JAOO conference
- for Developers by Developers

REST & Caching: Web Services, Accelerated

JAOO 2009

Stefan Tilkov, innoQ

innoQ Deutschland GmbH
Halskestraße 17
D-40880 Ratingen
Phone +49 21 02 77 162-100

innoQ Schweiz GmbH
Gewerbestrasse 11
CH-6330 Cham
Phone +41 41 743 01 11

info@innoq.com · www.innoq.com

stefan.tilkov@innoq.com
http://www.innoq.com/blog/st/
@stilkov

http://rest-http.info

http://soa-expertenwissen.de

The REST Uniform Interface

identification of resources

resource manipulation through representations

hypermedia as the engine of application state

self-descriptive messages

The REST Uniform Interface

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http://example.com/orders?year=2008

http://example.com/customers/1234

http://example.com/orders/2007/10/776654

http://example.com/products/4554

http://example.com/processes/sal-increase-234

The REST Uniform Interface

identification of resources

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self-descriptive messages

```
GET /customers/1234
Host: example.com
Accept: application/vnd.mycompany.customer+xml
```

```
<customer>...</customer>
```

```
GET /customers/1234
Host: example.com
Accept: text/x-vcard
```

```
begin:vcard
...
end:vcard
```

The REST Uniform Interface

identification of resources

resource manipulation through representations

hypermedia as the engine of application state

self-descriptive messages

```
<order self='http://example.com/orders/3321'>
  <amount>23</amount>
  <product ref='http://example.com/products/4554' />
  <customer ref='http://example.com/customers/1234' />
  <link rel='edit’
        ref='http://example.com/order-edit/ACDB' />
</order>
```

The REST Uniform Interface

identification of resources

resource manipulation through representations

hypermedia as the engine of application state

self-descriptive messages

Standard Method

Media Type

```
GET /service/customers/1234 HTTP 1.1
Host: www.example.com
User-Agent:     XYZ 1.1
Accept:         text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Keep-Alive:     300
Connection:     keep-alive
If-Modified-Since:      Fri, 02 Oct 2009 16:47:31 GMT
If-None-Match: "600028c-59fb-474f6852c9dab"
Cache-Control: max-age=60

HTTP/1.1 304 Not Modified
Date:  Sun, 04 Oct 2009 19:36:25 GMT
Server:         Apache/2.2.11 (Debian)
Last-Modified:Fri, 02 Oct 2009 16:47:31 GMT
Etag:   "600028c-59fb-474f6852c9dab"
Cache-Control:  max-age=300
Accept-Ranges:          bytes
Vary:   Accept-Encoding
Content-Encoding:   gzip
Content-Length:         7160
Keep-Alive:     timeout=15, max=91
Connection:   Keep-Alive
Content-Type:           application/xml

<?xml version='1.0' encoding='utf-8' ?>
...
```

Control Data

Data

getOrderDetails()

submitApplicationData()

updateQuote()

findMatchingBid()

initiateProcess()

cancelSubscription()

listAuctions()

getUsers()

getOrderDetails()

findMatchingBid()

listAuctions()

getUsers()

GET

initiateProcess()

submitApplicationData()

POST

PUT

updateQuote()

DELETE

cancelSubscription()

```
interface Resource {
      Resource(URI u)
      Response get()
      Response post(Request r)
      Response put(Request r)
      Response delete()
}
```

generic

Any HTTP client
(Firefox, IE, curl, wget)

Any HTTP server

Caches

Proxies

Google, Yahoo!, MSN

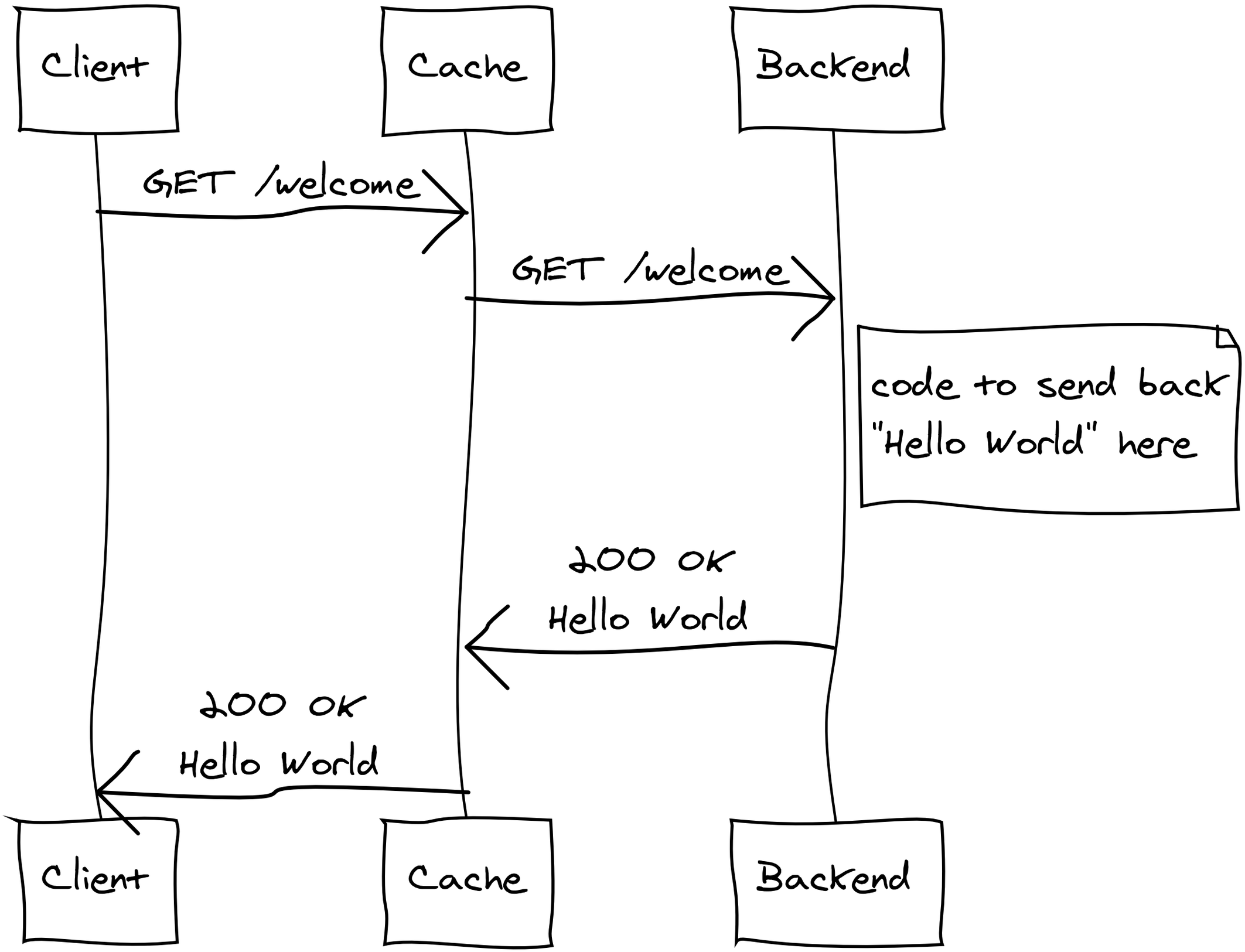
```
class CustomerCollection : Resource {
      ...
      Response post(Request r) {
            id = createCustomer(r)
            return new Response(201, r)
      }
      ...
}
```

