

# JSON-B: Java™ API for JSON Binding

Version 1.0 Public Draft

23.05.16

Editors:

Martin Grebac

Martin Vojtek

Dmitry Kornilov

Comments to: [users@jsonb-spec.java.net](mailto:users@jsonb-spec.java.net)

*Oracle Corporation  
500 Oracle Parkway, Redwood Shores, CA 94065 USA.*

ORACLE AMERICA, INC. IS WILLING TO LICENSE THIS SPECIFICATION TO YOU ONLY UPON THE CONDITION THAT YOU ACCEPT ALL OF THE TERMS CONTAINED IN THIS LICENSE AGREEMENT ("AGREEMENT"). PLEASE READ THE TERMS AND CONDITIONS OF THIS AGREEMENT CAREFULLY. BY DOWNLOADING THIS SPECIFICATION, YOU ACCEPT THE TERMS AND CONDITIONS OF THIS AGREEMENT. IF YOU ARE NOT WILLING TO BE BOUND BY THEM, SELECT THE "DECLINE" BUTTON AT THE BOTTOM OF THIS PAGE AND THE DOWNLOADING PROCESS WILL NOT CONTINUE.

Specification: JSR- 367 Java API for JSON Binding ("Specification") Version: 1.0

Status: Early Draft Review

Release: May 2016

Copyright 2016 Oracle America, Inc.

500 Oracle Parkway, Redwood City, California 94065, U.S.A.

All rights reserved.

## NOTICE

The Specification is protected by copyright and the information described therein may be protected by one or more U.S. patents, foreign patents, or pending applications. Except as provided under the following license, no part of the Specification may be reproduced in any form by any means without the prior written authorization of Oracle America, Inc. ("Oracle") and its licensors, if any. Any use of the Specification and the information described therein will be governed by the terms and conditions of this Agreement.

Subject to the terms and conditions of this license, including your compliance with Paragraphs 1 and 2 below, Oracle hereby grants you a fully-paid, non-exclusive, non-transferable, limited license (without the right to sublicense) under Oracle's intellectual property rights to:

1. Review the Specification for the purposes of evaluation. This includes: (i) developing implementations of the Specification for your internal, non-commercial use; (ii) discussing the Specification with any third party; and (iii) excerpting brief portions of the Specification in oral or written communications which discuss the Specification provided that such excerpts do not in the aggregate constitute a significant portion of the Technology.

2. Distribute implementations of the Specification to third parties for their testing and evaluation use, provided that any such implementation:

(i) does not modify, subset, superset or otherwise extend the Licensor Name Space, or include any public or protected packages, classes, Java interfaces, fields or methods within the Licensor Name Space other than those required/authorized by the Specification or Specifications being implemented;

(ii) is clearly and prominently marked with the word "UNTESTED" or "EARLY ACCESS" or "INCOMPATIBLE" or "UNSTABLE" or "BETA" in any list of available builds and in proximity to every link initiating its download, where the list or link is under Licensee's control; and

(iii) includes the following notice:

"This is an implementation of an early-draft specification developed under the Java Community Process (JCP) and is made available for testing and evaluation purposes only. The code is not compatible with any specification of the JCP."

The grant set forth above concerning your distribution of implementations of the specification is contingent upon your agreement to terminate development and distribution of your "early draft" implementation as soon as feasible following final completion of the specification. If you fail to do so, the foregoing grant shall be considered null and void.

No provision of this Agreement shall be understood to restrict your ability to make and distribute to third parties applications written to the Specification.

Other than this limited license, you acquire no right, title or interest in or to the Specification or any other Oracle intellectual property, and the Specification may only be used in accordance with the license terms set forth herein. This license will expire on the earlier of: (a) two (2) years from the date of Release listed above; (b) the date on which the final version of the Specification is publicly released; or (c) the date on which the Java Specification Request (JSR) to which the Specification corresponds is withdrawn. In addition, this license will terminate immediately without notice from Oracle if you fail to comply with any provision of this license. Upon termination, you must cease use of or destroy the Specification.

"Licensor Name Space" means the public class or interface declarations whose names begin with "java", "javax", "com.oracle" or their equivalents in any subsequent naming convention adopted by Oracle through the Java Community Process, or any recognized successors or replacements thereof

#### TRADEMARKS

No right, title, or interest in or to any trademarks, service marks, or trade names of Oracle or Oracle's licensors is granted hereunder. Oracle, the Oracle logo, and Java are trademarks or registered trademarks of Oracle America, Inc. in the U.S. and other countries.

#### DISCLAIMER OF WARRANTIES

THE SPECIFICATION IS PROVIDED "AS IS" AND IS EXPERIMENTAL AND MAY CONTAIN DEFECTS OR DEFICIENCIES WHICH CANNOT OR WILL NOT BE CORRECTED BY ORACLE. ORACLE MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT THAT THE CONTENTS OF THE SPECIFICATION ARE SUITABLE FOR ANY PURPOSE OR THAT ANY PRACTICE OR IMPLEMENTATION OF SUCH CONTENTS WILL NOT INFRINGE ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER RIGHTS. This document does not represent any commitment to release or implement any portion of the Specification in any product.

THE SPECIFICATION COULD INCLUDE TECHNICAL INACCURACIES OR TYPOGRAPHICAL ERRORS. CHANGES ARE PERIODICALLY ADDED TO THE INFORMATION THEREIN; THESE CHANGES WILL BE INCORPORATED INTO NEW VERSIONS OF THE SPECIFICATION, IF ANY. ORACLE MAY MAKE IMPROVEMENTS AND/OR CHANGES TO THE PRODUCT(S) AND/OR THE PROGRAM(S) DESCRIBED IN THE SPECIFICATION AT ANY TIME. Any use of such changes in the Specification will be governed by the then-current license for the applicable version of the Specification.

#### LIMITATION OF LIABILITY

TO THE EXTENT NOT PROHIBITED BY LAW, IN NO EVENT WILL ORACLE OR ITS LICENSORS BE LIABLE FOR ANY DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUE, PROFITS OR DATA, OR FOR SPECIAL, INDIRECT, CONSEQUENTIAL, INCIDENTAL OR PUNITIVE DAMAGES, HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF OR RELATED TO ANY FURNISHING, PRACTICING,

MODIFYING OR ANY USE OF THE SPECIFICATION, EVEN IF ORACLE AND/OR ITS LICENSORS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

You will hold Oracle (and its licensors) harmless from any claims based on your use of the Specification for any purposes other than the limited right of evaluation as described above, and from any claims that later versions or releases of any Specification furnished to you are incompatible with the Specification provided to you under this license.

