Hazelcast

The Hitchhiker's Guide

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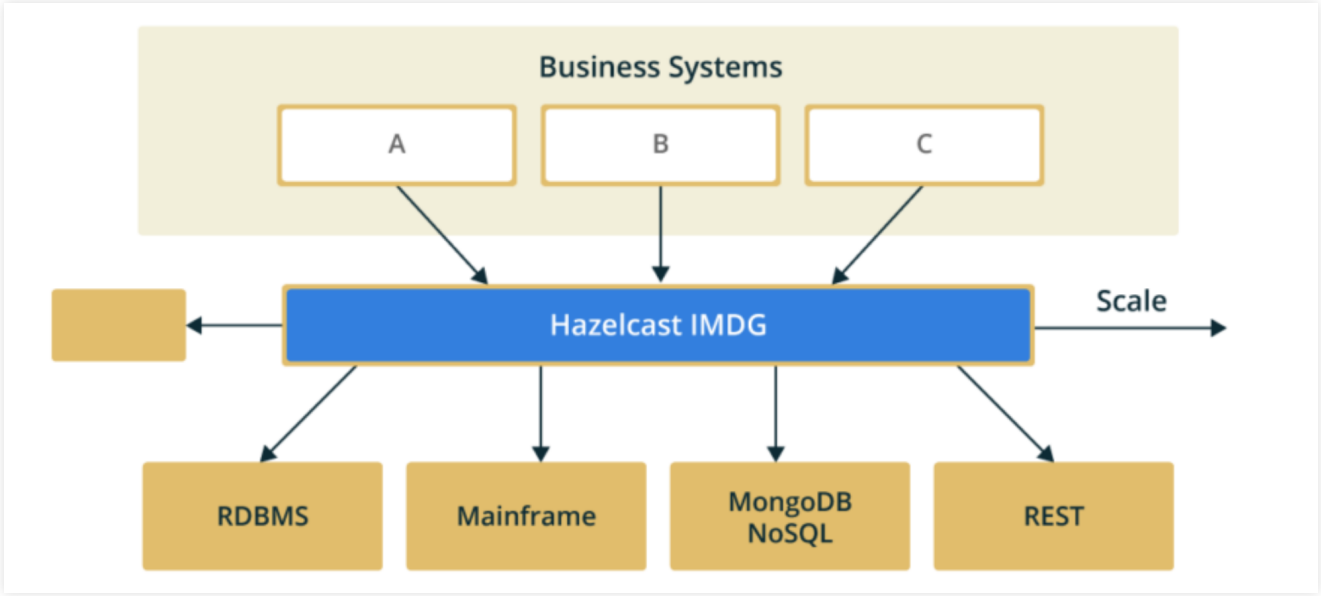
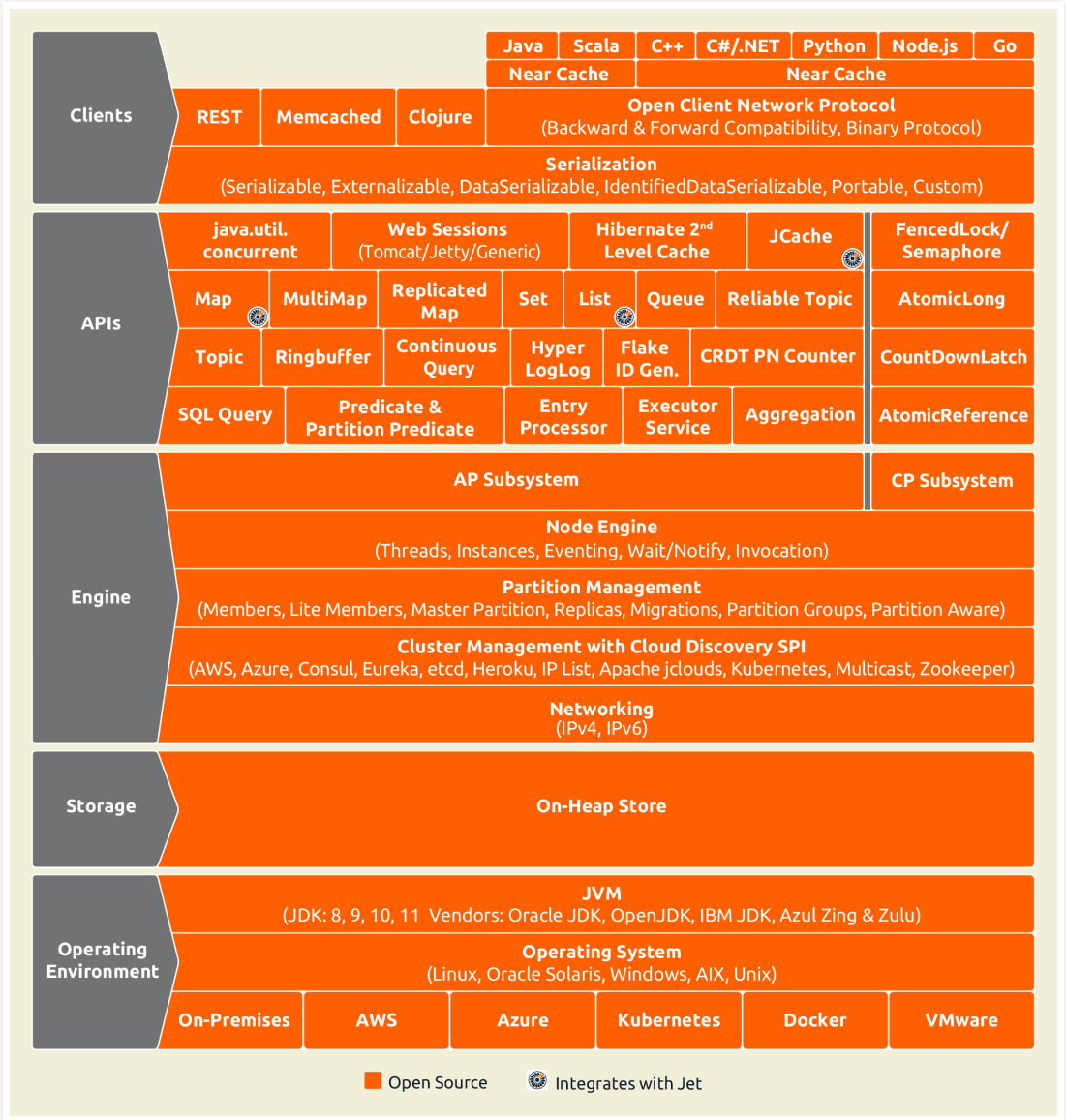
hazelcast®

