Introduction to SOP and CORS

WASA: Web and Software Architecture

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SOP: Same-origin policy

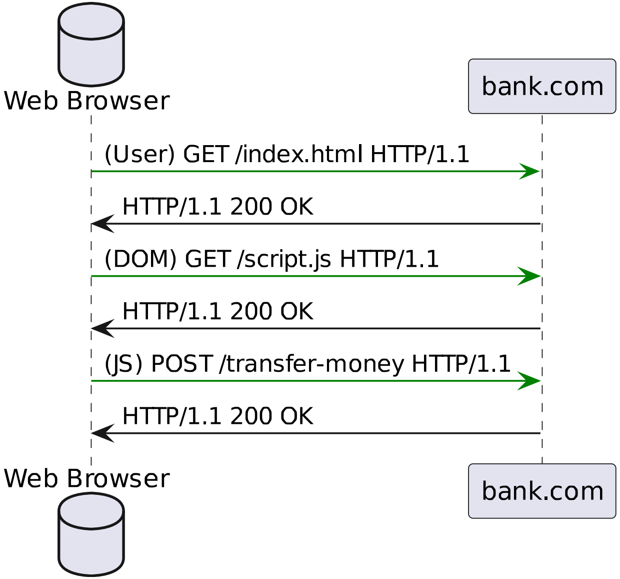
Same-origin policy

Same-origin policy is a security mechanism in **browser**. It restricts communication between scripts with different origins.

https://bank.com/index.html

```html
<!doctype html>
<html>
  <head><!-- … --></head>
<body>
  <!-- … -->
  <script src="/script.js"></script>
</body>
</html>
```

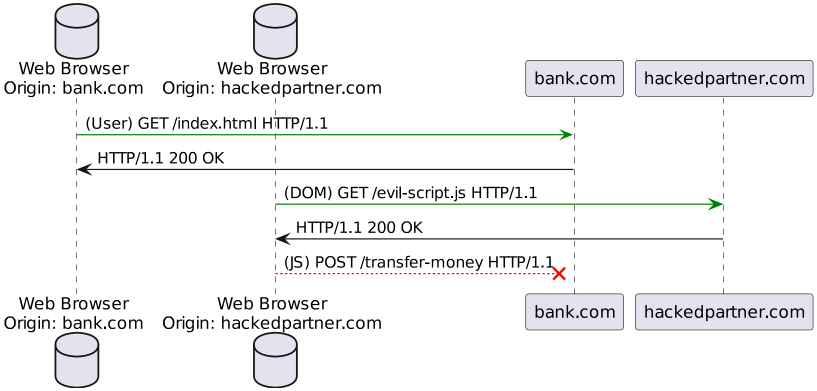
Script sequence diagram


Web Browser
bank.com
(User) GET /index.html HTTP/1.1
HTTP/1.1 200 OK
(DOM) GET /script.js HTTP/1.1
HTTP/1.1 200 OK
(JS) POST /transfer-money HTTP/1.1
HTTP/1.1 200 OK
Web Browser
bank.com

https://bank.com/index.html

```
<!doctype html>
<html>
  <head><!-- … --></head>
<body>
  <!-- … -->
  <script
    src="https://hackedpartner.com/evil-script.js">
  </script>
</body>
</html>
```

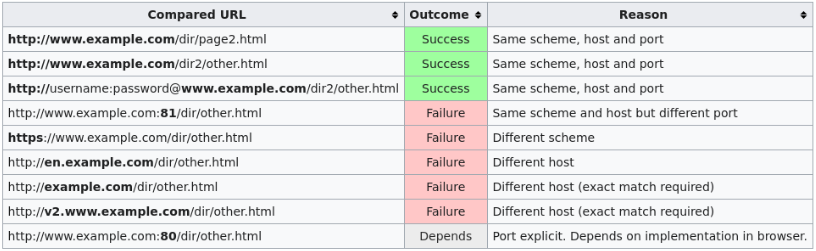
Malicious script, different origin



What SOP protects?

- Cookies
- HTTP Authentication
- IndexedDB
- Web Storage
- DOM

SOP rules



Compared URL	Outcome	Reason
http://www.example.com/dir/page2.html	Success	Same scheme, host and port
http://www.example.com/dir2/other.html	Success	Same scheme, host and port
http://username:password@**www.example.com**/dir2/other.html	Success	Same scheme, host and port
http://www.example.com:**81**/dir/other.html	Failure	Same scheme and host but different port
https://www.example.com/dir/other.html	Failure	Different scheme
http://**en.example.com**/dir/other.html	Failure	Different host
http://**example.com**/dir/other.html	Failure	Different host (exact match required)
http://**v2.www.example.com**/dir/other.html	Failure	Different host (exact match required)
http://www.example.com:**80**/dir/other.html	Depends	Port explicit. Depends on implementation in browser.

