Advanced Programming

Networking & Socket Programming

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Networking — Concept

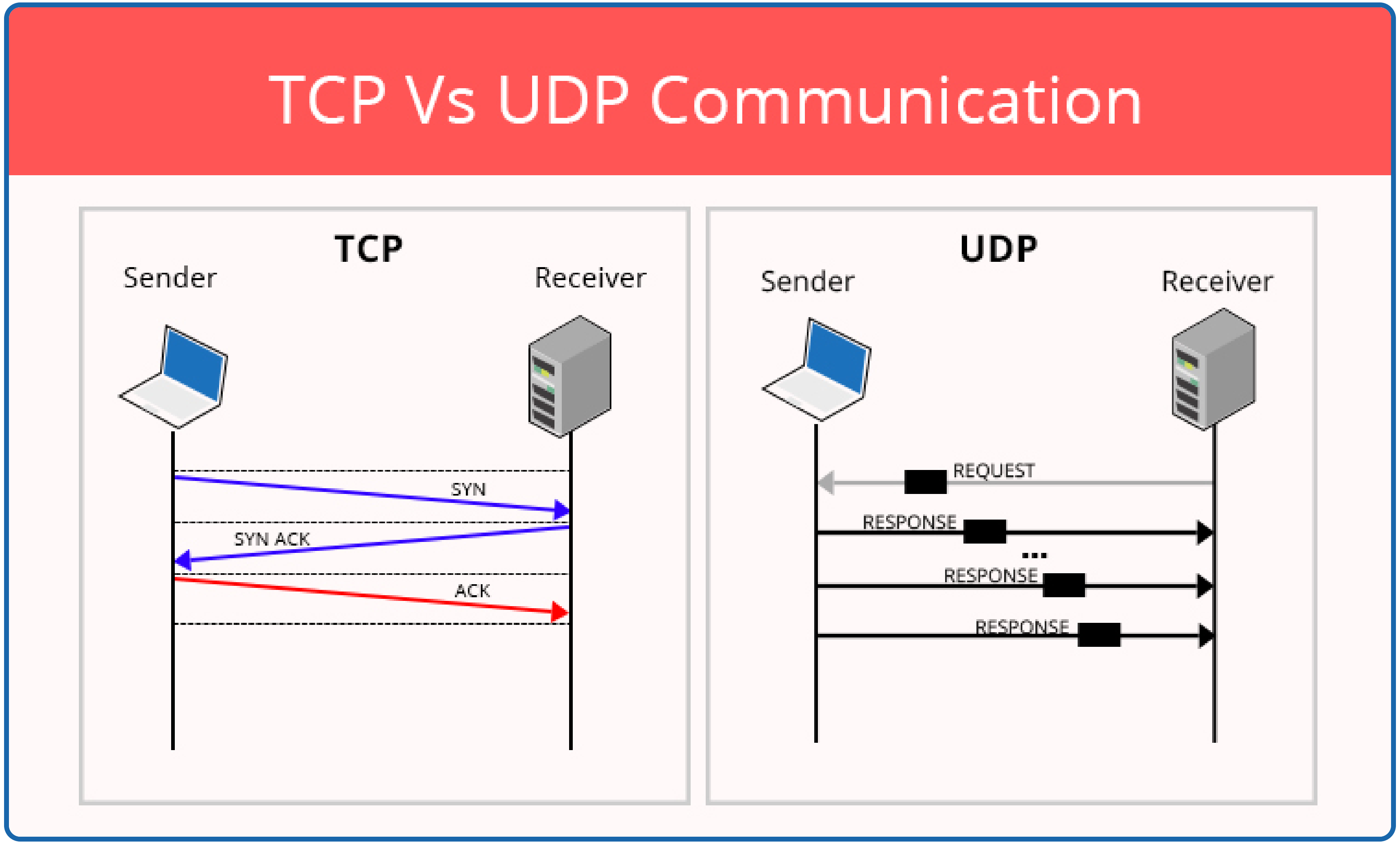
- **Networking** allows computers to communicate and share data.
- Communication happens through:
  - **IP Address** (identifies device)
  - **Port Number** (identifies application)
  - **Protocol** (rule of communication)

> Networking enables distributed systems and real-time applications.

TCP vs UDP

Feature	TCP	UDP
Reliability	Guaranteed delivery	No delivery guarantee
Ordering	Maintains packet order	No ordering
Speed	Slower	Faster
Use Case	Web, Email, Banking	Streaming, VoIP, Games

> TCP = Reliable.
>
> UDP = Fast.