Born in 2008 in Turkey as a simple caching solution...



source: Hazelcast

The Hazelcast IMDG is an operational in-memory computing platform that manages data and distributes processing using memory and parallel execution for breakthrough application speed and scale.



source: Hazelcast

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IMDG

In-Memory Data Grid

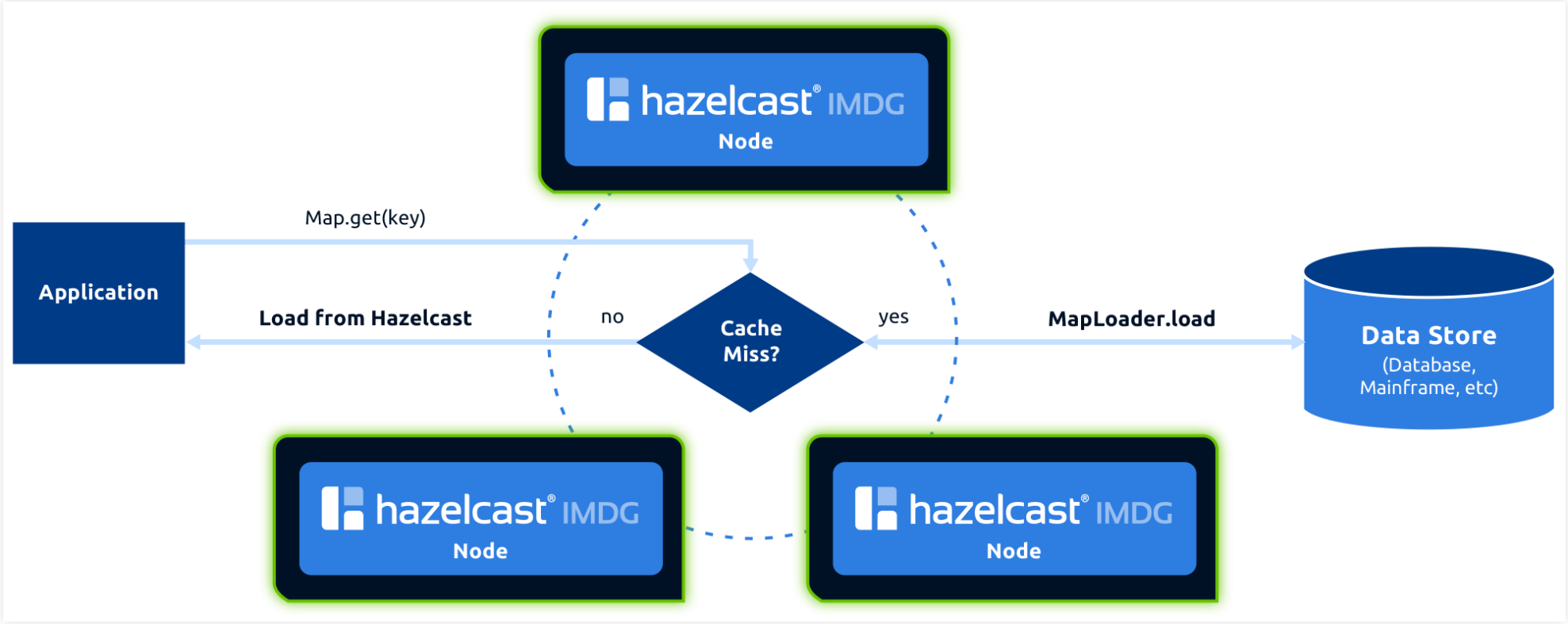
- In-Memory (no persistence)
  - Storage/Computation
- Multiple processes working as a group

