POLITECNICO DI MILANO

Scuola di Ingegneria Industriale e dell'Informazione

Corso di Laurea Magistrale in Ingegneria Informatica

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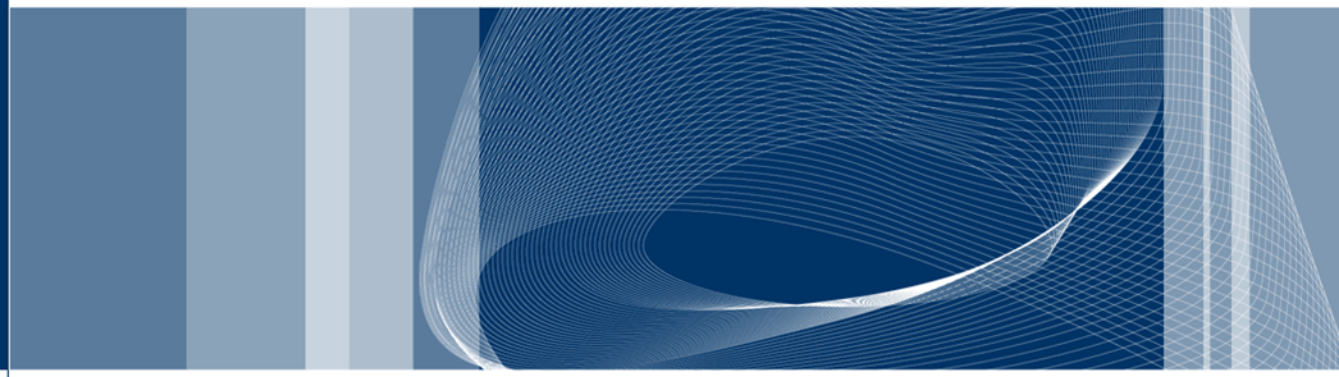

Avoiding CRUD operations lock-in in NoSQL databases: extension of the CPIM library

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Data management systems

RDBMS

Well structured data

Relational model

Vertical scaling

ACID transactions

SQL

NoSQL

Non-structured data

Various data models

Horizontal scaling

BASE properties

Proprietary API

NoSQL Common language approaches

Meta-model

- Apache MetaModel
- SOS platform

SQLification

- Apache Phoenix
- UnQL
- Native support

ORM

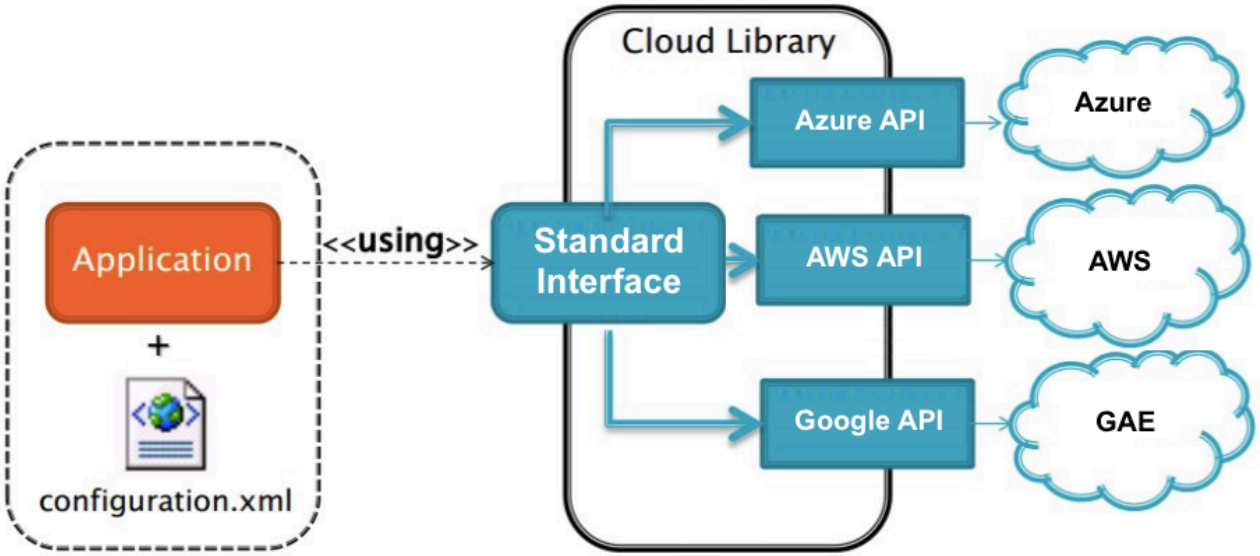
- Kundera
- PlayORM
- Spring-data
- Apache Gora

Cloud Platform Independent Model

Abstract application logic from the specific PaaS Provider to overcome the vendor lock-in

Many supported services:

