**Kafka Cluster**: Kafka is a distributed system, it acts as agent it consist of set of Broker / software, for production cluster must have 3 Broker.



**Producer**: Produce messages any in format. (JSON, XML, Text etc.) And send to Kafka cluster.

**Consumer**: Consume messages from Kafka broker.

**Kafka Broker**: it’s a Kafka server or s/w, the producer and Consumer don’t interact directly, they use Kafka broker / agent to exchange messages.

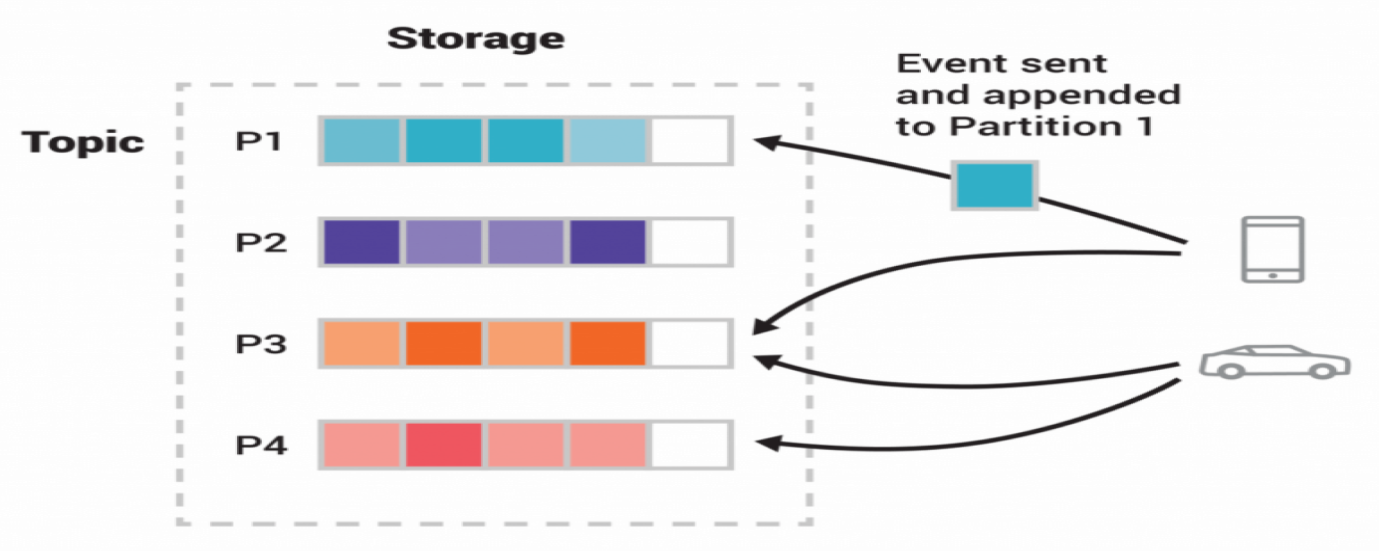
**Zookeeper**: Manages the state of the all Kafka broker in the Kafka cluster. It also maintains the configuration of all topics of producer and consumer.

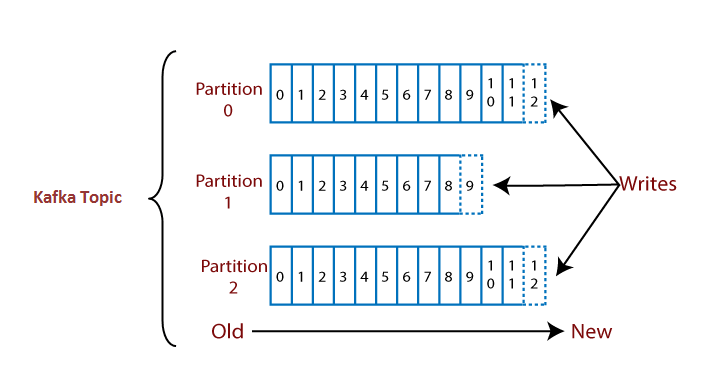
**Fault Tolerance**: If any broker gets down then automatically another broker handles the traffic as data is duplicated across the Kafka brokers in the cluster.

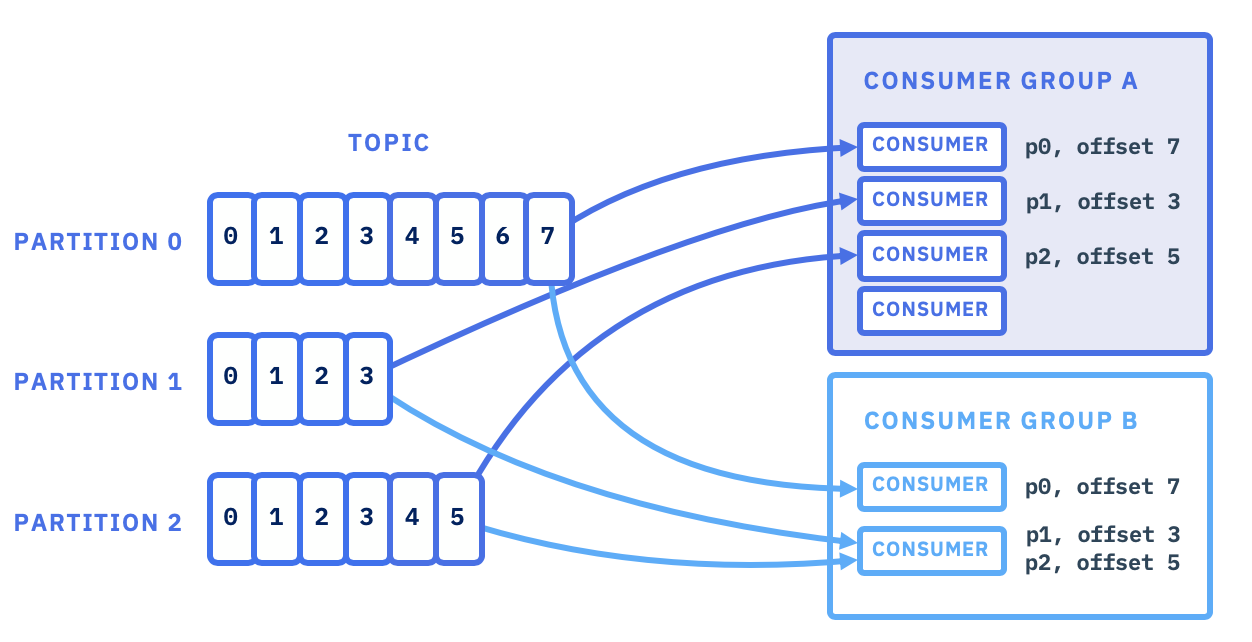
**Reference**: <https://kafka.apache.org/documentation/>

**Kafka Topic**: Is like Table in database or folder in file system, and is identified by name we can have any number of Topics in Kafka broker. Consumer subscribes the topic.