- Embedded
- Client-Server

Cache Access Patterns

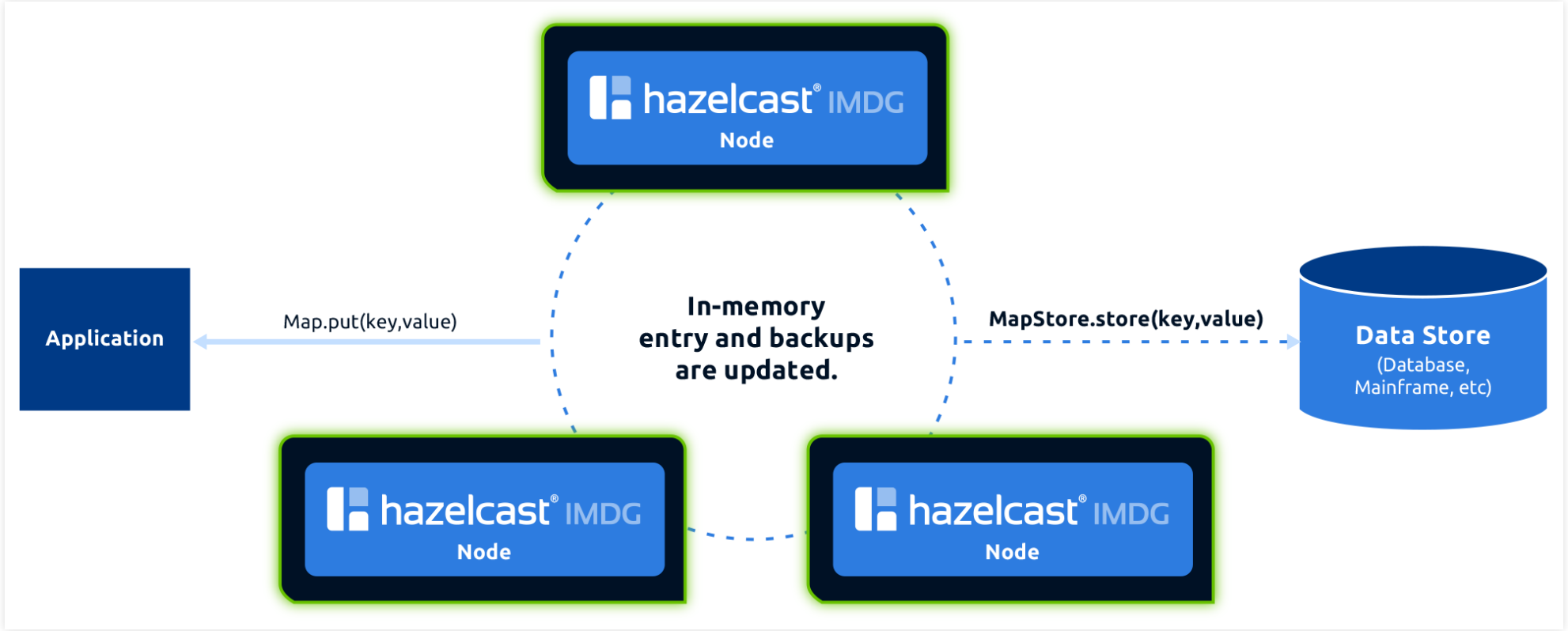
- Read-through
- Write-through
- Write-behind
- Near Cache

