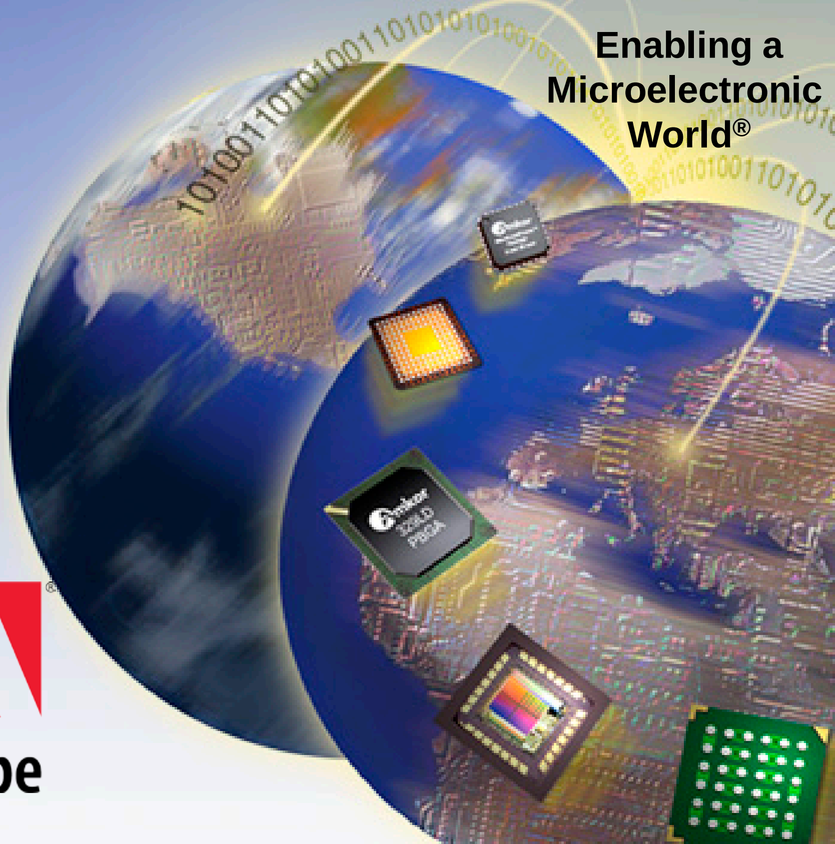
# Greater Memory Management with ColdFusion 9 & Ehcache 2.4

## Rob Brooks-Bilson

June, 2011



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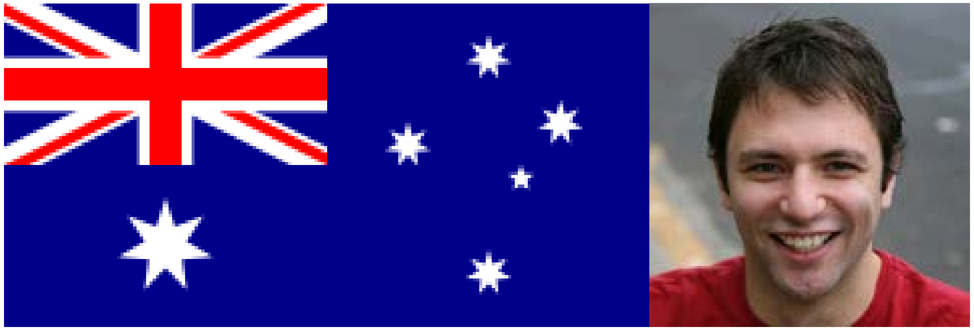
# What we'll Cover

- Ehcache Overview
- What's new in ColdFusion 9.0.1 and Ehcache 2.0
- Ehcache Enhancements Post 2.0
- Upgrading Ehcache
- Cache Search
- Cache Replication
- Distributed Caching
- Big Memory
- Cache Monitoring
- Q&A

# Ehcache Overview



“EE H Cayche”

“EE H Cash”

Written as Ehcache or ehcache, not ehCache or EhCache

# Ehcache Overview

- De facto cache for Enterprise Java and ColdFusion
- Over 500,000 implementations
- Can be configured to run:
  - Local: In-process
  - Replicated: In-process
  - Distributed: In-process and Out-of-process
- Cached items are stored in memory as key/value pairs
- Supports disk stores for cache overflow
- Implemented as ColdFusion 9’s caching provider for fragment, object and 2nd level Hibernate caching
- Also available in Railo as of 3.1.2

# Ehcache Overview

- Ehcache is fast
  - In-process caches are generally faster than out-of-process caches
  - No serialization required for objects written to memory
  - Order of magnitude faster than caching with MemcacheD or a NoSQL database
- Supports LRU, LFU, FIFO and Expiration Timeouts
- Cache-level operations are thread safe
- Ehcache can scale both vertically and horizontally
  - By default Ehcache runs within CF's JVM
    - Cache size is limited by the amount of memory available to CF's single jvm
    - You can cluster ehcache servers, but data is replicated among them
  - Ehcache 2.0 adds distributed caching via Terracotta
    - Open Source version allows for one active and one backup node
- Ehcache Enterprise
  - Built-in distributed caching – Terabyte Scale
  - Commercial support
  - Added enterprise features for production operation

# Ehcache vs. Persistent Variable Scopes

- Why use Ehcache when ColdFusion already lets you store data in persistent scopes and the query cache?
- Both session/application variables, the ColdFusion query cache and Ehcache implement a HashMap
- In simple cases, performance across all three caching methods may be relatively equal
- Ehcache advantages:
  - Performs well regardless of load
  - Easily replicated/distributed
  - Flexible eviction policies
  - Self-managing
  - Comprehensive monitoring and statistics
  - Search
  - Big Memory