Anything that knows
your app

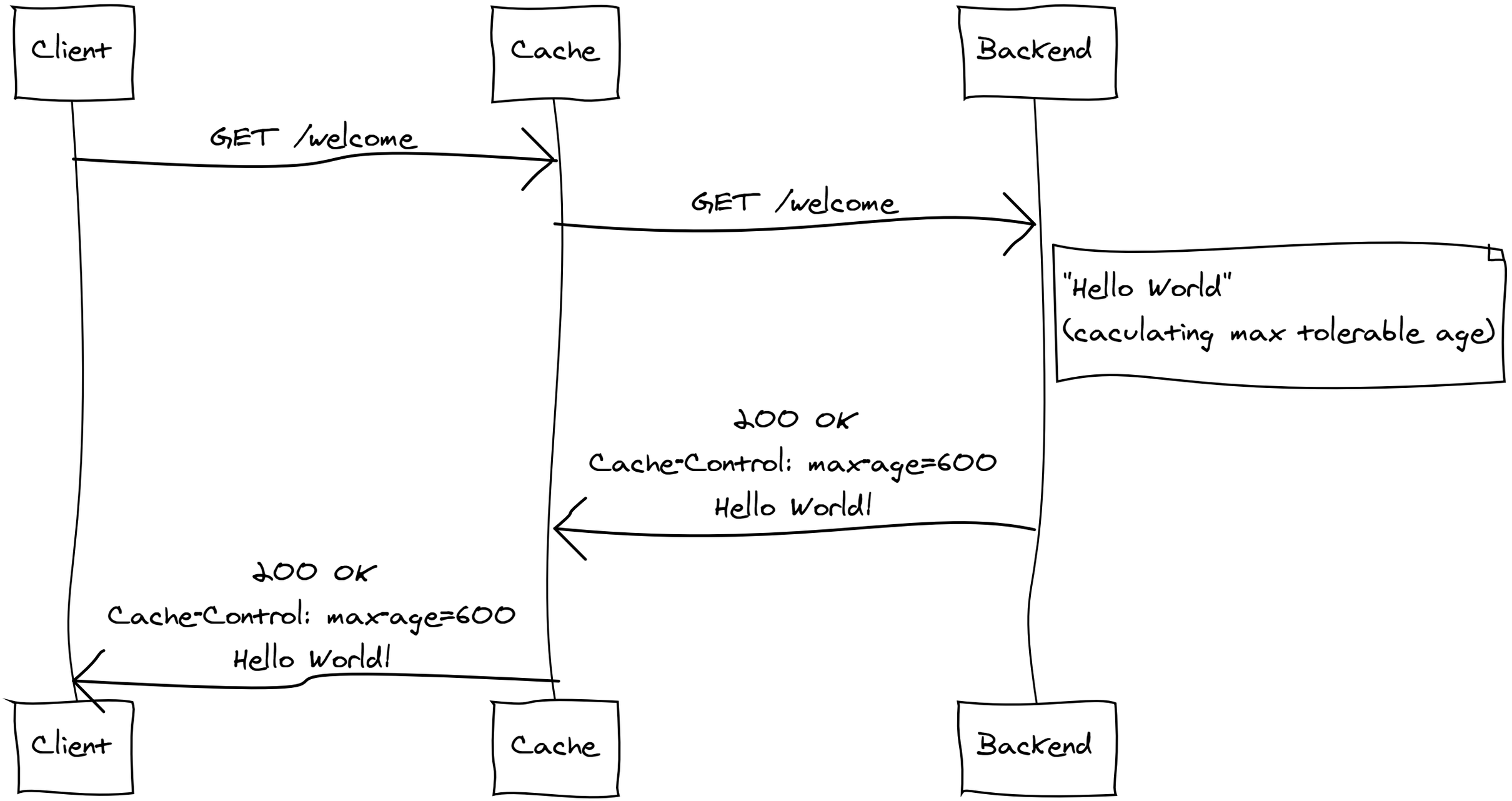
specific

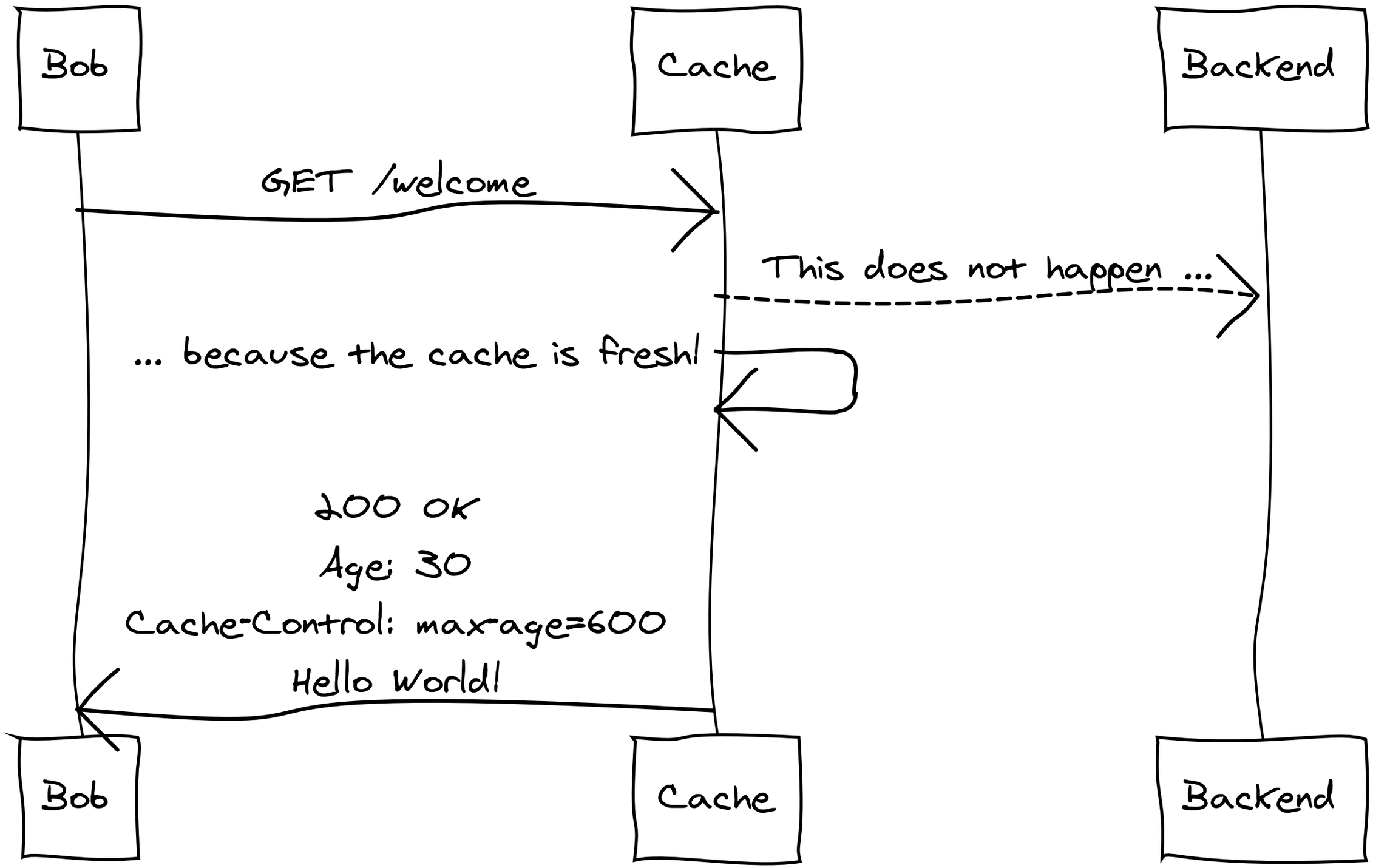
Caching Models

Note: Thanks to Ryan Tomayko for letting me ~~steal~~ base some work on his diagrams from http://tomayko.com/writings/things-caches-do

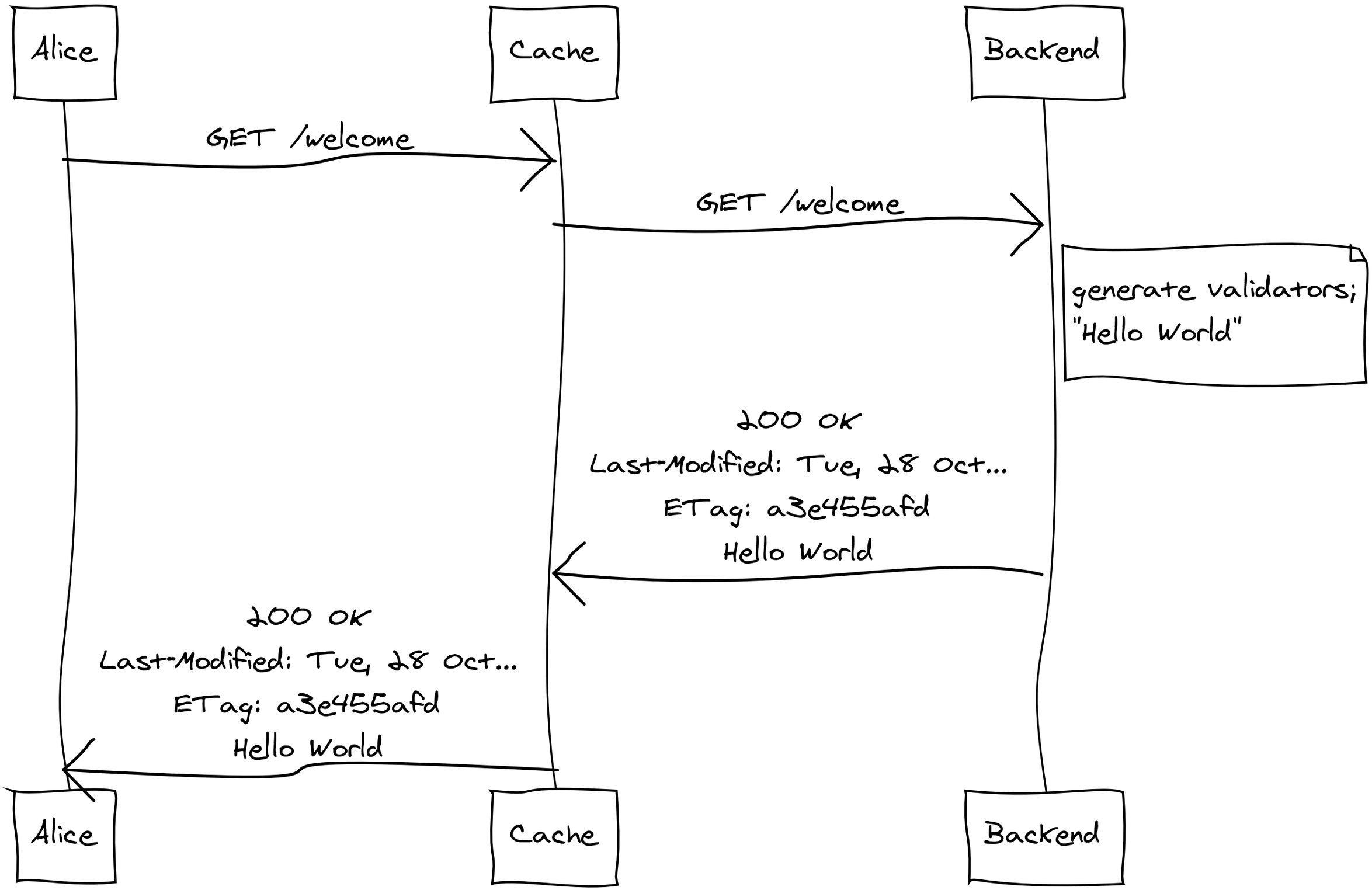

Client
Cache
Backend
GET /welcome
GET /welcome
code to send back
"Hello World" here
200 OK
Hello World
200 OK
Hello World
Client
Cache
Backend

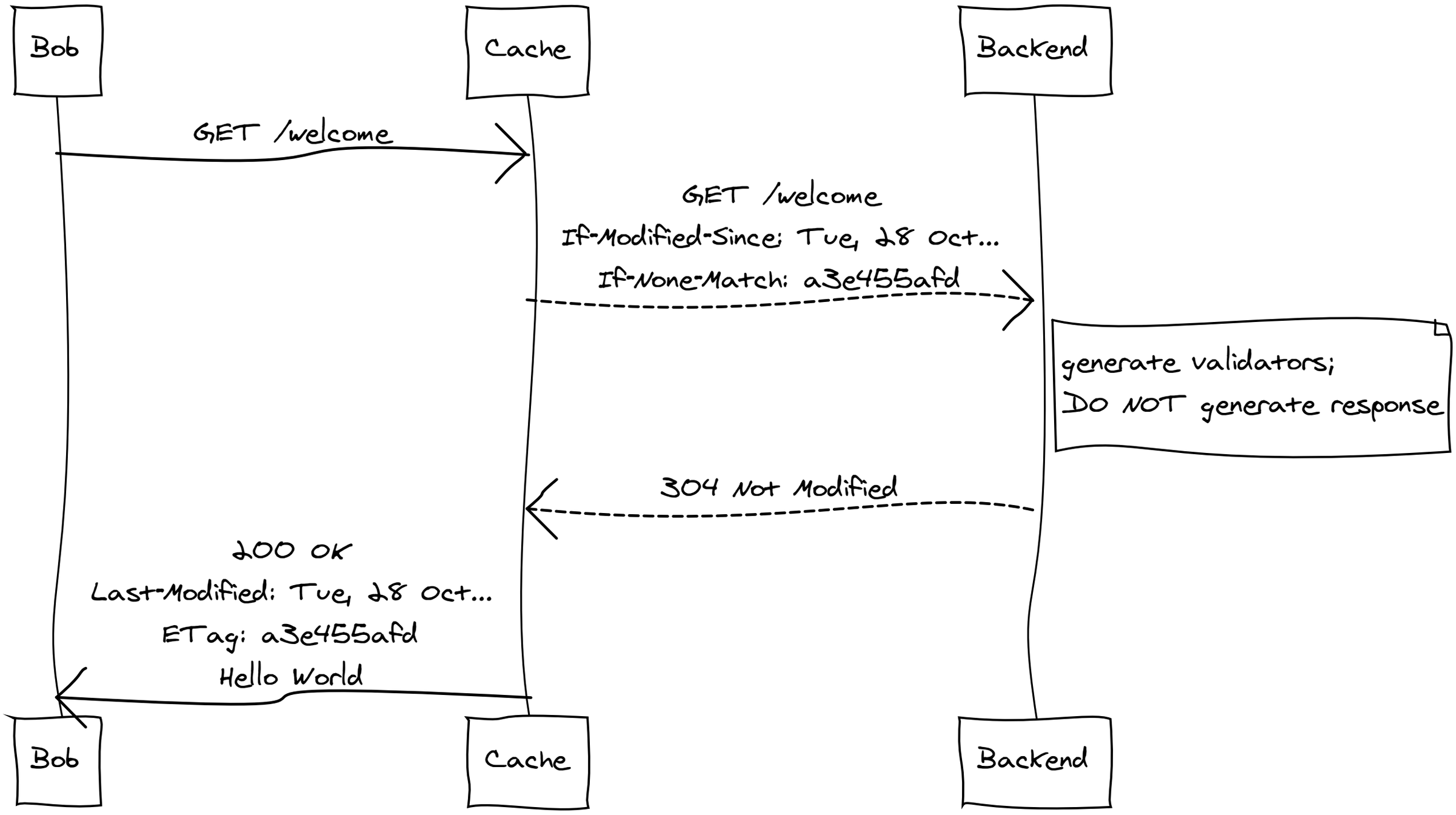
Expiration


Client
Cache
Backend
GET /welcome
GET /welcome
"Hello World"
(caculating max tolerable age)
200 OK
Cache-Control: max-age=600
Hello World!
200 OK
Cache-Control: max-age=600
Hello World!
Client
Cache
Backend

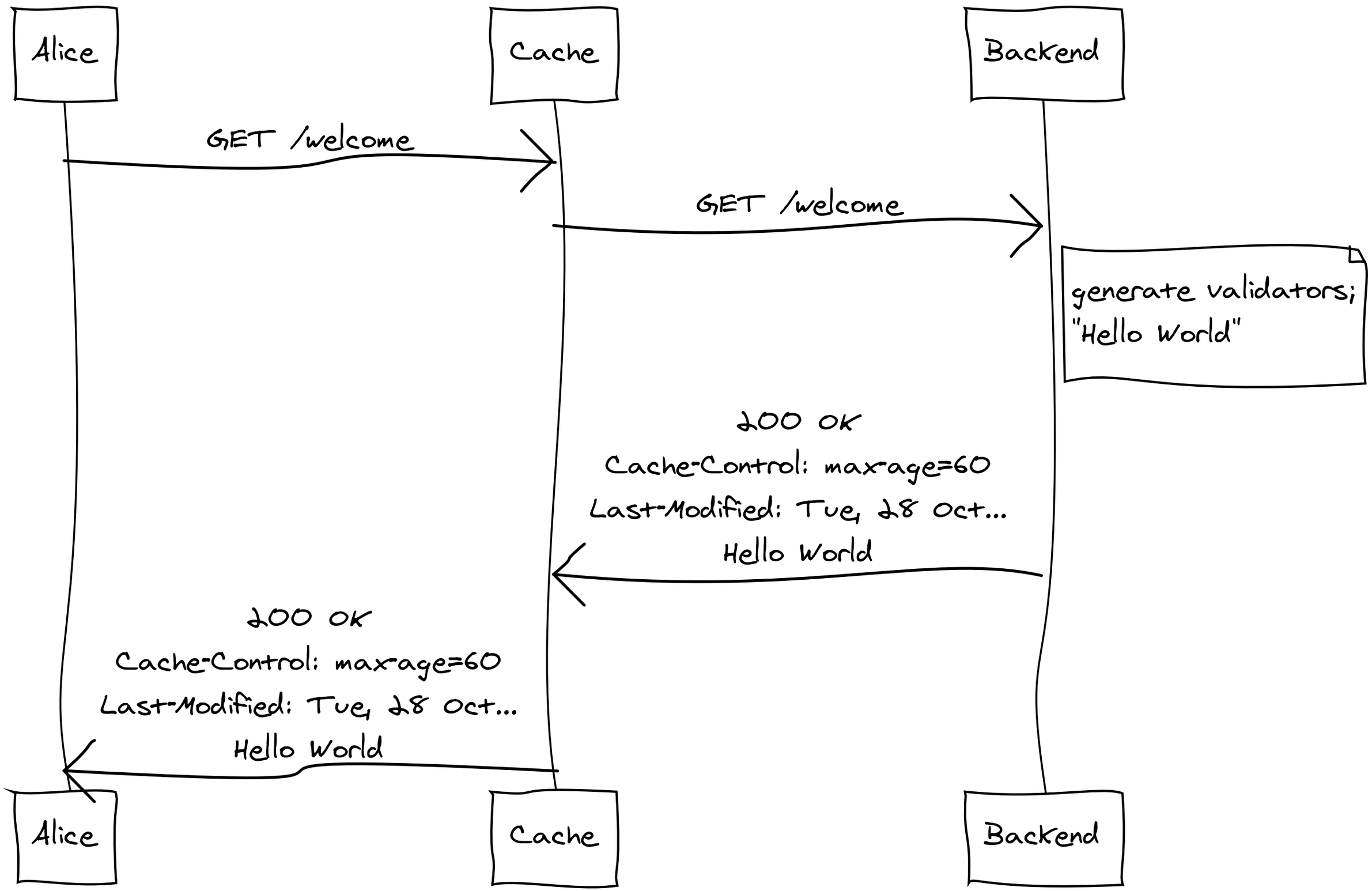

Bob
Cache
Backend
GET /welcome
This does not happen ...
... because the cache is fresh!
200 OK
Age: 30
Cache-Control: maxage=600
Hello World!
Bob
Cache
Backend