Read-through



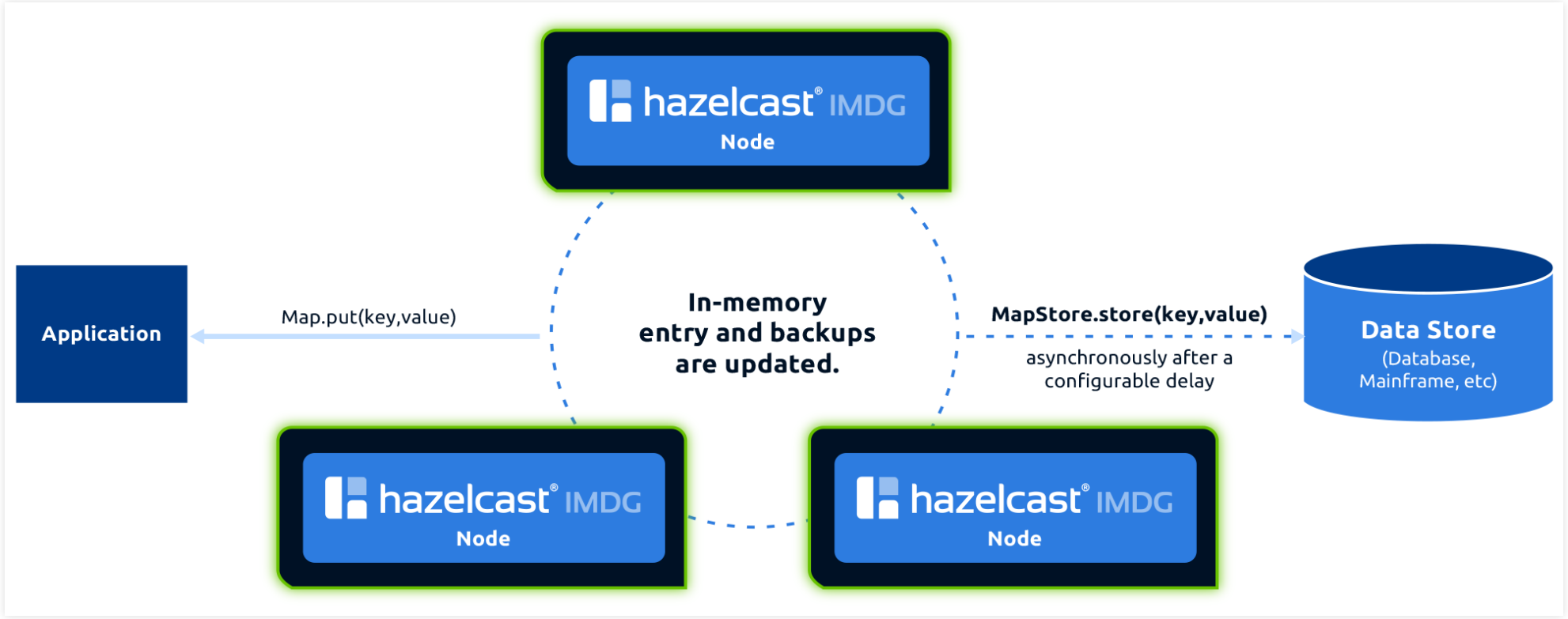
source: Hazelcast

Write-through



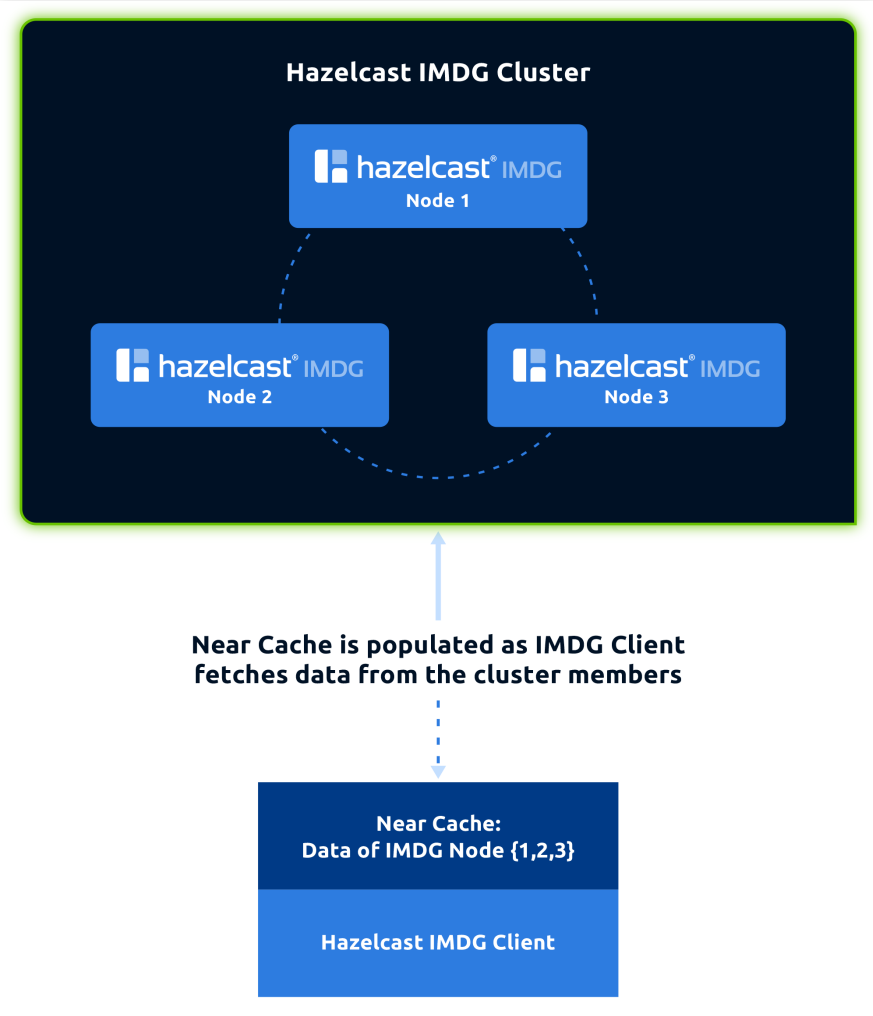
source: Hazelcast

Write-behind



source: Hazelcast

Near Cache



source: Hazelcast

```
<dependencies>
    <dependency>
        <groupid>com.hazelcast</groupid>
        <artifactid>hazelcast</artifactid>
        <version>4.1</version>
    </dependency>
</dependencies>
```

Shaded

Embedded

```
HazelcastInstance hazelcastInstance = Hazelcast.newHazelcastInstance();
```

Client-Server

```
HazelcastInstance hazelcastInstance = HazelcastClient.newHazelcastClient();
```

Clients

Binary Client Protocol

Java

Scala

C++

C#/.NET

Python

Node.js

Go

Rust (work-in-progress)

```
// import com.hazelcast.map.IMap;

HazelcastInstance hazelcastInstance = Hazelcast.newHazelcastInstance();

IMap<String, Integer> simpleMap = hazelcastInstance.getMap("simpleMap");

simpleMap.put("foo", 42);

simpleMap.get("foo"); // 42
```

