

REST – Theory vs Practice

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About the Speakers

- Subbu Allamaraju
 - Architect, Yahoo!
 - Web services standards/practices at Yahoo!
 - Built web portals, and web/WS services (SOAP kind) frameworks (BEA Systems)
- Mike Amundsen
 - Independent Consultant
 - .NET
 - Long-time RESTafarian

RESTful Web Services Cookbook

O'Reilly, March 2010

Objectives

- REST is set of **constraints** and not **rules**
- Knowingly relax constraints
- Work with the plumbing
- Apply sound software engineering

REST as Explained

1. Identify resources
2. Give a URI to every resource
3. Design representations for resources
4. Operate using a uniform interface
5. Use hypermedia as the engine of application state

Address Book 1.0

Build a RESTful address book

```
GET /user/subbu/address/{id}
Host: ex.org
```

```
200 OK ...
```

```
PUT /user/subbu/address/{id}
Host: ex.org
If-Match: xyz
```

```
200 OK ...
```

```
DELETE /user/subbu/address/{id}
Host: ex.org
If-Match: xyz
```

```
200 OK ...
```

```
POST /user/subbu/address-book
Host: ex.org
```

```
201 Created ...
```

Address
Resource

Address
Collection
Resource

```
<address>
  <link rel="http://ex.org/rel/person"
        href="http://ex.org/mike"/>
  <street>...</street>
  <city>...</city>
  ...
</address>
```

```
<address-book>
  <link rel="http://ex.org/rel/owner"
        href="http://ex.org/subbu"/>
  <link rel="next"
        href="http://ex.org/subbu/address-book?p=2/" />
  <address>...</address>
  <address>...</address>
  ...
</address-book>
```


GET /user/subbu/address/{id}
Host: ex.org



URIs

200 OK ...

PUT /user/subbu/address/{id}
Host: ex.org
If-Match: xyz

200 OK ...

DELETE /user/subbu/address/{id}
Host: ex.org
If-Match: xyz



Uniform interface

200 OK ...

POST /user/subbu/address-book
Host: ex.org

201 Created ...



Resources

Address
Resource

Address
Collection
Resource



Representations

```
<address>
  <link rel="http://ex.org/rel/person"
        href="http://ex.org/subbu"/>
  <street>...</street>
  <city>...</city>
  ...
</address>
```



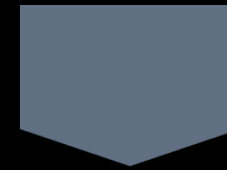
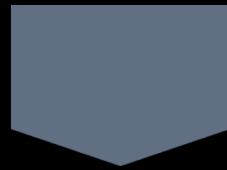
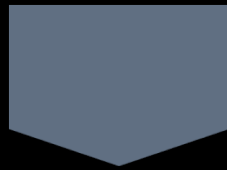
Application state

```
<address-book>
  <link rel="self"
        href="http://ex.org/subbu/address-book"/>
  <link rel="next"
        href="http://ex.org/subbu/address-book?p=2"/>
  <address>...</address>
  <address>...</address>
  ...
</address-book>
```

Stateless
Interactions

Uniform
Interface

Self-
Describing



Visibility



HTTP goodies – caching, optimistic concurrency,
conneg, monitoring, analytics + others

Address Book 1.1

[UC] Support address book sync for mobile users

GET /user/subbu/address-book

Address
Collection
Resource

For each address in the collection
Compare local copy

PUT if different

Address
Resource

DELETE if missing

POST if new

Address
Collection
Resource

Visibility

```
graph LR; A[Visibility] --> B[Separation of concerns]; A --> C[Network efficiency]
```

Separation of
concerns

Network
efficiency

Better Merge

```
POST /user/subbu/address-book/merge
Host: ex.org
Content-Length: xxx
Content-Type: application/xml;charset=UTF-8
```

```
<address-book>
  <address>...</address>
  <address>...</address>
  ...
</address-book>
```

303 See Other

Location: <http://ex.org/user/subbu/address-book>

```
POST /user/subbu/address-book/merge
```

```
Host: ex.org
```

```
Content-Type: application/xml; charset=UTF-8
```