- Blob
- NoSQL
- Memcache
- Queue
- Mail
- SQL



Work objectives

Integrate Kundera in the CPIM library

Contribute to the open source project Kundera

Integrate the migration and synchronization system Hegira

Evaluation

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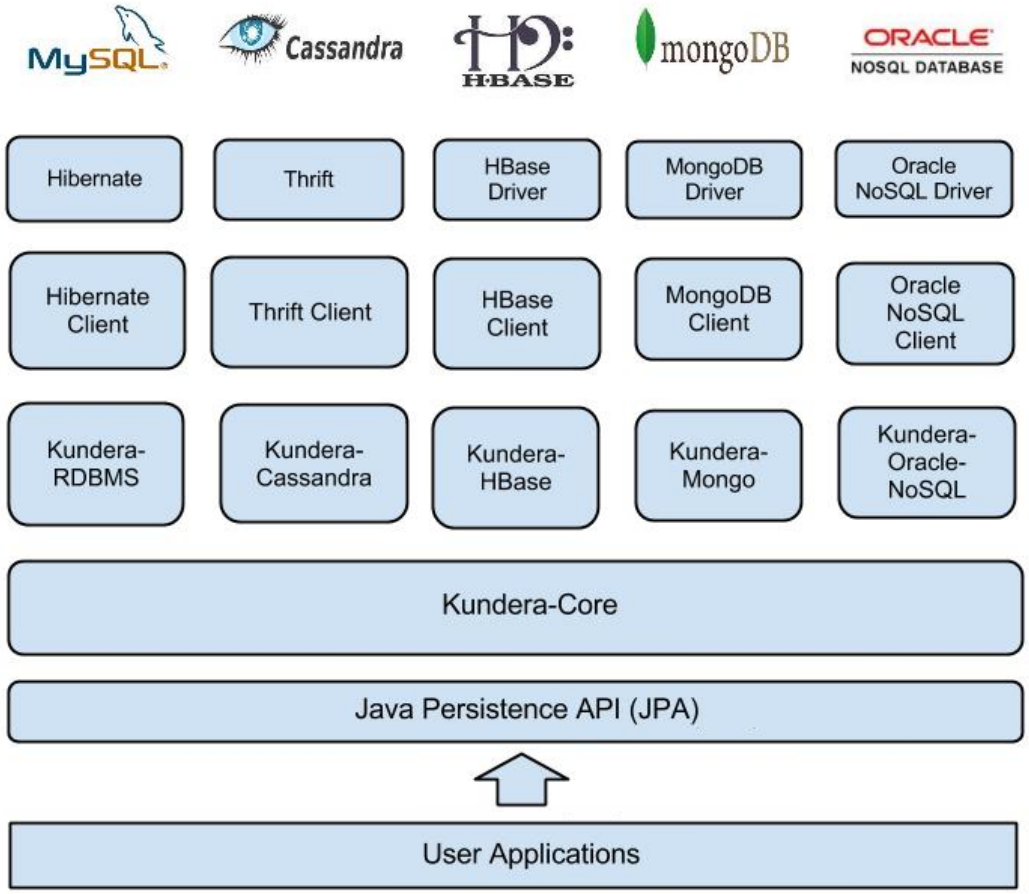
Kundera

A JPA 2.1 ORM Library for NoSQL databases

- ORM operation (through *EntityManager* interface)
- JPQL queries (DELETE and UPDATE)

On-premises databases:

- Cassandra
- HBase
- MongoDB
- Oracle NoSQL
- Redis
- Neo4j
- Couchdb
- Elastic Search
- MySQL

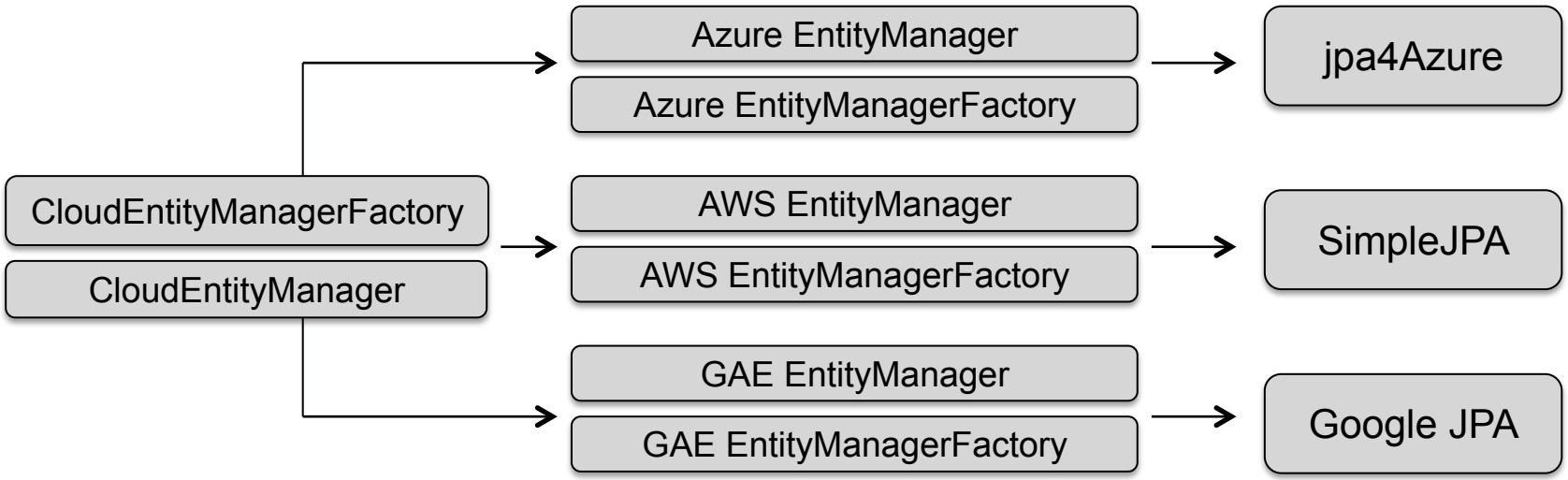


Why Kundera

- Open source
- Developed with extensibility as primary goal
- Support to many different NoSQL databases
- Polyglot persistency
- In the field since 2010 with an active community
- Already used in production

