WebSocket

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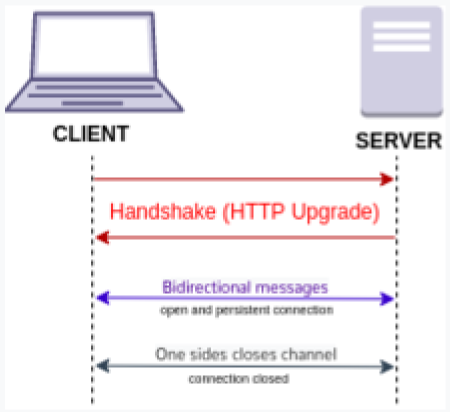


A diagram describing a connection using WebSocket

International standard	RFC 6455
Developed by	IETF
Industry	Computer science
Connector type	TCP
Website	Official website

WebSocket is a computer communications protocol, providing full-duplex communication channels over a single TCP connection. The WebSocket protocol was standardized by the IETF as RFC 6455 in 2011. The current API specification allowing web applications to use this protocol is known as *WebSockets*.[1] It is a living standard maintained by the WHATWG and a successor to *The WebSocket API* from the W3C.[2]

WebSocket is distinct from HTTP. Both protocols are located at layer 7 in the OSI model and depend on TCP at layer 4. Although they are different, RFC 6455 states that WebSocket "is designed to work over HTTP ports 443 and 80 as well as to support HTTP proxies and intermediaries", thus making it compatible with HTTP. To achieve compatibility, the WebSocket handshake uses the HTTP Upgrade header[3] to change from the HTTP protocol to the WebSocket protocol.

The WebSocket protocol enables interaction between a web browser (or other client application) and a web server with lower overhead than half-duplex alternatives such as HTTP polling, facilitating real-time data transfer from and to the server. This is made possible by providing a standardized way for the server to send content to the client without being first requested by the client, and allowing messages to be passed back and forth while keeping the connection open. In this way, a two-way ongoing conversation can take place between the client and the server. The communications are usually done over TCP port number 443 (or 80 in the case of unsecured connections), which is beneficial for environments that block non-web Internet connections using a firewall. Similar two-way browser–server communications have been achieved in non-standardized ways using stopgap technologies such as Comet or Adobe Flash Player.[4]

Most browsers support the protocol, including Google Chrome, Firefox, Microsoft Edge, Internet Explorer, Safari and Opera.[5]

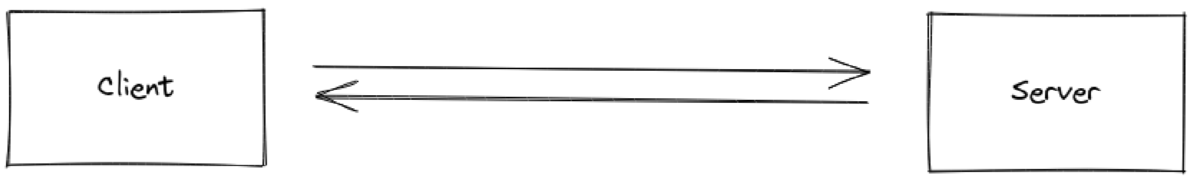
Unlike HTTP, WebSocket provides full-duplex communication.[6][7] Additionally, WebSocket enables streams of messages on top of TCP. TCP alone deals with streams of bytes with no inherent concept of a message. Before WebSocket, port 80 full-duplex communication was attainable using Comet channels; however, Comet implementation is nontrivial, and due to the TCP handshake and HTTP header overhead, it is inefficient for small messages. The WebSocket protocol aims to solve these problems without compromising the security assumptions of the web.

The WebSocket protocol specification defines `ws` (WebSocket) and `wss` (WebSocket Secure) as two new uniform resource identifier (URI) schemes[8] that are used for unencrypted and encrypted connections respectively. Apart from the scheme name and fragment (i.e. `#` is not supported), the rest of the URI components are defined to use URI generic syntax.[9]

Introduction

What Socket.IO is

Socket.IO is a library that enables **low-latency**, **bidirectional** and **event-based** communication between a client and a server.



It is built on top of the WebSocket protocol and provides additional guarantees like fallback to HTTP long-polling or automatic reconnection.

INFO

WebSocket is a communication protocol which provides a full-duplex and low-latency channel between the server and the browser. More information can be found here.

