Enabling Java applications for low-latency use cases at scale with Azul Zing and GridGain

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10 Mins That Saved Southwest Airlines

Apps That Require Much Lower Latency

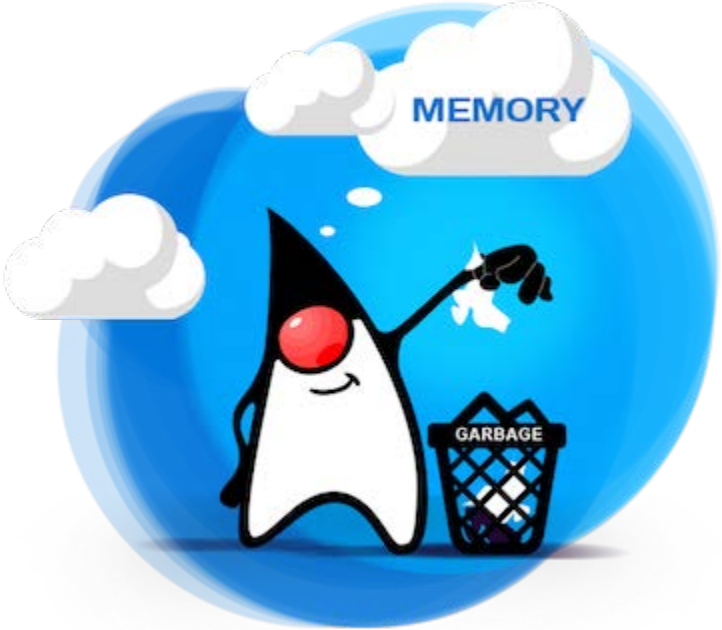
Payments Processing

Latency: 20 - 200 ms

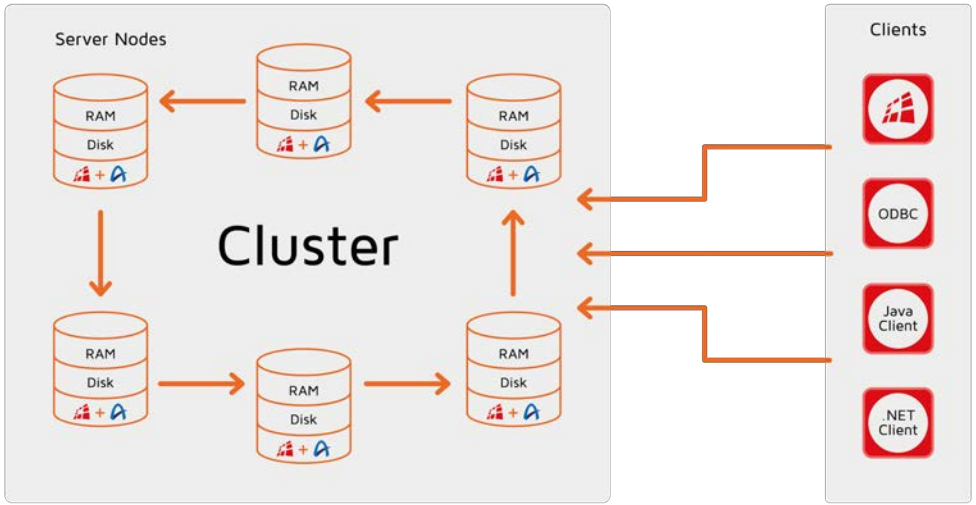
Electronic Trading

Latency: 20 - 100s µs

Garbage Collection Might Make Things Unpredictable



Unless You Select The Right Java Stack



Azul Zing - Java without the pauses

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An overview of Azul Zing

Gil Tene, CTO & co-Founder, Azul Systems

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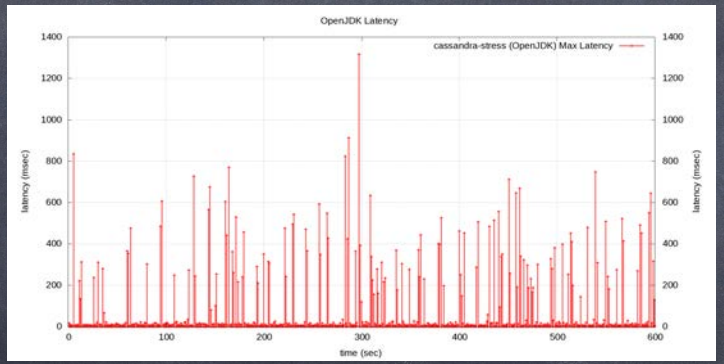
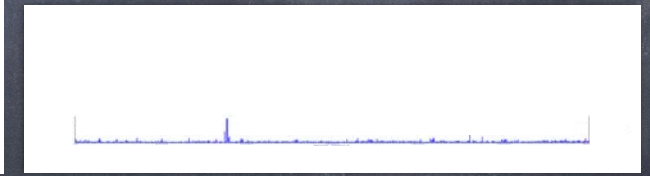
A simple visual summary

This is <Your App> on HotSpot



This is <Your App> on Zing



Any Questions?

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Azul Zing 

- A JVM for Linux/x86 (servers, clouds, containers)
  - "Not just Fast. Always Fast."
  - Improves application behavior metrics
  - Increases practical carrying capacity
  - Makes developers and their managers happier
- Delivers a continuously responsive execution platform
  - ELIMINATES Garbage Collection as a concern
  - Reduces negative impacts of frequent code deployment
- VERY wide operating range
  - from GBs to TBs, from low latency to streaming and batch

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Areas where Azul Zing shines

- Wherever speed & responsiveness matter:

- Human response times…
- Machine-to-machine "stuff"…
- "Low latency" or "Latency Sensitive"…
- "Large" data and in-memory analytics…

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Azul Zing shines in Java based infrastructure…

Solr

Cassandra

…

…

Elastic

Kafka

Lucene

GridGain

…

…

…

Ignite

HBase

Zookeeper

…

Flink

HDFS

…

…

Pinot

…

Aeron

Spark

Storm

AZUL

Zing shines in Java applications

API Gateways

...

Application containers

...

Back end

...

Front End

...

...

Streaming applications

In memory analytics

...

...

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Azul Zing's main feature areas

- C4: GC, solved.
- Falcon: Powerful JIT compiler. Speed.
- ReadyNow: Warmup/Startup. DevOps.

Speed

What is it good for?

?

?

Are you fast?

?

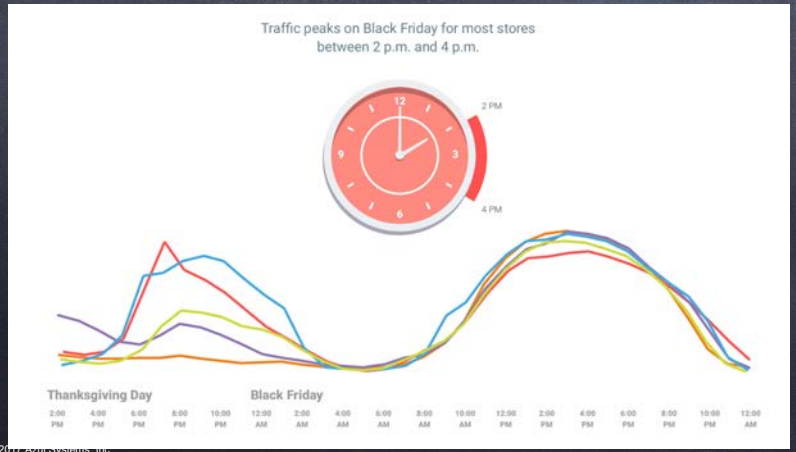
?

Are you fast when new code rolls out?

?

?

Are you fast when it matters?



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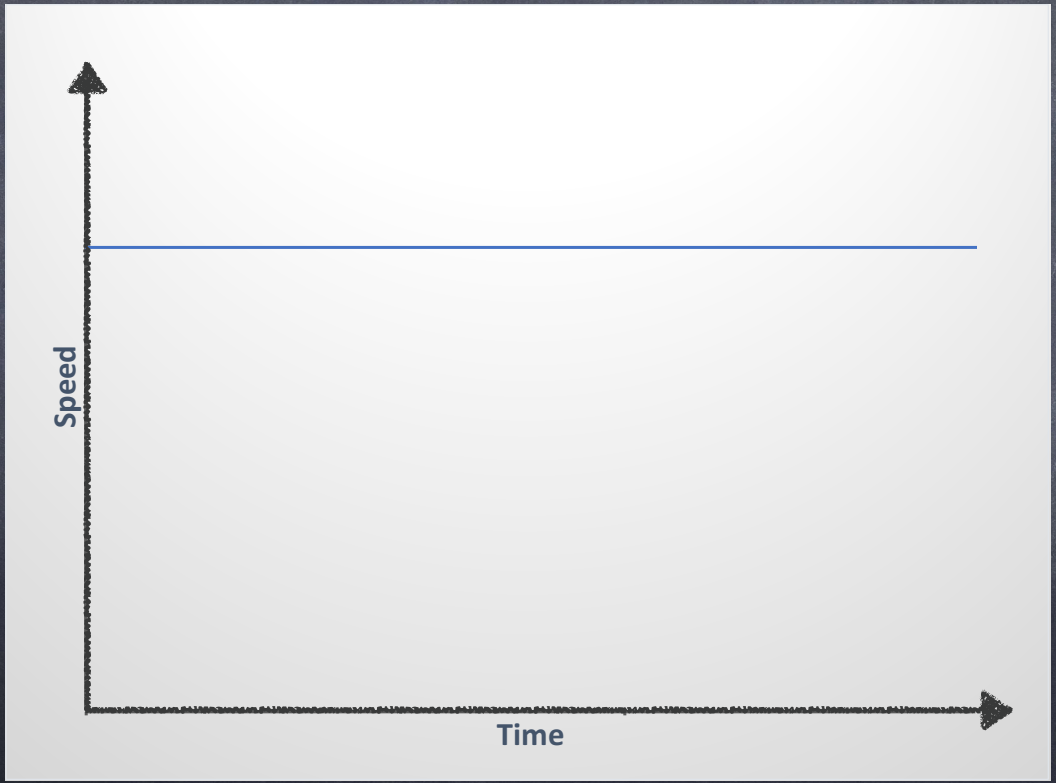
Are you fast at Market Open?

?

?

Are you reliably fast?

What does being “fast” mean?



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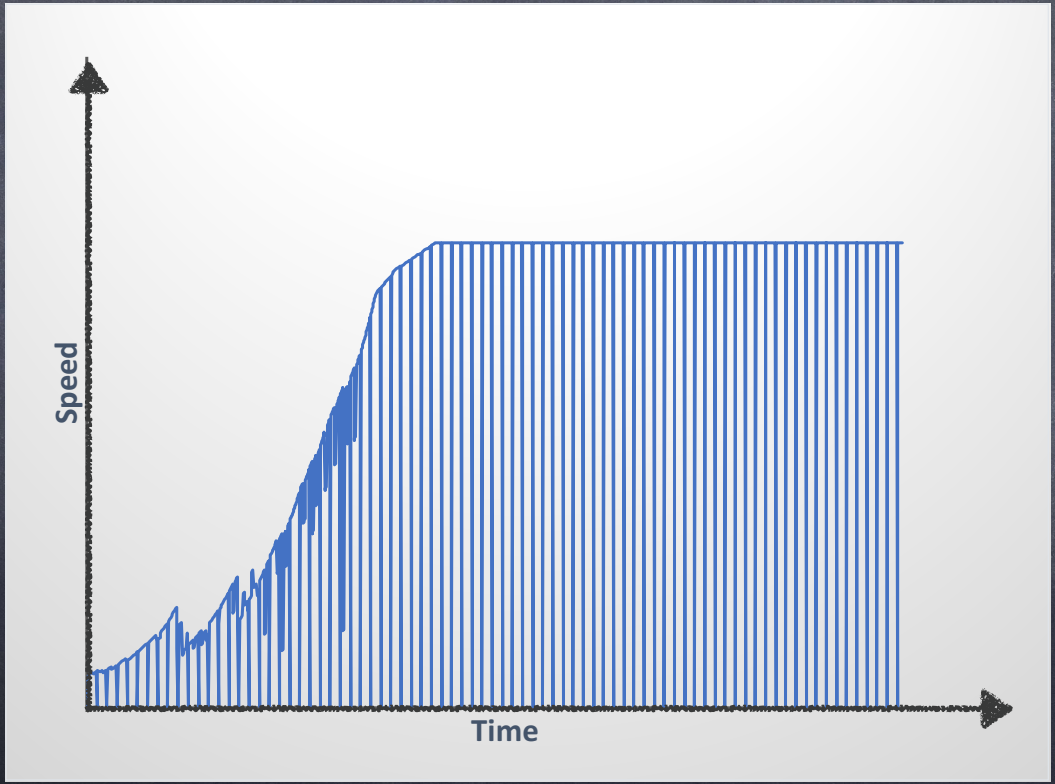
What does being “fast” mean?



