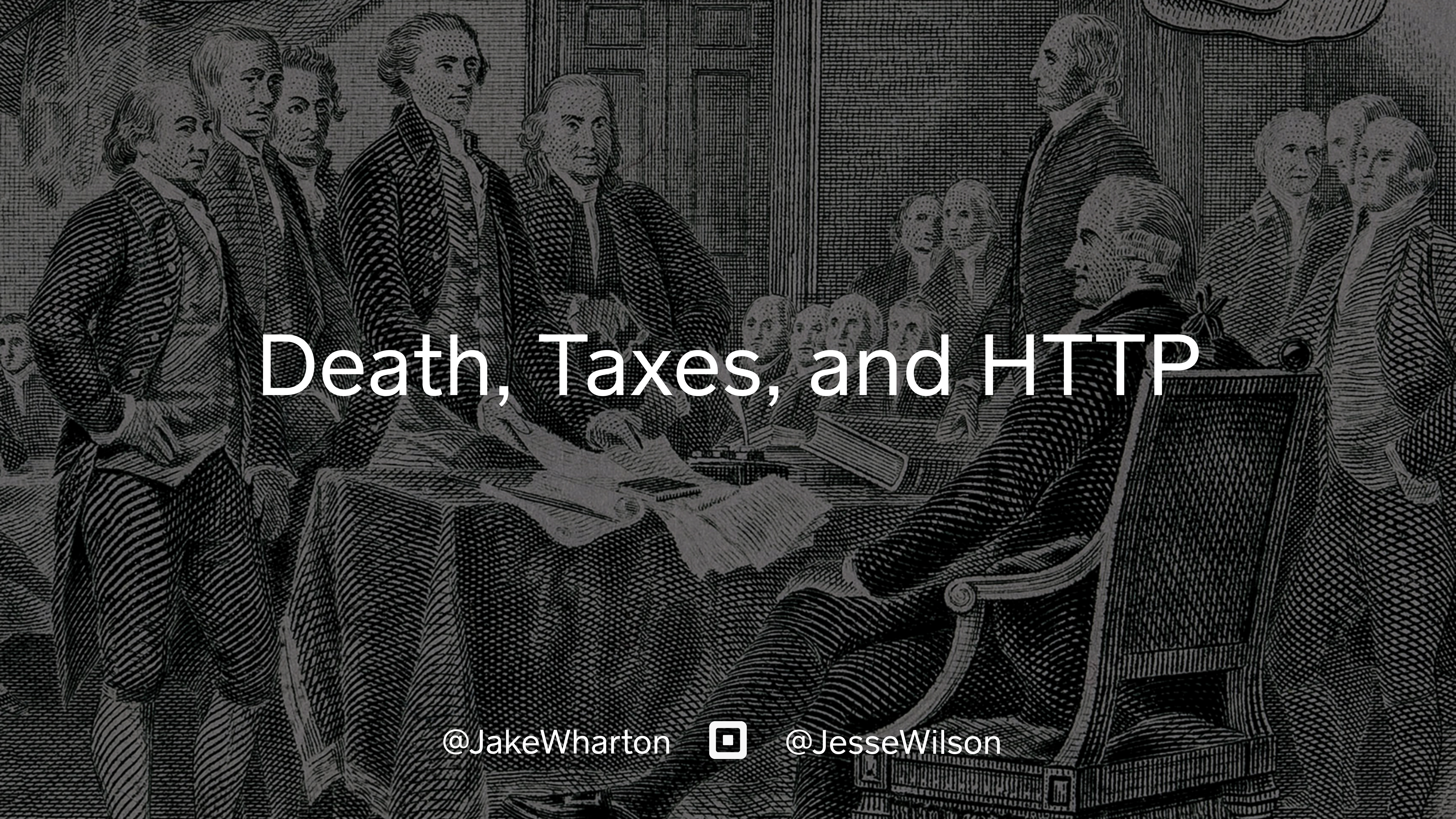


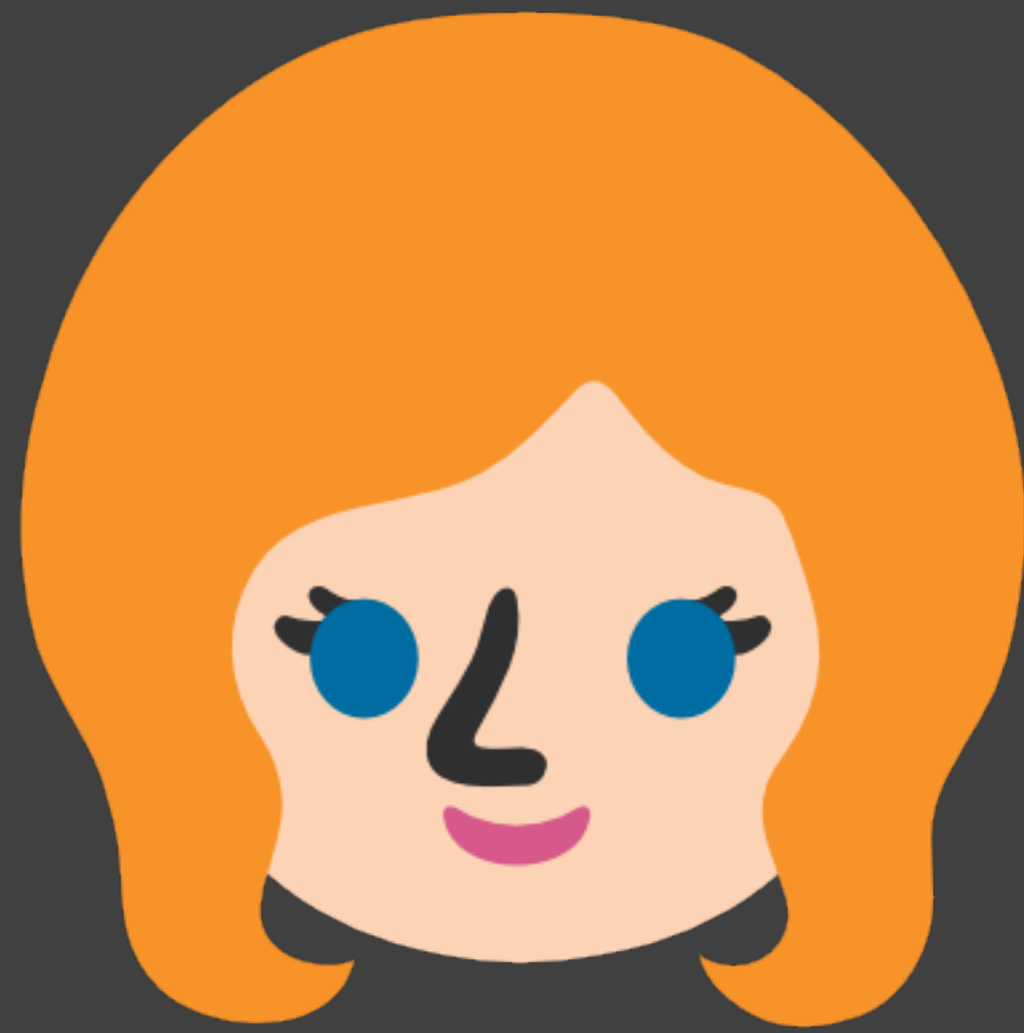


Death, Taxes, and HTTP

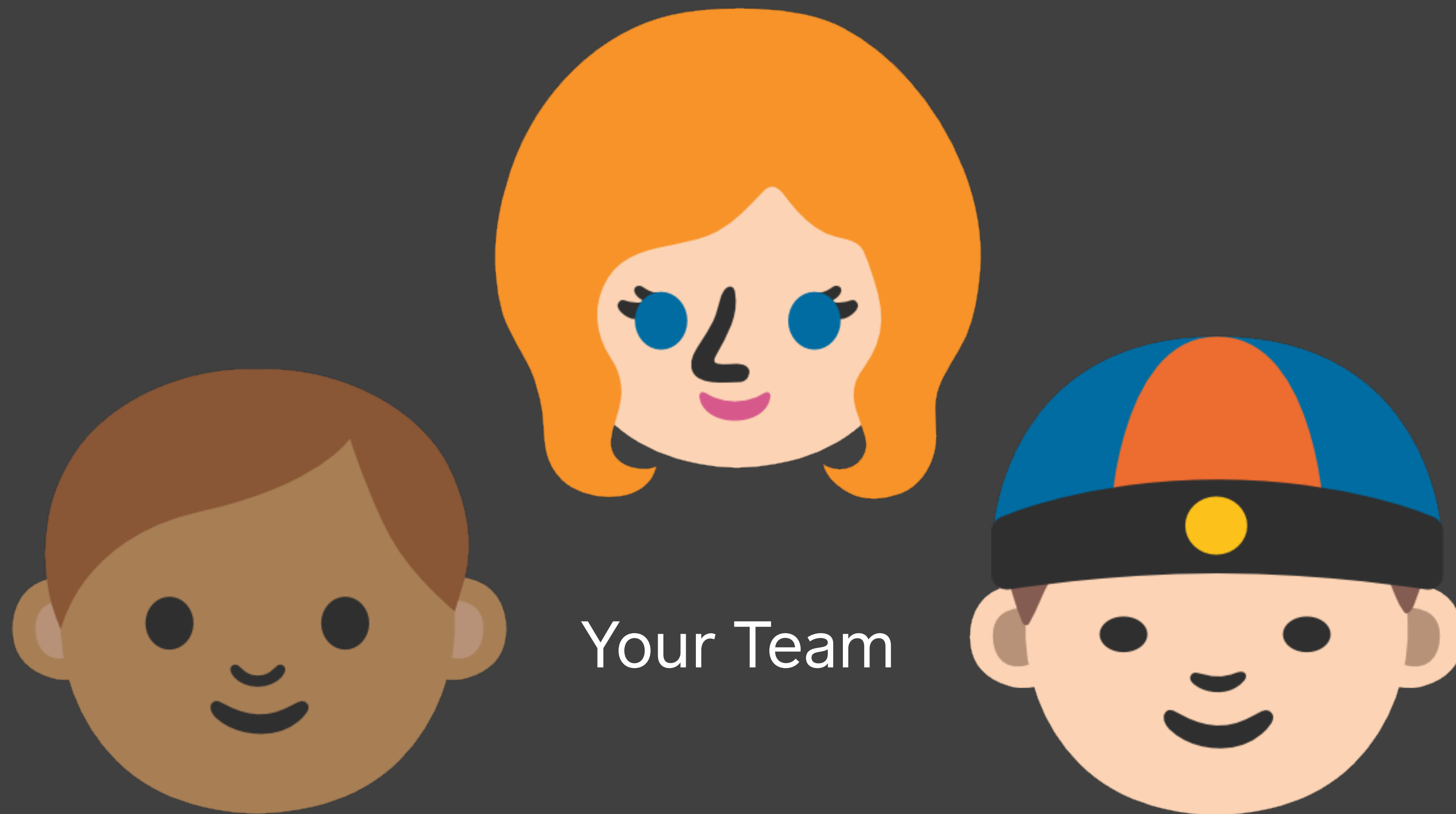
@JakeWharton



@JesseWilson

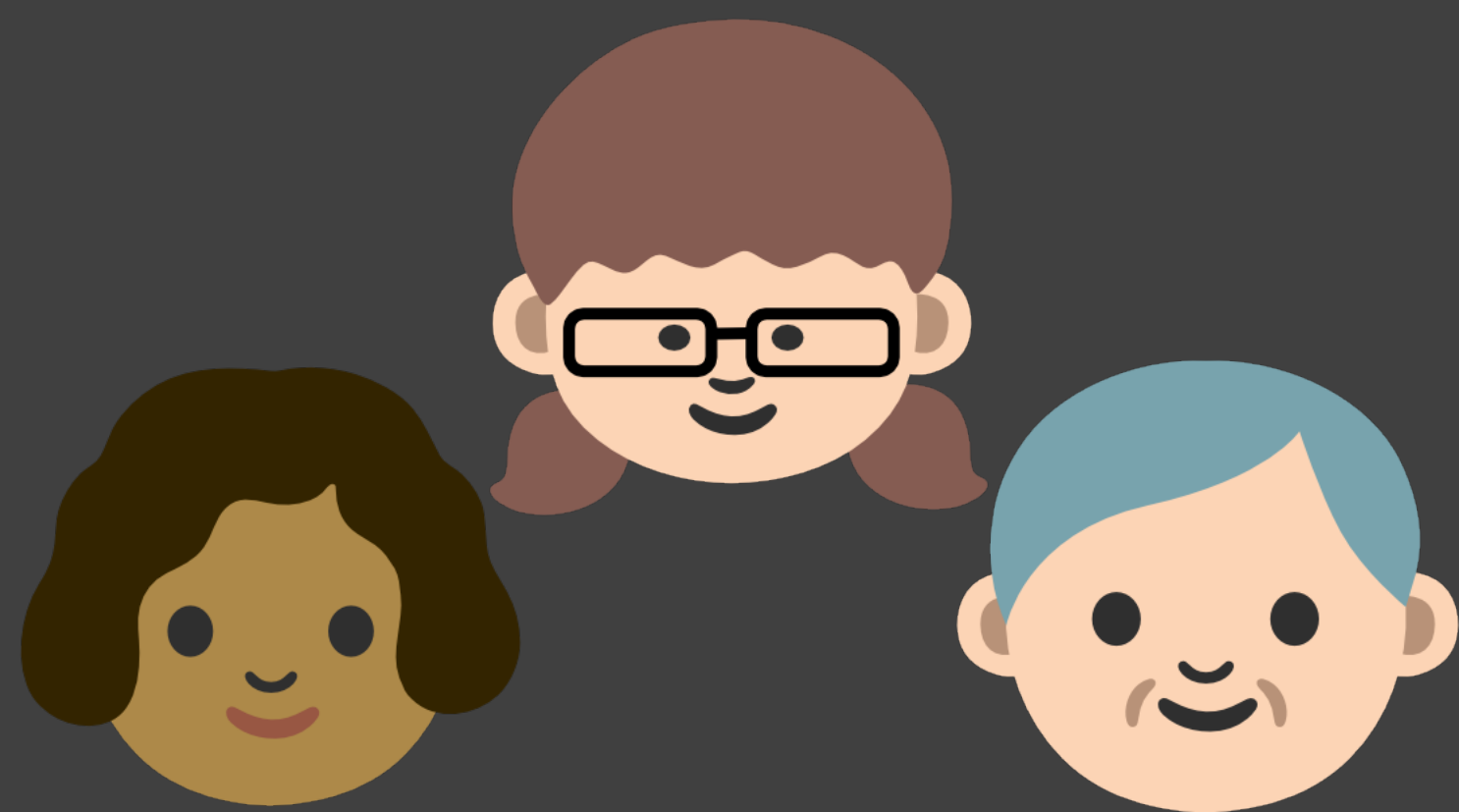


You





Client



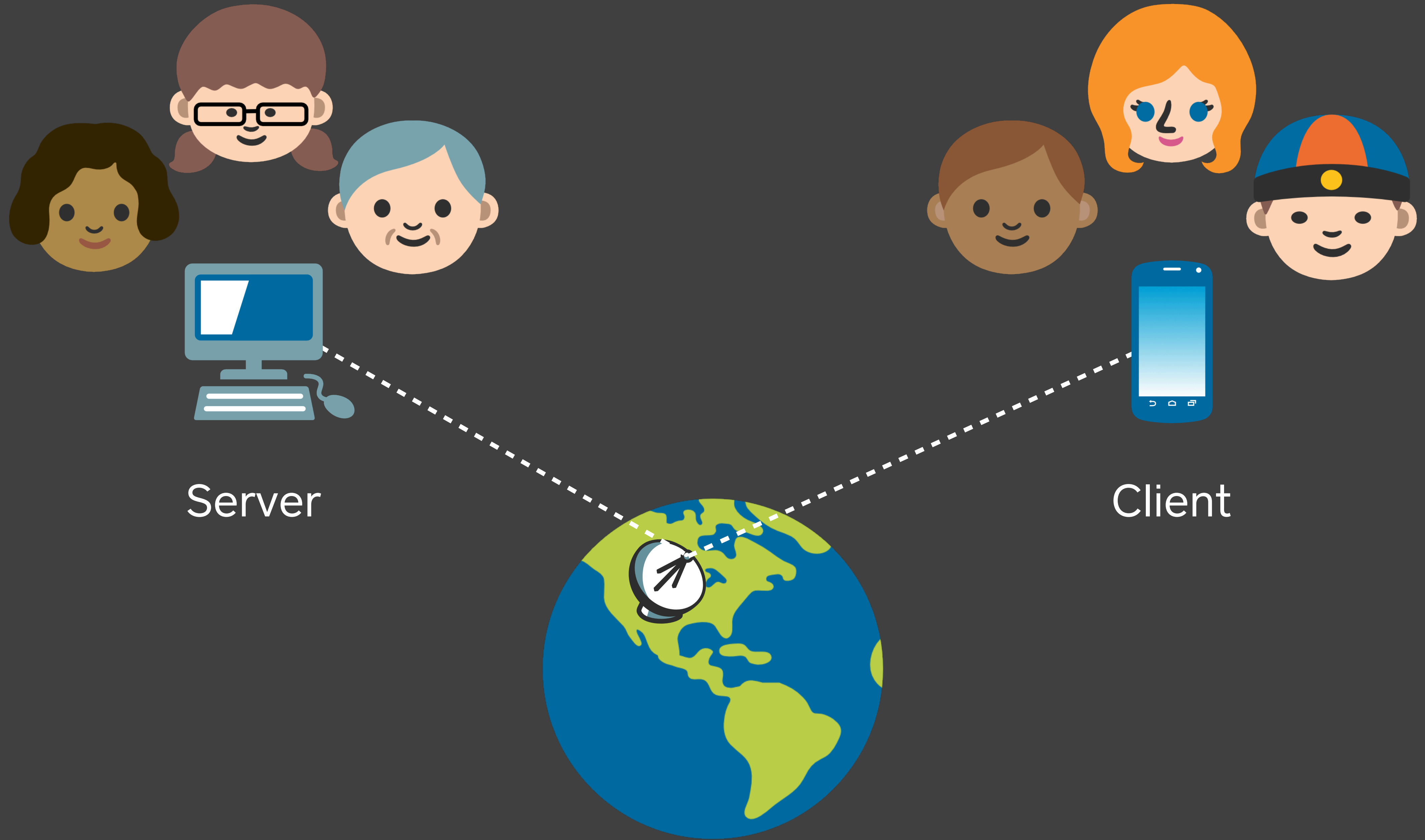
Client



Server

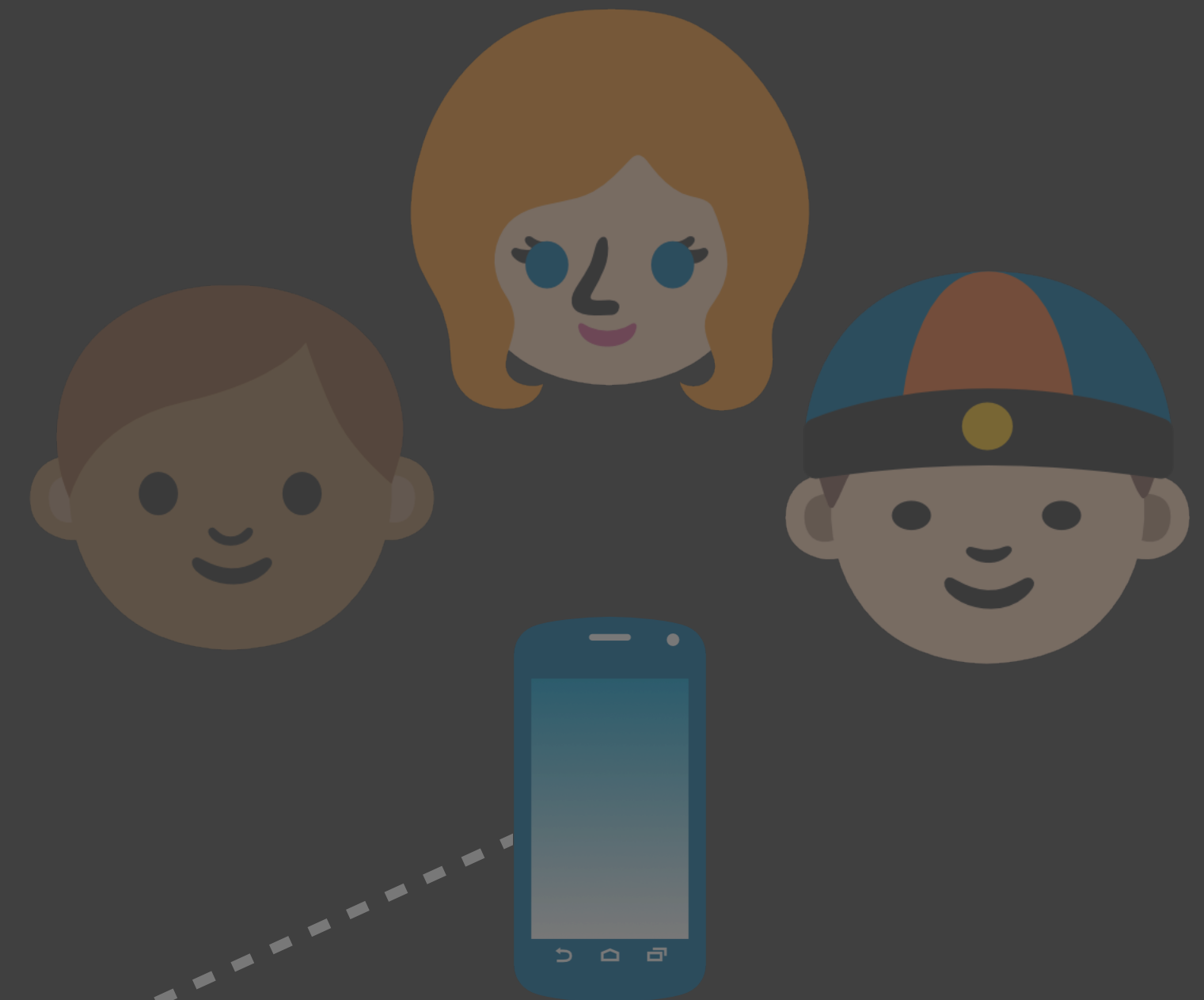


Client





Server

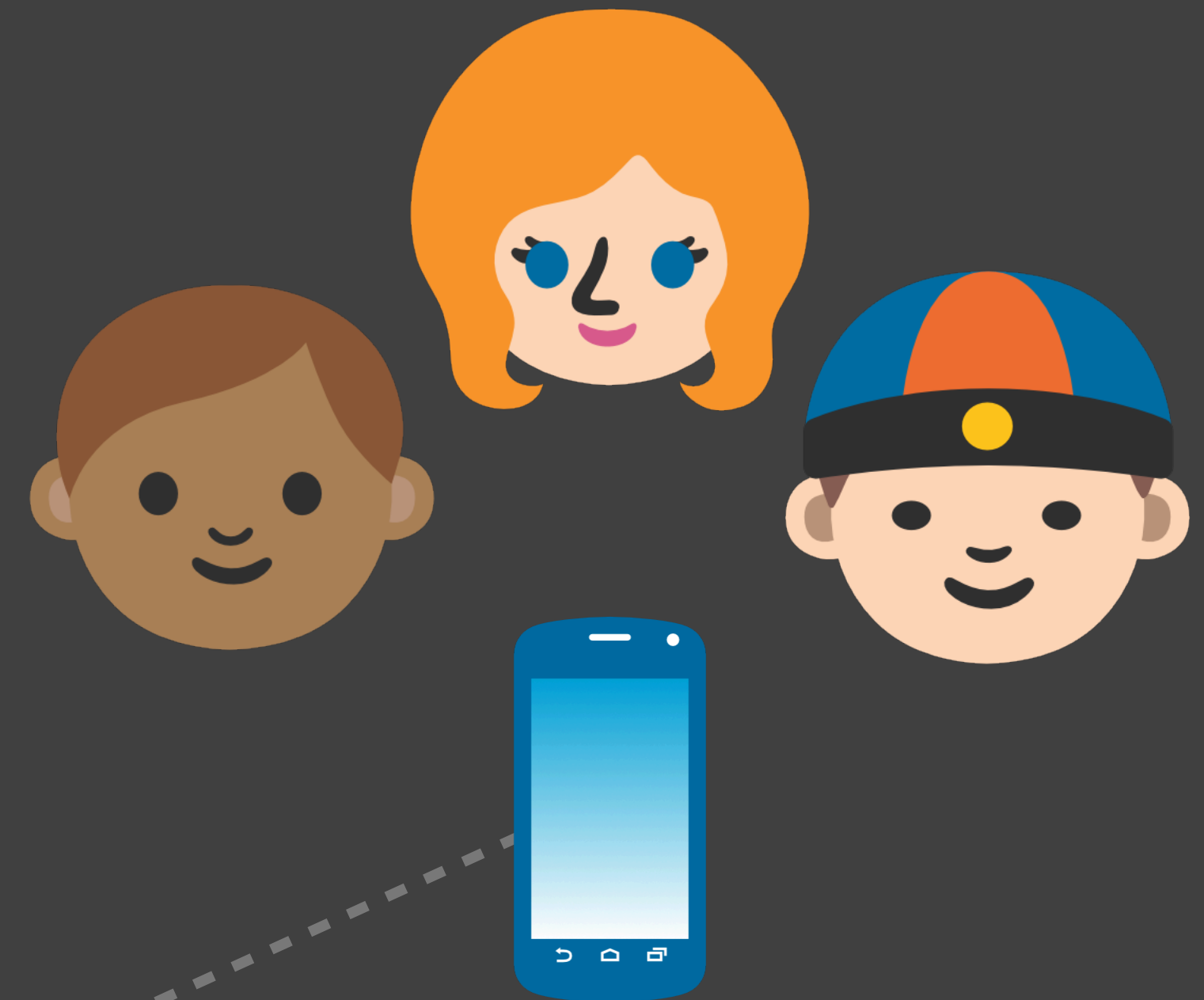


Client



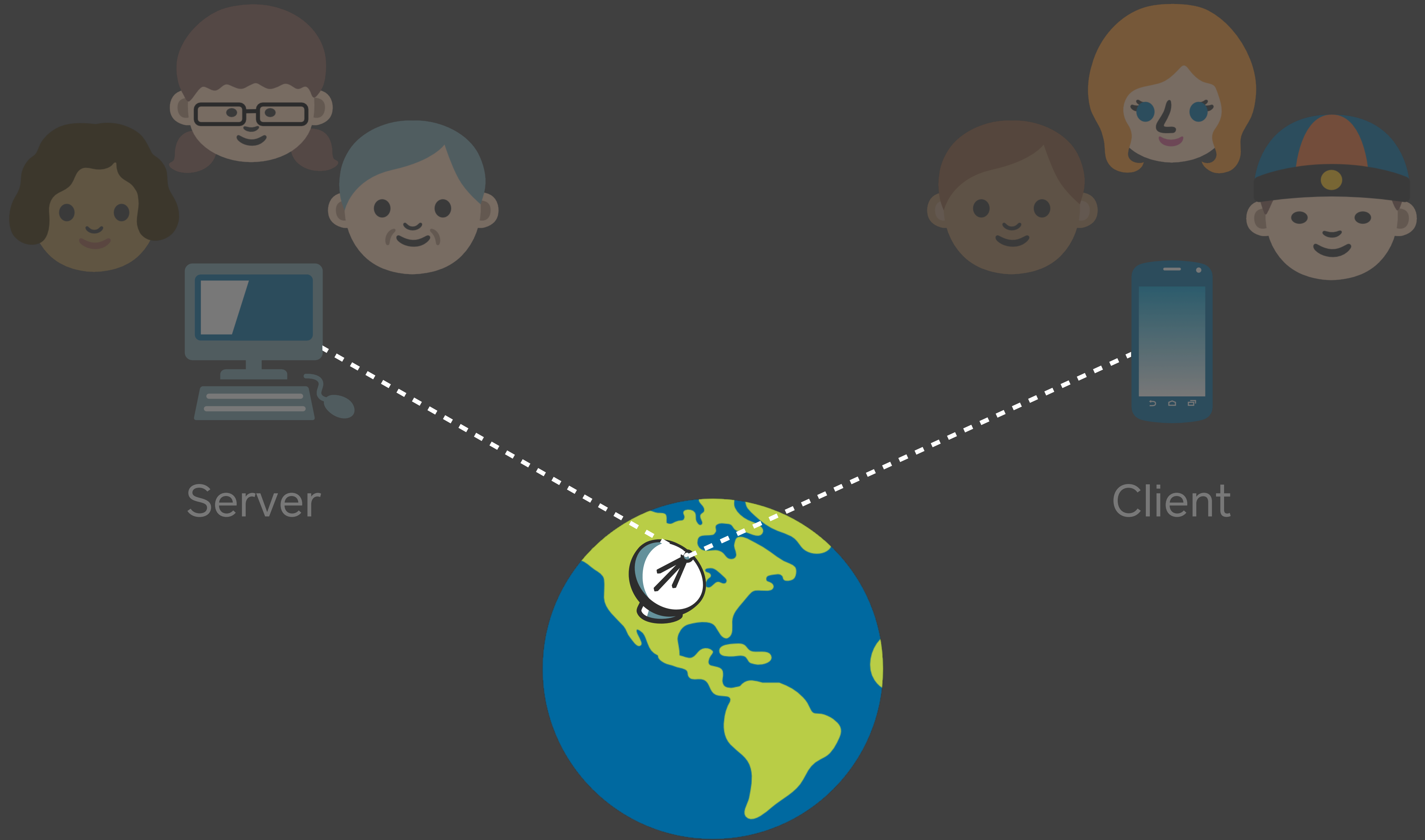


Server



Client





Round-Trip Time



Server



Client



RTT



Server

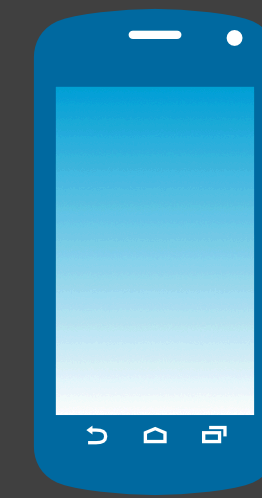


Client





Server



Client



Server

← GET / HTTP/1.1 —→



Client



Server

← GET / HTTP/1.1 —
— HTTP/1.1 200 OK →



Client



Server

← GET / HTTP/1.1
→ HTTP/1.1 200 OK



Client

Transport Layer Security



Server



Client

← GET / HTTP/1.1
→ HTTP/1.1 200 OK

TLS



Server



Client

← GET / HTTP/1.1
→ HTTP/1.1 200 OK

TLS



Server



Client

← GET / HTTP/1.1
→ HTTP/1.1 200 OK →

TLS v1.2



Server



Client

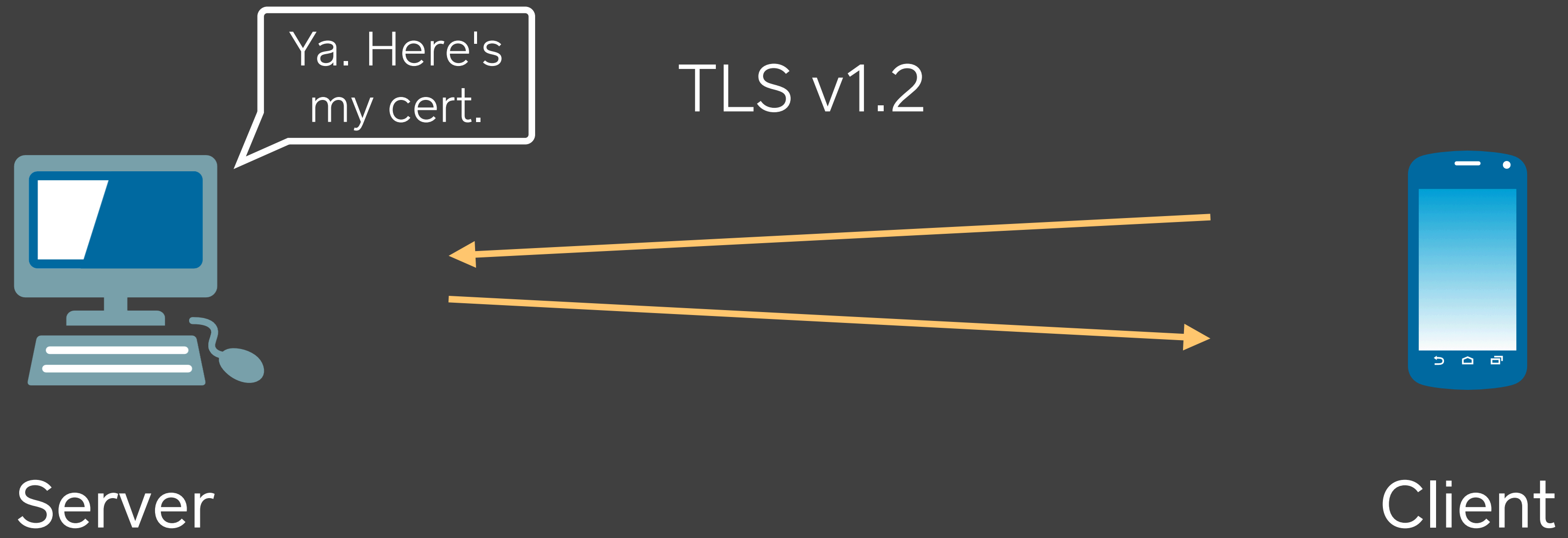


Server

TLS v1.2



Client





Server

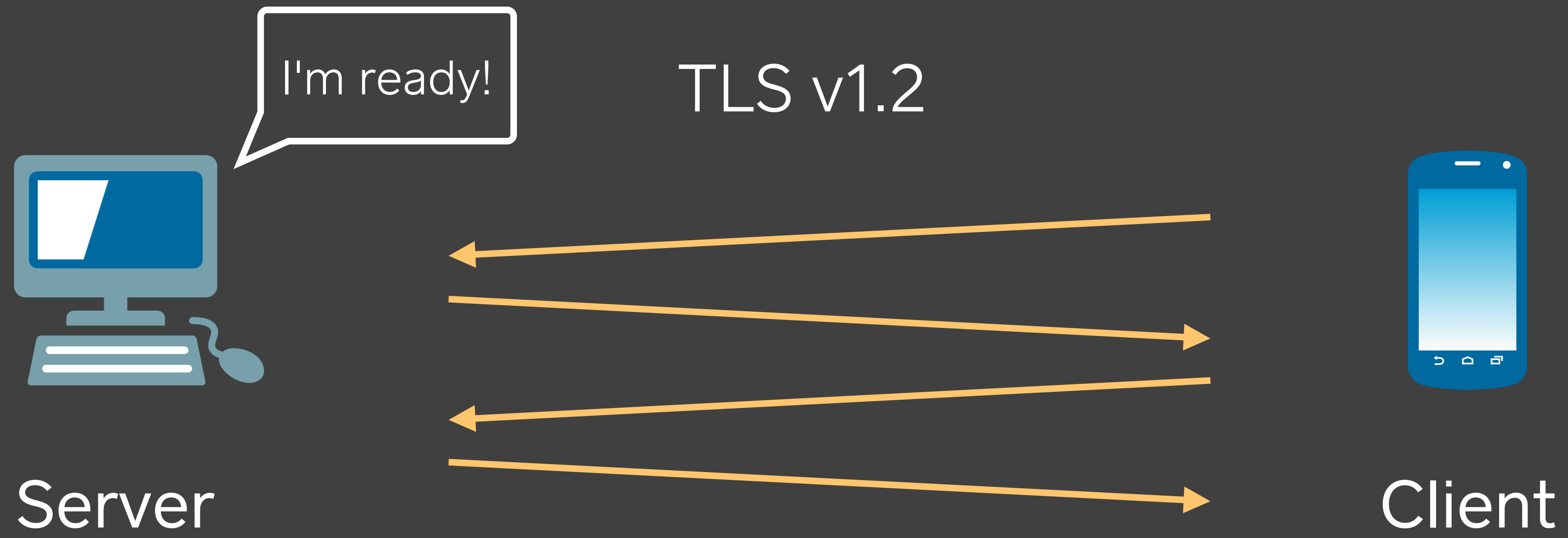
TLS v1.2



Great. Key
is hunter2



Client





Server

TLS v1.2

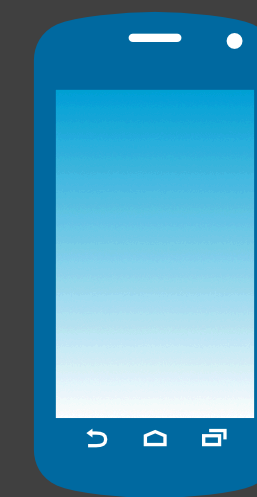


Client



Server

TLS v1.2



Client



TLS v1.2 w/ session resumption



Server



Client



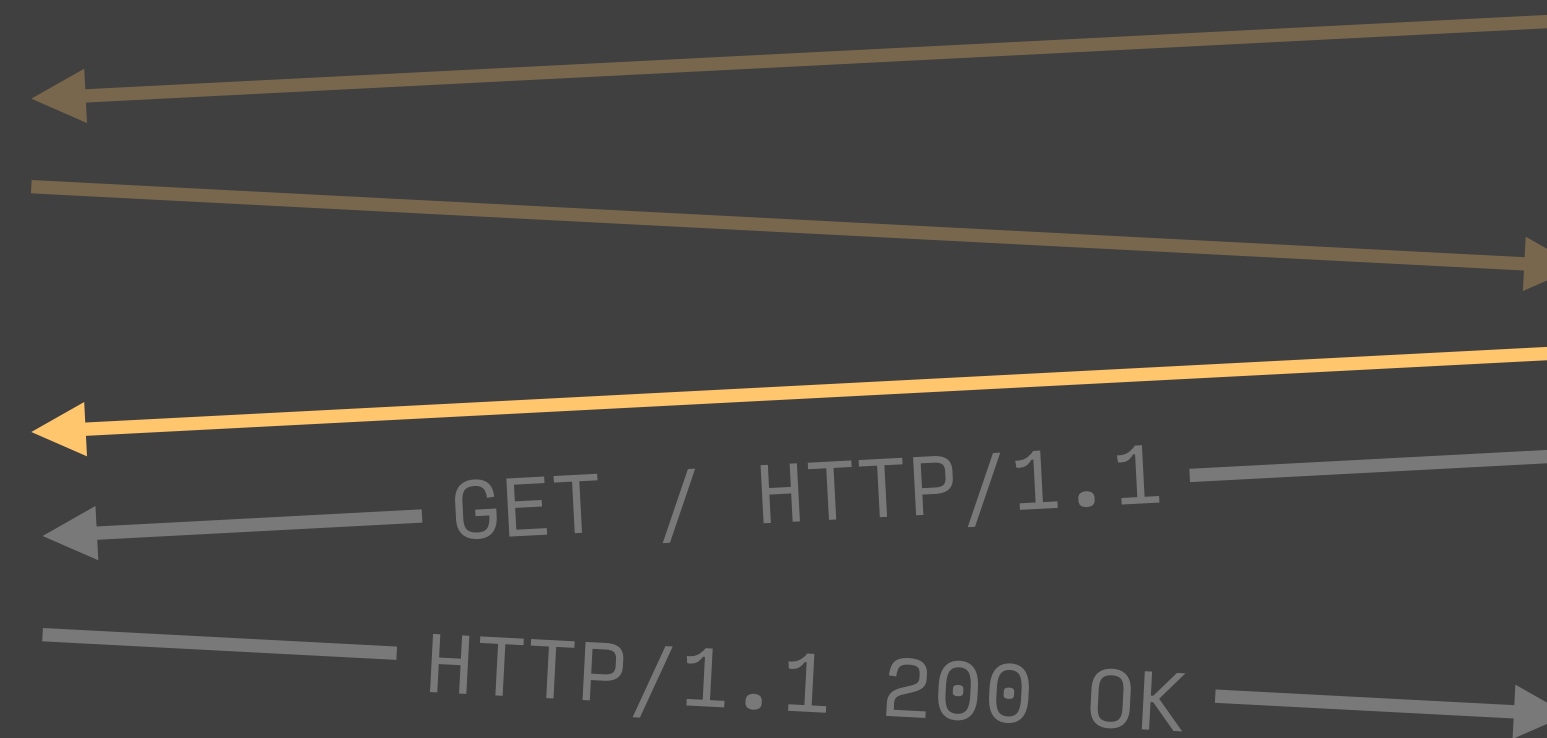
TLS v1.2 w/ session resumption



Server



Client



TLS v1.2 w/ session resumption



