Nothing is ever simple

The Tale of a Performance Improvement

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2017-03-22

elastic

The Code Change

12 ...ansport-netty4/src/main/java/org/elasticsearch/http/netty4/Netty4HttpServerTransport.java View

```
@@ -143,17 +143,7 @@
143 143         Setting.byteSizeSetting("http.tcp.receive_buffer_size", NetworkService.TcpSettings.TCP_RECEIVE_BUFFER_SIZE,
144 144             Property.NodeScope, Property.Shared);
145 145     public static final Setting<ByteSizeValue> SETTING_HTTP_NETTY_RECEIVE_PREDICTOR_SIZE =
146     -       Setting.byteSizeSetting("transport.netty.receive_predictor_size",
147     -           settings -> {
148     -               long defaultReceiverPredictor = 512 * 1024;
149     -               if (JvmInfo.jvmInfo().getMem().getDirectMemoryMax().getBytes() > 0) {
150     -                   // we can guess a better default...
151     -                   long l = (long) ((0.3 * JvmInfo.jvmInfo().getMem().getDirectMemoryMax().getBytes()) / SETTING_HTTP_WORKER_COUNT.get
152     -                       (settings));
153     -                   defaultReceiverPredictor = Math.min(defaultReceiverPredictor, Math.max(l, 64 * 1024));
154     -               }
155     -               return new ByteSizeValue(defaultReceiverPredictor).toString();
156     -           }, Property.NodeScope);
    146 +       Setting.byteSizeSetting("http.netty.receive_predictor_size", new ByteSizeValue(64, ByteSizeUnit.KB), Property.NodeScope);
157 147     public static final Setting<ByteSizeValue> SETTING_HTTP_NETTY_RECEIVE_PREDICTOR_MIN =
158 148         byteSizeSetting("http.netty.receive_predictor_min", SETTING_HTTP_NETTY_RECEIVE_PREDICTOR_SIZE, Property.NodeScope);
159 149     public static final Setting<ByteSizeValue> SETTING_HTTP_NETTY_RECEIVE_PREDICTOR_MAX =
```


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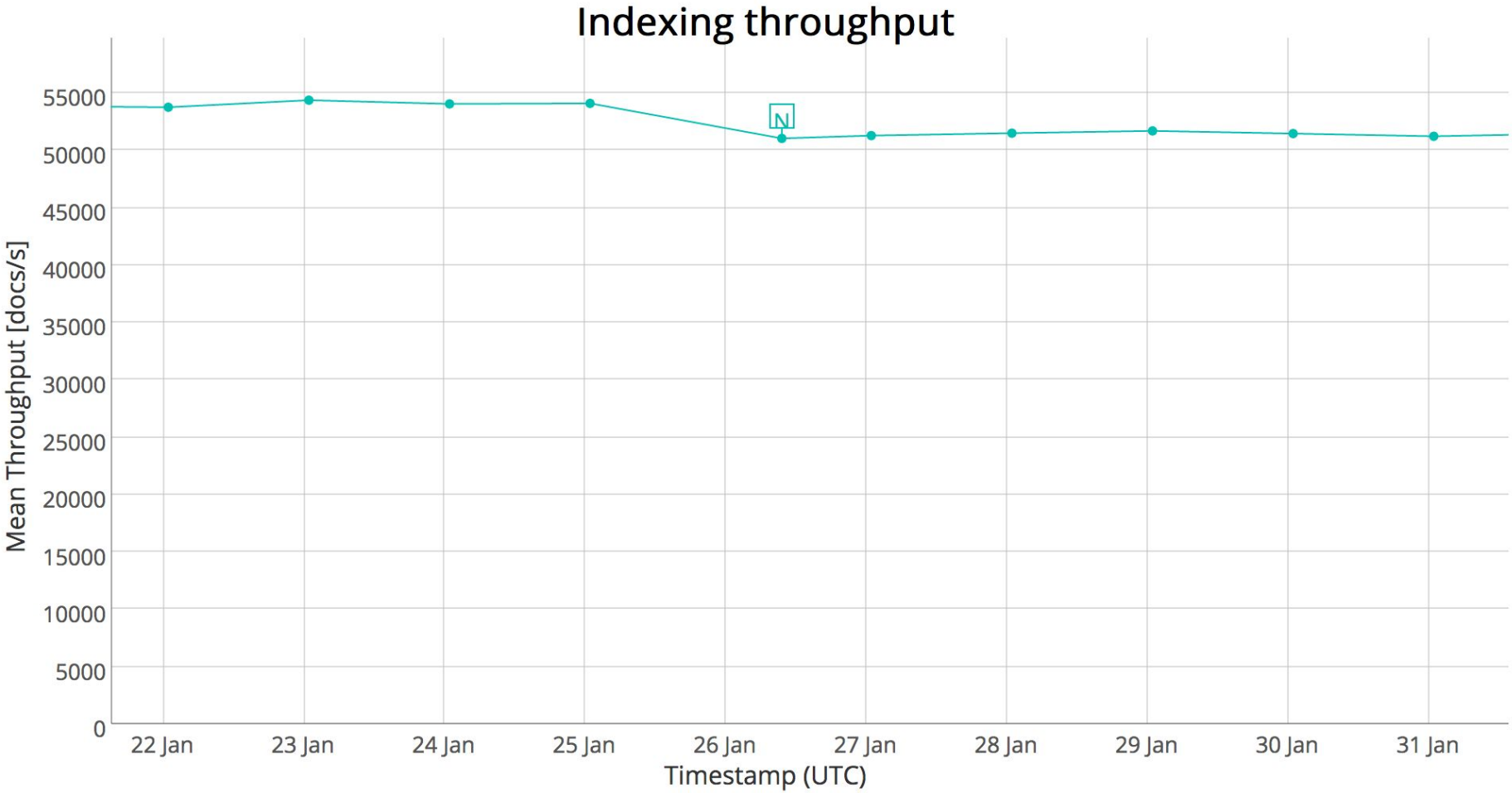
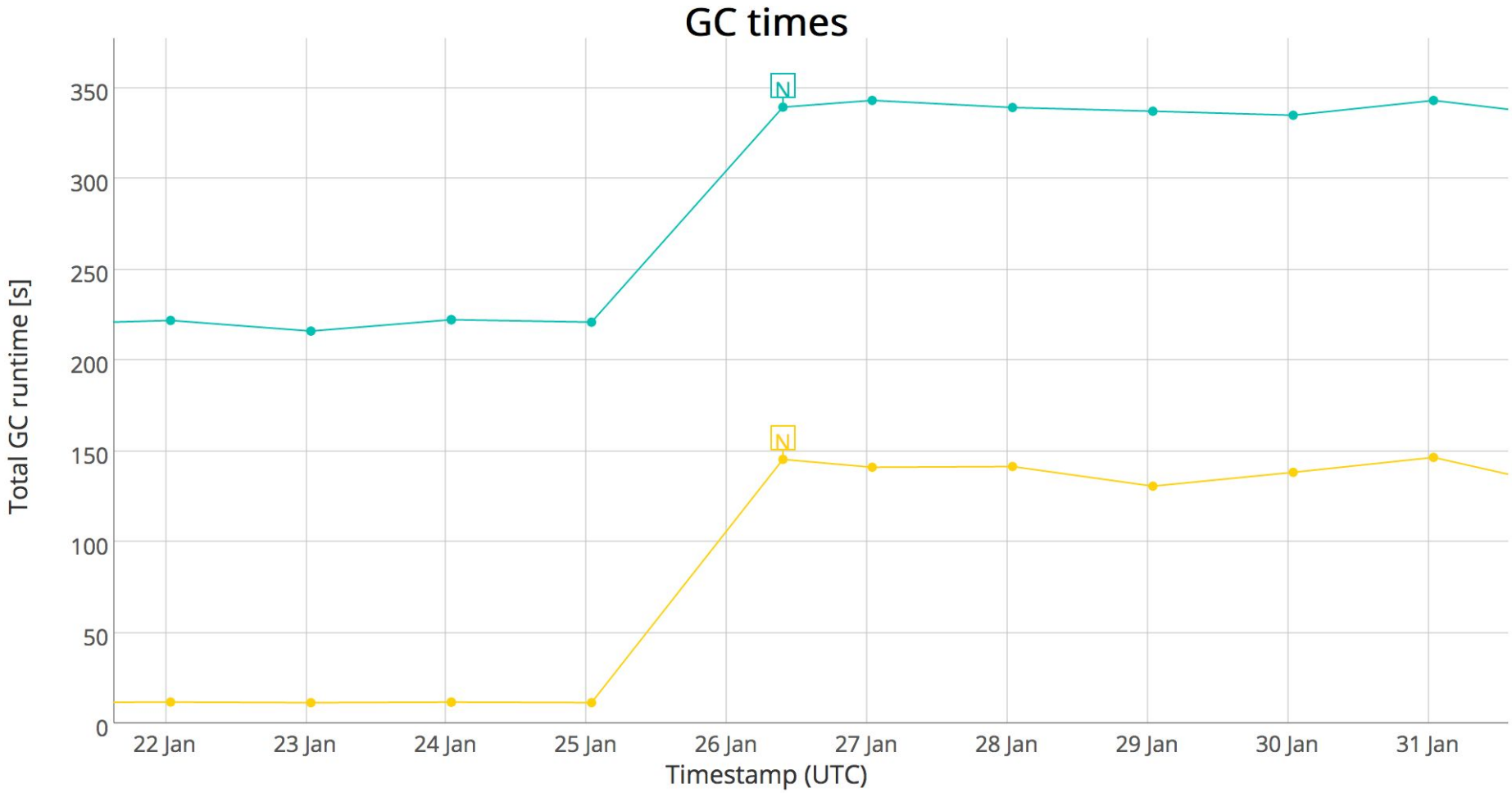