 **Reduced visibility**

```
<address-book>
```

```
<address>...</address>
```

 **Better separation of concerns**

```
<address>...</address>
```

```
...
```

```
</address-book>
```

 **Efficient network use**

```
303 See Other
```

```
Location: http://ex.org/user/subbu/address-book
```


Tradeoffs

Protocol-level
Visibility

Separation of
Concerns

Network
Efficiency

Atomicity and
Concurrency

Infrastructure
support

Take a Step Back

1. Everything at the end of a URI is a resource

Some “things”

“person”, “address book”

and some non-“things”

“merge address book”, “reserve”,
“cancel”, “compute distance”,
“reimage the virtual machine”

2. Use POST when in doubt

GET	Safe	+ Idempotent
PUT	Unsafe	+ Idempotent
DELETE	Unsafe	+ Idempotent
POST	Unsafe	+ Non-Idempotent

All bets are off with POST
POST limits damage

3. Don't tunnel using POST

POST /address-book

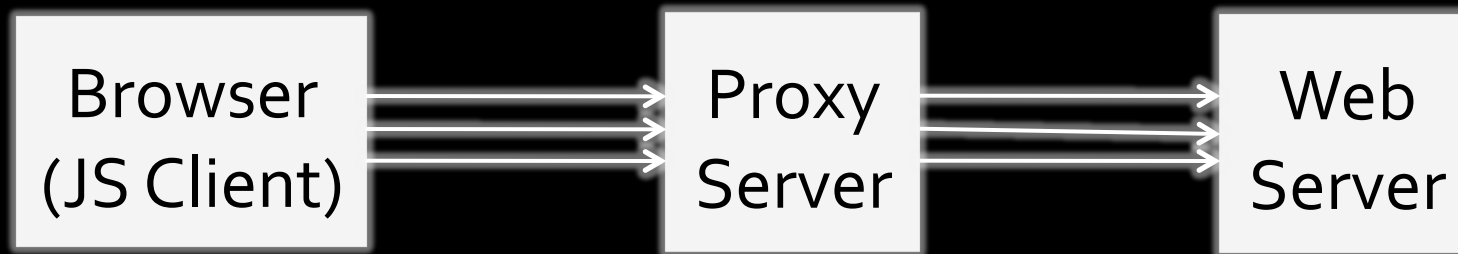
Merge an address book?

Fix duplicates?

Or something else?

