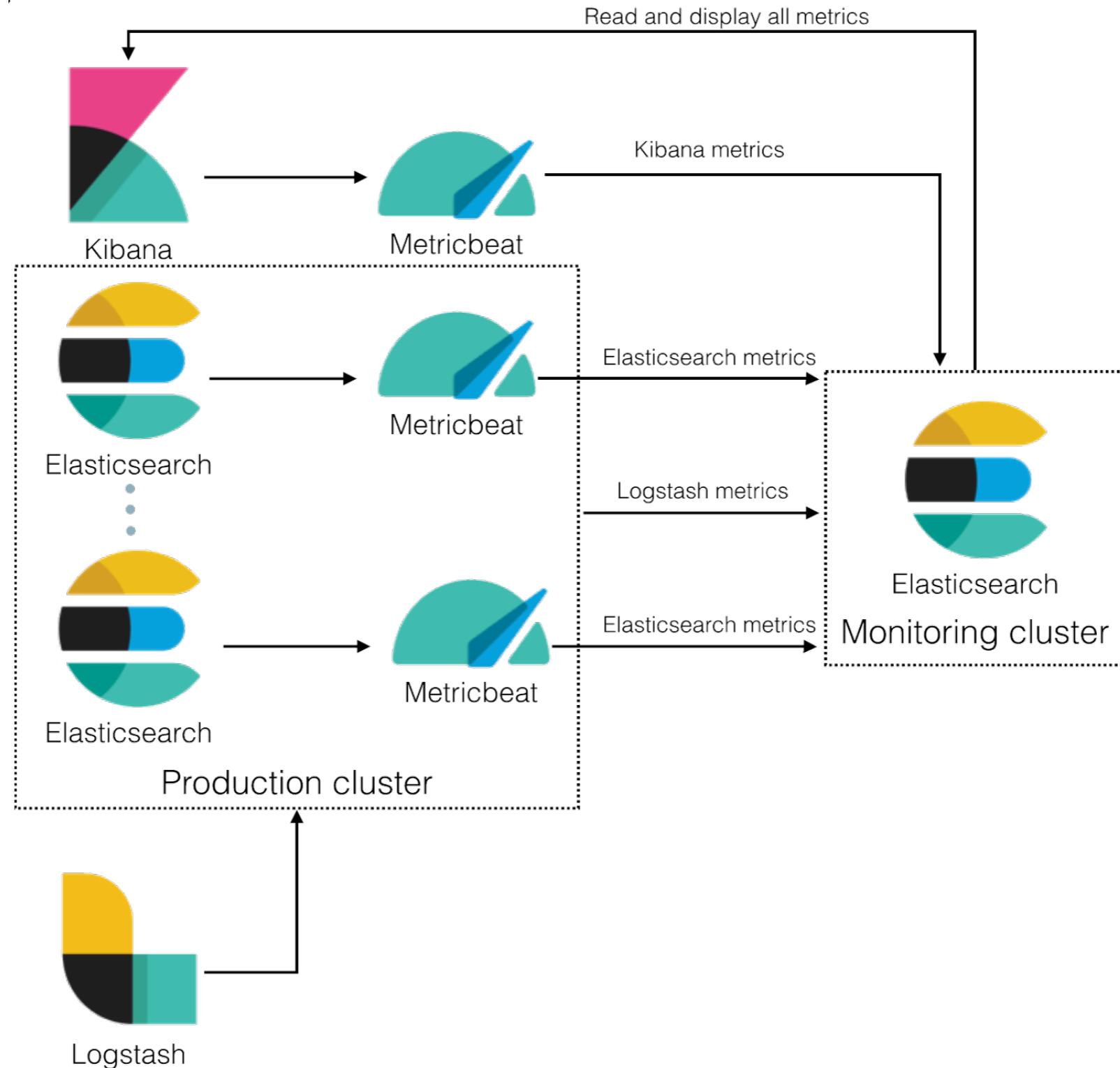
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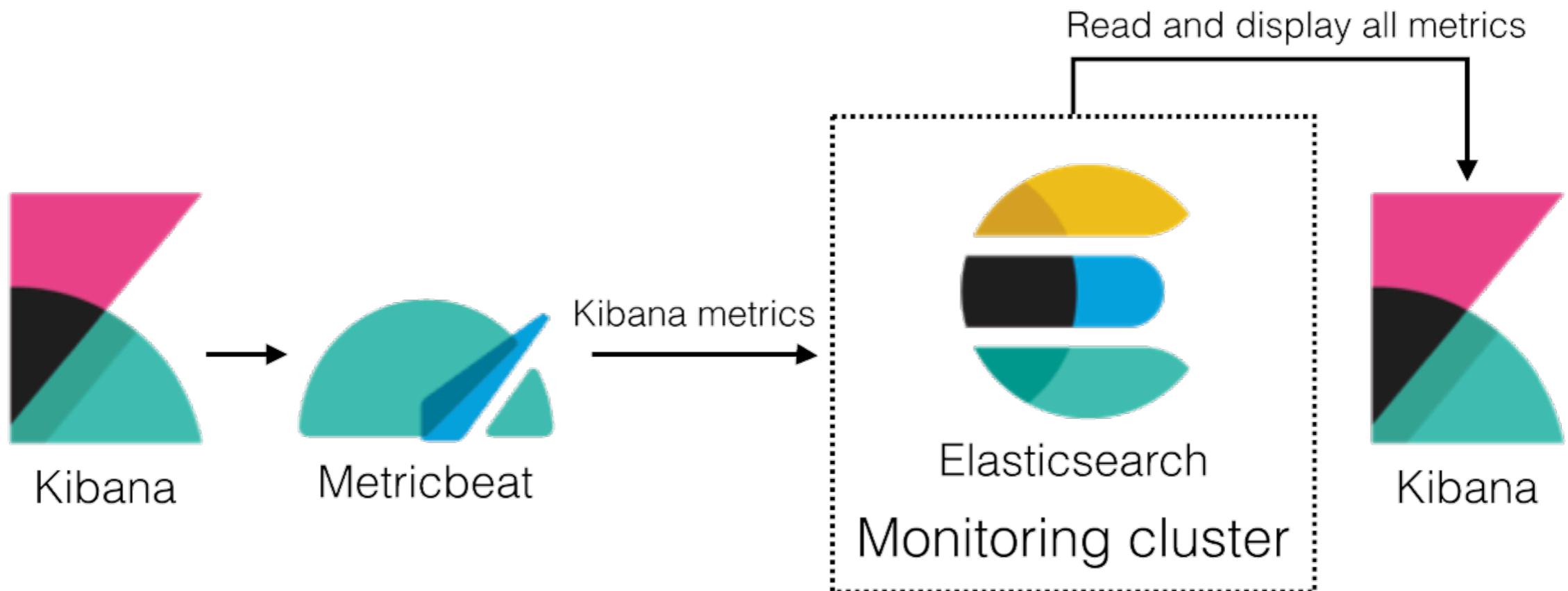
Recommend architecture



