



# Standard **Standard** Ecma-XXX

1<sup>st</sup> Edition / 31 May 2025

## Sockets API

# Standard

Ecma International  
Rue du Rhone 114 CH-1204 Geneva  
Tel: +41 22 849 6000  
Fax: +41 22 849 6001  
Web: <https://www.ecma-international.org>

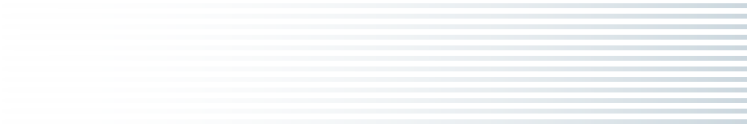


is the registered trademark of Ecma International



**COPYRIGHT PROTECTED DOCUMENT**

Table of Contents	page
<b>1 Concepts</b>	<b>4</b>
1.1 Socket	4
1.2 Connect.	4
1.3 Binding Object	4
<b>2 Socket</b>	<b>5</b>
2.1 Using a socket	5
2.2 The Socket class.	5
2.3 Attributes	6
2.3.1 readable	6
2.3.2 writable.	6
2.3.3 opened	6
2.3.4 closed.	7
2.4 Methods	7
2.4.1 close(optional any reason).	7
2.4.2 startTls().	7
2.5 SocketError.	8
<b>3 connect</b>	<b>8</b>
3.1 SocketOptions dictionary.	9
3.2 SocketInfo dictionary	10
3.3 AnySocketAddress type	10
<b>References</b>	<b>10</b>
<b>Normative References</b>	<b>10</b>
<b>Index</b>	<b>10</b>
<b>Terms defined by this specification</b>	<b>10</b>
<b>Terms defined by reference</b>	<b>11</b>
<b>IDL Index</b>	<b>12</b>
<b>4 Copyright Notice</b>	<b>13</b>
<b>5 Software License</b>	<b>13</b>



## Introduction

This document defines an API for establishing TCP connections in Non-Browser JavaScript runtime environments. Existing standard APIs are reused as much as possible, for example [ReadableStream](#) and [WritableStream](#) are used for reading and writing from a [socket](#). Some options are inspired by the existing Node.js `net.Socket` API.

# Contributing to this Specification

This version:

<https://sockets-api.proposal.wintercg.org/>

Issue Tracking:

[GitHub](#)

Editors:

[Dominik Picheta](#) ([Cloudflare](#))

[Ethan Arrowood](#)

[James M Snell](#) ([Cloudflare](#))

## 1. Concepts

### 1.1. Socket

A *socket* represents a TCP connection, from which you can read and write data. A socket begins in a *connected* state (if the socket fails to connect, an error is thrown). While in a *connected* state, the socket's [ReadableStream](#) and [WritableStream](#) can be read from and written to respectively.

A socket becomes *closed* when its [close\(\)](#) method is called. A socket configured with `allowHalfOpen: false` will close itself when it receives a FIN or RST packet in its read stream.

### 1.2. Connect

The [connect](#) method here is defined in a `sockets` module only for initial implementation purposes. It is imagined that in a finalized standard definition, the [connect](#) would be exposed as a global or within a [binding object](#)

A socket can be constructed using a *connect* method defined in a `sockets` module (early implementations may use `vendor: sockets` for the module name), or defined on a [binding object](#).

The connect method is the primary mechanism for creating a [socket](#) instance. It instantiates a socket with a resource identifier and some configuration values. It should synchronously return a socket instance in a *pending* state (or an error should be thrown). The socket will asynchronously *connect* depending on the implementation.

### 1.3. Binding Object

A [binding object](#) in this context is essentially just an object that exposes a [connect](#) method conformant with this specification. It is anticipated that a runtime may have any number of such objects. This is an area where there is still active discussion on how this should be defined.