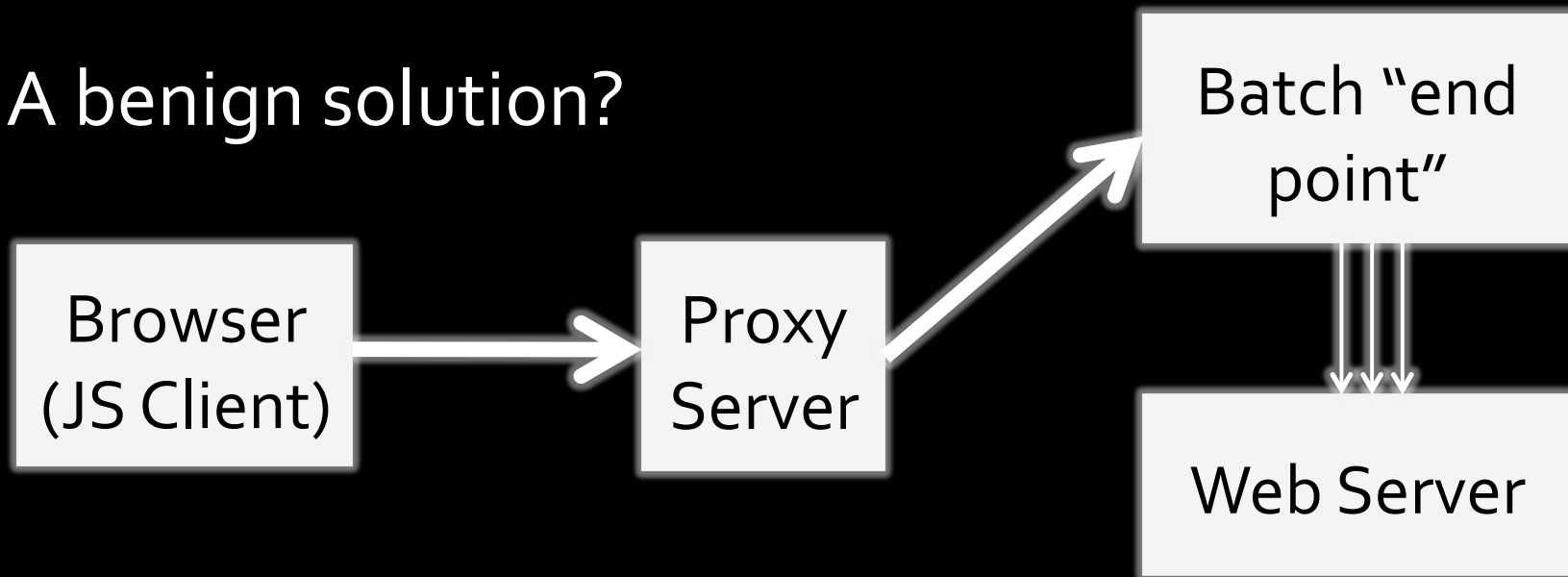
Tunneling = Back to dark ages

This is not a “pedantic” point of view



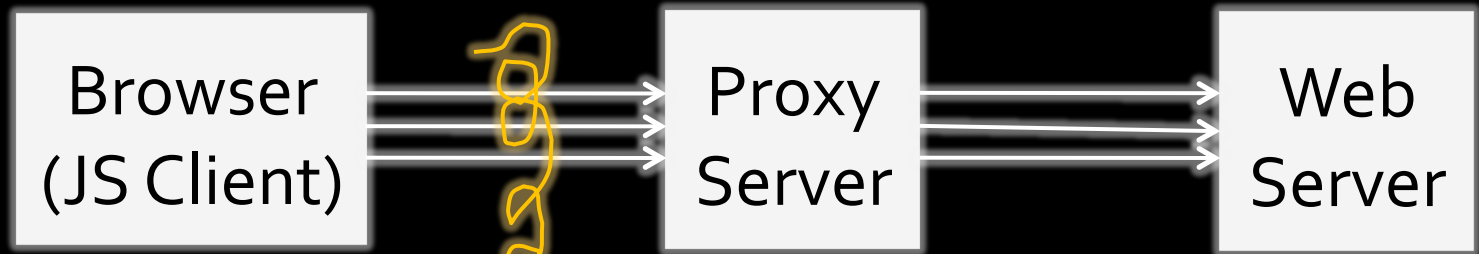
Dev: “We should find a way to make REST 'faster' and/or provide batching support”

A benign solution?

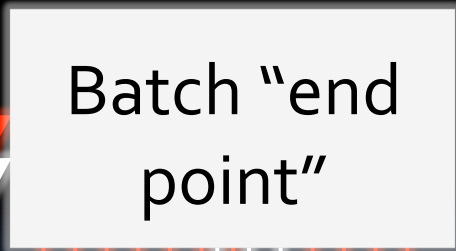
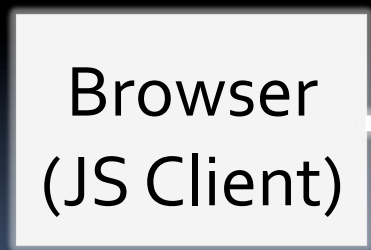


```
POST /batch
Host: ex.org
Content-Length: xxx
Content-Type: application/xml;charset=UTF-8
```

```
<batch>
  <request method="PUT" uri="/addr">...</request>
  <request method="GET" uri="/poi">...</request>
  <request method="GET" uri="/deals">...</request>
</batch>
```



Bad Guy




```
POST /batch
Host: ex.org
Content-Length: xxx
Content-Type: application/xml;charset=UTF-8
<batch>...</batch>
```



