Using HTTP Link: Header for Gateway Cache Invalidation

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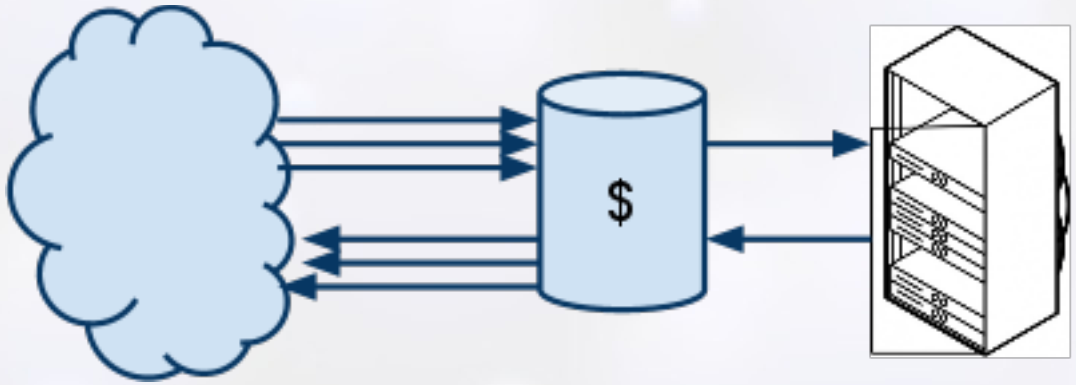
What is a gateway cache?

"reverse proxy cache"
A **layer** between *all* clients and destination server



Objective:
Minimize demand on destination server
Not so concerned with reducing bandwith

How do they work?

They can leverage the 3 principal caching mechanisms:

- Expiration
- Validation
- Invalidation

HTTP has mechanisms for each of these

Expiration-based caching

< 200 OK
< Content-Type: text/html
< **Cache-Control: public, s-maxage=600**
< ....

Pros:
+ Simple
+ No contact with server until expiration

Cons:
- Inefficient
- Difficult to manage

Validation-based caching

< 200 OK
< **ETag: "686897696a7c876b7e"**
> GET /example
> **If-None-Match: "686897696a7c876b7e"**
< **304 Not Modified**

Pros:
+ Reduces bandwidth
+ Ensures freshness

Cons:
- Server handling every request
- Generating 304 still costs processing and I/O

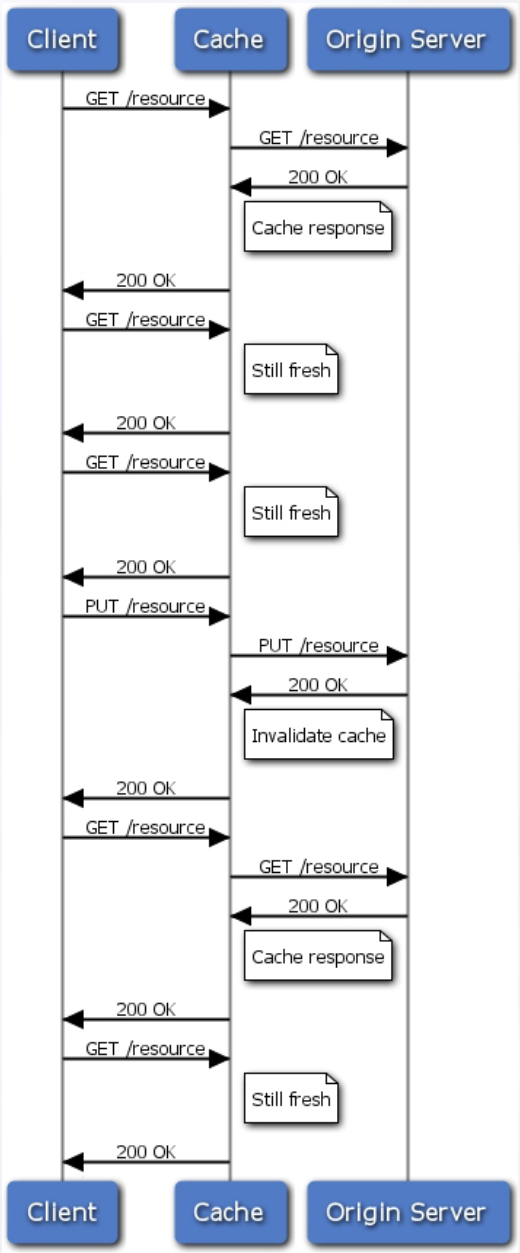
Expiration+Validation caching

< 200 OK
< **ETag: "686897696a7c876b7e"**
< **Cache-Control: public, s-maxage=600**

Pros:
+ Expiration reduces contact with server
+ Validation reduces bandwidth

Cons:
- "Worst case" inefficiency
- Still managing caching rules

Invalidation-based caching



- Responses fresh until invalidated

(by non-safe requests)

In HTTP:

PUT
POST
PATCH
DELETE
(PURGE?)