The *binding object* defines extra socket `connect` options. The options it contains can modify the behaviour of the `connect` invoked on it. Some of the options it can define:

- TLS settings
- The HTTP proxy to use for the socket connection

The binding object is the primary mechanism for runtimes to introduce unique behavior for the [connect](#) method. For example, in order to support more TLS settings, a runtime may introduce a `TLSSocket` interface that extends from [Socket](#). Thus, the binded [connect\(\)](#) method could then utilize additional properties and configuration values that are controlled by the new `TLSSocket` interface.

```
const tls_socket = new TLSSocket({ key: '...', cert: '...' });
tls_socket.connect("example.com:1234");
```

Additionally, the binding object does not necessarily have to be an instance of a class, nor does it even have to be JavaScript. It can be any mechanism that exposes the `connect()` method. Cloudflare achieves this through [environment bindings](#).

## 2. Socket

### 2.1. Using a socket

A basic example of using `connect` with an echo server.

```
const socket = connect({ hostname: "my-url.com", port: 43 });

const writer = socket.writable.getWriter();
await writer.write("Hello, World!\r\n");

const reader = socket.readable.getReader();
const result = await reader.read();

console.log(Buffer.from(result.value).toString()); // Hello, World!
```

### 2.2. The `Socket` class

The `Socket` class is an instance of the `socket` concept. It should not be instantiated directly (`new Socket()`), but instead created by calling `connect()`. A constructor for `Socket` is intentionally not specified, and is left to implementors to create.

```
[Exposed=*]
dictionary SocketInfo {
    DOMString remoteAddress = null;
    DOMString localAddress = null;
    DOMString alpn = null;
};

[Exposed=*]
interface Socket {
    readonly attribute ReadableStream readable;
    readonly attribute WritableStream writable;

    readonly attribute Promise<SocketInfo> opened;

    readonly attribute Promise<undefined> closed;
    Promise<undefined> close(optional any reason);

    [NewObject] Socket startTls();
};
```

The terms `ReadableStream` and `WritableStream` are defined in [\[WHATWG-STREAMS\]](#).

## 2.3. Attributes

### 2.3.1. readable

The **readable** attribute is a **ReadableStream** which receives data from the server the socket is connected to.

The below example shows typical **ReadableStream** usage to read data from a socket:

```
import { connect } from 'sockets';
const socket = connect("google.com:80");

const reader = socket.readable.getReader();

while (true) {
  const { value, done } = await reader.read();
  if (done) {
    // the ReadableStream has been closed or cancelled
    break;
  }
  // In many protocols the `value` needs to be decoded to be used:
  const decoder = new TextDecoder();
  console.log(decoder.decode(value));
}

reader.releaseLock();
```

The **ReadableStream** currently is defined to operate in non-byte mode, that is the **type** parameter to the **ReadableStream** constructor is not set. This means the stream's controller is **ReadableStreamDefaultController**. This, however, should be discussed and may be made configurable. It is reasonable, for instance, to assume that sockets used for most TCP cases would be byte-oriented, while sockets used for messages (e.g. UDP) would not.

### 2.3.2. writable

The **writable** attribute is a **WritableStream** which sends data to the server the socket is connected to.

The below example shows typical **WritableStream** usage to write data to a socket:

```
import { connect } from 'sockets';
const socket = connect("google.com:80");

const writer = socket.writable.getWriter();
const encoder = new TextEncoder();
writer.write(encoder.encode("GET / HTTP/1.0\r\n\r\n"));
```

### 2.3.3. opened

The **opened** attribute is a promise that is resolved when the socket connection has been successfully established, or is rejected if the connection fails. For sockets which use secure-transport, the resolution of the **opened** promise indicates the completion of the secure handshake.

The **opened** promise resolves a **SocketInfo** dictionary that optionally provides details about the connection that has been established.



By default, the `opened` promise is `marked as handled`.

### 2.3.4. `closed`

The `closed` attribute is a promise which can be used to keep track of the socket state. It gets resolved under the following circumstances:

- the `close()` method is called on the socket
- the socket was constructed with the `allowHalfOpen` parameter set to `false`, the `ReadableStream` is being read from, and the remote connection sends a FIN packet (graceful closure) or a RST packet

The current Cloudflare Workers implementation behaves as described above, specifically the `ReadableStream` needs to be read until completion for the `closed` promise to resolve, if the `ReadableStream` is not read then even if the server closes the connection the `closed` promise will not resolve.