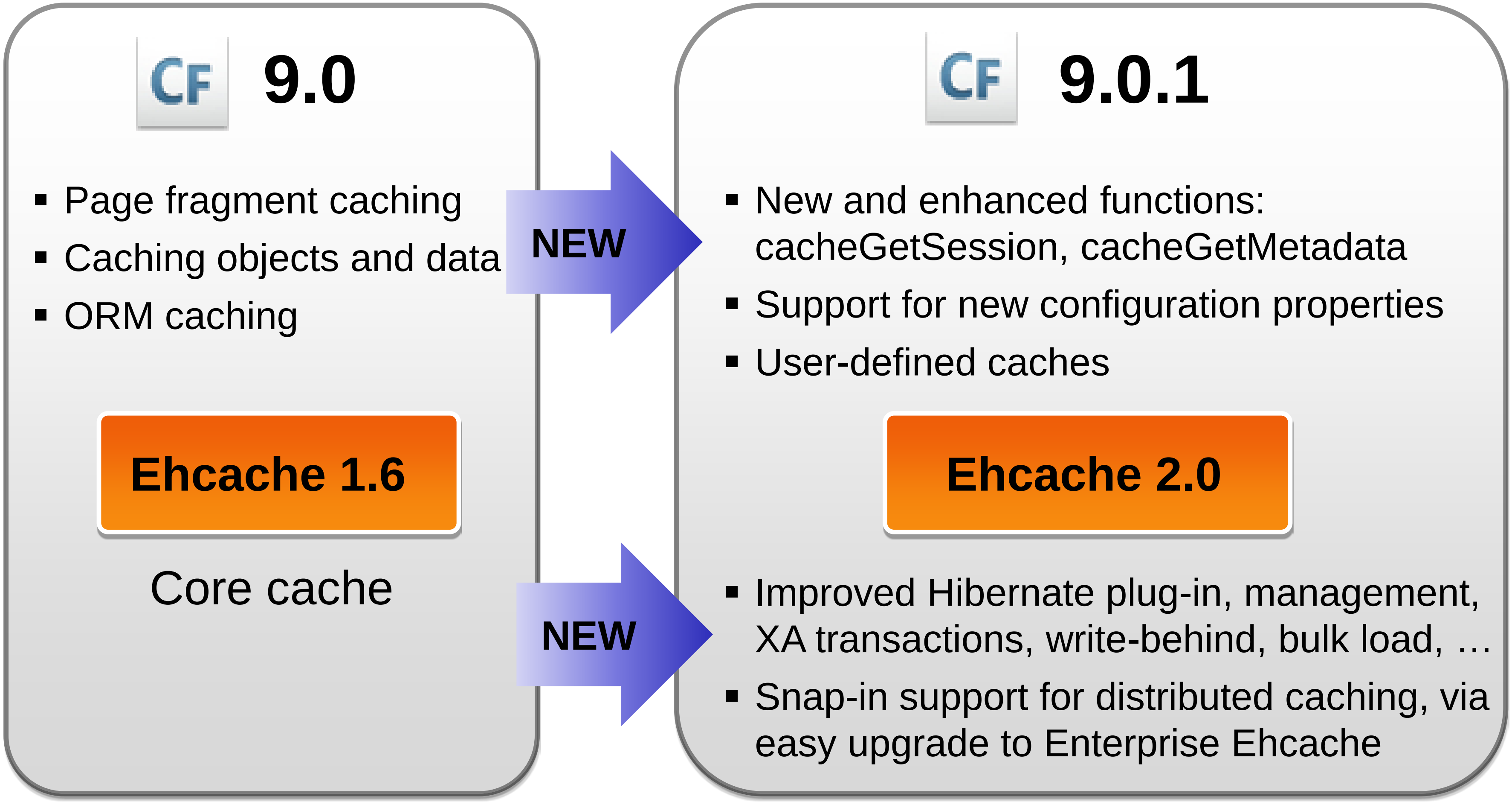
# Ehcache vs. NoSQL

- Use cases are different
  - Distributed cache vs. Big Data persistence
  - Low latency/speed vs. Durability
- Ehcache is always faster than NoSQL
  - Hot data is always kept in-process in Ehcache
  - All NoSQL solutions as well as Memcached are out-of-process
  - In-process is always faster than out-of-process
  - Ehcache in-process access is < 1 μs
  - Ehcache out-of-process (Terracotta) access is < 2ms

# Ehcache Editions

| | Open Source | DX | EX | FX |
|---|---|---|---|---|
| Ehcache Open Source Features and Modules | X | X | X | X |
| Query, search and analysis for distributed cache | Single Node | Single Node | Distributed | Distributed |
| Server array with striping for linear scale | | | | X |
| High availability | | | X | X |
| High performance data persistence | | | X | X |
| In-memory performance as you scale | | | X | X |
| Wide-area network (WAN) replication (add-on module) | | | X | X |
| Comprehensive cache management | | | X | X |
| Visual cache tuning | | X | X | X |
| Operations console \| monitor \| 3rd party monitoring integration | X | X | X | X |
| Enterprise-class 24x7 production and developer support | | X | X | X |
| Certified software, updates, and patches | | X | X | X |
| Commercial license and legal indemnification | | X | X | X |

# ColdFusion Caching – What's New



CF 9.0

- Page fragment caching
- Caching objects and data
- ORM caching

Ehcache 1.6

Core cache

NEW

NEW

CF 9.0.1

- New and enhanced functions: cacheGetSession, cacheGetMetadata
- Support for new configuration properties
- User-defined caches

Ehcache 2.0

- Improved Hibernate plug-in, management, XA transactions, write-behind, bulk load, …
- Snap-in support for distributed caching, via easy upgrade to Enterprise Ehcache

# Ehcache Enhancements Post 2.0

- Dozens of bug fixes
- Faster performance
- New features:
  - Cache Search
  - copyOnRead and copyOnWrite
  - Explicit locking API
  - Nonstop Cache
  - New consistency modes: Strong and Eventual
  - Local and XA transactions
  - XA Transactions for non clustered caches

# Upgrading Ehcache

| | |
|---|---|
| Add 5 grilled prawns to any steak | extra £1.49 |
| Add pepper sauce on the side | extra 79p |

UPGRADE YOUR CHIPS TO WEDGES FOR AN EXTRA 49P

Bal

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flat

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Caution!