Server



Client



TLS v1.3



Server



Client



Server

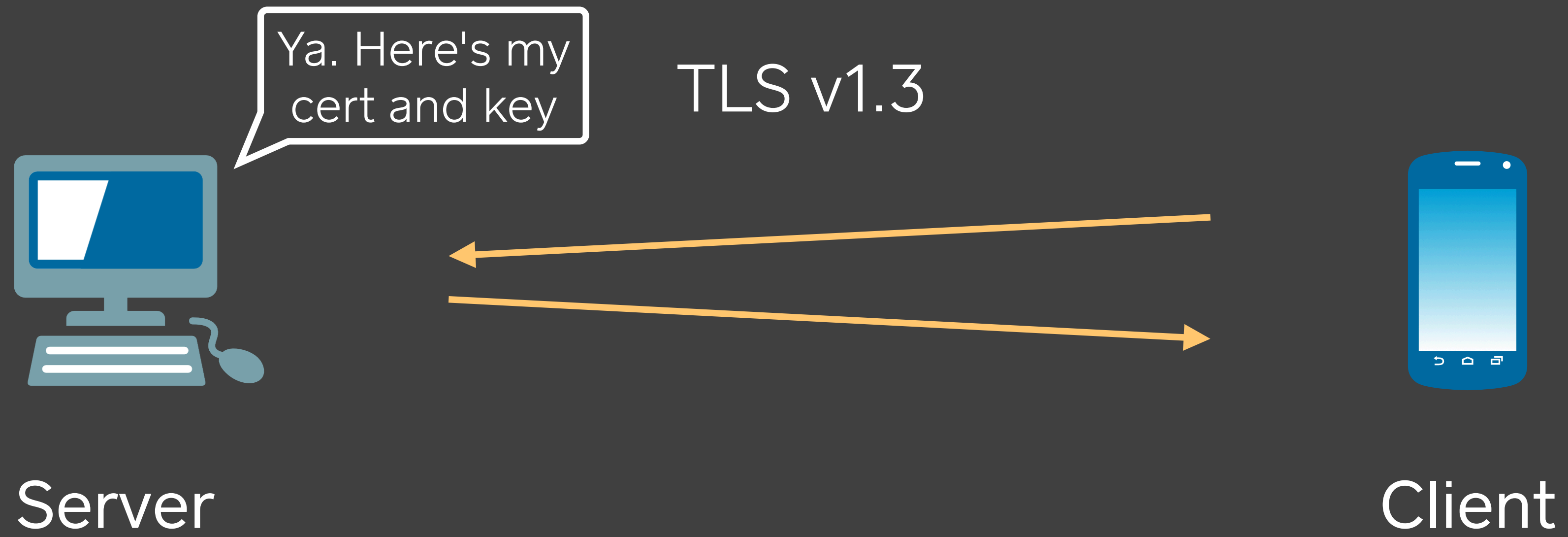
TLS v1.3

TLS? Key
is hunter2



Client







Server

TLS v1.3



Let's go!



Client



Server

TLS v1.3



Client



Server

TLS v1.3



Client



TLS v1.3 w/ session resumption



Server



Client



TLS v1.3 w/ 0-RTT session resumption



Server



Client

TLS v1.3 w/ 0-RTT session resumption



Server



Client



TLS v1.3 w/ 0-RTT session resumption



Server



Client



TLS v1.3 w/ 0-RTT session resumption



Server



Client

TLS v1.3 w/ 0-RTT session resumption



Server

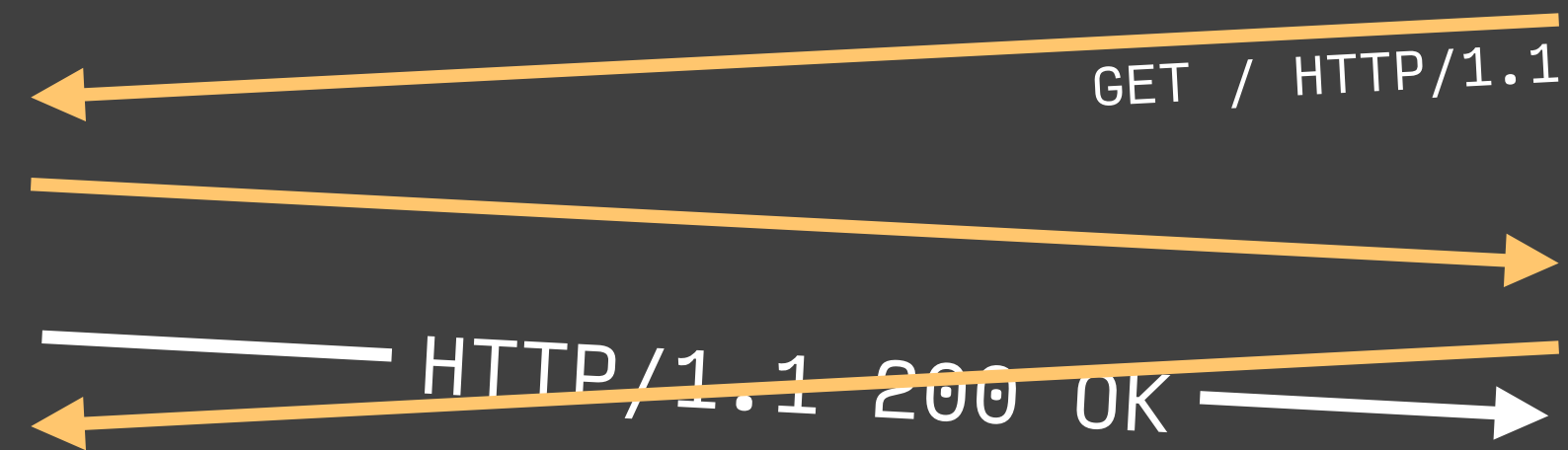


Client

TLS v1.3 w/ 0-RTT session resumption



Server

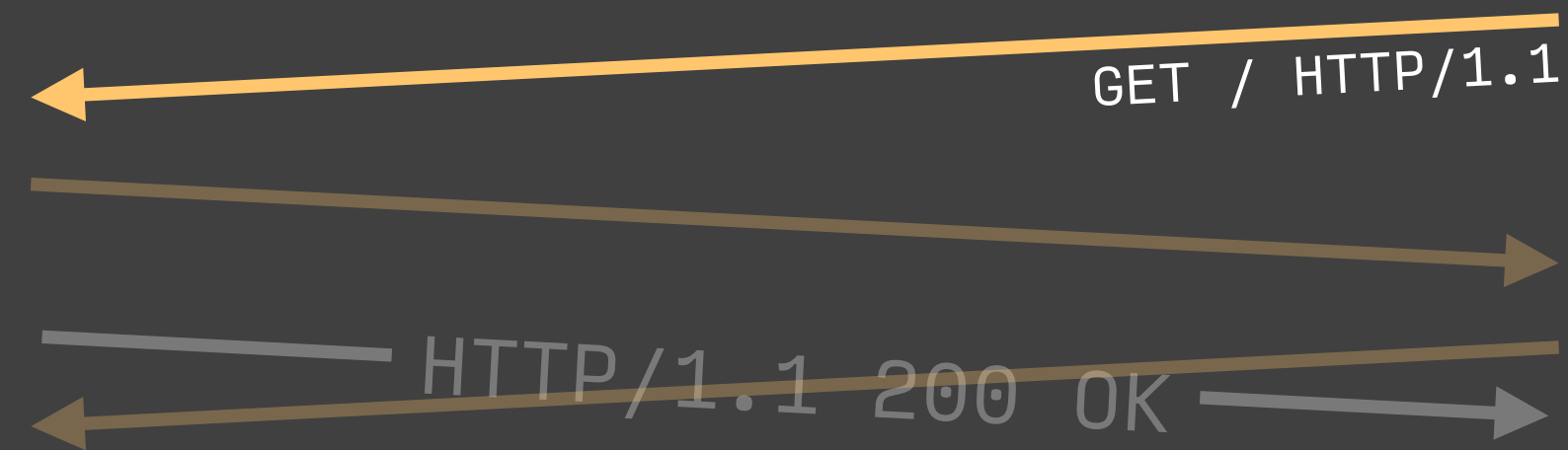


Client

TLS v1.3 w/ 0-RTT session resumption



Server



Client

RTT

TLS v1.2	2
TLS v1.2 w/ session resumption	1
TLS v1.3	1
TLS v1.3 w/ session resumption	1
TLS v1.3 w/ 0-RTT session resumption	0

```
OkHttpClient client = new OkHttpClient();

Request request = new Request.Builder()
    .url("https://twitter.com")
    .build();
Call call = client.newCall(request);

Response response = call.execute();
System.out.println(response.handshake().tlsVersion());
```



```
OkHttpClient client = new OkHttpClient();

Request request = new Request.Builder()
    .url("https://twitter.com")
    .build();
Call call = client.newCall(request);

Response response = call.execute();
System.out.println(response.handshake().tlsVersion());
```