Whether the promise should resolve without the `ReadableStream` being read is up for discussion.

It can also be rejected with a `SocketError` when a socket connection could not be established under the following circumstances:

- The address/port combo requested is blocked
- A transient issue with the runtime

Cancelling the socket's `ReadableStream` and closing the socket's `WritableStream` does not resolve the `closed` promise.

## 2.4. Methods

### 2.4.1. `close(optional any reason)`

The `close()` method closes the socket and its underlying connection. It returns the same promise as the `closed` attribute.

When called, the `ReadableStream` and `WritableStream` associated with the `Socket` will be canceled and aborted, respectively. If the `reason` argument is specified, the `reason` will be passed on to both the `ReadableStream` and `WritableStream`.

If the `opened` promise is still pending, it will be rejected with the `reason`.

### 2.4.2. `startTls()`

The `startTls()` method enables opportunistic TLS (otherwise known as `StartTLS`) which is a requirement for some protocols (primarily postgres/mysql and other DB protocols).

In this `secureTransport` mode of operation the socket begins the connection in plain-text, with messages read and written without any encryption. Then once the `startTls` method is called on the socket, the following shall take place:

- the original socket is closed, though the original connection is kept alive
- a secure TLS connection is established over that connection
- a new socket is created and returned from the `startTls` call

Here is a simple code example showing usage of the `startTls()` method:

```
import { connect } from 'sockets';
let sock = connect("google.com:443", { secureTransport: "starttls" });
// ... some code here ...
// We want to StartTLS at this point.
let tlsSock = sock.startTls();
```

The original readers and writers based off the original socket will no longer work. You must create new readers and writers from the new socket returned by `startTls`.

The method must fail with an `SocketError` if:

- called on an existing TLS socket
- the `secureTransport` option defined on the `Socket` instance is not equal to `"starttls"`.

## 2.5. SocketError

Arguably, this should be a type of `DOMException` rather than `TypeError`. More discussion is necessary on the form and structure of socket-related errors.

`SocketError` is an instance of `TypeError`. The error message should start with `"SocketError: "`.

An `"connection failed"` `SocketError`.

```
throw new SocketError('connection failed');
```

Should result in the following error:  
**Uncaught SocketError [TypeError]: SocketError: connection failed.**

## 3. connect

```
[Exposed=*]
dictionary SocketAddress {
    DOMString hostname;
    unsigned short port;
};

typedef (DOMString or SocketAddress) AnySocketAddress;

enum SecureTransportKind { "off", "on", "starttls" };

[Exposed=*]
dictionary SocketOptions {
    SecureTransportKind secureTransport = "off";
    boolean allowHalfOpen = false;
    DOMString sni = null;
    DOMString[] alpn = [];
};

[Exposed=*]
interface Connect {
    Socket connect(AnySocketAddress address, optional SocketOptions opts);
};
```

The `connect()` method performs the following steps:

1. New `Socket` instance is created with each of its attributes initialised immediately.
2. The socket's `opened` promise is set to a new promise. Set `opened.[[PromiselsHandled]]` to true.
3. The socket's `closed` promise is set to a new promise. Set `closed.[[PromiselsHandled]]` to true.
4. The created `Socket` instance is returned immediately in a *pending* state.
5. A connection is established to the specified `SocketAddress` asynchronously.
6. Once the connection is established, set `info` to a new `SocketInfo`, and `Resolve opened` with `info`. For a socket using secure transport, the connection is considered to be established once the secure handshake has been completed.
7. If the connection fails for any reason, set `error` to a new `SocketError` and reject the socket's `closed` and `opened` promises with `error`. Also, the `readable` is canceled with `error` and the `writable` is aborted with `error`.
8. The instance's `ReadableStream` and `WritableStream` streams can be used immediately but may not actually transmit or receive data until the socket is fully opened.

At any point during the creation of the `Socket` instance, `connect` may throw a `SocketError`. One case where this can happen is if the input address is incorrectly formatted.

