TERRACOTTA

JSR107: The new Caching Standard

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What is Caching?

Temporary Storage of data or results that are likely to be used more than once

Caching Characteristics

- Fastest To Implement
- Offload
- Performance
- Scale up
- Scale out (Distributed Caches Only)
- Buffer against load variability

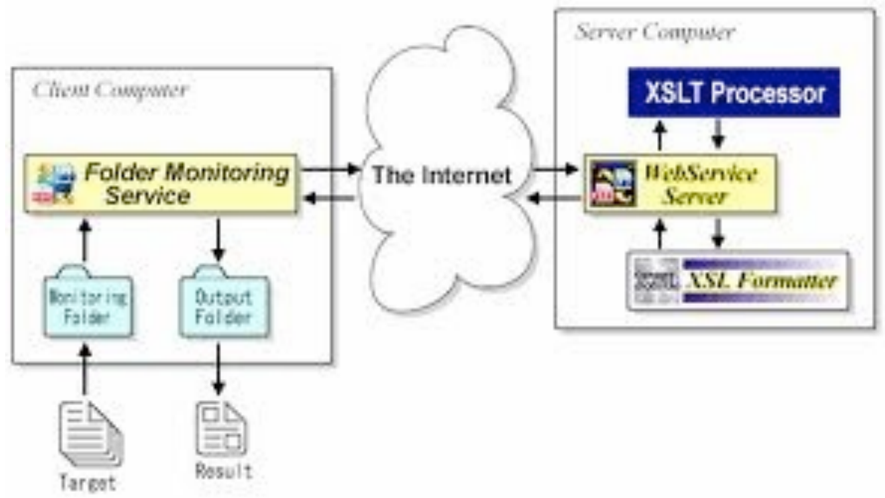
Maximising Cache Efficiency

cache efficiency = cache hits / total hits

- High efficiency = high offload
- High efficiency = high performance

Caching Use Cases

1



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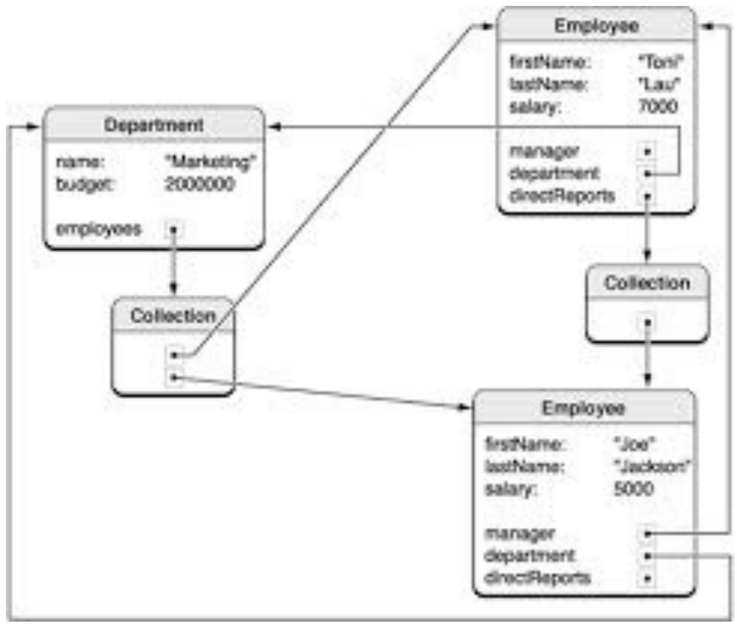