TLS_1_2

HTTP



Server



Client



HTTP



Server

GET / HTTP/1.1
HTTP/1.1 200 OK



Client

HTTP



Server

GET / HTTP/1.1

HTTP/1.1 200 OK



Client

HTTP



Server

GET / HTTP/1.1
HTTP/1.1 200 OK



Client

HTTP



Server

GET / HTTP/1.1
HTTP/1.1 200 OK



Client


```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

```
{"id":1234,"amount":4200,"currency":"USD"}
```



```
/
/payments.html
/profile.html
/login.html
/settings.html
/static/fonts/roboto.ttf
/static/js/app.js
/static/css/main.css
/static/image/logo.png
```

/

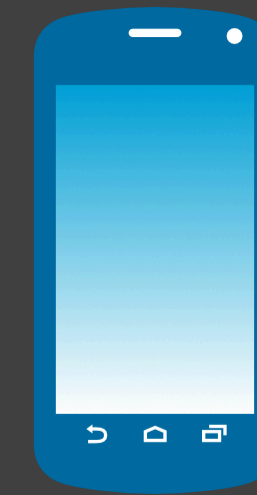
- /payments.html
- /profile.html
- /login.html
- /settings.html
- /static/fonts/roboto.ttf
- /static/js/app.js
- /static/css/main.css
- /static/image/logo.png

- /api/auth
- /api/user
- /api/payments
- /api/payments/1234
- /api/settings



Server

GET /api/payments
HTTP/1.1 200 OK



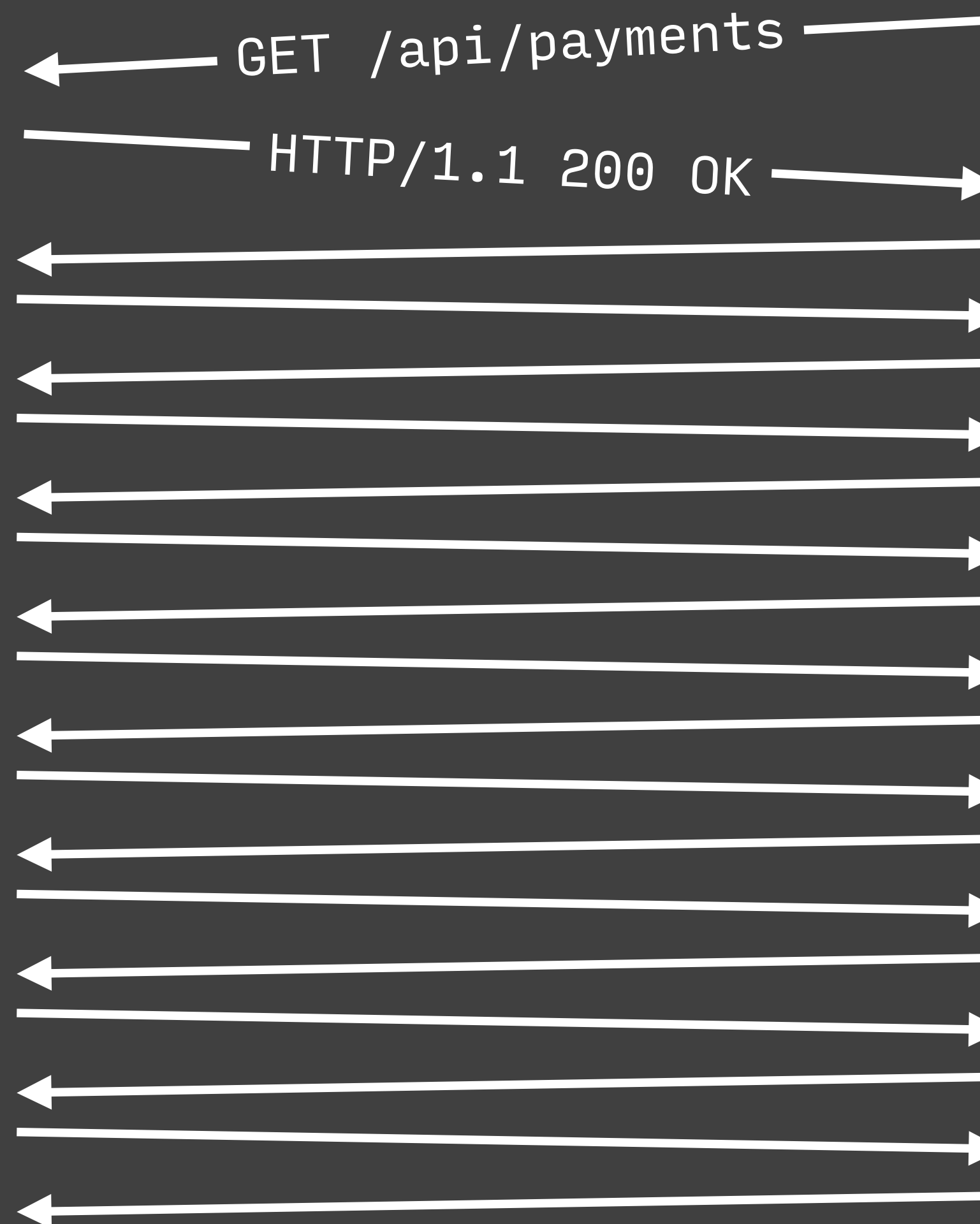
Client



Server



Client

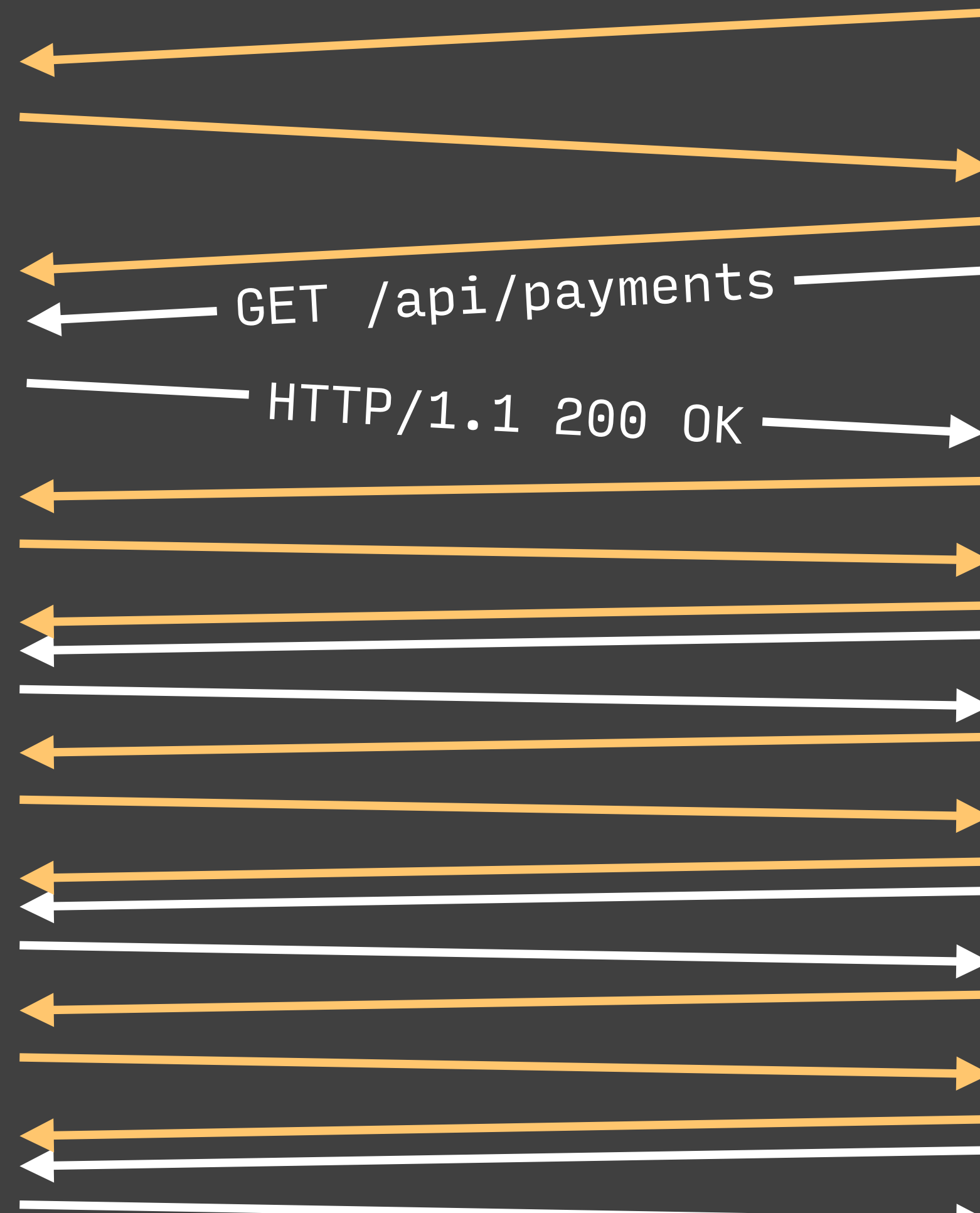




Server



Client

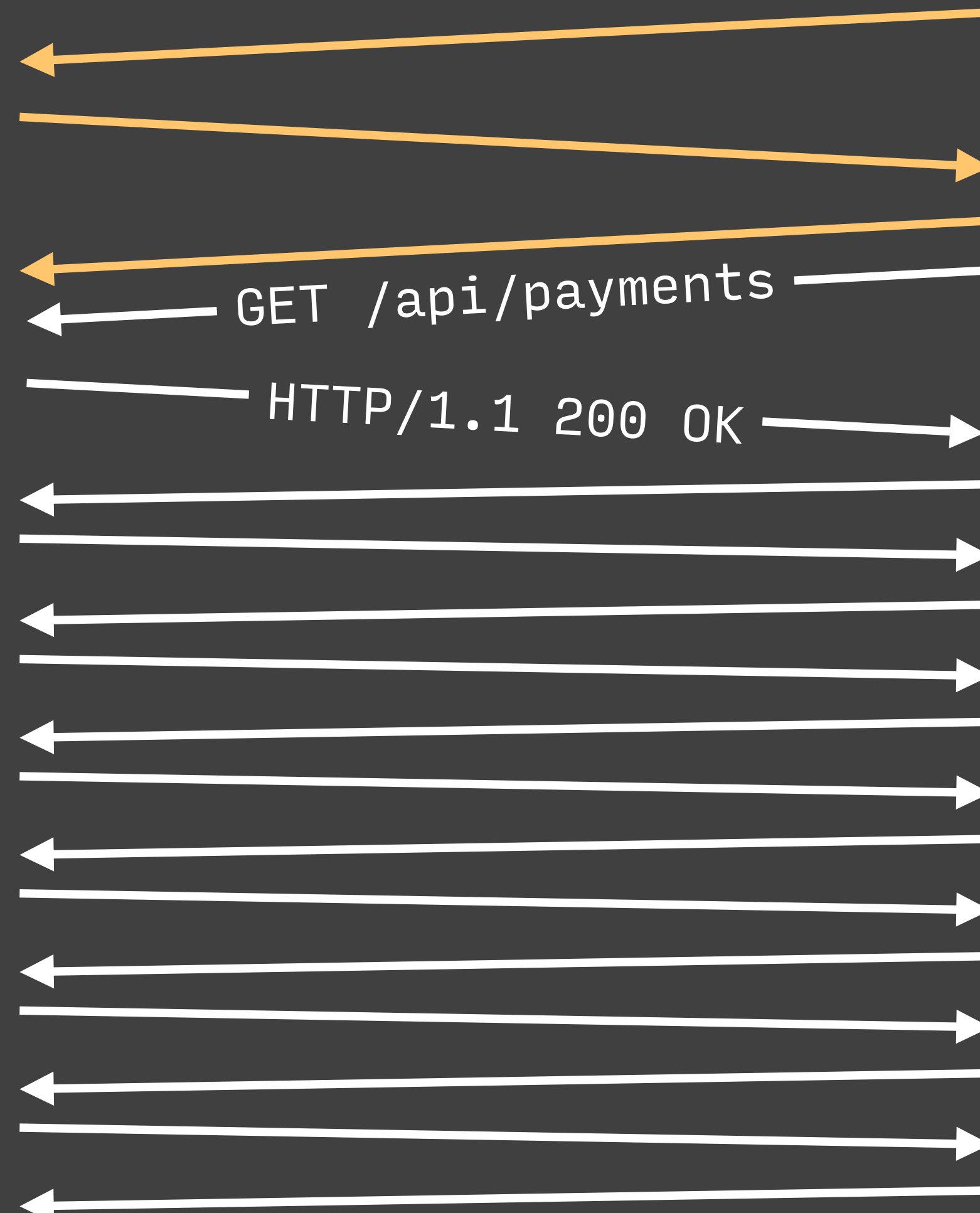




Server



Client

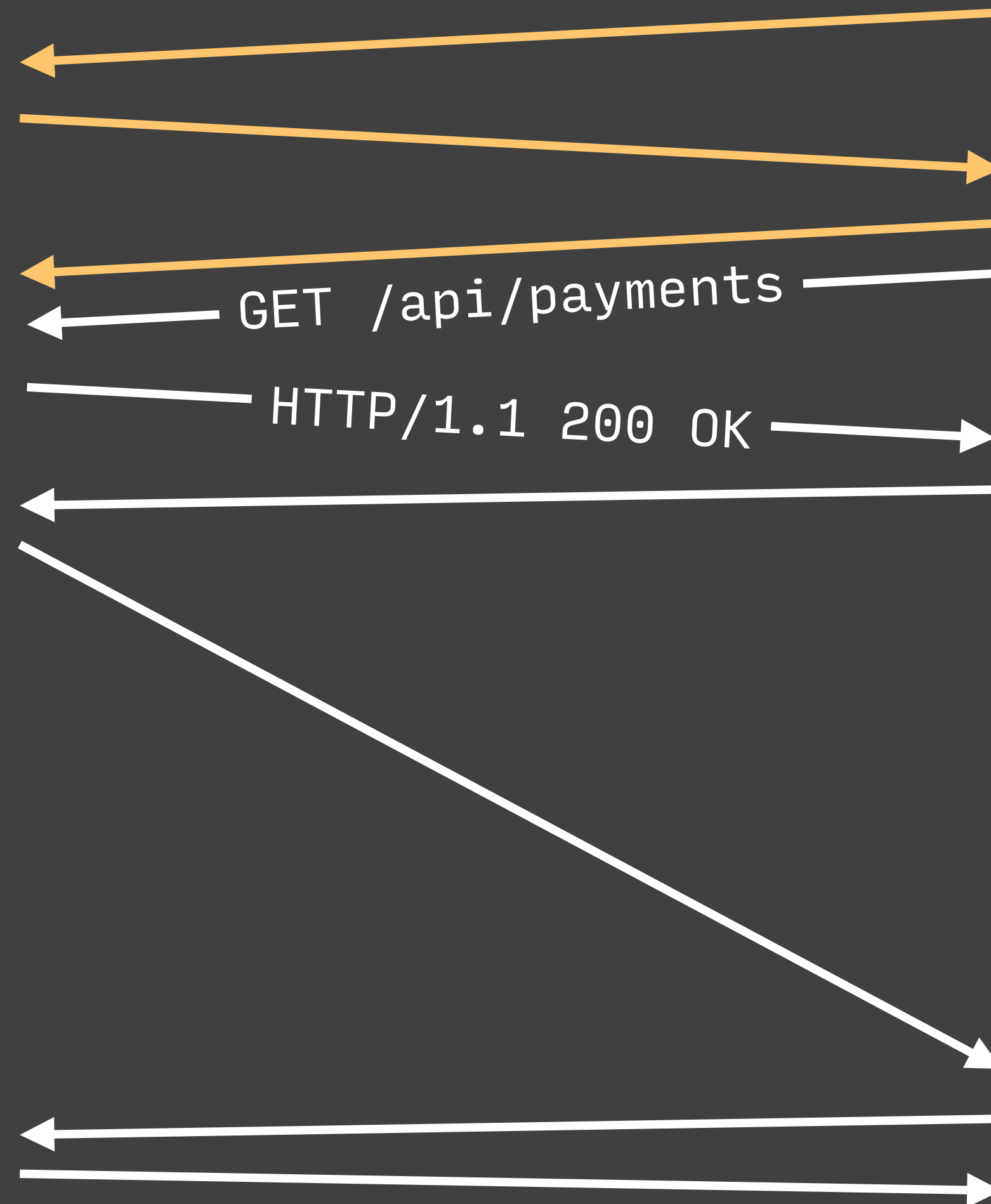




Server



Client

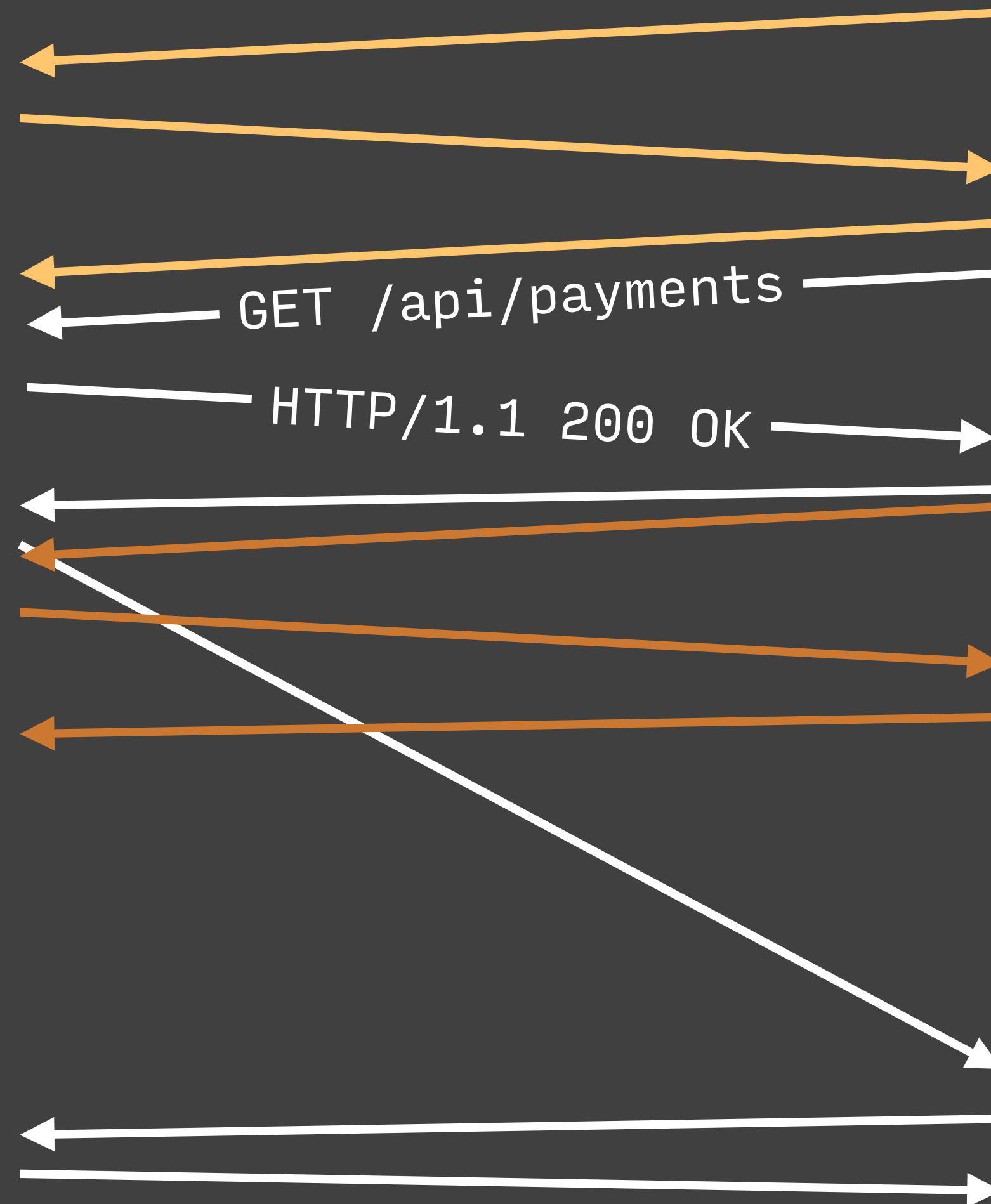