#### RESTRICTED RIGHTS LEGEND

If this Software is being acquired by or on behalf of the U.S. Government or by a U.S. Government prime contractor or subcontractor (at any tier), then the Government's rights in the Software and

accompanying documentation shall be only as set forth in this license; this is in accordance with 48 C.F.R. 227.7201 through 227.7202-4 (for Department of Defense (DoD) acquisitions) and with 48 C.F.R. 2.101 and 12.212 (for non-DoD acquisitions).

## REPORT

You may wish to report any ambiguities, inconsistencies or inaccuracies you may find in connection with your evaluation of the Specification ("Feedback"). To the extent that you provide Oracle with any Feedback, you hereby: (i) agree that such Feedback is provided on a non-proprietary and non-confidential basis, and (ii) grant Oracle a perpetual, non-exclusive, worldwide, fully paid-up, irrevocable license, with the right to sublicense through multiple levels of sublicensees, to incorporate, disclose, and use without limitation the Feedback for any purpose related to the Specification and future versions, implementations, and test suites thereof.

## GENERAL TERMS

Any action related to this Agreement will be governed by California law and controlling U.S. federal law. The U.N. Convention for the International Sale of Goods and the choice of law rules of any jurisdiction will not apply.

The Specification is subject to U.S. export control laws and may be subject to export or import regulations in other countries. Licensee agrees to comply strictly with all such laws and regulations and acknowledges that it has the responsibility to obtain such licenses to export, re-export or import as may be required after delivery to Licensee.

This Agreement is the parties' entire agreement relating to its subject matter. It supersedes all prior or contemporaneous oral or written communications, proposals, conditions, representations and warranties and prevails over any conflicting or additional terms of any quote, order, acknowledgment, or other communication between the parties relating to its subject matter during the term of this Agreement. No modification to this Agreement will be binding, unless in writing and signed by an authorized representative of each party.

# Table of Contents

<b>Table of Contents .....</b>	<b>5</b>
<b>1 Introduction .....</b>	<b>1</b>
1.1 Status .....	1
1.2 Goals.....	1
1.3 Non-Goals .....	2
1.4 Conventions .....	2
<b>Figure 1: Example Java Code .....</b>	<b>2</b>
1.5 Terminology.....	3
1.6 Expert Group Members .....	3
1.7 Acknowledgements .....	3
<b>2 Runtime API .....</b>	<b>4</b>
<b>3 Default Mapping.....</b>	<b>5</b>
3.1 General .....	5
3.2 Errors.....	5
3.3 Basic Java Types .....	5
3.3.1 java.lang.String, Character .....	5
3.3.2 java.lang.Byte, Short, Integer, Long, Float, Double .....	6
3.3.3 java.lang.Boolean .....	6
3.3.4 java.lang.Number .....	6
3.4 Specific Standard Java SE Types .....	6
3.4.1 java.math.BigInteger, BigDecimal .....	7
3.4.2 java.net.URL, URI.....	7
3.4.3 java.util.Optional, OptionalInt, OptionalLong, OptionalDouble .....	7
3.5 Dates .....	7
3.5.1 java.util.Date, Calendar, GregorianCalendar .....	8
3.5.2 java.util.TimeZone, SimpleTimeZone .....	8
3.5.3 java.time.* .....	8
3.6 Untyped mapping.....	9
3.7 Java Class .....	10
3.7.1 Scope and Field access strategy .....	10
3.7.2 Nested Classes.....	10
3.7.3 Static Nested Classes.....	10
3.7.4 Anonymous Classes .....	10
3.8 Polymorphic Types .....	11
3.9 Enum .....	11
3.10 Interfaces .....	11
3.11 Collections .....	11
3.12 Arrays .....	12
3.13 Attribute order .....	12
3.14 Null value handling.....	12
3.14.1 Null Java field .....	12
3.14.2 Null Array Values .....	13
3.15 Names and identifiers.....	13
3.16 Big numbers .....	13
3.17 Generics .....	13
3.17.1 Type resolution algorithm .....	13

<b>Figure 2: Example Type resolution .....</b>	<b>15</b>
<b>3.18 Must-Ignore policy .....</b>	<b>15</b>
<b>3.19 Uniqueness of properties.....</b>	<b>15</b>
<b>3.20 JSON Processing integration.....</b>	<b>15</b>
<b>4 Customizing Mapping .....</b>	<b>17</b>
<b>4.1 Customizing Property Names .....</b>	<b>17</b>
4.1.1 javax.json.bind.annotation.JsonbTransient .....	17
4.1.2 javax.json.bind.annotation.JsonbProperty .....	17
4.1.3 javax.json.bind.config.PropertyNamingStrategy .....	17
4.1.4 Property names resolution.....	18
<b>4.2 Customizing Property Order.....</b>	<b>18</b>
<b>4.3 Customizing Null Handling .....</b>	<b>18</b>
4.3.1 javax.json.bind.annotation.JsonbNillable .....	19
4.3.2 Global null handling configuration .....	19
<b>4.4 I-JSON support .....</b>	<b>19</b>
4.4.1 Strict date serialization.....	20
<b>4.5 Custom instantiation .....</b>	<b>20</b>
<b>4.6 Custom visibility .....</b>	<b>20</b>
<b>4.7 Custom mapping .....</b>	<b>20</b>
4.7.1 Adapters .....	21
4.7.2 Serializers/Deserializers .....	21
<b>4.8 Custom date format .....</b>	<b>21</b>
<b>4.9 Custom number format .....</b>	<b>22</b>
<b>4.10 Custom binary data handling .....</b>	<b>22</b>
<b>5 Appendix.....</b>	<b>23</b>
<b>5.1 Change Log.....</b>	<b>23</b>
5.1.1 Changes Since 1.0 Early Draft.....	23
<b>6 Bibliography .....</b>	<b>24</b>

# 1 Introduction

This specification defines binding API between Java objects and JSON [1] documents. Readers are assumed to be familiar with JSON; for more information about JSON, see:

- Architectural Styles and the Design of Network-based Software Architectures [2]
- The REST Wiki [3]
- JSON on Wikipedia [4]

## 1.1 Status

This is an early draft; this specification is not yet complete. A list of open issues can be found at:

[http://java.net/jira/browse/JSONB\\_SPEC](http://java.net/jira/browse/JSONB_SPEC)

The corresponding Javadocs can be found online at:

<http://jsonb-spec.java.net/>

The reference implementation will be obtainable from:

<http://eclipselink.org/jsonb>

The expert group is seeking feedback from the community on any aspect of this specification. Please send comments to:

[users@jsonb-spec.java.net](mailto:users@jsonb-spec.java.net)

## 1.2 Goals

The goals of the API are as follows:

- **JSON**  
Support binding (serialization and deserialization) for all RFC 7159-compatible JSON documents.
- **Relationships to JSON Related specifications**  
JSON-related specifications will be surveyed to determine their relationship to JSON-Binding.
- **Consistency**  
Maintain consistency with JAXB (Java API for XML Binding) and other Java EE and SE APIs where appropriate.
- **Convention**  
Define default mapping of Java classes and instances to JSON document counterparts.
- **Customization**  
Allow customization of the default mapping definition.

