# Building Consistent and Highly Available Distributed Systems with **Apache Ignite™** and **GridGain**

Valentin Kulichenko
GridGain Lead Architect
Apache Ignite PMC

Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

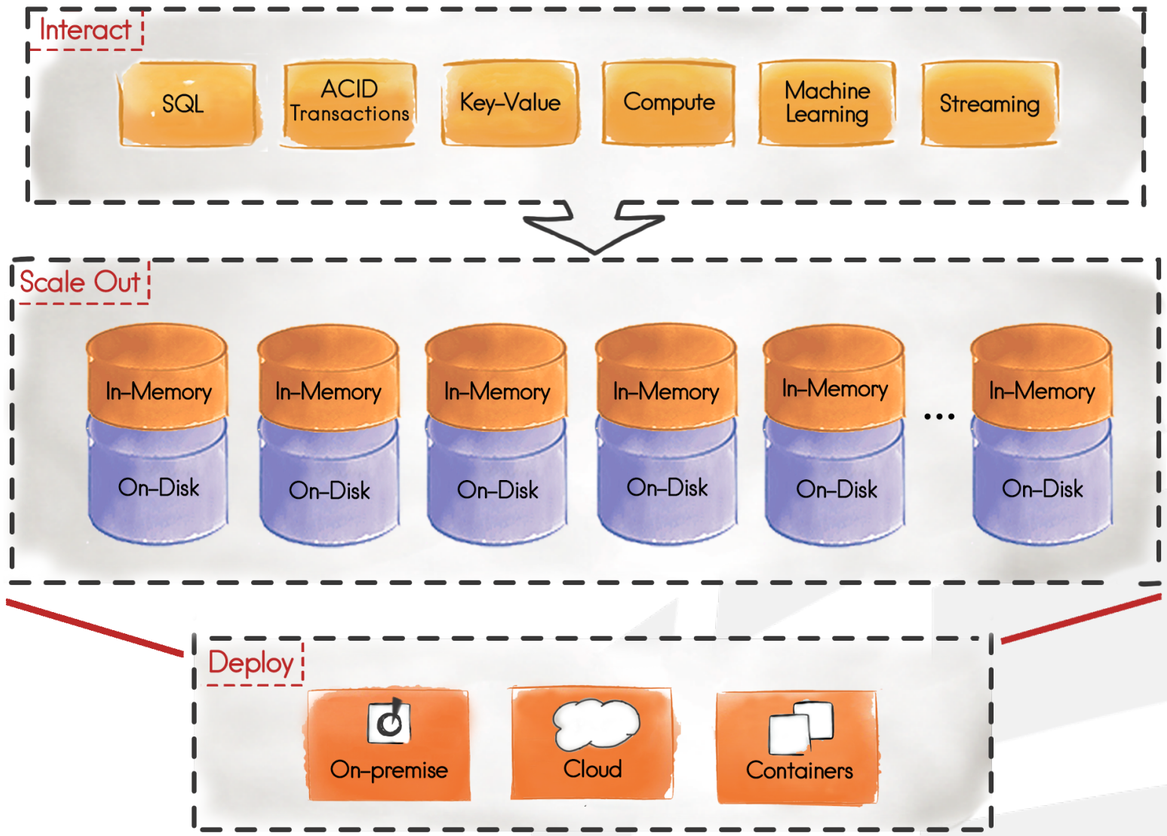
# Agenda

- What is Ignite and GridGain
- Ignite and CAP Theorem
- High Availability in Ignite
  - Cache Backups
  - Persistence
  - Data Center Replication
  - Data Snapshots (+ Demo)
- Q&A

Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# What is Ignite?