Indexing throughput
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Mean Throughput [docs/s]
22 Jan
23 Jan
24 Jan
25 Jan
26 Jan
27 Jan
28 Jan
29 Jan
30 Jan
31 Jan
Timestamp (UTC)

elastic


GC times
Total GC runtime [s]
350
300
250
200
150
100
50
0
N
N
22 Jan
23 Jan
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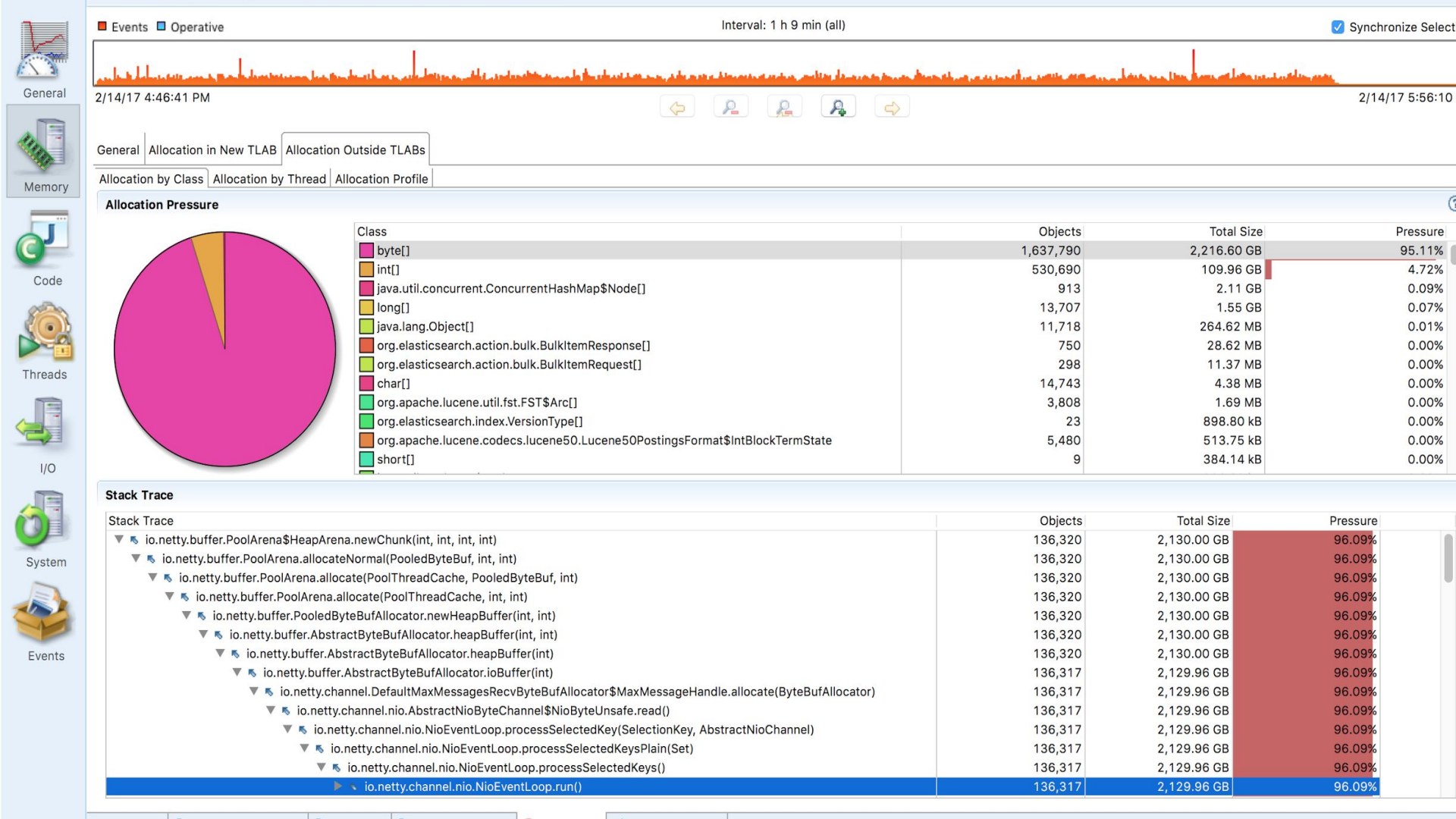
25 Jan
26 Jan
27 Jan
28 Jan
29 Jan
30 Jan
31 Jan
Timestamp (UTC)

