

# Développement d'applications internet - DAI

Leonard Cseres | January 11, 2025

**GitHub** Plateforme et service cloud pour le dev. de logiciels et le contrôle de version utilisant Git, permettant aux développeurs de stocker et de gérer leur code.

**SSH** Plus sécurisé et il n'y a pas besoin de s'authentifier à chaque fois par rapport à **HTTPS**.

**Maven** Composé de phases et de goals. Les phases chargent les goals, qui exécutent des tâches projet (par exemple, compiler, tester, emballer).

**POM** Project Object Model, XML qui contient des infos sur le projet et configuration de Maven.

**MVNW** Wrapper Maven, permet d'avoir une version de Maven spécifique tous les collaborateurs du projet et éviter des problèmes de compatibilité.

**maven-jar-plugin** Plugin Maven pour créer un fichier JAR. **maven-shade-plugin** Plugin Maven pour créer un fichier JAR **fat** (contient toutes les dépendances).

```
# Télécharge les dépendances & transitives
./mvnw dependency:go-offline
# Supprime les classes compilées
./mvnw clean
# Compile le code source
./mvnw compile
# Emballe l'application dans un fichier JAR
./mvnw package
# Plusieurs phases
./mvnw ...
```

**Java** Portable grâce à la JVM, orienté objet, multi-threadé, fortement typé, compilé en byte-code. (SD-KMAN! utilisé pour gérer les versions)

**JAR** Java ARchive, contient des fichiers .class et des métadonnées.

**ASCII** 7 bits, 128 caractères.

**Extended ASCII** 8 bits, 256 caractères.

**Unicode** UTF-8, UTF-16, UTF-32, standard pour tous les caractères.

**UTF-8** 8 bits, 1 à 4 octets, compatible ASCII.

```
import java.io.*;
// Binary
InputStream; OutputStream; FileInputStream;
FileOutputStream; BufferedInputStream;
BufferedOutputStream;
// Text
Reader; Writer; FileReader; FileWriter;
BufferedReader; BufferedWriter;
import java.nio.charset.StandardCharsets;
// Exception
IOException; UnsupportedEncodingException;
FileNotFoundException;

// Binary Read
String filename;
```

```
try (InputStream fis = new
    FileInputStream(filename)) {
    int b;
    while ((b = fis.read()) != -1) {
        // Do nothing - simulate processing
    }
} catch (IOException e) {
    System.err.println("Error: " + e.getMessage());
}

// Binary Write
String filename;
int sizeInBytes;

try (OutputStream fos = new
    FileOutputStream(filename)) {
    for (int i = 0; i < sizeInBytes; i++) {
        fos.write(1);
    }
} catch (IOException e) {
    System.err.println("Error: " + e.getMessage());
}

// Binary Buffered Read
String filename;

try (InputStream fis = new
    FileInputStream(filename);
    BufferedInputStream bis = new
        BufferedInputStream(fis)) {
    int b;
    while ((b = bis.read()) != -1) {
        // Do nothing - simulate processing
    }
} catch (java.io.IOException e) {
    System.err.println("Error: " + e.getMessage());
}

// Binary Buffered Write
String filename, int sizeInBytes;

try (OutputStream fos = new
    FileOutputStream(filename);
    BufferedOutputStream bos = new
        BufferedOutputStream(fos)) {
    for (int i = 0; i < sizeInBytes; i++) {
        bos.write(1);
    }
    bos.flush();
} catch (java.io.IOException e) {
    System.err.println("Error: " + e.getMessage());
}

// Text Read
String filename;

try (Reader reader = new FileReader(filename,
    StandardCharsets.UTF_8)) {
    int b;
    while ((b = reader.read()) != -1) {
        // Do nothing - simulate processing
    }
} catch (IOException e) {
    System.err.println("Error: " + e.getMessage());
}

// Text Write
String filename, int sizeInBytes;

try (Writer writer = new FileWriter(filename,
    StandardCharsets.UTF_8)) {
    for (int i = 0; i < sizeInBytes; i++) {
        writer.write('a');
    }
} catch (IOException e) {
    System.err.println("Error: " + e.getMessage());
}

// Text Buffered Read
String filename;

try (Reader reader = new FileReader(filename,
    StandardCharsets.UTF_8);
    BufferedReader br = new
        BufferedReader(reader)) {
    int b;
    while ((b = br.read()) != -1) {
        // Do nothing - simulate processing
    }
} catch (java.io.IOException e) {
    System.err.println("Error: " + e.getMessage());
}

// Text Buffered Write
String filename, int sizeInBytes;

try (Writer writer = new FileWriter(filename,
    StandardCharsets.UTF_8);
    BufferedWriter bw = new
        BufferedWriter(writer)) {
    for (int i = 0; i < sizeInBytes; i++) {
        bw.write('a');
    }
    bw.flush();
} catch (IOException e) {
    System.err.println("Error: " + e.getMessage());
}
```

```
try (Reader reader = new FileReader(filename,
    StandardCharsets.UTF_8);
    BufferedReader br = new
        BufferedReader(reader)) {
    int b;
    while ((b = br.read()) != -1) {
        // Do nothing - simulate processing
    }
} catch (java.io.IOException e) {
    System.err.println("Error: " + e.getMessage());
}

// Text Buffered Write
String filename, int sizeInBytes;

try (Writer writer = new FileWriter(filename,
    StandardCharsets.UTF_8);
    BufferedWriter bw = new
        BufferedWriter(writer)) {
    for (int i = 0; i < sizeInBytes; i++) {
        bw.write('a');
    }
    bw.flush();
} catch (IOException e) {
    System.err.println("Error: " + e.getMessage());
}
```