Server



Client

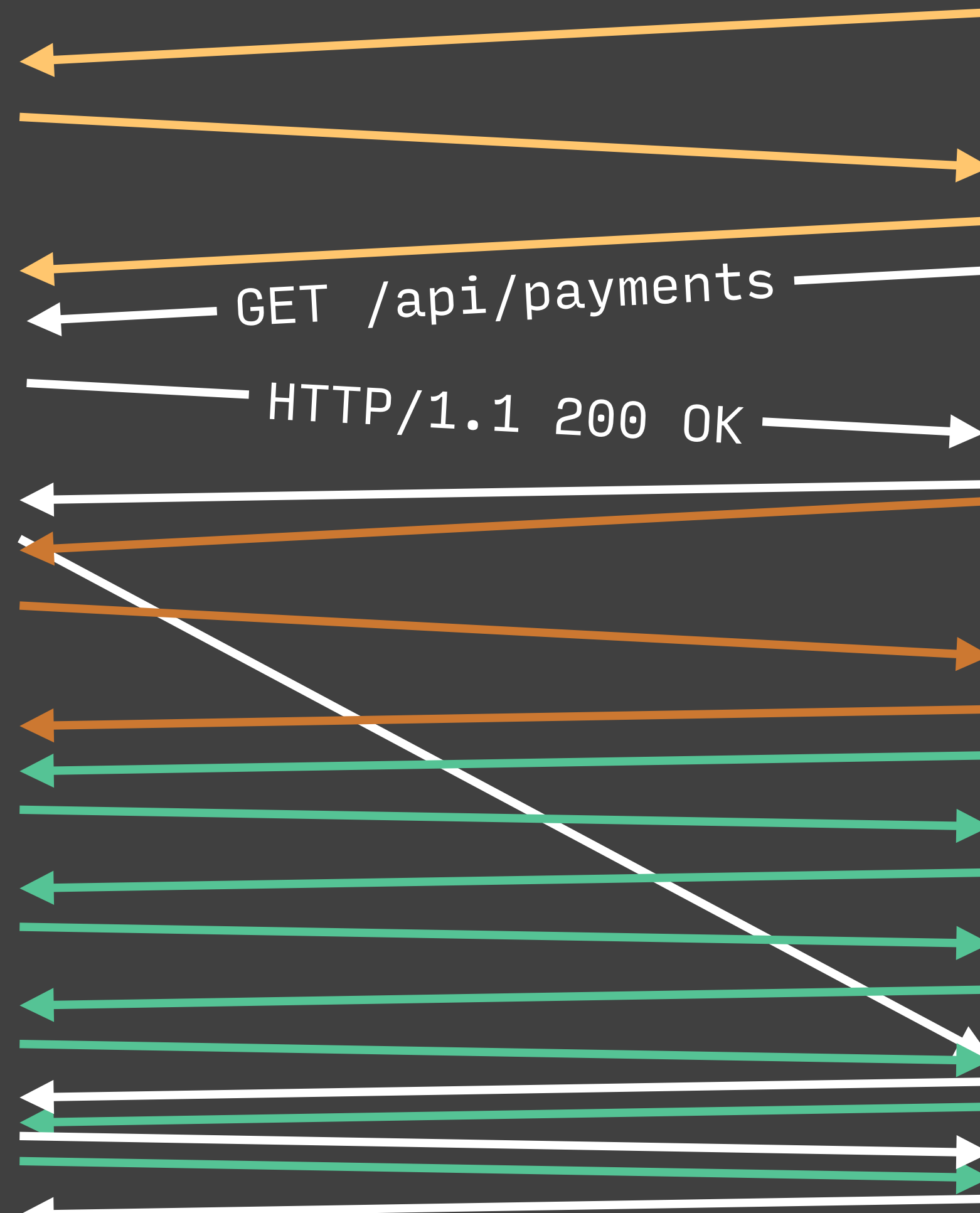


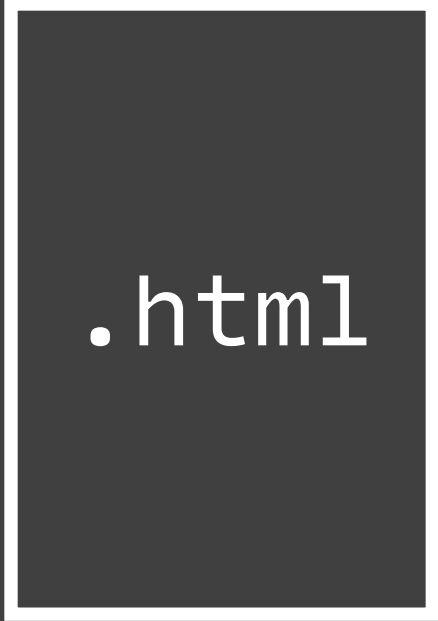


Server



Client





.html

.js

.js

.js

.js

.js

.js

.js

.html

.js

.js

.js

.js

.js

.js

.js

.css

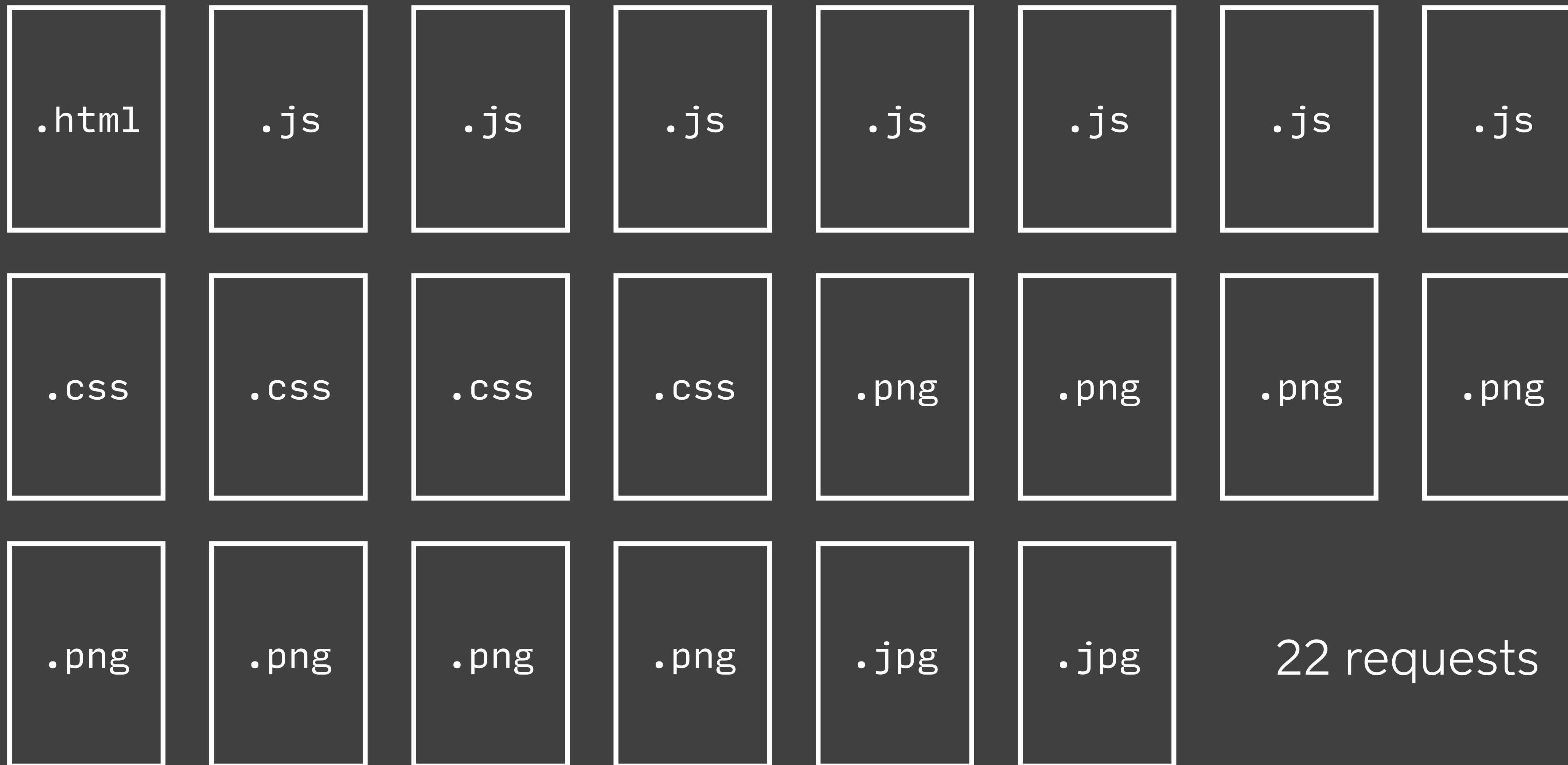
.css

.css

.css

.html	.js	.js	.js	.js	.js	.js	.js
.css	.css	.css	.css	.png	.png	.png	.png
.png	.png	.png	.png				

.html	.js	.js	.js	.js	.js	.js	.js
.css	.css	.css	.css	.png	.png	.png	.png
.png	.png	.png	.png	.jpg	.jpg		



.html

.js

.css

.css

.css

.css

.png

.png

.png

.png

.png

.png

.png

.png

.jpg

.jpg

16 requests

.html

.js

.css

.png

.png

.png

.png

.png

.png

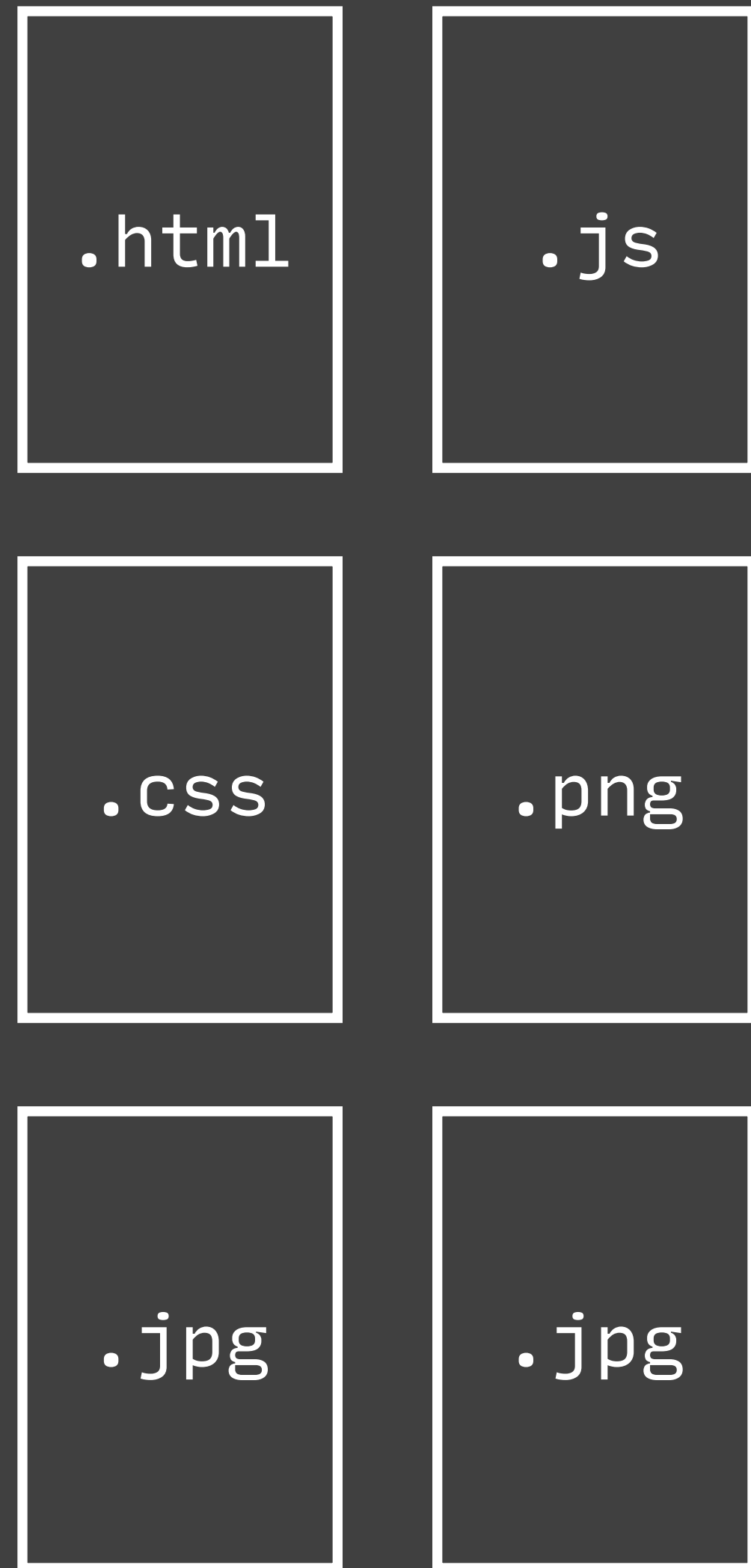
.png

.png

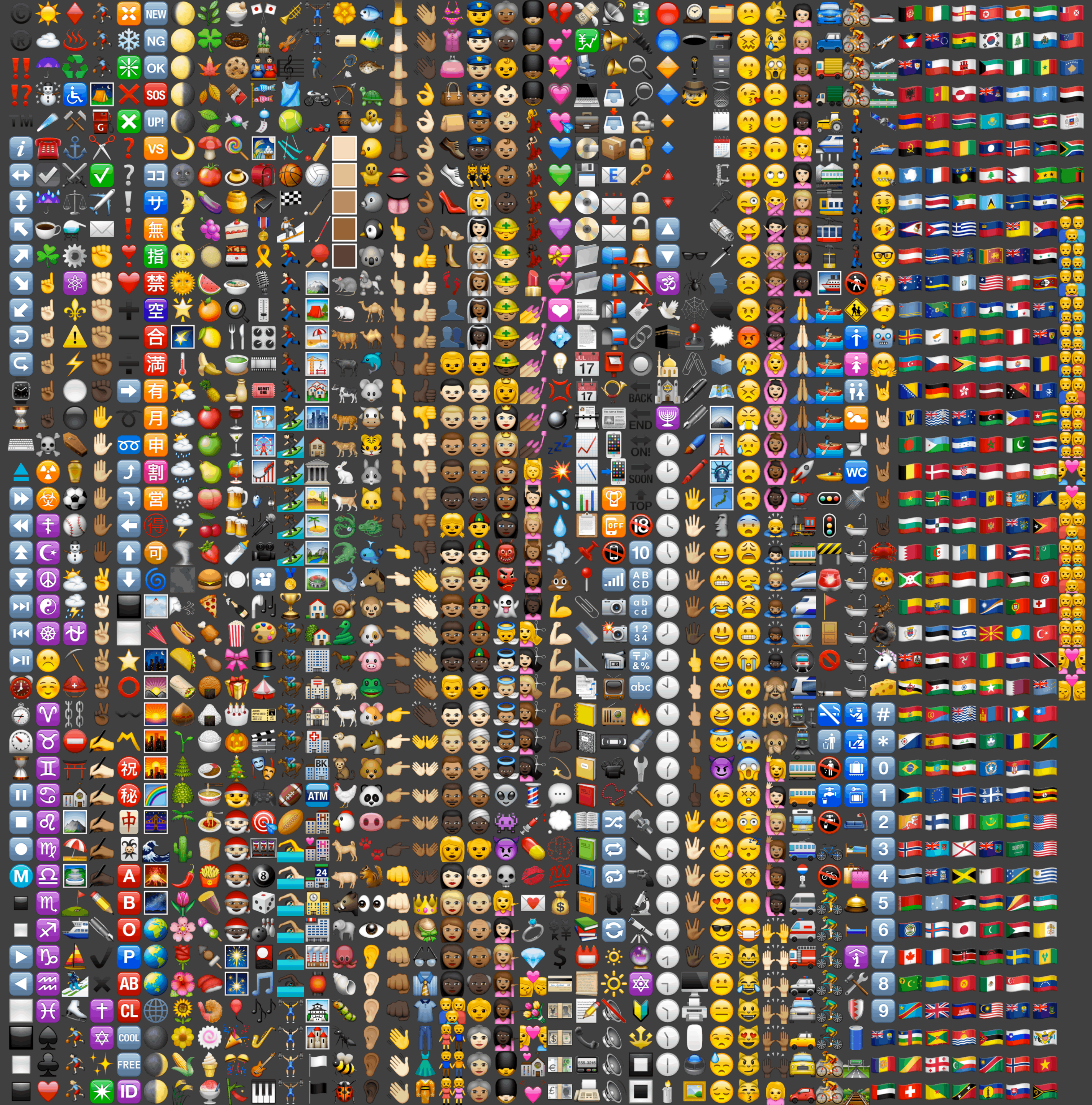
.jpg

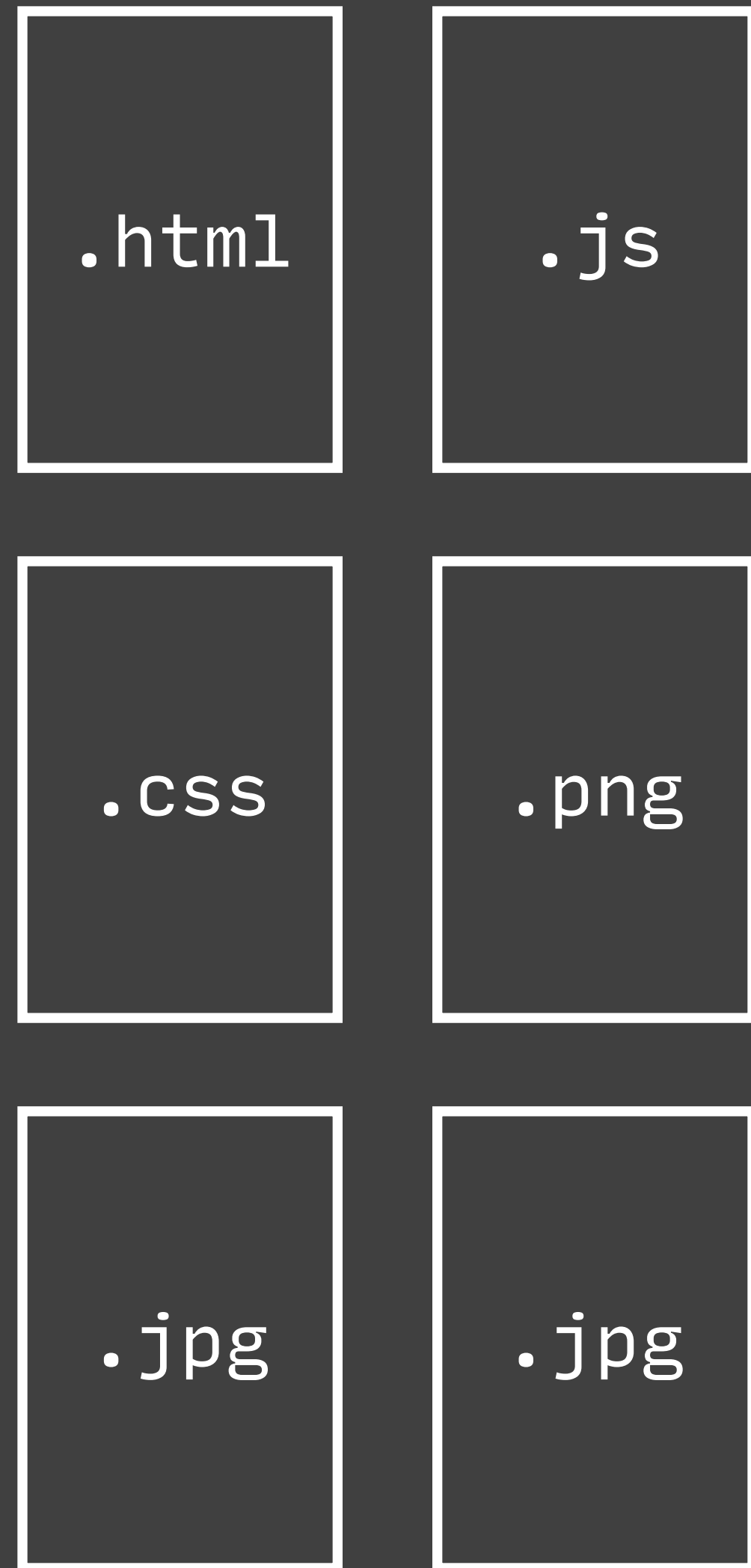
.jpg

13 requests



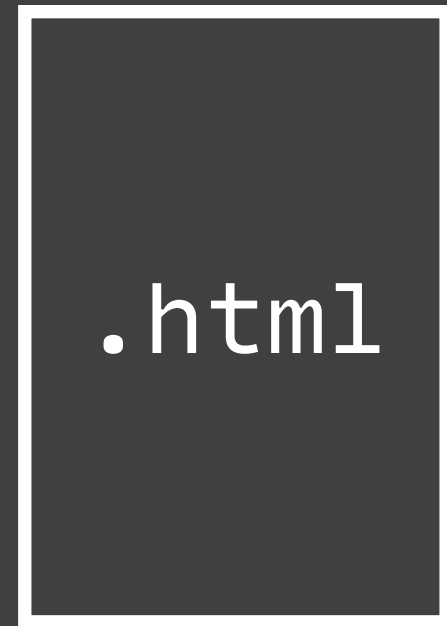
6 requests



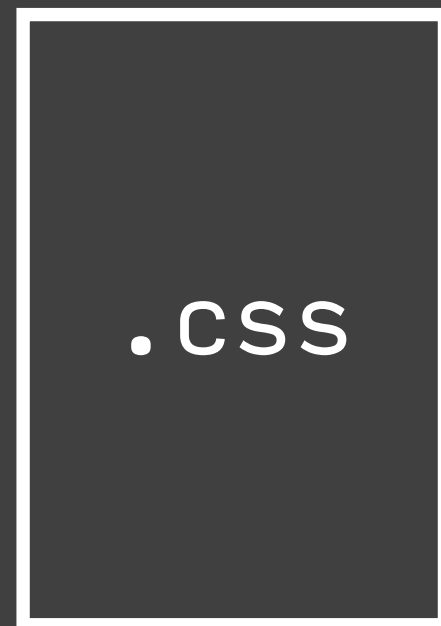
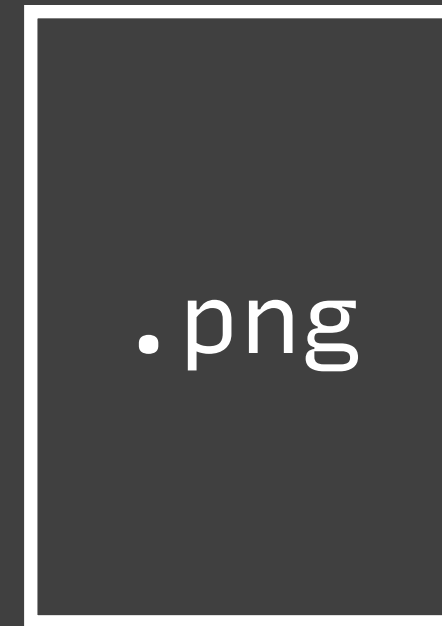
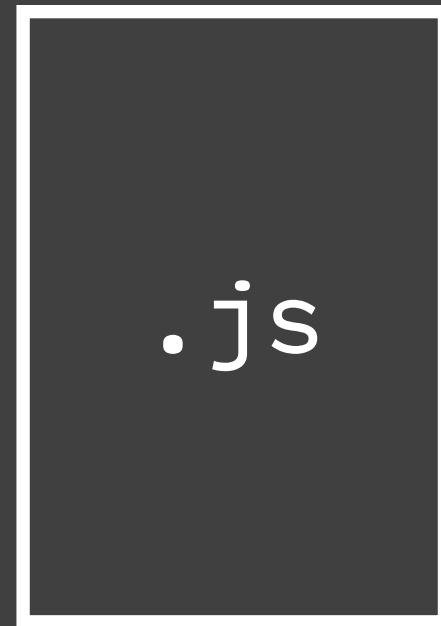


6 requests

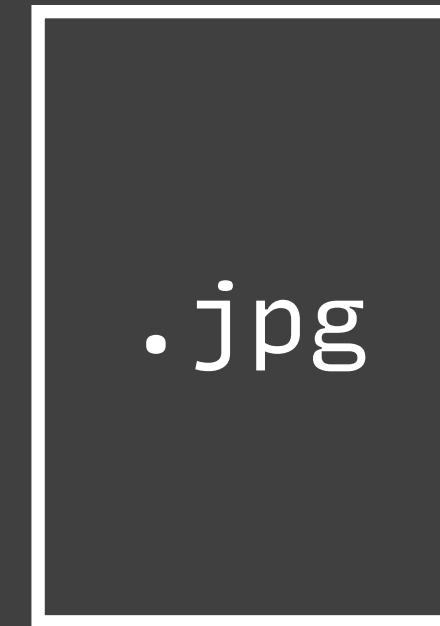
example.com



cdn.example.com



images.example.com



1+3+2 requests

example.com

.html

cdn.example.com

