There is REST and then there is “REST”

Evolveum

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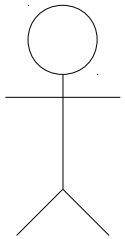
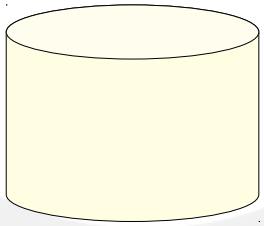
Who Am I?

Ing. Radovan Semančík, PhD.

- Software Architect at Evolveum
- Architect of Evolveum midPoint
- Apache Foundation committer
- Contributor to ConnId and Apache Directory API

What is REST?





JSON request

Client

HTTP

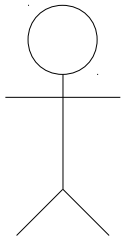
Server

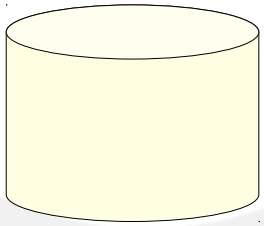
JSON response

JavaScript in browser
Mobile application
Enterprise application
CLI tool
Desktop client
…

Web application
Enterprise application
“Cloud” application
Whatever as a Service
“Serverless” server
...

What is REST?





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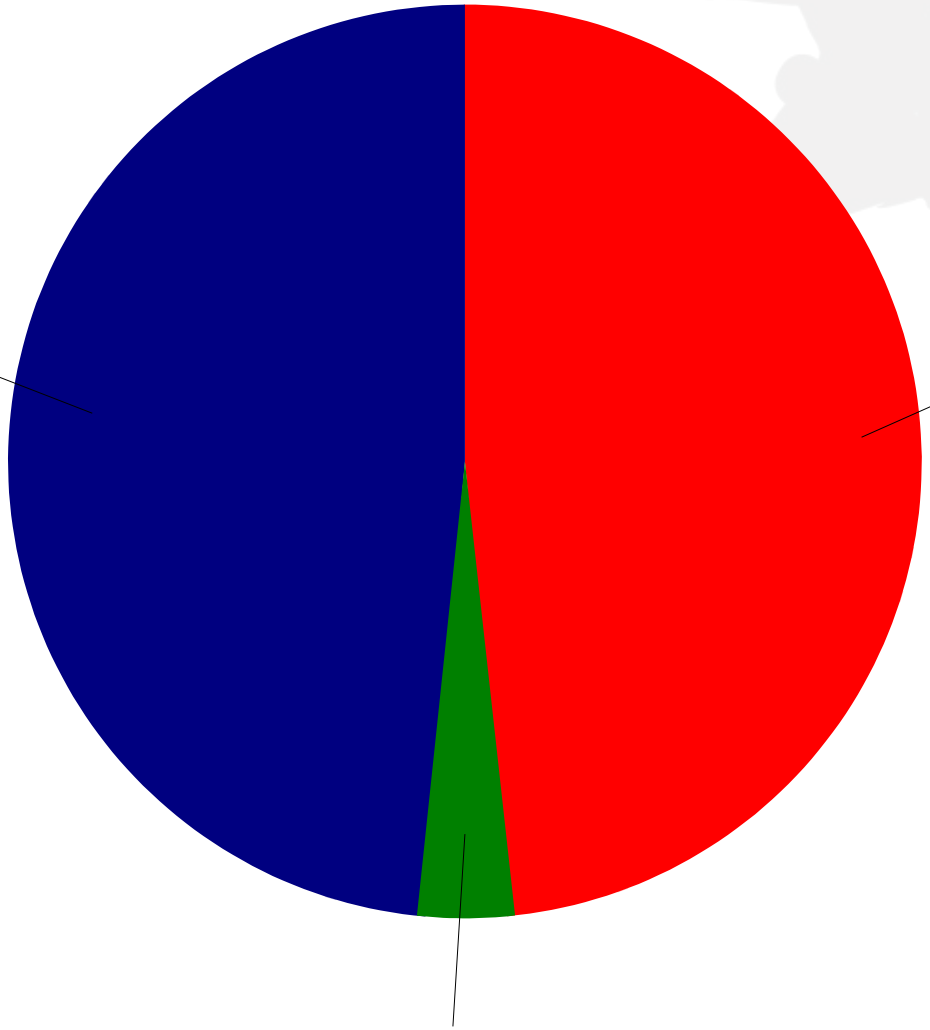
This is simple, easy to understand … and wrong

Who Are You?