Speed in the Java world…

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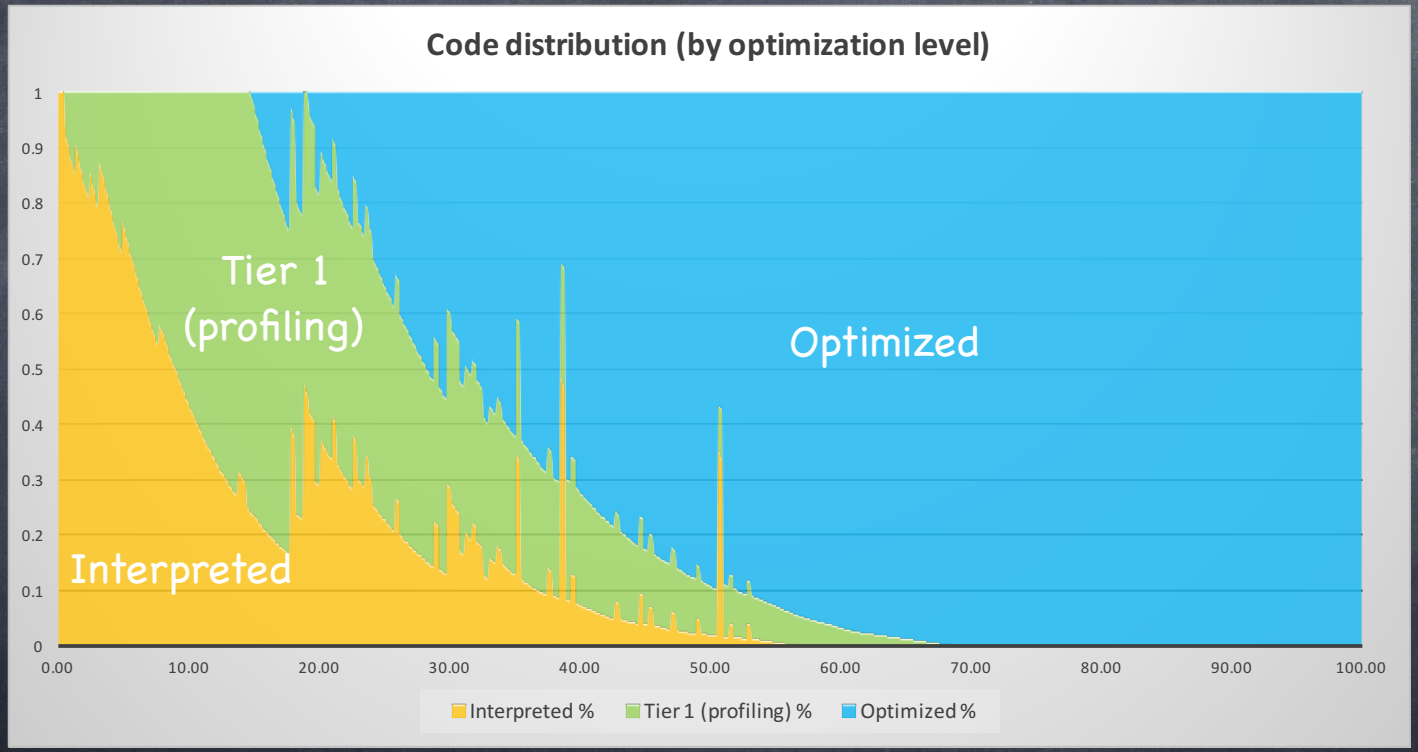
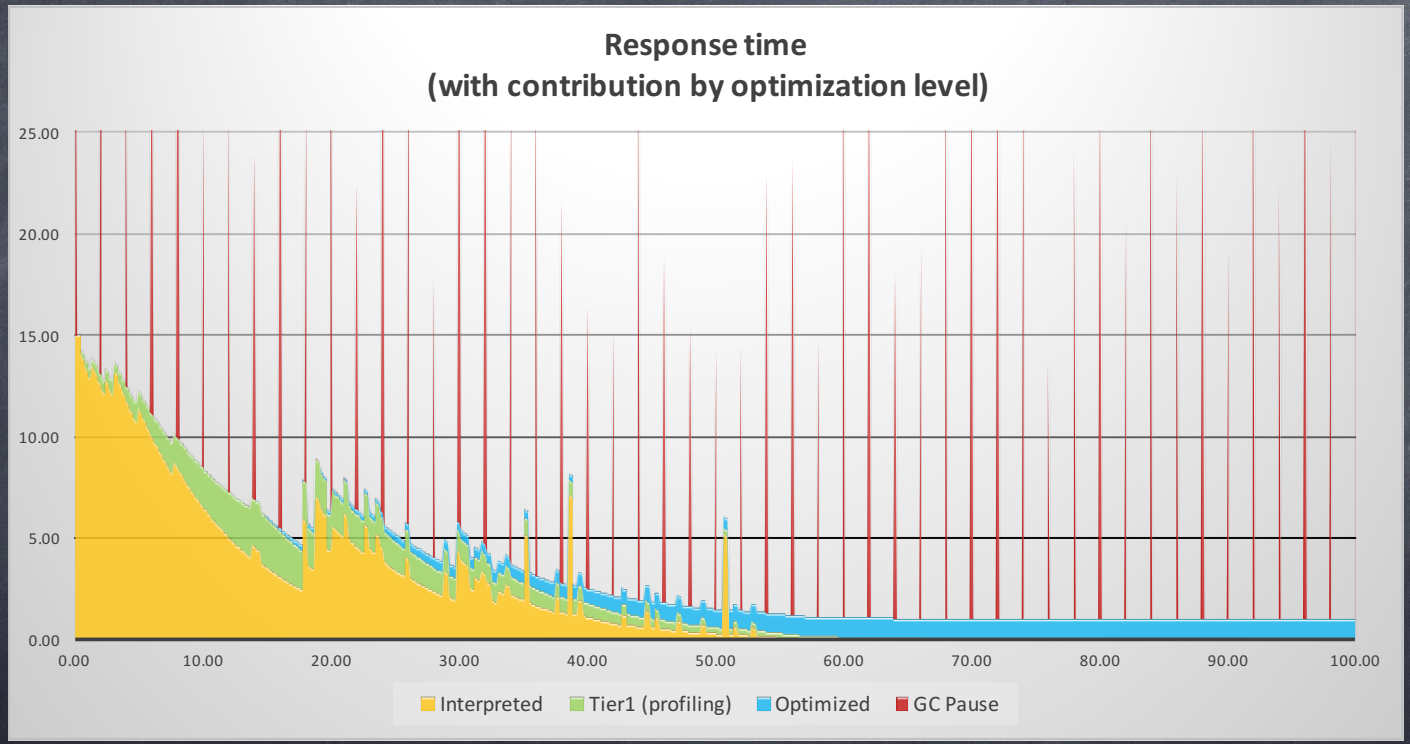
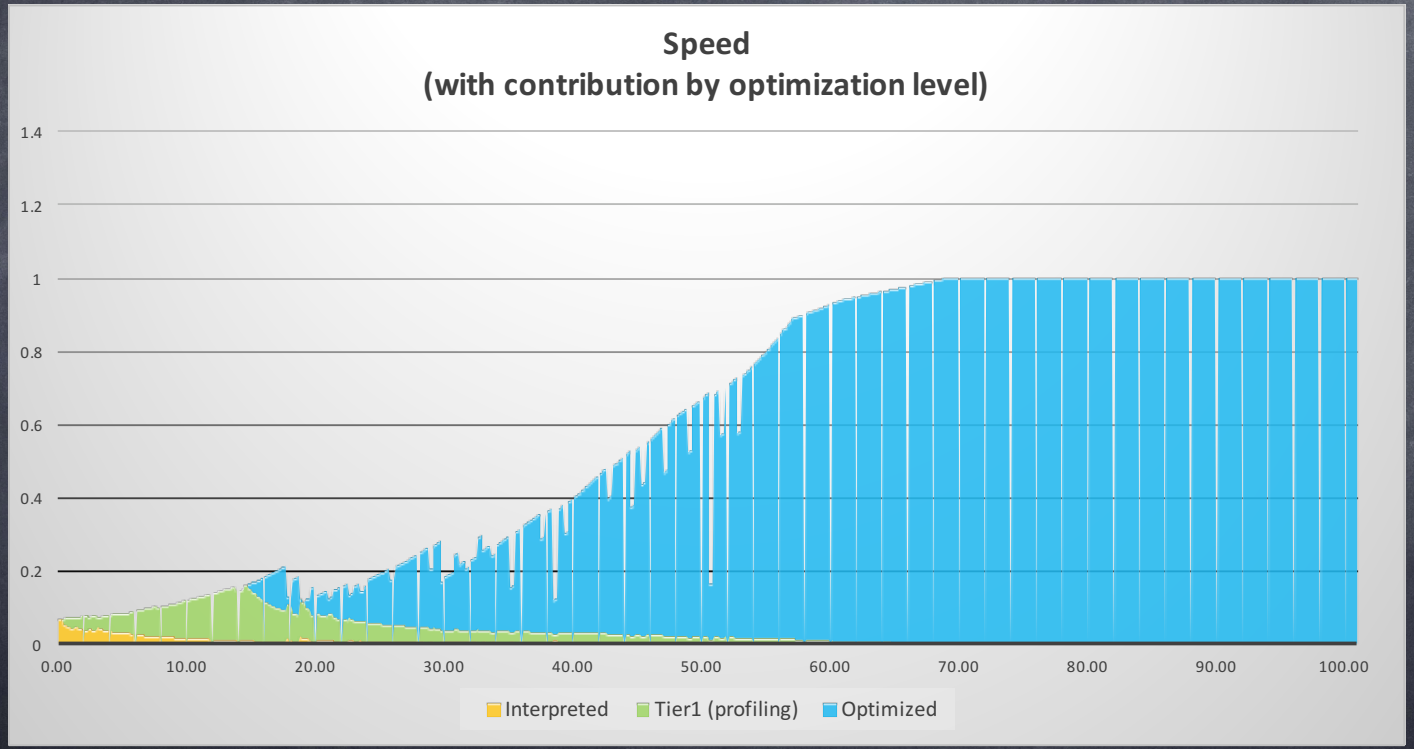
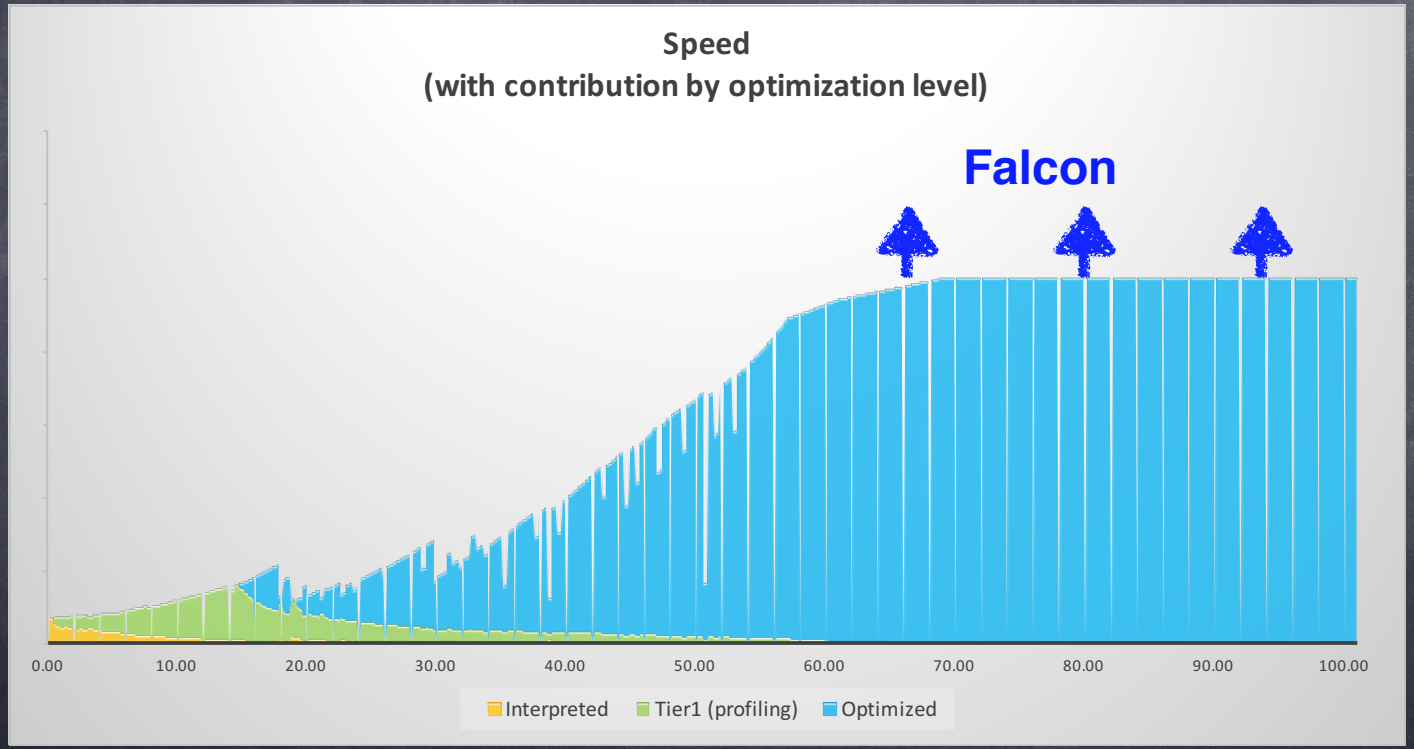


