EVENTS AND SOCKET.IO

Building real-time software

```
var userTweets = new EventEmitter();

// Elsewhere in the program . . .
userTweets.on('newTweet', function (tweet) {
    console.log(tweet);
});

// Elsewhere in the program . . .
userTweets.emit('newTweet', {
    text: 'Check out this fruit I ate'
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- Objects that can “emit” specific events with a payload to any amount of registered listeners
- An instance of the “observer/observable” a.k.a “pub/sub” pattern
- Feels at-home in an *event*-driven environment

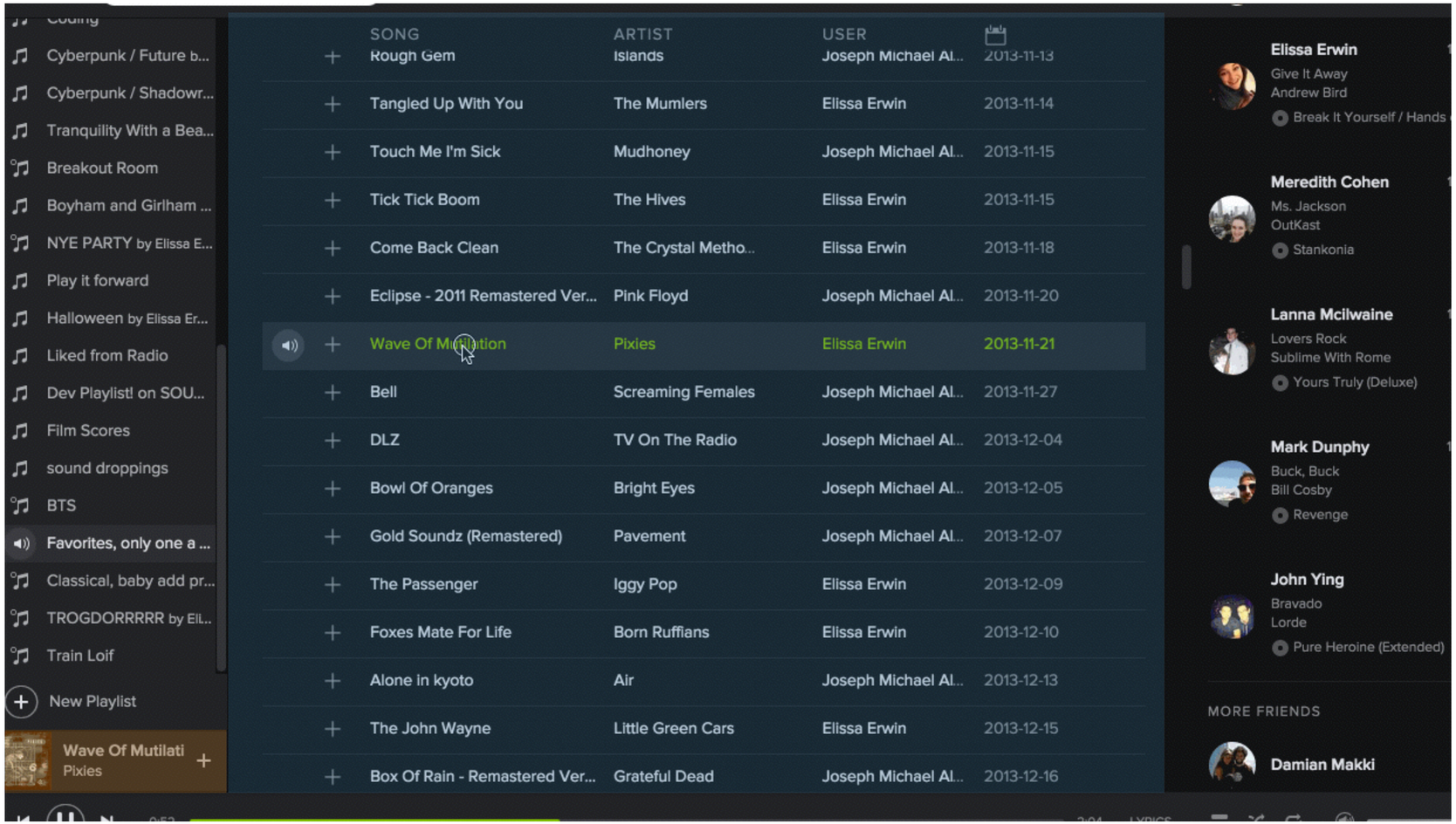
PRACTICAL USES

- Connect two decoupled parts of an application

```
var currentTrack = new EventEmitter();
```

```
currentTrack.emit('changeTrack', newTrack);
```

```
currentTrack.on('changeTrack', function (newTrack) {
    // Display new track!
});
```



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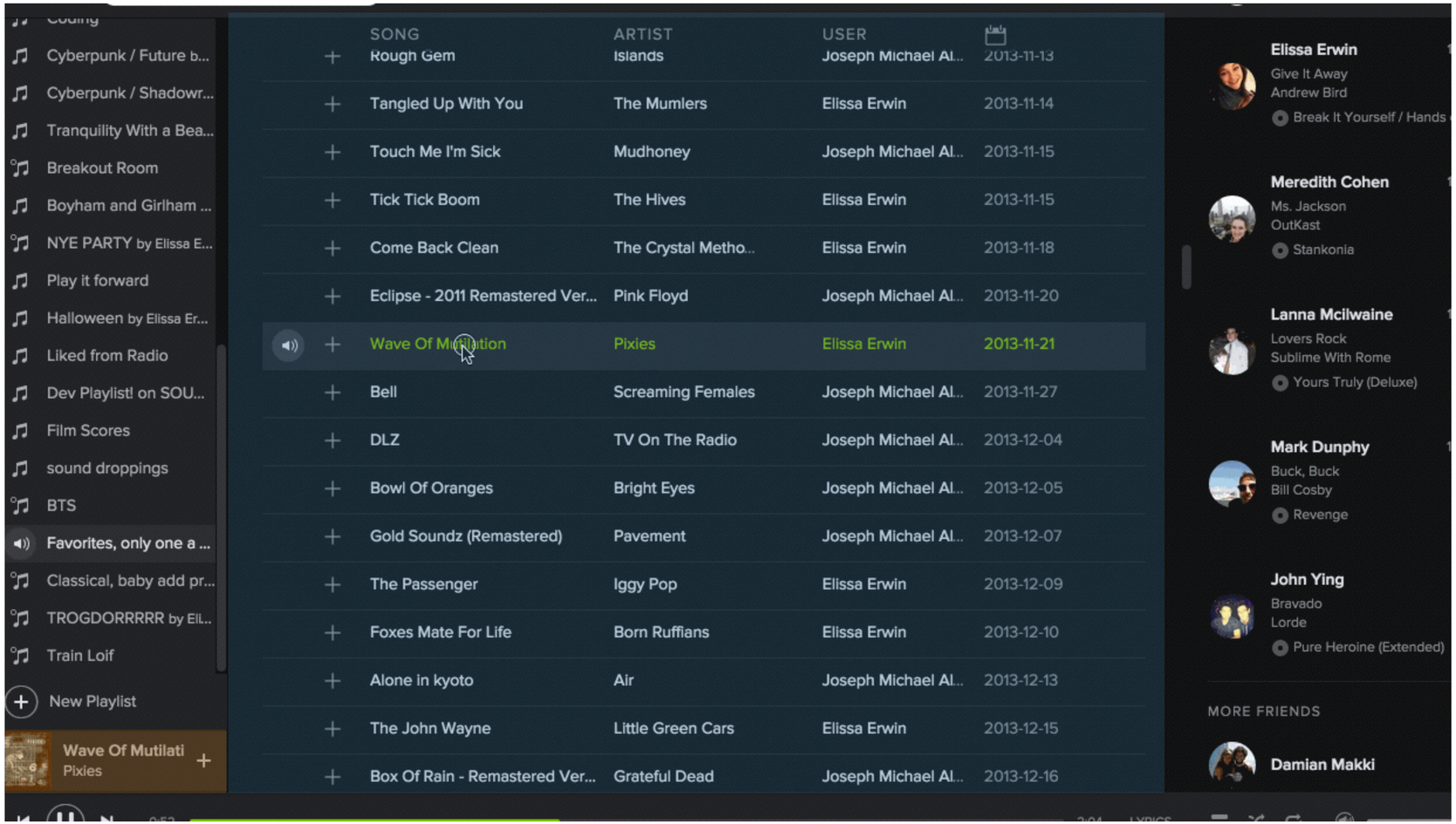

PRACTICAL USES

- Represent multiple asynchronous events on a single entity.

```
var upload = uploadFile();

upload.on('error', function (e) {
    e.message; // World exploded!
