Enabling Java in Low Latency and Low Jitter Applications

Gil Tene, CTO & co-Founder, Azul Systems

Session # 8206

High level agenda

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- Intro, jitter vs. JITTER

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- Java in a low latency application world

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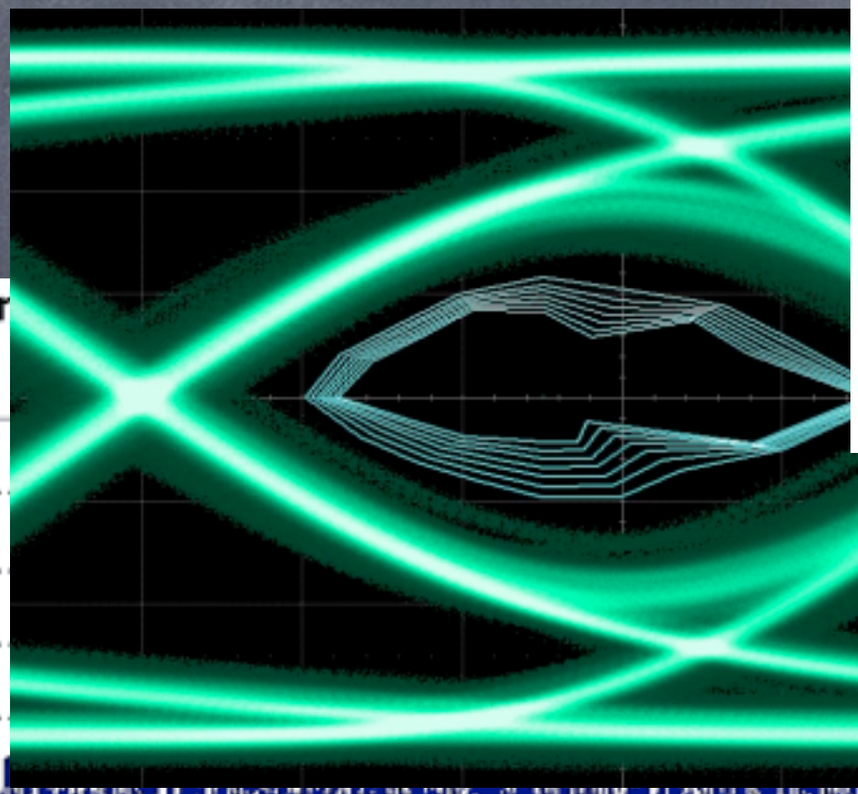
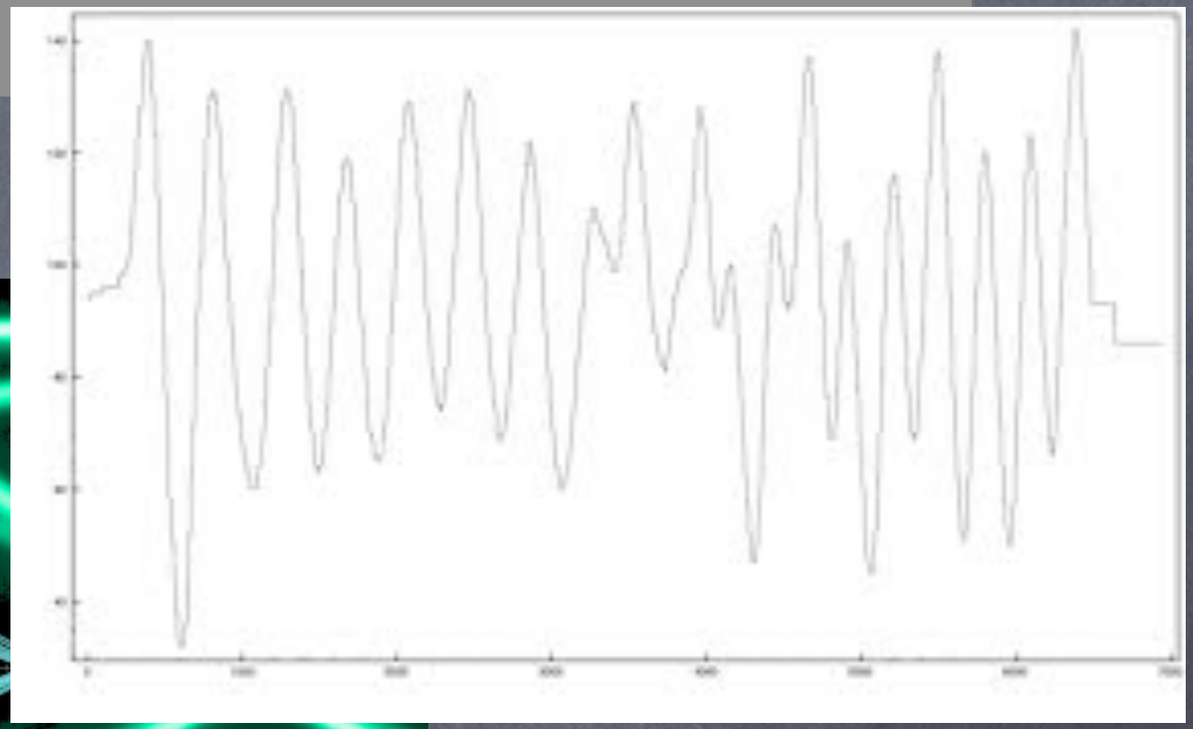
- What if the fundamental problems were eliminated?
- What 2013 looks like for Low latency Java developers

This is Jitter





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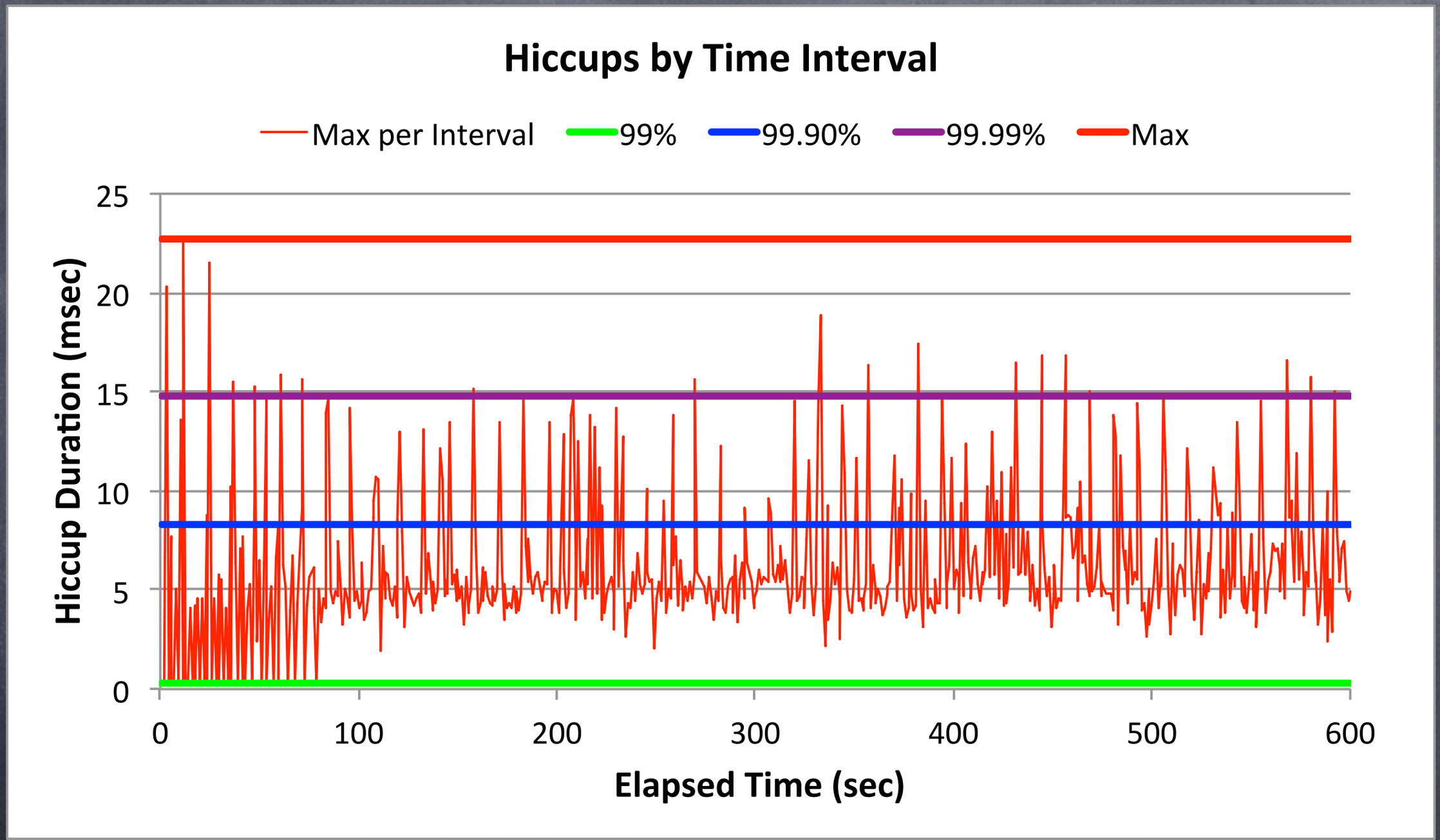

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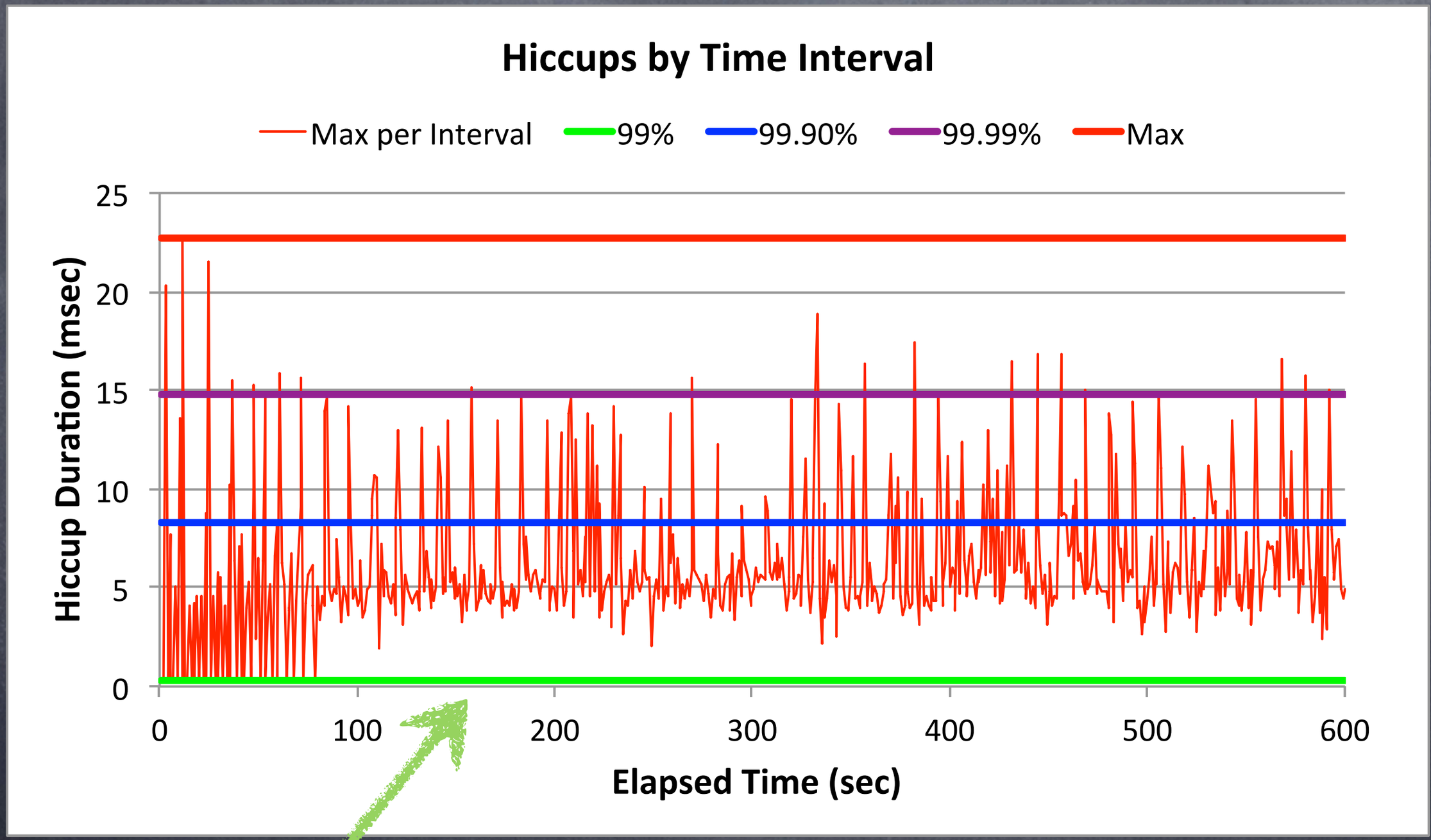

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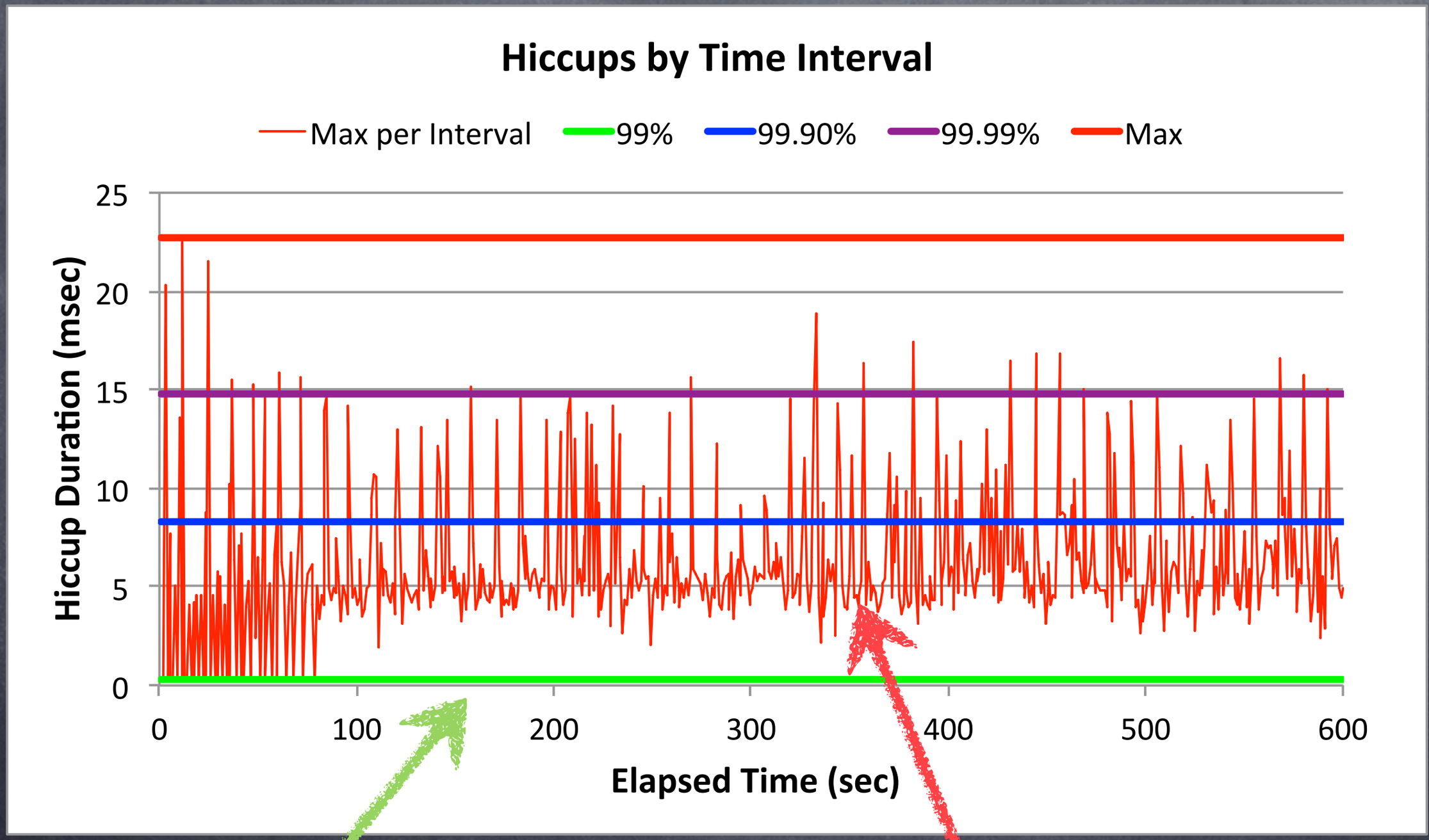

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- A Long history building Virtual & Physical Machines, Operating Systems, Enterprise apps, etc...

