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Highly Scalable Data Grids and Distributed Caching with Infinispan

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Red Hat, Inc.

Infinispan

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Rules of the game

#jbw

#infinispan

Who am I?

- R&D Engineer, Red Hat Inc.
- Founder and project lead, Infinispan
- Project lead, JBoss Cache
- Frequent speaker on cloud computing and cloud data storage

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http://blog.infinispan.org

The wide world of Infinispan

- Brief introduction to Infinispan
- Categorize major Infinispan uses
- Discuss each one
  - Benefits
  - Typical usage
  - Tuning tricks and tradeoffs

What is Infinispan?

- Open source (LGPL) in-memory Data Grid
- Some concepts from Amazon Dynamo

2 usage modes

- Embedded
- Client-server
  - memcached
  - Hot Rod
  - REST

Consistent hash based distribution

- Self healing
- No single point of failure

Highly concurrent

- MVCC locking

XA Transactions

- 2-phase commit based
- Deadlock detection algorithms
- Coming soon: Atomic Broadcast

Map/Reduce

- Clean, fluent API to deal with an otherwise complex programming model

Querying

- Using Lucene and Hibernate Search

Persistence

- Not *just* in memory!
- Write through and write behind
- Pluggable "*drivers*"

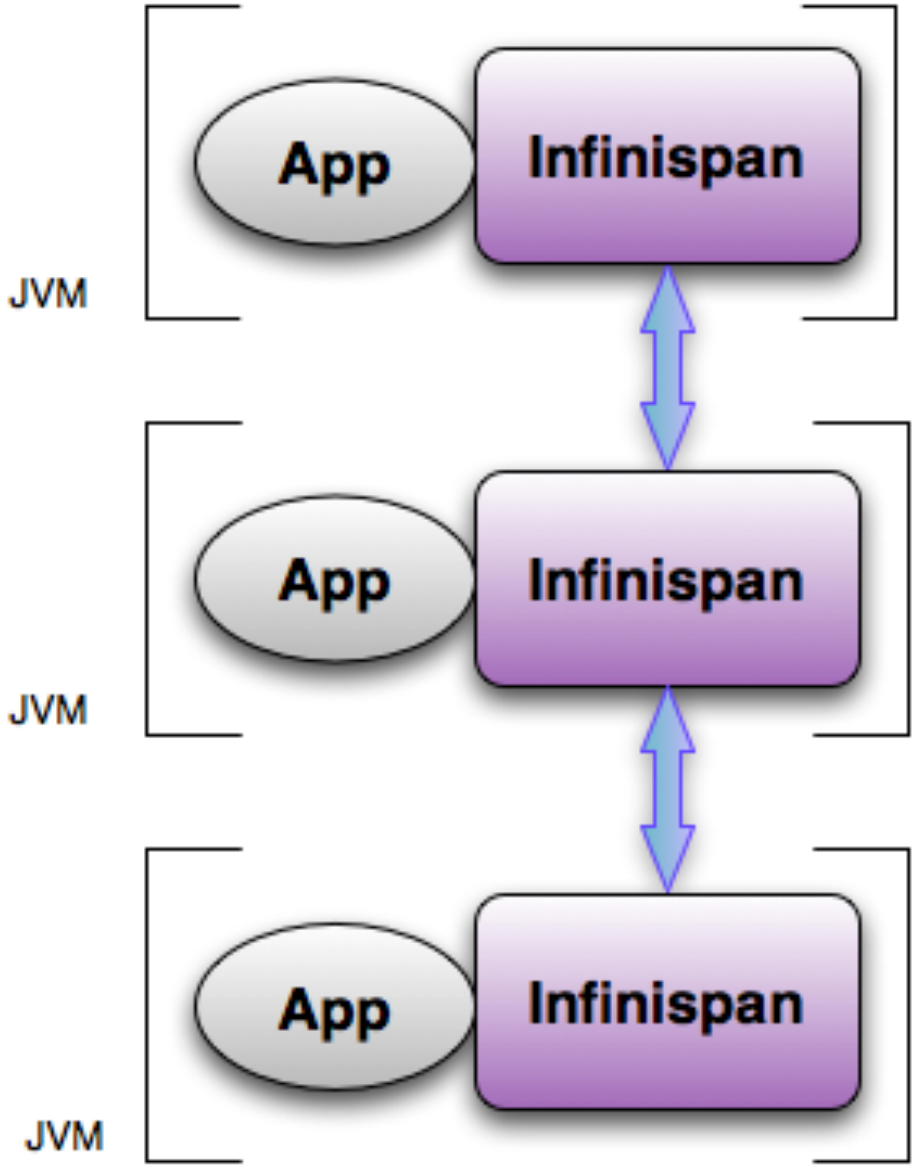
Eviction and expiry

- Efficient, adaptive algorithms
- Addresses shortcomings of LRU & FIFO

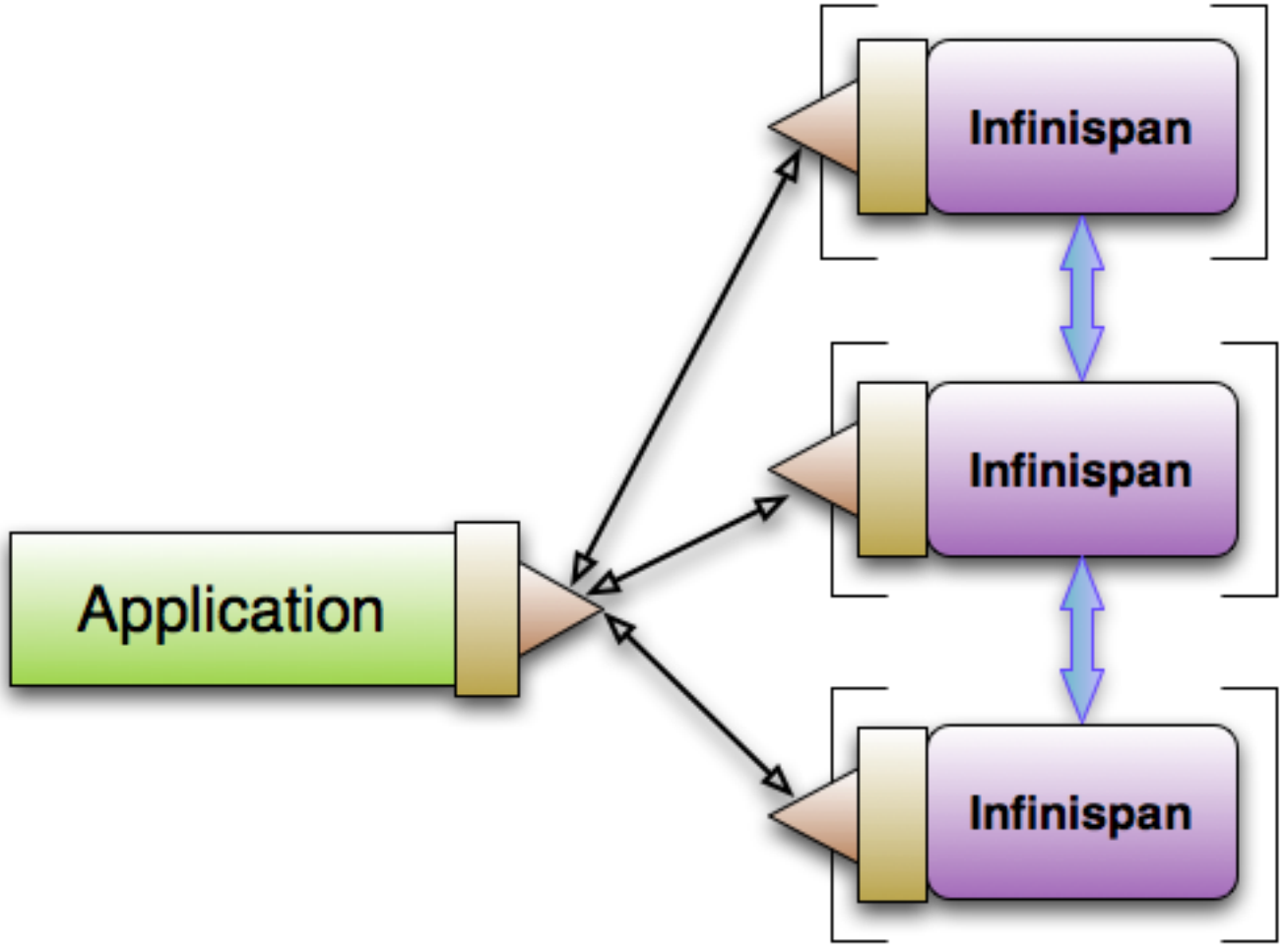
API

- Map-like key/value store (JSR 107)
- Proposed data grid API (JSR 347)
- Upcoming JPA-like layer
  - Hibernate OGM

