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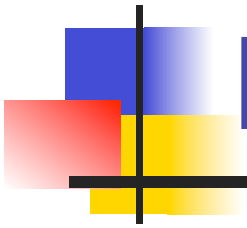

Pragmatic REST

Building RESTful Web APIs

Subbu Allamaraju

Yahoo! Inc || http://subbu.org

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About

- Tech Yahoo!
  - Developing standards, patterns and practices for HTTP web APIs
- Past
  - At BEA
- A "Convert"

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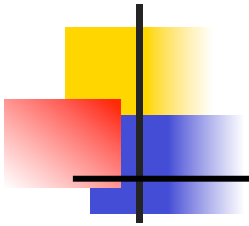

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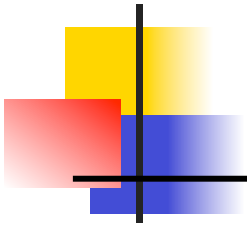

Agenda

~~REST – The Architecture~~

~~REST vs WS – Pros and Cons~~

Building HTTP APIs RESTfully

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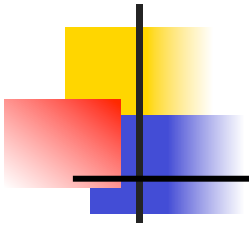

Smell Test

"We offer SOAP and REST end points"

"Our technology supports REST-style URLs"

"REST is not fit for machine-machine interactions"

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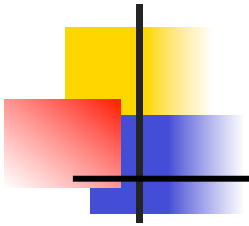

QUIZ

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Are these RESTful?

```
http://example.org/persons?start=10&count=100
http://example.org/person/123.xml
http://example.org/person/123/address/4
http://example.org/movie/Gone_With_the_Wind
http://example.org/movie/Terminator/reviews
```

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Is this RESTful?

```
GET /services/rest/?
   method=flickr.photos.setPerms&photo_id=2691065403&
   is_public=1&is_friend=0&is_family=0&perm_comment=1&
   perm_addmeta=1 HTTP/1.1
Host: example.org


HTTP/1.1 200 OK
Content-Type: application/xml;charset=UTF-8

<rsp stat="ok">
  <photoid>2691065403</photoid>
</rsp>
```

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Is this RESTful?

```
POST /services/rest/?
   method=flickr.photos.getRecent&api_key=… HTTP/1.1
Host: example.org

HTTP/1.1 200 OK
Content-Type: application/xml;charset=UTF-8

<rsp stat="ok">
  <photos page="1" pages="10" perpage="100”>
    <photo id="2947640330" owner="15150729@N07”
           secret="…" server="3060" farm="4" title="…"
           ispublic="1" isfriend="0" isfamily="0" />
    …
  </photos>
</rsp>
```

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Is this RESTful?

```
GET /photos?filterBy=recent HTTP/1.1
Host: example.org

HTTP/1.1 200 OK
Content-Type: application/xml;charset=UTF-8

<rsp stat="ok">
  <photos page="1" pages="10" perpage="100
          total="1000”>
    <photo id="2947640330" owner="15150729@N07”
           secret="…" server="3060" farm="4" title="…"
           ispublic="1" isfriend="0" isfamily="0" />
    …

  </photos>
</rsp>
```

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Is this RESTful?

```
GET /photos?filterBy=recent&api_key=blah
Host: example.org


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

<rsp stat=”fail">
  <err code="96" msg="Invalid signature"/>
</rsp>
```

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REST

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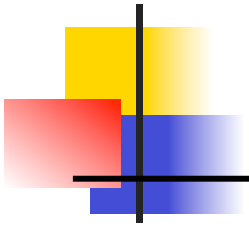

REST is defined by four interface constraints: identification of resources; manipulation of resources through representations; self-descriptive messages; hypermedia as the engine of application state.

- Roy Fielding, 2000

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In other words

1. Resources and URIs
2. Representations
3. Uniform interface
4. HATEOAS

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But no

- Schemas
- Description languages
- Code generation
- Registries

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REST/HTTP EXPLAINED

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Tenet 1: Resources

- A thing with an identity
  - A blog entry, a person, a friend, an address
- Resources are named via URIs
  - `http://example.org/blog/what-is-rest`
  - `http://example.org/person/subbu`
  - `http://example.org/person/subbu/friends`
  - `http://example.org/person/subbu/address/home`
- URIs are stable
  - URIs are names
  - Names don't change often

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Identifying Resources

- We will come back to this later

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Assigning URIs

Think primary keys

A person	`http://example.org/person/123`
An address of a person	`http://example.org/person/123/address/4`
A movie	`http://example.org/movie/Gone_With_the_Wind`
Reviews of a movie	`http://example.org/movie/Terminator/reviews`
A group of people	`http://example.org/persons?start=10&count=100`