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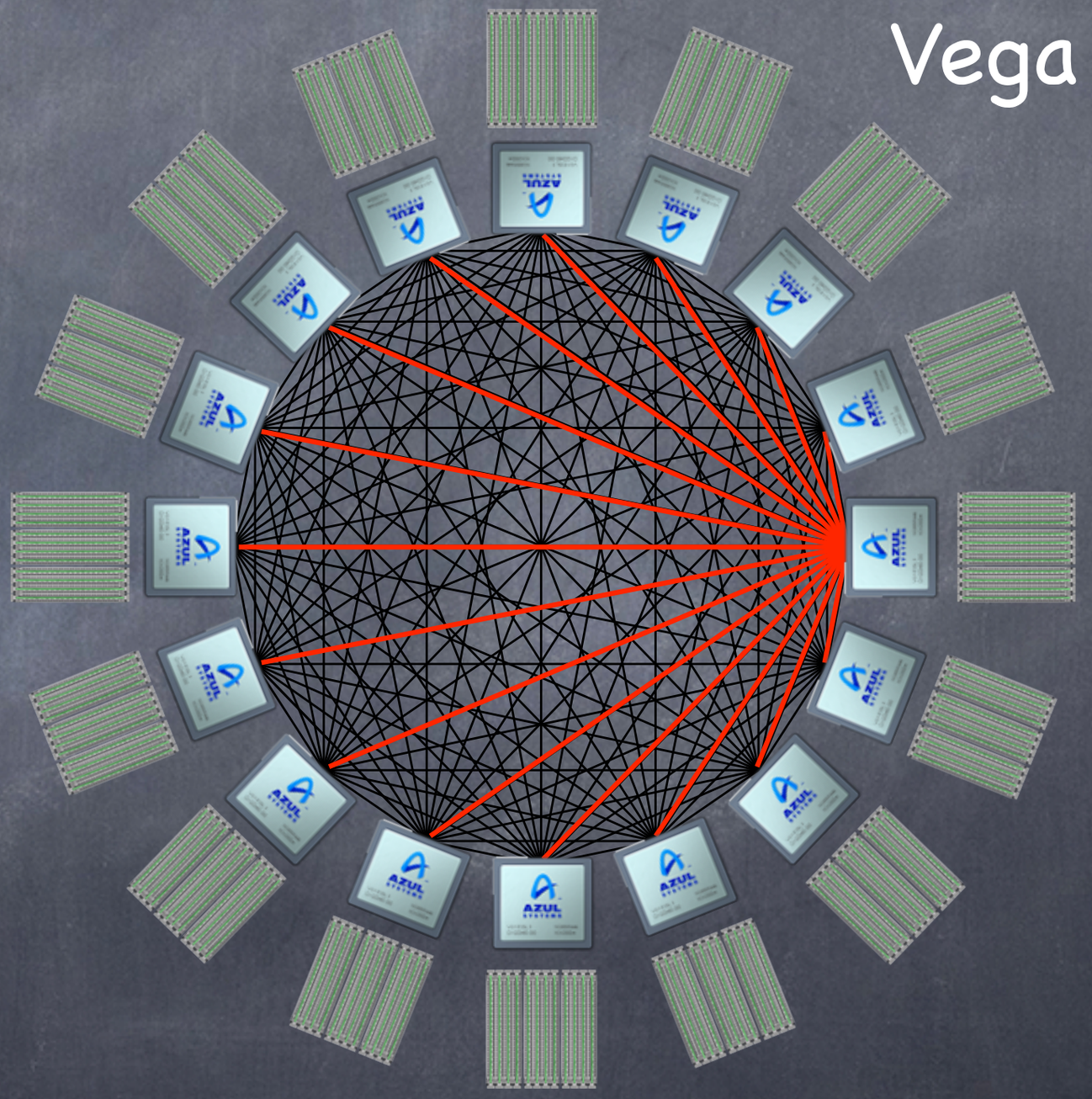

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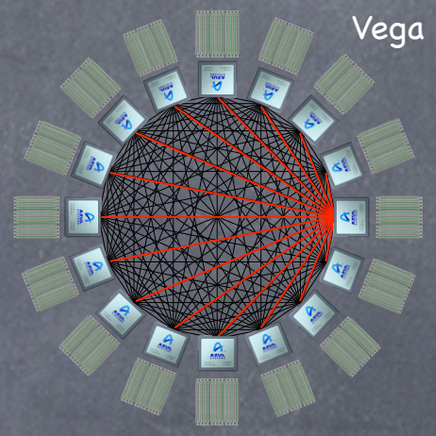

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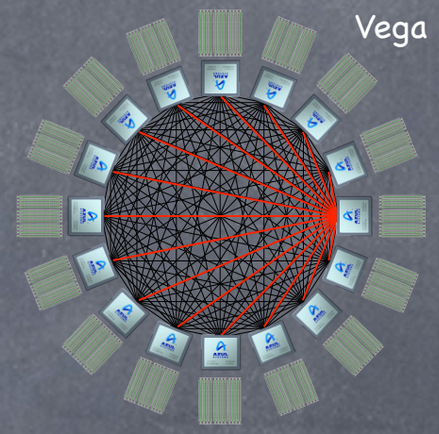

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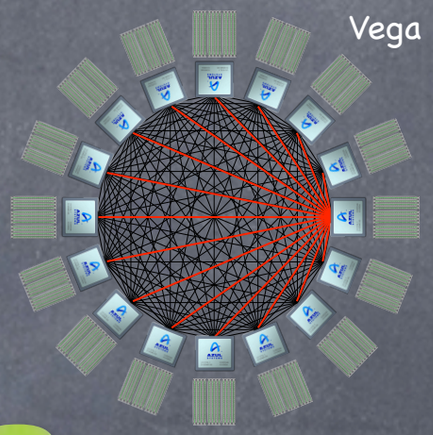

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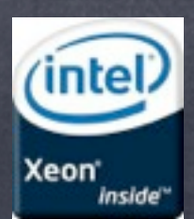

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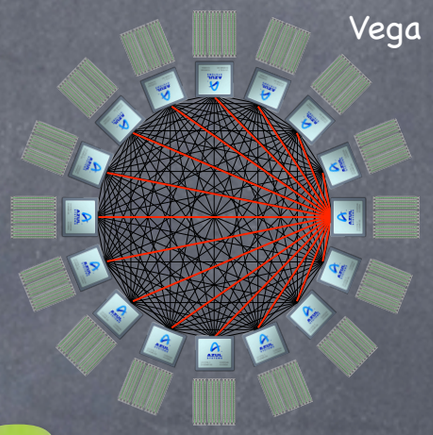
- Known for Low Latency, Consistent execution, and Large data set excellence



Zing

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- Time-to-product, Time-to-market, ...
- Leverage, ecosystem, ability to hire

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- Our developers seem to be able to produce 2x-3x as much when using a Java environment as they would with C++ ...

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- Ever hear of Garbage Collection?

Java’s achilles heel

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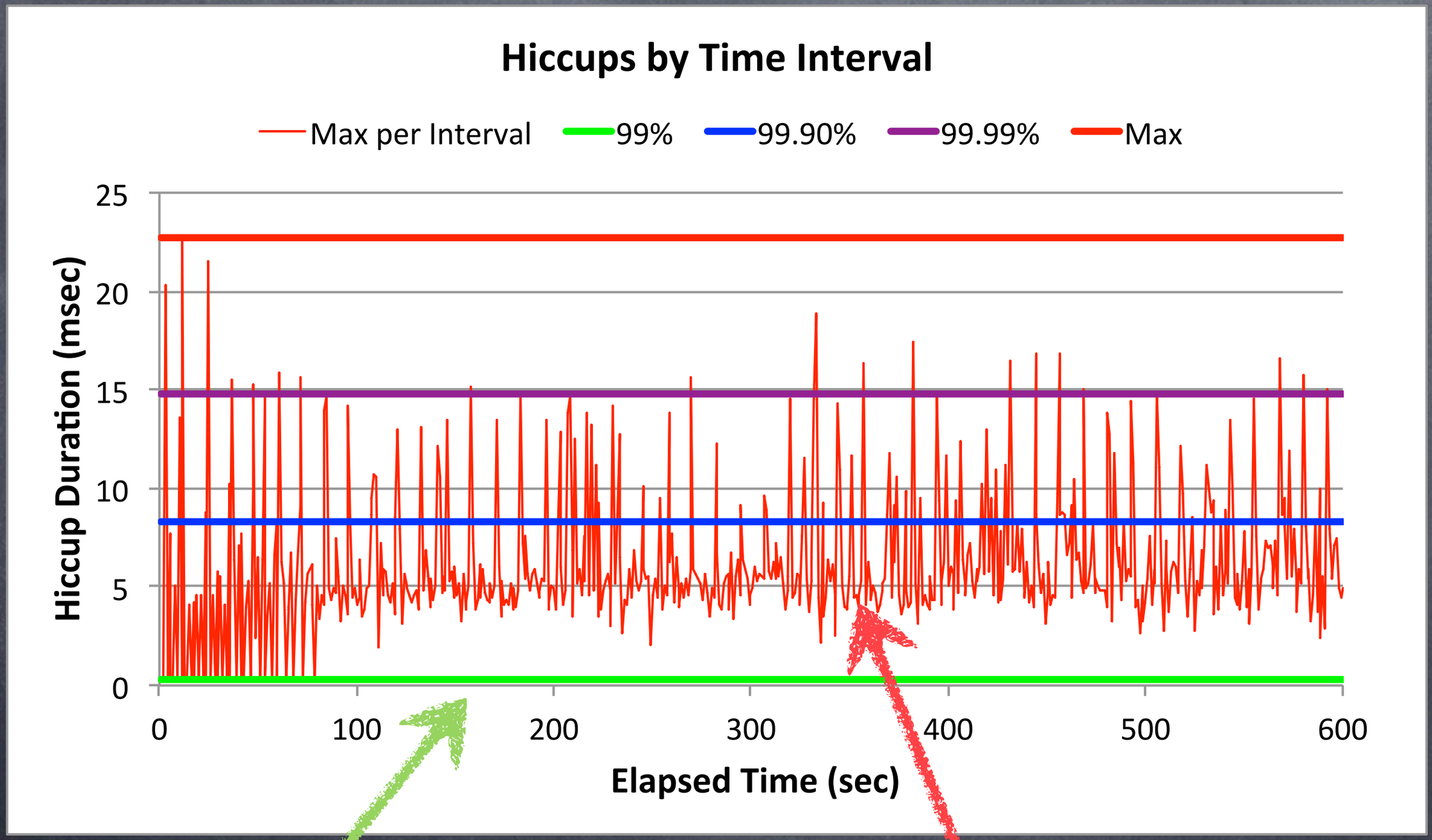
- So bad that it affects risk, profitability, service expectations, etc.

STW-GC effects in a low latency application



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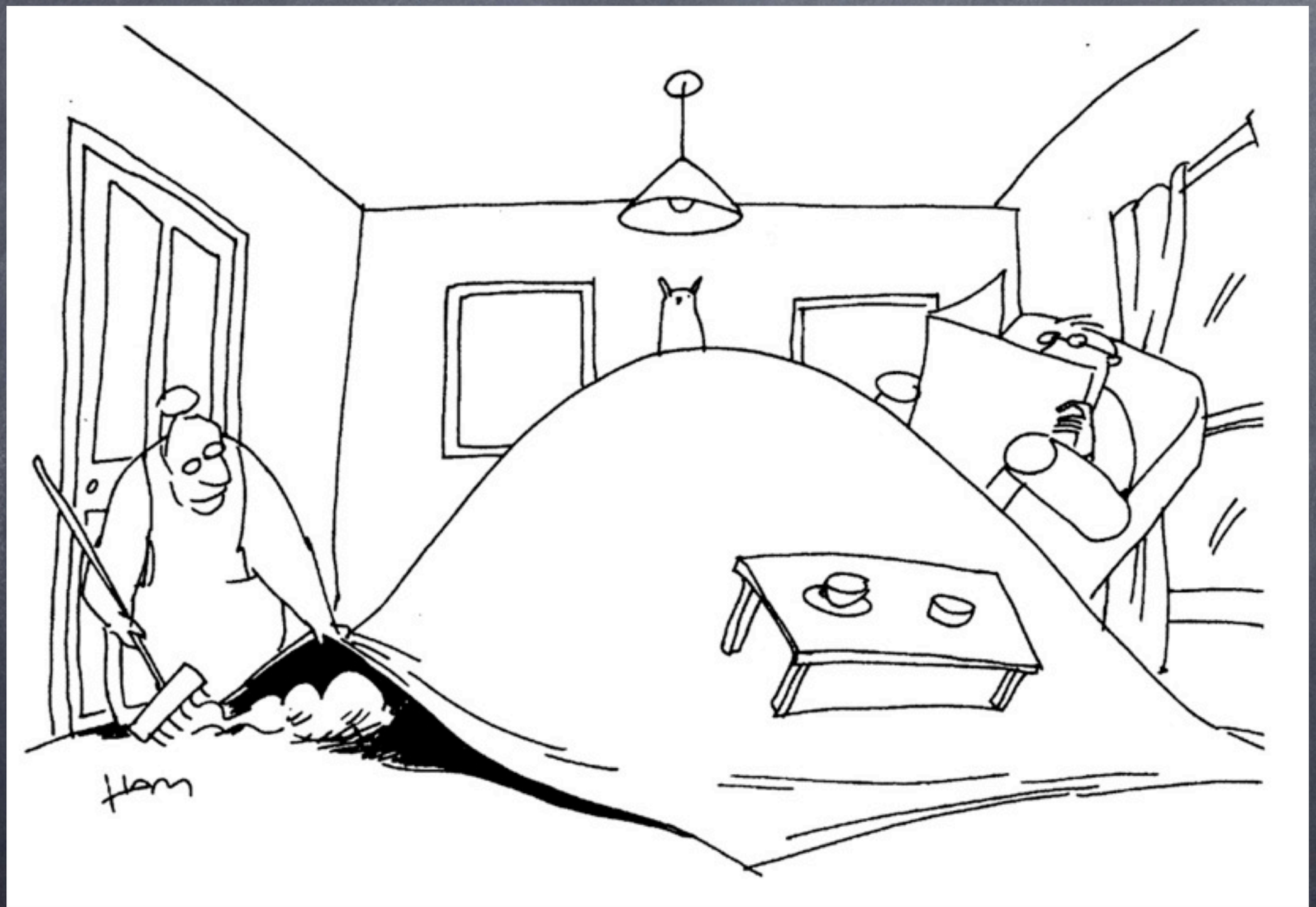

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- "Typical pauses in the tens of milliseconds"

Translation: "Some pauses are much longer than tens of milliseconds"

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- ...
- Some call it "fun"... Others "duct tape engineering"...

There is a fundamental problem

Stop-The-World GC mechanisms are contradictory to the fundamental requirements of low latency & low jitter apps

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- ALL use a Fallback to Full Stop-the-world Collection
  - Used for dealing with the inevitable pile of dust under the rug
  - Used to recover when other mechanisms fail
  - Hidden under the term "Mostly"...

Sustainable Throughput:
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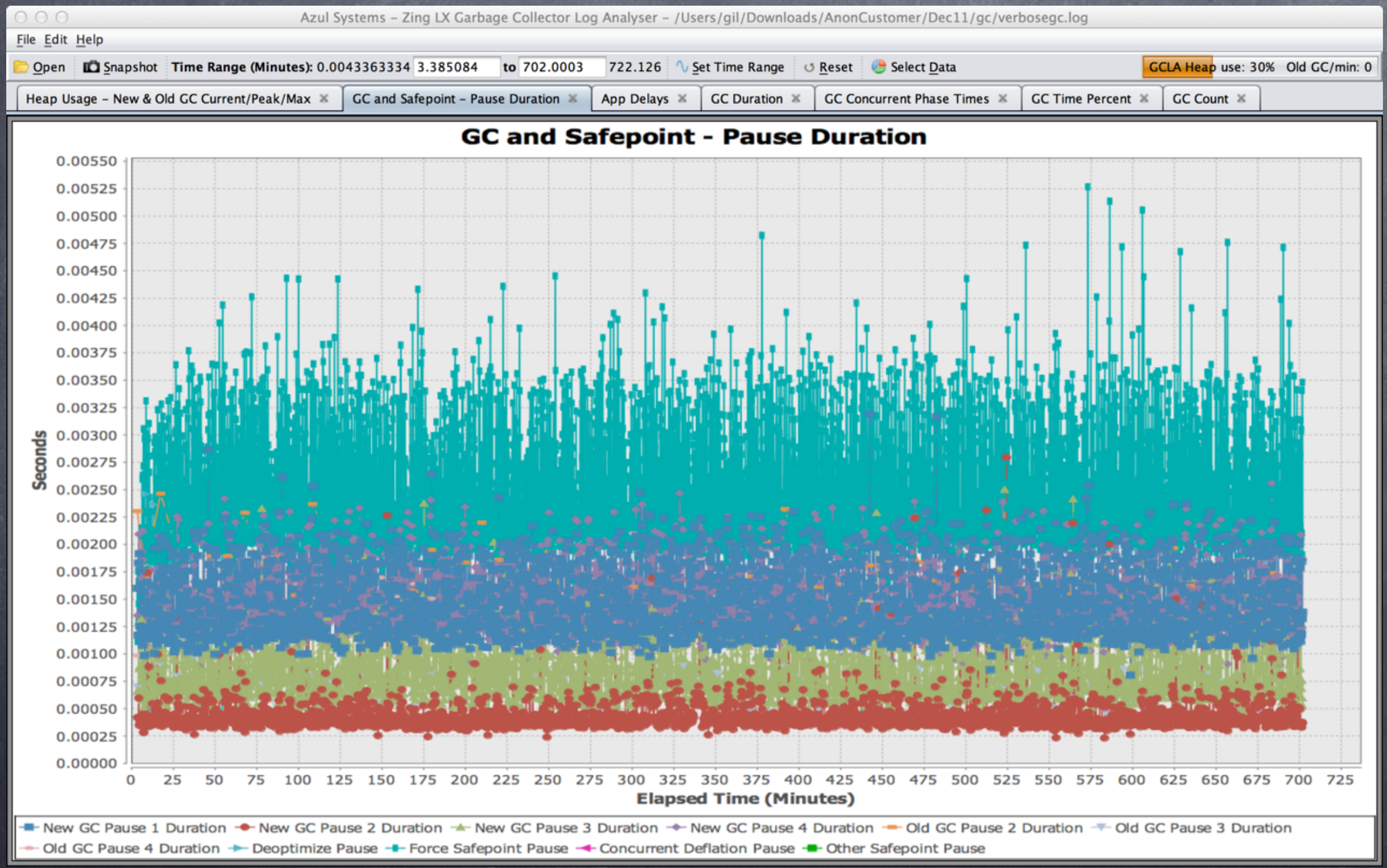
Benefits