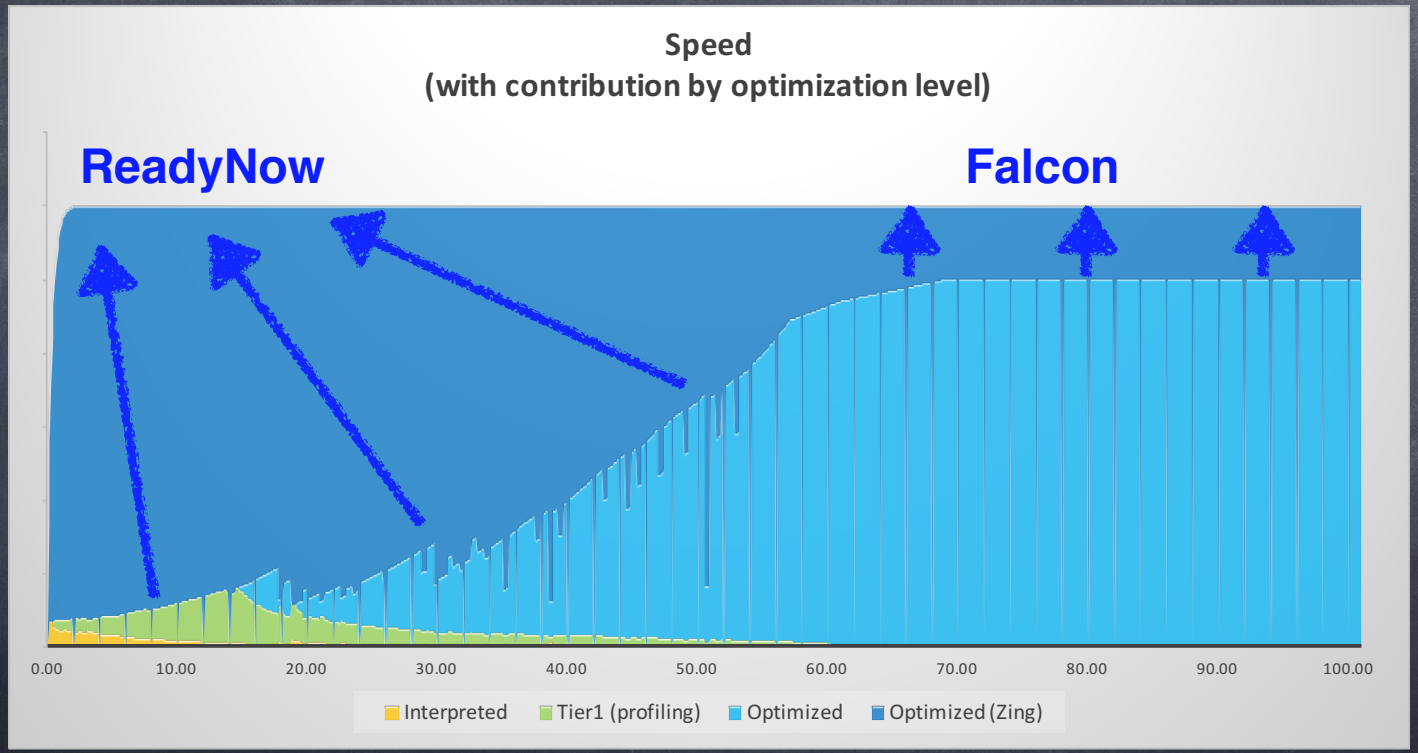




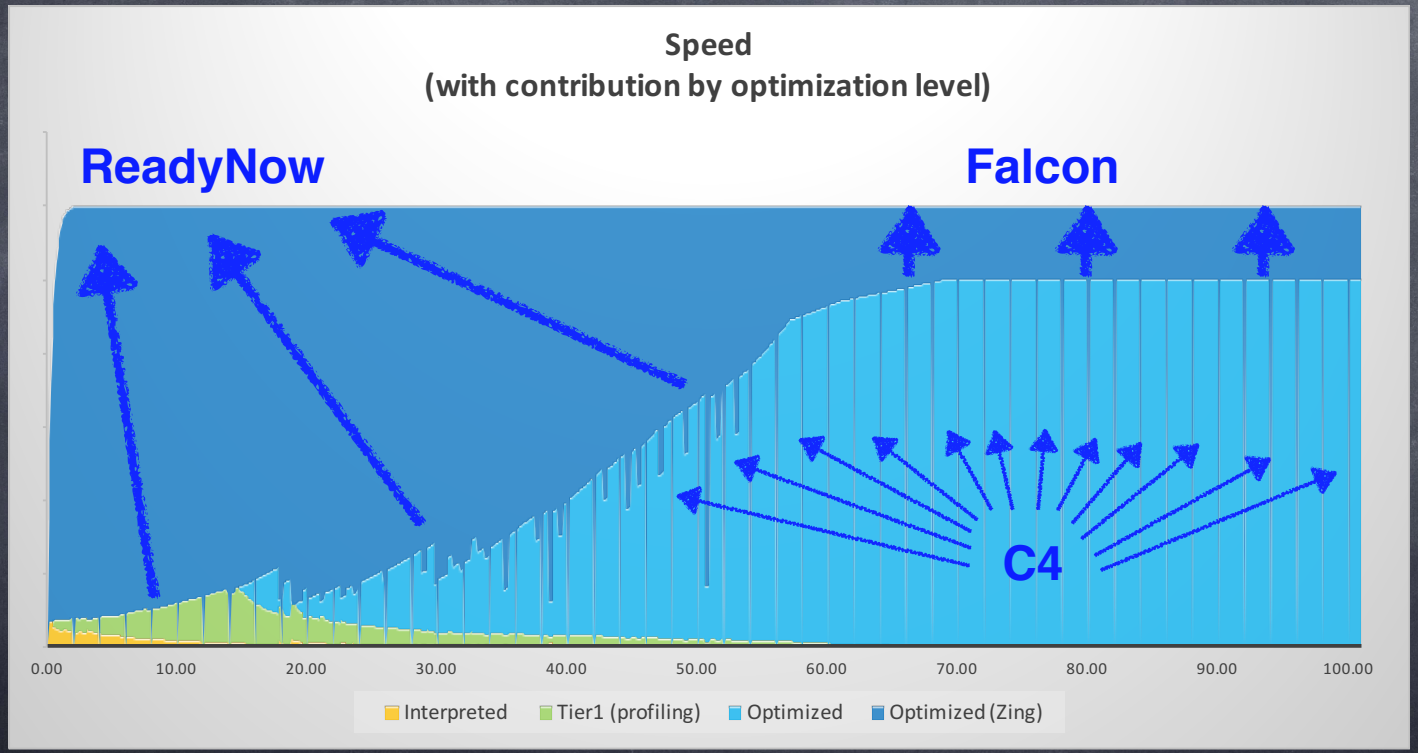
Falcon is basically about speed



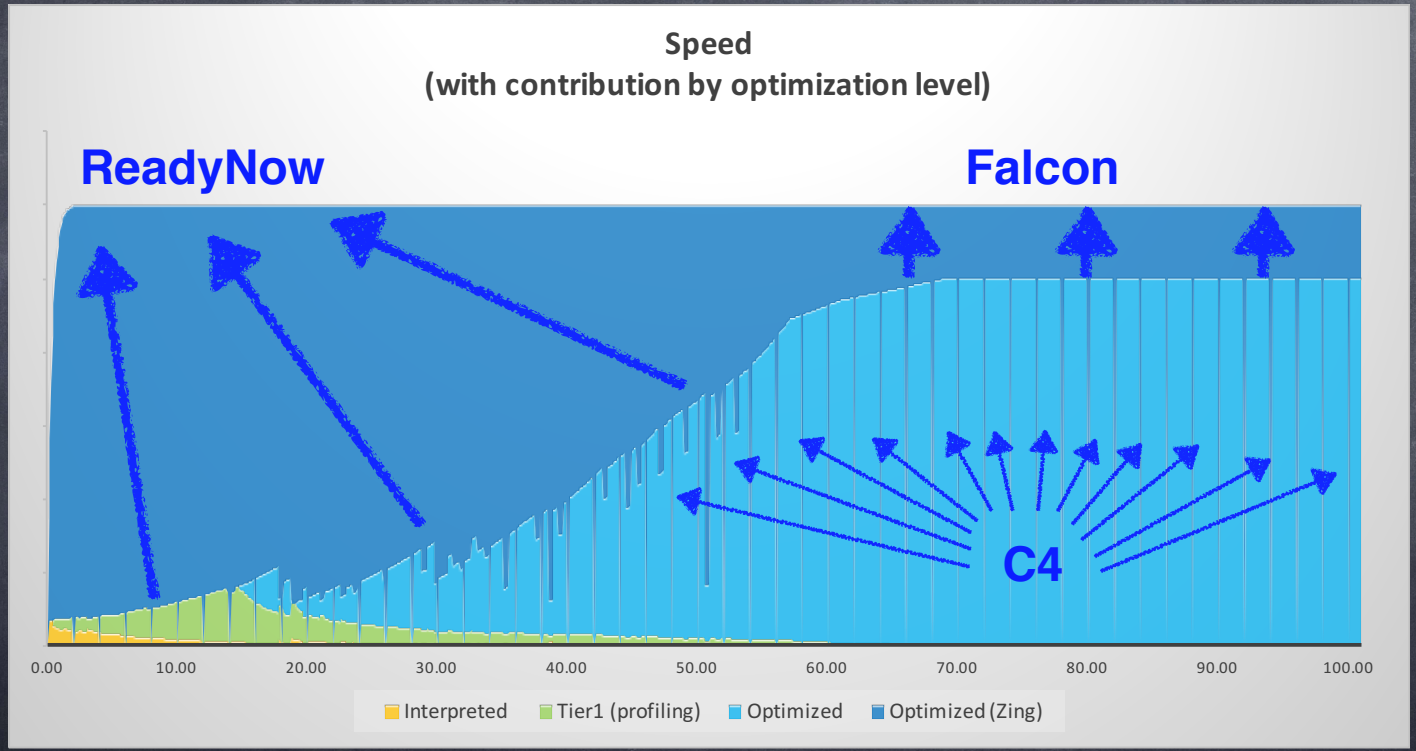
ReadyNow is focused on warmup



C4 takes out the stalls



Start Fast, Go Fast, Stay Fast



GC Tuning

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Java GC tuning is "hard"…

Examples of actual command line GC tuning parameters:

```
Java -Xmx12g -XX:MaxPermSize=64M -XX:PermSize=32M -XX:MaxNewSize=2g
       -XX:NewSize=1g -XX:SurvivorRatio=128 -XX:+UseParNewGC
       -XX:+UseConcMarkSweepGC -XX:MaxTenuringThreshold=0
       -XX:CMSInitiatingOccupancyFraction=60 -XX:+CMSParallelRemarkEnabled
       -XX:+UseCMSInitiatingOccupancyOnly -XX:ParallelGCThreads=12
       -XX:LargePageSizeInBytes=256m …

Java -Xms8g -Xmx8g -Xmn2g -XX:PermSize=64M -XX:MaxPermSize=256M
          -XX:-OmitStackTraceInFastThrow -XX:SurvivorRatio=2 -XX:-UseAdaptiveSizePolicy
          -XX:+UseConcMarkSweepGC -XX:+CMSConcurrentMTEnabled
          -XX:+CMSParallelRemarkEnabled -XX:+CMSParallelSurvivorRemarkEnabled