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URIS are Generally Opaque

Clean URIs don't generally matter

`http://example.org/76asfg2g`

Okay as long as clients don't have to parse and understand these

URI Opacity - We will come back to this later

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URI Design Considerations

Opaque to client apps –
Transparent to client developers

Hierarchical path segments

- A good way to organize resources

```
http://example.org/movie/Terminator/
  reviews
```

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URI Considerations

Reserve query params for optional inputs

(A convention, not a rule)

```
http://example.org/movies

        findBy        {latest,director,studio}
        fromYear      Year
        toYear        Year
        location      Postal code, or city
        …
```

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Tenet 2: Representations

Things sent over requests and received over responses

An XML representation of a book

A PNG representation of a map

Data submitted through an HTML form to create a user

A JSON representation of the user created

An HTML view of the same user

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Media Types

Like the "type" of an object

Like the "schema" of an XML element

An XML representation of a book: **application/vnd.example.book+xml**

A PNG representation of a map: **image/png**

HTML form submission: **application/x-www-form-urlencoded**

A JSON representation of the user created: **application/vnd.example.user+json**

An HTML view of the same user: **text/html**

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Representations are Negotiable

```
Accept: application/atom+xml;q=1.0,text/html;q=0.1
Accept-Charset: UTF-8

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


Accept-Language: fr;q=1.0,en=0.8

        Content-Language: en


Accept-Encoding: gzip,deflate

        Content-Encoding: deflate
```

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Varying a Response

Don't overload URIs

Tell intermediaries and clients how you chose a representation

```
Accept: application/atom+xml;q=1.0,text/htm;q=0.1
Accept-Charset: UTF-8
Accept-Language: fr;q=1.0,en=0.8
Accept-Encoding: gzip,deflate
```

```
Content-Type: application/atom+xml;charset=UTF-8
Content-Encoding: deflate
Vary: Accept,Accept-Encoding
```

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Tenet 3 – Uniform Interface

Network transparency

- A uniform interface to operate on resources
- Uniform interface == A fixed set of operations
- Uniform interface == Generic interface
  - Irrespective of what resource is being operated on

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HTTP is a Uniform Interface

CRUD

A protocol between clients and resources

GET	• Get a representation • Safe and idempotent
POST	• Like a factory operation • Unsafe and non-idempotent
PUT	• Create or update a resource • Unsafe but idempotent
DELETE	• Delete a resource • Unsafe but idempotent

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A Generic Application Protocol

- CRUD on resources
- Content negotiation
- Caching
- Optimistic concurrency

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Is CRUD Crude?

- Yes, may be – depends on how you identify resources

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Domain Nouns

Obvious Approach

- Nouns in your application domain
- NYT Movie Reviews API
  - Movies, Reviews, Critics, Critic's picks, Reviews by reviewer
- Netflix API
  - Catalog, Users, Rentals, Rental History, Rental Queue, Reviews, Recommendations etc.