.js

.png

.css

images.example.com

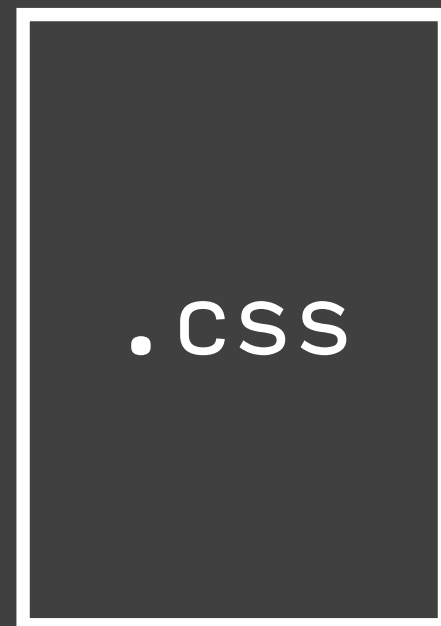
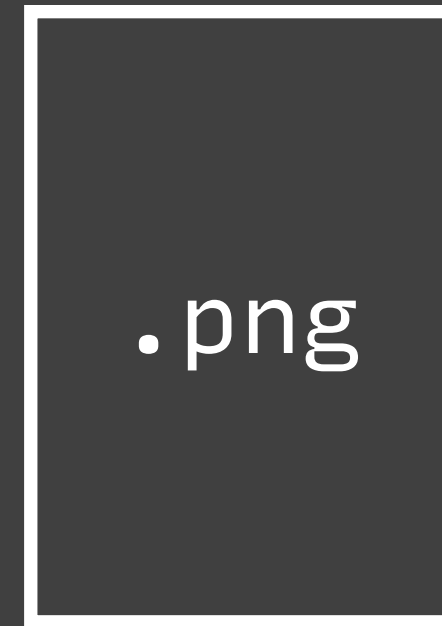
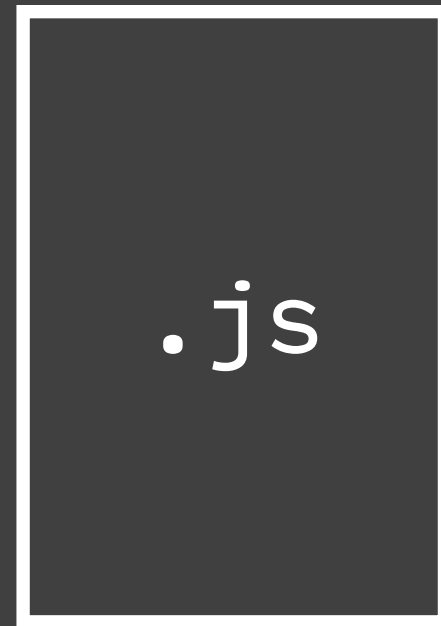
.jpg

.jpg

example.com



cdn.example.com



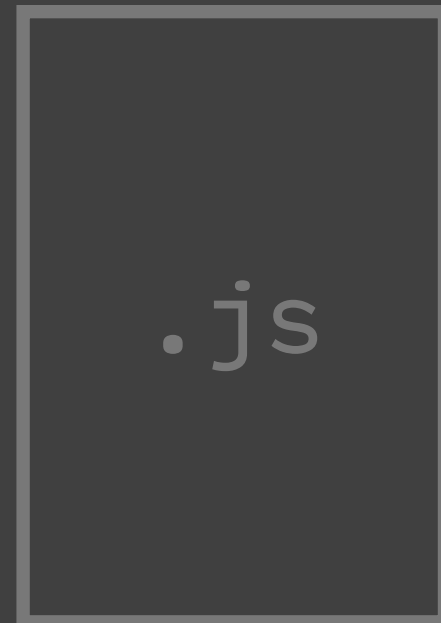
images.example.com



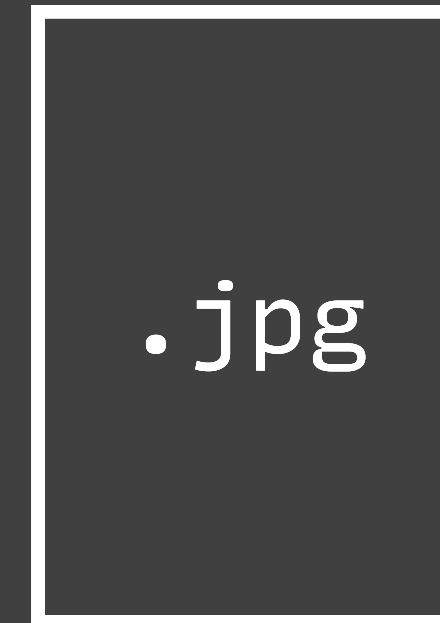
example.com



cdn.example.com



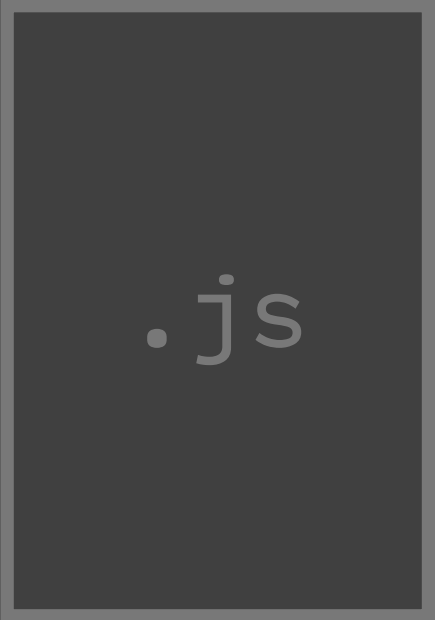
images.example.com



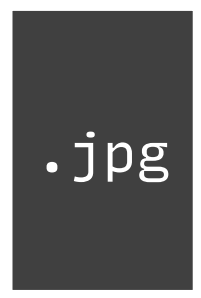
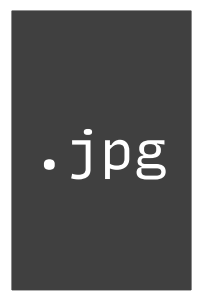
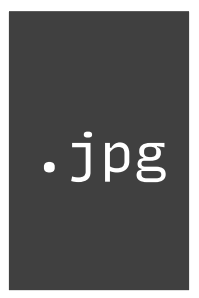
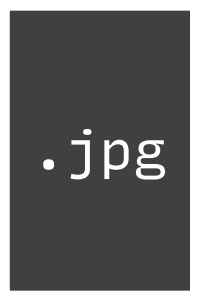
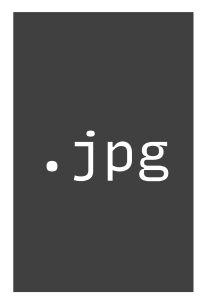
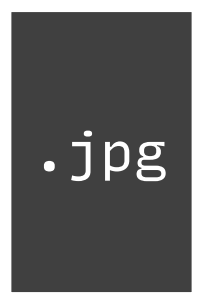
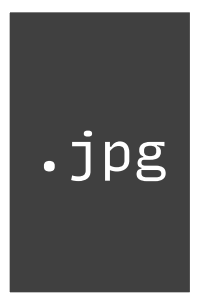
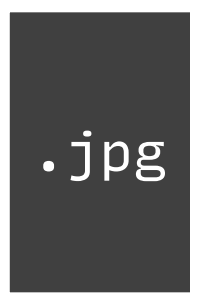
example.com



cdn.example.com



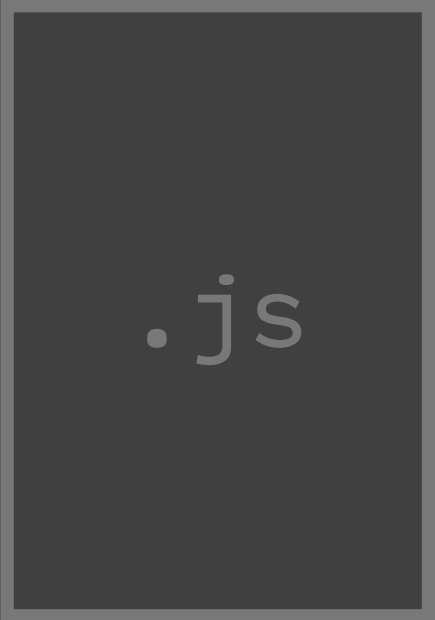
images.example.com



example.com



cdn.example.com



images1.example.com



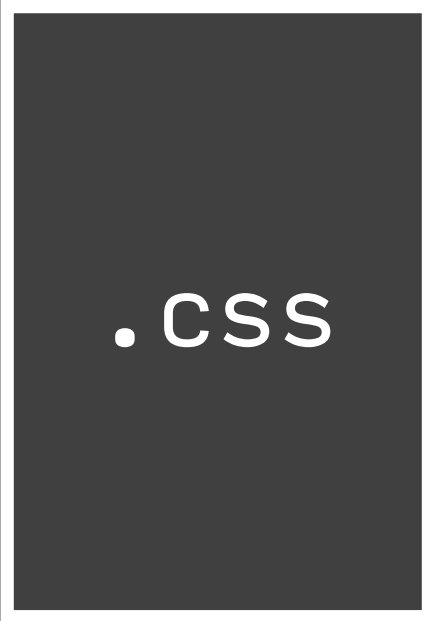
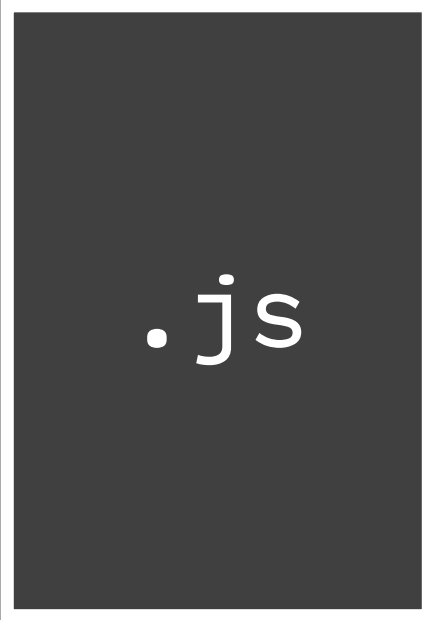
images2.example.com



example.com



cdn.example.com



images1.example.com



images2.example.com

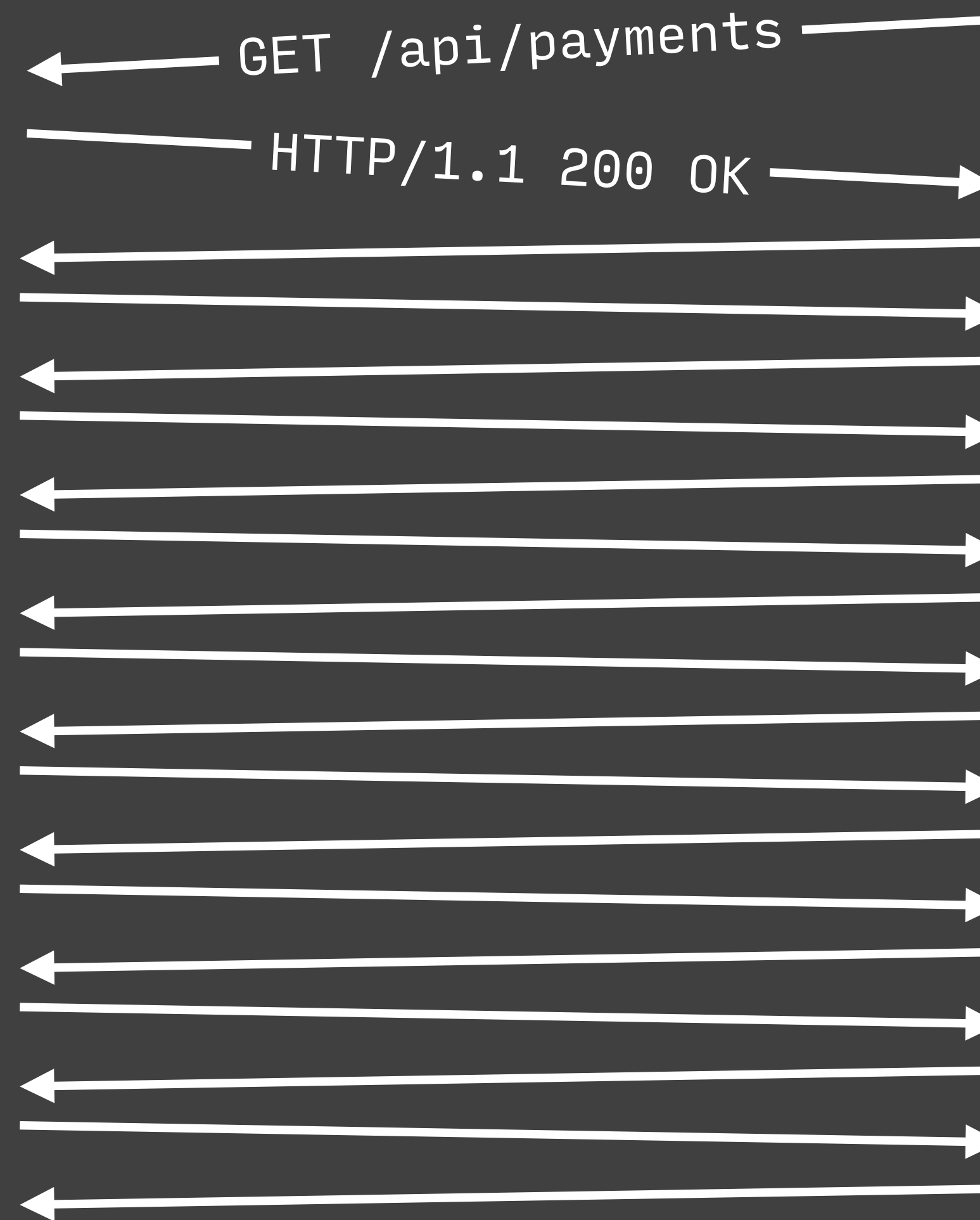




Server



Client



/api/payments