- **Ease of Use**  
Default use of the APIs should not require prior knowledge of the JSON document format and specification.
- **Partial Mapping**  
In many use cases, only a subset of JSON Document is required to be mapped to a Java object instance.
- **Integration**  
Define or enable integration with JSR 374: Java API for JSON Processing (JSON-P) 1.1.

## 1.3 Non-Goals

The following are non-goals:

- **Preserving equivalence (Round-trip)**  
The specification recommends, but does not require equivalence of content for deserialized and serialized JSON documents.
- **JSON Schema**  
Generation of JSON Schema from Java classes, as well as validation based on JSON schema.
- **JEP 198 Lightweight JSON API**  
Support Support and integration with Lightweight JSON API as defined within JEP 198 is out of scope of this specification. Will be reconsidered in future specification revisions.

## 1.4 Conventions

The keywords ‘MUST’, ‘MUST NOT’, ‘REQUIRED’, ‘SHALL’, ‘SHALL NOT’, ‘SHOULD’, ‘SHOULD NOT’, ‘RECOMMENDED’, ‘MAY’, and ‘OPTIONAL’ in this document are to be interpreted as described in RFC 2119 [5].

Java code and sample data fragments are formatted as shown in Figure 1:

```
package com.example.hello;

public class Hello {
    public static void main(String args[]) {
        System.out.println("Hello World");
    }
}
```

Figure 1: Example Java Code

URIs of the general form ‘http://example.org/...’ and ‘http://example.com/...’ represent application or context-dependent URIs.

All parts of this specification are normative, with the exception of examples, notes and sections explicitly marked as ‘Non-Normative’. Non-normative notes are formatted as shown below:

**Note:** *This is a note.*



## 1.5 Terminology

### Data binding

Process which defines the representation of information in a JSON document as an object instance, and vice versa.

### Deserialization

Process of reading a JSON document and constructing a tree of content objects, where each object corresponds to part of JSON document, thus the content tree reflects the document's content.

### Serialization

Inverse process to deserialization. Process of traversing content object tree and writing a JSON document that reflects the tree's content.

## 1.6 Expert Group Members

This specification is being developed as part of JSR 367 under the Java Community Process. It is the result of the collaborative work of the members of the JSR 367 Expert Group. The following are the present expert group members:

- Dmitry Kornilov (Oracle)
- Roman Grigoriadi (Oracle)
- Martin Grebac (Oracle)
- Martin Vojtek (Oracle, Datlowe)
- Hendrik Saly (Individual Member)
- Gregor Zurowski (Individual Member)
- Inderjeet Singh (Individual Member)
- Eugen Cepoi (Individual Member)
- Przemyslaw Bielicki (Individual Member)
- Kyung Koo Yoon (TmaxSoft, Inc.)
- Otavio Santana (Individual Member)
- Rick Curtis (IBM)
- Alexander Salvanos (Individual Member)
- Romain Manni-Bucau (Tomitribe)

## 1.7 Acknowledgements

During the course of this JSR we received many excellent suggestions. Special thanks to Heather VanCura and David Delabassee for feedback and help with evangelizing the specification, and John Clingan for feedback and language corrections.

During the course of this JSR we also received many excellent suggestions on the JSR's java.net project mailing lists. Thanks in particular to Olena Syrota, Oleg Tsal-Tsalko and whole JUG UA for their contributions.

## 2 Runtime API

The JSON-B runtime API provides access to serialization and deserialization operations for manipulating JSON documents and mapped JSON-B classes and instances. The full specification of the binding framework is available in the javadoc for the *javax.json.bind* package accompanied with this specification.

## 3 Default Mapping

This section defines the default binding (representation) of Java components and classes to JSON documents. The default binding defined here can be further customized as specified in Customizing Mapping.

### 3.1 General

JSON Binding implementations ('implementations' in further text) MUST support binding of JSON documents as defined in RFC 7159 JSON Grammar [1]. Serialized JSON output MUST conform to the RFC 7159 JSON Grammar [1] and be encoded in UTF-8 encoding as defined in Section 8.1 (Character Encoding) of RFC 7159 [1]. Implementations MUST support deserialization of documents conforming to RFC 7159 JSON Grammar [1]. In addition, implementations SHOULD NOT allow deserialization of RFC 7159 [1] non-conforming text (e.g. unsupported encoding, ...) and report error in such cases. Detection of UTF encoding of a deserialized document MUST follow the encoding process defined in the Section 3 (Encoding) of RFC 4627 [6]. Implementations SHOULD ignore the presence of an UTF byte order mark (BOM) and not treat it as an error.

### 3.2 Errors

Implementations SHOULD NOT allow deserialization of RFC 7159 [1] non-conforming text (e.g. unsupported encoding, ...) and report an error in such case. Implementations SHOULD also report an error during a deserialization operation, if it is not possible to represent a JSON document value with the expected Java type.

### 3.3 Basic Java Types

Implementations MUST support binding of the following basic Java classes and their corresponding primitive types:

- `java.lang.String`
- `java.lang.Character`
- `java.lang.Byte`
- `java.lang.Short`
- `java.lang.Integer`
- `java.lang.Long`
- `java.lang.Float`
- `java.lang.Double`
- `java.lang.Boolean`

#### 3.3.1 `java.lang.String`, `Character`

Instances of type *java.lang.String* and *java.lang.Character* are serialized to JSON String values as defined within RFC 7159 Section 7 (Strings) [1] in UTF-8 encoding without a byte order mark.

[JSB-3.3.1-1] Implementations SHOULD support deserialization of JSON text in other (than UTF-8) UTF encodings into *java.lang.String* instances.