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Composites

Listen to Client Developers

A map with traffic directions + weather alerts + and construction data

A user profile with 5 contacts + favorite colors + 10 latest updates

- A group of other resources
- Generally read-only

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Tasks and Processes

Clear the CRUD

Transfer $100 from A to B

An order processing workflow

Hiring an employee

- Spawn several resources and have their own lifecycle

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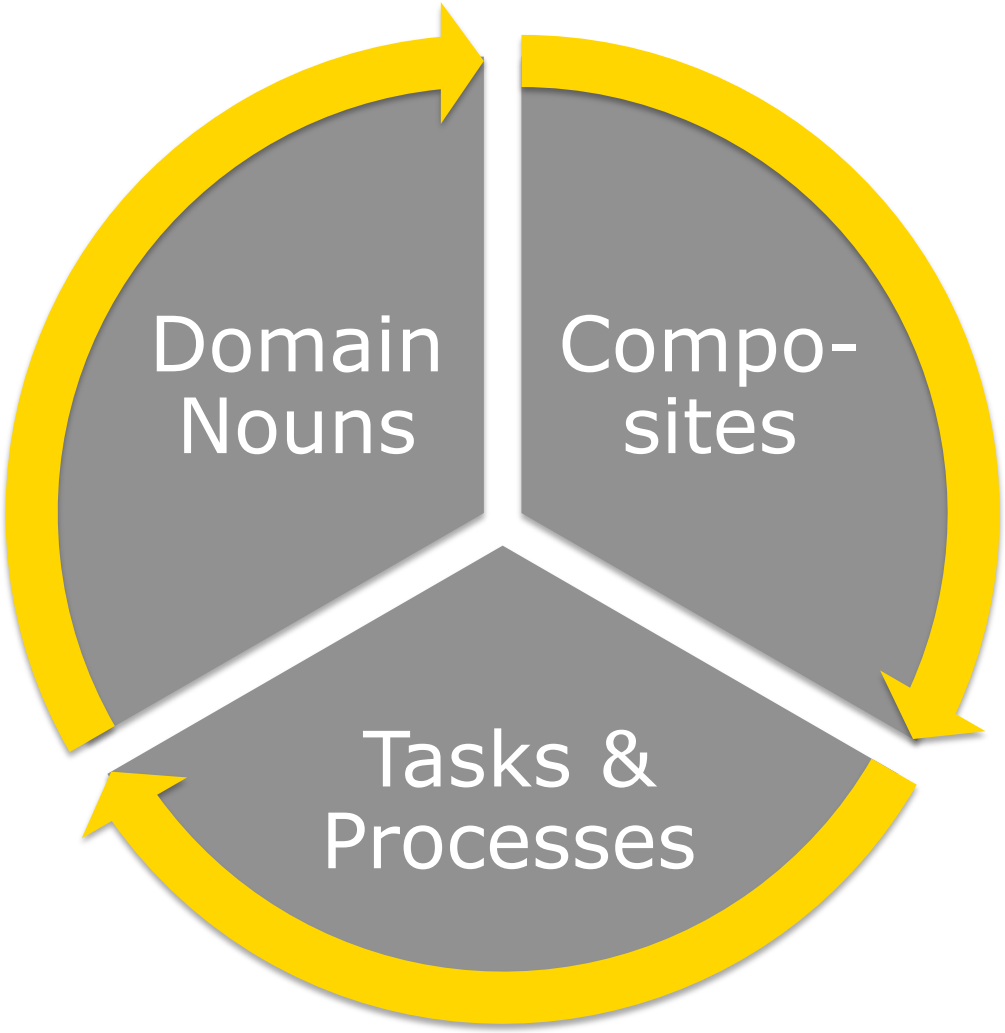
Finding Resources



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HTTP Caching

```
GET /photo/2691065403/comments

        200 OK
        Last-Modified: Thu, 24 Jul 2008 16:25:14 GMT
        ETag: 584219-2bb-80758e80
        Cache-Control: max-age=300
```

For DB stored data, maintain version IDs and time stamps

```
GET /photo/2691065403/comments
If-Modified-Since: Thu, 24 Jul 2008 16:25:14 GMT
If-None-Match: 584219-2bb-80758e80

        304 Not Modified
```

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Optimistic Concurrency

```
GET /photo/2691065403/comment/1

            200 OK
            Last-Modified: Thu, 24 Jul 2008 16:25:14 GMT
            ETag: 584219-2bb-80758e80
            Cache-Control: max-age=300


PUT /photo/2691065403/comment/1
If-Unmodified-Since: Thu, 24 Jul 2008 16:25:14 GMT
If-Match: 584219-2bb-80758e80

            412 Precondition Failed
```

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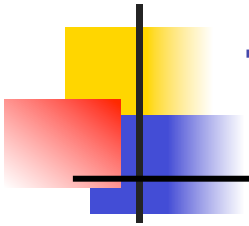

Tenet 4: HATEOAS

"Hypermedia as the engine of application state"

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Web APIs without Hypermedia

POXy REST

- All URIs *prepublished*
- Clients *solely* rely on documentation
- Clients *create* URIs from scratch
- Representations are like *POJOs*

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Hypermedia for Web APIs

```
<account>
    <link href="http://example.org/transaction/1"
          rel="self”/>
    <link href="http://example.org/account/1/history"
          rel="http://example.org/rels/history"/>
    <link href="http://example.org/customer/aZff13"
          rel="http://example.org/rels/customer"/>
    …
</account>
```

http://tools.ietf.org/id/draft-nottingham-http-link-header-02.txt for a consolidated list of well-known relations.

Or define your own.

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Hypermedia for Web APIs

Representations reflect app state

```
<customer>
    <link href="http://example.org/customer/aZff13"
          rel="self”/>
    <link href="http://example.org/invite?z09sa3k"
          rel="http://example.org/rels/verify"/>
    …
</profile>
```

e.g. a one time link

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HATEOAS – Consequences

- URIs are given to clients
  - Or clients use known algorithms, or URI templates
  - Don't have to prepublish all URIs
- URIs can be context and state sensitive
- URIs remain opaque
  - Less coupling

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URI Templates

Use when client needs to supply inputs

A URI to fetch all movies with title containing a keyword:

```
http://example.org/movies?contains={keyword}
```

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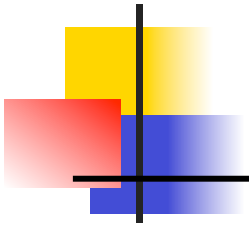

Describing Web APIs

Hypermedia and media types to reduce the need for description languages such as WADL

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Describing Web APIs

No silver bullet

Publish a few root level URIs

OPTIONS to discover verbs

Media type specifications

Links with known relations to discover new contextual URIs

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EXAMPLE: ACCOUNT TRANSFER

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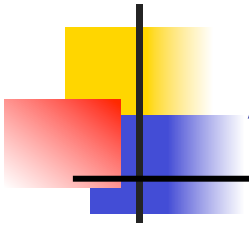

Account Transfer

A client app would like to transfer $100 from one bank account to another.