          -XX:CMSMaxAbortablePrecleanTime=10000 -XX:+UseCMSInitiatingOccupancyOnly
          -XX:CMSInitiatingOccupancyFraction=63 -XX:+UseParNewGC -Xnoclassgc …
```


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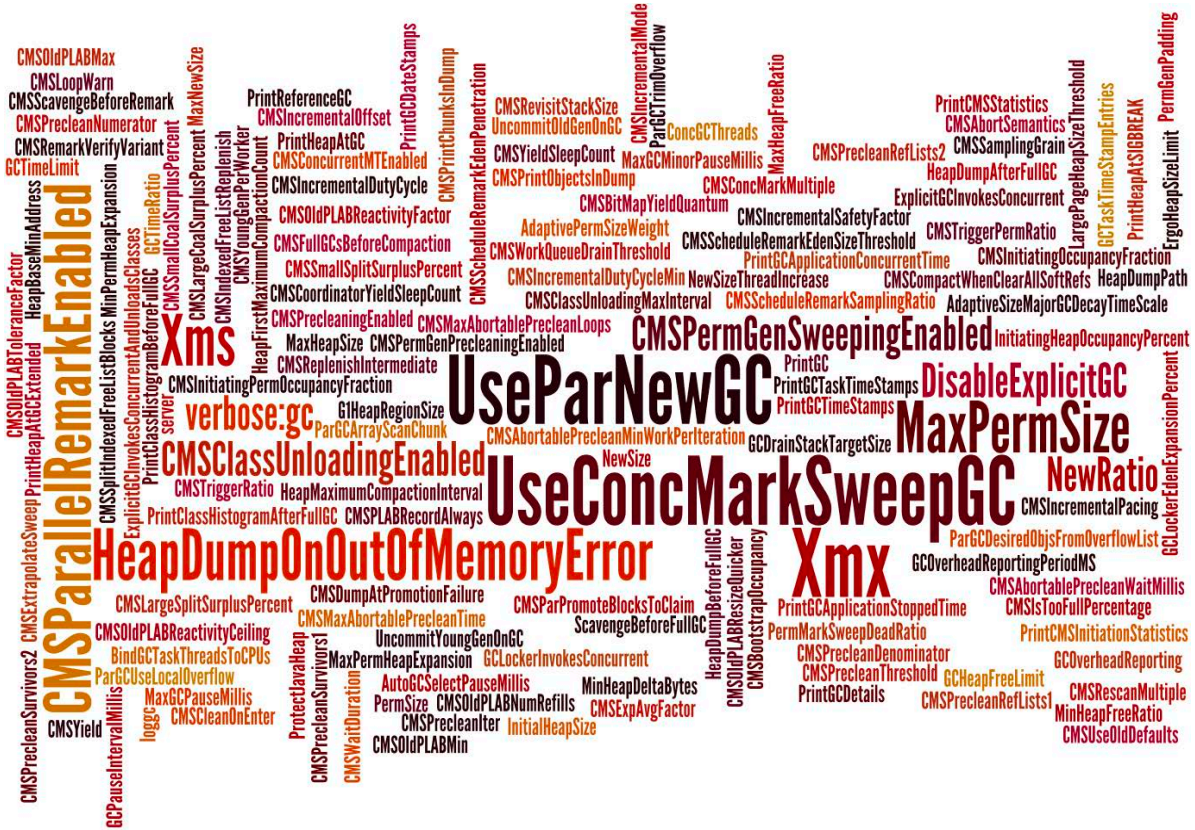
A few more GC tuning flags



Source: Word Cloud created by Frank Pavageau in his Devoxx FR 2012 presentation titled “Death by Pauses”

The complete guide to modern GC tuning**

java -Xmx40g

java -Xmx20g

java -Xmx10g

java -Xmx5g

** It's 2019, Zing is widely available. Tweaking 10s of GC flags is a thing of the past.

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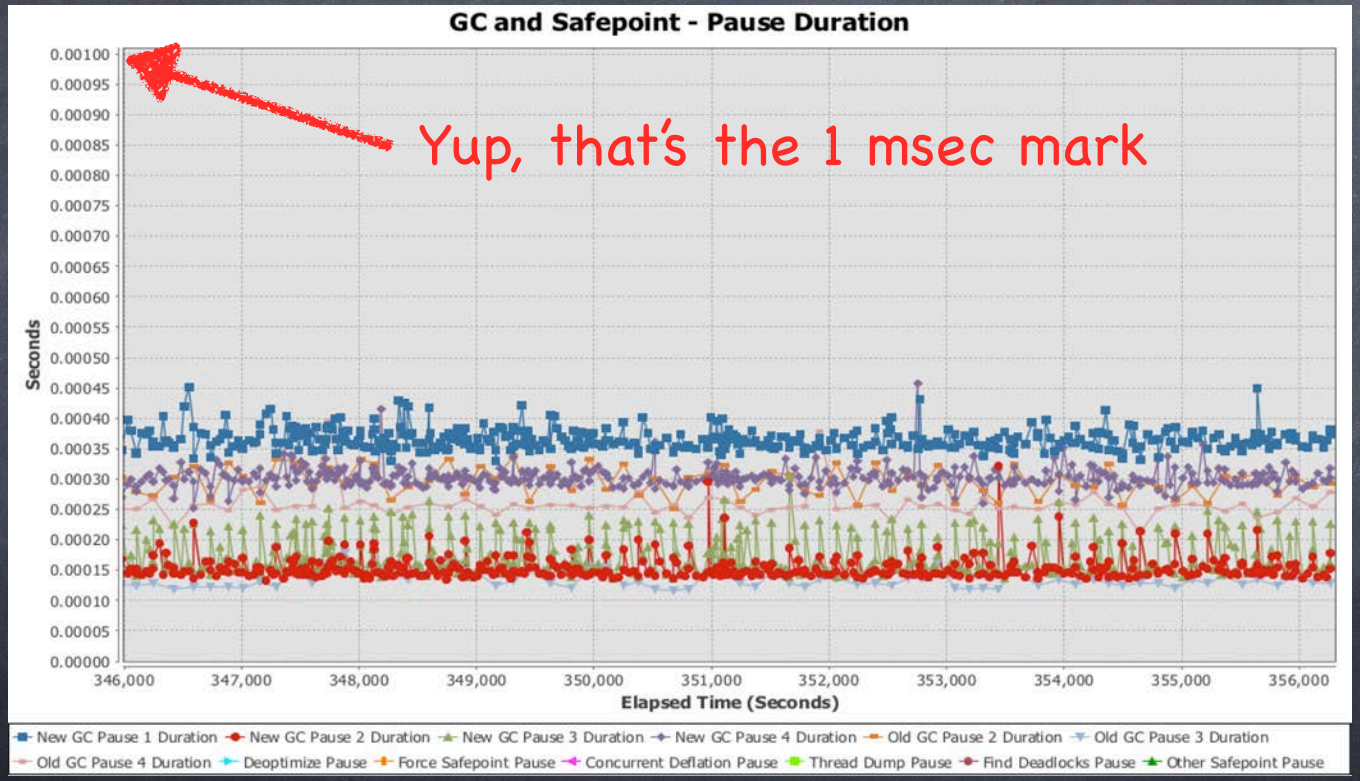
Cassandra under heavy load, Intel E5-2690 v4 server



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A real world use case with In Memory Computing:

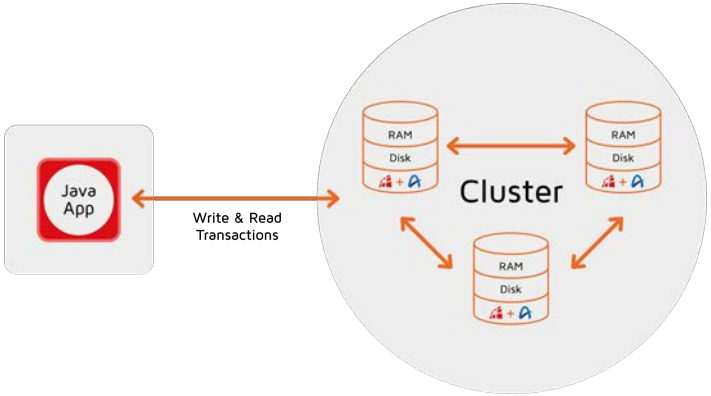
GridGain in a Credit Card payments processing application

In-Memory Computing SUMMIT NORTH AMERICA 2019

Payments Benchmark: Configuration

- 3 nodes GridGain cluster
  - 3 x AWS i3en.6xlarge
  - 72 cores
  - 600 GB RAM and 45 TB disk