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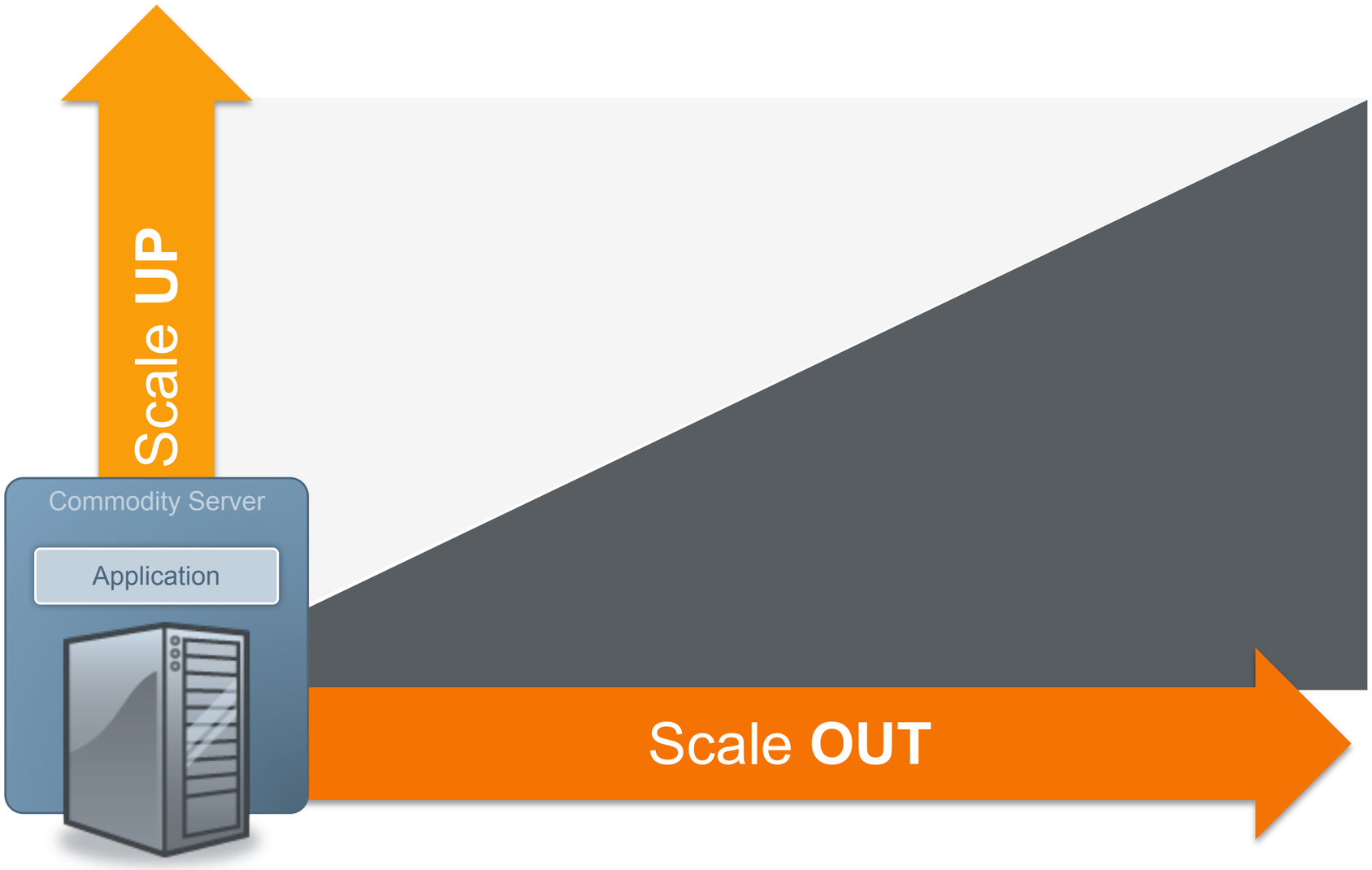
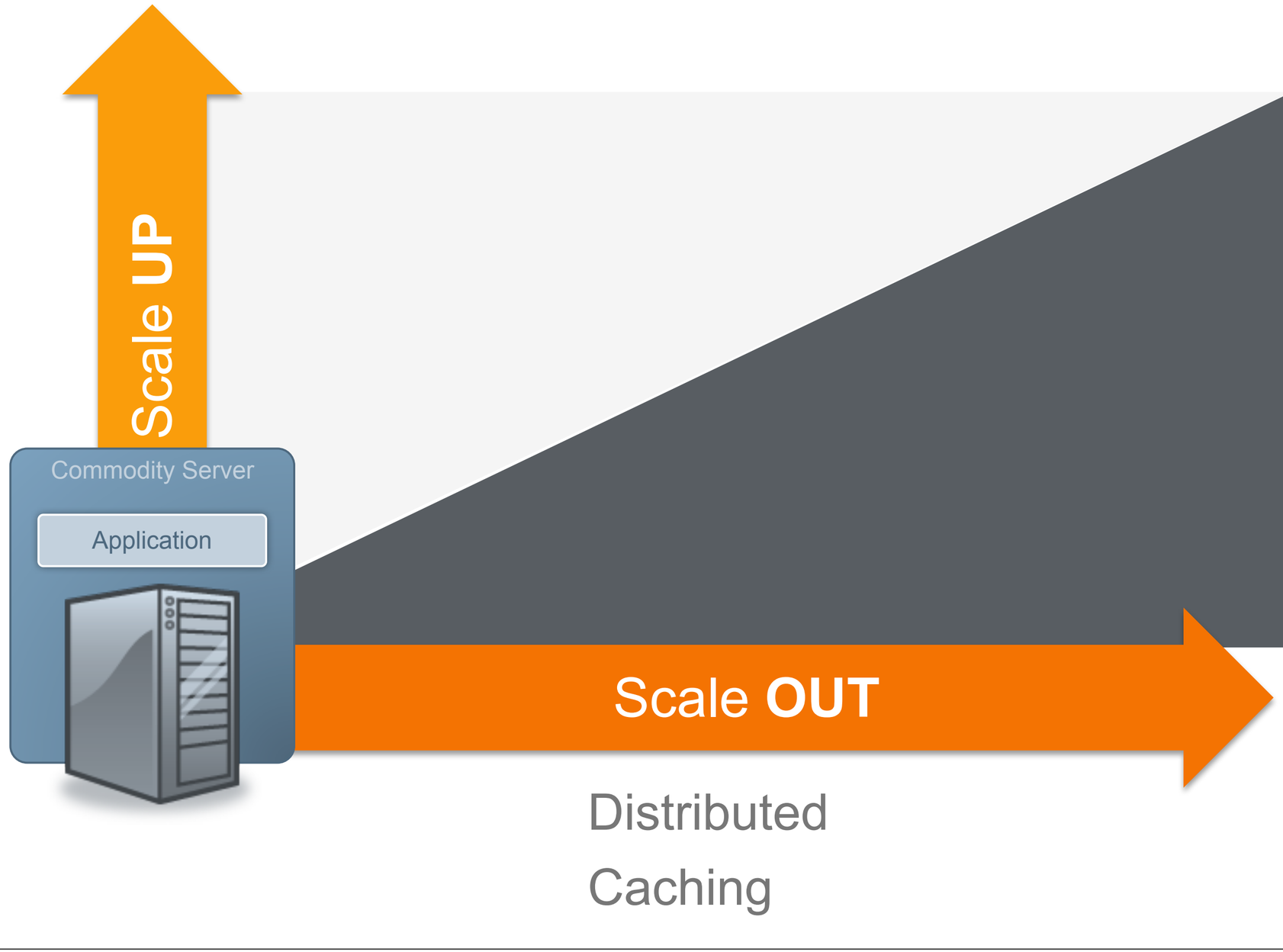
Types of Scaling



