INFO/CS 4302
Web Information Systems

FT 2012
Week 7: RESTful API Design

- Bernhard Haslhofer -

Plan for today...

- RESTful APIs – Architectural principles contd.
- REST API Design
- Real-world REST APIs (Groupwork)
- Questions, Housekeeping, ...

RESTFUL APIS – ARCHITECTURAL PRINCIPLES CONTD.

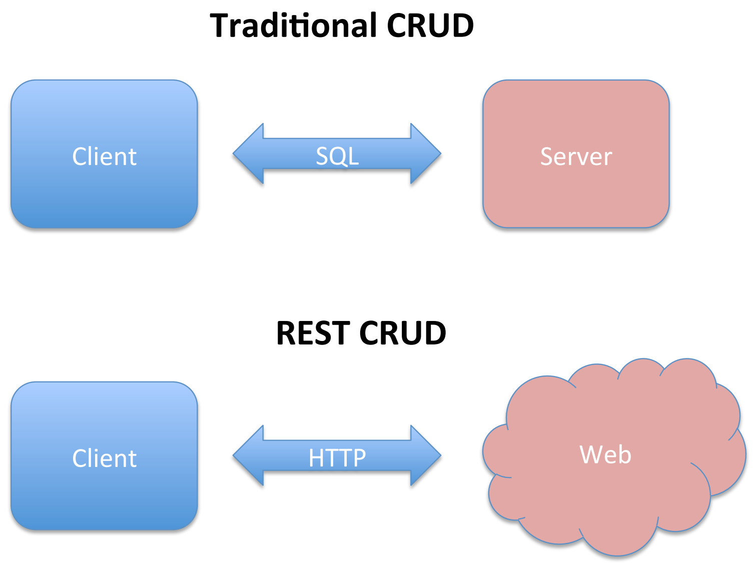
The Resource-Oriented Architecture

- A set of design principles for building RESTful Web Services
  - Addressability
  - Uniform interface
  - Connectedness
  - Statelessness

Web Services for the Real World
RESTful
Web Services
O'REILLY
Leonard Richardson & Sam Ruby

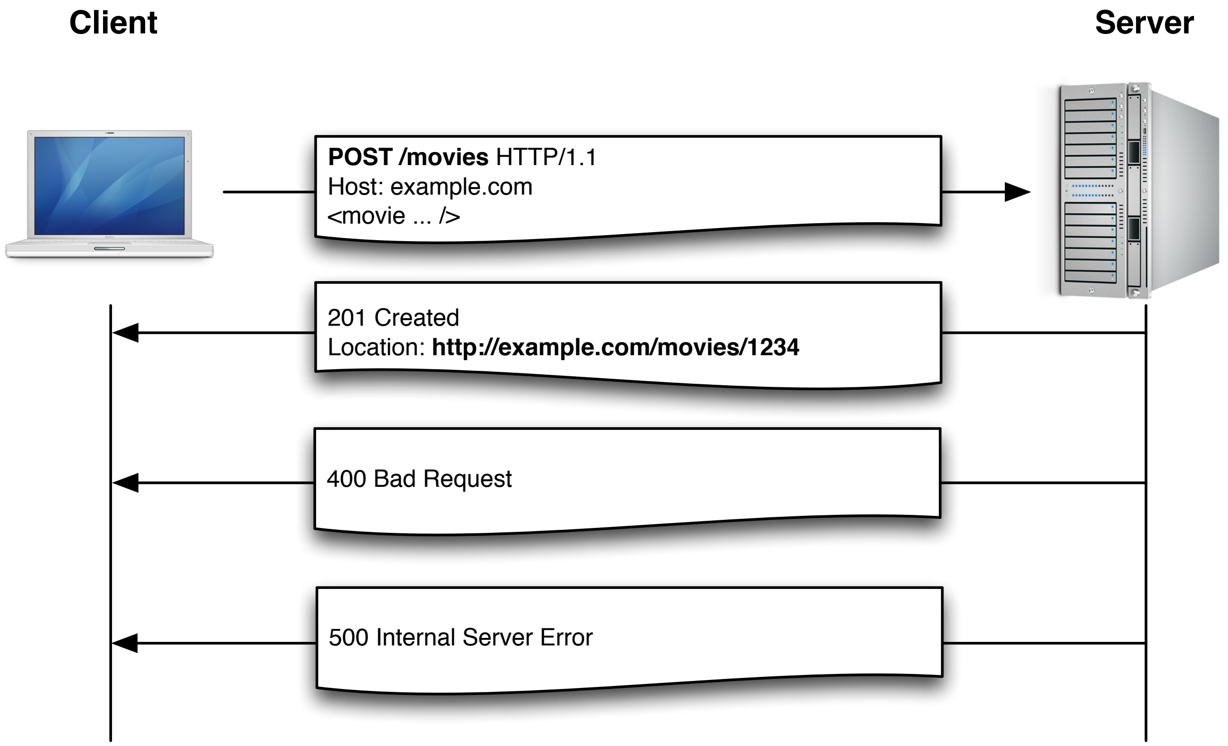
Uniform Interface

- With HTTP we have all methods we need to manipulate Web resources (**CRUD** interface)
  - **Create** = POST (or PUT)
  - **Read** = GET
  - **Update** = PUT
  - **Delete** = DELETE