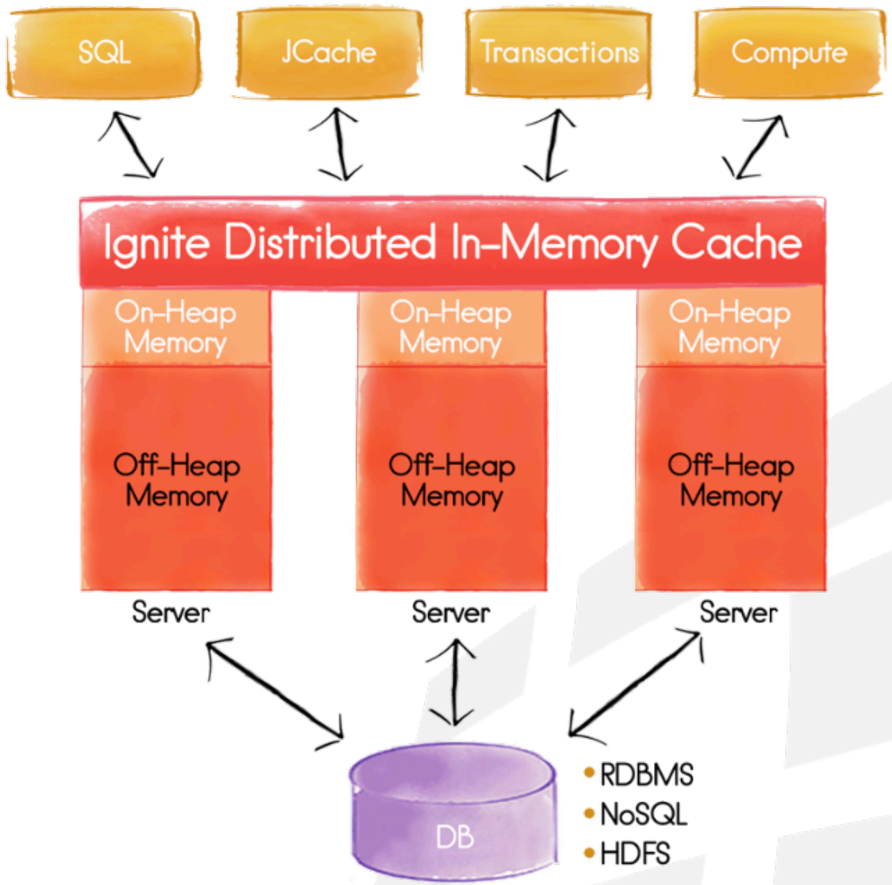
- A **memory-centric** data platform
- that is **strongly consistent**
- and **highly available**
- with powerful **SQL**,
- **key-value** and **processing** APIs




Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# Key-Value Data Grid

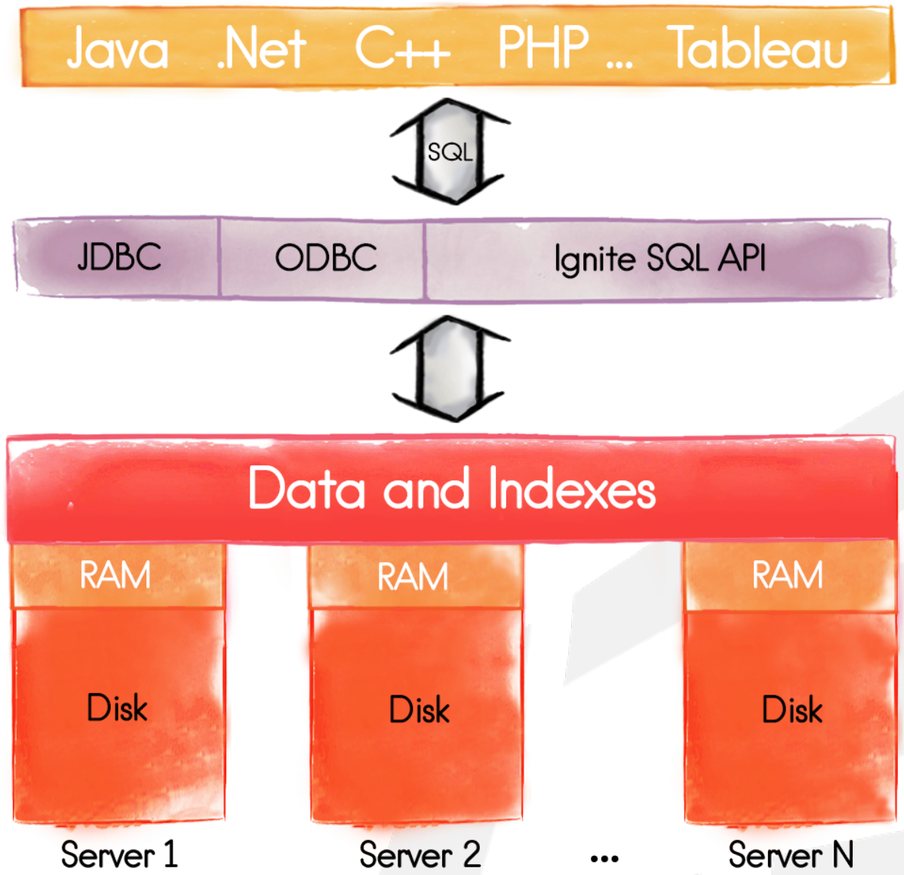
- In-Memory Key-Value Store
- ACID Compliant
- Collocated Processing
- Persistence
  - Native Ignite persistence
  - Pluggable 3rd party persistence
- Usage
  - Database Caching
  - Web Session Clustering




Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# Distributed SQL Database

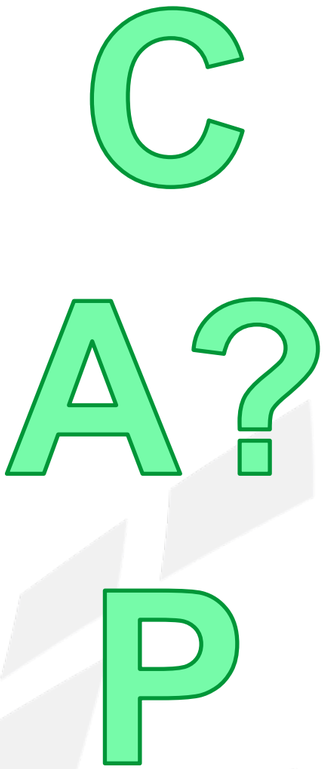
- Both In-Memory and On-Disk
- Full SQL Support
  - SELECT, UPDATE, DELETE, INSERT
- Data Definition Language
  - Configure schema and caches




Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

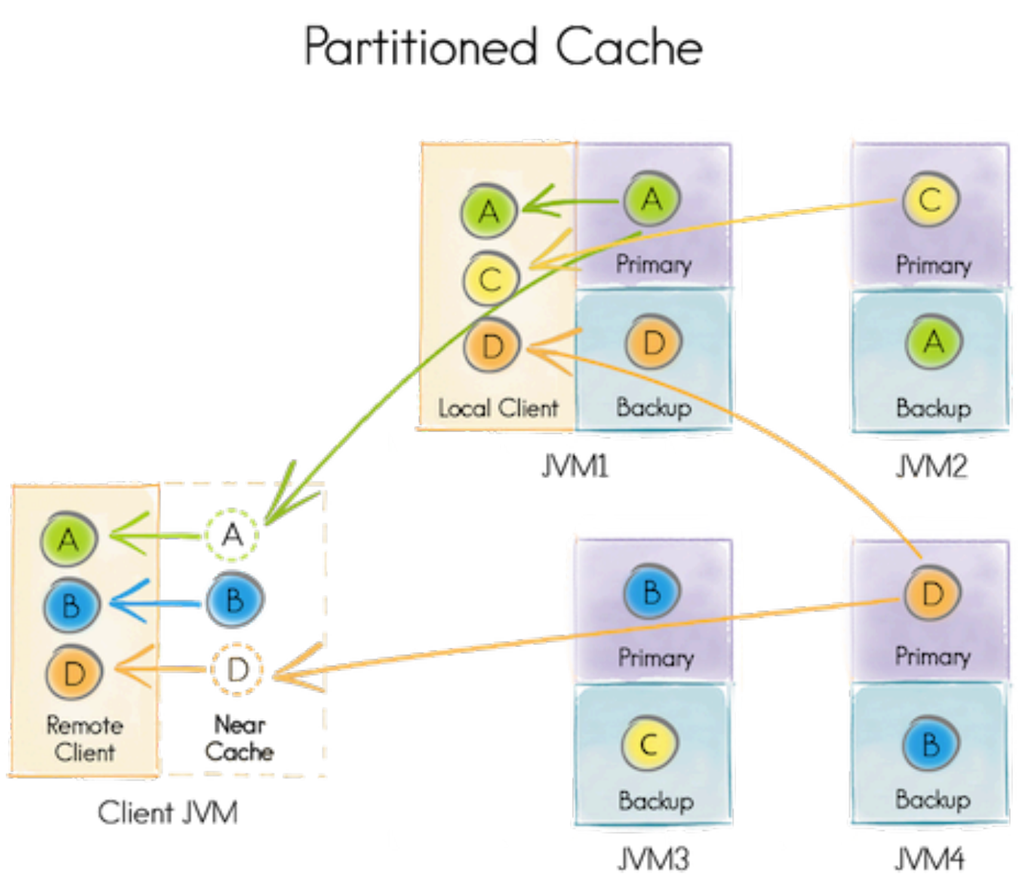
# Ignite and CAP Theorem

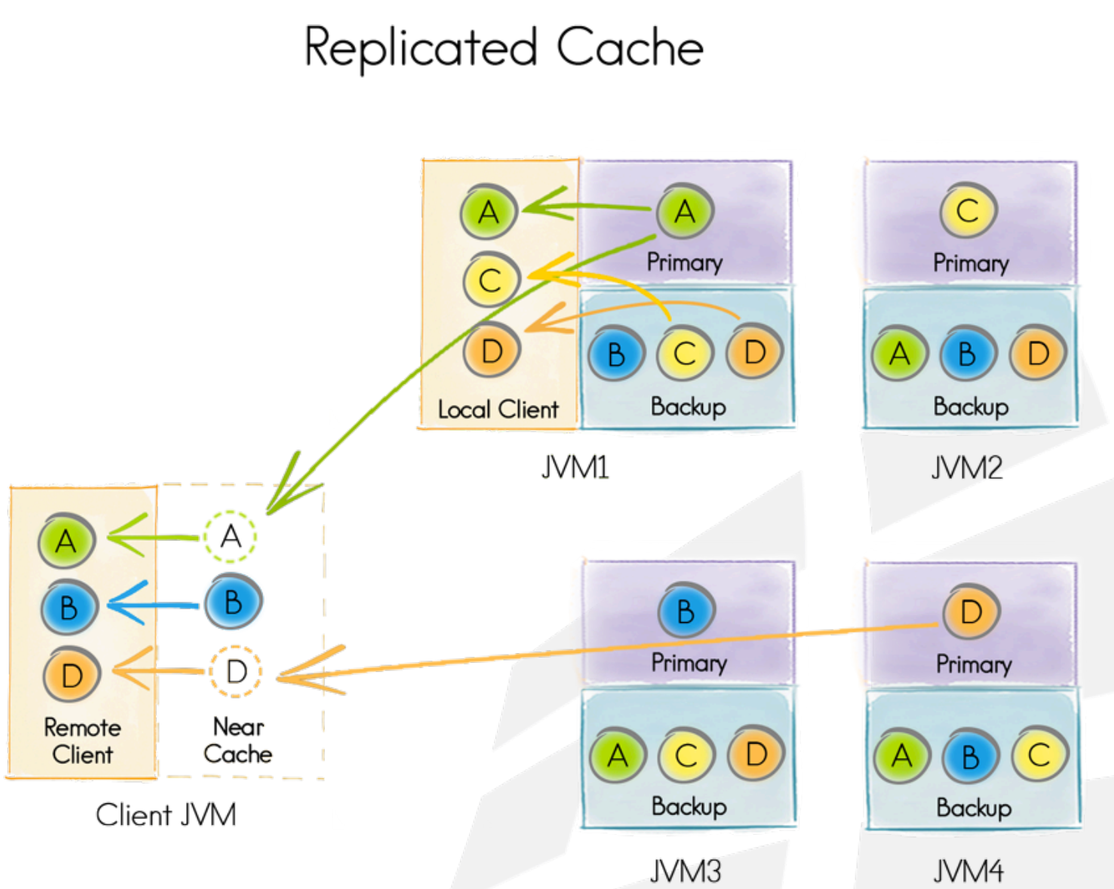
- CAP
  - Consistency (C)
  - Availability (A)
  - Network Partition Tolerance (P)
  - Most of distributed systems are CP or AP
  - Impossible: CAP
- Ignite
  - Strongly CP
  - But still highly available?




Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

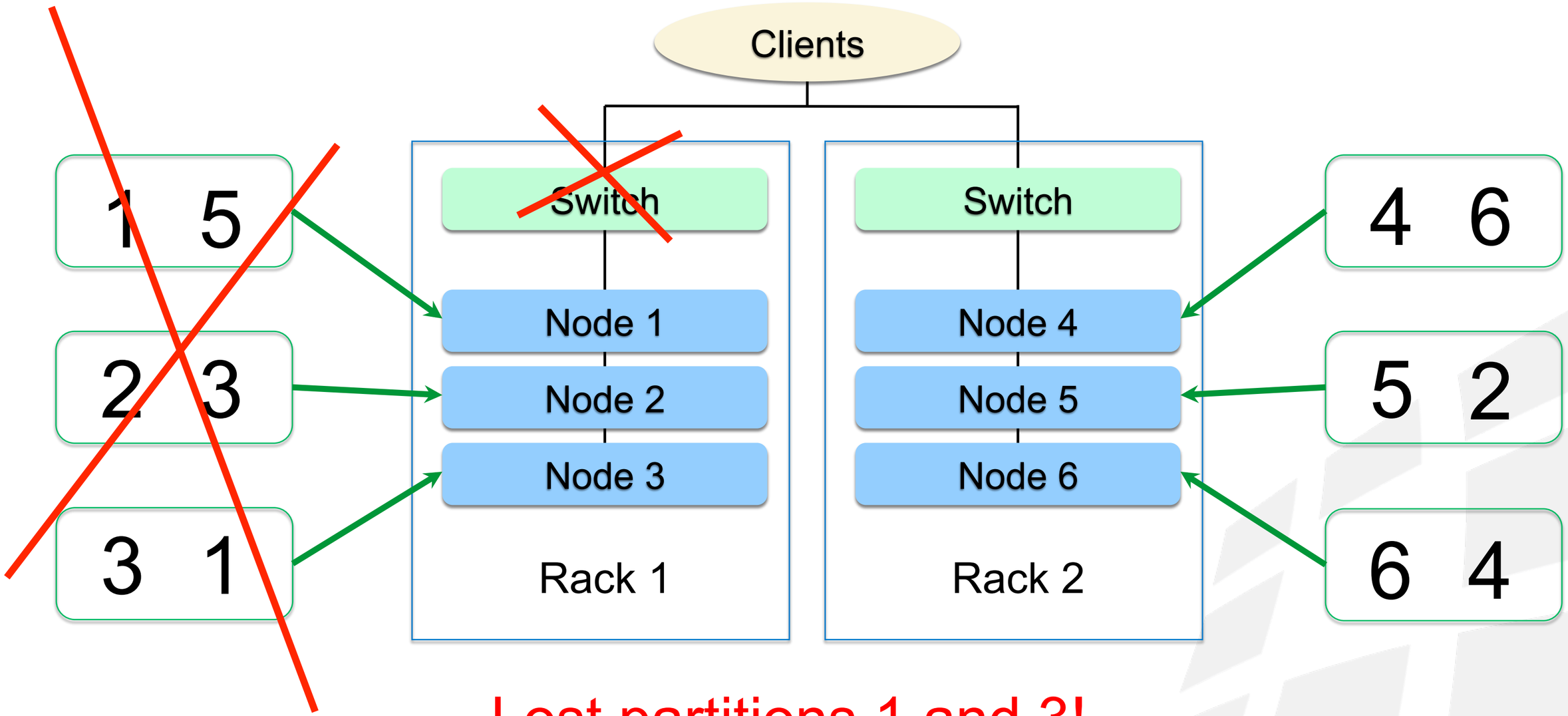
# Cache Backups: Partition vs. Replicated




Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# Cache Backups and Network Segmentation




Lost partitions 1 and 3!

Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# Cache Backups and Network Segmentation: Solution

- Assign attribute to each node:

```
<property name="userAttributes">
    <map>
        <entry key="rack" value="rack-1"/>
    </map>
</property>
```