An example of "First day's run" behavior
E-Commerce application



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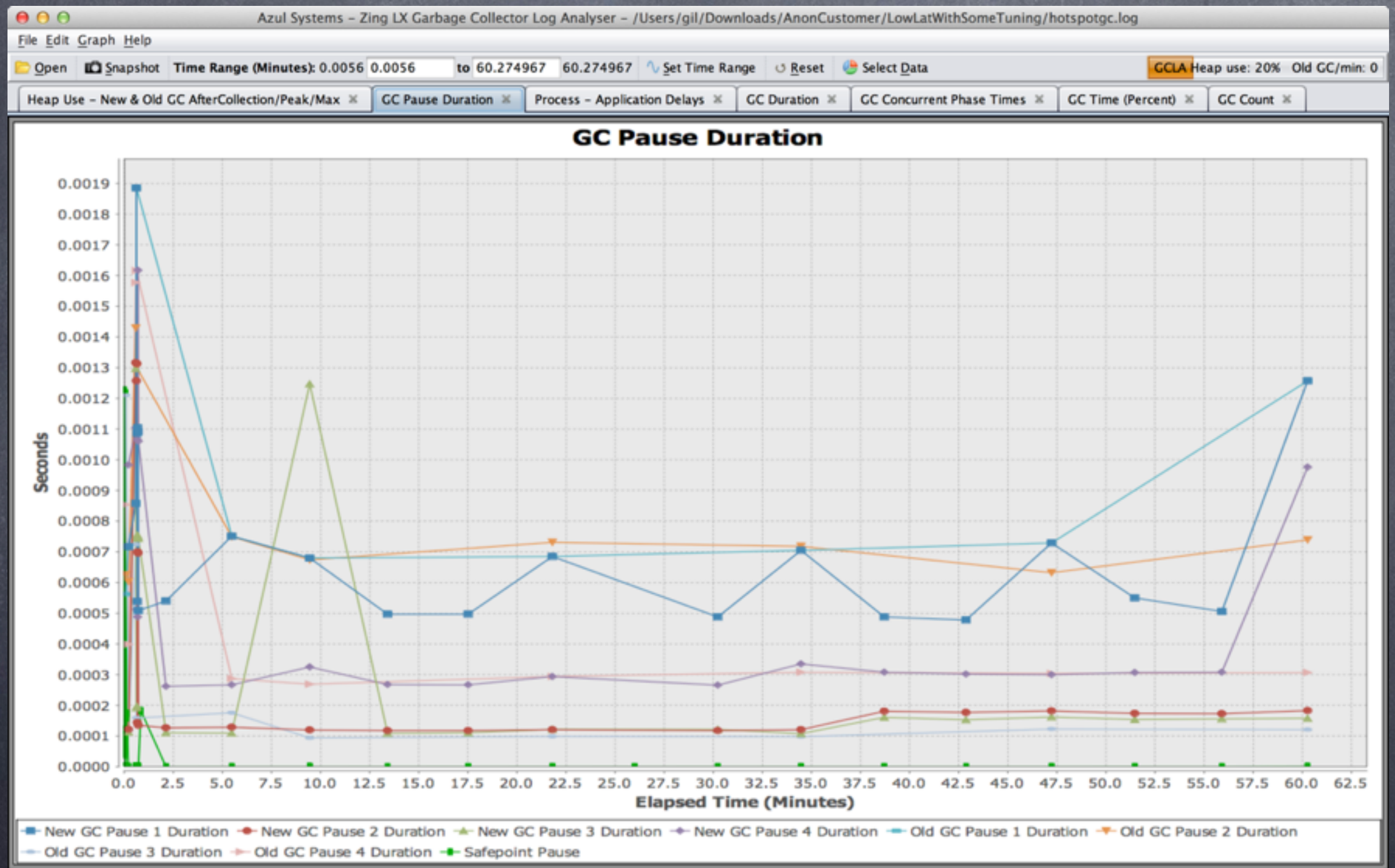
An example of behavior after 4 days of system tuning
Low latency application



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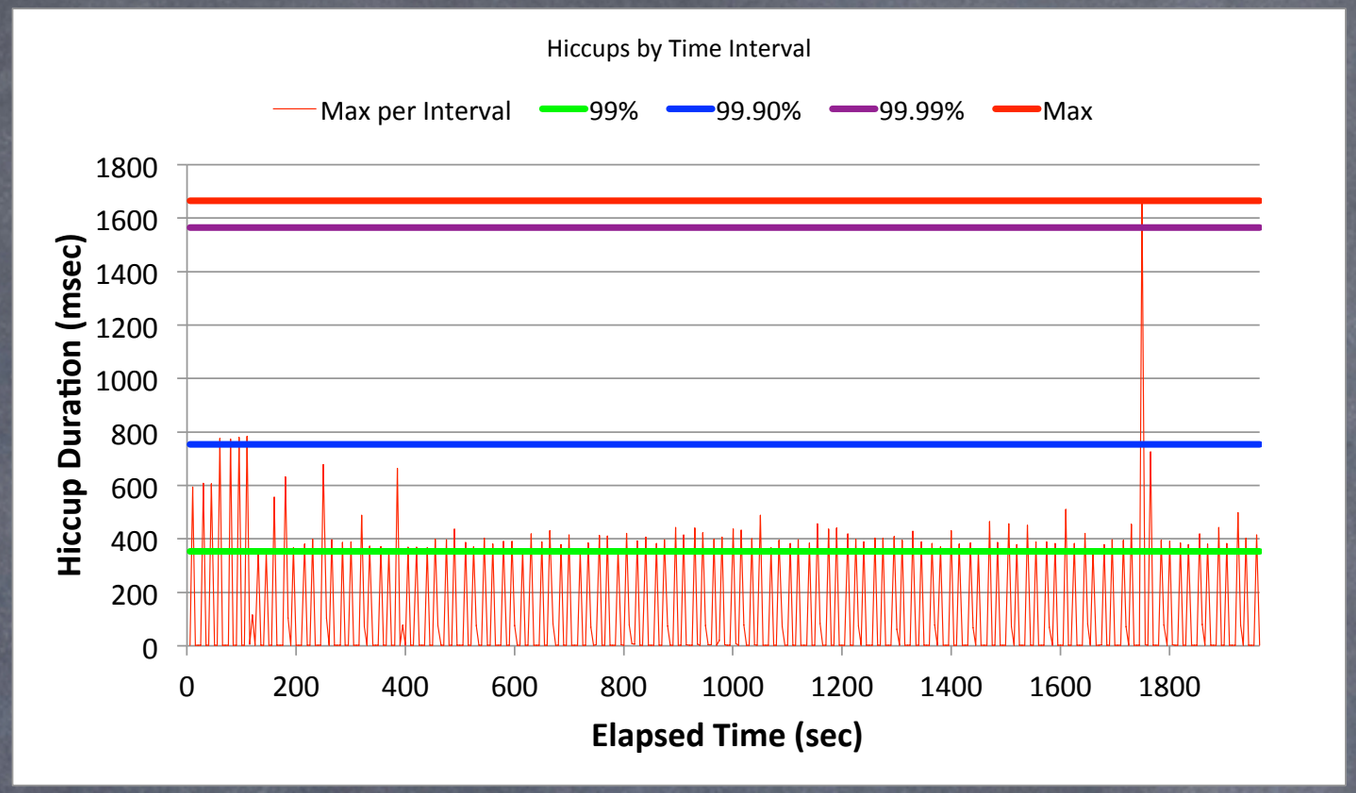
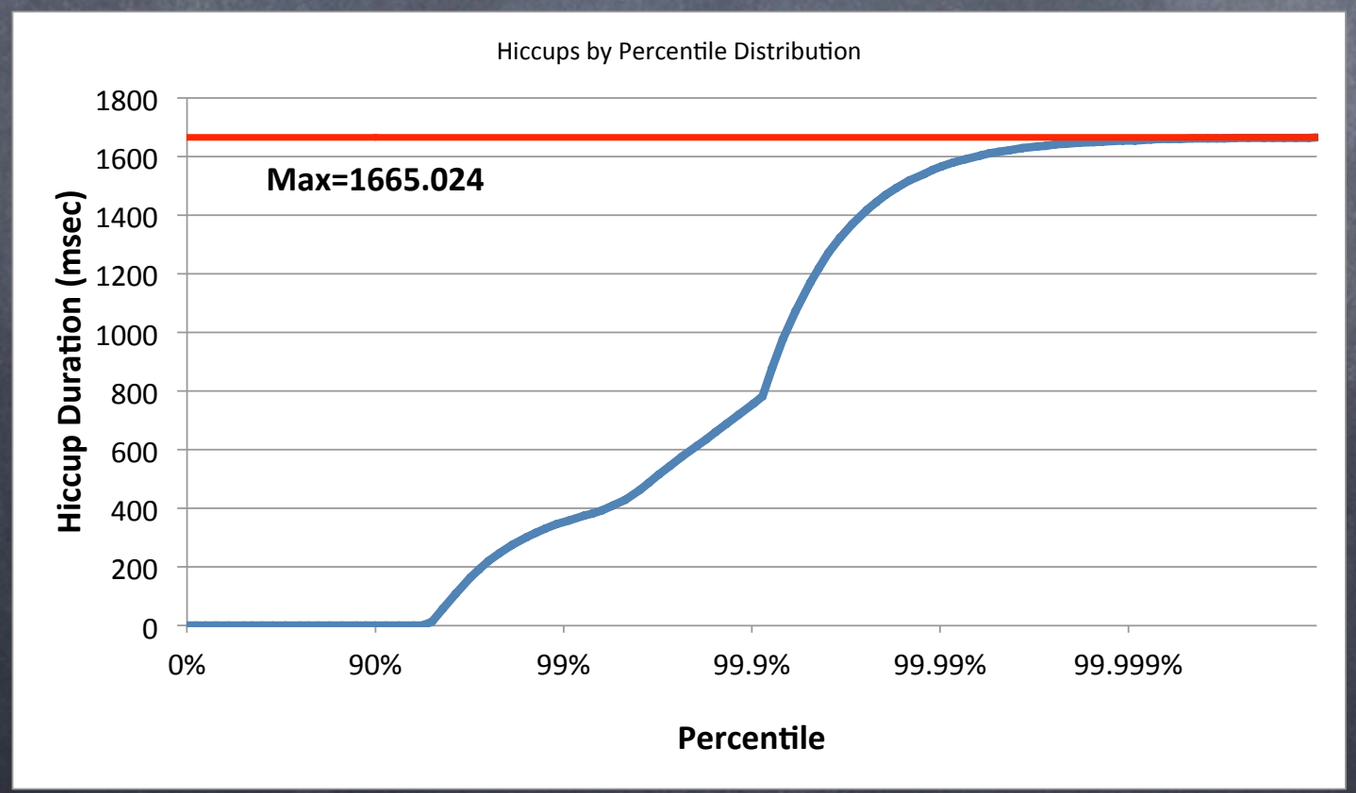
This is not "just Theory"

jHiccup:
A tool that measures and reports
(as your application is running)
if your JVM is running all the time

Discontinuities in Java platform execution - Easy To Measure





A telco App with a bit of a "problem"

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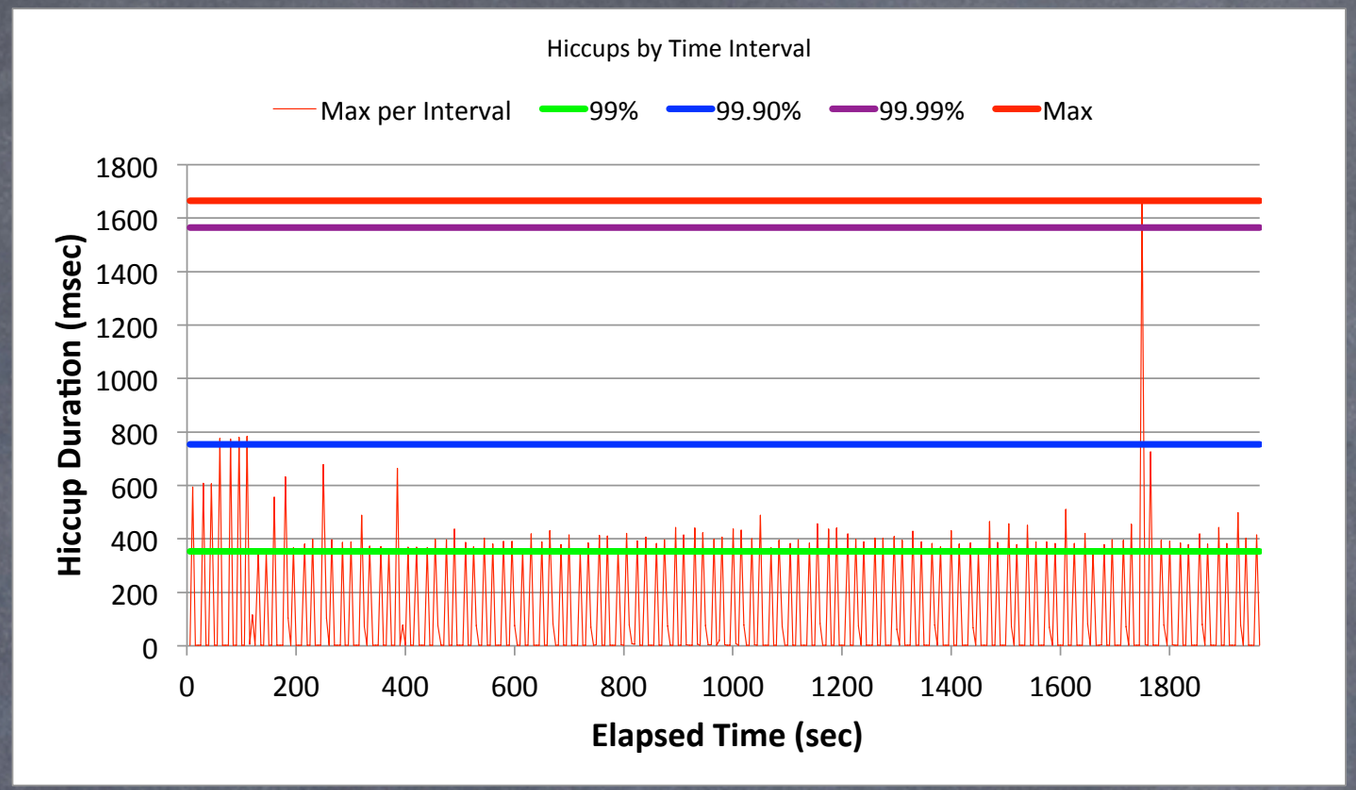
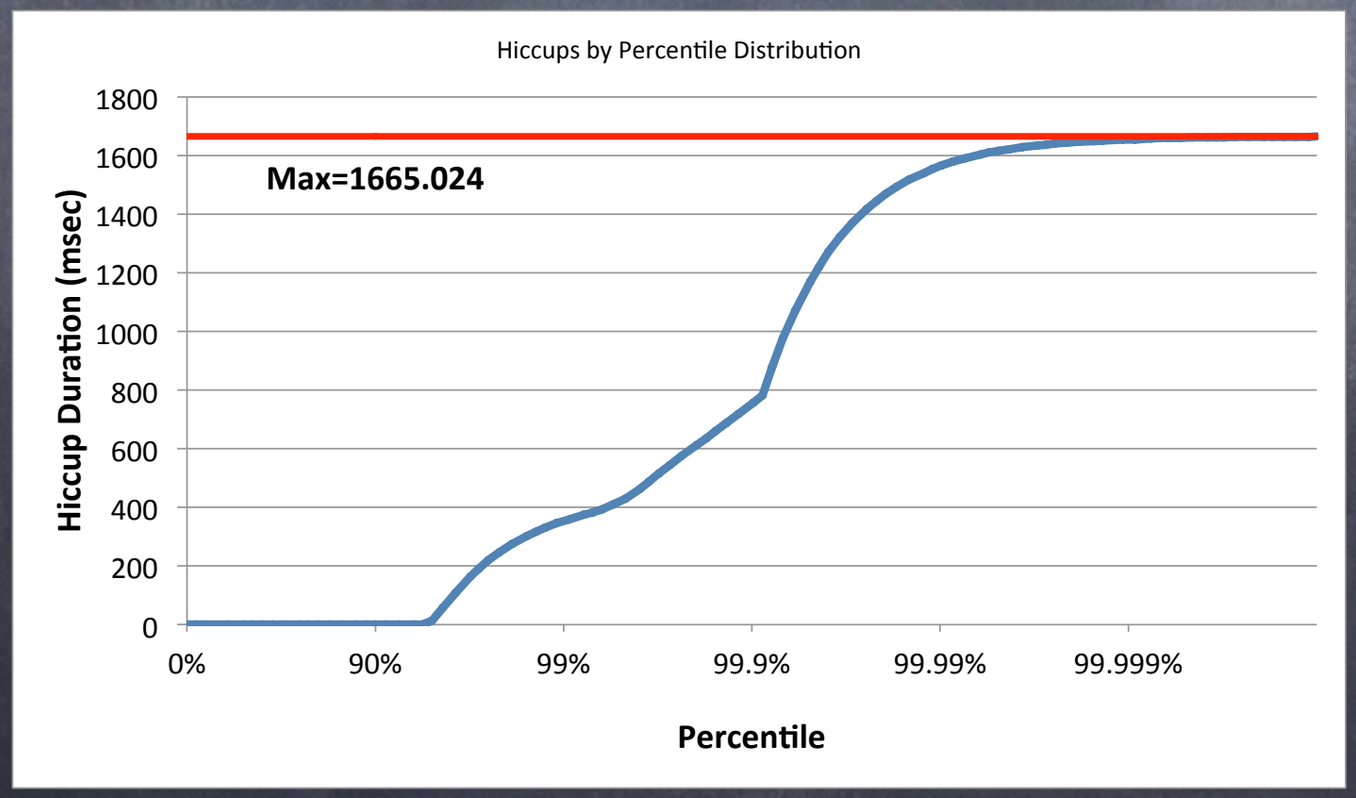
Discontinuities in Java platform execution - Easy To Measure