Uniform Interface

- **CREATE** a new resource with HTTP POST



POST /movies HTTP/1.1
Host: example.com
<movie ... />

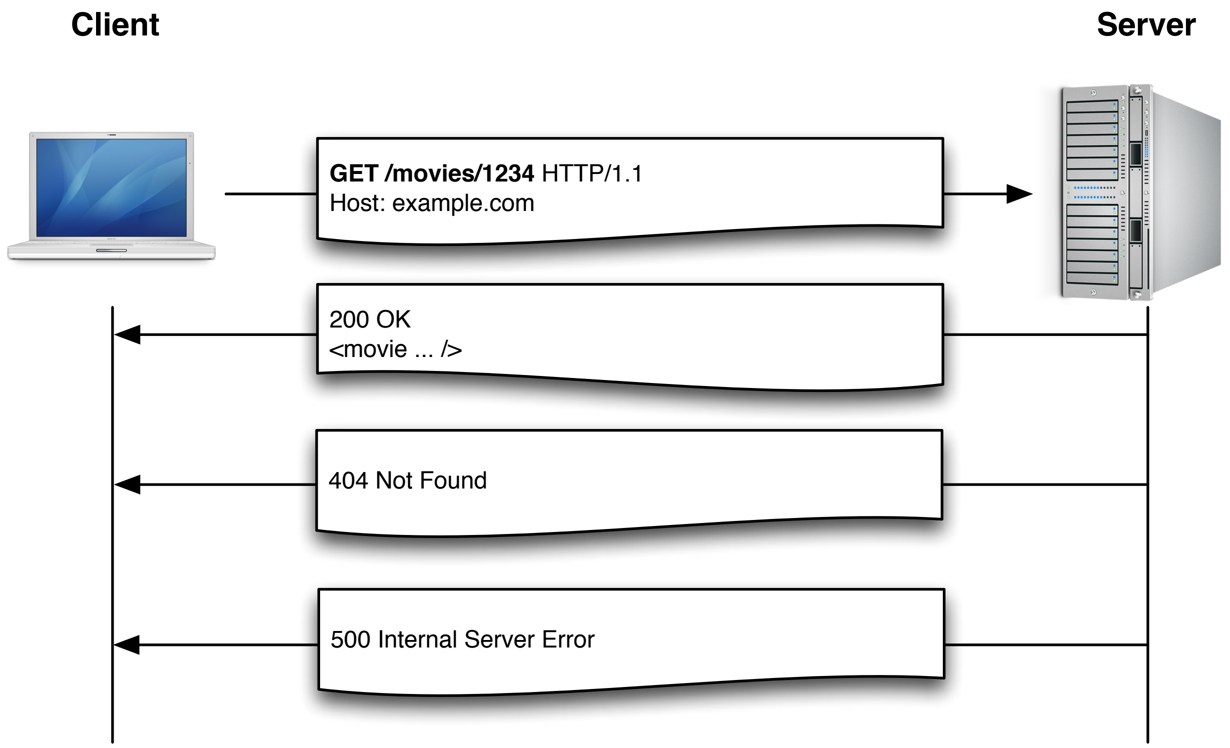
201 Created
Location: **http://example.com/movies/1234**

400 Bad Request

500 Internal Server Error

Uniform Interface

- **READ** an existing resource with HTTP GET



```
GET /movies/1234 HTTP/1.1
Host: example.com
```

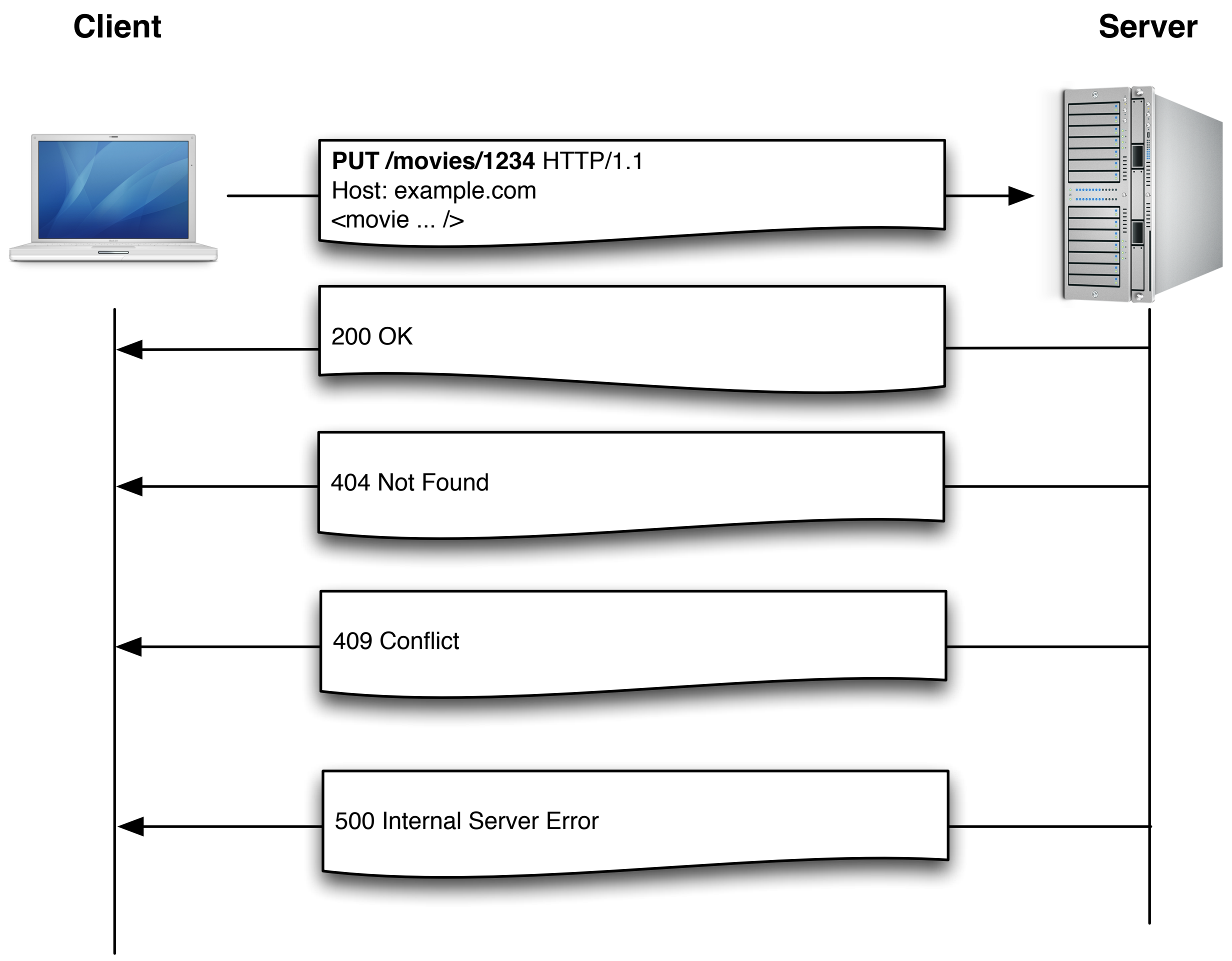
```
200 OK
<movie ... />
```

```
404 Not Found
```

```
500 Internal Server Error
```