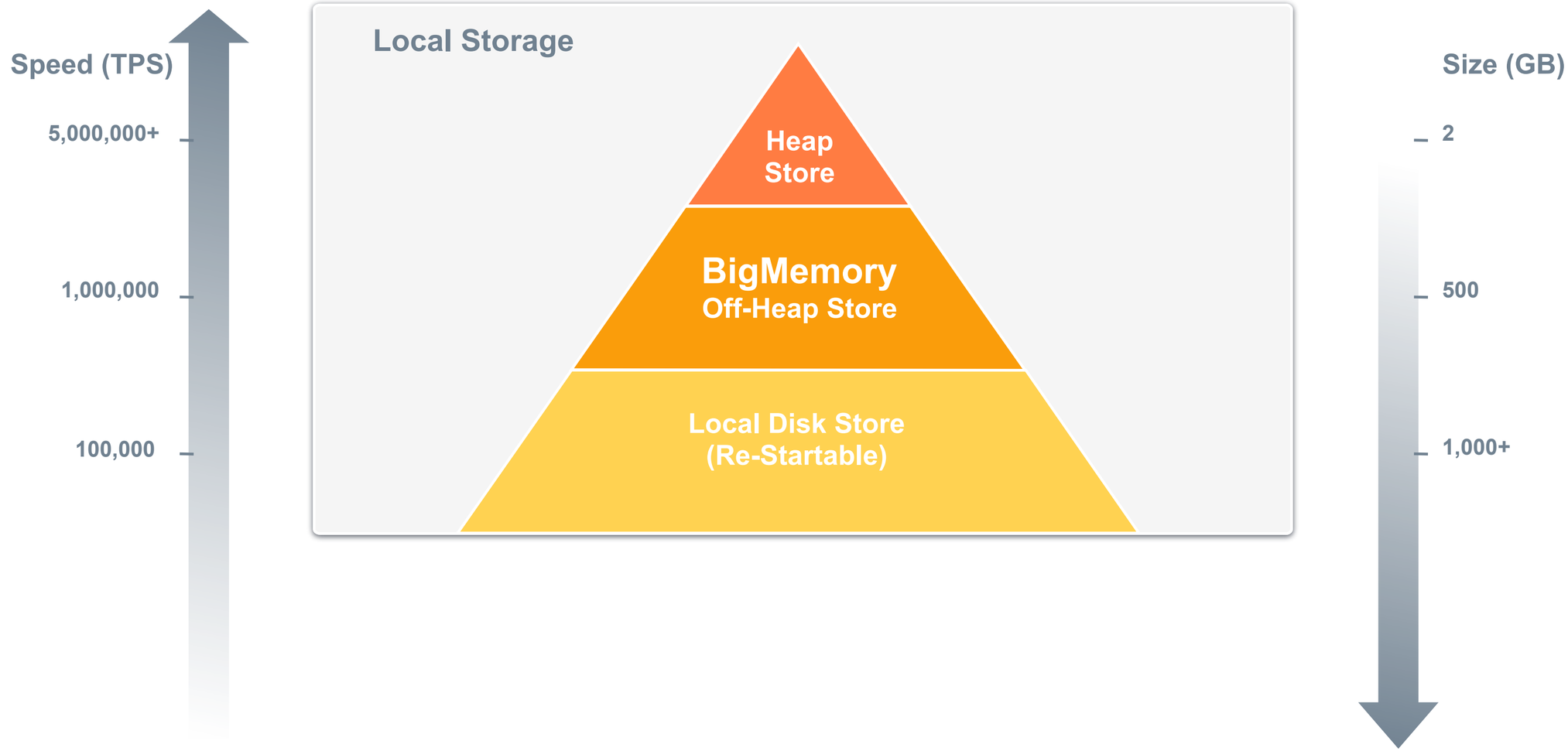
Types of Scaling Types of Caching

Standalone
Caching
(in-process)



Distributed
Caching

Scaling Example: Ehcache