Create application specific resources with distinct URIs

```
POST /updateAddressGetPoiDeals
Host: ex.org
Content-Length: xxx
Content-Type: application/xml;charset=UTF-8
<address>
  ..
</address>
```



4. Be creative with URIs

Fixed and known URIs (Cool URIs)

<http://ex.org/user/subbu>

Resources with many URIs

<http://ex.org/user/1234/profile;t=3231231dasd>

<http://ex.org/user/1234/profile;t=3da8432stgs>

Ephemeral URIs (Uncool URIs)

<http://ex.org/act/4567/status;t=rfdsf3adsd23das>

<http://ex.org/act/transfer?>

[f=12&t=32&sig=a359d72d424cbd913686435bc6e7e372](http://ex.org/act/transfer?f=12&t=32&sig=a359d72d424cbd913686435bc6e7e372)

5. IDs are not bad, but URIs are better

How much “hyper”media?
Should you care?

Separation of concerns

Loose coupling

Performance

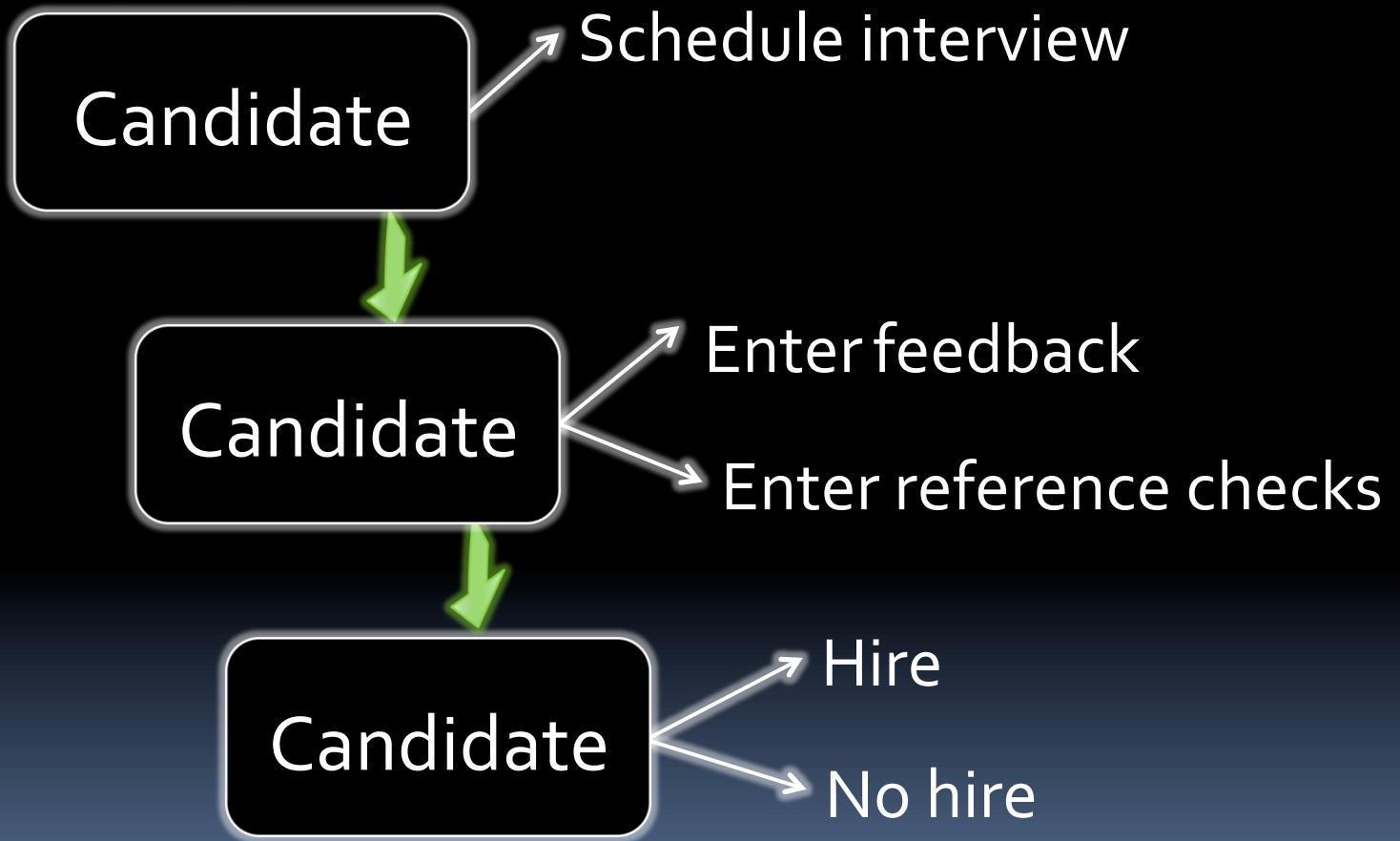
App complexity

```
<album>
  <photo id="1234">...</photo>
  <photo id="5678">...</photo>
</album>
```

