ORACLE

Elastic Data

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Agenda – Elastic Data

- Inception
- High Level Objectives
- Implementation Details
- Configuration
- More Details
- Collector

Traditional Stores

Backing Map Implementations

- LocalCache
  - In-memory binary map
  - Eviction / Expiry support

// MFU

// Allocations on heap

- External scheme
  - BDB
  - NIO [file | memory]
  - LH

// Sparse Usage

// Avoid LH

- ReadWriteBackingMap

// Coordinator

Local Cache

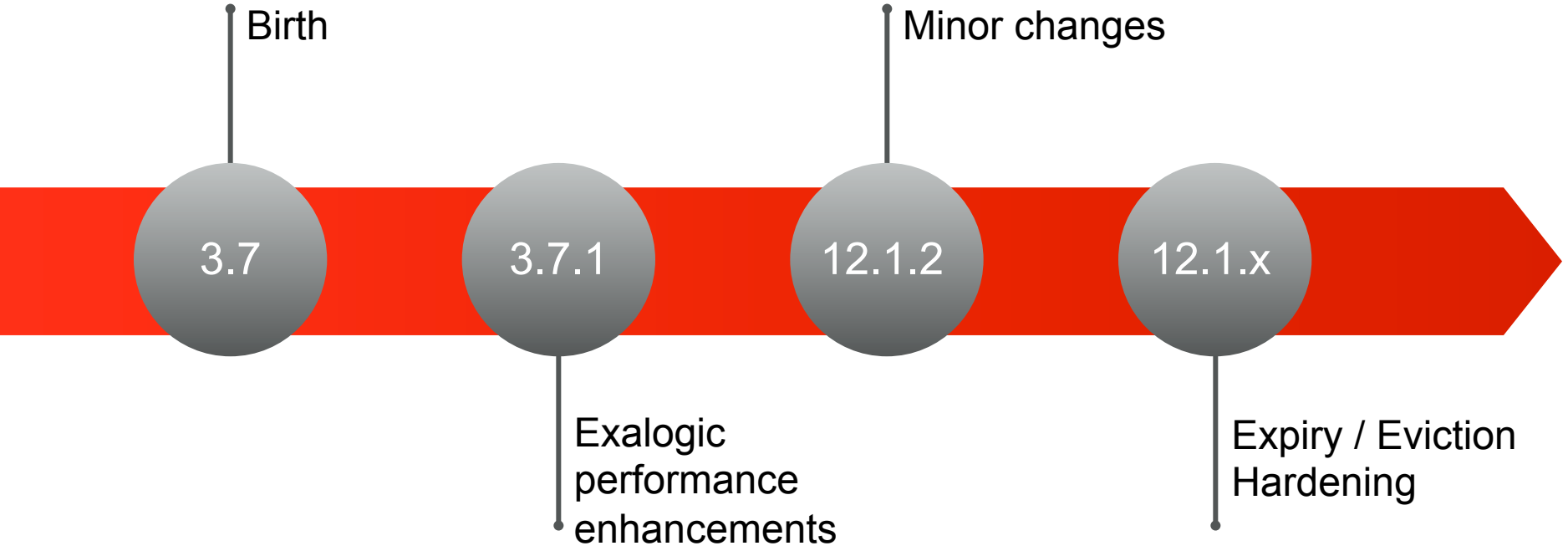
~~Disadvantages~~ Imperfections

- Allocations made on heap
  - Objects treated the same as any other allocations
- High storage in a backing map == Large heap
- Unable to isolate scratch space from application storage

Elastic Data: High Level Objectives

- Both RAM and Disk (off heap) based stores
- Retain keys in memory with tickets
- Journaling – append only
- Overflow from RAM to Disk
- Big Data – we manage the (de)allocations thus compaction