Elasticsearch 6.4 + (beta)



Try to separate kibana



Metrics

workshop/prometheus-grafana



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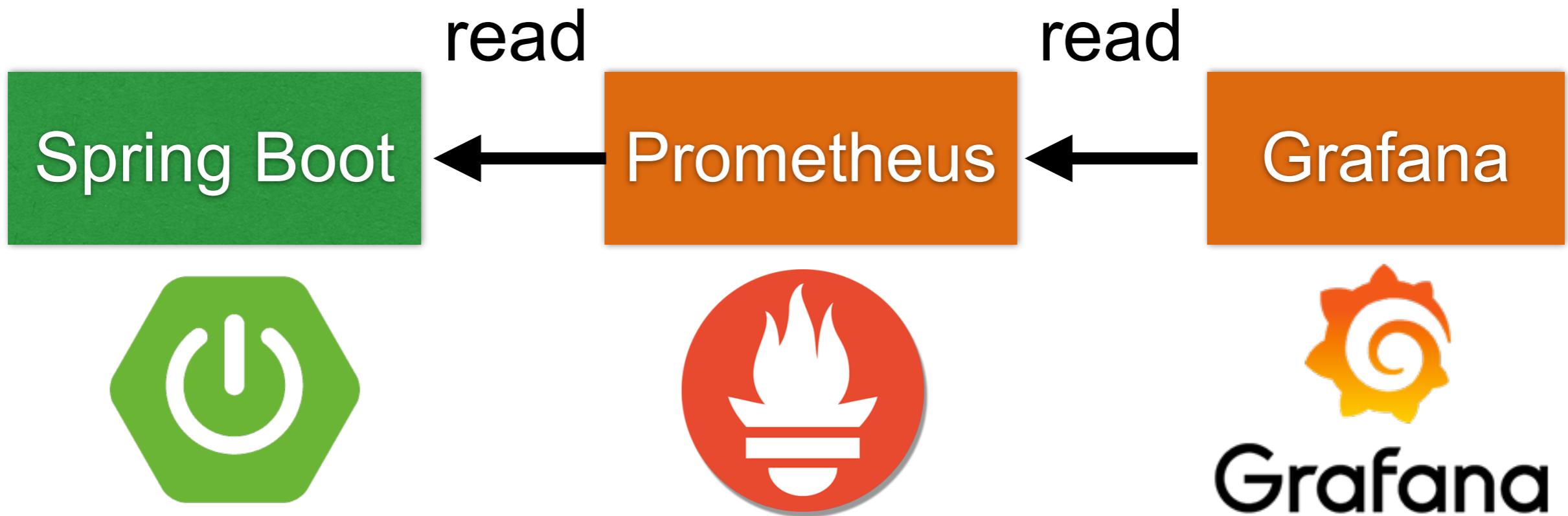
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Sample Architecture