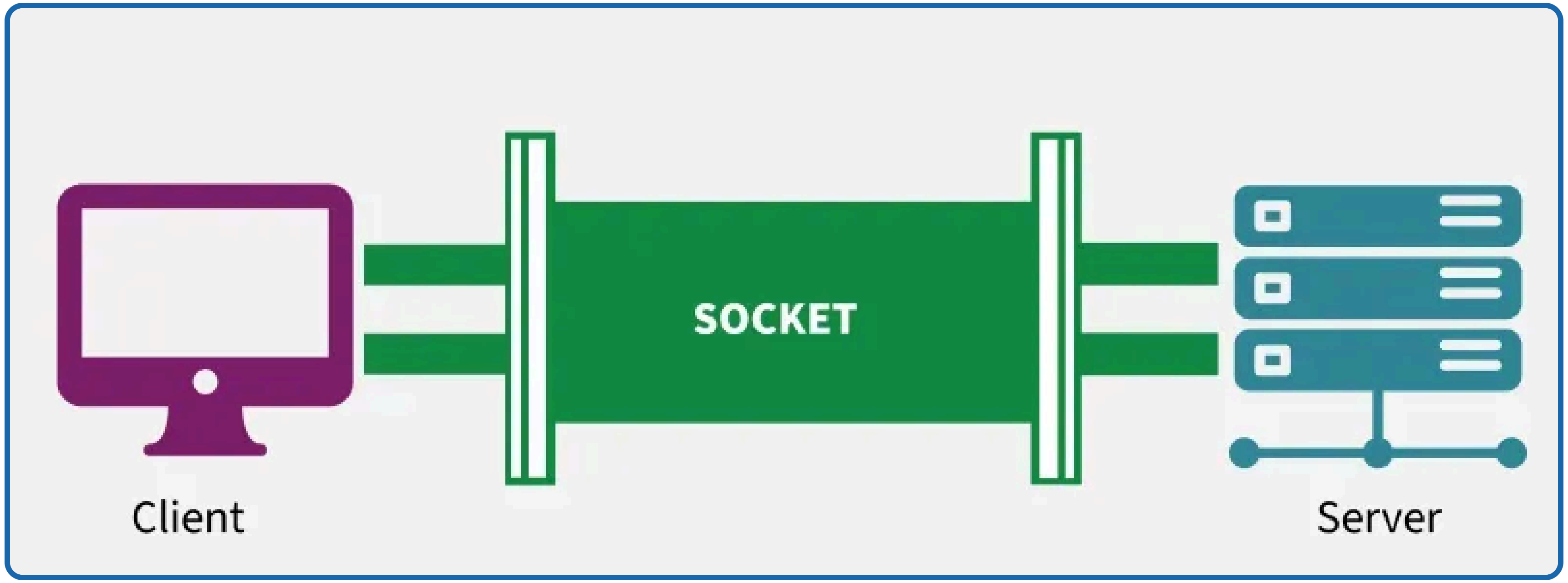

TCP Vs UDP Communication
TCP
Sender
Receiver
SYN
SYN ACK
ACK
UDP
Sender
Receiver
REQUEST
RESPONSE
...
RESPONSE
RESPONSE

What is a Socket?

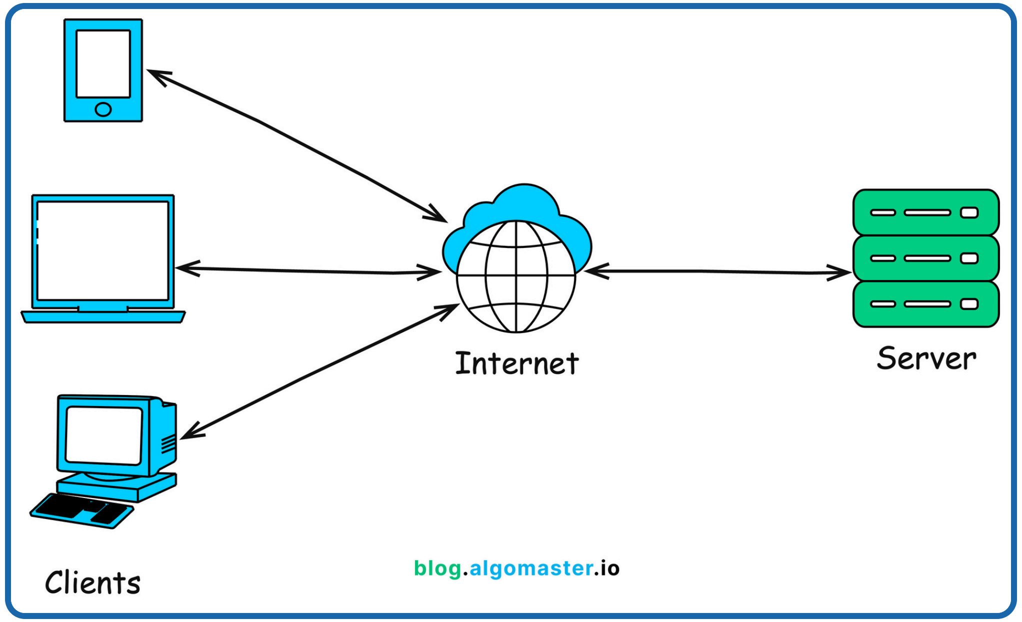
- A **socket** is an endpoint for communication.
- Created on both **client** and **server**.
- The server listens on a **port** waiting for clients.

```
Client <----> Network <----> Server
```

> Sockets enable bidirectional communication.


SOCKET
Client
Server

Client-Server Model



- Server waits for requests
- Client initiates communication

Example — Simple TCP Server (Java)

```java
import java.net.*;
import java.io.*;

public class Server {
    public static void main(String[] args) throws Exception {
        ServerSocket server = new ServerSocket(5000);
        Socket socket = server.accept();
        BufferedReader in = new BufferedReader(new InputStreamReader(socket.getInputStream()));
        System.out.println("Client says: " + in.readLine());
        server.close();
    }
}
```

Example — Simple TCP Client (Java)

```java
import java.net.*;
import java.io.*;

public class Client {
    public static void main(String[] args) throws Exception {
        Socket socket = new Socket("localhost", 5000);
        PrintWriter out = new PrintWriter(socket.getOutputStream(), true);
        out.println("Hello Server!");
        socket.close();
    }
}
```

> Client connects → sends → server receives.

Key Design Notes

Concept	Importance
Blocking I/O	Calls wait until completion
Multithreading Server	Supports multiple clients
Resource Cleanup	Always close streams & sockets
Protocol Design	Agree on message format

Summary

Concept	Description
Network	Enables remote communication
Socket	Endpoint for data transfer
TCP	Reliable, ordered communication
UDP	Fast, lightweight communication
Client/Server	Fundamental interaction model

> Sockets enable everything from chat apps to distributed computing.

Thank You!

Networking & Sockets — Practical Foundations

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