**Kafka Partition**: Topic has multiple partitions.



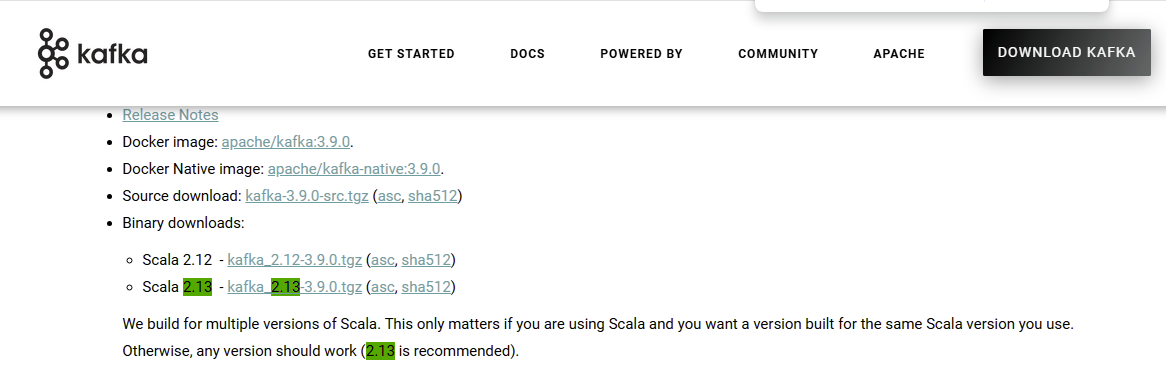
**Offset**: Is a sequence of Ids given to the messages at arrive position. Once the offset is assigned it will never changes.

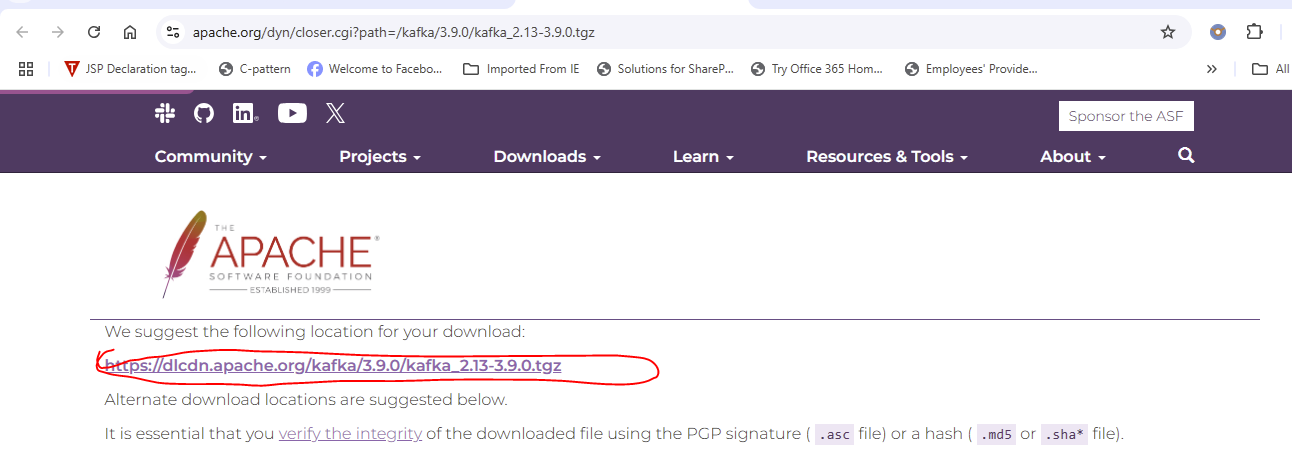
**Consumer Group**: A consumer group contains a one or more consumer’s working together to process the messages. 

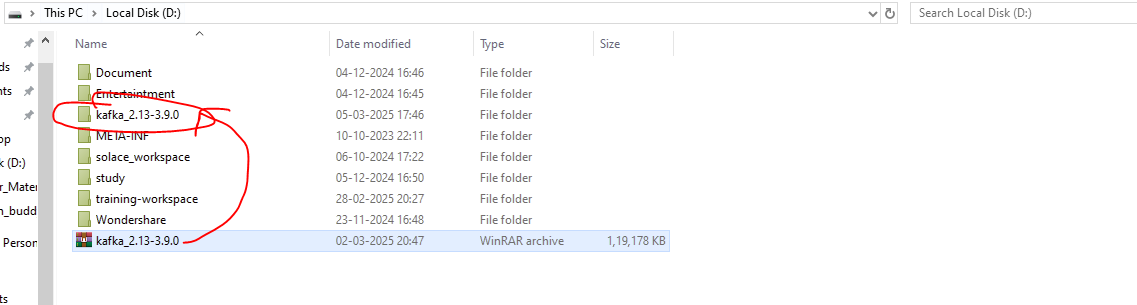
Can multiple consumers consume messages from same partition?

|  |
| --- |
| Within same group: **NO**  Two consumers (Consumer 1, 2) within the same group (Group 1) CAN NOT consume the same message from partition (Partition 0).  Across different groups: **YES**  Two consumers in two groups (Consumer 1 from Group 1, Consumer 1 from Group2) CAN consume the same message from partition (Partition 0). |