### 3.3.2 *java.lang.Byte*, *Short*, *Integer*, *Long*, *Float*, *Double*

Serialization of type *java.lang.Byte*, *Short*, *Integer*, *Long*, *Float* or *Double* (and their corresponding primitive types) to a JSON Number MUST follow the conversion process defined in the javadoc specification for the corresponding type's *toString()* method [JSB-3.3.2-1]. Deserialization of a JSON value into *java.lang.Byte*, *Short*, *Integer*, *Long*, *Float* or *Double* instance (or their corresponding primitive types) MUST follow the conversion process defined in the javadoc specification for the corresponding *parse\$Type* method, such as *java.lang.Byte.parseByte()* for *Byte*.

### 3.3.3 *java.lang.Boolean*

Serialization of type *java.lang.Boolean* and its corresponding *boolean* primitive type to a JSON value MUST follow the conversion process defined in the javadoc specification for *java.lang.Boolean.toString()* method. Deserialization of a JSON value into *java.lang.Boolean* instance or *boolean* primitive type MUST follow the conversion process defined in the javadoc specification for *java.lang.Boolean.parseBoolean()* method.

### 3.3.4 *java.lang.Number*

Serialization of *java.lang.Number* instances (if their more concrete type is not defined elsewhere in this chapter) to a JSON string MUST retrieve double value from *java.lang.Number.doubleValue()* method and convert it to a JSON Number as defined in section 3.3.2. Deserialization of a JSON value into *java.lang.Number* type MUST return an instance of *java.math.BigDecimal* by using conversion process defined in the javadoc specification for constructor of *java.math.BigDecimal* with *java.lang.String* argument.

## 3.4 Specific Standard Java SE Types

Implementations MUST support binding of the following standard Java SE classes:

- *java.math.BigInteger*
- *java.math.BigDecimal*
- *java.net.URL*
- *java.net.URI*
- *java.util.Optional*
- *java.util.OptionalInt*
- *java.util.OptionalLong*
- *java.util.OptionalDouble*

### 3.4.1 `java.math.BigInteger`, `BigDecimal`

Serialization of type `java.math.BigInteger` or `BigDecimal` to a JSON Number MUST follow the conversion process defined in the javadoc specification for the corresponding type's `toString()` method. Deserialization of a JSON value into `java.math.BigInteger` or `BigDecimal` instance MUST follow the conversion process defined in the javadoc specification for the constructor of `java.math.BigInteger` or `BigDecimal` with `java.lang.String` argument.

### 3.4.2 `java.net.URL`, `URI`

Serialization of type `java.net.URL` or `URI` to a JSON String MUST follow the conversion process defined in the javadoc specification for the corresponding type's `toString()` method.

Deserialization of a JSON value into `java.net.URL` or `URI` instance MUST follow the conversion process defined in the javadoc specification for the constructor of `java.net.URL` or `URI` with `java.lang.String` argument.

### 3.4.3 `java.util.Optional`, `OptionalInt`, `OptionalLong`, `OptionalDouble`

Non-empty instances of type `java.util.Optional`, `OptionalInt`, `OptionalLong`, `OptionalDouble` are serialized to a JSON value by retrieving their contained instance and converting it to JSON value based on its type and corresponding mapping definitions within this chapter. Class fields containing empty optional instances are treated as having a null value and serialized based on 3.14.1.

Empty optional instances in array items are serialized as null.

Deserializing into `Optional`, `OptionalInt`, `OptionalLong`, `OptionalDouble` return empty optional value for properties containing a null value. Otherwise any non-empty `Optional`, `OptionalInt`, `OptionalLong`, `OptionalDouble` value is constructed of type which deserialized based on mappings defined in this chapter.

Instances of type `java.util.Optional<T>` are serialized to a JSON value as JSON objects when T alone would be serialized as JSON object. When T would be serialized as a JSON value (e.g. `java.lang.String`, `java.lang.Integer`), an instance of `java.util.Optional<T>` is serialized as a JSON value (without curly brackets).

Deserialization of a JSON value into `java.util.Optional<T>` MUST be supported if deserialization of a JSON value into instance of T is supported.

## 3.5 Dates

Implementations MUST support binding of the following standard Java date/time classes:

- `java.util.Date`
- `java.util.Calendar`
- `java.util.GregorianCalendar`
- `java.util.TimeZone`
- `java.util.SimpleTimeZone`

- `java.time.Instant`
- `java.time.Duration`
- `java.time.Period`
- `java.time.LocalDate`
- `java.time.LocalTime`
- `java.time.LocalDateTime`
- `java.time.ZonedDateTime`
- `java.time.ZoneId`
- `java.time.ZoneOffset`
- `java.time.OffsetDateTime`
- `java.time.OffsetTime`

If not specified otherwise in this section, GMT standard time zone and offset specified from UTC Greenwich is used. If not specified otherwise, the date time format for serialization and deserialization is ISO 8601 without offset, as specified in *java.time.format.DateTimeFormatter.ISO\_DATE*.

Implementations MUST report an error if the date/time string in a JSON document does not correspond to the expected date/time format.

### 3.5.1 `java.util.Date`, `Calendar`, `GregorianCalendar`

The serialization format of *java.util.Date*, *Calendar*, *GregorianCalendar* instances with no time information is *ISO\_DATE*.

If time information is present, the format is *ISO\_DATE\_TIME*.

Implementations MUST support deserialization of both *ISO\_DATE* and *ISO\_DATE\_TIME* into *java.util.Date*, *Calendar* and *GregorianCalendar* instances.

### 3.5.2 `java.util.TimeZone`, `SimpleTimeZone`

Implementations MUST support deserialization of any time zone format specified in *java.util.TimeZone* into a field or property of type *java.util.TimeZone* and *SimpleTimeZone*.

Implementations MUST report an error for deprecated three-letter time zone IDs as specified in *java.util.Timezone*.

The serialization format of *java.util.TimeZone* and *SimpleTimeZone* is *NormalizedCustomID* as specified in *java.util.TimeZone*.

### 3.5.3 `java.time.*`

The serialization output for a *java.time.Instant* instance MUST be in a *ISO\_INSTANT* format, as specified in *java.time.format.DateTimeFormatter*. Implementations MUST support the deserialization of an *ISO\_INSTANT* formatted JSON string to a *java.time.Instant* instance.