We call these "hiccups"





A telco App with a bit of a "problem"

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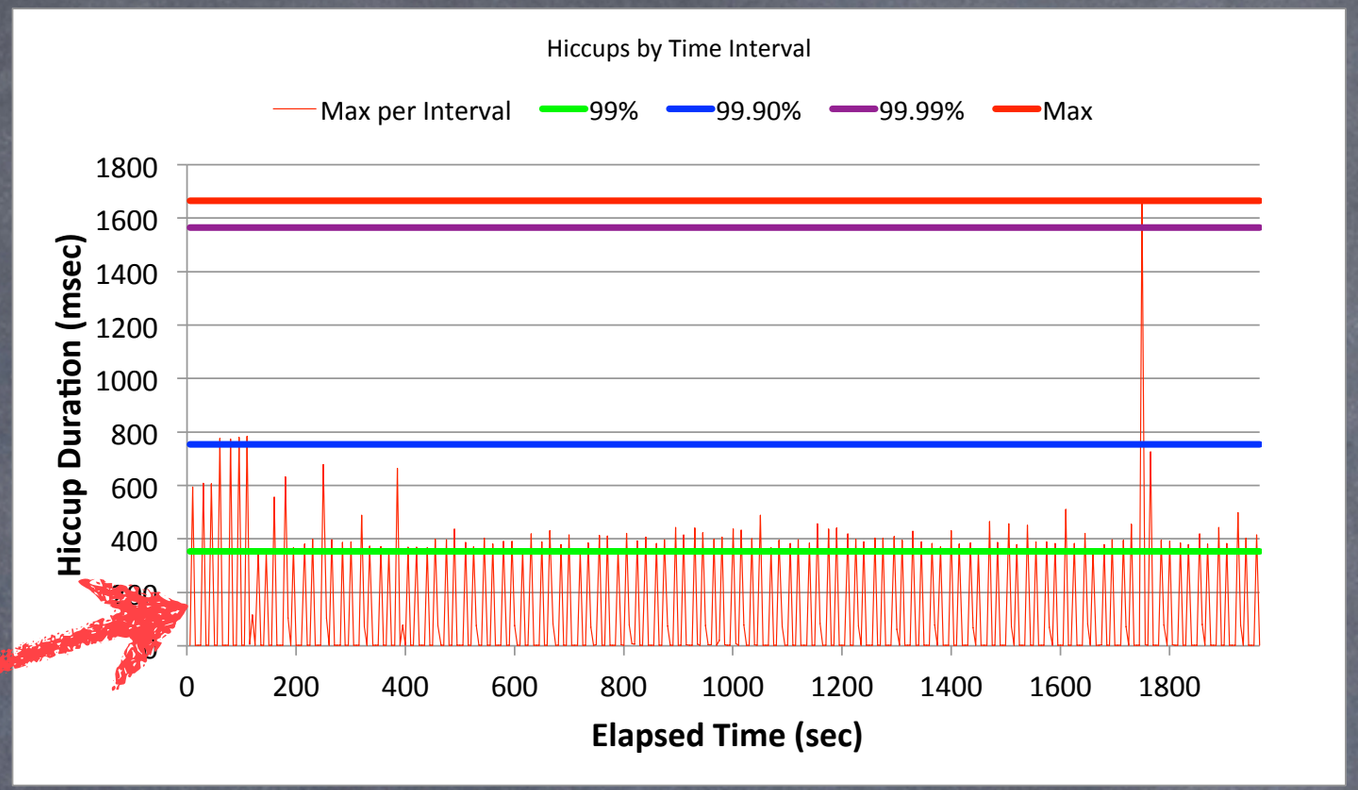
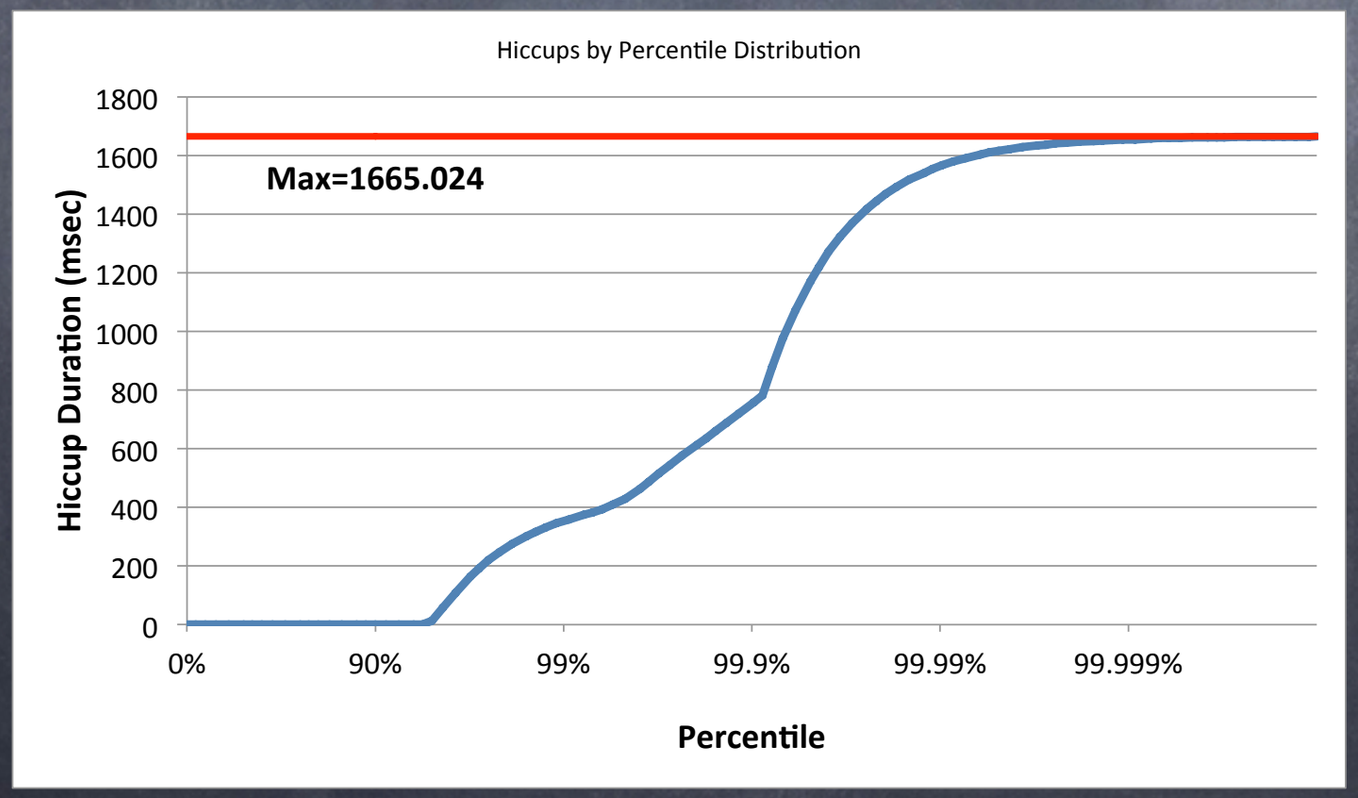
Discontinuities in Java platform execution - Easy To Measure

We call these "hiccups"





A telco App with a bit of a "problem"

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Fun with jHiccup

Charles Nutter @headius 20 Jan

jHiccup, @AzulSystems' free tool to show you why your JVM sucks compared to Zing: bit.ly/wsH5A8 (thx @bascule)

Retweeted by Gil Tene

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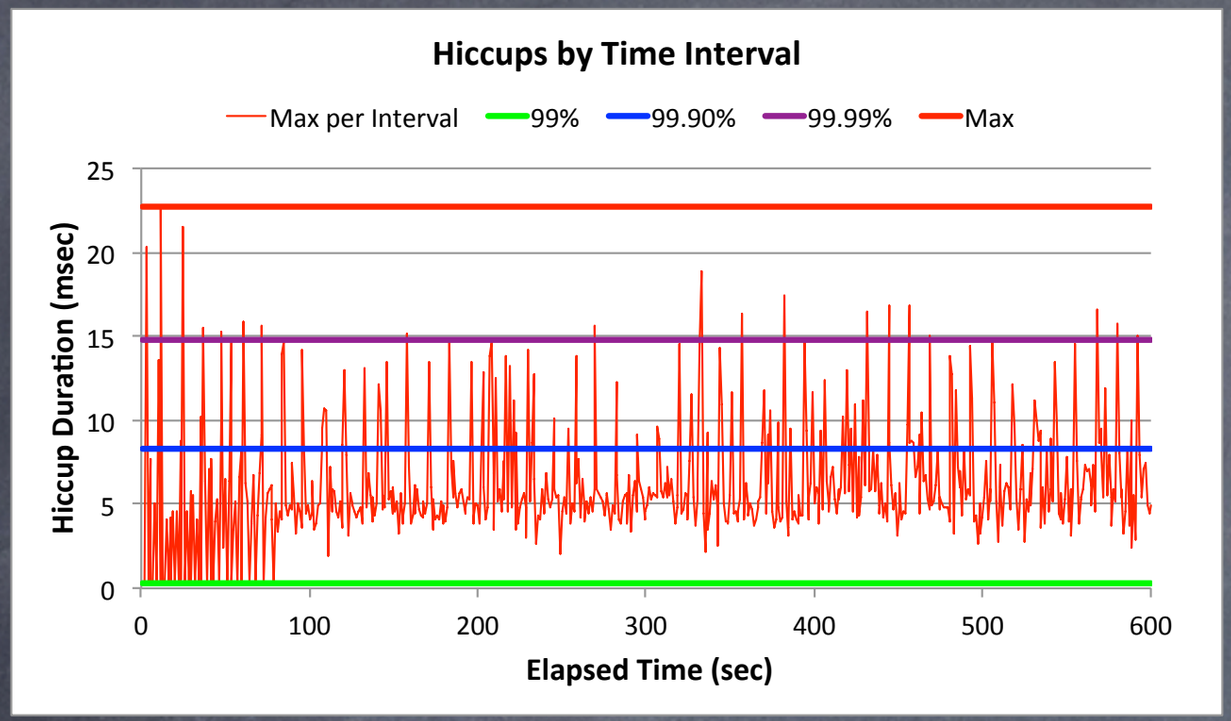
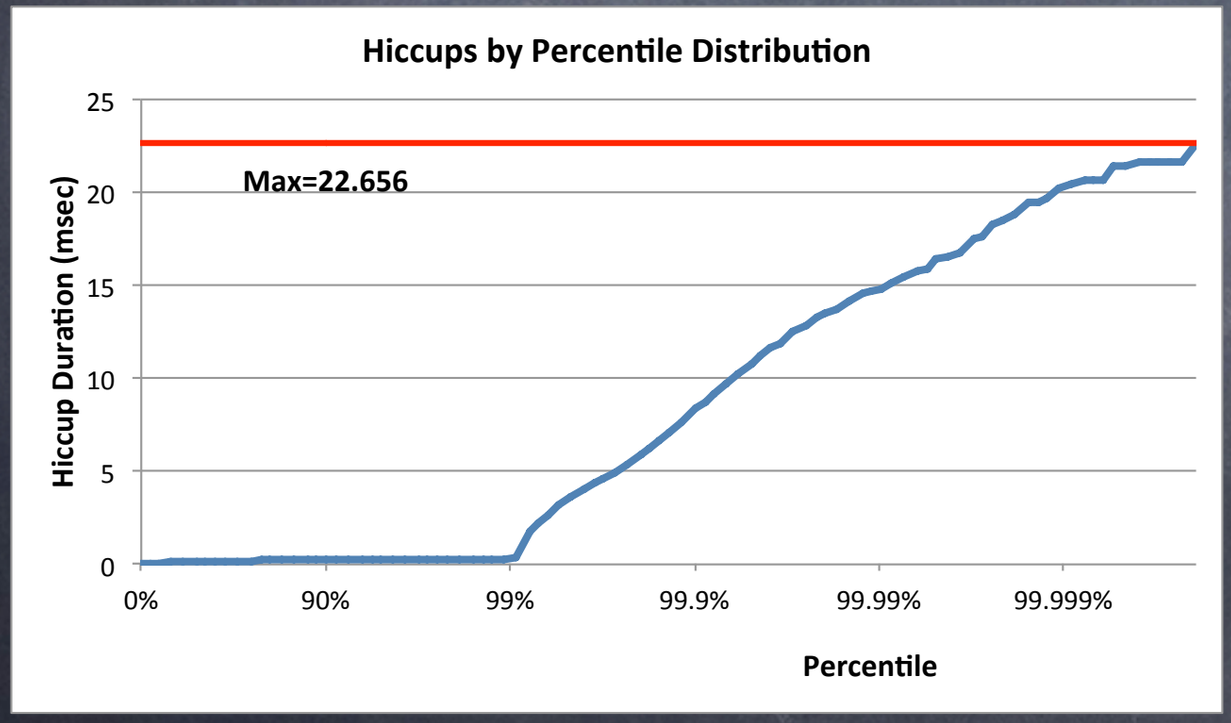
Oracle HotSpot (pure newgen)