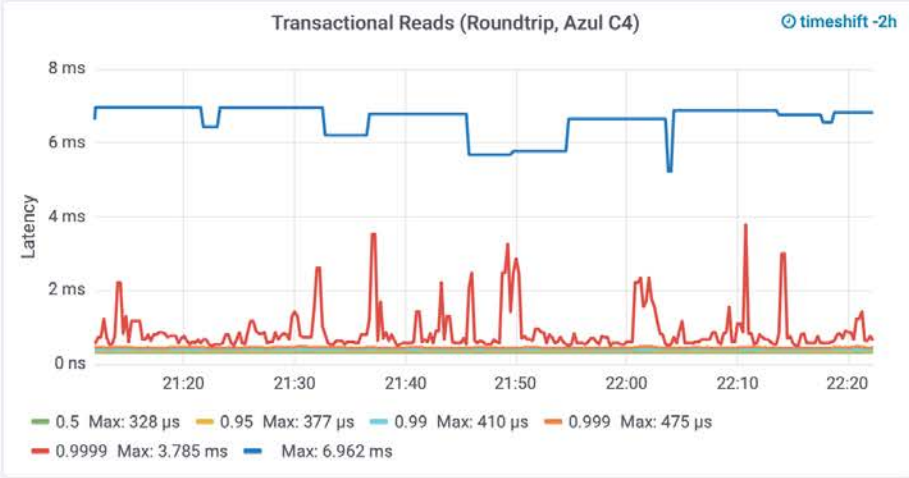
- Tested Scenarios
  - Azul Zing C4 vs. OpenJDK G1 **for**
  - 100% in RAM, no disk (200 GB)
  - 100% in RAM, 100% on disk (200 GB)
  - 30% in RAM, 100% on disk (600 GB)



Payments Benchmark: Workload

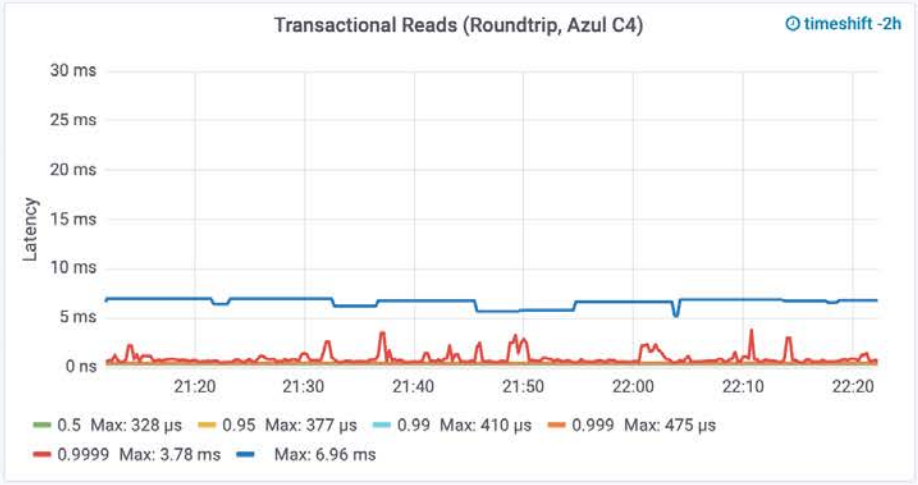
- Each transactions accesses 20 records
- Distributed Transactional Reads
  - Target throughput - **1000 reads/sec**
  - Target latency - **15ms for 99.99th percentile**
- Distributed Transactional Updates
  - Target throughput - **2000 updates/sec**
  - Target latency - **50ms for 99.99th percentile**
  - RAM and disk have to be updated for primary and backup copies
- Metrics Collection
  - Micrometer and jHiccup
  - 2 hours run

Transactional Reads
100% in RAM (200 GB)



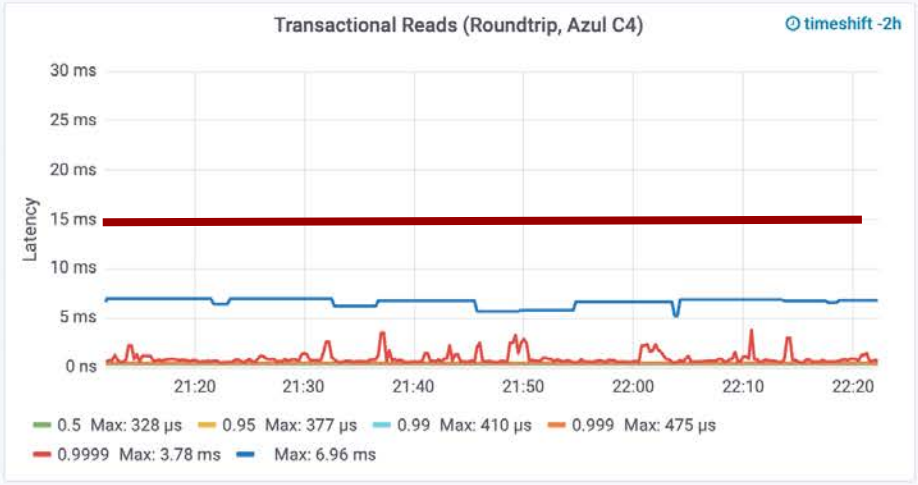
Transactional Reads

100% in RAM (200 GB) [equalized scale]



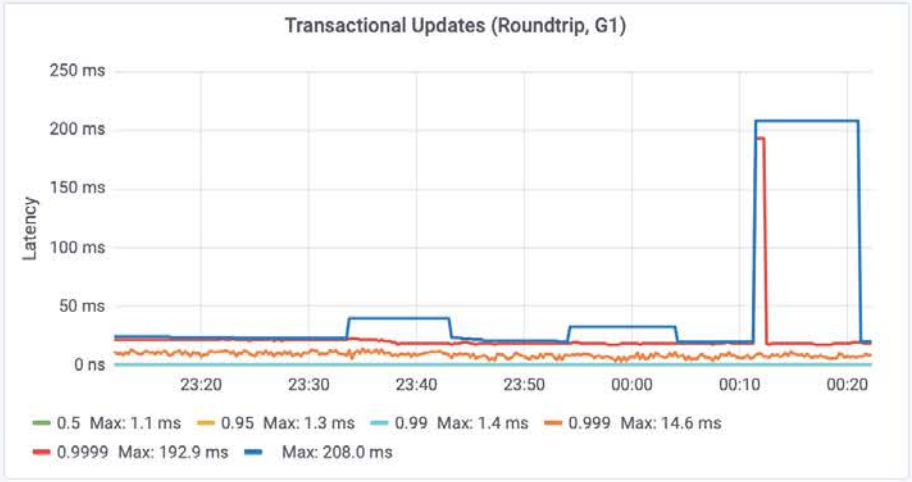
Transactional Reads

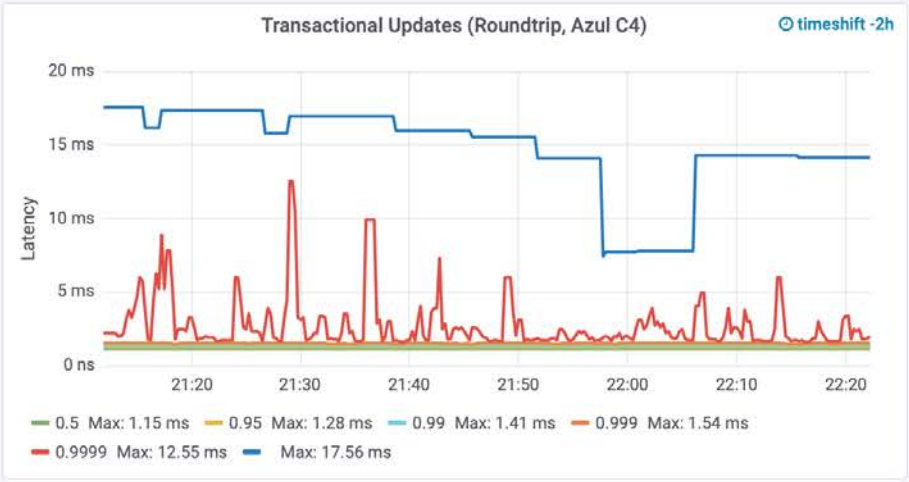
100% in RAM (200 GB) [equalized scale]



- target latency

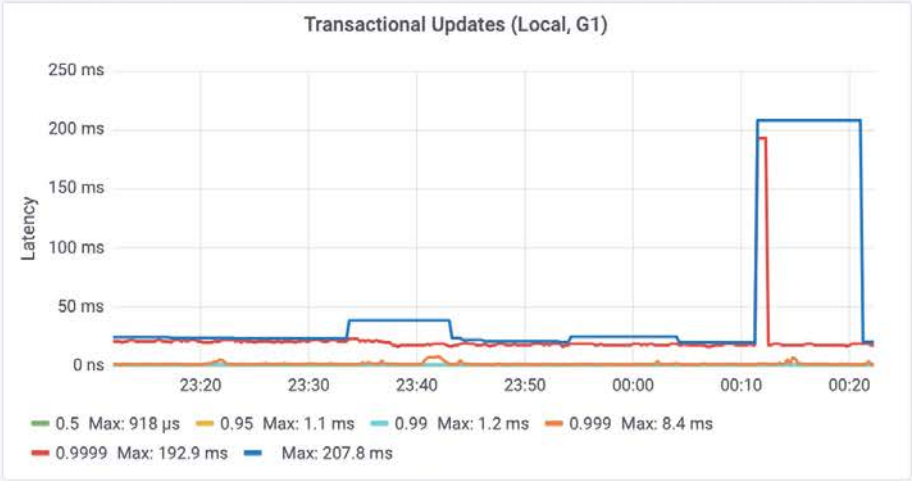
Transactional Updates:
100% in RAM (200 GB)

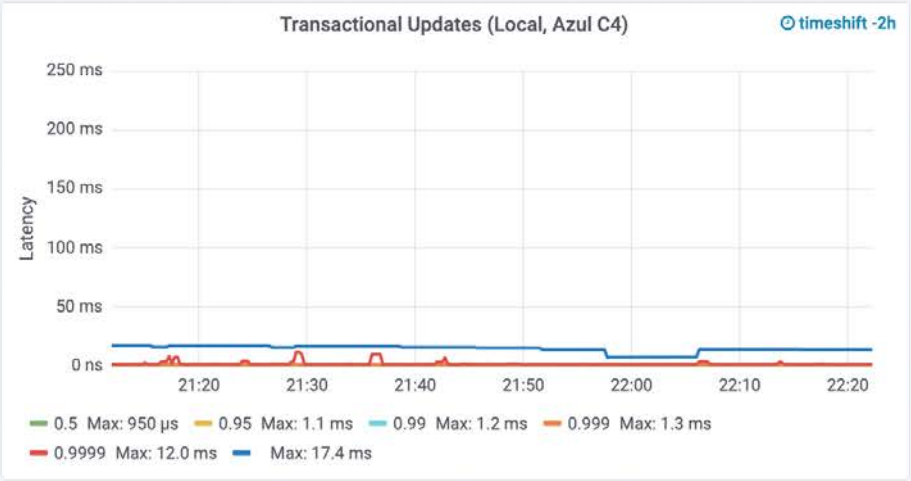




Transactional Updates

100% in RAM (200 GB) [equalized scale]