I know everything about REST already
Whatever. I do not need to know REST
This may be interesting

Back to 1990s ...

- 1990: WWW invented
  - Tim Berners-Lee
- 1996: HTTP 1.0
- 1997: HTTP 1.1
- 2000: Representational State Transfer
  - Roy Fielding
- 2002: WWW Architecture

REpresentational State Transfer

REST (according to Fielding)

- Architectural style
  - Not “architecture”, not “protocol”, not “API”
- Retro-architecture (HTTP 1.1)
- Transfer of resource representations
  - HTML page is a representation, HTTP is transfer protocol
- Architectural constraints
  - Client-server, Stateless, Cache, Uniform interface, Layered system, Code on demand

Representational State Transfer

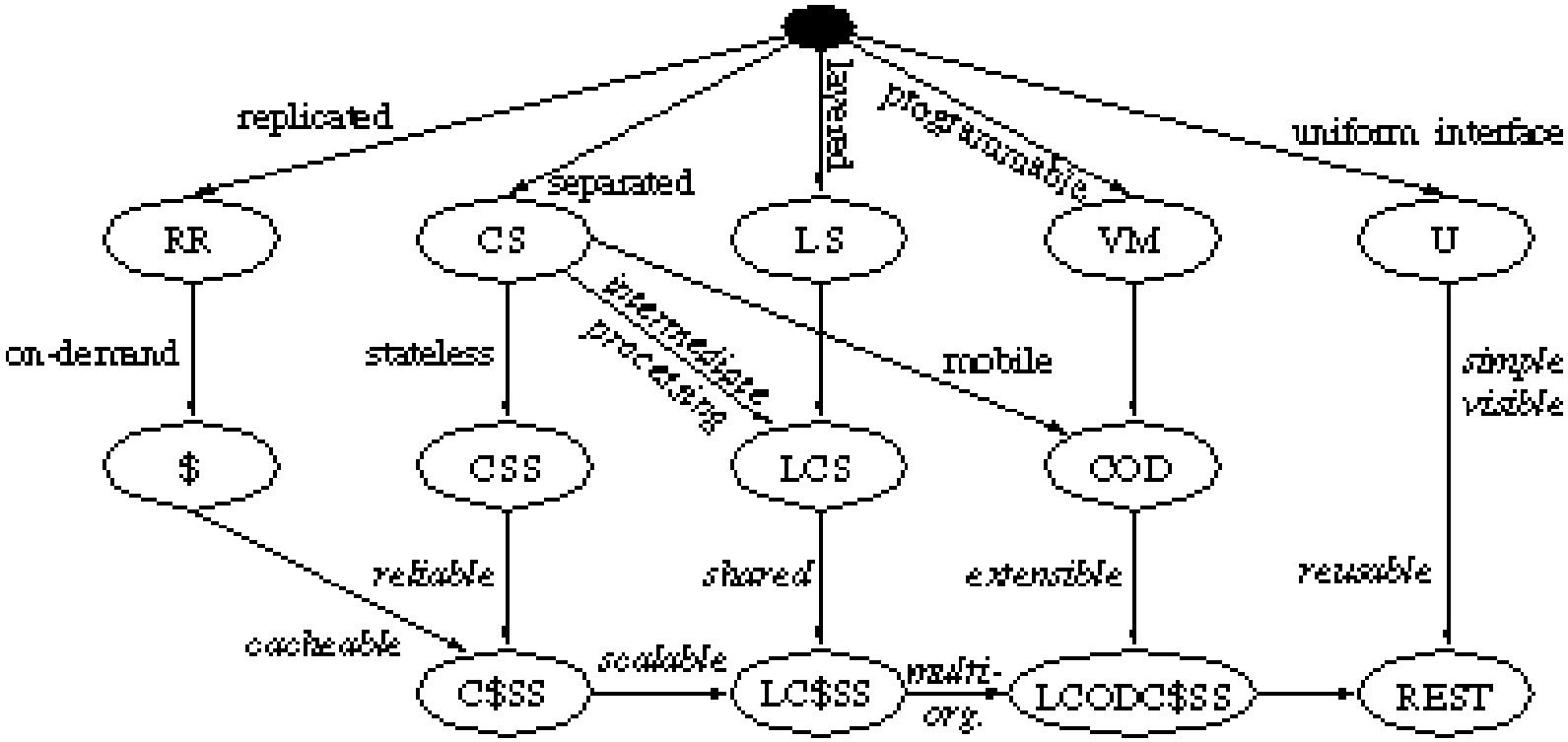
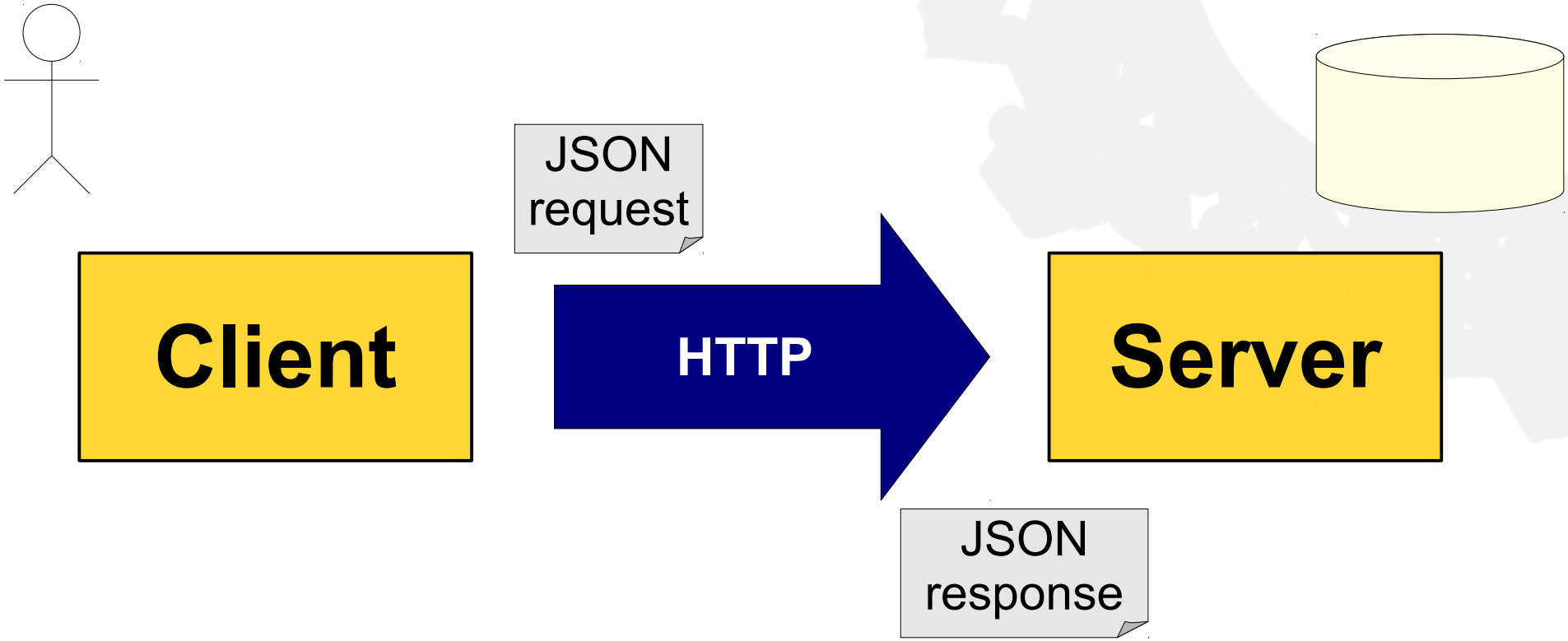


