Apache Tomcat 9

Preview

Mark Thomas, August 2015
Introduction

• Apache Tomcat committer since December 2003
  – markt@apache.org
• Tomcat 8 release manager
• Member of the Servlet, WebSocket and EL expert groups
• Consultant Software Engineer @ Pivotal
• Currently focused on Apache Tomcat 9
Agenda

- Specification mandated new features
- Tomcat specific new features
- Tomcat features removed
- Internal changes
## Tomcat versions

<table>
<thead>
<tr>
<th>Tomcat</th>
<th>JavaEE</th>
<th>Minimum Java SE</th>
<th>Servlet</th>
<th>JSP</th>
<th>EL</th>
<th>WebSocket</th>
<th>JASPIC</th>
<th>1st Stable Release</th>
<th>EOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.x</td>
<td>4</td>
<td>1.4</td>
<td>2.4</td>
<td>2.0</td>
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<td>N/A</td>
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<td>09 2012</td>
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<td>2.5</td>
<td>2.1</td>
<td>2.1</td>
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<td>02 2007</td>
<td>12 2016</td>
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<td>6</td>
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<td>3.0</td>
<td>2.2</td>
<td>2.2</td>
<td>1.1</td>
<td>N/A</td>
<td>01 2011</td>
<td>TBD</td>
</tr>
<tr>
<td>8.x</td>
<td>7</td>
<td>7</td>
<td>3.1</td>
<td>2.3</td>
<td>3.0</td>
<td>1.1</td>
<td>N/A</td>
<td>02 2014</td>
<td>TBD</td>
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<tr>
<td>9.x</td>
<td>8</td>
<td>8</td>
<td>4.0</td>
<td>2.4?</td>
<td>3.1?</td>
<td>2.0?</td>
<td>1.1?</td>
<td>Q4 2016?</td>
<td>TBD</td>
</tr>
</tbody>
</table>
Specification changes
Specifications
JavaEE 8

• Key elements
  – HTML 5.0
  – HTTP/2
  – Simplification
  – Better integration for managed beans
  – Better infrastructure for the cloud
Specifications
Servlet 4.0

• Work started, stalled and is now starting again

• HTTP/2
  – HTTP/2 close to SPDY v4
  – Tomcat had an initial SPDY v2 implementation
  – Browsers no longer support SPDY v2 so it has been removed

• Tomcat 9.0.x has HTTP/2 support
  – h2 and h2c
Specifications
Servlet 4.0

• HTTP/2 progress
  – Work in progress: not yet considered stable
  – h2c available with all connectors
  – h2 requires APR/native due to ALPN requirements
  – Haven’t tested h2 with NIO/NIO2 and OpenSSL engine (see later)
  – Basic HTTP requests work
  – Async support not yet implemented
  – Non-blocking I/O support not yet implemented
  – Server push has not been implemented yet
Specifications
Servlet 4.0

• HTTP/2 on Java 8
  – JSSE APIs don’t, and won’t, support ALPN
  – ALPN is two-way so SNI trick (see later) won’t work
  – Java 9 should support ALPN
  – TBD if ALPN API is sufficient
Specifications
WebSocket 2.0

• Work has not started
• Assuming 2.0
  – Could be 1.2
• Standardize extension support
  – Compression
  – Multiplexing
Specifications
EL 3.1

• Work has not started
• Nothing obvious to do here
• Java 8 lambda alignment?
• Most issues opened against UEL are implementation bugs
• Expect minor changes and clarifications
Specifications

JSP 2.4

- There is no JSP expert group
- Just an other maintenance release
- Issues to resolve with EL 3.0 and JSPs
  - Imports (definition and resolution)
Specifications

JASPIC 1.1

- Java Authentication Service Provider Interface for Containers
- Not much demand
- There are benefits (e.g. drop-in support for OAuth)
- Unsuccessful GSoC 2015 project to implement
- I intend to complete the JASPIC work for Tomcat 9
Specifications