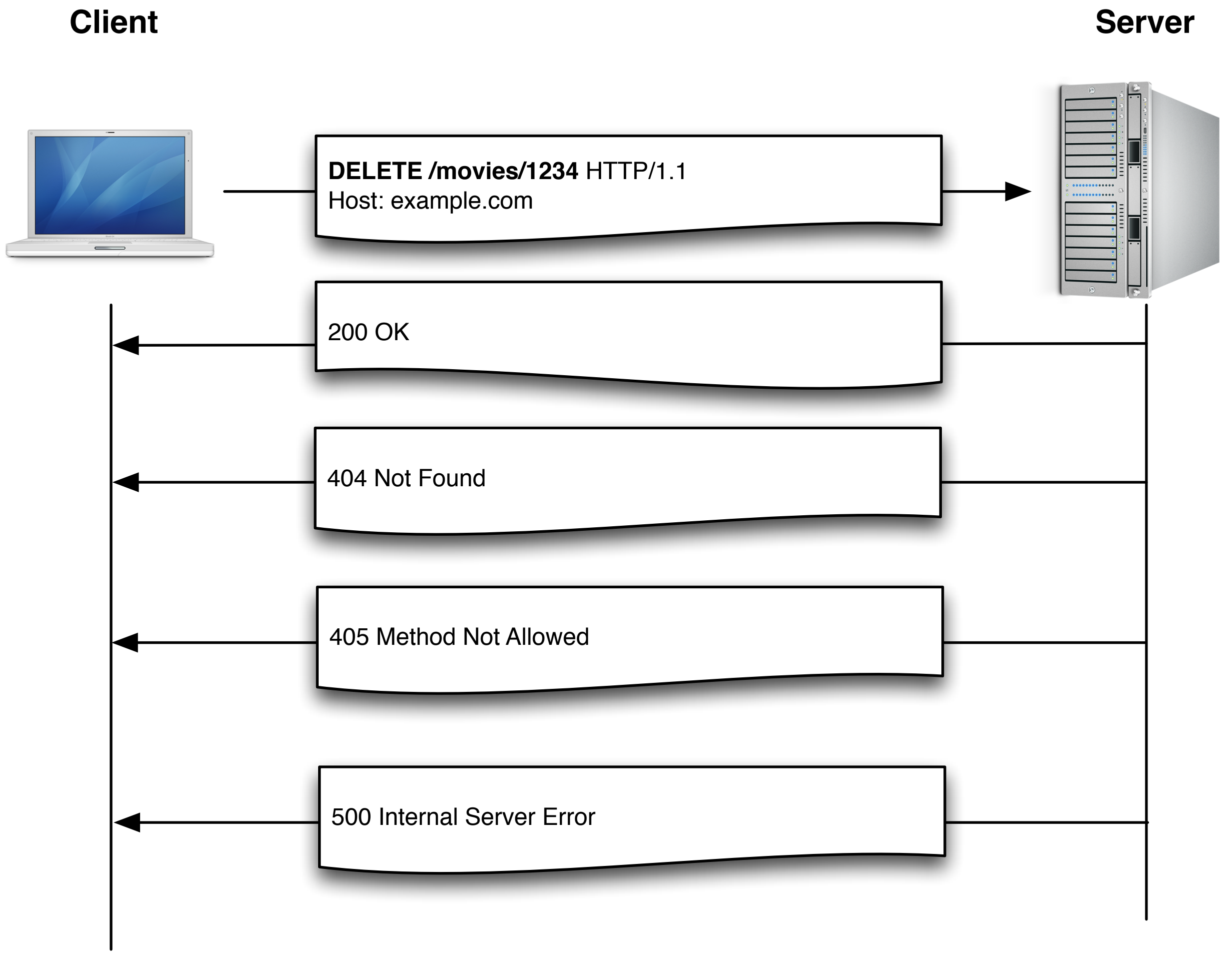
Uniform Interface

- **UPDATE** an existing resource with HTTP PUT



Uniform Interface

- **DELETE** an existing resource with HTTP DELETE



The Resource-Oriented Architecture

- A set of design principles for building RESTful Web Services
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  - Connectedness
  - Statelessness

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Connectedness

- In RESTful services, resource representations are hypermedia
- Served documents contain not just data, but also links to other resources

```
HTTP/1.1 200 OK
Date: ...
Content-Type: application/xml

<?xml...>
<movie>
    <title>The Godfather</title>
    <synopsis>...</synopsis>
    <actor>http://example.com/actors/567</actor>
</movie>
```

The Resource-Oriented Architecture

- A set of design principles for building RESTful Web Services
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  - Statelessness

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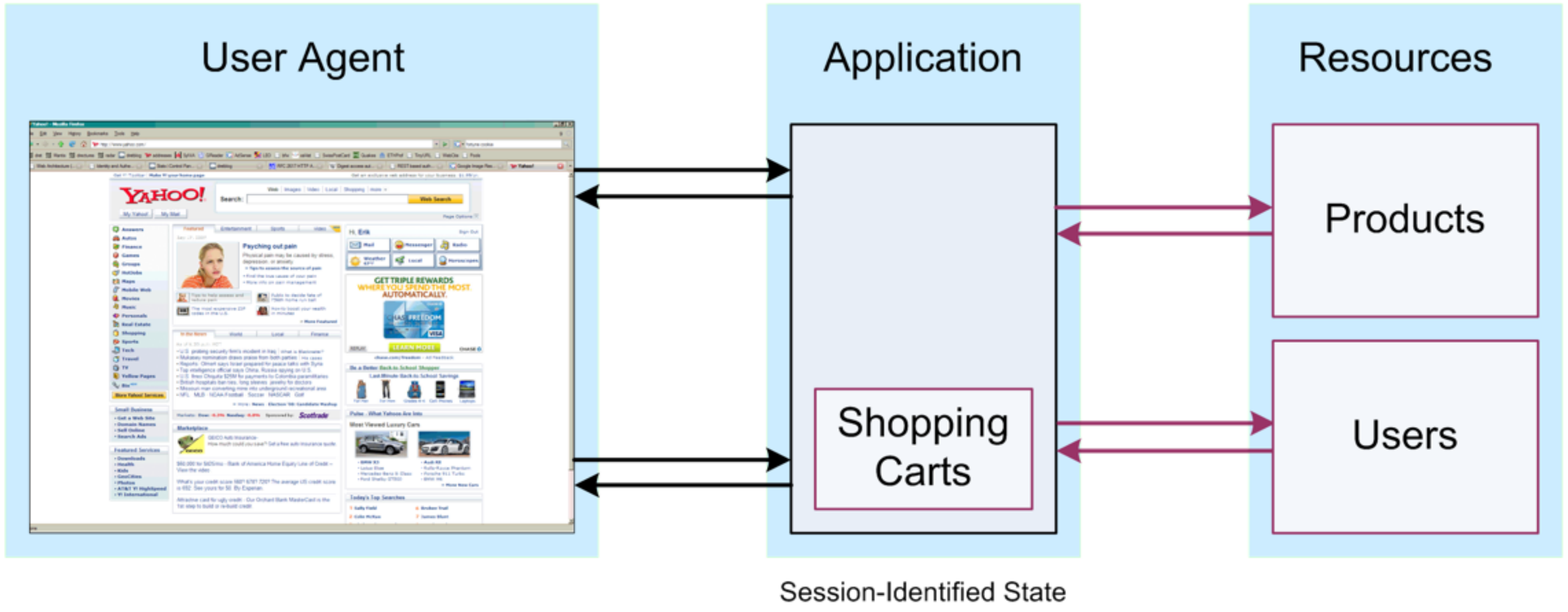
Statelessness