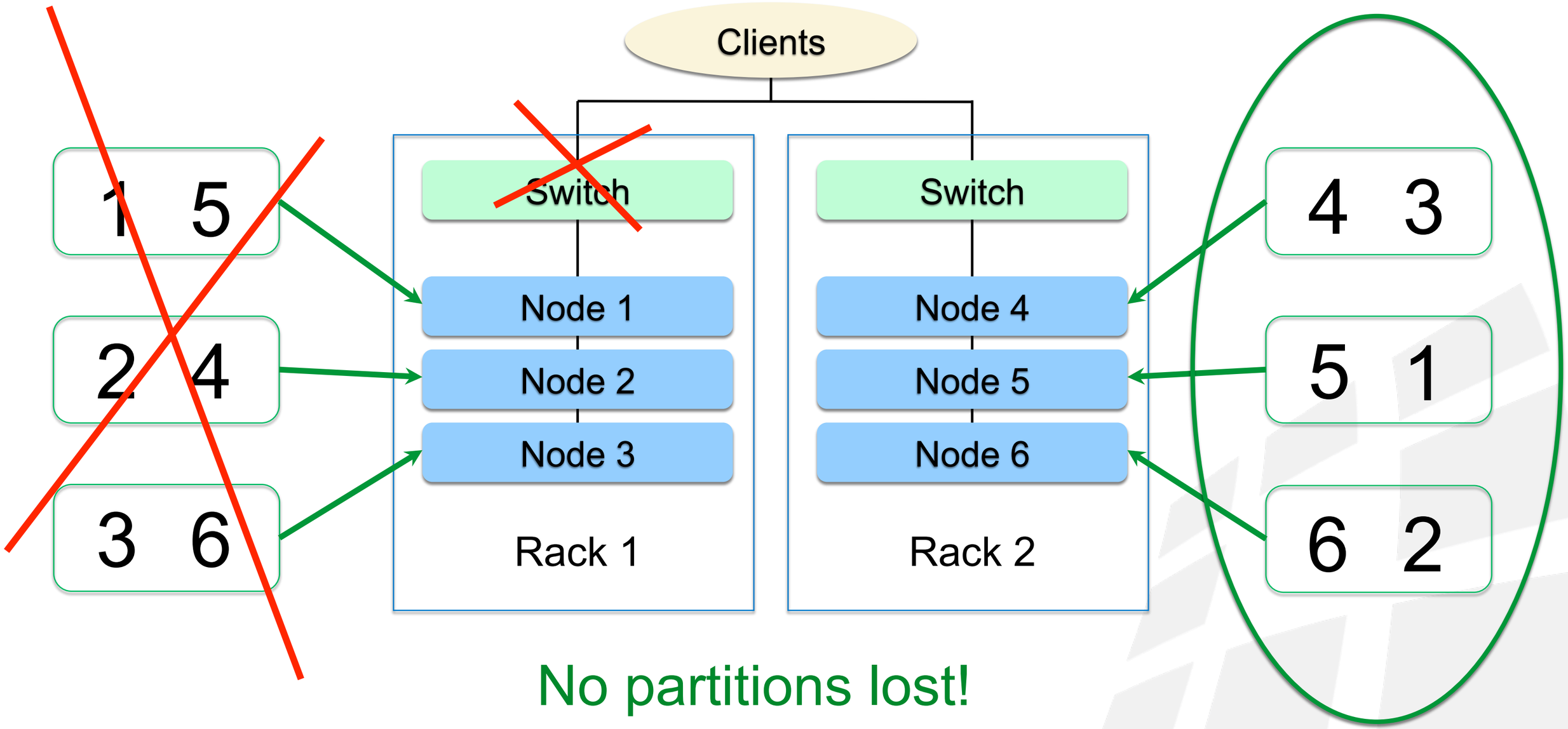
- Implement backup filter:

```
public class RackFilter implements IgniteBiPredicate<ClusterNode, List<ClusterNode>> {
    @Override public boolean apply(ClusterNode candidate, List<ClusterNode> assigned) {
        String candidateRack = candidate.attribute("rack");
        String primaryRack = assigned.get(0).attribute("rack");

        return !Objects.equals(candidateRack, primaryRack);