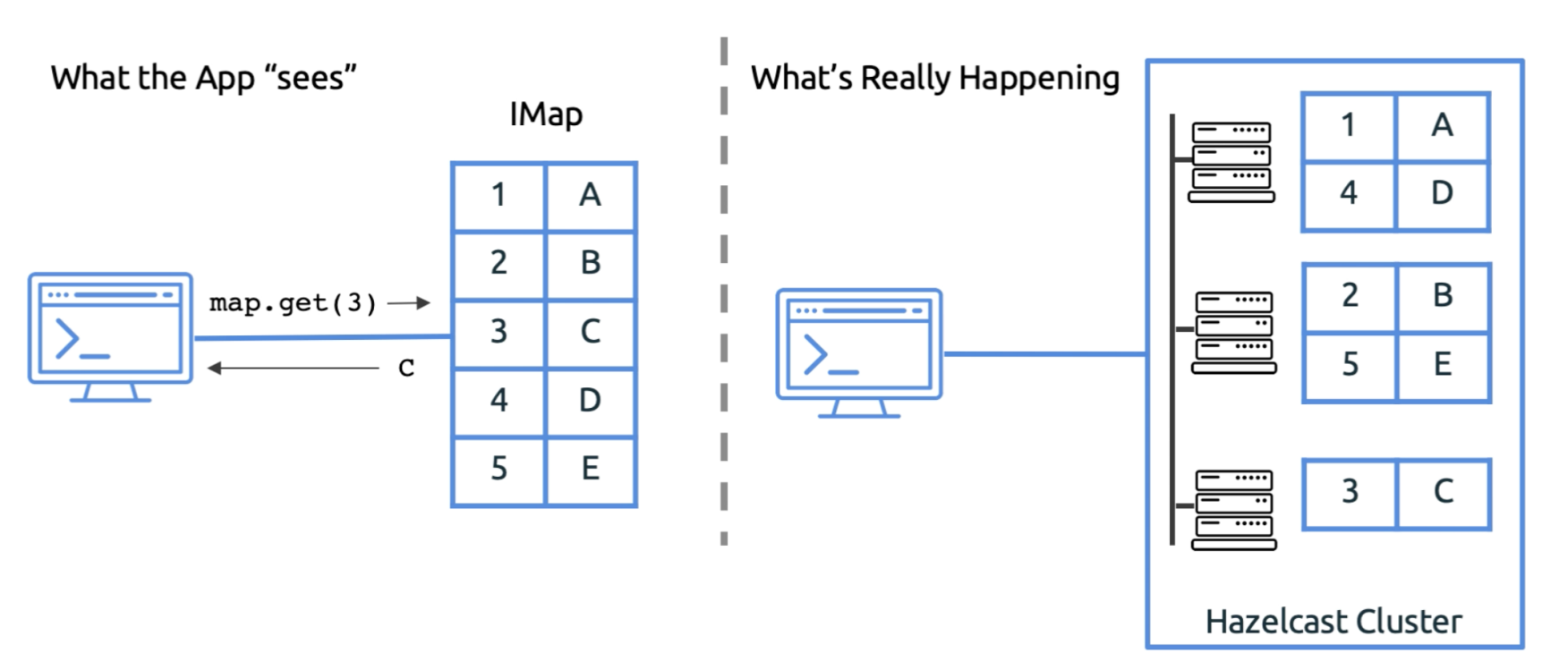
```
// import java.util.Map;

HazelcastInstance hazelcastInstance = Hazelcast.newHazelcastInstance();

Map<String, Integer> simpleMap = hazelcastInstance.getMap("simpleMap");

simpleMap.put("foo", 42);

simpleMap.get("foo"); // 42
```



source: Hazelcast

Map is just the beginning

- MultiMap
- ReplicatedMap (non-partitioned Map)
- Set
- List

- Queue
- Topic

Data Structures is just the beginning

EntryProcessor

Instead of fetching the data, processing it and sending it back, let a cluster process it. A processed entry remains locked during processing

```
@BinaryInterface
@FunctionalInterface
public interface EntryProcessor<K, V, R> extends Serializable {
    R process(Entry<K, V> entry);
}
```

ExecutorService

```
public interface IExecutorService
  extends ExecutorService, DistributedObject {
    void execute(Runnable command, MemberSelector memberSelector);
    void executeOnAllMembers(Runnable command);
    // ...
}
```

Aggregation

```
IMap<String, Employee> employees = hz.getMap("employees");

double avgSalary = employees.aggregate(
  new Aggregator<Map.Entry<String, Employee>, Double>() {

    protected long sum;
    protected long count;

    @Override
    public void accumulate(Map.Entry<String, Employee> entry) {
        count++;
        sum += entry.getValue().getSalaryPerMonth();
    }

    // ...
 });
```

Queries

```
IMap<String, Employee> map = hazelcastInstance.getMap("employee");

Set<Employee> employees = map.values(new SqlPredicate("active AND age < 30"));
```