Upgrade at Your Own Risk

# Upgrading to Newer Versions of Ehcache

1. Download the latest version of Ehcache
2. Extract ehcache-core-2.4.2.jar into your ColdFusion /lib directory
3. Rename your existing ehcache.jar file to ehcache.original
4. Restart you ColdFusion server

# Cache Search

# Cache Search

- Available starting in Ehcache 2.4.0
- Single node for open source Ehcache
  - Multi-node requires Enterprise Ehcache and Enterprise Terracotta
- Support for simple and compound expressions:
  - Additional clauses automatically *and*

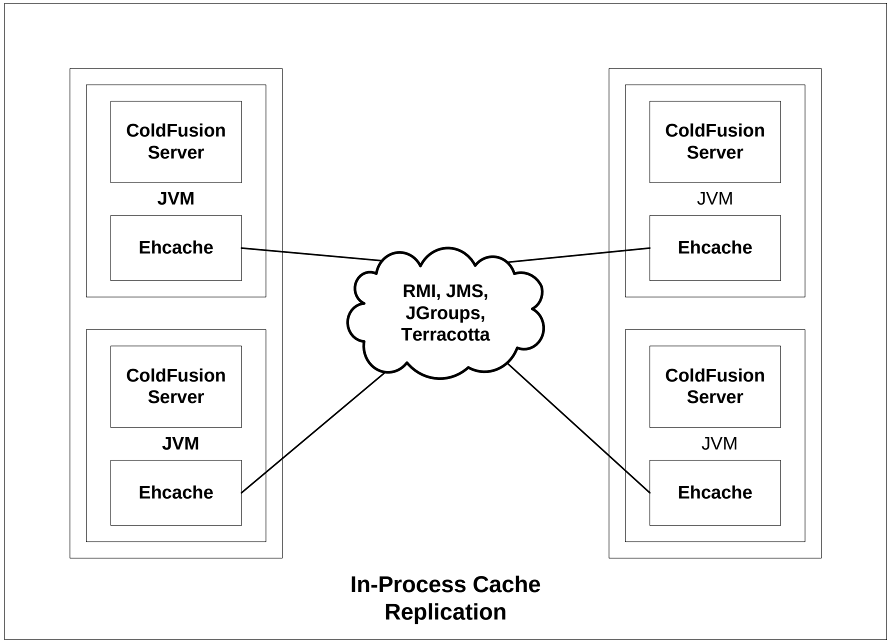
# Search Operators

| Shorthand | Criteria Class | Description |
|---|---|---|
| and | And | The Boolean AND logical operator |
| between | Between | A comparison operator meaning between two values |
| eq | EqualTo | A comparison operator meaning Java "equals to" condition |
| gt | GreaterThan | A comparison operator meaning greater than. |
| ge | GreaterThanOrEqual | A comparison operator meaning greater than or equal to. |
| in | InCollection | A comparison operator meaning in the collection given as an argument |
| lt | LessThan | A comparison operator meaning less than. |
| le | LessThanOrEqual | A comparison operator meaning less than or equal to |
| ilike | ILike | A regular expression matcher. '?' and "*" may be used. Note that placing a wildcard in front of the expression will cause a table scan. ILike is always case insensitive. |
| not | Not | The Boolean NOT logical operator |
| ne | NotEqualTo | A comparison operator meaning not the Java "equals to" condition |
| or | Or | The Boolean OR logical operator |

# Cache Replication

# Cache Replication in ColdFusion 9

- Object, Template and Hibernate caches can be replicated
- Simple configuration via ehcache.xml file
- Cache replication via RMI, JMS, JGroups or Terracotta
- Replication can be synchronous or asynchronous



In-Process Cache Replication

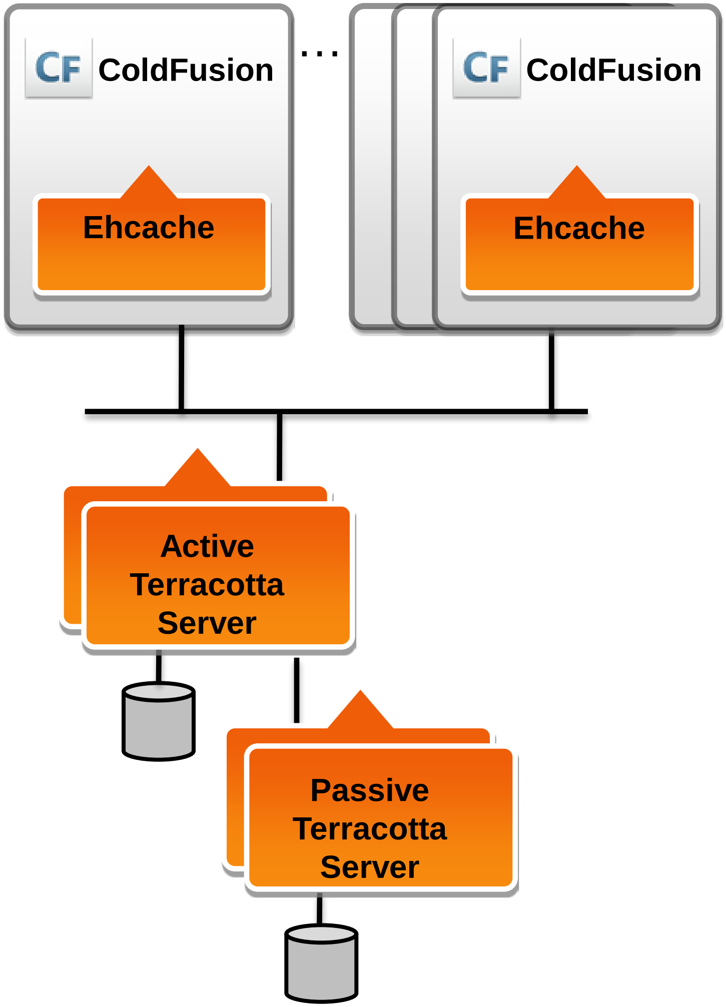
# Potential Replication Gotchas

- Synchronous vs. Asynchronous delivery
  - Asynchronous replication is the fastest method
    - Because it’s asynchronous the caller returns immediately
    - Messages are placed in a queue and batched via RMI as they are processed
    - Potential for data inconsistency exists
  - Synchronous
    - Removes potential for data inconsistency
    - Slower operation as caller waits for replication to complete before returning
- Time To Idle
  - Inconsistent with replicated caching
  - Data on some nodes will live longer than on others due to cache usage patterns
  - Do not use unless you don’t care about inconsistent  data across cache nodes