Elastic Data Over Time



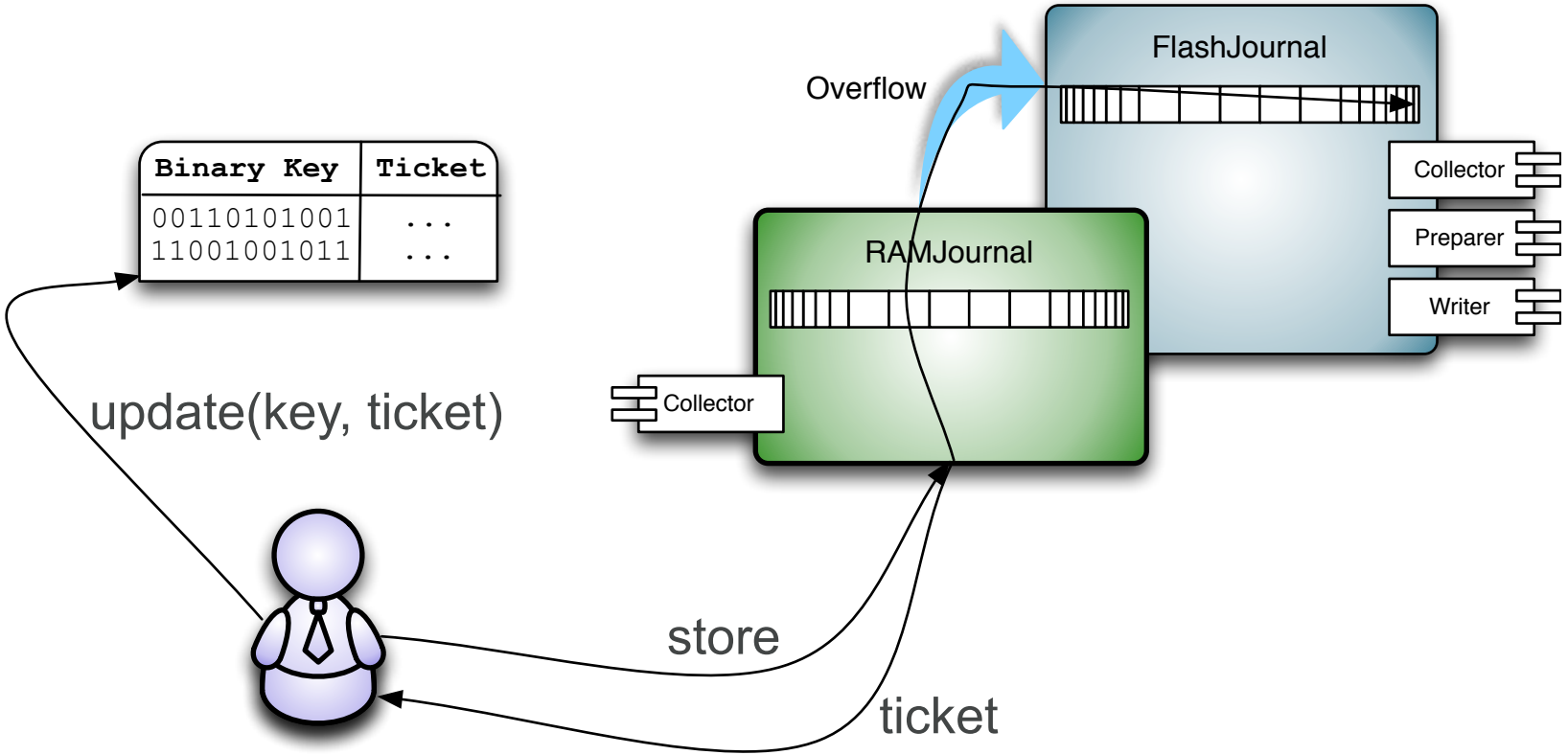
Implementation Details

- Resource Managers (RamJournalRM, FlashJournalRM)
  - Scoped to member
  - Manage resources (Journals)
- Hold in-memory structure of keys to tickets
- Ticket returned from the journal after a successful store
- Ticket used to locate binary thus is passed to Journal.read