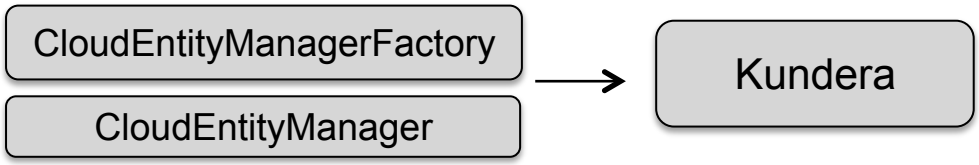
Original CPIM NoSQL service implementation

- Many JPA providers
- Duplicated code
- No complete code portability
- Choice of the NoSQL database strictly bounded to the cloud provider (e.g. App Engine → Datastore)
- Limited NoSQL databases support



Kundera integration

- Single persistence provider
- Complete code portability
- NoSQL support inherited by Kundera
- Easier Configuration through standard persistence.xml



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Contributions to Kundera

Open Two newly developed clients

- Azure Tables[1]
- GAE Datastore[2]

Paradigm shift

- Off-premises databases → DaaS solutions
- Merged Bug fix Kundera deploy on PaaS

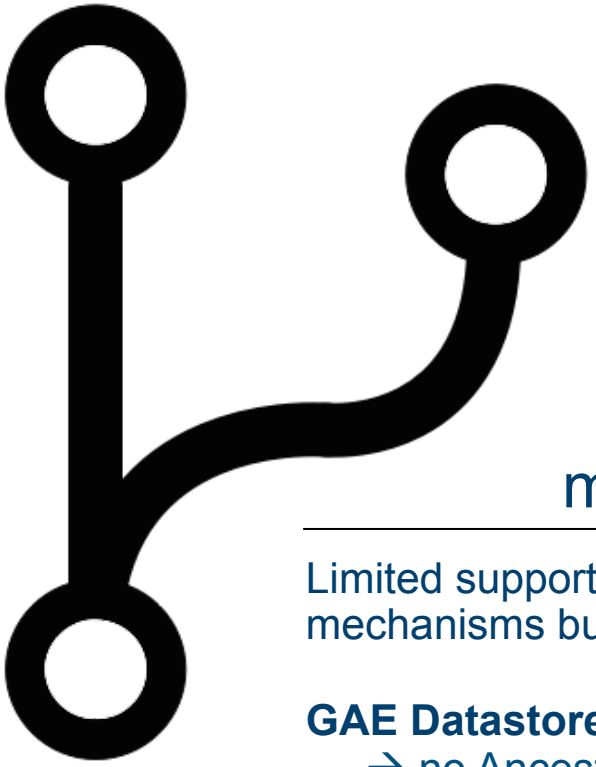
1: https://github.com/deib-polimi/kundera-azure-table
2: https://github.com/deib-polimi/kundera-gae-datastore

Developed clients

master

Exploit consistency mechanisms as much as possible

GAE Datastore
→ no Ancestor Path support
Azure Tables
→ manage partition key and row key



migration

Limited support to consistency mechanisms but achieve interoperability

GAE Datastore
→ no Ancestor Path support
Azure Tables
→ fix partition key to table name