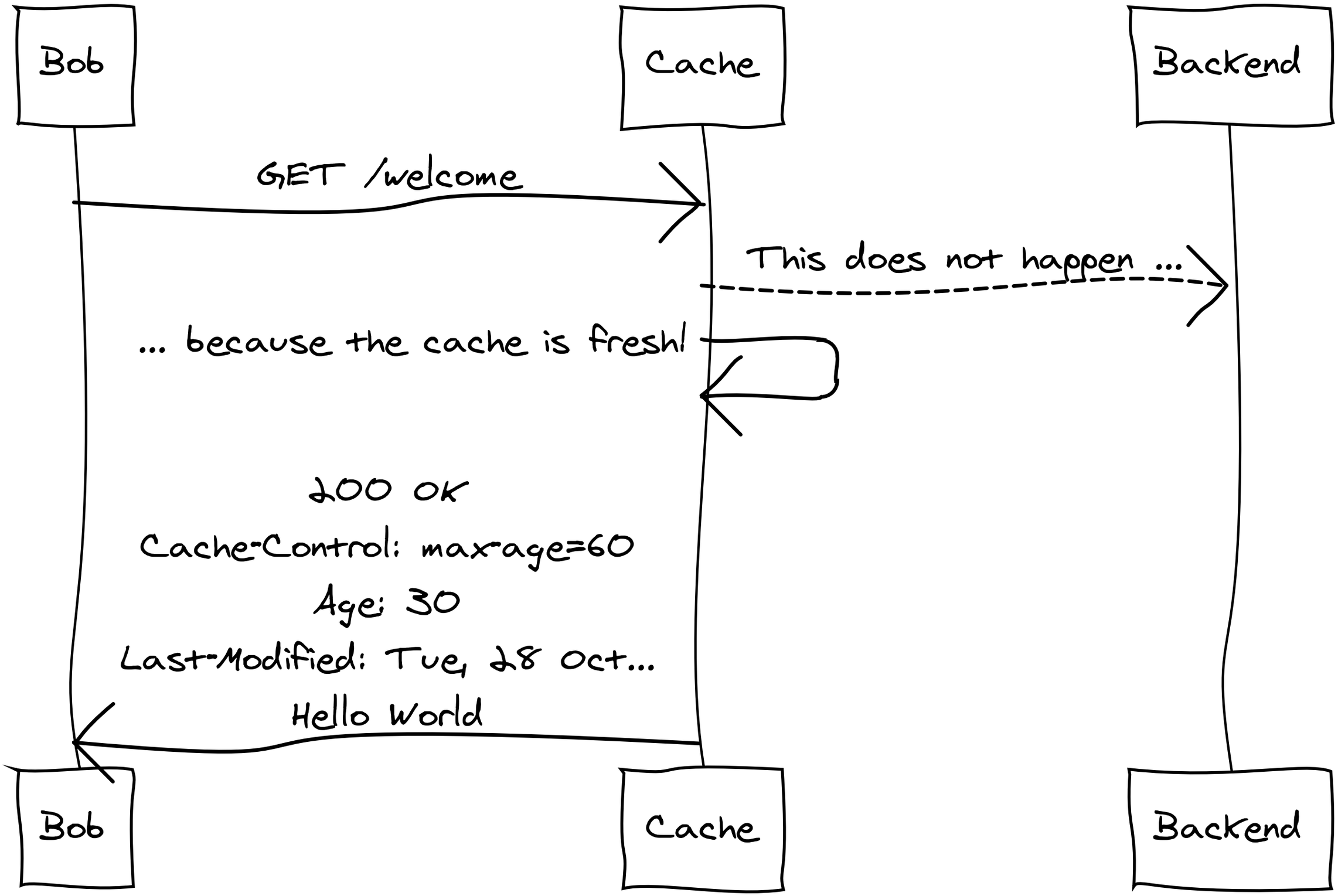
Validation

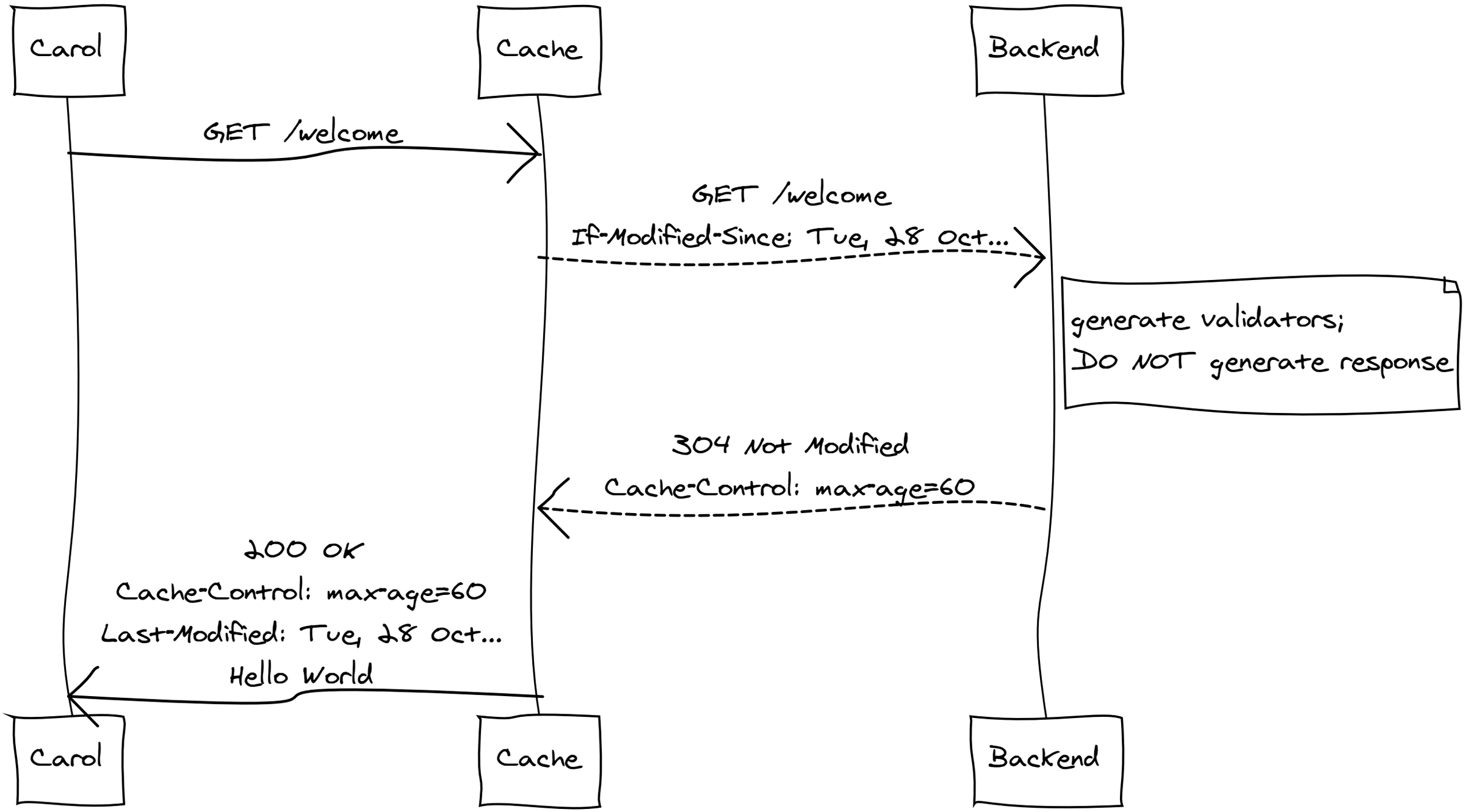

Alice
Cache
Backend
GET /welcome
GET /welcome
generate validators;
"Hello World"
200 OK
Last-Modified: Tue, 28 Oct...
ETag: a3e455afd
Hello World
200 OK
Last-Modified: Tue, 28 Oct...
ETag: a3e455afd
Hello World
Alice
Cache
Backend


Bob
Cache
Backend
GET /welcome
GET /welcome
If-Modified-Since: Tue, 28 Oct...
If-None-Match: a3e455afd
generate validators;
DO NOT generate response
304 Not Modified
200 OK
Last-Modified: Tue, 28 Oct...
ETag: a3e455afd
Hello World
Bob
Cache
Backend

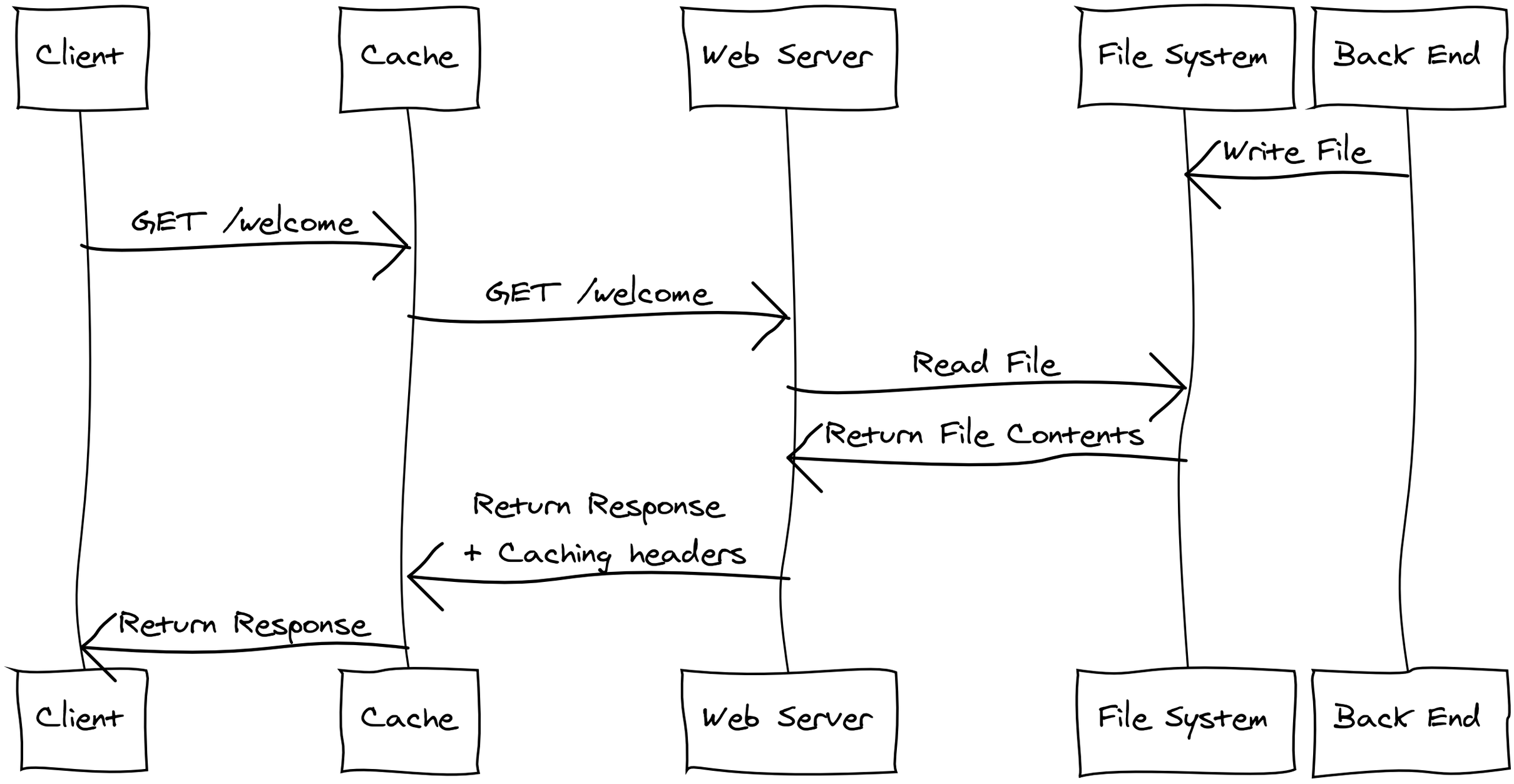
Combination


Alice
Cache
Backend
GET /welcome
GET /welcome
generate validators;
"Hello World"
200 OK
Cache-Control: max-age=60
Last-Modified: Tue, 28 Oct...
Hello World
200 OK
Cache-Control: max-age=60
Last-Modified: Tue, 28 Oct...
Hello World
Alice
Cache
Backend

