JSONB introduction and comparison with other frameworks

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Program Agenda

1. What is JSON-B
2. What is in the spec
3. Default mapping
4. Customized mapping
5. Q&A

What is JSON Binding?

- JSON Binding is a standard
- It’s about converting Java objects to and from JSON documents
- JSON Binding = JSON-B = JSONB = JSR 367

What is JSON Binding?

Java

```
public class Customer {
    public int id;
    public String firstName;
    public String lastName;
   ....
}
```

```
Customer e = new Customer();
e.id = 1;
e.firstName = “John”;
e.lastName = “Doe”;
```

JSON

```
{
   "id": 1,
   "firstName" : "John",
   "lastName" : "Doe",
}
```

What is JSON Binding?

Java

```
public class Customer {
    public int id;
    public String firstName;
    public String lastName;
   ....
}
```

```
Customer e = new Customer();
e.id = 1;
e.firstName = “John”;
e.lastName = “Doe”;
```

JSON-B

JSON

```
{
   "id": 1,
   "firstName" : "John",
   "lastName" : "Doe",
}
```

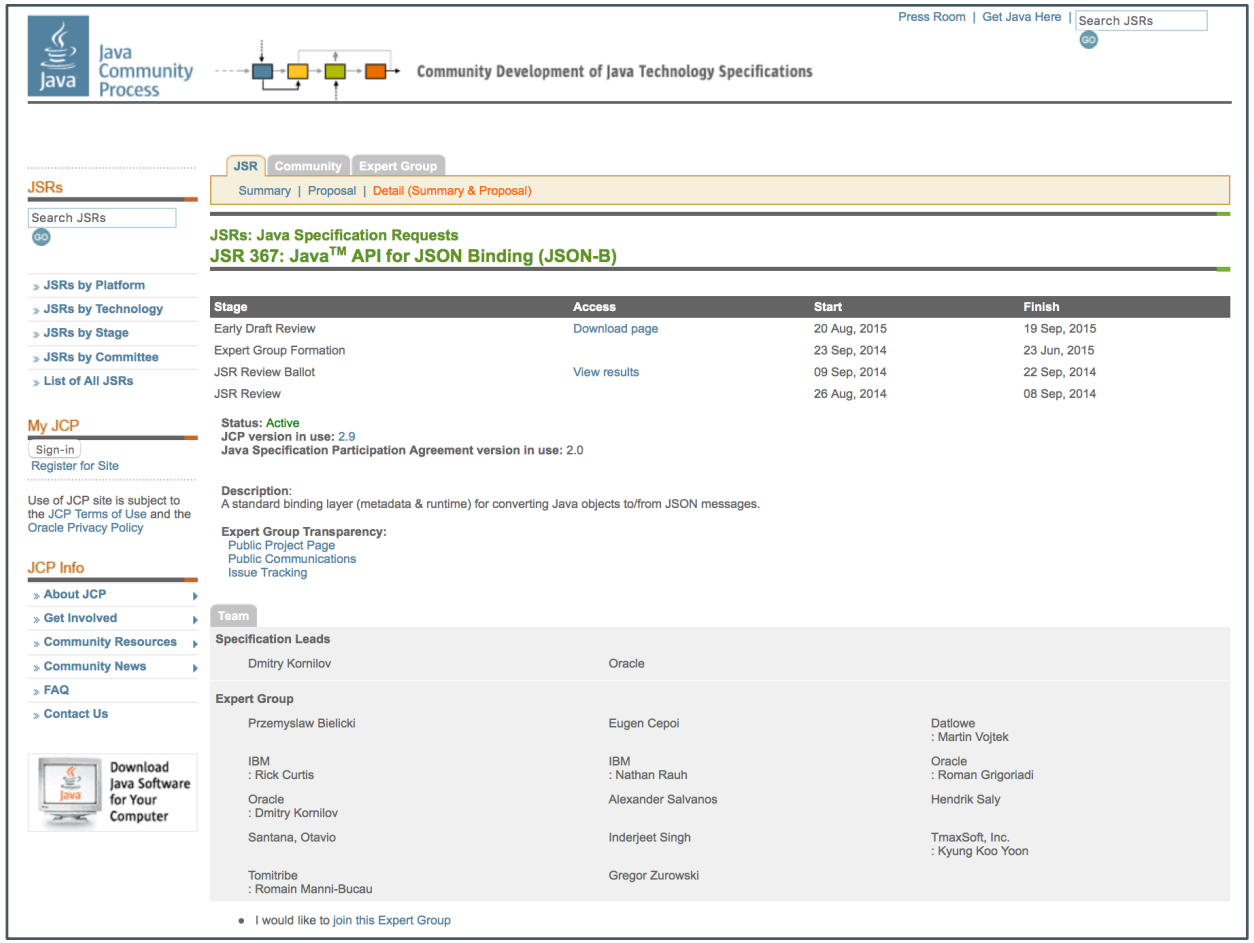
Alternatives

- Genson
- Gson
- Jackson
- …

JSON-B Specification

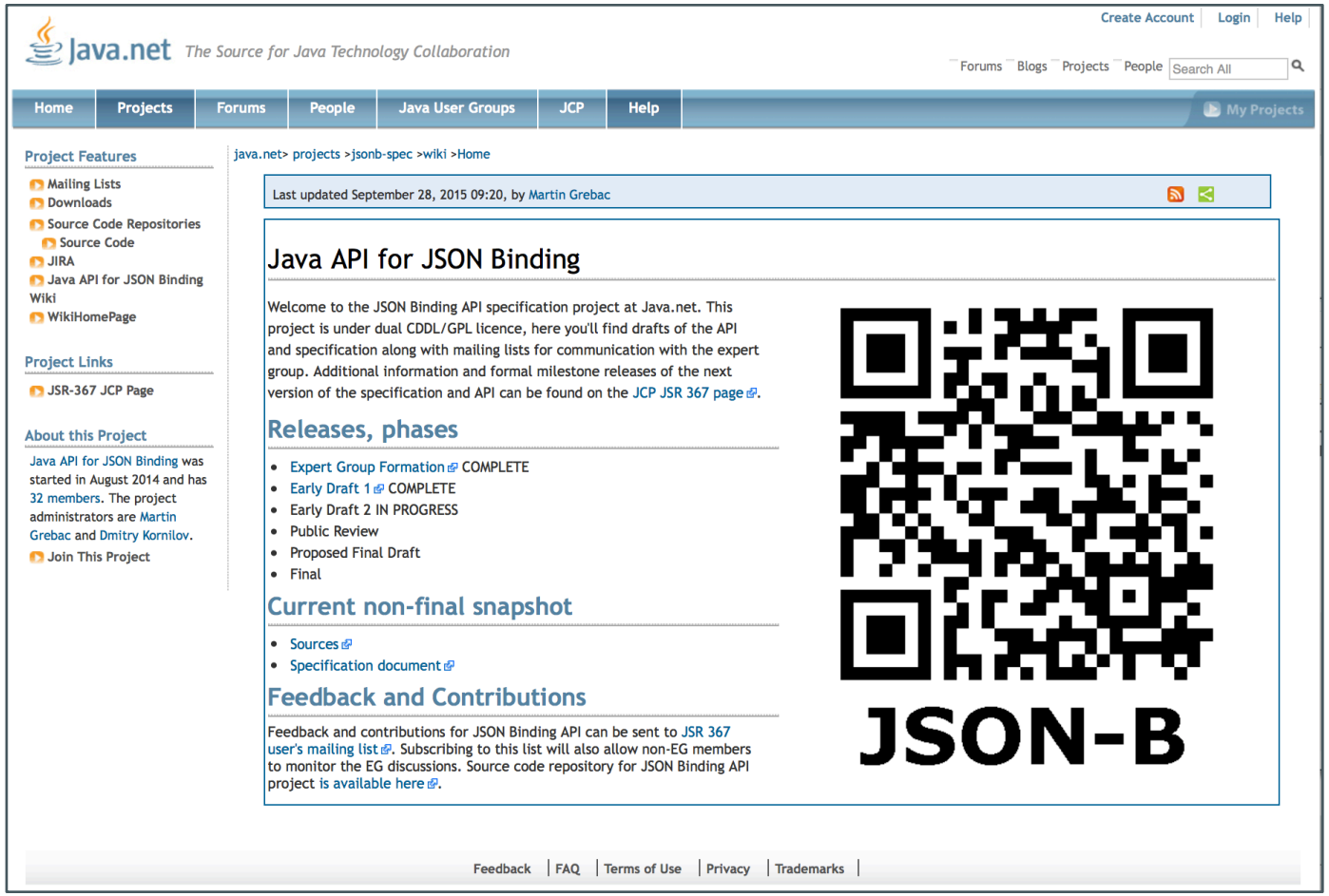
Java Community Process

- JSR-367
- JSR status and updates
- Expert group



Specification and API Project

- Hosted on java.net
- Spec in pdf format
- Git repository
- Wiki
- Bug tracker
- Mailing lists

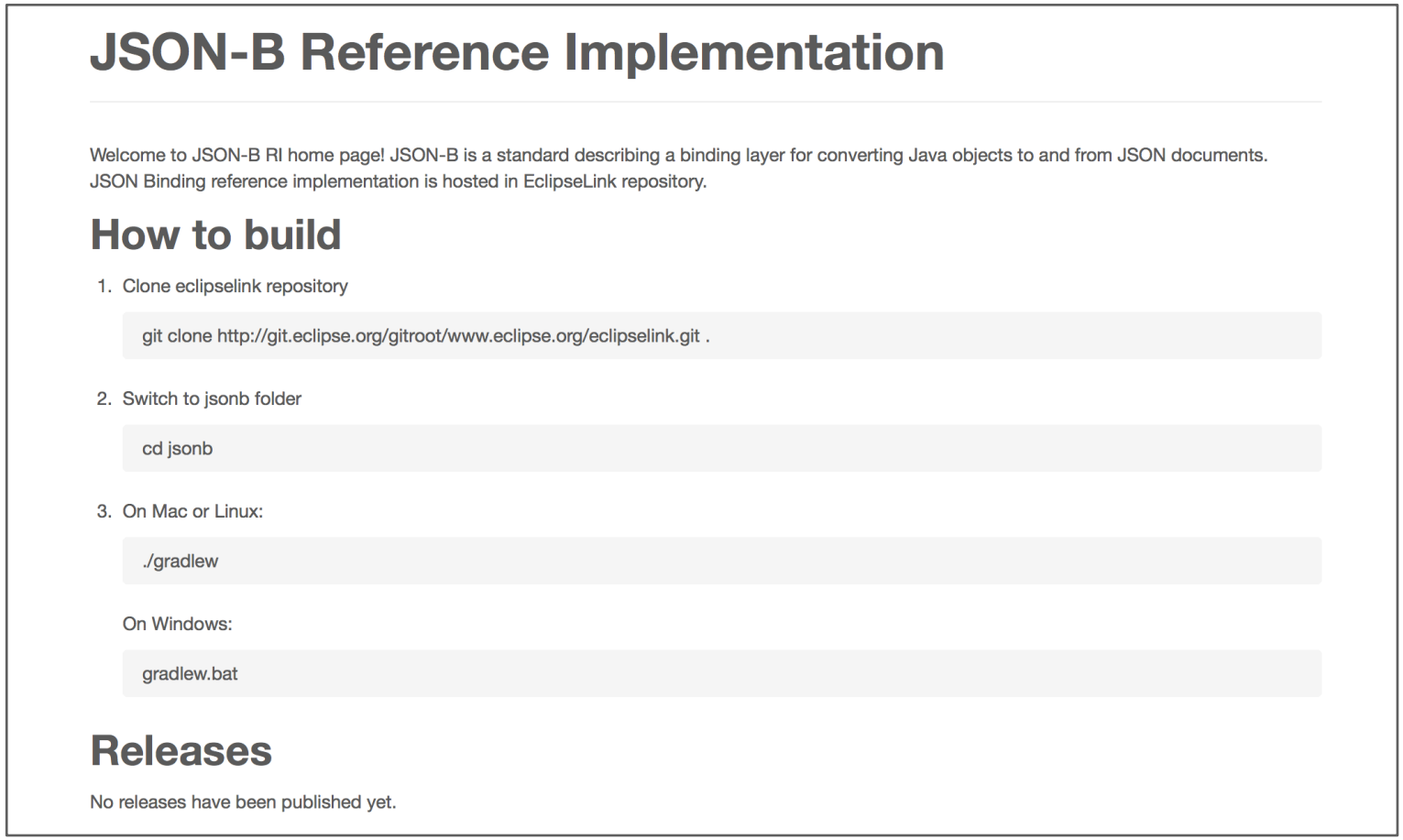


Participate!