elastic

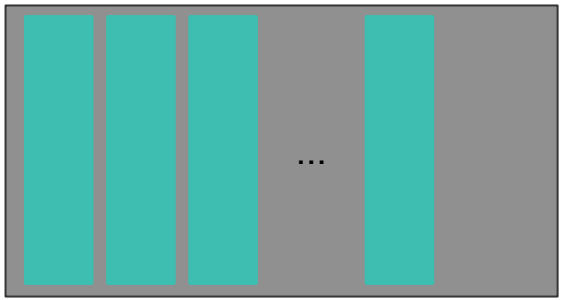
78 GB

2130 GB


Events
Operative
Interval: 1 h 9 min (all)
Synchronize Select
2/14/17 4:46:41 PM
2/14/17 5:56:10
General
Memory
Code
Threads
I/O
System
Events
General
Allocation in New TLAB
Allocation Outside TLABs
Allocation by Class
Allocation by Thread
Allocation Profile
Allocation Pressure
Class
Objects
Total Size
Pressure
byte[] 1,637,790 2,216.60 GB 95.11%
int[] 530,690 109.96 GB 4.72%
java.util.concurrent.ConcurrentHashMap$Node[] 913 2.11 GB 0.09%
long[] 13,707 1.55 GB 0.07%
java.lang.Object[] 11,718 264.62 MB 0.01%
org.elasticsearch.action.bulk.BulkItemResponse[] 750 28.62 MB 0.00%
org.elasticsearch.action.bulk.BulkItemRequest[] 298 11.37 MB 0.00%
char[] 14,743 4.38 MB 0.00%
org.apache.lucene.util.fst.FST$Arc[] 3,808 1.69 MB 0.00%
org.elasticsearch.index.VersionType[] 23 898.80 kB 0.00%
org.apache.lucene.codecs.lucene50.Lucene50PostingsFormat$IntBlockTermState 5,480 513.75 kB 0.00%
short[] 9 384.14 kB 0.00%
Stack Trace
Stack Trace
Objects
Total Size
Pressure
io.netty.buffer.PoolArena$HeapArena.newChunk(int, int, int, int) 136,320 2,130.00 GB 96.09%
io.netty.buffer.PoolArena.allocateNormal(PooledByteBuf, int, int) 136,320 2,130.00 GB 96.09%
io.netty.buffer.PoolArena.allocate(PoolThreadCache, PooledByteBuf, int) 136,320 2,130.00 GB 96.09%
io.netty.buffer.PoolArena.allocate(PoolThreadCache, int, int) 136,320 2,130.00 GB 96.09%
io.netty.buffer.PooledByteBufAllocator.newHeapBuffer(int, int) 136,320 2,130.00 GB 96.09%
io.netty.buffer.AbstractByteBufAllocator.heapBuffer(int, int) 136,320 2,130.00 GB 96.09%
io.netty.buffer.AbstractByteBufAllocator.heapBuffer(int) 136,320 2,130.00 GB 96.09%
io.netty.buffer.AbstractByteBufAllocator.ioBuffer(int) 136,317 2,129.96 GB 96.09%
io.netty.channel.DefaultMaxMessagesRecvByteBufAllocator$MaxMessageHandle.allocate(ByteBufAllocator) 136,317 2,129.96 GB 96.09%
io.netty.channel.nio.AbstractNioByteChannel$NioByteUnsafe.read() 136,317 2,129.96 GB 96.09%
io.netty.channel.nio.NioEventLoop.processSelectedKey(SelectionKey, AbstractNioChannel) 136,317 2,129.96 GB 96.09%
io.netty.channel.nio.NioEventLoop.processSelectedKeysPlain(Set) 136,317 2,129.96 GB 96.09%
io.netty.channel.nio.NioEventLoop.processSelectedKeys() 136,317 2,129.96 GB 96.09%
io.netty.channel.nio.NioEventLoop.run() 136,317 2,129.96 GB 96.09%

Buffers in Netty

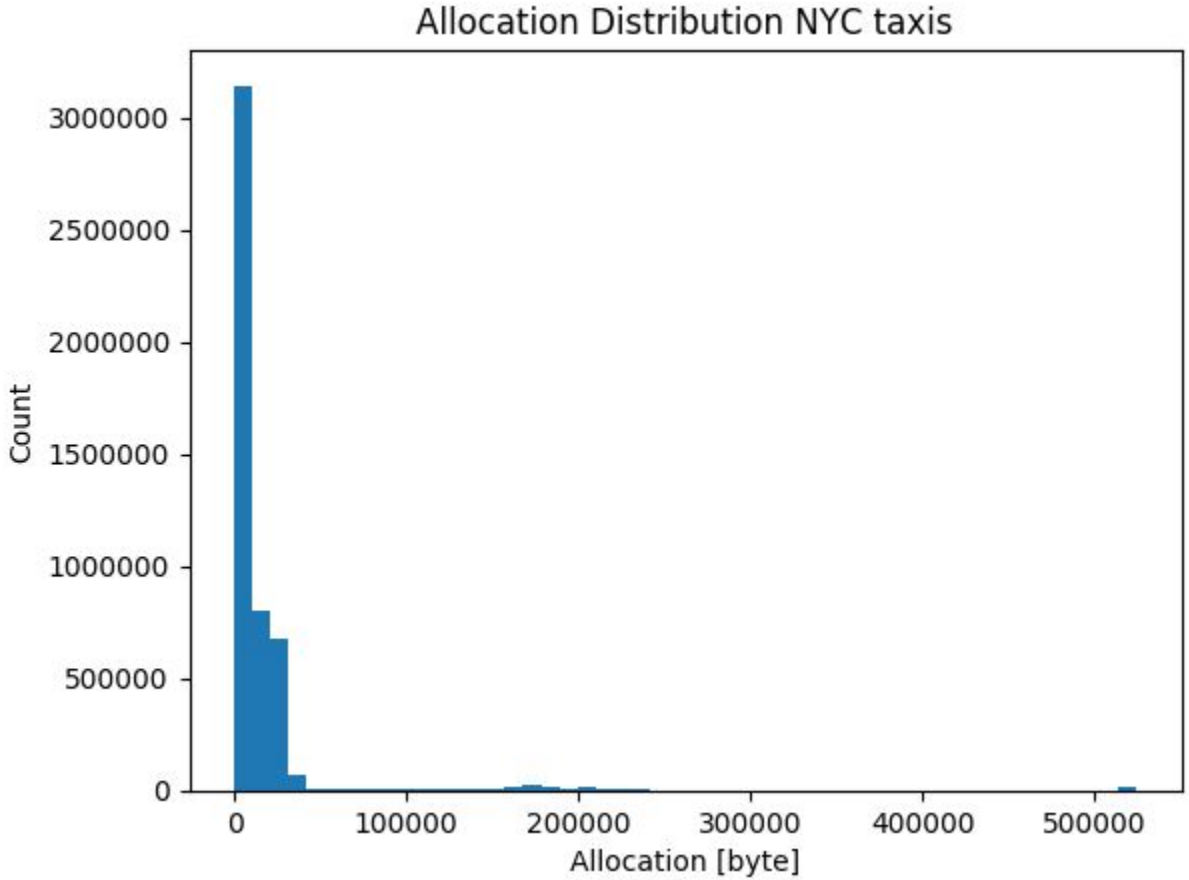
Many Buffers - One per read



One HTTP Request

MTU

512kB


Allocation Distribution NYC taxis
3000000
2500000
2000000
1500000
1000000
500000
0
Count
0
100000
200000
300000
400000
500000
Allocation [byte]