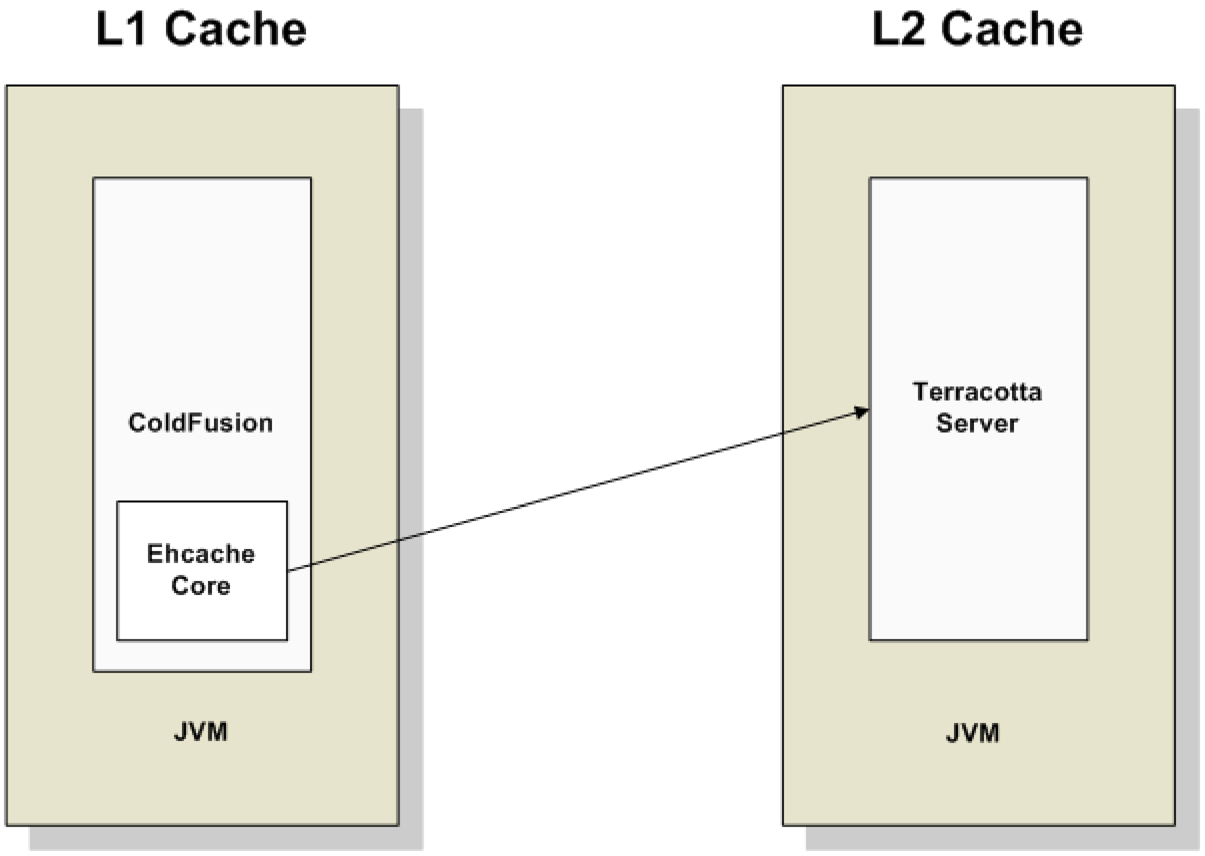
# Distributed Caching

# Distributed Caching: Ehcache Core with Terracotta Server

- Open source license
- Terracotta runs out-of-process
- Single active node + passive backup
- Works with single node ehcache or replicated ehcache
- Simple config via ehcache.xml
- Supports template, object & hibernate caches



# Ehcache/Terracotta Tiered Caching Architecture



L1 Cache

ColdFusion

Ehcache Core

JVM

L2 Cache

Terracotta Server

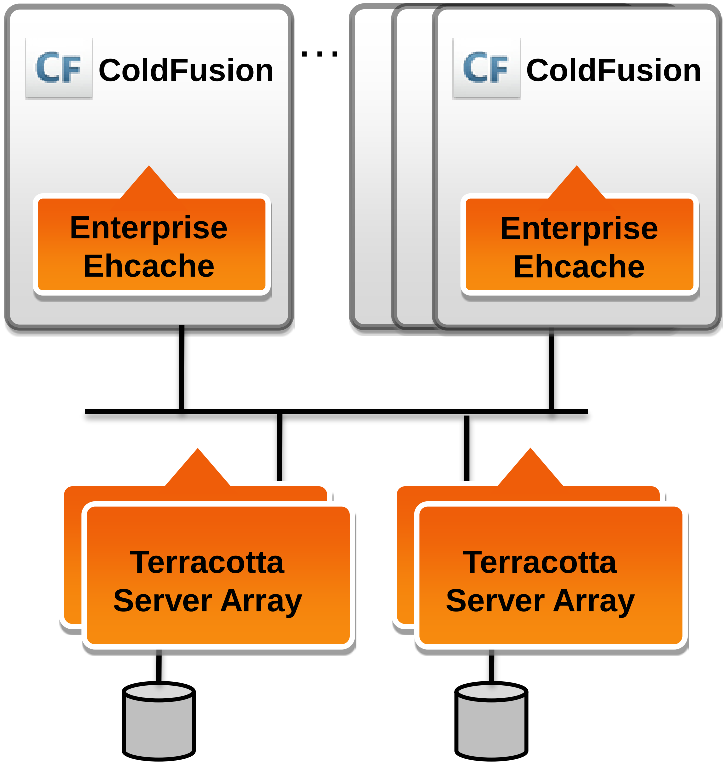
JVM

20% of Total Items in Cache
80% of Cache Hits
Access Time < 1 Microsecond

100% of Items in Cache
20% of Cache Hits
Access Time <2 Millisecods

# Distributed Caching: Enterprise Ehcache with Terracotta Server Array

- Commercial license
- “Snap-in scale”
- Same API
- High data capacity: 1TB+
- Highly available
- Coherent–i.e., drift-free data consistency between machines
- Flexible–you set the cache semantics based on business requirements