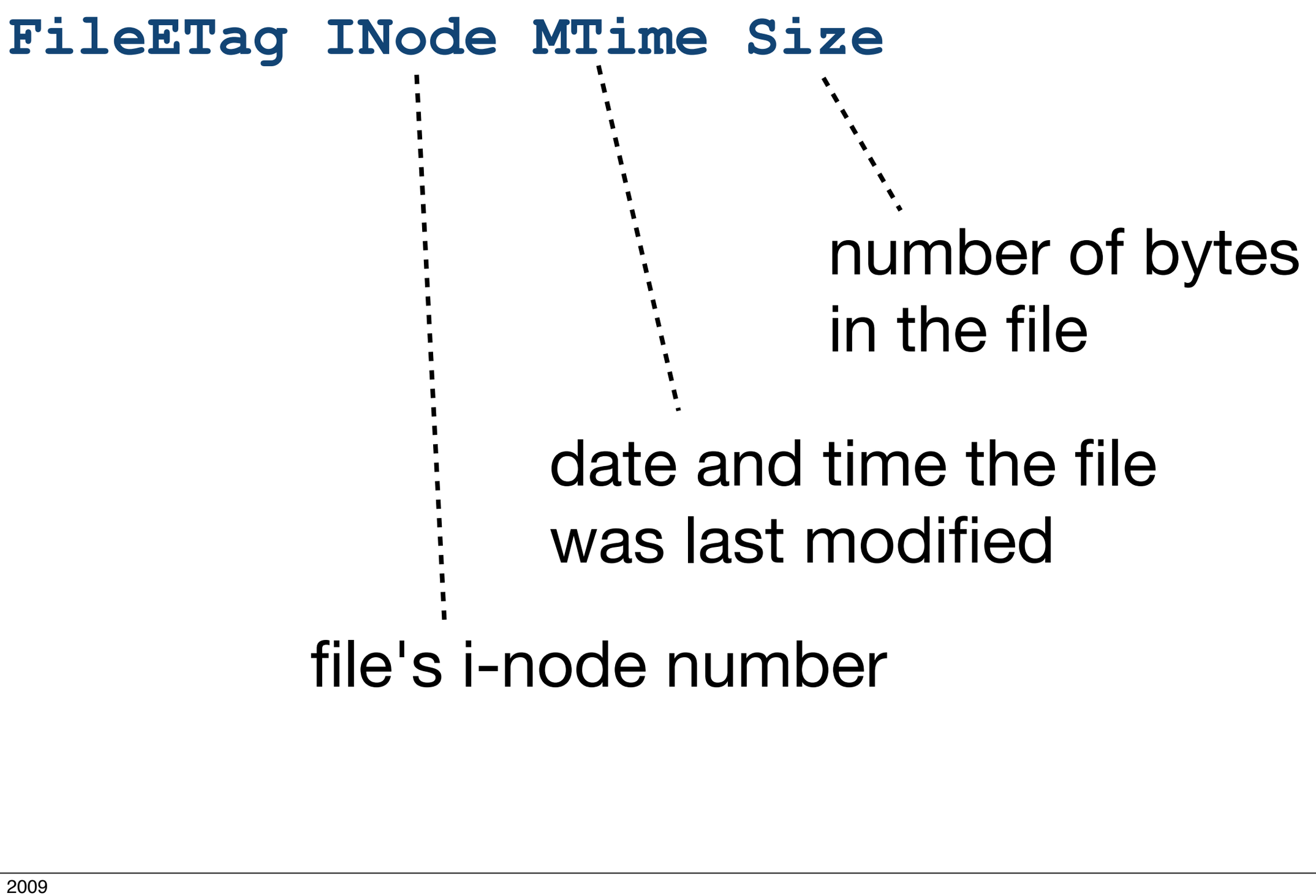

Bob
Cache
Backend
GET /welcome
This does not happen ...
... because the cache is fresh!
200 OK
Cache-Control: max-age=60
Age: 30
Last-Modified: Tue, 28 Oct...
Hello World
Bob
Cache
Backend


Carol
Cache
Backend
GET /welcome
GET /welcome
If-Modified-Since: Tue, 28 Oct...
generate validators;
DO NOT generate response
304 Not Modified
Cache-Control: max-age=60
200 OK
Cache-Control: max-age=60
Last-Modified: Tue, 28 Oct...
Hello World
Carol
Cache
Backend

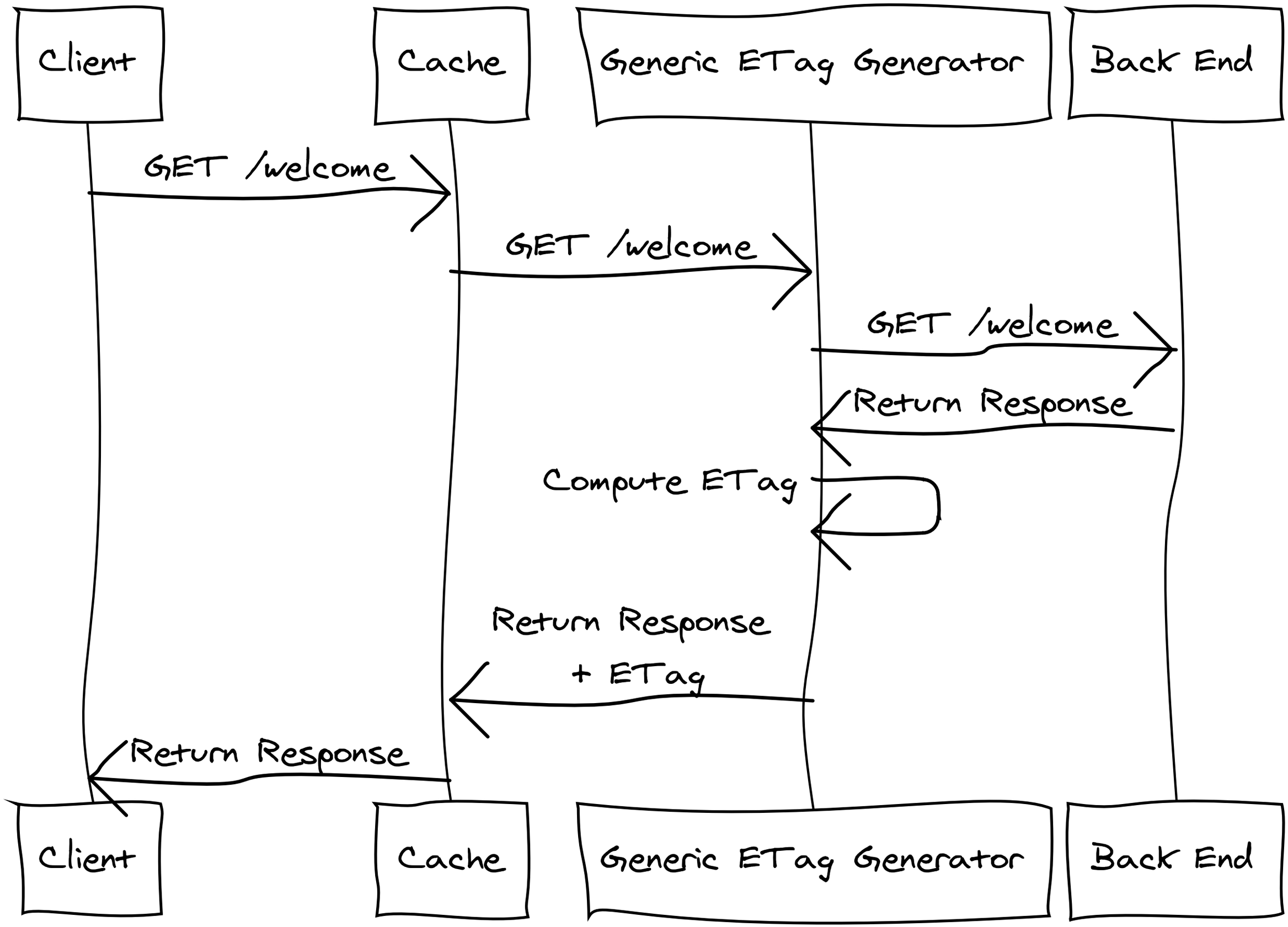
Implementation

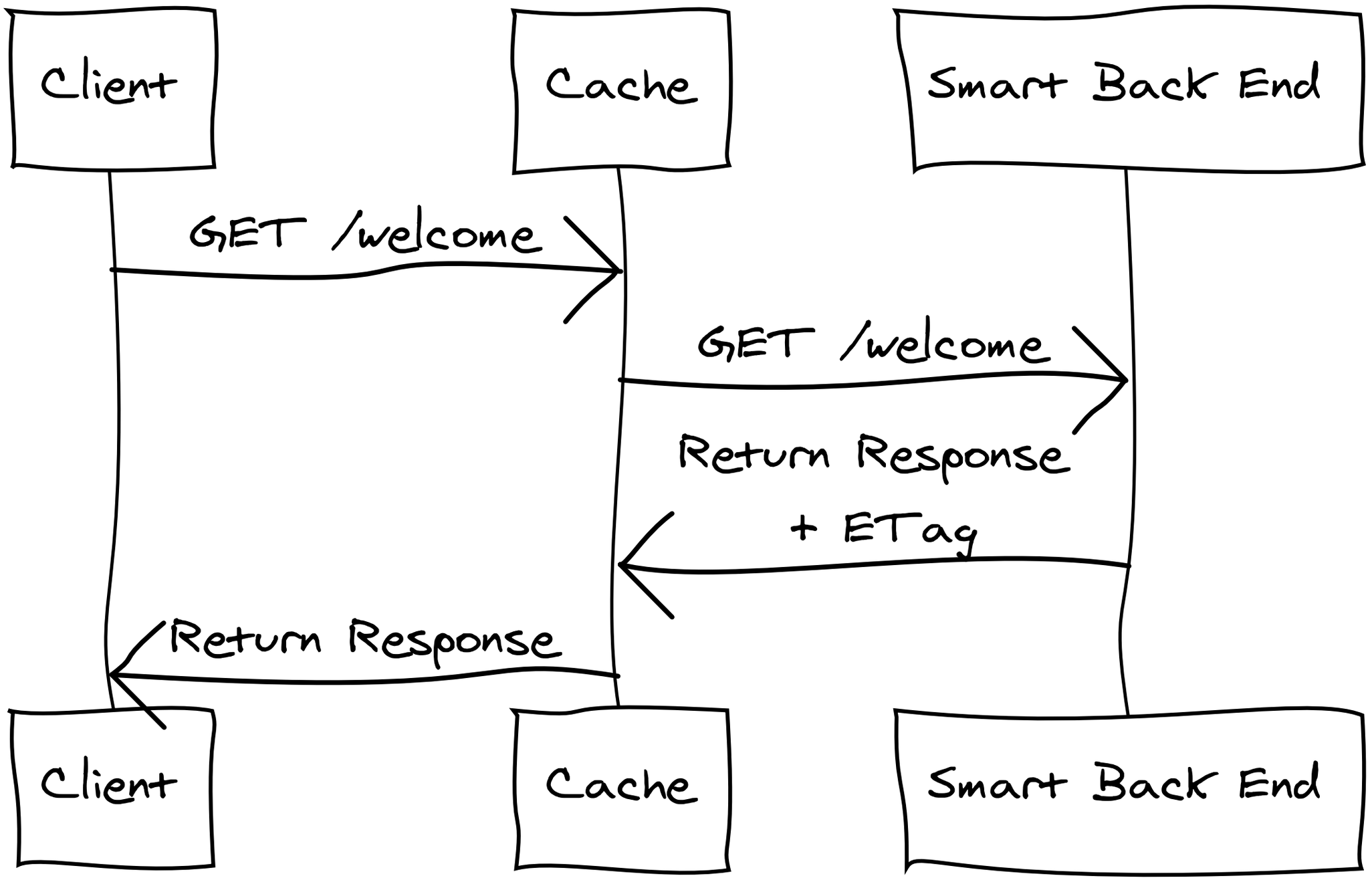

Client
Cache
Web Server
File System
Back End
Write File
GET /welcome
GET /welcome
Read File
Return File Contents
Return Response
+ Caching headers
Return Response
Client
Cache
Web Server
File System
Back End