});

upload.on('progress', function (percentage) {
    setProgressOnBar(percentage);
});

upload.on('complete', function (fileUrl, totalUploadTime) {

});
```

ALL OVER NODE

- server.on(‘request’)
- request.on(‘data’) / request.on(‘end’)
- process.stdin.on(‘data’)
- db.on(‘connection’)
- Streams

HTTP, PART 2

Sequels are always worse than the original

WHAT WE KNOW ABOUT HTTP

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- Responses can include a body (payload)

The New York Times

FIFA WORLD CUP
Brasil

LIVE WORLD CUP COVERAGE

- A user visits a web page
- This web page has a live updating list of game coverage (“events”) provided by New York Times commentator (“Brazil receives yellow card”/“Germany scores goal”)
- When the event line is submitted by the commentator, it should immediately display to the user

HTTP LONG POLLING

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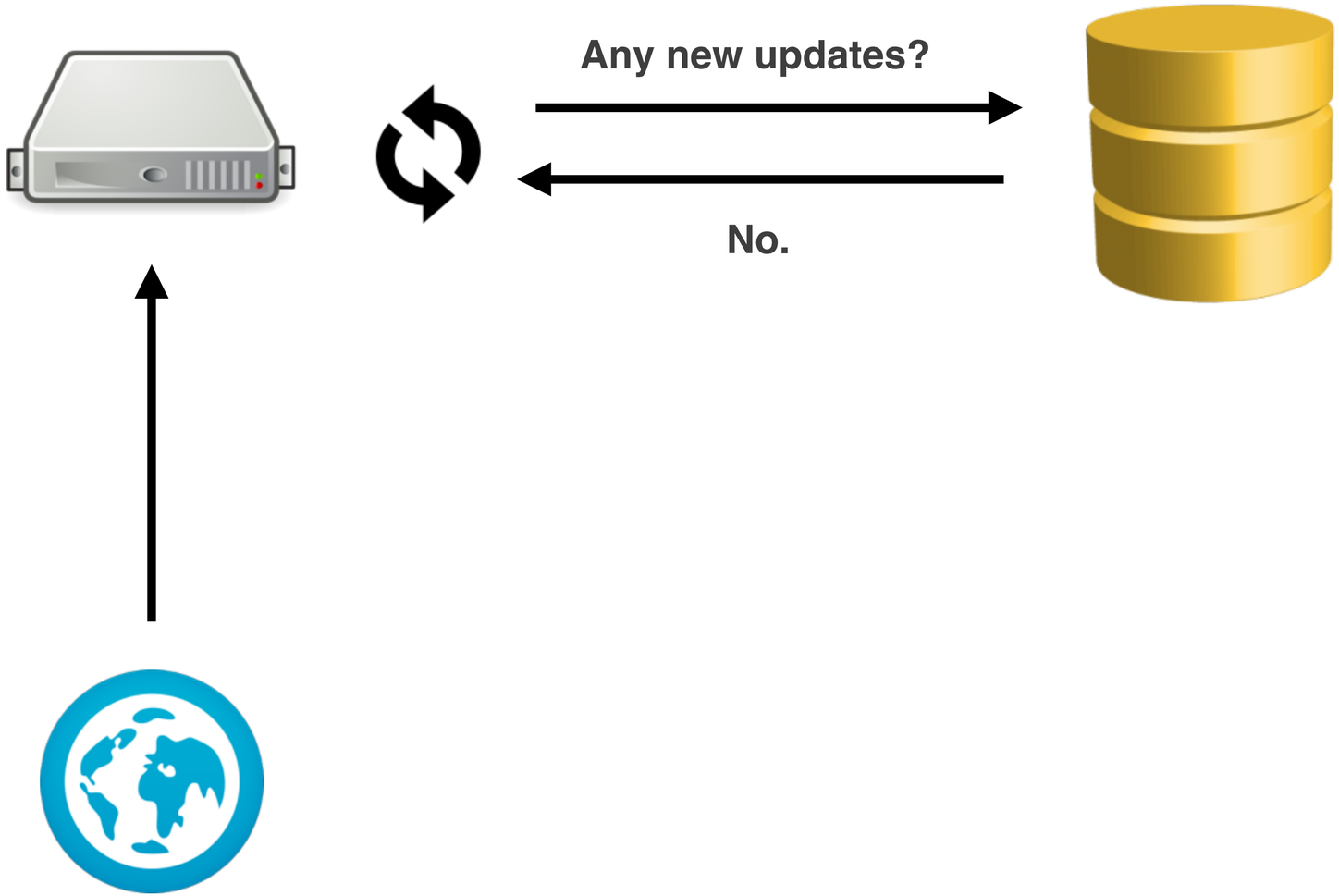

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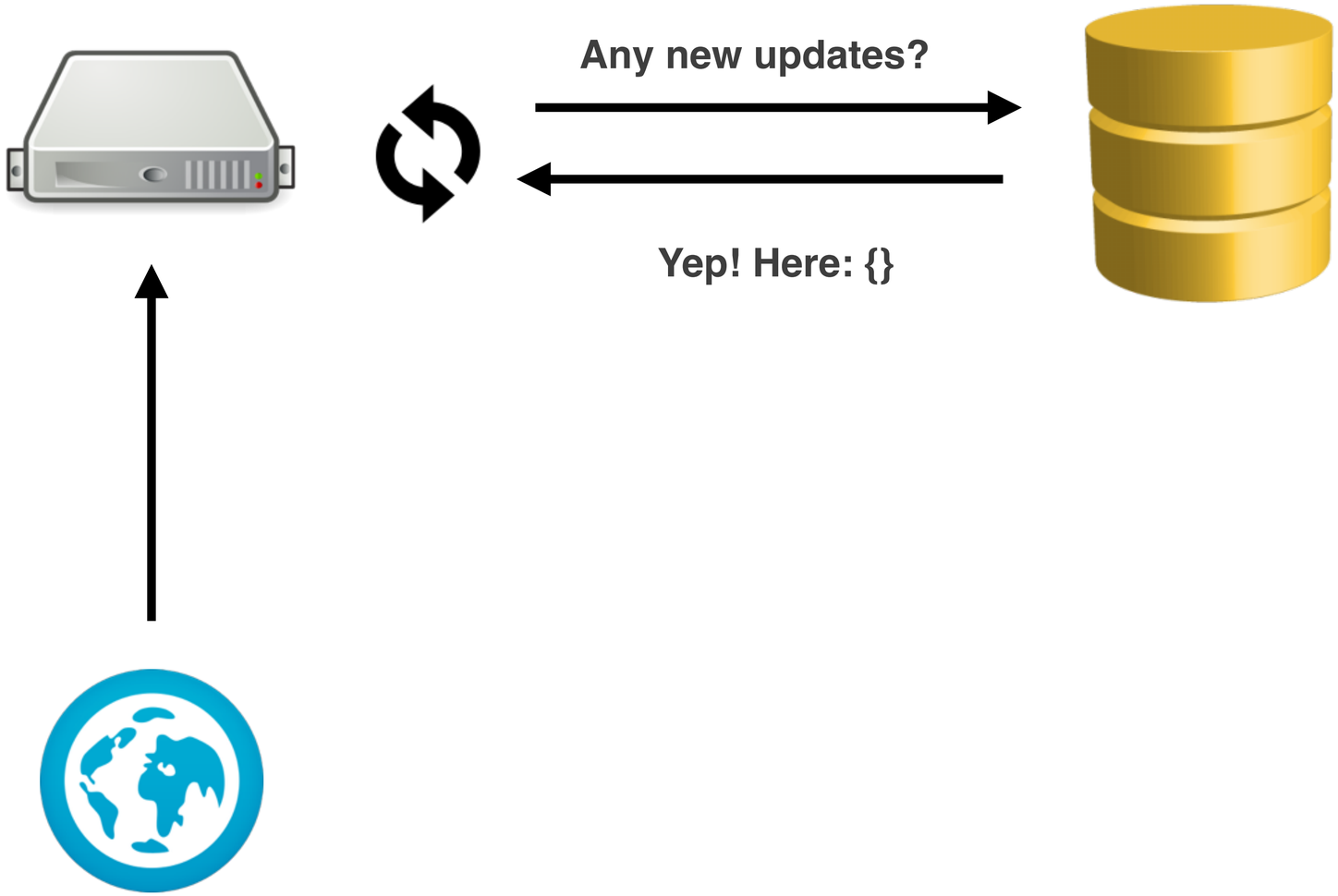

