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# Ajax Battle: XMLHttpRequest vs the Fetch API

**Craig Buckler**, April 17th, 2022 · 5 min read

## XMLHttpRequest

`XMLHttpRequest` first appeared as a non-standard Internet Explorer 5.0 ActiveX component in 1999. Microsoft developed it to power their browser-based version of Outlook. XML was the most popular (or hyped) data format at the time, but `XMLHttpRequest` supported text and the yet-to-be-invented JSON.

Jesse James Garrett devised the term "AJAX" in his 2005 article *AJAX: A New Approach to Web Applications*. AJAX-based apps such as Gmail and Google Maps already existed, but the term galvanized developers and led to an explosion in slick Web 2.0 experiences.

AJAX is a mnemonic for "Asynchronous JavaScript and XML", although, strictly speaking, developers didn't need to use asynchronous methods, JavaScript, or XML. We now use the generic "Ajax" term for any client-side process that fetches data from a server and updates the DOM without requiring a full-page refresh.

`XMLHttpRequest` is supported by all mainstream browsers and became an official web standard in 2006. A simple example which fetches data from your domain's `/service/` endpoint and displays the JSON result in the console as text:

```
const xhr = new XMLHttpRequest();
xhr.open("GET", "/service");
```

```
// state change event
xhr.onreadystatechange = () => {
  // is request complete?
  if (xhr.readyState !== 4) return;

  if (xhr.status === 200) {
    // request successful
    console.log(JSON.parse(xhr.responseText));
  } else {
    // request not successful
    console.log("HTTP error", xhr.status, xhr.statusText);
  }
};

// start request
xhr.send();
```

The `onreadystatechange` callback function runs several times throughout the lifecycle of the request. The `XMLHttpRequest` object's `readyState` property returns the current state:

- 0 (uninitialized) - request not initialized
- 1 (loading) - server connection established
- 2 (loaded) - request received
- 3 (interactive) - processing request
- 4 (complete) - request complete, response is ready

Few functions do much until state 4 is reached.

## Fetch

`Fetch` is a modern Promise-based Ajax request API that first appeared in 2015 and is supported in most browsers. It is not built on `XMLHttpRequest` and offers better consistency with a more concise syntax. The following Promise chain functions identically to the `XMLHttpRequest` example above:

```
fetch("/service", { method: "GET" })
  .then((res) => res.json())
  .then((json) => console.log(json))
  .catch((err) => console.error("error:", err));
```

Or you can use `async` / `await`:

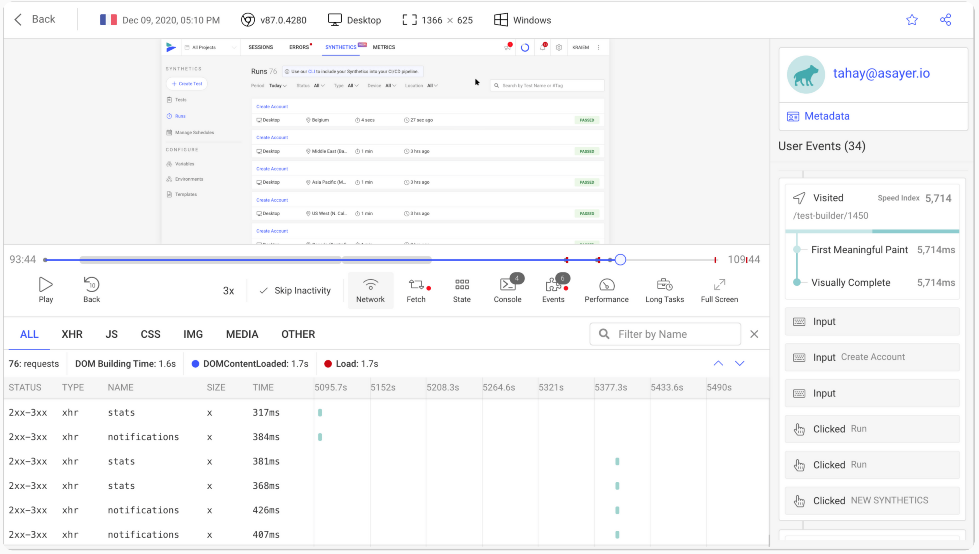
```
try {
  const res = await fetch("/service", { method: "GET" }),
    json = await res.json();

  console.log(json);
} catch (err) {
  console.error("error:", err);
}
```

`Fetch` is cleaner, simpler, and regularly used in Service Workers.