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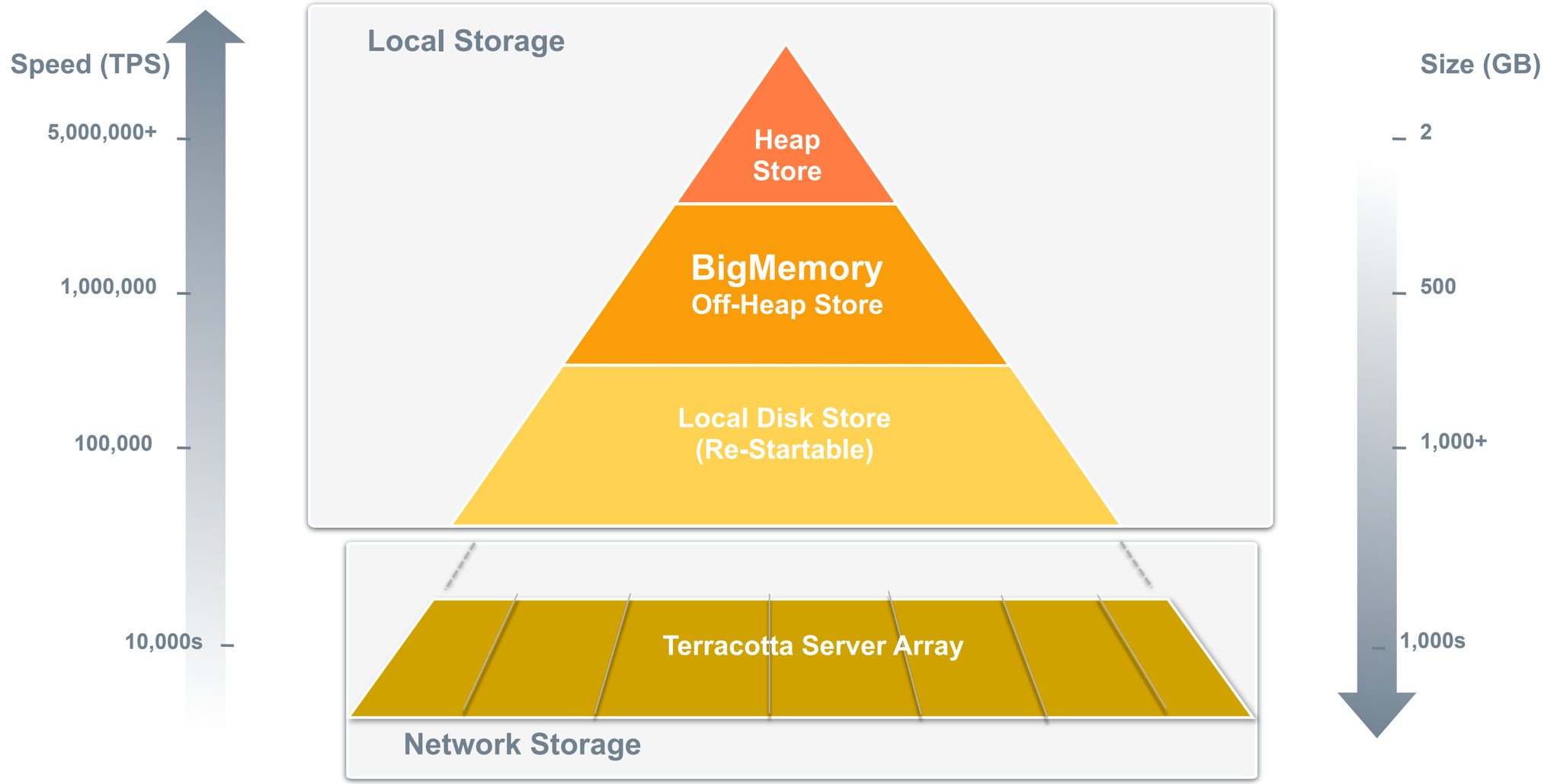
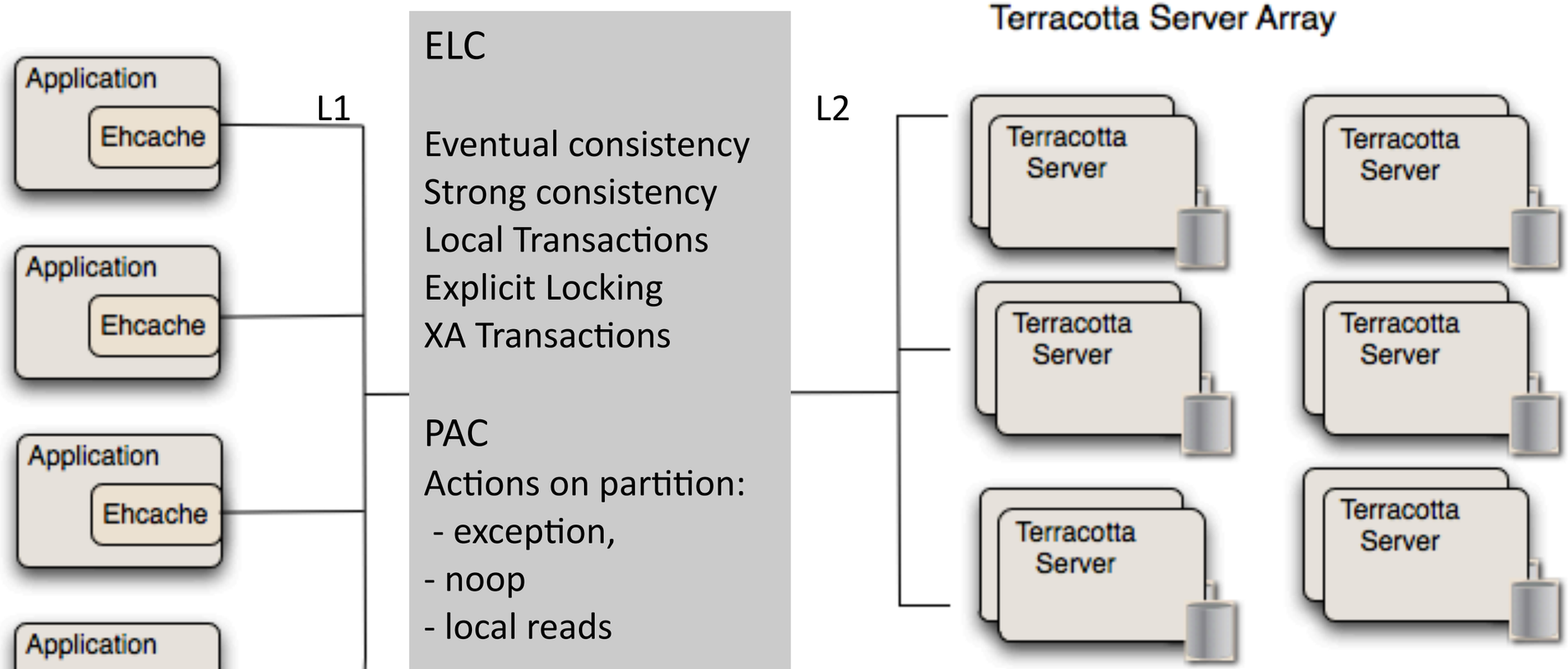


