OpenJDK 17

Using Shenandoah garbage collector with OpenJDK 17

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Abstract

OpenJDK is a Red Hat offering on the Red Hat Enterprise Linux platform. The Using Shenandoah garbage collector with OpenJDK 17 guide provides an overview of Shenandoah garbage collector and explains how to configure it with OpenJDK 17.

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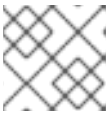

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CHAPTER 1. SHENANDOAH GARBAGE COLLECTOR

Shenandoah is the low pause time garbage collector (GC) that reduces GC pause times by performing more garbage collection work concurrently with the running Java program. Concurrent Mark Sweep garbage collector (CMS) and G1, default garbage collector for OpenJDK 17 perform concurrent marking of live objects.

Shenandoah adds concurrent compaction. Shenandoah also reduces GC pause times by compacting objects concurrently with running Java threads. Pause times with Shenandoah are independent of the heap size, meaning you will have consistent pause time whether your heap is 200 MB or 200 GB. Shenandoah is an algorithm for applications which require responsiveness and predictable short pauses.

Additional resources

- For more information about the Shenandoah garbage collector, see Shenandoah GC in the Oracle OpenJDK documentation.

CHAPTER 2. RUNNING JAVA APPLICATIONS WITH SHENANDOAH GARBAGE COLLECTOR

You can run your Java application with the Shenandoah garbage collector (GC).

Prerequisites

- Installed OpenJDK. See Installing OpenJDK 17 on Red Hat Enterprise Linux in the *Installing and using OpenJDK 17 on RHEL* guide.

Procedure

- Run your Java application with Shenandoah GC by using **-XX:+UseShenandoahGC** JVM option.

```
$ java <PATH_TO_YOUR_APPLICATION> -XX:+UseShenandoahGC
```

CHAPTER 3. SHENANDOAH GARBAGE COLLECTOR MODES

You can run Shenandoah in three different modes. Select a specific mode with the **-XX:ShenandoahGCMode=<name>**. The following list describes each Shenandoah mode:

normal/satb (product, default)

This mode runs a concurrent garbage collector (GC) with Snapshot-At-The-Beginning (SATB) marking. This marking mode does the similar work as G1, the default garbage collector for OpenJDK 17.

iu (experimental)

This mode runs a concurrent GC with Incremental Update (IU) marking. It can reclaim unreachably memory more aggressively. This marking mode mirrors the SATB mode. This may make marking less conservative, especially around accessing weak references.

passive (diagnostic)

This mode runs Stop the World Event GCs. This mode is used for functional testing, but sometimes it is useful for bisecting performance anomalies with GC barriers, or to ascertain the actual live data size in the application.

CHAPTER 4. BASIC CONFIGURATION OPTIONS OF SHENANDOAH GARBAGE COLLECTOR

Shenandoah garbage collector (GC) has the following basic configuration options:

-Xlog:gc

Print the individual GC timing.

-Xlog:gc+ergo

Print the heuristics decisions, which might shed light on outliers, if any.

-Xlog:gc+stats

Print the summary table on Shenandoah internal timings at the end of the run.
It is best to run this with logging enabled. This summary table conveys important information about GC performance. Heuristics logs are useful to figure out GC outliers.

-XX:+AlwaysPreTouch

Commit heap pages into memory and helps to reduce latency hiccups.

-Xms and -Xmx

Making the heap non-resizeable with **-Xms = -Xmx** reduces difficulties with heap management. Along with **AlwaysPreTouch**, the **-Xms = -Xmx** commit all memory on startup, which avoids difficulties when memory is finally used. **-Xms** also defines the low boundary for memory uncommit, so with **-Xms = -Xmx** all memory stays committed. If you want to configure Shenandoah for a lower footprint, then setting lower **-Xms** is recommended. You need to decide how low to set it to balance the commit/uncommit overhead versus memory footprint. In many cases, you can set **-Xms** arbitrarily low.

-XX:+UseLargePages

Enables **hugetlbfs** Linux support.

-XX:+UseTransparentHugePages

Enables huge pages transparently. With transparent huge pages, it is recommended to set **/sys/kernel/mm/transparent_hugepage/enabled** and **/sys/kernel/mm/transparent_hugepage/defrag** to **madvise**. When running with **AlwaysPreTouch**, it will also pay the **defrag** tool costs upfront at startup.

-XX:+UseNUMA

While Shenandoah does not support NUMA explicitly yet, it is a good idea to enable NUMA interleaving on multi-socket hosts. Coupled with **AlwaysPreTouch**, it provides better performance than the default out-of-the-box configuration.

-XX:-UseBiasedLocking

There is a tradeoff between uncontended (biased) locking throughput, and the safepoints JVM does to enable and disable them. For latency-oriented workloads, turn biased locking off.

-XX:+DisableExplicitGC

Invoking System.gc() from user code forces Shenandoah to perform additional GC cycle. It usually does not harm, as **-XX:+ExplicitGCInvokesConcurrent** gets enabled by default, which means the concurrent GC cycle would be invoked, not the STW Full GC.

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