# REST API Design

*"Let your plans be dark and impenetrable as night, and when you move, fall like a thunderbolt."*
*- Sun Tzu*

RONIN™
ENGINEER

## Outline

## 1. Mindset

## 1.1. Why Design First?

- Think how it works at high level
  → Cover almost cases
  → Reduce resources
- Better coordination among other teams
- Good designs make you a good engineer, a potential employee

## 1.2. Mindset

- **Scalable**
- **Consistency**
- **Inspect every single aspect**
- **No one fits all (Trade-offs)**

## 2. REST Conventions

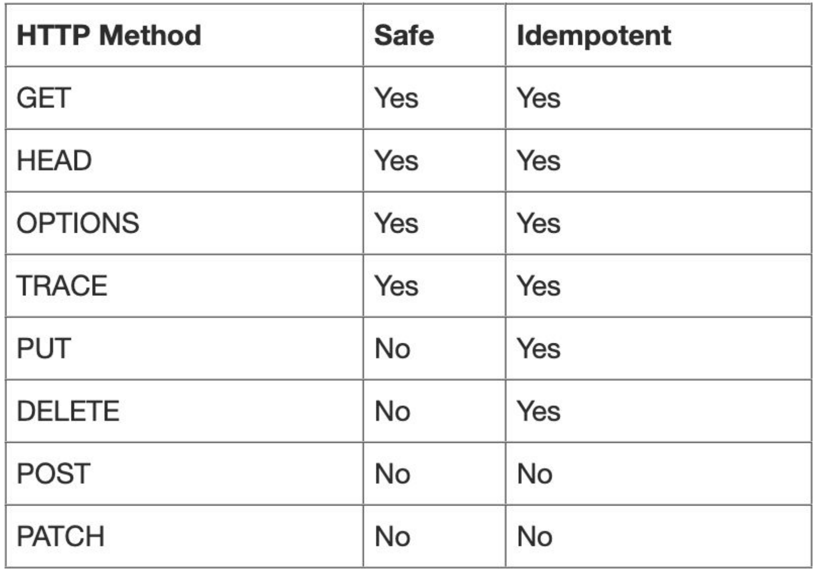
## 2.1. HTTP Methods

Properties:

- Safety: do not alter the server state/data
- Idempotency: a same request is sent once or multiple times, the response is the same.

Operations:

- Create: POST
- Read: GET
- Update Totally: PUT
- Delete/Disable: DELETE
- **Update Partially: PATCH**



| **HTTP Method** | **Safe** | **Idempotent** |
|---|---|---|
| GET | Yes | Yes |
| HEAD | Yes | Yes |
| OPTIONS | Yes | Yes |
| TRACE | Yes | Yes |
| PUT | No | Yes |
| DELETE | No | Yes |
| POST | No | No |
| PATCH | No | No |

## 2.2. RESTful API Conventions

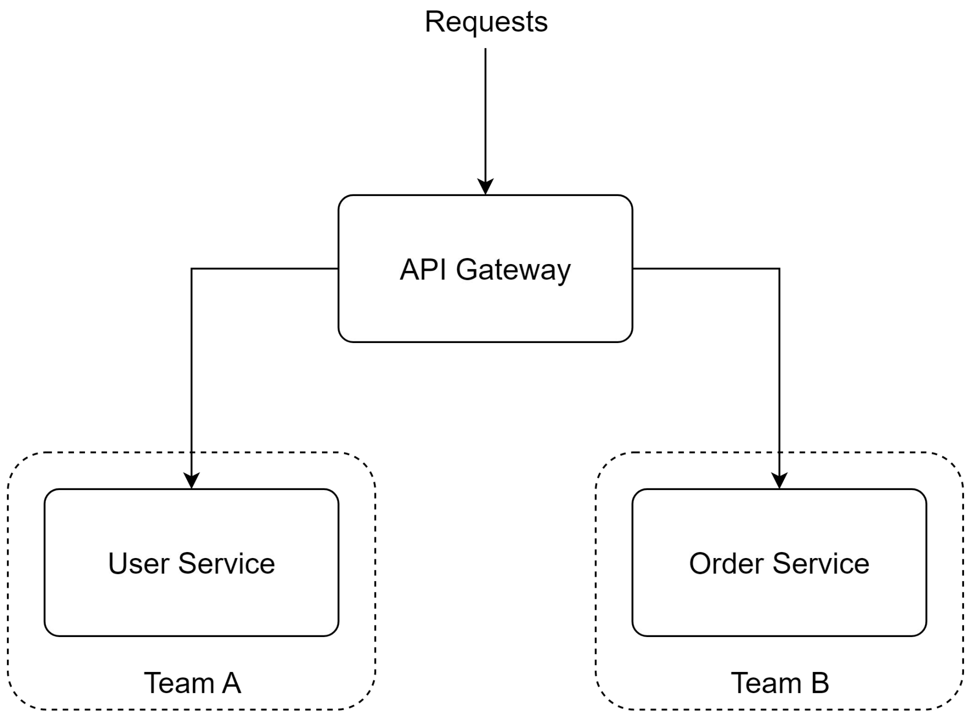
- **Use Nouns Instead of Verbs**
- Plural Nouns
- Use Nesting to Show Relationships
- Versioning
- Slug-case for URL
- Snake_case for request, response body