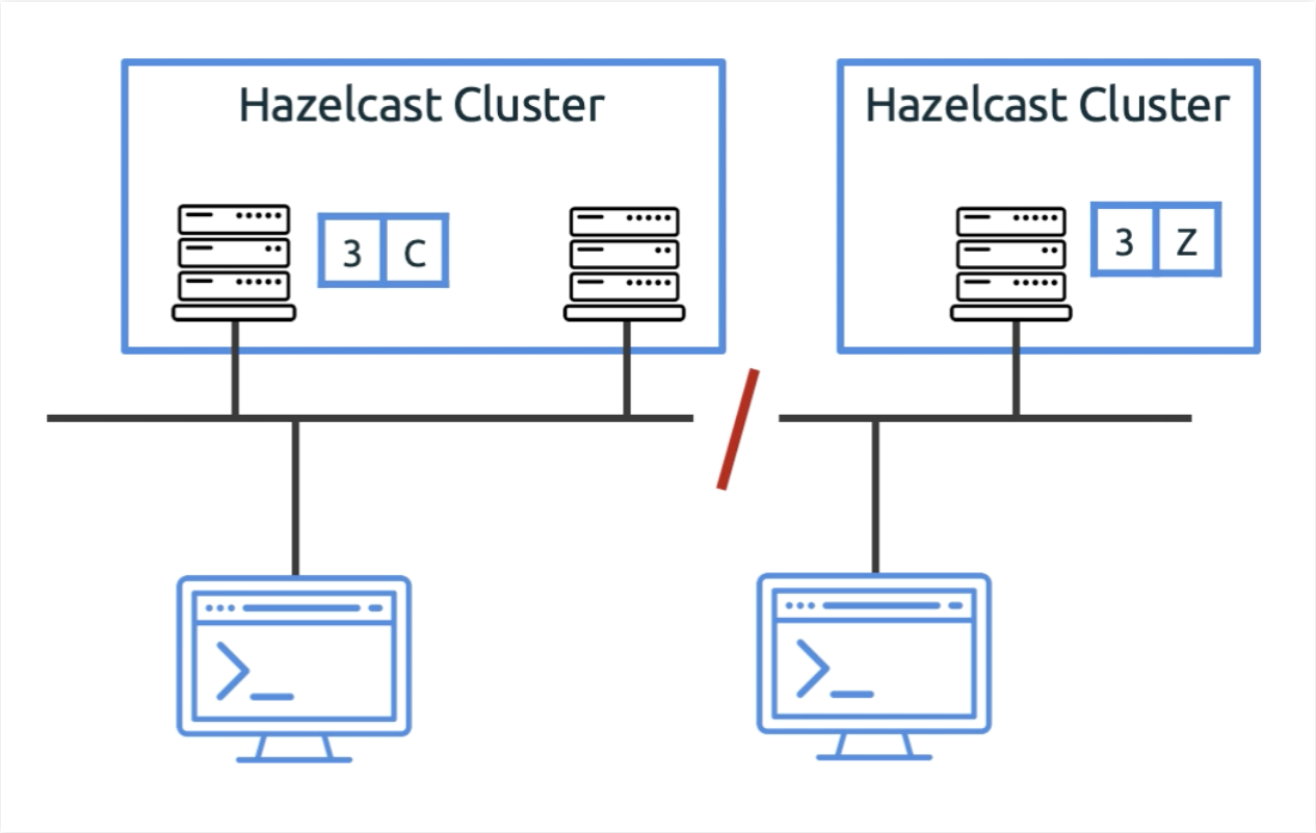
CAP Theorem

Consistency

Availability

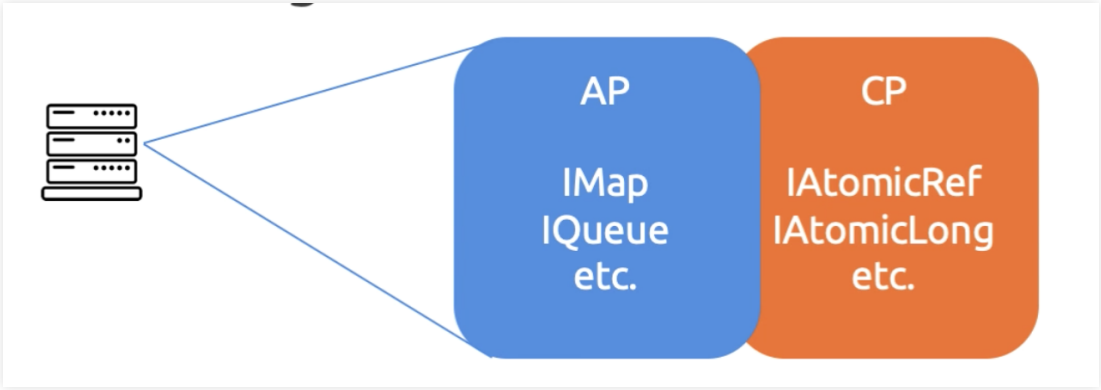
Partition Tolerance

Pick two.



source: Hazelcast

CP Subsystem



source: Hazelcast

- Linearizable, distributed implementations of Java concurrency primitives
- Raft-based(http://thesecretlivesofdata.com/raft/)
- Jepsen-verified
- Requires minimum 3 members

- Semaphore
- CountDownLatch
- AtomicReference
- AtomicLong

Advanced Data Structures

RingBuffer

A fixed-capacity data structure that overwrites oldest elements when capacity is exceeded

HyperLogLog

A probabilistic data structure used to estimate the cardinality(number of unique elements) of a data set.

The HyperLogLog algorithm can estimate cardinalities well beyond 10^9 with a relative accuracy (standard error) of 2% while only using 1.5kb of memory.
Fangjin Yang Fast, Cheap, and 98% Right: Cardinality Estimation for Big Data

Flake Id Generator

Cluster-wide ordered and unique identifiers IDs without any coordination between members
safe even in split-brain scenario

CRDT PN Counter

A conflict-free alternative to AtomicLong

Other Integrations

Hibernate 2LC

Hazelcast provides a distributed second level cache for your Hibernate entities, collections and queries.

http://github.com/hazelcast/hazelcast-hibernate5/

Spring Data

Spring Data Hazelcast Integration

https://github.com/hazelcast/spring-data-hazelcast

Quarkus Hazelcast Client

https://github.com/hazelcast/quarkus-hazelcast-client

Tomcat Session Manager

Each HttpSession object is kept in the Hazelcast Map

https://github.com/hazelcast/hazelcast-tomcat-sessionmanager

Apache Shiro

Apache Shiro is a security framework that performs authentication, authorization, cryptography, and session management. Shiro uses Hazelcast for caching and session clustering.