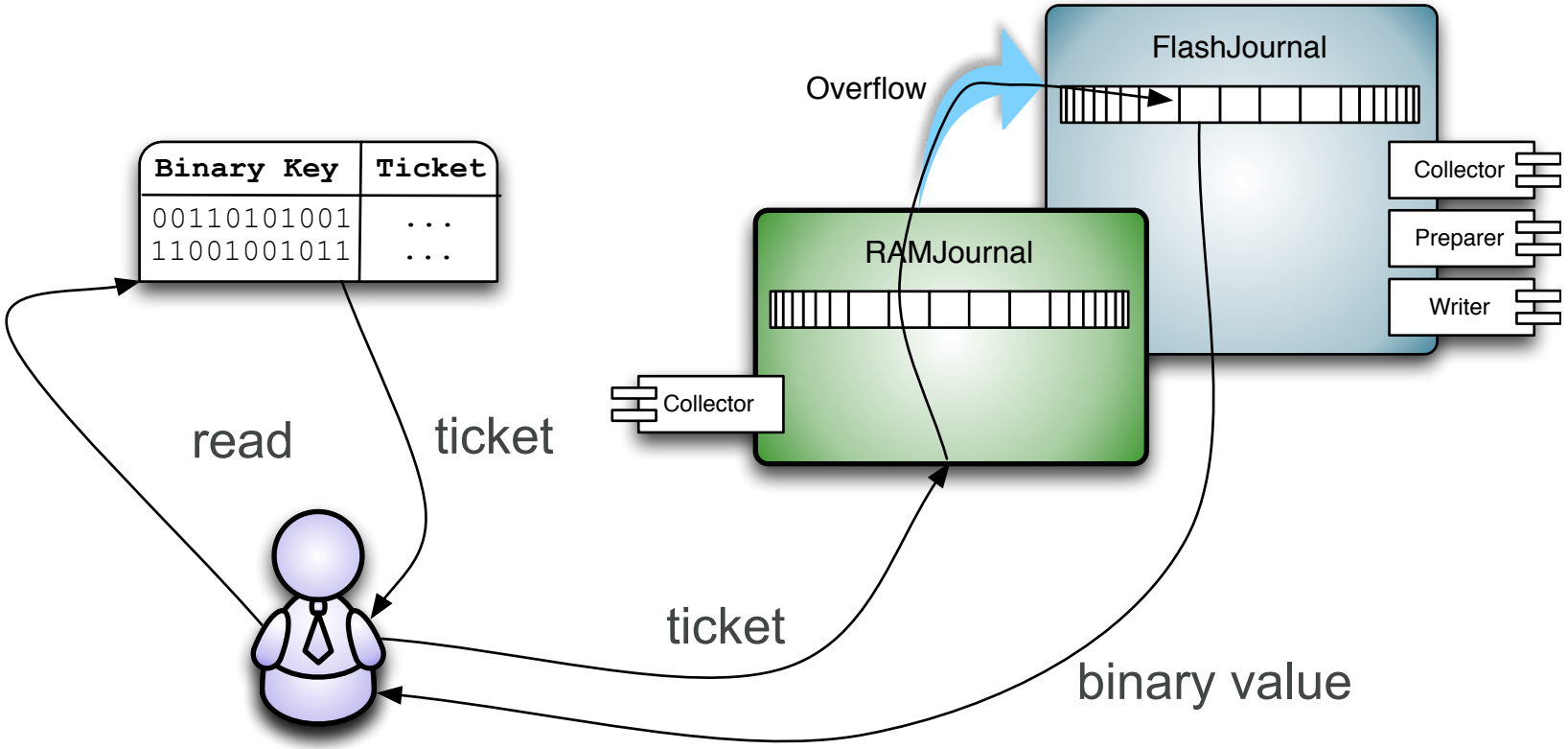
Implementation Details

- Update to an existing entry is an append and release
  - Journaling
- All ResourceManagers require a collector
  - Responsible for garbage collection and compaction (evacuation)
- RAM is always used in conjunction with Disk (Flash)
  - When RAM reaches capacity we overflow to Flash
- Minimal locking; CAS operations where possible