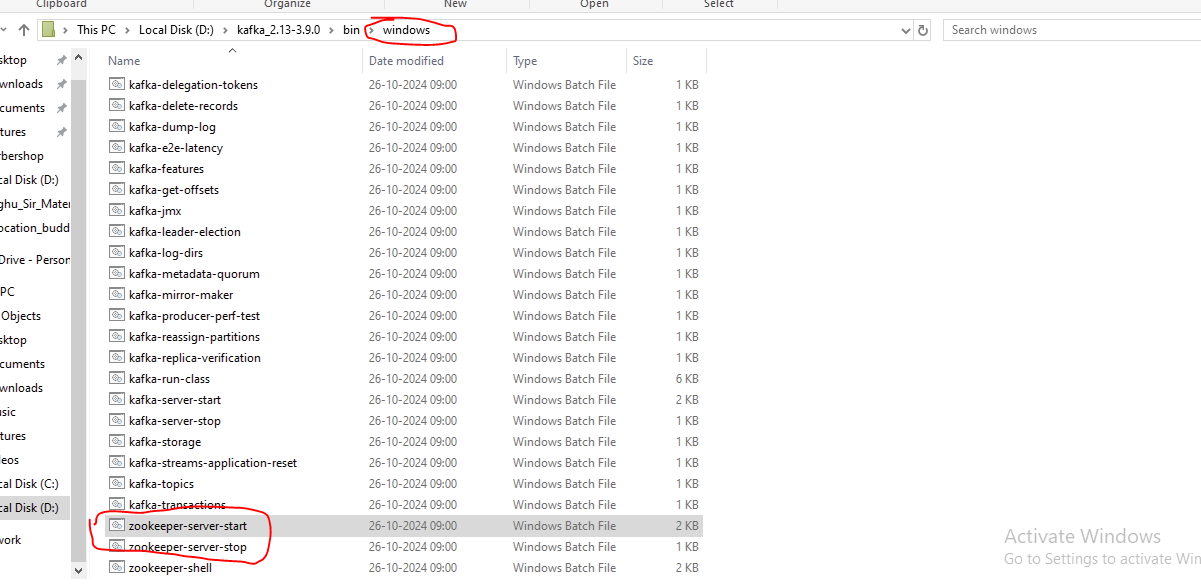
**How to install Kafka**: <https://kafka.apache.org/downloads>

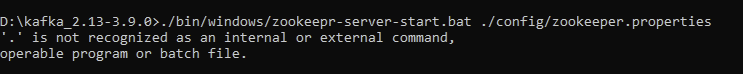




Extract Here

You will get multiple windows batch file as utility D:\kafka\_2.13-3.9.0\bin\windows

**Start Zookeeper:**

.\bin\windows\zookeeper-server-start.bat .\config\zookeeper.properties

**Check status if Zookeeper started**

.\bin\windows\zookeeper-shell.bat status or find log binding to port 0.0.0.0/0.0.0.0:2181

**Start Kafka broker**:

.\bin\windows\kafka-server-start.bat .\config\server.properties**Create Topic**

.\bin\windows\kafka-topics.bat --create --topic **<topic-name>** --bootstrap-server localhost:9092 --partitions 1 --replication-factor 1

You can pass **multiple brokers**, separated by commas:

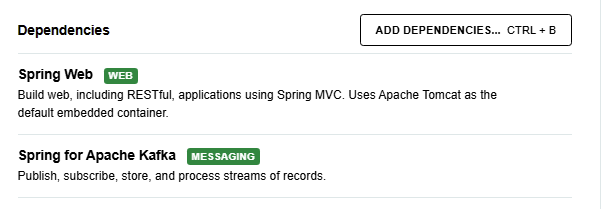
* --bootstrap-server broker1:9092,broker2:9092
* kafka clients (producers, consumers, etc.) do **not** communicate with Zookeeper — they only interact with Kafka broker

**List Topic**

.\bin\windows\kafka-topics.bat --list --bootstrap-server localhost:9092

**List messages from topic**

.\bin\windows\kafka-console-consumer.bat --bootstrap-server localhost:9092 --topic json\_topic --from-beginning

**Create Spring Application**

application.properties

|  |
| --- |
| spring.kafka.consumer.bootstrap-servers: localhost:9092 OR  ~~spring.kafka.consumer.bootstrap-servers: broker1:9092,broker2:9092,broker3:9092~~ spring.kafka.consumer.group-id: myGroup spring.kafka.consumer.auto-offset-reset:earliest #Deserilise Key into Message spring.kafka.consumer.key-deserializer: org.apache.kafka.common.serialization.StringDeserializer #Deserilise value into Message spring.kafka.consumer.value-deserializer: org.apache.kafka.common.serialization.StringDeserializer  spring.kafka.producer.bootstrap-servers: localhost:9092 spring.kafka.producer.key-serializer: org.apache.kafka.common.serialization.StringSerializer spring.kafka.producer.value-serializer: org.apache.kafka.common.serialization.StringSerializer |

When a producer sends a message to Kafka, it sends:

* A key (optional)
* A value (the message content)

Both are sent as byte arrays, Kafka doesn't know or care what your data is—it just stores and transports bytes.

To turn these bytes into something useful in your code (like a String, a JSON object, or a custom Java class), you need to **deserialize** them.

**Create Kafka Topic**

|  |
| --- |
| @Bean  public NewTopic rlbinTopic() {  return TopicBuilder.name("rlbIn").build();  } |

**Create Kafka Producer**

|  |
| --- |
| @Service public class KafkaProducer {  private KafkaTemplate<String, String> kafkaTemplate;   public KafkaProducer(KafkaTemplate<String, String> kafkaTemplate) {  this.kafkaTemplate = kafkaTemplate;  }   public void send(String message) {  kafkaTemplate.send("rlbIn", message);  } } |

**Create Rest API to publish Message**

|  |
| --- |
| @RestController @RequestMapping("/kafka/v1") public class KafkaController {   private KafkaProducer kafkaProducer;   public KafkaController(KafkaProducer kafkaProducer) {  this.kafkaProducer = kafkaProducer;  }   @RequestMapping("/publish")  public ResponseEntity<String> publish(@RequestParam("message") String msg) {  kafkaProducer.send(msg);  return new ResponseEntity<>("success", HttpStatus.*CREATED*);  } } |

**Create Consumer**

|  |
| --- |
| @Service public class KafkaConsumer {  private static final Logger *LOGGER* = LogManager.*getLogger*(KafkaConsumer.class);   @KafkaListener(topics = "rlbIn", groupId = "myGroup")  public void consume(String msg) {  *LOGGER*.info(String.*format*("Message received : %s",msg));  } } |

**JSON Deserializer and JSON Serializer**

Apache Kafka store and transport byte[], There are number of built in serializers and deserializers but it does not include any for JSON. Spring Kafka created JsonSerializer and JsonDeserializer which can use to convert Java Object to and from JSON.

Spring Boot auto-configures a lot of Kafka properties for you, using sensible defaults. So unless you’re doing something custom, you often don’t need to set

spring.kafka.producer.value-serializer.