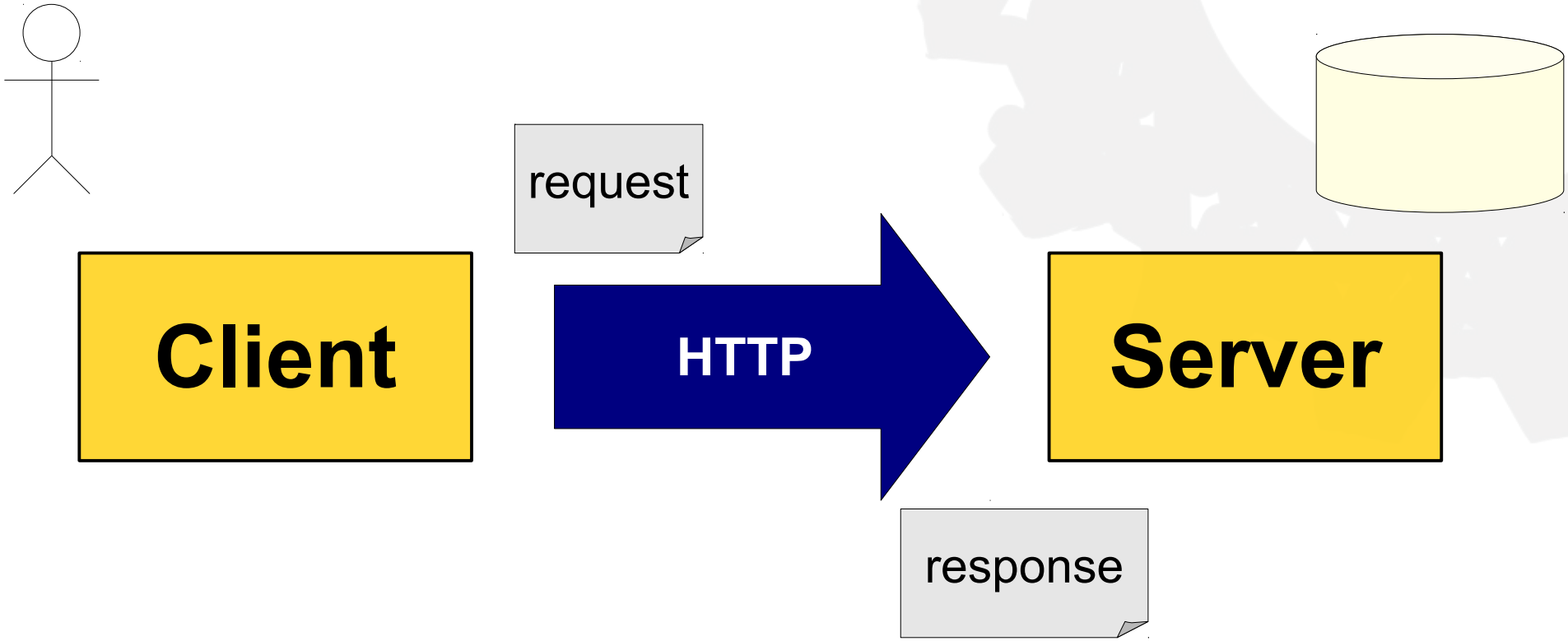
Figure 5-9. REST Derivation by Style Constraints