Bad?

```
<album xml:base="http://ex.org">
  <photo>
    <link href="/photo/1234"/>...
  </photo>
  <photo>
    <link href="/photo/5678"/>...
  </photo>
</album>
```

Good?



```
GET /transfer/token?from=1234&to=5678
Host: ex.org
```

```
200 OK
Content-Type: application/xml;charset=UTF-8
```

```
<token>
  <link rel="http://ex.org/rels/transfer"
    href="http://ex.org/transfer;9ihrdsadas"/>
  <from>
    <balance>...</balance>
  </from>
  <to>
    <balance>...</balance>
  </to>
</token>
```

URI decoupling

Application flow

Opaque application state

6. Managing concurrency

```
GET /subbu/address/1
```

```
200 OK  
Date: Mon, 28 Sep 2009 14:30:53 GMT  
Etag: "8cf498a1ca3ceb67fe50d401d4759e34"  
Last-Modified: Mon, 28 Sep 2009 01:30:53 GMT  
Cache-Control: public,max-age=3600
```

```
<address>...</address>
```

```
PUT /subbu/address/1
```

```
If-Unmodified-Since: Mon, 28 Sep 2009 14:30:53 GMT  
If-Match: "8cf498a1ca3ceb67fe50d401d4759e34"
```

```
412 Precondition Failed
```



```
GET /acct/1234
```

```
200 OK  
ETag: "f091aae21b44c71:6b9"  
Content-Type: application/xml; charset=UTF-8
```

```
<account>  
  ..  
</address>
```

```
GET /acct/5678
```

```
...
```

```
POST /transfer  
Host: ex.org  
Content-Type: application/x-www-form-urlencoded  
  
amount=1000&from=1234&to=5678...
```

GET /acct/1234

200 OK
ETag: "f091aae21b44c71:6b9"
Content-Type: application/xml; charset=UTF-8

<account>
...
</address>

GET /acct/5678



No concurrency control

...

POST /transfer
Host: ex.org
Content-Type: application/x-www-form-urlencoded
amount=1000&from=1234&to=5678...

```
GET /transfer/token?from=1234&to=5678
Host: ex.org
```

```
200 OK
Content-Type: application/xml;charset=UTF-8
```

```
<token>
  <link rel="http://ex.org/rels/transfer"
    href="http://ex.org/transfer;9ihrdsadas"/>
  <from>
    <balance>...</balance>
  </from>
  <to>
    <balance>...</balance>
  </to>
</token>
```

```
POST /transfer/token;9ihrdsadas
Host: ex.org
Content-Type: application/x-www-form-urlencoded

amount=1000
```