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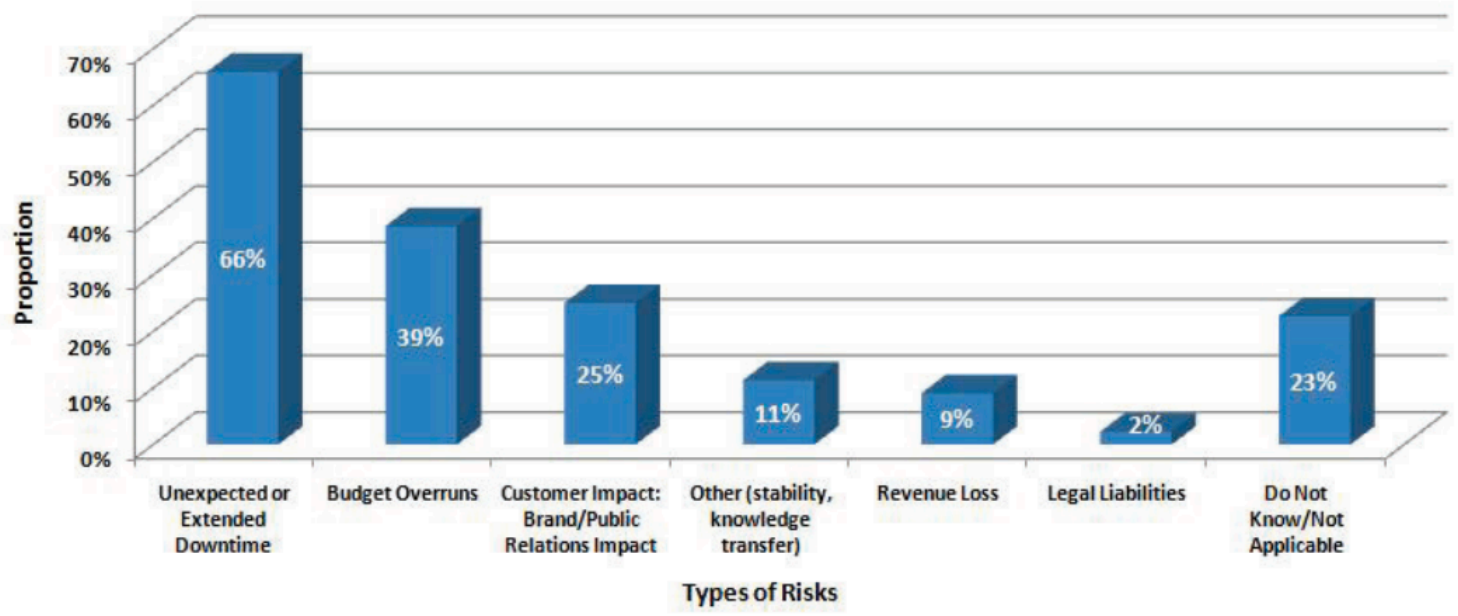
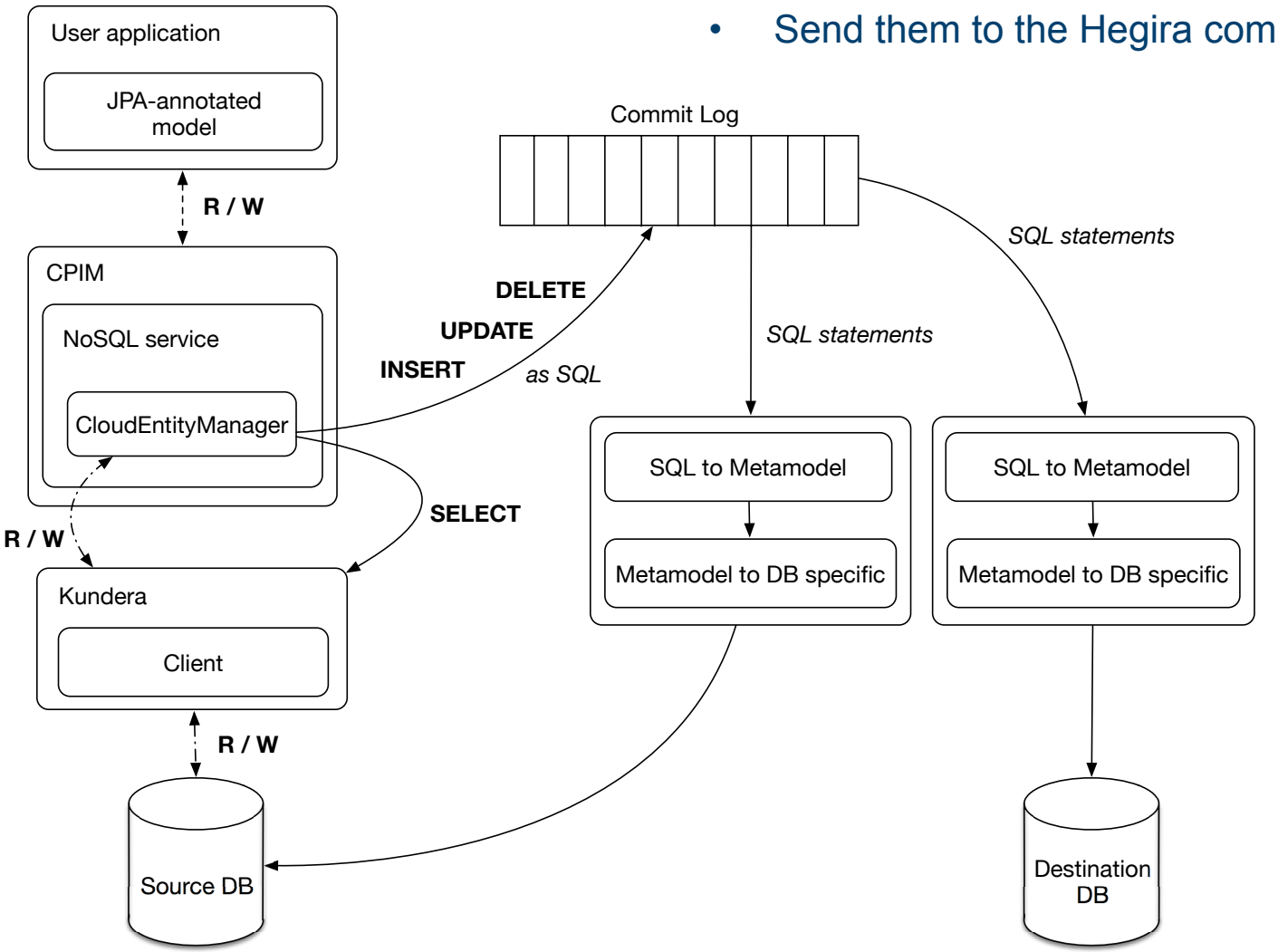
Data migration