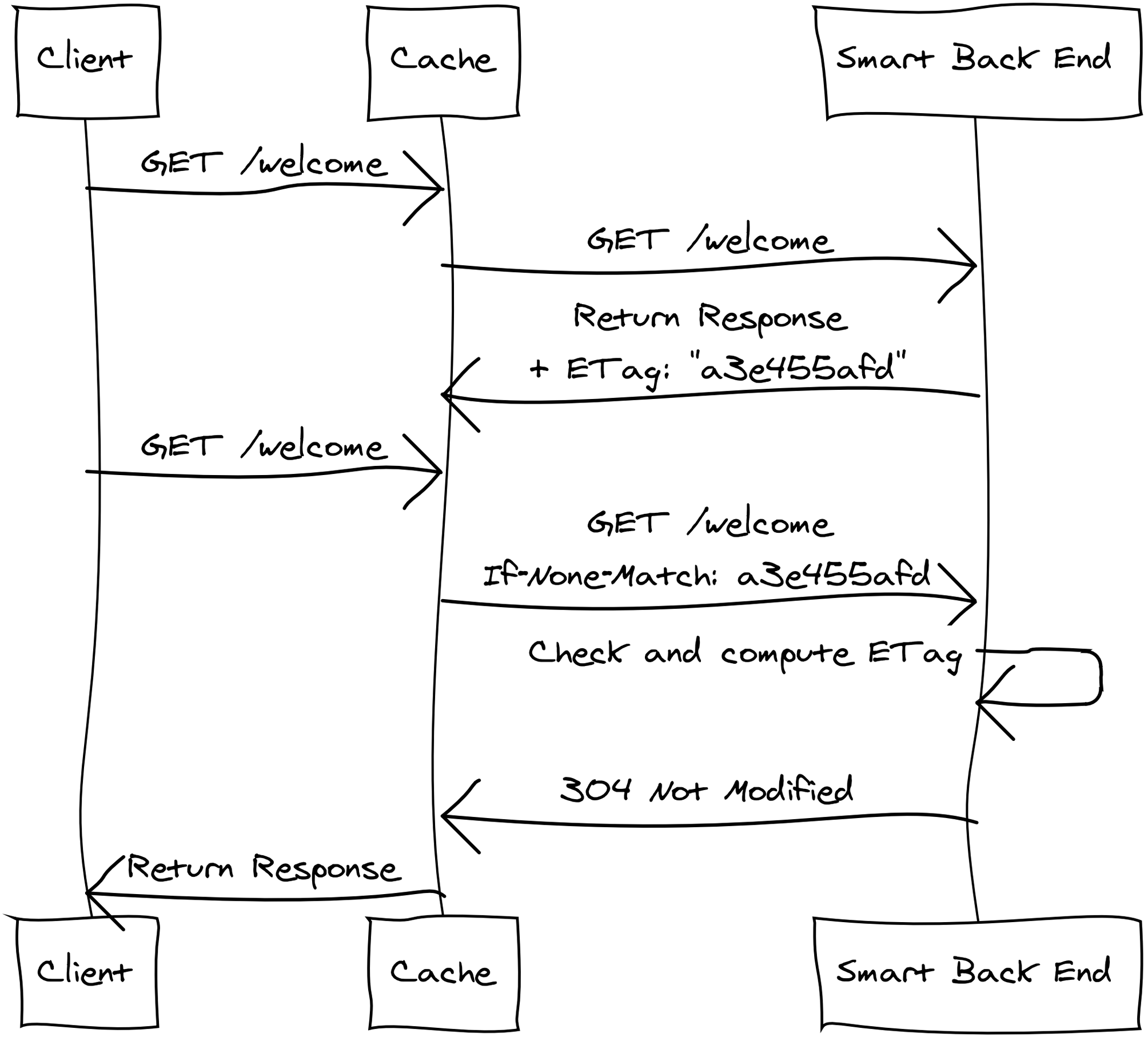
Apache FileETag



ETag Depth

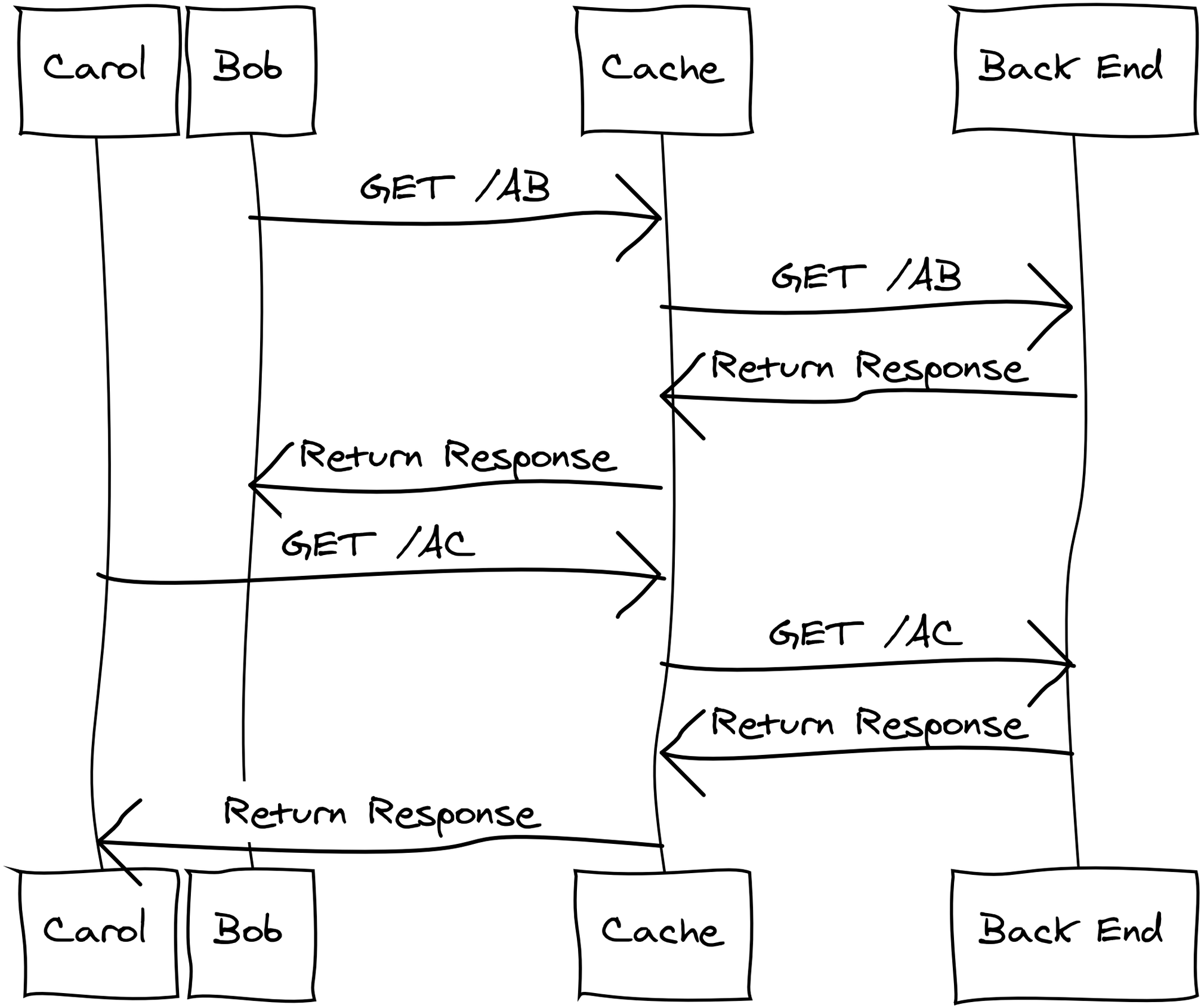

Client
Cache
Generic ETag Generator
Back End
GET /welcome
GET /welcome
GET /welcome
Return Response
Compute ETag
Return Response
+ ETag
Return Response
Client
Cache
Generic ETag Generator
Back End

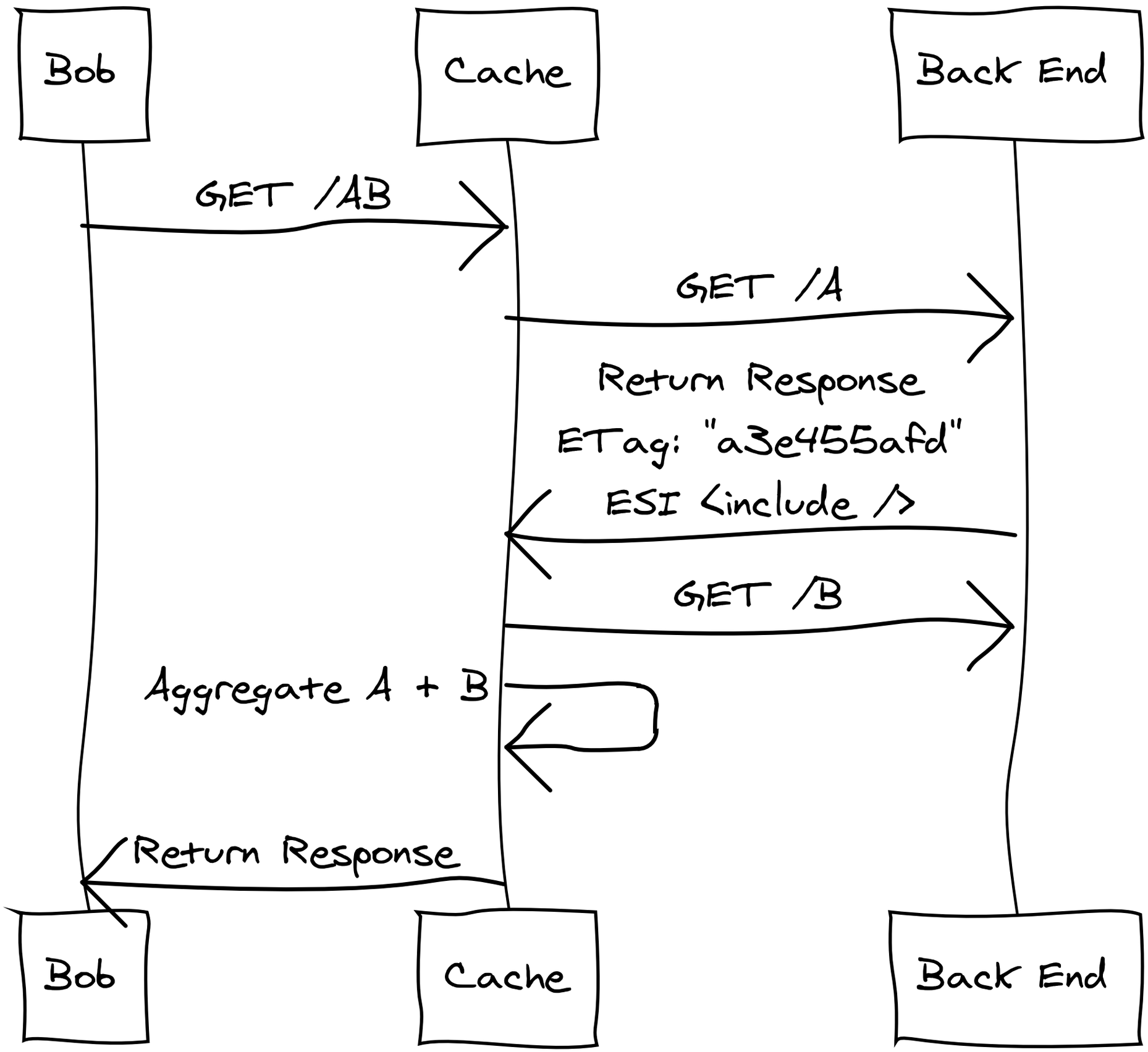

Client
Cache
Smart Back End
GET /welcome
GET /welcome
Return Response
+ ETag
Return Response
Client
Cache
Smart Back End