Store flow



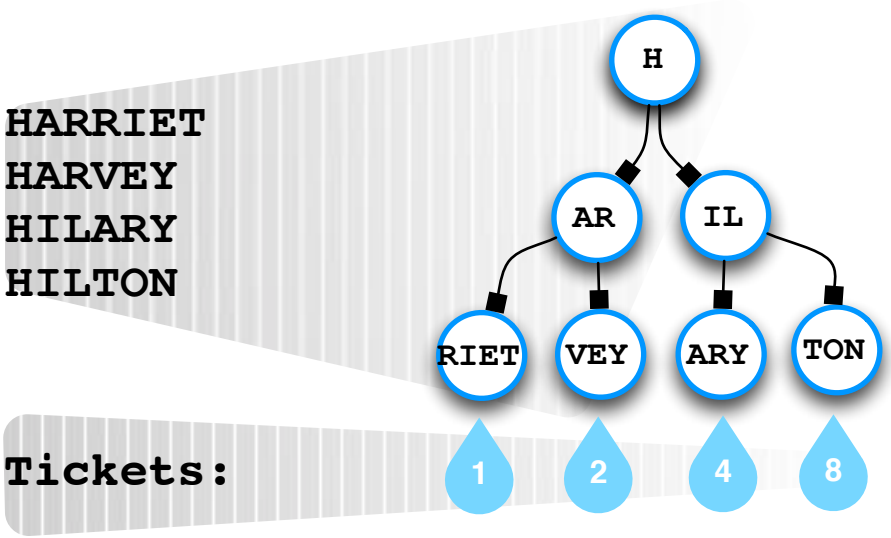
Load flow



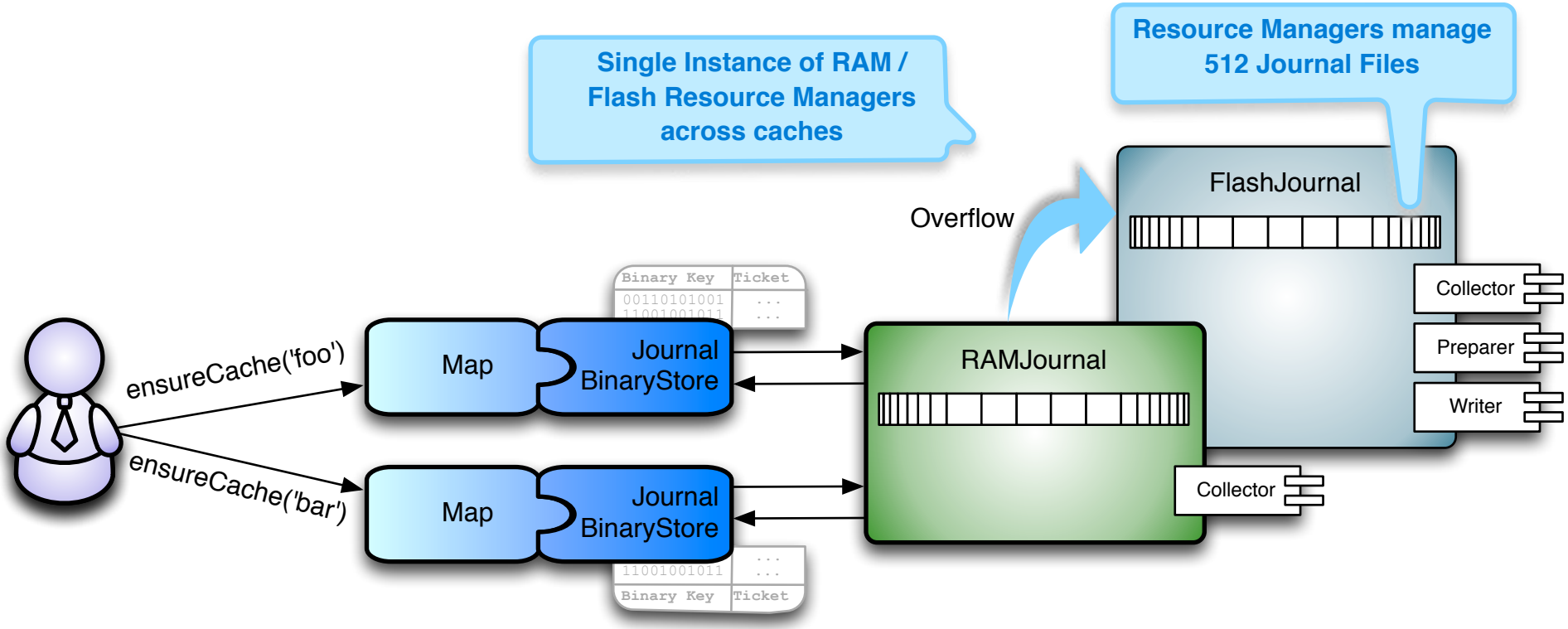
Binary Radix Tree

Keys and Tickets

- Keys are stored in memory but in compact form
- Binary Radix tree allows sharing of common denominators
- Tree instance per partition and cache
  - Increase in (cache & partition) density likely to yield more benefit
  - Specifically common segments in binary values, however tricky to measure