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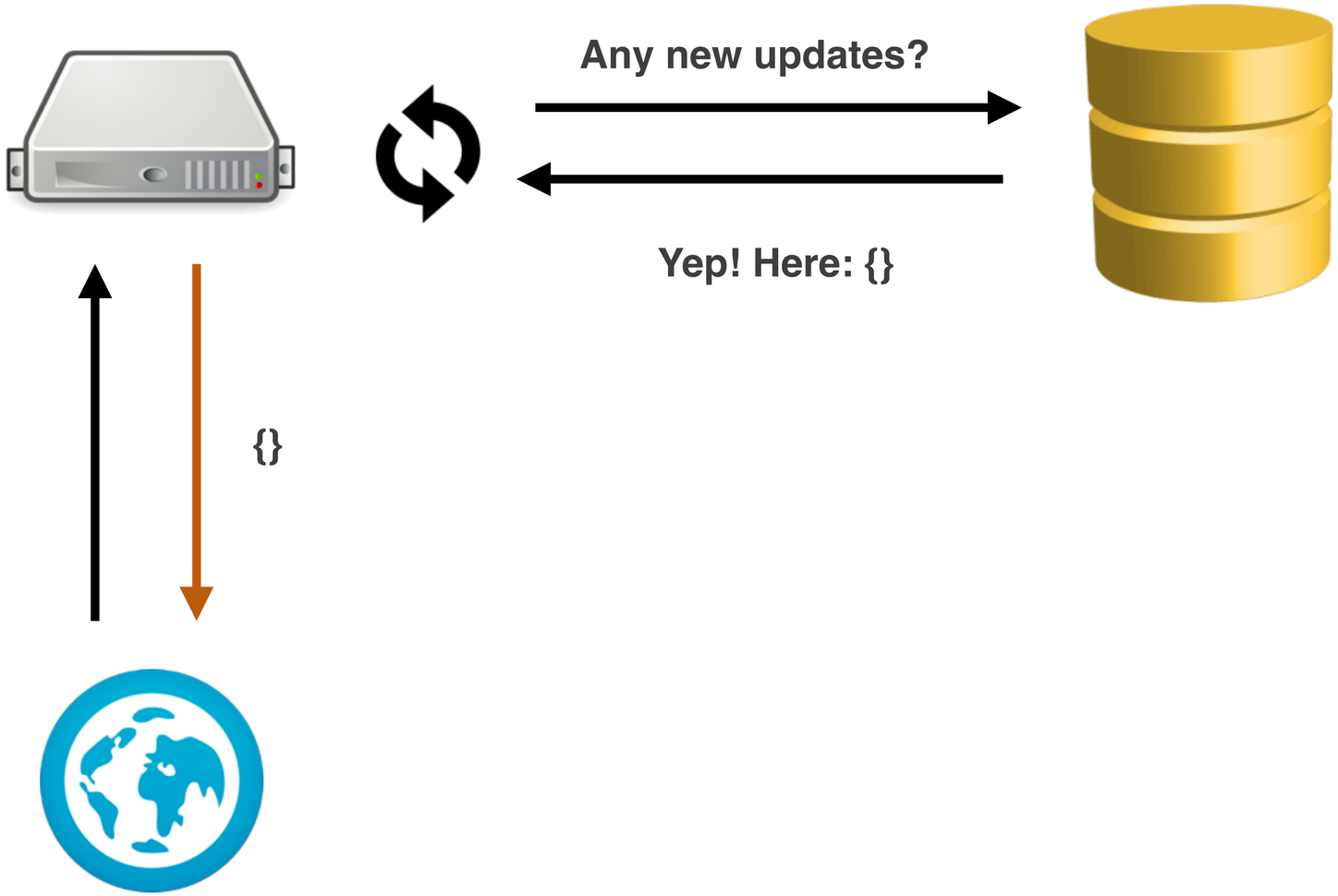

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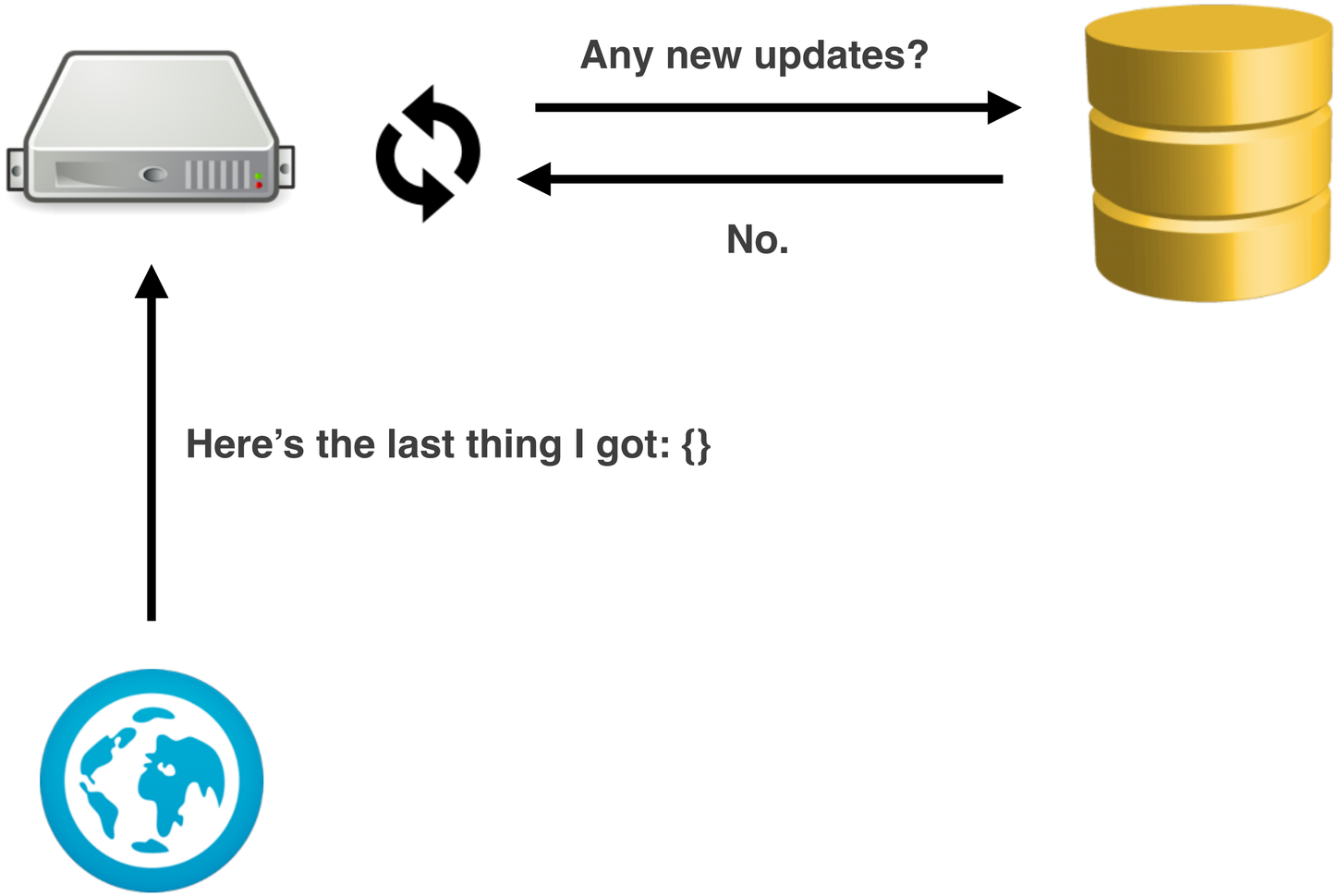

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- No live updates without long polling 😢

TCP

Transmission Control Protocol

TCP

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- **TCP is a *transport* layer protocol**

INTERNET PROTOCOL SUITE — LAYERS WITHIN LAYERS

(opening into more layers)

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(opening into more layers)

1: Link

What physical media are we using?

Who can talk when?

Ethernet

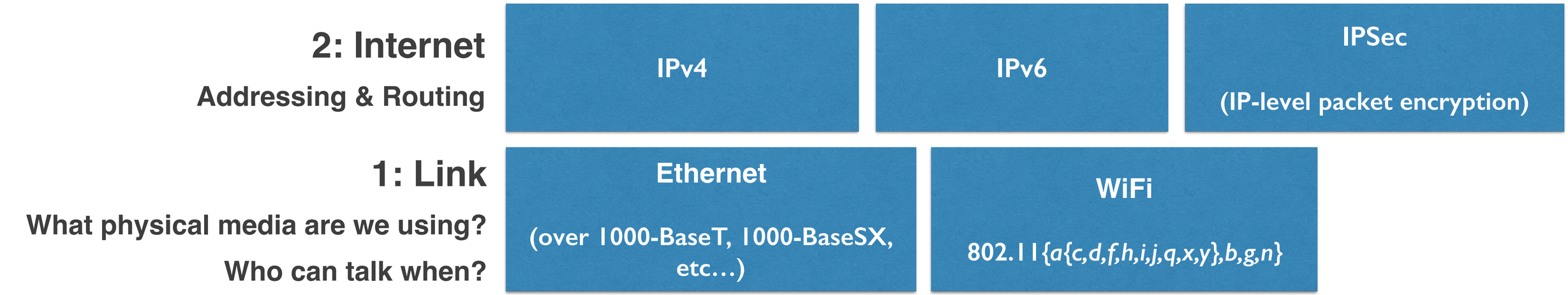
(over 1000-BaseT, 1000-BaseSX, etc…)

WiFi

802.11{*a*{*c,d,f,h,i,j,q,x,y*},*b,g,n*}

INTERNET PROTOCOL SUITE — LAYERS WITHIN LAYERS

(opening into more layers)



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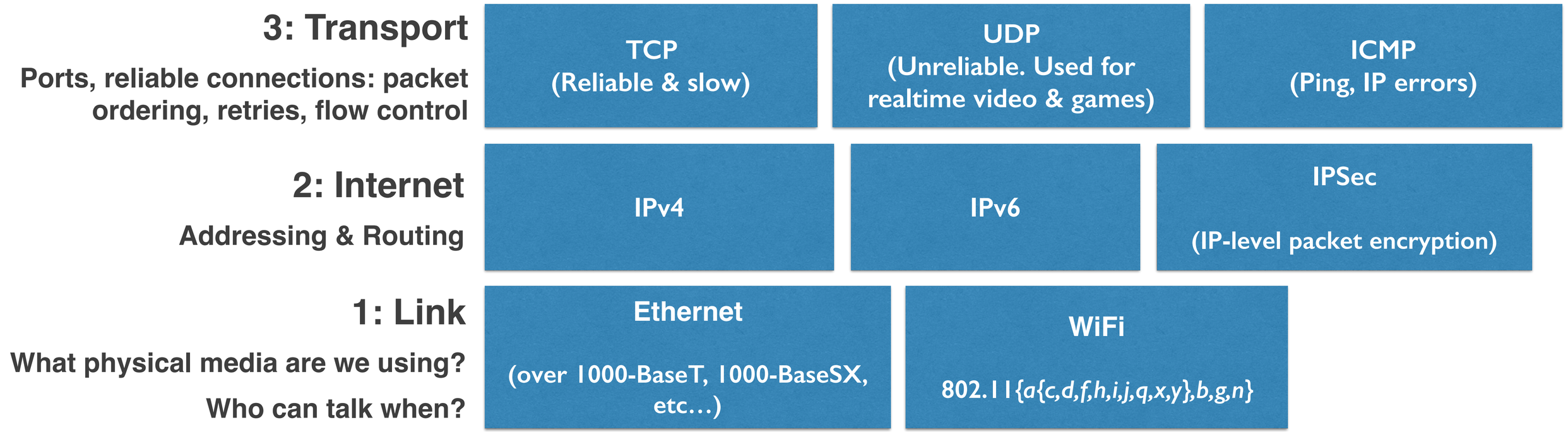

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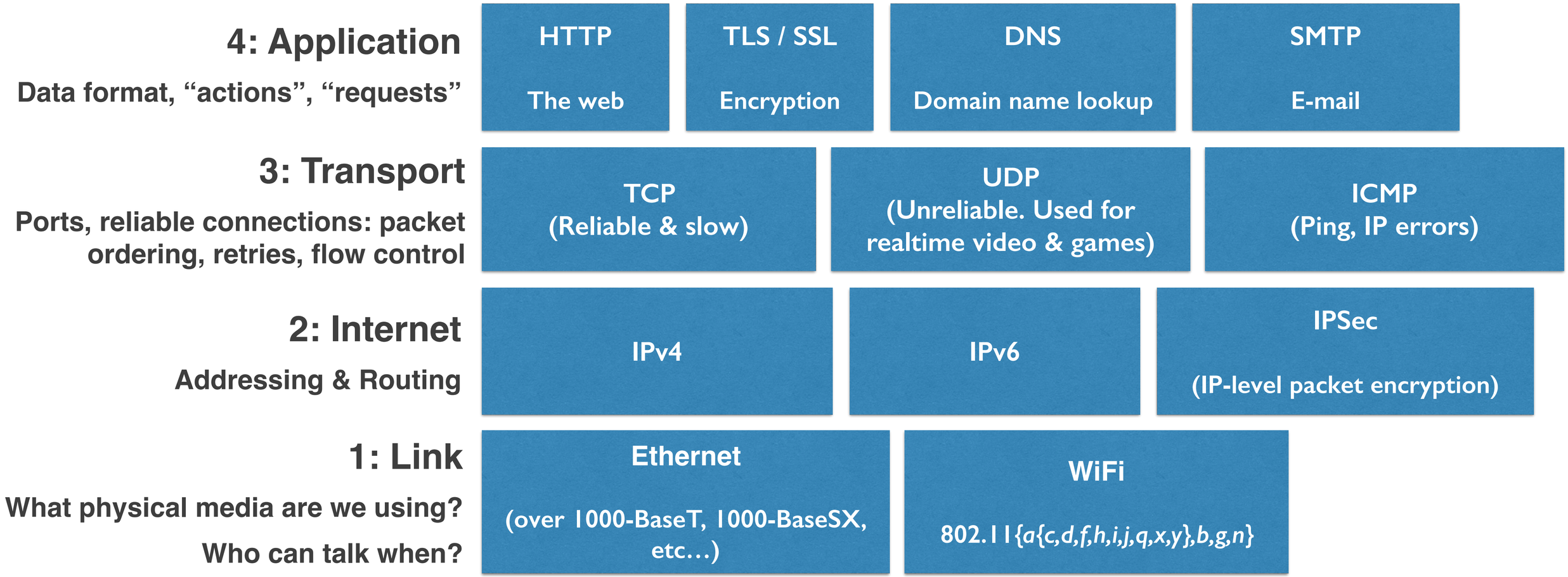

These are IPv6

They’re really long so there can be more of them than with IPv4.