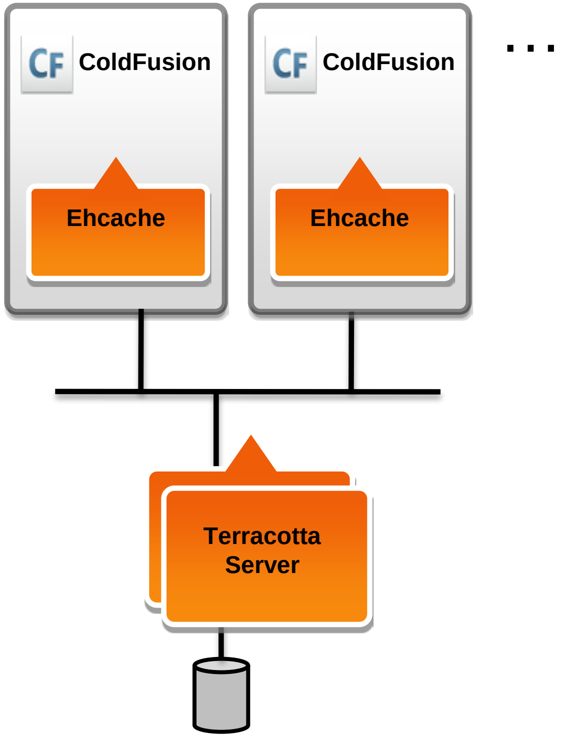
# Distributed Caching in ColdFusion

*3 Easy Steps, 2 Lines of Config*

1. Add the following jar files for Terracotta 3.5.1 / Ehcache 2.4.2:

   ehcache-terracotta-2.4.2.jar
   terracotta-toolkit-1.2-runtime-3.1.0.jar
   slf4j-api-1.6.1.jar
   slf4j-log4j12-1.6.1.jar
   slf4j-jdk14-1.6.1.jar

*You'll be updating some of ColdFusion's existing slf4j files

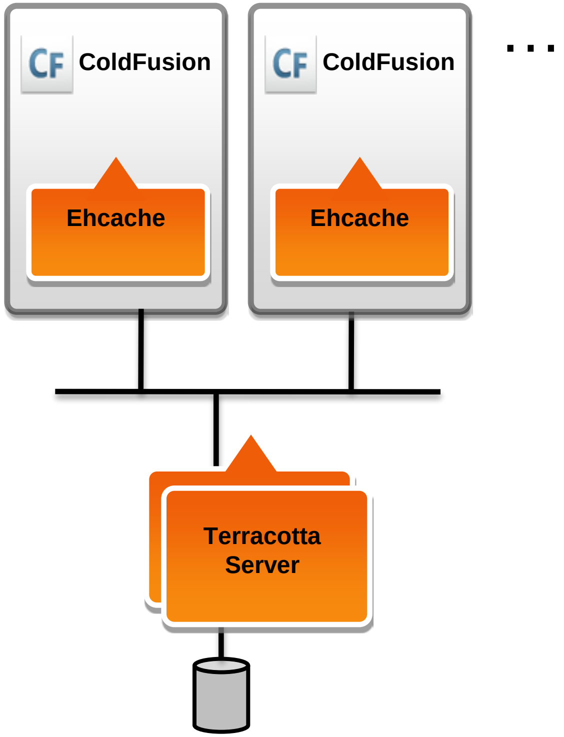


# Distributed Caching in ColdFusion

*3 Easy Steps, 2 Lines of Config*

## 2. Edit your ehcache.xml

```
<ehcache>

        <terracottaConfig url="someserver:9510"/>

        <defaultCache
                maxElementsInMemory="10000"
                timeToLiveSeconds="120">

          <terracotta clustered="true">

        </defaultCache>

</ehcache>
```