Low latency trading application

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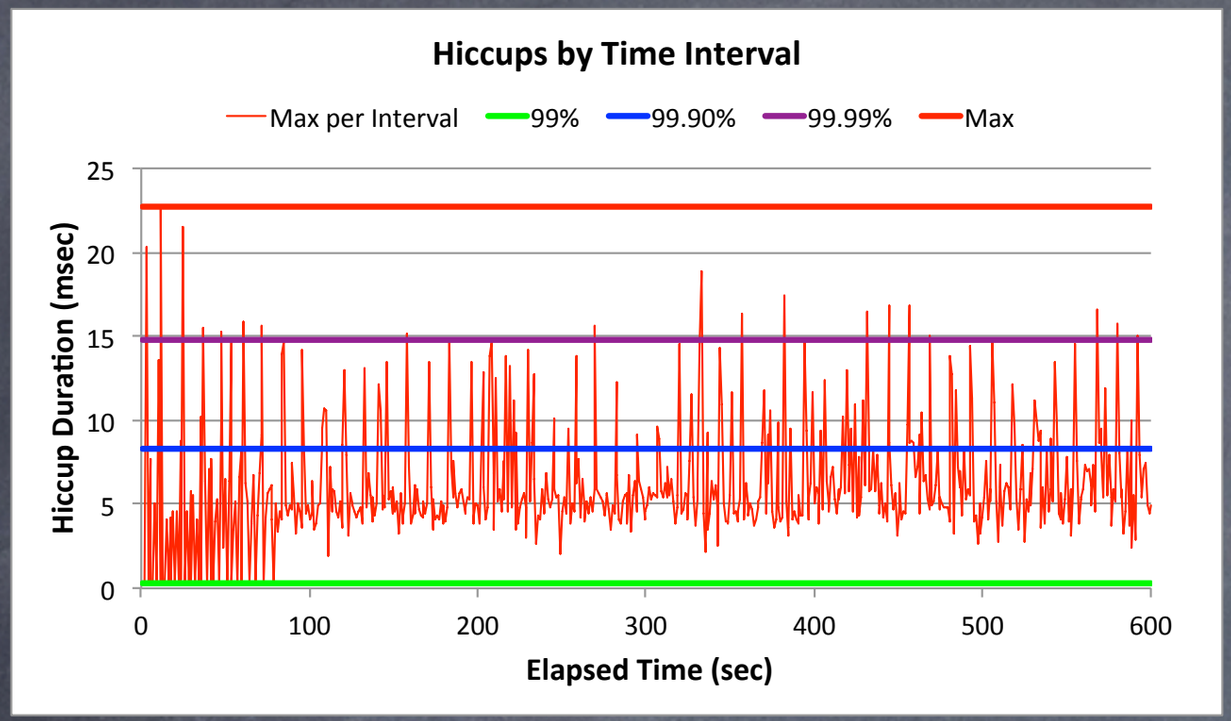
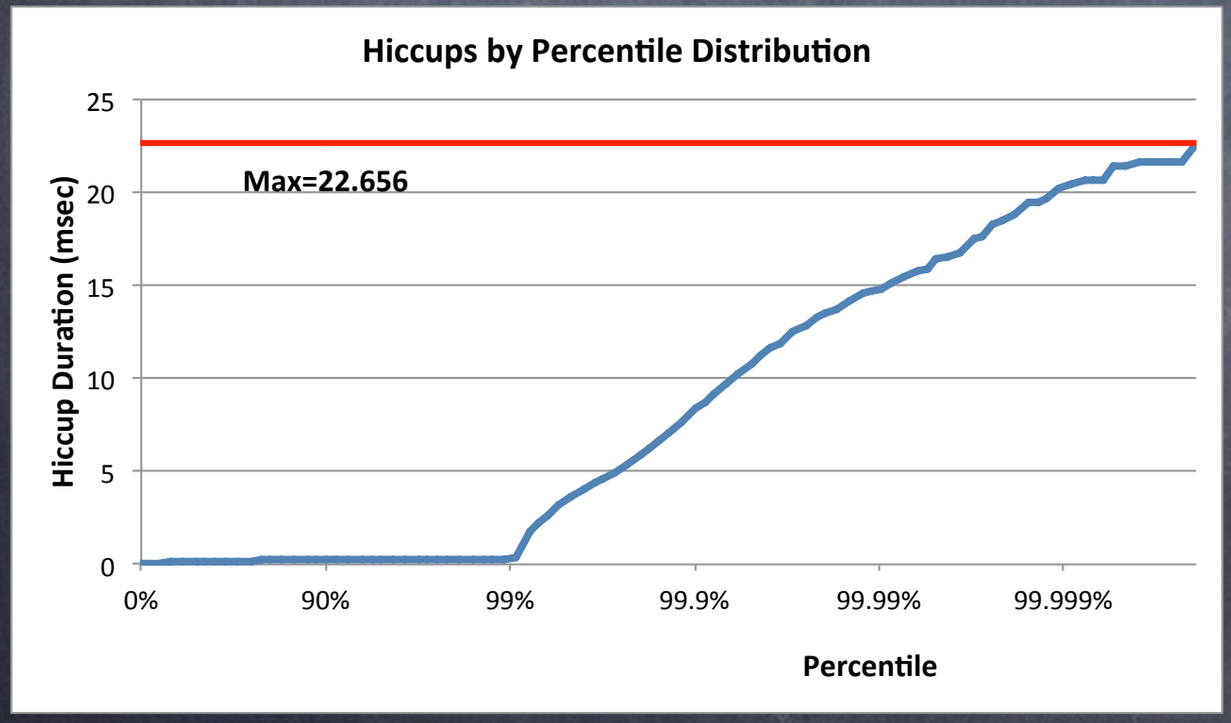
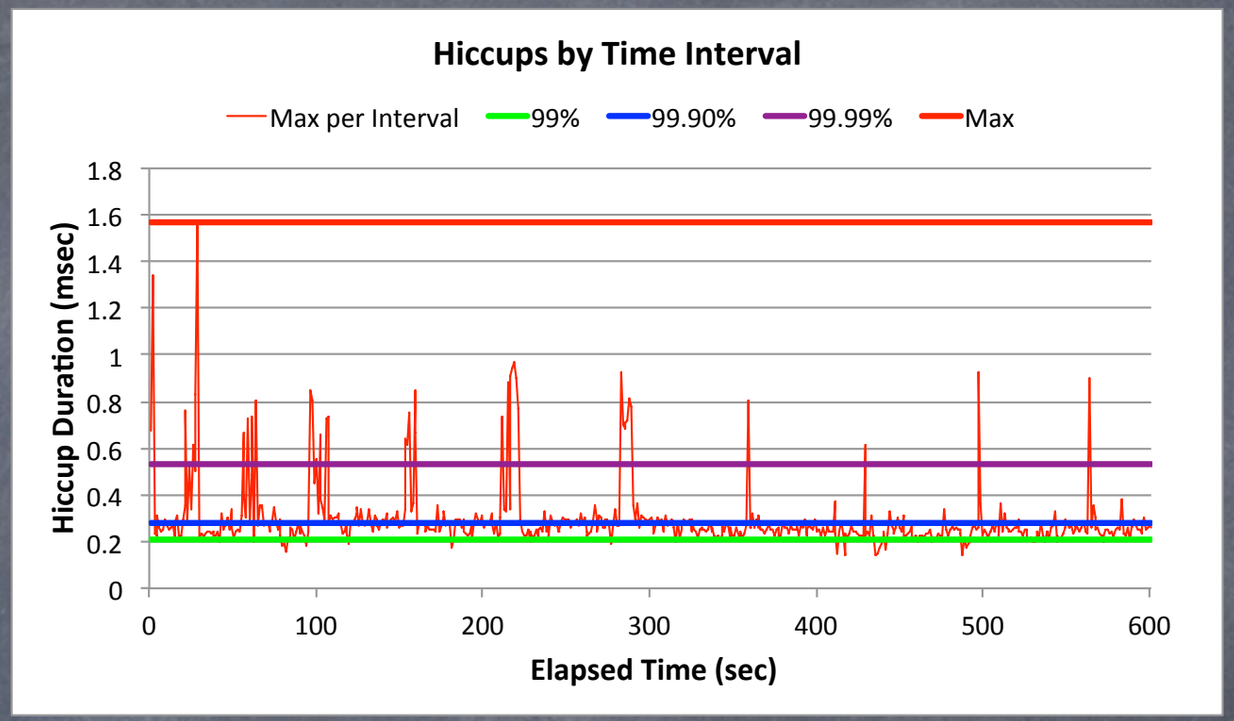
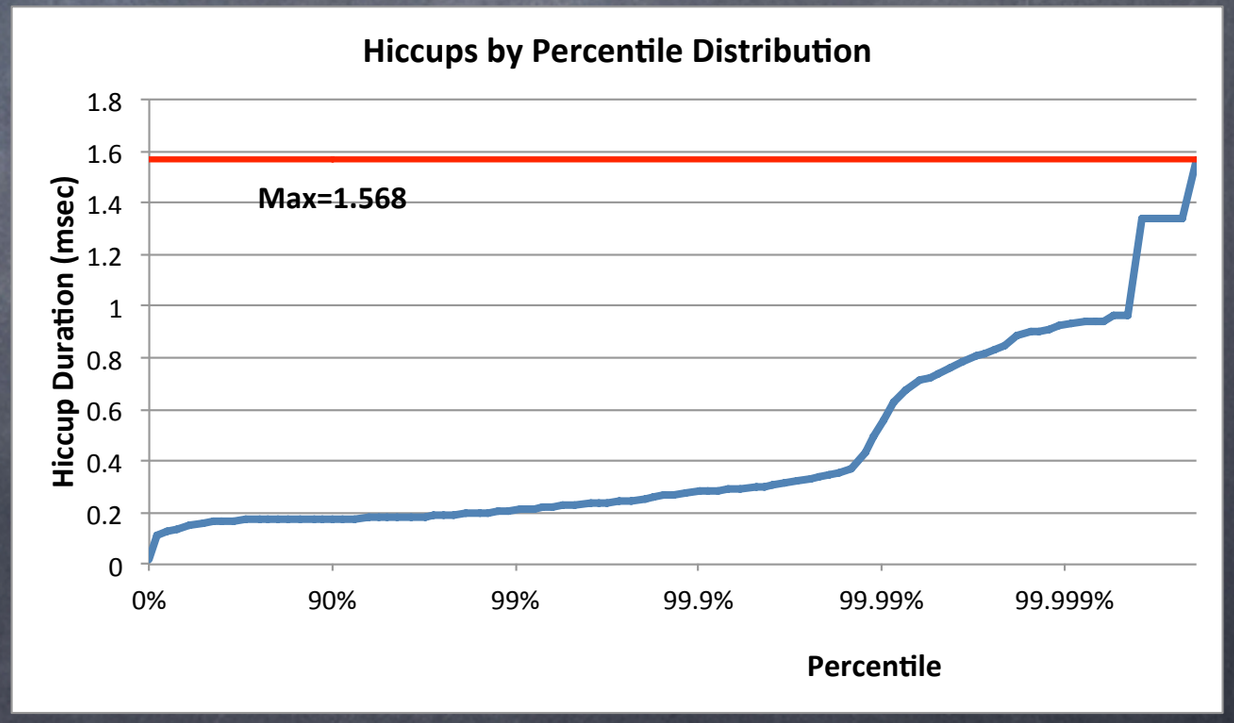




Zing





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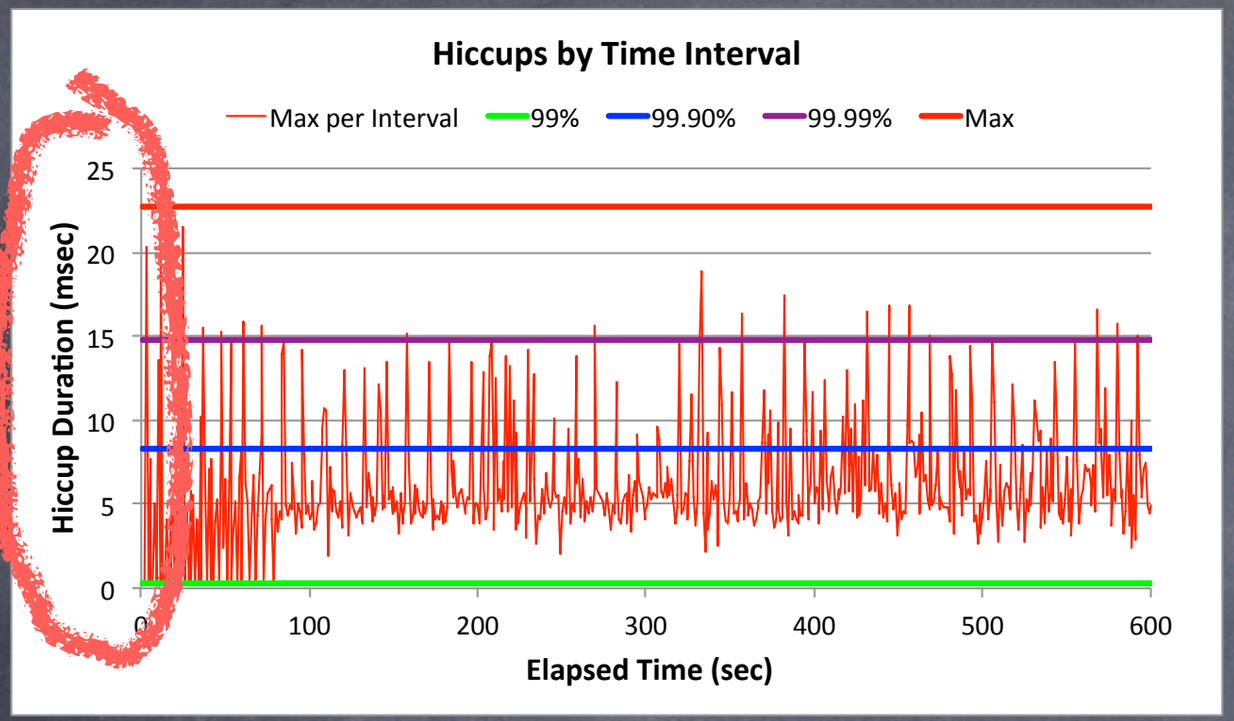

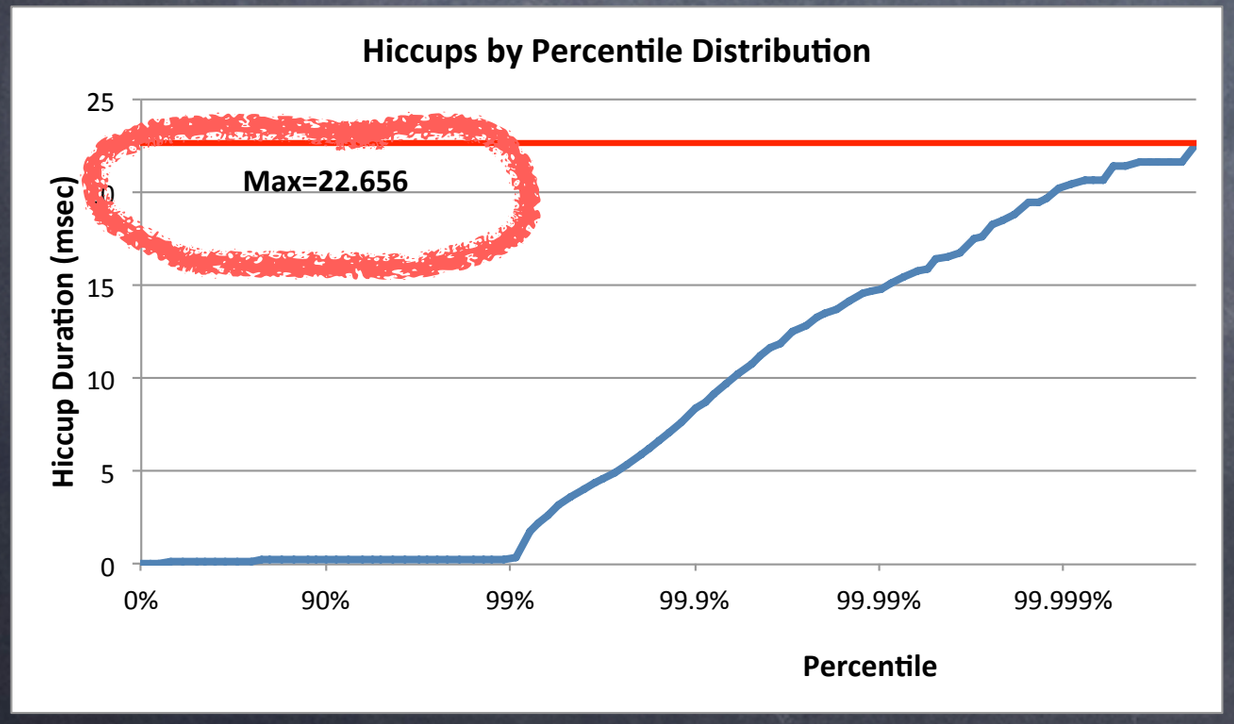

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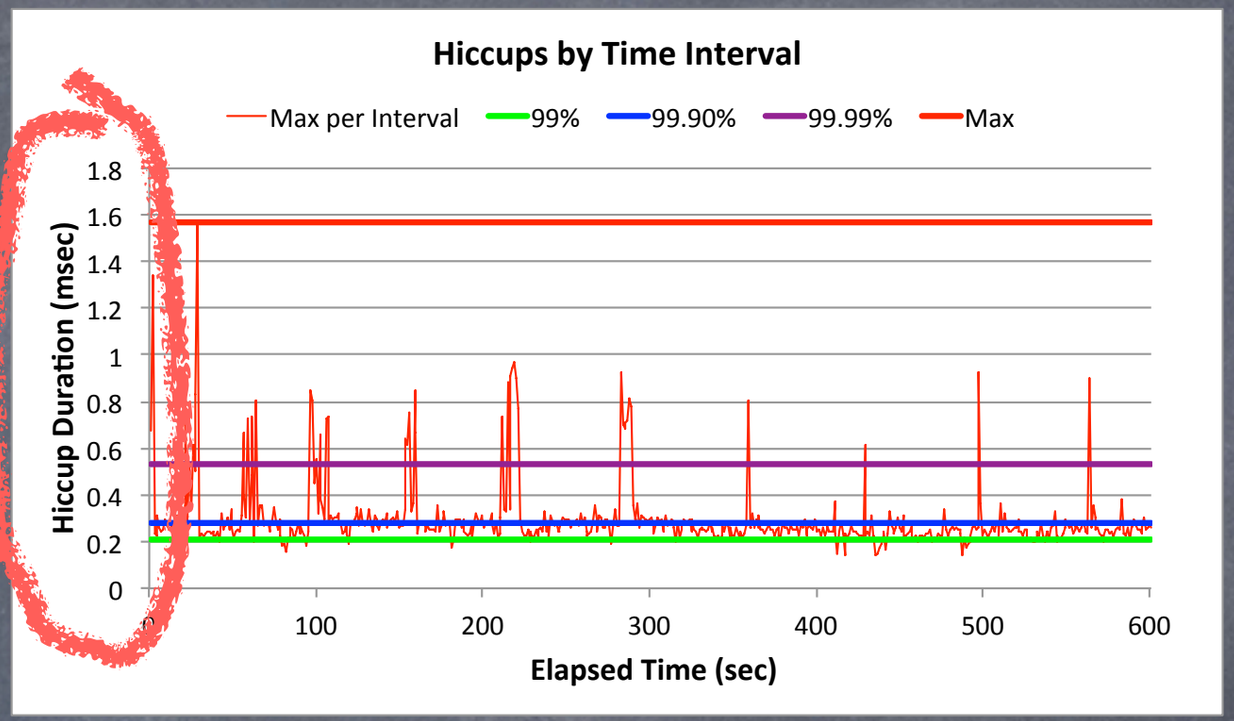

