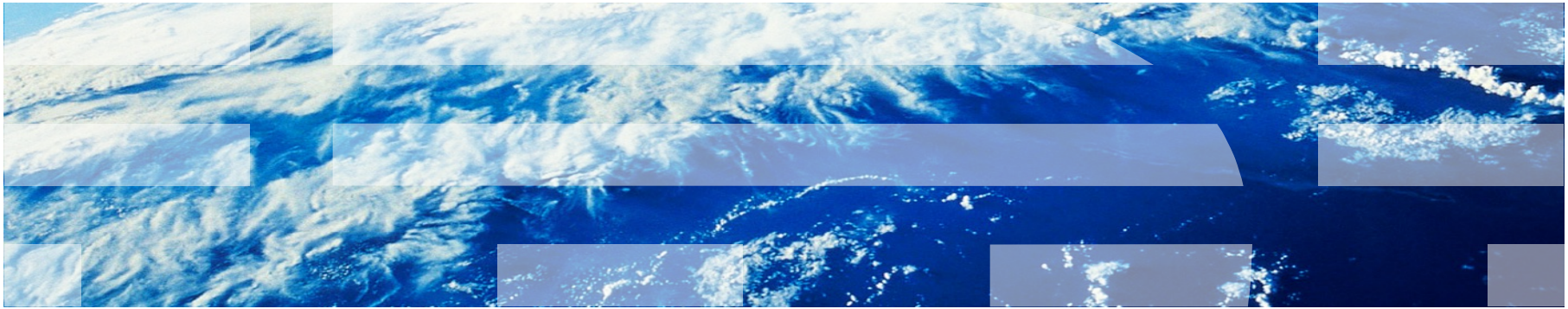
WebSphere Application Server

How to tune Java Garbage Collection to improve performance

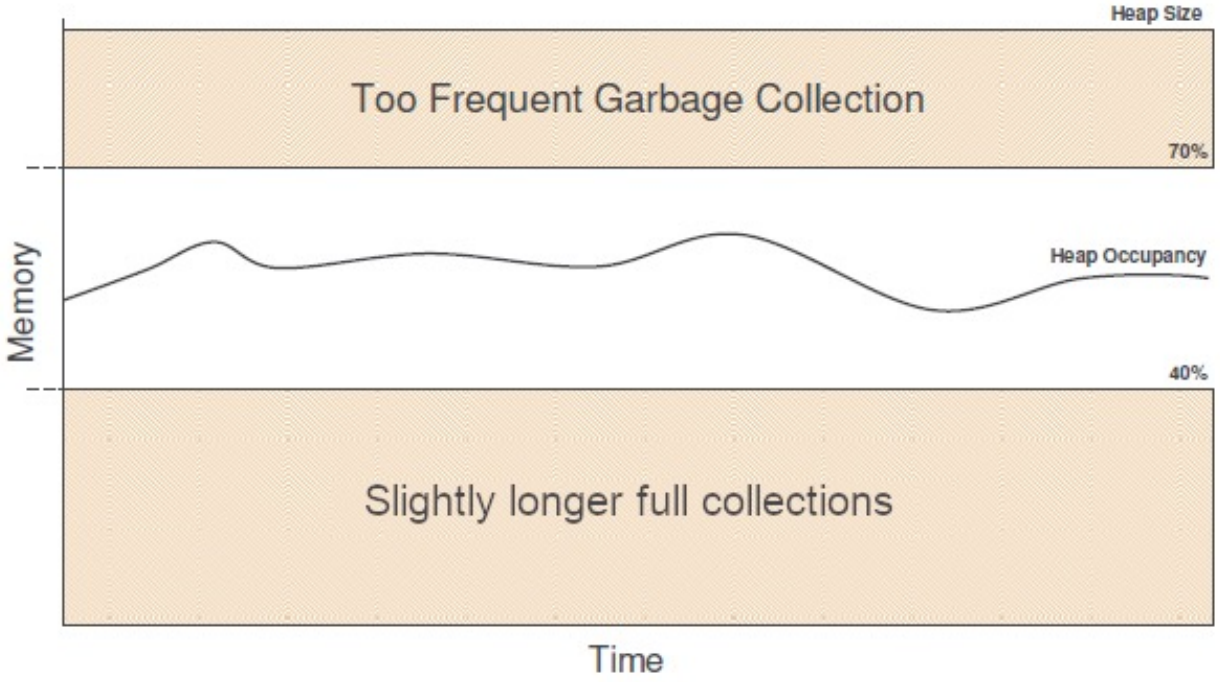


Agenda

- Garbage Collection Fundamentals
- Demo
- Summary of Common GC Tuning

Garbage Collection Fundamentals

- In general, the proportion of time in GC should be less than ~5-10% and ideally < 1%



