



IBM Software Group

# IBM® SDK, Java™ Technology Edition, V6

## *Heap dump changes*



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This presentation discusses the changes in how the virtual machine produces heap dumps in the IBM SDK for Java Version 6.

## Agenda

- Heap dump overview
- Change in default heap dump behavior
- Heap dump compression and performance improvements

This presentation will start with a brief description of heap dumps and then discuss the changes in heap dump behavior in the IBM SDK for Java Version 6, including the default conditions for producing heap dumps, file compression, and performance improvements.

## Heap dump overview

- Heap dumps contain information about the Java heap
  - ▶ All objects in the heap
  - ▶ Identifying Java class
  - ▶ References to other objects in the heap
- Default heap dump format is binary
  - ▶ Text format is also available
- Control heap dump behavior using `-Xdump:heap` command-line options
- Memory Dump Diagnostic for Java is the recommended tool for processing heap dumps

The term heap dump describes the IBM Virtual Machine for Java mechanism that generates a dump of all the live objects that are on the Java heap; that is, those that are being used by the running Java application. The heap dump file contains information about all of the objects in the heap, including the identifying Java class for each object and references to other objects in the heap and is produced when the Java heap is exhausted. This dump is stored in a portable heap dump file, a compressed binary format, by default. The text or classic heap dump is a list of all object instances in the heap, including object type, size, and references between objects, in a human-readable format. It is in EBCDIC on z/OS and in ASCII on all other platforms. Use the environment variable `IBM_JAVA_HEAPDUMP_TEXT=true` to enable text heap dumps. You can use various tools on the heap dump output to analyze the composition of the objects on the heap and, for example, help to find the objects that are controlling large amounts of memory on the Java heap and the reason why the garbage collector cannot collect them. The preferred heap dump analysis tool, Memory Dump Diagnostic for Java, is available in IBM Support Assistant.

## Heap dump default behavior

- In V5, heap dumps were produced by default for any uncaught `java/lang/OutOfMemoryError` event
- In V6, heap dumps are produced for any `java/lang/OutOfMemoryError` event triggered by the virtual machine
  - ▶ This change was also backported to Java 5 SR5

```
-Xdump:heap:events=systhrow,  
      filter=java/lang/OutOfMemoryError,  
      label=C:\test\heapdump.%Y%m%d.%H%M%S.%pid.phd,  
      ...
```

- Use the `-Xdump:what` command-line option to see all default dump agents

In Version 5, heap dumps were produced by default for any uncaught `OutOfMemoryError` event, including `OutOfMemoryErrors` produced in user code. The default behavior has changed in Version 6, so that heap dumps are produced for `OutOfMemoryErrors` triggered by the virtual machine. The new `systhrow` event has been added in this release to support this new heap dump behavior. The example on the slide shows a portion of the default dump agent configuration for heap dumps. You can see the default behavior for all of the dump agents in your Java environment by running with the `-Xdump:what` command-line parameter.

## Heap dump compression

- Binary heap dump compression
  - ▶ Previous release did not take advantage of PHD compression allowed in the file format specification
  - ▶ As a result, on 64-bit platforms, dumps could be up to 10 times larger than similar dumps from earlier releases
  - ▶ PHD format dumps now take advantage of the compression supported in the file format specification
  - ▶ Dump processing tools continue to work as expected

When moving from Version 1.4.2 to Version 5.0 of the SDK, some users experienced a large increase in heap dump file size on 64-bit platforms. In Version 6, the Portable heap dump file format has been updated to allow for more compression in binary heap dump files. Many users may notice substantially smaller heap dump files when moving from the Version 5.0 SDK to Version 6. While the underlying PHD format has changed, heap dump processing tools like the Memory Dump Diagnostic for Java will continue to function as expected.

## Heap dump performance

- Improved dump performance
  - ▶ Able to write the dump file faster because of:
    - Compression – there is less data to write to file
    - Caching – crossing over to do native file system operations less frequently
  - ▶ Writing heap dumps can be over 10 times faster than Java 5



In conjunction with the updates for compressed heap dump files, it is now also much faster to write heap dumps to disk. Clearly, it will be faster to record smaller files in the file system. In addition to the compression scheme, the SDK now incorporates a caching mechanism for writing heap dump files so that the dump generator performs fewer native file operations. Crossing over the boundary to write data out to a file is an expensive operation, so this new caching scheme offers substantial performance improvements. In some cases in Version 6, you will see that heap dumps are generated more than 10 times as fast as similar heap dump files in the Java 5 SDK.

## Section

# ***Summary and references***

This section contains a summary and reference.

## Summary

- Heap dumps contain information about the Java heap
- Produced by the new `systhrow` trigger on `java/lang/OutOfMemoryError` events
- Heap dump compression and performance improvements

Heap dump files contain information about all of the objects in the Java heap. A new dump trigger – `systhrow` – was introduced in this release to allow heap dumps to be generated by default when the virtual machine triggers an `OutOfMemoryError` event. Heap dump files are also smaller than in the previous release, and this compression and a new caching scheme mean that the heap dump generator can produce heap dump files faster.



## References

- Diagnostics guide
  - ▶ <http://publib.boulder.ibm.com/infocenter/javasdk/v6r0/index.jsp>

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