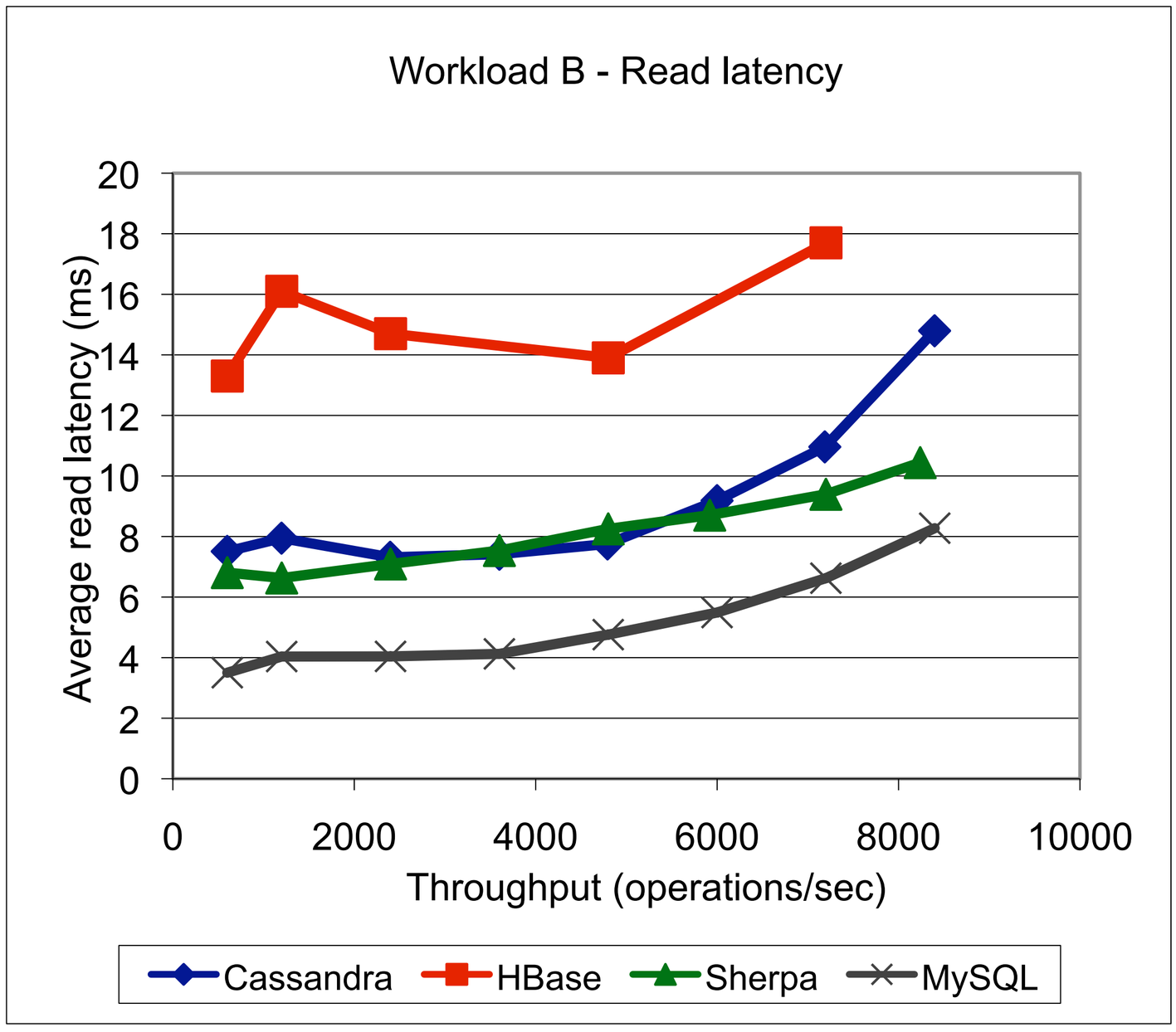
Network Topology Example: Ehcache



Compared to NoSQL

- NoSQL focused on persistence - Caching on temporary Storage
- NoSQL focused on BigData - Caching on valuable data
- Caching focused on RAM storage
- Caches are key-value stores, like key-value NoSQL
- Caching is a use case for NoSQL
- Much Lower latencies

Comparative Speeds



The code is available publicly on GitHub: https://github.com/brianfrankcooper/YCSB

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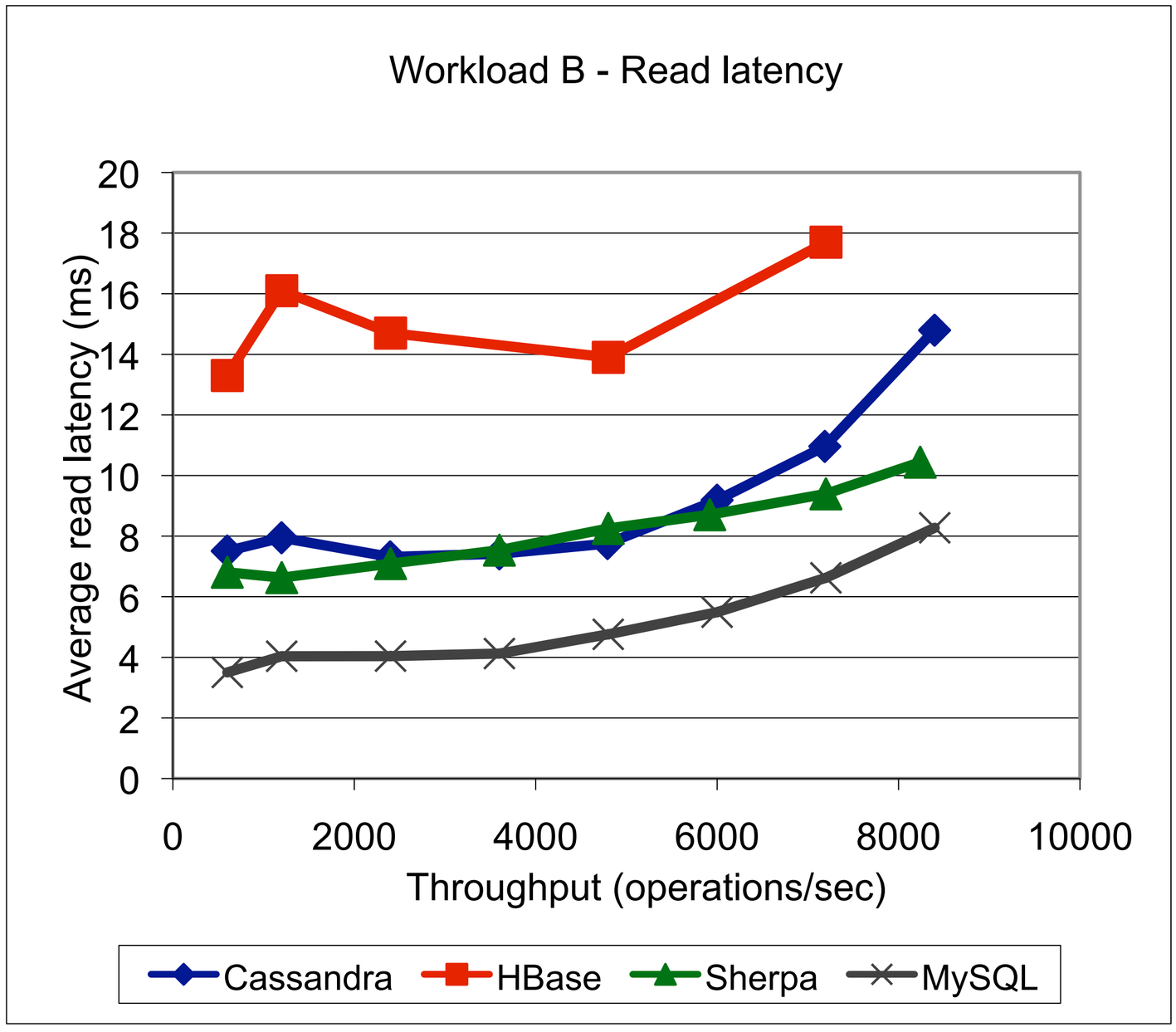