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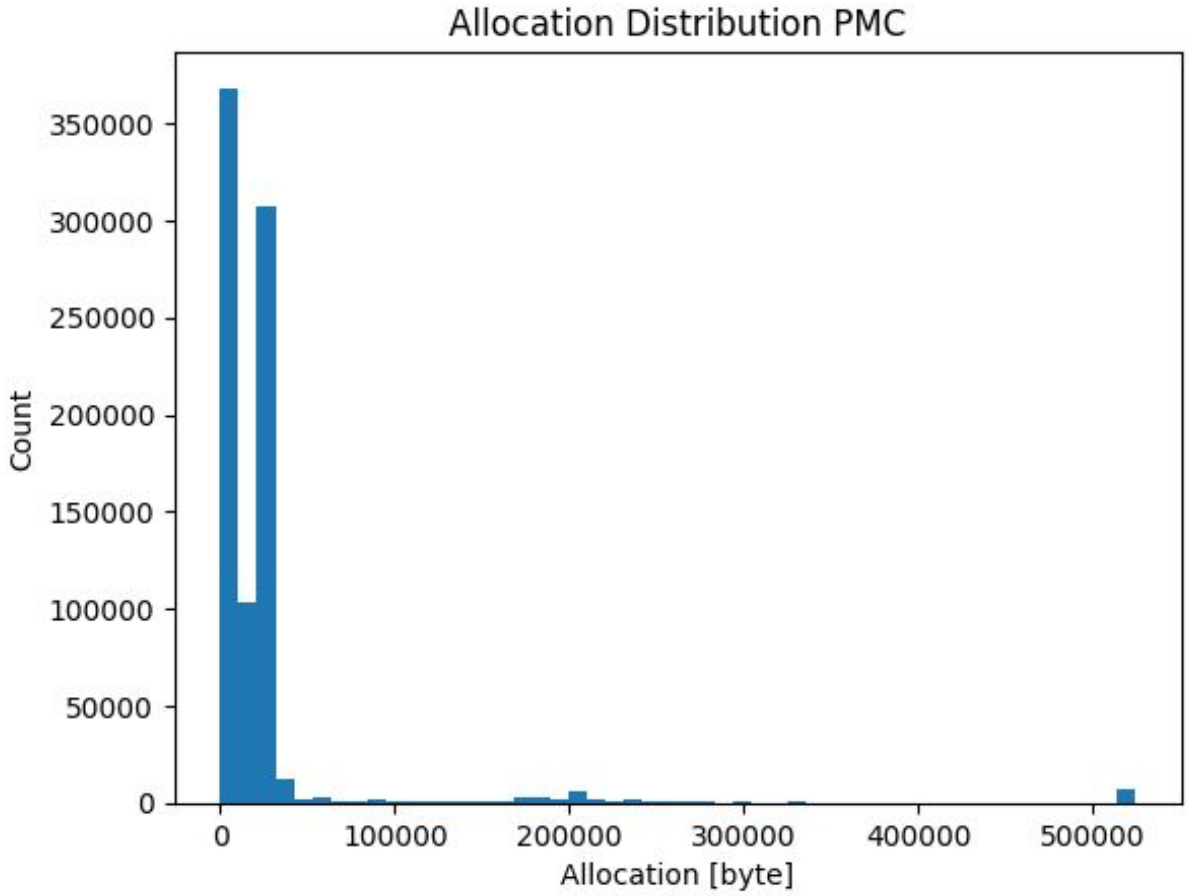
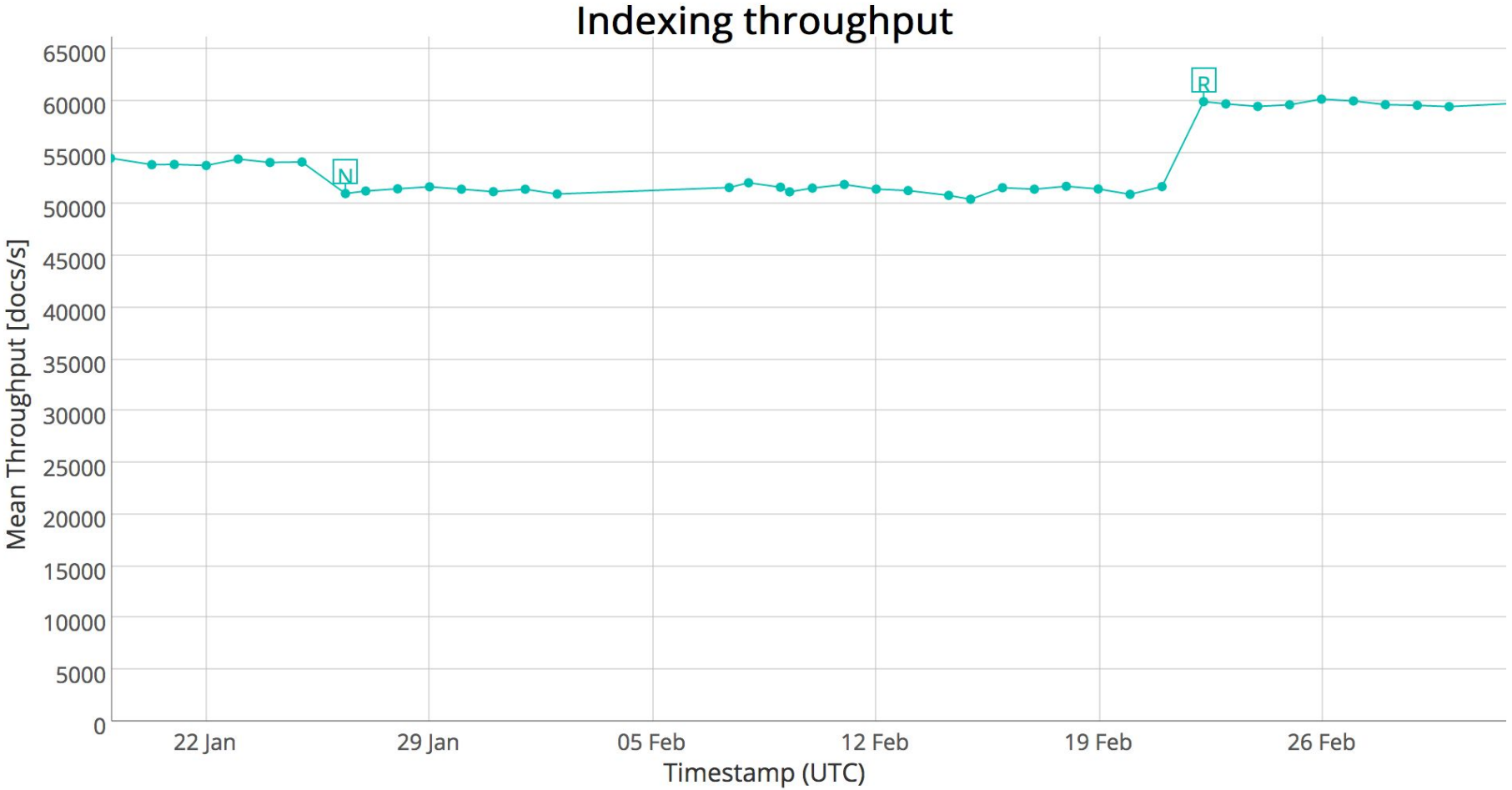
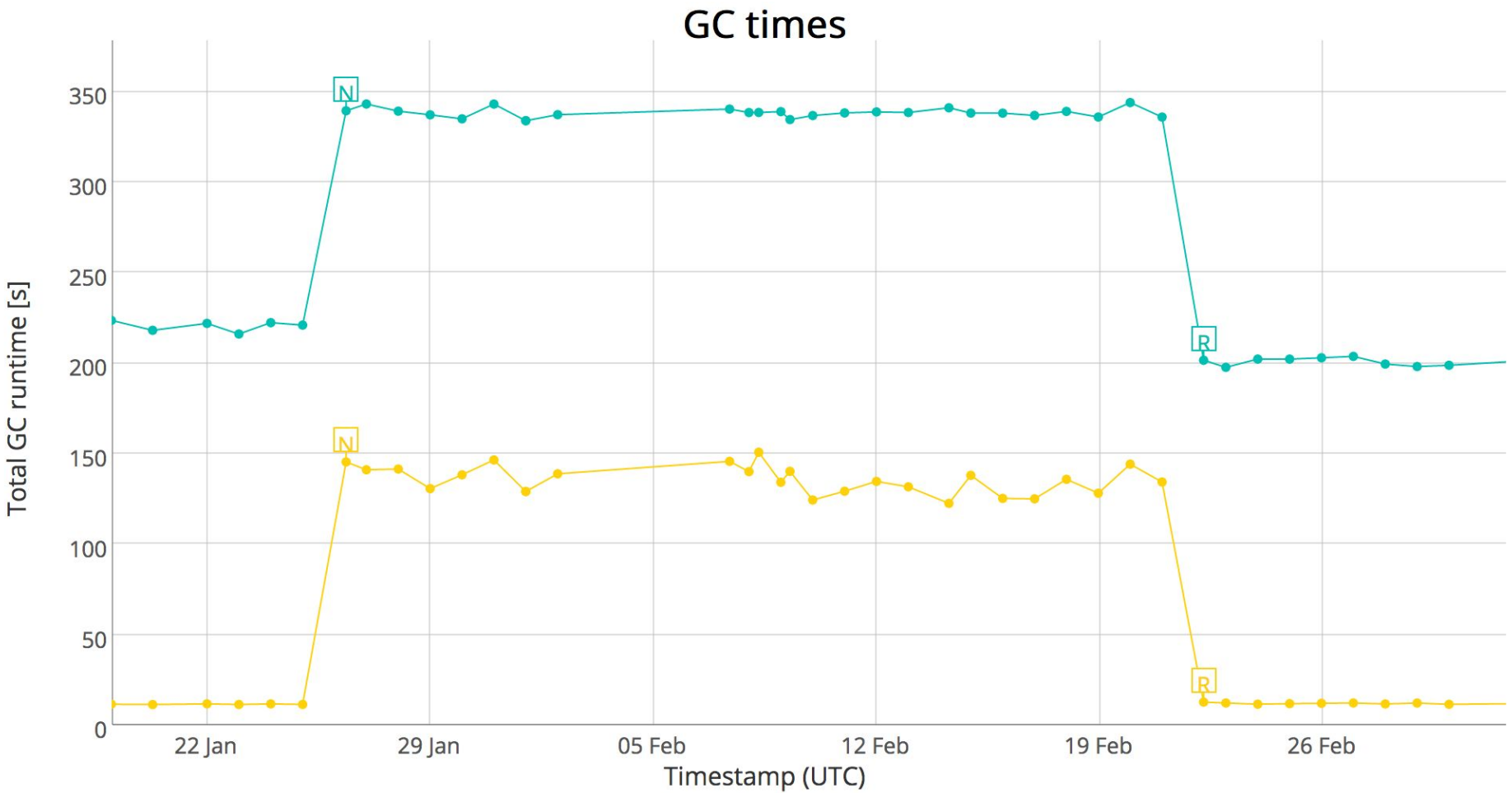