For other *java.time.\** classes, the following mapping table maps Java types to their corresponding formats:

Java Type	Format
<code>java.time.Instant</code>	ISO_INSTANT
<code>java.time.LocalDate</code>	ISO_LOCAL_DATE
<code>java.time.LocalTime</code>	ISO_LOCAL_TIME
<code>java.time.LocalDateTime</code>	ISO_LOCAL_DATE_TIME
<code>java.time.ZonedDateTime</code>	ISO_ZONED_DATE_TIME
<code>java.time.OffsetDateTime</code>	ISO_OFFSET_DATE_TIME
<code>java.time.OffsetTime</code>	ISO_OFFSET_TIME

Table 1: Date/time formats for `java.time.*` types

Implementations MUST support the deserialization of any time zone ID format specified in *java.time.Zoneld* into a field or property of type *java.time.Zoneld*. The serialization format of *java.time.Zoneld* is the normalized zone ID as specified in *java.time.Zoneld*.

Implementations MUST support the deserialization of any time zone ID format specified in *java.time.ZoneOffset* into a field or property of type *java.time.ZoneOffset*. The serialization format of *java.time.ZoneOffset* is the normalized zone ID as specified in *java.time.ZoneOffset*.

Implementations MUST support the deserialization of any duration format specified in *java.time.Duration* into a field or property of type *java.time.Duration*. This is super-set of ISO 8601 duration format. The serialization format of *java.time.Duration* is the ISO 8601 seconds based representation, such as PT8H6M12.345S.

Implementations MUST support the deserialization of any period format specified in *java.time.Period* into a field or property of type *java.time.Period*. This is a super-set of ISO 8601 period format. The serialization format of *java.time.Period* is ISO 8601 period representation. A zero-length period is represented as zero days 'P0D'.

## 3.6 Untyped mapping

For an unspecified output type of a deserialization operation, as well as where output type is specified as *Object.class*, implementations MUST deserialize a JSON document using Java runtime types specified in table below:

JSON Value	Java Type
object	<code>java.util.Map&lt;String, Object&gt;</code>
array	<code>java.util.List&lt;Object&gt;</code>
string	<code>java.lang.String</code>
number	<code>java.math.BigDecimal</code>
true, false	<code>java.lang.Boolean</code>
null	null

Table 2: Untyped Mapping

JSON object values are deserialized into an implementation of *java.util.Map<String, Object>* with a predictable iteration order.

## 3.7 Java Class

Any instance passed to a deserialization operation must have a public or protected no-argument constructor. Implementations SHOULD throw an error if this condition is not met. This limitation does not apply to serialization operations, as well as to classes which specify explicit instantiation methods as described in section 4.5.

### 3.7.1 Scope and Field access strategy

For a deserialization operation of a Java property, if a matching public setter method exists, the method is called to set the value of the property. If a matching setter method with private, protected, or defaulted to package-only access exists, then this field is ignored. If no matching setter method exists and the field is public, then direct field assignment is used.

For a serialization operation, if a matching public getter method exists, the method is called to obtain the value of the property. If a matching getter method with private, protected, or defaulted to package-only access exists, then this field is ignored. If no matching getter method exists and the field is public, then the value is obtained directly from the field.

JSON Binding implementations MUST NOT deserialize into transient, final or static fields and MUST ignore name/value pairs corresponding to such fields.

Implementations MUST support serialization of final fields. Transient and static fields MUST be ignored during serialization operation.

If a JSON document contains a name/value pair not corresponding to field or setter method, then this name/value pair MUST be ignored.

Public getter/setter methods without a corresponding field MUST be supported. When only public getter/setter method without corresponding field is present in the class, the getter method is called to obtain the value to serialize, and the setter method is called during deserialization operation.

### 3.7.2 Nested Classes

Implementations MUST support the binding of public and protected nested classes. For deserialization operations, both nested and encapsulating classes MUST fulfill the same instantiation requirements as specified in 3.7.1.

### 3.7.3 Static Nested Classes

Implementations MUST support the binding of public and protected static nested classes. For deserialization operations, the nested class MUST fulfill the same instantiation requirements as specified in 3.7.1.

### 3.7.4 Anonymous Classes

Deserialization into anonymous classes is not supported. Serialization of anonymous classes is supported by default object mapping.



## 3.8 Polymorphic Types

Deserialization into polymorphic types is not supported by default mapping.

## 3.9 Enum

Serialization of an Enum instance to a JSON String value MUST follow the conversion process defined in javadoc specification for their *name()*.

Deserialization of a JSON value into an enum instance MUST be done by calling the enum's *valueOf(String)* method.

## 3.10 Interfaces

Implementations MUST support the deserialization of specific interfaces defined in 3.11 and 3.3.4.

Deserialization to other interfaces is not supported and implementations SHOULD report error in such case.

If a class property is defined with an interface and not concrete type, then the mapping for a serialized property is resolved based on its runtime type.

## 3.11 Collections

Implementations MUST support the binding of the following collection interfaces, classes and their implementations:

- `java.util.Collection`
- `java.util.Map`
- `java.util.Set`
- `java.util.HashSet`
- `java.util.NavigableSet`
- `java.util.SortedSet`
- `java.util.TreeSet`
- `java.util.LinkedHashSet`
- `java.util.TreeHashSet`
- `java.util.HashMap`
- `java.util.NavigableMap`
- `java.util.SortedMap`
- `java.util.TreeMap`
- `java.util.LinkedHashMap`
- `java.util.TreeHashMap`
- `java.util.List`
- `java.util.ArrayList`

- `java.util.LinkedList`
- `java.util.Deque`
- `java.util.ArrayDeque`
- `java.util.Queue`
- `java.util.PriorityQueue`
- `java.util.EnumSet`
- `java.util.EnumMap`

Implementations of these interfaces must provide an accessible default constructor.

JSON Binding implementations **MUST** report a deserialization error if a default constructor is not present or is not in accessible scope.

## 3.12 Arrays

JSON Binding implementations **MUST** support the binding of Java arrays of all supported Java types from this chapter into/from JSON array structures as defined in Section 5 of RFC 7159 [1].

Arrays of primitive types and multi-dimensional arrays **MUST** be supported.

## 3.13 Attribute order

Declared fields **MUST** be serialized in lexicographical order into the resulting JSON document. In case of inheritance, declared fields of super class **MUST** be serialized before declared fields of child class.

When deserializing a JSON document, declared fields **MUST** be set in the order of attributes present in the JSON document.

## 3.14 Null value handling

### 3.14.1 Null Java field

The result of serializing a java field with a null value is the absence of the property in the resulting JSON document.

The deserialization operation of a property absent in JSON document **MUST** not set the value of the field, the setter (if available) **MUST** not be called, and thus original value of the field **MUST** be preserved.