Transactional Updates

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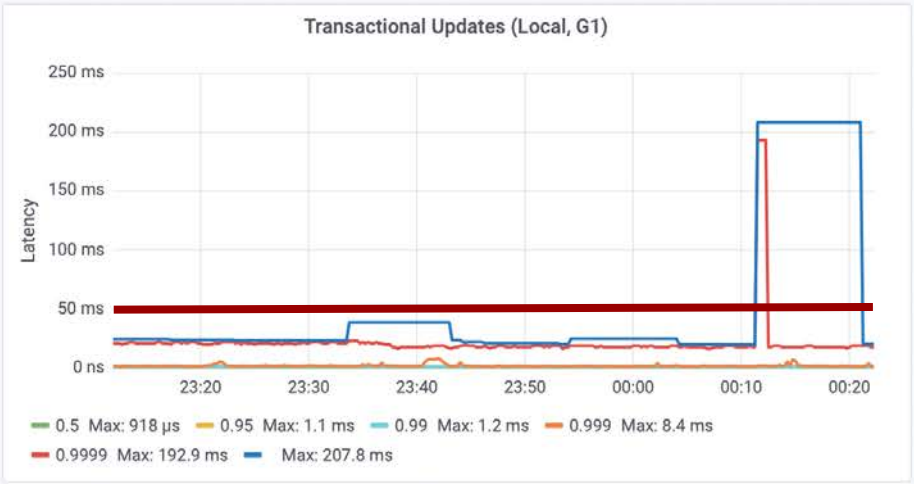
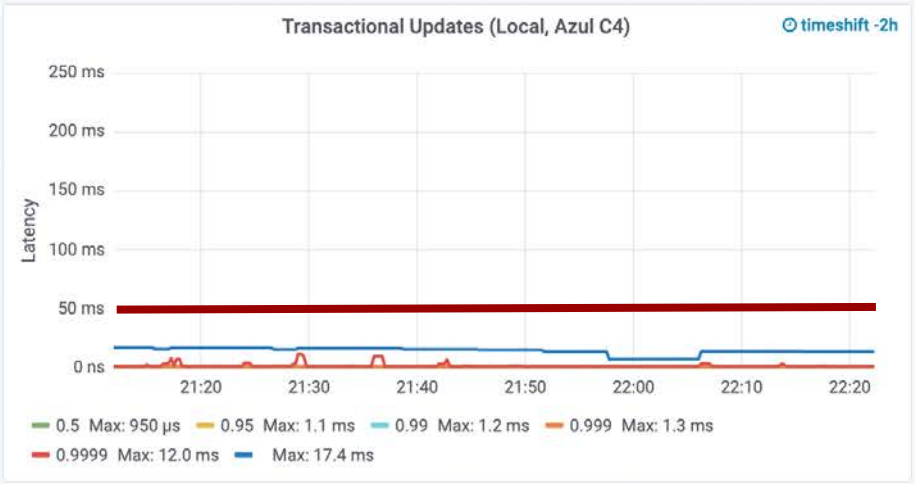
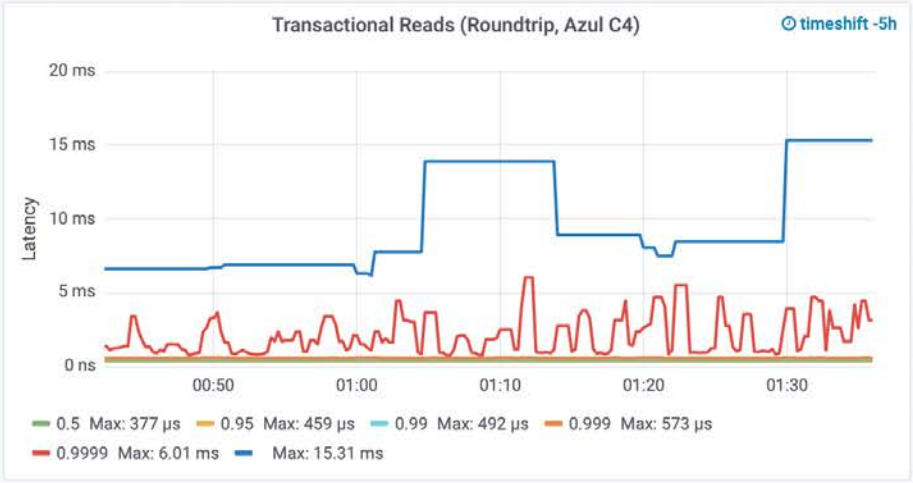




- target latency

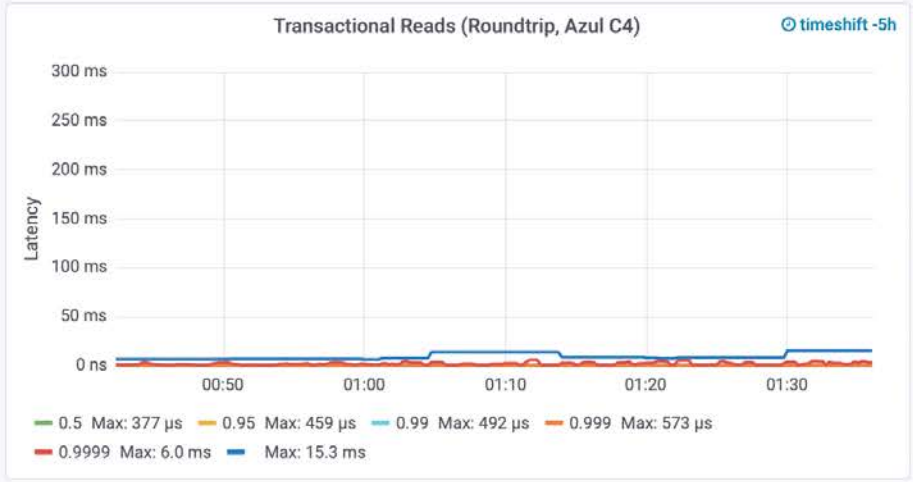
Transactional Reads With Persistence

100% in RAM, 100% on Disk (200 GB)



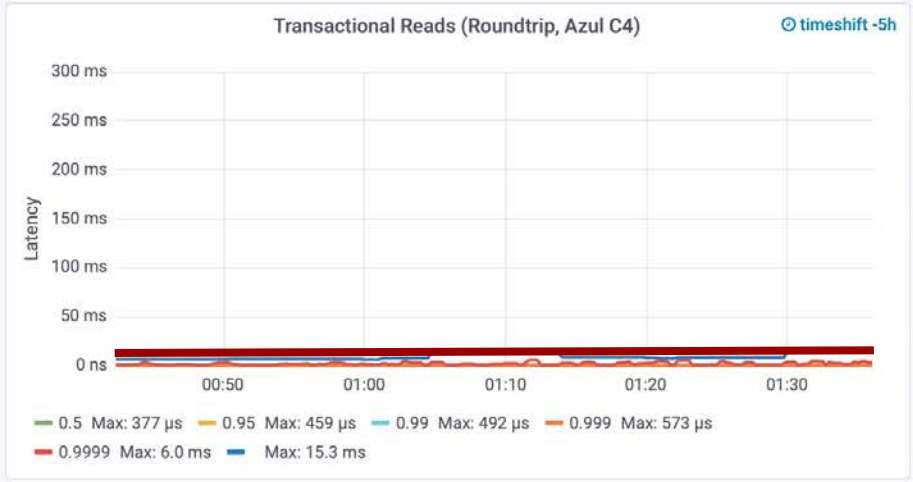
Transactional Reads With Persistence

100% in RAM, 100% on Disk (200 GB) [equalized scale]



Transactional Reads With Persistence

100% in RAM, 100% on Disk (200 GB) [equalized scale]



- target latency

Transactional Updates With Persistence

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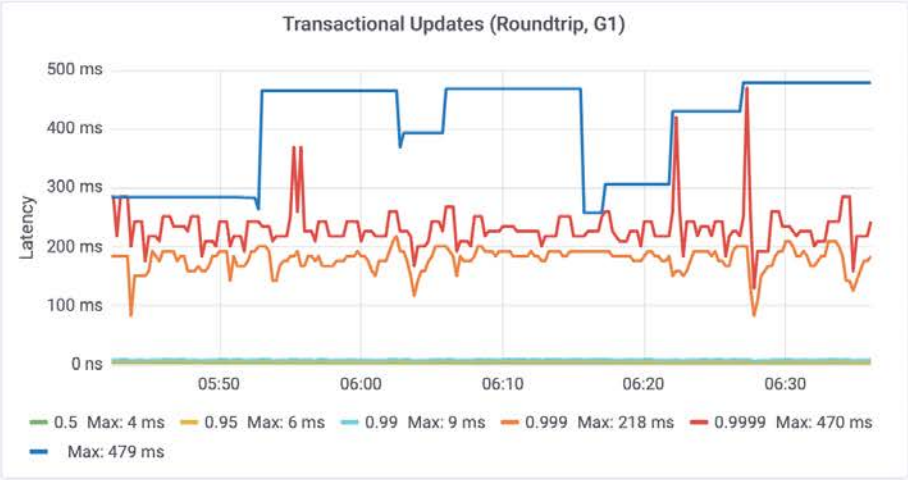

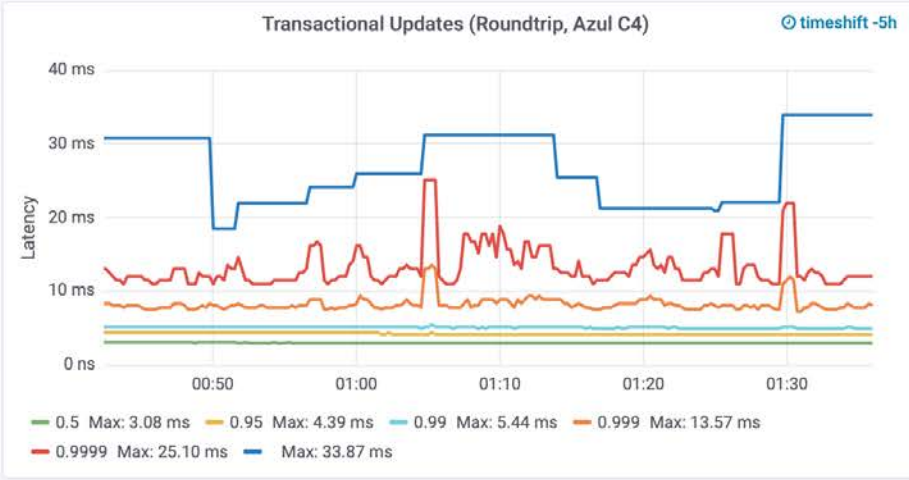

Transactional Updates With Persistence

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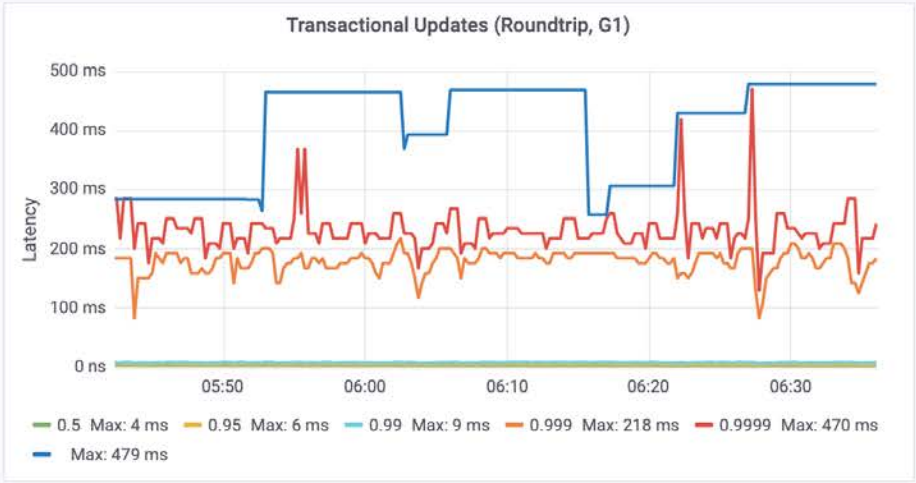