- move application to another cloud provider
- move data to a database that better fit requirements
- load balancing, system expansion, failure recovery, costs, etc.
- modern computer systems are expected to be up continuously
- data synchronization between the two involved systems



Hegira support

- Intercept transparently user operations (DMQ)
- Translate operations to SQL statements
- Send them to the Hegira commit-log



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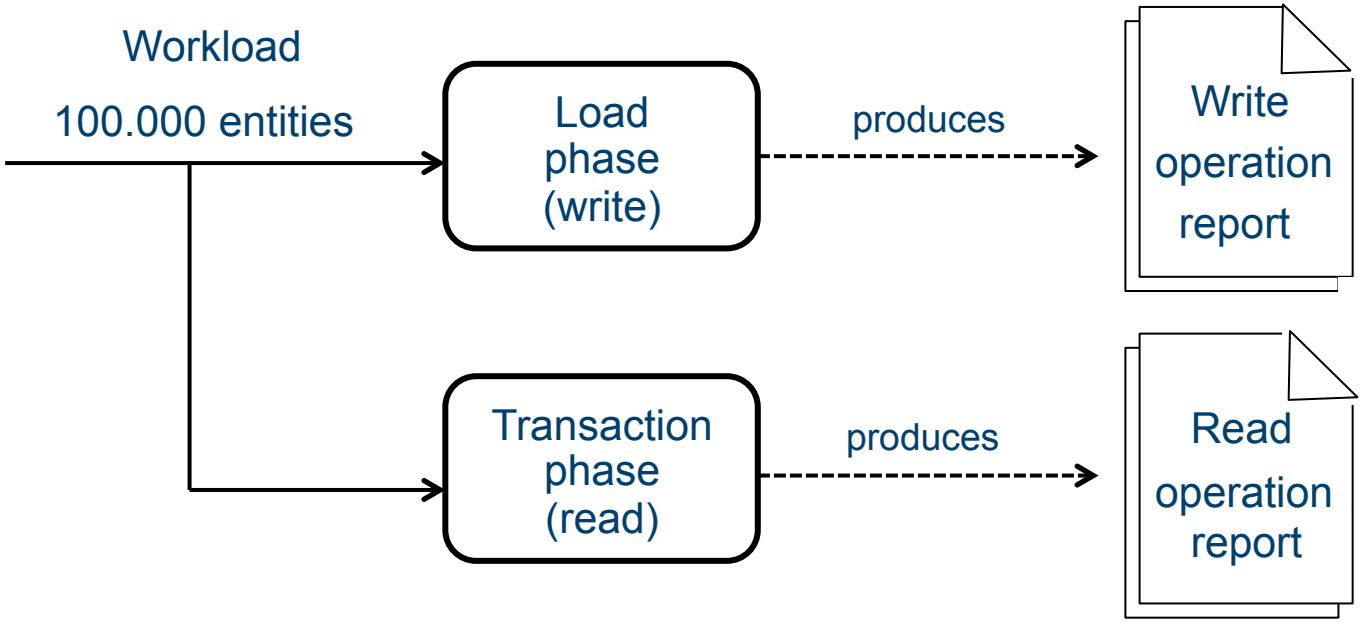
YAHOO! Cloud Serving Benchmark