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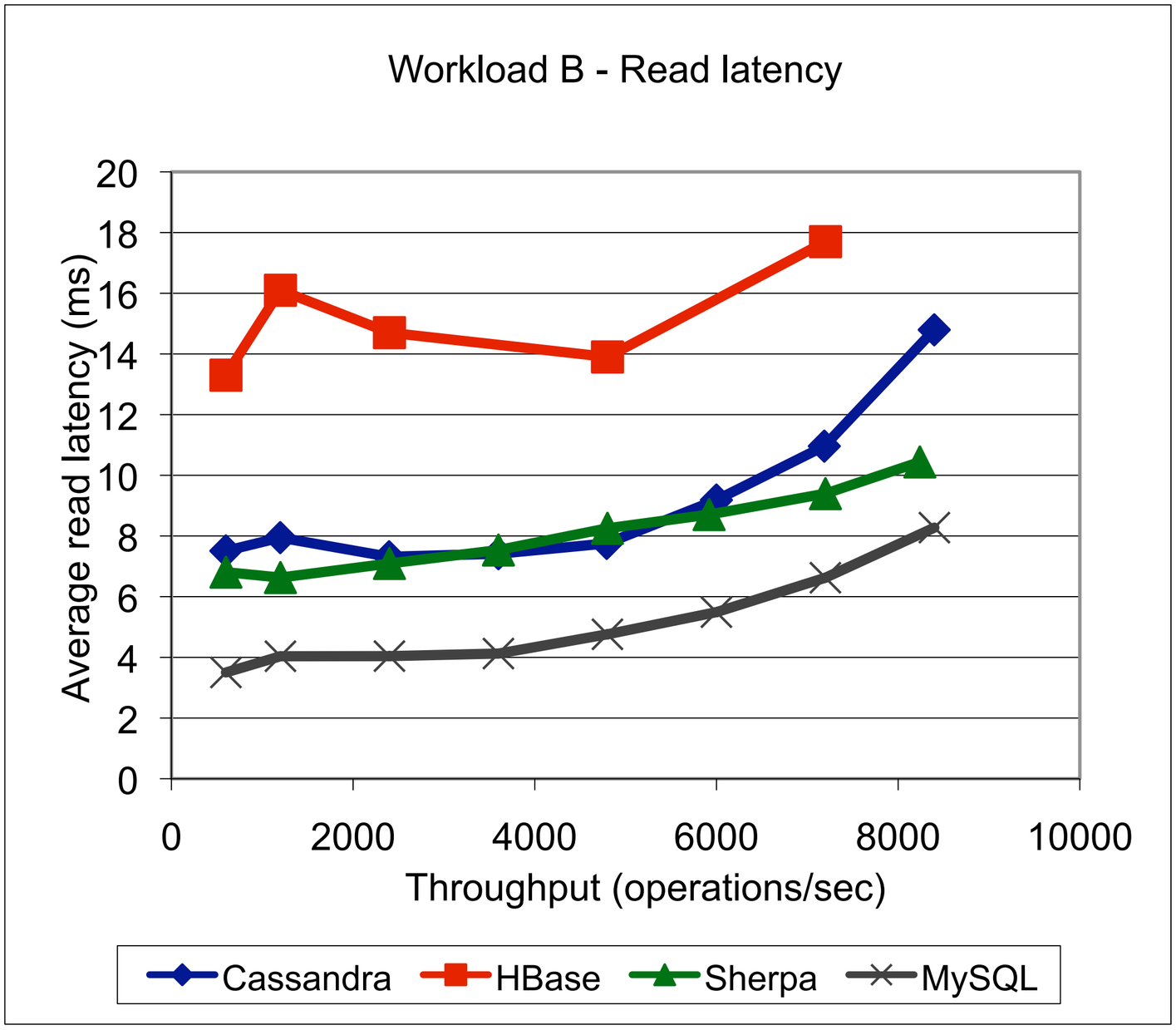

Compared with hybrid in-process and distributed cache:

Latency = L1 speed * proportion
+ L2 speed * proportion

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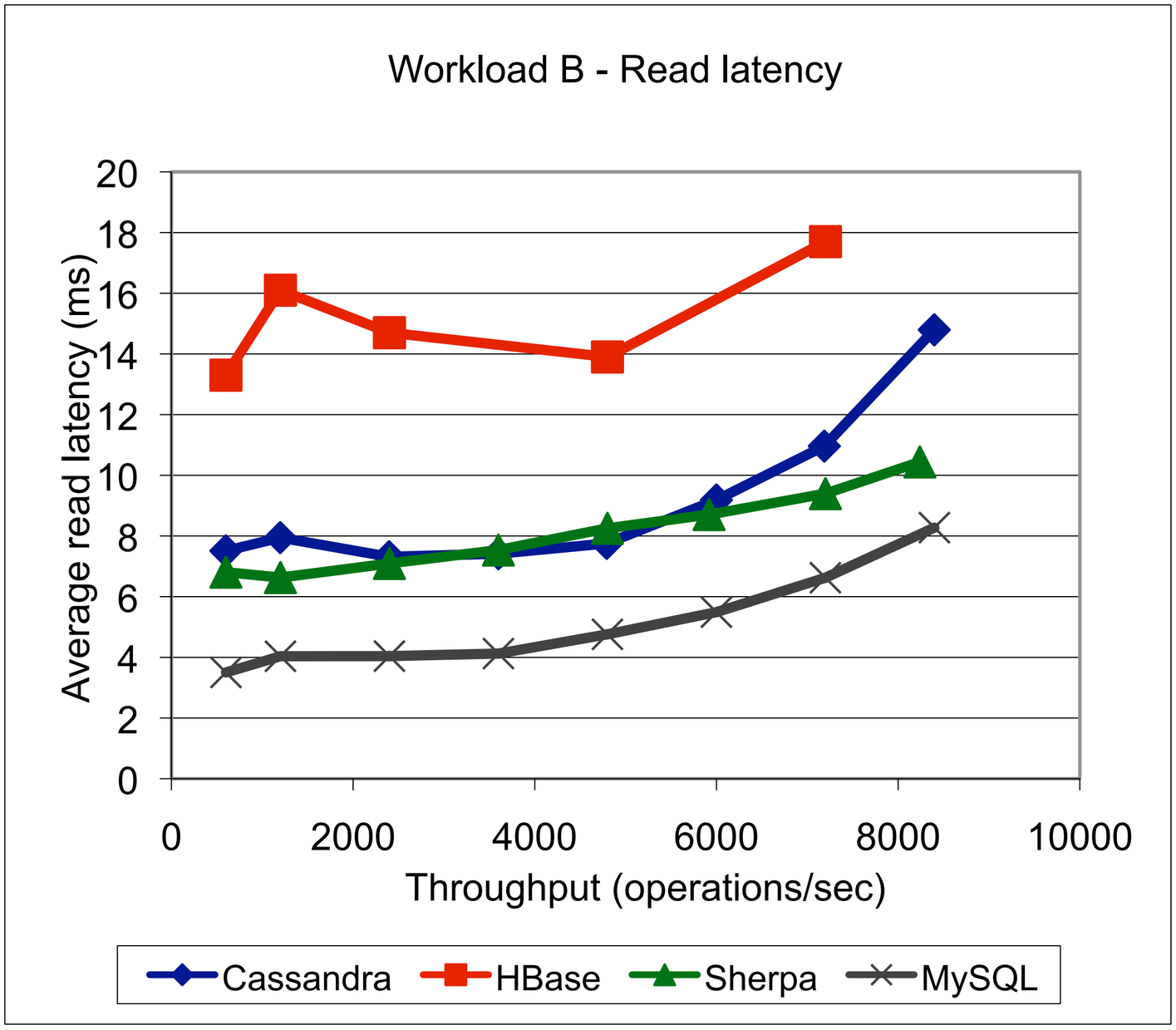
Comparative Speeds