Source: Fielding R.: Architectural Styles and the Design of Network-based Software Architectures, 2000

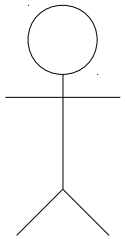
So, what exactly is wrong?

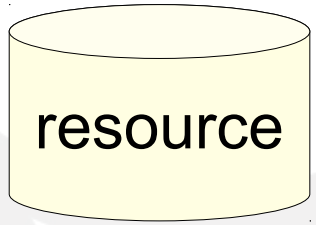


JSON? Not really ...



Request-response … kind of ...





URL

Client

HTTP

Server

representation

Operations (verbs):

- GET
- PUT
- DELETE
- POST
- ...

REST is not RPC

- Objects (resources) addressed by URL
- Fixed operation set (verbs)
  - GET, HEAD, PUT, DELETE, POST, OPTIONS, TRACE, CONNECT
- Stateless
  - Sessions are evil
- Hypertext
  - Thou shalt not construct your URLs

Theory and Practice

- **Theory:** REST is architectural style for hypertext applications
- **Practice:** we really need RCP
- REST is not good for RPC

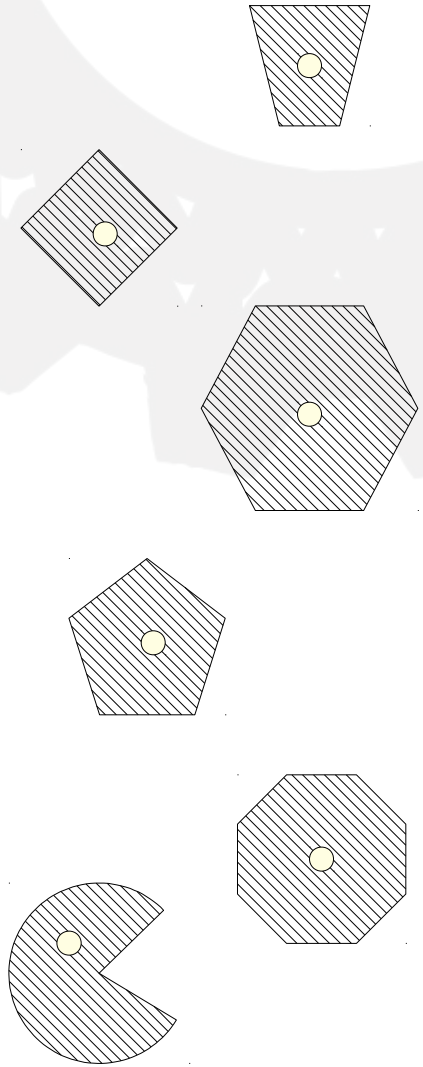
  … but REST is popular, we want it …
- **Result:** RESTful APIs