- Statelessness = every HTTP request executes in complete isolation
- The request contains all the information necessary for the server to fulfill that request
- The server never relies on information from a previous request
  - if information is important (e.g., user-authentication), the client must send it again

Statelessness

- This constraint does not say “stateless applications”!
  - for many RESTful applications, state is essential
  - e.g., shopping carts
- It means to move state to clients or resources
- State in resources
  - the same for every client working with the service
  - when a client changes resource state other clients see this change as well
- State in clients (e.g., cookies)
  - specific to client and has to be maintained by each client
  - makes sense for maintaining session state (login / logout)

State in the Application



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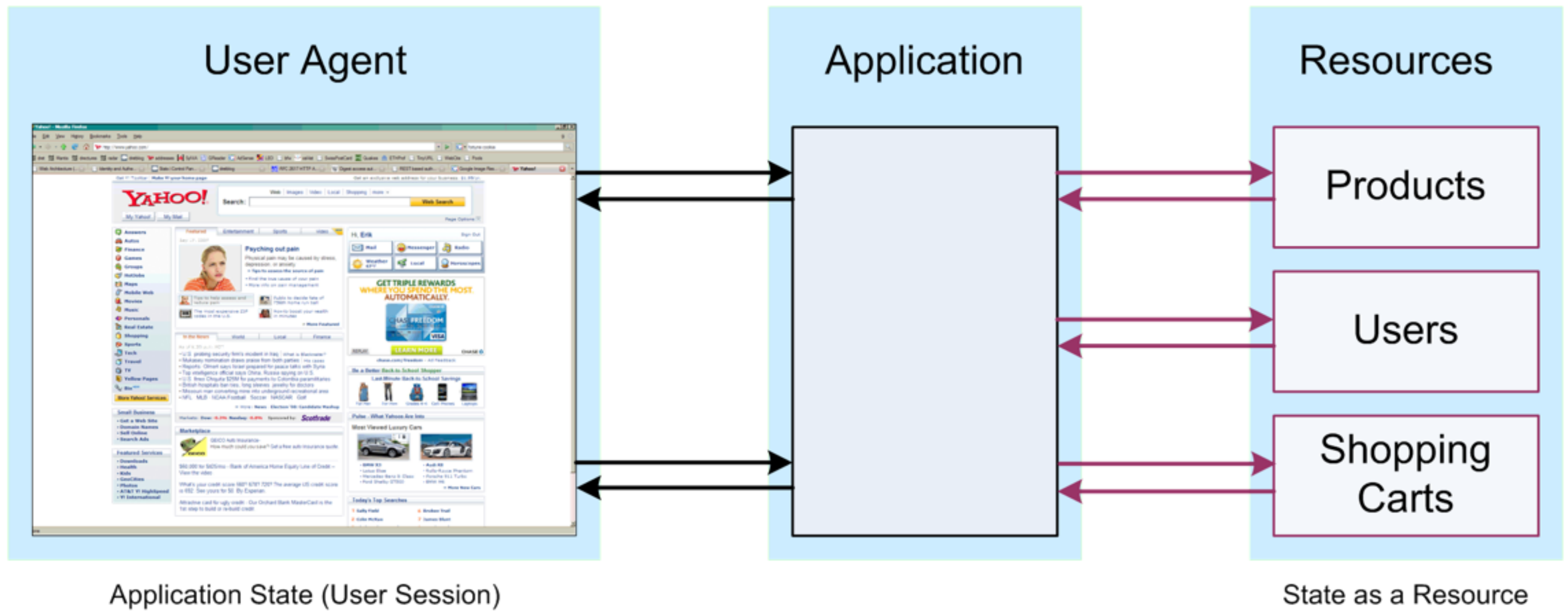
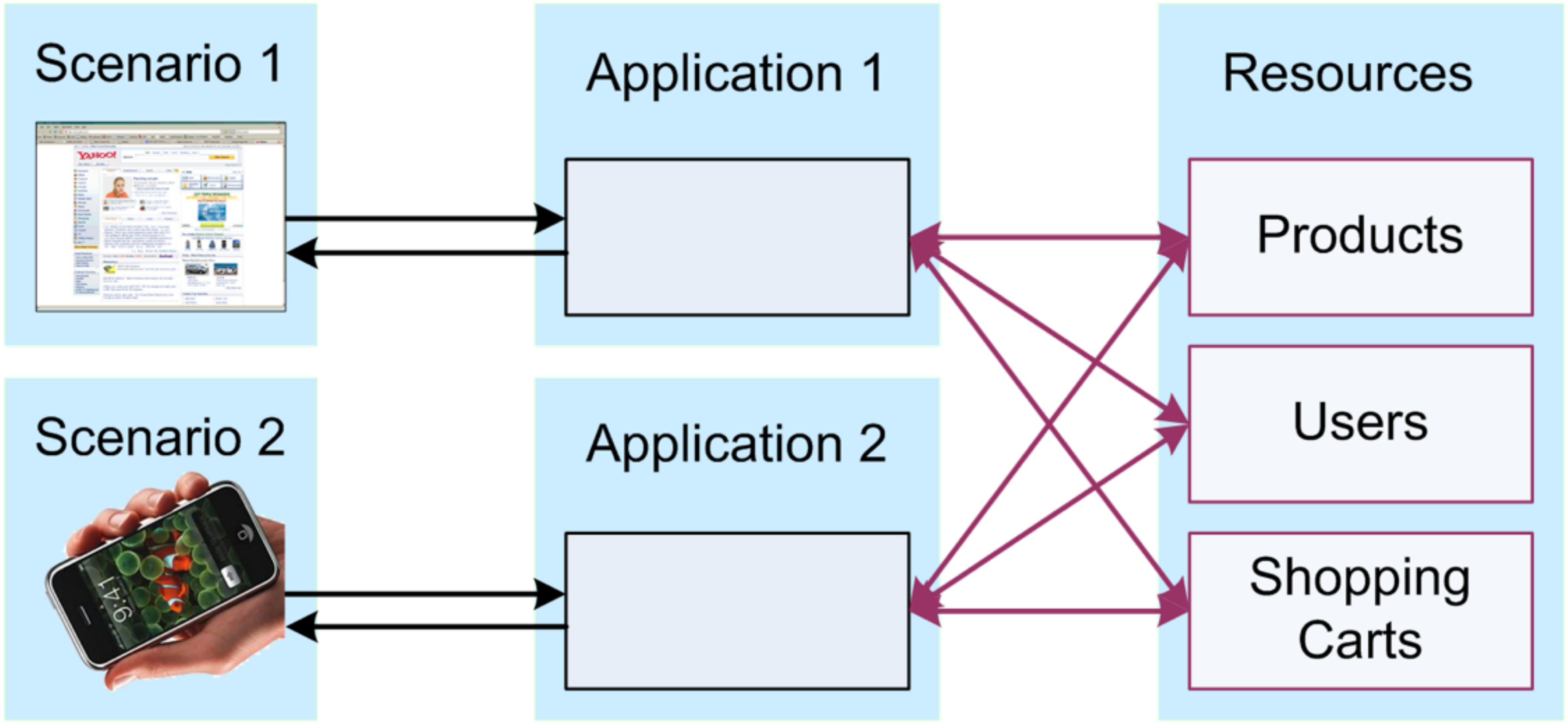
Statelessness