Cache ResourceManagers



Configuration

Overview

- Operational configuration
  - Defines member scoped resource managers
- Cache configuration
  - Defines cache storage implementation
  - No child elements (3.7.1)

```
<coherence>
  <cluster-config>
    <journaling-config>
      <ramjournal-manager>
          ...
      </ramjournal-manager>
      <flashjournal-manager>
          ...
      </flashjournal-manager>
    </journaling-config>
  </cluster-config>
</coherence>
```

```
<cache-config>
  ...
  <caching-schemes>
    <distributed-scheme>
      <scheme-name>dist-ram</scheme-name>
      <backing-map-scheme>
        <ramjournal-scheme/>
      </backing-map-scheme>
    </distributed-scheme>
    ...
  </caching-schemes>
</cache-config>
```

Configuration

RAM Journal

- How utilized a file is to be eligible for compaction
- Maximum amount of storage per file
- Maximum size for each binary value
- Maximum size in total
- Whether NIO should be used opposed to storing on heap

```
<coherence>
  <cluster-config>
    <journaling-config>
      <ramjournal-manager>
        <minimum-load-factor>0.84</minimum-load-factor>
        <maximum-file-size>512K</maximum-file-size>
        <maximum-value-size>128K</maximum-value-size>
        <maximum-size>25%</maximum-size>
        <off-heap>false</off-heap>
      </ramjournal-manager>
      ...
    </journaling-config>
  </cluster-config>
</coherence>
```

Configuration

RAM Journal Validation

- Maximum Size can be percentage of heap
- Maximum File Size == Maximum Size / 512
- Maximum Value Size <= Maximum File Size / 2
- Log statements if values are adjusted due to conflicts with other values

Configuration

Flash Journal

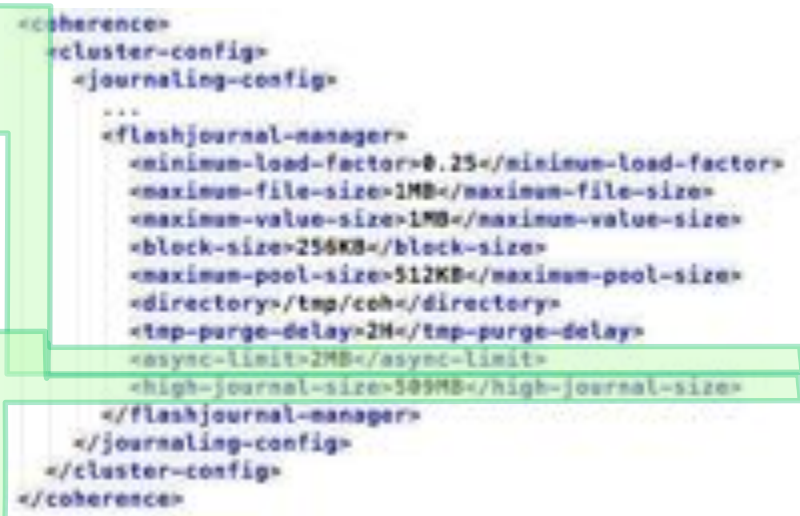
- Batch size to perform writes to file
- Maximum size of buffer prior to writing to disk
  - max-pool-size % block-size == 0
- Mount point for device writes
- Upon startup which files should be eligible for purge

```
<coherence>
  <cluster-config>
    <journaling-config>
      ...
      <flashjournal-manager>
        <minimum-load-factor>0.25</minimum-load-factor>
        <maximum-file-size>1MB</maximum-file-size>
        <maximum-value-size>1MB</maximum-value-size>
        <block-size>256KB</block-size>
        <maximum-pool-size>512KB</maximum-pool-size>
        <directory>/tmp/coh</directory>
        <tmp-purge-delay>2M</tmp-purge-delay>
        <async-limit>2MB</async-limit>
        <high-journal-size>509MB</high-journal-size>
      </flashjournal-manager>
    </journaling-config>
  </cluster-config>
</coherence>
```

Configuration

Flash Journal

- Maximum amount of storage that can be pending to be written to device
  - Will stop further writes until writing to the device catches up
- How much memory should be used to enter an aggressive collection mode