Allocation Distribution PMC
Count
350000
300000
250000
200000
150000
100000
50000
0
0
100000
200000
300000
400000
500000
Allocation [byte]

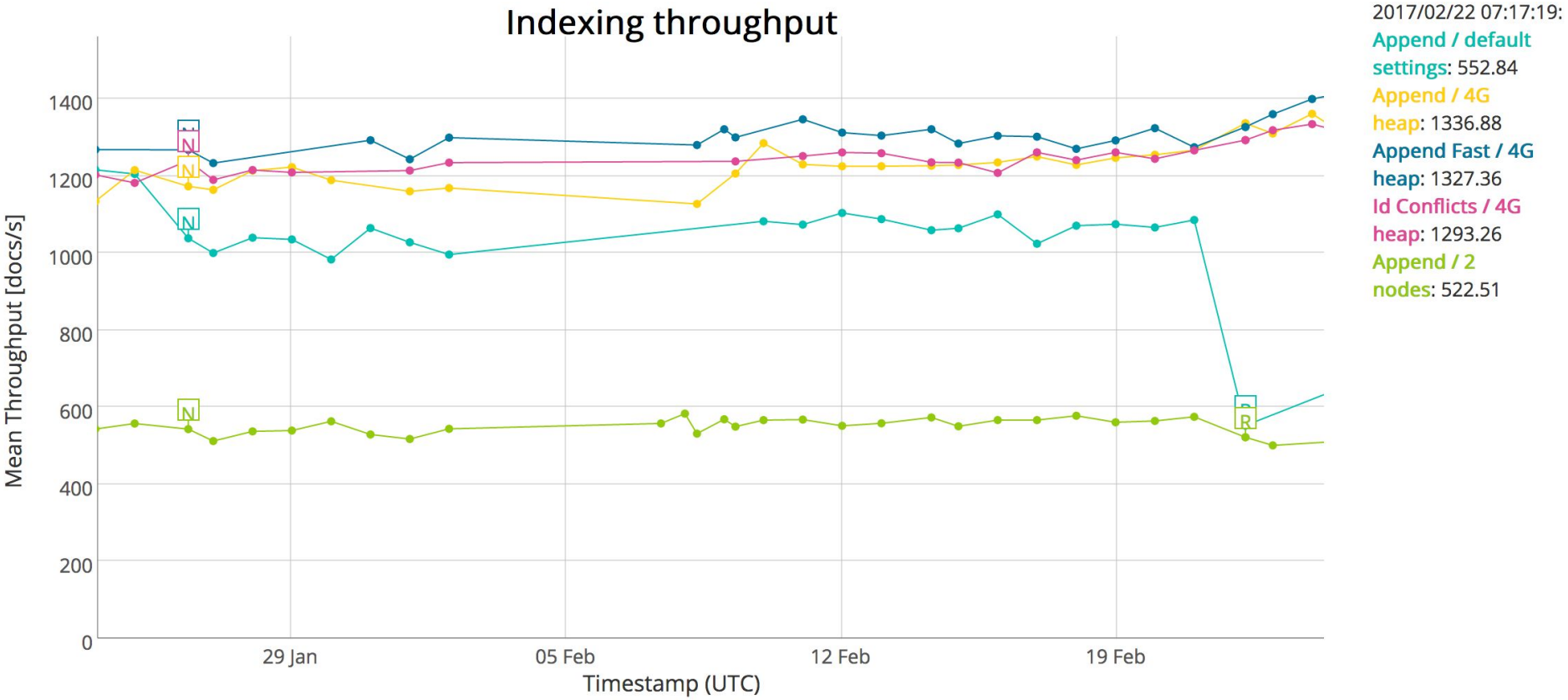
elastic


Indexing throughput
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Mean Throughput [docs/s]
N
R
22 Jan
29 Jan
05 Feb
12 Feb
19 Feb
26 Feb
Timestamp (UTC)

elastic

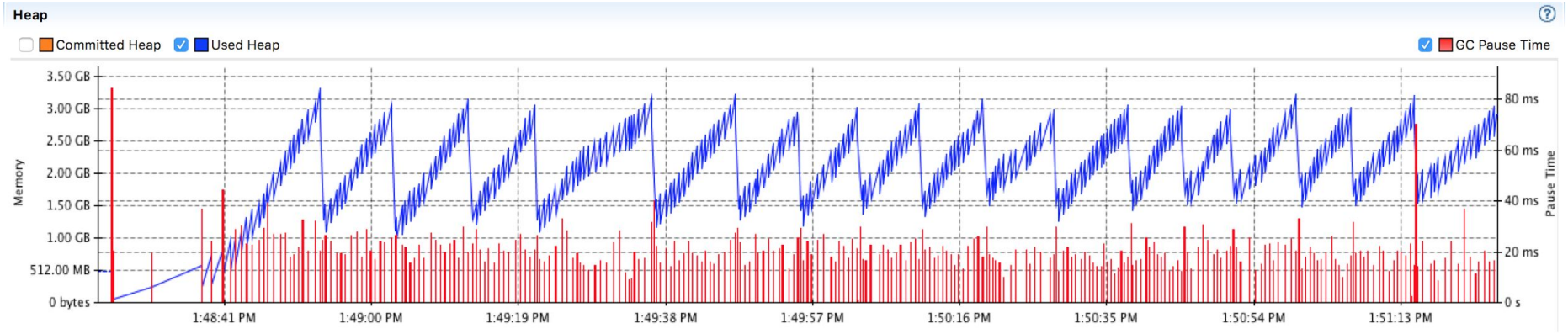

GC times
Total GC runtime [s]
350
300
250
200
150
100
50
0
N
N
R
R
22 Jan
29 Jan
05 Feb
12 Feb
19 Feb
26 Feb
Timestamp (UTC)

elastic


Indexing throughput
Mean Throughput [docs/s]
0
200
400
600
800
1000
1200
1400
29 Jan
05 Feb
12 Feb
19 Feb
Timestamp (UTC)
2017/02/22 07:17:19:
Append / default settings: 552.84
Append / 4G heap: 1336.88
Append Fast / 4G heap: 1327.36
Id Conflicts / 4G heap: 1293.26
Append / 2 nodes: 522.51