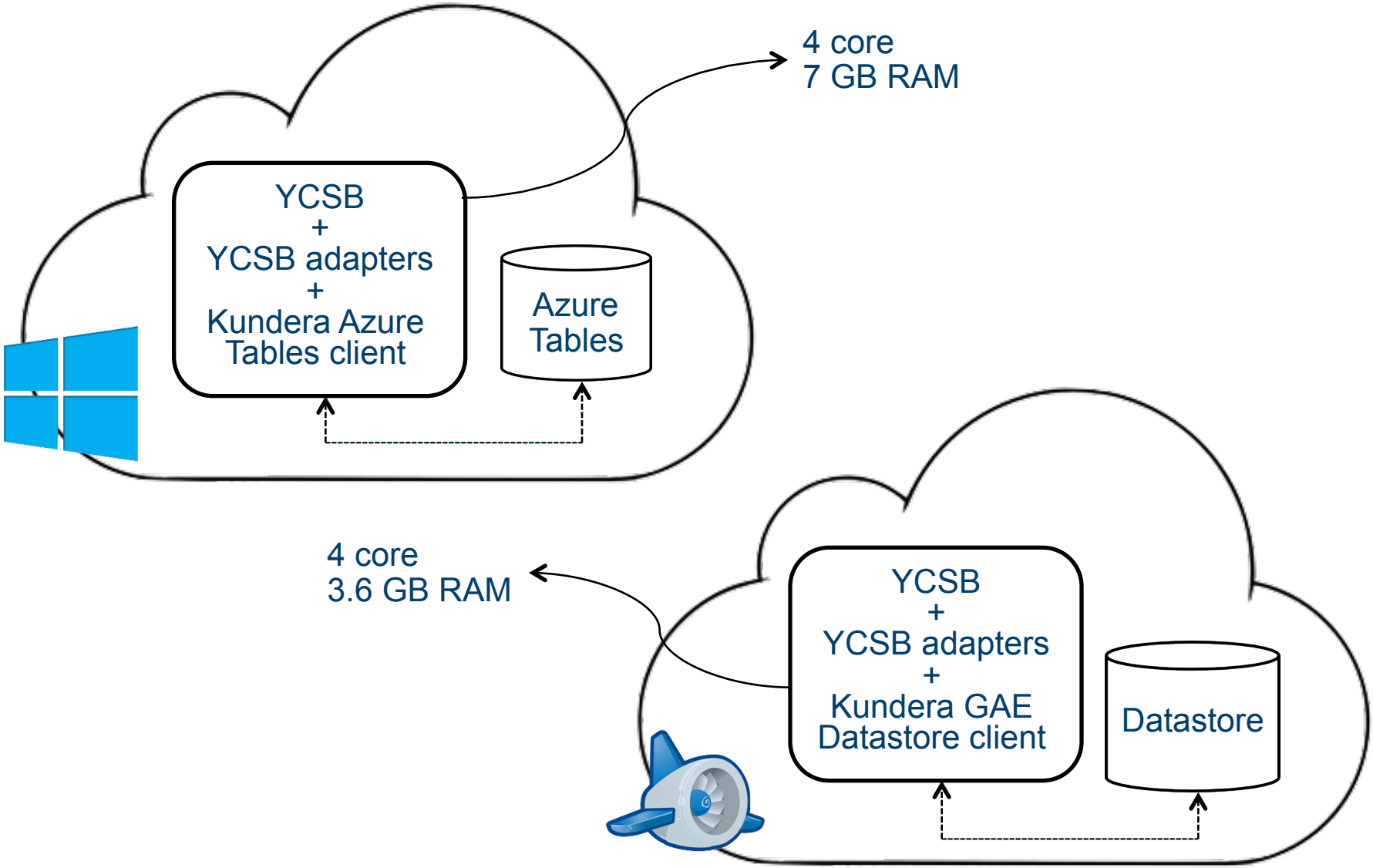
Framework for evaluating the performance of different NoSQL databases



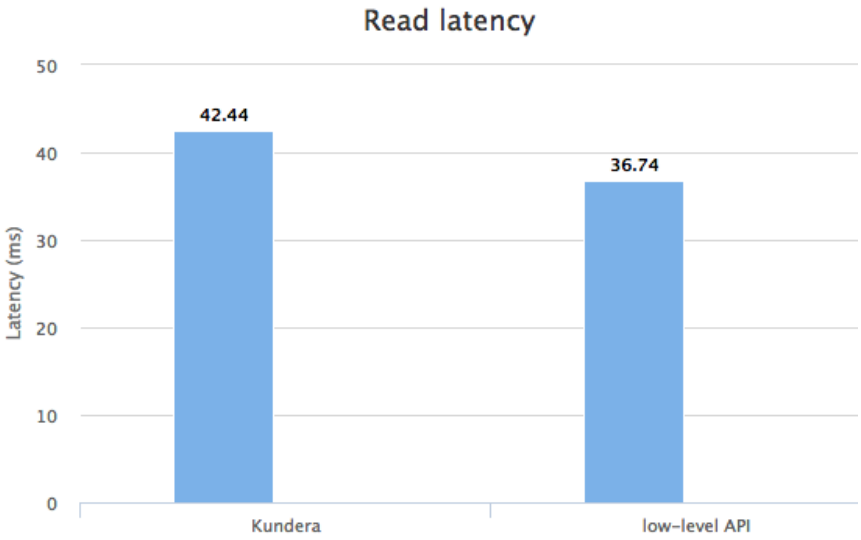
Compare Kundera client w.r.t. the use of low-level API for the same operations

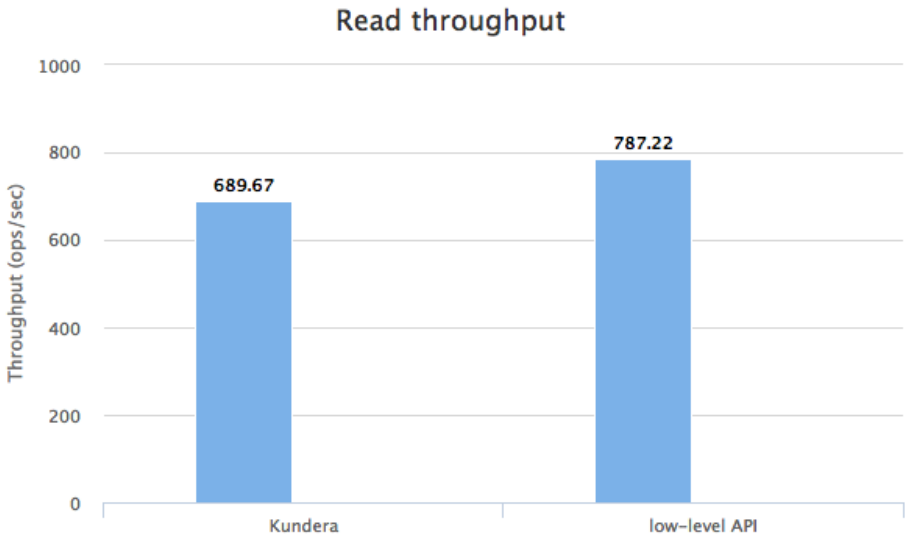
- Development of new adapter for operations through Kundera
- Development of new adapter for operations through the low-level API