Sample Architecture



Metric in Spring Boot

Spring Boot Actuator for Spring Boot 1.x
MicroMeter for Spring Boot 2.0



Spring Boot Actuator (1)

Add library to pom.xml

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-actuator</artifactId>
</dependency>
```



Spring Boot Actuator (2)

Enabled endpoint in application.properties

```
info.app.name=Toy Store
```

```
info.app.description=This is my first spring boot application
```

```
info.app.version=1.0.0
```

```
management.endpoints.web.exposure.include=health,info,metrics,httptrace
```



Spring Boot Actuator (3)

List of endpoints = /actuator/

```
← → ⌂ ⓘ localhost:8080/actuator/  
  
{  
  - _links: {  
    - self: {  
      href: "http://localhost:8080/actuator",  
      templated: false  
    },  
    - health: {  
      href: "http://localhost:8080/actuator/health",  
      templated: false  
    },  
    - info: {  
      href: "http://localhost:8080/actuator/info",  
      templated: false  
    },  
    - metrics-requiredMetricName: {  
      href: "http://localhost:8080/actuator/metrics/{requiredMetricName}",  
      templated: true  
    },  
    - metrics: {  
      href: "http://localhost:8080/actuator/metrics",  
      templated: false  
    },  
    - httptrace: {  
      href: "http://localhost:8080/actuator/httptrace",  
      templated: false  
    }  
  }  
}
```



Spring Boot Actuator (4)

Info endpoint = /actuator/info

```
← → ⌂ ⓘ localhost:8080/actuator/info

{
  - app: {
      name: "Toy Store",
      description: "This is my first spring boot application",
      version: "1.0.0"
    }
}
```



Spring Boot Actuator (5)

Info endpoint = /actuator/info

```
← → ⌂ ⓘ localhost:8080/actuator/info

{
  - app: {
      name: "Toy Store",
      description: "This is my first spring boot application",
      version: "1.0.0"
    }
}
```



Spring Boot Actuator (6)

Info endpoint = /actuator/httptrace

```
← → ⌂ ⓘ localhost:8080/actuator/httptrace

{
  - traces: [
    - {
      timestamp: "2018-03-06T13:33:02.800Z",
      principal: null,
      session: null,
      - request: {
        method: "GET",
        uri: "http://localhost:8080/prometheus",
        - headers: {
          - host: [
            "localhost:8080"
          ],
          - user-agent: [
            "Prometheus/2.0.0"
          ],
          - accept: [
            "text/plain;version=0.0.4;q=1,*/*;q=0.1"
          ],
          - accept-encoding: [
            "gzip"
          ],
          - x-prometheus-scrape-timeout-seconds: [
            "5.000000"
          ]
        },
        remoteAddress: null
      },
    }
  ]
}
```



Spring Boot Actuator (7)

List of metrics endpoint = /actuator/metrics