(See, we ran out of IPv4 addresses. So we made IPv6 addresses big enough to assign an address to every atom in the universe every nanosecond.)

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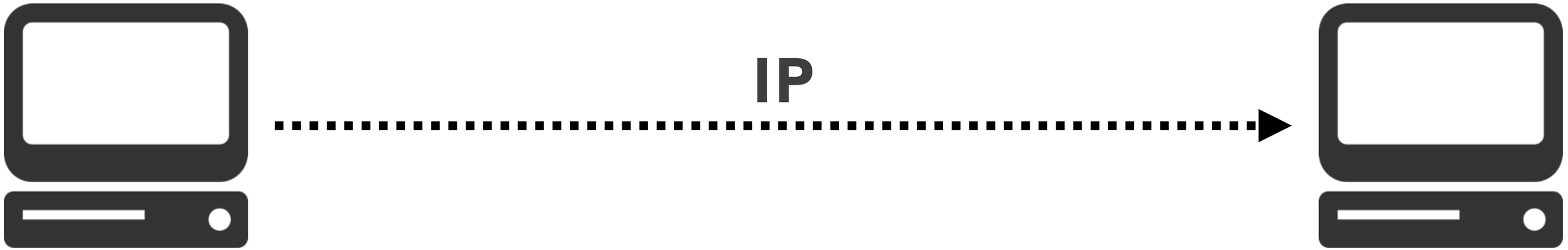

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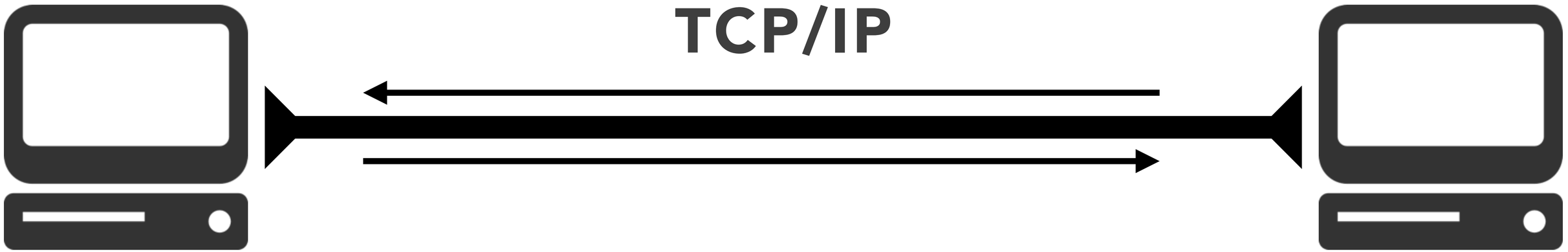
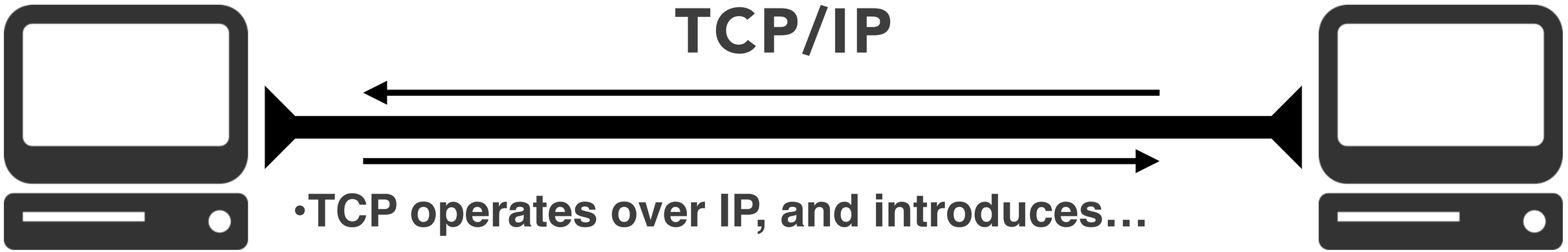
- **Unreliable, connectionless**


TCP/IP



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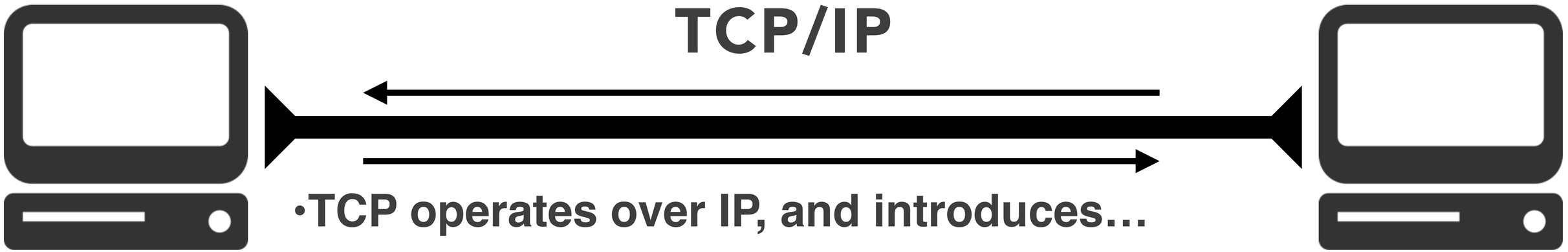

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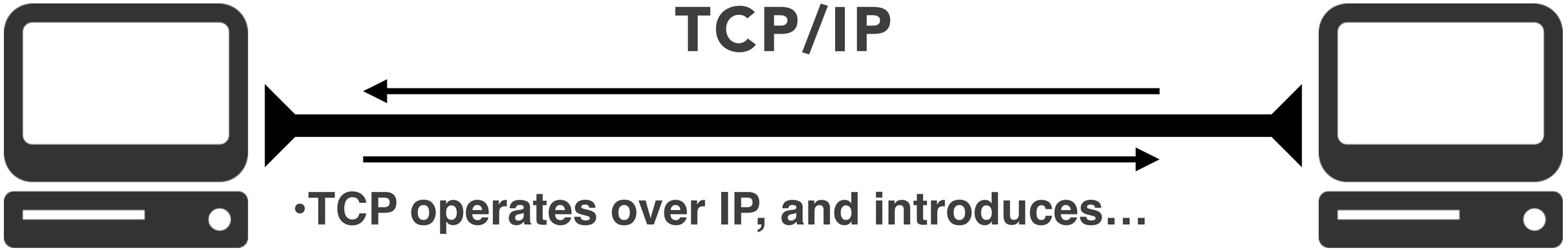

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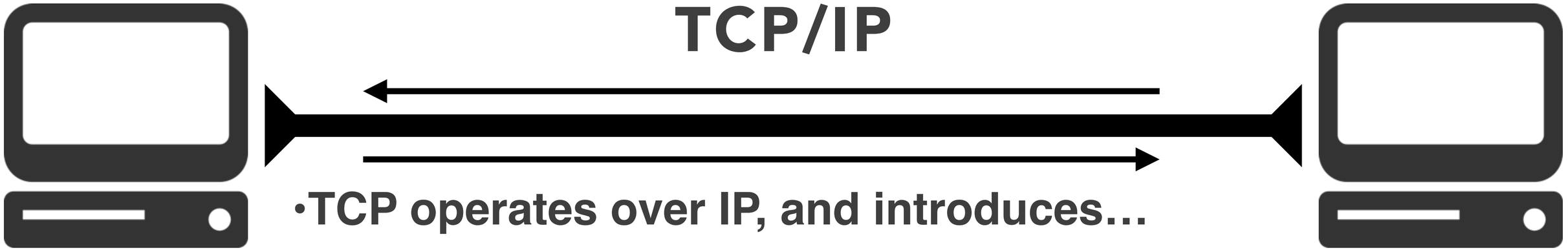

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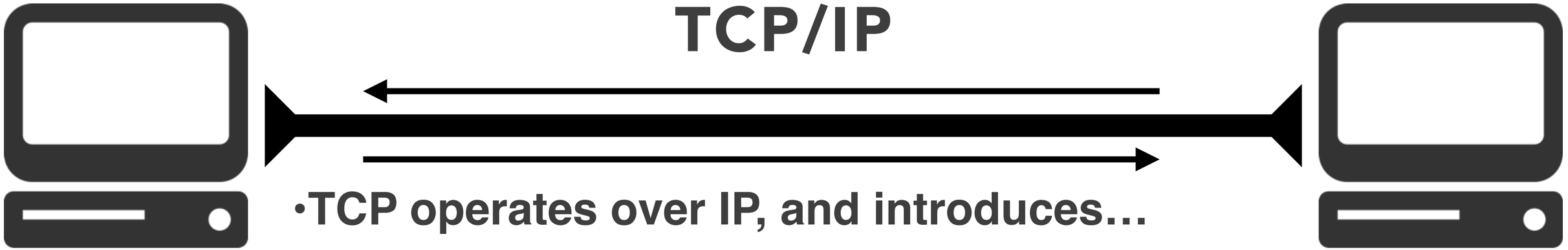

- TCP operates over IP, and introduces…
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- Connections: to figure out packet ordering & loss
- Retries & flow control: to deal with packet loss
- Reliable connection that persists over time

TCP AND HTTP

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- **Implements the idea of a “session”, which establishes a TCP socket for the client to make requests and the server to issue responses**

CLIENT OPENS A TCP CONNECTION TO SERVER

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let’s synchronize!