How is this possible?

Product of adhering to constraints of REST, particularly:

Uniform Interface
+ Self-descriptive messages

Intermediaries can make ***assertions*** about client-server interactions.

Invalidation-based caching

Pros:
+ Caches have self-control
+ "Best case" efficiency
+ Ensured freshness*

Cons:
- Only reliable for gateway caches
- Impractical*

* (sort of)

Cache invalidation in practice

Two main problems for cache invalidation arise from pragmatism and trade-offs in **resource granularity** and **identification**:

- The ***"Composite Problem"***
- The ***"Split-resource Problem"***

Composite Problem

Perfect World:

```
<collection>
   <item rel="item" href="/items/123" />
   <item rel="item" href="/items/asdf" />
   <item rel="item" href="/items/foobar" />
</collection>
```

Real World:

```
<collection>
   <item rel="item" href="/items/123">
      <title>Item 123</title>
      <content>Content for item 123 - an example of embedded state</content>
   </item>
   <item rel="item" href="/items/asdf">
      <title>Item asdf</title>
      <content>This state is also embedded</content>
   </item>
   <item rel="item" href="/items/foobar">
      <title>FooBar</title>
      <content>Yet more embedded state!! :(</content>
   </item>
</collection>
```

Composite Problem

What effect would the following interaction have on the composite collection it belongs to?

> PUT /composite-collection/item123
< 200 OK

The Split-resource Problem

Given /document resource with representations:

/document.html
/document.xml
/document.json

When a client does this:

PUT /document

Then invalidation of each representation is invisible to intermediaries

What's the Problem?

.. The Solution

Beef up the uniform interface:

Express these common types of **resource dependency** as **control data** using Link header and **standard link relations**

This increases:

- Self-descriptiveness of messages

- **Visibility**

"Link Header-based Invalidation of Caches" (LHIC)

LHIC-I

Express dependency in response to an invalidating request

> PUT /composite-collection/item123

< 200 OK
< **Link: </composite-collection>;**
< **rel="http://example.org/rels/dependant"**

LHIC-II

Express dependencies in initial cacheable responses

> GET /document.html
< 200 OK
< **Link: </document>;**
< **rel="http://example.org/rels/dependsOn"**

> GET /document.xml
< 200 OK
< **Link: </document>;**
< **rel="http://example.org/rels/dependsOn"**

> GET /document.json
< 200 OK
< **Link: </document>;**
< **rel="http://example.org/rels/dependsOn"**

> PUT /document
< 200 OK

Comparison

LHIC-I
+ More dynamic control of invalidation

- DoS risk
- Invalidation does not cascade

LHIC-II
+ No DoS risk
+ Cascading invalidation

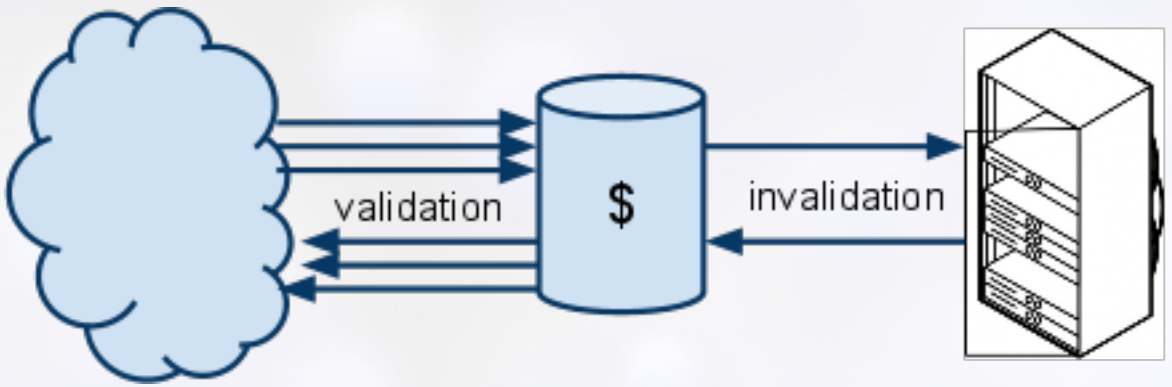
- Complexity

Conclusion

LHIC injects lost visibility. Resulting mechanism:

+ Very efficient
+ Ensures freshness
+ Easily managed
+ Leverages existing specs

- Only for gateway caching
    + Combine Invalidation (gateway) & Validation (client)



Considerations

Resource state altered outside of uniform interface
- Don't do that
- Reintroduce expiration and validation

Peering
- Further research

Size limits for HTTP headers