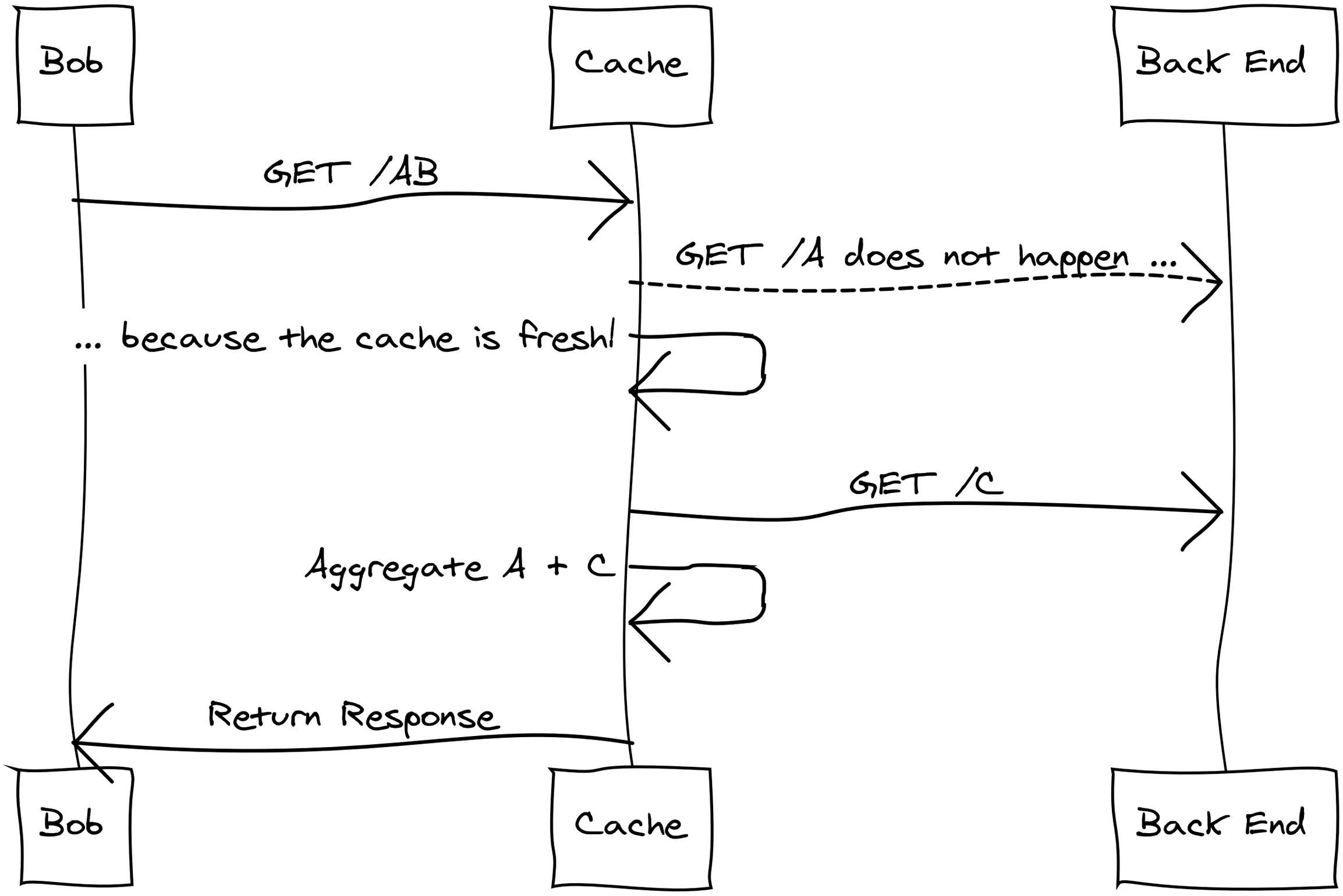

Client
Cache
Smart Back End
GET /welcome
GET /welcome
Return Response
+ ETag: "a3e455afd"
GET /welcome
GET /welcome
If-None-Match: a3e455afd
Check and compute ETag
304 Not Modified
Return Response
Client
Cache
Smart Back End

Edge Side Includes (ESI)

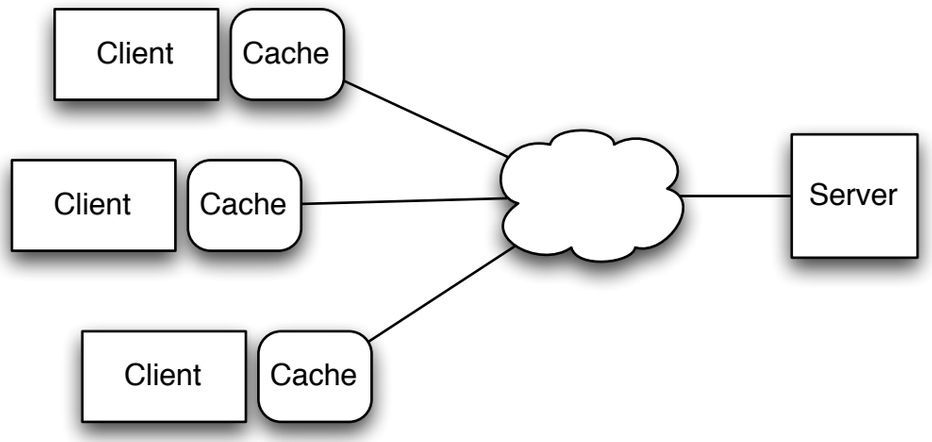
```
<esi:include
    src="http://example.com/1.html"
    alt="http://bak.example.com/2.html"
    onerror="continue"/>

<esi:include
    src="http://example.com/search?query=$(QUERY_STRING{query})"/>
```


Carol
Bob
Cache
Back End
GET /AB
GET /AB
Return Response
Return Response
GET /AC
GET /AC
Return Response
Return Response
Carol
Bob
Cache
Back End

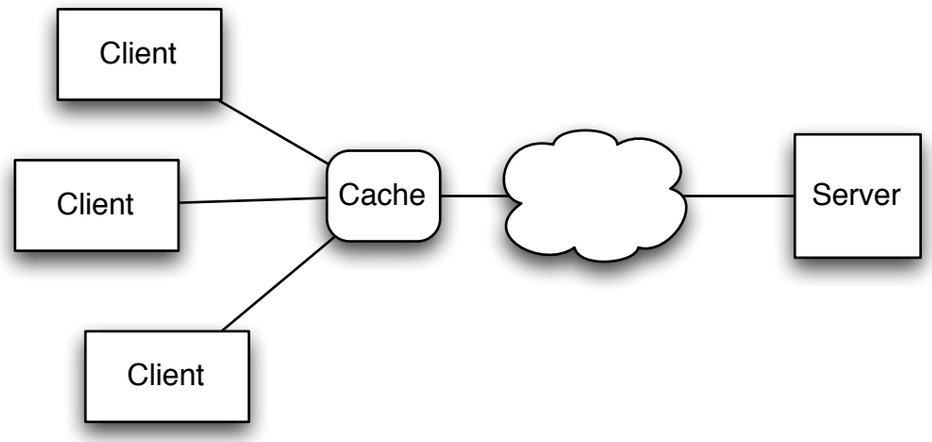

Bob
Cache
Back End
GET /AB
GET /A
Return Response
ETag: "a3e455afd"
ESI <include />
GET /B
Aggregate A + B
Return Response
Bob
Cache
Back End


Bob
Cache
Back End
GET /AB
GET /A does not happen ...
... because the cache is fresh!
GET /C
Aggregate A + C
Return Response
Bob
Cache
Back End