users@jsonb-spec.java.net

Reference Implementation

- eclipselink.org/jsonb
- Mirror on GitHub



JSON-B Reference Implementation

Welcome to JSON-B RI home page! JSON-B is a standard describing a binding layer for converting Java objects to and from JSON documents. JSON Binding reference implementation is hosted in EclipseLink repository.

How to build

1. Clone eclipselink repository

```
git clone http://git.eclipse.org/gitroot/www.eclipse.org/eclipselink.git .
```

2. Switch to jsonb folder

```
cd jsonb
```

3. On Mac or Linux:

```
./gradlew
```

On Windows:

```
gradlew.bat
```

Releases

No releases have been published yet.

Summary

- JCP Page
  https://www.jcp.org/en/jsr/detail?id=367
- Specification Project Home:
  https://java.net/projects/jsonb-spec
- API sources & samples:
  https://java.net/projects/jsonb-spec/sources/git/show/api
- Specification in pdf:
  https://java.net/projects/jsonb-spec/sources/git/content/spec/spec.pdf
- Reference implementation:
  http://eclipselink.org/jsonb

JSON-B Default Mapping

Default Mapping

- No configuration, no annotations
- The scope:
  - Basic Types
  - Specific JDK Types
  - Dates
  - Classes
  - Collections/Arrays
  - Enumerations
  - JSON-P

```
import javax.json.bind.Jsonb;
import javax.json.bind.JsonbBuilder;

// Create with default config
Jsonb jsonb = JsonbBuilder.create();
```

JSON-B Engine

- toJson(…)
- fromJson(…)

```
String toJson(Object object);
String toJson(Object object, Type runtimeType);
void toJson(Object object, Writer writer);
void toJson(Object object, Type runtimeType, Writer appendable);
void toJson(Object object, OutputStream stream);
void toJson(Object object, Type runtimeType, OutputStream stream);


<T> T fromJson(String str, Class<T> type);
<T> T fromJson(String str, Type runtimeType);
<T> T fromJson(Reader readable, Class<T> type);
<T> T fromJson(Reader readable, Type runtimeType);
<T> T fromJson(InputStream stream, Class<T> type);
<T> T fromJson(InputStream stream, Type runtimeType);
```

Default Mapping – Basic Types

- java.lang.String
- java.lang.Character
- java.lang.Byte (byte)
- java.lang.Short (short)
- java.lang.Integer (int)
- java.lang.Long (long)
- java.lang.Float (float)
- java.lang.Double (double)
- java.lang.Boolean (boolean)

Default Mapping – Basic Types

- java.lang.String
- java.lang.Character
- java.lang.Byte (byte)
- java.lang.Short (short)
- java.lang.Integer (int)
- java.lang.Long (long)
- java.lang.Float (float)
- java.lang.Double (double)
- java.lang.Boolean (boolean)

Serialization:
toString()

Deserialization:
parseXXX()

Default Mapping – Basic Types

• java.lang.String	**“string”**	**“string”**
• java.lang.Character	**’\u0041’**	**“A”**
• java.lang.Byte (byte)	(**byte**) 1	1
• java.lang.Short (short)	(**short**) 1	1
• java.lang.Integer (int)	(**int**) 1	1
• java.lang.Long (long)	1L	1
• java.lang.Float (float)	1.2f	1.2
• java.lang.Double (double)	1.2	1.2
• java.lang.Boolean (boolean)	**true**	**true**

Default Mapping – Specific Types

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

Default Mapping – Specific Types

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

Serialization:
toString()