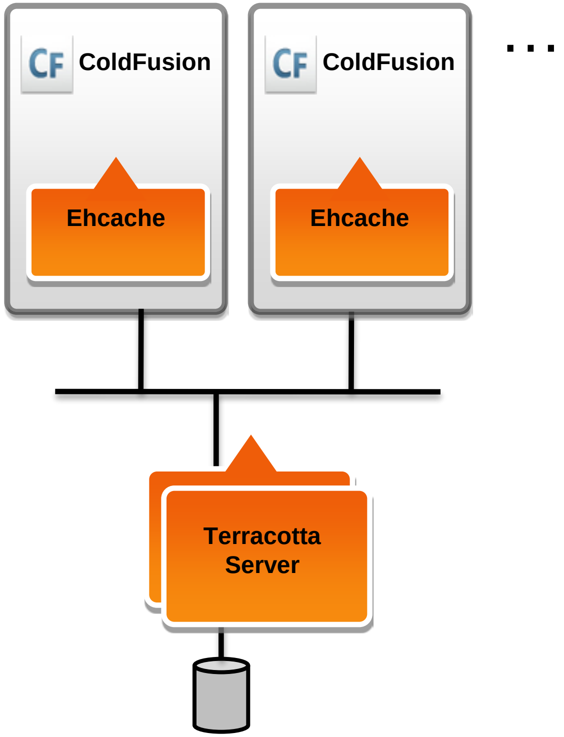
# Distributed Caching in ColdFusion

## *3 Easy Steps, 2 Lines of Config*

3. Start the Terracotta server, then restart ColdFusion

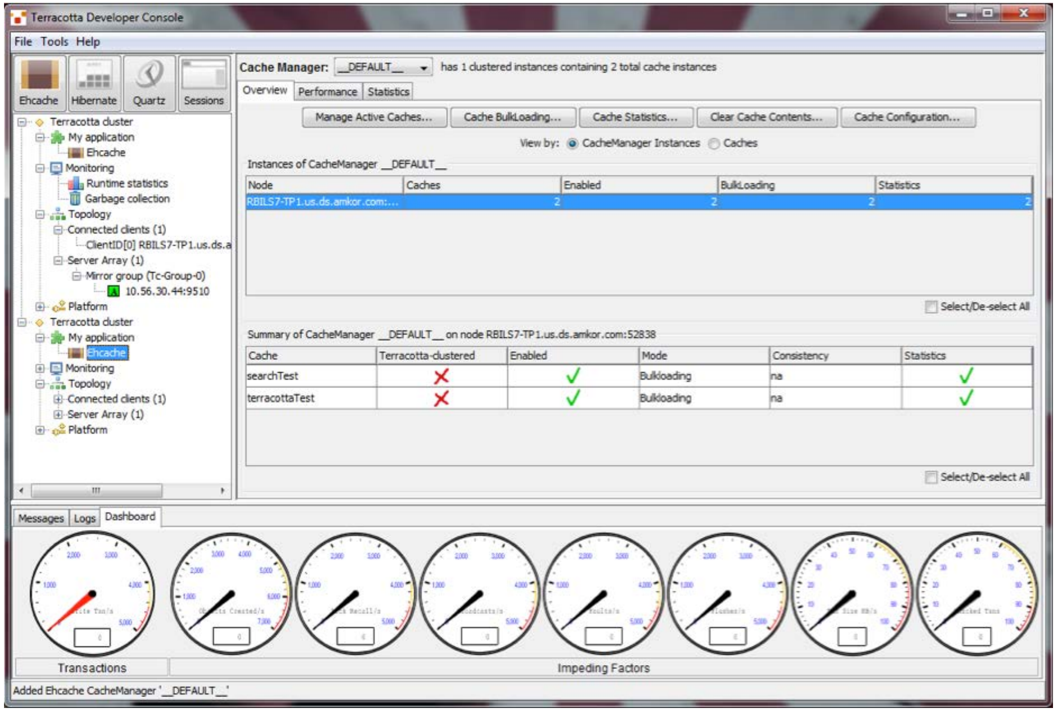
```
bin/start-tc-server.sh
```

*Note that the Terracotta server must be running before you bring up your ColdFusion server otherwise ColdFusion will hang when Ehcache can't get a connection to the Terracotta server.



# Developer Console

- Client app to monitor Ehcache, Hibernate Cache, Web Sessions and Quartz Scheduler
- For Ehcache:
  - Caches
  - Statistics
  - Config
- For Hibernate:
  - Hibernate cache view
  - Hibernate cache stats



Cache Manager: __DEFAULT__ has 1 clustered instances containing 2 total cache instances

View by: ● CacheManager Instances ○ Caches

Instances of CacheManager __DEFAULT__

| Node | Caches | Enabled | BulkLoading | Statistics |
|---|---|---|---|---|
| RBILS7-TP1.us.ds.amkor.com:... | 2 | 2 | 2 | 2 |

□ Select/De-select All

Summary of CacheManager __DEFAULT__ on node RBILS7-TP1.us.ds.amkor.com:52838

| Cache | Terracotta-clustered | Enabled | Mode | Consistency | Statistics |
|---|---|---|---|---|---|
| searchTest | ✗ | ✓ | Bulkloading | na | ✓ |
| terracottaTest | ✗ | ✓ | Bulkloading | na | ✓ |

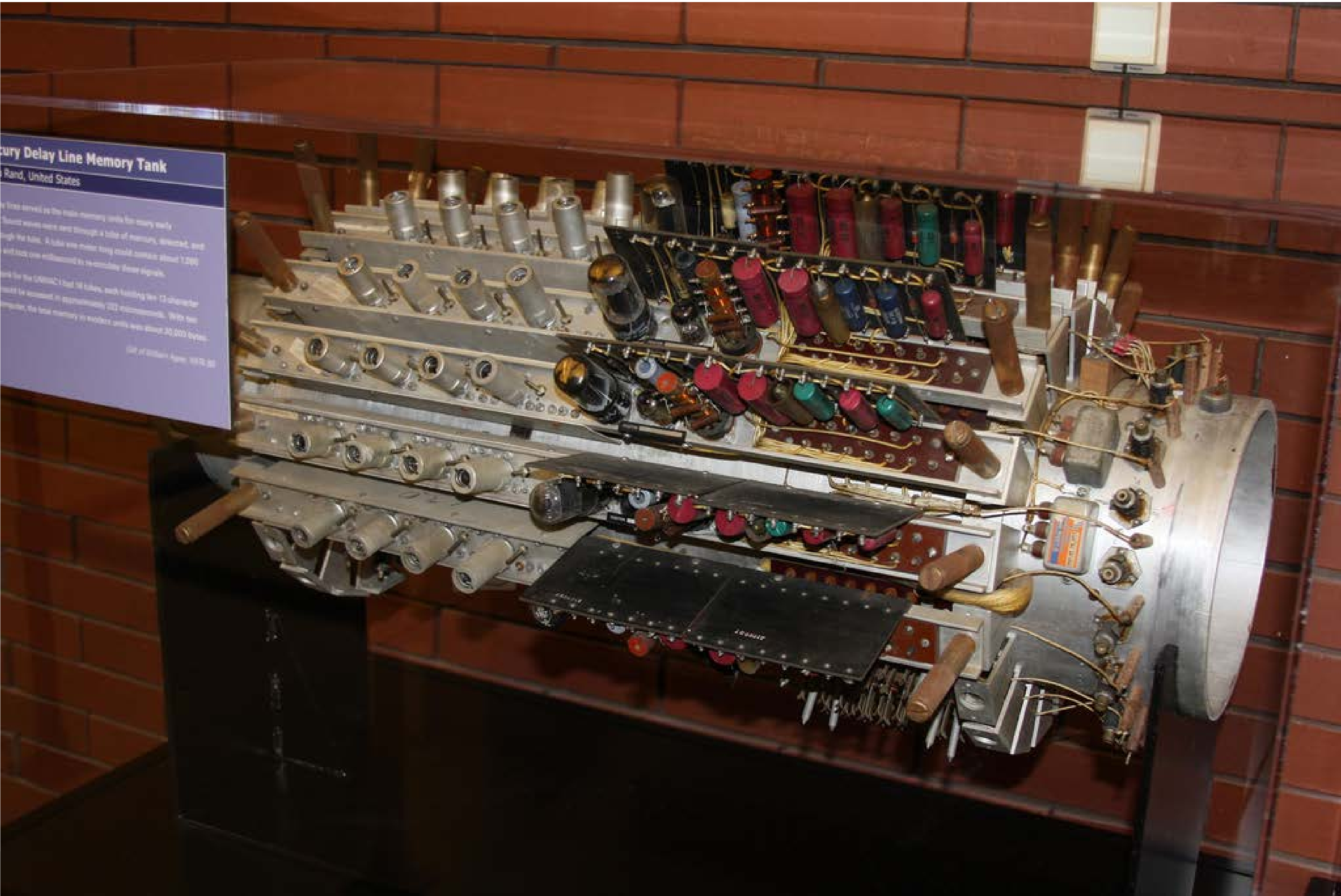
□ Select/De-select All

Added Ehcache CacheManager '__DEFAULT__'