    }
}
```

Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# Cache Backups and Network Segmentation: Solved!




No partitions lost!

Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# Persistence

## Ignite Persistent Store

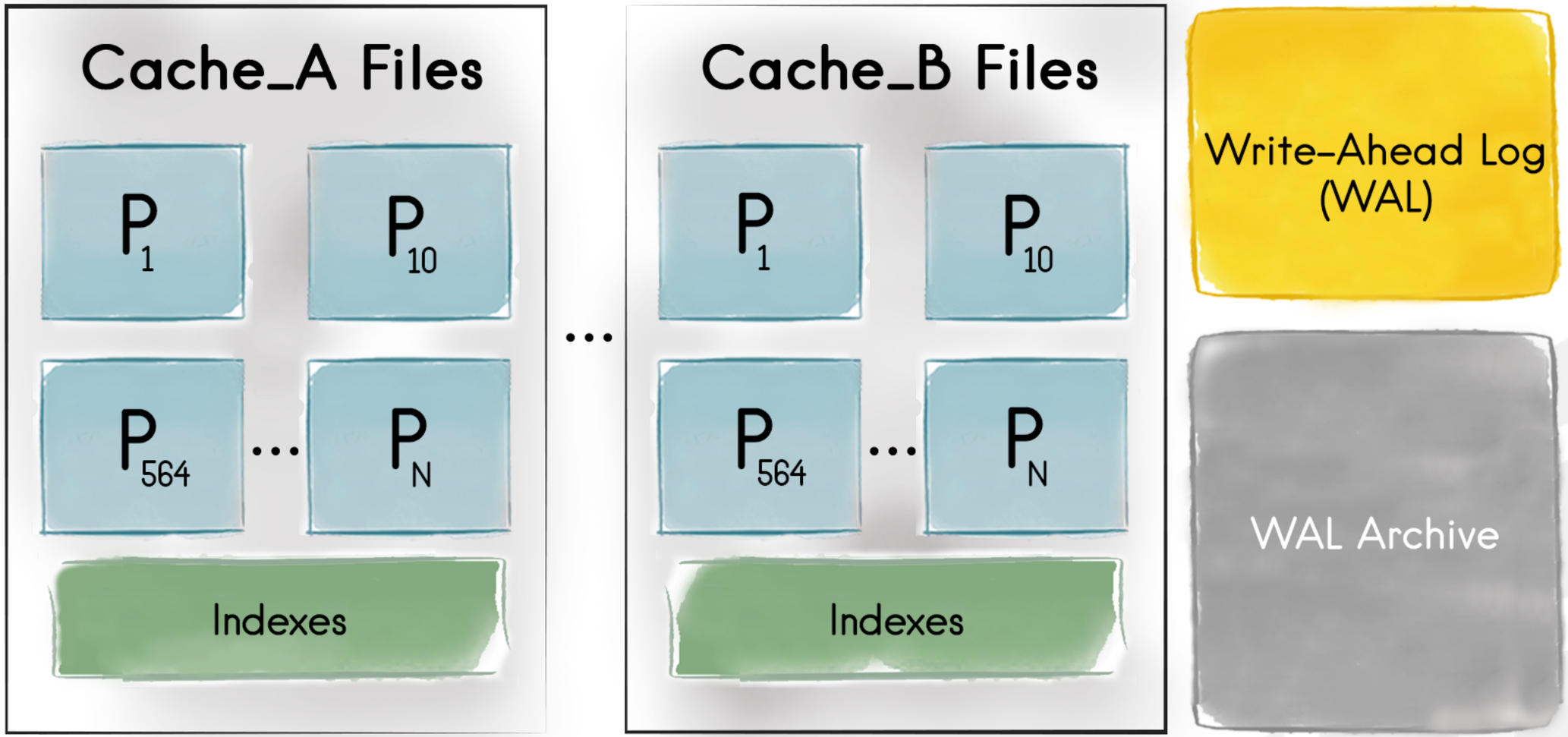
- Additional Disk Tier
- SQL & key-value over both memory and disk
- Memory warmup never required
- Distributed disk storage
- Reads/writes are distributed