Peer To Peer Architecture



Client/Server Architecture



Supported Protocols

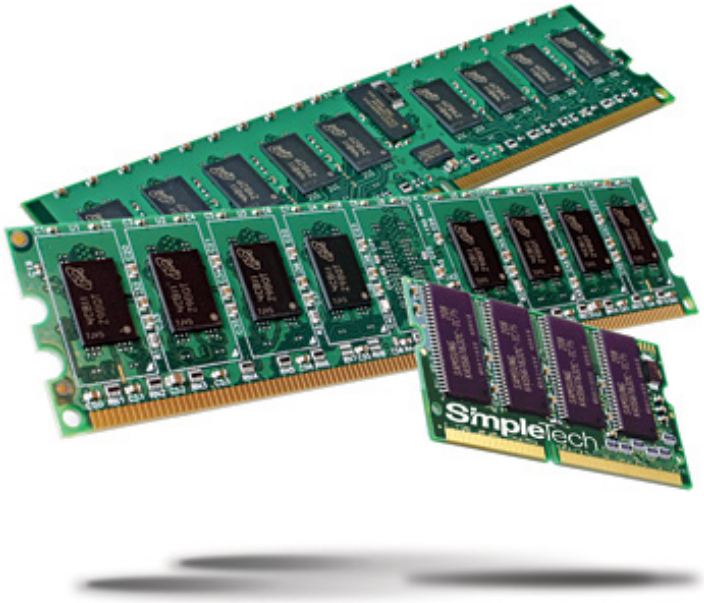
- REST
- Memcached
- Hot Rod

Infinispan as a ...

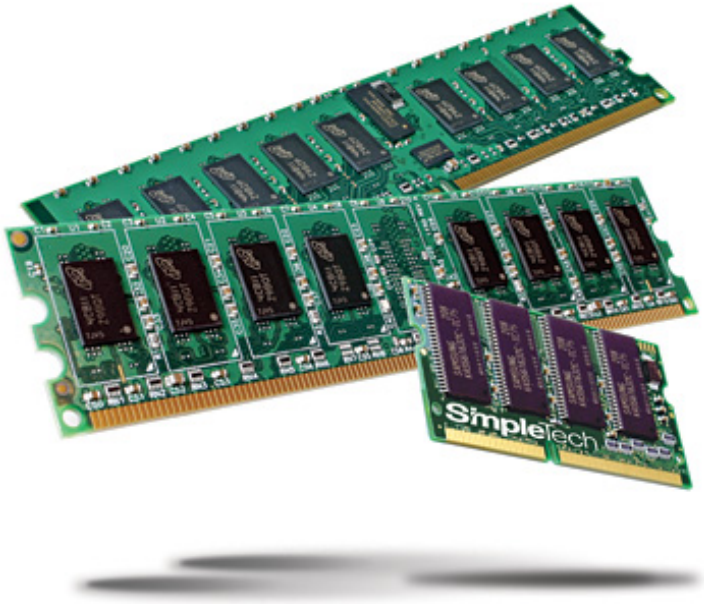
- ... local, in-memory object cache
- ... clustering/high availability toolkit
- ... clustered in-memory cache
- ... in-memory data grid
- ... cloud-ready data store

Local, in-memory object cache

- Performance booster
- Good for data that is:
  - Hard to calculate
  - Expensive to retrieve
    - E.g., from a DB or a Web Service
  - Frequently accessed