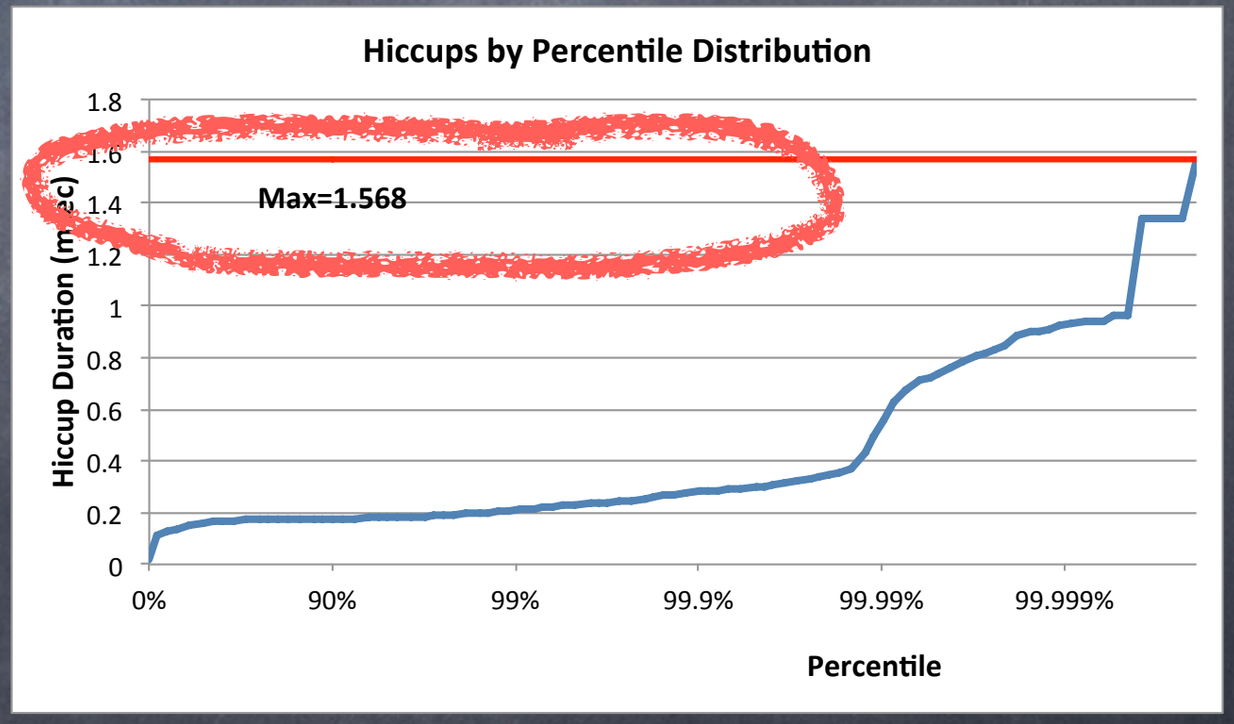

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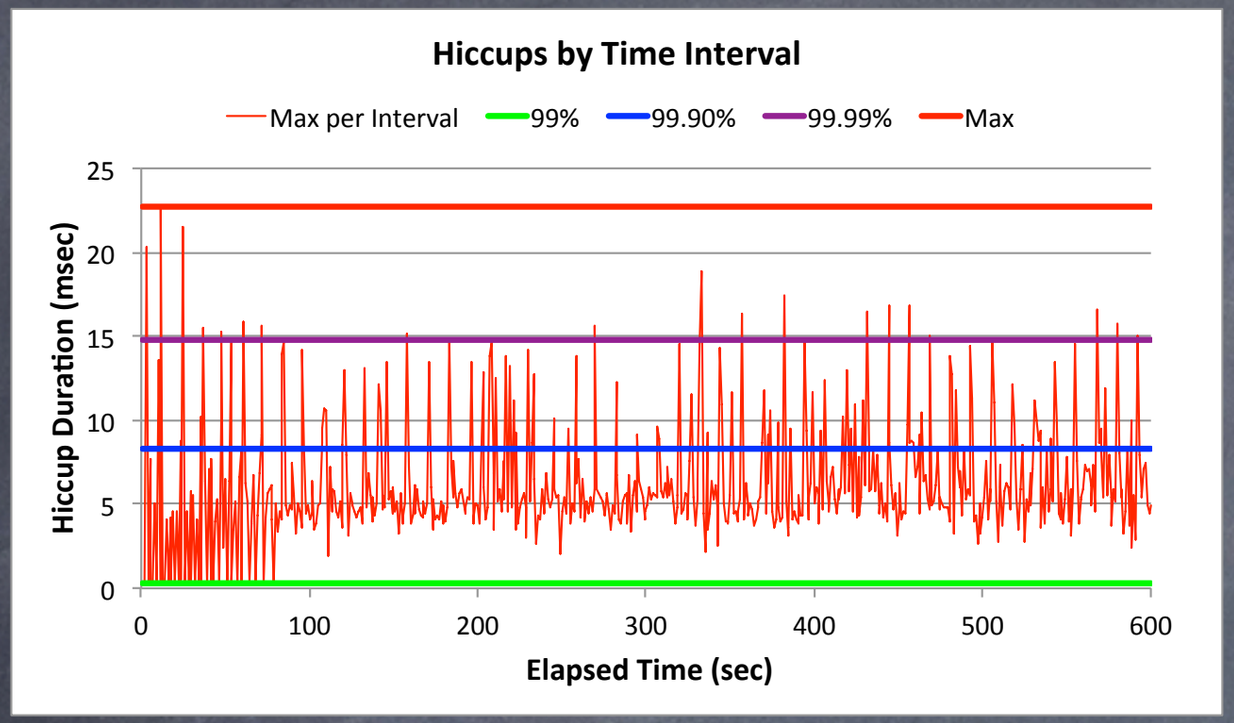

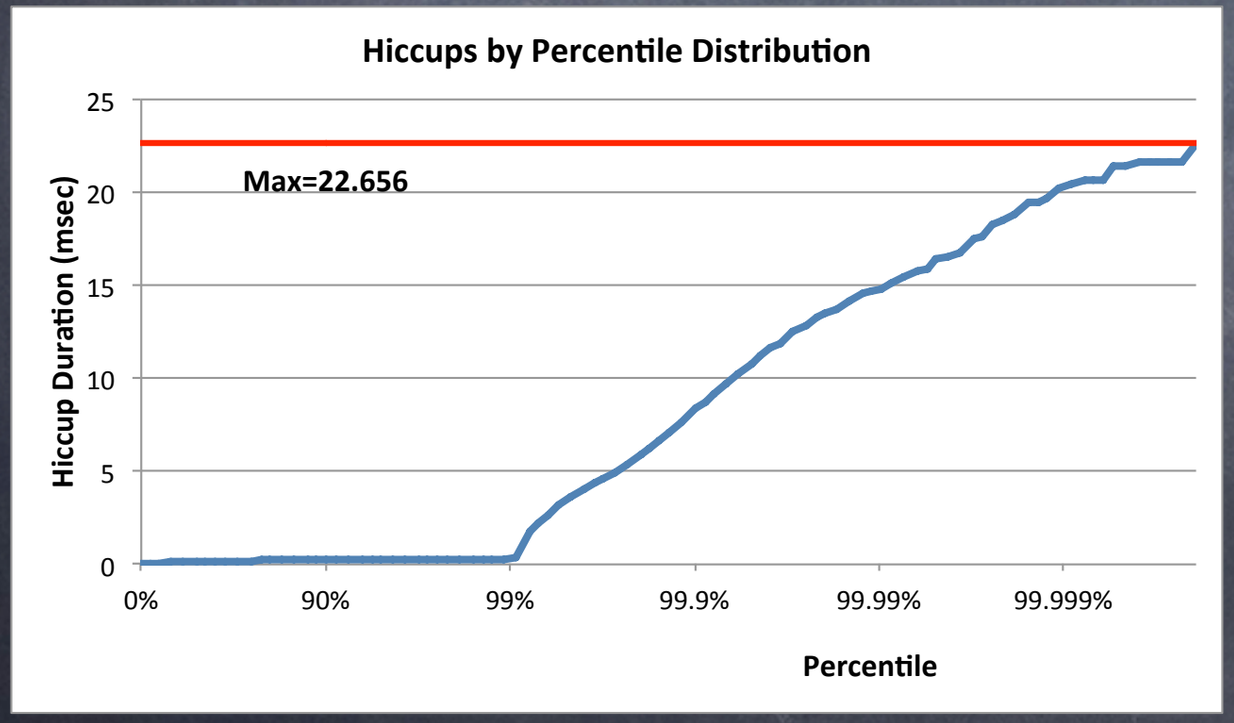

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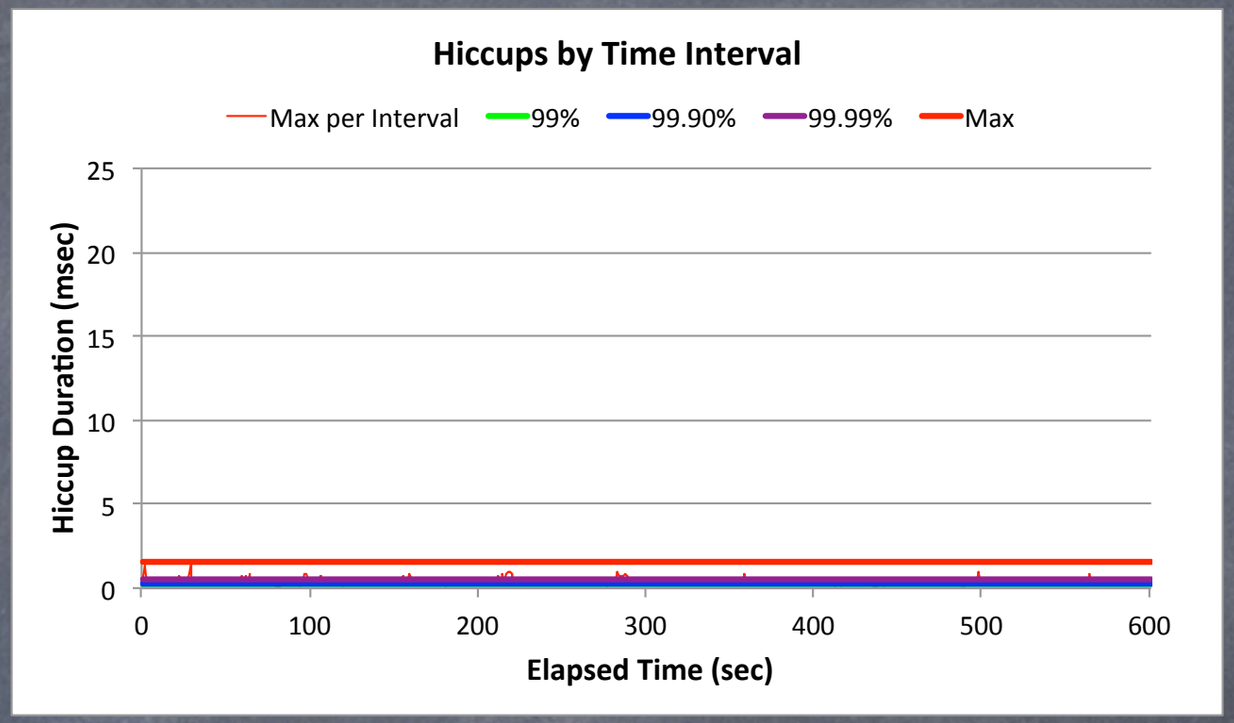

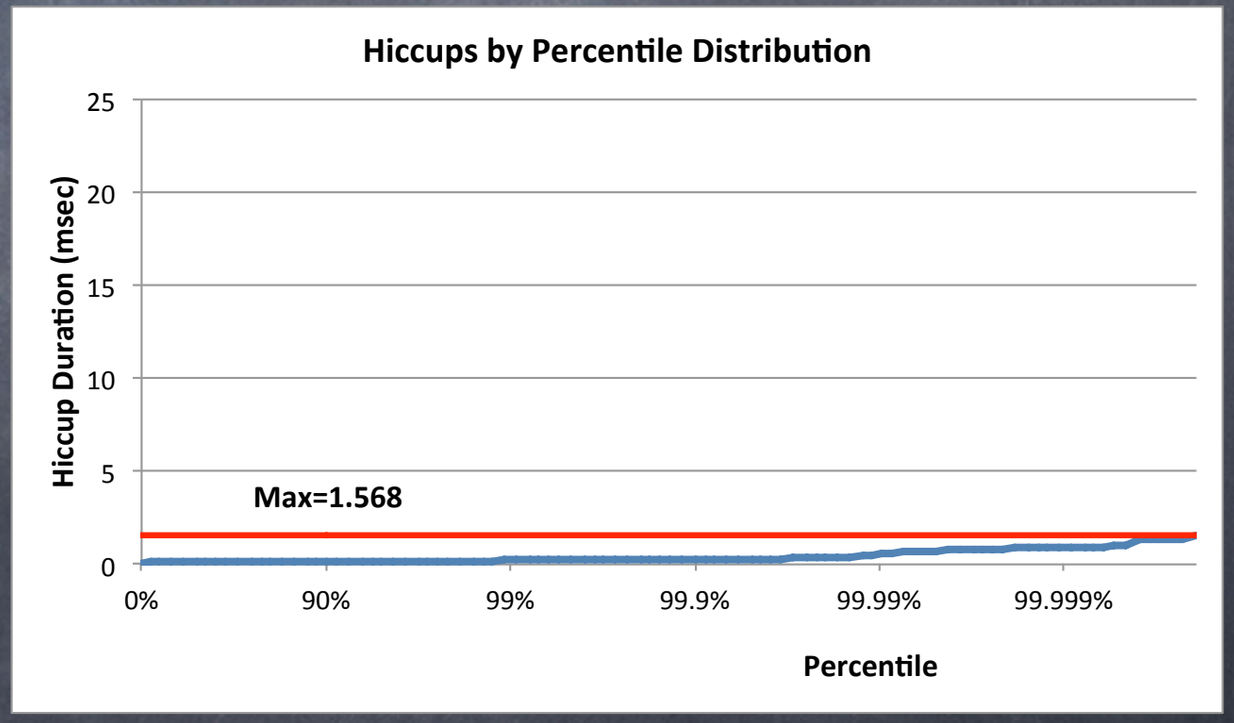

Low latency - Drawn to scale

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It's not just for Low Latency

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It's not just for
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Just as easy to demonstrate
for human-response-time
apps

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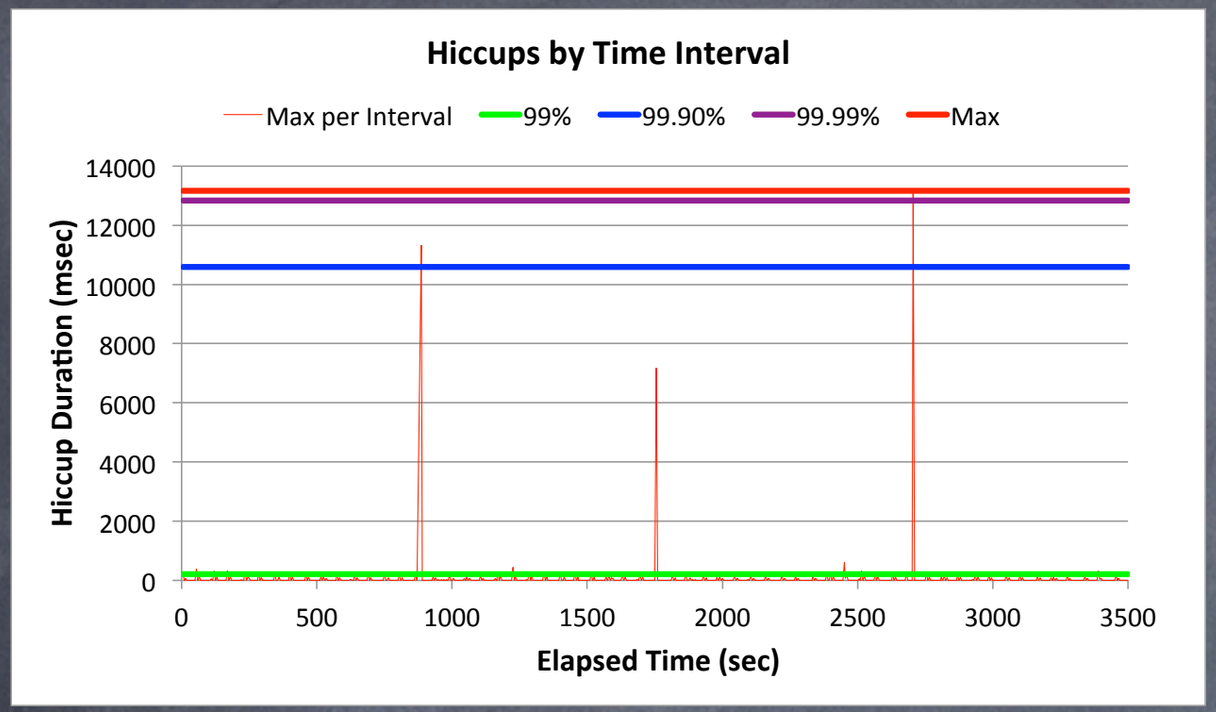
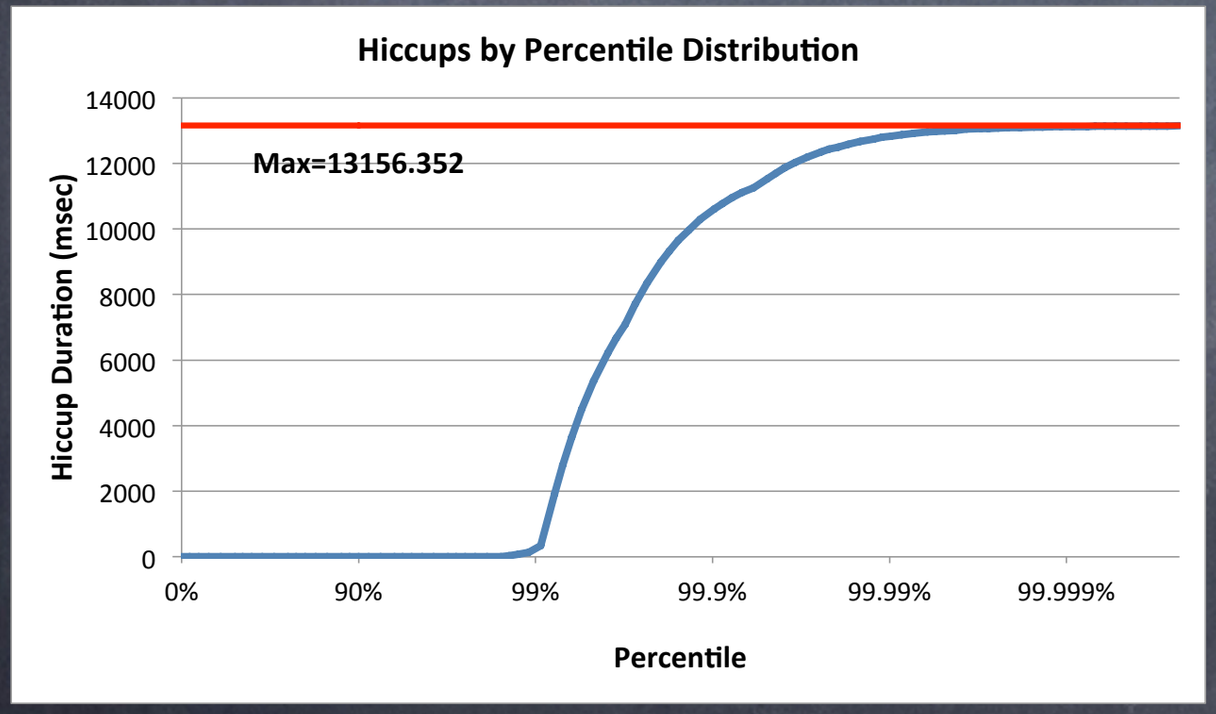
Oracle HotSpot CMS, 1GB in an 8GB heap