```
← → ⌂ ⓘ localhost:8080/actuator/metrics

{
  - names: [
    "jvm.buffer.memory.used",
    "jvm.memory.used",
    "jvm.gc.memory.allocated",
    "jvm.memory.committed",
    "http.server.requests",
    "jdbc.connections.min",
    "tomcat.sessions.created",
    "tomcat.sessions.expired",
    "hikaricp.connections.usage",
    "tomcat.global.request.max",
    "tomcat.global.error",
    "jvm.gc.max.data.size",
    "logback.events",
    "system.cpu.count",
    "jvm.memory.max",
    "jdbc.connections.active",
    "jvm.buffer.total.capacity",
    "jvm.buffer.count",
    "process.files.max",
    "jvm.threads.daemon",
```



Spring Boot Actuator (8)

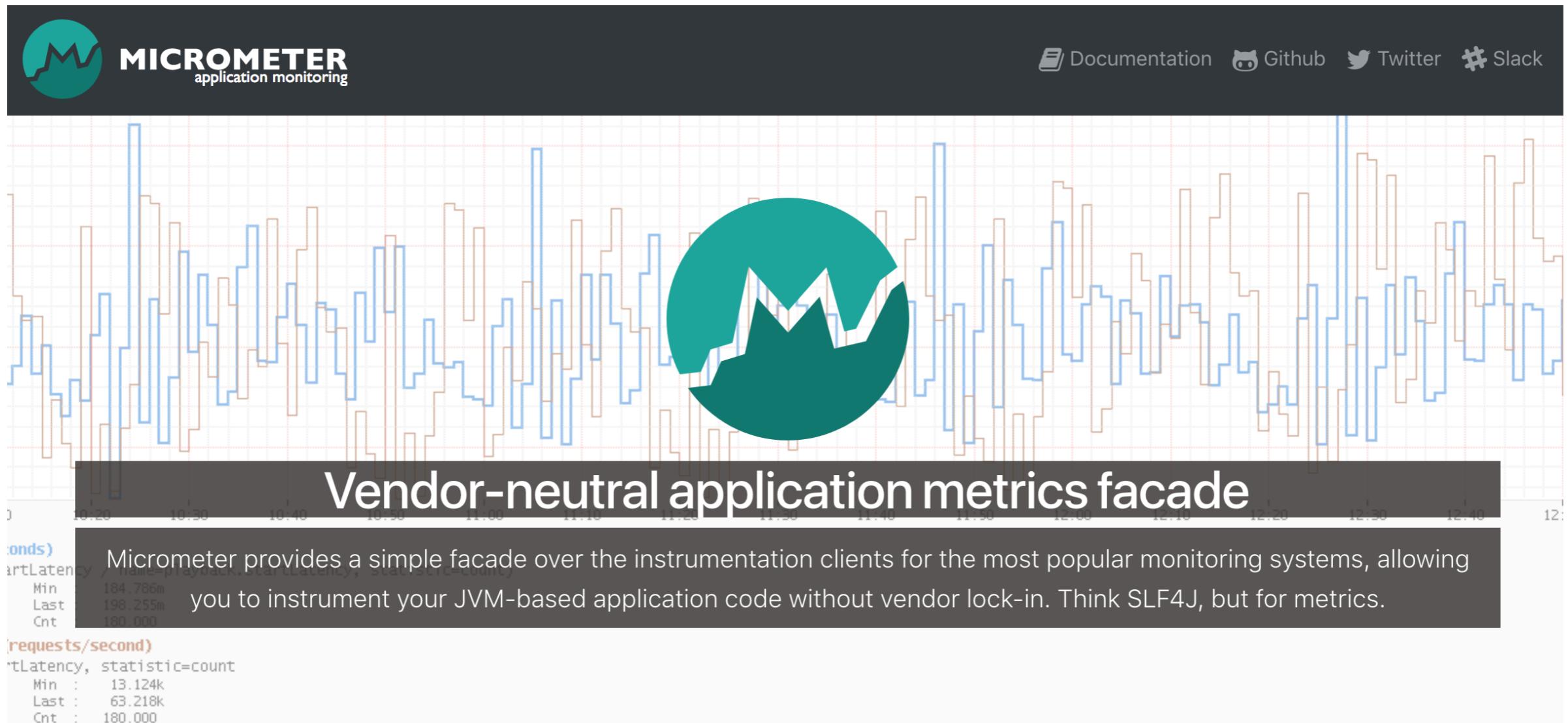
/actuator/metrics/http.server.requests

```
← → ⌂ ⓘ localhost:8080/actuator/metrics/http.server.requests

{
  name: "http.server.requests",
  - measurements: [
    - {
      statistic: "COUNT",
      value: 269
    },
    - {
      statistic: "TOTAL_TIME",
      value: 1.1072010200000002
    },
    - {
      statistic: "MAX",
      value: 0.04373569
    }
  ],
  - availableTags: [
    - {
      tag: "exception",
      - values: [
        "None"
      ]
    },
    - {
      tag: "method",
      - values: [
        "GET"
      ]
    },
  ],
}
```



Spring Boot 2.0 with MicroMeter



<https://micrometer.io/>



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Service metric for Prometheus



Enable Prometheus (1)

Add library to pom.xml

```
<dependency>
    <groupId>io.micrometer</groupId>
    <artifactId>micrometer-registry-prometheus</artifactId>
    <version>1.0.1</version>
</dependency>
```



Enable Prometheus (2)

Enabled endpoint in application.properties

```
management.endpoints.web.exposure.include  
=....,prometheus
```



Enable Prometheus (3)

New endpoint = actuator/prometheus