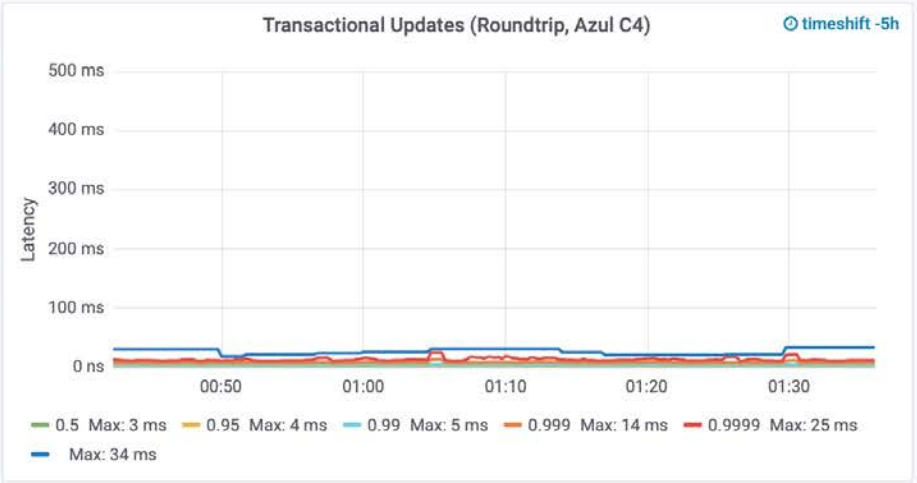

Transactional Updates With Persistence

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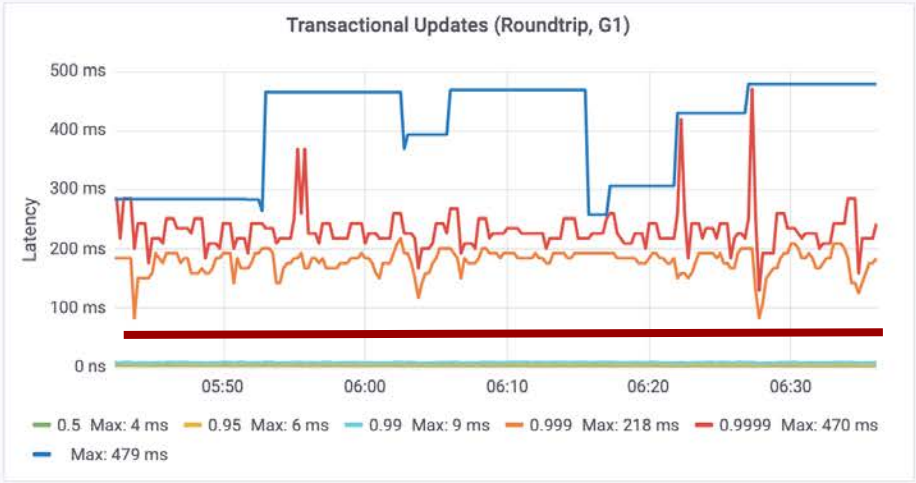
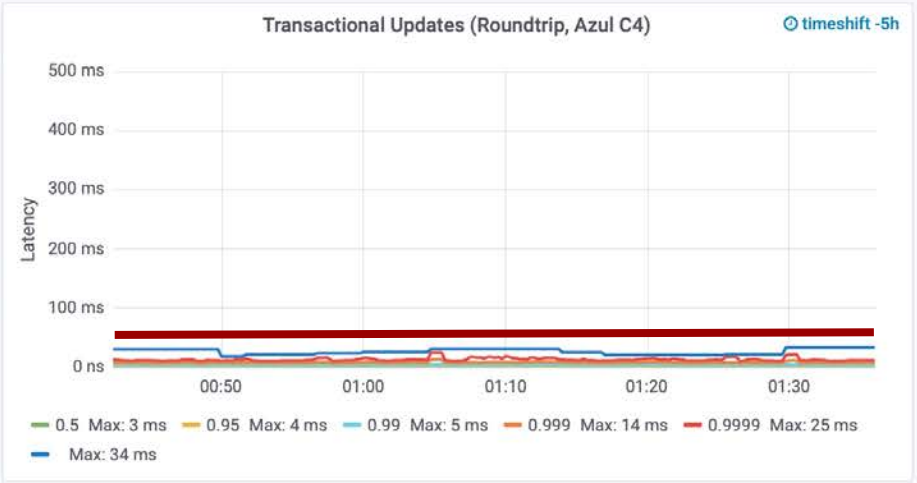




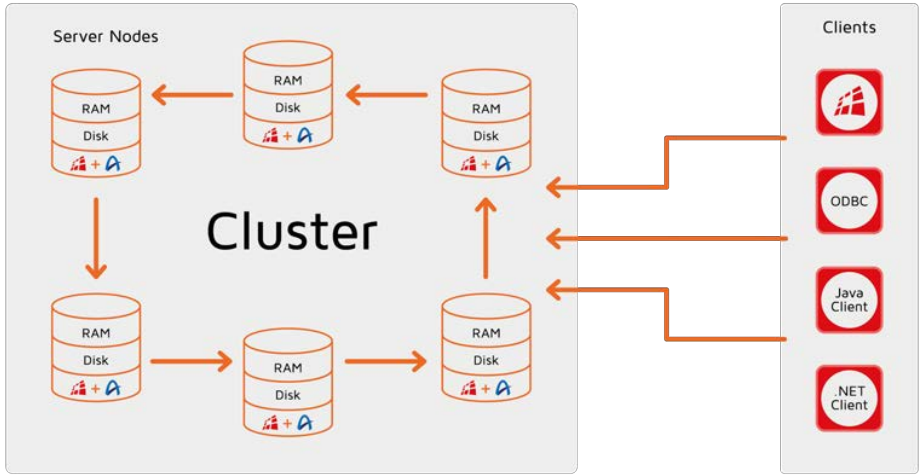
- target latency

GridGain - In-Memory Computing Platform That Scales

Click to add text

GridGain Let's Us Scale To Terabytes
Across RAM and Disk Space

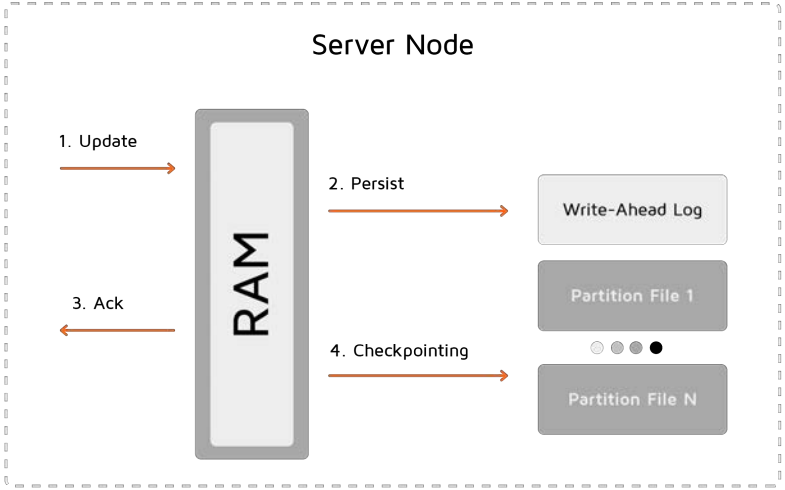
Unlimited off-heap memory and disk space for data



Java Heap for objects generated in runtime

Transactional Persistence

- Distributed Persistence Tier
  - Fully transactional and consistent
  - No need to cache 100% of data in RAM
  - No need to warm-up RAM on restarts
- Performance vs. Cost Tradeoff
  - Cache more for fastest performance
  - Cache less to reduce infrastructure costs

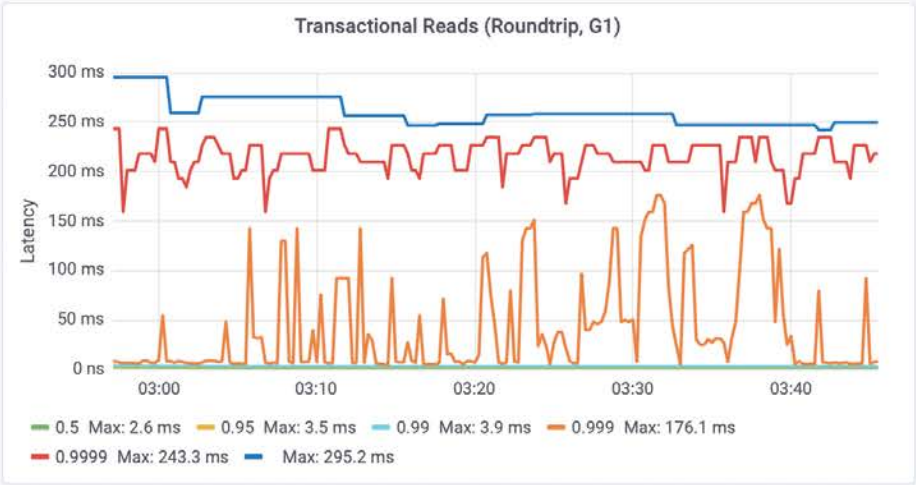


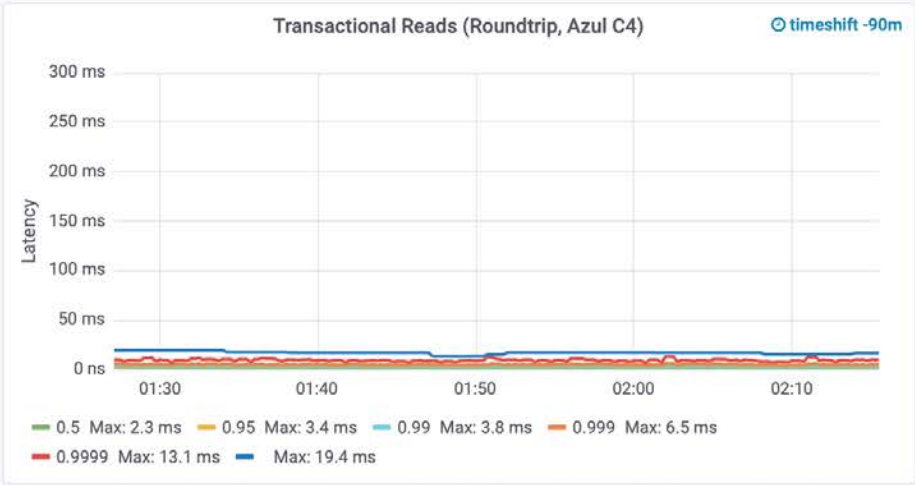
Transactional Reads with Persistence

30% in RAM, 100% on Disk (600 GB)

Transactional Reads with Persistence

30% in RAM, 100% on Disk (600 GB) [equalized scale]





Transactional Reads with Persistence

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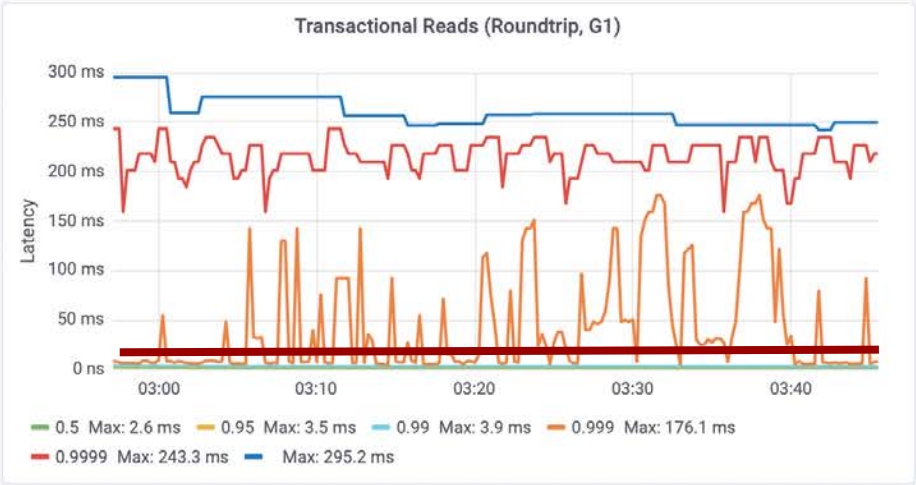