**Default Behavior**

If you’re using KafkaTemplate<String, String>, Spring Boot sees you're dealing with Strings, so it auto-applies:

|  |
| --- |
| spring.kafka.producer.key-serializer = org.apache.kafka.common.serialization.StringSerializer  spring.kafka.producer.value-serializer = org.apache.kafka.common.serialization.StringSerializer |

You do need to set spring.kafka.producer.value-serializer when:

* You’re sending custom Java objects
* You're using a format like JSON, Avro, or Protobuf
* You have multiple producers with different data formats

Example: Sending custom Java objects as JSON

|  |
| --- |
| spring.kafka.producer.value-serializer=org.springframework.kafka.support.serializer.JsonSerializer  spring.kafka.producer.properties.spring.json.type.mapping=yourTypeId:com.example.YourClass |

kafkaTemplate.send("my-topic", new User("Alice", "admin")); Where User is a custom class.

|  |
| --- |
| spring.kafka.producer.value-serializer=org.springframework.kafka.support.serializer.JsonSerializer  spring.kafka.producer.properties.spring.json.type.mapping=user:com.example.User |

**spring.kafka.producer.properties.spring.json.type.mapping**=yourTypeId:com.example.YourClass

This is used with JsonSerializer and JsonDeserializer to help Spring Kafka map a type ID (like a string) to a specific Java class during serialization/deserialization

When Kafka messages are serialized as **JSON**, Spring Kafka’s JsonSerializer adds metadata (like the type info) into the message headers so the JsonDeserializer on the **consumer** side knows what class to turn the JSON back into.

|  |
| --- |
| spring.kafka.consumer.value.deserializer=org.springframework.kafka.support.serializer.JsonDeserializer  spring.kafka.consumer.properties.spring.json.type.mapping=user:com.example.User  spring.kafka.consumer.properties.spring.json.trusted.packages=\* |

Use this property when:

* You're sending multiple types of messages to the same topic
* You want custom, readable type IDs instead of full Java class names in headers
* You want to avoid exposing full class names for security reasons

**spring.kafka.consumer.properties.spring.json.trusted.packages=\***

Deserializing JSON can be dangerous if someone sends a malicious payload. For example, a bad actor could try to deserialize something into a class that could execute code — security risk!

To prevent that, Spring Kafka’s JsonDeserializer only allows classes from trusted packages — unless you explicitly say otherwise.

**Is \* safe?**

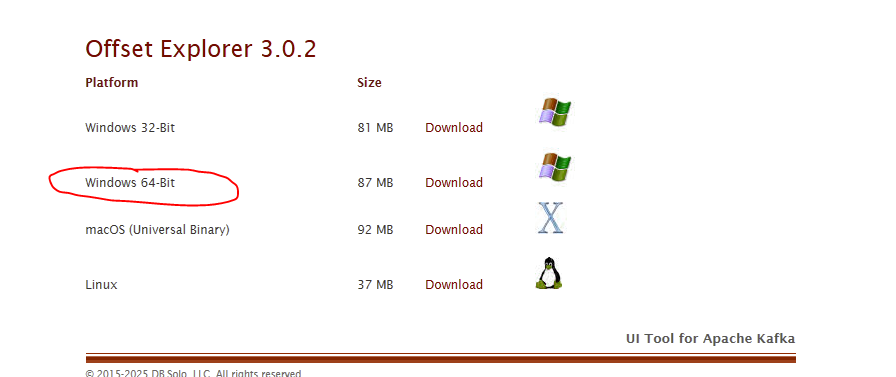
Technically yes — but **use it with caution**.

* ✅ Okay in internal, tightly controlled systems
* ❌ Risky if you're consuming messages from untrusted sources or multi-tenant environments

If you're building something more secure or external-facing, it's better to be explicit, like:

spring.kafka.consumer.properties.spring.json.trusted.packages=com.example.model

**Download offset explorer** <https://www.kafkatool.com/download.html>



application.properties

|  |
| --- |
| spring.kafka.consumer.value-deserializer: org.springframework.kafka.support.serializer.JsonDeserializer  spring.kafka.consumer.properties.spring.json.trusted.packages=\*  spring.kafka.producer.value-serializer: org.springframework.kafka.support.serializer.JsonSerializer |

**Create payload**

|  |
| --- |
| public class User {  private Integer id;  private String firstName;  private String lastName;  //getter setter  } |

**Create JsonProducer**

|  |
| --- |
| @Service public class JsonProducer {  private static final Logger *LOGGER* = LoggerFactory.*getLogger*(JsonProducer.class);   KafkaTemplate<String, User> kafkaTemplate;   public void sendMsg(User data) {  *LOGGER*.info(String.*format*("Message Send -> %s ", data.toString()));  Message<User> message = MessageBuilder.*withPayload*(data).setHeader(KafkaHeaders.*TOPIC*, "rlbIn").build();  kafkaTemplate.send(message);  } } |

**Create RestAPI to send Message**

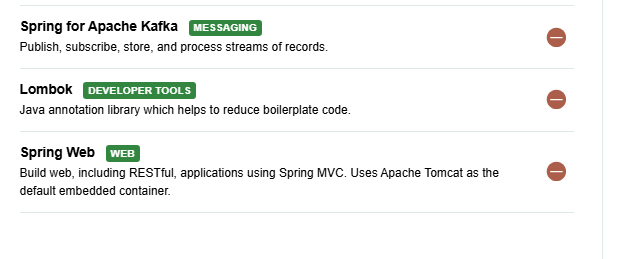
|  |
| --- |
| @RestController @RequestMapping("/kafka/v1") public class JsonController {  private static final Logger *LOGGER* = LoggerFactory.*getLogger*(JsonController.class);  private JsonProducer jsonProducer;   public JsonController(JsonProducer jsonProducer) {  this.jsonProducer = jsonProducer;  }   @PostMapping("/publish/json")  public ResponseEntity<String> publish(@RequestBody User user) {  *LOGGER*.info(String.*format*("Message Sent- > %s", user.toString()));  jsonProducer.sendMsg(user);  return new ResponseEntity<>("JSON Message sent", HttpStatus.*CREATED*);  } } |

**JSON Consumer**

|  |
| --- |
| @Service public class JsonConsumer {  private static final Logger LOGGER = LoggerFactory.getLogger(JsonConsumer.class);   @KafkaListener(topics = "rlbIn", groupId = "myGroup")  public void jsonConsume(User data) {  LOGGER.info(String.format("JSON Message received : %s", data.toString()));  } } |