```
[  
  1234,  
  1275,  
  1690,  
  2641,  
  2903,  
  4991,  
  5312,  
  5319,  
  14328,  
  28321,  
  29948,  
  30991,  
  37174,  
  73572  
]
```


/api/payments

```
[  
  1234,  
  1275,  
  1690,  
  2641,  
  2903,  
  4991,  
  5312,  
  5319,  
  14328,  
  28321,  
  29948,  
  30991,  
  37174,  
  73572  
]
```

/api/payments/{id}

```
{  
  id: 1234,  
  amount: 4200,  
  currency: "USD",  
  initiator_id: 48818374,  
  recipient_id: 24567654,  
  initiated_at: 14764993868,  
  completed_at: 14769455213  
}
```

/api/payments

```
[
  {
    id: 1234,
    amount: 4200,
    currency: "USD",
    initiator: {
      id: 48818374,
      name: "Jake Wharton"
    },
    recipient: {
      id: 24567654,
      name: "Jesse Wilson"
    },
    initiated_at: 14764993868,
    completed_at: 14769455213
  },
  ...
]
```


HTTP/2



Server



Client



HTTP/2



Server



Client



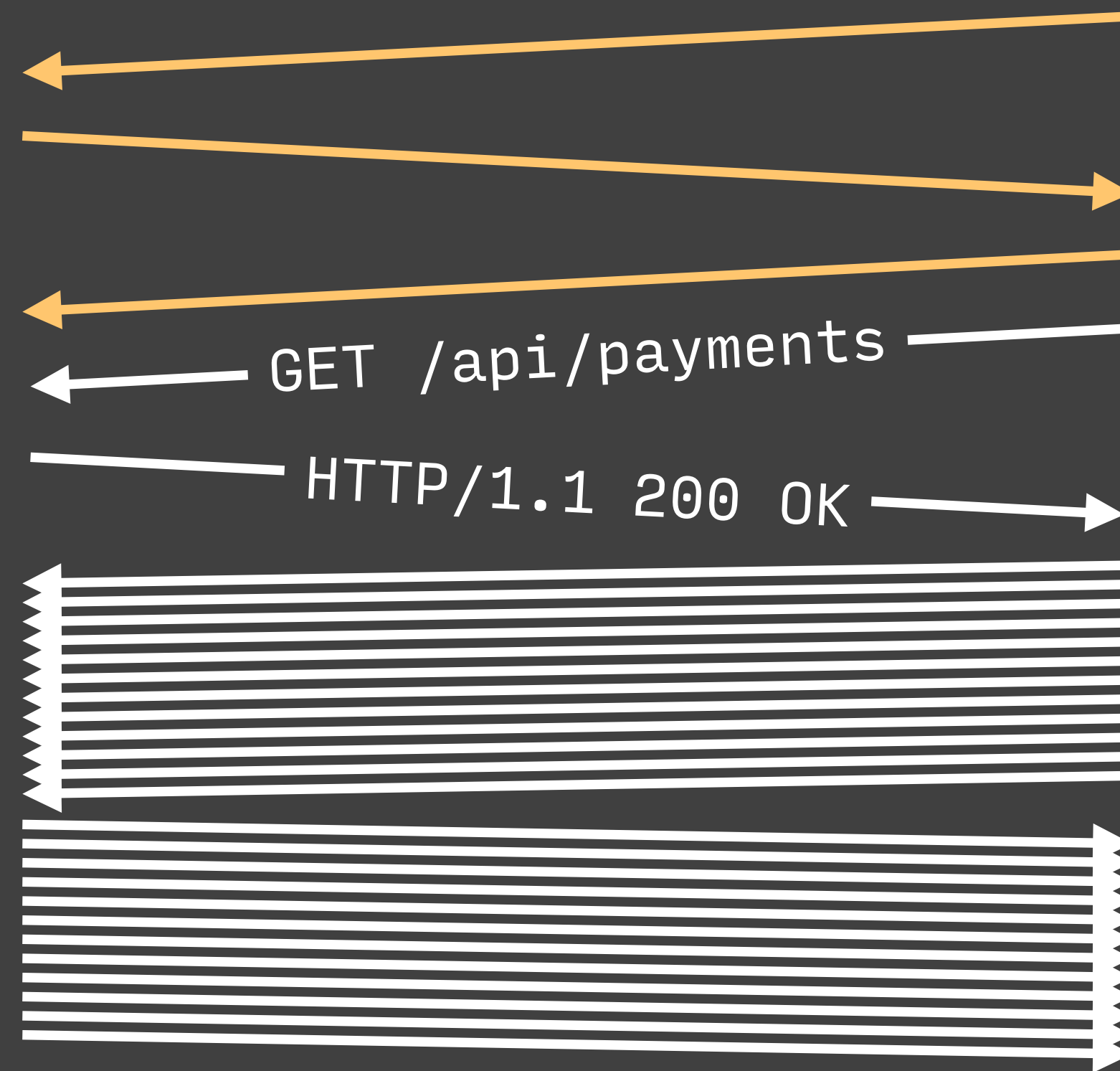
HTTP/2



Server



Client



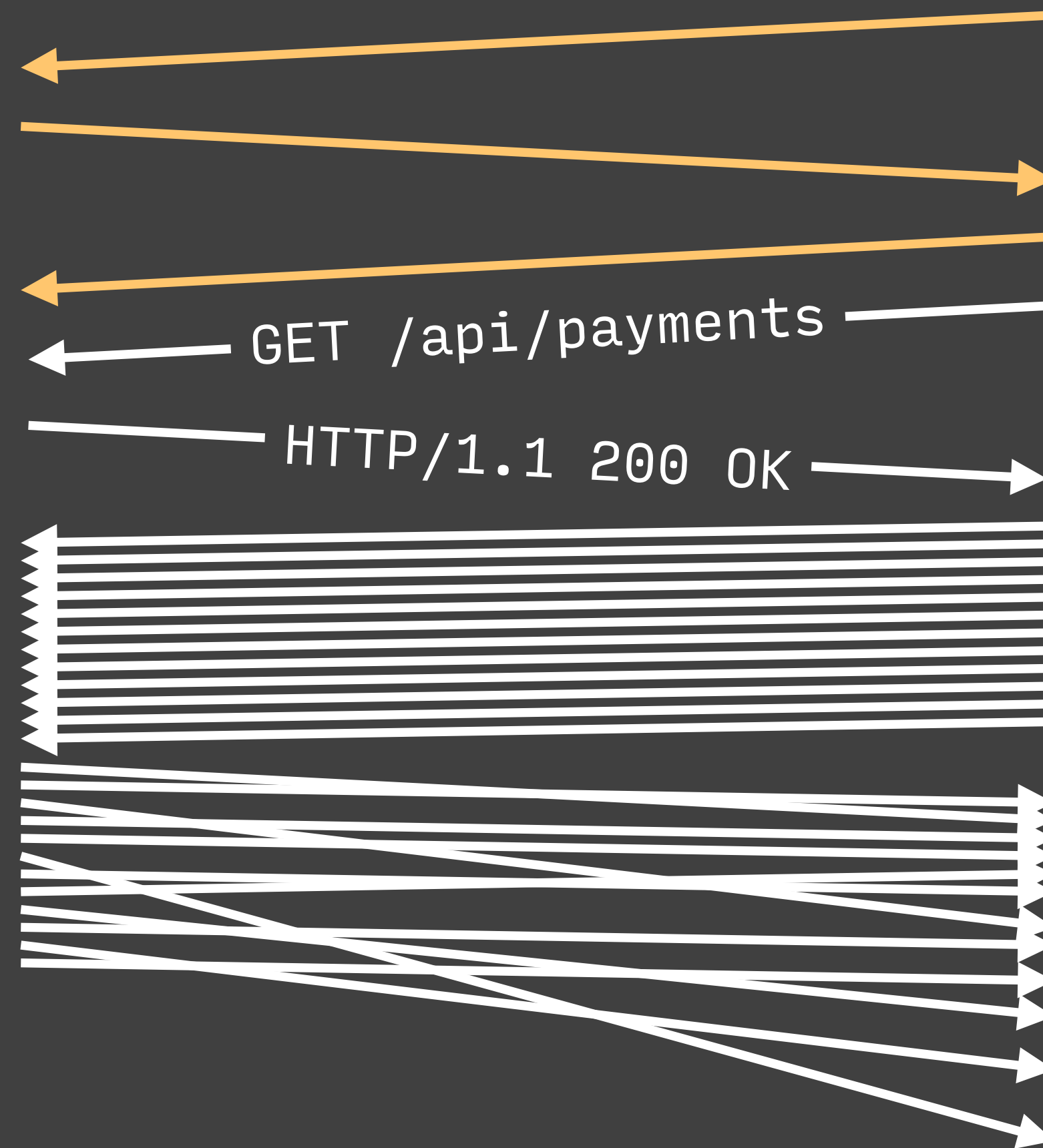
HTTP/2



Server



Client



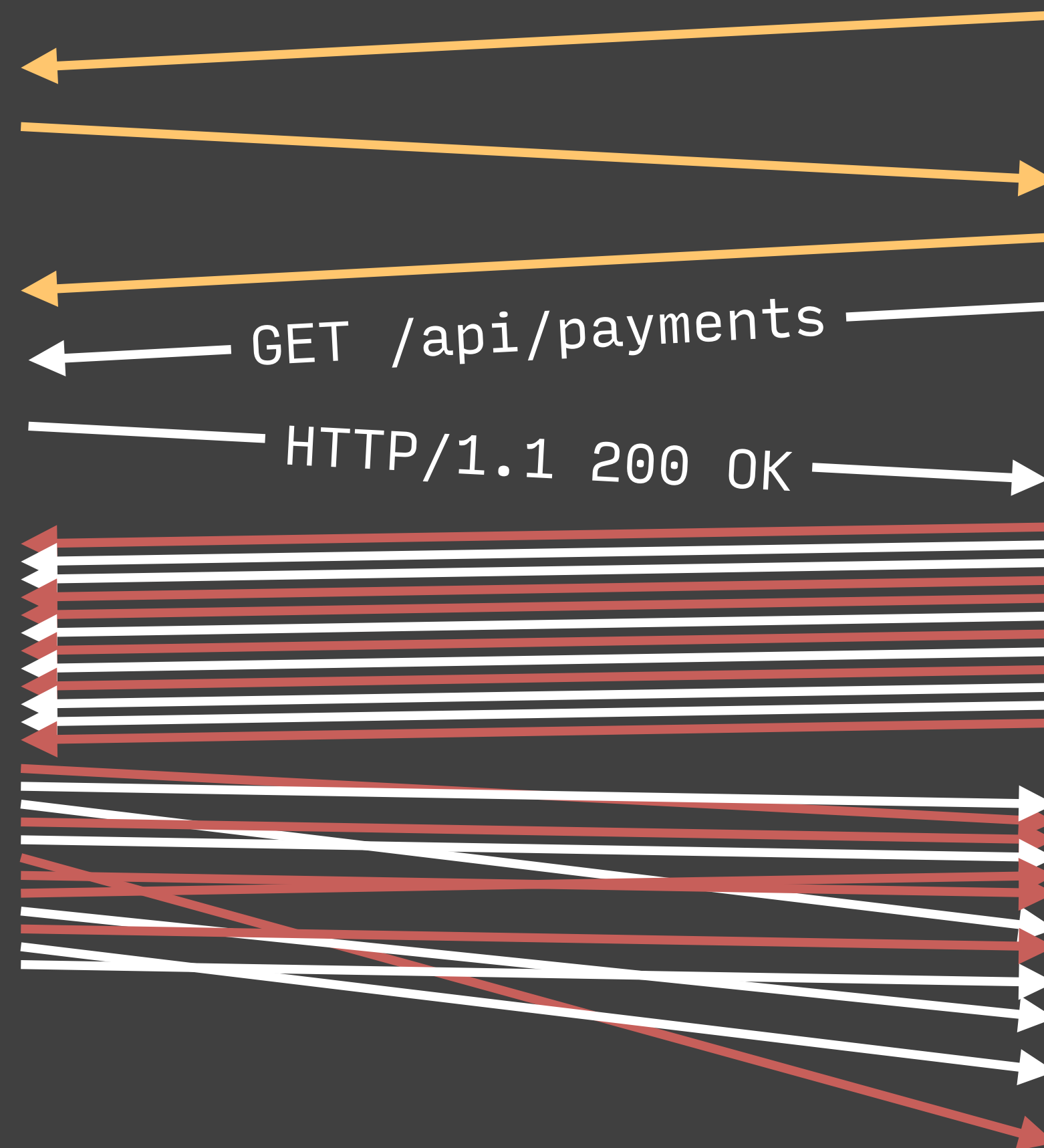
HTTP/2



Server



Client



HTTP/2



Server



Client



HTTP/2



Server



Client



HTTP/2



Server



Client



HTTP/2



Server



Client



HTTP/2



Server



Client



HTTP/2



Server



Client



HTTP/2



Server



Client



HTTP/2



Server



Client



HTTP/2



Server



Client



HTTP/2



Server



Client



HTTP/2



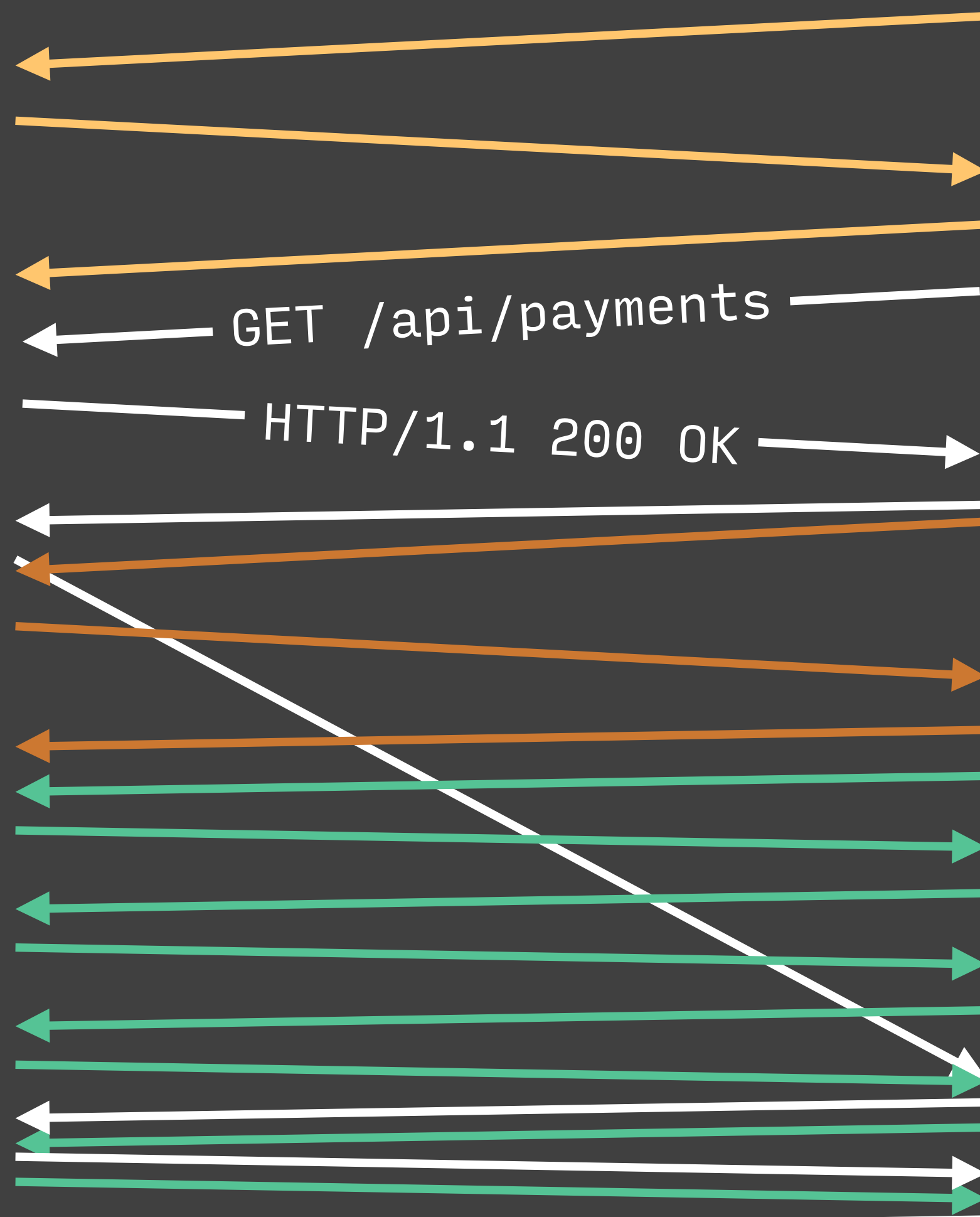
Server



Client



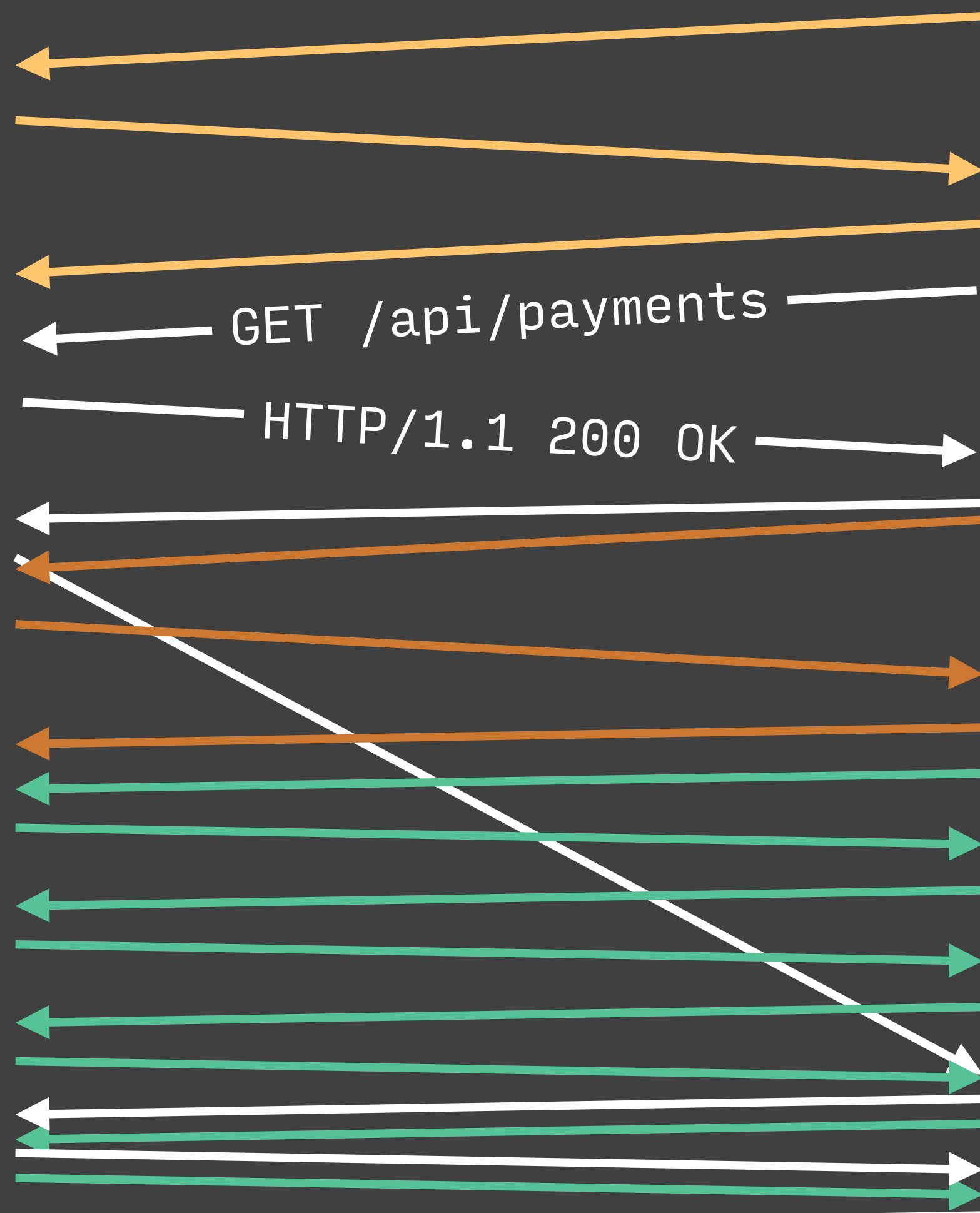
HTTP/1.1



HTTP/2



HTTP/1.1



HTTP/2



time

HTTP/1.1

HTTP/2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT

{"id":1234,"amount":4200,"currency":"USD"}
```


HTTP/1.1

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT

{"id":1234,"amount":4200,"currency":"USD"}
```

HTTP/2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT

{"id":1234,"amount":4200,"currency":"USD"}
```



Server

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```



Client

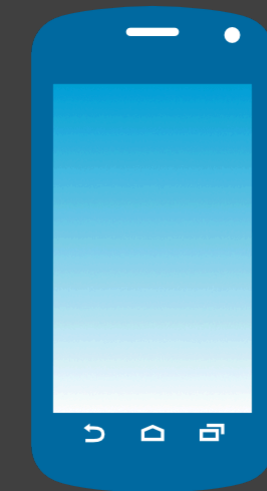
```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT

{"id":1234,"amount":4200,"currency":"USD"}
```



Server

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```



Client

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT

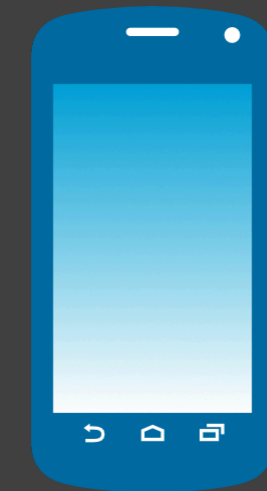
{"id":1234,"amount":4200,"currency":"USD"}
```




Server

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```



Client

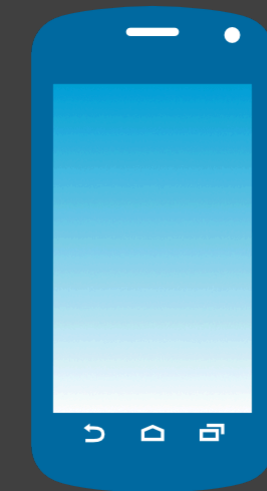
ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT

{"id":1234,"amount":4200,"currency":"USD"}
```



Server



Client

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT

{"id":1234,"amount":4200,"currency":"USD"}
```




Server



Client

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT

{"id":1234,"amount":4200,"currency":"USD"}
```



Server



Client

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT

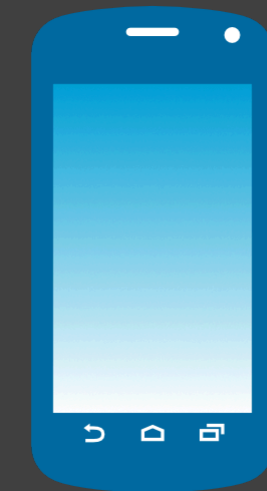
{"id":1234,"amount":4200,"currency":"USD"}
```



Server

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```



Client

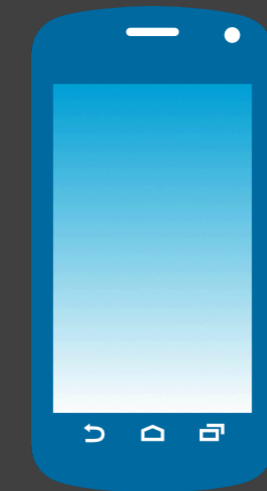
ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT

{"id":1234,"amount":4200,"currency":"USD"}
```




Server



Client

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

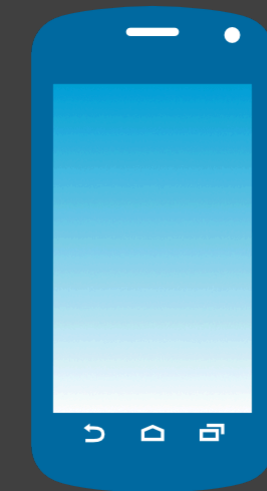
```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2

```
{"id":1234,"amount":4200,"currency":"USD"}
```



Server



Client

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2

```
{"id":1234,"amount":420
```

ID: 2

```
0,"currency":"USD"}
```



Server



Client

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 4

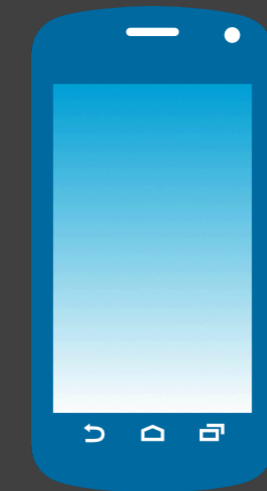
```
[1234,1275,1690,2641,2903,49]
```

ID: 2

```
{"id":1234,"amount":420}
```




Server



Client

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2

```
{"id":1234,"amount":420
```

ID: 2

```
0,"currency":"USD"}
```



Server



Client

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
Host: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
0x25: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
0x25: square.com:443
User-Agent: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
Accept: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
Authorization: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
Content-Type: application/json
Content-Length: 42
E-Tag: "686897696a7c876b7e"