## Open Source Session Replay

*OpenReplay is an open-source alternative to FullStory and LogRocket. It gives you full observability by replaying everything your users do on your app and showing how your stack behaves for every issue. OpenReplay is self-*

*hosted for full control over your data.*



76: requests | DOM Building Time: 1.6s | ● DOMContentLoaded: 1.7s | ● Load: 1.7s

| STATUS | TYPE | NAME | SIZE | TIME |
|---|---|---|---|---|
| 2xx-3xx | xhr | stats | x | 317ms |
| 2xx-3xx | xhr | notifications | x | 384ms |
| 2xx-3xx | xhr | stats | x | 381ms |
| 2xx-3xx | xhr | stats | x | 368ms |
| 2xx-3xx | xhr | notifications | x | 426ms |
| 2xx-3xx | xhr | notifications | x | 407ms |

Visited /test-builder/1450 Speed Index 5,714
First Meaningful Paint 5,714ms
Visually Complete 5,714ms
Input
Input Create Account
Input
Clicked Run
Clicked Run
Clicked NEW SYNTHETICS

*Happy debugging, for modern frontend teams - start monitoring your web app for free.*

## Round 1: Fetch Wins

As well as a cleaner, more concise syntax, the `Fetch` API offers several advantages over the aging `XMLHttpRequest`.

### Header, Request, and Response Objects

The simple `fetch()` example above uses a string to define an endpoint URL. A configurable `Request` object can also be passed, which provides a range of properties about the call:

```
const request = new Request("/service", { method: "POST" });

console.log(request.url);
console.log(request.method);
console.log(request.credentials);
```

```
// FormData representation of body
const fd = await request.formData();

// clone request
const req2 = request.clone();

const res = await fetch(request);
```

The `Response` object provides similar access to all details of the response:

```
console.log(res.ok); // true/false
console.log(res.status); // HTTP status
console.log(res.url);

const json = await res.json(); // parses body as JSON
const text = await res.text(); // parses body as text
const fd = await res.formData(); // FormData representation of bo
```

A `Headers` object provides an easy interface to set headers in the Request or examine headers in the Response:

```
// set request headers
const headers = new Headers();
headers.set("X-Requested-With", "ajax");
headers.append("Content-Type", "text/xml");

const request = new Request("/service", {
  method: "POST",
  headers,
});

const res = await fetch(request);

// examine response headers
console.log(res.headers.get("Content-Type"));
```

## Caching Control

It’s challenging to manage caching in `XMLHttpRequest`, and you may find it necessary to append a random query string value to bypass the browser cache. `Fetch` offers built-in caching support in the second parameter `init` object:

```
const res = await fetch("/service", {
  method: "GET",
  cache: "default",
});
```

`cache` can be set to:

- `'default'` - the browser cache is used if there’s a fresh (unexpired) match. If not, the browser makes a conditional request to check whether the resource has changed and makes a new request if necessary
- `'no-store'` - the browser cache is bypassed, and the network response will not update it
- `'reload'` - the browser cache is bypassed, but the network response will update it
- `'no-cache'` - similar to `'default'` except a conditional request is always made
- `'force-cache'` - the cached version is used if possible, even when it’s stale
- `'only-if-cached'` - identical to `force-cache` except no network request is made

### CORS Control

Cross-Origin Resource Sharing allows a client-side script to make an Ajax request to another domain if that server permits the origin domain in the `Access-Control-Allow-Origin` response header. Both `fetch()` and `XMLHttpRequest` will fail when this is not set. However, `Fetch` provides a `mode` property which can be set to `'no-cors'` in the second parameter `init` object:

```
const res = await fetch(
  'https://anotherdomain.com/service',
  {
    method: 'GET',
    mode: 'no-cors'
  }
);
```

This retrieves a response that cannot be read but can be used by other APIs. For example, you could use the Cache API to store the response and use it later, perhaps from a Service Worker to return an image, script, or CSS file.

### Credential Control

`XMLHttpRequest` always sends browser cookies. The `Fetch` API does not send cookies unless you explicitly set a `credentials` property in the second parameter `init` object:

```
const res = await fetch("/service", {
  method: "GET",
  credentials: "same-origin",
});
```

`credentials` can be set to:

- `'omit'` - exclude cookies and HTTP authentication entries (the default)
- `'same-origin'` - include credentials with requests to same-origin URLs
- `'include'` - include credentials on all requests

Note that `include` was the default in earlier API implementations. Explicitly set the `credentials` property if your users are likely to run older browsers.