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SOP interactions

Cross-origin requests can be:

- **Writes**: typically allowed but limited, CORS may be needed
- **Embedding**: typically allowed
- **Reads**: typically denied

SOP is not enough...

Unfortunately, SOP is not enough: CSRF (Cross-site request forgery) may be executed via cross-origin writes.

CSRF token + SOP can mitigate that (SOP will disallow reading the CSRF token).

In a Single-page application, the token is in the SPA website origin, and we use a header for that - no need for a CSRF token (see CORS).

CORS: Cross-Origin Resource Sharing

Cross-Origin Resource Sharing

Sometimes you need to share resources between origins.

CORS is an HTTP-header-based mechanism for configuring Same-origin policy.

Type of requests

CORS defines two different types of requests:

- **Simple requests**
    - Always sent to the server
    - The server decides which origin can read the response
- **Preflighted requests**
    - Before sending the request, the browser sends a preflight request
    - The server decides which origin can send requests and what can be sent
    - The server decides which origin can read the response

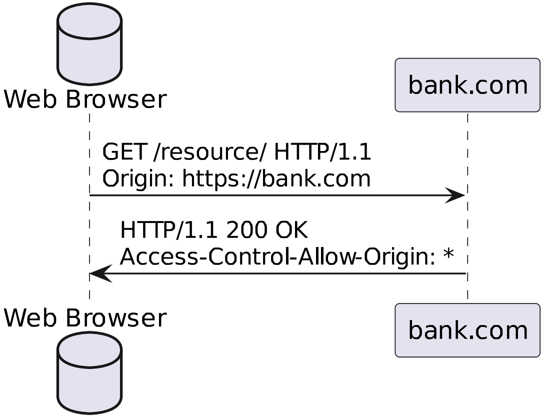
Simple requests

A **simple request** must meet all the following conditions:

- One of: GET, HEAD or POST
- Apart from automatic headers, allowed headers are: Accept, Accept-Language, Content-Language, Content-Type, Range
- Content-Type, if set, is one of: application/x-www-form-urlencoded, multipart/form-data, or text/plain
- If XMLHttpRequest is used, no XMLHttpRequest.upload listeners
- No ReadableStream object used

Browsers may have additional restrictions.

Simple requests

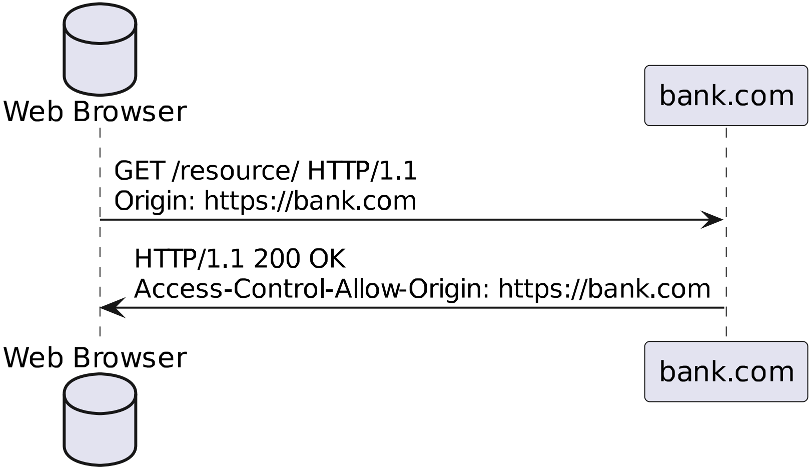


```
GET /resource/ HTTP/1.1
Origin: https://bank.com
```

```
HTTP/1.1 200 OK
Access-Control-Allow-Origin: *
```

- The request always contains the Origin header
- The server can control which origins can access the response via Access-Control-Allow-Origin