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L1 = 0ms (< 5us) for on-heap and 50-100 us off-heap
L2 = 2-3ms

80% L1 Pareto Model:

= 0 * .8 + 3 * .2
= .6 ms

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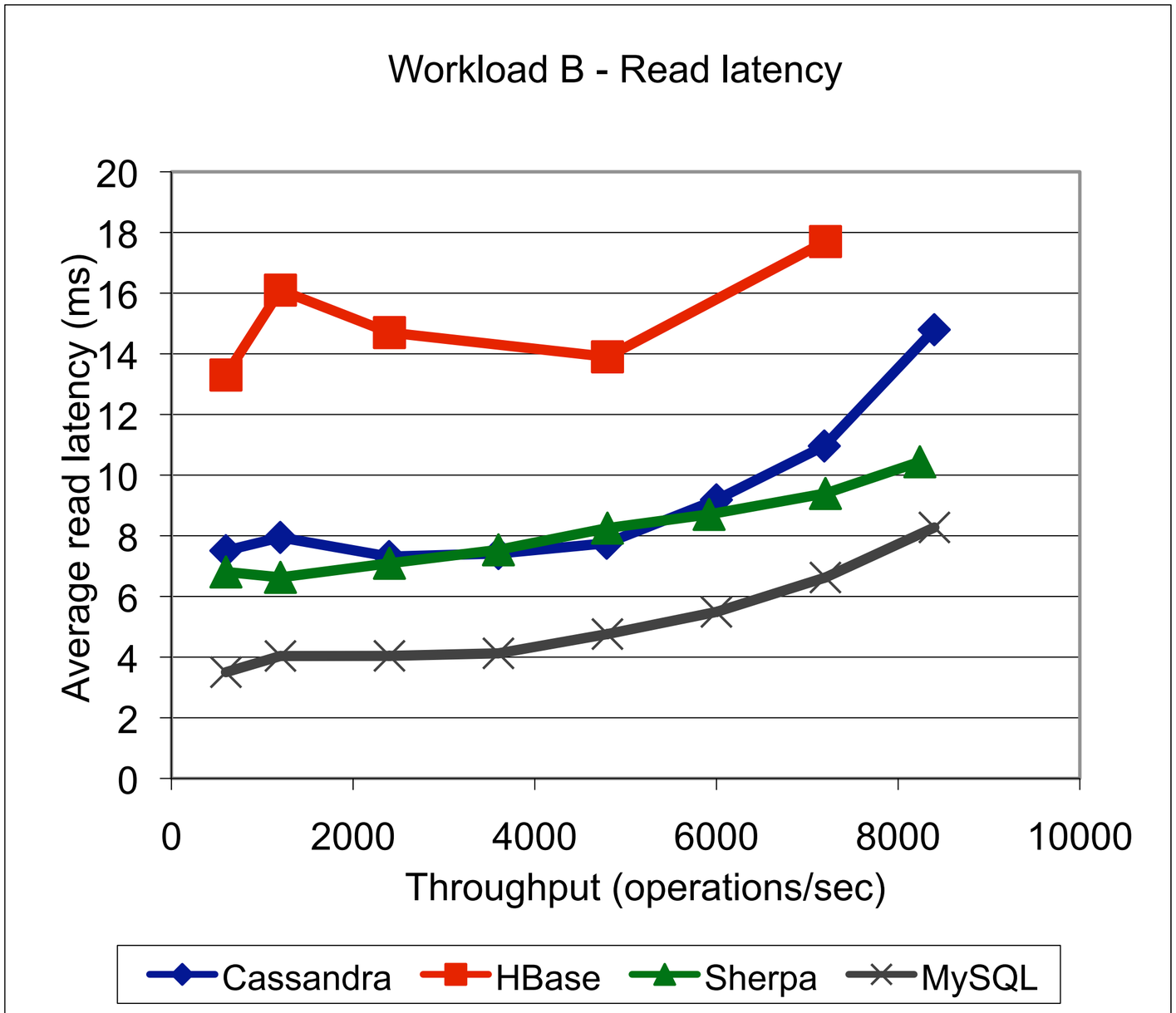
Comparative Speeds



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L1 = 0ms (< 5us) for on-heap and 50-100 us off-heap
L2 = 2-3ms

80% L1 Pareto Model:

= 0 * .8 + 3 * .2
= .6 ms

90% L1 Pareto Model:

latency = 0 * .9 + 3 * .1
= .3 ms

The code is available publicly on GitHub: https://github.com/brianfrankcooper/YCSB

Compared to (Concurrent)Map

- a Map is an in-process key-value store

  Even local in caches add:

  - expiry
  - eviction once full of least valuable entries
- Map is always store by reference
- Caches typically are distributed

JSR107: Java Caching Standard

- javax.cache.Cache
- Being developed by JSR107
- Java 6 and above is required
- Included in JSR 342: Java EE 7 due end of 2012
- Immediately usable by Java EE 6 and Spring
- Immediately usable by any Java based app

Open, Transparent Standards Approach

- Terracotta and Oracle have tasked an FTE (Greg and Yannis) with developing the spec
- Developed in the open
- 15 expert group members
- Lots of healthy debate. See the mailing list: jsr107@googlegroups.com
- Specification is standard spec license - free to use and implement
- Reference Implementation is Apache 2
- Tests which is the major part of the TCK is Apache 2

Expected Implementations

- Terracotta - Ehcache
- Oracle - Coherence
- JBoss - Infinispan
- IBM - ExtemeScale
- SpringSource - Gemfire
- GridGain
- TMax
- Google App Engine Java memcache client
- Spymemcache memcache client

Getting Started

API in Maven Central

```
<dependency>
    <groupId>javax.cache</groupId>
    <artifactId>cache-api</artifactId>
    <version>0.3-SNAPSHOT</version>
</dependency>
```

Everything to get started

https://github.com/jsr107/jsr107spec

Key Concepts

- CacheManager => Caches
- Cache => Entries
- Entry => Key, Value
- The basic API can be thought of map--like with the following additional features:
- atomic operations, similar to java.util.ConcurrentMap
- read-through caching
- write-through caching
- cache event listeners
- statistics

API Features

Map-like with the following additional features:

- atomic operations, similar to java.util.ConcurrentMap
- read-through caching
- write-through caching
- cache event listeners
- statistics
- transactions including all isolation levels
- caching annotations
- generics

How to Please Everyone - No Dependencies

- Java SE - no dependencies.
- EE/Spring - provided dependencies - they are already there.