Deserialization:
Single argument constructor

Default Mapping – Specific Types

- java.math.BigInteger
- java.math.BigDecimal
- java.net.URL
- java.net.URI

Serialization:
toString()

Deserialization:
Single argument constructor

- java.util.Optional
- java.util.OptionalInt
- java.util.OptionalLong
- java.util.OptionalDouble

- Represented by its value if not empty
- Considered null if empty

Optional Types

```
OptionalInt.of(1)
```

JSON-B	1
Genson	{"asInt": 1, "present": true}
Gson	{"value": 1, "present": true}
Jackson	1

```
OptionalInt.empty()
```

JSON-B	null
Genson	–
Gson	{"value": 0, "present": false}
Jackson	null

Default Mapping – Dates

java.util.Date	ISO_DATE_TIME
java.util.Calendar, java.util.GregorianCalendar	ISO_DATE if to time information present, otherwise ISO_DATE_TIME
Java.util.TimeZone, java.util.SimpleTimeZone	NormalizedCustomId (see TimeZone javadoc)
java.time.Instant	ISO_INSTANT
java.time.LocalDate	ISO_LOCAL_DATE
java.time.LocalTime	ISO_LOCAL_TIME
java.time.LocalDateTime	ISO_LOCAL_DATE_TIME
java.time.ZonedDateTime	ISO_ZONED_DATE_TIME
java.time.OffsetDateTime	ISO_OFFSET_DATE_TIME
java.time.OffsetTime	ISO_OFFSET_TIME
java.time.ZoneId	NormalizedZoneId as specified in ZoneId javadoc
java.time.ZoneOffset	NormalizedZoneId as specified in ZoneOffset javadoc
java.time.Duration	ISO 8601 seconds based representation
java.time.Period	ISO 8601 period representation

Default Mapping – Date Sample

```
SimpleDateFormat sdf =
  new SimpleDateFormat("dd.MM.yyyy");
Date date = sdf.parse("08.03.2016");
```

JSON-B	“2016-03-08T00:00:00”
Genson	1457391600000
Gson	"Mar 8, 2016 12:00:00 AM”
Jackson	1457391600000

Default Mapping – Calendar Sample

```
Calendar cal = Calendar.getInstance();
cal.clear();
cal.set(2016, 3, 8);
```

JSON-B	“2016-03-08”
Genson	1457391600000
Gson	{"year":2016, "month":3, "dayOfMonth":8, "hourOfDay":0, "minute":0, "second": 0}
Jackson	1457391600000

Default Mapping – Classes

- Public and protected **nested** and **static nested** classes
- **Anonymous** classes (serialization only)
- Inheritance is supported
- Default no-argument constructor is required for deserialization

Default Mapping – Fields

- **Final** fields are serialized
- **Static** fields are skipped
- **Transient** fields are skipped
- **Null** fields are skipped
- **Lexicographical** order
- Parent class fields are serialized before child class fields

Fields Order Comparison

```
class Parent {
    public int parentB = 2;
    public int parentA = 1;
}

class Child extends Parent {
    public int childB = 4;
    public int childA = 3;
}
```

JSON-B	{"parentA":1,"parentB":2, "childA":3, "childB":4}
Genson	{"childA":3, "childB":4, "parentA":1,"parentB":2}
Gson	{"childB":4, "childA":3, "parentB":2,"parentA":1}
Jackson	{"parentB":2,"parentA":1, "childB":4, "childA":3}

Default Mapping – Scope and Field Access Strategy

Serialization

- Existing fields with public getters
- Public fields with no getters
- Public getter/setter pair without a corresponding field

Deserialization

- Existing fields with public setters
- Public fields with no setters
- Public getter/setter pair without a corresponding field

Scope and Field Access Strategy – JSON-B

```
public class Foo {
    public final int publicFinalField;
    private final int privateFinalField;

    public static int publicStaticField;

    public int publicWithNoGetter;
    public int publicWithPrivateGetter;
    public Integer publicNullField = null;

    private int privateWithNoGetter;
    private int privateWithPublicGetter;

    public int getNoField() {};
    public void setNoField(int value) {};
}
```

```
{
  "publicFinalField": 1,

  "publicWithNoGetter": 1,

  "privateWithPublicGetter": 1,

  "noField": 1
}
```