# Terracotta Editions

| Terracotta Software | Open Source | Commercial |
|---|---|---|
| Linear unlimited Terabyte scale and Terracotta Server Array data striping | | X |
| Enterprise-class operations and management capabilities | | X |
| Authentication, authorization and security features | | X |
| Search for distributed cache | | X |
| Quartz Where cluster locality API | | X |
| Enterprise-class 24x7 support | | X |
| Certified software, updates, patches, & legal indemnification | | X |
| Industry-standard Java cache (Ehcache) | X | X |
| Industry-standard Hibernate cache (Ehcache for Hibernate) | X | X |
| Industry-standard Java scheduler (Quartz) | X | X |
| High-performance web cache and coherent, distributed sessions cache | X | X |
| Performance, reliability, and scalability for Spring applications | X | X |
| Terracotta server to provide coherent scale and HA for all technologies | X | X |

# BigMemory



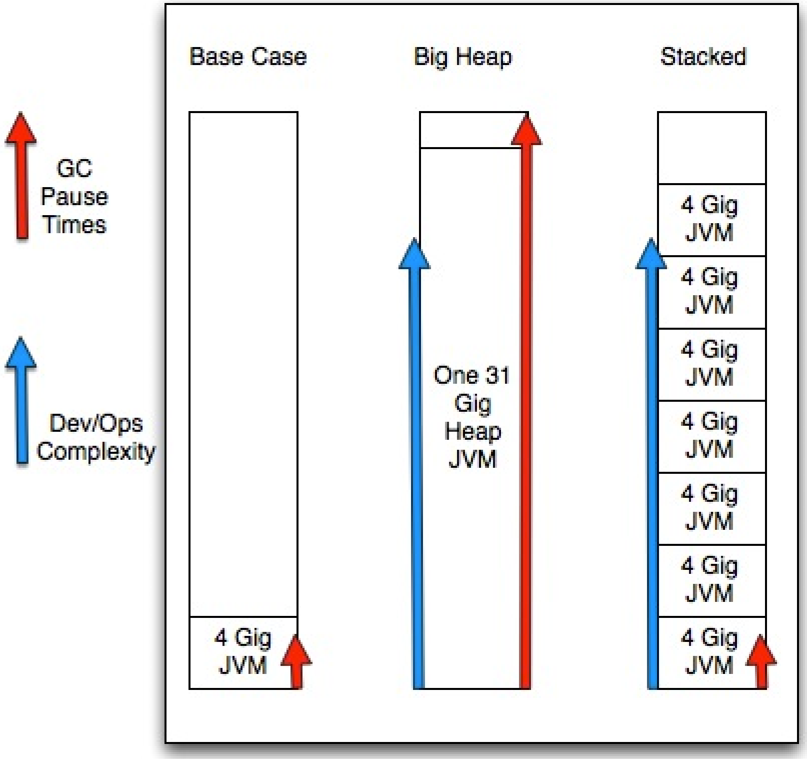
"640K ought to be enough for anybody."

Attributed to Bill Gates, although he denies it

# Problems with Application Scalability on the JVM

- Slow Applications lead to caching
- Large caches lead to latency from Garbage Collection pauses
- GC pauses necessitate JVM tuning
- Application usage and data grows
- More caching is needed
- More JVM tuning is needed
- As cache size increases, more heap memory is used
- More heap memory usage results in unpredictable and longer GC pauses
- Eventually you hit a wall
- Add more JVMs
- Increased deployment and management complexity
- Tune! Tune! Tune!