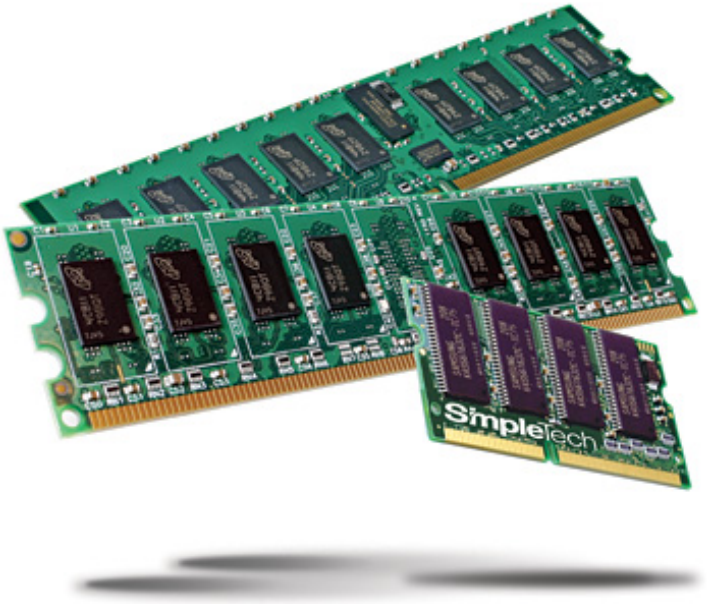
Local, in-memory object cache



- Better than a HashMap
  - Greater concurrency
  - Built-in eviction, prevents OOMs!
  - Overflow to disk
  - Warm starts, preloading
  - Events, notifications
  - Highly configurable locking strategies
  - JTA compatible
  - JMX monitoring

Local, in-memory object cache

- Plugs in to various frameworks to boost performance
  - Hibernate/JPA
  - SEAM
    - Cache JSF fragments
  - Wicket
  - Apache Camel, ESBs
  - ... etc ...



Clustering toolkit

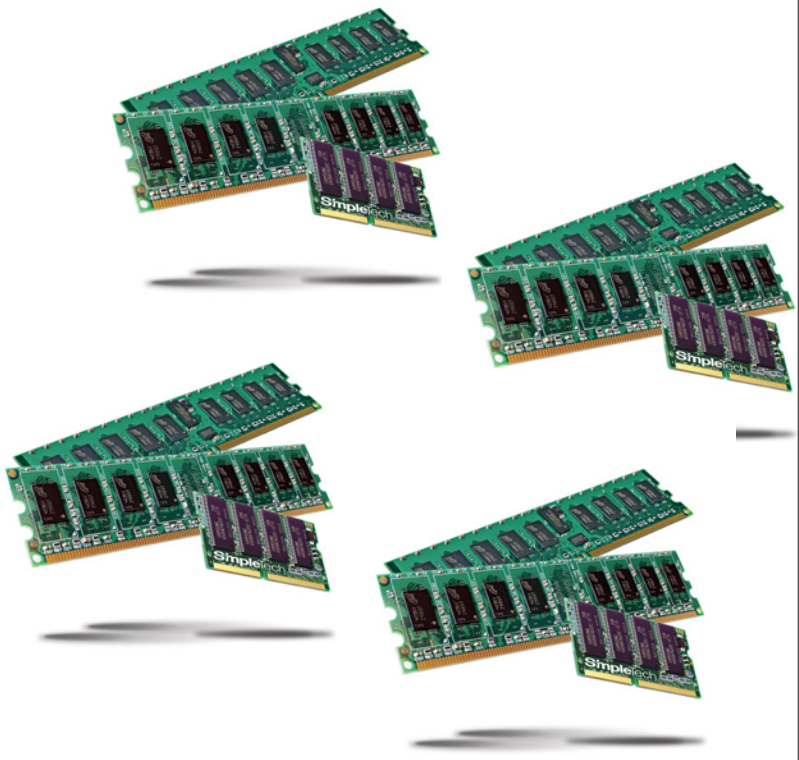
- Helps cluster your framework
- Helps you add the following features:
  - High Availability
  - Failover
  - Scale-out