The deserialization operation of a property with a null value in a JSON document **MUST** set the value of the field to null value (or call setter with null value if setter is present). The exception is *java.util.Optional*, *OptionalInt*, *OptionalLong*, *OptionalDouble* instances. In this case the value of the field is set to an empty optional value.

### 3.14.2 Null Array Values

The result of deserialization n-ary array represented in JSON document is n-ary Java array.

Null value in JSON array is represented by null value in Java array.

Serialization operation on Java array with null value at index *i* MUST output null value at index *i* of the array in resulting JSON document.

## 3.15 Names and identifiers

According to RFC 7159 Section 7 [1], every Java identifier name can be transformed using identity function into a valid JSON String. Identity function MUST be used for transforming Java identifier names into Strings in JSON document.

For deserialization operations defined in 3.6 section, identity function is used to transform JSON name strings into Java *String* instances in the resulting map *Map<String, Object>*.

If a Java identifier with corresponding name does not exist or is not accessible, the implementations MUST report error.

Naming and error reporting strategies can be further customized in customization.

## 3.16 Big numbers

JSON Binding implementation MUST serialize numbers that express greater magnitude or precision than an IEEE 754 double precision number as strings.

## 3.17 Generics

JSON Binding implementations MUST support binding of generic types.

Due to type erasure, there are situations when it is not possible to obtain generic type information. There are two ways for JSON Binding implementations to obtain generic type information.

If there is a class file available (in the following text referred as static type information), it is possible to obtain generic type information (effectively generic type declaration) from Signature attribute (if this information is present).

The second option is to provide generic type information at runtime. To provide generic type information at runtime, an argument of *java.lang.reflect.Type* MUST be passed to *Jsonb::toJson* or to *Jsonb::fromJson* method.

### 3.17.1 Type resolution algorithm

There are several levels of information JSON Binding implementations may obtain about the type of field/class/interface:

1. runtime type provided via *java.lang.reflect.Type* parameter passed to *Jsonb::toJson* or *Jsonb::fromJson* method
2. static type provided in class file (effectively stored in Signature attribute)
3. raw type
4. no information about the type

If there is no information about the type, JSON Binding implementation MUST treat this type as *java.lang.Object*.

If only raw type of given field/class/interface is known, then the type MUST be treated like raw type. For example, if the only available information is that given field/class/interface is of type *java.util.ArrayList*, then the type MUST be treated as *java.util.ArrayList<Object>*.

JSON Binding implementations MUST use the most specific type derived from the information available.

Let's consider situation when there is only a static type information of a given field/class/interface known, and there is no runtime type information available.

Let  $\text{GenericClass} < T_1 \dots T_n >$  be part of generic type declaration, where *GenericClass* is name of the generic type and  $T_1 \dots T_n$  are type parameters. For every  $T_i$ , where  $i$  in  $1 \dots n$ , there are 3 possible options:

1.  $T_i$  is concrete parameter type
2.  $T_i$  is bounded parameter type
3.  $T_i$  is wildcard parameter type without bounds

In case 1, the most specific parameter type MUST be given concrete parameter type  $T_i$ .

For bounded parameter type, let's use bounds  $B_1, \dots, B_m$ .

If  $m = 1$ , then the most specific parameter type MUST be derived from the given bound  $B_1$ .

If  $B_1$  is class or interface, the most specific parameter type MUST be the class or interface.

Otherwise, the most specific parameter type SHOULD be *java.lang.Object*.

If multiple bounds are specified, the first step is to resolve every bound separately. Let's define result of such resolution as  $S_1, \dots, S_m$  specific parameter types.

If  $S_1, \dots, S_m$  are *java.lang.Object*, then the bounded parameter type  $T_i$  MUST be *java.lang.Object*.

If there is exactly one  $S_k$ , where  $1 \leq k \leq m$  is different than *java.lang.Object*, then the most specific parameter type for this bounded parameter type  $T_i$  MUST be  $S_k$ .

If there exists  $S_{k1}, S_{k2}$ , where  $1 \leq k1 \leq k2 \leq m$ , then the most specific parameter type is  $S_{k1}$ .

For wildcard parameter type without bounds, the most specific parameter type MUST be *java.lang.Object*.

Any unresolved type parameter MUST be treated as *java.lang.Object*.

If runtime type is provided via *java.lang.reflect.Type* parameter passed to *Jsonb::toJson* or *Jsonb::fromJson* method, then that runtime type overrides static type declaration wherever applicable.

There are situations when it is necessary to use combination of runtime and static type information.

```
public class Hello {
    public static void main(String args[]) {
        System.out.println("Hello World");
    }
}
```

Figure 2: Example Type resolution

To resolve type of *field1*, runtime type of *MyGenericType* and static type of *field1* is required.

### 3.18 Must-Ignore policy

When JSON Binding implementation during deserialization encounters key in key/value pair that it does not recognize, it should treat the rest of the JSON document as if the element simply did not appear, and in particular, the implementation MUST NOT treat this as an error condition.

### 3.19 Uniqueness of properties

JSON Binding implementations MUST NOT produce JSON documents with members with duplicate names. In this context, "duplicate" means that the names, after processing any escaped characters, are identical sequences of Unicode characters.

When non-unique property (after override and rename) is found, implementation MUST throw an exception. This doesn't apply for customized user serialization behavior implemented with the usage of *JsonbAdapter* and *JsonbSerializer/JsonbDeserializer* mechanisms.

### 3.20 JSON Processing integration

JSON Binding implementations MUST support binding of the following JSON Processing types:

- *javax.json.JsonObject*
- *javax.json.JsonArray*
- *javax.json.JsonStructure*
- *javax.json.JsonValue*
- *javax.json.JsonPointer*
- *javax.json.JsonString*
- *javax.json.JsonNumber*

Serialization of supported *javax.json.\** objects/interfaces/fields MUST have the same result as serialization these objects with *javax.json.JsonWriter*.

Deserialization into supported *javax.json.\** objects/interfaces/fields MUST have the same result as deserialization into such objects with *javax.json.JsonReader*.

## 4 Customizing Mapping

This section defines several ways how to customize the default behavior. The default behavior can be customized annotating a given field, JavaBean property, type or package, or by providing an implementation of particular strategy, e.g. *PropertyOrderStrategy*. JSON Binding provider MUST support these customization options.

### 4.1 Customizing Property Names

There are two standard ways how to customize serialization of field (or JavaBean property) to JSON document. The same applies to deserialization. The first way is to annotate field (or JavaBean property) with *javax.json.bind.annotation.JsonbProperty* annotation. The second option is to set *javax.json.bind.config.PropertyNamingPolicy*.