Example: https://ronin-engineer.com/api/v1/posts/<post_id>/comments

## 2.3. Exercise 1

Write Method + URL for:

1. Create Order
2. Get the detail of order 145
3. Update age of user 34 only
4. Disable user 34



## 2.3. Exercise 1

Write Method + URL for:

- Create Order:
  - **POST /order-service/api/v1/orders**
- Get the detail of order 145:
  - **GET /order-service/api/v1/orders/145**
- Update age of user 34 only:
  - **PATCH /user-service/api/v1/users/34**
- Disable user 34:
  - **DELETE /user-service/api/v1/users/34**
- Note: Prefix paths make routing easier.

## 2.4. Pagination

2 ways:

- Page, size parameters:
  - Example: GET /users?page=0&size=10
  - Use case: management portal
  - Must document: Page start counting with 0 or 1
- Offset, limit parameters:
  - Example: GET /users?offset=0&limit=10
  - Use case: a infinite scrollable list, newsfeed, logging events, …

SELECT * FROM users OFFSET 100 LIMIT 10 ?

## 2.4. Problem 01

2 problems:

- Performance issue for a large dataset in relational DB
  - Take time to count all rows
  - Offset scan through rows to know how many should be skipped
- Resource skipping
  - Firstly, get page 1: [1 … 10]
  - Then delete X records in page 1: [3 … 10] and expectation: page 2: [11 … 20]
  - Get page 2 → the X first records in page 2 moved to page 1
    - Page 1: [3 … 10, 11, 12]
    - Page 2: [13 … 24]

## 2.4. Problem 01

Solutions:

- **Deferred join**: (Performance issue)
  SELECT * FROM
  (SELECT id FROM users ORDER BY id LIMIT 100, 10) a USING id
  JOIN users b ON a.id = b.id;
- **Cursor**: (Resource skipping)
  - SELECT * FROM users WHERE id > last_id ORDER BY id LIMIT 10;
- Note:
  - Each solution has its own pros and cons → based on requirements to choose the right solution.
  - Cursor is not suitable for random ID.

## 2.5. Sorting

- Examples:
  - GET /products?sort=price:asc,name:desc
  - GET /products?sort=+price,-name
  - GET /products?sort=price asc,name desc
- Note: White list of sortable fields
- Ref:
  - Common design patterns | Cloud API Design Guide | Google Cloud
  - REST API | GitLab
  - Stripe API Reference

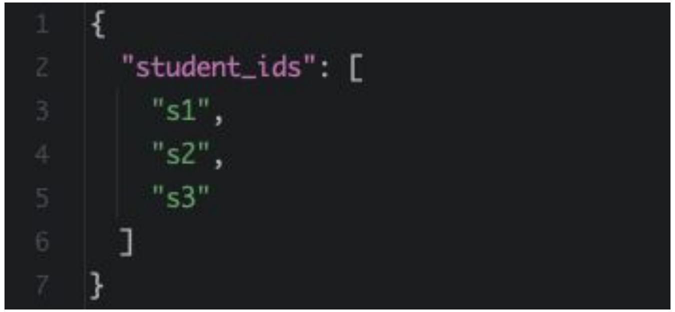
## 2.6. Relations

One-To-Many

- Get all comments of an article 123
    - GET /articles/123/comments

Many-To-Many

- Get students in a class
    - GET /classes/<class_id>/students
- Add a student into a class
    - POST /classes/<class_id>/students/<student_id>
    - Note: Using PUT here is ok because of idempotence
- Add students into a class
    - POST /classes/<class_id>/students



```
{
  "student_ids": [
    "s1",
    "s2",
    "s3"
  ]
}
```

Body for add students into a class

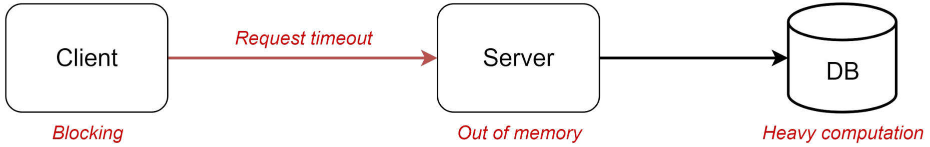
## 3. Case Studies

## 3.1. Problem 02: Exporting a large file

**Design API** for exporting a file with the size of 500MB.

Process:

1. Query DB
2. Write file
3. Response file to client directly



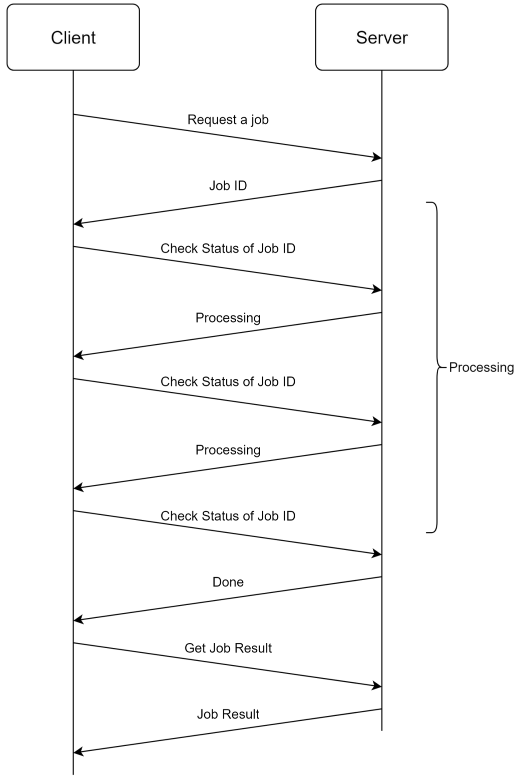
Issues:

- **Request timeout**
- **Client is blocked**
- Out of Mem
- Heavy computation, Large result of the query

## 3.1. Solution: Polling (Async API)

Use case: export file

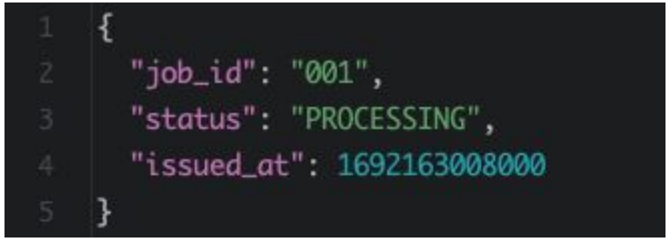
1. API request to export
   - Endpoint: GET /products/jobs/export?name=pen
2. API check status
   - Endpoint: GET /jobs/001
3. API get job result
   - Endpoint: GET /jobs/001/result



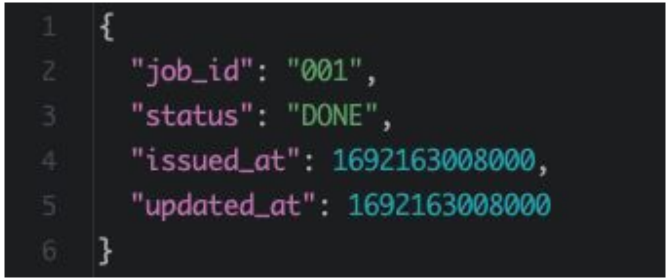
## 3.1. Solution: Polling (Async API)

Use case: export file

1. API request to export
   - Endpoint: GET /products/jobs/export?name=pen
2. API check status
   - Endpoint: GET /jobs/001
3. API get job result
   - Endpoint: GET /jobs/001/result

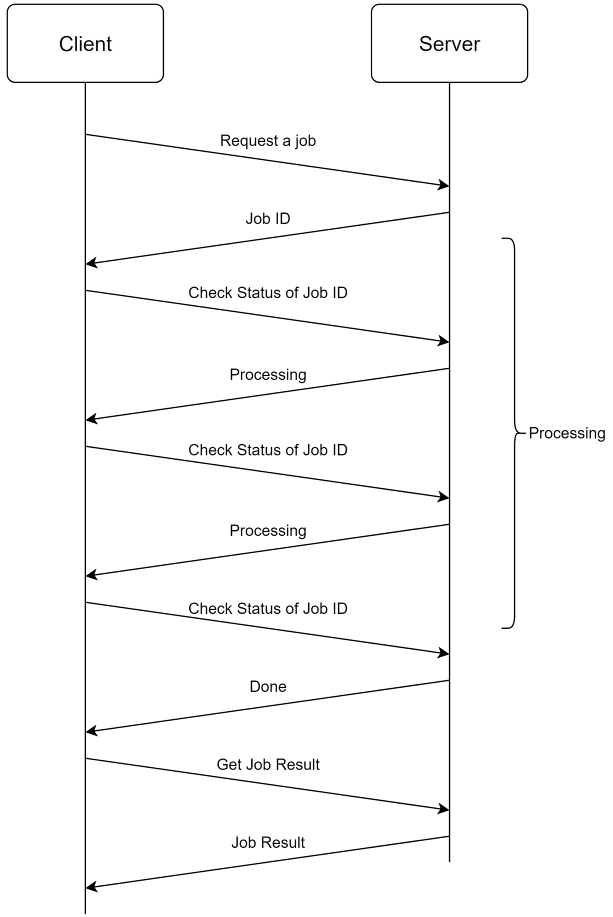


```json
{
  "job_id": "001",
  "status": "PROCESSING",
  "issued_at": 1692163008000
}
```