Clustering toolkit

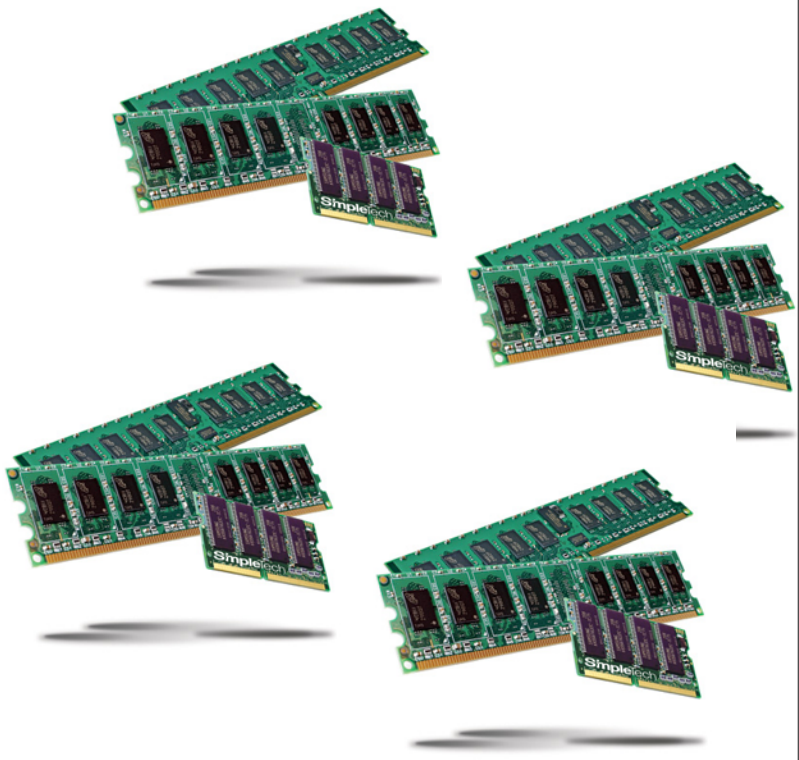
- E.g., clustering EJB and Servlet containers
  - JBoss AS, others
- SIP session state
  - Mobicents
- Lucene directory
- ModeShape, JCR
- Plenty of custom frameworks, servers
  - MMORPG servers
  - Financial trading systems

Clustered in-memory cache

- Performance booster
- Similar to a local cache
- Cluster-aware
- More shared-cache space!

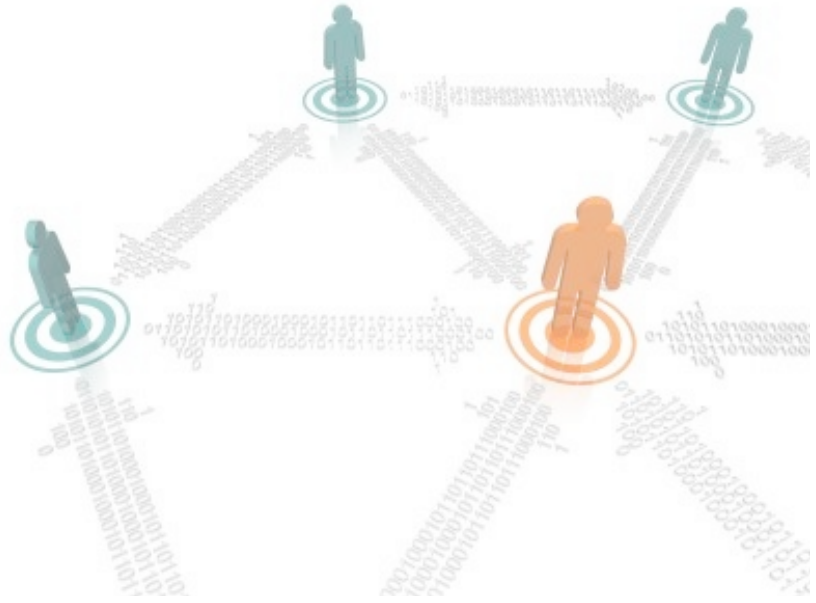


Clustered in-memory cache



- Just as an in-memory cache:
  - Cache data that is costly to:
    - Calculate (e.g., deserialize)
    - Retrieve (e.g., RDBMS, Web Svc)
- Hibernate/JPA
  - cluster-aware 2nd-level cache
- Apache Camel, ESBs