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ok, let's synchronize!

ok!

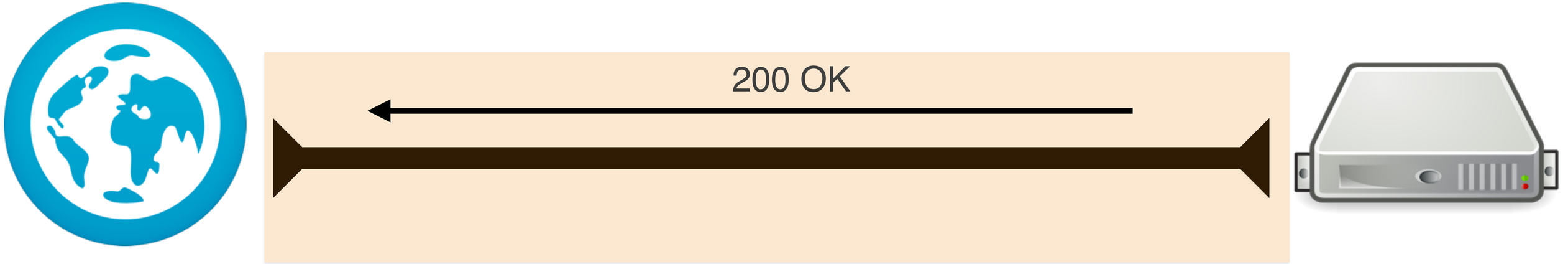
TCP CONNECTION IS ESTABLISHED

CLIENT SENDS A REQUEST

(over the connection)

SERVER SENDS A RESPONSE

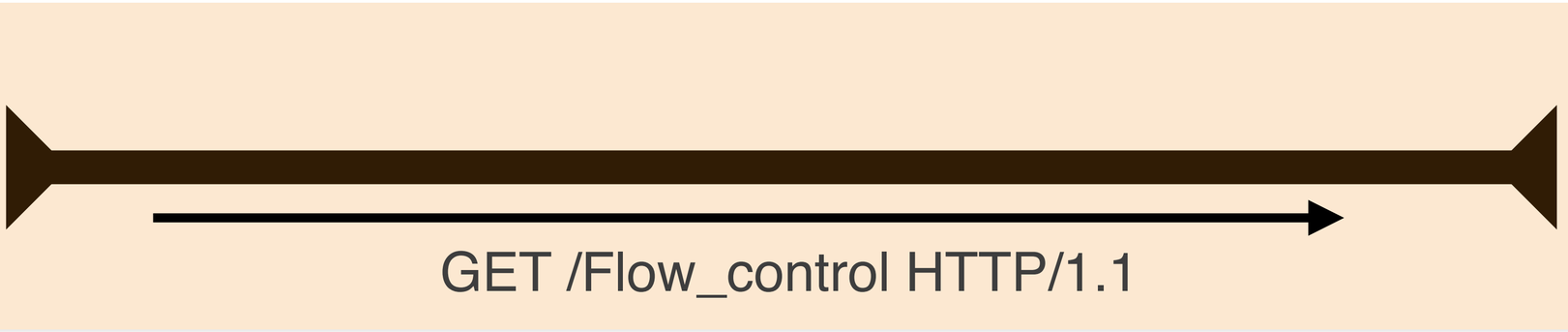
(over the connection)



TCP CONNECTION STAYS OPEN

CLIENT SENDS MORE REQUESTS

(over the same connection)



SERVER SENDS MORE RESPONSES

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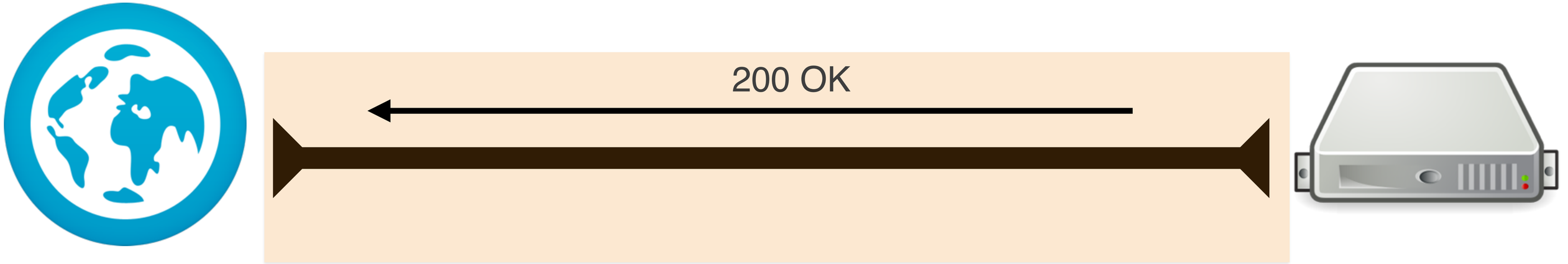

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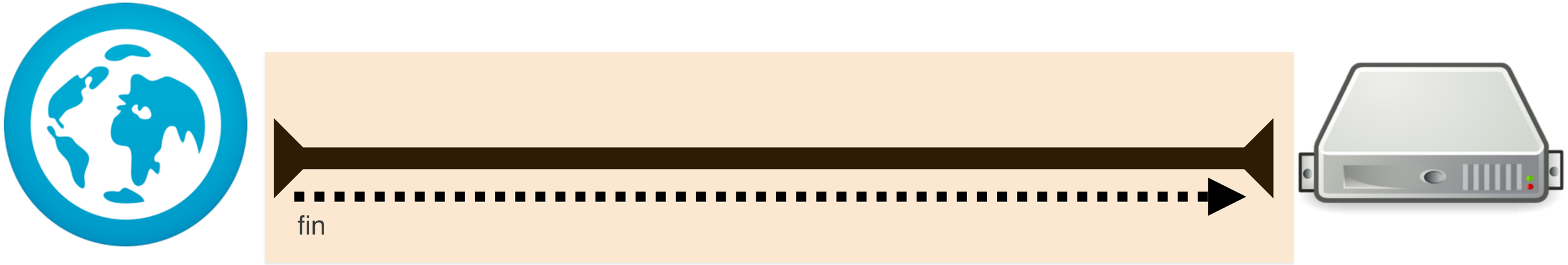

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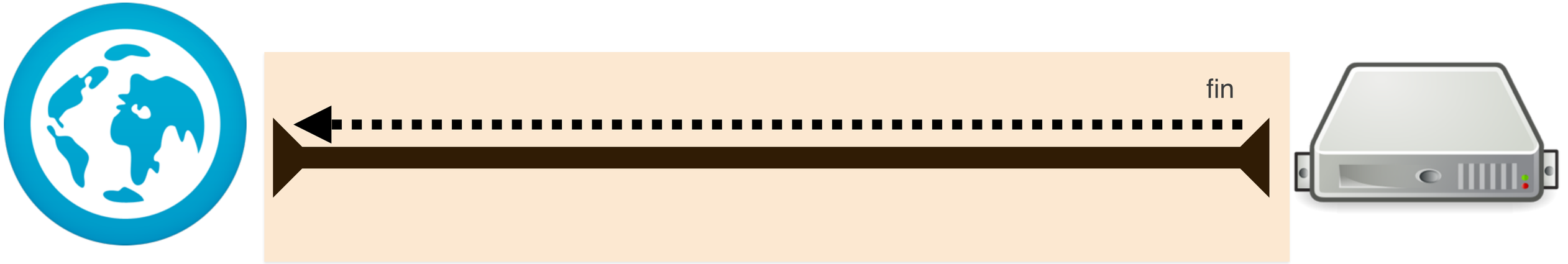

AND ONE OF YOU ENDS THE CONNECTION

HTTP 1.1 REQUEST / RESPONSE CYCLE

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HTTP 1.1 REQUEST / RESPONSE CYCLE

- **Client sends a request**
- **Server sends a response**
- **Server can't "push" more data to the client unless the client makes another request**
  - …Even though there's this tasty TCP connection just sitting around

WEBSOCKETS AND SOCKET.IO

