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Software Engineering and Architecture

Networking in Java: Sockets

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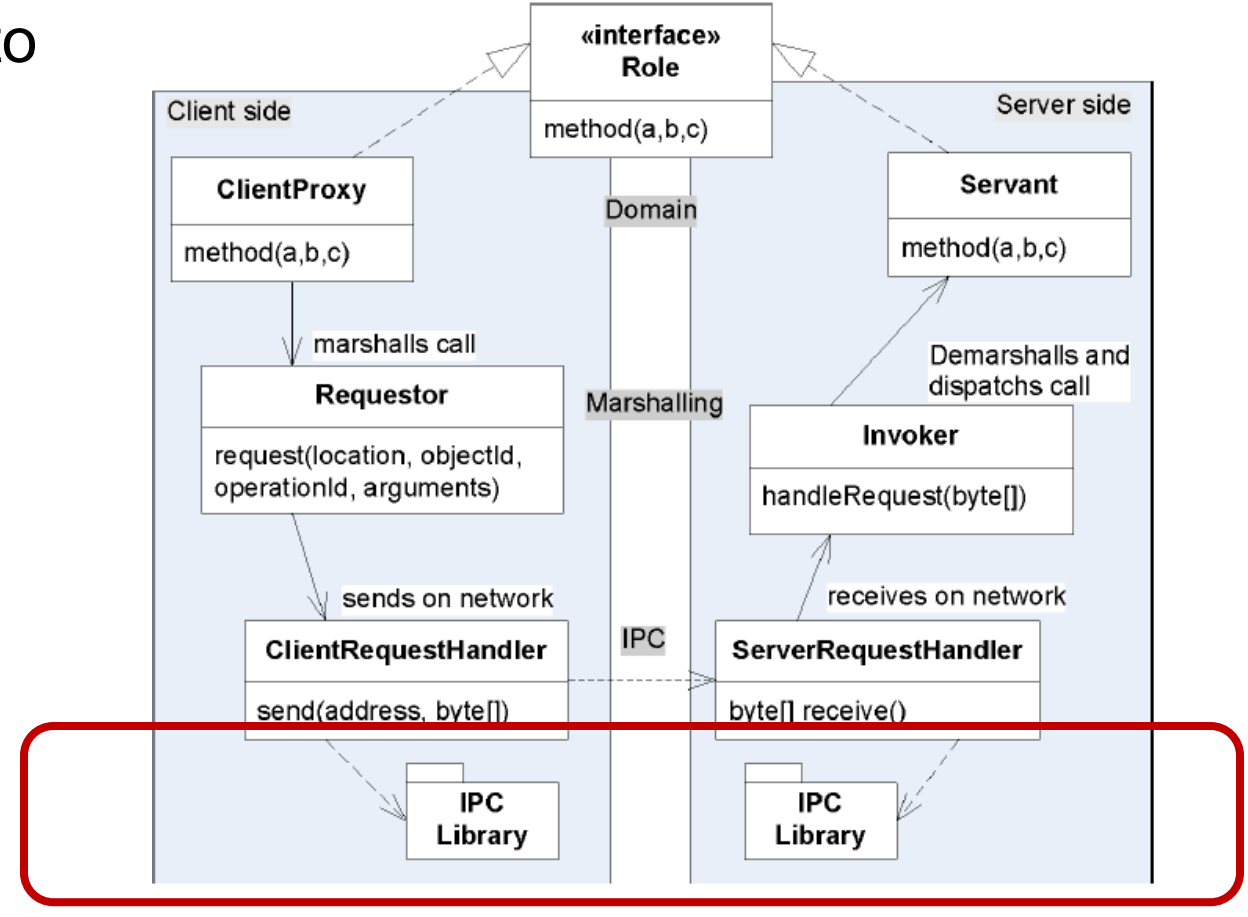
Getting Data over Network

- The IPC needs to transmit/receive data over the network
- InterProcess-Communication



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Networking from Code

- The most fundamental abstraction of network is the **Socket**

Definition:

A *socket* is one endpoint of a two-way communication link between two programs running on the network. A socket is bound to a port number so that the TCP layer can identify the application that data is destined to be sent to.

- So, your computer has an IP address, and you then create a Socket with a specific port number
  - And you have something you can address from a client

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The Socket Abstraction

- Once a socket is established you can get an input- and output stream

`InputStream`	`getInputStream()` Returns an input stream for this socket.
`OutputStream`	`getOutputStream()` Returns an output stream for this socket.

- That is, you can *read* and *write* to the stream, just as you would read and write to a File!

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Example from Java Tutorial

- The Echo Server
  - Just returns anything you send to it (Booooring...)
- Start the server on port 37000

```
csdev@small22:~/proj/frsproject/echo$ java EchoServer.java
Usage: java EchoServer <port number>
csdev@small22:~/proj/frsproject/echo$ java EchoServer.java 37000
```

- And a client

```
csdev@small22:~/proj/frsproject/echo$ java EchoClient localhost 37000
Dette er en test.
echo: Dette er en test.
Som er noget kedelig, men OK.
echo: Som er noget kedelig, men OK.
```

Echo

- Echo Server
  - ServerSocket accepts, and…
  - Returns a Socket
  - With the in/out streams

```
public class EchoServer {
    public static void main(String[] args) throws IOException {

        if (args.length != 1) {
            System.err.println("Usage: java EchoServer <port number>");
            System.exit(1);
        }

        int portNumber = Integer.parseInt(args[0]);

        try (
            ServerSocket serverSocket =
                new ServerSocket(portNumber);
            Socket socket = serverSocket.accept();
            PrintWriter out =
                new PrintWriter(socket.getOutputStream(), true);
            BufferedReader in = new BufferedReader(
                new InputStreamReader(socket.getInputStream()));
        ) {
            String inputLine;
            while ((inputLine = in.readLine()) != null) {
                System.out.println(" I will echo: " + inputLine);
                out.println(inputLine);
            }
        } catch (IOException e) {
            System.out.println("Exception caught when trying to listen on port "
                + portNumber + " or listening for a connection");
            System.out.println(e.getMessage());
        }
    }
}
```

Echo

- Echo Client
  - The client creates the Socket directly

```
public class EchoClient {
    public static void main(String[] args) throws IOException {

        if (args.length != 2) {
            System.err.println(
                "Usage: java EchoClient <host name> <port number>");
            System.exit(1);
        }

        String hostName = args[0];
        int portNumber = Integer.parseInt(args[1]);

        try (
            Socket echoSocket = new Socket(hostName, portNumber);
            PrintWriter out =
                new PrintWriter(echoSocket.getOutputStream(), true);
            BufferedReader in =
                new BufferedReader(
                    new InputStreamReader(echoSocket.getInputStream()));
            BufferedReader stdIn =
                new BufferedReader(
                    new InputStreamReader(System.in))
        ) {
            String userInput;
            while ((userInput = stdIn.readLine()) != null) {
                out.println(userInput);
                System.out.println("echo: " + in.readLine());
            }
        } catch (UnknownHostException e) {
            System.err.println("Don't know about host " + hostName);
            System.exit(1);
        } catch (IOException e) {
            System.err.println("Couldn't get I/O for the connection to " +
                hostName);
            System.exit(1);
        }
    }
}
```

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Exercise

- Now, you have enough to build Fortnite or LoL ☺
  - Tack a bit of graphics on...

- *Almost...*
  - *Quality Attributes needed*
    - *Security*
    - *Performance*
    - *Availability*
    - *Modifiability – the programming model is terrible lowlevel*
  - The reason we will do **Broker**
    - **Architectural Pattern to address the programming model…**