In-memory data grid

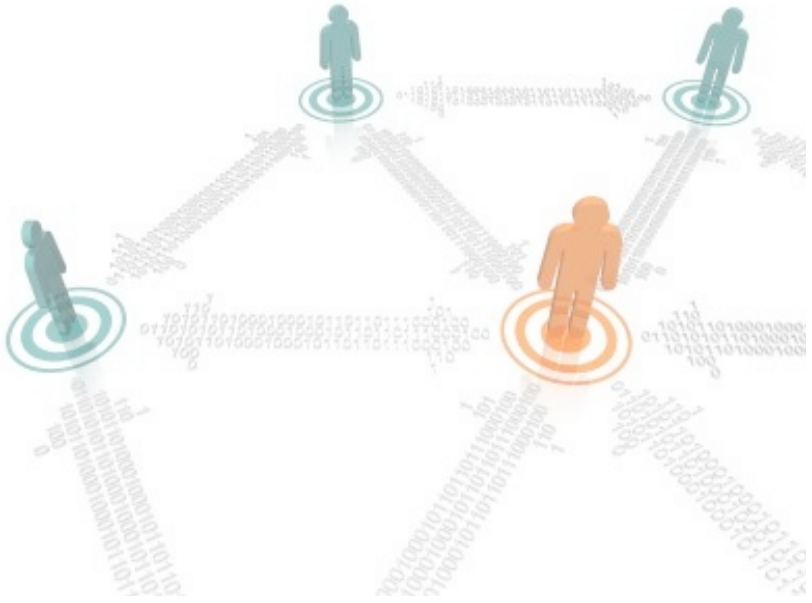


- Alternate data store
- Not just a cache
  - An authoritative data sink
- Highly scalable, low latency
- Accessed in a P2P *or* client/server manner

"Memory is the new disk, disk is the new tape!"