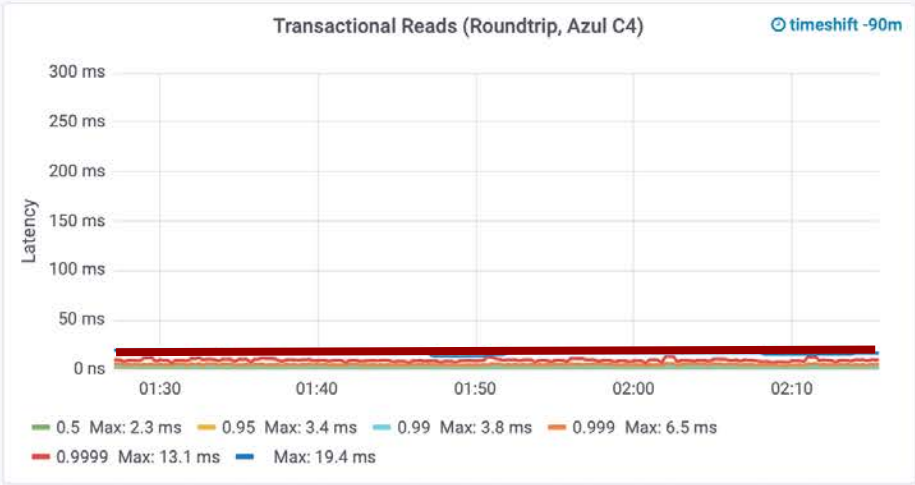

- target latency

Transactional Updates with Persistence

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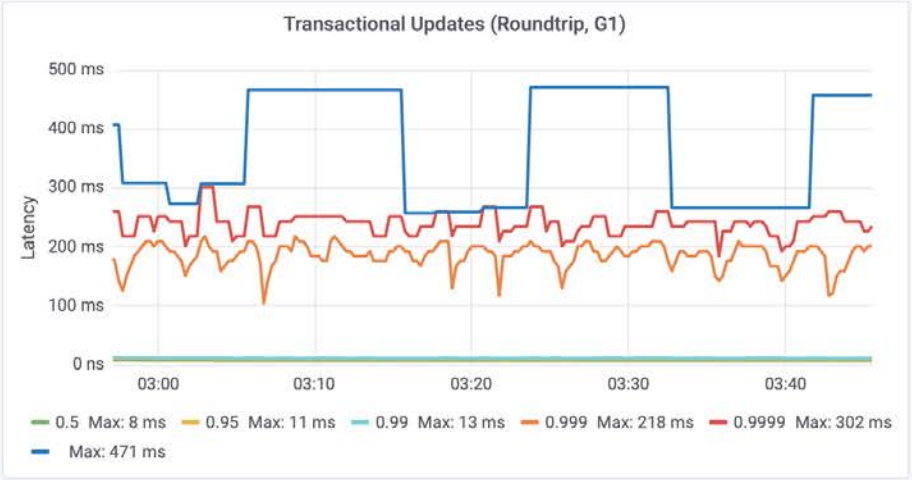

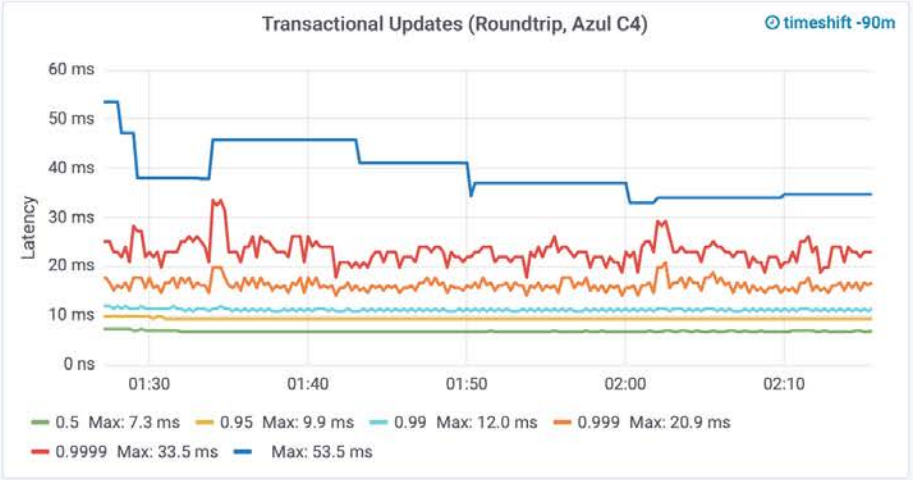

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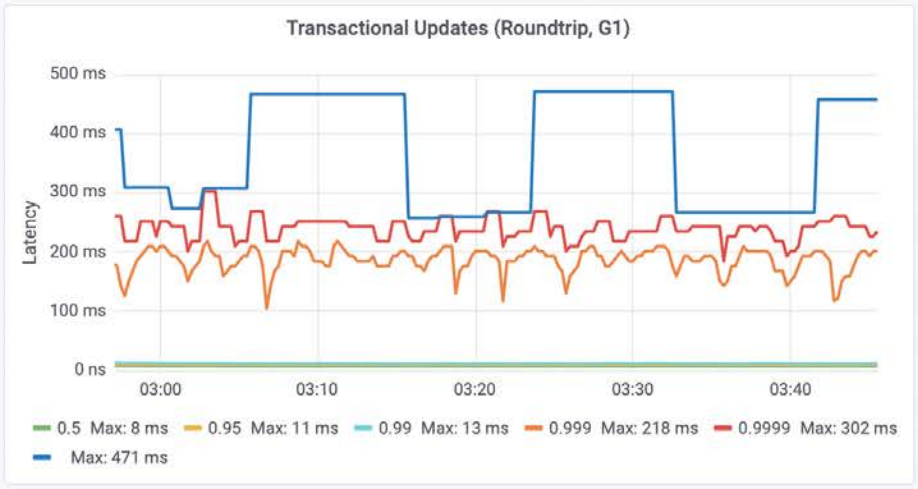
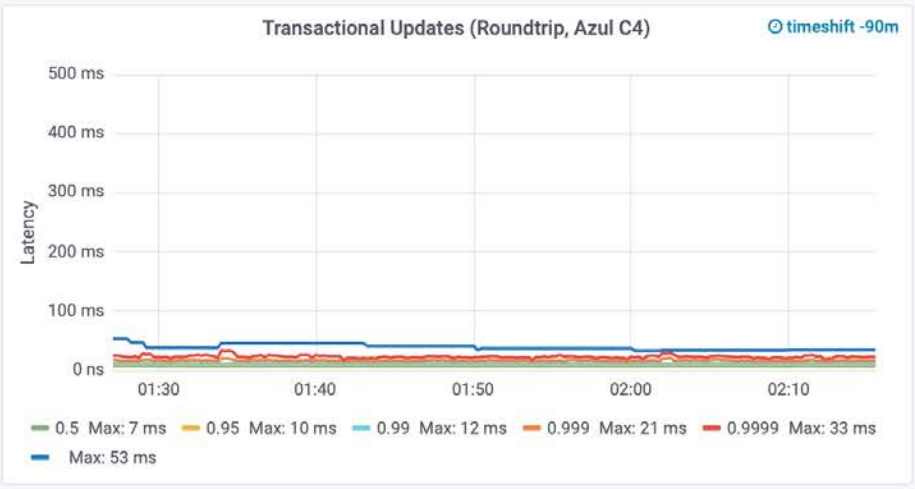
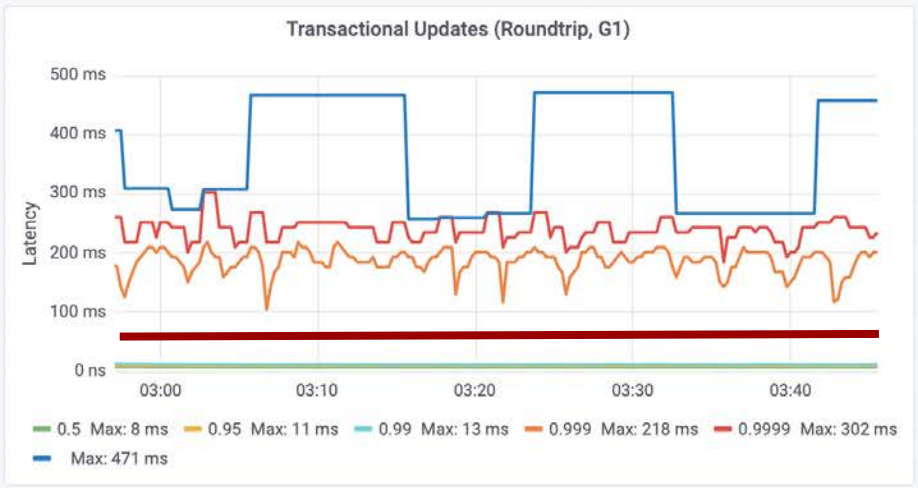
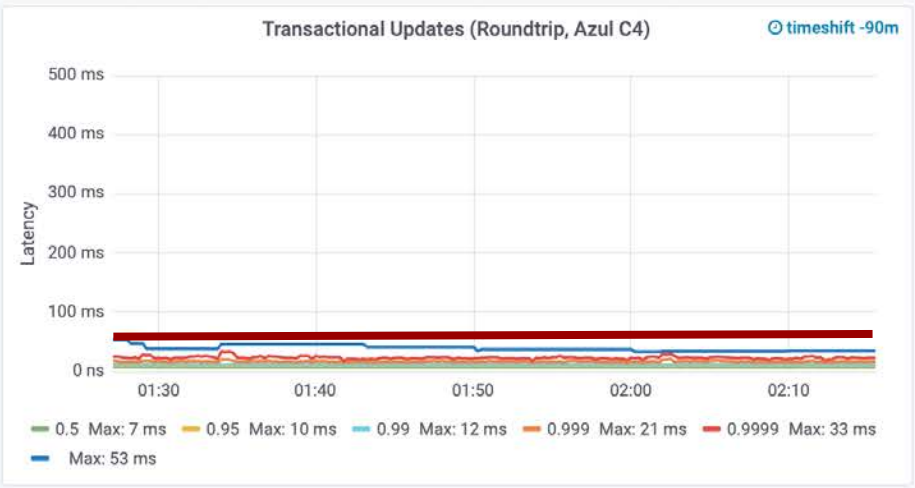




Transactional Updates with Persistence

30% in RAM, 100% on Disk (600 GB) [equalized scale]

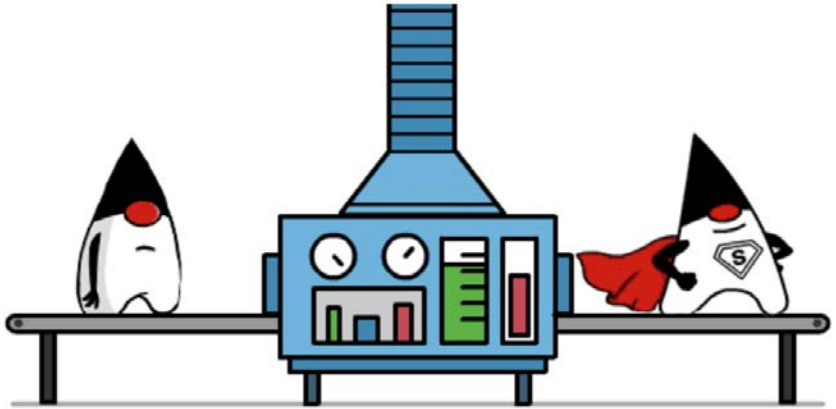




- target latency

Is Java Ready for Low-Latency Scenarios?

- Eliminate GC pauses with Azul Zing
- Scale Out with GridGain across RAM and Disk
- Select a configuration you need to meet infrastructure costs



Q&A

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