Envoy Proxy

Envoy is an open source edge and service proxy, designed for cloud-native applications.

https://github.com/envoyproxy/envoy/pull/10536

Cloud Integrations

Zone-awareness + autodiscovery

- AWS
- GCP
- Azure

Hazelcast Cloud

Hazelcast IMDG cluster as a service

https://cloud.hazelcast.com

Enterprise Features

- Management Center
  - Security Suite
- Disaster Recovery
- WAN Replication
- Rolling Upgrades
- HD Memory

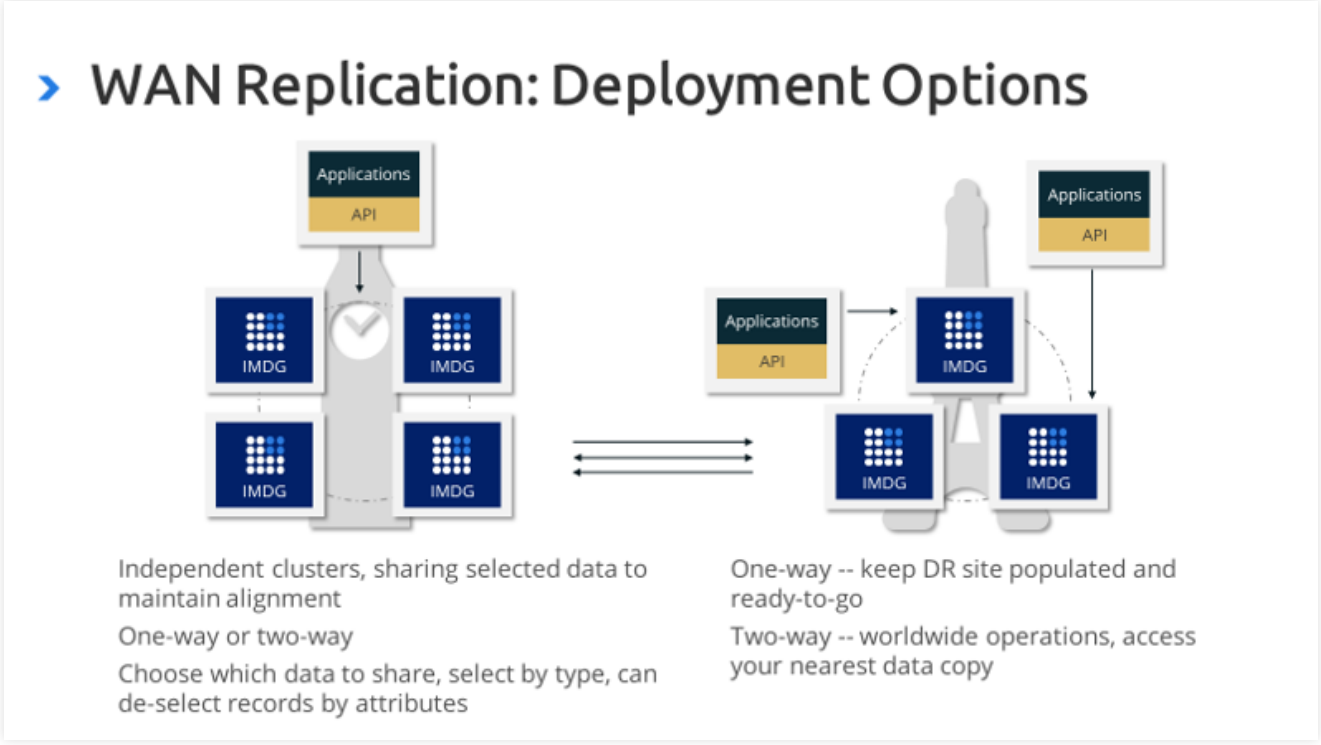
Disaster Recovery

Automatic Disaster Recovery Failover

Automatic disaster recovery fail-over provides clients connected to Hazelcast® Enterprise IMDG clusters with the ability to automatically fail-over to a Disaster Recovery cluster should there be an unplanned outage of the primary production Hazelcast cluster.