RESTful APIs

- Not really REST
  - Not hypertext
  - Mostly resource-based, but still some RPC
- Not really API
  - Application Programming Interface
  - Problematic interface definition (Swagger/OpenAPI?)
  - Security? Reliability? Transactions?
- Read: “HTTP-based service”

Reinvented Wheel … again

- 1976: RFC 707
- 1981: Xerox Courier
- 1991: CORBA
- 1993: DCE/RPC → DCOM
- 1995: SunRPC
- 1998: SOAP
- 200x: “RESTful” API



Pure REST

- It *is* possible to implement pure REST service

  … but it is going to be real pain (very likely)

  - Careful design and implementation
  - Unnecessary complexity
  - Too many network round-trips
  - Expect poor performance

- Hypertext is not suitable for everything

What do we do?

- Keep the parts that fit
  - Resources, URLs, representations
  - GET, DELETE, POST, …
- Ditch the parts that do not fit
  - Hypertext
- Compromises
  - Statelessness, caching, security, consistency, ...
- Interface definition
  - Swagger/OpenAPI

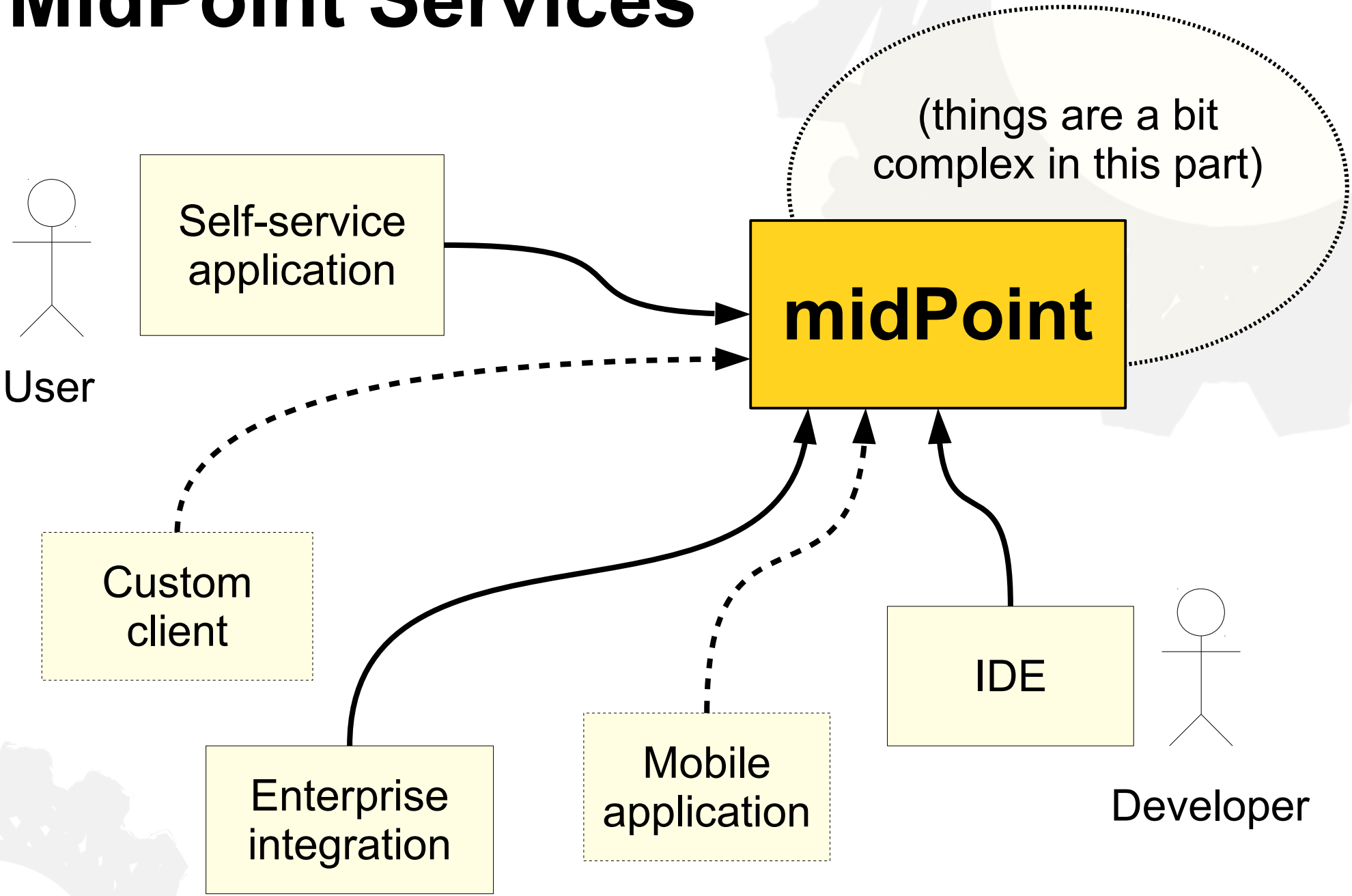
Practical “REST”