Statelessness



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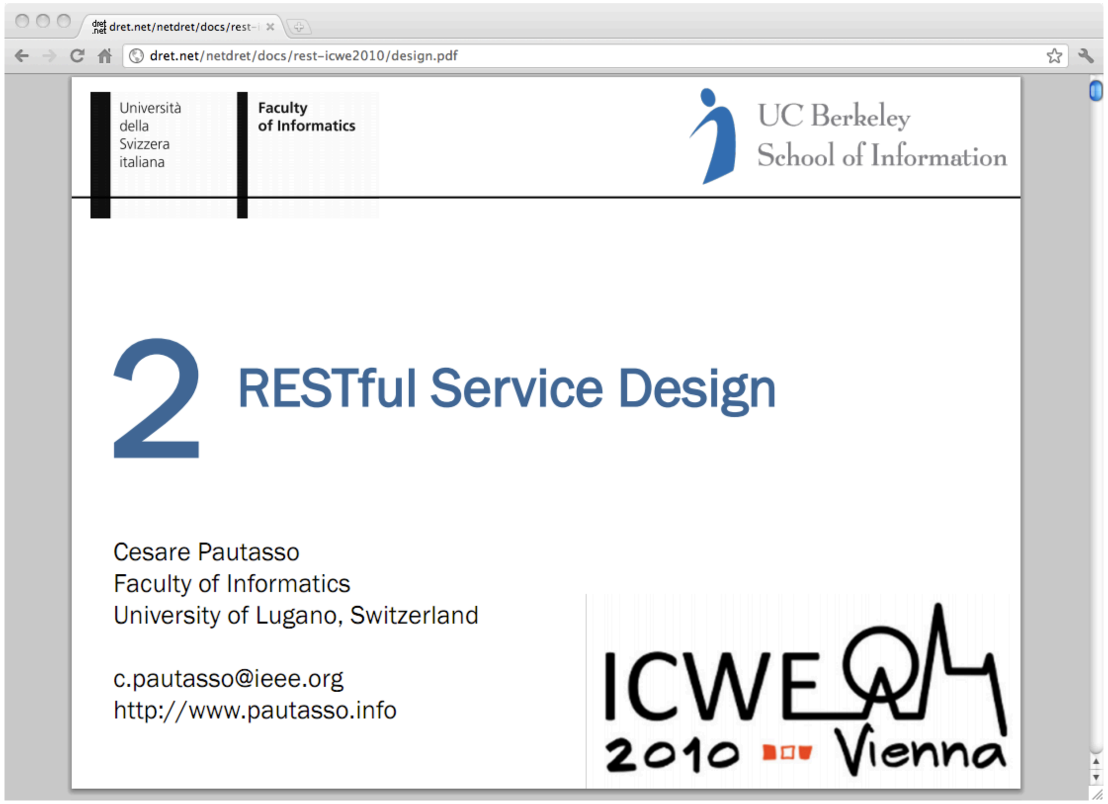
Tools and Frameworks

- Ruby on Rails - a framework for building RESTful Web applications
  - http://www.rubyonrails.org/
- Restlet - framework for mapping REST concepts to Java classes
  - http://www.restlet.org
- Django - framework for building RESTful Web applications in Python
- JAX-RC specification (http://jsr311.java.net/) provides a Java API for RESTful Web Services over the HTTP protocol.
- RESTEasy (http://www.jboss.org/resteasy/) - JBoss project that provides various frameworks for building RESTful Web Services and RESTful Java applications. Fully certified JAX-RC implementation.