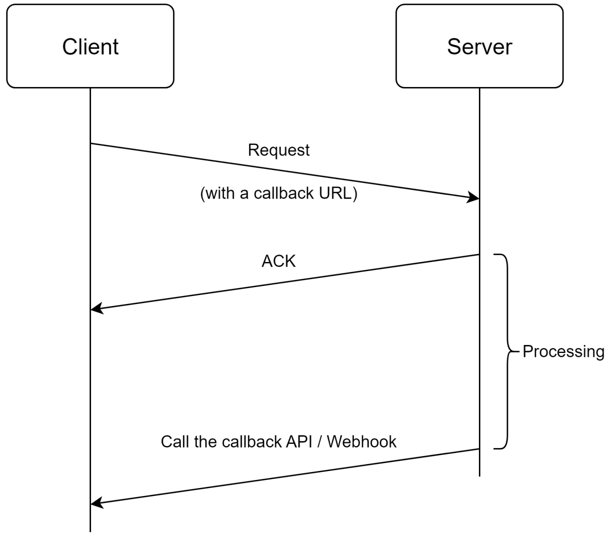


```json
{
  "job_id": "001",
  "status": "DONE",
  "issued_at": 1692163008000,
  "updated_at": 1692163008000
}
```

## Polling



## Callback



## 3.2. Types of Async API

- Polling:
    - Pros: Easy to implement
    - Cons: Waste resource
    - Use case: small load, import/export file

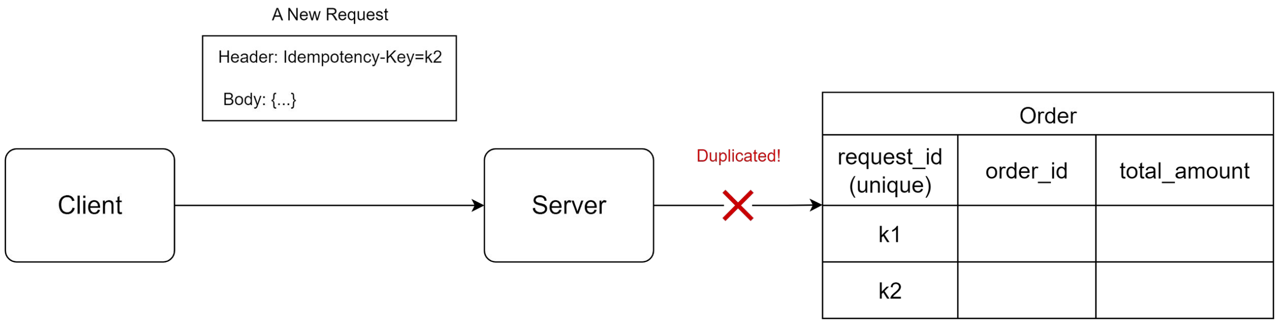
- Callback / Webhook:
    - Pros: Optimize the resource
    - Cons: Complex to implement in both client side and server side
    - Use case: large load, payment

## 3.3. Problem 03

Problem: A request might **be sent twice** due to network issue or replay attack.
This problem is sensitive to use cases such as payment, order.

Solution:

- Client generates and adds an **Idempotency Key** to the request header.
- Server checks Idempotency Key with **unique constraint in DB**.



| Order | | |
|---|---|---|
| request_id (unique) | order_id | total_amount |
| k1 | | |
| k2 | | |

# 4. REST API Document

## What info is important to REST API document?

## 4.1. API Document

Resources:

- REST API Document
- REST API Map

Note:

- Describe request, response body clearly
- **Show all errors and their meanings**
- Nice to have cURL samples

## Recap

- Scalable
- Consistency
- Inspect every single aspect
- No one fits all (Trade-offs)

## References

- Web API design best practices - Azure Architecture Center | Microsoft Learn
- REST API Best Practices – REST Endpoint Design Examples
- RESTful web API Design best practices | Google Cloud Blog
- Stripe API reference
- How to Optimize Paging in MySQL? 3 Best Ways - iheavy
- Deferred join: https://hackmysql.com/post/deferred-join-deep-dive/

Thank you 🙏

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## Homework

Airline Booking, API documents:

- API search flights
- API book a flight
- API get history of booking