**Multimodal Project**

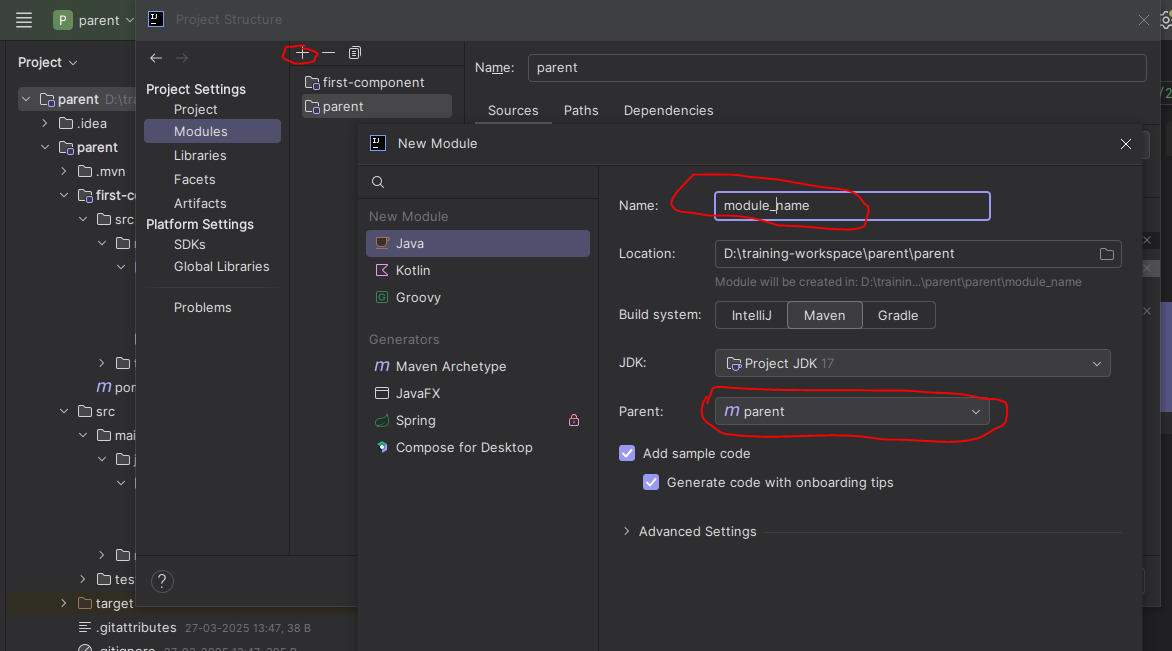
<https://start.spring.io/>



To make this project as Parent in pom.xml the packaging is set to **pom**

|  |
| --- |
| <packaging>**pom**</packaging> |

Create child project->Right click on parent project -> Open Module Setting

**Load maven then in parent pom file the child module will be added**

|  |
| --- |
| <name>parent</name> <description>Demo project for Spring Boot</description> <modules>  <module>first-component</module> </modules> <packaging>pom</packaging> |

**In child pom file add packaging to jar.**

|  |
| --- |
| <parent> </parent> <packaging>**jar**</packaging> <artifactId>first-component</artifactId> |

**Reuse Parent dependency into child module.**

If you want to **inherit dependencies from a parent project into child modules**, Maven makes this super clean with **inheritance via the** parent **tag**

**Project Structure Example**

my-multi-module-project/

├── pom.xml ← parent project

├── common-lib/

│ └── pom.xml ← child module

├── service-api/

│ └── pom.xml ← child module

Parent pom.xml This parent acts as the **dependency manager** for all your child modules

|  |
| --- |
| <dependencyManagement>  <dependencies>  <!-- Define versions centrally -->  <dependency>  <groupId>org.springframework.boot</groupId>  <artifactId>spring-boot-starter-web</artifactId>  <version>3.1.0</version>  </dependency>  </dependencies>  </dependencyManagement>  <dependencies>  <!-- Common dependency for all child modules -->  <dependency>  <groupId>com.google.guava</groupId>  <artifactId>guava</artifactId>  <version>32.0.0-jre</version>  </dependency>  </dependencies> |

The <dependencyManagement> section **only defines versions** — it does **not automatically add** the dependency to child projects.

Add parent pom file reference into child project

|  |
| --- |
| <parent>  <groupId>com.example</groupId>  <artifactId>my-springboot-parent</artifactId>  <version>1.0.0</version>  <relativePath>../pom.xml</relativePath>  </parent>  <dependencies>  <!-- Dependency defined in dependencyManagement -->  <dependency>  <groupId>org.springframework.boot</groupId>  <artifactId>spring-boot-starter-web</artifactId>  </dependency>  <!-- Dependency inherited directly from parent -->  <dependency>  <groupId>com.google.guava</groupId>  <artifactId>guava</artifactId>  </dependency>  </dependencies>  </project> |

**Use a sibling module (rlb-core) inside another module(rlb-oc)**

Update this part in rlb-oc/pom.xml

|  |
| --- |
| <dependency>  <groupId>com.rlb</groupId>  <artifactId>rlb-core</artifactId>  <version>0.0.1-SNAPSHOT</version>  </dependency> |

**Publish Event with Key**

|  |
| --- |
| public void publishJSOSNpPayload(User payload) {  LOGGER.info("Event sent ->{}", payload.toString());  ~~//Message<User> message = MessageBuilder.withPayload(payload).setHeader(KafkaHeaders.TOPIC, "json\_topic").build();  // kafkaTemplate.send("json\_topic",payload.getId().toString(),payload);~~  ProducerRecord<String, User> record = new ProducerRecord<>(  "json\_topic",  payload.getId().toString(),  payload  );  kafkaTemplate.send(record); } |

**Consumer with concurrency**

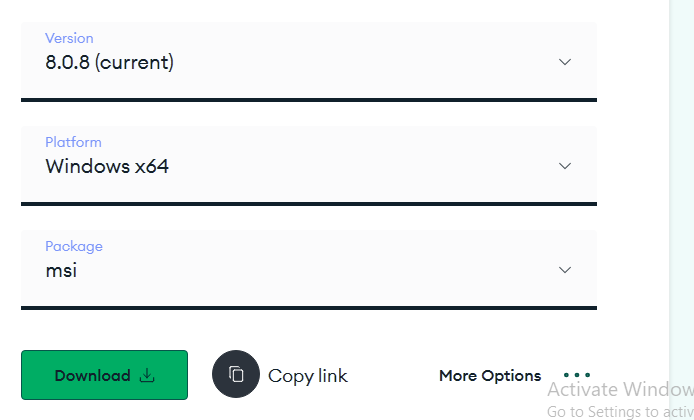
|  |
| --- |
| @KafkaListener(topics = "json\_topic", groupId = "rlbGroup", concurrency = "2")  public void JsonPayloadConsume(User payload) {  String threadName = Thread.currentThread().getName();  LOGGER.info("JSON payload received ->{} by Thread {}", payload,threadName);  } } |