source: Hazelcast

WAN Replication



source: Hazelcast

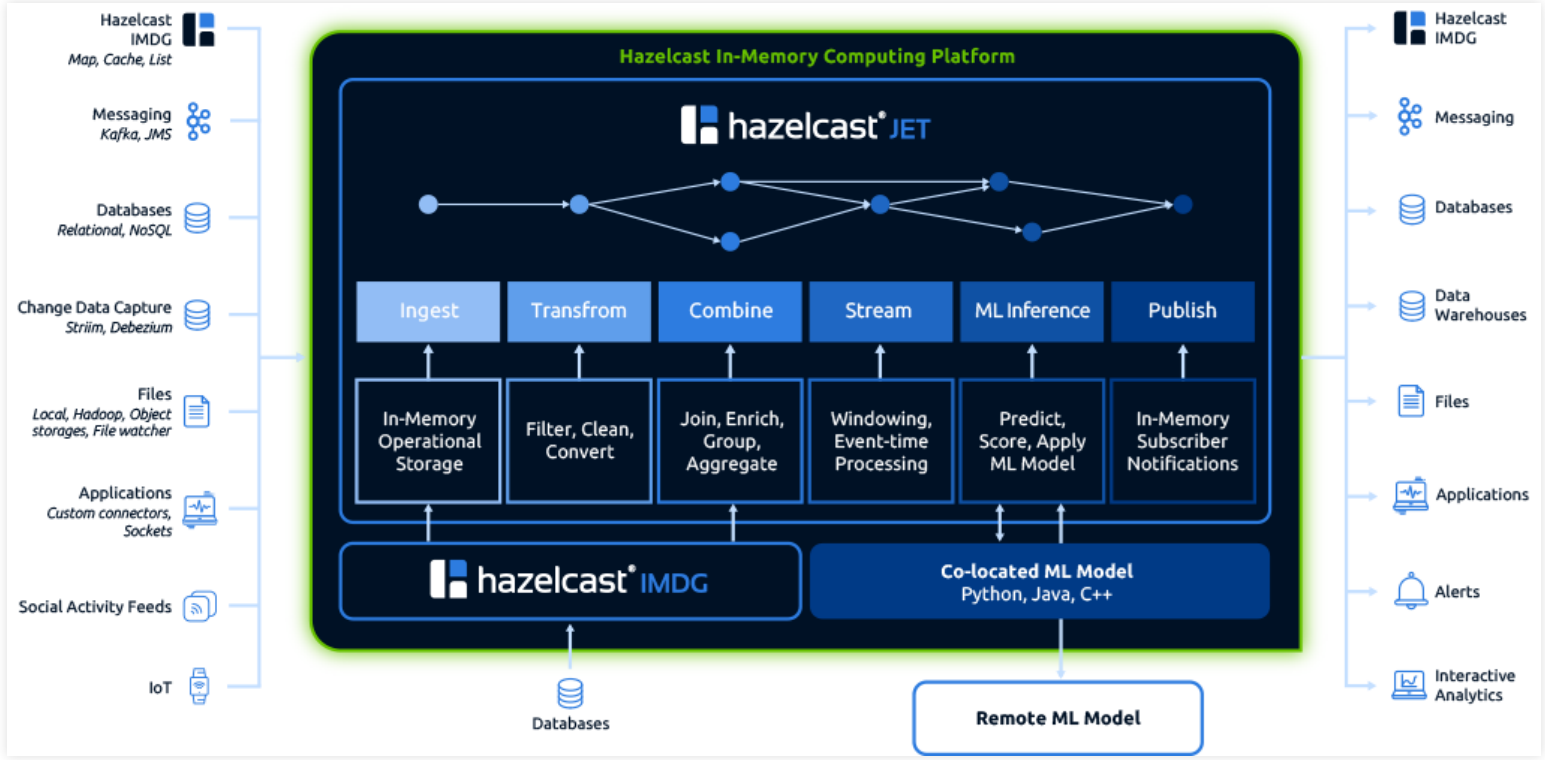
HD Memory(off-heap store)

Hot Restart Store

Future


Vladimir Ozerov
@devozerov
I am excited to announce that after many months of research and prototyping, we have started working on the implementation of the SQL engine for Hazelcast IMDG! Major step forward. We'll start sharing technical details with the community in the nearest time. Stay tuned!
9:56 AM · Mar 12, 2020 · Twitter Web App

Hazelcast Jet



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```
private static Pipeline buildPipeline() {
    Pipeline p = Pipeline.create();
    p.readFrom(TestSources.itemStream(100, (ts, seq) -> nextRandomNumber()))
      .withIngestionTimestamps()
      .window(WindowDefinition.tumbling(1000))
      .aggregate(AggregateOperations.topN(TOP, ComparatorEx.comparingLong(l -> l)))
      .map(WindowResult::result)
      .writeTo(Sinks.observable(RESULTS));
    return p;
}
```

Hazelcast Jet Design Documents

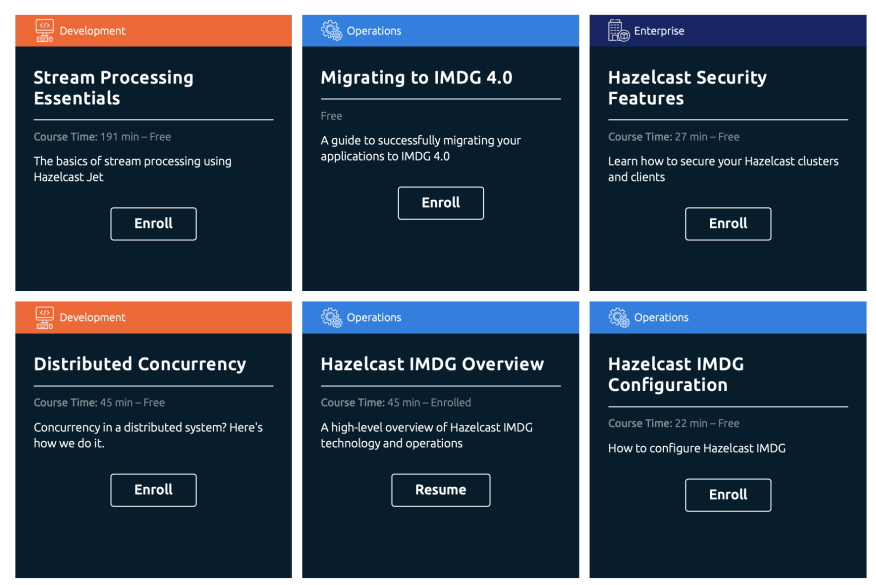
https://jet-start.sh/docs/design-docs/

Hazelcast Jet Architecture

https://jet-start.sh/docs/architecture/distributed-computing

Tutorials

https://training.hazelcast.com



Want to contribute but don't know where/how to start?

@jholusa

Thank You!

https://pivovarit.github.io/talks/hazelcast

Twitter: @pivovarit