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- Application-layer protocol

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- **So how do you open a WebSocket?**

WEBSOCKETS START WITH HTTP

Client says:

Server replies:

WEBSOCKETS START WITH HTTP

Client says:

GET /chat HTTP/1.1

Host: server.example.com

Upgrade: websocket

Connection: Upgrade

Sec-WebSocket-Key: x3JJHMbDL1EzLkh9GBhXDw==

Sec-WebSocket-Protocol: chat, superchat

Sec-WebSocket-Version: 13

Origin: http://example.com

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HTTP/1.1 101 Switching Protocols

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Connection: Upgrade

Sec-WebSocket-Key: x3JJHMbDL1EzLkh9GBhXDw==

Sec-WebSocket-Protocol: chat, superchat

Sec-WebSocket-Version: 13

Origin: http://example.com

Server replies:

HTTP/1.1 101 Switching Protocols

Upgrade: websocket

Connection: Upgrade

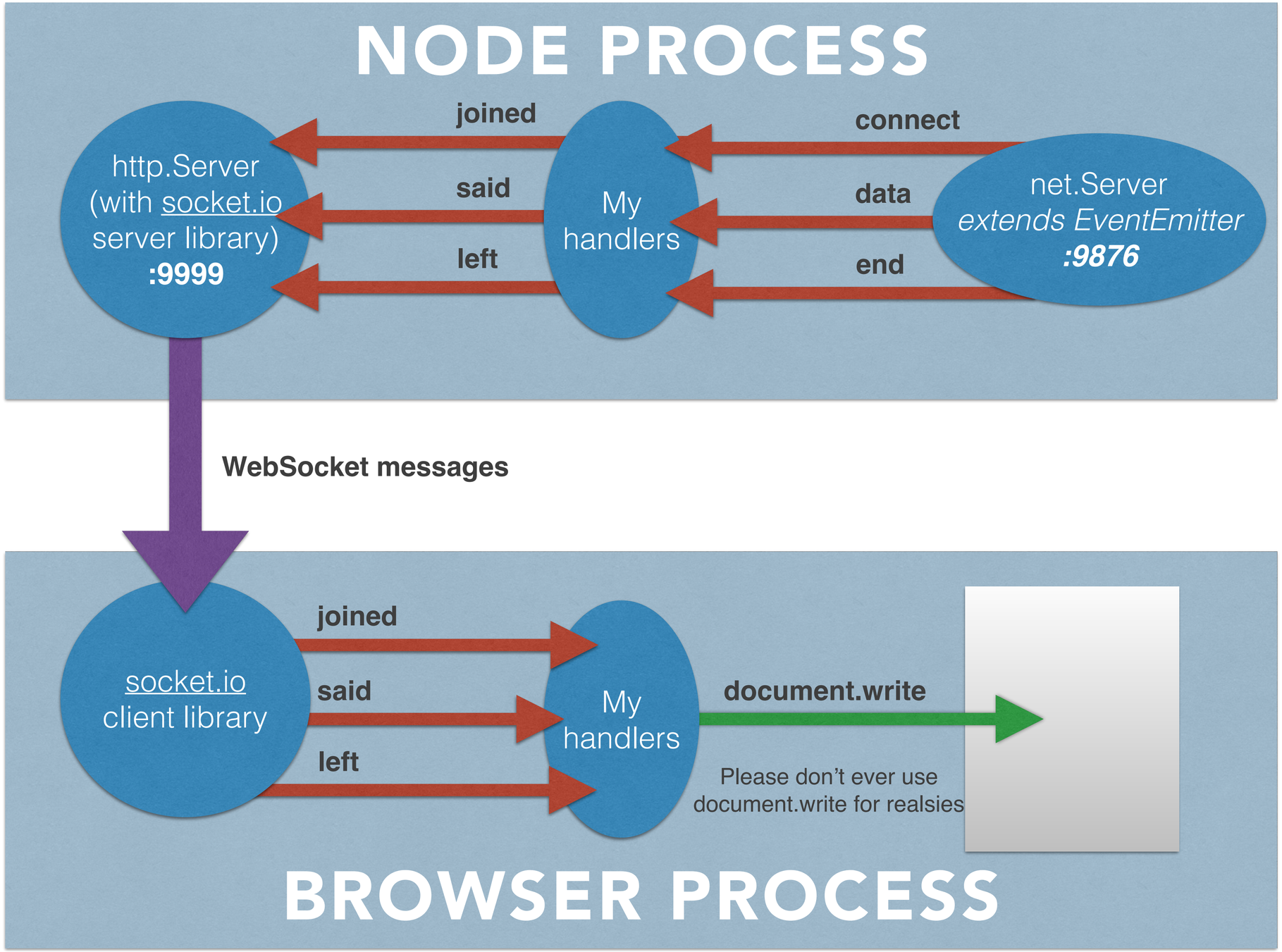
Sec-WebSocket-Accept: HSmrc0sMlYUkAGmm5OPpG2HaGWk=

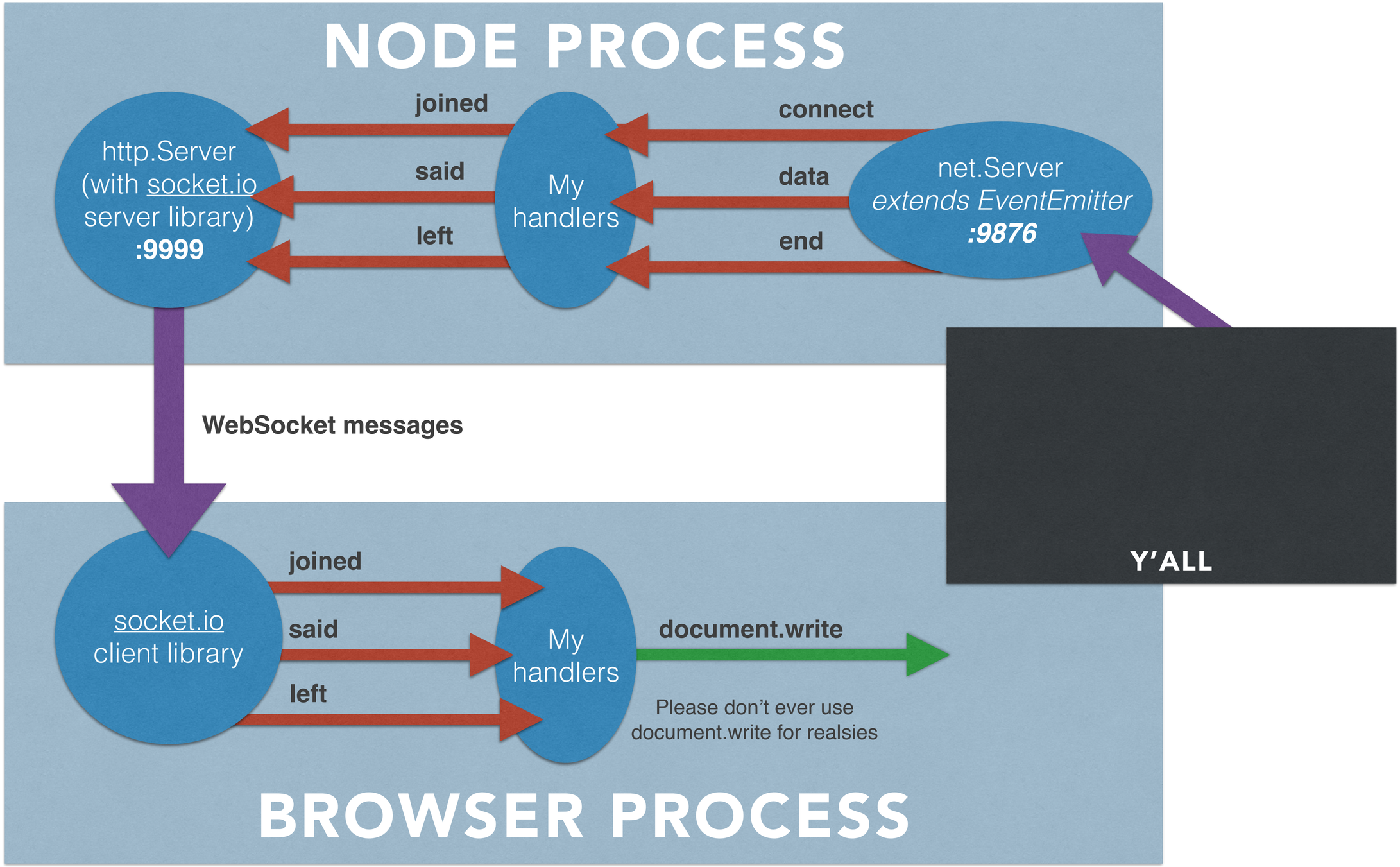
Sec-WebSocket-Protocol: chat

And now WebSocket has taken over the connection.