The implementation may consider blocking connections to certain hostname/port combinations which can pose a threat of abuse or security vulnerability.

For example, port 25 may be blocked to prevent abuse of SMTP servers and private IPs can be blocked to avoid connecting to private services hosted locally (or on the server's LAN).

## 3.1. SocketOptions dictionary

### `secureTransport` member

The secure transport mode to use.

`off`

A connection is established in plain text.

`on`

A TLS connection is established using default CAs

`starttls`

Initially the same as the `off` option, the connection continues in plain text until the `startTls()` method is called

### `alpn` member

The Application-Layer Protocol Negotiation list to send, as an array of strings. If the server agrees with one of the protocols specified in this list, it will return the matching protocol in the `info` property. May be specified if and only if `secureTransport` is `on` or `starttls`.

### `sni` member

The Server Name Indication TLS option to send as part of the TLS handshake. If specified, requests that the server send a certificate with a matching common name. May be specified if and only if `secureTransport` is `on` or `starttls`.

### `allowHalfOpen` member

This option is similar to that offered by the Node.js `net` module and allows interoperability with code which utilizes it.

`false`

The `WritableStream`- and the socket instance- will be automatically closed when a FIN packet is received from the remote connection.

`true`

When a FIN packet is received, the socket will enter a "half-open" state where the `ReadableStream` is closed but the `WritableStream` can still be written to.

## 3.2. SocketInfo dictionary

### remoteAddress member

Provides the hostname/port combo of the remote peer the `Socket` is connected to, for example `"example.com:443"`. This value may or may not be the same as the address provided to the `connect()` method used to create the `Socket`.

### localAddress member

Optionally provides the hostname/port combo of the local network endpoint, for example `"localhost:12345"`.

### alpn property

If the server agrees with one of the protocols specified in the `alpn` negotiation list, returns that protocol name as a string, otherwise `null`.

## 3.3. AnySocketAddress type

### SocketAddress dictionary

The address to connect to. For example `{ hostname: "google.com", port: 443 }`.

#### hostname

A connection is established in plain text.

#### port

A TLS connection is established using default CAs

### DOMString

A hostname/port combo separated by a colon. For example `"google.com:443"`.

# References

## Normative References

### [WEBGPU]

Kai Ninomiya; Brandon Jones; Jim Blandy. *WebGPU*. URL: <https://gpuweb.github.io/gpuweb/>

### [WEBIDL]

Edgar Chen; Timothy Gu. *Web IDL Standard*. Living Standard. URL: <https://webidl.spec.whatwg.org/>

### [WHATWG-STREAMS]

Adam Rice; et al. *Streams Standard*. Living Standard. URL: <https://streams.spec.whatwg.org/>

# Index

## Terms defined by this specification

- `allowHalfOpen`, in § 3
- `alpn`
  - `dict-member for SocketInfo`, in § 2.2
  - `dict-member for SocketOptions`, in § 3
- `AnySocketAddress`, in § 3
- `binding object`, in § 1.3
- `close()`, in § 2.2
- `closed`, in § 2.2
- `close(reason)`, in § 2.2

- [Connect](#), in § 3
- [connect](#), in § 1.2
- [connect\(address\)](#), in § 3
- [connect\(address, opts\)](#), in § 3
- [hostname](#), in § 3
- [localAddress](#), in § 2.2
- ["off"](#), in § 3
- ["on"](#), in § 3
- [opened](#), in § 2.2
- [port](#), in § 3
- [readable](#), in § 2.2
- [remoteAddress](#), in § 2.2
- [secureTransport](#), in § 3
- [SecureTransportKind](#), in § 3
- [sni](#), in § 3
- [Socket](#), in § 2.2
- [socket](#), in § 1.1
- [SocketAddress](#), in § 3
- [SocketError](#), in § 2.5
- [SocketInfo](#), in § 2.2
- [SocketOptions](#), in § 3
- ["starttls"](#), in § 3
- [startTls\(\)](#), in § 2.2
- [writable](#), in § 2.2