- Try to stick to *resources* and *representations*
  - URL represents object (resource)
- GET as safe operation
- Use POST for RPC when needed
  - But do not abuse
- Define the interface
  - URL formats and meaning, data types, inputs/outputs, ...

Practical case study: midPoint

- MidPoint: comprehensive identity management and governance system
  - Identity management, provisioning, role-based access control, audit, workflow, entitlement management, password management, policy management, segregation of duties, …
- 100% open source
- Started in 2011
- 700k lines of (mostly) Java code

MidPoint Services



MidPoint “REST” service

- Development started in 2013
- Existing data model and operations
  - Object-based: User, Role, Organizational unit, Account, Task, Security policy, ...
  - CRUD … but there are exceptions
- “RESTful” part and RPC part
- Kept as close to REST ideas as was practical

RESTful Operations: object

prefix	type	object identifier (OID)

`http://…./rest/users/02c15378-c48b-11e7-b010-1ff8606bae23`

Verbs:

- GET: read
- POST: modify
- DELETE: delete
- PUT: create (not recommended)

How does object look like?

XML

```
<user oid="02c15378-c48b-11e7-b010-1ff8606bae23">
    <name>jack</name>
    <description>Where's the rum?</description>
    <fullName>Jack Sparrow</fullName>
    <givenName>Jack</givenName>
    <familyName>Sparrow</familyName>
    <emailAddress>jack.sparrow@evolveum.com</emailAddress>
    <locality>Caribbean</locality>
    <activation>
      <administrativeStatus>enabled</administrativeStatus>
    </activation>
</user>
```

JSON

```
{
    "name" : "jack",
    "fullName" : "Jack Sparrow",
    "givenName" : "Jack",
    "familyName" : "Sparrow",
    …
```

RESTful Operations: collection

prefix type

`http://…./rest/users`

Verbs:

- GET: list objects, search (theoretically)
- POST: create new object
- DELETE: not supported
- PUT: not supported

Search

```
http://…./rest/users/search
```

- Query language

```
<q:equal>
    <q:path>name</q:path>
    <q:value>jack</q:value>
</q:equal>
```

- Search with POST: convenience
- Deviation from REST
  - Dedicated “search” resource for POST instead of GET
  - Should return list of URLs, but returns objects (to save round trips)

HTTP verbs

- GET is safe
- POST used for many things
- DELETE deletes
- PUT is not very useful
- PATCH for modification
  - But POST works as well