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Here's a basic example with plain WebSockets:

Server (based on ws)

```
import { WebSocketServer } from "ws";

const server = new WebSocketServer({ port: 3000 });

server.on("connection", (socket) => {
  // send a message to the client
  socket.send(JSON.stringify({
    type: "hello from server",
    content: [ 1, "2" ]
  }));

  // receive a message from the client
  socket.on("message", (data) => {
    const packet = JSON.parse(data);

    switch (packet.type) {
      case "hello from client":
        // ...
        break;
    }
  });
});
```

Copy

Client

```
const socket = new WebSocket("ws://localhost:3000");

socket.addEventListener("open", () => {
  // send a message to the server
  socket.send(JSON.stringify({
    type: "hello from client",
    content: [ 3, "4" ]
  }));
});

// receive a message from the server
socket.addEventListener("message", ({ data }) => {
  const packet = JSON.parse(data);

  switch (packet.type) {
    case "hello from server":
      // ...
      break;
  }
});
```
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And here's the same example with Socket.IO:

Server

```
import { Server } from "socket.io";

const io = new Server(3000);

io.on("connection", (socket) => {
  // send a message to the client
  socket.emit("hello from server", 1, "2", { 3: Buffer.from([4]) });

  // receive a message from the client
  socket.on("hello from client", (...args) => {
    // ...
  });
});
```
Copy

Client

```
import { io } from "socket.io-client";

const socket = io("ws://localhost:3000");

// send a message to the server
socket.emit("hello from client", 5, "6", { 7: Uint8Array.from([8]) });

// receive a message from the server
socket.on("hello from server", (...args) => {
  // ...
});
```
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Both examples looks really similar, but under the hood Socket.IO provides additional features that hide the complexity of running an application based on WebSockets in production. Those features are listed below.

But first, let's make it clear what Socket.IO is not.

What Socket.IO is not

CAUTION

Socket.IO is **NOT** a WebSocket implementation.

Although Socket.IO indeed uses WebSocket for transport when possible, it adds additional metadata to each packet. That is why a WebSocket client will not be able to successfully connect to a Socket.IO server, and a Socket.IO client will not be able to connect to a plain WebSocket server either.

```
// WARNING: the client will NOT be able to connect!
const socket = io("ws://echo.websocket.org");
```

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If you are looking for a plain WebSocket server, please take a look at ws or µWebSockets.js.

There are also discussions for including a WebSocket server in the Node.js core.

On the client-side, you might be interested in the robust-websocket package.

CAUTION

Socket.IO is not meant to be used in a background service for mobile applications.

The Socket.IO library keeps an open TCP connection to the server, which may result in a high battery drain for your users. Please use a dedicated messaging platform like FCM for this use case.

Features

Here are the features provided by Socket.IO over plain WebSockets:

HTTP long-polling fallback

The connection will fall back to HTTP long-polling in case the WebSocket connection cannot be established.

This feature was the #1 reason people used Socket.IO when the project was created more than ten years ago (!), as the browser support for WebSockets was still in its infancy.

Even if most browsers now support WebSockets (more than 97%), it is still a great feature as we still receive reports from users that cannot establish a WebSocket connection because they are behind some misconfigured proxy.

Automatic reconnection

Under some particular conditions, the WebSocket connection between the server and the client can be interrupted with both sides being unaware of the broken state of the link.

That's why Socket.IO includes a heartbeat mechanism, which periodically checks the status of the connection.

And when the client eventually gets disconnected, it automatically reconnects with an exponential back-off delay, in order not to overwhelm the server.

Packet buffering

The packets are automatically buffered when the client is disconnected, and will be sent upon reconnection.

More information here.

Acknowledgements

Socket.IO provides a convenient way to send an event and receive a response:

Sender

```
socket.emit("hello", "world", (response) => {
  console.log(response); // "got it"
});
```

Copy

Receiver

```
socket.on("hello", (arg, callback) => {
  console.log(arg); // "world"
  callback("got it");
});
```

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You can also add a timeout:

```
socket.timeout(5000).emit("hello", "world", (err, response) => {
  if (err) {
    // the other side did not acknowledge the event in the given delay
  } else {
    console.log(response); // "got it"
  }
});
```

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Broadcasting

On the server-side, you can send an event to all connected clients or to a subset of clients:

```
// to all connected clients
io.emit("hello");

// to all connected clients in the "news" room
io.to("news").emit("hello");
```

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This also works when scaling to multiple nodes.

Multiplexing

Namespaces allow you to split the logic of your application over a single shared connection. This can be useful for example if you want to create an "admin" channel that only authorized users can join.

```
io.on("connection", (socket) => {
  // classic users
});

io.of("/admin").on("connection", (socket) => {
  // admin users
});
```

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More on that here.

Common questions

Is Socket.IO still needed today?

That's a fair question, since WebSockets are supported almost everywhere now.

That being said, we believe that, if you use plain WebSockets for your application, you will eventually need to implement most of the features that are already included (and battle-tested) in Socket.IO,
like reconnection, acknowledgements or broadcasting.

What is the overhead of the Socket.IO protocol?

`socket.emit("hello", "world")` will be sent as a single WebSocket frame containing `42["hello","world"]` with:

- `4` being Engine.IO "message" packet type
- `2` being Socket.IO "message" packet type
- `["hello","world"]` being the `JSON.stringify()`-ed version of the arguments array

So, a few additional bytes for each message, which can be further reduced by the usage of a custom parser.

INFO

The size of the browser bundle itself is `10.4 kB` (minified and gzipped).