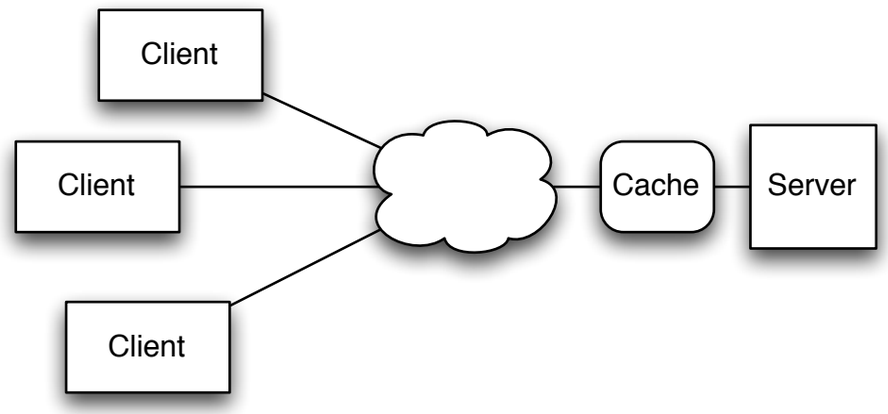
Cache Topologies



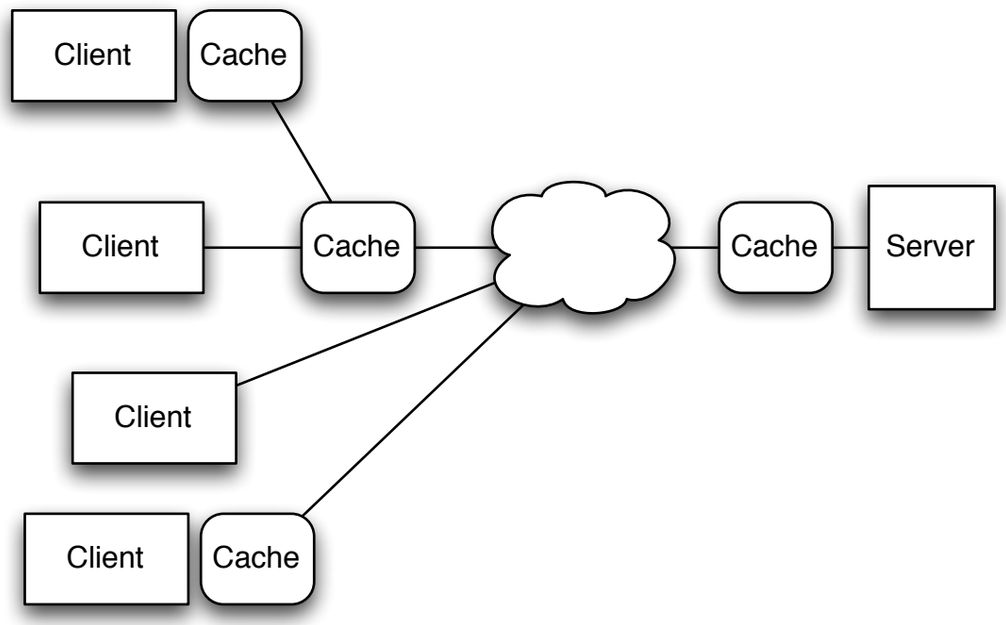
Client only



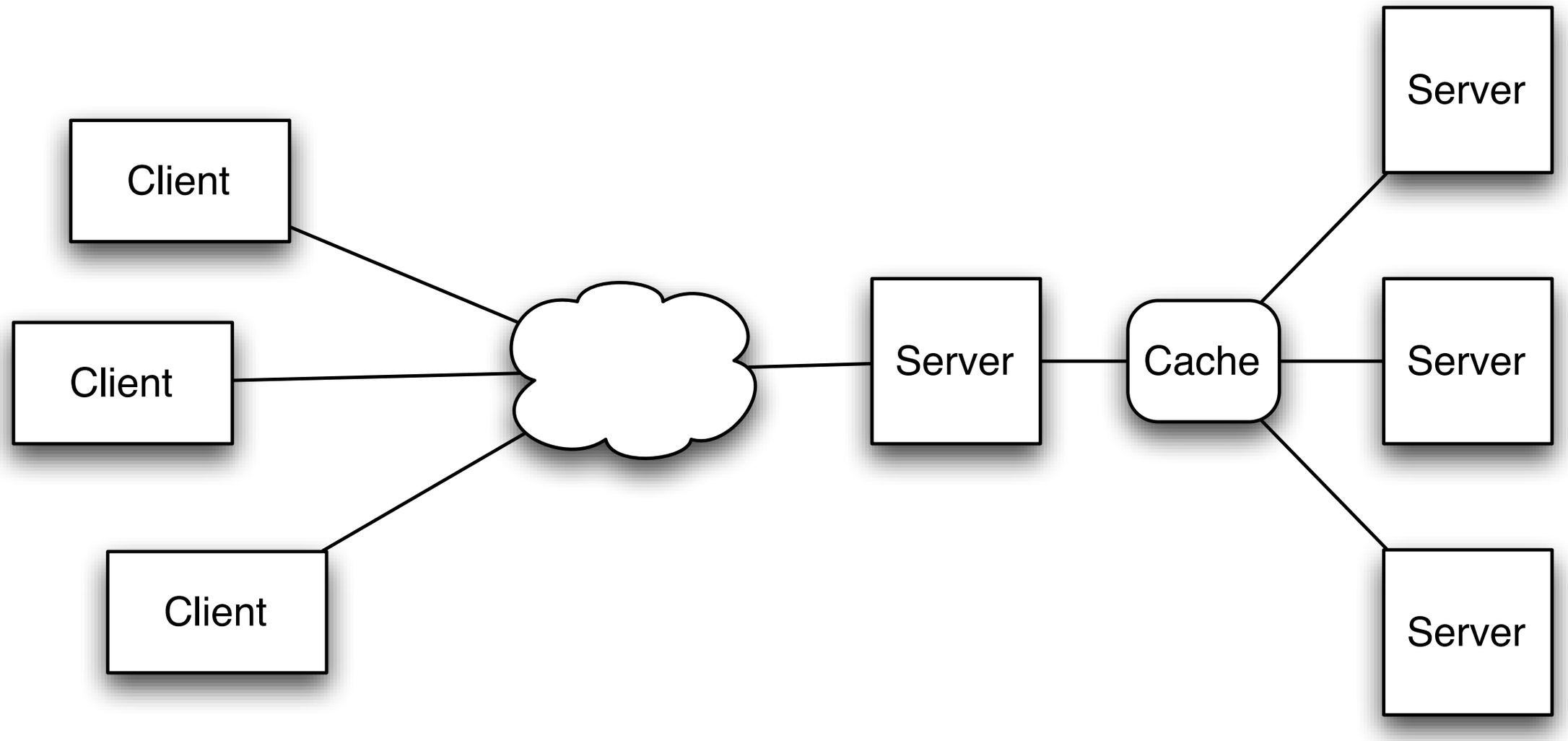
Proxy Cache



Reverse Proxy Cache



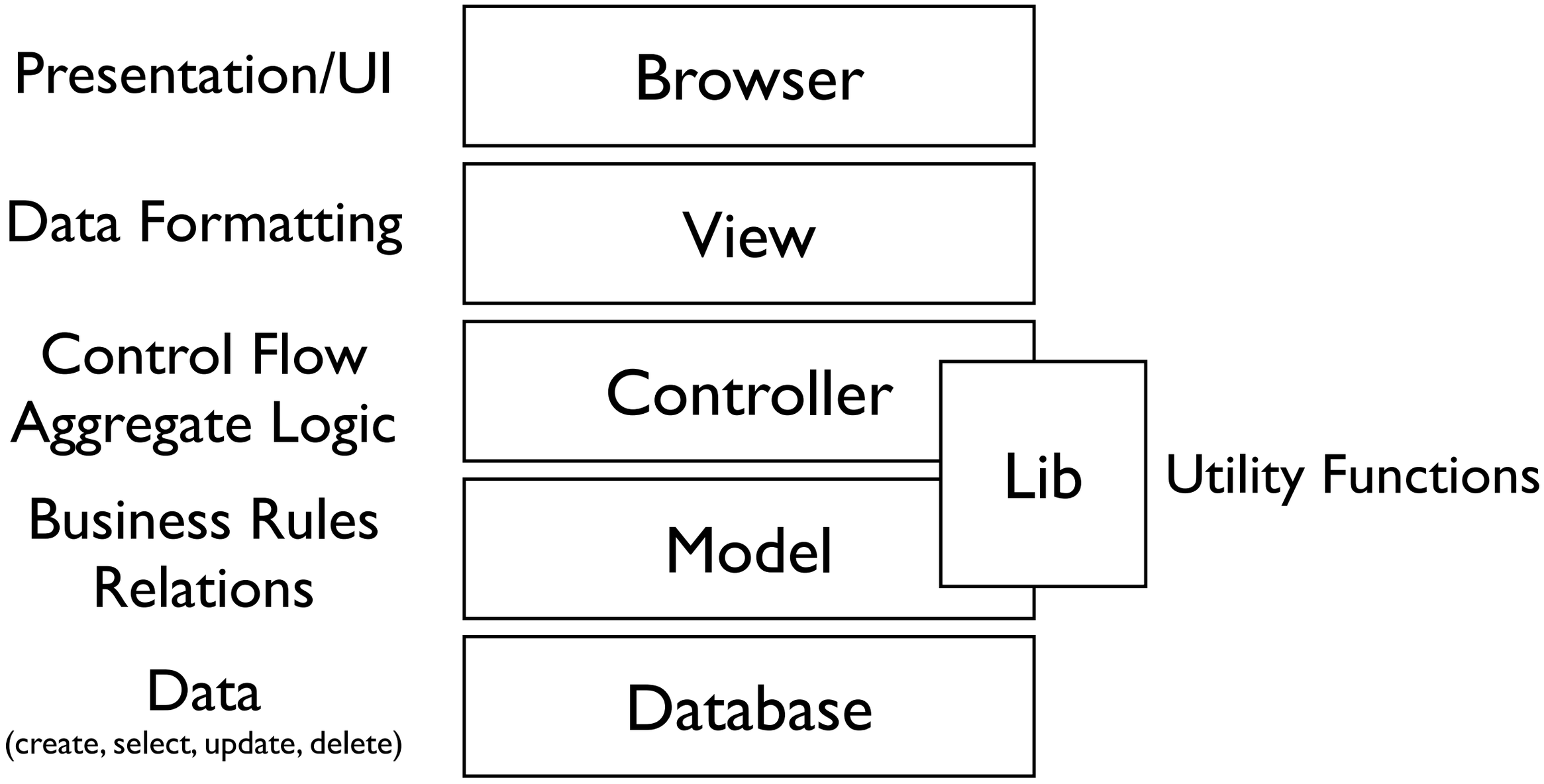
Complex Topology



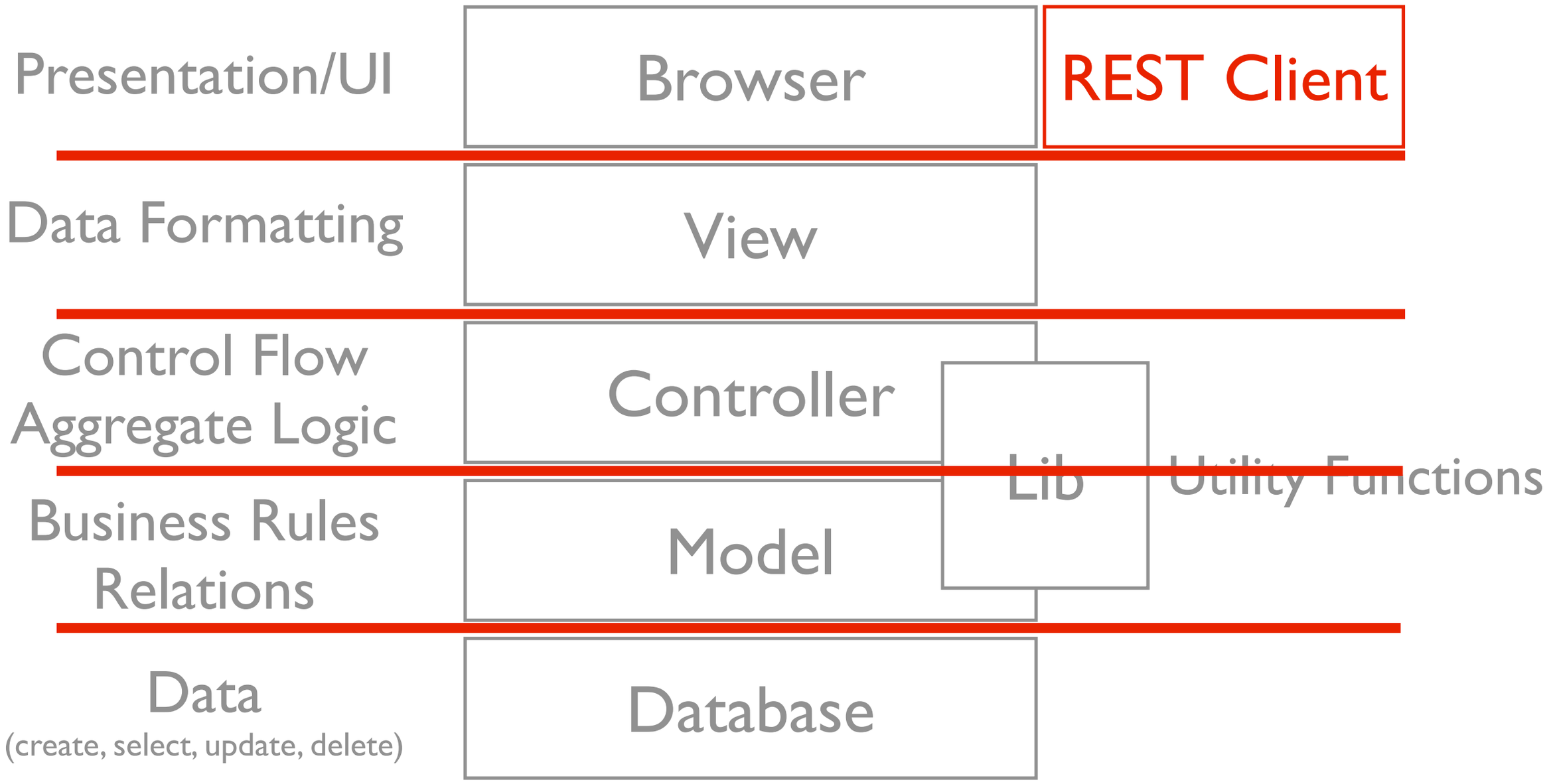
"Cache as ESB"

Web Sites vs. Web Services

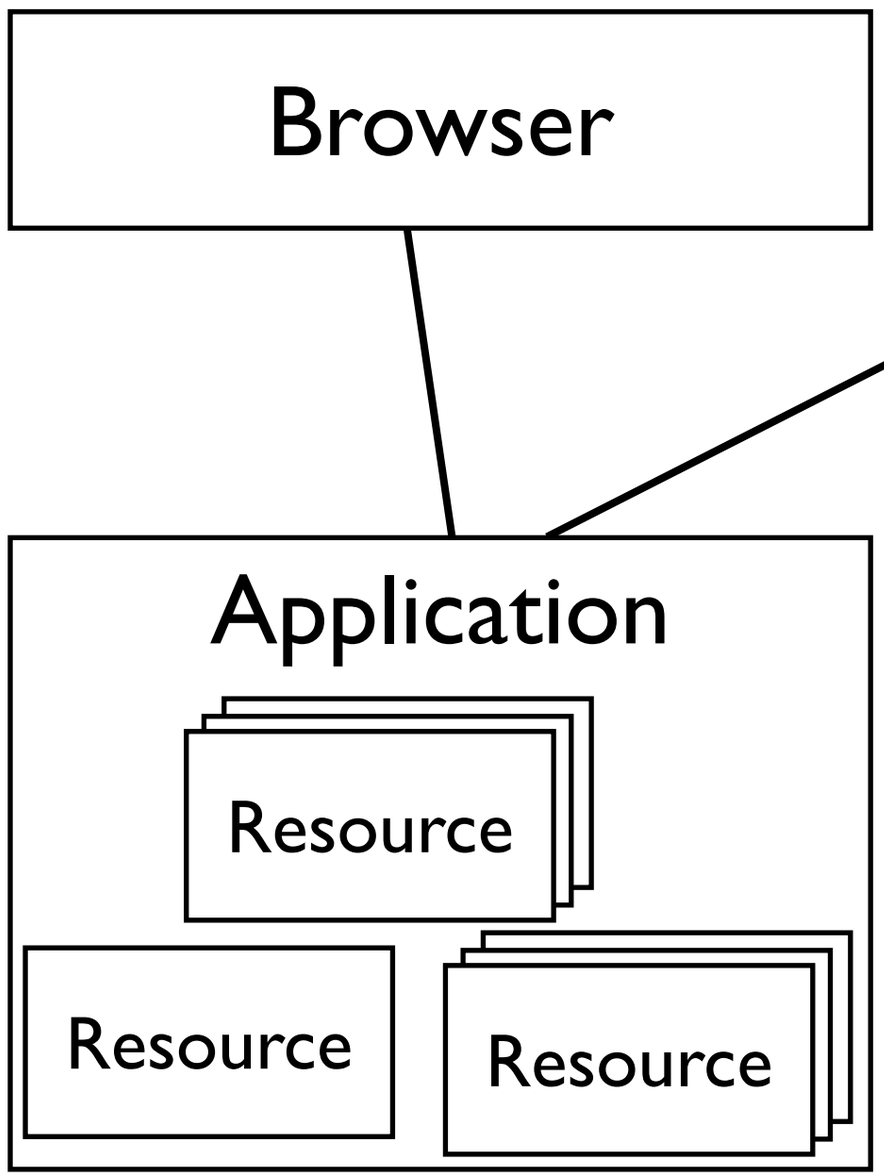
Application Layers



App Layers & Resources



Single Resource Model



Everything doable via UI …

… becomes doable via API

UI Backend = API

Intermediaries

Squid

Full proxy cache w/ reverse proxy option

Mature/stable/old, widely used

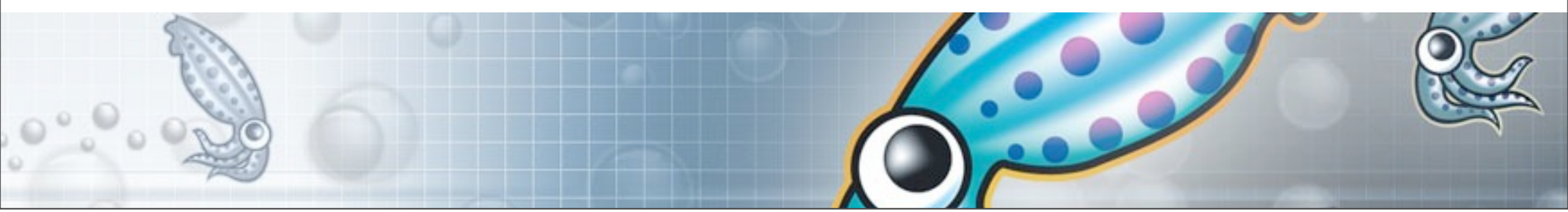
Complicated configuration

Support for ESI

Support for external invalidation (PURGE)