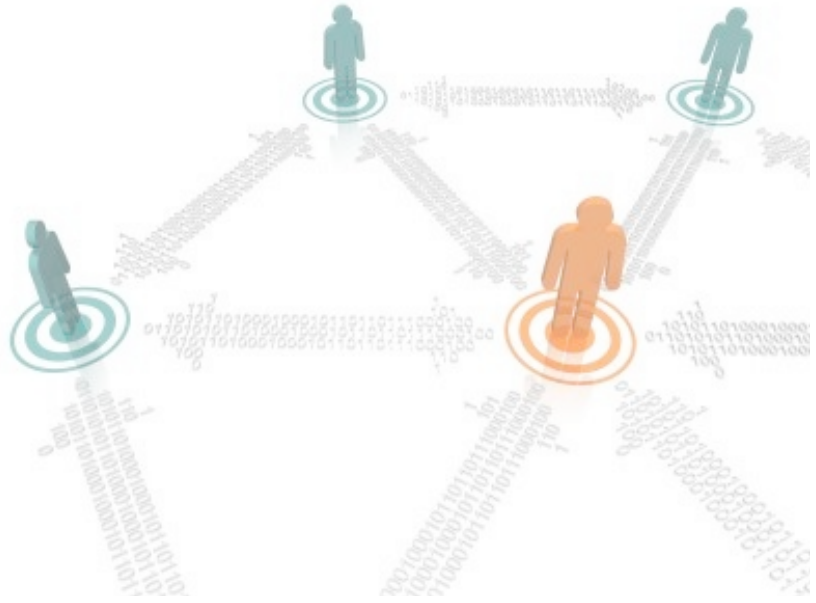
- Tim Bray

In-memory data grid



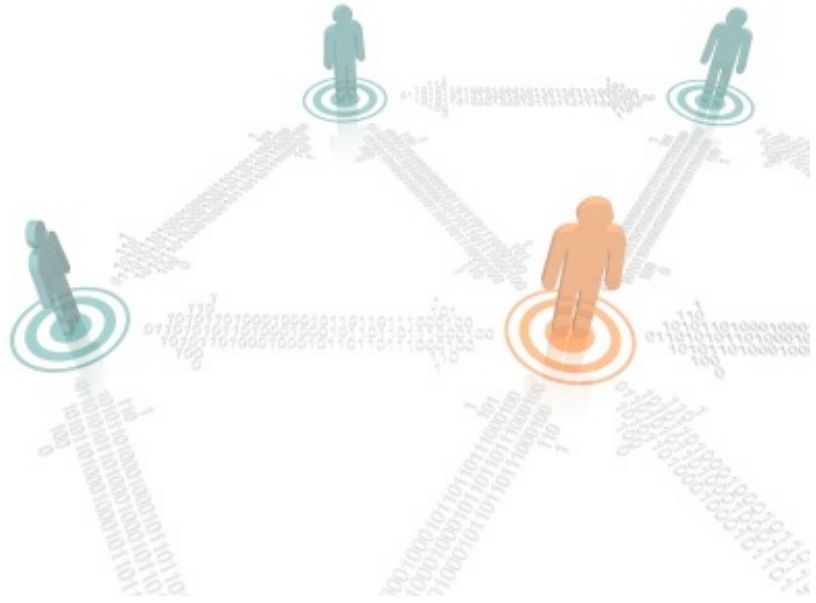
- Multiple access mechanisms
  - Embedded: P2P
  - Client/Server
    - REST
    - Memcached
    - Hot Rod
- Familiar APIs
  - Cache API (JSR 107)
  - JPA-like API (Hibernate OGM)
- Queryability

In-memory data grid



- Four major characteristics
  - **F**ast
    - In-memory, low latency
    - high concurrency
  - **A**vailable
    - Inherent redundancy
  - **D**istributed
    - Data locality
  - **E**lastic
    - Scalable. Out and back in again.

In-memory data grid



- Used in HPC environments
  - Latency is key
  - High performance web
  - Consumer-facing systems
- Massive compute grids
  - Distributing computation needs distributed data
  - Financial systems, risk engines, arbitrage systems
  - Scientific use

Cloud-ready data store

- RDBMS in clouds suck
  - Ephemeral cloud nodes
  - Inelastic
  - single point of failure
- Data grids a much better solution
  - Deals with transience
  - Elastic, scalable
  - Distributed

Cloud-ready data store

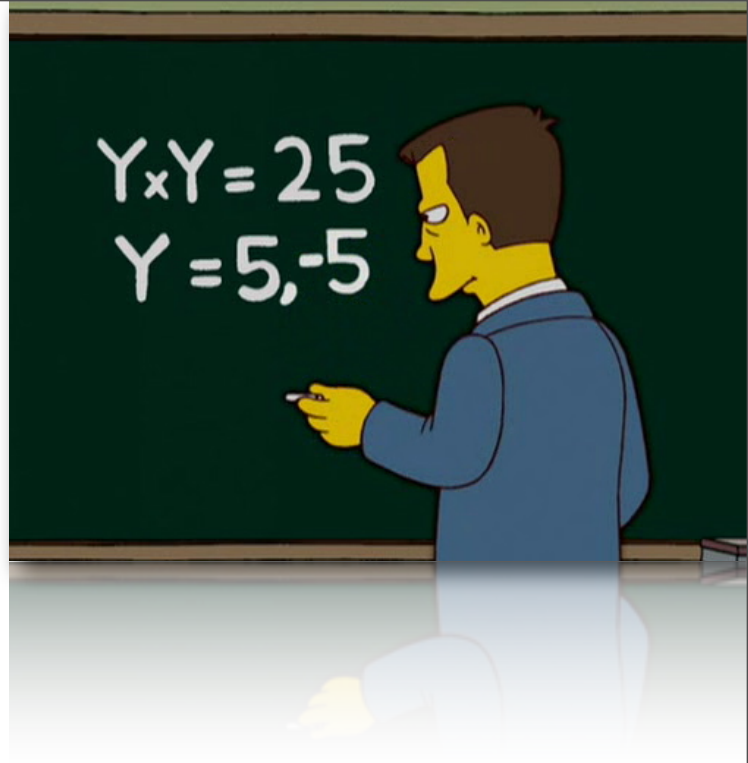
- Google App Engine
  - BigTable
- Amazon SimpleDB
  - Dynamo
- Facebook
  - Cassandra, HBase
- etc.

Cloud-ready data store

- Like Data Grids, API is key
  - Cache API
  - JPA-like API
    - Hibernate OGM
  - REST
  - Hot Rod
- Dedicated data grid tier in the cloud
  - Allows for scalable, stateless app tier

To sum it up...

- Infinispan can be used in a variety of ways
  - From a simple in-memory cache
  - ... to a cloud-ready data store
- To increase performance
- ... or to provide high availability, elasticity



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