Simple requests



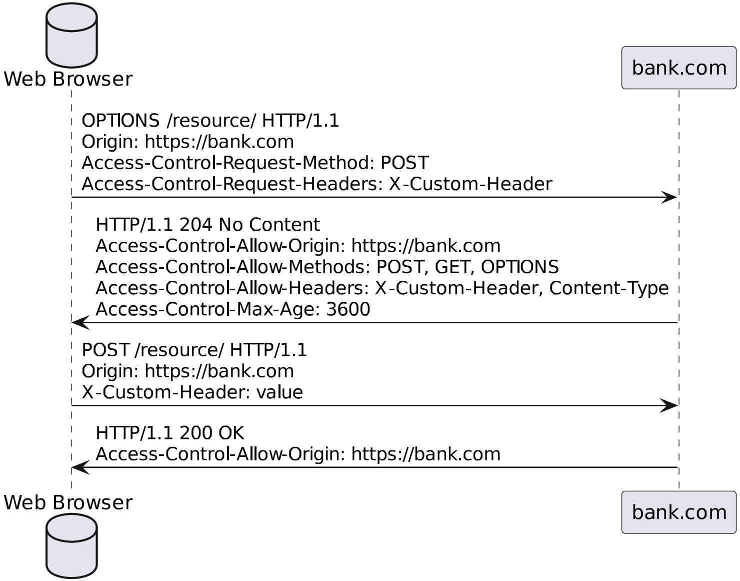
- Here, only https://bank.com can access the response

Preflighted requests

A **preflighted request** is a request that does not match the conditions for **simple requests**.

It requires an HTTP OPTIONS request before the actual request (handled automatically by browsers) to agree on the SOP with the server.

Preflighted requests



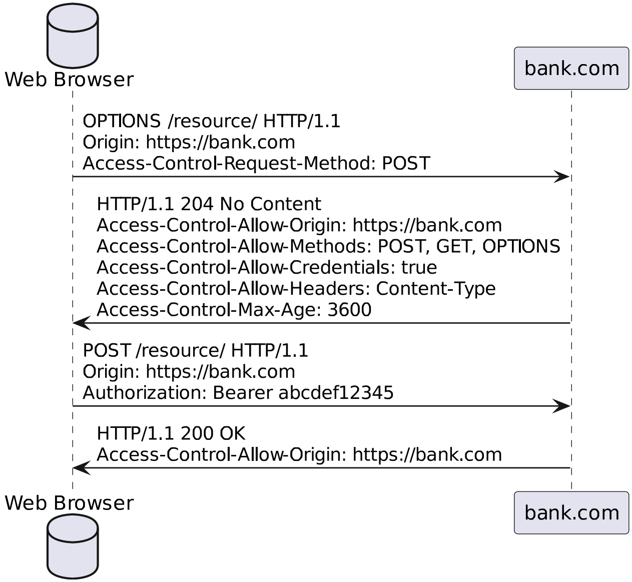
```
OPTIONS /resource/ HTTP/1.1
Origin: https://bank.com
Access-Control-Request-Method: POST
Access-Control-Request-Headers: X-Custom-Header
```

```
HTTP/1.1 204 No Content
Access-Control-Allow-Origin: https://bank.com
Access-Control-Allow-Methods: POST, GET, OPTIONS
Access-Control-Allow-Headers: X-Custom-Header, Content-Type
Access-Control-Max-Age: 3600
```

```
POST /resource/ HTTP/1.1
Origin: https://bank.com
X-Custom-Header: value
```

```
HTTP/1.1 200 OK
Access-Control-Allow-Origin: https://bank.com
```

Preflighted requests with authentication



```
OPTIONS /resource/ HTTP/1.1
Origin: https://bank.com
Access-Control-Request-Method: POST
```

```
HTTP/1.1 204 No Content
Access-Control-Allow-Origin: https://bank.com
Access-Control-Allow-Methods: POST, GET, OPTIONS
Access-Control-Allow-Credentials: true
Access-Control-Allow-Headers: Content-Type
Access-Control-Max-Age: 3600
```

```
POST /resource/ HTTP/1.1
Origin: https://bank.com
Authorization: Bearer abcdef12345
```

```
HTTP/1.1 200 OK
Access-Control-Allow-Origin: https://bank.com
```

No need for CSRF token

We use the Authorization header for authentication/authorization in the WASA project.

Given that Authorization will trigger a preflight request, there is no need for a CSRF token — just configure CORS correctly.

Links

- https://developer.mozilla.org/en-US/docs/Web/Security/Same-origin_policy
- https://developer.mozilla.org/en-US/docs/Web/HTTP/CORS
- https://www.youtube.com/watch?v=KaEj_qZgiKY
- https://en.wikipedia.org/wiki/Same-origin_policy
- https://en.wikipedia.org/wiki/Cross-origin_resource_sharing