SOCKET.IO

- **You don’t have to implement that**
- **Socket.IO is a duet of libraries (one for server-side [node.js] and one for client-side [the browser])**
- **Abstracts the complex implementation of websockets for easy use**
- **Extensively uses** EventEmitter**s**
  - EventEmitters are a good fit for a message-based protocol


NODE PROCESS
http.Server
(with socket.io
server library)
:9999
joined
said
left
My
handlers
connect
data
end
net.Server
extends EventEmitter
:9876
WebSocket messages
socket.io
client library
joined
said
left
My
handlers
document.write
Please don't ever use
document.write for realsies
BROWSER PROCESS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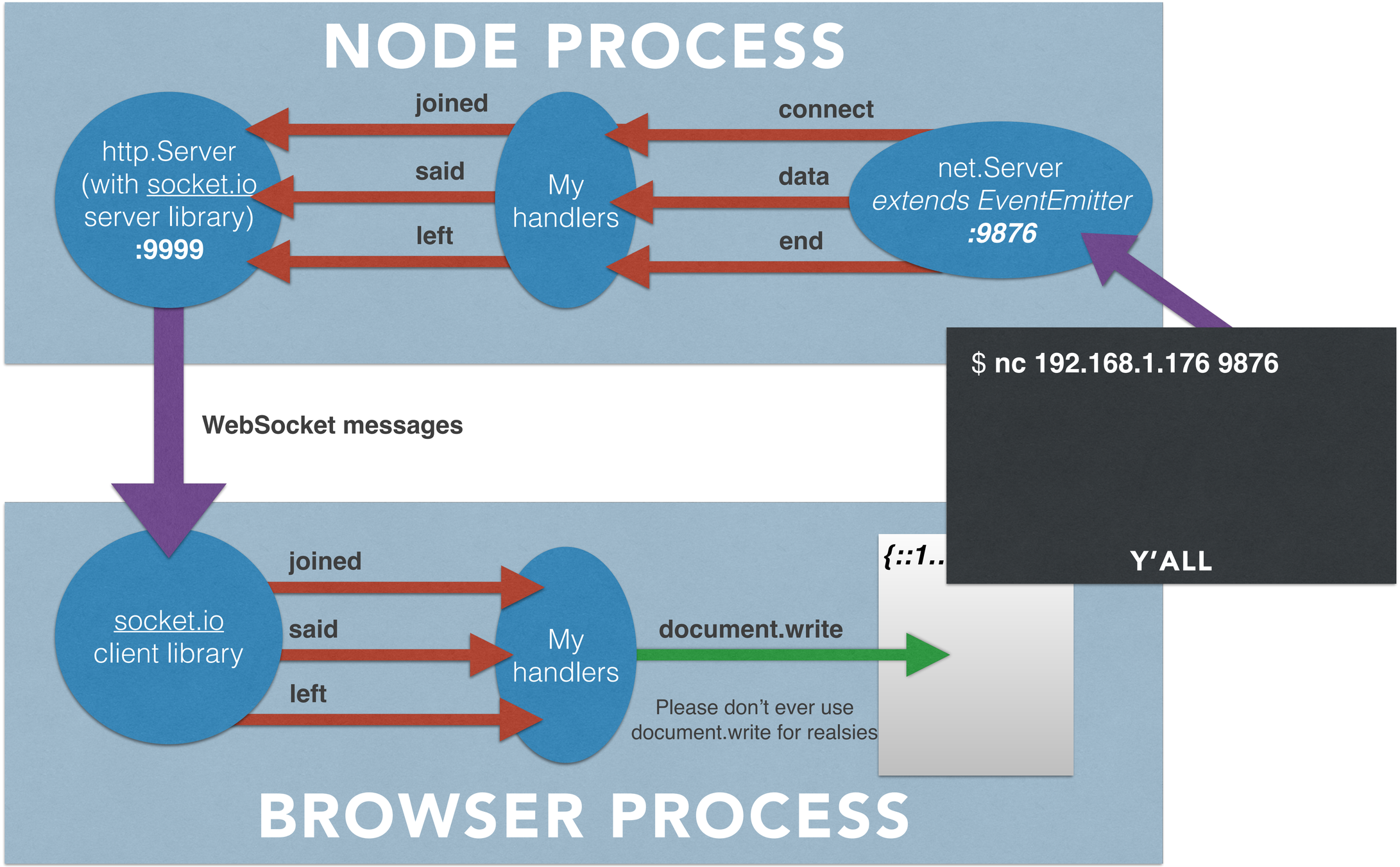
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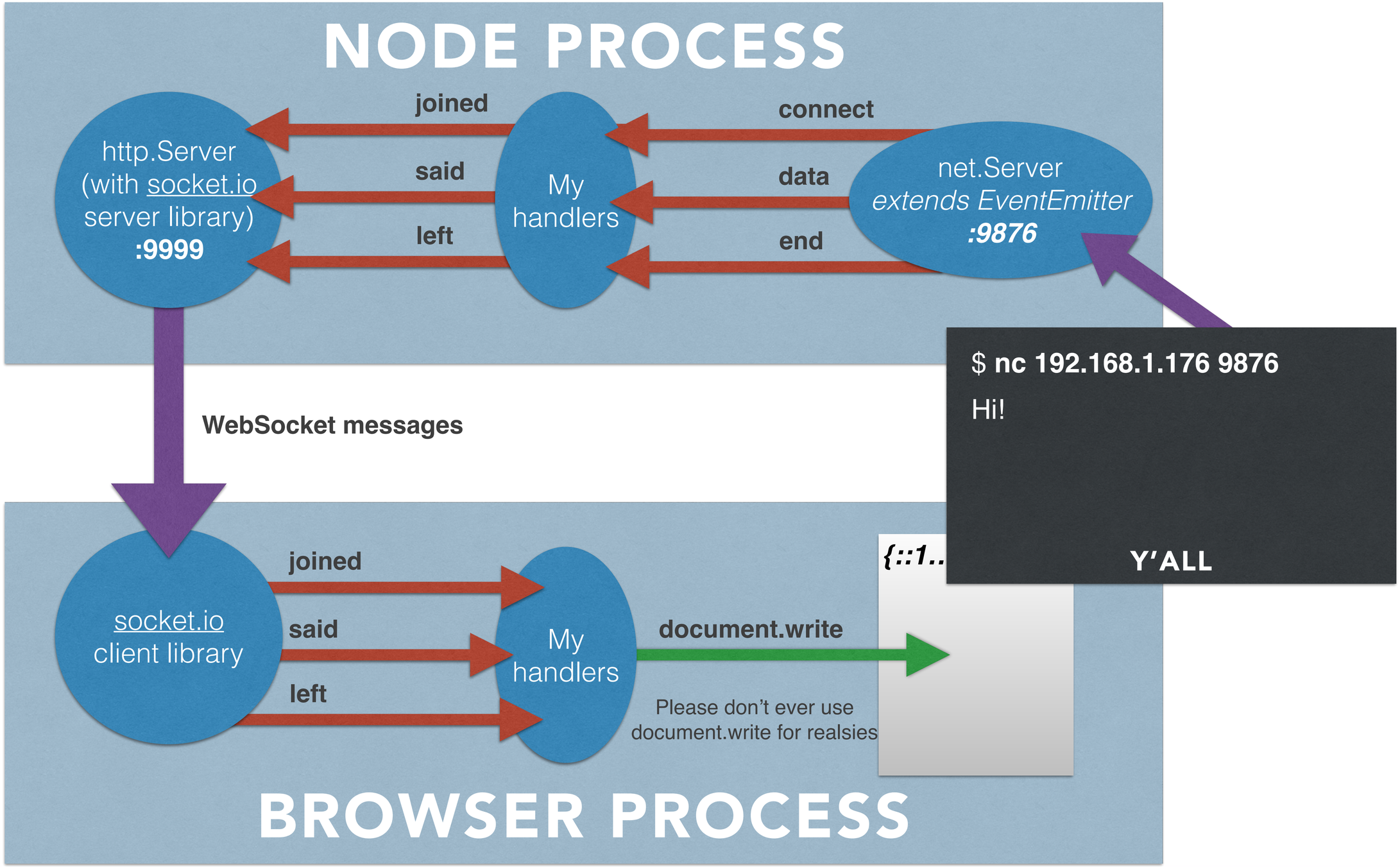
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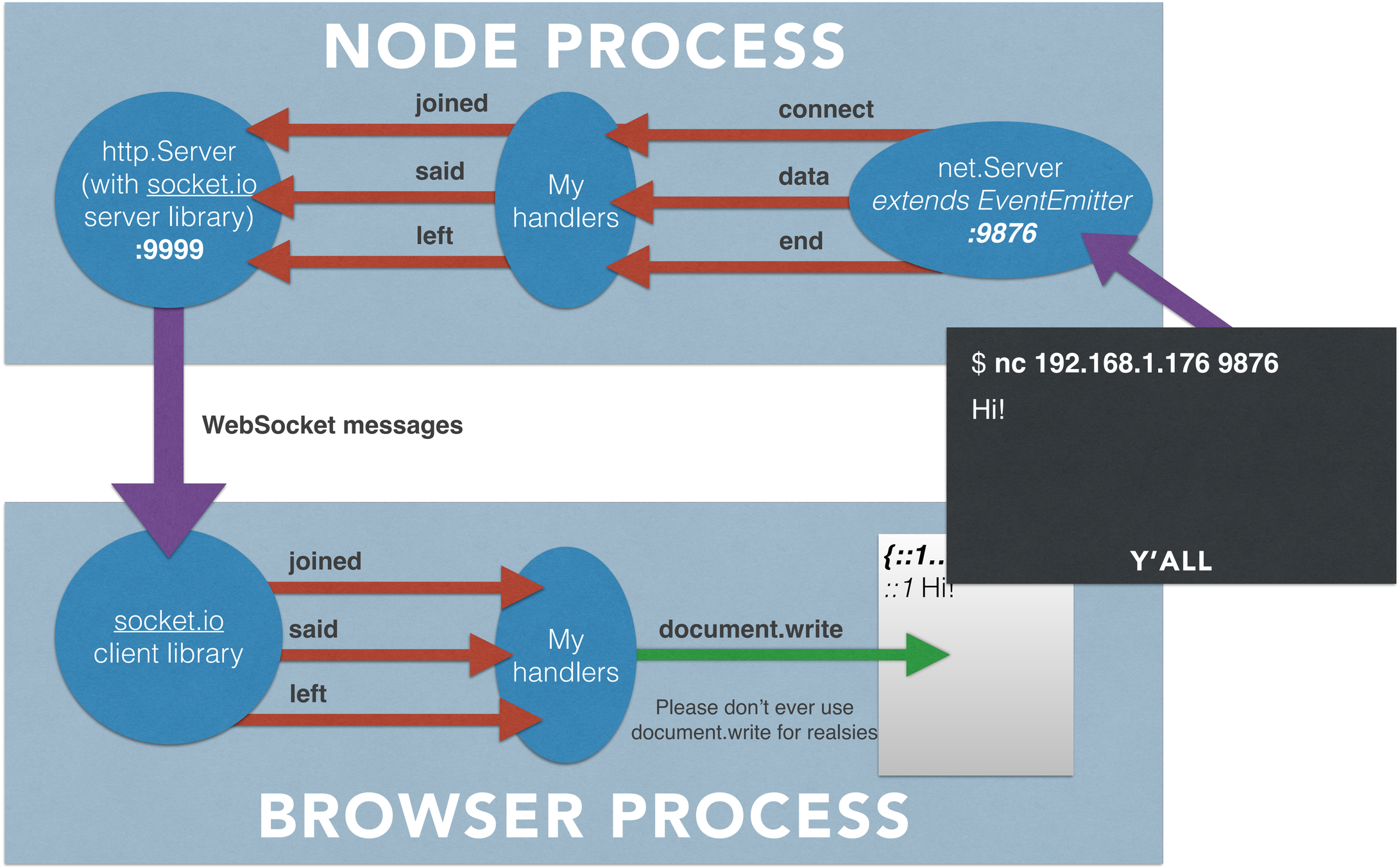