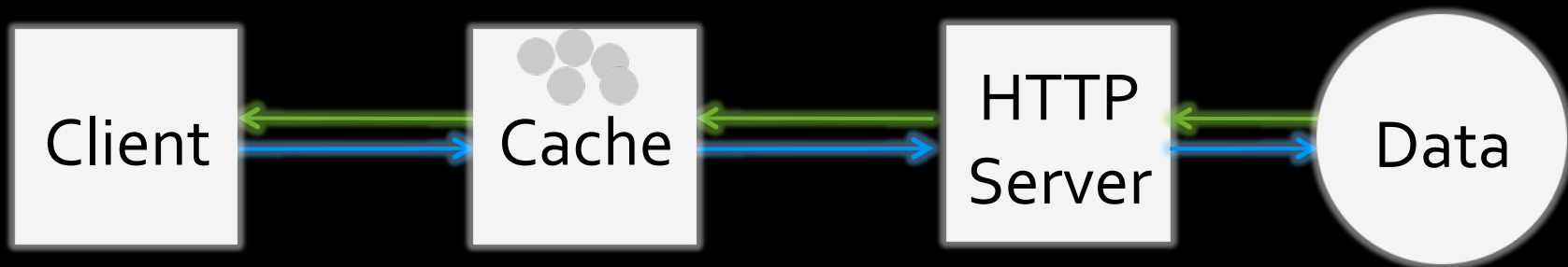
```
201 Created
Location: http://ex.org/transfer/1234
Content-Type: application/xml;charset=UTF-8
```

```
<transfer>
  <created>2009-09-30T15:00:00Z</created>
  <from>
    <balance>...</balance>
  </from>
  <to>
    <balance>...</balance>
  </to>
</transfer>
```