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Resources and URIs

Perhaps upon authentication or through a previous search

```
Bank account: http://example.org/account/{id}
```

```
Transfers collection: http://example.org/transfers
```

```
Account transfer: http://example.org/transfer/{id}
Status: http://example.org/status/{…}
```

Prepublished, or linked from an account representation

Link returned upon account transfer

How do client apps find these URIs?

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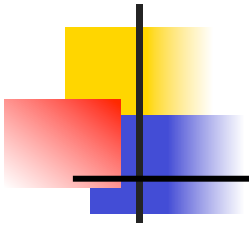

Representations

```
application/vnd.example.account+xml
application/vnd.example.transfer+xml
application/vnd.example.status+xml
```

Describe each media type

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Link Relations

```
"self": To self-link to each resource
"edit": Link to create a new transfer request
"http://example.org/rels/source": Source
"http://example.org/rels/target": Target
"http://example.org/rels/status": Status
```

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Create a Transfer

```
POST /transfers HTTP/1.1
Host: example.org
Content-Type: application/vnd.example.transfer+xml

<transfer>
    <link href="http://example.org/account/1"
          rel="http://example.org/rels/source"/>
    <link href="http://example.org/account/2"
          rel="http://example.org/rels/target"/>
    <currency>USD</currency>
    <amount>100.00</amount>
    <note>Testing transfer</note>
</transfer>
```

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Response

```
HTTP/1.1 201 Created
Location: http://example.org/transfer/1
Content-Type: application/vnd.example.transfer+xml

<transfer>
    <link href="http://example.org/transfer/1"
          rel="self”/>
    <link href="http://example.org/status/1?z09sa3k"
          rel="http://example.org/rels/status"/>
    <id>org:example:transfer:1</id>
    …
</transfer>
```

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Get Status

```
GET /status/1?z09sa3k HTTP/1.1
Host: example.org


HTTP/1.1 200 OK
<status>
    <link href="http://example.org/status/1?z09sa3k"
          rel="self"/>
    <id>org:example:status:999</id>
    <text>…</text>
</status>
```

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QUIZ - REVISIT

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Are these RESTful?

```
http://example.org/persons?start=10&count=100
http://example.org/person/123.xml
http://example.org/person/123/address/4
http://example.org/movie/Gone_With_the_Wind
http://example.org/movie/Terminator/reviews
```

There is nothing RESTful or unRESTful.

These are just names of resources.

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Is this RESTful?

```
GET /services/rest/?
  method=flickr.photos.setPerms&photo_id=2691065403&
  is_public=1&is_friend=0&is_family=0&perm_comment=1&
  perm_addmeta=1 HTTP/1.1
Host: example.org


HTTP/1.1 200 OK
Content-Type: text/xml; c

<rsp stat="ok">
  <photoid>2691065403</photoid>
</rsp>
```

Using an unsafe operation over GET

Use PUT

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Is this RESTful?

```
POST /services/rest/?
   method=flickr.photos.getRecent&api_key=… HTTP/1.1
Host:

HTTP/
Conte                    rset=utf-8

<rsp
  <photos page="1" pages="10" perpage="100”>
    <photo id="2947640330" owner="15150729@N07”
           secret="…" server="3060" farm="4" title="…"
           ispublic="1" isfriend="0" isfamily="0" />
    …
  </photos>
</rsp>
```

Using GET and POST synonymously

GET is idempotent and safe. POST is not.

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Is this RESTful?

```
GET /photos?filterBy=recent HTTP/1.1
Host: example.org

HTTP/1.1 200 OK
Content-Type: application/xml;

<rsp stat="ok">
  <photos page="1" pages="10" perp      100
          total="1000”>
    <photo id="2947640330" owner="15150729@N07”
           secret="…" server="3060" farm="4" title="…"
           ispublic="1" isfriend="0" isfamily="0" />
    …

  </photos>
</rsp>
```

Use links – not internal IDs

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Is this RESTful?

```
GET /pho                                    i_key=blah
Host: ex

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

<rsp stat="fail">
  <err code="96" msg="Invalid signature"/>
</rsp>
```

Hiding errors from intermediaries and client infrastructure.

Use 4xx or 5xx codes

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CHALLENGES

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Key Challenges

- Modeling resources
  - Not just as data, but linked and context aware
- Respecting the uniform interface
- Programming to hypermedia

- And occasional fights between “that one” and “the other one”.

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THANKS