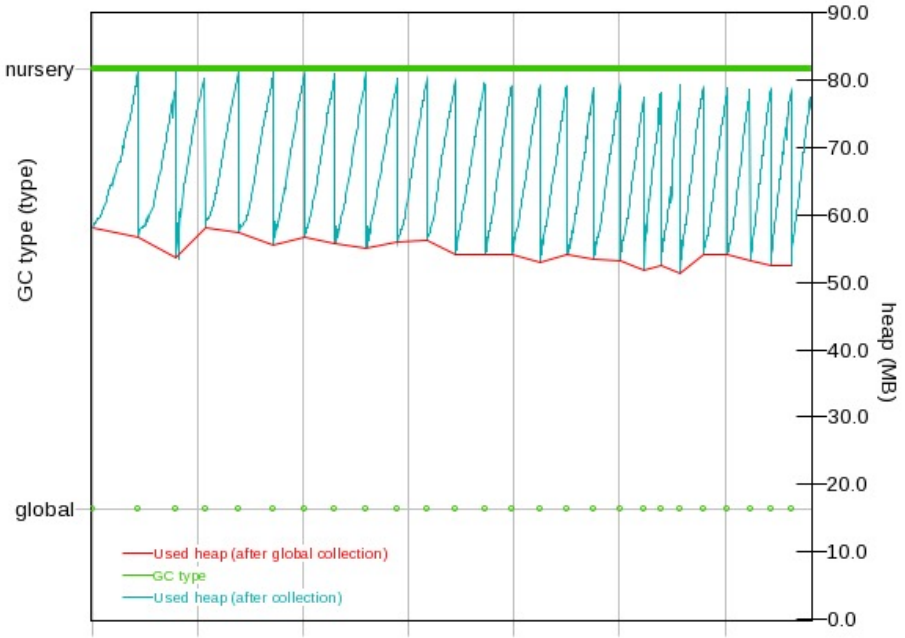
Garbage Collection

- Choose a garbage collector

gencon	balanced	optthruput	optavgpause	metronome
• Default • Two generations • Balances throughput and pause times • Occasional long pauses	• Many generations • Live heap > ~10GB • Reduces worst-case long pauses • Optimized for NUMA • Better class unloading	• No generations • Some batch workloads • Less frequent pauses but all pauses are long	• No generations • Similar to optthruput but reduces pause times at the cost of throughput	• No generations • Soft real time • Very low, consistent GC pauses at the cost of increased heap usage and CPU

Generational collector sawtooth

- Generational collectors exhibit a normal and expected ”sawtooth” pattern as trash builds up and gets clean periodically in global collections



Verbose garbage collection

- Print GC activity to logs for analysis
- Benchmarks show an overhead of < ~0.2%. Generally recommended for production.
- IBM Java and IBM Semeru/OpenJ9 Java:

  -Xverbosegclog:verbosegc.%seq.log,20,50000

- HotSpot Java >= 9

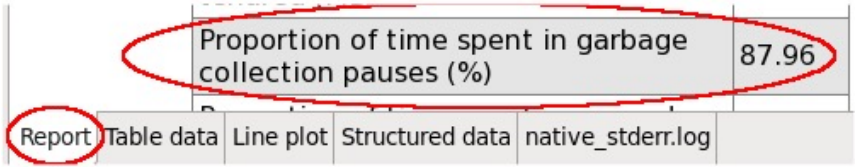
  -Xlog:safepoint=info,gc:file=logs/verbosegc.log:time,level,tags:filecount=5,filesize=20M

- Hot Spot Java < 9

  -Xloggc:verbosegc.log -XX:+UseGCLogFileRotation -XX:NumberOfGCLogFiles=5 -XX:GCLogFileSize=20M -XX:+PrintGCDateStamps -XX:+PrintGCDetails