```
← → ⌂ ⓘ localhost:8080/actuator/prometheus

# HELP jvm_memory_used_bytes The amount of used memory
# TYPE jvm_memory_used_bytes gauge
jvm_memory_used_bytes{area="nonheap",id="Code Cache",} 1.49056E7
jvm_memory_used_bytes{area="nonheap",id="Metaspace",} 5.6766712E7
jvm_memory_used_bytes{area="nonheap",id="Compressed Class Space",} 7617096.0
jvm_memory_used_bytes{area="heap",id="PS Eden Space",} 1.7135864E7
jvm_memory_used_bytes{area="heap",id="PS Survivor Space",} 1.6235192E7
jvm_memory_used_bytes{area="heap",id="PS Old Gen",} 2.1936456E7
# HELP hikaricp_connections_idle Idle connections
# TYPE hikaricp_connections_idle gauge
hikaricp_connections_idle{pool="HikariPool-1",} NaN
# HELP tomcat_threads_config_max
# TYPE tomcat_threads_config_max gauge
tomcat_threads_config_max{name="http-nio-8080",} 200.0
# HELP tomcat_servlet_error_total
# TYPE tomcat_servlet_error_total counter
tomcat_servlet_error_total{name="default",} 0.0
# HELP jvm_threads_peak The peak live thread count since the Java virtual machine start
# TYPE jvm_threads_peak gauge
jvm_threads_peak 28.0
# HELP hikaricp_connections_pending Pending threads
# TYPE hikaricp_connections_pending gauge
hikaricp_connections_pending{pool="HikariPool-1",} NaN
# HELP system_cpu_count The number of processors available to the Java virtual machine
```



Keep data in Prometheus

<https://prometheus.io/>



Prometheus



Prometheus

DOCS

DOWNLOAD

COMMUNITY

BLOG



From metrics to insight

Power your metrics and alerting with a leading
open-source monitoring solution.

GET STARTED

DOWNLOAD

Prometheus v2.0 is available now — [Read the announcement blog post!](#)

<https://prometheus.io/>



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Prometheus

PUBLIC | AUTOMATED BUILD

[prom/prometheus](#) 

Last pushed: 17 hours ago

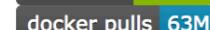
[Repo Info](#) [Tags](#) [Dockerfile](#) [Build Details](#)

Short Description

Short description is empty for this repo.

Full Description

Prometheus 

Visit prometheus.io for the full documentation, examples and guides.

Prometheus is a systems and service monitoring system. It collects metrics

Docker Pull Command

`docker pull prom/prometheus`

Owner



prom

Source Repository

 [prometheus/prometheus](#)

<https://hub.docker.com/r/prom/prometheus/>



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Create container of Prometheus

```
$ docker container run --rm  
  -p 9090:9090  
  -v $(pwd)/prometheus.yml:/etc/prometheus/  
prometheus.yml  
  --name monitor prom/prometheus
```



Check Data in Prometheus

http://localhost:9090/

The screenshot shows the Prometheus web interface at the URL `http://localhost:9090/graph`. The interface has a dark header bar with the Prometheus logo and navigation links for Alerts, Graph, Status, and Help. Below the header is a checkbox labeled "Enable query history". A text input field is labeled "Expression (press Shift+Enter for newlines)" with the placeholder "- insert metric at cursor -". Below the input field are two tabs: "Graph" (which is selected) and "Console". A table section displays the results of the query, with columns "Element" and "Value". The table shows a single row with the text "no data". At the bottom left is a blue button labeled "Add Graph".



Check Target in Prometheus

Status -> Targets

The screenshot shows the Prometheus web interface at the URL `localhost:9090/targets`. The top navigation bar includes links for Prometheus, Alerts, Graph, Status, and Help. The main section is titled "Targets" and features a checkbox labeled "Only unhealthy jobs" which is unchecked. Below this, a summary box displays "spring-boot (1/1 up)" with a "show less" button. A table lists one target endpoint:

Endpoint	State	Labels	Last Scrape	Error
http://10.10.99.59:8080/actuator/prometheus	UP	instance="10.10.99.59:8080"	2.355s ago	



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Show data in Grafana

<https://grafana.com/>



Grafana

The screenshot shows the Grafana Labs website. At the top, there's a navigation bar with links for Plugins (currently installed), Grafana, GrafanaCloud, Services, Dashboards, Plugins, and Get Grafana. Below the navigation, a large central text area features the slogan "The open platform for beautiful analytics and monitoring". To the left, there's a card for "Grafana TestData" by Grafana Project, which includes a network icon. To the right, there are cards for "Kentik Connect Pro" (with a Kentik logo) and "NS1 for Grafana" by NS1. (with an NS1 logo). At the bottom left, there's a card for "kubernetes" by Raintank Inc. (with a Kubernetes logo). In the center, there's a prominent orange button labeled "Get Grafana". Below the main text area, there's another line of text: "The leading open source software for time series analytics". At the very bottom, the Grafana logo is displayed.

<https://grafana.com/>



Grafana

PUBLIC REPOSITORY

[grafana/grafana](#) 

Last pushed: 25 minutes ago

[Repo Info](#)

[Tags](#)

Short Description

The official Grafana docker container

Full Description

Grafana Docker image

This project builds a Docker image with the latest master build of Grafana.

Running your Grafana container

Start your container binding the external port 3000 .