Scope and Field Access Strategy – Genson

```java
public class Foo {
    public final int publicFinalField;
    private final int privateFinalField;

    public static int publicStaticField;

    public int publicWithNoGetter;
    public int publicWithPrivateGetter;
    public Integer publicNullField = null;

    private int privateWithNoGetter;
    private int privateWithPublicGetter;

    public int getNoField() {};
    public void setNoField(int value) {};
}
```

```json
{
  "publicFinalField": 1,

  "publicWithNoGetter": 1,
  "publicWithPrivateGetter": 1,
  "publicNullField": null,

  "privateWithPublicGetter": 1,

  "noField": 1
}
```

Scope and Field Access Strategy – Gson

```
public class Foo {
    public final int publicFinalField;
    private final int privateFinalField;

    public static int publicStaticField;

    public int publicWithNoGetter;
    public int publicWithPrivateGetter;
    public Integer publicNullField = null;

    private int privateWithNoGetter;
    private int privateWithPublicGetter;

    public int getNoField() {};
    public void setNoField(int value) {};
}
```

```
{
  "publicFinalField": 1,
  "privateFinalField": 1,

  "publicWithNoGetter": 1,
  "publicWithPrivateGetter": 1,

  "privateWithNoGetter": 1,
  "privateWithPublicGetter": 1,
}
```

Scope and Field Access Strategy – Jackson

```
public class Foo {
    public final int publicFinalField;
    private final int privateFinalField;

    public static int publicStaticField;

    public int publicWithNoGetter;
    public int publicWithPrivateGetter;
    public Integer publicNullField = null;

    private int privateWithNoGetter;
    private int privateWithPublicGetter;

    public int getNoField() {};
    public void setNoField(int value) {};
}
```

```
{
  "publicFinalField": 1,

  "publicWithNoGetter": 1,
  "publicWithPrivateGetter": 1,
  "publicNullField": null,

  "privateWithPublicGetter": 1,

  "noField": 1
}
```

Scope and Field Access Strategy – Summary

Framework	Respects getters/setters	Strict getter/setter	Private fields	Virtual fields
JSON-B	Yes	Yes	No	Yes
Genson	Yes	No	No	Yes
Gson	No	No	Yes	No
Jackson	Yes	No	No	Yes

Arrays/Collections

- Collection
- Map
- Set
- HashSet
- NavigableSet
- SortedSet
- TreeSet
- LinkedHashSet
- TreeHashSet
- HashMap
- NavigableMap
- SortedMap
- TreeMap
- LinkedHashMap
- TreeHashMap
- List
- ArrayList
- LinkedList
- Deque
- ArrayDeque
- Queue
- PriorityQueue
- EnumSet
- EnumMap

```
// Array
int[] intArray = {1, 2, 3};

jsonb.toJson(intArray);       // [1,2,3]

// Collection
Collection<Object> list = new ArrayList<>();
list.add(1);
list.add(2);
list.add(null);

jsonb.toJson(list);           // [1,2,null]

// Map
Map<String, Object> map = new LinkedHashMap<>();
map.put("first", 1);
map.put("second", 2);

jsonb.toJson(map);            // {"first":1,"second":2}
```

JSON-P Types

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

JSON-P Types

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

Serialization:
javax.json.JsonWriter

Deserialization:
javax.json.JsonReader

JSON-P Sample

```
JsonBuilderFactory f =
    Json.createBuilderFactory(null);

JsonObject jsonObject = f.createObjectBuilder()
        .add("name", "Jason")
        .add("city", "Prague")
        .build();
```

```
{
   "name": "Jason",
   "city": "Prague"
}
```

JSON-P Types Support in Other Frameworks

- Genson:
  - Support added in JSR353Bundle
- Gson
  - No JSON-P support
- Jackson
  - Support added in JSR353Module