RESTFUL SERVICE DESIGN – IN BRIEF


dret.net/netdret/docs/rest-icwe2010/design.pdf

Università della Svizzera italiana

Faculty of Informatics

UC Berkeley School of Information

2 RESTful Service Design

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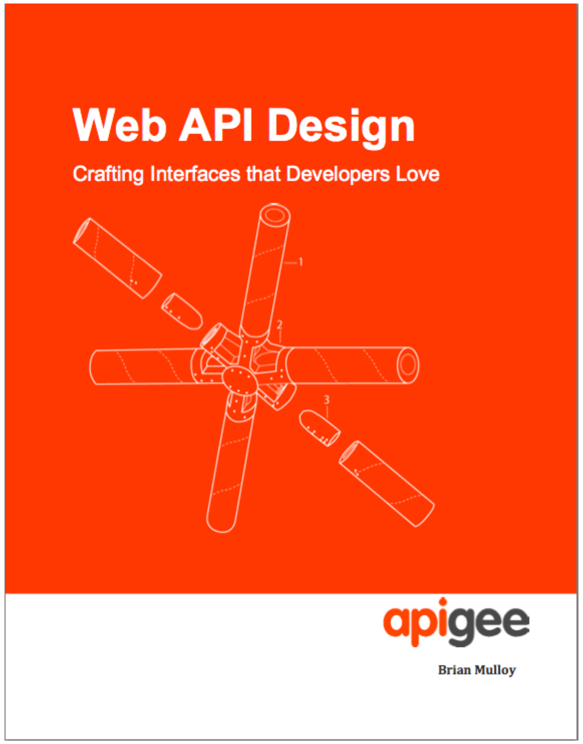
ICWE 2010 Vienna


Web API Design

Crafting Interfaces that Developers Love

apigee

Brian Mulloy

Design Methodology

- Identify and name resources to be exposed by the service
  - actors and movies
- Model relationships between resources that can be followed to get more details
  - an actor can play in several movies
  - several actors are playing in a movie
- Define "nice" URIs to address the resources

Design Methodology

- Map HTTP verbs to resources
  - e.g., GET movie, POST movie, etc...
- Design and document resource representations
  - we want to serve JSON (and XML)
  - the JSON mime-type is application/json
- Implement and deploy Web Service
- Test with cURL or browser developer tools

REST API Design Principles

- Who is the target audience?
- What are we trying to achive with an API?

REST API Design Principles

- Make application developer as successful as possible
- Primary design principle: .“...maximize developer productivity and success“ (Mulloy)
- Keep simple things simple
- Take the developer‘s point of view

Nouns are good; verbs are bad

- Simple and intuitive base URLs
  - /actors
  - /peopleplayingin80iesmovies
- 2 base URLs per resource
  - /actors (collection)
  - /actors/1234 (specific element in collection)
- Keep verbs out of your base URLs
  - /getAllActors

Nouns are good; verbs are bad

- Use HTTP verbs

Resource	**POST (create)**	**GET (read)**	**PUT (update)**	**DELETE (delete)**
/actors	Create a new actor	List actors	Bulk update actors	Delete all actors
/actors/1234	Error	Show actor 1234	If exists update actor 1234 Else: error	Delete actor 1234

Plural nouns and concrete names

- Using plural nouns might be more intuitive
  - /movies
  - /actors
- Singular nouns are OK, but avoid mixed model
  - /movie /actor
  - /movies /actor
- Prefer a managable number (12-24) of concrete entities over abstraction
  - /movie /actor /producer /cinema ...
  - /item

Simplify associations

- Relationships can be complex
  - movie -> actor -> pets -> ...
  - URL levels can become deep
- In most cases URL level shouldn‘t be deeper than: resource/identifier/resource
  - /actor/1234/movies
  - /movies/1234/actors

Filtering

...sweep complexity behind the ?

```
/actors?gender=male&age=50
```

Handling Errors

- Use HTTP status codes
  - over 70 are defined; most APIs use only subset of 8-10
- Start by using
  - 200 OK (...everything worked)
  - 400 Bad Request (..the application did sth. wrong)
  - 500 Internal Server Error (...the API did sth. wrong)
- If you need more, add them
  - 201 Created, 304 Not Modified, 401 Unauthorized, 403 Forbidden, etc..

Handling Errors

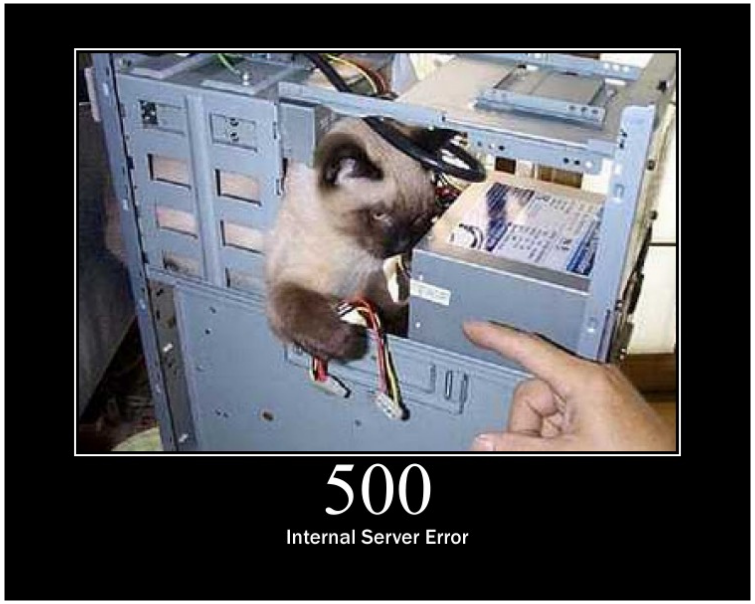
- Make messages returned in HTTP body as verbose as possible

```
{"developerMessage" : "Verbose, plain
language description of the problem for
the app developer with hints about how to
fix it.”,

"userMessage":"Pass this message on to the
app user if needed.”,

"errorCode" : 12345,

"more info": http://example.com/errors/
12345”}
```



http://httpcats.herokuapp.com/

Versioning

- Never release an API without a version
- Suggested syntax
  - put version number in first path element
  - ‚v‘ prefix
  - simple ordinal number
  - /v1/actors
- Maintain at least one version back

Partial responses

- Sometimes you don't need the entire representation
- Save bandwith

- Add optional fields in a comma-delimited list
  - /movies?fields=title

Pagination

- It‘s almost always a bad idea to return every available resource

- Use limit and offset to allow pagination
  - /movies?limit=20&offset=0

- Include metadata about total number of resources in representation

Actions not dealing with resources

- Certain API calls don‘t send resource responses
  - calculate
  - translate
  - convert
- Use verbs and make it clear in the docs
- /convert?from=EUR&to=USD&amount=100

Multiple Formats

- Support for more than one format is recommended
  - JSON default format; XML secondary
  - mapping can be automated
- „Pure“ RESTful approach
  - Accept: application/xml in HTTP Header
- Pragmatic approach
  - /actors.json, /actors.xml
  - /actors/1234.json, /actors/1234.xml
- Mixed approach
  - /actors -> content negotiated depending on Accept header
  - /actors.json -> direct format-specific access