```
docker run -d --name=grafana -p 3000:3000 grafana/grafana
```

Docker Pull Command

`docker pull grafana/grafana`

Owner



grafana

<https://hub.docker.com/r/grafana/grafana/>



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Create container of Grafana

```
$docker container run  
--name=grafana  
-p 3000:3000 grafana/grafana
```



Grafana Dashboard

<https://grafana.com/dashboards/4701>

All dashboards » [JVM \(Micrometer\)](#)



JVM (Micrometer) by [mweirauch](#)

[DASHBOARD](#)

Dashboard for Micrometer instrumented applications (Java, Spring Boot)
Last updated: 21 days ago

[Overview](#) [Revisions](#)



Get this dashboard:

[4701](#) [Copy ID to Clipboard](#)

A dashboard for [Micrometer](#) instrumented applications (Java, Spring Boot).

Features

- JVM memory
- Process memory (provided by [micrometer-jvm-extras](#))
- CPU-Usage, Load, Threads, File Descriptors, Log Events
- JVM Memory Pools (Heap, Non-Heap)
- Garbage Collection

Dependencies:

GRAFANA 4.6.3 [GRAPH](#)



Take to your home

Always improve, always practice



Machine Learning



Machine Learning

Dataset increase in size and complexity

Human effort is limited !!

Infrastructure problem

Cyber attacks

Business issues

<https://www.elastic.co/guide/en/kibana/current/xpack-ml.html>



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Machine Learning in ES

Supervised
Unsupervised



Machine Learning in ES

Supervised
Classification
Regression



Machine Learning in ES

Unsupervised
Outlier detection
Anatomy detection



Machine Learning in ES

For basic licence (30 days trial)

Data Visualizer

The Machine Learning Data Visualizer tool helps you understand your data, by analyzing the metrics and fields in a log file or an existing Elasticsearch index.

EXPERIMENTAL



Import data

Import data from a log file. You can upload files up to 100 MB.

[Upload file](#)



Select an index pattern

Visualize the data in an existing Elasticsearch index.

[Select index](#)

Start trial

To experience the full Machine Learning features that a [Platinum subscription](#) offers, start a 30-day trial.

[Start trial](#)



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Continuous Learning Process