**Mongo DB installation**

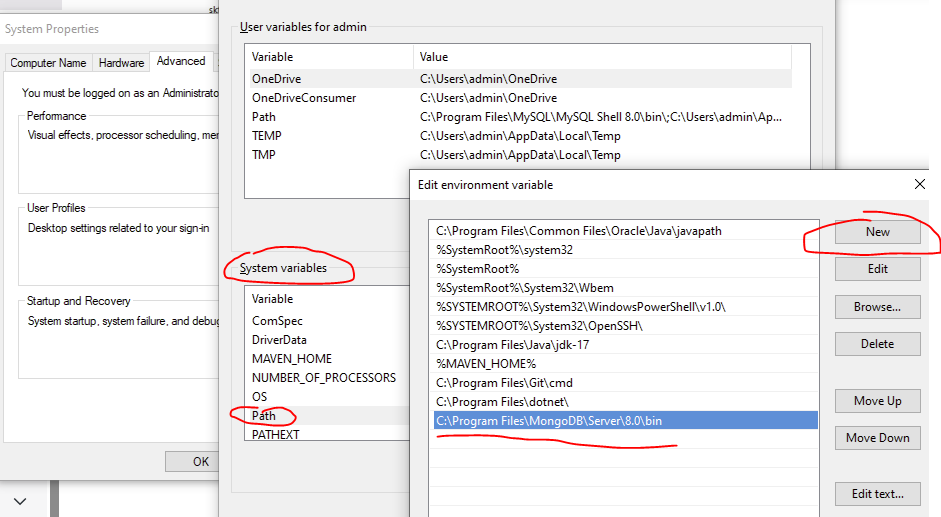
[MongoDB](https://www.geeksforgeeks.org/mongodb-an-introduction/), the most popular NoSQL database, is an open-source document-oriented database. The term ‘NoSQL’ means ‘non-relational’. It means that MongoDB isn’t based on the table-like relational database structure but provides an altogether different mechanism for the storage and retrieval of data. This format of storage is called [BSON](https://www.geeksforgeeks.org/difference-between-json-and-bson/)(similar to JSON format). A simple MongoDB document Structure:

|  |
| --- |
| {  title: rlb,  by: 'Avinash Khadsan,  url: 'https://www.rlb.com',  type: 'NoSQL'  } |

**Download MongoDB**: <https://www.mongodb.com/try/download/community>



 Set Environment Variables: C:\Program Files\MongoDB\Server\8.0\bin



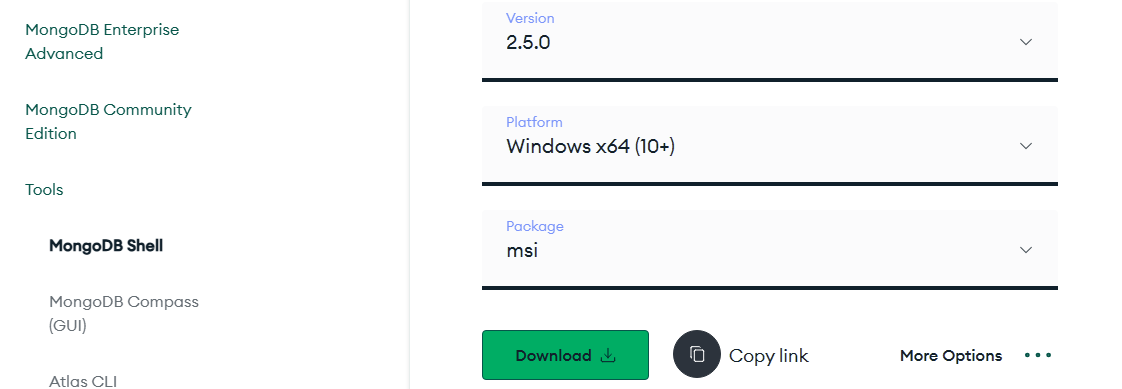
Create Folder for storage:  **C:/data/db/**

**Start mongo DB:**

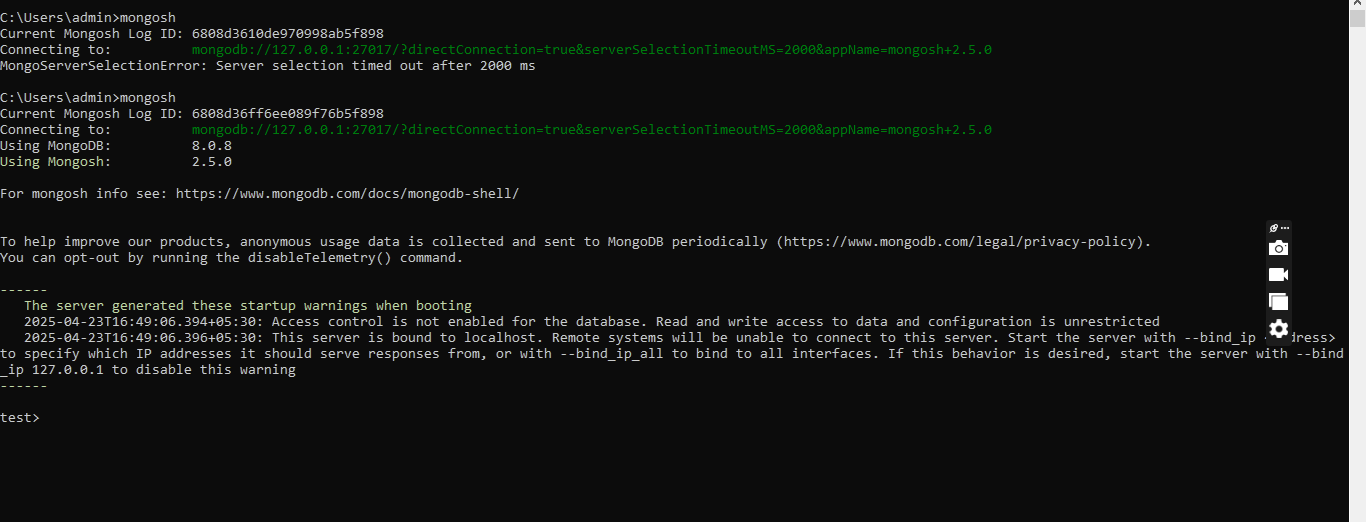
C:\Users\admin>mongod

The recommended shell for interacting with MongoDB databases is now **mongosh**, which provides improved functionality, better syntax, and full compatibility with the latest MongoDB features.