## 3rd Party Store

- RDBMS, MongoDB, etc.
- Key-value over both memory and disk
- Memory warmup might be required (SQL usage)
- Single point of failure (RDBMS)
- Bottleneck for writes (RDBMS)

Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

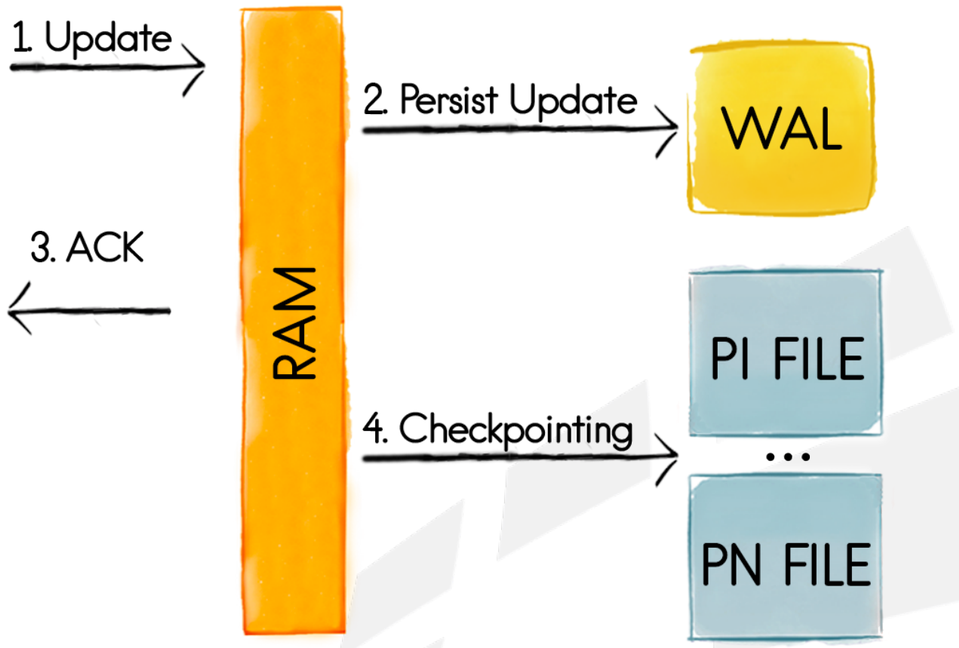
# Ignite Persistence Store: Per-Node Architecture




Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# Ignite Persistence Store: Consistency and Durability