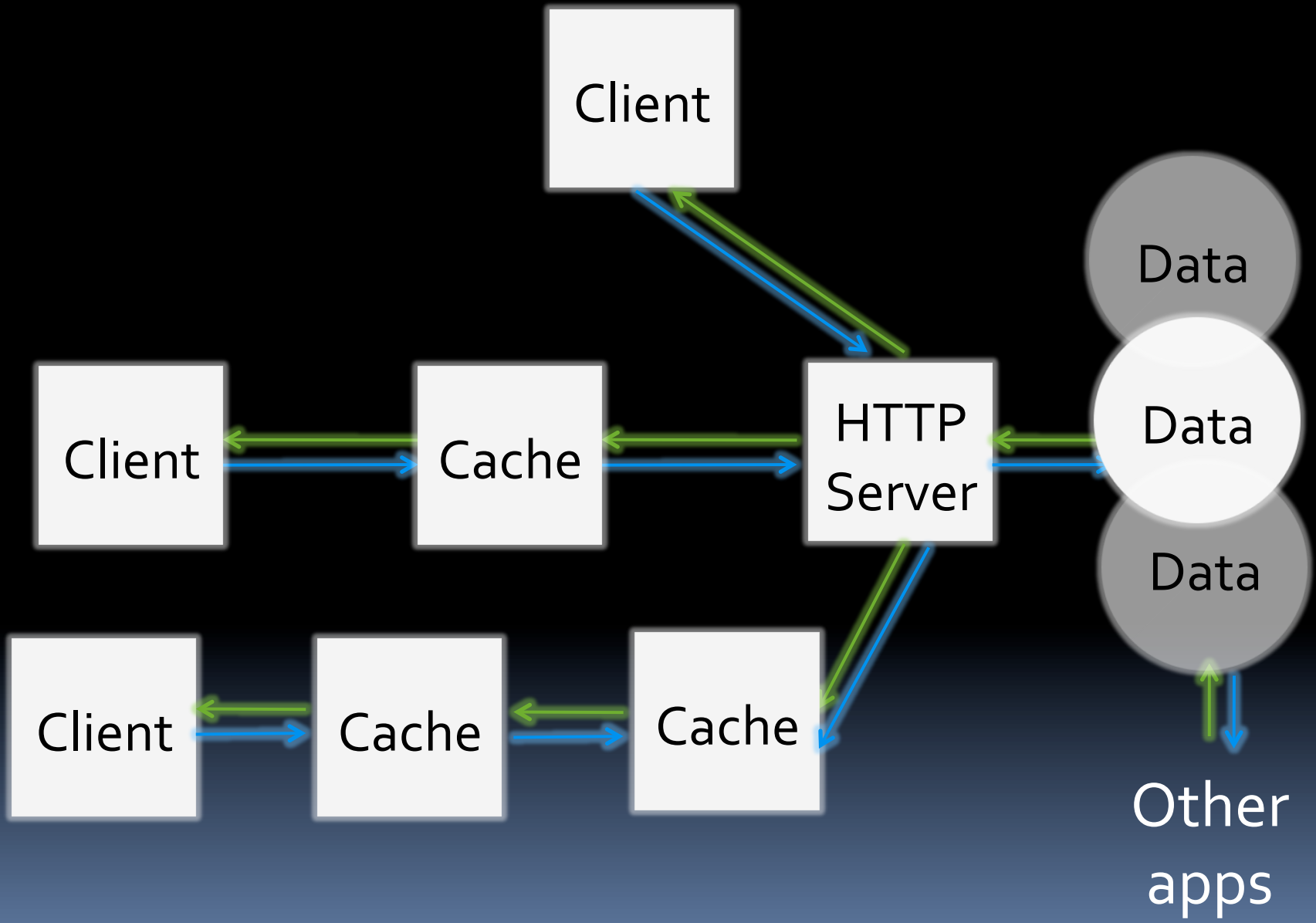


Concurrency control

7. Caching is not perfect



Ideal – perfectly visible



Every row is a resource

	id	name	email
▶	1	subbu	subbu@example.org
	2	mike	mike@example.org
	3	stanley	stan@example.org
	4	mark	mark@example.org
*	NULL	NULL	NULL

	id	user_id	street	city	region_provin...	country
	a1	1	123 main	sometown	wa	usa
	a2	2	456 north	byteville	md	usa
▶*	NULL	NULL	NULL	NULL	NULL	NULL

Overlapping data

	id	name	email
▶	1	subbu	subbu@example.org
	2	mike	mike@example.org
	3	stanley	stan@example.org
	4	mark	mark@example.org
*	NULL	NULL	NULL

	id	user_id	street	city	region_provin...	country
	a1	1	123 main	sometown	wa	usa
	a2	2	456 north	byteville	md	usa
▶*	NULL	NULL	NULL	NULL	NULL	NULL

	id	name	email	street	city	region_provin...	country
▶	1	subbu	subbu@example.org	123 main	sometown	wa	usa
	2	mike	mike@example.org	456 north	byteville	md	usa
*	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Yahoo! | Mail | Make My Yahoo! your home page Oct 5, 7:16 pm EDT | Build apps for Yahoo!


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 [FrontPage](#) |
 [Entertainment](#) |
 [Sports](#) |
 [Politics Tab](#) |
 [New Tab](#)
Hi, Michael | [Sign Out](#) | [Tips](#) | [Help](#)

[Add Content](#) |
 [Change Appearance](#) |
 [More Options](#)
[My Yahoo! Blog: It's You](#)

Open App Options

Lead Photo Options



WH says Obama won't pull US out of Afghanistan (AP)
 U.S. Marine radio operator and infantryman Lance Cpl. Walter Jennings of Normal, Ill. with Bravo Company, 1st Battalion 5th Marines walks in front of an armored vehicle, in Nawa district, Helmand province, southern Afghanistan, Monday, Oct. 5, 2009. (AP Photo/Brennan Linsley)

Weather Options

Compact | Classic | Full

Location	Today	Tomorrow	Wednesday
Erlanger, KY Fair	63° / 45°	67° / 51°	60° / 44°
Ahus, Denmark	55° / 44°	57° / 53°	56° / 45°
Louisville, KY	68° / 53°	70° / 54°	63° / 48°
New York, NY	66° / 49°	68° / 57°	68° / 50°
San Francisco, CA	62° / 50°	68° / 52°	68° / 53°
Seattle, WA	64° / 45°	68° / 50°	62° / 46°
Washington, DC	69° / 52°	72° / 62°	72° / 52°
Oslo, Norway	48° / 27°	48° / 39°	48° / 37°
Stockholm, Sweden	47° / 34°	51° / 42°	57° / 44°