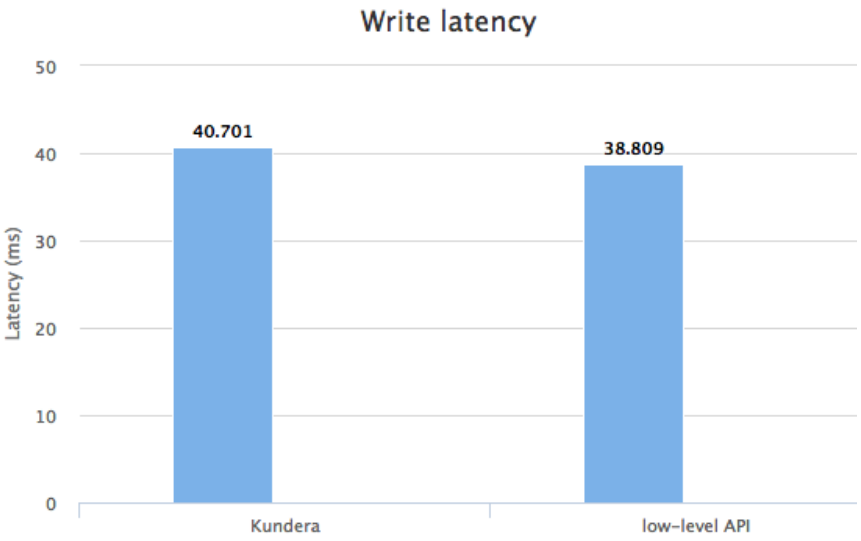
Environment setup

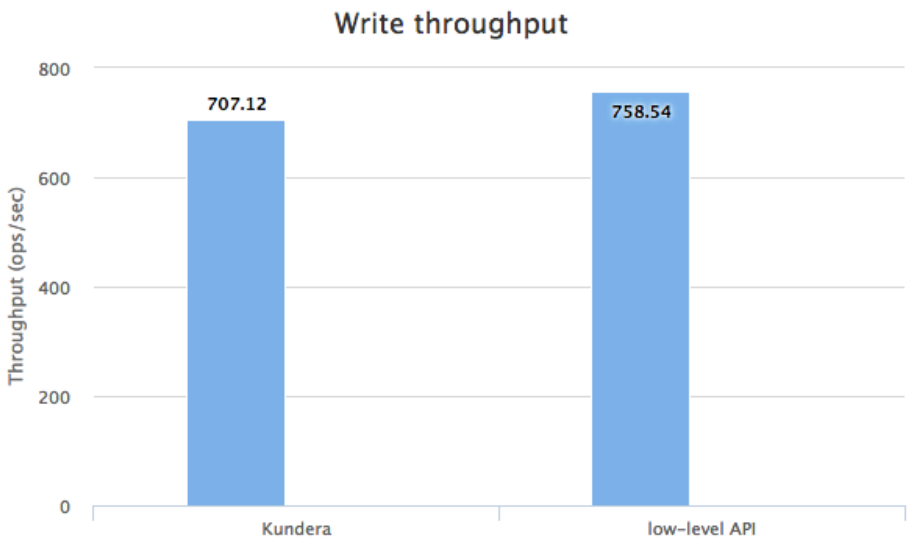


Results - Azure Tables

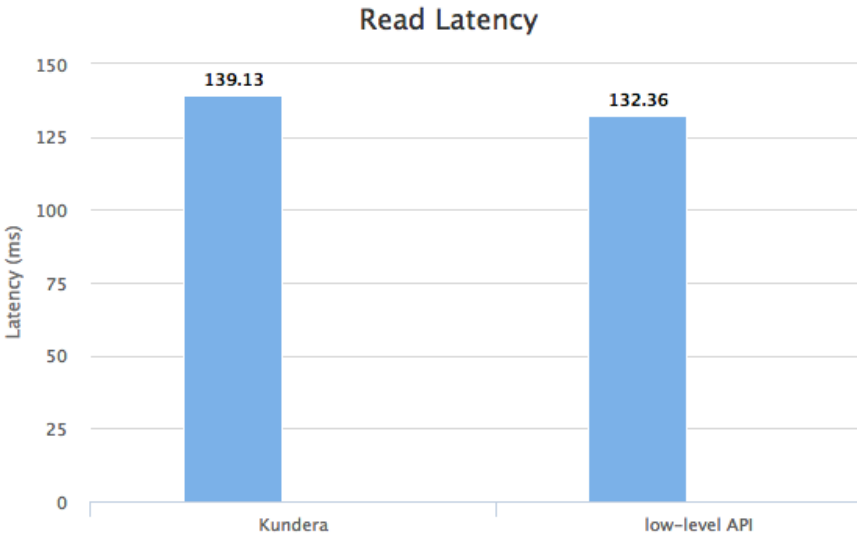


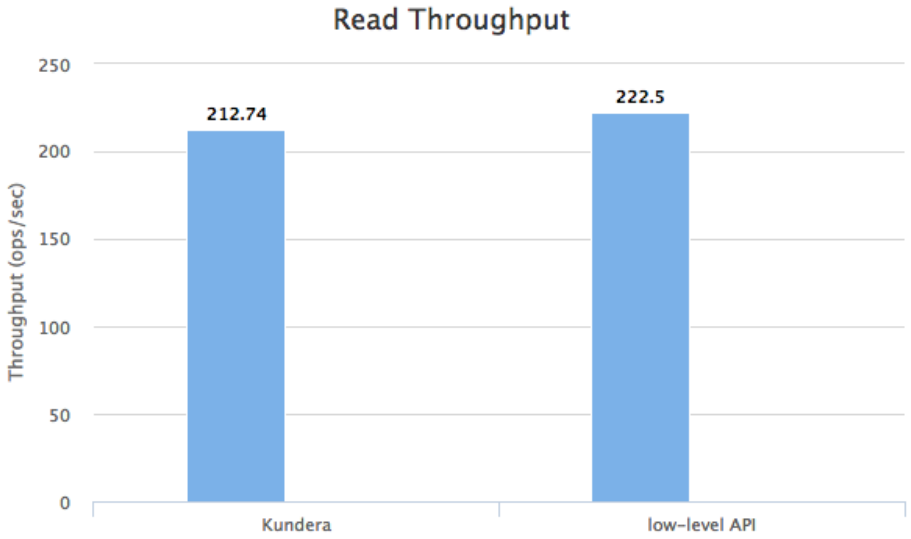


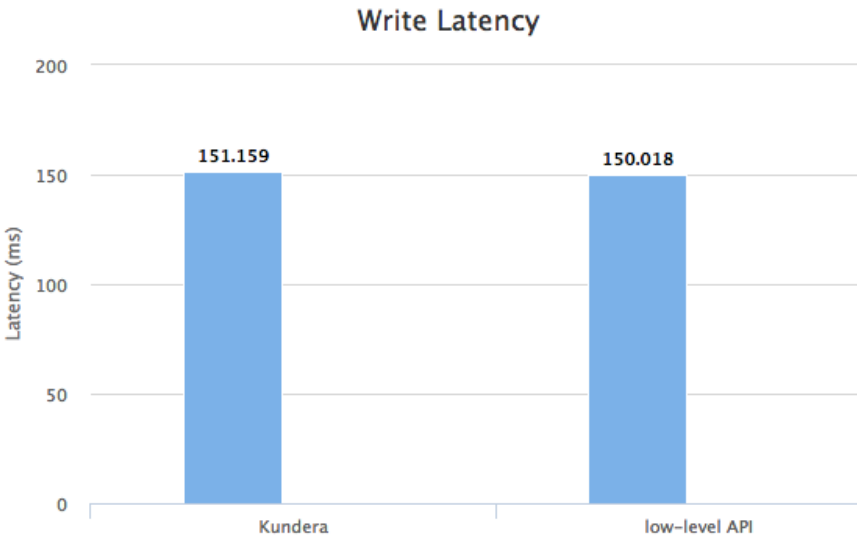


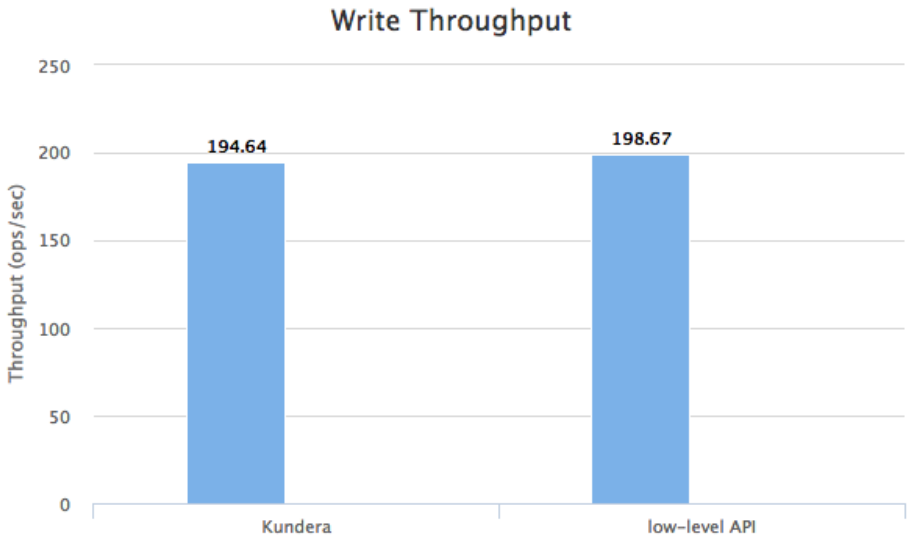


Results - GAE Datastore









Results comparison

Azure Tables

Kunedra overhead w.r.t low-level API

Read latency	Read throughput	Write latency	Write throughput
13,43 %	12,39 %	4,75 %	6,78 %

Google Datastore

Kundera overhead w.r.t low-level API

Read latency	Read throughput	Write latency	Write throughput
4,36 %	4,39 %	0,76 %	2,03 %

Conclusions

Contributions:

- Integration of Kundera in CPIM library
- New Kundera clients to support Google Datastore and Azure Tables
- Hegira integration in the CPIM library

Future work:

- Compare developed client performance with the ones of the other client developed by Kundera team

THANK YOU