**Docker** Bare metal software runs directly on hardware, virtualization software runs on a virtual machine, containerization software runs in a container.

**Image** read-only template for container creation

**Container** runnable instance of an image

**Registry** service storing images

```
FROM eclipse-temurin:21-jre
COPY target/app.jar app.jar
ENTRYPOINT ["java", "-jar", "app.jar"]
CMD ["goodbye"]
```

## DNS

Record Type	Description
NS	Name server
CNAME	Alias
A	IPv4 address
AAAA	IPv6 address
MX	Mail exchange (email server)
TXT	Text record (e.g., SPF, DKIM)

**Ports** Unsigned 16-bit, 0-1023 reserved

## Parallélisme

```
@Override
public Integer call() {
    try (ExecutorService executorService =
        Executors.newFixedThreadPool(2);) {
        executorService.submit(this::emittersWorker);
        executorService.submit(this::operatorsWorker);
    } catch (Exception e) {
        System.out.println("[Receiver] Exception: " +
            e);
        return 1;
    }
    return 0;
}
```

TODO: MORE CONCURRENCY

## Protocole Applicatif

- Aperçu** Quel est le but?
- Protocole de transport** Quel protocol? Quel port? Encodage? Délimiteur? Messages texte ou binaire. Qui initialise la communication?
- Messages** Fonctionnalité, requête et réponses
- Exemples** Fonctionnel et non-fonctionnel

**SMTP (Send)** Send emails from client to server

- 25 (unencrypted)

```
465, 587 (encrypted; 587 recommended)
EHLO <sender> # or HELO
MAIL FROM: <sender email address>
RCPT TO: <recipient email address>
DATA
<email content>
.
QUIT
```

**POP3 (Retrieve)** Download emails (no sync)

- 110 (unencrypted)
- 995 (encrypted)

**IMAP (Sync)** Sync emails (server-client updates)

- 143 (unencrypted)
- 993 (encrypted)

## SCP

```
scp [user@source-ip:]source [user@dest-ip:]dest
```

## HTTP

```
# Request
<HTTP method> <URL> HTTP/<HTTP version>
<HTTP headers>
<Empty line>
<HTTP body (optional)>
```

```
# Response
HTTP/<HTTP version> <HTTP status code> <HTTP
    status message>
<HTTP headers>
<Empty line>
<HTTP body>
```

**HTTP Negotiation** A process where the client and server agree on the response format using headers like Accept, Content-Type, and Accept-Language.