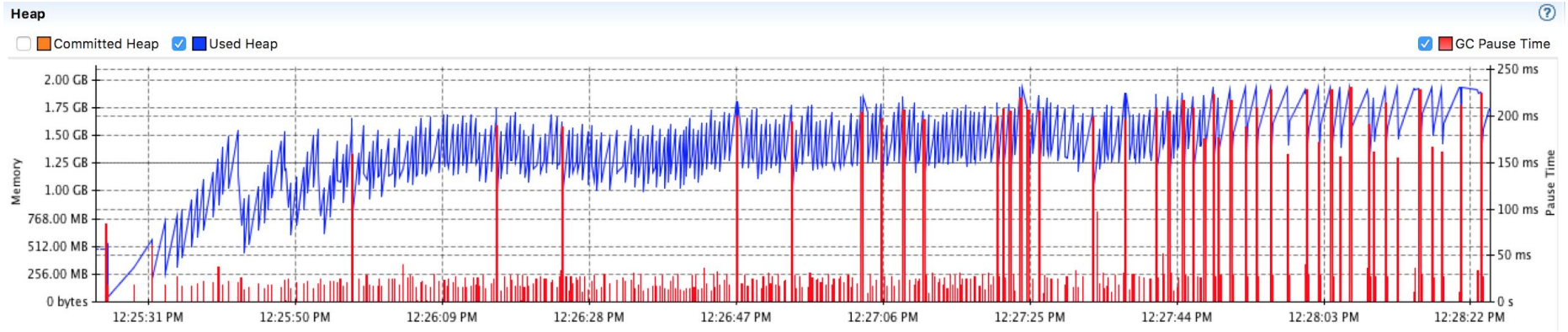
elastic

4G Heap

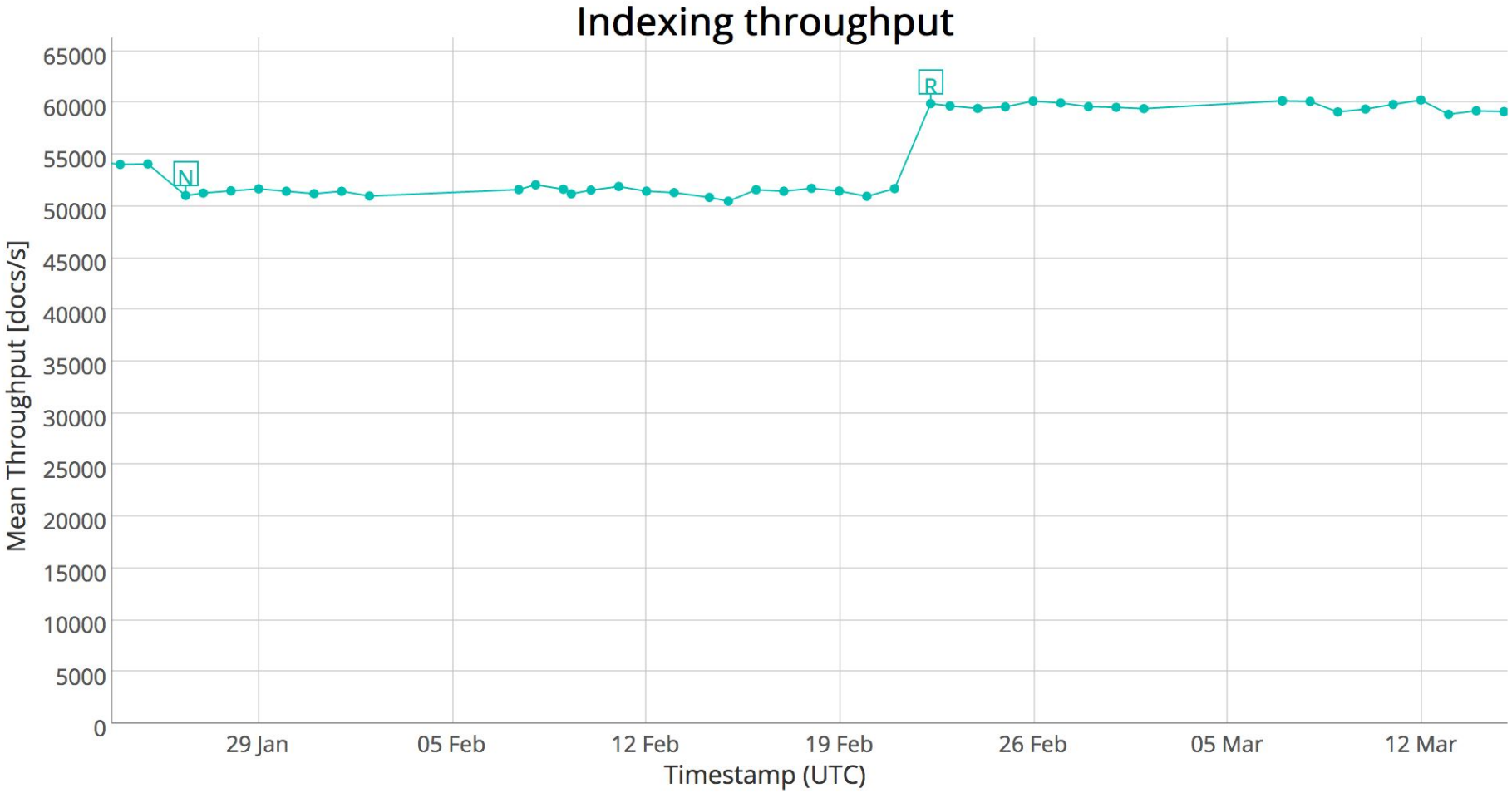


elastic

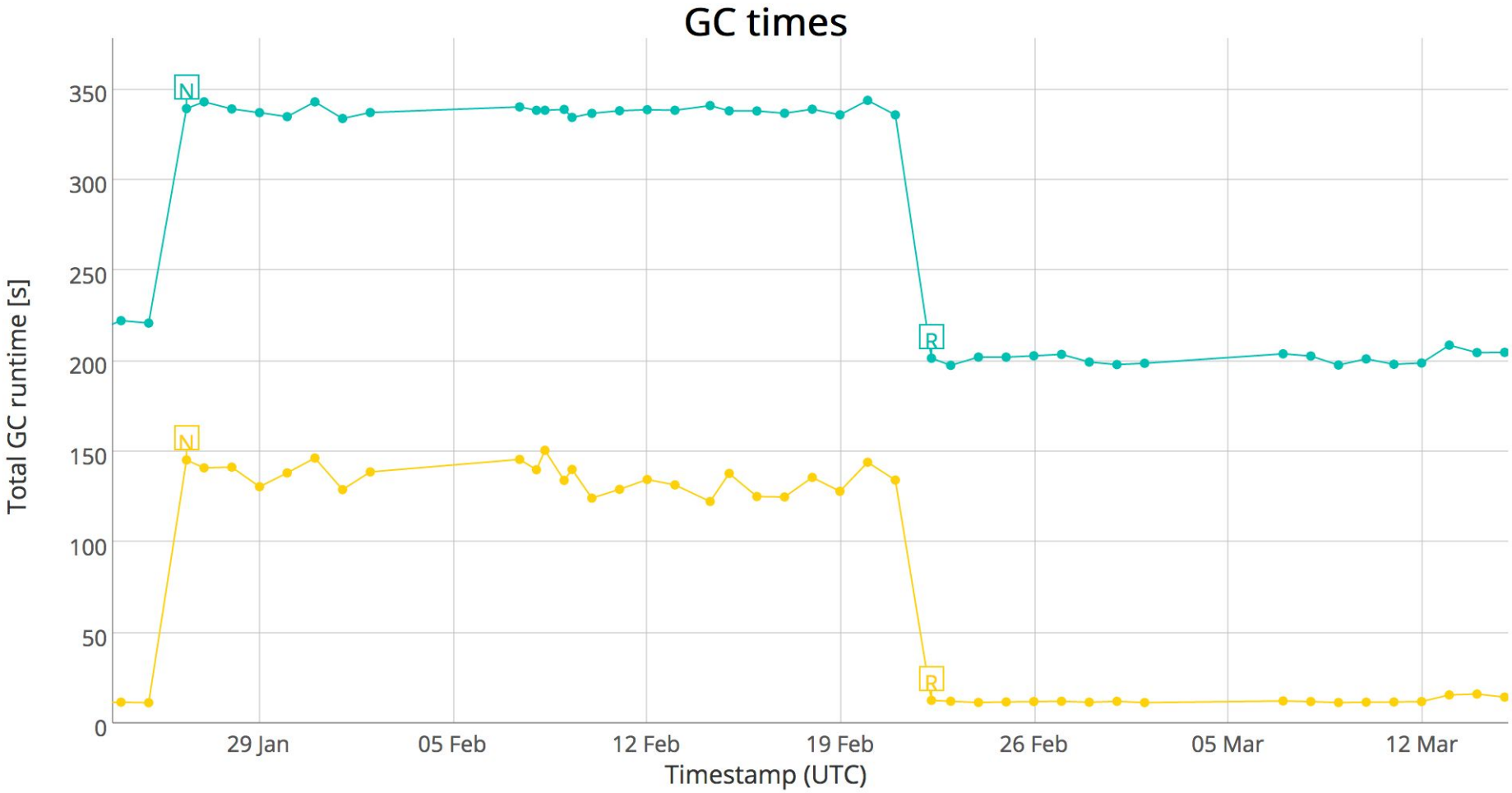
2G Heap



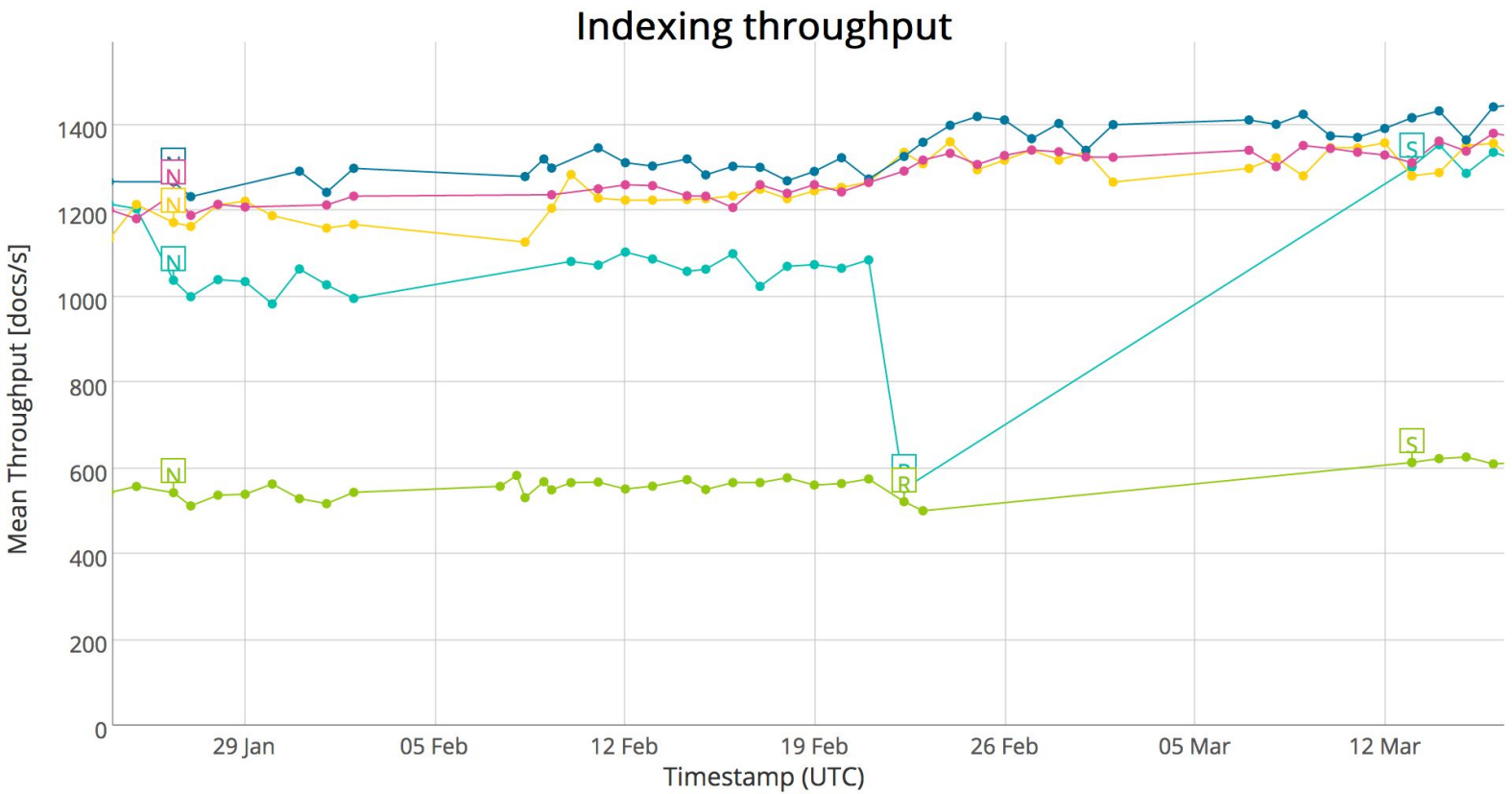
elastic


Indexing throughput
Mean Throughput [docs/s]
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
N
R
29 Jan
05 Feb
12 Feb
19 Feb
26 Feb
05 Mar
12 Mar
Timestamp (UTC)

elastic


GC times
Total GC runtime [s]