(Experimental) support for cache channels

(much, much more)



mod_cache

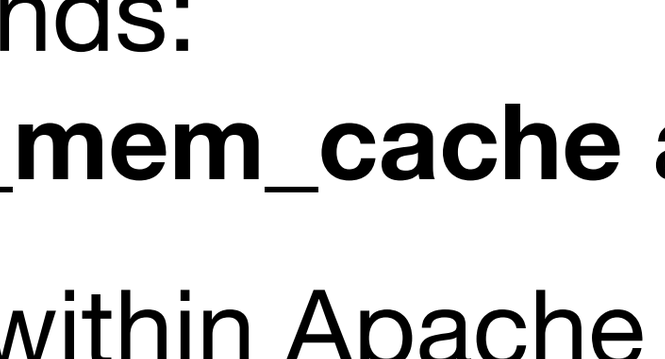
mod_cache module for Apache HTTPD 2.x (production-ready in 2.2)

backends:
mod_mem_cache and **mod_disk_cache**

Runs within Apache process

Simple solution in conjunction with Passenger

No support for ESI or explicit invalidation



```
<VirtualHost 1.2.3.4>
  ServerName example.com
  <Location /images>
    ExpiresActive On
    ExpiresDefault A3600
  </Location>
  <Location /user>
    ExpiresActive On
    ExpiresDefault "access plus 1 month"
  </Location>
  CacheEnable disk /images
  CacheRoot /var/www/cache
  ProxyPass / http://localhost:3000
  ProxyPassReverse / http://localhost:3000
</VirtualHost>
```

Varnish

Pure in-memory reverse proxy

Disk storage through OS swap mechanism

(Partial) ESI support

External invalidation

VCL configuration language

Easy configuration

```
sub vcl_recv {
    if (req.request != "GET" &&
      req.request != "HEAD" &&
      req.request != "PUT" &&
      req.request != "POST" &&
      req.request != "TRACE" &&
      req.request != "OPTIONS" &&
      req.request != "DELETE") {
        /* Non-RFC2616 or CONNECT
           which is weird. */
        return (pipe);
    }
    if (req.request != "GET"
        && req.request != "HEAD") {
        /* We only deal with GET and
           HEAD by default */
        return (pass);
    }
    if (req.http.Authorization
        || req.http.Cookie) {
        /* Not cacheable by default */
        return (pass);
    }
    return (lookup);
}
```

VCL

Hook	Meaning
vcl_recv	Called at the beginning of a request
vcl_pipe	Called upon entering pipe mode
vcl_pass	Called upon entering pass mode
vcl_hit	Called after a cache lookup if the requested document was found in the cache
vcl_miss	Called after a cache lookup if the requested document was not found in the cache
vcl_fetch	Called after a document has been successfully retrieved from the backend
vcl_deliver	Called before a cached object is delivered to the client
vcl_timeout	Called by the reaper thread shortly before a cached document reaches its expiry time
vcl_discard	Called by the reaper thread when a cached document is about to be discarded

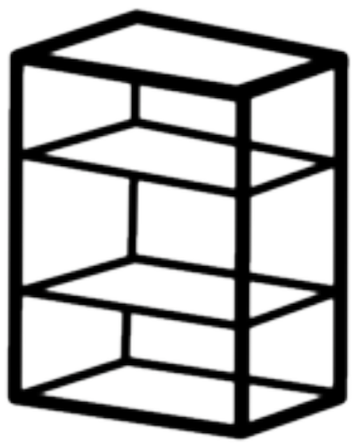
Rack::Cache

Runs within Ruby process

Cross-process synchronization via memcached

Absurdly simple + transparent

```
config.middleware.use(Rack::Cache,
    :verbose => true,
    :metastore   => 'file:/var/cache/rack/meta',
    :entitystore => 'file:/var/cache/rack/body')
```



rack::cache

powers web applications

Clients

Cache-aware HTTP Clients

Note: Conditional GET does not require anything special

Your browser and news reader

.NET (HttpWebRequest)

Python httplib2

HttpCache4J

So what?

How to Exploit HTTP Caching

1. Provide “safe” resource access via GET
2. Include appropriate validation and cache control headers
3. Leave caching to a reverse proxy cache
4. Use conditional GET on the client
5. Profit :-)

"I do think the REST-afarians are missing an opportunity by not driving home the secret sauce that is HTTP GET. […] **GET is one of the most optimized pieces of distributed systems plumbing in the world.** It's an absolute/objective slam dunk. No arguing/evangelism needed IMO. GET is the classic 'the first bag is free' kind of feature a platform builder dreams about."

Don Box, Co-inventor of SOAP

Thank you!
Any questions?

http://www.innoq.com

Stefan Tilkov

http://www.innoq.com/blog/st/

innoQ

Architectural Consulting

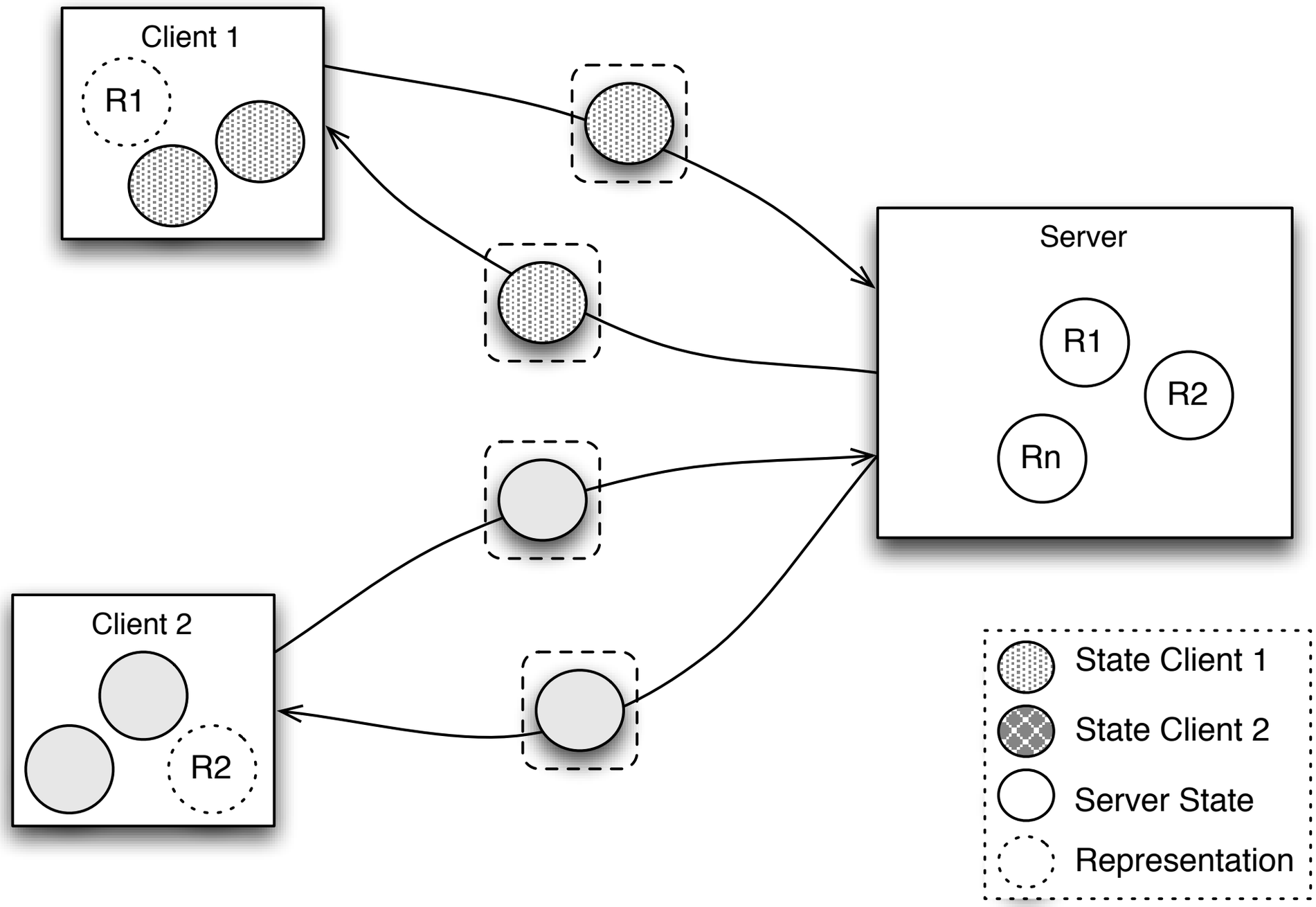
SOA	WS-*	REST
MDA	MDSD	MDE
J(2)EE	RoR	.NET

innoQ Deutschland GmbH
Halskestraße 17
D-40880 Ratingen
Phone +49 2102 77 162-100
info@innoq.com · www.innoq.com

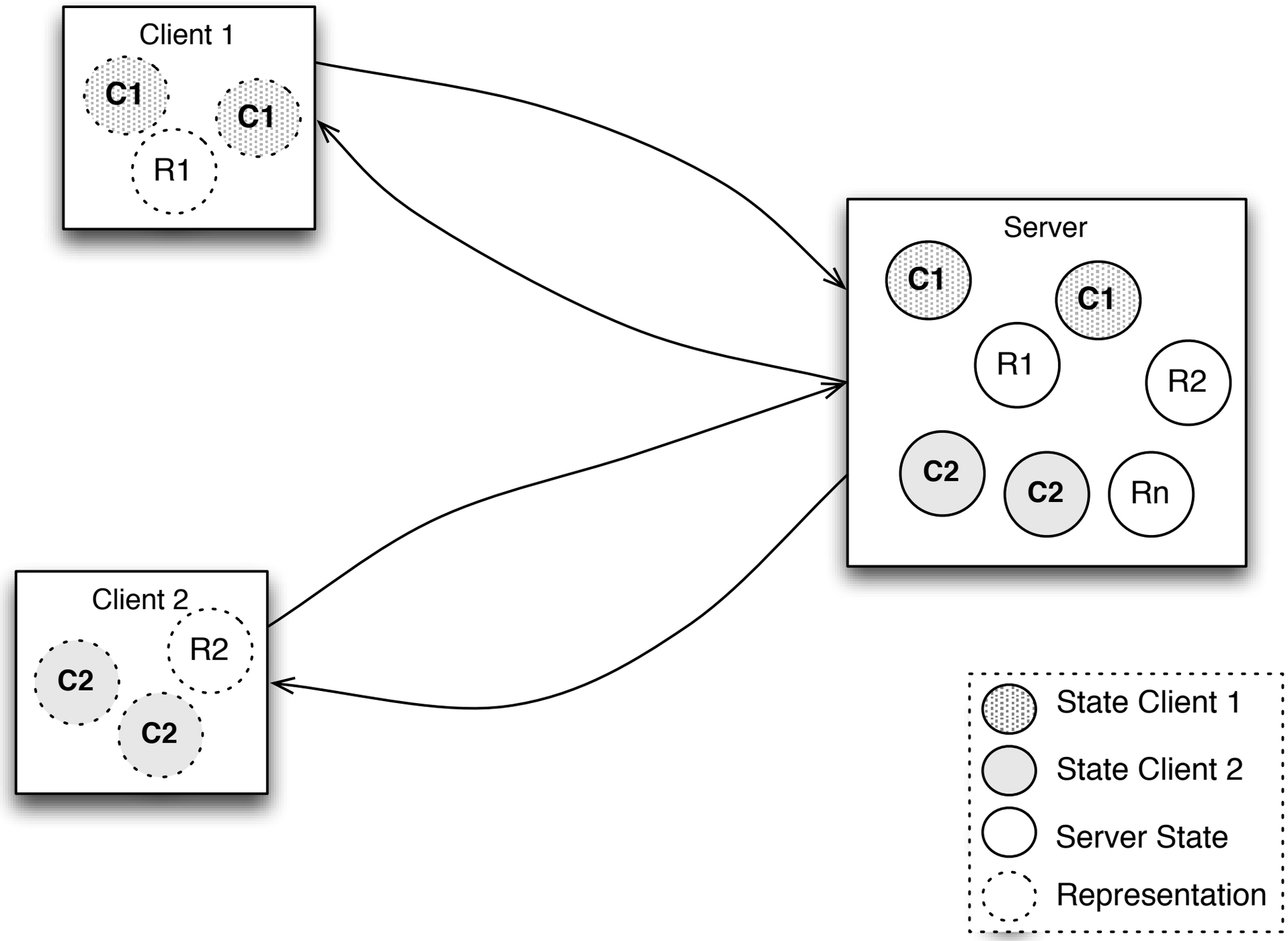
innoQ Schweiz GmbH
Gewerbestrasse 11
CH-6330 Cham
Phone +41 41 743 01 11

Backup

Turning Session State …



… into Resource or Client State



Resources

Nothingham, Mark: The State of Proxy Caching
http://www.mnot.net/blog/2007/06/20/proxy_caching

Nottingham, Mark: The State of Browser Caching
http://www.mnot.net/blog/2006/05/11/browser_caching

Nottingham, Mark: Caching Tutorial
http://www.mnot.net/cache_docs/

Squid, http://www.squid-cache.org/

Nottingham, Mark: Cache Channels for Squid
http://www.mnot.net/cache_channels/

The Varnish Project, http://varnish.projects.linpro.no/

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http://varnish.projects.linpro.no/wiki/ArchitectNotes

Tomoyako, Ryan: Things Caches Do
http://tomayko.com/writings/things-caches-do

W3C, ESI Language Specification 1.0
http://www.w3.org/TR/esi-lang

Apache HTTP 2.2 Caching Guide
http://httpd.apache.org/docs/2.2/caching.html