Analyzing verbosegc

- Verbose garbage collection should always be enabled, even in production
- For performance issues, always review verbosegc
- Use the free IBM Garbage Collection and Memory Visualizer tool
- Crop to the time period of interest, click Report, and review “Proportion of time spent in garbage collection pauses (%)”



Demo

Summary of Common GC Tuning

- In general, a healthy proportion of time in GC is less than ~5-10%, ideally less than 1%
- Maximum heap size: -Xmx or -XX:MaxRAMPercentage
  - If used tenured > 70% after global, test increasing max heap size
- Maximum nursery size: -Xmn (defaults to 25% of -Xmx)
  - If used tenured < 40% after global, test increasing max nursery size
- Check for long GC pauses - find/fix cause
  - Eliminate system GCs
  - Reduce class loading/unloading churn
  - Make sure Java process size fits in RAM; paging has massive performance impact
- Gencon: Trade throughput/CPU for reduced nursery pause times: -Xgc:concurrentScavenge

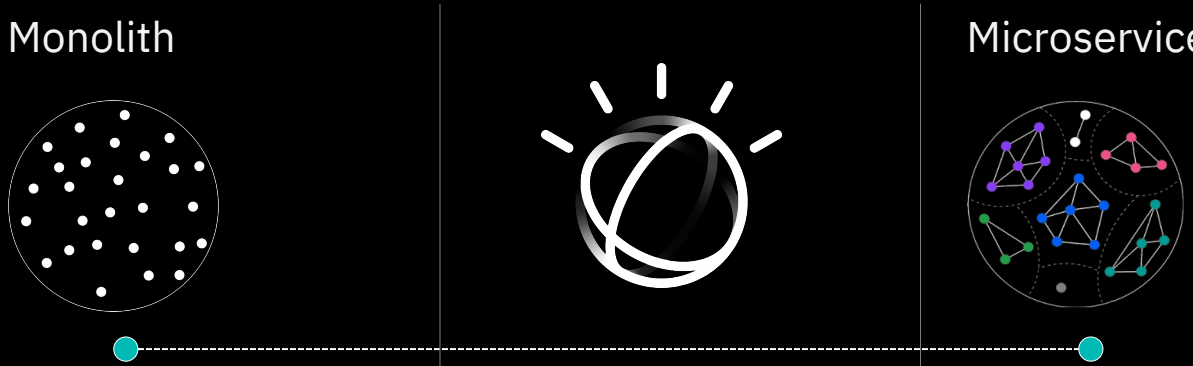
Thank you

Mono2Micro

AI based automatic transformation of monoliths into microservices available in WebSphere Hybrid Edition

Mono2Micro's AI capabilities generate recommendations, semantic analysis and a significant portion of the code needed for refactoring

90-day free trial
http://ibm.biz/Mono2Micro



Microservice Generation Engine

AI identifies high cohesive, low coupling components

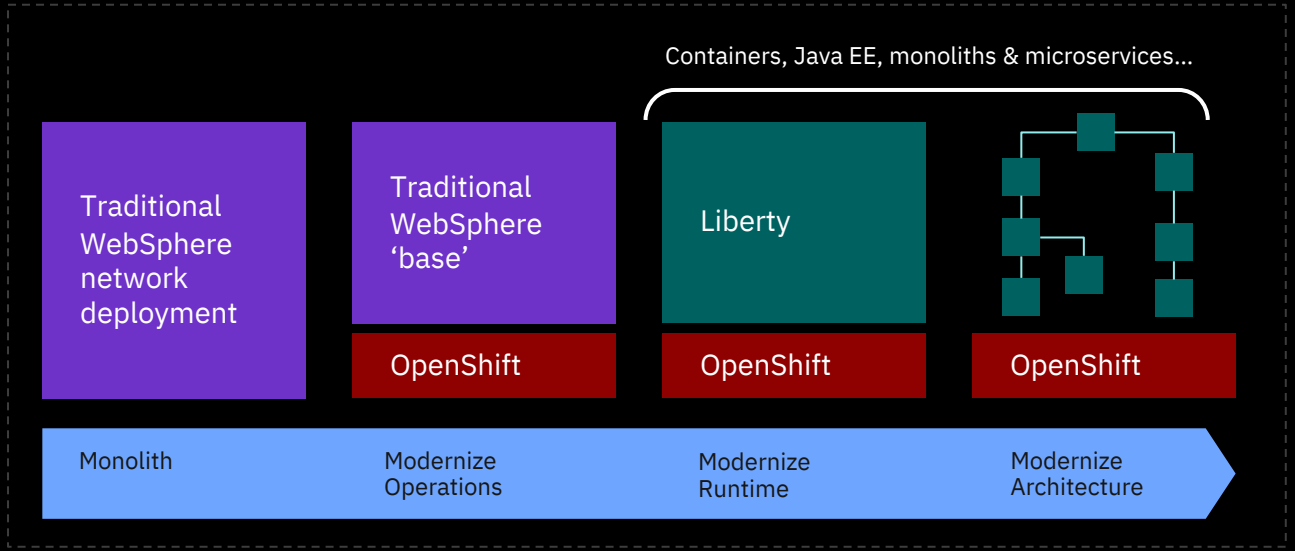
User can interactively refine recommended Microservices