350
300
250
200
150
100
50
0
N
R
N
R
29 Jan
05 Feb
12 Feb
19 Feb
26 Feb
05 Mar
12 Mar
Timestamp (UTC)

elastic



2017/03/13 00:00:51:
Append / default settings: 1303.08
Append / 4G heap: 1282.17
Append Fast / 4G heap: 1417.41
Id Conflicts / 4G heap: 1312.57
Append / 2 nodes: 613.96

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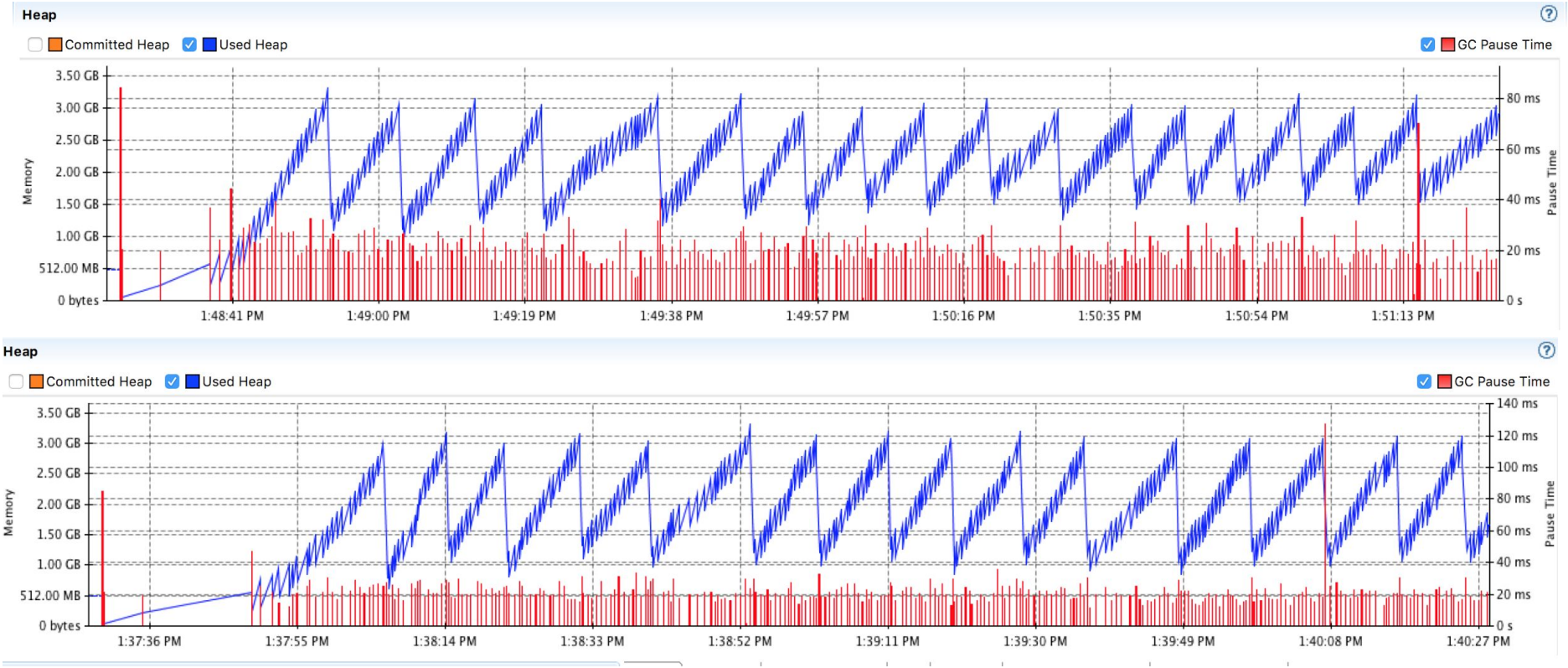
4G Heap with 32k (top) and 64k (bottom)