Other

• Tomcat 9 isn’t going to implement the web profile
  – Lack of demand
  – TomEE

• JACC
  – Java Authorization Contract for Containers
  – Zero demand
  – Might be useful
  – On the ‘have a look if there is time’ list
Tomcat New Features
Tomcat 9 New Features

• Major overhaul of TLS support

• Tomcat 8 supports
  – one TLS virtual host per connector
  – one certificate per virtual host

• Tomcat 9 supports
  – multiple virtual hosts per connector (SNI)
  – multiple certificates per virtual host

• TLS configuration has changed to support this
Tomcat 9 New Features

- SNI and multiple certificates supported by all connectors
  - APR/native support via the OpenSSL API
  - JSSE support via parsing the initial handshake
- ALPN support for APR/native
  - JSSE support is currently TBD
- Common (where possible) configuration for all connectors
  - Some JSSE / OpenSSL differences remain
- OpenSSL engine option for NIO and NIO2
Tomcat 9 New Features

• Other possibilities
  – HTTP upgrade support for AJP
  – Needs help with the C code

• Suggestions welcome
  – Suggestions with patches are even better ;)
Tomcat 9 New Features

- With OpenSSL engine support for NIO and NIO2 why bother with the APR/native connector?
- NIO and NIO2 are very similar in performance
  - NIO is more stable
  - NIO2 API is (arguably) better suited to WebSocket and HTTP2
- Do we need both NIO and NIO2?
- Is a single connector implementation viable?
  - Maybe…
Removed Features
Removed Features
BIO HTTP and BIO AJP connectors

• Both WebSocket and Servlet 3.1 require non-blocking IO
• BIO connectors currently pretend to be non-blocking
  – Creates complexity
  – No scalability benefits
  – Opportunity for things to break
• Therefore decided to remove them
 Removed Features

BIO HTTP and BIO AJP connectors

• NIO implementation remains the default
  – HTTP and AJP

• NIO2 introduced in Tomcat 8

• APR/native still available
  – Requires native library
Removed Features

Comet

- Proprietary interface for asynchronous I/O
- Users are moving (have moved) to WebSocket
- Adds complexity to all the connectors
- Therefore decided to remove it
Internal Changes
Internal Changes
Connectors

- HTTP 2.0 support adds complexity
- Connectors were already complex
- Connector code was fragile in some areas
- Cleaned up the code up before starting on HTTP 2.0
Internal Changes

Connectors

• Removed
  – BIO
  – Comet

• Implementation specific per connector code
  – Move to Endpoint

• Implementation specific per connection code
  – Move to SocketWrapper
Internal Changes

Connectors

• Used to have connector specific HTTP, AJP and upgrade implementations

• Reduce duplication
  – HTTP upgrade reduced to 3 classes from 12
  – Removed ~400 loc (of ~120,000)
  – HTTP 1.1 removed ~50% / 2500 loc
  – AJP 1.3 removed ~30% / 400 loc

• No connector specific HTTP/2 code
Internal Changes

WebSocket

• Refactored I/O implementation
  – Direct to Tomcat’s I/O layer
  – Not via Servlet 3.1 non-blocking API

• Simpler

• Faster

• Extension support likely to require further refactoring
Internal Changes

Other

• Remove use of system properties for configuration
  – Move to per Context / Host / Server / Connector
  – May keep the system property for one version as a default

• Made RFC 6265 CookieProcessor the default
  – Note UTF-8 extension
Get Involved
Get Involved

• Ask questions
  – users@tomcat.apache.org

• Report bugs
  – https://issues.apache.org/bugzilla

• Provide patches
  – https://issues.apache.org/bugzilla
  – GitHub pull request
Get Involved

• Development
  – https://svn.apache.org/repos/asf/tomcat/trunk (9.0.x)
  – dev@tomcat.apache.org

• Update the wiki
  – https://wiki.apache.org/tomcat

• You don’t need to be an expert

• Documentation needs patches too
Questions