Customized Mapping

JSON-B Engine Configuration

- Annotations
- Runtime configuration
  - JsonbConfig
  - JsonbBuilder

```
JsonbConfig config = new JsonbConfig()
    .withFormatting(…)
    .withNullValues(…)
    .withEncoding(…)
    .withStrictIJSON(…)
    .withPropertyNamingStrategy(…)
    .withPropertyOrderStrategy(…)
    .withPropertyVisibilityStrategy(…)
    .withAdapters(…)
    .withBinaryDataStrategy(…);

Jsonb jsonb = JsonbBuilder.newBuilder()
        .withConfig(…)
        .withProvider(…)
        .build();
```

Customizations

- Property names
- Property order
- Ignoring properties
- Null handling
- Custom instantiation
- Fields visibility
- Adapters
- Date/Number Formats
- Binary Encoding

Property Name Customization

- JSON-B:
  - @JsonbProperty (Field, Method)
- Genson:
  - @JsonProperty (Field, Method)
  - Use GensonBuilder().rename() method
- Gson:
  - @SerializedName (Field)
- Jackson:
  - @JsonProperty (Field, Method)

Custom Mapping - Property Names

```
public class Customer {
    public int id;
    public String firstName;
}
```

```
{
  "id": 1,
  "firstName": "Jason"
}
```

Custom Mapping - Property Names

```
public class Customer {
    private int id;

    @JsonbProperty("name")
    private String firstName;
}
```

```
public class Customer {
    public int id;
    public String firstName;

    @JsonbProperty("name")
    public String getFirstName() {
        return firstName;
    }
}
```

```
{
  "id": 1,
  "name": "Jason"
}
```

Custom Mapping - Property Names

```
public class Customer {
    public int id;
    public String firstName;

    @JsonbProperty(“getter-name")
    String getFirstName() {
        return firstName;
    }

    @JsonbProperty(“setter-name")
    void setFirstName(String str) {
        this.firstName = str;
    }
}
```

Serialization:

```
{
  "id": 1,
  “getter-name": "Jason"
}
```

Deserialization:

```
{
  "id": 1,
  “setter-name": "Jason"
}
```

Property Naming Strategy

- Supported naming strategies
  - IDENTITY (myMixedCaseProperty)
  - LOWER_CASE_WITH_DASHES (my-mixed-case-property)
  - LOWER_CASE_WITH_UNDERSCORES (my_mixed_case_property)
  - UPPER_CAMEL_CASE (MyMixedCaseProperty)
  - UPPER_CAMEL_CASE_WITH_SPACES (My Mixed Case Property)
  - CASE_INSENSITIVE (mYmIxEdCaSePrOpErTy)
  - Or a custom implementation
- JsonbConfig().withPropertyNamingStrategy(…):

Property Naming Strategy

- Genson
  - `GensonBuilder.with(PropertyNameResolver… resolvers)`
- Gson:
  - `GsonBuilder.setFieldNamingPolicy(FieldNamingPolicy policy)`
- Jackson
  - `ObjectMapper.setPropertyNamingStrategy(PropertyNamingStrategy pns)`

Property Order Strategy

- Strategies:
  - LEXICOGRAPHICAL (A-Z)
  - ANY
  - REVERSE (Z-A)
- Compile Time:
  - @JsonbPropertyOrder on class
- Runtime:
  - withPropertyOrderStrategy(…)

```
@JsonbPropertyOrder(ANY)
public class Foo {
    public int bar2;
    public int bar1;
}
```

Ignoring Properties and Visibility Customization

- Compile Time:
  - Transient modifier
  - @JsonbTransient annotation
  - PropertyVisibilityStrategy interface
  - @JsonbVisibility annotation
- Runtime:
  - withPropertyVisibilityStrategy(…)

```
public class Foo {
    public transient int skipped;

    @JsonbTransient
    public int alsoSkipped;
}

@JsonbVisibility(MyStrategy.class)
public class Bar {
    private int field1;
    private int field2;
}
```

Ignoring Properties in Other Frameworks

- Genson
  - @JsonIgnore annotation
  - Include(…) and exclude(…) methods in GensonBuilder class
- Gson:
  - @Exposed annotation
  - ExclusionStrategy interface
- Jackson
  - @JsonIgnore annotation on field
  - @JsonIgnoreProperties annotation on class
  - Filters and mix-ins