Data collection
Feature engineering
Training model
Evaluate modele
Deploy on production
Monitoring
Continuous Improvement



Let's workshop machine-learning/instruction.md



1. Data collection



Add data to ES

Using Add sample data

Add Data to Kibana

Use these solutions to quickly turn your data into pre-built dashboards and monitoring systems.



APM

APM automatically collects in-depth performance metrics and errors from inside your applications.

[Add APM](#)

Logging

Ingest logs from popular data sources and easily visualize in preconfigured dashboards.

[Add log data](#)

Metrics

Collect metrics from the operating system and services running on your servers.

[Add metric data](#)

SIEM

Centralize security events for interactive investigation in ready-to-go visualizations.

[Add security events](#)

Add sample data

Load a data set and a Kibana dashboard

Upload data from log file

Import a CSV, NDJSON, or log file

Use Elasticsearch data

Connect to your Elasticsearch index



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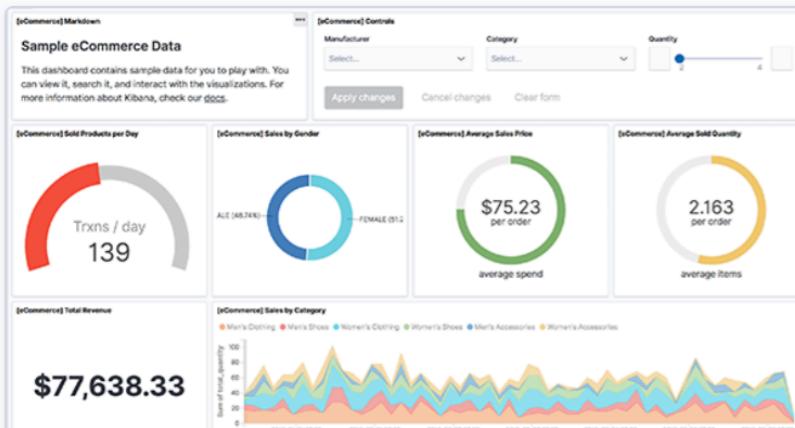
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Add data to ES

Add Data to Kibana

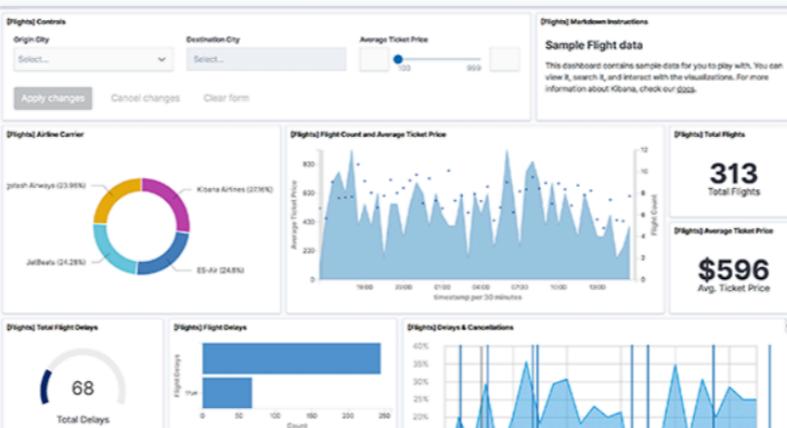
All Logging Metrics SIEM **Sample data**



Sample eCommerce orders

Sample data, visualizations, and dashboards for tracking eCommerce orders.

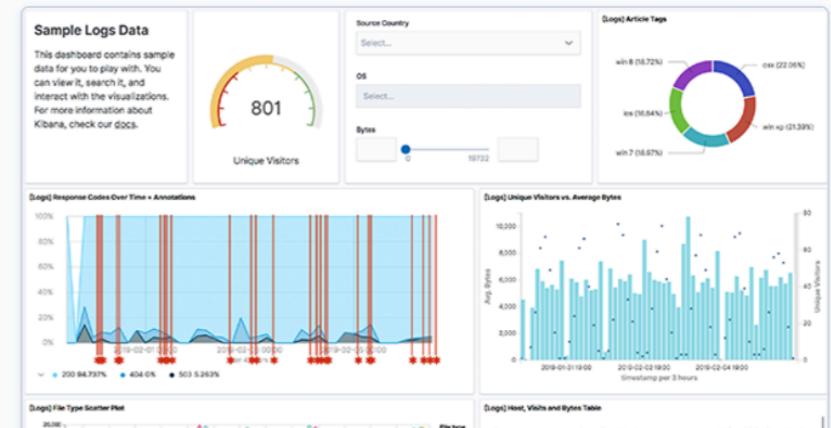
[Add data](#)



Sample flight data

Sample data, visualizations, and dashboards for monitoring flight routes.

[Add data](#)



Sample web logs

Sample data, visualizations, and dashboards for monitoring web logs.

[Add data](#)



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Query sample data

GET _cat/indices?v

health	status	index	uuid	pri	rep	docs.count
		.size	pri.store.size			
green	open	.kibana_task_manager_1	JeYrzD1dTeeBgp34aFT2Fg	1	0	2
		.4kb	51.4kb			
green	open	.apm-agent-configuration	V9bxRNDIRm-QIT88FKU1Gw	1	0	0
		283b	283b			
green	open	.kibana_1	GMiyZBhbTyaomAA6JfCQ6A	1	0	72
		.6kb	107.6kb			
green	open	kibana_sample_data_flights	I-fLlueyTk22RIHu9TIyRQ	1	0	13059
		6mb	6mb			



Query sample data

GET kibana_sample_data_flights/_search