Configuration

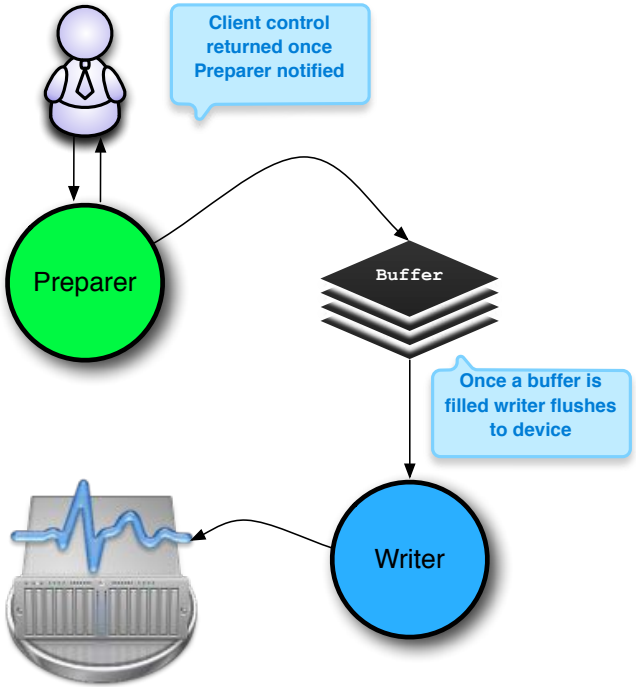
Flash Journal Validation

- Block size must be a 2^x
- Pool Size % Block Size == 0
- 4K <= Async Limit <= 1GB
- High Journal Size > Max File Size

Flash Journal

- Writes performed asynchronous to store
- A couple of threads co-ordinate to perform writing
- Inbuilt flow control mechanism to ensure writer is not overwhelmed

Flash Journal




```
$ kill -3 pid
Full thread dump Java HotSpot(TM) 64-Bit Server VM (20.14-b01-447 mixed mode):
...
"Journal-Writer" daemon prio=5 tid=7f8dfb844000 nid=0x10d86b000 runnable [10d86a0
   java.lang.Thread.State: RUNNABLE
            at java.lang.Thread.currentThread(Native Method)
            at java.nio.channels.spi.AbstractInterruptibleChannel.blockedOn(Abst
            at java.nio.channels.spi.AbstractInterruptibleChannel.end(AbstractIr
            at sun.nio.ch.FileChannelImpl.write(FileChannelImpl.java:203)
            - locked <7bf64fc68> (a java.lang.Object)
            at com.tangosol.io.journal.FlashJournalRM$WriterDaemon$PendingWriteT
            at com.tangosol.io.journal.FlashJournalRM$WriterDaemon.run(FlashJour
            at com.tangosol.util.Daemon$DaemonWorker.run(Daemon.java:803)
            at java.lang.Thread.run(Thread.java:680)

"Journal-Preparer" daemon prio=5 tid=7f8dfb843800 nid=0x10d768000 in Object.wait(
   java.lang.Thread.State: WAITING (on object monitor)
            at java.lang.Object.wait(Native Method)
            at java.lang.Object.wait(Object.java:485)
            at com.tangosol.util.SingleWaiterMultiNotifier.await(SingleWaiterMul
            - locked <7c4b36590> (a java.lang.Object)
            at com.tangosol.io.journal.FlashJournalRM$PreparerDaemon.run(FlashJo
            at com.tangosol.util.Daemon$DaemonWorker.run(Daemon.java:803)
            at com.tangosol.io.journal.FlashJournalRM$PreparerDaemon$1.run(Flash
            at java.lang.Thread.run(Thread.java:680)
```

Collector

- Responsibility: To reclaim memory from Journal Files
  - Dispose of files only with garbage
  - Compacts allocated memory thus reclaiming inaccessible memory segments
- Initial interval is 30s but adjusts based on Journal usage and predicting benefit of an execution
- Each Resource Manager has its own Collector

Collector

Continued

- RAM Journal executes against multiple Journal files as it is relatively cheap to compact
- Flash Journal compacts a single file per execution to avoid overwhelming the block device
- Configuring High Journal Size (3.7.1) allows configuring when the collector should become aggressive in collection

Q & A

Hardware and Software

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