Code	Category	Description
1xx		Informational
2xx		Success
3xx		Redirection
4xx		Client Error
5xx		Server Error

**API** Application Programming Interface

## REST APIs

1. **Client/Server** Client and server are separate, communicating only through the API.
2. **Stateless** The server does not store session info; each request must be self-contained.
3. **Cacheable** Responses can be cached by the client with proper control.
4. **Layered System** Intermediary systems (e.g., cache, load balancer) can be added without affecting the client.
5. **Uniform Interface**
  - Use URIs/URLs to identify resources.
  - Responses include data and links for further interaction.
  - Standardized response formats.
6. **Code on Demand (optional)** Servers may send executable code for client customization.

*Note:* Not all APIs are REST APIs.

## Web Infrastructures

All *load balancers* are reverse proxies, but not all *reverse proxies* perform load balancing.

Routing	Example
Host based	app1.example.com
Path based	example.com/app1

**Host Header** HTTP header sent by the client to indicate the domain being requested. Servers use this to differentiate between multiple websites hosted on the same IP address (known as virtual hosting).

```
networks:
  traefik_network:
    external: true

services:
  proxy:
    image: traefik/whoami:latest
    networks:
      - traefik_network
    expose:
      - 80
    labels:
      # Traefik
      - traefik.enable=true
      - traefik.docker.network=traefik_network
      # Routers
      - traefik.http.routers
        .proxy.entrypoints=https
      # We use Host and PathPrefix rules at the
        same time
```

```
- traefik.http.routers.proxy.
  rule=Host(`whoami.DOMAIN`) &&
  PathPrefix(`/whoami`)
# Stipprefix (https://example.com/foo ->
  /foo)
- traefik.http.routers.proxy.
  middlewares=whoami-stripprefix
```

## Sticky Sessions (Round-robin LB)

```
# We add the sticky session configuration
- traefik.http.services.proxy.loadbalancer.
  sticky=true
# We can also configure the cookie name and its
  options (useful for multiple services)
- traefik.http.services.proxy.loadbalancer.
  sticky.cookie.name=whoami_cookie
- traefik.http.services.proxy.loadbalancer.
  sticky.cookie.httpOnly=true
```

## Caching

**Client-side (Private)** Cache stored on the client after receiving a server response; reused for future requests.

**Server-side (Shared)** Cache stored on the server via reverse proxy or app; reused for similar incoming requests.

**Expiration model** The cache is valid for a certain amount of time. Cache-Control: max-age=<number of seconds>

**Validation model** The cache is valid until the data is modified.

### Last-Modified

- Last-Modified: Timestamp of the last resource update.
- If-Modified-Since: 304 if unchanged (cache hit).
- If-Unmodified-Since: 412 if changed (cache miss) on update/delete.

### ETag

- ETag: Hash/version of the resource.
- If-None-Match: 304 if unchanged (cache hit).
- If-Match: 412 if changed (cache miss) on update/delete.