Null Handling

- Null fields are skipped by default
- Compile Time:
  - @JsonbNillable annotation
- Runtime:
  - JsonbConfig().withNullValues(true)

```
public class Customer {
    public int id = 1;

    @JsonbNillable
    public String name = null;
}
```

Null Handling in Other Frameworks

Framework	Serializes nulls by default	Null Handling
JSON-B	No	@JsonbNillable
Genson	Yes	GensonBuilder.setSkipNull(true)
Gson	No	GsonBuilder.serializeNulls()
Jackson	Yes	@JsonInclude(JsonInclude.Include.NON_NULL) ObjectMapper.setSerializationInclusion(JsonInclude.Include.*NON_NULL*);

Custom Instantiation

```
public class Customer {
    public int id;
    public String name;

    @JsonbCreator
    public static Customer getFromDb(int id) {
        return CustomerDao.getByPrimaryKey(id);
    }
}

public class Order {
    public int id;
    public Customer customer;
}
```

```
{
  "id": 1,
  "customer": {
    "id": 2  }
}
```

Adapters

- JAXB inspired JsonbAdapter interface
- @JsonbTypeAdapter annotation
- JsonbConfig().withAdapters(JsonbAdapter… adapters);

Adapters Sample

```
public class Car {
    public Integer distance; // In Miles
}
```

Adapters Sample

```
public class Car {
    public Integer distance; // In Miles
}

public class AdaptedCar {
    public Integer distance; // In Kilometers
}
```

Adapters Sample

```
public class Car {
    public Integer distance; // In Miles
}

public class AdaptedCar {
    public Integer distance; // In Kilometers
}

public class CarAdapter implements JsonbAdapter<Car, AdaptedCar> {
    public AdaptedCar toJson(Car car) {
        AdaptedCar adaptedCar = new AdaptedCar();
        adaptedCar.distance = car.distance * 1,60934;
        return adaptedCar;
    }

    public Car fromJson(AdaptedCar adaptedCar) {
        Car car = new Car();
        car.distance = adaptedCar.distance / 1,60934;
        return car;
    }
}
```

Adapters Sample

```
JsonbConfig config = new JsonbConfig()
    .withAdapters(new CarAdapter());
Jsonb jsonb = JsonbBuilder.create(config);

Car car = new Car();
car.distance = 100; // miles

String json = jsonb.toJson(car);
```

```
{
  "distance": 160
}
```

Adapters in Other Frameworks

- Genson
  - Converter interface
  - JAXB adapters support with JAXBBundle
- Gson:
  - TypeAdapter interface
- Jackson
  - External serializers
  - Mix-In annotations

Date/Number Format

```
public class FormatTest {
    public Date defaultDate;

    @JsonbDateFormat("dd.MM.yyyy")
    public Date formattedDate;

    public BigDecimal defaultNumber;

    @JsonbNumberFormat(“#0.00")
    public BigDecimal formattedNumber;
}
```

```
{
  “defaultDate”: “2015-07-26T23:00:00",

  “formattedDate”: ”26.07.2015",

  “defaultNumber": 1.2,

  “formattedNumber": 1.20
}
```

Date/Number Formats in other Frameworks

- Genson
  - @JsonDateFormat annotation
  - GensonBuilder.setDateFormat(dateFormat)
- Gson:
  - GsonBuilder.setDateFormat
- Jackson
  - @JsonFormat annotation
  - objectMapper.setDateFormat(myDateFormat);

Binary Data Encoding

- BYTE (default)
- BASE_64
- BASE_64_URL

```
JsonbConfig config = new JsonbConfig()
   .withBinaryDataStrategy(BinaryDataStrategy.BASE_64);

Jsonb jsonb = JsonbBuilder.create(config);
String json = jsonb.toJson(obj);
```

I-JSON

- I-JSON (”Internet JSON”) is a restricted profile of JSON
  - https://tools.ietf.org/html/draft-ietf-json-i-json-06
- JSON-B fully supports I-JSON by default 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.
- Configuration: withStrictIJSONSerializationCompliance

Special Thanks

- Roman Grigoriadi and David Kral from JSON-B team
- All members of JSON-B experts group
- others on users@jsonb-spec.java.net

Q&A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