Last-Modified: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
0x25: 0x01
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
0x25: 0x01
0x39: 0x02
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
0x25: 0x01
0x39: 0x02
0x12: 0x03
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 2

```
HTTP/1.1 200 OK
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
0x25: 0x01
0x39: 0x02
0x12: 0x03
0x16: 0x04
```

ID: 2

```
HTTP/1.1 200 OK
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

ID: 2

```
GET / HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11
```

ID: 4

```
GET /api/payments HTTP/1.1
0x25: 0x01
0x39: 0x02
0x12: 0x03
0x16: 0x04
```

ID: 2

```
HTTP/1.1 200 OK
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT
```

ID: 2



Server



Client

GET /api/payments HTTP/1.1
0x25: 0x01
0x39: 0x02
0x12: 0x03
0x16: 0x04

ID: 2

HTTP/1.1 200 OK
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT

ID: 2

{"id":1234,"amount":420

ID: 4

HTTP/1.1 200 OK
0x1E: application/json
0x1B: 471
0x21: "ae7284b30ccc93"
0x2B: Wed, 19 Apr 2017 09:22:09 GMT

ID: 2

0,"currency":"USD"}



Server



Client

GET /api/payments HTTP/1.1
0x25: 0x01
0x39: 0x02
0x12: 0x03
0x16: 0x04

ID: 2

HTTP/1.1 200 OK
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT

ID: 2

{"id":1234,"amount":420

ID: 4

HTTP/1.1 200 OK
0x1E: application/json
0x1B: 471
0x21: "ae7284b30ccc93"
0x2B: Wed, 19 Apr 2017 09:22:09 GMT

ID: 2

0,"currency":"USD"}



Server



Client

GET /api/payments HTTP/1.1
0x25: 0x01
0x39: 0x02
0x12: 0x03
0x16: 0x04

ID: 2

0x08
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT

ID: 2

{"id":1234,"amount":420

ID: 4

0x08
0x1E: application/json
0x1B: 471
0x21: "ae7284b30ccc93"
0x2B: Wed, 19 Apr 2017 09:22:09 GMT

ID: 2

0,"currency":"USD"}



Server



Client

GET /api/payments HTTP/1.1
0x25: 0x01
0x39: 0x02
0x12: 0x03
0x16: 0x04

ID: 2

0x08
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT

ID: 2

{"id":1234,"amount":420

ID: 4

0x08
0x1E: 0x1A
0x1B: 471
0x21: "ae7284b30ccc93"
0x2B: Wed, 19 Apr 2017 09:22:09 GMT

ID: 2

0,"currency":"USD"}



Server



Client

GET /api/payments HTTP/1.1
0x25: 0x01
0x39: 0x02
0x12: 0x03
0x16: 0x04

ID: 2

0x08
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT

ID: 2

{"id":1234,"amount":420

ID: 4

0x08
0x1E: 0x1A
0x1B: 471
0x21: "ae7284b30ccc93"
0x2B: Wed, 19 Apr 2017 09:22:09 GMT

ID: 2

0,"currency":"USD"}



Server



Client

ID: 2
GET / HTTP/1.1
0x25: square.com:443
0x39: okhttp/3.7.0
0x12: application/json
0x16: Basic QWxhZGRpbjpPcGVuU2VzYW11

ID: 4
GET /api/payments HTTP/1.1
0x25: 0x01
0x39: 0x02
0x12: 0x03
0x16: 0x04

ID: 2
0x08
0x1E: application/json
0x1B: 42
0x21: "686897696a7c876b7e"
0x2B: Thu, 20 Apr 2017 12:45:26 GMT

ID: 2
{ "id": 1234, "amount": 420 }

ID: 4
0x08
0x1E: 0x1A
0x1B: 471
0x21: "ae7284b30ccc93"
0x2B: Wed, 19 Apr 2017 09:22:09 GMT

ID: 2
0, "currency": "USD" }

```
OkHttpClient client = new OkHttpClient();

Request request = new Request.Builder()
    .url("https://twitter.com")
    .build();
Call call = client.newCall(request);

Response response = call.execute();
System.out.println(response.protocol());
```


Payloads

```
{"id":1234,"amount":4200,"currency":"USD"}
```


JSON

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

JSON

```
{"id":1234,"amount":4200,"currency":"USD"}
```

Protocol Buffers

```
message Payment {  
    string id = 1;  
    int32 amount = 2;  
    Currency currency = 3;  
}
```

```
enum Currency {  
    USD = 1;  
}
```


JSON

```
{"id":1234,"amount":4200,"currency":"USD"}
```

Protocol Buffers

```
message Payment {  
    string id = 1;  
    int32 amount = 2;  
    Currency currency = 3;  
}
```

1=1234
2=4200
3=1

```
enum Currency {  
    USD = 1;  
}
```

JSON

```
{"id":1234,"amount":4200,"currency":"USD"}
```

Protocol Buffers

```
message Payment {  
    string id = 1;  
    int32 amount = 2;  
    Currency currency = 3;  
}
```

```
1=1234  
2=4200  
3=1
```

```
0104D20210680301
```

```
enum Currency {  
    USD = 1;  
}
```

JSON

```
{"id":1234,"amount":4200,"currency":"USD"}
```

Protocol Buffers

```
message Payment {  
    string id = 1;  
    int32 amount = 2;  
    Currency currency = 3;  
}
```

```
enum Currency {  
    USD = 1;  
}
```



```
{"id":1234,"amount":4200,"currency":"USD"}
```

```
{  
  "id":1234,  
  "amount":4200,  
  "currency":"USD"  
}
```

```
{"id":1234,"amount":4200,"currency":"USD"}
```



```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