- Typical “REST” API

Error Codes

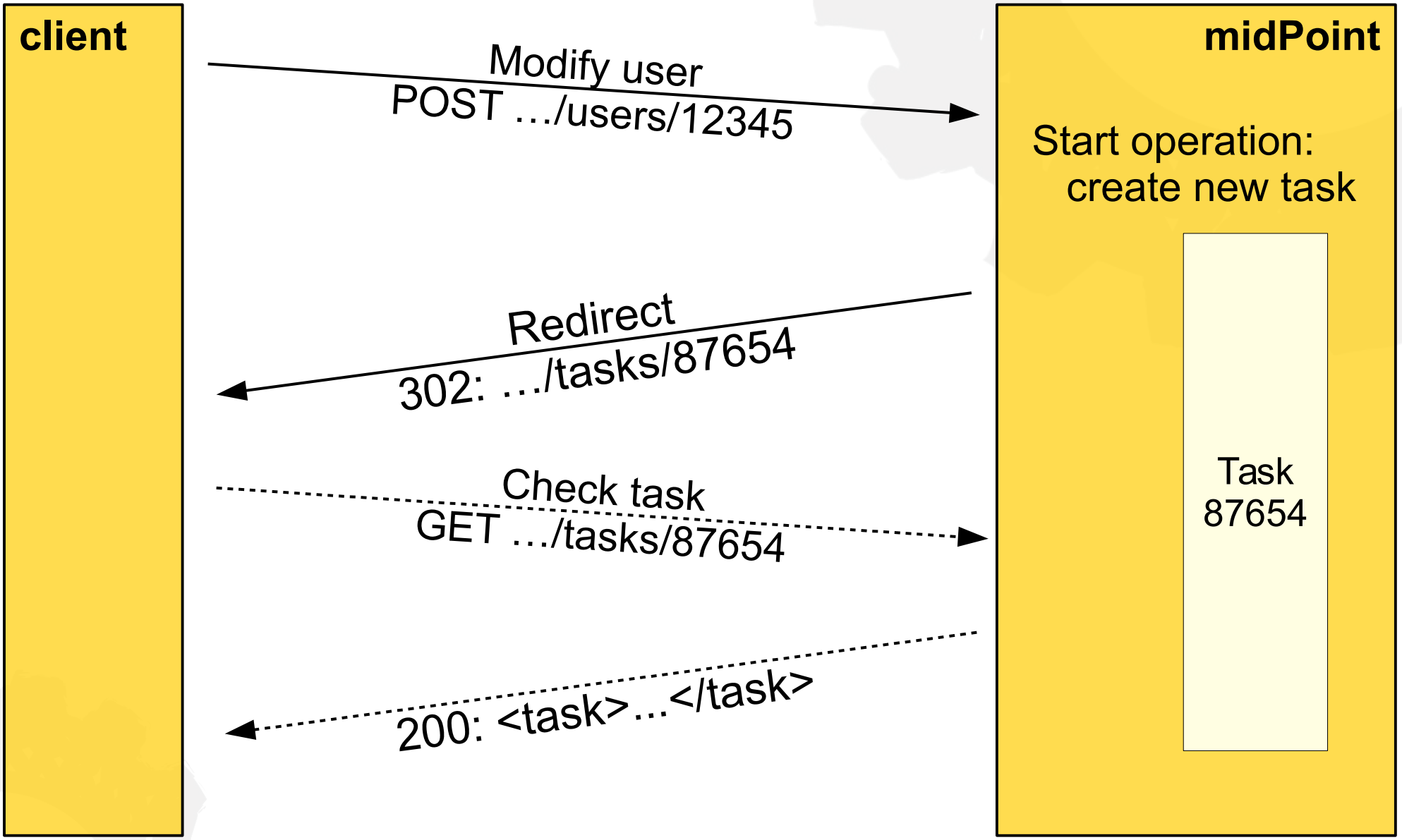
- 1xx: Information. Stay tuned.
- 2xx: Success. All done.
- 3xx: Redirection or “in progress” (we will get to that)
- 4xx: Client error (e.g. bad request)
- 5xx: Server error (e.g. bug in server code)

Trivial, isn’t it? Now let’s have a look at the interesting stuff.

Asynchronous Operations

- Operations that take a looooong time (days)
- Cannot return success (2xx)
- Solution: redirects (3xx)

Asynchronous Operations



RPC Operations: object-related

prefix	type	object identifier (OID)	op

`http://…/rest/tasks/c68d7770-c493-11e7-bce6-9bec1fc3b57c/suspend`

Verbs:

- GET: not applicable
- POST: execute the operation
- DELETE: not applicable
- PUT: not applicable

Object-related RPC operations

- Deviation from pure REST
  - Should be modeled as resource changes or separate resources

    … but that is a pain
- Error handling

RPC Operations: global

prefix operation

`http://…/rest/notifyChange`

Verbs:

- GET: not applicable
- POST: execute the operation
- DELETE: not applicable
- PUT: not applicable

Global RPC operations

- Complex input and output data structures
- Huge deviation from pure REST
- It was necessary to keep the interface simple and efficient

Next: really hard problems ...