Today's 32 Gig 16 Core Servers Using Java



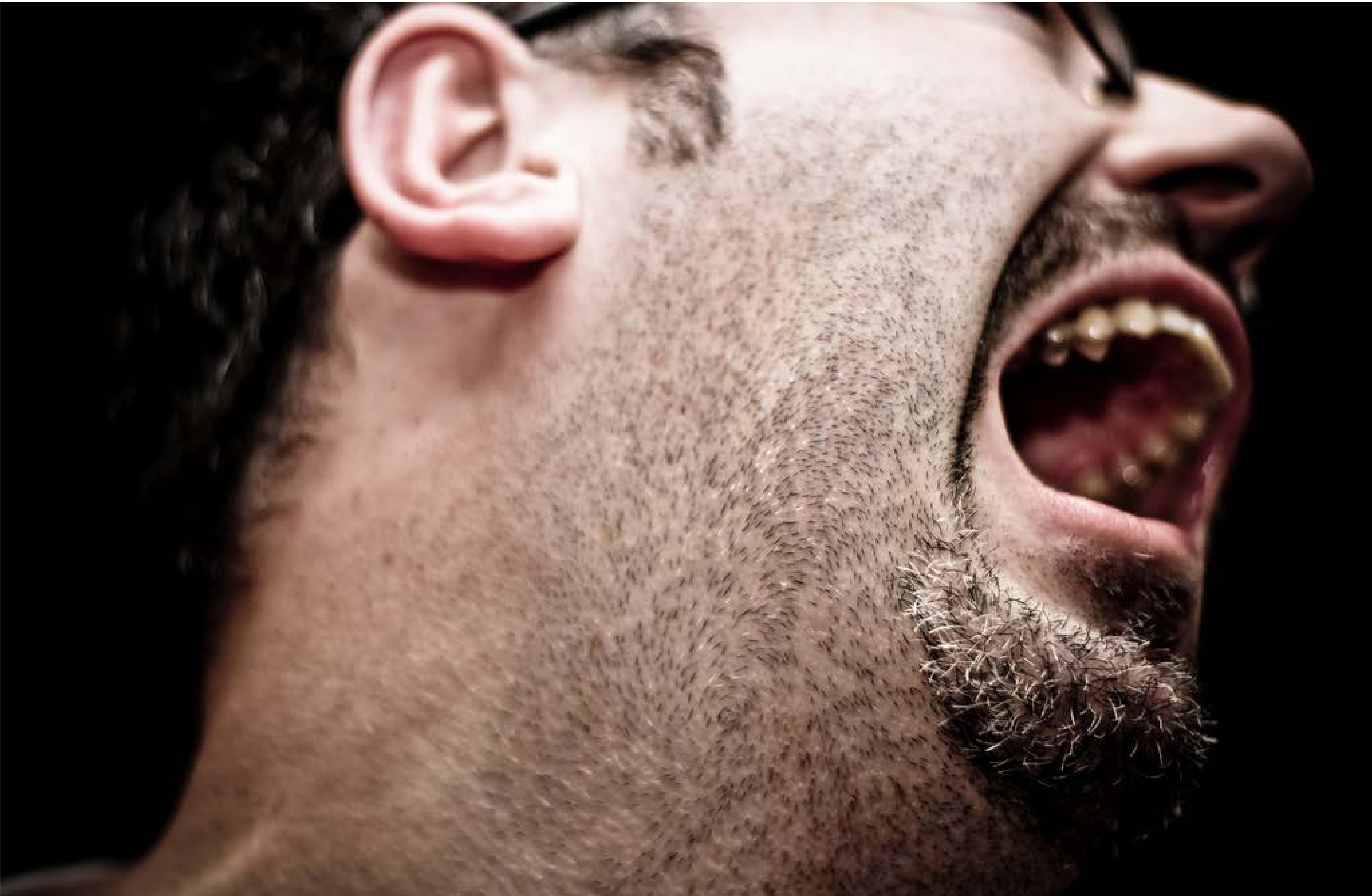
# The Problem with Memory and the JVM

- RAM is outpacing the JVM
  - 32GB is now fairly standard on most servers
  - Amazon EC2 allows for up to 68.4GB
  - Most of that memory is used inefficiently if it’s used at all
- Cached data ages differently than standard business objects which can confuse the Java garbage collector
  - The cache expiration determines when the data becomes garbage
- And then there's tuning…

# GC Tuning – It’s a Black Art

# GC Tuning –Ninja Skills?

# GC Tuning – It Can Be Painful



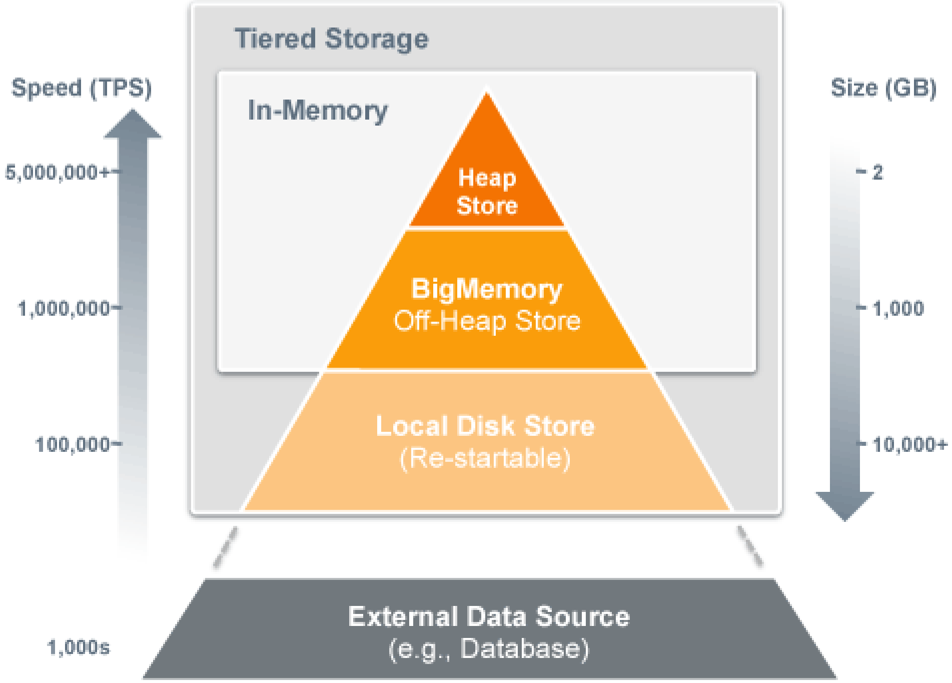
# GC Tuning – Frustrating!

# GC Tuning – Why Torture Yourself?

# BigMemory to the Rescue

- Cache huge amounts of data with no GC pauses
- Easy to implement
  - Pure Java implementation
  - Works with all JVMs
  - Works with both standalone and distributed caches
  - No application code changes necessary to implement
- Avoid GC because of pauses
  - Off heap store on direct memory buffers
  - 1 million puts per second
  - Tested up to 350GB
  - 1 line of config to use it
  - JVM doesn’t have to search for garbage because we already know when a cache item needs to be thrown out (cache expiry)
- Commercial product

# Tiered Storage



# BigMemory Basic Configuration

ehcache.xml:

```
<cache name="sample-offheap-cache"
  maxElementsInMemory="10000"
  eternal="true"
  memoryStoreEvictionPolicy="LRU"
  overflowToOffHeap="true"
  maxMemoryOffHeap="1G"/>
```

JVM Config:

```
-XX:MaxDirectMemorySize=2G
```

# Ehcache Monitor

# Ehcache Monitor

- Free for development, commercial license for production
- Monitor multiple cache servers from a single web console
- Two components:
  - Probe
    - ehcache-probe-1.0.2.jar
    - Install in same directory as your ehcache.jar file
  - Server
    - Standalone server
    - May be installed local or remote
- Simple config
  - Add a cacheManagerPeerListenerFactory to ehcache.xml
  - Uncomment the server and port
- Stats are transmitted via XML over HTTP

# Resources

- Ehcache: http://ehcache.org/
- ColdFusion 9 Documentation
- Using Ehcache with ColdFusion: http://ehcache.org/documentation/coldfusion.html
- My Blog Series on Caching in ColdFusion 9: http://www.brooks-bilson.com/blogs/rob/index.cfm/Caching
- High Scalability: http://highscalability.com/
- Building High Performance Applications with ColdFusion 9 and Ehcache 2.4: http://java.dzone.com/articles/building-high-performance

# Q&A

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*Questions about Adobe*

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Visit www.terracotta.org/webcasts to register for our upcoming webcast on June 29th. Learn more about implementing ColdFusion and Ehcache from Full Sail University.

SNAP IN SPEED UP SCALE OUT