## Annexes

### TCP

```
public class TCPClient {
    public static void main(String[] args) {
        String serverAddr = "127.0.0.1";
        int port = 1234;

        try (
            Socket socket = new Socket(serverAddr, port);
            InputStreamReader isr = new
                InputStreamReader(socket.getInputStream(),
                    StandardCharsets.UTF_8);
            BufferedReader in = new BufferedReader(isr);
            OutputStreamWriter osw = new
                OutputStreamWriter(socket.getOutputStream(),
                    StandardCharsets.UTF_8);
            BufferedWriter out = new BufferedWriter(osw)) {
            // connected
            out.write("Hello, Server!\n");
            out.flush();
            String response = in.readLine();
            if (response == null) {
                // server disconnected
            } else {
                // response
            }
        } catch (IOException e) {}
    }
}

.....

public class TCPServer {
    public static void main(String[] args) {
        int port = 1234;
        int nbThreads = 2;

        try (
            ServerSocket serverSocket = new ServerSocket(port);
            ExecutorService e = Executors.newFixedThreadPool(nbThreads)) {
            // server started
            while (true) {
                Socket socket = serverSocket.accept();
                e.submit(new ClientHandler(socket));
            }
        } catch (IOException e) {}
    }

    static class ClientHandler implements Runnable {
        private final Socket socket;
        public ClientHandler(Socket socket) { this.socket = socket; }

        @Override
        public void run() {
            try (
                InputStreamReader isr = new
                    InputStreamReader(socket.getInputStream(),
                        StandardCharsets.UTF_8);
                BufferedReader in = new BufferedReader(isr);
                OutputStreamWriter osw = new
                    OutputStreamWriter(socket.getOutputStream(),
                        StandardCharsets.UTF_8);
                BufferedWriter out = new BufferedWriter(osw)) {
                // client connected
                String request = in.readLine();
                if (request != null) {
                    out.write("Echo: " + request + "\n");
                    out.flush();
                }
            }
        }
    }
}
```

```
        } else {
            // client disconnected
        }
    } catch (IOException e) {}
}
}
```

### UDP Unicast

```
public class UDPClient {
    public static void main(String[] args) {
        String serverAddr = "127.0.0.1";
        int port = 1234;

        try (DatagramSocket socket = new DatagramSocket()) {
            byte[] buffer = "Hello, Server!".getBytes();
            InetAddress address = InetAddress.getByName(serverAddr);

            DatagramPacket packet = new DatagramPacket(
                buffer, buffer.length, address, port);
            socket.send(packet);

            buffer = new byte[1024];
            packet = new DatagramPacket(buffer, buffer.length);
            socket.receive(packet);

            String response = new String(
                packet.getData(), 0, packet.getLength());
            System.out.println("Server Response: " + response);
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
}

.....

public class UDPServer {
    public static void main(String[] args) {
        int port = 1234;

        try (DatagramSocket socket = new DatagramSocket(port)) {
            System.out.println("Listening on port " + port);

            while (true) {
                byte[] buffer = new byte[1024];
                DatagramPacket packet = new DatagramPacket(
                    buffer, buffer.length);
                socket.receive(packet);

                String msg = new String(
                    packet.getData(), 0, packet.getLength());
                System.out.println("Received: " + msg);

                InetAddress clientAddr = packet.getAddress();
                int clientPort = packet.getPort();
                buffer = ("Echo: " + msg).getBytes();

                packet = new DatagramPacket(
                    buffer, buffer.length, clientAddr, clientPort);
                socket.send(packet);
            }
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
}
```

### UDP Multicast

```
public class UDPMulticastSender {
    public static void main(String[] args) {
        String multicastGroup = "230.0.0.1";
        int port = 1234;

        try (DatagramSocket socket = new DatagramSocket()) {
            byte[] buffer = "Hello, Group!".getBytes();
            InetAddress group = InetAddress.getByName(multicastGroup);

            DatagramPacket packet = new DatagramPacket(
                buffer, buffer.length, group, port);
            socket.send(packet);

            System.out.println("Message sent to group");
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
}

.....

public class UDPMulticastReceiver {
    public static void main(String[] args) {
        String multicastGroup = "230.0.0.1";
        int port = 1234;

        try (MulticastSocket socket = new MulticastSocket(port)) {
            InetAddress group = InetAddress.getByName(multicastGroup);
            socket.joinGroup(group);

            System.out.println("Joined group");
            byte[] buffer = new byte[1024];
            DatagramPacket packet = new DatagramPacket(
                buffer, buffer.length);

            while (true) {
                socket.receive(packet);
                String msg = new String(
                    packet.getData(), 0, packet.getLength());
                System.out.println("Received: " + msg);
            }
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
}
```