How to Please Everyone - Optional Features

Optional Features are:

- storeByReference
- XA and Local Transactions
- Caching Interceptor Annotations e.g.

Options interrogation at runtime via Capabilities API:

- ServiceProvider.isSupported(OptionalFeature feature)
- CacheManager.isSupported(OptionalFeature feature)

Works for implementers and Users

Aimed at Standalone and Distributed Caching

Standalone Features

- storeByReference - allows speeds similar to CHM
- CacheEventListener callbacks - useful for triggering events

Distributed Features

- storeByValue
- NotificationScope in CacheEventListener
- modifications/differences to Map and ConcurrentHashMap to reduce network cost. e.g.
  - No values() and many others.
  - Calls may not return a value e.g. remove(Object key) returns boolean rather than the old value

Not a Data Grid Specification

- Infinispan, Coherence and Extreme Scale are Data Grids
- Ehcache and Memcache are distributed client-server caches
- NoSQL key value stores are distributed client-server key stores which could be used for caching

  So:
- JSR107 does not mandate a topology
- JSR347 does - it is for data grids and builds on JSR107

Classloading

- Caches contain data ***shared*** by multiple threads/JVMs which may be using Java SE, EE, OSGi or custom class loading.
- This makes class loading tricky
- A classloader can be specified when the CacheManager is created or a default is used. Either way all classes will be loaded by the CacheManager's classloader, not the environment's classloader.
- public static CacheManager getCacheManager(ClassLoader classLoader)
- public static CacheManager getCacheManager(ClassLoader classLoader, String name)

Creating a CacheManager

ServiceLoader Creation

We support the Java 6 java.util.ServiceLoader creational approach. It will automaticaly detect a cache implementation in your classpath. You then create a CacheManager with:

CacheManager cacheManager = CacheManagerFactory.getCacheManager();

or more fully:

CacheManager cacheManager = CacheManagerFactory.getCacheManager(“app1”, Thread.currentThread().getContextClassLoader());

“new” Creation

CacheManager cacheManager = new RICacheManager(“app1”, Thread.currentThread().getContextClassLoader());

Creating a Cache

To programmatically configure a cache named “testCache” which is set for read-through

```
CacheManager cacheManager = getCacheManager();
Cache testCache = cacheManager.createCacheBuilder(“testCache)
.setReadThrough(true).setSize(Size.UNLIMITED).
.setExpiry(Duration.ETERNAL).build();
```

Using a Cache

You get caches from the CacheManager. To get a cache called “testCache”:

```
Cache<Integer, Date> cache = cacheManager.getCache(“testCache”);
```

Putting a value in a Cache

```
Cache<Integer, Date> cache = cacheManager.getCache(cacheName);
Date value1 = new Date();
Integer key = 1;
cache.put(key, value1);
```

Getting a Value

```
Cache<Integer, Date> cache = cacheManager.getCache(cacheName);
Date value2 = cache.get(key);
```

Removing a mapping

```
Cache<Integer, Date> cache = cacheManager.getCache(cacheName);
Integer key = 1;
cache.remove(1);
```

Exposing the underlying Cache's API

Unwrap Method on Cache

```
<T> T unwrap(java.lang.Class<T> cls);
```

Ehcache Example

```
net.sf.ehcache.Cache cache =
javax.cache.cache.unwrap(net.sf.ehcache.Cache.class);
```

IDE API Review

Annotations

JSR107 introduces a standardised set of caching annotations, which do ***method level caching interception*** on annotated classes running in **dependency injection containers**.

Caching annotations are becoming increasingly popular:

- Ehcache Annotations for Spring
- Spring 3's caching annotations.

Annotation Operations

The JSR107 annotations cover the most common cache operations including:

- @CacheResult
- @CachePut
- @CacheRemoveEntry
- @CacheRemoveAll

Specific Overrides

```
public class DomainDao {
  @CachePut(cacheName="domainCache")
  public void updateDomain(String domainId, @CacheKeyParam int index,
     @CacheValue Domain domain) {
     ...
  }
}
```

Fully Annotated Class Example

```
public class BlogManager {
    @CacheResult(cacheName="blogManager")
    public Blog getBlogEntry(String title) {...}

    @CacheRemoveEntry(cacheName="blogManager")
    public void removeBlogEntry(String title) {...}

    @CacheRemoveAll(cacheName="blogManager")
    public void removeAllBlogs() {...}

    @CachePut(cacheName=”blogManager”)
    public void createEntry(@CacheKeyParam String title, @CacheValue Blog blog) {...}

    @CacheResult(cacheName="blogManager")
    public Blog getEntryCached(String randomArg, @CacheKeyParam String title){...}
}
```

Wiring Up Spring

```
<beans ...>
    <context:annotation-config/>
    <jcache-spring:annotation-driven proxy-target-class="true"/>

    <bean id="cacheManager" class="javax.cache.Caching"
                factory-method="getCacheManager" />
    <bean class="manager.CacheNameOnEachMethodBlogManagerImpl"/>
    <bean class="manager.ClassLevelCacheConfigBlogManagerImpl"/>
    <bean class="manager.UsingDefaultCacheNameBlogManagerImpl"/>
</beans>
```

Wiring Up CDI

1. Create an implementation of javax.cache.annotation.BeanProvider

2. Declare a resource named javax.cache.annotation.BeanProvider in the classpath at /META-INF/services/.

For an example using the Weld implementation of CDI, see the CdiBeanProvider in our CDI test harness.

More Information

Jumping Off Point to Everything Else

https://github.com/jsr107/jsr107spec

Maven Snippet

```
<dependency>
  <groupId>javax.cache</groupId>
  <artifactId>cache-api</artifactId>
  <version>0.x</version>
</dependency>
```