## Terms defined by reference

- [\[WEBGPU\]](#) defines the following terms:
  - [info](#)
- [\[WEBIDL\]](#) defines the following terms:
  - [DOMException](#)
  - [DOMString](#)
  - [NewObject](#)
  - [Promise](#)
  - [TypeError](#)
  - [a new promise](#)
  - [any](#)
  - [boolean](#)
  - [resolve](#)
  - [undefined](#)
  - [unsigned short](#)
- [\[WHATWG-STREAMS\]](#) defines the following terms:
  - [ReadableStream](#)
  - [ReadableStreamDefaultController](#)
  - [WritableStream](#)

## IDL Index

```
[Exposed=*]
dictionary SocketInfo {
    DOMString remoteAddress = null;
    DOMString localAddress = null;
    DOMString alpn = null;
};

[Exposed=*]
interface Socket {
    readonly attribute ReadableStream readable;
    readonly attribute WritableStream writable;

    readonly attribute Promise<SocketInfo> opened;

    readonly attribute Promise<undefined> closed;
    Promise<undefined> close(optional any reason);

    [NewObject] Socket startTls();
};

[Exposed=*]
dictionary SocketAddress {
    DOMString hostname;
    unsigned short port;
};

typedef (DOMString or SocketAddress) AnySocketAddress;

enum SecureTransportKind { "off", "on", "starttls" };

[Exposed=*]
dictionary SocketOptions {
    SecureTransportKind secureTransport = "off";
    boolean allowHalfOpen = false;
    DOMString sni = null;
    DOMString[] alpn = [];
};

[Exposed=*]
interface Connect {
    Socket connect(AnySocketAddress address, optional SocketOptions opts);
};
```

## Copyright & Software License

Ecma International

Rue du Rhone 114

CH-1204 Geneva

Tel: +41 22 849 6000

## 4. Copyright Notice

### ALTERNATIVE COPYRIGHT NOTICE AND COPYRIGHT LICENSE

© 2025 Ecma International

By obtaining and/or copying this work, you (the licensee) agree that you have read, understood, and will comply with the following terms and conditions.

Permission under Ecma's copyright to copy, modify, prepare derivative works of, and distribute this work, with or without modification, for any purpose and without fee or royalty is hereby granted, provided that you include the following on ALL copies of the work or portions thereof, including modifications:

(i) The full text of this COPYRIGHT NOTICE AND COPYRIGHT LICENSE in a location viewable to users of the redistributed or derivative work.

(ii) Any pre-existing intellectual property disclaimers, notices, or terms and conditions. If none exist, the Ecma alternative copyright notice should be included.

(iii) Notice of any changes or modifications, through a copyright statement on the document such as "This document includes material copied from or derived from !DOCUMENT!.  
Copyright © Ecma International."

### Disclaimers

THIS WORK IS PROVIDED "AS IS," AND COPYRIGHT HOLDERS MAKE NO REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR THAT THE USE OF THE DOCUMENT WILL NOT INFRINGE ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADEMARKS OR OTHER RIGHTS.

COPYRIGHT HOLDERS WILL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF ANY USE OF THE DOCUMENT.

The name and trademarks of copyright holders may NOT be used in advertising or publicity pertaining to the work without specific, written prior permission. Title to copyright in this work will at all times remain with copyright holders.

## 5. Software License

All Software contained in this document ("Software") is protected by copyright and is being made available under the "BSD License", included below. This Software may be subject to third party rights (rights from parties other than Ecma International), including patent rights, and no licenses under such third party rights are granted under this license even if the third party concerned is a member of Ecma International. SEE THE ECMA CODE OF CONDUCT IN PATENT MATTERS AVAILABLE AT <https://ecma-international.org/memento/codeofconduct.htm> FOR INFORMATION REGARDING THE LICENSING OF PATENT CLAIMS THAT ARE REQUIRED TO IMPLEMENT ECMA INTERNATIONAL STANDARDS.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

3. Neither the name of the authors nor Ecma International may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE ECMA INTERNATIONAL "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL ECMA INTERNATIONAL BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.