Search

- Global search (across resources)
  - /search?q=godfather
- Scoped search
  - /actors/1234/movies?q=godfather
- Formatted results
  - /search.xml?q=godfather

API subdomain

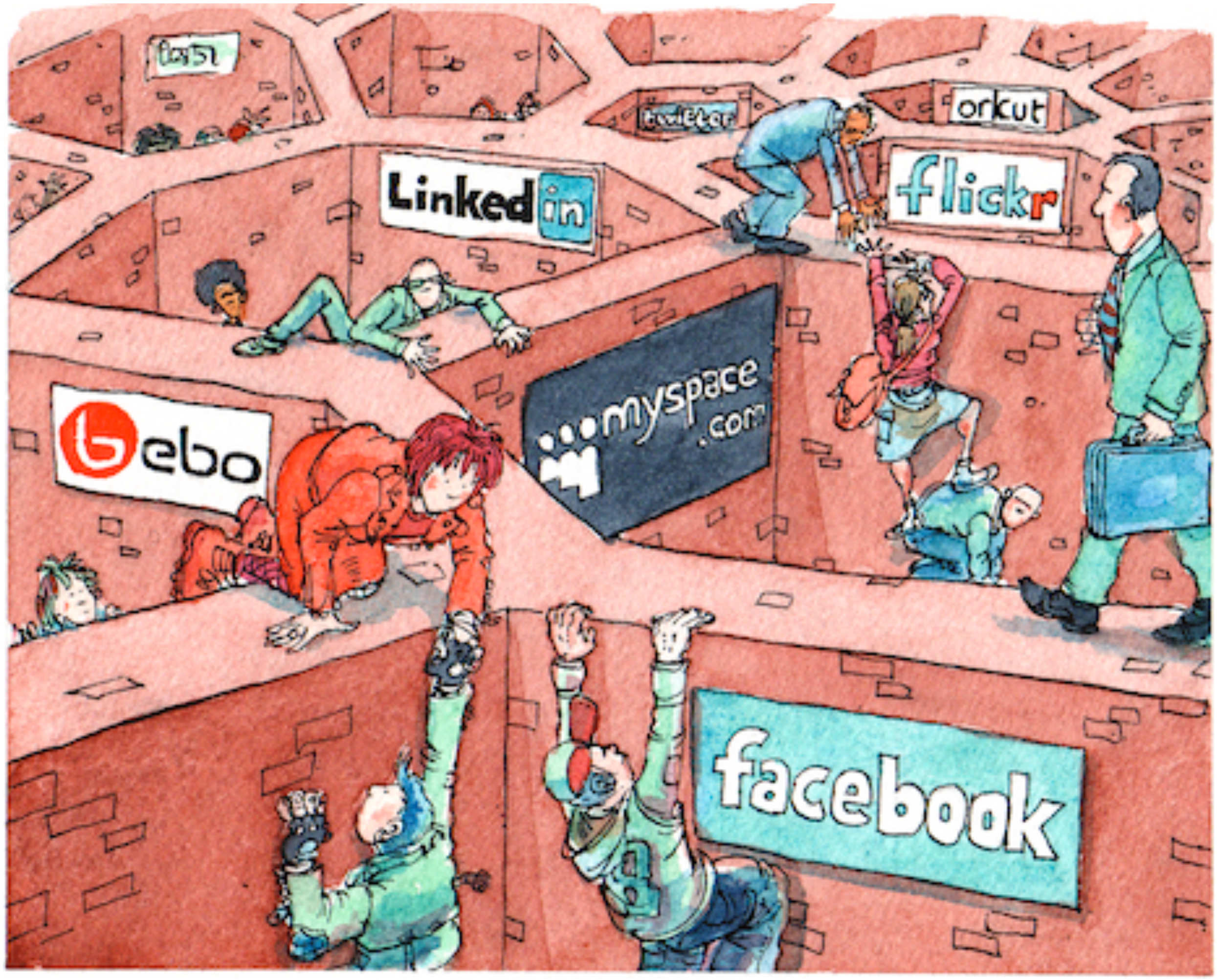
- Consolidate all API requests under one API subdomain
  - api.example.com
- Developer portal (documenation, etc...)
  - developer.example.com
- Web redirects
  - e.g., redirect browser requests to developer portal