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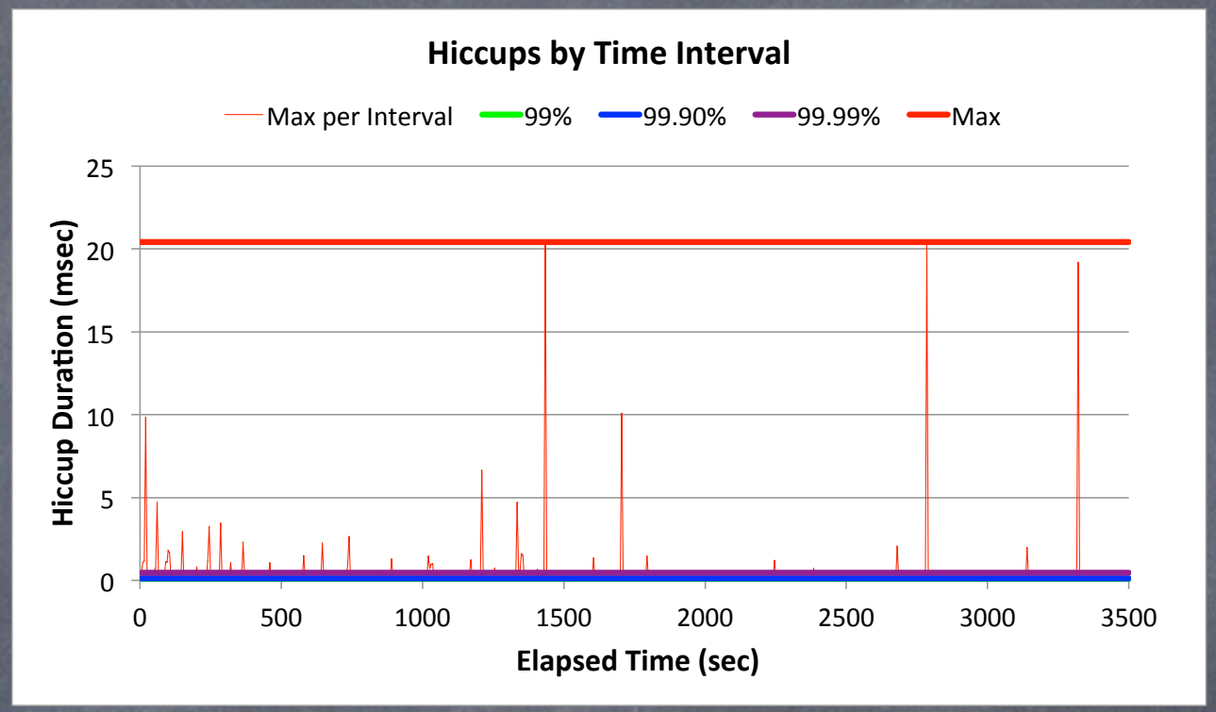

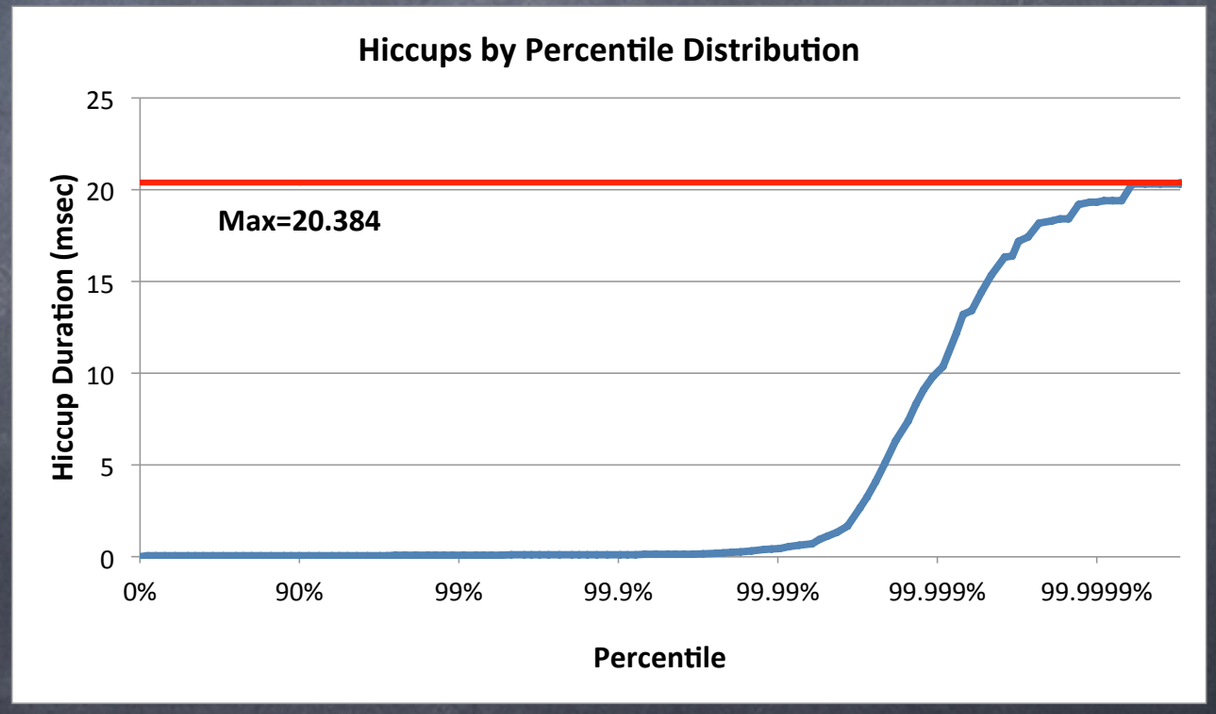

Portal Application, slow Ehcache "churn"

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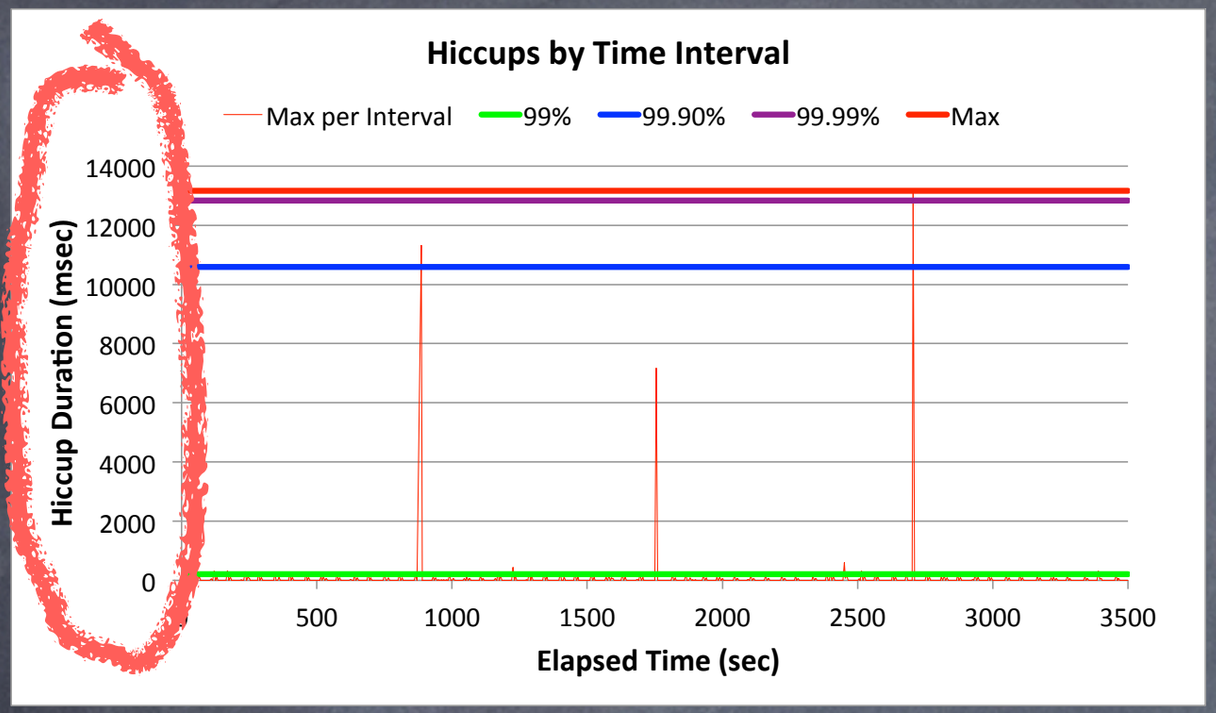

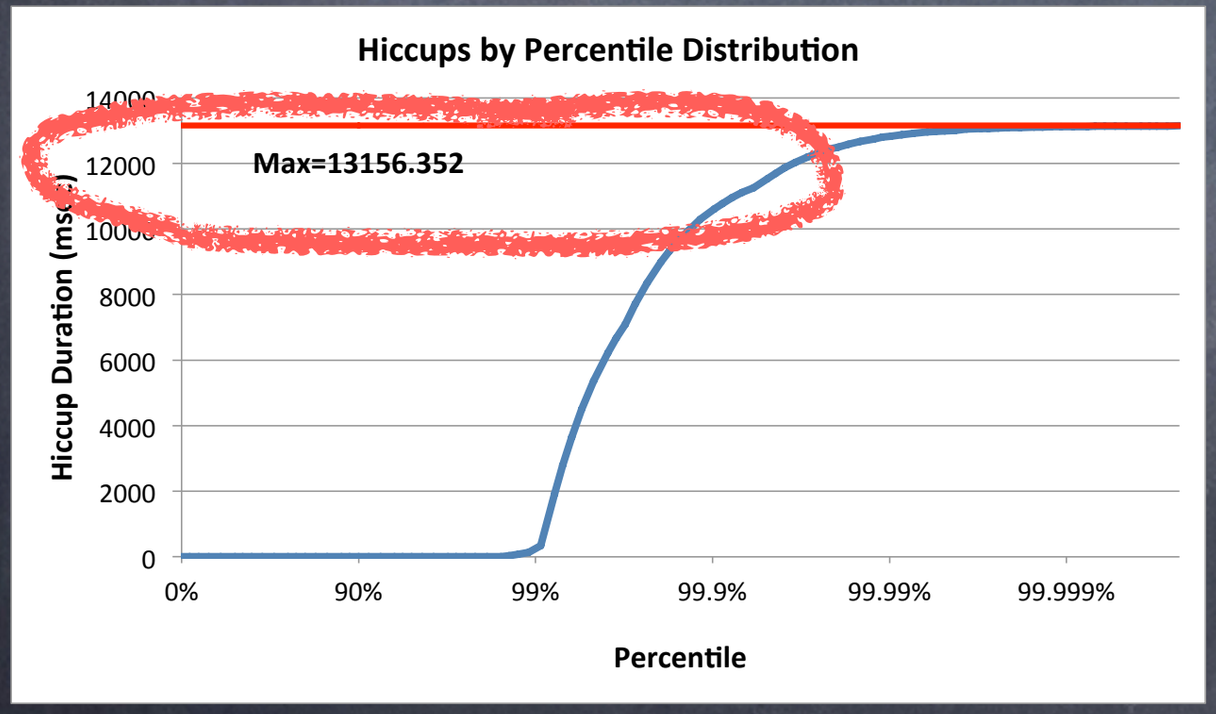

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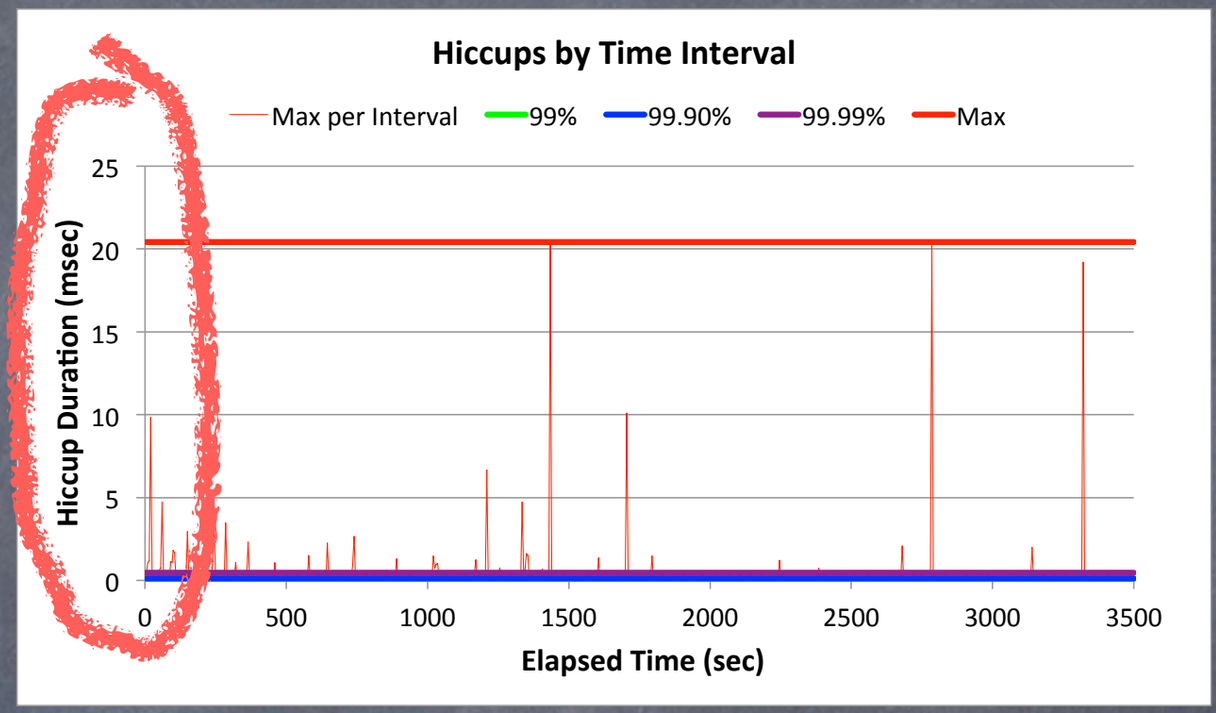