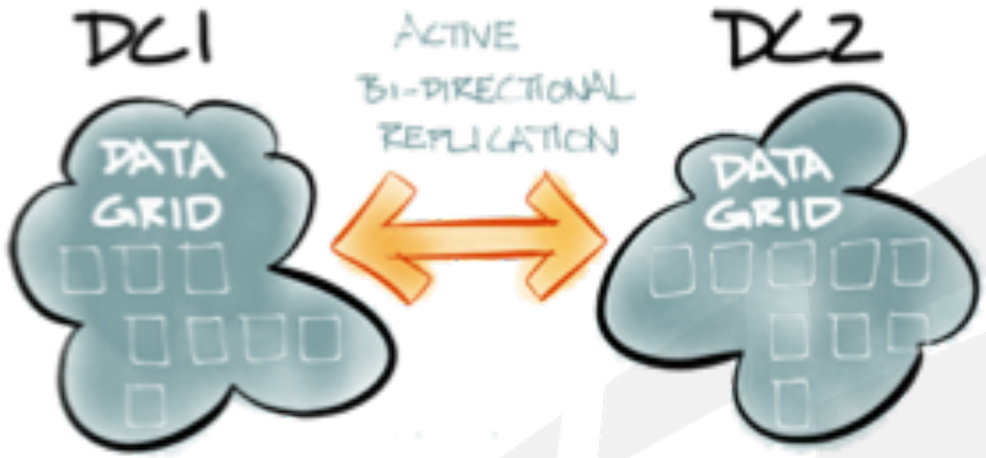
- Write-Ahead Log (WAL)
  - Append only file
  - Propagates updates to disk
  - Provides recovery mechanism
- Checkpointing
  - Triggered periodically
  - Copies actual data from RAM to disk
  - Reduces WAL size




Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# Data Center Replication

- Multiple (up to 32) Data Centers
- Active-Active & Active-Passive
- Smart Conflict Resolution
- Durable Persistent Queues
- Automatic Throttling

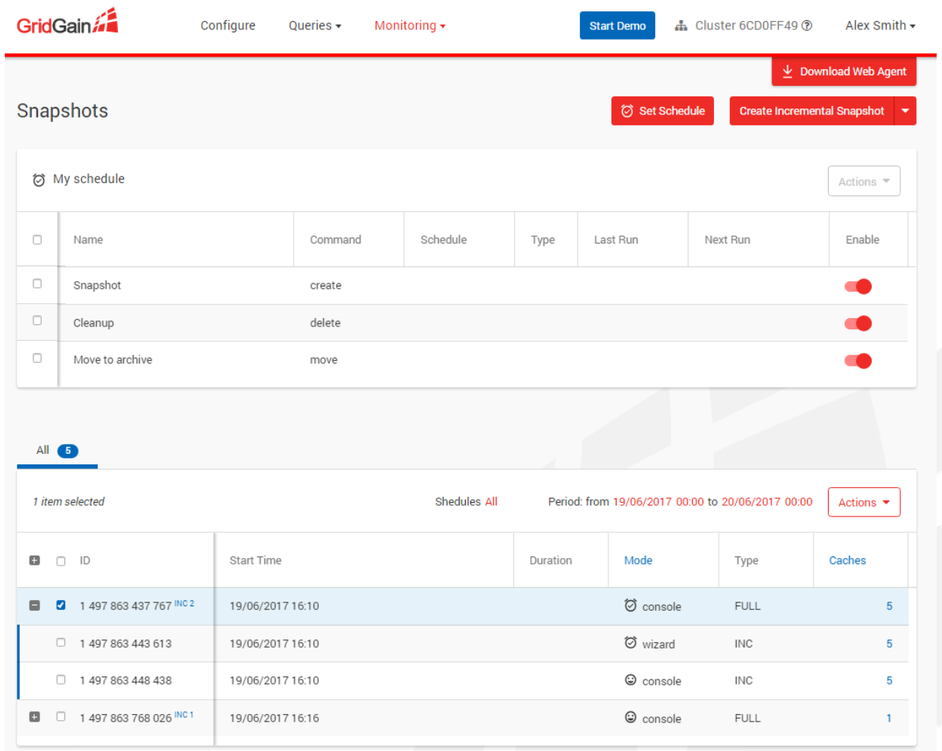



*GridGain Enterprise Edition Only!*

Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# Data Snapshots

- Full snapshots
  - Full state
  - May take long time
- Incremental snapshots
  - Partial state
  - Only delta since last full snapshot
- Scheduled snapshots
- Restore on different clusters
- Fully managed




*GridGain Ultimate Edition Only!*

Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

# ANY QUESTIONS?

Thank you for joining us. Follow the conversation.

http://ignite.apache.org

#apacheignite

Apache®, Apache Ignite, Ignite®, and the Apache Ignite logo are either registered trademarks or trademarks of the Apache Software Foundation in the United States and/or other countries.

GridGain