Reuters: Top News Options

- Obama touts health plan to doctors, key vote nears - 2 hours ago
- Conde Nast magazines shut as review bites - 2 hours ago
- U.S. trio wins medicine Nobel for telomerase - 2 hours ago
- Sulolde bomber kills 5 at Pakistani U.N. office - 8 hours ago
- U.S. not to seek death for Africa bombings suspect - 9 hours ago

Stock Portfolios Options

Last update: 07:16 pm EDT - Refresh

Quotes - Edit

Symbol	Price	Change
DJIA	9,599.75	+112.08 +1.18%
^DOWCF	10,634.07	+164.52 +1.57%
^NIX	213.61	+2.40 +1.14%
NA\$DAQ	2,068.15	+20.04 +0.98%

Top Stories from The Christian Science Monitor Options

- Supreme Court to decide case on animal cruelty and free speech - 14 hours ago
- Supreme Court refuses Confederate flag T-shirt case - 14 hours ago
- Supreme Court declines Pledge of Allegiance case - 14 hours ago
- For Indonesia earthquake relief, true test comes in remote areas - 14 hours ago
- Sulolde bomb on UN breaks Pakistan's lull in major attacks - 14 hours ago

Cincinnati Post - KENTUCKY NEWS Options

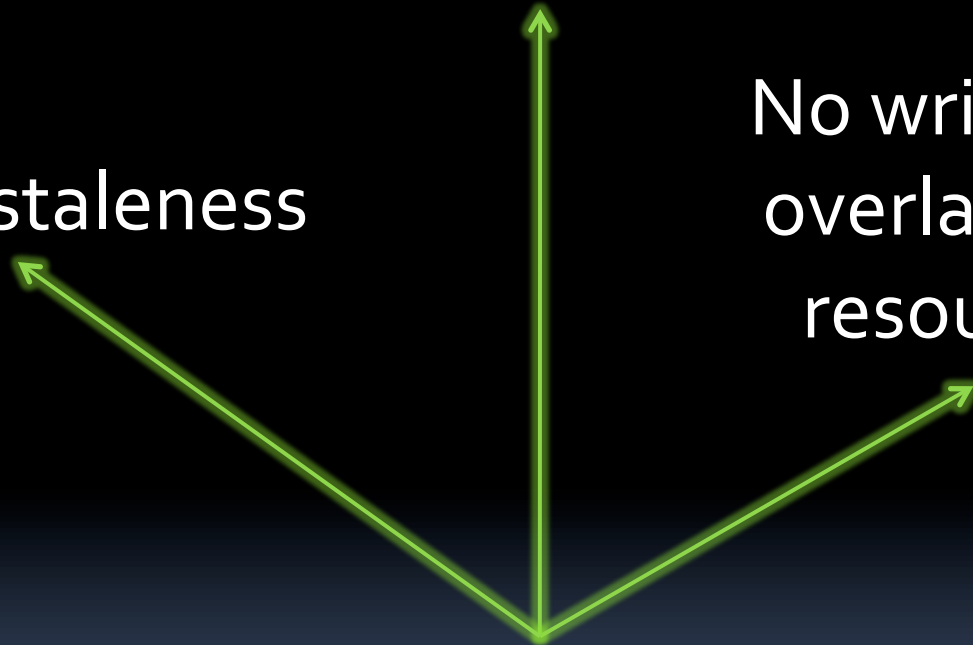
Most recent content added one year ago. [\[view\]](#)

Some resources are like home pages

No conditional reads

Accept staleness

No writes on
overlapping
resources



Conclusion

- Focus on tradeoffs
- Relax constraints judiciously, but not accidentally or by ignorance
- Put HTTP and its plumbing to good use

8. URIs for Extensibility and Versioning

HTTP methods are fixed

New headers may get dropped

Plumbing may not differentiate between media types



URIs are your best bet

9. Focus on Design Time Discovery

- Runtime discovery works great for browsers + humans, not for machine clients
- Developers need design-time information
- Leverage OPTIONS and conventions whenever possible

Developers need design-time info

- All resources and methods supported for each
- Media types and representations for requests and responses
- Link relations, descriptions, expected resources, media types
- Any fixed URIs not available via links
- Query parameters for fixed URIs
- URI templates and token parsing rules