Download mongosh: <https://www.mongodb.com/try/download/database-tools>



**Start mongosh: C:\Users\admin>mongosh**



**Create a Database**

Now we can make a new **database**, **collections**, and **documents**in our shell. Use the following command within the mongosh shell to create a new database:

use database\_name

The use **Database\_name**command makes a new [database](https://www.geeksforgeeks.org/what-is-database/) in the system if it does not exist, if the database exists it uses that database:

use rlb

**Add Data to a Collection**

Insert a document into a collection using:

db.collection\_name.insertOne({field: value})

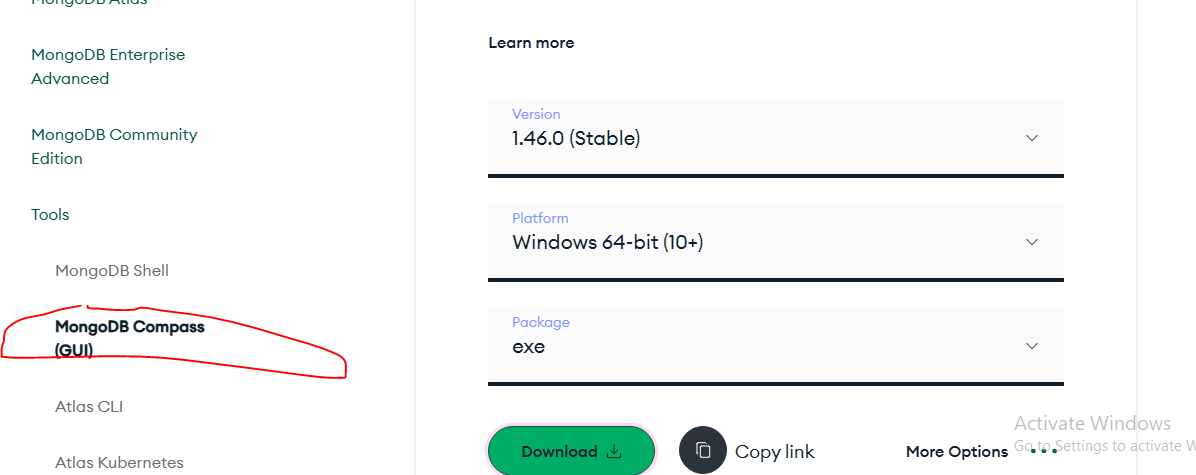
The**db.collection\_name** command makes a new collection in the rlb database and the [insertOne()](https://www.geeksforgeeks.org/mongodb-insertone-method-db-collection-insertone/" \t "_blank) method inserts the document in the **user** collection:

db.user.insertOne({name:'avinash'})

**Retrieve document from collection**

db.user.find()

**Download compass**: <https://www.mongodb.com/try/download/compass>



[**MongoDB Compass**](https://www.geeksforgeeks.org/install-mongodb-compass-on-windows/) is a powerful GUI for querying, aggregating, and analyzing your MongoDB data in a visual environment. Compass is free to use and source available and can be run on macOS, Windows, and Linux

Use default PORT: **27017** to connect mongodb from compass.

**Spring Boot + Mongo DB**

[**application.properties**](https://www.geeksforgeeks.org/spring-boot-application-properties/?ref=rp)

|  |
| --- |
| spring.data.mongodb.host=localhost  spring.data.mongodb.port=27017  spring.data.mongodb.database=rlb |

MongoRepository is an interface provided by Spring Data in the package org.springframework.data.mongodb.repository. MongoRepository extends the PagingAndSortingRepository and QueryByExampleExecutor interfaces that further extend the CrudRepository interface. MongoRepository provides all the necessary methods which help to create a CRUD application and it also supports the custom derived query methods.

public interface MongoRepository<T,ID>

extends PagingAndSortingRepository<T,ID>, QueryByExampleExecutor<T>

|  |
| --- |
| <dependency>      <groupId>org.springframework.boot</groupId>      <artifactId>spring-boot-starter-data-mongodb</artifactId>  </dependency> |

**Create Document Model**

|  |
| --- |
| @Document(collection = "user") public class User {  @Id  private Integer id;  private String userName;  private String surname; } |

**Create Repository**

|  |
| --- |
| @Repository public interface UserRepository extends MongoRepository<User, Integer> { } |

**Primary key in MongoDB collection**

MongoDB can use Integer (or Long) as the ID in theory, but it's not recommended by default.

* MongoDB natively expects the \_id to be unique and usually uses a special type called ObjectId.
* If you use an Integer for the @Id, you must manually handle ID generation yourself — MongoDB won't auto-generate integers for you.
* If you don't manage it carefully, you can easily get duplicate key errors.
* To generates IDs automatically for your entities use @Id and the field type is String or ObjectId.
* If you don't set the id when saving a new document, Spring Data MongoDB will generate a unique ID (using MongoDB's ObjectId). If you manually set an id, it will use your provided value instead.
* If the type is String, Spring will generate an ObjectId and convert it to a string automatically.
* If the type is org.bson.types.ObjectId, it just keeps it as an ObjectId.

**Use UUID instead of ObjectId**

Sometimes people prefer **UUIDs** over MongoDB's ObjectId (for readability, integration with other systems, etc).

|  |
| --- |
| @Data  @Document(collection = "user")  public class User {  @Id  private String id;  private String name;  private int age;  public User() {  this.id = UUID.randomUUID().toString();  }  } |

### Why **use UUID** instead of MongoDB's **ObjectId**?

**Consistency across systems**:

If your system uses UUIDs elsewhere (Postgres, Kafka keys, Redis, etc.), it’s easier to keep everything using UUIDs instead of mixing ObjectId and UUID

**Client-side generation:**

UUIDs can be generated **before** saving to MongoDB. (This can be useful if you need an ID immediately without touching the database.)

**Readability:**

UUIDs (e.g., f47ac10b-58cc-4372-a567-0e02b2c3d479) are often seen as more "standard" and recognizable in APIs than ObjectIds (e.g., 650fdc44eb2a1d23f8b9aa2e).

**Globally Unique:**

UUIDs (e.g., f47ac10b-58cc-4372-a567-0e02b2c3d479) are often seen as more "standard" and recognizable in APIs than ObjectIds (e.g., 650fdc44eb2a1d23f8b9aa2e).

### But why stick with **ObjectId** usually?

**Smaller size:**

ObjectId = 12 bytes; UUID = 16 bytes. (Saves a little space.)

**Built-in features:**

ObjectId includes a timestamp inside it (first 4 bytes), which can be useful for sorting by creation time without an extra createdAt field.

**Optimized for Mongo:**

MongoDB indexes and handles ObjectIds very efficiently.

**Default behaviour:**

Less code to maintain — Mongo handles ID generation automatically

### Real-world guideline:

* If you're **only** using MongoDB → **stick with ObjectId**.
* If you need **cross-system compatibility** or **client-side ID generation** → consider **UUID**.

**Example scenario**:  
Imagine you have a microservices system where:

* Kafka events use UUIDs
* PostgreSQL uses UUIDs
* Redis keys are UUID-based  
  Then you'd prefer to use UUIDs **everywhere**, including Mongo, to avoid confusion.

UUIDs are random whereas ObjectID values always increase over time

An attacker cannot deduce the ID of another object if they have the ID of one object in case of UUID.