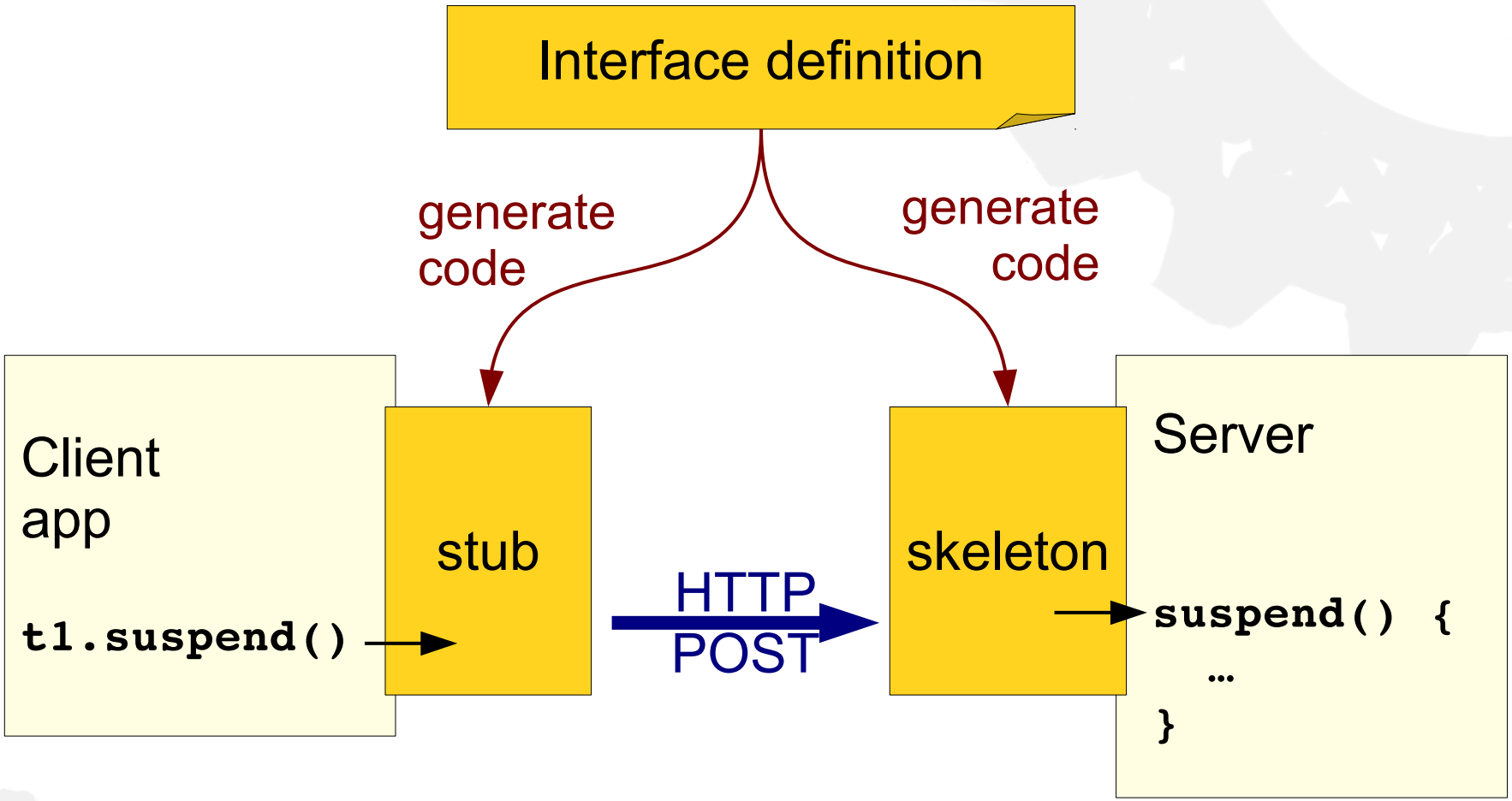
Security

- REST is stateless
  - Cookie-based sessions are out
- HTTP Basic authentication
  - Oh, really?
- OAuth2 / OpenID Connect
  - “best” practice for REST APIs
- JSON Web Tokens (JWT)
  - SAML tokens reinvented

Interface Definition

- Swagger / OpenAPI
  - WSDL reinvented (CORBA IDL reinvented)
  - JSON-oriented
  - Still quite limited, but at least something
- REST purists hate it
  - Because this goes directly against hypertext principles

Stub and Skeleton



Does not really works in “RESTful” APIs (yet)

Transactions and Consistency

- Transactions (ACID)
  - Forget it
- Consistency
  - Cannot forget it, but it is tricky
  - Optimistic locking / MVCC is best bet
  - ETag (RFC7232) is a standard mechanism
  - But a lot of proprietary mechanisms is used instead

Conclusion

- REST is no good for RPC

  … but we are going to use it anyway
- And it is practical

  … with some tweaks and compromises
- Future?

Questions and Answers

Thank You

Radovan Semančík

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