#### 4.1.1 *javax.json.bind.annotation.JsonbTransient*

JSON Binding implementations MUST NOT serialize fields, JavaBean properties or types annotated with *javax.json.bind.annotation.JsonbTransient*.

*JsonbTransient* annotation is mutually exclusive with all other JSON Binding defined annotations. If this condition is not met, JSON Binding implementation MUST throw *JsonbException*.

#### 4.1.2 *javax.json.bind.annotation.JsonbProperty*

According to default mapping 3.15, property names are serialized unchanged to JSON document (identity transformation). To provide custom name for given field (or JavaBean property), *javax.json.bind.annotation.JsonbProperty* may be used. *JsonbProperty* annotation may be specified on field, getter or setter method.

If specified on field, custom name is used both for serialization and deserialization.

If *javax.json.bind.annotation.JsonbProperty* is specified on getter method, it is used only for serialization. If *javax.json.bind.annotation.JsonbProperty* is specified on setter method, it is used only for deserialization.

It is possible to specify different values for getter and setter method for *javax.json.bind.annotation.JsonbProperty* annotation. In such case the different custom name will be used for serialization and deserialization.

#### 4.1.3 *javax.json.bind.config.PropertyNamingStrategy*

To customize name translation of properties, JSON Binding provides *javax.json.bind.config.PropertyNamingStrategy* interface.

Interface *javax.json.bind.config.PropertyNamingStrategy* provides the most common property naming strategies.

- IDENTITY
- LOWER\_CASE\_WITH\_DASHES
- LOWER\_CASE\_WITH\_UNDERSCORES
- UPPER\_CAMEL\_CASE
- UPPER\_CAMEL\_CASE\_WITH\_SPACES
- CASE\_INSENSITIVE

The detailed description of property naming strategies can be found in javadoc.

The way to set custom property naming strategy is to use *javax.json.bind.JsonbConfig::withPropertyNamingStrategy* method.

#### 4.1.4 Property names resolution

Property name resolution consists of two phases:

1. Standard override mechanism
2. Applying property name resolution, which involves the value of *@JsonbProperty*

If duplicate name is found exception MUST be thrown. The definition of duplicate (non-unique) property can be found in 3.19.

## 4.2 Customizing Property Order

To customize the order of serialized properties, JSON Binding provides *javax.json.bind.config.PropertyOrderStrategy* class.

Class *javax.json.bind.config.PropertyOrderStrategy* provides the most common property order strategies.

- LEXICOGRAPHICAL
- ANY
- REVERSE

The detailed description of property order strategies can be found in javadoc.

The way to set custom property order strategy is to use *javax.json.bind.JsonbConfig::withPropertyOrderStrategy* method.

To customize the order of serialized properties only for one specific type, JSON Binding provides *javax.json.bind.annotation.JsonbPropertyOrder* annotation. Order specified by *JsonbPropertyOrder* annotation overrides order specified by *PropertyOrderStrategy*.

The order is applied to already renamed properties as stated in 4.1.

## 4.3 Customizing Null Handling

There are three ways how to change default null handling. The first option is to annotate type or package with *javax.json.bind.annotation.JsonbNillable* annotation. The second option is to annotate field or JavaBean property with *javax.json.bind.annotation.JsonbProperty* and to set nillable parameter to true. The third option is to set config-wide configuration via *JsonbConfig::withNullValues* method.



If annotations (*JsonbNillable* or *JsonbProperty*) on different level apply to the same field (or JavaBean property) or if there is config wide configuration and some annotation (*JsonbNillable* or *JsonbProperty*) which apply to the same field (or JavaBean property), the annotation with the smallest scope applies. For example, if there is type level *JsonbNillable* annotation applied to some class with field which is annotated with *JsonbProperty* annotation with `nillable = false`, then *JsonbProperty* annotation overrides *JsonbNillable* annotation.

### 4.3.1 javax.json.bind.annotation.JsonbNillable

To customize the result of serializing field (or JavaBean property) with null value, JSON Binding provides *javax.json.bind.annotation.JsonbNillable* and *javax.json.bind.annotation.JsonbProperty* annotations.

When given object (type or package) is annotated with *javax.json.bind.annotation.JsonbNillable* annotation, the result of null value will be presence of associated property in JSON document with explicit null value.

The same behavior as *JsonbNillable*, but only at field, parameter and method (JavaBean property) level is provided by *javax.json.bind.annotation.JsonbProperty* annotation with its *nillable* parameter.

JSON Binding implementations MUST implement override of annotations according to target of the annotation (FIELD, PARAMETER, METHOD, TYPE, PACKAGE). Type level annotation overrides behavior set at the package level. Method, parameter or field level annotation overrides behavior set at the type level.

### 4.3.2 Global null handling configuration

Null handling behavior can be customized via *javax.json.bind.JsonbConfig::withNullValues* method.

The way to enforce serialization of null values, is to call method *javax.json.bind.JsonbConfig::withNullValues* with parameter `true`.

The way to skip serialization of null values is to call method *javax.json.bind.JsonbConfig::withNullValues* with parameter `false`.

## 4.4 I-JSON support

I-JSON (short for "Internet JSON") is a restricted profile of JSON designed to maximize interoperability and increase confidence that software can process it successfully with predictable results. The profile is defined in [1].

JSON Binding provides full support for I-JSON standard. Without any configuration, JSON Binding produces JSON documents which are compliant with I-JSON with three exceptions.

- JSON Binding does not restrict the serialization of top-level JSON texts that are neither objects nor arrays. The restriction should happen at application level.
- JSON Binding does not serialize binary data with base64url encoding.
- JSON Binding does not enforce additional restrictions on dates/times/duration.

These exceptions refer only to recommended areas of I-JSON.

To enforce strict compliance of serialized JSON documents, JSON Binding implementations MUST implement configuration option "jsonb.i-json.strict-ser-compliance".

The way to enable strict compliance of serialized JSON documents, is to call method

*JsonbConfig::withStrictJSONSerializationCompliance* with parameter *true*.

#### 4.4.1 Strict date serialization

Uppercase rather than lowercase letters MUST be used.

The time zone MUST always be included and optional trailing seconds MUST be included even when their value is "00".

JSON Binding implementations MUST serialize *java.util.Date*, *java.util.Calendar*, *java.util.GregorianCalendar*, *java.time.LocalDate*, *java.time.LocalDateTime* and *java.time.Instant* in the same format as *java.time.ZonedDateTime*.