```
{"id":1234,"amount":4200,"currency":"USD"}
```



```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```



```
id
```

```
{"id":1234,"amount":4200,"currency":"USD"}
```



```
String(id)
```



```
{"id":1234,"amount":4200,"currency":"USD"}
```



```
String(id)
```



```
Map<String, Adapter<?>>
```

```
{"id":1234,"amount":4200,"currency":"USD"}
```



```
String(id)
```



```
Map<String, Adapter<?>>
```



```
Adapter<Long>
```

```
{"id":1234,"amount":4200,"currency":"USD"}
```



```
String(id)
```



```
Map<String, Adapter<?>>
```



```
Adapter<Long>
```




```
{"id":1234,"amount":4200,"currency":"USD"}
```



String(id)



Map<String, Adapter<?>>



Adapter<Long>



1234L

`{"id":1234,"amount":4200,"currency":"USD"}`



`String(id)`



`Map<String, Adapter<?>>`



`Adapter<Long>`



1234L

`{"id":1234,"amount":4200,"currency":"USD"}`

1234L

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

1234L

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```


1234L

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

1234L

`{"id":1234,"amount":4200,"currency":"USD"}`



`String(amount)`

1234L

`{"id":1234,"amount":4200,"currency":"USD"}`



`String(amount)`



`Map<String, Adapter<?>>`

1234L

`{"id":1234,"amount":4200,"currency":"USD"}`



`String(amount)`



`Map<String, Adapter<?>>`



`Adapter<Long>`

1234L

`{"id":1234,"amount":4200,"currency":"USD"}`



`String(amount)`



`Map<String, Adapter<?>>`



`Adapter<Long>`



1234L

`{"id":1234,"amount":4200,"currency":"USD"}`

`String(amount)`

`Map<String, Adapter<?>>`

`Adapter<Long>`



1234L

4200L

`{"id":1234,"amount":4200,"currency":"USD"}`



`String(amount)`



`Map<String, Adapter<?>>`



`Adapter<Long>`



1234L

4200L

`{"id":1234,"amount":4200,"currency":"USD"}`

1234L

4200L

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

1234L

4200L

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

1234L

4200L

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```


1234L

4200L

`{"id":1234,"amount":4200,"currency":"USD"}`



`String(currency)`

1234L

4200L

`{"id":1234,"amount":4200,"currency":"USD"}`



`String(currency)`



`Map<String, Adapter<?>>`

1234L

4200L

`{"id":1234,"amount":4200,"currency":"USD"}`



`String(currency)`



`Map<String, Adapter<?>>`



`Adapter<CurrencyCode>`

1234L

4200L

```
{"id":1234,"amount":4200,"currency":"USD"}
```



String(currency)



Map<String, Adapter<?>>



Adapter<CurrencyCode>



1234L

4200L

```
{"id":1234,"amount":4200,"currency":"USD"}
```



String(currency)



Map<String, Adapter<?>>



Adapter<CurrencyCode>



1234L

4200L

CurrencyCode.USD

`{"id":1234,"amount":4200,"currency":"USD"}`



`String(currency)`



`Map<String, Adapter<?>>`



`Adapter<CurrencyCode>`



1234L

4200L

CurrencyCode.USD

```
{"id":1234,"amount":4200,"currency":"USD"}
```

1234L

4200L

CurrencyCode.USD

```
{"id":1234,"amount":4200,"currency":"USD"}
```


1234L

4200L

CurrencyCode.USD

```
{"id":1234,"amount":4200,"currency":"USD"}
```

```
[
  {"id":1234,"amount":4200,"currency":"USD"},
  {"id":1275,"amount":10000,"currency":"USD"},
  {"id":1690,"amount":834,"currency":"USD"},
  {"id":2641,"amount":2448,"currency":"USD"},
  {"id":2903,"amount":11305,"currency":"USD"},
  {"id":4991,"amount":566,"currency":"USD"},
  {"id":5312,"amount":702,"currency":"USD"},
  {"id":5319,"amount":3885,"currency":"USD"},
  {"id":14328,"amount":34400,"currency":"USD"},
  {"id":28321,"amount":892,"currency":"USD"},
  {"id":29948,"amount":2261,"currency":"USD"},
  {"id":30991,"amount":6600,"currency":"USD"},
  {"id":37174,"amount":939,"currency":"USD"},
  {"id":73572,"amount":40000,"currency":"USD"}
]
```



```
{"id":1234,"amount":4200,"currency":"USD"}
```

```
ByteString("amount")  
ByteString("currency")  
ByteString("id")
```

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

```
ByteString("amount")  
ByteString("currency")  
ByteString("id")
```

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```



```
ByteString("amount")  
ByteString("currency")  
ByteString("id")
```

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

```
ByteString("amount")  
ByteString("currency")  
ByteString("id")
```

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

```
ByteString("amount")  
ByteString("currency")  
ByteString("id")
```

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```



```
ByteString("amount")  
ByteString("currency")  
ByteString("id")
```

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

```
ByteString("amount")  
ByteString("currency")  
ByteString("id")
```

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```



```
ByteString("amount")  
ByteString("currency")  
ByteString("id")
```

```
{ "id": 1234, "amount": 4200, "currency": "USD" }
```

~~ByteString("amount")~~
~~ByteString("currency")~~
ByteString("id")

Adapter<Long>
Adapter<CurrencyCode>
Adapter<Long>

{"id":1234,"amount":4200,"currency":"USD"}

ByteString("amount")	Adapter<Long>
ByteString("currency")	Adapter<CurrencyCode>
ByteString("id") →	Adapter<Long>

{ "id": 1234, "amount": 4200, "currency": "USD" }

~~ByteString("amount")~~

Adapter<Long>

~~ByteString("currency")~~

Adapter<CurrencyCode>

ByteString("id") → Adapter<Long>



{"id":1234,"amount":4200,"currency":"USD"}

Adapter<Payment>

```
ByteString("amount")  
ByteString("currency")  
ByteString("id")
```

Adapter<Long>

Adapter<CurrencyCode>

Adapter<Long>

```
{"id":1234,"amount":4200,"currency":"USD"}
```

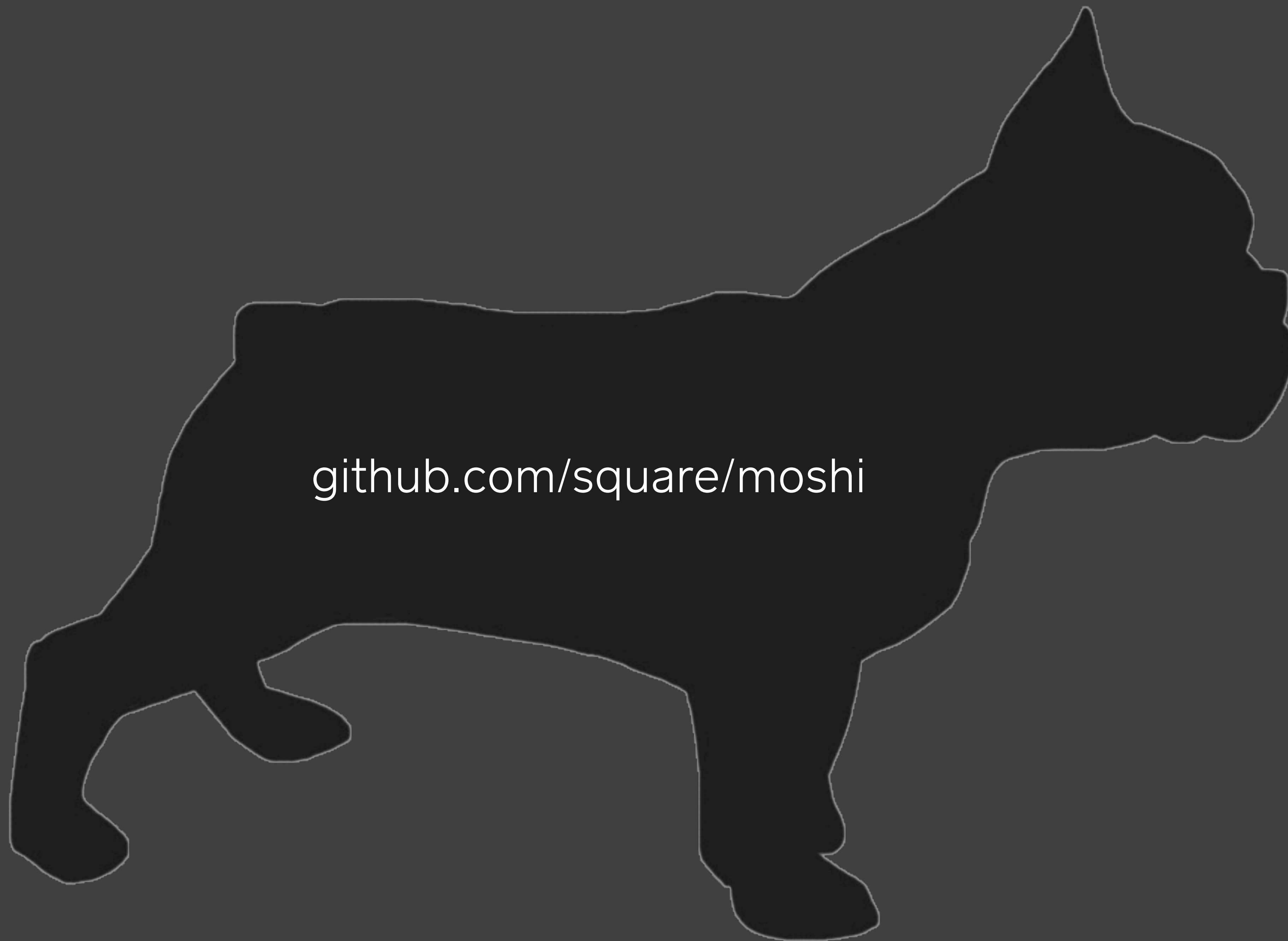
Adapter<Payment>

```
ByteString("amount")  
ByteString("currency")  
ByteString("id")
```

```
Adapter<Long>  
Adapter<CurrencyCode>  
Adapter<Long>
```

[

```
{ "id": 1234, "amount": 4200, "currency": "USD" },  
{ "id": 1275, "amount": 10000, "currency": "USD" },  
{ "id": 1690, "amount": 834, "currency": "USD" },  
{ "id": 2641, "amount": 2448, "currency": "USD" },  
{ "id": 2903, "amount": 11305, "currency": "USD" },  
{ "id": 4991, "amount": 566, "currency": "USD" },  
{ "id": 5312, "amount": 702, "currency": "USD" },  
{ "id": 5319, "amount": 3885, "currency": "USD" },  
{ "id": 14328, "amount": 34400, "currency": "USD" },  
{ "id": 22221, "amount": 800, "currency": "USD" },
```

github.com/square/moshi

WebSocket

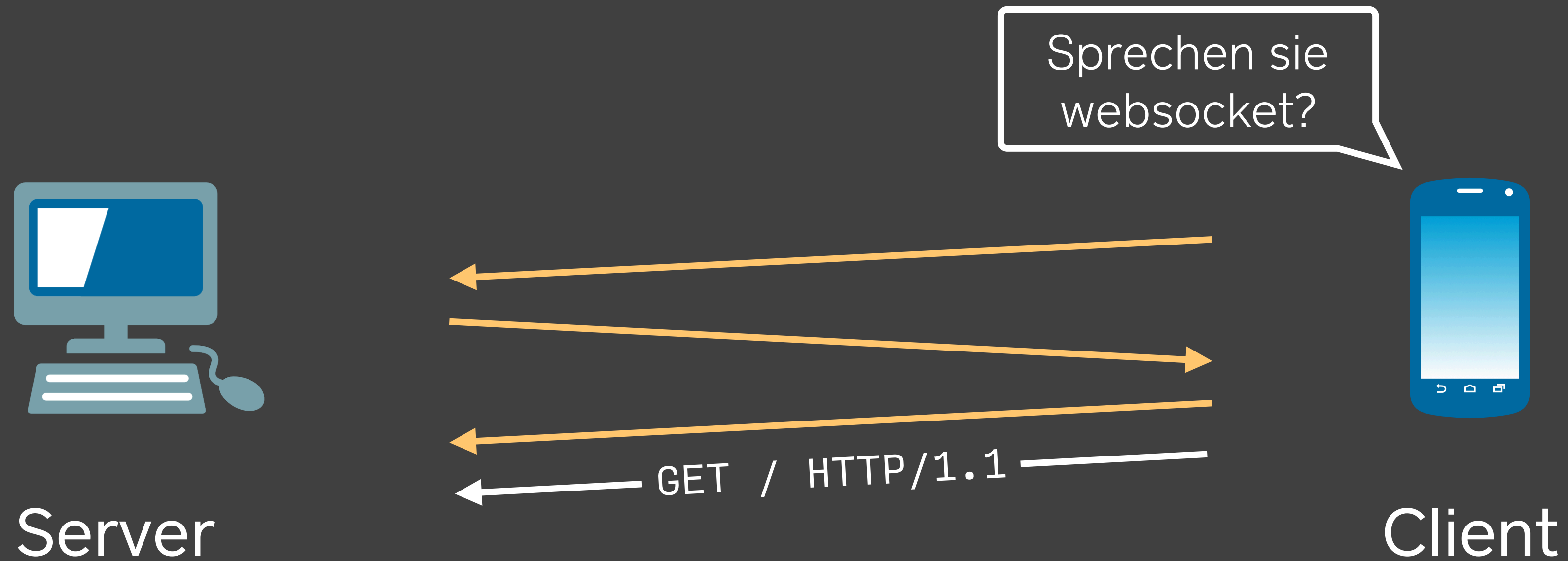


Server



Client

WebSocket



WebSocket



WebSocket



Server



Client



WebSocket



Server



Client



WebSocket

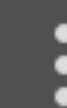


Server



Client





WebSocket to Me!

LOCATION: **Great Room Two**

DATE: **April 20, 2017**

TIME: **3:00 pm - 3:45 pm**



CHRIS GUZMAN

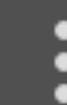


WebSocket to Me! « Chicago R x

Retrofitting Retrofit « Chicago x



chicagoroboto.com/sessions/retrofitting-retrofit/



Retrofitting Retrofit

LOCATION: **Great Room One**

DATE: **April 20, 2017**

TIME: **1:00 pm - 1:45 pm**



CHRISTINA LEE



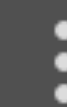
WebSocket to Me! < x

Retrofitting Retrofit x

Coordinating Space x



chicagoroboto.com/sessions/coordinating-space-and-time/



Coordinating Space and Time

LOCATION: **Great Room One**

DATE: **April 21, 2017**

TIME: **2:00 pm - 2:45 pm**



JESSE WILSON



Search



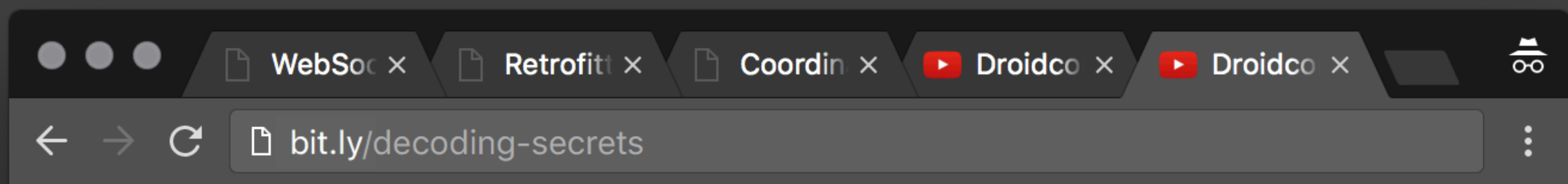
Sign in

A Few "OK" Libraries

Jake Wharton



Droidcon Montreal Jake Wharton
- A Few Ok Libraries



Search



Sign in

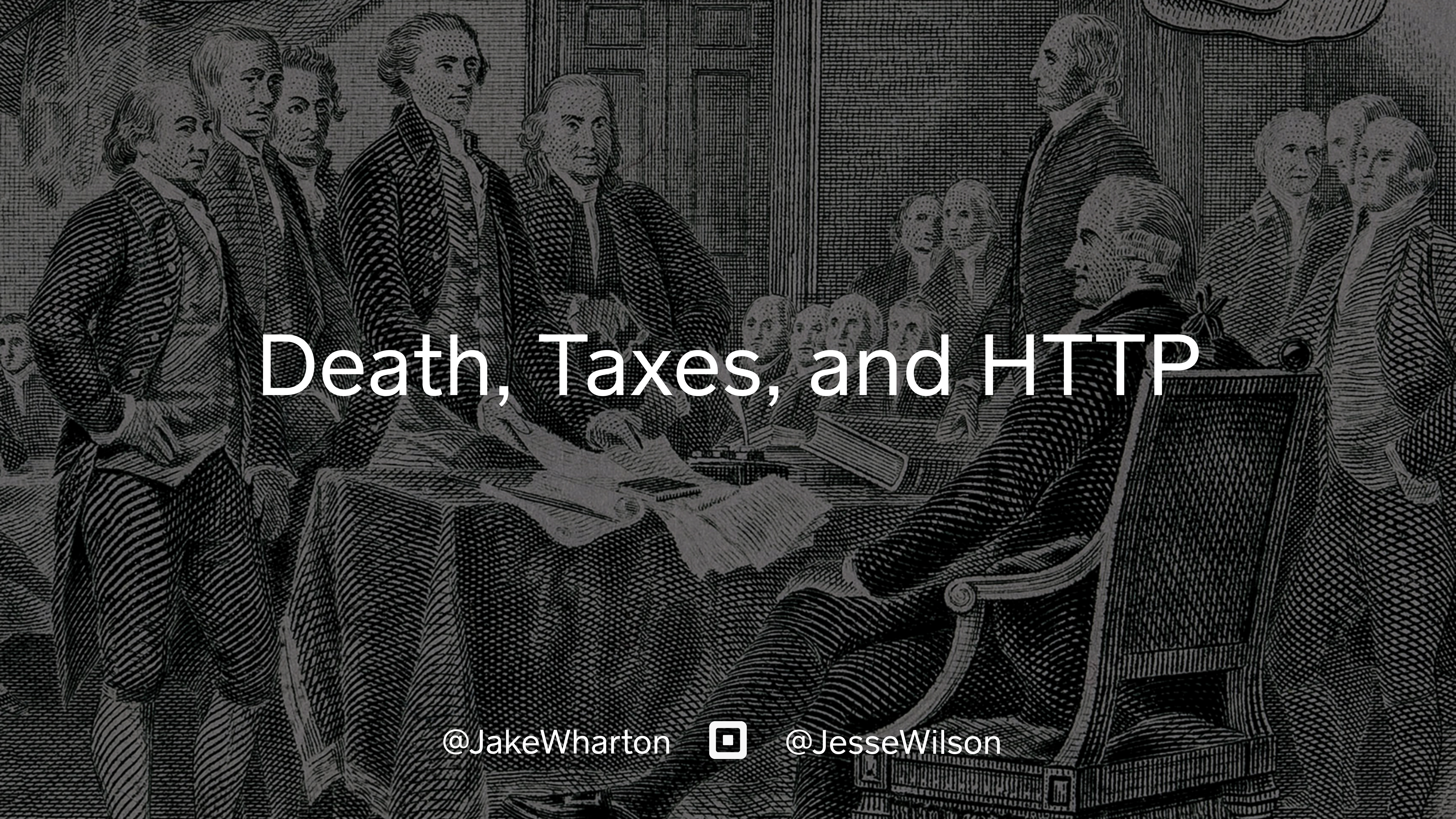


@jessewilson

Decoding the Secrets of Binary Data

<https://github.com/swankjesse/encoding>

Droidcon NYC 2016 - Decoding
the Secrets of Binary Data



Death, Taxes, and HTTP

@JakeWharton



@JesseWilson