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BROWSER PROCESS

USE CASES

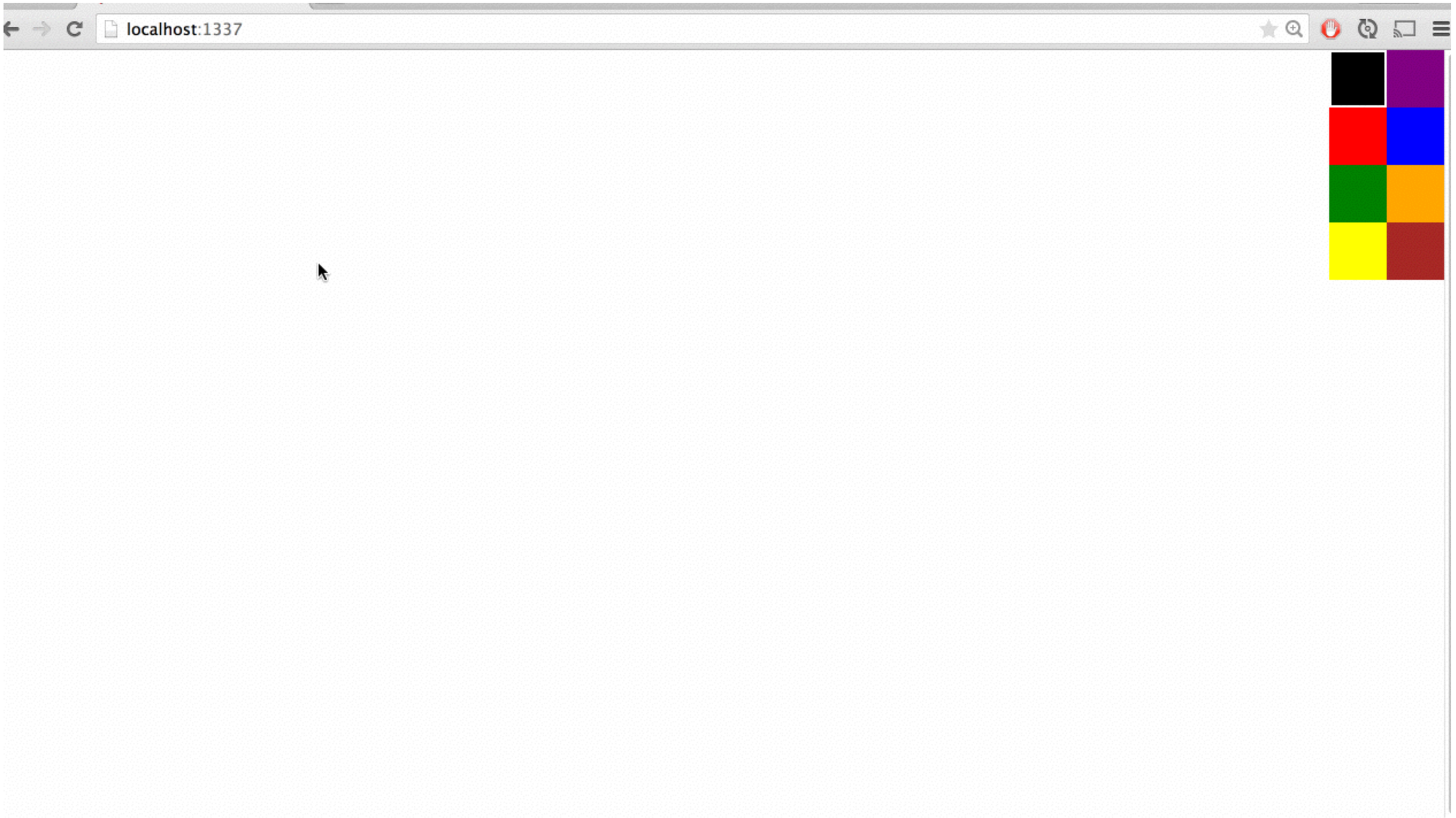
- Networked enabled games
- Chat applications
- Collaborative applications
- Any “real-time” software

DRAWBACKS

- **The server now *must* hold on to the connection**
- **Connections are expensive (they require memory within the operating system)**
- **If a socket sits dormant for a long time, it's wasting server resources.**
  - You could fix this in your app, though! You have the power!

OTHER SOCKET.IO NOTES

- Documentation leaves a lot to be desired
- Automatically uses fallbacks for different capabilities and environments (long polling, Flash)
- Has “rooms” and “namespaces” for socket organization
- Can “broadcast” to all sockets within a “room”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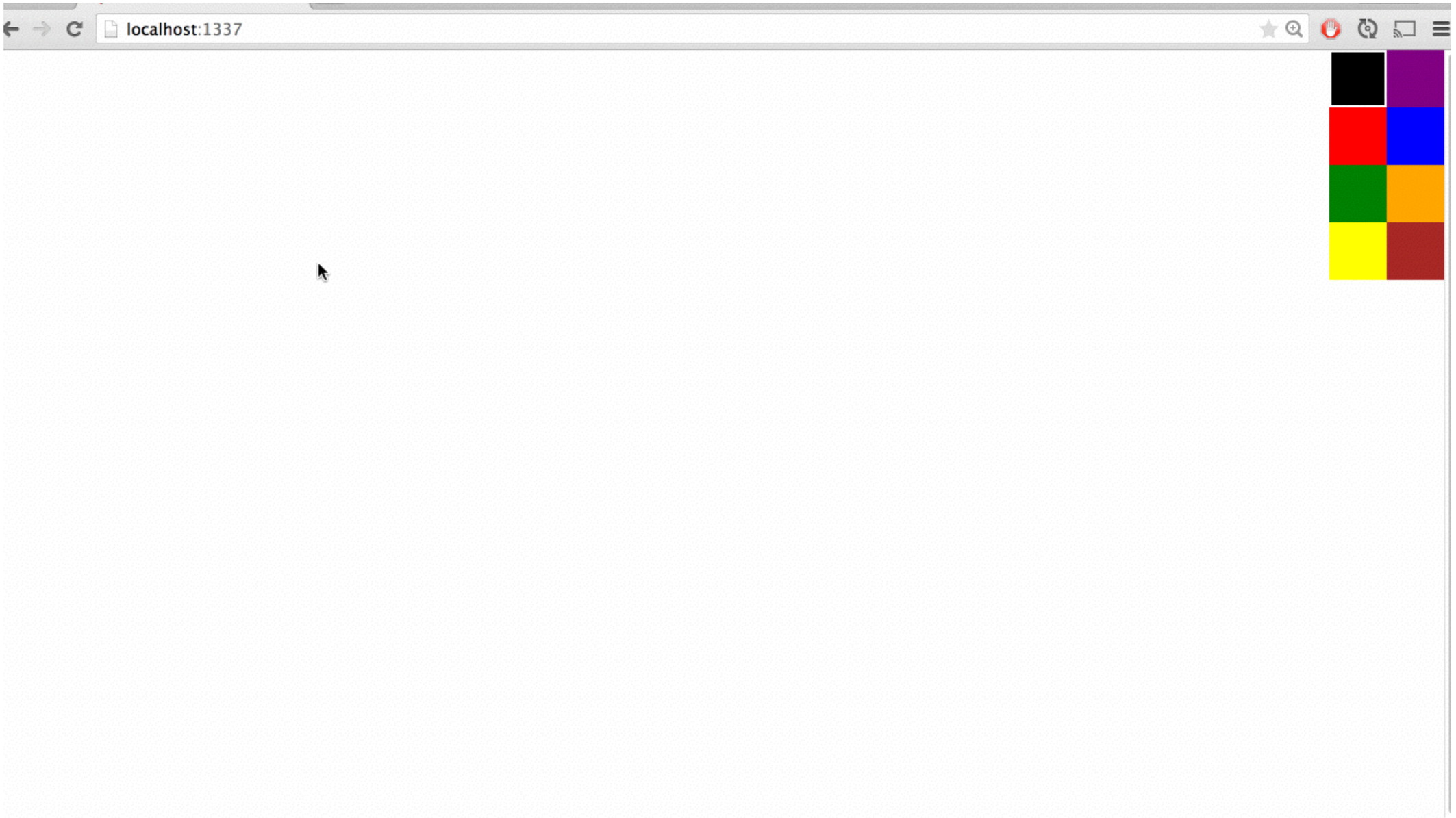
localhost:1337