**Redirect Control**

By default, both `fetch()` and `XMLHttpRequest` follow server redirects. However, `fetch()` provides alternative options in the second parameter `init` object:

```
const res = await fetch("/service", {
  method: "GET",
  redirect: "follow",
});
```

`redirect` can be set to:

- `'follow'` - follow all redirects (the default)
- `'error'` - abort (reject) when a redirect occurs
- `'manual'` - return the response for manual handling

### Data Streams

`XMLHttpRequest` reads the whole response into a memory buffer but `fetch()` can stream both request and response data. The technology is new, but streams allow you to work on smaller chunks of data as they are sent or received. For example, you could process information in a multi-megabyte file before it is fully downloaded. The following example transforms incoming (binary) data chunks into text and outputs it to the console. On slower connections, you will see smaller chunks arriving over an extended period.

```
const response = await fetch("/service"),
  reader = response.body
    .pipeThrough(new TextDecoderStream())
    .getReader();

while (true) {
  const { value, done } = await reader.read();
  if (done) break;
  console.log(value);
}
```

### Server-Side Support

`Fetch` is fully supported in Deno and Node 18. Using the same API on both the server and the client helps reduce cognitive overhead and offers the possibility of isomorphic

JavaScript libraries which work anywhere.

## Round 2: `XMLHttpRequest` Wins

Despite a bruising, `XMLHttpRequest` has a few tricks to out-Ajax `Fetch()`.

### Progress Support

We may monitor the progress of requests by attaching a handler to the `XMLHttpRequest` object's `progress` event. This is especially useful when uploading large files such as photographs, e.g.

```
const xhr = new XMLHttpRequest();

// progress event
xhr.upload.onprogress = (p) => {
  console.log(Math.round((p.loaded / p.total) * 100) + "%");
};
```

The event handler is passed an object with three properties:

1. `lengthComputable` - set `true` if the progress can be calculated
2. `total` - the total amount of work - or `Content-Length` - of the message body
3. `loaded` - the amount of work - or content - completed so far

The `Fetch` API does not offer any way to monitor upload progress.

**Timeout Support**

The `XMLHttpRequest` object provides a `timeout` property which can be set to the number of milliseconds a request is permitted to run before it's automatically terminated. A `timeout` event handler can also be triggered when this occurs:

```
const xhr = new XMLHttpRequest();
xhr.timeout = 5000; // 5-second maximum
xhr.ontimeout = () => console.log("timeout");
```

Wrapper functions can implement timeout functionality in a `fetch()`:

```
function fetchTimeout(url, init, timeout = 5000) {
  return new Promise((resolve, reject) => {
    fetch(url, init).then(resolve).catch(reject);
    setTimeout(reject, timeout);
  });
}
```

Alternatively, you could use `Promise.race()`:

```
Promise.race([
  fetch("/service", { method: "GET" }),
  new Promise((resolve) => setTimeout(resolve, 5000)),
]).then((res) => console.log(res));
```

Neither option is easy to use, and the request will continue in the background.

### Abort Support

An in-flight request can be cancelled by running the `XMLHttpRequest` `abort()` method. An `abort` handler can be attached if necessary:

```
const xhr = new XMLHttpRequest();
xhr.open("GET", "/service");
xhr.send();

// ...

xhr.onabort = () => console.log("aborted");
xhr.abort();
```

You can abort a `fetch()` but it's not as straight-forward and requires a AbortController object:

```
const controller = new AbortController();

fetch("/service", {
  method: "GET",
  signal: controller.signal,
})
  .then((res) => res.json())
  .then((json) => console.log(json))
  .catch((error) => console.error("Error:", error));

// abort request
controller.abort();
```

The `catch()` block executes when the `fetch()` aborts.

### More Obvious Failure Detection

When developers first use `fetch()`, it seems logical to presume that an HTTP error such as `404 Not Found` or `500 Internal Server Error` will trigger a Promise reject and run the associated `catch()` block. **This is not the case**: the Promise successfully resolves on *any* response. A rejection is only likely to occur when there's no response from the network or the request is aborted.

The `fetch()` Response object provides `status` and `ok` properties, but it's not always obvious they need to be checked. `XMLHttpRequest` is more explicit because a single callback function handles every outcome: you should see a `status` check in every example.

### Browser Support

I hope you do not have to support Internet Explorer or browser versions prior to 2015, but if that's the case, `XMLHttpRequest` is your only option. `XMLHttpRequest` is also stable, and the API is unlikely to be updated. `Fetch` is newer and missing several key features: updates are unlikely to break code, but you can expect some maintenance.

## Which API Should You Use?

Most developers will reach for the more modern `Fetch` API. It has a cleaner syntax and more benefits over `XMLHttpRequest`. That said, many of those benefits have niche use-cases, and you won't require them in most applications. There are two occasions when `XMLHttpRequest` remains essential:

1. You're supporting very old browsers - that requirement should decline over time.
2. You need to show upload progress bars. `Fetch` will gain support eventually, but it could be several years away.

Both alternatives are interesting, and it's worth knowing them in detail!