**Spring Boot + Hibernate Integration**

pom.xml

|  |
| --- |
| <dependencies>  <dependency>  <groupId>org.springframework.boot</groupId>  <artifactId>spring-boot-starter-web</artifactId>  </dependency>  <dependency>  <groupId>org.springframework.kafka</groupId>  <artifactId>spring-kafka</artifactId>  </dependency>  <dependency>  <groupId>org.springframework.boot</groupId>  <artifactId>spring-boot-starter-test</artifactId>  <scope>test</scope>  </dependency>  <dependency>  <groupId>org.springframework.kafka</groupId>  <artifactId>spring-kafka-test</artifactId>  <scope>test</scope>  </dependency>   **<!--** You want full manual control over Hibernate sessions and mappings **-->  <dependency>  <groupId>org.hibernate.orm</groupId>  <artifactId>hibernate-core</artifactId>  <version>6.4.4.Final</version>  </dependency>**  **<!—**to use LocalSessionFactoryBean & need integration between Spring's @Transactional and Hibernate's SessionFactory **-->  <dependency>  <groupId>org.springframework</groupId>  <artifactId>spring-orm</artifactId>  </dependency>**  **<!--** Transaction management with DataSourceTransactionManager **-->  <dependency>  <groupId>org.springframework</groupId>  <artifactId>spring-jdbc</artifactId>  </dependency>  <!--** provides the **JPA (**interfaces such as @Entity, @Table, @Id, EntityManager **-->**  **<dependency>  <groupId>jakarta.persistence</groupId>  <artifactId>jakarta.persistence-api</artifactId>  <version>3.1.0</version>  </dependency>   <!-- MySQL Driver -->  <dependency>  <groupId>com.mysql</groupId>  <artifactId>mysql-connector-j</artifactId>  <version>8.0.33</version>  </dependency>**   </dependencies> </project> |

**Relational Mapping**

**Spring Boot + Whatsapp Integration**

By communicating over WhatsApp, we can enhance customer engagement, provide efficient support, and build stronger relationships with our users.

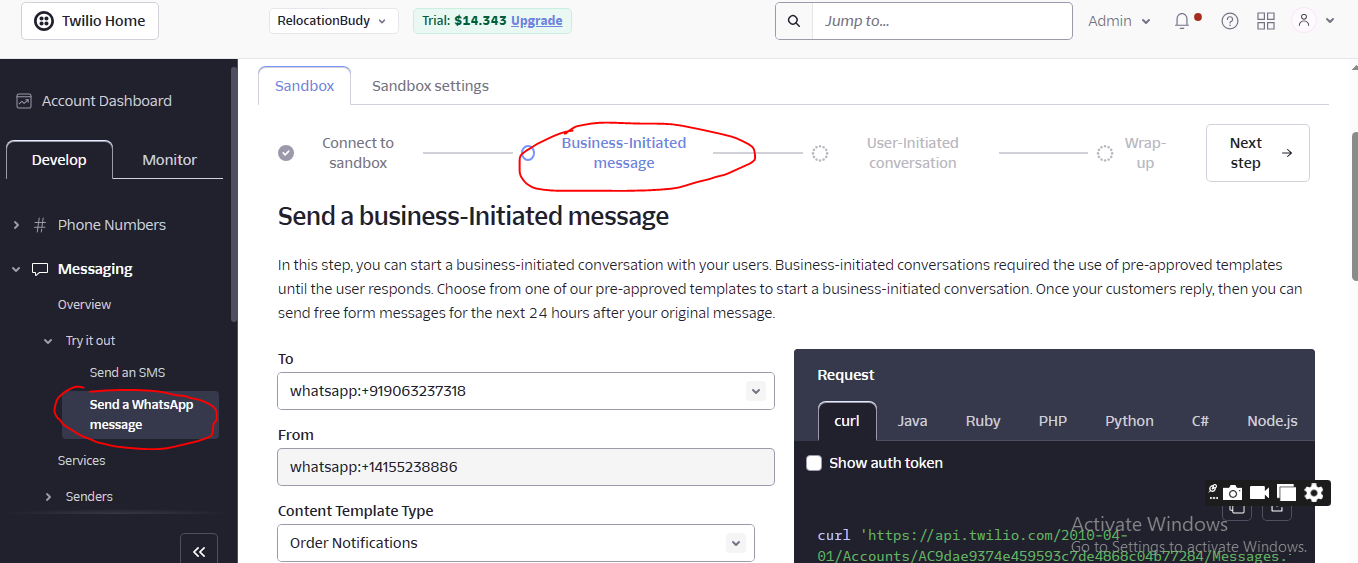
**Create Twilio account**

[**https://www.twilio.com/docs/whatsapp/self-sign-up#1-create-a-whatsapp-sender**](https://www.twilio.com/docs/whatsapp/self-sign-up#1-create-a-whatsapp-sender)

**Create** [**WhatsApp Business Account (WABA)**](https://en-gb.facebook.com/business/help/2087193751603668?id=2129163877102343)

<https://en-gb.facebook.com/business/help/2087193751603668?id=2129163877102343>

**Activate your Number to send message.**



**application.properties**

|  |
| --- |
| **twilio:  accountSid: AC9dae9374e459593c7de4868c04b77284  authToken: edd4949c4724dcb4b104996d61e317bc  phoneNumber: +14155238886  #phoneNumber: +919063237318  order:  placed: "Thank you for your order. Your delivery is scheduled for {0} at {1}. If you need to change it, please reply back and let us know."** |

**Controller**

|  |
| --- |
| @RestController @RequestMapping("/api") public class TwilioController {   @Autowired  private TwilioService twilioService;  @Value("${order.placed}")  private String msg;  @GetMapping("/send")  public String sendSms() {  System.out.println("Send message-> -> ->");  String date = "May 5, 2025";  String time = "2:00 PM";  String msg = MessageFormat.format(msg, date, time);  return twilioService.sendWhatsAppMessage("+919063237318", msg);  } } |

**TwilioService**

|  |
| --- |
| @Service public class TwilioService {   @Value("${twilio.accountSid}")  private String accountSid;   @Value("${twilio.authToken}")  private String authToken;   @Value("${twilio.phoneNumber}")  private String fromWhatsAppNumber;     @PostConstruct  public void initTwilio() {  Twilio.*init*(accountSid, authToken);  }   public String sendWhatsAppMessage(String to, String messageBody) {  Message message = Message.*creator*(  new PhoneNumber("whatsapp:" + to),  new PhoneNumber("whatsapp:" + fromWhatsAppNumber),  messageBody)  .create();   return message.getSid();  } } |

**Spring Boot +Google Integration**

Google application setup Register our application with our own Google account first. Go to

<https://console.cloud.google.com/> and follow these steps