```
{  
  "took" : 0,  
  "timed_out" : false,  
  "_shards" : {  
    "total" : 1,  
    "successful" : 1,  
    "skipped" : 0,  
    "failed" : 0  
  },  
  "hits" : {  
    "total" : {  
      "value" : 10000,  
      "relation" : "gte"  
    },  
    "max_score" : 1.0,  
    "hits" : [  
      {  
        "_index" : "kibana_sample_data_flights",  
        "_type" : "_doc",  
        "_id" : "r8fXHG8B8iN3UstZlXDN",  
        "_score" : 1.0,  
        "source" : {  
          "flight_id" : "r8fXHG8B8iN3UstZlXDN",  
          "origin" : "JFK",  
          "destination" : "SFO",  
          "airline" : "AA",  
          "flight_number" : 1234,  
          "gate" : "A123",  
          "aircraft" : "Boeing 737-800",  
          "status" : "On Time",  
          "actual_gate_time" : "2018-01-15T15:00:00",  
          "estimated_gate_time" : "2018-01-15T14:55:00",  
          "estimated_departure_time" : "2018-01-15T15:00:00",  
          "estimated_arrival_time" : "2018-01-15T16:00:00",  
          "actual_departure_time" : "2018-01-15T15:00:00",  
          "actual_arrival_time" : "2018-01-15T16:00:00",  
          "delay" : 0, "on_time" : true  
        }  
      }  
    ]  
  }  
}
```

10,000 != 13,059 ?



Query sample data

GET kibana_sample_data_flights/_search?
scroll=1m

```
{
  "_scroll_id" : "DXF1ZXJ5QW5kRmV0Y2gBAAAAAAEucL
    0ZfdlFsYkpBQQ==",
  "took" : 0,
  "timed_out" : false,
  "_shards" : {
    "total" : 1,
    "successful" : 1,
    "skipped" : 0,
    "failed" : 0
  },
  "hits" : {
    "total" : {
      "value" : 13059,
      "relation" : "eq"
    },
    "max_score" : 1.0,
    "hits" : [

```

<https://www.elastic.co/guide/en/elasticsearch/reference/current/search-request-body.html#request-body-search-scroll>



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2. Training model with ES



Create data frame

Choose source and destination

Choose features/fields

Choose model to analyse

```
"analysis": {  
    "classification": {  
        "outlier_detection": "FlightDelay",  
        "regression": "FlightDelay",  
        "training_percent": 10  
    }  
},
```

<https://www.elastic.co/guide/en/elastic-stack-overview/7.5/dfa-classification.html>



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Data frame analytic

Data frame analytics type	Learning type	Evaluation type
outlier detection	unsupervised	binary soft classification
regression	supervised	regression
classification	supervised	classification

https://www.elastic.co/guide/en/elasticsearch/_search.html



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Start job to create model

POST _ml/data_frame/analytics/model-flight-delay-classification/_start

```
"data_frame_analytics" : [  
    {  
        "id" : "model-flight-delay-classification",  
        "state" : "analyzing",  
        "progress" : [  
            {  
                "phase" : "reindexing",  
                "progress_percent" : 100  
            },  
            {  
                "phase" : "loading_data",  
                "progress_percent" : 100  
            },  
            {  
                "phase" : "analyzing",  
                "progress_percent" : 46  
            },  
            {  
                "phase" : "writing_results",  
                "progress_percent" : 0  
            }  
        ]  
    },  
    {  
        "id" : "model-flight-delay-classification",  
        "state" : "analyzing",  
        "progress" : [  
            {  
                "phase" : "reindexing",  
                "progress_percent" : 100  
            },  
            {  
                "phase" : "loading_data",  
                "progress_percent" : 100  
            },  
            {  
                "phase" : "analyzing",  
                "progress_percent" : 46  
            },  
            {  
                "phase" : "writing_results",  
                "progress_percent" : 0  
            }  
        ]  
    }]
```



See result

GET df-flight-delayed/_search

```
"ml" : {  
    "top_classes" : [  
        {  
            "class_probability" : 0  
                .6113160839068559,  
            "class_name" : "true"  
        },  
        {  
            "class_probability" : 0  
                .3886839160931441,  
            "class_name" : "false"  
        }  
    ],  
    "FlightDelay_prediction" : "true",  
    "is_training" : true  
}
```



3. Evaluate your model



See result

POST _ml/data_frame/_evaluate

```
"classification" : {
    "multiclass_confusion_matrix" : {
        "confusion_matrix" : [
            {
                "actual_class" : "false",
                "actual_class_doc_count" : 8822,
                "predicted_classes" : [
                    {
                        "predicted_class" : "false",
                        "count" : 7660
                    },
                    {
                        "predicted_class" : "true",
                        "count" : 1162
                    }
                ],
                "other_predicted_class_doc_count" : 0
            },
            ...
        ]
    }
}
```



Continuous Improvement



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Experiment features in ES !!



Limitation of data frame

Cross cluster search is not supported

Delete data frame job does not delete index !!

Data frame can't be updated

Memory limitation

Missing fields are skipped

https://www.elastic.co/guide/en/elasticsearch/_search/7.5/ml-dfa-limitations.html



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