The result of serialization of duration must conform to the "duration" production in Appendix A of RFC 3339, with the same additional restrictions.

### 4.5 Custom instantiation

In many scenarios instantiation with the use of default constructor is not enough. To support these scenarios, JSON Binding provides *javax.json.bind.annotation.JsonbCreator* annotation.

At most one *JsonbCreator* annotation can be used to annotate custom constructor or static void factory method in a class, otherwise *JsonbException* MUST be thrown.

Factory method annotated with *JsonbCreator* annotation should return instance of particular class this annotation is used for, otherwise *JsonbException* MUST be thrown.

Parameters of constructor/factory method annotated with *JsonbCreator* will be mapped from JSON fields with the same name. The name of a parameter can be changed annotating given parameter with *JsonbProperty* annotation. When a JSON field is not mappable to a parameter with the same name, *JsonbException* MUST be thrown.

### 4.6 Custom visibility

To customize scope and field access strategy as specified in section 3.7.1, it is possible to specify *javax.json.bind.annotation.JsonbVisibility* annotation or to override default behavior globally calling *JsonbConfig::withPropertyVisibilityStrategy* method with given custom property visibility strategy.

### 4.7 Custom mapping

Some Java types do not map naturally to a JSON representation and annotations cannot be used to customize mapping. An example can be some third party classes or classes without no-arg constructor. To customize mapping in this case JSON Binding has two mechanisms: Adapters and Serializers.

### 4.7.1 Adapters

Adapter is a class implementing *javax.json.bind.adapter.JsonbAdapter* interface. It has a custom code to convert the “unmappable” type (Original) into another one that JSONB can handle (Adapted).

On serialization of Original type JSONB calls *JsonbAdapter::adaptToJson* method of the adapter to convert Original to Adapted and serializes Adapted the standard way.

On deserialization JSONB deserializes Adapted from JSON and converts it to Original using *JsonbAdapter::adaptFromJson* method.

There are two ways how to register *JsonbAdapter*:

1. Using *JsonbConfig::withAdapters* method;
2. Annotating a class field with *JsonbTypeAdapter* annotation.

*JsonbAdapter* registered via *JsonbConfig::withAdapters* is visible to all serialize/deserialize operations performed with given *JsonbConfig*. *JsonbAdapter* registered with annotation is visible to serialize/deserialize operation used only for annotated field.

### 4.7.2 Serializers/Deserializers

Sometimes adapters mechanism is not enough and low level access to JSONP parser/generator is needed.

Serializer is a class implementing *javax.json.bind.serializers.JsonbSerializer* interface. It is used to serialize the type it's registered on (Original). On marshalling of Original type JSONB calls *JsonbSerializer::serialize* method. This method has to contain a custom code to serialize Original type using provided *JsonpGenerator*.

Deserializer is a class implementing *javax.json.bind.serializers.JsonbDeserializer* interface. It is used to deserialize the type it's registered on (Original). On deserialization of Original type JSONB calls *JsonbDeserializer::deserialize* method. This method has to contain a custom code to deserialize Original type using provided *JsonpParser*.

There are two ways how to register *JsonbSerializer/JsonbDeserializer*:

1. Using *JsonbConfig::withSerializers/JsonbConfig::withDeserializers* method;
2. Annotating a type with *JsonbSerializer/JsonbDeserializer* annotation.

## 4.8 Custom date format

To specify custom date format, it is necessary to annotate given annotation target with *javax.json.bind.annotation.JsonbDateFormat* annotation. *JsonbDateFormat* annotation can be applied to the following targets:

- field
- method
- type
- parameter
- package

Default date format and default locale can be customized globally using *javax.json.bind.JsonbConfig::withDateFormat* and *javax.json.bind.JsonbConfig::withLocale* methods.

Annotation applied to more specific target overrides the same annotation applied to target with wider scope and global configuration. For example, annotation applied to type target will override the same annotation applied to package target.

## 4.9 Custom number format

To specify custom number format, it is necessary to annotate given annotation target with *javax.json.bind.annotation.JsonbNumberFormat* annotation. *JsonbNumberFormat* annotation can be applied to the following targets:

- field
- method
- type
- parameter
- package

Annotation applied to more specific target overrides the same annotation applied to target with wider scope. For example, annotation applied to type target will override the same annotation applied to package target.

## 4.10 Custom binary data handling

To customize encoding of binary data, JSON Binding provides *javax.json.bind.config.BinaryDataStrategy* class.

Class *javax.json.bind.config.BinaryDataStrategy* provides the most common binary data encodings.

- BYTE
- BASE\_64
- BASE\_64\_URL

The detailed description of binary encoding strategies can be found in javadoc.

The way to set custom binary data handling strategy is to use *javax.json.bind.JsonbConfig::withBinaryDataStrategy* method.

## 5 Appendix

### 5.1 Change Log

#### 5.1.1 Changes Since 1.0 Early Draft

- Section 3.7: Clarified that default constructor is not needed in case of *JsonbCreator*.
- Chapters 3 and 4: Synchronized vocabulary to serialization and deserialization.
- Section 3.9: Conversion method changed from *toString()* to *name()*.
- Section 3.4.3: Changed serialization rules of object properties with *Optional* type and *null* value.
- Section 3.14.1: Added an exception for *Optional* fields.
- Section 4.1.1: *JsonbTransient* annotation made allowed only on fields.
- Section 3.6: Removed 'smallest possible type' rule for number types. JSON number type is always mapped to *BigDecimal* in case target type is not specified.
- Removed 'Simple Value' customization (*@JsonbValue*). Adapters should be used instead.
- Adapters section (4.7.1) changed.
- Serializers/Deserializers section (4.7.2) added.

## 6 Bibliography

- [1] E. T. Bray, «The JavaScript Object Notation (JSON) Data Interchange Format,» 2014.
- [2] R. Fielding, «Architectural Styles and the Design of Network-based Software Architectures,» 2000.
- [3] «REST Wiki».
- [4] «JSON,» [В Интернете]. Available: <http://en.wikipedia.org/wiki/JSON>.
- [5] S. Bradner, «Key words for use in RFCs to Indicate Requirement Levels,» 1997.
- [6] D. Crockford, «The application/json Media Type for JavaScript Object Notation (JSON),» 2006.
- [7] K. Kawaguchi, «The Java Architecture for XML Binding (JAXB),» 2009.
- [8] T. Bray, «The I-JSON Message Format,» 2015.
- [9] K.-M. Chung, «Java API for JSON Processing,» 2015.