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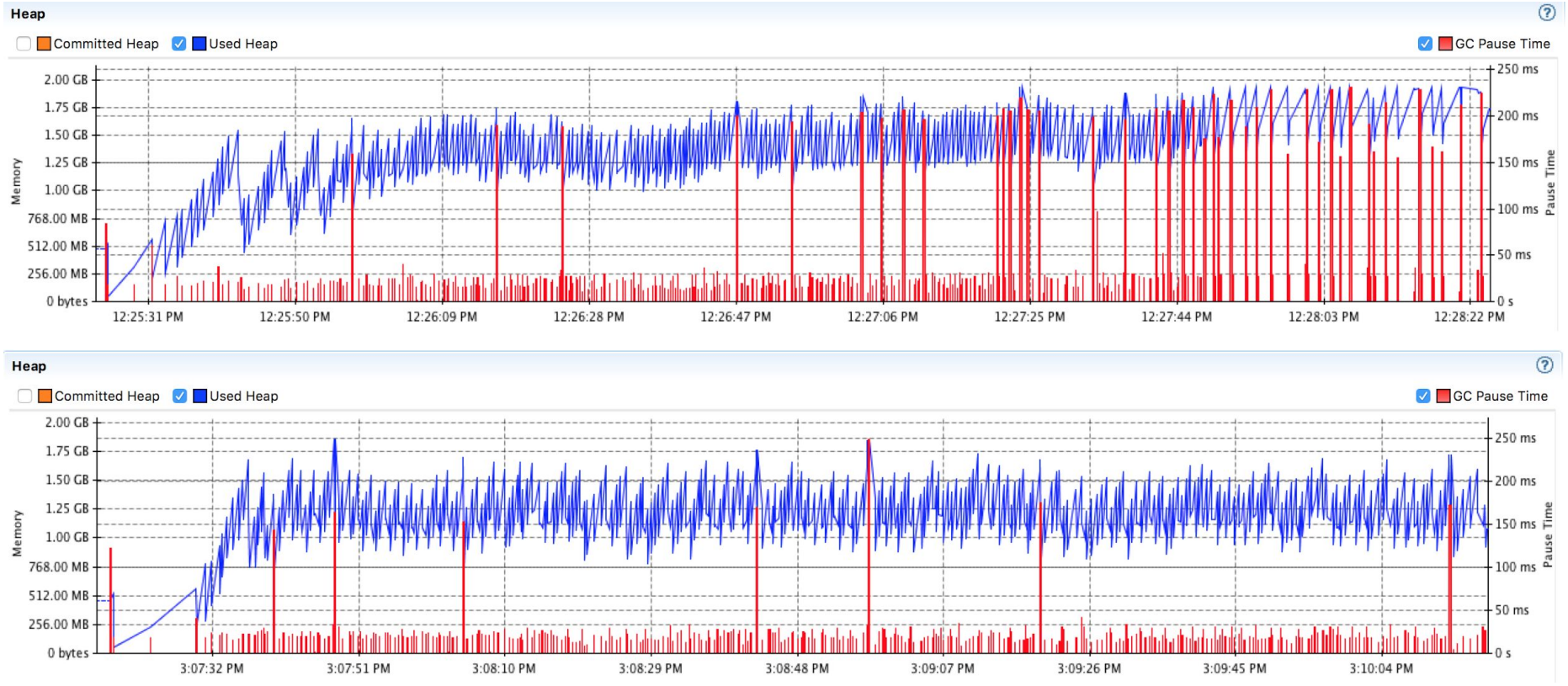
2G Heap with 32k (top) and 64k (bottom)



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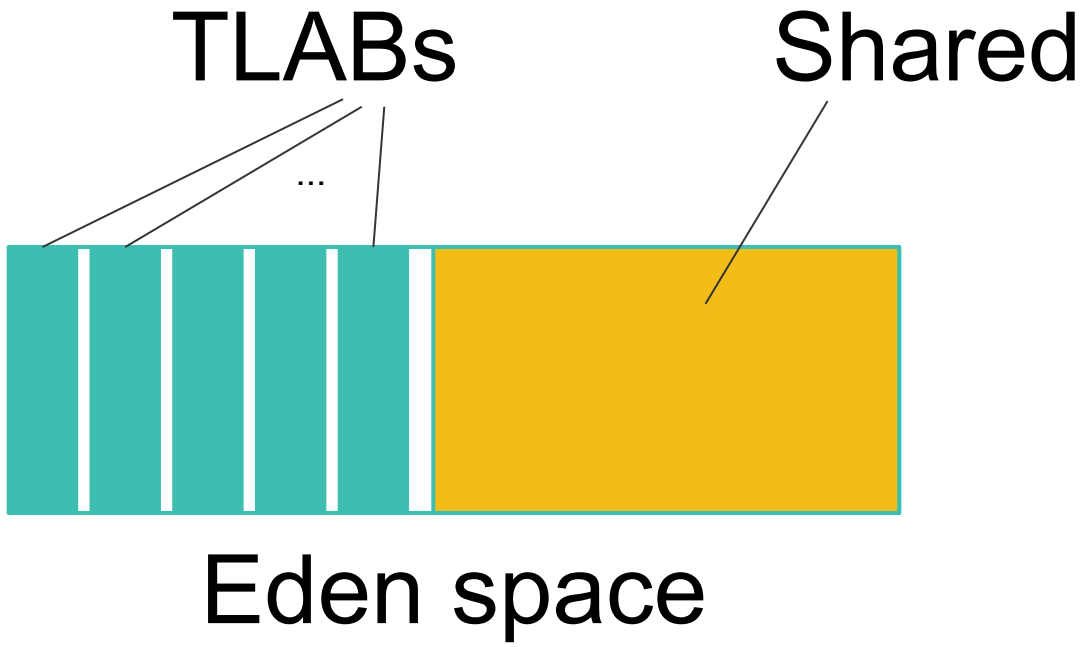
Thread Local Allocation Buffers (TLABs)



Allocation Numbers (2GB heap)

Receive predictor size [kB]	Number of TLABs	Allocations outside TLAB
32	238,169*	**36,108,455***
64	689,016	726,691

* until OOMEd

Ongoing investigation

https://github.com/elastic/elasticsearch/issues/23185

- Question: Why do fill up TLABs more quickly with smaller buffers?
- Hypothesis: We need to allocate more buffers but do not use them efficiently

Takeaways

Follow Up Talk

“Java Flight Recorder: The hidden arrow in your quiver”

May 10, Lightweight Java User Group

Image Credits

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