Generated Microservices ready to be deployed

Generates code for communication between microservices

IBM Cloud Transformation Advisor

Accelerates the modernization journey by quickly discovering and analyzing on-premise Java EE and/or messaging workloads in the enterprise to help in determining and executing the optimum modernization steps for each.



Optimum modernization depends on workload needs! https://ibm.biz/6ReasonsWhyLiberty

Workloads:

Java EE

- WebSphere Application Server
- Oracle WebLogic
- Red Hat JBoss
- Apache Tomcat

Integration

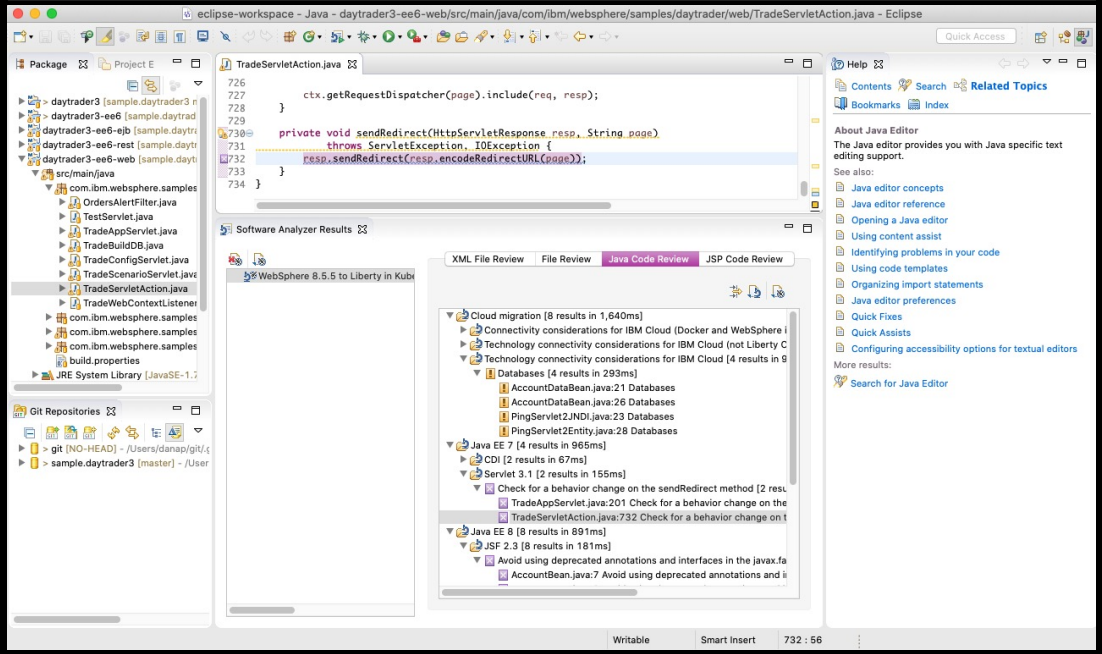
- IBM MQ
- App Connect Enterprise (IIB)

Open Source SDK for other extenders:

https://github.com/IBM/transformation-advisor-sdk

WebSphere Application Migration Toolkit

Confidently apply necessary remediations recommended by Transformation Advisor http://ibm.biz/WAMT4Eclipse



- Includes binary scanner and automated WAS migration
- Eclipse IDE plugin (Eclipse, WDT, RAD)
- Executes source code analysis and provides developer assistance with remediations
  - WebSphere to Liberty
  - WebLogic, JBoss, Tomcat to Liberty
  - WebSphere version-to-version