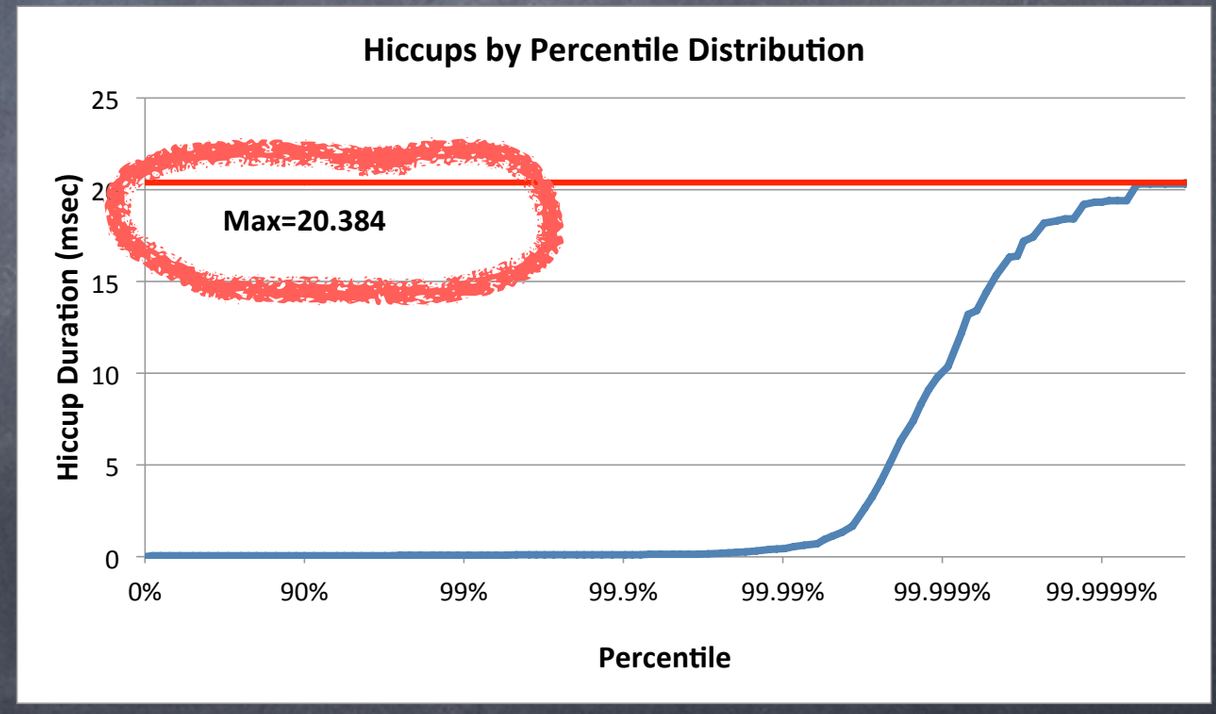

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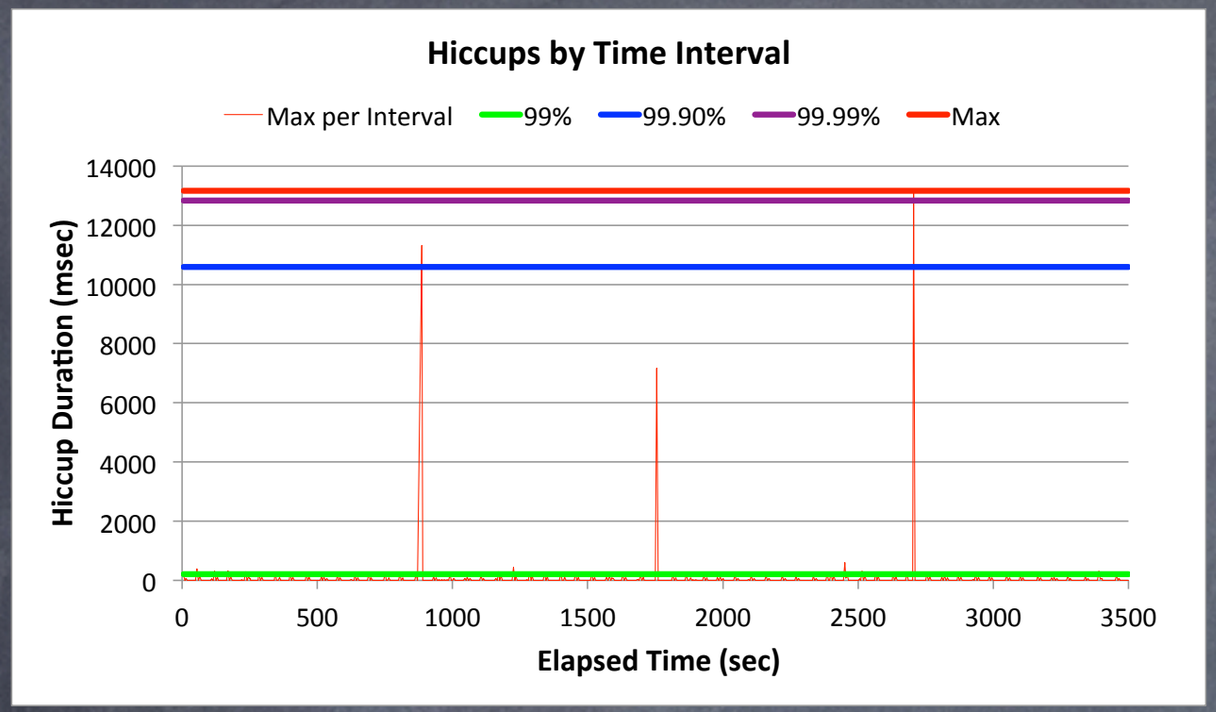

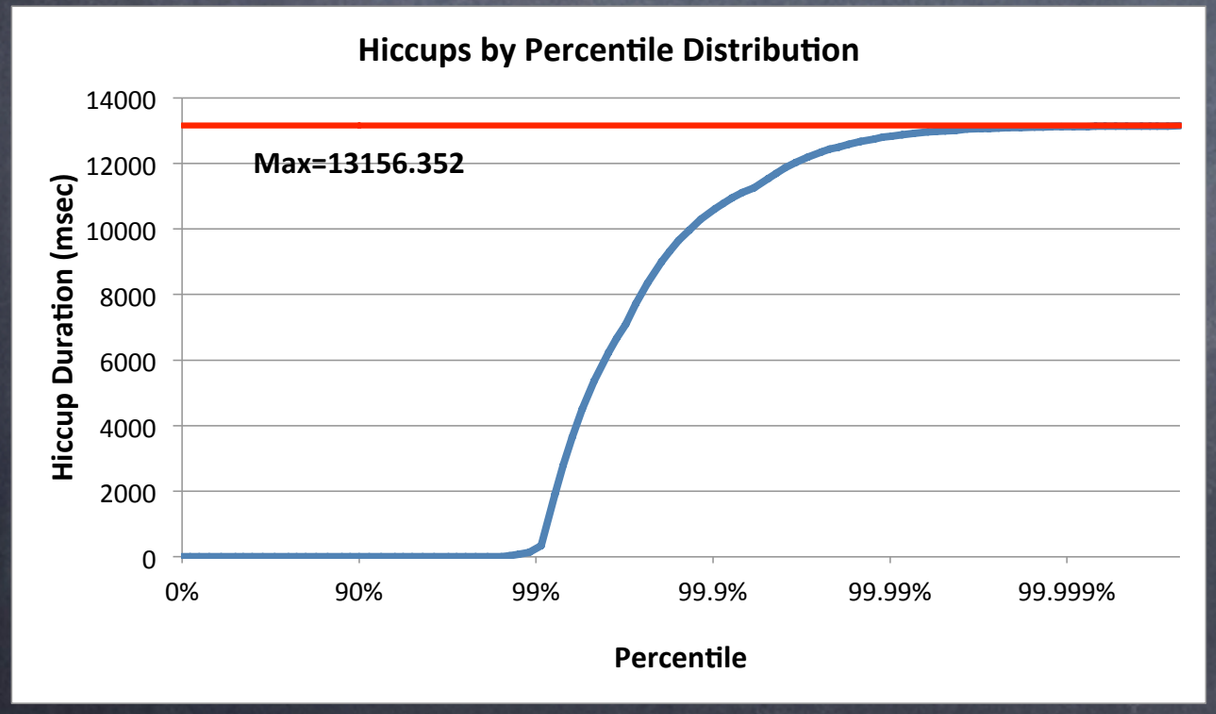

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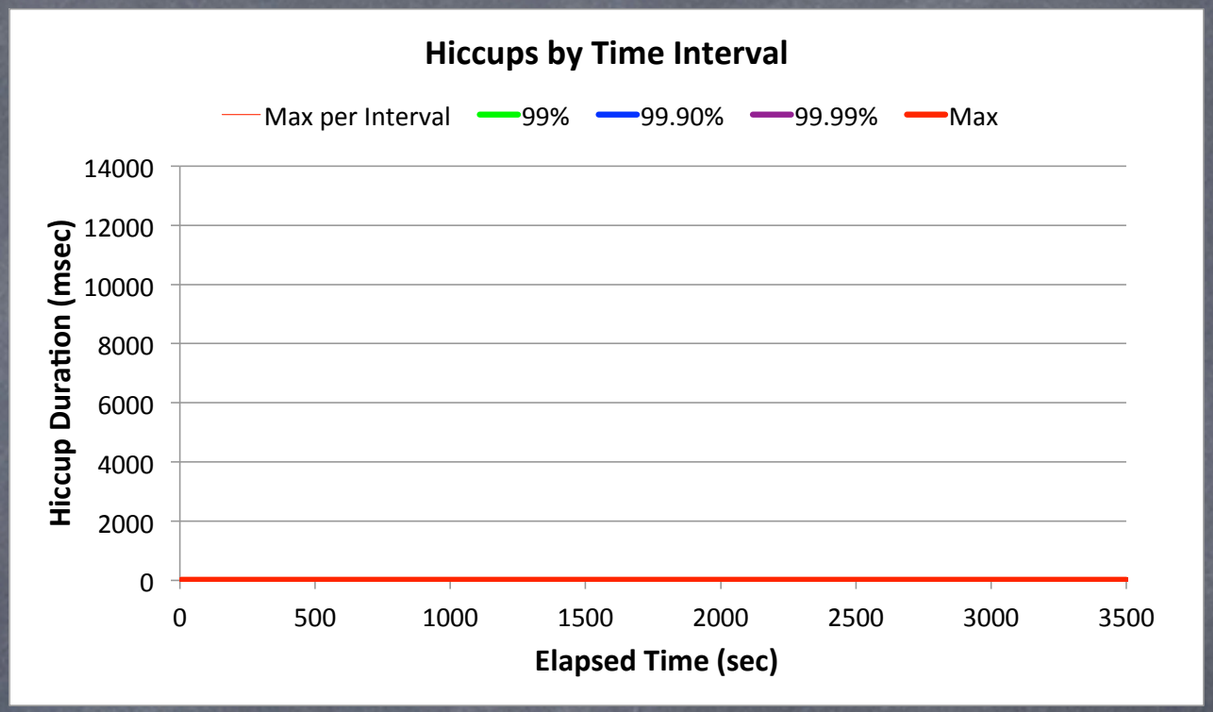

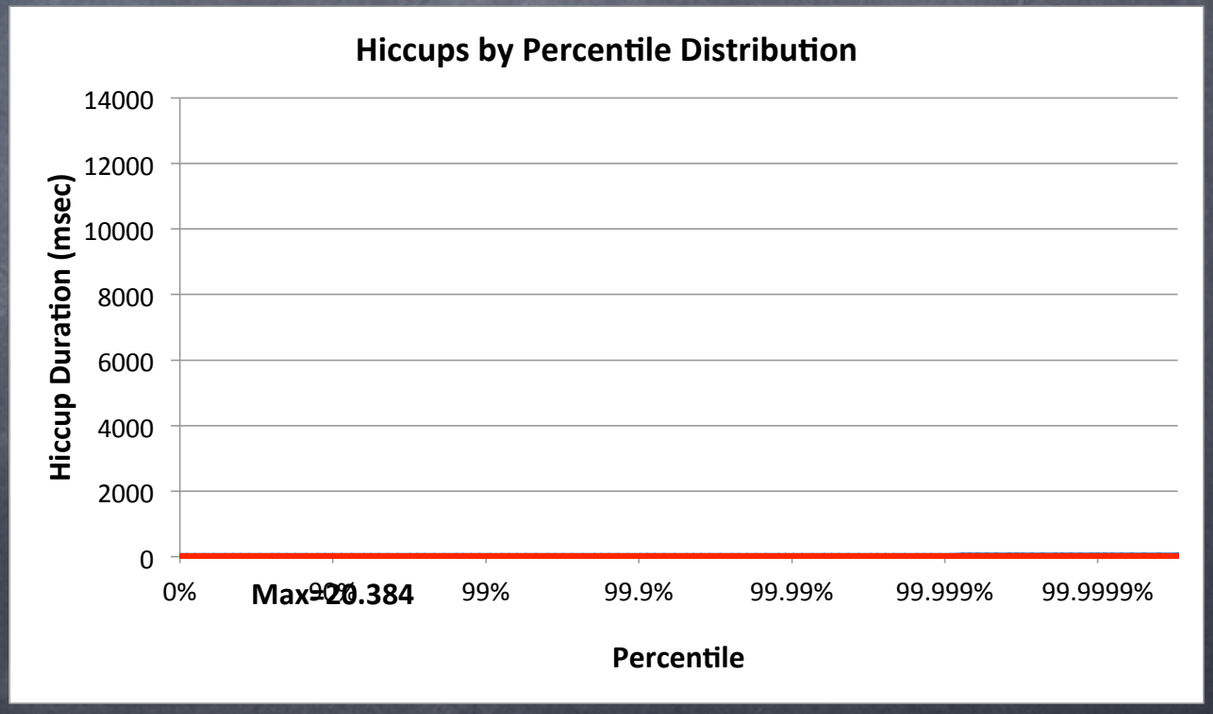

Portal Application - Drawn to scale

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Lets not forget about GC tuning

Java GC tuning is "hard"...

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Examples of actual command line GC tuning parameters:

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```
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        -XX:+UseConcMarkSweepGC -XX:MaxTenuringThreshold=0
        -XX:CMSInitiatingOccupancyFraction=60 -XX:+CMSParallelRemarkEnabled
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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
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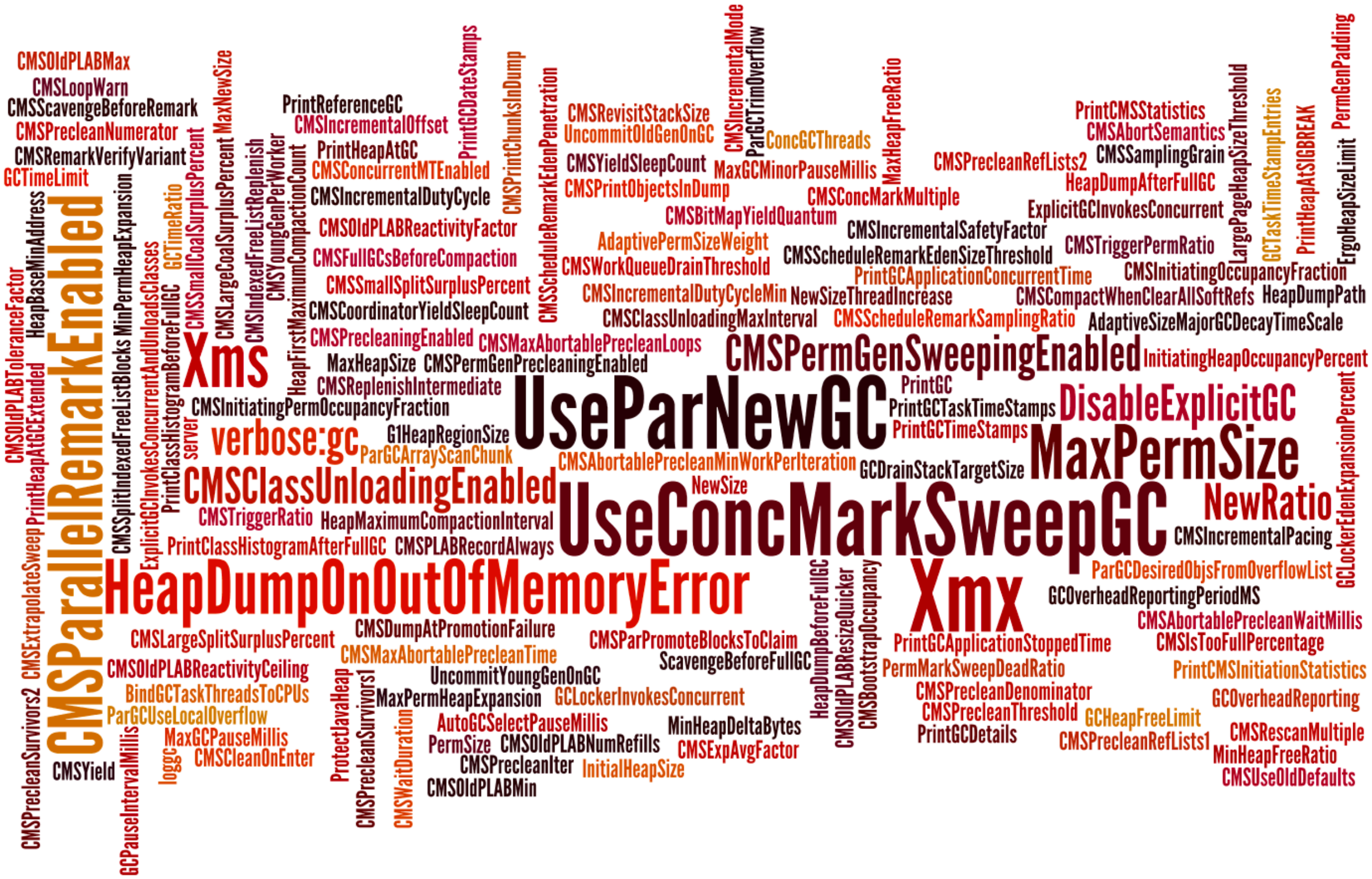
A few GC tuning flags



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

The complete guide to Zing GC tuning

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The complete guide to Zing GC tuning

java -Xmx40g

GC is only the biggest problem...

JVMs make many tradeoffs
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  - E.g. GC phase shifts, Deoptimization, Class unloading, Thread Dumps, Lock Deflation, etc. etc.

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Time To Safepoint (TTSP)
the most common examples

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- Measure, Measure, Measure...
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- Zing has a built-in TTSP profiler

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OS related stuff
(once GC and TTSP are taken care of)

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Takeaway: In 2013, "Real" Java is finally viable for low latency applications

- GC is no longer a dominant issue, even for outliers
- 2-3msec **worst case** case with "easy" tuning
- < 1 msec **worst case** is very doable
- No need to code in special ways any more
  - You can finally use "real" Java for everything
  - You can finally 3rd party libraries without worries
  - You can finally use as much memory as you want
  - You can finally use regular (good) programmers

One-liner Takeaway:

Zing: A cure for the Java hiccups

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Q & A

Session # 8206

One-liner Takeaway:

Zing: A cure for the Java hiccups

jHiccup:

http://www.azulsystems.com/dev_resources/jhiccup

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