REAL-WORLD REST APIS

Instructions

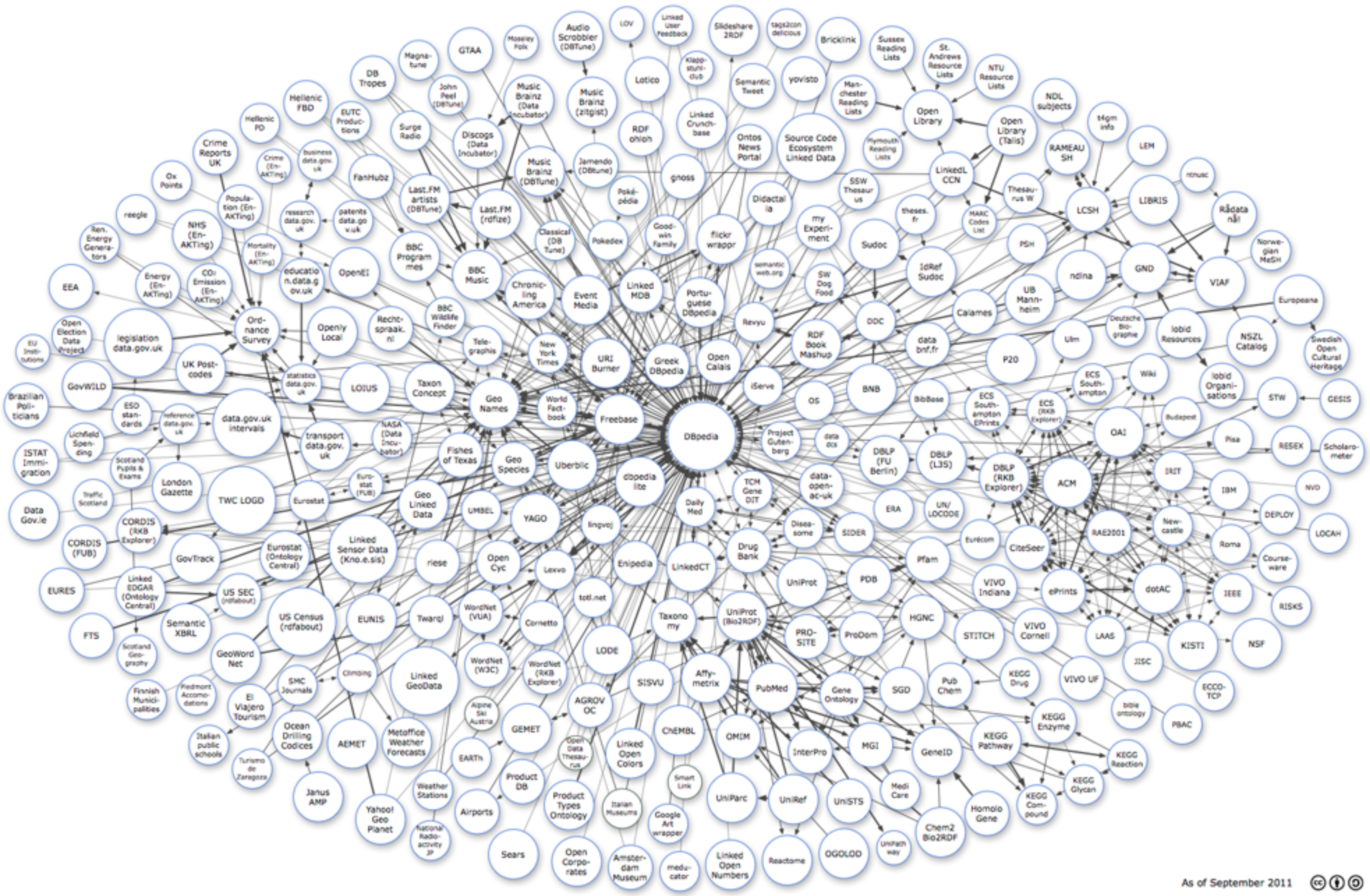
- Form groups of 5 and choose one Web API
- Answer the following questions (15 min):
  - Which resources are exposed and how are they named?
  - Which HTTP verbs are used and for what purpose?
  - How is error handling implemented? Which HTTP error codes are used?
  - Is filtering, pagination, and search supported? If yes, how?
  - how RESTful is the Web API?
- Create summary slides at: http://bit.ly/info4302-existing-apis
- Be prepared to talk about your findings

Outlook



Social Networking Sites as Walled Gardens by David Simonds

Outlook


LOV
Linked User Feedback
Slideshare 2RDF
tags2con delicious
Audio Scrobbler (DBTune)
Moseley Folk
GTAA
Magna-tune
DB Tropes
Bricklink
Sussex Reading Lists
St. Andrews Resource Lists
NTU Resource Lists
Klapp-stuhl-club
Lotico
Semantic Tweet
yovisto
Man-chester Reading Lists
Open Library
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NDL subjects
t4gm info
LEM
Music Brainz (zitgist)
Music Brainz (Data Incubator)
John Peel (DBTune)
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Surge Radio
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SW Dog Food
IdRef Sudoc
ndlna
GND
VIAF
Europeana
Open Election Data Project
EU Insti-tutions
legislation data.gov.uk
Ord-nance Survey
Openly Local
Recht-spraak.nl
BBC Wildlife Finder
Tele-graphis
New York Times
URI Burner
Greek DBpedia
Open Calais
Revyu
RDF Book Mashup
DDC
data bnf.fr
Calames
UB Mann-heim
Ulm
Deutsche Bio-graphie
lobid Resources
NSZL Catalog
Swedish Open Cultural Heritage
Brazilian Poli-ticians
GovWILD
UK Post-codes
statistics data.gov.uk
LOIUS
Taxon Concept
Geo Names
World Fact-book
Freebase
DBpedia
iServe
OS
BNB
BibBase
ECS South-ampton EPrints
ECS (RKB Explorer)
ECS South-ampton
P20
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lobid Organi-sations
STW
GESIS
ESD stan-dards
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data.gov.uk intervals
transport data.gov.uk
NASA (Data Incu-bator)
Fishes of Texas
Geo Species
Uberblic
dbpedia lite
Project Guten-berg
data dcs
DBLP (FU Berlin)
DBLP (L3S)
DBLP (RKB Explorer)
ACM
OAI
Budapest
Pisa
RESEX
Scholaro-meter
ISTAT Immi-gration
Lichfield Spen-ding
Scotland Pupils & Exams
London Gazette
TWC LOGD
Eurostat
Euro-stat (FUB)
Geo Linked Data
Traffic Scotland
Data Gov.ie
CORDIS (RKB Explorer)
CORDIS (FUB)
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lingvoj
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US Census (rdfabout)
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HGNC
VIVO Indiana
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dotAC
IEEE
RISKS
FTS
Semantic XBRL
Scotland Geo-graphy
GeoWord Net
SMC Journals
Climbing
Linked GeoData
WordNet (W3C)
WordNet (RKB Explorer)
LODE
PRO-SITE
ProDom
STITCH
VIVO Cornell
LAAS
KISTI
NSF
JISC
ECCO-TCP
Finnish Munici-palities
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Ocean Drilling Codices
AEMET
Metoffice Weather Forecasts
Alpine Ski Austria
GEMET
AGROV OC
SISVU
Affy-metrix
PubMed
Gene Ontology
SGD
Pub Chem
KEGG Drug
VIVO UF
bible ontology
PBAC
Italian public schools
Turismo de Zaragoza
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Linked Open Colors
ChEMBL
OMIM
InterPro
MGI
GeneID
KEGG Pathway
KEGG Enzyme
KEGG Reaction
Janus AMP
Yahoo! Geo Planet
Weather Stations
Airports
Product DB
Product Types Ontology
Italian Museums
Smart Link
Google Art wrapper
UniParc
UniRef
UniSTS
Medi Care
Homolo Gene
Chem2 Bio2RDF
KEGG Com-pound
KEGG Glycan
National Radio-activity JP
Sears
Open Corpo-rates
Amster-dam Museum
medu-cator
Linked Open Numbers
Reactome
OGOLOD
UniPath way
As of September 2011

Readings

- Tutorial Design Principles, Patterns and Emerging Technologies for RESTful Web Services (Cesare Pautasso and Erik Wilde): http://dret.net/netdret/docs/rest-icwe2010/
- Web API Design – Crafting Interfaces that Developers Love: http://apigee.com/about/api-best-practices